

MEDICINAL PLANTS
OF THE ASIA-PACIFIC:
DRUGS FOR THE FUTURE?



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CHRISTOPHE WIART



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University of Malaya, Malaysia



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*...Tum cynaeis erepit ab undis
Insula, quae prisci signatur nominis usu
Aurea, quod fulvo sol hic magis orbe rubescat*

Rufus Festus Avienus
AD 370

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Preface

Looking globally, there is a considerable interest to find cure from nature. We all know that in some sense there *are* drugs awaiting discovery in nature and especially in medicinal plants. The question that grips us is, *why?* Why are these drugs undiscovered in spite of enormous technical achievements. If the scientific techniques of pharmacological evaluations are so well mastered, it is natural to expect an increasing number of important drugs discovered from plants, thus improving human health drastically. Instead, we observe that cancers and microbial infections are still life threatening. This observation raises several questions:

1. What is the present rationale in terms of the research of drugs from plants?
2. Should we reconsider our strategies in assessing medicinal plants and opt for an alternative approach?
3. In regard to the pharmacological activities measured so far, why should these be circumjacent of plant species?
4. Do they exist above the level of the plant species, where subclasses and orders might experience macrolevel intrinsic content?
5. Are we targeting the correct groups of lead compounds?
6. Is ethnopharmacology really used as a tool to excavate drugs, or is it a mere transitory fashion? In other words, what role does ethnopharmacology really play in today's high technological world of drug discovery?

By constitutively interconnecting several aspects of phylogeny, taxonomy, ethnology, structure–activity relationship, molecular pharmacology and toxicology, I attempt to answer these questions from the first principles with a premier reference source for traditional medicine and the development of drugs from plants, especially from the medicinal plants of a region I had the opportunity to explore: Asia-Pacific. This may seem like an extraordinary project because the topics of botany, chemistry and pharmacology are individual and independent disciplines as its own. It is not clear that thumping them together will really help us crack them open. My burden is to argue that they need to be treated together, and to show, in a very concrete manner, how they do go hand-in-hand in opening the little door of scientific consciousness.

This book proposes a place for consciousness in ethnopharmacology, and to a more general sense, an alternative approach to the discovery of drugs from plants; an approach I would like to call *phytopharmacology*. The framework developed here is ambitious in its scope and detail. It ties experience with a theory of the botanical and ethnological foundations of plant bioactivities. Scholars should see it as an attempt to advance in the development of Mark J. Plotkin's *Medicine Quest: In Search of Nature's Healing Secrets*, by borrowing some inspiration from Cronquist's system of taxonomy. General readers can simply see it as an attempt to explain the *why* of a medicinal property.

Within the book, I often point to the lack of pharmacological and/or toxicological scientific evidences on specific plants or taxa. I believe this framework should at least cause some stirs in pharmacologists, by showing that most plants on the verge of extinction, remain yet to be assessed. No one should rest comfortably with any assumption that the present approach in drug discovery must lead to unreasonableness. At the next level of ambition, I hope to *challenge* the readers. Pharmacologist's strongest support has so far been the widespread use of massive automated screenings to guarantee the discovery of lead compounds in an acceptable way. A first challenge that this book propose is by showing that the pharmacological profile of a given plant or taxa is understandable and therefore predictable, we need a more thoughtful and sensitive approach. Pharmacological activities make sense only against a detailed background theory of botanical and chemical causation. A second challenge is to see whether the ideas lead to fruitful avenues of research, or whether they lead to a dead end instead. The book presents a framework, providing a new perspective from which we could understand nature.

At a third level, I hope to actually *stimulate* further research on the discovery of drugs from the medicinal plants of Asia-Pacific. To date, there is a lack of books on medicinal plants in Asia-Pacific, one of the richest region in terms of biodiversity as well as a rich source for traditional medicines. This book provides a very detailed ethnopharmacological accounting of over 400 plant species, enhanced by more than 300 original pictures, 400 chemical structures, voucher plants, pharmaceutical interest and thousands of bibliographic references.

I have made the book as accessible and interesting as possible to the general public, even to those who have little or no specific training in biological sciences. My intention was not to pontify, but merely to create something where its importance lies beyond the details of its presentation. I consider this to be primarily a book of personal thoughts. Of all my hopes, my dearest is that *Medicinal Plants of Asia-Pacific: Drugs for the Future?* should provide inspiration to those looking for drugs from plants. In the space of ideas, I believe

that this book acts as a pointer to the existence of originality, where readers could freely explore endlessly on their own.

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Foreword

by

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Christophe Wiart has produced a magnificent book covering all pertinent aspects of the potential medicinal plants of the Asia-Pacific Region. Plants (dicots and monocots) are organized by class, subclass, order, family, genus and species. More than 315 species of plants are included in this tome. Botanical descriptions are first given for each family with a general statement of the potential pharmaceutical interest for the family, followed by discussions of the physical characteristics of each species, uses in the region and pharmaceutical interests in the species; the pharmacology, including potential toxicity, of extracts of each plant and an indication of the major pharmacologically active principles with their structures are mentioned. Photographs and/or line drawings are included for each species.

I have never seen such a book that has been this carefully prepared, so botanists, chemists, pharmacognosists and pharmacologists having any interest in the medicinal or potentially medicinal higher plants of the Asia-Pacific Region, will be satisfied in the book content. The book will be found useful by academic, industrial and government scientists having any interest in the potential of plants as a source of new drugs.

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Foreword

by

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“Medicinal plants of Asia-Pacific: Drugs for Future?” offers researchers a strong foundation from which to advance the field of ethnopharmacology. The challenge is to use the information contained herein in meaningful ways to understand the conjunction of medical ethnography and the biology of therapeutic action. An impediment to predicting the structure and content of an ethnopharmacology of the future is to identify objectives for a field whose self-identified membership represents various academic and applied disciplines, as well as commercial interests. At present, most ethnopharmacology research is conducted by investigators trained in anthropology, botany, pharmacognosy, and pharmacology. Other contributors include biochemists, researchers in veterinary medicine, clinicians, and historians of science. In the past, this multi-but not trans-disciplinarity has embodied substantial disparities, which challenged efforts to harmonize objectives and coordinate methodologies. At the same time these disparities underlie a dynamic tension that inspires discussion and collaborations for the future.

My own perspective on ethnopharmacology resonates the voices that forged the International Society for Ethnopharmacology (ISE), and later the mission statement of the ISE’s official journal: the Journal of Ethnopharmacology (JEP) encourages scholarly and applied research “concerned with the observation, description and experimental investigation of indigenous drugs and their biological activity.” Despite this call for convergence across a range of natural and social sciences, most of what was published as ethnopharmacology in the last few decades more closely approximates pharmacognosy

and pharmacology, than it does transdisciplinary research. Privileging bioscientific ideologies and technology reproduces a Euro-American tradition that discounts traditional ways of knowing *i.e.*, the implicit assertion that medicines become meaningful only when validated by pharmacologic inquiry. In an integrated ethnopharmacology of the future, bioscience would instead serve as one of the several lenses through which we understand how people manage resources and health.

These comprehensive data on the medicinal plants of Asia and the Pacific represent the kind of reference material that encourages researchers in ethnopharmacology to project these findings against some higher level of abstraction, in order to better comprehend human-plant relations. That is to say, advancing scholarship and application of ethnopharmacology will require more than incremental growth through collection of technical data. For instance, this book can be used by researchers to explore how traditional knowledge and management of Pacific and Asia resources are culturally constructed and socially negotiated in ways that impact human health; how the use of plants in overlapping contexts such as food and medicine influences both local ecologies and human health; or how the diverse microecologies of diverse Pacific populations influence medicinal cultures.

An integrated, theory- and issue-driven ethnopharmacology will advance beyond multidisciplinary (parallel streams), to interdisciplinary (some theoretical and methodological exchange across disciplines), to transdisciplinary research that integrates the perspectives and tools of diverse disciplines. Further, we can hope that in the future, ethnopharmacology research will be contextualized to broader issues of biodiversity conservation, sustainable resource management, and intellectual and biological property rights.

Foreword

by

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This new volume, *Medicinal Plants of Asia-Pacific: Drugs for Future?*, by Christophe Wiart, represents a huge and important undertaking, since much of the flora of this area of the world, while well-known locally as a source of medicines, has been neglected in terms of scientific evaluation. Public interest in traditional forms of herbal medicine, and in Asian medicine in particular, continues to grow and not only do many people — over 80% of the world population in fact, rely upon herbal medicines for their healthcare needs, but further investigations into the potential of the species covered in this book may lead to the discovery of novel drugs of global importance.

The medicinal flora of the Asia-Pacific region embodies a virtually untapped reserve of original molecules which await isolation, and chemical and pharmacological investigation. Such development may also deliver a valuable asset for local people, who can then benefit from the exploitation of their natural resources. Furthermore, some of these plants are endangered species, and documentation of their potential usefulness may help to ensure their conservation, and perhaps even lead to programmes for sustainable development. The book includes 429 species found from India to Hawaii, all covered in commendable depth, and most beautifully illustrated. For all entries, botanical and taxonomic details are given, including synonyms and even some phylogenetic information about the order and plant family. The description of the plant is comprehensive enough to allow for identification, and is aided by photos and drawings. The pharmaceutical uses are dealt with in a thorough manner, the chemistry explained and supplemented with more than 300 chemical structures, and about 2500 bibliographic references.

Trained as a pharmacist in France and having worked in the French pharmaceutical industry, (isolating, purifying and determining the structures of new

bioactive compounds from plants.) Christophe Wiart is an experienced phytochemist. For many years now, he has been a scientist at the University of Malaysia, involved with the Malaysia tropical rainforest plant screening programme and managing expeditions in primary and secondary tropical rainforest. His work includes the collection of plants, identification of them and preparation for the herbarium, as well as phytochemical and pharmacological evaluation for drug discovery. He has published many scientific papers devoted to the discovery of new natural compounds, and has written several books on the subject of medicinal plants. This wide experience has given him a broad perspective on drug discovery from plants, and has benefited this book enormously. It will be an invaluable resource for doctors, pharmacists, plant scientists, pharmaceutical companies and conservationists in the region, and to all who are interested in medicinal plants.

DIVISION MAGNOLIOPHYTA CRONQUIST, TAKHTAJAN & ZIMMERMANN 1966, THE ANGIOSPERMS OR FLOWERING PLANTS

The division Magnoliophyta consists of 2 distinct classes, the Magnoliopsida and the Liliopsida, which are believed to have appeared some 130 million years ago. The Magnoliopsida is the largest and oldest class.

Part I: Class MAGNOLIOPSIDA Cronquist, Takhtajan & Zimmermann 1966, the Dicotyledons

The class Magnoliopsida consists of 6 subclasses, 64 orders, 318 families, and about 165,000 species of plants which have evolved from aquatic weeds forced to adapt to dry climatic conditions. The Magnoliidae is the most primitive subclass of Magnoliopsida (Appendix I) and a common archaic ancestor for all existing dicotyledons.

I. Subclass MAGNOLIIDAE Takhtajan 1966

The Magnoliidae consists of 8 orders, 39 families and about 12 000 species of primitive trees, shrubs or woody climbers confined in primary rainforests. The flowers of Magnoliidae are often large, and made up of an indefinite number of free carpels, stamens, petals and sepals. The orders Magnoliales, Laurales and Ranunculales make up more than two-thirds of the species of Magnoliidae. The chemical weapons used here are *isoquinoline alkaloids* which bind to protein receptors of



neurons and impede or promote neurotransmission. Besides, isoquinolines are amphiphile and penetrate bacteria wherein are inactivated enzymes and

DNA. The ability of alkaloids to bind to cellular receptors often explains the medicinal and toxic properties of plants and their pharmaceutical interest.

A. Order MAGNOLIALES Bromhead 1838

The order Magnoliales is the most primitive order of the subclass Magnoliidae (Appendix I). This order consists of 10 families and about 3000 species of trees or shrubs, the therapeutic potential of which is still waiting to be discovered. Magnoliales are living fossils rich in *isoquinolines* and indoles alkaloids, *lignans*, essential oils, *diterpenes*, triterpenes, tannins, and phenylpropanoids. Of particular interest in this order are alkaloids which might hold potentials for the treatment of cancers, microbial infections, anxiety, mood disorder, hypertension and Alzheimer's and Parkinson diseases.

1. Family HIMANTANDRACEAE Diels 1917 *nom. conserv.*, the *Himantandra* Family

The family Himantandraceae consists of the single plant *Galbulimima belgraveana* (F. Muell.) Sprague.

Galbulimima belgraveana (F. Muell.) Sprague

Physical description: It is a tree which grows to a height of 35 m and which has a girth of 60 cm. The plant is common in the mountain rainforests of Papua New Guinea, Australia and Indonesia.

The buttresses can reach up to 3 m, with a width of 1 m and a thickness of 5 cm–20 cm. The bark is greenish brown, bitter, and has a resinous smell. The inner bark is cream-colored and rapidly turns red-brown when exposed to light. The wood is white or pale yellow and very soft. The sap-wood and heart-wood are white to a pale straw color. The stems, underside of leaves, petioles, inflorescences and fruits are densely to sparsely covered with copper-colored peltate scales. Leaves: the leaves are simple, alternate and estipulate. The petiole is 1.3 cm–1.5 cm long, channeled and glabrous. The blade is elliptic, oblong, hard, 14 cm × 5.7 cm, glossy green above and silvery brown below. The midrib is sunken above and prominent below. The margin of the blade is recurved. The blade shows 13–15 pairs of indistinct secondary nerves. The flowers are bisexual, large, and have a strong unpleasant odour. The perianth is white, cream or brown. The fruits are pink or red drupes which are 1.5 cm–3 cm in diameter. The fruit pedicel is 2.5 cm long (Fig. 1).

Synonymy: *Himantandra belgraveana* (F. Muell.) F. Muell.

Common name: Pigeon berry ash, agara, white Magnolia.

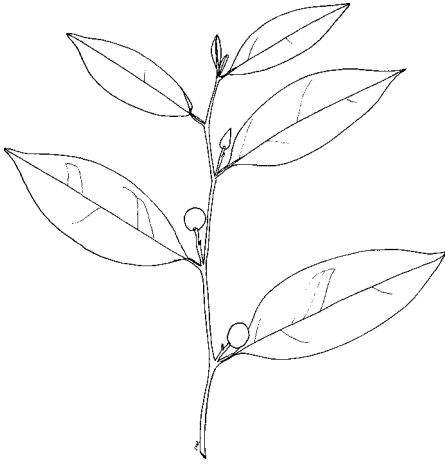
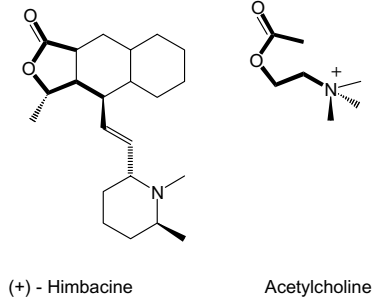


Fig. 1. *Galbulimima belgraveana* (F. Muell.) Sprague. From: KLU Herbarium 33852, Flora of Sulawesi (Celebes). Ex Herb. Leiden Indonesian. Dutch Expedition 1979. Field collector & botanical identification: V Balgooy, 11.7. Geographical localization: South Sulawesi 2° 15'–3° 3' South — 121°–121° 45' East, behind Inco driving, altitude: 500 m. Center near Nickel Plant, disturbed forest on ultra-basic soil.



Pharmaceutical interest: The medicinal properties of *Galbulimima belgraveana* (F. Muell.) Sprague are attributed to piperidine alkaloids, such as (+)-himbacine, which are structurally shaped like acetylcholine and are therefore muscarinic receptor antagonist/agonist (Zholos AV *et al.*, 1997). These anticholinergic alkaloids have become the focus of attention as a potential source of drugs for the treatment of Alzheimer's diseases, cardiac bradycardia and glaucoma.

Uses: In Papua New Guinea, a decoction of bark of *Galbulimima belgraveana* (F. Muell.) Sprague is drunk to invigorate health before war, and to give hallucination and premonition.

Reference

Zholos AV, *et al.* (1997) *Br J Pharmacol* **122**(5): 855–893.

Caution: This plant is toxic.

2. Family ANNONACEAE A. L. de Jussieu 1789 nom. conserv., the Custard-apple Family

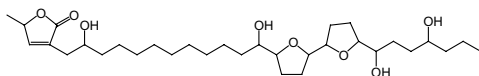
Physical description: The family Annonaceae consists of about 120 genera and over 2000 species of tropical trees, shrubs or climbers making up about three-fourths of the order Magnoliales. The bark of Annonaceae is fibrous and fragrant. The leaves are simple, alternate, and without stipules. The flowers consist of a thalamus to which are inserted 3 sepals, 2 whorls of 3 petals, an indefinite number of short and compressed stamens and numerous free carpels. The fruits are ripe carpels.



Pharmaceutical interest: Examples of Annonaceae are *Annona reticulata* L. (custard apple), *Annona cherimola* (cherimoya), and *Annona squamosa* L. (sweetsop), the fruit of which are palatable. Another example is *Cananga odorata* (Imk.) Hook. f. & Thoms. the essential oil of which (ylang-ylang) is used to make perfumes.

Annonaceae have attracted a great deal of interest on account of their ability to elaborate secondary metabolites which might hold potential for the treatment of cancer, bacterial infection, hypertension and brain dysfunctions.

Acetogenins: A number of plants classified within the genera *Annona*, *Asimia*, *Goniothalamus*, *Polyalthia*, *Rollinia*, *Uvaria* and *Xylopia* contain a unique type of lipid-



Acetogenin

related substances consisting of 35–39 carbons, 1 or 2 tetrahydrofurane rings, a terminal γ -lactone and oxygen functions. These compounds are difficult to extract but are worth being studied as they kill eukaryotic cells by impeding the enzymatic activity of NADH-ubiquinone reductase (complex-I) [NADH dehydrogenase (ubiquinone)] which is normally responsible for the mitochondrial electron transport or cellular respiration. A classical example of acetogenin is bullatacin from *Annona bullata*. Bullatacin displays cytotoxic potencies a number of order of magnitude greater than those of adriamycine (doxorubicin) and has been patented as a clinical anti-tumor agent.

Isoquinoline alkaloids: *isoquinoline* (aporphines) alkaloids bind to the cellular receptors of serotonin, dopamine, acetylcholine and noradrenaline. This property is attributed to the fact that the chemical structure of isoquinolines is similar to that of neurotransmitters (Fig. 2). Aporphine alkaloids, being an α_1 -adrenoreceptor antagonist or partial agonist, and a calcium channel blocker

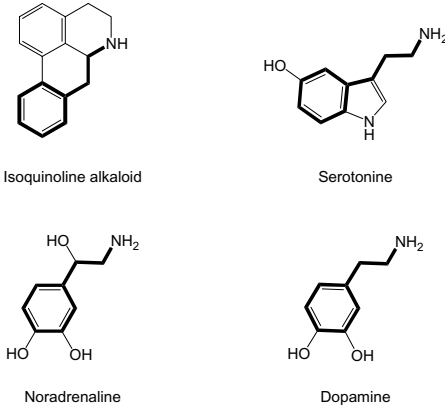


Fig. 2. Examples of neuroactive natural products characterized from the family Annonaceae. Note the similitude of chemical structure of isoquinoline alkaloids with serotonin, dopamine and noradrenaline.

or 5-hydroxytryptamine (5HT₂) antagonist, might hold potential for the treatment of hypertension. A number of isoquinoline alkaloids, being a muscarinic blocker, 5-hydroxytryptamine (5HT₁) receptor agonist or dopamine reuptake inhibitor, might hold potential for the treatment of asthma, gastric ulcer, anxiety or depression.

Terpenes and flavonoids: Clerodane and kaurane diterpenes characterized from *Polyalthia* and *Annona*, as well as chalcones and flavanones characterized from *Desmos*, *Fissistigma*, and *Uvaria* species are cytotoxic and antimicrobial.

In the Asia-Pacific, about 50 species of Annonaceae are used for medicinal purposes, particularly to treat fever, to assuage stomachaches, to facilitate abortion and to treat skin diseases.

***Anaxagorea javanica* Bl.**

[*Anaxagoras* = Greek philosopher; Latin *javanica* = from Java]

Physical description: It is a treelet of the lowland rainforest of Malaysia, Borneo and Java. The bark is slightly fissured and yellowish. Leaves: simple, alternate and exstipulate. The petiole is 5 mm–1 cm long, transversally fissured and channeled above. The blade is leathery, 7 cm–18 cm × 4 cm–6 cm, and oblong-lanceolate. The apex of the blade is acute or slightly acuminate and the base is tapering. The margin is slightly recurved and wavy. The blade shows 6–10 pairs of secondary nerves.

Synonymy: *Anaxagorea scortechinii* King.

Common name: *Champooon* (Thai).

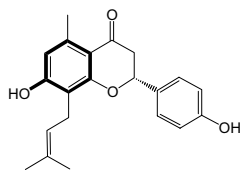


Fig. 3. *Anaxagorea javanica* Bl.

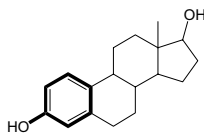
The flowers are fragrant, grouped by 1–4, terminal and opposite the leaves. The calyx comprises of 2–3 sepals which are valvate. The corolla consists of 6 petals which are valvate and arranged in 2 distinct whorls. The outer petals are elliptic with a broad base, greenish outside and white inside. The inner petals are white with narrow claw and rhomboid blade. The gynecium consists of 8–9 angled distinct carpels. The stigmas are conical with U-shaped opening at the apex. The fruits are bunches of 4–8, light-green, club-shaped, succulent and dehiscent 5 cm long ripe carpels radiating from the thalamus. Each carpel contains a pair of glossy and pure black, tear-shaped, and 5 mm long seeds (Fig. 3).

Pharmaceutical interest: Bioassay-guided fractionation of a methanolic extract of heartwood of *Anaxagorea luzonensis* resulted in the isolation of a nonsteroidal phytoestrogens: 8-isopentenylnaringenin (Kitaoka M *et al.*, 1998). 8-Isopentenylnaringenin injected into ovariectomized rats (30 mg/Kg/day) completely suppresses bone and uterine changes as effectively as 17- β -estradiol (Masaaki M *et al.*, 1998). The pharmacological potential of *Anaxagorea javanica* Bl. is unknown.

Use: A decoction of the root of *Anaxagorea javanica* Bl. is drunk by Malays to aid recovery from childbirth.



8 Isopentenylnaringenin



Estradiol

References

- Kitaoka M, *et al.* (1998) *Planta Med* **64**(6): 511–515.
 Masaaki M, *et al.* (1998) *Planta Med* **64**(6): 6516–6519.

Warning: This plant may have some estrogenic properties and potentially increase the risk of breast cancer.

***Annona muricata* L.**

[From Latin, *annonna* = yearly produce and *muricata* = muricate]

Physical description: It is a fruit tree native to tropical America, probably introduced in the very early times by the Spaniards. The leaves: simple, alternate, exstipulate and 5.5 cm–18 cm × 2 cm–7 cm. The blade is oblong, lanceolate-obovate, often shortly acuminate at the apex, and sparingly appressed and hairy beneath. The flowers are at first green, then ripening into yellowish-pale. The outer petals are 3.5 cm–5 cm long, acuminate, when the inner ones are imbricate, obtuse and 2.5 cm–3.5 cm long. The stamens are 4 mm–5 mm long and the carpels are numerous and free. The fruits are heart-shaped, muricate, green, 15 cm–35 cm × 10 cm–15 cm and edible (Fig. 4).

Common names: Sour sop; *corrossolier* (French), *pulippala* (Tamil); *mempisang*, *durian b'landa*, *sri kaya blanda*, *nona blanda* (Malay); *goyabrano*, *guanabano* (Filipino); *mak khieb thet*, *mang can xiem*, *tiép parang* (Vietnamese).

Pharmaceutical interest:

Cytotoxic property: In regards to the cytotoxic property of *Annona muricata* L., a number of experiments conducted *in vitro* have clearly

Uses: The tanniferous unripe fruits and bark of *Annona muricata* L. are eaten so as to stop dysentery and diarrhea. In Indonesia, the crushed leaves are applied externally to heal boils and a powder of the dried leaves is used to kill insects. A decoction of the leaves is drunk to expel intestinal worms. In Malaysia, a liquid preparation containing the leaves is applied externally to treat rheumatism, and to alleviate cough and fever. A poultice of the powdered leaves is applied externally to soothe inflamed parts and to treat skin diseases. In the Philippines, the green bark is applied externally to heal wounds and to stop bleeding, and a decoction of the leaves is used to wash ulcers and to heal wounds. In Vietnam, an infusion of leaves is drunk to combat anxiety. In India, the oil expressed from the seeds is applied to the hair to kill lice, but it burns the eyes.



Fig. 4. *Annona muricata* L.

demonstrated that acetogenins are drastically antineoplastic. Annonapentocins A–C, *cis*- and *trans*-annonuricin D-one inhibit the proliferation of lung carcinoma cells (A549), colon cells (HT29) and pancreatic cells (PACA) cultured *in vitro*, with potencies equal to or greater than that of adriamycin (Bories C *et al.*, 1991; Liaw CC *et al.*, 2002).

Neurological properties: Anonaine, nornuciferine, and asimilobine from *Annona muricata* L., block 5-hydroxytryptaminergic (5HT_{1A}) receptors (Hasrat JA *et al.*, 1997) thereby substantiating the anxiolytic use of the plant. Such a property is not surprising since the molecular structures of anonaine, nornuciferine and asimilobine are similar to that of serotonin. 5-Hydroxytryptaminergic (5HT_{1A}) receptors mediate in the central nervous system the autonomic control of hypothermia, hyperphagia, analgesia, blood pressure, venereal desire, anxiety and several behavioral paradigms. It has been hypothesized that the anxiolytic property of buspirone is on account of a blockade of 5-hydroxytryptaminergic (5HT_{1A}) receptors. Methysergide, a partial 5-hydroxytryptaminergic (5HT₁) agonist, and sumatriptan, a 5-hydroxytryptaminergic (5HT_{1D}) agonist, are drugs used to assuage headache.

There is an expanding body of evidence to suggest that over representation of atypical Parkinsonism and progressive supranuclear palsy in the French West Indies could be due to the ingestion of *Annona muricata* L. A case-control work carried on 87 patients with Parkinsonism indicates that 29 patients with progressive supranuclear palsy and 30 patients with atypical Parkinsonism were regularly ingesting the fruit of *Annona muricata* L. (Caparros-Lefebvre D *et al.*, 1999). Movement disorder is a symptom of extrapyramidal motor

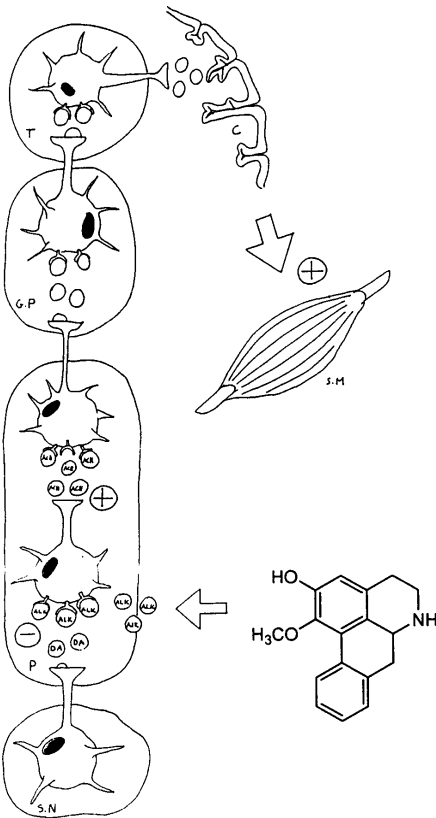
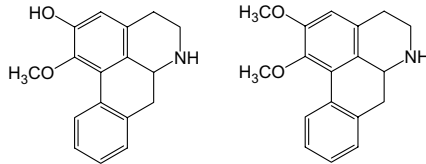


Fig. 5. Hypothetic mechanism of action of *Annona muricata* L. alkaloid on the central nervous system via blockage of dopaminergic D₂ receptors in the basal ganglia. ACH: acetylcholine; ALK: alkaloid of *Annona muricata*; C: cortex; DA: dopamine; GP: globus pallidus; SM: striated muscle; P: putamen; SN: substantia nigra; T: thalamus.

dysfunction and a prominent manifestation of diseases affecting the basal ganglia. The basal ganglia receives impulses from different parts of the cerebral cortex and plays a key role in the control of movement. The basal ganglia consists of the caudate nucleus, putamen, globus pallidus, substantia nigra and subthalamic nucleus, which are interconnected by dopaminergic and cholinergic neurons, deep within the cerebral hemispheres (Fig. 5). Under normal condition, the dopaminergic system inhibits the cholinergic output. In the case of Parkinsonism, the dopaminergic neurons of the substantia nigra fail to control the cholinergic output, thus resulting in tremors, rigidity and akinesia. Antipsychotic drugs reducing the concentration of striatal dopamine (reserpine) or blocking the dopaminergic D₂ receptors (phenothiazines and butyrophenones) are well-known to cause Parkinsonism. Are anonaine, nornuciferine, and asimilobine able to block the dopaminergic D₂ receptors of the basal ganglia or do they enhance the cholinergic activity? Ingestion of *Annona muricata* L. causes galactorrhea and tremors (Rom'an G, 1998), two typical symptoms of dopamine D₂ blockade. Oxoaporphine, aporphine, and a series of phenanthrene alkaloids characterized from *Annona purpurea* inhibit significantly the aggregation of platelets (Chang FR *et al.*, 1998), suggesting the inhibition of phospholipase A₂.



Asimilobine

Nornuciferine

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 Liaw CC, *et al.* (2002) *J Nat Prod* **65**(4): 470–475.
 Rom'an G. (1998) *Curr Opin Neurol* **11**(5): 539–544.

Warning: Cases of association of cancer (due to tannins) and Parkinsonism (due to alkaloids) following ingestion of *Annona muricata* L. are possible.

***Artabotrys suaveolens* Bl.**

[From Greek, *artao* = support and *botrys* = bunch of grapes and *suavis* = sweet]

Physical description: It is a rainforest climber of Burma, Java, Moluccas and the Philippines. The bark is blackish and smooth and the stems are hooked.

Leaves: simple, alternate and exstipulate. The petiole is glabrous, channeled and 3 mm–5 mm long. The blade is dark green, glossy, glabrous, leathery, elliptic and 8.5 cm × 3.5 cm–5 cm × 3 cm. The apex of the blade is acute-acuminate; the base is tapering; and the margin is entire and slightly acuminate. The flowers are 1 cm long, whitish and tomentose. The calyx comprises of 3 sepals which are ovate, acute and 2.5 mm long. The corolla comprises of 2 distinct whorls of 3 petals which are valvate. The petals are dilated at the base, and develop a cylindrical limb and a recurved apex. The fruits are green, glossy, ellipsoid, 1.4 cm × 5 mm ripe carpels, each containing a single seed (Fig. 6).

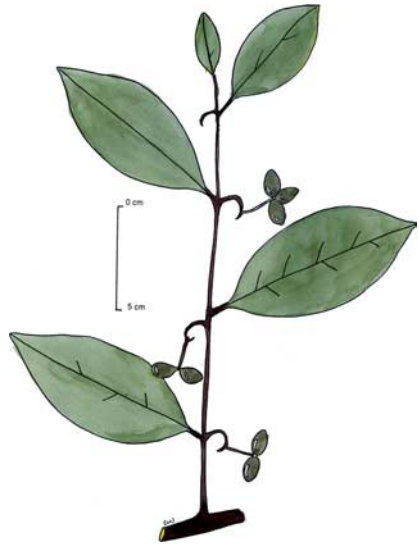


Fig. 6. *Artabotrys suaveolens* Bl.

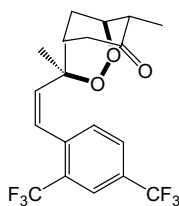
Pharmaceutical interest: The pharmacological properties of *Artabotrys suaveolens* Bl. are unexplored. One might set the hypothesis that isoquinoline alkaloids, such as artabotrine, suaveoline and artabotrinine, could be responsible for both antibacterial and emmenagogue properties (Maranon J, 1929; Barger G *et al.*, 1939; Santos AC *et al.*, 1932). Artabotrine from *Artabotrys zeylanicus* alleviates yeast cells cultured *in vitro* (Wijeratne EMK *et al.*, 1995). Both liriodenine and atherospermidine characterized from *Artabotrys uncinatus* are cytotoxic *in vitro* (Wu YC *et al.*, 1989). The leaves of *Artabotrys odoratissimus* display an antifertility property (Chakrabarti B *et al.*, 1968). Norstephalagine and atherospermidine characterized from the bark of *Artabotrys maingayi* relax rat uterine KCl- and oxytocin-induced contractions induced by potassium chloride and the rhythmic contractions induced by oxytocin (Cortes D *et al.*, 1990).

Antiplasmodial property: An interesting feature of the genus *Artabotrys* is the production of antimalarial sesquiterpenes peroxides. One such compound is yingzhaosu A, from *Artabotrys uncinatus*, a plant used in India to make aromatic tea. Arteflene, a synthetic peroxide developed from yingzhaosu A given (single oral dose 25 mg/Kg) in a phase 3, open-labeled randomized clinical

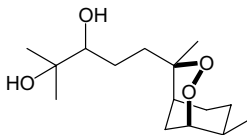
Common name: *Akar cenana* (Malay).

Uses: In Malaysia and Indonesia, an infusion of the leaves provides an aromatic drink used to treat cholera. In the Philippines, a decoction of the bark and roots is drunk to promote menses and to aid recovery from childbirth.

trial, was not effective in curing *Plasmodium falciparum* malaria (Radloff PD *et al.*, 1996).



Arteflene



Yingzhaosu

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Cananga odorata (Lamk.) Hook. f. & Thoms.

[From Malay, *kananga* = *Canangaodorata* (Lamk.) Hook. f. & Thoms. and from Latin, *odorem* = odour]

Physical description: It is a shrub which grows to a height of 4 m. The plant grows wild in a geographical zone spanning from India to Polynesia. The bark is blackish to grey, smooth and the young stems are pubescent. Leaves: simple, alternate and exstipulate. The blade is light green, soft, dull, oblong to broadly elliptic, and 6.5 cm × 20 cm–3 cm × 8.5 cm. The apex of the blade is acuminate and the base is round. The blade shows 6–10 pairs of secondary nerves. The flowers are strongly fragrant. The calyx consists of 3 sepals and the corolla consists of 6 linear valvate petals, yellow at first then turning golden yellow. The fruits consist of 2 to 12 ripe carpels arranged in 2 whorls, ripening to black, and 1.75 cm × 2.5 cm. Each carpel contains 6 to 12 seeds (Fig. 7).

History: The oil obtained by distillation of the flowers is the Cananga oil or ylang-ylang oil, which is used to make perfumes. Cananga oil added to coconut oil and other ingredients makes the Macassar oil which was so familiar to the well-groomed Victorian and Edwardian males. The British Standards Institution has published standard specifications for Cananga oil (BS 2991/1:1965). Cananga oil contains geraniol, linalool esters of acetic and benzoic acids, p-cresol methyl ester, cadidene, some sesquiterpenes and phenols (Greenberg LA *et al.*, 1954).

Synonymy: *Canangium odoratum* Baill.

Common names: Ylang-ylang tree; *bois de lance batard* (French); *maladi* (Tamil); *kenanga* (Malay); *kadapnyan* (Burmese).

Pharmaceutical interest:

Cytotoxic properties: *Cananga odorata* (Lamk.) Hook. f. & Thoms. contains a cytotoxic oxoaporphine alkaloid known as liriodenine, which inhibits the enzymatic activity of topoisomerase II *in vitro* and *in vivo* (Woo S *et al.*, 1997). The inhibition of topoisomerase II, a key enzyme of the DNA replication, causes a quick cleavage of the DNA backbone and thereby cellular death. Topoisomerase II inhibitors are of critical chemotherapeutic importance and the family Annonaceae, which abound with liriodenine-like alkaloids, may appear as a potential reserve of chemotherapeutic agents. Examples of therapeutic topoisomerase II inhibitors are the relatively newly introduced oral antibacterial broad-spectrum antibiotic fluoroquinolones. An example of fluoroquinolone is ciprofloxacin, generally regarded as the most significant development in the field of antibacterial chemotherapy. The fruits contain some alkaloids, and sesquiterpenes which have cytotoxic properties (Hsieh TJ *et al.*, 2001).

Amebicidal properties: An extract of *Cananga odorata* (Lamk.) Hook. f. & Thoms. inhibits, *in vitro*, the proliferation of *Acanthameba culbertsoni*, *Acanthameba castellani*, and *Acanthameba polyphaga* which are the causative agents of granulomatous amoebic encephalitis and amoebic keratitis (Chu DM *et al.*, 1998).

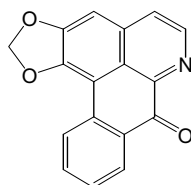
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 Woo S, *et al.* (1997) *Biochem Pharmacol* **54**(4): 467–473.

Warning: Perfumes containing Cananga oil can produce dermatitis in sensitized individuals and have been removed from certain cosmetics (Greenberg LA *et al.*, 1954; Schieffelin, 1973).



Fig. 7. *Cananga odorata* (Lamk.) Hook. f. & Thoms.



Liriodenine

***Cyathostemma argenteum* (Bl.) J. Sinclair**

[From Latin, *argentum* = silver]

Physical description: It is a rainforest climber of Malaysia and Indonesia. The young stems are rufous-pubescent. Leaves: simple, alternate and exstipulate. The blade is oblong-lanceolate, 10 cm–17 cm × 4 cm–6 cm, slightly silvery-grey puberulous beneath and glabrous above, except the midrib. The base of the blade is broad, round, truncate and the apex is shortly and obtusely acuminate. The petiole is 3 mm–5 mm long. The flowers are dark purple. The corolla consists of 6 petals which are broadly ovate, obtuse, 5 mm long, imbricate, pubescent and inflexed at the apex. The calyx comprises of 3 sepals which are broadly ovate, obtuse, and 2 mm long. The fruits are sausage-shaped and 2 cm × 4 cm.

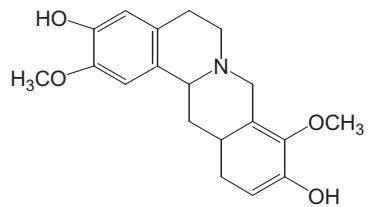
Synonymy: *Uvaria micrantha* Hook. f. & Thoms.

Pharmaceutical interest:

Antispasmodic properties: Isoquinoline alkaloids in *Cyathostemma argenteum* (Bl.) J. Sinclair and in other Annonaceae probably explain the frequent use of these plants to stop spasms. One such alkaloid, from *Fis-sistigma glaucescens*, is (-)-discretamine which inhibits, experimentally, the contraction of rat aorta induced by noradrenaline, phenylephrine, and clonidine. (-)-Discretamine inhibits the irreversible blockade of α -adrenoreceptors by phenoxybenzamine and inhibits the formation of [3 H]-inositol monophosphate caused by noradrenaline, appearing, therefore, as a selective α_1 -adrenoreceptor blocking agent. (-)-Discretamine blocks non-competitively 5-hydroxytryptamine (5HT) receptors (Ko FN *et al.*, 1994).

Uses: In Indonesia, the bark is used to stop spasms and to soothe inflamed parts. The flowers are used to treat malaria, and the seeds are eaten to assuage stomach discomfort and to combat fever. In Malaysia, a paste of the fresh flowers is applied to the chest to treat asthma. In the Solomon Islands, a paste of the leaves is used externally to heal boils. In India, the essential oil makes an external remedy used to treat cephalgia, ophtalmia and gout.

Cytotoxic properties: (-)-Discretamine inhibits the proliferation of brine shrimps ($LC_{50} > 125 \mu\text{g/mL}$) less efficiently than emetine (LC_{50} : 30 $\mu\text{g/mL}$; Khamis SB *et al.*, 1998). *Cyathostemma viridifolium*, inhibits the proliferation of KB cells cultured *in vitro* ($IC_{50} = 4.5 \mu\text{g/mL}$; Mahmood K *et al.*, 1993).



Discretamine

References

- Khamis SB, *et al.* (1998) *J Pharm Pharmacol* **50**: 281.
 Ko NK, *et al.* (1993) *Br J Pharmacol* **110**: 882–888.
 Mahmood K, *et al.* (1993) *Nat Prod Lett* **3**: 245–249.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Desmos chinensis Lour.

[From Greek, *desmos* = a bundle and from Latin, *chinensis* = from China]

Physical description: It is a handsome treelet which grows wild in a geographical zone spanning from the Himalayas to China and the Asia-Pacific. The bark is lenticelled. Leaves: simple, alternate and exstipulate. The blade is 3 cm–2 cm × 7 cm–15 cm, very thin, oblong, glaucous below and round at the base and shows 8–10 pairs of secondary nerves. The petiole is 5 mm–8 mm long. The flowers are solitary, sweet scented, showy, facing the leaves and attached to 3 cm–5 cm long pedicels. The sepals are 5 mm–1 cm long. The petals are valvate, greenish yellow and 4 cm–8 cm long. The fruits are strings of greenish to reddish, 3 cm–4 cm × 1 cm–1.5 cm beads. The pedicels are 1 cm–1.5 cm long (Fig. 8).

Pharmaceutical interest: *Desmos chinensis* has attracted a great deal of interest on account of its ability to elaborate C-benzylated chalcones (Rahman MM *et al.*, 2003).

Antibacterial and leishmaniocidal properties: 5-methoxy-7-hydroxyflavanone and 6''-hydroxydehydroavaretin characterized from *Desmos chinensis* Lour. inhibit the proliferation of *Bacillus subtilis* and *Shigella boydii* cultured *in vitro*. 5-methoxy-7-hydroxyflavanone inhibits the proliferation of *Staphylococcus aureus* and

Synonymy: *Unona discolor* Vahl

Common names: Chinese Desmos; *kenanga hutan*, *akar darah*, *akar mariam* (Malay).

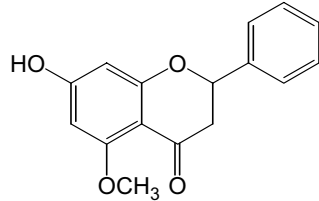
Uses: In Malaysia, a decoction of the roots of *Desmos chinensis* is drunk to stop diarrhea, dysentery, to treat vertigo and to aid recovery from childbirth. In Vietnam, *Desmos chinensis* Lour. is used to treat cold.



Fig. 8. *Desmos chinensis* Lour.

6''-hydroxydehydrovaretin is active against the flagellated protozoan *Leishmania donovani* (Nazmul Q *et al.*, 1996). 2', 4'-dihydroxy-6'-chalcone and chrysin characterized from *Desmos chinensis* Lour. inhibit the proliferation of several sorts of Gram-positive bacilli and Gram-negative bacilli (Qais N *et al.*, 1997).

Tyrosine kinase property: 8 formyl-2,5,7-trihydroxy-6-methylflavanone characterized from *Desmos chinensis* Lour., inhibits tyrosine kinase in the epidermal growth factor receptor-over expressing NIH3T3 (ER12) cells, and inhibits the formation of inositol phosphate induced by the epidermal growth factor (Kakeya H *et al.*, 1993). Inhibitors of tyrosine kinase could help to suppress the development of tumors and breast carcinoma.



5 - Methoxy - 7- hydroxyflavanone

References

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 Rahman MM, *et al.* (2003) *Fitoter* **74**(5): 511–514.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Fissistigma species

[From Latin, *fiss* = cleave and from Greek, *stigma* = mark made by pointed instrument]

Physical description: *Fissistigma* species are woody climbers with the dorsal side of sepals and petals, ovaries, ripe carpels, apices of stems and petiole densely covered with a golden-brown tomentum. The flowers are often large and comprise of 3 valvate sepals and 6 valvate petals in 2 whorls, the inner ones being smaller. The fruits are large, globose and thick-walled free carpels, each carpel containing 1–8, glossy and brown seeds (Fig. 9).

Pharmaceutical interest:

Muscarinic properties of liriodenine: One might set the hypothesis that *Fissistigma* species assuage stomachaches on account of isoquinoline

Uses: Malaysians have been known to drink decoctions of *Fissistigma manubriatum* (Hook. f. & Thoms.) Merr. (*Melodorum manubriatum* Hook. f. & Thoms.), *Fissistigma lanuginosum* or *Fissistigma kingii* to assuage stomachaches, and the leaves of *Fissistigma fulgens* are applied externally to soothe inflammation.

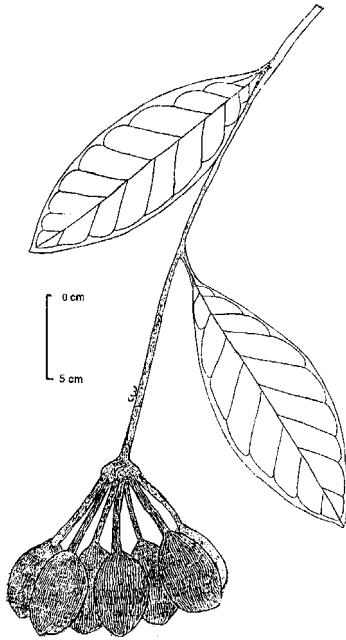


Fig. 9. *Fissistigma latifolium* (Dunal) Merr. var. *ovoideum*.

effect on the cAMP and cGMP content of the trachea. Liriodenine is a selective muscarinic receptor antagonist in isolated portions of ileum and cardiac preparations (Lin C *et al.*, 1994). Liriodenine has inotropic positive property and is a potential candidate for the treatment of cardiac arrhythmia (Lin C *et al.*, 1993). Further experiments using whole-cell voltage clamp show that liriodenine suppresses ventricular arrhythmia through blockade of Na^+ -channels (Chang GJ *et al.*, 1996).

Note that the vascular and cardioprotective effects of liriodenine in ischemia–reperfusion injury involves NO-dependent pathway (Chang WL *et al.*, 2004).

Other properties: Atherosperminine from *Fissistigma glaucescens* inhibits the aggregation of platelets caused by adenosine-5-diphosphate, collagen and the platelet activating factor, and relaxes portions of rat thoracic aorta (Chen K *et al.*, 1996). Another vasodilating alkaloid characterized from the genus *Fissistigma* is (-)-discretamine (see *Cyathostemma argenteum*; Ko FN *et al.*, 1994). *Fissistigma lanuginosum* elaborates a chalcone, pedicin, which inhibits the assembly of tubulin ($\text{IC}_{50} = 300 \text{ nm}$; Alias Y *et al.*, 1995).

alkaloids, such as liriodenine, which are known to block muscarinic receptors and therefore impede both the secretion of gastric juices and the contraction of the gastric smooth muscles. Liriodenine (an oxoaporphine), characterized from *Fissistigma glaucescens*, inhibits the contraction of isolated portions of guinea-pig trachea induced by carbachol. Liriodenine is slightly more potent than methocramine but less potent than atropine, pirenzepine and 4-diphenylacetoxy-N-methylpiperidine. Liriodenine ($300 \mu\text{M}$) partially inhibits the contraction induced by potassium, leukotriene C_4 , neurokinin A, prostaglandine $\text{F}_{2\alpha}$, histamine and U46619. Liriodenine does not affect the tracheal contraction induced U46619 and neurokinin in the presence of nifedipine ($1 \mu\text{M}$) or in the presence of a calcium-free medium, and it has no

References

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 Lin C, *et al.* (1993) *Eur J Pharmacol* **237**(1): 109–116.
 Lin C, *et al.* (1994) *Br J Pharmacol* **113**(1): 275–281.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Goniothalamus macrophyllus (Bl.) Hook. f. & Thoms.

[From Greek, *gonia* = hook, *thalamus* = receptacle, *macro* = large and *phullon* = leaves]

Physical description: It is a treelet of the rainforest of Indonesia, Malaysia and Thailand. Leaves: leathery and 25 cm–35 cm × 6 cm–11 cm. The blade is oblong-lanceolate, and shows 16 to 20 pairs of secondary nerves. The apex is acute or acuminate, and the base is sub-acute or round. The petiole is 2.5 cm long and stout. The flowers are solitary or in pairs, being green, large, slightly supra-axillary or pendulous from the branches below the leaves. The calyx consists of 3 sepals which are broadly ovate, acute, connate at the base and 1.5 cm long. The corolla comprises of 6 petals, the outer ones being oblong lanceolate, acute, 2.5 cm–3.75 cm long, and the inner ones half as long, ovate acuminate, and ciliate. The fruits are globular, ovoid and glabrous ripe carpels (Fig. 10).

Common names: *Bihidieng*, *penawar hitam*, *bongsoi* (Malay).

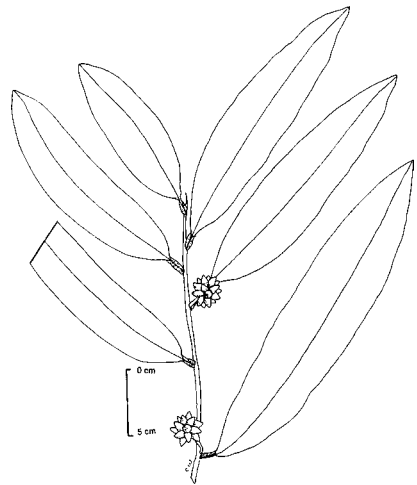


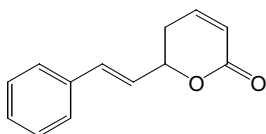
Fig. 10. *Goniothalamus macrophyllus* (Bl.) Hook. f. & Thoms.

Pharmaceutical interest:

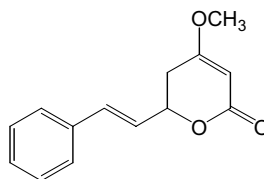
Cytotoxic properties: *Goniothalamus* species are interesting because they produce cytotoxic acetogenins, styryl-lactones and quinones.

Acetogenins: 2,4-cis and trans-giganterinones characterized from the bark of *Goniothalamus giganteus* Hook. f. & Thoms., inhibit the proliferation of the PC-human prostate adenocarcinoma cell-line cultured *in vitro* (Alali FQ *et al.*, 1997).

Use: In Malaysia, a decoction of the root is used to aid abortion or to aid recovery from childbirth. A decoction of the leaves is drunk to combat fever. Indonesians drink a decoction of the roots for the same purpose.



Goniotalamin



Kavain

Styryl lactones: An example of cytotoxic styryl-lactone is goniodiol-7-monoacetate, which inhibits the proliferation of KB, P388, RPMI and TE 671 tumor cell-lines cultured *in vitro* (Wu YC *et al.*, 1991). Another styryl-lactone, goniotalamin, characterized from *Goniothalamus tapis* Miq. inhibits the proliferation of HCG-27, MCF7, PAN C-1, HeLa cancerous cell-lines and non-cancerous (3T3) cell-lines cultured *in vitro* (Ali AM *et al.*, 1997). The cytotoxic mode of action involved here needs to be further clarified and could involve apoptosis, inhibition of the mitochondrial respiratory chain, and inhibition of topoisomerase II. Goniotalamin causes apoptosis in Jurkat T-cells on account of the activation of caspases 3 and 7 (Inayat-Hussain SH *et al.*, 1999). Styryl-lactones characterized from *Goniothalamus arvensis* inhibit the mitochondrial respiratory chain (Peris E *et al.*, 2000). Howiinol, a phenylethylene pyrone characterized from *Goniothalamus howii* exerts a potent inhibitory effect on cancer cells and inhibits topoisomerase II (Xu CX *et al.*, 1999). 1-azaanthraquinones and 3-aminonaphthoquinone, 2 cytotoxic quinones were characterized from *Goniothalamus marcanii* (Soonthornchareonnon N *et al.*, 1999).

Other pharmacological properties: The abortifacient property of *Goniothalamus macrophyllus* (Bl.) Hook. f. & Thoms. could probably be owed to goniotalamin, the intraperitoneal injections of which (139 mg/Kg) during the first 7 days of gestation causes abortion in animals (Azimahtol HL *et al.*, 1994). Goniotalamin and goniodiol inhibit the expression of intercellular and vascular inflammatory messengers by murine endothelial cells, suggesting anti-inflammatory and immunosuppressive properties (Tanaka S *et al.*, 2001). Note that the structure of goniotalamin is very much like the structure of kawaine from *Piper methysticum* Forst. (family Piperaceae, order Piperales, subclass Magnoliidae), an anxiolytic herb of commercial value. Does *Goniothalamus macrophyllus* (Bl.) Hook. f. & Thoms. hold any anxiolytic properties?

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Mitrella kentii (Bl.) Miq.

[From Greek, *mitra* = belt or girdle worn by warriors round the waist]

Physical description: It is a woody climber of peat swamp forest, coastal beach and seashores of the Asia-Pacific. The pedicels, calyx, outer petals and young leaves are covered with a golden tomentum. Leaves: simple, alternate and exstipulate. The petiole is 1 cm long. The blade is oblong-elliptic, leathery, dark green above and grey green below. The apex of the blade is acute-acuminate and the base is acute. The midrib is sunken above and raised below, and there are about 12 pairs of secondary nerves. The flowers are axillary. The calyx consists of a 3-angled connate cups, and the petals are ovate, valvate, small, the inner ones being smaller. The fruits are dull-orange ripe carpels (Fig. 11).

Synonymy: *Melodorum pisocarpum* Hk. f. et Thoms, *Melodorum elegans* Hk.f et Thoms.

Common names: *Kiawi* (Indonesian).



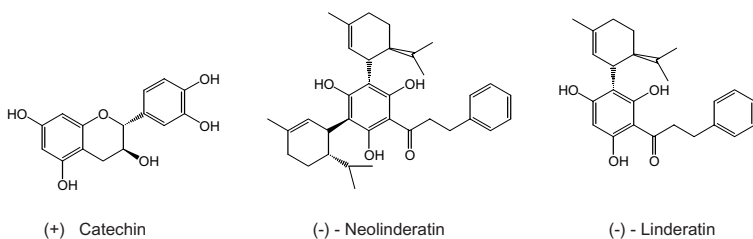
Fig. 11. *Mitrella kentii* (Bl.) Miq. From: Herbarium 34155. Field collector & botanical identification: JF Maxwell. Geographical localization: Singapore, 1982.

Pharmaceutical interest: Dihydrochalcones: (-)-neolideratin, (-)-lideratin and 2',6'-dihydroxy-4'-methoxydihydrochalcone, and (+)-catechin are known to occur in the stem bark of *Mitrella kentii* (Bl.) Miq (Benosman A *et al.*, 1997).

One might set the hypothesis that these phenolic substances are responsible

for the property mentioned above by inhibition of enzymes that catalyze the synthesis of autacoids.

Uses: Malaysia: a decoction of the roots of *Mitrella kentii* (Bl.) Miq. is drunk to treat fever.



Reference

Benosman A, *et al.* (1997) *J Nat Prod* **60**(9): 921–924.

Orophea polycarpa A. DC.

[From Greek, *orophe* = roof, *poly* = many and *karpos* = fruit]

Physical description: It is a tree of the rainforest of Malaysia which grows to a height of 8 m. The bark is blackish and fissured. The wood is yellow, and cross sections of stems show broad medullary rays. Leaves: simple, alternate and exstipulate. The petiole is indistinct. The blade is ovate-lanceolate, and 5 cm × 2 cm–10 cm × 4 cm. The apex of the blade is attenuate and the base slightly cordate. The blade shows 7–10 pairs of indistinct secondary nerves. The inflorescences are terminal clusters of small and flesh colored flowers. The calyx consists of 3 valvate sepals which are smaller than outer petals. The corolla consists of 6 petals, the outer ones of which are shorter than the inner, and the inner petals joined at the top (in a roof-like manner). The andrecium consists of 6 stamens. The fruits are globose, 1 cm, bright red, and contain a single seed (Fig. 12).

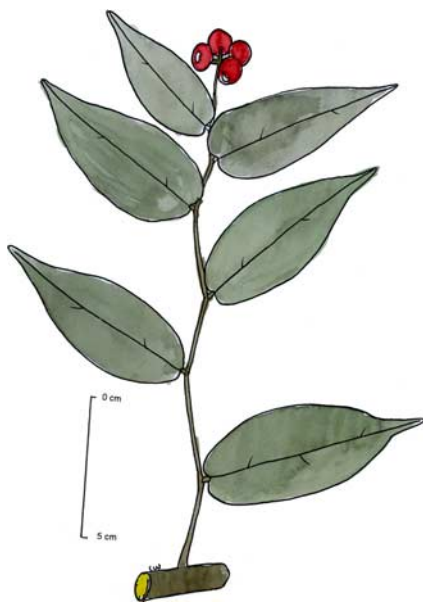
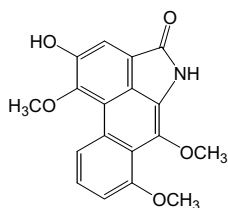
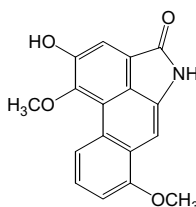


Fig. 12. *Orophea polycarpa* A. DC. From: KLU 23448. Field collector and botanical identification: Benjamin Stone. Geographical localization: Gua Musang, Kelantan, Malaysia, 1976.



Enterocarpam I



Enterocarpam II

Pharmaceutical interest: The anti-inflammatory property of *Orophea polycarpa* A. DC is still not confirmed yet. A dichloromethane extract of leaves of *Orophea enneandra* displays antifungal, antioxidant and radical scavenging properties on account of lignans: (-)-phylligenin, (-)-eudesmin, (-)-epieudesmine, tocopherol derivative: polycerasoidol and a polyacetylene: oropheic acid (Cavin A *et al.*, 1998). Aristolactams: enterocarpam I and II are known to occur in *Orophea enterocarpa* (Kamalia M *et al.*, 1986). Enterocarpam II has been synthesized (Couture A *et al.*, 1998).

Synonymy: *Orophea gracilis* King.

Uses: In Malaysia, *Orophea polycarpa* A. DC. is used to promote the secretion of sweat and to soothe an inflamed throat.

References

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Polyalthia cauliflora Hook. f. & Thoms. var. *beccarii* (King) J. Sinclair

[From Greek, *polus* = many, *althein* = cure, from Latin, *caulis* = stem and *floris* = flower]

Physical description: It is a shrub of the rainforests of Borneo, Malaysia and Sumatra. Leaves: simple, alternate and exstipulate. The blade is 9 cm–20 cm × 4 cm–8 cm, leathery, glossy, elliptic acuminate, acute at the base and shows 8–10 pairs of secondary nerves. The petiole is 5 mm–7 mm long. The flowers are cauline, on 2 cm–4 cm long pedicels. The calyx

Synonymy: *Balet* (Malay).

consists of 3 sepals which are triangular, pubescent on the outside and 6 mm–7 mm long. The corolla consists of 6 petals arranged in 2 whorls. The petals are 3.5 cm–5.5 cm long, thick, and cream to pinkish brown. The fruits consist of several ovoid, 1 cm long, ripe, 2 cm–2.5 cm long carpels, each carpel containing 1 to 2 seeds (Fig. 13).

Uses: *Polyalthia cauliflora* Hook. f. & Thoms. var. *beccarii* (King) J. Sinclair is principally used in Malaysia, where a paste of the powdered leaves is applied externally to treat skin infection.

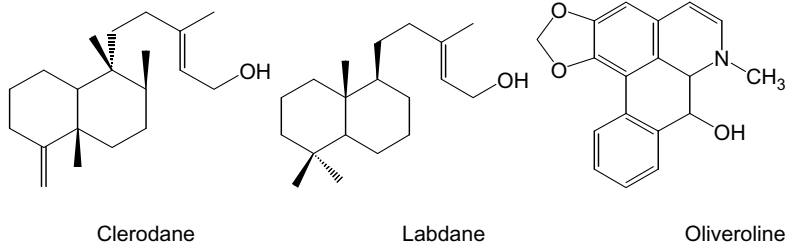
Pharmaceutical interest: The anti-septic property of *Polyalthia cauliflora* Hook. f. & Thoms. var. *beccarii* (King) J. Sinclair involves probably four sorts of natural products: terpenes, alkaloids, benzopyrans and tannins:

Diterpenes: A common and interesting feature of *Polyalthia* species, is the presence of cytotoxic and antimicrobial clerodane and labdane diterpenes. Labdane diterpenes characterized from *Polyalthia barnesii* inhibit the proliferation of several human cancer cell-lines and P388 cell-line cultured *in vitro* ($ED_{50} = 0.5 \mu\text{g/mL}$ – $18.5 \mu\text{g/mL}$; Ma X *et al.*, 1994). Polyalthialdoic acid, a clerodane diterpene characterized from the stem bark of *Polyalthia longifolia*, inhibits the proliferation of human tumor cell-lines cultured *in vitro* ($ED_{50} = 0.6 \mu\text{g/mL}$; Zhao GX *et al.*, 1991). The stem bark of *Polyalthia longifolia* var. *pendulla* contains a number of clerodane diterpenes which are strongly antimicrobial (minimal inhibiting concentration: $8 \mu\text{g/mL}$ – $64 \mu\text{g/mL}$; Rashid MA *et al.*, 1996). Other examples of terpenes are leishmaniacidal (*Leishmania donovani donovani* $ED_{50} = 0.75 \text{ mg/mL}$) labdane diterpenes characterized from the stem bark *Polyalthia macropoda* (Richomme P *et al.*, 1991) and a lanostane-type triterpene from *Polyalthia suberosa* (Roxb.). Twaites which inhibits the replication of the Human Immunodeficiency Virus in H9 lymphocytes (Li H *et al.*, 1993).

Isoquinoline alkaloids: Lanuginosine and oxostepharine characterized from the bark of *Polyalthia longifolia* var. *pendulla*, inhibit, *in vitro*, the proliferation of



Fig. 13. *Polyalthia cauliflora* Hook. f. & Thoms. var. *beccarii* (King) J. Sinclair.



Clerodane

Labdane

Oliveroline

Staphylococcus aureus. Lanuginosine inhibits the proliferation of several types of fungi (Ferdous AJ *et al.*, 1992). The stem bark of *Polyalthia longifolia* contains liriodenine, which is cytotoxic (Wu YC *et al.*, 1990; see *Fissistigma* species). The leaves *Polyalthia oliveri* contain oliveroline, which interestingly displays, *in vivo*, anti-Parkinson properties, whereas oliverine relaxes vascular smooth muscle in a papaverine-like way and is therefore antihypertensive (Quevauviller A *et al.*, 1977).

Benzopyrans: Polyalthidine characterized from *Polyalthia cerasoides* inhibits the enzymatic activity of mitochondrial ubiquinol cytochrome-C oxidoreductase respiratory chain in cancer cell-line cultured *in vitro* ($IC_{50} < 5$ mM; Zafra-Polo MC *et al.*, 1996).

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Pyramidanthe prismatica J. Sinclair (Hook. f. & Thoms.)

[From Greek, *pyramis* = pyramid and *prisma-matos* = thing sawn]

Physical description: It is a climber of the rainforest of Malaysia which grows from tree to tree to a length of 12 m. The bark is blackish and showily lenticelled.

Synonymy: *Fissistigma cylindricum* (Maingay) Merr., *Melodorum prismaticum* Hk. f. & Thoms.

Uses: In Malaysia, a decoction of the roots of *Pyramidanthe prismatica* (Hook. f. & Thoms.) J. Sinclair is drunk to treat diarrhea and snake bites. The pharmacological property of this plant is unknown. The plant may have disappeared before it is assessed for pharmacology.

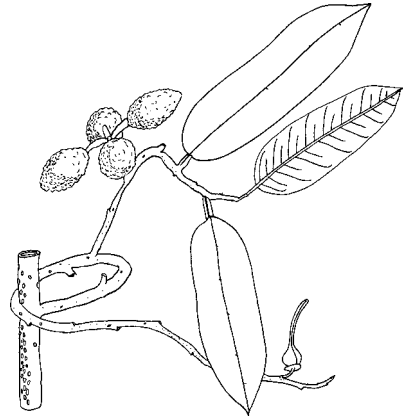


Fig. 14. *Pyramidanthe prismatica* (Hook. f. & Thoms.) J. Sinclair. From: KLU Herbarium 042520 and 15681 Field collector & botanical identification: Ahmad, Singapore, 1977.

Leaves: simple, alternate and exstipulate. The petiole is stout, 1 cm long and channeled. The blade is leathery, 14 cm–20 cm × 5 cm–7 cm, dark green on the surface, glossy and velvety underneath. The apex is shortly acuminate or acute and the base is round. The blade shows 12–14 pairs of secondary nerves with conspicuous internerves. The flower buds are axillary, golden velvety, 5 cm–7 cm long and conical. The calyx is disc-shaped, obscurely 3-angled and persistent in fruits. The petals are valvate, linear-lanceolate, the outer ones are 5 cm–7 cm long, and the inner ones are ovate and 1 cm long. The stigmas are capitate and lobed. The fruits are ovoid, 2 cm × 1.5 cm, dark green and rugose (Fig. 14).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Uvaria grandiflora* Roxb.**

[From Latin, *grandis* = full-grown and *flores* = flower]

Physical description: It is a climbing rainforest shrub found in Burma, Thailand, Indonesia, Malaysia and the Philippines. The young stems are hairy. Leaves: simple, alternate and exstipulate. The blade is 11 cm–28 cm × 6 cm–10 cm, thin, dark green, glossy on the surface and hairy below and shows 14–17 pairs of secondary nerves. The petiole is 3 mm–7 mm long and hairy. The flowers are solitary, facing the leaves and 9 cm–11 cm long. The calyx consists of 3 sepals which are 2 cm–2.5 cm long, thin, yellowish brown and broadly triangular. The corolla consists of 6 petals which are 3.5 cm–4 cm long, oblong cylindrical and red-purplish. The fruits are 4 cm–6 cm long and hairy ripe carpels containing 2 series of glossy seeds (Fig. 15).

Synonymy: *Uvaria purpurea* Bl.

Common names: *Pisang pisang* (Malay).

Uses: In Malaysia, the leaves of *Uvaria grandiflora* Roxb. are cooked and ingested to treat flatulence, and a decoction is drunk to assuage stomachache and to aid in recovery from childbirth. The pounded leaves are used to counteract putrefaction.

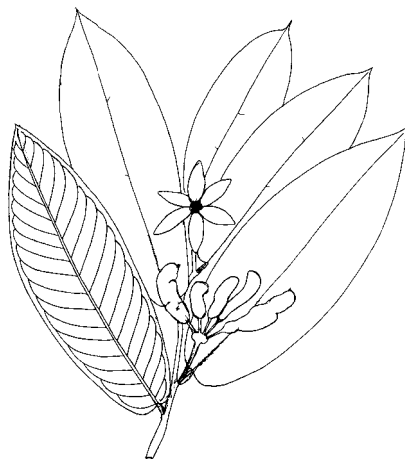


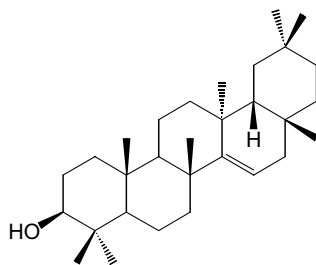
Fig. 15. *Uvaria grandiflora* Roxb. From: KLU 037294. Field Collector: SC Chin & Mustafa, 4 Feb 1985. Geographical localization: Sungai Layang, in old rubber estate, Negeri Sembilan, Malaysia.

Pharmaceutical interest:

Chemotherapeutic properties: Acetogenins: Uvarigrin, an acetogenin characterized by the roots of *Uvaria grandiflora* Roxb, inhibits the growth of HCT-8, Bel7402 and A2780 human tumor cells with ED₅₀ of 0.15 μg/mL, 0.21 μg/mL and 0.41 μg/mL respectively (Pan XP *et al.*, 1997). A number of triterpenes (glutinol, glutinone, taraxerol, β-sitosterol) and acetogenins (uvariamicin I–III, squamocin, squamocin-28-one, narumicin I–II, isodesacetyluvaricin and panalicin) characterized from *Uvaria narum* and *Uvaria hookeri* inhibit the proliferation of several sorts of microorganisms including cocci: *Staphylococcus pyogenes*; bacilli: *Bacillus brevis*, *Bacillus circulans*, *Bacillus licheniformis*, *Salmonella thyphi*, *Escherichia coli*, *Klebsiella aerogene*, *Pseudomonas pyocyaneae*; and fungi: *Aspergillus niger*, *Penicillium notatum*, *Trichophyton mentagrophytes*, *Microsporum gipsum*, *Epidermophyton floccosum*. A number of these acetogenins destroy *Haemonchus contortus* as efficiently as a mebendazole (Vermox®; Padmaja V *et al.*, 1993). Root bark extracts of *Uvaria narum* and *Uvaria hookeri* are cytotoxic on probable account of acetogenins (Padjama V *et al.*, 1995).

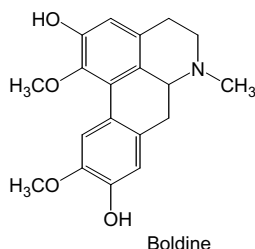
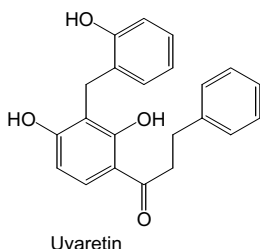
The essential oil extracted from the root bark of *Uvaria narum* is calming, stops flatulence and counteracts putrefaction. This oil contains 15% of bornyl acetate, 8% of patchoulinone and a tricyclic sesquiterpene ketone.

Flavonoids: An interesting feature of the *Uvaria* species is the occurrence of C-benzylated flavonoids such as uvaretin and isouvaretin characterized from *Uvaria chamae* (Hufford CD *et al.*, 1976; 1978), or triuvaretin and isotriuvaretin,



Taraxerol

characterized from the root bark of *Uvaria leptocladon* (Nkunya MHH *et al.*, 1993). Extracts of the bark of *Uvaria lucida* and the root bark of *Uvaria scheffleri* destroy efficiently the multidrug-resistant K1 strain of *Plasmodium falciparum* on account of uvaretin ($IC_{50} = 3.49 \mu\text{g/mL}$) and diuvaretin ($IC_{50} = 4.2 \mu\text{g/mL}$; Nkunya MH *et al.*, 1991). Hamiltrene, an aurone characterized from *Uvaria hamiltonii*, has a strong DNA strand-scission property (Huang L *et al.*, 1998). Chamuvaretin, a dihydrobenzylchalcone from *Uvaria chamae*, induces mutations in TA98 and TA 100 strains *Salmonella thyphimurium* (Uwaifo AO *et al.*, 1979).



Isoquinoline alkaloids: An ethanolic extract of the root bark of *Uvaria chamae* relaxes the smooth muscles of guinea-pig ileum, rabbit jejunum and rat uterus *in vitro* and *in vivo* (Langason RBF *et al.*, 1994), and displays anti-ulcerogen, hepatoprotective and trypanocidal properties (Madubunyi II *et al.*, 1996). The antispasmodic property could be attributed to toisoquinolines alkaloid which are known to block the muscarinic receptors (see Fissistigma), whereas the hepatoprotective property could involve choleric aporphinoid boldine-like alkaloids. Boldine is commercially used to treat hepatic disturbances and is currently extracted from *Peumus boldus* (family Monimiaceae). Boldine is found in a number of plants classified within the genus *Desmos* which botanically is close to the genus *Uvaria*.

References

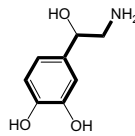
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 Padmaja V, *et al.* (1993) *J Ethnopharmacol* **40**(3): 181–186.
 Padmaja V, *et al.* (1995) *Fitoter* **66**(1): 77–81.
 Pan XP, *et al.* (1997) *Yao Xue Xue Bao* **32**(4): 286–293.
 Uwaifo AO, *et al.* (1979) *Cancer Lett* **8**(1): 87–92.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

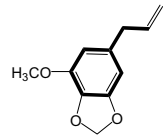
3. Family MYRISTICACEAE R. Brown 1810 nom. conserv., the Nutmeg Family

Physical description: The family Myristicaceae consists of about 16 genera and 380 species of lowland rainforest trees. In this family, isoquinolines and acetogenins weapons are replaced by *phenylacetylphenols*, serotonin-like *indole alkaloids* and lignans. Myristicaceae are quite easily recognized in the fields as they have a straight trunk which exudes a very characteristic blood-like sap, few leaves (hence a Christmas tree look) and nutmeg-like fruits. The leaves are simple, without stipules and alternate, often dark green and leathery. The flowers are tiny, male or female, and on different trees. The perianth is tiny, cup-shaped and 3-lobed. The stamens are united in a column, and the ovary is 1-celled and contains 1 ovule. The fruits are yellowish-red, ovoid, drupes, the seed of which is embedded in an aril, the divisions of which are of taxonomic importance.

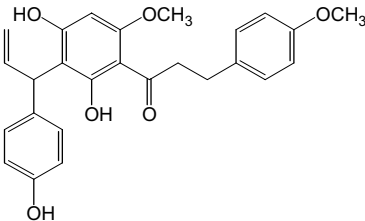
Pharmaceutical interest: The family Myristicaceae is interesting because it produces indole alkaloids which bind to serotonin receptors and hence have some potential for the treatment of anxiety, mood disorders and other psychological disturbances. Such alkaloids are *N,N*-dimethyl tryptamine, 5-methoxy-*N,N*-dimethyl tryptamine, 2-methyl-1,2,3,4-tetrahydro- β -carboline which have been characterized from *Virola sebifera* which is used by South American shamans to cause hallucination (Fig. 14). Other interesting compounds are possible cytotoxic, antineoplastic and antibacterial phenylacetylphenols known as iryantherins which are very specific to the genus *Iryanthera*. A classical example of Myristicaceae is *Myristica fragrans* Houtt., the dried seeds of which: nutmeg are flavorful, narcotic and carminative. Excessive ingestion of nutmeg causes tachycardia, early constriction of the pupils, and a divorce from surroundings, delirium, semistupor and an "unpleasant and frightening" experience". The



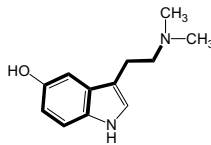
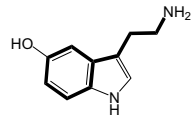
Noradrenaline



Myristicin



Iryantherin A

5-Hydroxy-*N,N*-dimethyl tryptamine

Serotonin

Fig. 16. Examples of neuroactive natural products characterized from the family Myristicaceae. Similarity of chemical structure with noradrenaline and serotonin.

neuroactive principles involved are phenylpropanoids: myristicin and elemicin, the chemical structures of which are similar to the chemical structure of noradrenaline (Fig. 16). In the Asia-Pacific, about 20 species of plants classified within the family Myristicaceae are used for medicinal purposes, mostly for gastrointestinal disturbances.

***Horsfieldia irya* (Gaertn.) Warb.**

[After Thomas Horsfield (1773–1859), an American doctor and botanist who took service in the Dutch East Indies]

Physical description: It is a medium-sized tree found in the swampy rainforests of the Asia-Pacific. The bark shows diamond-shaped short fissures and exudes a red sap after cutting. Leaves: simple, alternate and exstipulate. The blade is oblong-lanceolate, 14 cm–20 cm × 4 cm–5 cm, and shows 10–20 pairs of arching secondary nerves. The flowers are tiny with a bilobed perianth cup. The fruits are globose, dehiscent, yellowish-red and 1.5 cm × 1 cm drupes. The seed is embedded in a non-divided aril [Fig. 16(a)].

Pharmaceutical interest: Nothing is known so far about the pharmacological properties of *Horsfieldia irya* (Gaertn.). Note that the plant is known to elaborate 5,7-Dihydroxychromones and 8-hydroxytetrahydrochromones which might have anti-inflammatory properties but this remains to be confirmed experimentally.

The fruit of *Horsfieldia amygdaline* contains a chroman which dose-dependently and competitively inhibits the enzymatic activity of phospholipase A₂ of rabbit platelets, with an IC₅₀ value of 6.7 mM (Miyake A *et al.*, 1992). Methanolic extracts of leaves, roots and the stem bark of *Horsfieldia helwigii* show a broad spectrum of antibacterial activity (Khan MR *et al.*, 2001).



Fig. 16. (a) *Horsfieldia irya* (Gaertn.) Warb.

Synonymy: *Horsfieldia lemmania* (A. DC.) Warb.

Common name: *Penarahan pianggu* (Malay).

Uses: In China, the red sap of *Horsfieldia irya* (Gaertn.) Warb. is used to soothe sore throat. In Malaysia, a decoction of the bark is used to soothe sore throat.

References

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Knema globularia (Lamk.) Warb.

[From Greek, *knema* = internode and from Latin, *globulus* = globe]

Physical description: It is a treelet found in the Asia-Pacific and China (Yunnan). The stems are scurfy. Leaves: simple, alternate and exstipulate. The blade is narrow, slightly glaucous below and scurfy, glossy dark green on the surface, lanceolate, and 7 cm–15 cm × 1.5 cm–5 cm. The apex and base of the blade are both pointed, and the blade shows 12–20 pairs of secondary nerves. The flowers are tiny. The fruits are globular, succulent and orange drupes which are at first scurfy, and exhibit a perianth scar at the apex. The seed is embedded in a red aril divided only at the apex (Fig. 17).

Pharmaceutical interest: The therapeutic potential of *Knema globularia* (Lamk.) Warb. is unexplored but one could suspect its antiseptic activity to be mediated by phenolic compounds, since phenylacylphenolic compounds: kneracheline A and B, characterized from *Knema furfuracea* inhibit the proliferation of bacteria cultured *in vitro* (Zahir LA *et al.*, 1994). Phenolic compounds characterized from the stem bark of *Knema glomerata* inhibit moderately the proliferation of human tumour cell-lines cultured *in vitro* (Zeng L *et al.*, 1994). 3-Undecylphenol and 3-(8Z-tridecenyl)-phenol characterized from *Knema hookeriana* inhibit the proliferation of *Bursaphelchus*

Synonymy: *Knema corticosa* Lour., *Myristica glaucescens*, *Knema missioni* (King.) Warb., *Knema sphaerula* (Hk. f.).

Common names: Seashore nutmeg, small-leaved nutmeg.

Uses: In Vietnam, the oil expressed from the seeds of *Knema globularia* (Lamk.) Warb. is applied externally to counteract putrefaction.

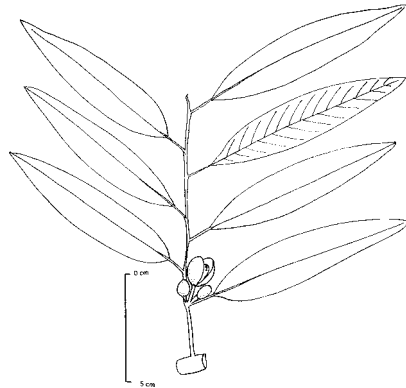


Fig. 17. *Knema globularia* (Lamk.) Warb. From: KLU Herbarium 11926. Field collector & botanical identification: Benjamin C Stone, 24 May 1974. Geographical localization: Pulau Tioman, NR Kg Tekek, along Sg. Ayer Besar, Malaysia.

xylophilus cultured *in vitro* with a maximum effective dose of 4.5 mg/cotton ball and 20 mg/cotton ball respectively (Alen Y *et al.*, 2002).

References

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 Zahir A, *et al.* (1994) *J Nat Prod* **56**(9): 1634–1637.
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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Myristica iners Bl.

[From Greek, *muron* = a sweet juice distilled from plants and from Latin, *iners* = soft]

Physical description: It is a timber tree found in Malaysia, Indonesia, Vietnam, Thailand and Burma. The wood is of good quality, red and exploited for commercial purposes. The bark is black and fissured and exudes a blood-like sap when cut. Leaves: simple, alternate and exstipulate. The blade is papery, oblong, lanceolate, and 12 cm–20 cm × 5 cm–6 cm. The blade is tapering at the base and the apex and shows 12–15 pairs of secondary nerves. The margin is slightly recurved. The fruits are ovoid, pale yellow, and 5 cm long drupes. The seed is embedded in a finely divided red aril (Fig. 18).

Common names: *Laka* (Malay).

Uses: Malays have been known to burn the wood of this tree as incense. In Indonesia, the sap of *Myristica iners* Bl. is drunk to promote urination. The therapeutic potential of *Myristica iners* Bl. is unknown but one might set the hypothesis that cytotoxic or antiviral lignans could be characterized from it as several lignans are known to occur in *Myristica argentea* Warb. (Filleur F *et al.*, 2002).

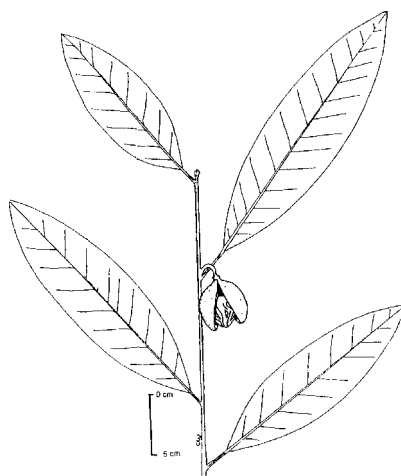


Fig. 18. *Myristica iners* Bl.

Reference

Filleur F, *et al.* (2002) *Nat Prod Lett* **16**(1): 1–7.

Warning: Caution must be taken with these plants as their toxic effects are unknown.

B. Order LAURALES Lindley 1833

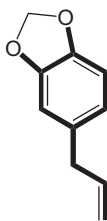
The order Laurales consists of 8 families and about 2500 species of woody plants which are thought to have evolved from the order Magnoliales from which it inherits the capability to elaborate isoquinoline alkaloids (benzylisoquinolines or aporphines), phenylpropanoids and essential oils.

1. Family LAURACEAE

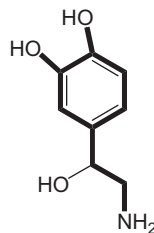
A. L. de Jussieu 1789

nom. conserv., the Laurel Family

Physical description: The family Lauraceae is by far the largest family of the order Laurales with about 50 genera and 2000 species of trees shrubs and herbs producing *benzylisoquinoline* and oxoaporphine alkaloids, *phenylpropanoids* (safrole), lignans, terpenes (mono- and sesquiterpenes), and mucilage. The bark of Lauraceae is smooth, leathery, and lenticelled. The inner bark is fragrant, yellow, orange, reddish or pinkish and exudes a pale yellow to pale brown sap after incision. The leaves in this family are simple, without stipules, opposite, spiral, whorled or alternate, usually with several gland dots and often aromatic when crushed. The inflorescences are racemose or in clusters. The flowers are bisexual, actinomorphic, small, regular, greenish-white or yellow, fragrant, trimerous (2 rows of 3 tepals) and variously accrescent in fruit. The stamens are typically in 4 whorls. The gynecium consists of a carpel forming a single-celled and superior ovary. The style is terminal and simple, and the stigma is small. The fruits are baccate or drupaceous, and often seated or enclosed in a persistent and cup-shaped corolla, the morphology of which is of taxonomic value.



Safrole



Noradrenaline

Pharmaceutical interest: Classical examples of Lauraceae are *Laurus nobilis* L. (sweet bay laurel), *Cinnamomum zeylanicum* Nees (cinnamon), *Cinnamomum camphora* (L.) T. Nees & Eberm. (camphor), *Persea americana* Miller (avocado), *Sassafras albidum* (Nutt.) Nees (sassafras oil), *Umbellularia californica* (California bay laurel), *Persea nanmu* Oliv. (nan-mu wood), *Nectandra rodiaei* Schk. (green-heart wood), *Eusideroxylon zwageri* (ironwood) and *Ocotea bullata* E. Mey. The dried ripe berries of *Laurus nobilis* L. (Lauri Fructus; Swiss Pharmacopoeia 1934) containing about 1% of volatile oil and 25% of fixed oil were used to promote digestion, menstruation and urination.

Safrole is a neuroactive because its chemical structure is similar to the chemical structure of asarone, myristicine and noradrenaline. Safrole is aromatic and used to give flavor in root beer. At concentration levels of 0.5% and 1% of the diet, safrole causes liver tumors in rats. It is found in camphor oil, in oil of cinnamon, and especially in sassafras. This family is interesting because the alkaloids it produces are cytotoxic and neuroactive. In the Asia-Pacific, about 150 species of plants classified within the family Lauraceae are used for medicinal purposes, and especially to treat digestive ailments and to invigorate.

***Cassytha filiformis* L.**

[From Latin, *filum* = thread and *forma* = shape]

Physical description: It is a slender, tropical, parasitic plant which grows by the seashores of the Asia-Pacific. The plant scrambles over bushes and trees. The stems are pale green, succulent, soft, thread-shaped and without leaves. The flowers are 2 mm–3 mm long, white, yellowish, and globose. The corolla consists of 6 sepals, where the 3 outer ones are smaller than the inner ones. There are 9 or 6 stamens, in 3 whorls, and the ovary is superior. The fruits are berries of about 5 mm diameter and enclosed in an enlarged, succulent, pale and persistent corolla (Fig. 19).

Pharmaceutical interest:

Sympatholytic properties: *Cassytha filiformis* L. contains ocoteine, an aporphine alkaloid which blocks competitively α_1 -adrenoreceptors of rat thoracic aorta. At high concentration, this alkaloid blocks 5-hydroxytryptaminergic receptors and acts on ventricular myocytes (Chang CW *et al.*, 1997).

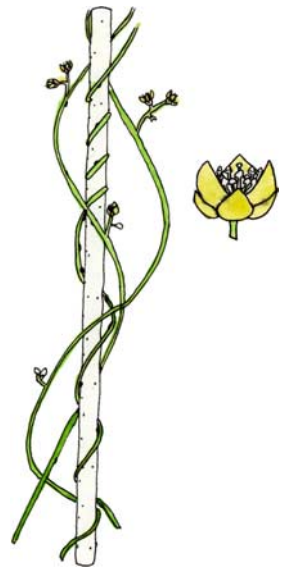


Fig. 19. *Cassytha filiformis* L.

Common names: Dodder-laurel, snotty-gobble, *chemar batu* (Malay).

Uses: In Malaysia, a lotion consisting of powdered *Cassytha filiformis* L. and sesame oil is used externally to stimulate hair growth. In Indonesia, *Cassytha filiformis* L. is used to expel intestinal worms, and it is combined with nutmeg in order to assuage stomach and bowel discomfort. In the Philippines, a decoction of the fresh plant is drunk to induce parturition and to stop haemoptysis. In Taiwan, the stems are used to promote urination, to treat gonorrhea and to assuage kidney discomfort. In Vietnam, the plant is used to expel impurities, to treat syphilis and to treat pulmonary diseases.

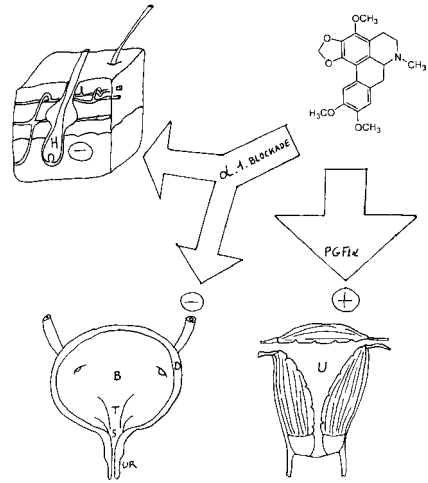
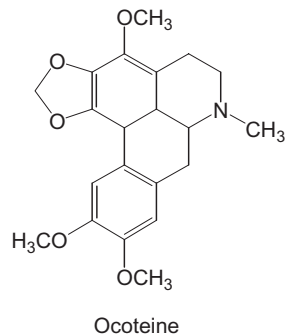


Fig. 20. Hypothetical pharmacological properties *Cassytha filiformis* L alkaloids: the blockade of α_1 -adrenoreceptors stimulates urination through relaxation of the trigone (T), ureter (UR) and sphincter (S). Blockade of α_1 -adrenoreceptors stimulates hair growth through relaxation of hair follicles, smooth muscle and scalp vessels. Contraction of uterus through prostaglandin. $F_{2\alpha}$.

Physiological stimulation of α_1 -adrenoreceptors contracts the smooth muscle of arteries, veins, splenic capsules, uterus, vas deferent, prostatic capsules, iris radial muscles (mydriasis), trigone and sphincter of the urinary bladder, ureter, hair follicles, and increases gland secretion.

An example of α_1 -adrenoreceptor blocker is prazosin which is currently used to reduce blood pressure. This drug preserves pre-junctional α_2 -receptors function and prevents an unmodulated disproportionate increase in noradrenaline release with sympathetic activation. The α_1 -adrenoreceptor antagonist property of ocoteine and probably of other isoquinoline analogues, could explain some of the medicinal uses mentioned above (Fig. 20). The hair tonic property of *Cassytha filiformis* L could be mediated via a blockade of α_1 -adrenergic receptors of the hair follicles, and vasodilatation of the vessels that irrigate the scalp. Minoxidil is a vasodilator is used to stimulate hair growth. The diuretic use of *Cassytha filiformis* L. may involve relaxation of the trigone, sphincter and ureter. The parturition-inducing property of *Cassytha filiformis* L. does not



result from α_1 -adrenoreceptors blockade but probably from prostaglandin. $F_{2\alpha}$ through the activation of phospholipase A_2 or cyclo-oxygenase. Prostaglandin $F_{2\alpha}$ contracts the uterus and is used in veterinary medicine to cause abortion. This phospholipase A_2 -or cyclo-oxygenase-mediated mechanism may explain the fact that ocoteine inhibits the aggregation of platelets (Chang FR *et al.*, 1998).

This plant elaborates a number of cytotoxic aporphine alkaloids such as neolitsine, cassythine and actinodaphnine. Neolitsine alleviates HeLa and 3T3 cells (IC_{50} : 21.6 μ M, and 21.4 μ M, respectively), and cassythine and actinodaphnine are active against Mel-5 (IC_{50} : 24.3 μ M and 25.7 μ M, respectively) and HL-60 (IC_{50} : 19.9 μ M and 15.4 μ M, respectively)(Stevigny C *et al.*, 2002).

References

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 Stevigny C, *et al.* (2002) *Planta Med* **68**(11): 1042–1044.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Cinnamomum iners Reinw. ex Bl.

[From Greek, *kinnamon* = cinnamon and from Latin, *iners* = soft]

Physical description: *Cinnamomum iners* Reinw. ex Bl. is a tree which grows to a height of 24 m and a girth of 1.8 m. The plant is found in India, Indo-China,

Indonesia, the Philippines, Peninsular Malaysia in lowland and hill forests, or planted in towns as a shade tree. The wood is of commercial value. The bark is greyish-brown, smooth and lenticelled. The inner bark is pinkish and fragrant. The sapwood is whitish. Leaves: fragrant, simple, opposite and exstipulate. The petiole is 1 cm–2 cm long and yellowish. The blade is leathery, oblong-elliptic, glaucous below and 7.5 cm–30 cm \times 2.5 cm–9 cm. The apex of the blade is blunt and the base is cuneate. The blade shows 3 yellowish longitudinal nerves with scalariform tertiary nerves. Inflorescence: axillary or terminal, 10 cm–20 cm long light green panicles. The flowers are tiny, whitish, and smelly. The fruits are ovoid, green, glossy, and 1.5 cm \times 1 cm drupes on persistent corolla cups (Fig. 21).

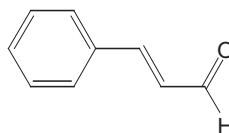
<p>Common names: Clove cinnamon, wild cinnamon; <i>kulit kayu manis</i> (Malay).</p>

Pharmaceutical interest: The pharmacological potential of *Cinnamomum iners* Reinw. ex Bl. would be worth studying, as interesting findings were made in other *Cinnamomum* species such as *Cinnamomum cassia*. One such finding is that trans-cinnamaldehyde from *Cinnamomum cassia* inhibits *in vitro*



Fig. 21. *Cinnamomum iners* Bl.

Uses: In Indonesia, an extract of the bark is drunk to aid recovery from childbirth and Malays drink a decoction of the roots for the same purpose. In Malaysia, a poultice made from the powdered leaves is applied externally to assuage the pain caused by rheumatism. In Vietnam, the bark is used to treat colic and to relieve the bowels of costiveness.



Trans - cinnamaldehyde

the activity of aldose reductase and nitric oxide synthetase with an IC_{50} value of 0.003 mg/mL and about $1\mu\text{g}/\mu\text{L}$ respectively (Lee HS 2002; Lee HS *et al.*, 2002a). Nitric oxide is a toxic-free radical that can cause substantial tissue damage in high concentrations, especially in the brain. In a stroke, for example, large amounts of nitric oxide are released from nerve cells to cause damage to surrounding tissues.

Therefore, one might set the hypothesis that the medicinal properties mentioned above involve the reduction of nitric oxide levels in inflamed tissues by cinnamic acid derivatives which are also antiseptic and antimicrobial. These cinnamates are possibly involved in the dose-dependent anti-nociceptive effects displayed by an ethanolic extract of *Cinnamomum zeylanicum* against both acetic acid-induced writhing and hot plate-induced thermal stimulation. (Attah AH *et al.*, 1998).

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 Lee HS. (2002a) *J Agric Food Chem* **50**(26): 7700–7703.
 Westra WH, *et al.* (1998) *Head Neck* **20**(5): 430–433.

Warning: Squamous cell carcinoma of the tongue associated with cinnamon gum use is reported (Westra WH *et al.*, 1998).

***Litsea glutinosa* (Lour.) C.BV. Robinson**

[From Chinese, *litse* = *Litsea glutinosa* (Lour.) C. BV. Robinson and from Latin, *glutinis* = glue]

Physical description: *Litsea glutinosa* (Lour.)

C.BV. Robinson is a tropical tree, which grows to a size of 15 m by 90 cm, that is native to tropical Asia. The young stems are tomentose and yellowish. Leaves: simple, stipulate and smelly. The blade is 7 cm–16 cm ×

3.5 cm–8 cm, elliptic-oblong, glaucous and yellowish, hairy underneath, hairy on midrib and shows 8–10 pairs of secondary nerves. The apex of the blade is blunt and the base is cuneate. The inflorescences are axillary and 7 mm long umbellules. The fruits are globose, black, glossy and large drupes of 2.5 cm in diameter, obconic, succulent and persistent corolla cups (Fig. 22).

Synonymy: *Litsea chinensis* Lam., *Litsea sebifera* Pers.

Common name: Indian laurel, pond spice.

Pharmaceutical interest:

Antibacterial and antiviral properties: A methanolic extract of the bark of *Litsea glutinosa* (Lour.) C.BV. Robinson inhibits the growth of 16 microorganisms as effectively as chloramphenicol (Mandal SC *et al.*, 2002). This plant produces a eudesman sesquiterpene called verticillatol and the lignan (+)-demethoxyeoiexcelsin which inhibit the replication of the Human Immunodeficiency Virus with IC₅₀ of 34.5 mg/mL and 16.4 mg/mL respectively (Hoang VD *et al.*, 2002).

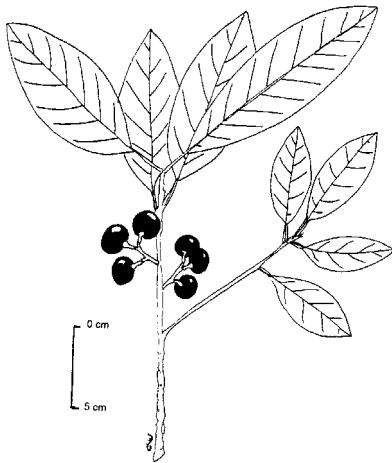
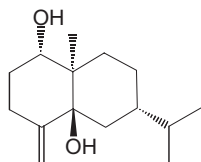


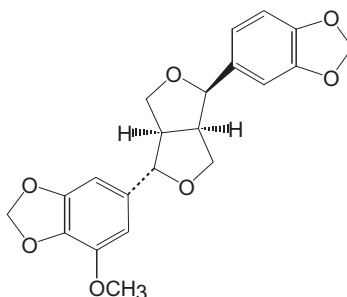
Fig. 22. *Litsea glutinosa* (Lour.) C. BV. Robinson.

Other properties: The essential oil extracted from *Litsea glutinosa* (Lour.) C. BV. Robinson displays a number of psychopharmacological

Uses: In Burma, *Litsea glutinosa* (Lour.) C. BV. Robinson is used to stop dysentery. In China, the pounded leaves are applied externally to treat skin diseases. In Malaysia, the crushed seeds are applied externally to treat skin diseases. In the Philippines, *Litsea glutinosa* (Lour.) C. BV. Robinson is used to stop dysentery. The roots and leaves are used to soothe sprains and bruises. In Vietnam, the pounded bark is used to heal boils.



Verticillatol



Demethoxyeoiexcelsin

(Menon MK *et al.*, 1970) and cardiovascular (Kar A *et al.*, 1970) properties experimentally.

References

- Hoang VD, *et al.* (2002) *Phytochem* **59**(3): 325–329.
 Kar A, *et al.* (1970) *Indian J Exp Biol* **8**(1): 61–62.
 Mandal C, *et al.* (2000) *Fitoter* **71**(4): 439–441.
 Menon MK, *et al.* (1970) *Indian J Physiol Pharmacol* **14**(3): 185–192.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

C. Order PIPERALES Lindley 1833

The order Piperales consists of 3 families and about 2000 species of herbs, shrubs and trees which are thought to have originated directly from Magnoliales from which are inherited the ability to elaborate piperidine, isoquinoline and phenanthrene alkaloids, essential oils, triterpenes and lignans (Appendix I). Piperales can be quickly recognized in a field collection by their strongly articulate stems. Piperales of economic importance are so far found in the family Piperaceae which provides pepper and kava.

1. Family *CHLORANTHACEAE* R. Brown ex Lindley 1821 *nom. conserv.*, the *Chloranthus* Family

Physical description: The family Chloranthaceae comprises of 5 genera and about 75 species of tropical and subtropical herbs which have been hardly studied from a pharmaceutical point of view. In terms of evolution, this family probably connects the order Piperales to the order Magnoliales. The leaves are simple, opposite, lobed or entire, stipulate and with a petiole more or less connate. The flowers are tiny, unisexual or bisexual, and epigynous and arranged in axillary or terminal compound spikes, panicles or heads.

The perianth is wanting or moderately 3-lobed. The andrecium consists of 1–3 stamens connate into a mass. The anthers are 1–2-celled, and open lengthwise. The gynecium comprises of a single carpel. The stigma is sessile, the style is short, and the ovule is solitary and orthotropous. The fruits are small, and ovoid or globose berries.



Pharmaceutical interest: Chloranthaceae are interesting because they produce pentacyclic triterpenes such as betulinic acid. *Chloranthus officinalis* Bl. *Chloranthus eliator* R. Br. ex Link (*Chloranthus officinalis* Bl.), *Chloranthus spicatus* (Thunb.) Mak. (*Chloranthus inconspicuus* Sw.), *Chloranthus serratus*, *Chloranthus oldhamii* Solms, *Sarcandra glabra* (Thunb.) Nak., *Ascarina maheshwarii* Swamy are of medicinal value in the Asia-Pacific. These are often used to make aromatic teas, treat fever and to invigorate health. It will be interesting to learn whether more intensive future research on this family will disclose any molecules of therapeutic interest.

***Chloranthus eliator* R. Br. ex Link**

[From Greek, *khlóros* = green and *anthos* = flower]

Physical description: It is an understorey herb which grows to a height of 60 cm in the rainforest of tropical Asia. Leaves: simple, opposite, aromatic, serrate, elliptic, lanceolate, acuminate, dark green, glossy, and very thin. The blade is 15 cm × 6 cm. The petiole is 5 mm long and the stipules are small on the margin of the petiole sheath. The inflorescences are terminal groups of 4 or 5, 4 cm long spikes. The flowers are tiny and white. The andrecium consists of 3 stamens connate by connective. The gynecium consists of a 1-celled ovary, a very short and thick style, and a subsessile and a truncate stigma. The ovule

Synonymy: *Chloranthus officinalis* Bl.

Common names: *Chloranthus*, *sigeh putih*, *sambau paya* (Malay).

Uses: In Malaysia, the dried roots are applied externally or used internally to treat fever. In Indonesia, a paste made from the powdered leaves is applied externally to soothe contusion and bone fracture, and a decoction of the leaves is drunk to stop vomiting. Another species, *Chloranthus spicatus* (Thunb.) Nak. (*Chloranthus inconspicuus* SW.), is a Chinese remedy used to treat malaria, relieve coughs, heal boils and carbuncles, treat fever and to invigorate health. It will be interesting to know whether further study on this plant will disclose any molecules with anti-inflammatory and/or antibacterial properties.



Fig. 23. *Chloranthus eliator* R. Br. ex Link.

is solitary and orthotropous. The fruits are succulent, 1.2 cm long, pulpy and white berries (Fig. 23).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Sarcandra glabra* (Thunb.) Nak.**

[From Greek, *sarkos* = flesh, *andros* = man and from Latin, *glaber* = free from hairs]

Physical description: It is an understory herb which grows to a height of 1.2 m. It is native to the mountain forests of India, China and Malaysia. The stems are cylindrical, glabrous, dark green and articulate. Leaves: simple, glabrous, glossy, serrate, opposite and very thin. The blade is elliptic lanceolate, with an acute apex and an acuminate base, measuring 12.5 cm–18 cm × 5 cm. The petiole is 6 mm–1.3 cm long, connate and forms a short stipular sheath. The flowers are small, in terminal, 1.5 cm long, and lax spikes. The

Synonymy: *Chloranthus glaber* (Thunb.) Nak.; *Chloranthus brachystachys* Bl., *Chloranthus monander* R.Br., *Sarcandra chloranthoides* Gardn.

Common names: Sarcandra, glabrous Sarcandra; *karas turan* (Indonesian).

Uses: In China, *Sarcandra glabra* (Thunb.) Nak. is applied externally to soothe bone fracture and contusion and a decoction of the leaves is used to stop vomiting. In India, this plant is used to invigorate health. In Indonesia, a mixture of stems, roots and leaves is used to treat fever, venereal diseases, stop spasms and to invigorate health. In Malaysia, the leaves are used to scent tea or to add bulk. In the Philippines, an infusion of the plant is drunk to assuage headache. In Vietnam, a tea-like beverage of the plant is used to relieve cough.

flowers are sessile, in connate pairs of male and female with small bracts. The male flower shows a short stamen, the anther of which is 4-celled. The ovary is 1-celled and contains a single ovule. The style is short and the stigma is subsessile and truncate. The fruits are bright red, succulent, glossy, globose, apiculate, and 5 mm diameter berries (Fig. 24).

Pharmaceutical interest: Analysis of *Sarcandra glabra* (Thunb.) Nak. and its medicinal preparations by capillary electrophoresis has been reported by Zheng *et al.*, 2003. The plant is interesting because it accumulates betulinic acid which might hold potential for the treatment of melanoma, Human Immunodeficiency Virus and bacterial infection. Twenty-six cases of idiopathic thrombocytopenic purpura were clinically treated with *Sarcandra glabra* (Zhang JZ, 1981). Are pentacyclic triterpenes involved in the medicinal uses mentioned above?

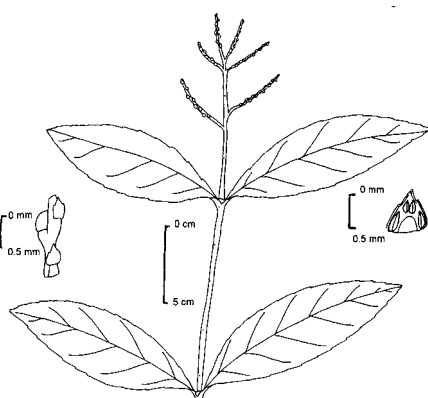
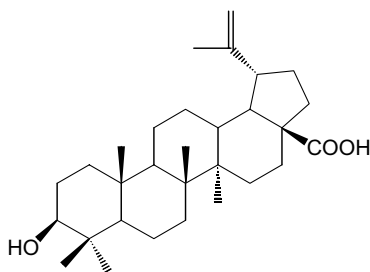


Fig. 24. *Sarcandra glabra* (Thunb.) Nak.



Betulinic acid

Reference

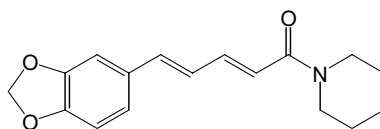
Zhang JZ. (1981) *J Tradit Chin Med* 1(1): 61–62.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family PIPERACEAE C. A. Agardh 1825 nom conserv., the Pepper Family

Physical description: The family Piperaceae comprises of 10 genera and about 2000 species of tropical herbs, climbers and treelets known to elaborate isoquinoline and *piperidine alkaloids* as well as *styryl-lactones*. Like Chloranthaceae, the stems are articulate. The leaves are simple, alternate and stipulate. The blade is often cordate. The flowers are tiny, without perianth, and packed in dense and succulent spikes. The andrecium comprises of 1–10 stamens, and the gynecium consists of a superior and 1-celled ovary containing a single orthotropous ovule. The fruits are capsular or drupaceous.

Pharmaceutical interest: Black Pepper (*British Pharmaceutical Codex*, 1949) consists of the dried unripe fruits of *Piper nigrum* L. which have been used since time immemorial in India. This spice at doses ranging from 300 mg to 600 mg stimulates the taste-buds, produces a reflex increase in gastric secretion, treats fever and promotes urination. White pepper consists of dried unripe fruits of *Piper nigrum* L. deprived of the outer part of the pericarp. The taste of peppers is due to piperine, a piperidine alkaloid. Other Piperaceae are *Piper longum* (Long Pepper, *Indian Pharmaceutical Codex*, 1955), *Piper methysticum* Forst. (Kava, *British Pharmaceutical Codex*, 1934) and *Piper betle* (*British Pharmacopoeia*, 1934). A beverage prepared from the roots of *Piper methysticum* Forst. or kava has been used for centuries by a number of Polynesian ethnic groups to calm and to promote sleep, and although toxic, it has been marketed in Europe to treat sleeping disorders and anxiety. The leaves of *Piper betle* are mixed with lime and the scraping of Areca nuts for social purposes in Asia. About 30 species of plants classified within the family Piperaceae are of medicinal value in the Asia-Pacific. A growing body of evidences indicates that lignans of Piperaceae might hold potential for the treatment of cancers.



Piperine

Piper cubeba L. f

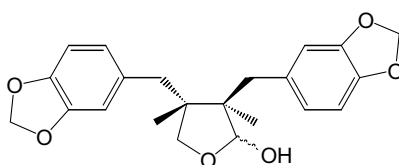
[From Greek, *peperi* = pepper and from Arabic, *kababah* = cubeb]

Physical description: It is a climbing shrub which grows to a length of 1 m in tropical Asia. The plant is native to Indonesia and Malaysia. The stems are glabrous, articulate and succulent.

Leaves: simple and alternate. The petiole is 1.5 cm–1.7 cm long, velvety, and channeled. The blade is broadly elliptic, velvety underneath, very thin, and 11 cm × 6.4 cm–8.5 cm × 4.8 cm. The margin is wavy, the apex of the blade is acuminate, and the base is asymmetrical and cordate. The blade shows 5–7 pairs of secondary nerves which are raised on both surfaces. The inflorescences are 4 cm × 3 mm spikes (Fig. 25).

History: The dried unripe fruit forms the condiment cubeb. Cubeb (*British Pharmaceutical Codex*, 1934) consists of the dried unripe fully-grown fruit of *Piper cubeba* L. f. It was formerly employed as a urinary antiseptic (liquid extract; 1 in 1; dose 2 mL–4 mL). Lozenges of cubeb have been used to treat bronchitis. Cubeb

Common names: Java pepper, cubeb, or tailed pepper; *lada berekur* (Malay); *tieu that* (Vietnamese); *thipli* (Tamil); *poivre de Java* (French).



(-) Cubebin

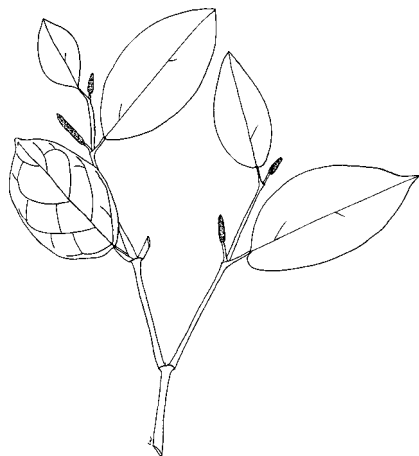


Fig. 25. *Piper cubeba* L. f.

From: KLU Herbarium 33497. Flora of Malaya. Date: 1979. Geographical localization: Nursery Garden, Dept of Botany, U.M. Obtained from AGR. RES. Center Semongok, Kuching, Sarawak, Malaysia. Field collector & botanical identification: KG Peare.

Oil (*British Pharmaceutical Codex*, 1949) is the oil obtained by the distillation of cubebbs. It has been used as an emulsion or in capsules as a urinary antiseptic at doses of 0.3 mL to 1.2 mL, and to make cosmetics. A British Standard Specification for cubeb oil (B.S. 2999/5: 1965) has been published by the British Standards Institution.

Uses: The fruits of *Piper cubeba* L. have been used in Europe as a spice as early as the 11th century. It has the repute of being antiseptic. In China, the fruits of *Piper cubeba* L. are eaten to promote digestion, and to stop vomiting. In Indonesia, *Piper cubeba* L. is used to treat venereal diseases and dysentery. In Taiwan, *Piper cubeba* L. is used to treat diabetes, gonorrhoea, and to promote appetite. In Malaysia, *Piper cubeba* L. is used during confinement.

Pharmaceutical interest: The fruit of *Piper cubeba* L. contains terpenes, sesquiterpenes and some lignans including the dibenzylbutyrolactone lignan (–)-cubebin. The anti-viral, antifungal, antibacterial and cytotoxic potential of (–)-cubebin awaits further experimentation. Note that cubebin, isolated from the crude hexane extract of the leaves of *Zanthoxylum naranjillo* (Family Rutaceae), protects rats against edema induced by carrageenan and prostaglandin PGE₂ and protects mice against the pain caused by both acetic acid and PGI₂ in mice (Bastos JK *et al.*, 2001). In addition (–)-cubebin derivatives abrogate the survival of amastigote forms of *Trypanosoma cruzi* (de Souza VA *et al.*, 2005).

References

- Bastos JK, *et al.* *J Ethnopharmacol* **75**: 279–282.
 De Souza VA, *et al.* (2005) *Bioorganic & Medicinal Chemistry Letters* **15** (2): 17: 303–307.

***Peperomia pellucida* (L.) HBK.**

[From Greek, *peperi* = pepper and *homoios* = resembling and from Latin, *pellucidus* = transparent]

Common names: Shiny bush; *pansit pansitan* (Filipino).

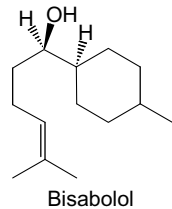
Uses: In Indonesia, *Peperomia pellucida* (L.) HBK. is used to assuage headaches and to treat colic. In the Philippines, *Peperomia pellucida* (L.) HBK. is used to heal abscesses and boils.



Fig. 26. *Peperomia pellucida* (L.) HBK.

Physical description: It is a dwarf herb which grows to a height of 20 cm. The plant is native to South America. It is very common and can be seen almost everywhere, particularly in pots besides ornamental plants. The stems are fleshy and translucent. Leaves: simple, alternate and without stipules. The petiole is 5 mm–7 mm long. The blade is cordate, very thin, translucent, glaucous underneath and 1.7 cm × 2 cm–9 mm × 1.1 cm. The inflorescences are 4.5 cm–5 cm long and succulent spikes facing the leaves (Fig. 26).

Pharmaceutical interest: A methanol extract of *Peperomia pellucida* (L.) HBK. assuages the pain of mice experimentally injured with acetic acid (Adeyemi O *et al.*, 2001). The antiseptic and analgesic properties of the plant have been confirmed (Khan MR *et al.*, 2002; Arrigoni-Blank MF *et al.*, 2004). Is (+)-epi- α -Bisabolol or lignans involved here? (Villegas LF *et al.*, 2002).

**References**

- Adeyemi O, *et al.* (2001) *J Nat Prod* **65**(2): 248–250.
 Arrigoni-Blank MF, *et al.* (2004) *J Ethnopharmacol* **91**(2–3): 215–218.
 Khan MR, *et al.* (2002) *Fitoterapia* **73**(3): 251–254.
 Villegas LF, *et al.* (2002) *Fitoter* **72**(1): 57–58.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

D. Order ARISTOLOCHIALES Lindley 1833

This order consists of the single family Aristolochiaceae.

1. Family ARISTOLOCHIACEAE A. L. de Jussieu 1789 nom. conserv., the Birthwort Family

Physical description: The family Aristolochiaceae consists of about 5 genera and 300 species of foetid climbers and herbs thought to have originated directly from the order Magnoliales from which is inherited the ability to produce toxic isoquinolines and their derivatives *nitrophenanthrene alkaloids*, and essential oils (Appendix I). Aristolochiaceae are usually bitter. The stems of woody species are articulate and show broad Menispermaceae-like medullary rays in cross-section. The leaves are simple, without stipules, often with oil-secreting cells, alternate, entire or lobed. Aristolochiaceae can be easily spotted in the field because of their flowers which are 3-lobed or pipe-shaped. The andrecium consists of 6 or more stamens in 1 or 2 whorls around the apex of the ovary or stylar column. The ovary is 4–6-celled and the style is columnar. The fruits are capsular or baccate.

Pharmaceutical interest: Classical examples of Aristolochiaceae are *Aristolochia reticulata* (serpentary, red river snakeroot, and Texan snakeroot) and *Aristolochia serpentaria* (Virginian snakeroot), both of which are used to treat dyspepsia, considering their bitterness. Other examples are *Aristolochia clematis* (birthwort) and *Asarum europeum* which were used in European medicine. The dried rhizomes, roots and leaves of *Asarum europeum* (asarabaca) are used to induce vomiting, relieve the bowels of costiveness, and assuage headache, and are listed in the *Spanish Pharmacopoeia* 1954. The sodium salt of aristolochic acid has been given *per os* to treat a number of inflammatory conditions, but it is nephrotoxic in humans and in animals, as well as carcinogenic in rodent. About 20 species of plants classified within the family Aristolochiaceae are used for medicinal purposes in the Asia–Pacific. These are often used to counteract snake-poisoning, promote urination and menses, assuage stomachaches and to treat dropsy and skin diseases. The therapeutic potential of most Aristolochiaceae is unknown but one might set the hypothesis that the rhizomes of *Aristolochia* species counteract snake-poison and inhibit inflammation on account of a probable inhibition of phospholipase A₂ by isoquinoline alkaloids through a steroidal-like mechanism. Of interest are also the antimicrobial and cytotoxic potential of Aristolochiaceae alkaloids.



***Apama corymbosa* (Griff.) Willd.**

[From Greek, *korumbos* = cluster]

Physical description: It is a shrub which grows to a height of 3 m. The plant is a common sight along the jungle tracks of Malaysia and Sumatra. The stems are glaucous, soft, zig-zag-shaped and articulate. Leaves: simple, 15 cm × 6 cm, glabrous, alternate and without stipules. The blade is lanceolate and pubescent and shows 3–5 pairs of secondary nerves. The petiole is 5 mm long. The inflorescences are terminal, pubescent, panicles of small yellowish-green flowers. The perianth comprises of 3 yellowish-green lobes around a black mouth. The andrecium consists of 1 whorl of 8–10 stamens.



Fig. 27. *Apama corymbosa* (Griff.) Willd.

The stigma is disc-shaped. The fruits are capsular, 25 cm–30 cm × 4 mm, 4 keeled and contain several triangular seeds (Fig. 27).

Pharmaceutical interest: The general tendency in terms of medicinal uses suggests the anti-inflammatory potential of the plant. It would not be surprising as antibacterial alkaloids occur in *Bragantia wallichii* (Panse MV *et al.*, 1971). The same group of alkaloids is very likely to be present here and it would be interesting to assess their activity towards the enzymatic activity of phospholipase A₂, or cyclo-oxygenase, key enzymes of inflammation.

Synonymy: *Bragantia corymbosa* Griff.

Common names: *Akar julong*, *bukit*, *akar surai* (Malay).

Uses: In Java, the stems and leaves are applied externally to counteract snake-poison. In Malaysia, the pounded leaves are applied to the gums or laid onto the hollow of teeth to assuage toothache. The roots are mixed with the kernel of *Myristica fragrans* Houtt. to make a protective postpartum medicine.

Reference

Panse MV, *et al.* (1971) *Indian J Med Res* **59**(8): 1190–1193.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Apama tomentosa* (Bl.) O. Ktze.**

[From Latin, *tomentum* = padding of wool]

Common name: Creeping apama.

Uses: In Indonesia, the juice expressed from the leaves and stems is drunk to relieve cough. The plant is used as an ingredient in a remedy to promote urination. *Apama tomentosa* (Bl.) O. Ktze. is used to counteract snake-poison. Malays use this plant to heal boils and to counteract putrefaction. The pharmacological potential of this herb is unknown.

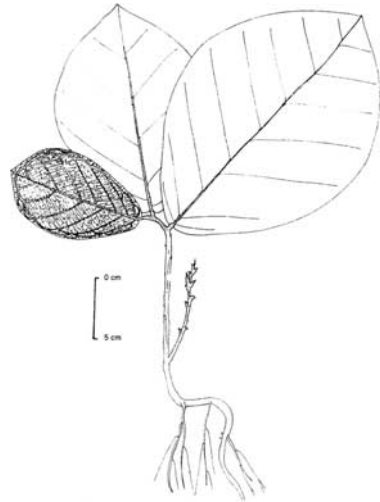


Fig. 28. *Apama tomentosa* (Bl.) O. Ktze.

Physical description: It is an understory herb which grows to a height of 80 cm. It is found in Malaysia, India and Indonesia. The stems are woody and tomentose. Leaves: 12 cm–22 cm × 9 cm–14 cm, simple, and without stipules. The petiole is tomentose and 2 cm long. The blade is leathery, obovate, tomentose underneath, and glabrous above except for the nerves. The apex of the blade is acute and the base cordate. The tertiary nerves are scalariform, sunken above and filled with hairs. The margin is slightly recurved. The inflorescences are 9 cm long and tomentose racemes from the base of the stems. The flowers are tiny, dull red, and comprise of 6 stamens. The fruits are capsular (Fig. 28).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Aristolochia indica* L.**

[From Greek, *aristo* = best and *lochia* = delivery and from Latin, *indica* = from India]

Physical description: It is a climber native to India. Leaves: foetid, simple, and 4 cm–12 cm × 1.5 cm–7 cm. The blade is broad or linear-oblong to obovate-oblong, subtruncate or subcordate, glabrous and the margin is undulating. The apex is obtusely acuminate and the base cuneate. The inflorescences are few flowered axillary racemes. The flowers are greenish-white with

Common names: Indian aristolochia or Indian birthwort; *ishvara* (Sanskrit), *adagam* (Tamil).

a 5 cm long pipe-shaped perianth. The andrecium comprises of 6 anthers. The gynecium consists of 6 carpels united to form a compound ovary. The fruits are 6-valved, 3.5 cm–5 cm long, oblong or globose capsules. The seeds are deltoid-ovate, acute, flat and winged (Fig. 29).

Pharmaceutical interest: The rhizome of *Aristolochia indica* L. contains aristolochic acid together with other phenanthrene derivatives, N-glycosides and steroids.

Glucocorticoidal properties: The anti-inflammatory property of *Aristolochia* species is probably on account of a direct interaction of aristolochic acid and derivatives with the enzymes of the inflammatory process. For example, aristolochic acid inhibits *in vitro* and dose-dependent phospholipid hydrolysis by the human synovial fluid phospholipase A₂, snake venom phospholipase A₂, porcine pancreatic phospholipase A₂ and human platelet phospholipase A₂ (Vishwanath BS *et al.*, 1988). An ethanolic extract of rhizomes of *Aristolochia indica* L. given postcoitally decreases the fertility of rats and hamsters (Che CT *et al.*, 1984). The concomitance of both anti-inflammatory and post-coital abortive properties brings to mind the property RU486 or mifepristone, a synthetic steroid antagonist of both progesterone and glucocorticoid receptors, which is used (tablets 50 mg or 200 mg) to stop pregnancy (Fig. 30).

Aristolochic acid characterized from *Aristolochia indica* L. is another phenanthrene derivative which has a structure similar to progesterone. This natural product

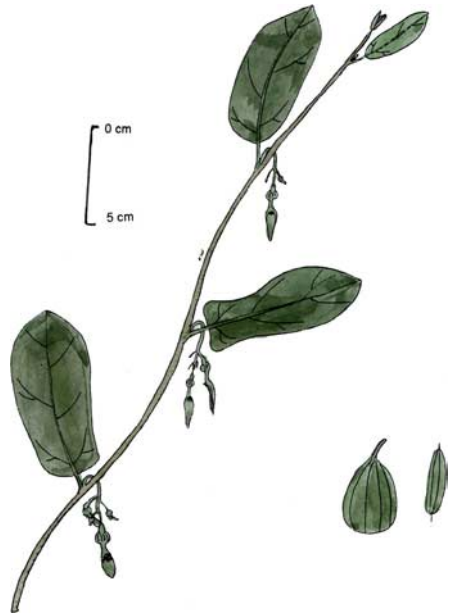


Fig. 29. *Aristolochia indica* L.

Uses: In India, the rhizome of *Aristolochia indica* L. is used to treat impotence, resolve inflammation, induce vomiting, treat malarial fever and to invigorate health. In Burma, the leaves are applied externally to treat skin diseases. In the Philippines, the rhizome is used to counteract insect-poison, combat fever, regulate menses, to invigorate the body, and to assuage intestinal discomfort. In Vietnam, the rhizome is used to treat malaria, dropsy and fever, and to stimulate appetite. A tincture of dried stems and rhizomes of *Aristolochia indica* L. was used in Britain to promote digestion (*British Pharmaceutical Codex*, 1934).

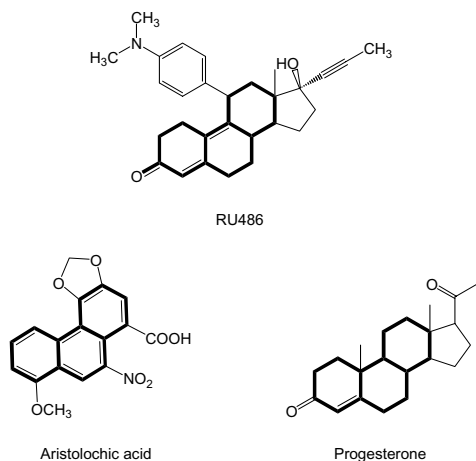
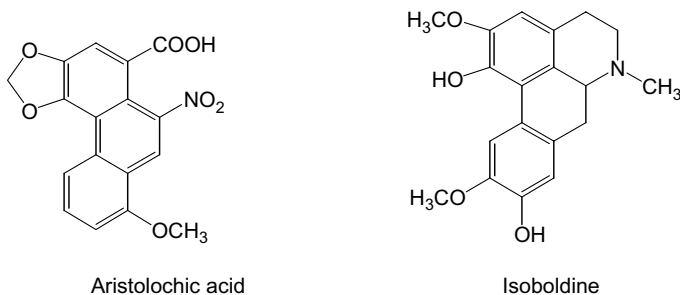


Fig. 30. Note the similitude of chemical structure of RU486, aristolochic acid, and progesterone.

inhibits nidation in mice when given from the first day of pregnancy. Histological observations revealed an impairment of development (decidualization), and a decrease of the uterine weight. Aristolic acid may interfere with the steroidal conditioning of the uterus making it therefore hostile to the ovum implantation (Ganguly T *et al.*, 1986). A methyl ester of aristolic acid is strongly abortifacient *per os* (100% at 60 mg/Kg; Pakrashi A *et al.*, 1978) as well as p-coumaric acid (single dose of 50 mg/Kg; Pakrashi A *et al.*, 1979) and a sesquiterpene (Pakrashi A *et al.*, 1977).



Other pharmacological properties: Both ethanol and alkaloidal extracts of *Aristolochia papillaris* inhibit the contraction caused by oxytocin on non-pregnant rat uterus preparation. Moupinamide, coclaurine and isoboldine, 3 isoquinoline alkaloids characterized from an alkaloidal fraction of *Aristolochia papillaris* relax the smooth muscle of guinea-pig preparation. Propranolol inhibits the effect of coclaurine and isoboldine, suggesting a muscle relaxant property via adrenoreceptors (Lemos VS *et al.*, 1993). An acetylated N-glycoside characterized from *Aristolochia contorta* inhibits significantly the proliferation of Gram-positive bacteria *in vitro*. (Lee HS *et al.*, 1992.)

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 Pakrashi A, *et al.* (1977) *Ind J Exp Biol* **15**(12): 1197–1198.
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Warning: Exposure to *Aristolochia* species is associated with the development of renal interstitial fibrosis and urothelial cancer in humans. Health professionals should be aware that in traditional Chinese medicine, *Aristolochia* species are considered interchangeable with certain other herbal ingredients and are also sometimes mistaken for *Stephania tetrandra*, *Akebia*, *Asarum*, *Clematis* species and *Cocculus* species in herbal remedies. Aristolochic acid is a typical example of natural product (P388 ED₅₀ = 0.58 μ M) which is both cytotoxic and mutagen (*Salmonella thyphimurium* TA100, TA102, TA1537, TA677 strains; Pezzuto JM *et al.*, 1988).

Aristolochia tagala Cham.

[From Greek, *aristo* = best and *lochia* = delivery

Physical description: It is a climber which grows in the geographical zone

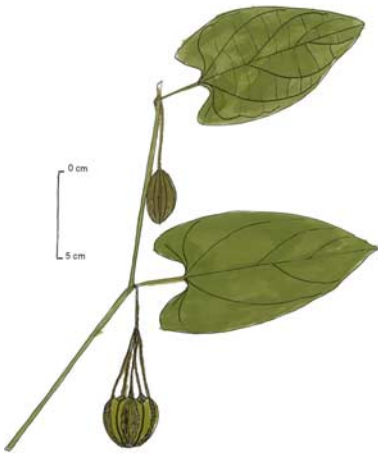


Fig. 31. *Aristolochia tagala* Cham. From: Ex. Herbario BC Stone. Field collector & botanical identification: BC Stone, 4 Jul 1977. Geographical localization: altitude 1000 ft, Selangor, Kuala Lumpur, University of Malaya campus, Malaysia.

Synonymy: *Aristolochia roxburghiana* Klotzsch.

Common names: Roxburgh's Aristolochia; *kalayar*, *puyan*, *kunit* (Indonesian); *akar ketola hutan* (Malay); *goan-goan*, *nagerus*, *timbangan* (Filipino); *krachao mot*, *krachao pheemot* (Thai); *daaly khoos* (Vietnamese).

spanning India to Papua New Guinea. The stems are smooth, terete and glabrous. Leaves: light green, spiral and without stipules. The petiole is 2.5 cm–3.5 cm long. The blade is sagittate, 14 cm \times 7.5 cm–12 cm \times 7 cm, and leathery. The margin is recurved. The blade shows 3–5 pairs of secondary nerves. The tertiary nerves are showily scalariform underneath. The fruits are axillary, 5-lobed, basket-shaped, and 2 cm \times 1.5 cm–3 cm \times 2.5 cm when opened. The seeds are numerous, flat and small (Fig. 31).

Pharmaceutical interest: The usefulness of *Aristolochia tagala* Cham. in dermatology has been assessed (Konigsbauer H, 1968). It will be interesting to learn whether more intensive future research on *Aristolochia tagala* Cham. will disclose any molecules of therapeutic interest.

Uses: In Indonesia, the leaves are used to resolve swollen limbs and to treat bilious disorders. In Malaysia, the pounded leaves are used to treat fever. In the Philippines, a powder of the roots is used to invigorate health, to treat infantile tympanites and to promote digestion and menses.

Reference

Konigsbauer H. (1968) *Z Haut Geschlechtskr* **43**(4): 153–159.

Warning: Caution must be taken with this plants as its toxic effects are unknown.

Asarum sieboldii Miq.

[From Greek, *asarum* = a plant, described by Dioscorides and Pliny, and after Philip Franz Von Siebold (1796–1866), a German naturalist who explored Japan]

Physical description: It is a rhizomatous herb found on the shady stream banks and in the deciduous

Synonymy: *Asarum heterotropoides* Fr. Schmidt var. *mandshuricum* (Maxim.) Kitawaga.

Common names: Chinese wild ginger; *xi xin* (Chinese).

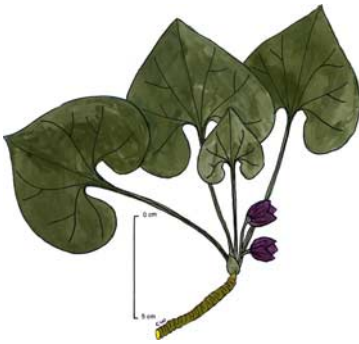


Fig. 32. *Asarum sieboldii* Miq. From: Herbarium 10071. Ex. Herbario Universitatis Imperialis Tokyoensis. Field collector & botanical identification: H Nakai & K Obuko, 23 May 1965. Geographical localization: Japan: Nagano Pref. Shiya-Kosen Uchiyama-Mura, Minamisaku — Gun, altitude 900 m–1,000 m.

forests of China and Japan. The plant grows to a height of 20 cm–30 cm. Leaves: simple, spiral and without stipules. The petiole is 9 cm–13.5 cm × 2 mm–3 mm. The blade is cordate, irregular, very thin and 5.5 cm × 5 cm–10 cm × 11 cm. The blade shows a few secondary nerves which originate from the base. The flowers are solitary, axillary and dark purple. The flower pedicel is 5 mm–2 cm long. The perianth is bell-shaped, 3-lobed and 1.5 cm × 1.4 cm (Fig. 32).

Pharmaceutical interest: The roots contain 3% of essential oil which comprises of methyleugenol, phenol, safrole, pinene, asarinin, eucarvone, and palmitic acid (Nagasawa, 1961). The anti-inflammatory property of *Asarum sieboldii* is confirmed (Qu SY *et al.*, 1982). Phenylpropanoids such as methyleugenol could mediate both the expectorating and analgesic properties as demonstrated in *Asarum europaeum* L. (Gracza L., 1981; Belova LF *et al.*, 1985). The effect of *Asarum sieboldii* on the left ventricular function of dogs is known (Chen ZZ *et al.*, 1981). The plant is interesting because its analgesic property involves bradykinin, histamine and opioid receptor-mediated pathways (Kim SJ *et al.*, 2003).

Uses: In Japan and China, the entire plant is used to treat colds and an inflamed mouth, to curb vomiting, and to assuage headache and toothache. The roots are used to induce vomiting, cough, perspiration, urination, and to purge the bowels. The roots are also used to treat epilepsy, rheumatic affections, nasal polyps and ulcers in the mouth. In Korea, the roots and stems are used to treat colds and to kill insects.

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 Gracza L. (1981) *Planta Med* **42**(2): 155–159.
 Kim SJ, *et al.* (2003) *J of Ethnopharmacol* **88**(1): 5–9.
 Nagasawa M. (1961) *J Pharm Soc Japan* **81**: 129–138.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Thottea dependens Klotzsch

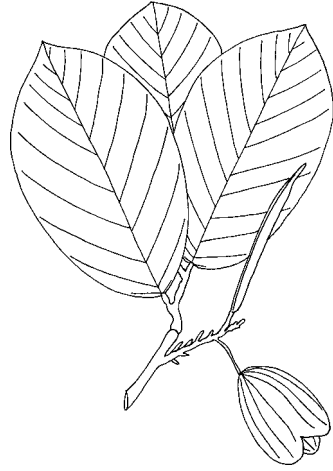
[From Latin, *pendere* = be suspended]

Physical description: It is an uncommon shrub found in the open forests and old rubber estates of Malaysia. The stems are smooth and velvety. Leaves: alternate, simple and without stipules. The petiole is stout, velvety and 5 mm long. The blade is oblong-ovate, leathery, glabrous on the surface and velvety underneath. The apex is acute-acuminate and the base acute-round. The margin is entire and recurved. The midrib is sunken above and strongly raised below. The blade shows 9 to 12 pairs of secondary nerves which are flat above and raised below, and scalariform tertiary nerves. The inflorescences are velvety and axillary

Uses: The plant is probably counter-irritant. In Malaysia, a paste made from the leaves is applied externally to treat skin diseases and fever, and to stimulate the skin to redness. It will be interesting to know if further study on this plant discloses any molecules of therapeutic interest.

racemes. The flowers are bell-shaped, 3-lobed, and 10.5 cm × 7 cm–7 cm × 8 cm. The perianth is dark purple and showily nerved. The pedicel is velvety and 1.4 cm–9 cm. The fruits are 14 cm–7 mm–16.5 cm × 5 mm, velvety and obscurely quadrangular capsules. The seeds are tiny and numerous (Fig. 33).

Warning: Caution must be taken as the toxic effects of this plant are unknown.



E. Order RANUNCULALES

Lindley 1833

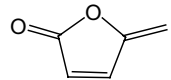
The order Ranunculales consists of 8 families and about 3200 species of herbs, known to abound with triterpenoid saponins, sesqui-, di- and triterpenes, diterpene alkaloids, lignans and isoquinolines inherited from the Magnoliales (Appendix I). Ranunculales is a common ancestor to both the Caryophyllales and Papaverales to which it brings triterpenoid saponins and isoquinoline alkaloids respectively (Appendix I). More than half of the species belong to the family Ranunculaceae, and most of the others belong to the family Berberidaceae and the family Menispermaceae.

Fig. 33. *Thottea dependens* Klotzsch.

From: Herbarium 6437. Field collector & botanical identification: MED Poore. Flora of Malaya, 12 Oct 1964. Geographical localization: Fort Iskandar, shady locality in Belukar. From Herbarium 037272. Field collector & botanical identification: SC Chin & Mustafa. 14 Feb 1985. Geographical localization: Kampung Sungai Layang, Rembau, Negeri Sembilan, Malaysia.

1. Family RANUNCULACEAE A.L. de Jussieu 1789 nom. conserv., the Buttercup Family

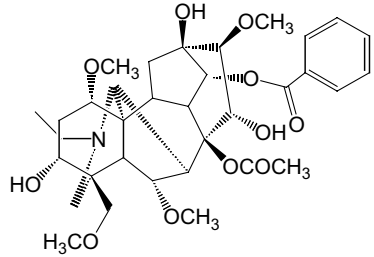
Physical description: The family Ranunculaceae, a vast group which consists of 50 genera and 2000 species of rhizomatous herbs, is widespread in temperate and boreal regions. The leaves are simple, without stipules, radical and alternate and variously compound or dissected. The flowers are bisexual, actinomorphic, and solitary to panicle. The calyx comprises of 3–8 sepals which are imbricate or valvate, deciduous and sometimes petaloid. The corolla comprises many to few and free petals, mainly with a nectariferous claw, showy, yellow, white, blue or pink. The stamens are numerous, spirally



Protoanemonin

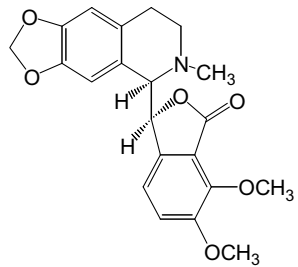
arranged and centripetal, free, distinct, with long and thin filaments and well-defined anthers. The gynecium consists of many free carpels, each with a style. The ovules are anatropous, numerous or solitary. The placentation is marginal or basal. The fruits are follicles, achenes or berries. Classical examples of Ranunculaceae are *Ranunculus acris* (buttercup) and the ornamental *Aquilegia vulgaris* and *Helleborus orientalis*.

Pharmaceutical interest: In ancient times, decoctions of *Ranunculus* were used to make arrow poison, punish criminals, and put to death, the elderly with incurable and painful diseases, and Dioskurides (1st century A.D.) noted: "*Ranunculus*... of this there are many kinds, but ye faculty is one, sharp and too much exulcerating". A large number of Ranunculaceae are irritants on account of a glycoside called ranunculin, which readily breaks down in bruised plant tissue by enzyme action to release protoanemonin, which is a volatile, strongly irritant and unstable terpenoid lactone. Other toxic principles of Ranunculaceae are diterpene alkaloids, isoquinoline alkaloids, and cardiac glycosides.



Aconitine

Diterpene alkaloids: Examples of diterpene alkaloids are aconitine, elatine and delphinine. The dried roots of *Aconitum napellus* L. (wolfsbane root) containing not less than 0.5% of alkaloids calculated as aconitine (*Aconite*, *British Pharmaceutical Codex*, 1963) was formerly used as tincture in the early stages of fever and as liniment in the treatment of neuralgia, sciatica and rheumatism, but it has been dropped because it is too toxic. Oral intake of aconitine is followed shortly by tingling of the tongue, mouth, stomach and skin as well as numbness, anesthesia, nausea, vomiting, diarrhea, excessive salivation, incoordination, muscular weakness, vertigo and death from paralysis of the heart or the respiratory center. Elatine, a diterpene alkaloid obtained from *Delphinium elatum*, has been used to relax muscles similar to tubocurarine at a dose of 10 mg, 3 to 5 times daily. Staphisagria (*British Pharmaceutical Codex*, 1949) consists of the dried ripe seeds of *Delphinium staphisagria* L. (stavesacre seeds) containing 1% of alkaloids, of which delphinine. It has been used to combat lice infestation.



Hydrastine

Isoquinolines: Classical examples of isoquinolines of Ranunculaceae are hydrastine (a phthalyltetrahydroisoquinoline) and berberine (a protoberberine).

Hydrastis (*British pharmaceutical Codex*, 1949) consists of the dried rhizome and roots of *Hydrastis canadensis* L. (golden seal) containing not less than 1.5% of hydrastine. It has been used to stop excessive uterine hemorrhage and as a bitter stomachic. Hydrastine hydrochloride (*British pharmaceutical Codex*, 1949) constricts peripheral vessels and causes uterine contraction and arrests uterine hemorrhage. It has been used at a dose of 15 mg–60 mg but it is of doubtful value. *Hydrastis canadensis* L. contains berberine which is antibacterial, fungicidal and antiprotozoal, and it decreases intestinal peristalsis.

Cardiac glycosides: Hellebore (*British Pharmaceutical Codex*, 1934) consists of the dried rhizomes and roots of *Helleborus niger* (Christmas rose) which contains cardiac glycosides of the bufadienolide type including helleborin, helleborein and hellebrin. Hellebrin has a strophanth-like action and has been used as a cardiotonic. The aerial parts of *Adonis vernalis* L. (*Adonis*, *French Pharmacopoeia* 1965) have been used instead of digitalis as a tincture (1 in 10, dose 10 to 30 minims). It contains a number of cardenolides among which cymarins is the chief active constituent.

About 50 species of Ranunculaceae including *Ranunculus sceleratus* L. and *Coptis japonica* (Thunb.) Mak are of medicinal value in Asia. These are commonly used to assuage pain, to counteract putrefaction, and to treat fever and dysentery.

***Coptis japonica* (Thunb.) Mak.**

[From Latin, *japonica* = from Japan]

Physical description: It is a herb which grows to a height of 30 cm. It is found in China and Japan. Leaves: originate from a rhizome. The petiole is 12 cm–20 cm long and channeled. The petiolules are channeled and 1 cm–2.5 cm long. The blade consists of 3 folioles which are deeply incised, very thin and 6.7 cm × 5.5 cm–4.7 cm × 3.5 cm. The midrib is sunken above and raised below. The folioles show 4 to 5 pairs of secondary nerves. The flowers are small and white, and attached to reddish pedicels arising from the rhizomes. The fruits consist of 7–9, papery and 1.1 cm–1.3 cm × 4 cm pedicel carpels hooked at the apex (Fig. 34).

Synonymy: *Coptis anemonaefolia* Sieb. & Zucc.

Common names: Japanese goldthread; *huang lia* (Chinese).

Uses: In Japan, the rhizome of *Coptis japonica* (Thunb.) Mak. is used to promote appetite and digestion. In Cambodia, Laos and Vietnam, *Coptis japonica* (Thunb.) Mak. is used to assuage headaches, soothe itchiness and treat eczema marginatum. In Malaysia, *Coptis japonica* (Thunb.) Mak. is used to resolve eye inflammation.

Pharmaceutical interest: The rhizome of *Coptis japonica* (Thunb.) Mak. is known to accumulate several sorts of protoberberines, among which are palmatine, jatrorrhizine and berberine, the last being a powerful antibacterial agent. Recent research shows that berberine chloride from the rhizome of *Coptis japonica* (Thunb.) Mak. inhibits aldose reductase isolated from male Sprague-Dawley rats (Lee HS 2002). Berberine and palmatine from *Coptis japonica* (Thunb.) Mak. inhibit catecholamine by impeding the activity of tyrosine hydroxylase in PC12 cells with IC_{50} values of $9.5 \mu\text{g/mL}$ and $7.7 \mu\text{g/mL}$ respectively (Lee MK *et al.*, 1996). Jatrorrhizine and berberine extracted from the rhizome of *Coptis chinensis* are monoamine oxidase inhibitors which might hold some potential for the treatment of depression. Jatrorrhizine inhibits non-competitively both MAO-A and -B from rat brain mitochondria with the IC_{50} value of 4 and $62 \mu\text{M}$, respectively, berberine competitively inhibits MAO-A with an IC_{50} value of $126 \mu\text{M}$ (Kong LD *et al.*, 2001). Several lignans, including pinoresinol and isolariciresinol, isolated from *Coptis japonica* (Thunb.) Mak. inhibit the production of $\text{TNF-}\alpha$, (Cho JY *et al.*, 2000; 2001).

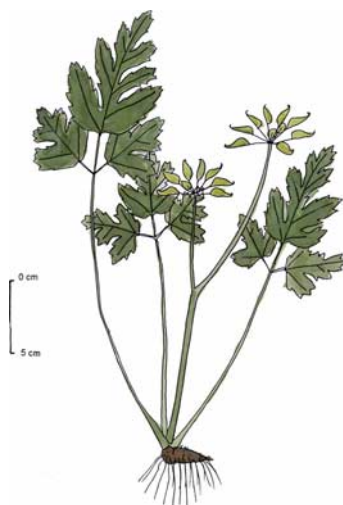
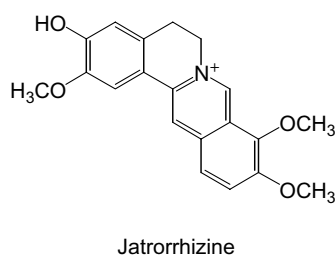


Fig. 34. *Coptis japonica* (Thunb.) Mak. From: KLU Herbarium 17902. Ex. Herb. Universitatis Tokyoensis. Geographical localization: Japan, Niigata Pref., Iwahune-gun, Sekikawa-mura, near Takanosu-onsen, 27 Apr 1972, altitude: 400 m, Japan. Field collector & botanical identification: M Togashi & Y Tateishu.



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 Kong LD, *et al.* (2001) *Planta Med* **67**(1): 74–76.
 Lee MK, *et al.* (1996) *Planta Med* **62**(1): 31–34.
 Lee HS. (2002) *J Agric Food Chem* **50**(24): 7013–7016.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Ranunculus sceleratus* L.**

[From Latin, *rana* = frog and from Greek, *selinon* = parsley]

Physical description: It is a herb which grows to a height of 60 cm. It is found in the ditches and paddles of the temperate regions. The stems are succulent, inflated and glabrous. Leaves: radical, 1.8 cm–3.7 cm diameter, reniform and 3-fid. The upper leaves are cauline, entire or 3-fid and smaller. The petiole is slender, channeled, sheathing at the base and 1 cm–4.5 cm long. The blade is very thin, deeply incised and shows nervations which are prominent on both surfaces. Inflorescences: axillary and solitary. The pedicels are 1 cm–3 cm long. The flowers are yellow, showy and 6 mm–1.2 cm in diameter. The sepals are oblong, pubescent and caducous. The corolla consists of 4–5 elliptic oblong petals. The fruits are numerous hooked and free 3 mm × 5 mm follicles (Fig. 35).

Common names: Celery-leaved buttercup, cursed crowfoot; *grenouillette aquatique, mort aux vaches* (French); *shih lung juei* (Chinese); *ranunculo mataboi* (Portuguese); *ranunculo malvado* (Spanish); *thach long noi* (Vietnamese).

Uses: *Ranunculus sceleratus* L. has been used to raise blisters and as counter-irritant since time immemorial. In China, *Ranunculus sceleratus* L. is used to treat colds, arthritis and rheumatism and to invigorate health. In Laos, Cambodia and Vietnam, the seeds are eaten to promote appetite and digestion, treat kidney diseases and heal abscesses.

Pharmaceutical interest: The plant contains tryptamine derivatives (Bhargava KP *et al.*, 1965). A leaf extract of *Ranunculus sceleratus* L. displays a quick and broad fungicidal activity (Misra SB *et al.*, 1978). An extract of *Ranunculus sceleratus* L. shows significant effects against epimastigote of *Trypanozoma cruzi* Bra C15C2 clone *in vitro* with an IC₅₀ value of 10.7 μg/mL (Schinella GR *et al.*, 2002). It will be interesting to know if further study on *Ranunculus. sceleratus* will

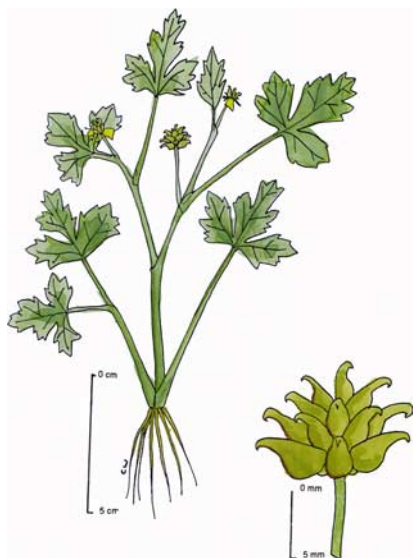


Fig. 35. *Ranunculus sceleratus* L. From: KLU Herbarium 004451. Delhi University Herbarium. Geographical localization: Shakti Nagar, Delhi, India. 26 Feb 1961. Field collector & botanical identification: Krishnan Kumar. Altitude: 620 ft, rainfall 20°–50°.

disclose any molecules clinically active against *Trypanozoma cruzi*. In regard to the anti-rheumatic uses mentioned above, a pharmacological approach to the pro- and anti-inflammatory effects of the plant is reported by Prieto *et al.*, 2003.

References

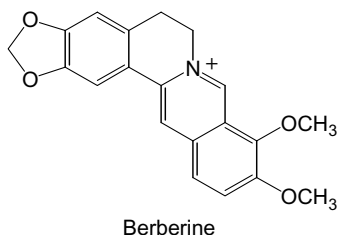
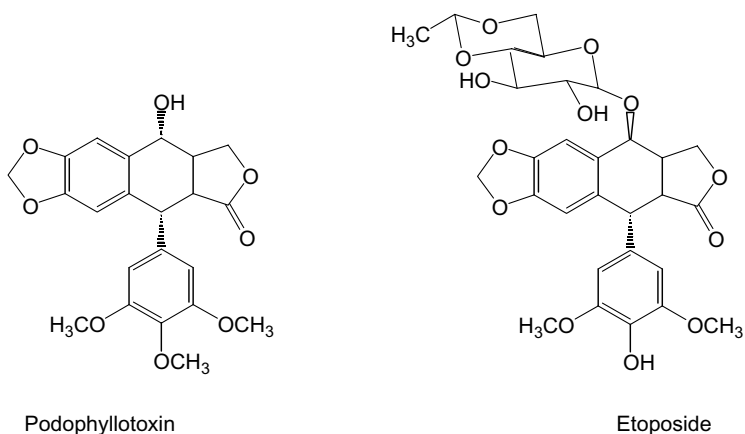
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Mahran GH, *et al.* (1968) *Planta Med* **16**(3): 323–328.
Misra SB, *et al.* (1978) *Experientia* **34** (11): 1442–1443.
Prieto *et al.* (2003) *J Ethnopharmacol* **89**(1): 131–137.
Schinella GR, *et al.* (2002) *Fitoter* **73**(7–8): 569–575.

Warning: *Ranunculus sceleratus* L. is intensely irritating and produces violent blistering of the lips, tongue and skin on account of anemonin (Mahran GH *et al.*, 1968). The plant can be mistaken for parsley and eaten resulting in fatal intoxication.

2. Family BERBERIDACEAE A. L. de Jussieu 1789 nom. conserv., the Barberry Family

Physical description: The family Berberidaceae consists of about 13 genera and 650 species of woody herbs, shrubs and treelets which are widespread in the temperate regions of the Northern Hemisphere. The genus *Berberis* is by far the largest genus with some 500 species. The chemical weapons used here are mainly *isoquinoline* (berberine) alkaloids, occasionally quinolizidine alkaloids, and lignans and triterpenoid saponins. The stems are often woody and show typical broad medullary rays in transversal section. The leaves are simple or compound, alternate and without stipules. The flowers are hermaphrodite, hypogynous, and mostly trimerous. The sepals and petals are similar. The perianth consists of 2 series of sepals, and 4 series of petals. The andrecium consists of 6 stamens facing the petals, with short filaments, and with tetrasporangiate anthers which are dithecal and open by valves. The gynecium comprises of a single carpel which encloses a few anatropous ovules. The fruits are berries. The seeds are often arillate.

Pharmaceutical interest: *Berberis aristata* is a herbal ingredient of Asian medicines used in UK to invigorate and to treat fever, and has been listed 3000 BC by the Caraka Samhita to treat obesity. The tubers of *Leontice leontopetalum* contain saponins and alkaloids and have been used for the treatment of epilepsy. *Jeffersonia diphylla* (twinleaf), *Mahonia aquifolium*, *Hydrastis canadensis*, *Caulophyllum thalictroides* and *Podophyllum peltatum* L. (May apple) have long been used by North American Indians for medicinal purposes.



The roots of *Jeffersonia diphylla* (twinleaf) and *Mahonia aquifolium* (Oregon grape) have been used to invigorate health. The dried rhizomes and roots of *Hydrastis canadensis* (Hydrastis, BHP) have been used to stop uterine hemorrhage. The rhizome of *Podophyllum peltatum* L. (May apple) has been used to remove warts and to relieve the bowels of costiveness. It contains podophyllotoxin, a cytotoxic *lignan* from which etoposide has been semisynthetically developed to treat lung cancer, lymphoma and leukemia.

Berberidaceae abound with isoquinoline alkaloids of therapeutic value. One such compound is berberine (*Chinese Pharmacopoeia*, 1997) which is a broad spectrum antibiotic and antiprotozoal benzyltetrahydroisoquinolines alkaloid. Berberine is amphiphile and penetrates bacteria. It is bacteriostatic at low doses and bactericide at higher doses and is used to make antiseptic collyres in Europe. It destroys *in vitro* several sorts of bacteria, fungi and protozoa (*Leishmania* and *Plasmodium*). In the Asia-Pacific, a number of plants classified within the family Berberidaceae are used to invigorate health, treat fever and counteract putrefaction.

***Berberis thunbergii* DC.**

[From Arabic, *barbaris* and after Carl Peter Thunberg (1743–1828), Swedish naturalist and favorite pupil of Linnaeus]

Common name: Japanese barberry.

Physical description: It is a spiny shrub of China and Japan which grows to a height of 1 m. The plant is often cultivated to decorate gardens and is even made into bonsais. Leaves: simple, without stipules, in groups, and sessile. The blade is spatulate, 1 cm–4 cm × 5 mm–1 cm, and reddish or green. The margin is slightly wavy and recurved. The secondary nerves are indistinct. The flowers are solitary, axillary and showy. The calyx comprises of 3 triangular sepals. The corolla comprises of 4 series of petals. The andrecium comprises of 6 stamens. The gynecium consists of a single-celled ovary. The fruits are ovoid, with red berries attached to the slender pedicels (Fig. 36).

Uses: In China and Japan, the bark is used to cool, to expel intestinal worms, to counteract putrefaction and to check menorrhagia. A decoction of the stem and roots is used to wash the eyes. In Vietnam, a decoction of the plant is used to wash the eyes and to treat dental caries.



Fig. 36. *Berberis thunbergii* DC.

From: KLU Herbarium 039313. Field Collectors: Benjamin C Stone, AE Schuyler & Emilie Russell. Geographical localization: United States of America, Pennsylvania, Hopewell Furnace/village National Historic Site "shunk cabbage". Botanical Identification: Benjamin C Stone.

Pharmaceutical interest: It will be interesting to learn whether more intensive future research on *Berberis thunbergii* DC. will disclose any alkaloid of therapeutic interest. Note that *Berberis thunbergii* DC. contains berberine, oxyberberine, jatrorrhizine and other isoquinoline alkaloids which are probably responsible for uses mentioned above (Kawashima Y *et al.*, 1969; Khamidov I *et al.*, 1997).

References

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 Khamidov I, *et al.* (1997) *Khim Prir Soedin* **5**: 763–764.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Caulophyllum robustum Maxim.

[From Latin, *caulis* = stem; from Greek, *phullon* = leaf; and from Latin, *robustus* = robust]

Physical description: It is a small woody shrub native to Japan. The plant is ornamental in temperate gardens. The stems are terete and glabrous. Leaves: consist of 2 pairs of folioles and a terminal one. Some folioles are pinnate, and the terminal one is 3-lobed at the apex. The folioles are 5 cm–10 cm long, very thin, sessile, asymmetric and acute at the apex. Each foliole shows 2–3 pairs of secondary nerves. The margin of the blade is wavy or toothed at the apex. The inflorescences are axillary panicles of about 20 cm long. The fruits are blackish-blue berries of about 7 mm in diameter (Fig. 37).

Uses: In China, the roots are soaked for 2 weeks in wine and the liquid is used externally to treat injuries caused by machines. The rhizome and roots of *Caulophyllum thalictroides* (*Caulophyllum*, *British Pharmaceutical Codex*, 1934) have been used to promote urination and menses, usually in the form of a liquid extract (1 in 1; dose of 0.6 mL to 2 mL).

Synonymy: *Leontice robusa* (Maxim.) Diels.

Common name: Blue cohosh.

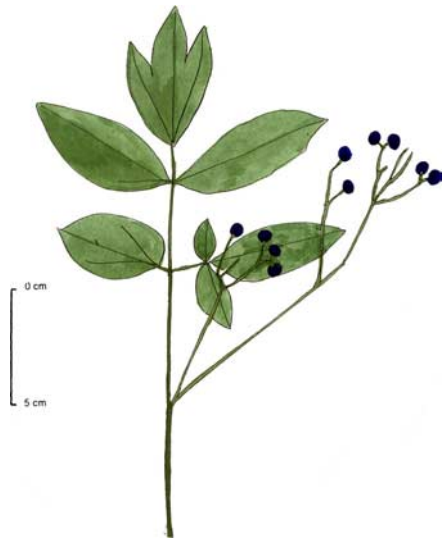
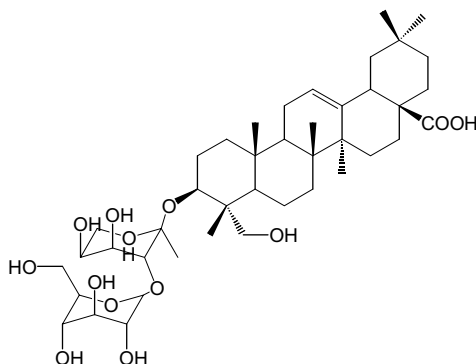


Fig. 37. *Caulophyllum robustum* Maxim.

From: Herbarium KLU 040275. Field collector & botanical identification: Monica, 10 Aug 1988, altitude 600 m. Geographical localization: Ogawa Experimental Station. North Ibaraki, Japan.

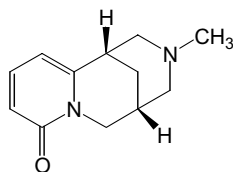


Cauloside C

Pharmaceutical interest: Cauloside C, a pentacyclic glycoside isolated from *Caulophyllum robustum* Maxim., inhibits the synthesis of ergosterol in *Saccharomyces carlsbergensis* and inhibits the synthesis of RNA at the stage of ^{14}C uridine incorporation into the nucleotide pool of *Saccharomyces carlsbergensis* (Anisimov MM *et al.*, 1972, 1977; 1977, 1978). Cauloside C interacts with cells pH-dependently and increases potassium leakage and calcium uptake. It might be a new biochemical tool for cell permeabilisation (Aminin DL *et al.*, 1999). Note that cauloside C promotes the growth of fibroblasts cultured *in vitro* and hence has some healing properties.

References

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 Anisimov MM, *et al.* (1972) *Antibiotiki* **17**(9): 834–837.
 Anisimov MM, *et al.* (1977) *Antibiotiki* **22**(9): 837–841.
 Anisimov MM, *et al.* (1978) *Prikl Biokhim. Mikrobiol* **14**(4): 573–582.



N - Methylcytisine

Warning: N-methylcytisine from *Caulophyllum thalictroides*, acting as a teratogen in rat embryos cultured *in vitro* (Kennelly EJ *et al.*, 1999).

3. Family LARDIZABALACEAE Decaisne 1838 *nom. conserv.*, the Lardizabala Family

Physical description: The family Lardizabalaceae consists of 8 genera and about 30 species of twining woody climbers and shrubs which are strongly tanniferous and known to abound with *triterpenoid saponins*. The leaves are alternate digitately compound or rarely pinnate. The flowers are racemose, unisexual, actinomorphic and developing with the leaves from perulate buds. The calyx consists of 3 or 6 imbricate sepals. The corolla consists of 6 petals which are smaller than the sepals. The andrecium is made of 6 stamens which are free or connate. The gynecium consists of 3 carpels, each containing 1–numerous ovules. The fruits are succulent, colored and indehiscent ripe carpels.

Pharmaceutical interest: A classical example of Lardizabalaceae is *Akebia quinata* (Thunb.) Decne. which is grown as a porch-vine in the United States. In the Asia-Pacific, *Akebia quinata* (Thunb.) Decne., *Akebia trifoliata* Koidz. var. *australis* (Diels) Rehd., and *Stauntonia hexaphylla* Decne. are medicinal and mostly used to promote urination.

***Akebia quinata* (Thunb.) Decne.**

[From Japanese, *akebi* = *Akebia quinata* (Thunb.) Decne. and from Latin, *quinque* = five]

Physical description: It is a woody climber which grows in the geographical area spanning Mongolia, China, Taiwan and Japan. Leaves: palmate, 5-lobed, spiral and arising from perulate buds. The petiole is 3.5 cm–6 cm long and twisted. The folioles are obovate, very thin, 3.2 cm × 1.5 cm–2.2 cm × 1.1 cm, and show 3–4 pairs of arching secondary nerves. The apex of the folioles is notched with a tiny tip and the base is tapered. The tertiary nerves are showy below the blade and form some curled patterns. The inflorescences are racemes of about

Common name: Chocolate vine, *mu tong* (Chinese).

Uses: *Akebia quinata* (Thunb.) Decne. is used mainly to promote urination and treat fever. In China, the wood of *Akebia quinata* (Thunb.) Decne. is used to promote sweating, digestion, milk secretion and menses, to treat fever, relieve the bowels from costiveness, to resolve inflammation, and to invigorate health. The stalks and fruits are used to expel impurities. The plant is used to treat rheumatism, lumbago, hernia, dropsy, cold and diabetes, to resolve inflammation of the stomach and kidneys, and to assuage headache. In Cambodia, Laos and Vietnam, the plant is used to invigorate health. The pharmacological potential of *Akebia quinata* (Thunb.) Decne. remains unexplored. The plant contains saponins (Fujita M *et al.*, 1974) which might be involved in the uses mentioned above.

5 cm long. The flowers are unisexual, and Berberis-like. The perianth is red, with 3 mm × 2 mm and elliptic lobes. The andrecium includes 6 stamens of 2 mm long (Fig. 38).

Reference

Fujita M, *et al.* (1974) *Yakugaku Zasshi* **94**(2): 194–198.

Warning: Caution must be taken as the toxic effects of this plant are unknown and products containing this plant may therefore be hazardous. Note that *Akebia quinata* (Thunb.) Decne products are often falsified with the *Aristolochia* species which are toxic to the kidneys.

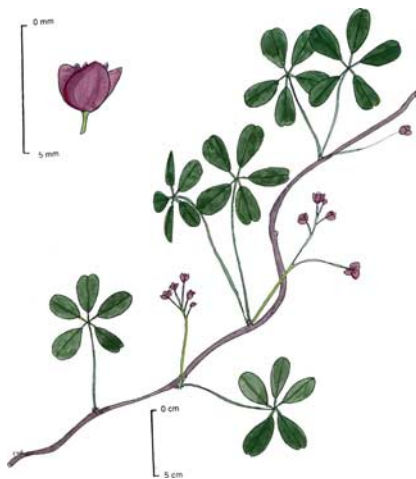
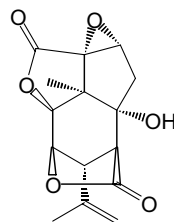


Fig. 38. *Akebia quinata* (Thunb.) Decne. From: KLU Herbarium 10063. Ex. Herbario Universitatis Imperialis Tokyoensis. Field Collector and botanical identification. H. Kanai, 16 May 1965, Geographical localization Ohira, at the N. foot of Mt. Mishotai, Minamitsuru-Gun, Pref.: Yamanashi, Japan.

4. Family MENISPERMACEAE A. L. de Jussieu 1789 nom. conserv., the Moonseed Family.

Physical description: The family Menispermaceae consists of 70 genera and about 400 species of tropical climbers so far known to elaborate bitter *sesquiterpenes*, diterpenes and benzyloisoquinoline and aporphine alkaloids. In a field collection, Menispermaceae can be recognized by cross sections of the stems showing broad medullary rays, a bright yellow wood and seeds which are shaped like horseshoes. The leaves are simple, alternate, simple and without stipules. The petiole is often long and thin and the blade is often cordate. The flowers are tiny, unisexual, dioecious, and actinomorphic. In the male flowers, the sepals are tiny, in 2–4 series, imbricate, the outer smaller. The petals if present, are smaller than the sepals and the anthers are short. In the female flowers, the gynecium comprises of 3–6 carpels, which are free, sessile and contain a single ovule attached to the ventral suture. The fruits are drupaceous.



Picrotoxinin

Pharmaceutical interest: *Sesquiterpenes:* A classical example of Menispermaceae is *Anamirta paniculata* Coleb. (Levant berries), the seeds of which

contain a toxic substance known as picrotoxin or cocculin. *Picrotoxin* is a mixture of picrotoxinin and picrotin. Picrotoxinin is a sesquiterpene specific GABA_A receptor blocking agents which impede the GABAergic presynaptic inhibition of excitatory transmission of primary afferent neurones of the spinal cord (Fig. 38). Picrotoxin is toxic and as little as 20 mg induces epileptiform convulsions, myosis, and dyspnea with more or less prolonged apnea. Picrotoxin (*British Pharmacopoeia*, 1963), has been used in the treatment of barbiturate poisoning (3 mg–6 mg, intravenously) in Western medicine.

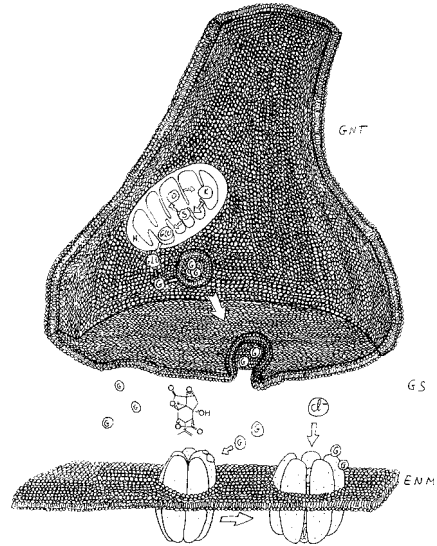
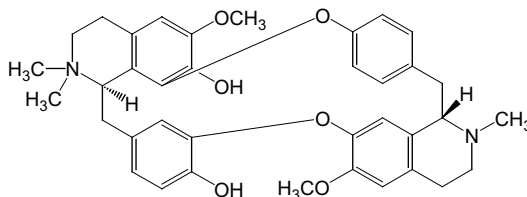


Fig. 39. Picrotoxin blocks the GABA receptors (GP). ENM: excitatory neuron membrane, Glu: glutamic acid, K: ketoacid, GNT: GABAergic neuron terminal, GS: GABAergic synapse, M: mitochondria, O: oxoglutamic acid, S: succinic semialdehyde. When a pair of GABA molecules bind to their sites, the receptors open and let Cl^- ions enter the neuron. The resulting hyperpolarization activates the sodium channels responsible for neuron activation.

Isoquinoline alkaloids: A number of Amazonian tribes use the extract of *Chondrodendron*, *Curarea*, *Sciadotenia*, *Abuta*, *Telotoxicum*, and *Cissampelos* species to make arrowpoisons or curares. These curares consist of *bisbenzyltetrahydroisoquinolines* alkaloids such as (+)-tubocurarine, (+)-isochondrodendrine, (-)-curine, and (+)-chondrocurine which block competitively acetylcholine at nicotinic receptors at the neuromuscular junction hence causing complete relaxation of skeletal muscles and death by asphyxia. (+)-Tubocurarine which has been used to relax muscles in surgical anaesthesia (Tubocurarine Chloride, *British Pharmacopoeia*, 1963).

Several Menispermaceae are used to promote appetite and digestion because of their bitterness which is attributed to sesquiterpenes. The dried transverse



(+) - Tubocurarine

slices of roots of *Jateorrhiza palmata* Miers (Calumba, *British Pharmaceutical Codex*, 1954) were used to treat atonic dyspepsia whereas the dried stems of *Tinospora cordifolia* (Tinospora, *Indian Pharmaceutical Codex*) were used to promote digestion and appetite in the form of an infusion. Weight loss phytopharmaceuticals containing *Stephania tetrandra* S. Moore are banned on account of their hazardous effect on the kidneys. Approximately 40 species of plants classified within the family Menispermaceae are used for medicinal purposes in the Asia-Pacific, particularly to promote urination and menses, to relieve gastrointestinal troubles, to treat fever, asthma, paralysis, rheumatism, to wash inflamed eyes, to assuage pain and to invigorate health. One might have noticed that the convulsions provoked by picrotoxin could be antagonized by the muscle-relaxing effect of bisbenzylteretrahydroquinoline alkaloids, confirming thereby the Asian belief that a poison and its antidote are inhabited in different parts of the same plant.

***Fibraurea chloroleuca* Miers**

[From Greek, *khloros* = green and *leukos* = white]

Physical description: It is a climber found in the rocky primary forests of the Asia-Pacific. The wood is yellow, the bark is fissured, and the medullary rays are broad in transversal section. Leaves: simple, spiral and without stipules. The petiole is 2.2 cm–5.2 cm long and keeled at both ends and twisted at the base. The blade is 8.5 cm–14.5 cm × 5.2 cm–4 cm, leathery, oblong, elliptic, and shows 3 nerves. The apex is acuminate. The inflorescences are long and pendulous panicles. The flowers are sweetly-scented and small. The fruits are yellow-orange, elliptic and smooth 3.5 cm–4 cm long drupes (Fig. 40).

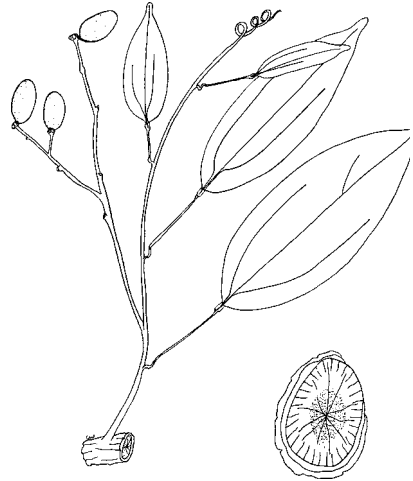


Fig. 40. *Fibraurea chloroleuca* Miers. From: KLU Herbarium 29771. Flora of Sarawak, University of Malaya Herbarium. Field collector & botanical identification: Chin See Chung, 21 July 1977. Geographical localization: behind house on hill and ridge 500–1000 ft, Long Sela-tong Ulu, upper Buram. From: KLU 11647. Flora of Malaya. Field collector & botanical identification: Benjamin C Stone, Tanjong Keruing. Tasek Bera, 27 July 1970, Malaysia.

Synonymy: *Fibraurea tinctoria* Lour.

Common names: *Fibraurea*; *balet*, *binak* (Kenyah); *peron* (Indonesia); *bintang habu*, *merkunyit* (Malay); *huang teng* (Chinese); *hoang dang* (Vietnamese); *kam-phaeng* (Thailand).

Pharmaceutical interest: It will be interesting to learn whether the antidiabetes, anti-inflammatory and antiseptic properties of *Fibraurea chloroleuca* Miers are attributed to isoquinoline alkaloids such as berberine and palmatine. Berberine acts through the delay of the onset or progression of diabetic complications in the eyes and other major organ systems via inhibition of aldose reductase (Lee HS, 2002). Berberine and palmatine possess significant and dose-dependent anti-inflammatory, antinociceptive and antipyretic activity (Kupeli E *et al.*, 2002).

Uses: In Indonesia, *Fibraurea chloroleuca* Miers is used to soothe inflamed eyes, remove blood from feces and to assuage headache. In Malaysia, the plant is used to aid recovery from childbirth, treat diabetes, and to heal ulcerated noses. The plant is used to produce a yellow dye.

References

- Kupeli E, *et al.* (2002) *Life Sci* **72**(6): 645–657.
 Lee HS. (2002) *J Agric Food Chem* **50**(24): 7013–7016.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Pericampylus glaucus (Lamk.) Merr.

[From Greek, *kampulos* = curved and from Latin, *glaucus* = glaucous]

Physical description: It is a climber found in India, Southeast Asia and China which forms some kind of glaucous bunches in secondary growths and by the roadside. The stems are slender, terete and velvety. Leaves: simple, spiral and without stipules. The petiole is velvety, 2 cm–4 cm long. The blade is papery, cordate, velvety underneath, 2.9 cm × 3.1 cm–5.5 cm × 6 cm, and glaucous or yellowish. The apex is round, the base is flat or cordate, and the margin is crenate. The blade shows 3–5 pairs of secondary nerves which are visible

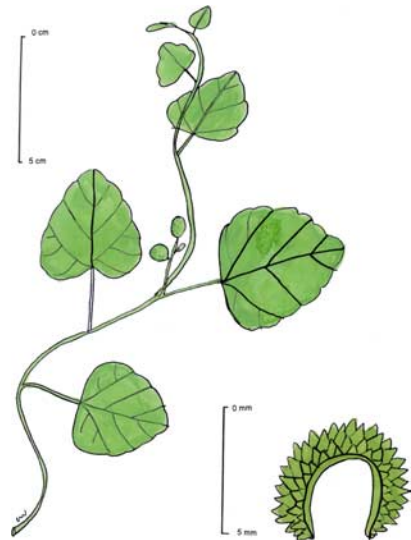


Fig. 41. *Pericampylus glaucus* (Lamk.) Merr.

above. The inflorescences are long and thin, pendulous, and axillary racemes of about 3 cm–5 cm long. The flowers are tiny and fragrant. The fruits are glaucous berries of 6 mm–7 mm diameter, each containing a horseshoe-shaped, 3 mm × 5 mm spiny seed (Fig. 41).

Pharmaceutical interest: The pharmacological potential of *Pericampylus glaucus* (Lamk.) Merr. remains unexplored. This plant is known to produce some alkaloids and triterpenes such as epifriedelinol and daucosterol (Liang P *et al.*, 1998; Tomita M *et al.*, 1967). The anti-hair loss, anti-inflammatory and antipyretic properties of this plant are most probably due to isoquinoline alkaloids. Note that norreticuline and reticuline, benzyltetrahydroisoquinoline alkaloids common in the Ranunculales, stimulate the proliferation of cultured cells from the murine hair apparatus and stimulate mouse hair regrowth (Nakaoji K *et al.*, 1997). What is the mechanism involved here? α -receptors?

Synonymy: *Pericampylus formosanus* auct. non Diels, *Cocculus glaucus* DC.

Common name: Pericampylus; *celuru* (Indonesian).

Uses: In Indonesia, *Pericampylus glaucus* (Lamk.) Merr. is used to counteract hair loss and to resolve swelling of the spleen. In Malaysia, the plant is used to treat fever, cough, headache and asthma. In Philippines, the juice of the roots is used to counteract snake-poisoning.

References

- Liang P, *et al.* (1998) *Chung Kuo Chung Yao Tsa Chih* **23**(1): 39–40.
 Nakaoji K, *et al.* (1997) *Biol Pharm Bull* **20**(5): 586–588.
 Tomita M, *et al.* (1967) *Yakugaku Zasshi* **87**(3): 315–316.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

F. Order PAPAVERALES Cronquist 1981

The order Papaverales consists of 2 families of herbaceous plants, the Papaveraceae and Fumariaceae. This order is thought to have originated from the order Ranunculales, from which it inherits the ability to elaborate several sorts of *isoquinoline alkaloids* (Appendix I). An interesting feature of this order is the production of isoquinoline alkaloids of therapeutic value. Morphine from Papaveraceae is an instance of such an alkaloid.

1. Family PAPAVERACEAE A. L. de Jussieu 1789 nom. conserv., the Poppy Family

Physical description: The family Papaveraceae consists of 25 genera and 200 species of laticiferous herbs or shrubs, occurring mainly in the temperate and tropical parts of the North Hemisphere. The leaves are simple, alternate, spiral and without stipules. The blade is often dissected. The flowers are showy, large, perfect, regular, and hypogynous. The calyx comprises of 2–4 caducous sepals and the corolla consists of 4–16 petals which are very thin, crumpled, brightly coloured, and imbricate. The andrecium is made of numerous stamens originating in a centripetal sequence. The anthers are tetrasporangiate and dithecal. The gynecium consists of 2–many carpels which are united to form a superior, unilocular ovary which encloses several ovules attached to parietal placentas. The stigma is flat, lobed and discoid. The fruits are capsular, containing numerous tiny seeds.

Pharmaceutical interest: A classical example of Papaveraceae is *Papaver rhoea* L. (corn poppy, red poppy) which grows wild in Europe and the petals of which (Red-Poppy, *British Pharmaceutical Codex*, 1949) have been used in the form of syrup to color and sweeten pharmaceutical mixtures. Of great interest in this family are the neuroactive isoquinoline alkaloids such as morphine, codeine and papaverine present in opium, i.e. the latex of *Papaver somniferum* L. (Fig. 42). Opium (from the Greek *opos* = juice) was known of the Babylonians (4000 BC), and it was used to pacify children in ancient Egypt before 2000 BC. The Greeks and Romans used it to induce sleeping. Arabian traders introduced opium to China, and it first appeared in Chinese medical text in about AD 1000, as a treatment for diarrhea. At the end of the Middle Age, the Swiss physician Paracelsus had such a high opinion of opium that he named preparations containing it *laudanum* (from Latin *laudare* = to praise). Another example of Papaveraceae is *Sanguinaria canadensis* the dried rhizome of which (*Sanguinaria*, *British Pharmaceutical Codex*, 1934): has been used as an expectorant in chronic bronchitis, usually as a tincture (1 in 10; dose 1 mL). *Argemone mexicana* L., *Chelidonium majus* L., *Papaver somniferum* L., *Macleaya cordata* (Willd.) R. Br., and *Pteridophyllum racemosum* Sieb. & Zucc. are used in the Asia–Pacific to treat various sorts of ailments.

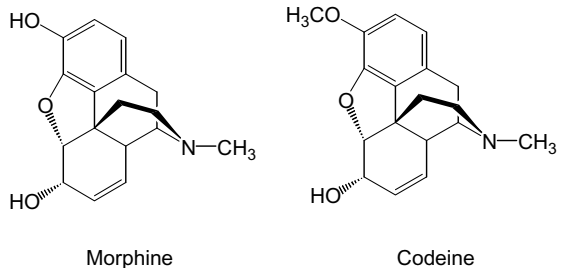


Fig. 42. Examples of neuroactive isoquinoline alkaloids from *Papaver somniferum* L.

***Argemone mexicana* L.**

[From Latin, *mexicana* = from Mexico]

Common names: Mexican poppy, thistle root, prickly poppy, thornapple; *khyaa* (Burmese); *lao chou li* (Chinese); *cardo santo*, *figo do inferno* (Portuguese); *chardon bénit des Antilles*, *herbe à femme* (French); *lao thu lac* (Vietnamese); *adormidera espinosa* (Spanish); *brahmadandi* (Tamil and Sanskrit).

Physical description: It is a tropical shrubby herb which grows to a height of 1.2 m. The plant is native to tropical America. The stems are thorny, succulent and glabrous. The latex is yellow and slightly corrosive. Leaves: simple, glaucous, without stipules and amplexicaul. The blade is glaucous, deeply incised, 11.5 cm × 7 cm–3.5 cm × 2.5 cm, and shows 3–4 pairs of secondary nerves. The margin is thorny. The flowers are yellow, terminal, and 4 cm in diameter. The calyx comprises of 3 prickly and ovate sepals. The corolla comprises of 6 petals which are yellow and membranaceous. The ovary is prickly and contains numerous ovules. The stigma is sessile and 4–6-lobed. The fruits are prickly capsules, 2.5 cm–3.8 cm in diameter and opening by 4–6 valves. The seeds are numerous and netted (Fig. 43).

Pharmaceutical interest:

Chemotherapeutic properties: The anti-septic property of *Argemone mexicana* L. is very likely to be attributed to isoquinoline alkaloids such as sanguinarine, berberine and protopine, which are abundant in the plant (Santos AC *et al.*, 1932). Sanguinarine exhibits a broad

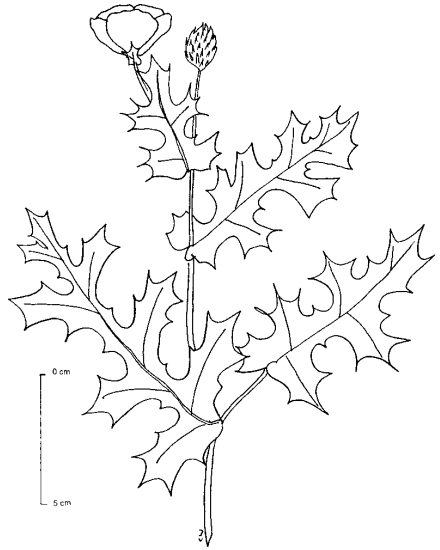


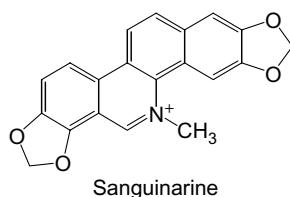
Fig. 43. *Argemone mexicana* L.

From: Delhi University Herbarium 004344. Flora of India. Geographical localization: Delhi ridge, Delhi, India, altitude 720 ft., Feb 1961. Field Collector: SK Avova. Botanical identification: CS Venktast.

petals which are yellow and membranaceous. The ovary is prickly and contains numerous

Uses: In Burma, the latex of *Argemone mexicana* L. is used to treat dropsy and the seeds are eaten to relieve the bowels of costiveness. In China, the leaves of *Argemone mexicana* L. are used to invigorate health, inhibit fertility and promote digestion. In Indonesia, *Argemone mexicana* L. is used to treat jaundice, skin affections, dropsy, blisters and ulcers, and to promote menses. In the Philippines, the flowers are used to induce narcosis and treat lung diseases.

panel of pharmacological activities. It is antimicrobial, antifungal, and anti-inflammatory. It inhibits Na^+/K^+ -dependent ATPases, has a positive inotropic action, and interacts with DNA. Sanguinarine chloride is used in mouthwashes for its ability to bind dental plaque and to inhibit the growth of bacteria at a very low dose. The plant is interesting because of (+/-)-6-acetyldihydrochelerythrine, which exhibits a significant Anti-Human Immunodeficiency Virus activity in H9 lymphocytes with EC_{50} and Therapeutic Index values of $1.77 \mu\text{g}/\text{mL}$ and 14.6, respectively (Chang YC *et al.*, 2003). The acetone fraction of the petroleum ether extract of seeds from *Argemone mexicana* L. destroys the larvae of *Aedes aegypti* at doses of 200, 100, 50 and 25 ppm (Sakthivadivel M *et al.*, 2003). The plant displays some levels of antiplasmodial activities (Adjobimey T *et al.*, 2004).



References

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 Santos AC, *et al.* (1932) *J Am Chem Soc* July **54**: 2923–2924.
 Sakthivadivel M, *et al.* (2003) *Bioresour Technol* **89**(2): 213–216.
 Sood NN, *et al.* (1985) *Trans R Soc Trop Med Hyg* **79**(4): 512–515.

Warning: Sanguinarine is toxic to the liver. A single intraperitoneal dose (10 mg/Kg) of sanguinarine will boost the enzymatic activity of SGPT and SGOT and cause a significant loss of microsomal cytochrome P-450, reduce body and liver weight, induce peritoneal and hepatic edema and hepatocellular degeneration and necrosis (Dalvi RR, 1985). The seed is a common adulterant of mustard seeds. Ingestion of *Argemone* seed oil causes epidemic dropsy in humans in Africa and India with hyperpigmentation of the skin and sarcoid angiomas swellings and glaucoma. Four cases of dropsy have been reported as a result of body massages with contaminated mustard oil sanguinarine (Sood NN *et al.*, 1985). The effects of sanguinarine and chelerythrine on pigs are also reported (Kosina *et al.*, 2004).

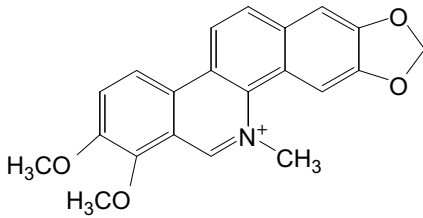
Chelidonium majus L.

[From Greek, *khelidon* = swallow and from Latin, *magnus* = great]

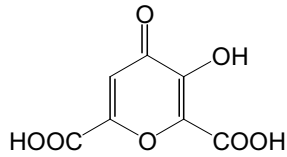
Physical description: It is a perennial herb which grows to a height of 40 cm. It is native to Eurasia where it grows wild on old walls, in piles of rubble and

Synonymy: *Chelidonium sinense* DC.

Common names: Greater celandine, tetterwort, pile-wort, or rock poppy.



Chelerythrine



Chelidonic acid

in ditches. The plant is laticiferous and the latex is orange and caustic. The stems are succulent and glaucous. Leaves: pinnate, without stipules, 14 cm–9 cm × 5 cm–4.7 cm and alternate. The margin of the blade is crenate. The flowers are showy and terminal. The corolla comprises of 4 petals which are yellow and membranaceous. The andrecium consists of numerous stamens. The ovary is fusiform. The fruits are fusiform capsules containing numerous seeds (Fig. 44).

Uses: In China and Japan, *Chelidonium majus* L. is used to heal stomach ulcers. In Korea, *Chelidonium majus* L. is used to treat gastric cancer.

Pharmaceutical interest:

Anti-cancer properties: *Chelidonium majus* L. elaborates several sorts of cytotoxic isoquinoline alkaloids such as chelidonine, chelerythrine, sanguinarine, berberine, coptisine and stylopine which are probably involved in the anti-cancer property mentioned above. NSC-631570 (Ukraine) is a semisynthetic compound of thiophosphoric acid and chelidonine which nearly doubles the median survival times of patients with histologically proven unresectable pancreatic cancer (Gansauge F *et al.*, 2002). The anti-cancer property of this plant can



Fig. 44. *Chelidonium majus* L.

From: KLU Herbarium 26739. Herb. Lugd. Batav. Field collector & botanical identification: JF Maxwell, 17 May 1977. Geographical localization: Leiden, Netherlands. Erect herb growing around the RijksHerbarium.

also be mediated by glycoproteins such as a CM-Ala, a protein-bound polysaccharide which enhances nitric oxide production in peritoneal macrophages and exhibits antitumoral activity, suggesting antitumoral immunostimulator properties (Song JY *et al.*, 2002).

Anti-ulcer property: One might set the hypothesis that the medicinal uses mentioned above results from isoquinoline alkaloids with anticholinergic effect. Note that an extract of *Chelidonium majus* reduces gastric acid output, increases mucin secretion, and boosts the release of prostaglandin E₂, and leukotrienes (Khayyal MT *et al.*, 2001).

References

- Gansauge F, *et al.* (2002) *Langenbecks Arch Surg* **386**(8): 570–574.
 Khayyal MT, *et al.* (2001) *Arzneimittelforschung* **51**(7): 545–553.
 Song JY, *et al.* (2002) *Arch Pharm Res* 2002 Apr **25**(2): 158–164.

Warning: The juice can produce congestion of the lungs and liver, and narcosis. Skin poisoning results from the handling of the crushed plant. The corrosive property of the latex of *Chelidonium majus* L. and of several other plants classified within the family Papaveraceae is partially attributed to a quinone, chelidonic acid.

2. Family FUMARIACEAE A. P. de Candolle 1821 *nom. conserv.*, the Fumitory Family

Physical description: The family Fumariaceae consists of about 20 genera and 400 species of poisonous perennial herbs, growing mainly in the Northern temperate regions and in South Africa. The stems are often slender and juicy. The leaves are simple, alternate or subopposite, without stipules and often dissected. The inflorescences are cymose or racemose. The flowers are perfect, zygomorphic, and hypogynous. The calyx comprises of a pair of small and deciduous sepals, and the corolla consists of 4 petals. The petals are imbricate, the outer 2 often saccate or spurred at the base, and the inner 2 narrower and sometimes coherent to the apex. The andrecium consists of 4 free stamens facing the petals, or 6 stamens united in 2 bundles. The gynecium comprises of a pair of carpels united to form a compound and unilocular ovary, containing a pair of anatropous ovules attached to the parietal placentas. The style is long and thin, and the stigma is lobed. The fruits are capsular. The seeds are glossy, crested or nude. Several handsome garden plants belong to family Fumariaceae, most notably, *Dicentra spectabilis* (L.) Lemaire (bleeding heart) and *Dicentra cucullaria* (L.) Bernh. (Dutchman's breeches).

Pharmaceutical interest: The dried tubers of *Dicentra canadensis* (squirrel or turkey corn) and *Dicentra cucullaria* (L.) Bernh. (*Corydalis*, *British*

Pharmaceutical Codex, 1934) have been used to invigorate and to promote urination (dose 0.3 g–1 g) in Western medicine.

Isoquinoline alkaloids: *Corydalis*, *Dicentra* and *Fumaria* species are toxic on account of *isoquinoline alkaloids* such as bulbocapnine, protopine, and bicuculline. Bulbocapnine is a dopaminergic antagonist which has been used as a sedative in postencephalitic conditions, Ménière's syndrome, and for tremors of various origins (dose 100 mg, orally or subcutaneously, once or twice daily). Protopine, is the principal alkaloid of jaundice herb or *Fumaria officinalis* L. (Common fumitory, *French Pharmacopoeia*, 10th edition) which has been used to treat liver disorders and to invigorate. This protoberberine is spasmolytic, anticholinergic, antiarrhythmic, antibacterial and increases the binding of γ -aminobutyric acid to its central receptor. Bicuculline, like picrotoxin, is a specific GABA receptor blocking agent which impedes the GABAergic presynaptic inhibition of excitatory transmission of primary afferent neurones of the spinal cord resulting in epileptiform convulsions, myosis, and dyspnea with more or less prolonged apnea (Fig. 45). Approximately 20 plants classified within the family Fumariaceae, including *Corydalis incisa* (Thunb.) Pers., are mostly used in the Asia-Pacific to assuage pain, counteract putrefaction of the skin and to heal hemorrhoids.

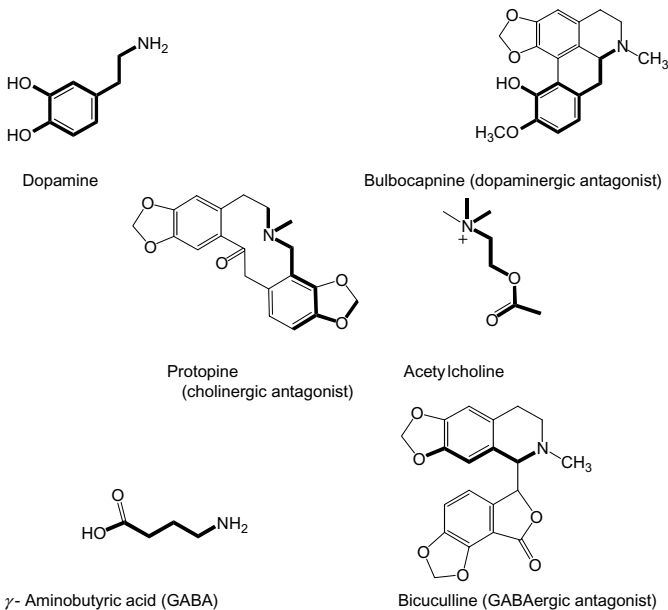


Fig. 45. Note the similitude of chemical structure of bulbocapnine, protopine and bicuculline with dopamine, acetylcholine and γ -aminobutyric acid.

***Corydalis incisa* (Thunb.) Pers.**

[From Greek, *korudallis* = crested lark and from Latin, *caedere* = cut]

Physical description: It is a herb which grows to a height of 30 cm. It is found in Korea, Japan and China. The stems are succulent, smooth and glabrous. The roots are fibrous. Leaves: simple, alternate, 5.5 cm × 1.2 cm–6 mm × 3 mm, cauline, and incised. The petiole is 10 cm–1.3 cm × 1 mm and forms a sheath at the base. The inflorescences are terminal racemes. The flowers are reddish-purple, 1.7 cm–1.4 cm long and tubular. The flower pedicels are 5 mm–1 cm long. The fruits are 8 mm–9 mm × 1 mm fusiform capsules (Fig. 46).

Pharmaceutical interest: It will be interesting to learn whether the medicinal properties of *Corydalis incisa* (Thunb.) Pers. are attributed to benzo[c]phenanthridine alkaloids such as corynoline, acetylcorynoline, corynoloxine, luguine, 6-oxocorynoline, and 12-hydroxycorynoloxine (Naruto S *et al.*, 1968; Kim DK *et al.*, 2000). Corynoline inhibits the enzymatic activity of acetylcholinesterase dose-dependently, in a reversible and non-competitive manner, with an IC₅₀ value of 30.6 μM. (Kim DK *et al.*, 2002). Benzo[c]phenanthridine alkaloids are very interesting because they inhibit the enzymatic activity of topoisomerase in cancerous cells. Are corynoline, acetylcorynoline, corynoloxine, luguine, 6-oxocorynoline, and 12-hydroxycorynoloxine able to inhibit the enzymatic activity of topoisomerase?

Common name: *Murasaki kewan* (Japanese).

Uses: In China, the flowers of *Corydalis incisa* (Thunb.) Pers. are used to treat prolapse of the rectum, and a decoction of the plant is applied externally to counteract skin putrefaction and to heal piles.



Fig. 46. *Corydalis incisa* (Thunb.) Pers. From: KLU Herbarium 17912. Ex. Herb Universitatis Tokyoensis. Field collector & botanical identification: Y Tateishi, 11 Apr 1971. Geographical localization: Japan, Tokyo, Kiyose, altitude 50 m.

References

- Kim DK, *et al.* (2000) *Arch Pharm Res* **23**(6): 589–591.
 Kim DK, *et al.* (2002) *Arch Pharm Res* **25**(6): 817–819.
 Naruto S, *et al.* (1968) *Tetrahedron Lett* **14**: 1705–1709.

Warning: This herb is very poisonous.

II. Subclass HAMAMELIDAE Takhtajan 1966

The subclass Hamamelidae consists of 11 orders and 24 families, and about 3400 species of plants which are thought to have originated from some tanniferous Magnoliidae, forced to adapt to a climate of alternating wet and dry seasons in the Upper Cretaceous (Appendix I). These are mostly trees, the flowers of which are tiny, packed in spikes, unisexual, with distinct carpels, and adapted to wind pollination. In this Subclass, the use of alkaloids as chemical weapons has dramatically declined with the advent of *tannins* and *flavonoids*. The mechanisms by which tannins impede microbial infestation are enzyme inhibition, substrate deprivation, action on membranes, and metal ion deprivation. When consumed by mammalian, tannins form complexes with salivary glycoproteins and rend the plant unpalatable. Levels of tannins above 5% of the diet induce hemorrhagic gastroenteritis, necrosis of the liver, and kidney damage with proximal tubular necrosis and death. Proanthocyanidins or condensed tannins (non-hydrolysable) are not absorbed by the digestive tract, but damage the mucosa of the gastrointestinal tract, and decrease the absorption of nutrients. Tannins explain the astringent properties of these plants. Urticales is the largest and oldest order in this subclass.

A. Order URTICALES Lindley 1833

The order Urticales consists of 6 families and 2200 species of trees, shrubs, climbers and herbs, which have evolved from the Hamamelidales where it inherited the ability to elaborate interesting series of prenylated flavonoids.

1. Family CANNABACEAE Endlicher 1837 *nom. conserv.*, *the Hemp Family*

Physical description: The Cannabaceae family consists of 2 genera and 3 species of herbs known to produce *prenylated flavonoids*. The leaves in this family are opposite, alternate, palmately lobed (*Humulus*) or palmately compound (*Cannabis*) and stipulate. The flowers are tiny and either male or female. The male flowers are paniculate and comprise of a calyx made of 5 imbricate sepals, with 5 stamens facing the sepals. The anthers are erect in buds, 2-locular, and open lengthwise. The female flowers are sessile, crowded or strobilate, with large showy bracts. The calyx envelops the ovary which is sessile, 1-locular and contains a single pendulous ovule. The style is central and 2-lobed. The fruits are achenes, covered with a persistent calyx.

Pharmaceutical interest: The dried strobiles of *Humulus lupulus* L. (hops, *British Pharmaceutical Codex*, 1934) are aromatic, bitter and mildly sedative,

considering its 2-methyl-3-buten-2-ol, and are used to prepare beer. *Cannabis sativa* subsp. *sativa* is cultivated for fiber (hemp) and *Cannabis sativa* subsp. *indica* (Lam.) Small & Cronq. is cultivated principally for psychotropic drugs (marijuana, hashish).

***Cannabis sativa* L.**

[Probably from Hebrew, *kaneh bosem* = aromatic reed, in Exodus 30:23, and refer to the recipe for the Holy Anointing Oil of Israel and from Latin, *sativus* = cultivated]

Synonymy: *Cannabis sativa* subsp. *indica* (Lam.) Small & Cronq.

Common names: Cannabis, hemp, *gánja* (Tamil); *vijaya*, *indrasana* (Sanskrit).

Physical description: It is a shrubby herb which grows to a height of 3 m. The plant grows wild in India and Pakistan. The stems are terete and hairy. Leaves: at the base of the stem the leaves are opposite and palmately lobed. At the apex of the stems the leaves are 1- or 3-foliolate. The petiolules are very short and channeled. The blade is hairy underneath, 10.5 cm–6 cm × 1.1 cm–6 mm, and papery. The margin is serrate. The midrib and secondary nerves are sunken above and raised below, and the blade shows 6–10 pairs of secondary nerves. The male flowers are grouped in panicles. The female flowers are grouped in compact cymes mixed with foliaceous bracts. The flowers are tiny and 5-lobed. The fruits are ovoid achenes (Fig. 47).

History and uses: Cannabis has been cultivated for its seeds and fibers from a very remote period in time, but its narcotic properties are usually not marked in plants grown in temperate regions, and even in India, an active drug can only be grown in certain districts. *Cannabis sativa* L. was valued as long ago as 6000 BC in China where the seeds were used for food. The Assyrians used it as incense, and in India and Africa, the

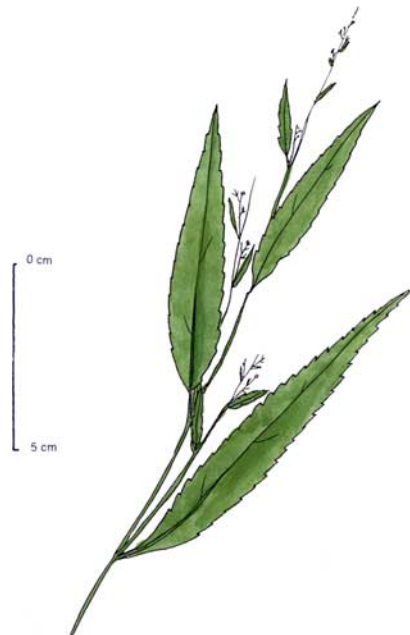


Fig. 47. *Cannabis sativa* L.

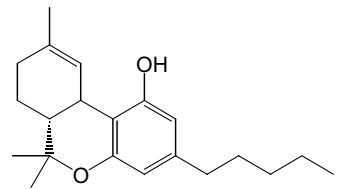
From: Herbarium KLU 14958. Field collector & botanical identification: Benjamin C Stone. Geographical localization: Phoenchit, Thailand (Peninsula).

drug was used in religion and magic, and activities requiring endurance or physical effort. Greeks were acquainted with hemp more than 2000 years ago. Herodotus mentioned that in 600 BC, the Scythians burned its seeds to produce a narcotic smoke. Dioskurides mentioned that if the seeds of cannabis were eaten too freely, they destroyed virility, and that the juice was used to relieve earache.

The earliest medical writer who distinctly mentioned the intoxicating properties of cannabis is Ibn Baitar, a native of Africa who died in Damascus in 1248. Galen asserted that in his time (Middle Ages), it was customary to give hemp seeds to the guests at banquets in order to promote hilarity and enjoyment (Lib.I, De Aliment. Facult.). Georg Everhardus Rumphius, a Dutch naturalist who lived in Indonesia during the 17th century, stated that the kind of mental excitement produced by hemp depended upon the temperament of the consumer. M Rouyer, apothecary to Napoleon and a member of the Egyptian Scientific Commission, noted that leaves and tops collected before ripening were used by Egyptians to prepare a conserve (Bulletin de Pharmacie, 1810, p 400).

The British physicians of the army of India (Dr O' Shaughnessy) and Bonaparte's expedition to Egypt shared the same responsibility for the introduction of cannabis into Europe in the 19th century. It was consumed in intellectual circles and the illicit use of cannabis spreaded rapidly. Cannabis (*British Pharmaceutical Codex*, 1949) consists of the dried flowering or fruiting tops of the male *Cannabis sativa* L. It has been used to assuage migraine and headache due to hypertension.

Three main types of narcotics are produced from the flowering tops, leaves, hairs and resin of *Cannabis sativa* L.: marihuana, Indian form and hashish. Marihuana consists of a mixture of the dried, crushed flowers, leaves and smaller stems. It is used for smoking, generally in the form of cigarettes, either alone or mixed with tobacco (joints). The name marihuana is thought to have originated from the Spanish word mari-



Δ^9 -Tetrahydrocannabinol

juana which is a low grade of tobacco. The Indian forms consist of 3 main types of preparations of *Cannabis sativa* L. *bhāng*, *gānja* and *charas*. *Bhāng* consists of the dried leaves and flowering shoots of male and female plants. *Gānja* consists of the dried flowering tops of the female plant harvested when coated with resinous exudate. *Charas* or *churrus* consists of hairs, resin and fragments of leaves collected from the flowering tops and leaves. Hashish corresponds to first grade *charas* and lower grade *ganja*. The name hashish comes from the name of hashishin, followers of Hasan ibn al-Sabbah (11th century Persian sect), who committed political murders throughout Asia Minor in return

for cannabis resin. The effect of hashish was described as early as the middle of the 19th century in the literary writing of Baudelaire as follows : “External objects, one by one, slowly assume peculiar appearances... Sounds put on colors, and colors put on music... your personality disappears... you will feel yourself evaporating... But you should see the results... hashish annihilates, hashish is a suicide weapon... will isolate you... it is for idle bastards. Hashish is useless and dangerous” (Les Paradis Artificiels, Garnier-Flammarion, 1966, Paris).

In Burma, cannabis is used to treat tetanus. In China, the seeds are used to invigorate health, stop vomiting, counteract putrefaction of the skin, promote menses and urination, relieve the bowels of costiveness, resolve inflammation, expel intestinal worms and to induce narcosis. In Vietnam, the plant is used to assuage rheumatic pains, headache and stomachache. The seeds are used to treat uterine prolapse and fever.

Pharmaceutical interest:

Cannabinoids: The chemical constituents and pharmacological effects of *Cannabis sativa* L. are well-known and thousands of references are available on these subjects. Among the hundreds of different compounds reported are a group of terpenophenolic substances known as cannabinoids. The narcotic principle of *Cannabis sativa* L. is a cannabinoid known as Δ^9 -tetrahydrocannabinol (Δ^9 -THC) which is absent from the seeds and stems and present in the leaves and resin. Δ^9 -THC is lipophilic and binds to specific receptors located in the brain. The effects, pleasant or frightening, of Δ^9 -THC depend on the dose, the route of administration and the personality of the user. An oral dose of 50 $\mu\text{g}/\text{Kg}$ –200 $\mu\text{g}/\text{Kg}$ of Δ^9 -THC produces euphoria, a feeling of well-being, hilarity and peace. An oral dose of 240 $\mu\text{g}/\text{Kg}$ of Δ^9 -THC produces a change in auditory and visual perception. An oral dose of 300 $\mu\text{g}/\text{Kg}$ –480 $\mu\text{g}/\text{Kg}$ of Δ^9 -THC produces visual and auditory perception hallucinations. Loss of concentration, anxiety, panic, drowsiness, lethargy and sleepiness occur after a single oral dose of 0.4 mg/Kg–1 mg/Kg. Clinical trials have confirmed the antiemetic activity of Δ^9 -THC orally. It is marketed in the United States, in capsules of 2.5 mg, 5 mg, and 10 mg (Marinol[®]). Δ^9 -THC and structural analogs could possibly be developed as drugs to treat glaucoma and asthma, to stop convulsions and spasms, and to assuage pains.

Reference

Hurd YL, *et al.* (2004) *Neurotoxicology and Teratology* In Press, Corrected Proof, Available online 8 December 2004.

Warning: Marijuana impairs growth in the mid-gestation fetuses (Hurd YL *et al.*, 2004).

***Humulus scandens* (Lour.) Merr.**

[From Latin, *humus* = soil and *scandere* = climb]

Physical description: It is a climber native to East Asia. The stems are slender, terete and hairy. Leaves: simple, opposite, without stipules. The petiole is 5 cm–7 cm long, hairy and grooved. The blade is papery, 3-lobed, 5.2 cm × 7.1 cm–2 cm × 2.5 cm and hairy. The margin is serrate, and the midrib and secondary nerves are sunkely above and raised below. The inflorescences are tiny axillary racemes. The flowers are 3 mm long. The calyx consists of 5 lanceolate sepals which are free and hairy. The petals are glabrous, yellow, lanceolate, free, and opposite to the sepals (Fig. 48).

Synonymy: *Humulus japonicus* Sieb. & Zucc.

Common name: Japanese hop.

Uses: In China, the aerial parts are used to treat malaria, typhoid, gonorrhoea, syphilis, cough, colds, lithiasis, spermatorrhea and malignant sores, promote urination, invigorate the genito-urinary system, stop dysentery and to resolve inflammation. The fruit is used to treat fever, promote appetite and urination, stop dysentery and to counteract poisoning from snake bites and scorpion stings. In Vietnam, the leaves are used to treat fever and stop dysentery.

Pharmaceutical interest:

Inhibition of Cytochrome P450 : To date, the therapeutic potential of *Humulus scandens* (Lour.) Merr. remains unexplored. A number of flavonoids isolated from *Humulus lupulus* L. (hop), inhibit potently and selectively the human cytochrome P450 which is responsible for steroid metabolism and microsomal oxidative

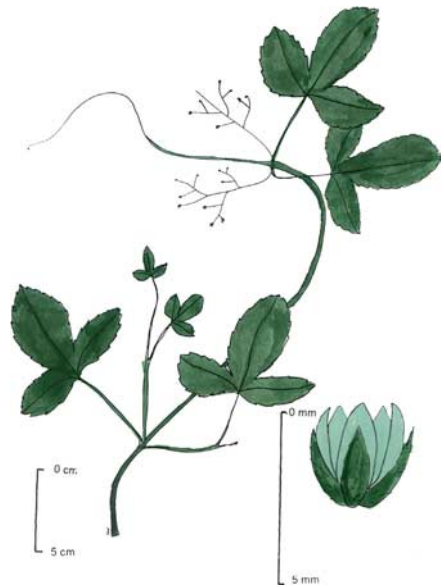
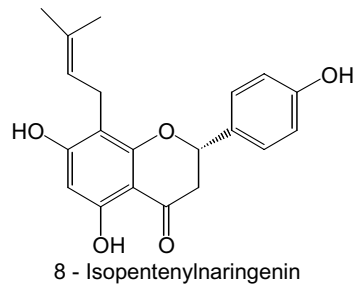


Fig. 48. *Humulus scandens* (Lour.) Merr. From: KLU Herbarium 042729. Field collector & botanical identification: Luo Lin-bo, 20 Aug 1994. Geographical localization: Hunan, China, Xining Co., 26° 4' North–110° 8' East, altitude: 320 m.

system (Henderson MC *et al.*, 2000). Such flavonoids could be responsible for the possible diuretic, hormonal and anti-malignant properties of *Humulus scandens* (Lour.) Merr. Cytochrome P450 is involved in the electron transport necessary for the 11-hydroxylation of cholesterol into aldosterone which is a steroid hormone that inhibits urination. Metapyrone is an example of a diuretic drug which acts by inhibiting 11-hydroxylation of the steroid nucleus. Three flavonoids, xanthohumol, dehydrocycloxanthohumol and isoxanthohumol, isolated from hop inhibit dose dependently ($0.1 \mu\text{M}$ – $100 \mu\text{M}$) the proliferation of human breast cancer (MCF-7), colon cancer (HT-29) and ovarian cancer (A-2780) cultured *in vitro* (Miranda CL *et al.*, 1999). It will be interesting to learn whether a more intensive future research on *Humulus scandens* (Lour.) Merr. will disclose any molecules of chemotherapeutic interest.

Hops is well-known to be estrogenic owing to the phytoestrogens 8-prenylnaringenin (8-isopentenylnaringenin) which binds to estrogen receptors (Milligan SR *et al.*, 2000). One might set the hypothesis that an estrogenic mechanism would explain the use of *Humulus scandens* (Lour.) Merr. to invigorate the genital system and to impede spermatorrhea. Estrogens act on the hypothalamus to inhibit the release of FSH which stimulates spermatogenesis. In addition, estrogen also inhibits the release of ICSH (LH), thereby decreasing testosterone production and inhibiting libido.



References

- Henderson MC, *et al.* (2000) *Xenobiotica* **30**(3): 235–251.
 Milligan SR, *et al.* (2000) *J Clin Endocrinol Metab* **85**(12): 4912–4915.
 Miranda CL, *et al.* (1999) *Food Chem Toxicol* **37**(4): 271–285.

Warning: Carcinoma of the breast is often dependent on estrogen. Most of the breast tumors occur in premenopausal women, in whom there is excess estrogen, and concern must be expressed regarding the unrestricted use of estrogenic herbal products.

2. Family MORACEAE Link 1831 *nom. conserv.*, the Mulberry Family

Physical description: The family Moraceae consists of about 40 genera and 1000 species of trees, shrubs, climbers and herbs. Moraceae are laticiferous and contain *prenylflavones*, and *cardenolides* (*Antiaris*, *Antiaropsis*, *Castilla*).

The leaves are simple, stipulate, often thick, large and glossy. The stipules often form a cap over the leaf buds. The flowers are tiny, packed in compact axillary inflorescences and comprise of 4–5 sepals and stamens, and 2 free carpels each containing 1 ovule. The fruits are syncarps or drupes. An example of Moraceae is *Ficus benjamina* L. (weeping fig). Other examples are *Morus alba* L. (mulberry), *Ficus elastica* Roxb. (India rubber plant), *Castilla elastica* Cerv. (caoutchouc), *Artocarpus communis* Forst. (bread-fruit), *Artocarpus heterophyllus* Lam. (jack-fruit) and *Ficus carica* L.

Pharmaceutical interest: Mulberry (*British Pharmaceutical Codex*, 1934), consists of the ripe fruits of *Morus alba* L. which have been used to relieve the bowels of costiveness, to promote expectoration and as adjuvant in the form of syrup (Mulberry syrup, dose 2 mL–4 mL) prepared by dissolving sucrose in the expressed juice. The latex of *Ficus* species is often used to heal wounds, remove warts, assuage toothache, and to treat skin infection. This could be due to the fact that the latex often contains mixtures of papain-like proteases (ficin), which could be used therapeutically to expel worms or to resolve inflammation, and in the food industry to tenderize meat. The therapeutic potential of this large family is not fully known til to date. *Prenylflavones* and *lectins* of Moraceae represent an interesting reserve field of chemotherapeutic investigation and should be worth being assessed further for their cytotoxic and/or antiviral properties. About 50 species of plants classified within the family Moraceae are used for medicinal purposes in the Asia-Pacific. These are mostly used to treat fever, heal wounds, assuage stomachache, promote the secretion of milk, and to stop diarrhea and bleeding.

***Antiaris toxicaria* Lesch.**

[From Malay, *antjar* = *Antiaris toxicaria* Lesch. and from Greek, *toxikon* = poison for arrow]

Physical description: It is a lowland rainforest tree which grows to a height of 45 m. It is found in Malaysia, Indone-

Common names: *Upas* tree; *pokok ipoh* (Malay); *upas* (Javanese).

sia, India and South China. The bark is dark grey. The inner bark is yellowish with a milky latex. The wood is white and soft. The stems are hairy at the apex. Leaves: simple, alternate and stipulate. The petiole is 2 mm–1 cm long. The blade is oblong-elliptic, and 7.5 cm–20 cm × 3.6 cm–8.5 cm. The apex of the blade is pointed, and the base is round and asymmetric. The inflorescences are axillary. The male flowers are tiny and consist of a 4-lobed perianth and 8 stamens. The female flowers show a pair of styles. The fruits are pear-shaped, pulpy, tomentose and crimson drupes (Fig. 49).

The plant is used for medicinal purposes in India, where the latex is ingested in very small doses to stimulate blood circulation and the heart. In Malaysia, Dayaks and Ibans use the latex to heal wounds, and to counteract snake-poison. In the Philippines, the leaves and bark are used to treat fever and to stop dysentery.

Pharmaceutical interest:

Cardiovascular properties: The toxic principles of *Antiaris toxicaria* Lesch. are cardiac glycosides (Chen KK *et al.*, 1983) which bind to the Na^+ ,



Fig. 49. *Antiaris toxicaria* Lesch.

Uses: This plant is the “*Arbor Toxicaria*” of Georgius Everhardus Rumphius (1628–1702), who wrote in *Thesaurus Amboinensis* that “everything perishes that its wind touches, as so too do all animals shun it when they pass this tree, while the birds fly over”. Although it is a little exaggerated, the plant is dreadfully toxic. The latex of *Antiaris toxicaria* Lesch. has been used in the Asia-Pacific either alone or mixed with the juice of *Strychnos* (see p.), *Amorphophallus*, *Dioscorea*, *Lophopetalum* or *Derris*, to make arrow and dart poison, and occasionally for judicial sentence. The process of getting the arrow-poison has been first reported by Mr L Wray (Curator and State Geologist of Perak) in the Kew Bulletin edition of October 1891 as follows: “the sap is obtained from the tree by scoring the bark and is heated on a spatula till evaporated, leaving a dark gummy substance in which the arrow is dipped. About 3 ounces and a half of sap will do for 100 arrow points”.

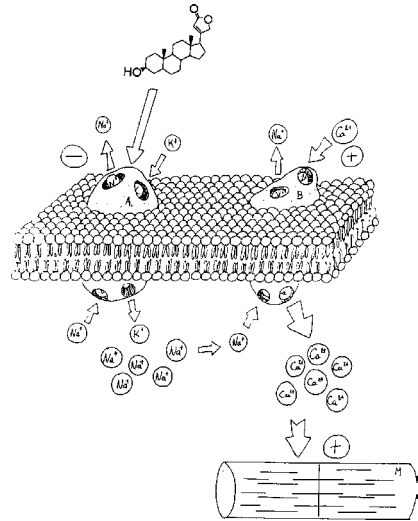
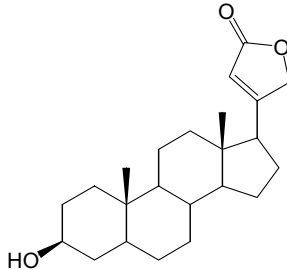


Fig. 50. Cardenolides bind to Na^+/K^+ ATPase protein (A) and inhibit therefore the active transfer of Na^+ out of the sarcolemma. Na^+ being in excess in the sarcolemma is transferred actively out of the sarcolemma through a $\text{Na}^+/\text{Ca}^{2+}$ protein (B) which transfers meanwhile Ca^{2+} into the sarcolemma. Increase of Ca^{2+} into the sarcolemma results in stronger myofibril (M) contraction, hence stronger cardiac contraction.

K^+ -ATPase pumps of the cardiac myocytes. In normal conditions, the contraction cycle of myocytes consists of 5 electrical events or phases, which correspond to the transfers of sodium, calcium and potassium ions through the sarcolemma transubular membrane. The first phase, or phase 0, corresponds to a massive entry of sodium ions through fast sodium ions channels and therefore resulting in the depolarization of the sarcolemma membrane. During the phases 1, 2 and 3, or repolarization, calcium ions and sodium ions enter the cell and potassium ions leave the cells slowly. During phase 4, or diastole, sodium ions are transported out of the cell and potassium ions are transported in the cell through a transubular Na^+ / K^+ -ATPase protein. The binding of cardiac glycosides to Na^+ / K^+ -ATPase results in an elevation of intracellular sodium which stimulates Na^+ / Ca^{2+} exchanges, leading therefore to increased intracellular calcium and enhanced contractility of the myofibrils (Fig. 50).



Cardenolide aglycone

References

- Chen KK, *et al.* (1965) *J Pharmacol Exp Ther* **150**(1): 53–54.
 Ho LM, *et al.* (1996) *Nephron* **72**(4): 676–678.

Warning: The latex of *Antiaris toxicaria* Lesch. is reported to cause *per os* a fatal rhabdomyolysis and acute oliguric renal failure (Ho LM *et al.*, 1996). The case of an occupational asthma caused by *Antiaris* wood has been recently reported.

Artocarpus heterophyllus Lamk.

[From Greek, *artos* = bread, *karpos* = fruit and *heteros* = different and *phullon* = leaves]

Physical description: It is a tropical fruit tree probably native to India. The bark is dark grey and exudes an abundant milky latex when incised.

Common names: Jack-fruit; *nangka* (Malay); *jaca* (Portuguese); *chakka* (Malayalam).

The stems are articulate. Leaves: simple, spiral, and stipulate. The petiole is 1.25 cm–4 cm long. The blade is elliptic to obovate, leathery, glossy, deep green on the surface, and 5 cm–23 cm × 2 cm–11 cm. The apex is blunt and the base of the blade is tapered. The flowers are unisexual, tiny and arranged in separate and axillary heads. The male flower consists of a tiny 2- to 4-lobed perianth and a single stamen. The female flower consists of a tiny perianth tube, a single ovary sunk in the receptacle and a long style. The fruits are 30 cm–90 cm × 15 cm–30 cm, ovoid, smelly, heavy, greenish-yellow, covered with conical warts and cauliflorous. The seeds are 4 cm × 2 cm, ovoid, brownish, smooth and embedded within a thick orange gelatinous jacket which is edible (Fig. 51).



Fig. 51. *Artocarpus heterophyllus* Lamk.

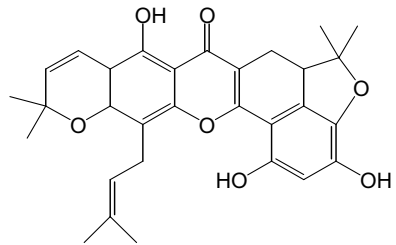
Pharmaceutical interest:

Antimicrobial properties: The seeds of *Artocarpus heterophyllus* Lamk. abound in lectins which have versatile application in immunopharmacological research (Kabir S *et al.*, 1998; Hashim ON *et al.*, 2001). One of these lectins inhibits *in vitro* the growth of Herpes Simplex Virus type 2 (HSV-2), Varicella-zoster Virus (VZV), and Cytomegalovirus (CMV) with IC₅₀ values of 2.5, 5, and 10 Eg/mL respectively and stimulates NK lymphocyte (CD16(+)/CD56(+)) proliferation (Wetprasit N *et al.*, 2000). Prenylflavones characterized from *Artocarpus heterophyllus* Lamk. inhibit the proliferation of cultured cariogen bacteria at 3.13 μg/mL–12.5 μg/mL (Sato M *et al.*, 1996).

Uses: In Burma and China, the latex is applied to heal ulcers and abscesses. The roots are used to stop diarrhea. In Malaysia, ashes of leaves are used to heal wounds. In the Philippines, the latex is used as it is in Burma, and the leaves as it is in Malaysia. In Vietnam, the wood is used to stop convulsion. A decoction of the leaves is drunk to stimulate the production of milk. The sap is used to treat syphilis and to expel intestinal worms.

Antidiabetes property: A decoction of the leaves given *per os* at a dose of 20 g/Kg improves glucose tolerance in normal and diabetic patients

(Fernando MR *et al.*, 1991). This activity might be attributed to prenylflavones like cycloheterophyllin, artonin A and artonin B, which inhibit iron-induced lipid peroxidation in rat brain homogenate, scavenge 1,1,-diphenyl-2-picrylhydrazyl and peroxy radicals, and scavenge hydroxyl radicals experimentally-generated (Ko FN *et al.*, 1998).



Artonin A

References

- Fernando MR, *et al.* (1991) *J Ethnopharmacol* **31**(3): 277–282.
 Hashim On, *et al.* (2001) *Immunol Invest* **30**(1): 21–31.
 Kabir S, *et al.* (1998) *J Immunol Methods* **212**(2): 193–211.
 Ko FN, *et al.* (1998) *Free Radic Biol Med* **25**(2): 160–162.
 Sato M, *et al.* (1996) *J Ethnopharmacol* **54**(2-3): 171–176.
 Wetprasit N, *et al.* (2000) *Jpn J Infect Dis* **53**(4): 156–161.

Parartocarpus venenosus (Zoll. & Mor.) Becc. ssp. *forbesii* (King) Jarret

[From Greek, *artos* = bread, *karpos* = fruit, *heteros* = different and from Latin, *venenosus* = poisonous]

Physical description: It is a tree which grows to a height of 40 m in the lowland flooded rainforests of Malaysia and Indonesia. The core of the trunk is hollow and often inhabited by red ants. The bole is straight. The wood is soft and whitish. The bark is ash-coloured, with large lenticels, and papery scaly. The inner bark is orange-cream, and exudes an abundant and very poisonous milky latex. Leaves: simple, entire, spiral and stipulate. The petiole is 1.5 cm–4 cm long. The blade is leathery, obovate, and 6 cm–17 cm × 3.5 cm–9 cm. The blade shows 6–12 pairs of secondary nerves. The flowers are axillary, and the male heads are globose. The fruits are globose, yellowish, 18 cm in diameter, spiny and attached to the stems by 3 cm–10 cm long pedicels.

Common name: *Berteh paya* (Malay).

Uses: In Malaysia, the latex of *Parartocarpus venenosus* (Zoll. & Mor.) Becc. ssp. *forbesii* (King) Jarret is used by the *Orang Asli* to make arrow-poison. In Indonesia, the latex is applied externally to resolve inflamed parts and to heal wounds. This plant has apparently not been investigated for its therapeutic potential.

Warning: This plant is very poisonous.

B. Order FAGALES Engler 1892

The order Fagales consists of 3 families and more than 900 species of timber trees, half of which belong to the genus *Quercus* (oak). Fagales are mostly North Temperate and thought to have originated from the order Hamamelidales independently from Urticales (Appendix 1). Tannins of Fagales are of pharmaceutical value.

1. Family FAGACEAE Dumortier 1829 *nom. conserv.*, the Beech Family

Physical description: The family Fagaceae consists of about 7 genera and 800 species of timber trees known to abound with *tannins* and *flavonoids*. The wood is hard and heavy, and of commercial value. The leaves are simple, alternate, often leathery, and stipulate. The stipules are deciduous. The inflorescences are spikes of tiny unisexual, and monoecious and anemophilous flowers. The calyx comprises of 6 small sepals. The andrecium comprises of 4–40 stamens, the anthers of which are tetrasporangiate, dithecal and opening by longitudinal slits. The gynecium comprises of 2–12 carpels united to form a compound, and an inferior ovary containing a pair of axial and pendulous ovules in each locule. The styles are free and as numerous as the carpels. The fruits are acorns. A classical example of Fagaceae is *Quercus robur* L., the common European oak.

Pharmaceutical interest: The nuts of *Fagus sylvatica* L. (common beech) yield an oil. *Castanea sativa* Mill. (sweet or Spanish chestnut) yields timber and a bark used for tanning. The cupules and unripe acorns of *Quercus aegolops* (valonia) are used in tanning. *Quercus suber* afford the commonly used cork, in an industry worth £20 million to Portugal's economy. Galls of *Quercus infectoria*, or Turkish galls, are an important source of tannic acid used in pharmacy. An extract of *Quercus stenophylla* has been marketed for the acceleration of the elimination of renal and urethral calculi. In the Asia-Pacific, a number of plants classified in the family Fagaceae are used owing to their astringent properties, to stop diarrhea and bleeding, promote urination, counteract putrefaction and to soothe inflamed parts.

***Castanea crenata* Sieb. & Zucc.**

[From Latin, *castanea* = chestnut and *crenatus* = with toothed edge]

Physical description: It is a magnificent timber tree found in China, Korea and Japan. The bark is dark reddish

Common name: Japanese chestnut;
Kuri (Japanese).

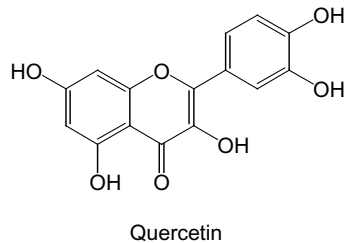
Uses: In China and Korea, the flowers are used to treat tuberculosis and scrofula, and a decoction of fresh leaves is used to resolve inflamed parts.

brown and the stems are glabrous. Leaves: simple, alternate and stipulate. The stipules are deciduous. The petiole is 9 mm–1.3 cm long. The blade is papery, 13.6 cm × 4 cm–11.5 cm × 3.5 cm, and lanceolate. The base of the blade is asymmetrical, somewhat cordate, and the apex ends in a 6 mm–8 mm long tail. The margin is toothed, each tooth 2 mm long. The blade is glabrous on the surface and covered with starry hairs underneath, showing 14–17 pairs of secondary nerves. The midrib and secondary nerves are raised below and sunke above, and the midrib is somewhat hairy above. The flowers are tiny and packed in axillary 4 cm–7 cm long spikes (Fig. 52).



Fig. 52. *Castanea crenata* Sieb. & Zucc. From: KLU Herbarium 8969. Geographical localization: Chiba, 1957. Botanical Identification: Benjamin C Stone, 9 Jan 1970.

Pharmaceutical interest: *Anti-inflammatory properties:* The anti-inflammatory property of *Castanea crenata* Sieb. & Zucc. is substantiated both *in vitro* and *in vivo*. Activity-guided fractionation of a water extract of leaves, based on the determination of inhibitory effect upon the release of hexosaminidase from RBL-2H3 cells, led to the isolation of quercetin as the principle responsible for the inhibition of degranulation of mast cells (Lee E *et al.*, 1999).



References

Lee E, *et al.* (1999) *ArchHuman Immunodeficiency Viruses of Pharmaceutical Research* **22**(3): 320–323.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Castanopsis cuspidata* (Thunb.) Schottky**

[From Latin, *castanopsis* = chestnut-like and from *cuspis* = point]

Physical description: It is a timber which grows wild in China and Japan. The wood is of commercial value. The stems are blackish, lenticelled, smooth and glabrous. The bark yields tannins. Leaves: simple, spiral and stipulate. The stipules are dioecious. The petiole is 1.5 cm–1 cm long, obscurely channeled above, and swollen at the base. The blade is lanceolate, glossy, leathery, and 8.9 cm × 2.8 cm–9 cm × 2.5 cm. The margin is laxly toothed and recurved. The base of the blade is acute, asymmetrical, and the apex is acuminate in a 1 cm–2 cm long tail. The blade shows 8–9 pairs of secondary nerves which are indistinct. The inflorescences are terminal spikes. The fruits are woody, globose. 1.4 cm long, velvety and scaly acorns (Fig. 53).

Uses: In China, the bark of *Castanopsis cuspidata* (Thunb.) Schottky is used to treat ascite.

Common names: Japanese tanbark oak; *ita-shii* (Japanese)

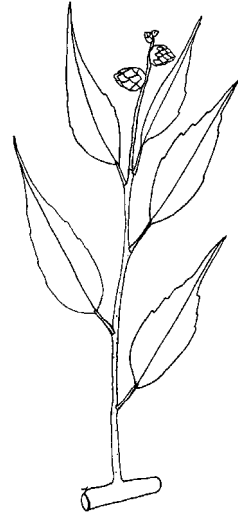


Fig. 53. *Castanopsis cuspidata* (Thunb.) Schottky. From: KLU Herbarium 21898. Ex. Herbario Kyotoensis. Flora of Japan. Botanical identification and field collectors: G. Murata & H. Tabata, 9 Aug 1974. Geographical localization: Ryuku (Pref. Okinawa). Isl. Iriomote: Shirahama. In evergreen forest near sea level.

Pharmaceutical interest: The pharmacological potential of *Castanopsis cuspidata* (Thunb.) Schottky would certainly be worth exploring as an expanding body of evidence, suggesting the genus *castanopsis* to abound with antimicrobial and cytotoxic principles.

Antimicrobial properties: Galloylshikimates and galloylquinates isolated from *Castanopsis hystrix* inhibit the enzymatic activity of Human Immunodeficiency Virus type-1 reverse-transcriptase (Chang CW *et al.*, 1995). The seeds of *Castanopsis chinensis* elaborate a 30 KDa protein (20 mg/10 Kg of seeds) which alleviates *Botrytis cinerea*, *Fusarium oxysporum*, *Mycosphaerella arachidicola*, and *Phyalospora piricola*, with an IC₅₀ value of 0.5 mM against *Fusarium oxysporum*. This protein exhibits also a potent inhibitory activity on Human Immunodeficiency Virus type-1 reverse-transcriptase with IC₅₀ value of 1.6 μM

(Chu KT *et al.*, 2003). A root extract of *Castanopsis cf evansii* immobilizes brine shrimps at 100 mg/mL (Horgen FD *et al.*, 2001). A methanol extract of the stem and the root bark of *Castanopsis acuminatissima* shows a broad spectrum of antimicrobial activity (Khan MR *et al.*, 2001).

References

- Chang CW, *et al.* (1995) *Antiviral Res* **27**(4): 367–374.
 Chu KT, *et al.* (2003) *Biochem Biophys Res Commun* **301**(2): 364–370.
 Khan MR, *et al.* (2001) *Fitoterapia* **72**(2): 174–176.
 Horgen FD, *et al.* (2001) *Phytotherapy* **8**(1): 71–81.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Lithocarpus elegans (Bl.) Hatus. ex Soepadmo

[From Greek, *Lithos* = stone, *karpos* = fruit and from French, *elegant* = handsome]

Synonymy: *Lithocarpus spicata*
Rehd. & Wils.

Common names: *Mempening bangkas* (Malay).



Fig. 54. *Lithocarpus elegans* (Bl.) Hatus. ex Soepadmo. From: KLU Herbarium 006267. Flora of Malaya. Field collector: MED Poore, 5 Oct 1963. Geographical localization: Hill forest, edge of the road just west of the Gap, Mile 56. Botanical Identification: E Soepadmo IV.1968.

Physical description: It is a timber which grows to a height of 20 m. The plant grows in the secondary or degraded rainforest in the geographical areas spanning India, Vietnam and Indonesia. The bark is greenish-white and the inner bark light yellowish-brown. The sapwood is white. The wood is very hard and heavy. The stems are brown, lenticelled and smooth. Leaves: simple, spiral, and stipulate. The stipules are triangular to linear and deciduous. The petiole is 8 mm–1 cm long and somewhat swollen at the base. The blade is 9.8 cm × 4.7 cm–12 cm × 4.5 cm, and leathery. Both the apex and the base of the blade are acute. The margin is entire and wavy. The blade shows 10–12 pairs of secondary nerves. The inflorescences are stout, woody, and 16.5 cm–11 cm × 5 mm terminal spikes. The fruits are leathery, glossy and smooth 1.3 cm × 1.1 cm acorns. The cupules are rugose (Fig. 54).

Pharmaceutical interest: The pharmacological potential of this plant remains unexplored. However, note that the medicinal property mentioned above is most probably attributed to tannins which are astringent, precipitate proteins and therefore styptic. These tannins are probably responsible for the toxicity of the root and stem bark of *Lithocarpus sp.* 1 against *Plasmodium falciparum* cultured *in vitro* at a dose of 10 $\mu\text{g/mL}$ (Horgen FD *et al.*, 2001). A methanol extract of the leaves, stem and root barks of *Lithocarpus celebicus* inhibits the growth of a broad spectrum of bacteria (Khan MR *et al.*, 2001). Are tannins involved here again?. It will be interesting to learn whether more intensive future research on *Lithocarpus elegans* (Bl.) Hatus. ex Soepadmo will disclose any molecules of therapeutic interest.

Uses: In China, the fruits and the leaves of *Lithocarpus elegans* (Bl.) Hatus. ex Soepadmo are used to check menorrhagia.

References

- Horgen FD, *et al.* (2001) *Phytomedicine* **8**(1): 71–81.
Khan MR, *et al.* (2001) *Fitoterapia* **72**(6): 703–705.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Quercus acutissima Carruthers

[From Latin, *quercus* = the oak and *acutus* = sharpen]

Physical description: *Quercus acutissima* Carruthers is a tree native to China, Japan and Korea. It is widespread in temperate Asia and is even found in the US. The stems are greyish, lenticelled, and hairy. Leaves: simple, spiral and stipulate.

Common name: Sawtooth oak; *kunugi* (Japanese).

Uses: In China, the acorns are astringent and used to treat diarrhea, flux, prolapse of the rectum, to promote resorption of tuberculous nodules and to check menorrhagia. In Korea, the acorns are used to stop diarrhea. The pharmacological properties of this plant are yet unveiled. Are tannins involved here?

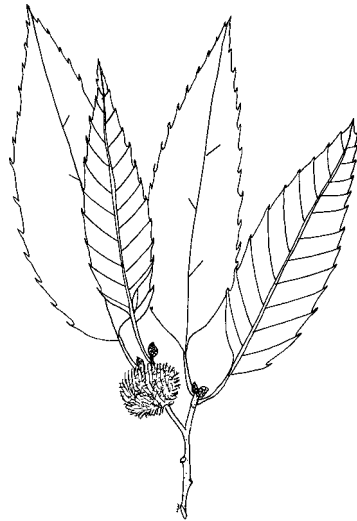


Fig. 55. *Quercus acutissima* Carruthers. From: KLU 043859. The Forest Herbarium (BKF), Royal Forest Department. Flora of Thailand. Field collector & botanical identification: D Bunpheng, 29 Sep 1949. Geographical localization Thailand, Northeast: Loei, Phu Krading.

The stipules are deciduous. The petiole is long and flat above. The surface of the blade is lanceolate, glabrous, except the midrib, 16 cm × 5 cm–4 cm × 11 cm and coriaceous. The base of the blade is asymmetrical and the apex is acute. The margin is conspicuously toothed, and each tooth is 3 mm long. The blade shows 3–6 pairs of secondary nerves with tufts of hairs near the margin. The inflorescences are spikes. The fruits are glossy acorns with fluffy involucre of 2.5 cm diameter (Fig. 55).

III. Subclass CARYOPHYLLIDAE Takhtajan 1966

The Caryophyllidae consists of 3 orders, 14 families and about 11 000 species of herbaceous plants. It developed some 70 million years ago from the subclass Magnoliidae, through the order Ranunculales and is considered quite a recent development, compared with the Magnoliidae, Hamamelidae, Dilleniidae and Rosidae (Appendix I). The gynecium of Caryophyllidae comprises of a finite number of carpels united to form an inferior ovary, where ovules are attached to free central or basal placentas. In the andrecium, the stamens are inserted in a centrifugal sequence. Common chemical weapons used by Caryophyllidae are *triterpenoid saponins*. Triterpenoids saponin are surface-acting agents which dissolve the cytoplasmic membrane of Eukaryotic cells and impede nutrition. Note that triterpenes resembling our own steroidal hormones have therefore the tendency to exert among other things anti-inflammatory and diuretic activities. Other interesting principles of Caryophyllidae are alkaloids, lectins, peptides and oligo- or polysaccharides. The triterpenoid saponins of Caryophyllales are historically of pharmaceutical value.

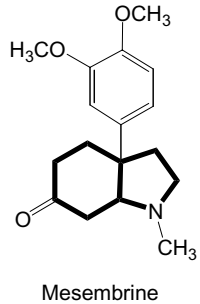
A. Order CARYOPHYLLALES Bentham & Hooker 1862

Nine-tenths of the species in Caryophyllidae belong to the single order Caryophyllales which consists of 12 families and about 10 000 species of herbs. An interesting feature of this order and particularly of *Phytolacca americana* L. (pokeweed) is the production of *ribosome-inactivating proteins* which have potent anti-HIV activities. Note that most Caryophyllales have evolved from the family Phytolaccaceae and are therefore disposed to produce such proteins. The very few alkaloids present in this order would be worth investigating.

1. Family AIZOACEAE Rudolphi 1830 *nom. conserv.*, the Fig — marigold Family

Physical description: The family Aizoaceae consists of about 2500 species and about 12 genera of succulent herbs, sometimes cactus-like, or less often shrubs or subshrubs known to abound with *triterpenoid saponins* and oxalic acid. The leaves are opposite, alternate, and without stipules. The

inflorescences are solitary or cymose. The flowers are perfect, and comprise of 3–8 sepals, and numerous petals in 1–6 whorls. The andrecium consists of 1–many stamens originating in a centrifugal sequence. The gynecium consists of 2–5 carpels united in a compound ovary. The fruits are loculicidal capsules.



Pharmaceutical interest: Many species of Aizoaceae are decorative and are cultivated as such. Some, notably from the genus *Mesembryanthemum*, have become naturalized in many parts of Europe. Examples of medicinal Aizoaceae are *Galenia africana* and *Sceletium tortuosum*, which are used in African indigenous medicine as a counter-irritant in the treatment of toothache. The counter-irritant property is due to crystals of oxalic acid which penetrate mucosa and skin. Oxalic acid is toxic. In the body, it combines with calcium ions to form calcium oxalate which precipitates in the kidneys. *Mesembryanthemum crystallinum* (ice plant) was considered a

sure treatment for venereal diseases by the early cowboys of western North America. Kanna or *Sceletium expansum* and *Sceletium tortuosum*, have been used by South African shamans from prehistoric times to “enhance animal spirits, sparkle the eyes, and to stimulate gaiety”. The active constituent of kanna is a serotonin-like alkaloid called mesembrine which is a potent serotonin uptake inhibitor. Hence, it has some potential for the treatment of anxiety and depression, but careful clinical trials must be performed. In the Asia-Pacific, *Tetragonia tetragonoides* (Pallas) O. Ktze. and *Trianthema portulacastrum* L. are of medicinal value.

***Tetragonia tetragonoides* (Pallas) O. Ktze.**

[From Greek, *tettares* = four and *gônos* = angled]

Physical description: It is a herb native to the Southern Hemisphere. It grows by the roads, along seashores and on the sea cliffs of the Pacific region, South America to Japan and Southeast China (including Norfolk and Lord Howe Islands), New Zealand, Australia, Tasmania, the Kermadec Islands, New Caledonia, Hawaii, and other Pacific Islands. It is widely naturalized in the temperate and subtropical parts of the world as an escape from cultivation. It is commonly found in California on sand dunes, bluffs, and the margins

Synonymy: *Tetragonia expansa* Murr.

Common names: New Zealand spinach, New England spinach, warrigal cabbage.

Uses: Most of the aborigine peoples of the southern part of Australia have been using *Tetragonia tetragonioides* (Pallas) O. Ktze. as a vegetable since the prehistoric times. They introduced it to the European explorers of the 17th century and it became the first Australian food plant to be cultivated overseas, the seeds being taken to Kew Gardens by Banks in 1771. Seeds were later distributed from Kew to Europe and North America. In Japan, a decoction of the dried plant is drunk to treat carcinoma ventriculi. The fresh plant is used to treat scurvy. The whole plant is used to heal stomach ulcers.

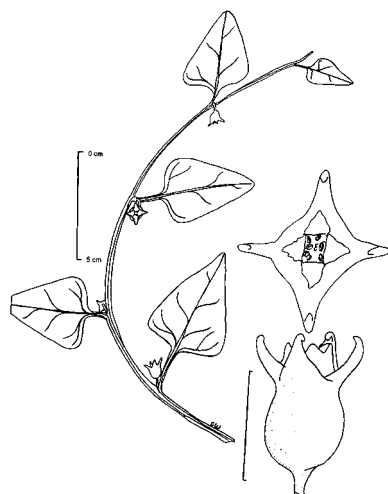


Fig. 56. *Tetragonia tetragonioides* (Pallas) O. Ktze.

of coastal wetlands below 100 m. The stems are succulent and glabrous.

Leaves: simple, without stipules, alternate and 6 cm × 2.5 cm–9 cm × 5 cm. The blade is deltoid and very thin, and the margin is slightly wavy. The apex of the blade is acute to round and the base is tapering towards the stem. The midrib is flat above and below the blade which shows about 4 pairs of discrete secondary nerves. The fruits are solitary, axillary, woody, 8 mm × 6 mm, and 4-angled (Fig. 56). Note that the plant is often misspelt as *Tetragonioides*.

Pharmaceutical interest: The antiulcer properties of *Tetragonia tetragonioides* (Pallas) O. Ktze. are attributed to cerebrosides and sterylglucosides (Okuyama E *et al.*, 1983, 1983a). A number of polysaccharides were isolated from this plant and their anti-inflammatory effects on carrageenan-induced edema and adjuvant arthritis were tested. Note that this plant is rich in vitamin C.

References

- Okuyama E, *et al.* (1983) *Chem Pharm Bull* **31**(7): 2209–2219.
 Okuyama E, *et al.* (1983a) *Yakugaku Zasshi* **103**(1): 43–48.

Warning: Caution must be taken since the toxic effects of this plant are unknown.

Trianthema portulacastrum L.

[From Greek, *treis* = three and *anthemon* = flower and from Latin, *portulacastrum* = portulaca-like]

Common name: Horse-purslane.

Physical description: It is a tropical herb which grows to a height of 1 m. The stems are glabrous and fleshy. Leaves: simple, opposite, without stipules and 3 cm–7 cm × 1.5 cm–4.5 cm. The petiole is 8 mm–2 cm long, sheathing at the base and channeled. The blade is 2 cm–4.4 cm × 1.5 cm–4.5 cm, orbicular and succulent. The apex is round or notched. The base is tapered and asymmetrical. The midrib is showy and flattened on both sides of the blade which shows 4–5 pairs of secondary nerves. The tertiary nerves form characteristic spiral patterns (Fig. 57).

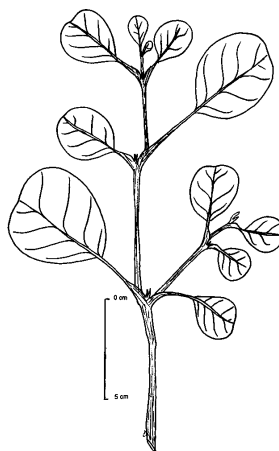
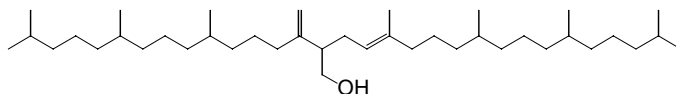


Fig. 57. *Trianthena portulacastrum* L.



Trianthenol 1

Pharmaceutical interest:

Hepatoprotective properties: Daily oral feeding with an ethanolic extract of this plant (150 mg/Kg) protects hepatocytes against carbon tetrachloride poisoning (Sarkar A. *et al.*, 1999). A chloroformic extract of *Trianthena portulacastrum* L. protects male Sprague-Dawley rats against L-diethylnitroso-amine-induced and phenobarbital-promoted hepatocarcinogenesis (Battacharya S *et al.*, 1999). These effects could be mediated by trianthenol 1, a carotenoid which was first isolated as antifungal principle (Nawar HR *et al.*, 2001).

Uses: The fresh or dried plant of the white variety of *Trianthena portulacastrum* L. (*Trianthena*, *Indian Pharmacopoeia*, 1967) is used in India to promote urination, in the form of a liquid extract (2 in 1, dose 2 mL to 8 mL). A decoction of the roots causes mild contraction of the uterus, but in large doses it is abortive. In the Philippines, a decoction of the roots is drunk to promote menses and to abort a pregnancy.

Other properties: This plant contains an alkaloid with similar properties to punarvanine from *Boerhaavia diffusa* (Family Nyctaginaceae; Basu *et al.*, 1947). The diuretic, uterotonic and abortive properties of this plant have not yet been substantiated experimentally.

References

- Basu, *et al.* (1947) *Quart J Pharm* **20**, **39**.
 Bhattacharya S, *et al.* (1999) *Neoplasma* **46**(2): 105–111.
 Nawaz HR, *et al.* (2001) *Phytochem* **56**(1): 99–102.
 Sarkar A, *et al.* (1999) *Cell Biol Int* **23**(10): 703–708.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family CACTACEAE A. L. de Jussieu 1789 *nom. conserv.*, the Cactus Family

Physical description: The family Cactaceae consists of 100 genera and about 2000 species of xerophytic plants native to South America which are thought to have originated from the family Phytolaccaceae. Cactaceae produce triterpenoid saponins, mucilages, simple tetrahydroisoquinoline and *phenethylamine alkaloids*. The stems are succulent with scarcely developed leaves. The flowers are solitary, hermaphrodite, large, and showy, and comprise of several sepals and stamens initiated in a centrifugal sequence. The gynecium consists of 3–several carpels united in an inferior and more or less partitioned ovary which encloses 3–several ovules attached to parietal placentas. The fruits are berries.



Pharmaceutical interest: Cactaceae of the genera *Carnegiea*, *Coryphanta*, *Marginatocereus* and *Lophophora* are known to produce epinephrine-like hallucinogen alkaloids. These are phenethylamine alkaloids derived from phenylalanine and tyrosine. *Lophophora williamsii* (*Echinocactus williamsii* (Lem. ex Salm-Dick) Coult.) or *peyote*, *peyotl*, *anhalonium* or mescal button, has been used by American shamans to cause hallucination. *Peyote* contains mescaline, the clinical properties of which are similar to those of lysergic acid diethylamide (Fig. 58). A few introduced Cactaceae species are used for medicinal purposes in Asia-Pacific, two of these are *Opuntia dillenii* (Ker — Gawl.) Haworth and *Pereskia bleo* DC.

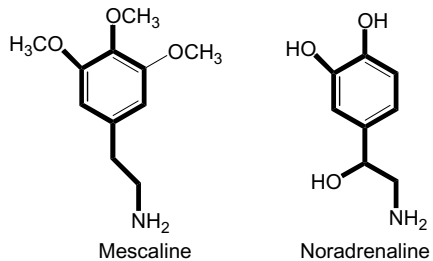


Fig. 58. Examples of neuroactive natural products characterized from the family Cactaceae. Note the similitude of chemical structure between mescaline and noradrenaline.

***Opuntia dillenii* (Ker — Gawl.) Haworth**

[From Greek, *opunte* = a city of ancient Greece and Johann Jacob Dillenius (1648–1747), a German botanist and Professor of Botany at Oxford]

Synonymy: *Cactus indicus* Roxb.

Common names: Prickly pear, slipper thorn; *kalazaw* (Burmese); *raquette*, figue de Barbarie (French); *palmatoria d'inferno* (Portuguese); *guda* (Sanskrit); *kalli* (Tamil).



Fig. 58. (a) *Opuntia dillenii* (Ker–Gawl.) Haworth.

Physical description: It is a shrubby cactus which grows to a height of 2 m. It is native to Central America. The plant is ornamental and cultivated as such throughout the tropics. The stems are 30 cm–40 cm × 15 cm–20 cm, broadly obovate, undulate, succulent, spiny and bluish. The leaves are 3.8 mm long, pale green, and conical. The areoles are large, and bear 4–6, 2.5 cm–3.8 cm prickles each. There are several 1.3 cm long yellowish glochidia. The flowers are 7.5 cm long, yellow, and tinged with orange. The perianth is rotate and reddish. The stamens are numerous and longer than the corolla. The style is stout, and there are 5–8 erect stigmas. The fruits consist of pyriform berries, which are truncate, depressed at the apex, deep reddish-purple when ripe and bearing tiny tufts of glochidia [Fig. 58(a)].

Pharmaceutical interest:

Anti-inflammatory and analgesic properties: A lyophilized aqueous extract of fruits protects rats against the paw edema formation induced by carrageenans and the pain caused by chemicals (writhing test) and heat (hot plate test), with doses ranging from 100 mg/Kg–400 mg/Kg, i.p. and 50 mg/Kg and 100 mg/Kg respectively (Loro JF *et al.*, 1999). Ethanolic

Uses: In China, the stems of *Opuntia dillenii* (Ker — Gawl.) Haworth are macerated in a little water or baked, and applied externally to heal deep-seated abscesses on the sole of the feet, and to soothe inflamed parts. In India, *Opuntia dillenii* (Ker — Gawl.) Haworth is used to relieve the bowels of costiveness, promote digestion, stop flatulence, treat fever and to resolve inflammation.

extracts of fruits and stems of *Opuntia ficus-indica* display interesting analgesic and anti-inflammatory properties experimentally (Park EH *et al.*, 1998). Oral administration of these extracts suppresses in rats acetic acid-induced writhing syndrome and carrageenan-induced paw-oedema. These extracts inhibit the migration of leukocytes, the release of β -glucuronidase by rat neutrophils and

protect the gastric mucosa. One might think that the anti-inflammatory and analgesic properties of *Opuntia dillenii* (Ker–Gawl) Haworth and *Opuntia ficus-indica* could be both mediated by flavonoids such as opuntioside I, 4-ethoxyl-6-hydroxymethyl- α -pyrone, and kaempferol 7-O- β -D-glucopyranosyl-(1 \rightarrow 4)- β -D-glucopyranoside (Qiu Y *et al.*, 2002) or mucilages.

Dietetic properties: Of particular interest in *Opuntia* species are neutral mucilages called glucomannans which impede the metabolism of sugars and lipids. This mucilages are possibly involved in the gastroregulator properties of *Opuntia dillenii* (Ker–Gawl) Haworth. The mucilages extracted from *Opuntia* species decrease the plasma concentration of low density lipoproteins in guinea-pigs fed with a hypercholesterolaemic diet (Fernandez ML *et al.*, 1992). A purified extract of *Opuntia fuliginosa* reduces to normal levels blood glucose and glycated hemoglobin values in streptozocin-induced diabetic rats (Trejo-Gonzalez A *et al.*, 1996). *Opuntia streptacantha* decreases significantly the hyperglycaemic peaks in healthy rabbits submitted moderately to subcutaneous glucose tolerance tests (Roman-Ramos R *et al.*, 1995). Commercial capsules of dried *Opuntia ficus* or *nopal* given to diabetic subjects fail to show significant hypoglycaemic effects (Fрати-Munani AC *et al.*, 1992).

In regard to the sugar metabolism, a number of experiments conducted in normal and diabetic subjects tend to demonstrate that the addition of neutral mucilages such as guar of *Cyamopsis tetragonolobus* (L.) Taub. (Fabaceae, p.) to the food ration decreases both blood sugar and postprandial insulinaemia. This effect would principally be on account of the high viscosity of these mucilages, which delay gastric emptying and reduce the rate of absorption of sugars in the intestine. In the case of lipid metabolism, the daily intake of guar, for example, decreases serum cholesterol and low density lipoproteins without notably affecting other lipoproteins and without decreasing blood triglycerides. Glucomannans of *Amorphophallus konjac* Koch. (Araceae, p.) have become available in the market (capsules, jelly) as adjunct in low-calorie diets and to control cholesterolaemia. Another example of a plant containing neutral mucilage is *Trigonella foenum graecum* L. (Fabaceae), the seeds of which are known for their antidiabetic, blood cholesterol-lowering, and blood lipid-lowering properties.

Antiviral properties: An extract of *Opuntia streptacantha* inhibits the replication of the Herpes Simplex Virus type 2, Equine Herpes Virus, Pseudorabies Virus, Influenza Virus, Respiratory Syncytial Virus and Human Immunodeficiency Virus (Ahmad A *et al.*, 1996).

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Pereskia bleo* DC**

[After the French astronomer Nicolas Claude Fabri de Peiresc (1580–1637) and from a local South American, *bleo* = *Pereskia bleo* DC]

Physical description: It is a spiny shrub which grows to a height of 2–8 m. It is native to South America and cultivated in several tropical countries for decorative and medicinal purposes. Leaves: simple, spiral, glossy and succulent. The petiole is 3 cm long. The blade is lanceolate and 6 cm–20 cm × 2 cm–7 cm. The areoles produce 0–5, 5 mm–1 cm long spines on young stems, and up to 40, 2 cm long spines for older stems. The flowers are 4 cm–6 cm, red or orange, terminal, grouped by 2–4 and showy. The fruits are 4 cm–5 cm in diameter, fleshy and glossy conical berries containing 6 mm–8 mm diameter seeds (Fig. 59).



Common name: Wax rose.

Uses: In Malaysia, *Pereskia bleo* is used internally to treat cancer.

Pharmaceutical interest: There is an expanding body of evidence to suggest that *Perecksia* species are of chemotherapeutic value. A methanolic extract of *Pereskia bleo* DC induce apoptosis in breast carcinoma, T47-D cell line (Tan ML *et al.*, 2005) and a



Fig. 59. *Pereskia bleo* DC.

methanol extract of *Pereskia corrugata* inhibits the growth of T-47D human breast carcinoma cell line cultured *in vitro* with an EC₅₀ value below 2 µg/mL and induces apoptosis, via activation of caspase-3 and c-myc pathway (Lan MT *et al.*, 2001). What are the principles involved here? Polysaccharides, flavonoid glycosides?

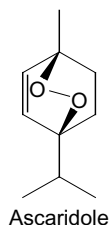
Reference

Tan ML, *et al.* (2005) *J Ethnopharmacol* **96**(1–2): 287–294.

3. Family CHENOPODIACEAE Ventenat 1799 *nom. conserv.*, the Goosefoot Family

Physical description: The family Chenopodiaceae consists of about 100 genera and 1500 species of annual or perennial, halophyte, and succulent herbs which are ubiquitously distributed and especially abundant in dry regions and coastal areas. Chenopodiaceae and Amaranthaceae have evolved side by side from the Phytolaccaceae and form a special group of small-flowered Caryophyllales. Chenopodiaceae accumulate *triterpenoid saponins*, oxalic acid and quite often free nitrate. The leaves in this family are thick, waxy, alternate or rarely opposite, simple and without stipules and often 3-lobed like a “foot of a goose”, hence the name of the family which comes from the Greek words *cheén* for goose and *pous* for foot. Flowers of Chenopodiaceae are very small, unisexual or hermaphrodite, and actinomorphic. The perianth comprises of 3–5 imbricate sepals often accrescent in fruits. The andrecium consists of 3–5 stamens which are free and facing the sepals. The gynecium consists of 2–5 carpels united to form a compound and unilocular superior ovary which encloses a single ovule. The fruits are very small nuts.

Pharmaceutical interest: Classical examples of Chenopodiaceae are *Spinacia oleracea* L. (spinach), *Beta vulgaris* L. (beetroot) and *Chenopodium ambrosioides* var. *anthelminticum*. The dried fruits of *Chenopodium ambrosioides* var. *anthelminticum* (Chenopodium, *British Pharmaceutical Codex*, 1949) and the oil obtained by steam distillation of fresh flowering and fruiting parts of *Chenopodium ambrosioides* var. *anthelminticum* (Chenopodium Oil, *British Pharmaceutical Codex*, 1959) containing not less than 65% w/w of the endoperoxidic monoterpene ascaridole have been used to expel roundworms. An interesting feature of Chenopodiaceae is their ability to produce a few indole alkaloids, the therapeutic potential of which is open for pharmacological exploration. One such alkaloid is dipterin from *Arthrophytum leptocladum* and *Girgensohnia dipter* which is well known for its antihypertensive property.



Beta vulgaris L., *Chenopodium album* L., *Chenopodium ambrosoides* L. var. *anthelminticum* and *Kochia scoparia* (L.) Schrad. are used for medicinal purposes in the Asia-Pacific. Note that most medicinal Chenopodiaceae owe their properties to saponins which are antiseptic and anti-inflammatory.

***Chenopodium album* L.**

[From Greek, *cheén* = goose and *pous* = foot and from Latin, *albus* = white]

Physical description: It is an invasive weed found in temperate countries, which grows to a height of 50 cm. The stems are glabrous, greenish and somewhat succulent. Leaves: simple, alternate and without stipules. The petiole is 1.5 cm–5 mm long, grooved and covered with microscopic cup-shaped scales. The blade is thick, 2.5 cm × 3.2 cm–1.8 cm × 7 mm, triangular, incised, and covered with microscopic cup-shaped scales. The base of the blade is acuminate, the midrib and secondary nerves are flat above and raised below, and the blade shows 3–5 pairs of secondary nerves. The inflorescences are axillary or terminal 2 cm long spikes. The flowers are 2 mm in diameter and comprise of 5 sepals, 5 stamens and a bifid style. The seeds are very small and black (Fig. 60).

Pharmaceutical interest: *Chenopodium album* L. contains saponins,

Uses: In Burma, a paste made from the root is used to stop diarrhea in children. In China, the seeds are eaten to expel intestinal worms and the juice of the fresh plant is applied externally to resolve sunburn. In Vietnam, the plant is used to treat putrefaction of the genitals.

Common names: Lamb's quarter, pigweed, all-good, fat hen, muck-weed; *chenopode sauvage* (French); *farinaccio* (Italian); *ceniglo blanco* (Spanish); *vastu* (Sanskrit).

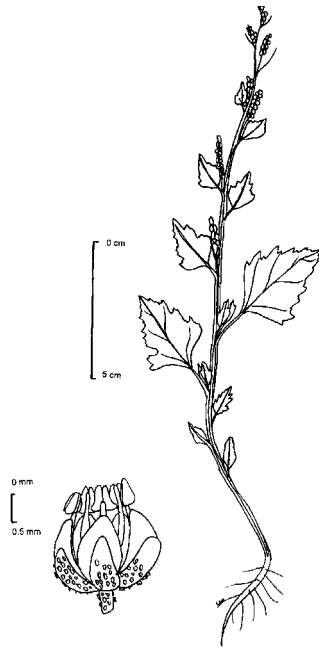
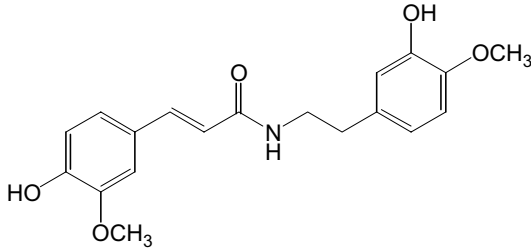


Fig. 60. *Chenopodium album* L. From: KLU Herbarium 15209. Geographical localization: Moss Side — Manchester (arable land, common) United Kingdom. Field collector & botanical identification: Wai Lu Lee, 2 Aug. 1971.

ascorbic acid (Guil JL *et al.*, 1997; Lavaud C *et al.*, 2000) and *N*-trans-feruloyl l-4-*O*-methyldopamine which shows attracting activity toward the spores of *Aphanomyces cochlioides*, a fungus pathogenic for *Chenopodium* species (Takeshi H *et al.*, 1993). An ethanol extract of the fruits of *Chenopodium album* L. given orally at doses of 100 mg/Kg–400 mg/Kg to mice dose-dependently inhibits itchiness induced by the subcutaneous injection of serotonin (Dai Y *et al.*, 2002).



N - trans - feruloyl - 4 - *O* - methyldopamine

References

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Warning: Chenopodiaceae accumulates toxic levels of nitrates when growing in fertilized lands. Cattle show ataxia, bluish-brown mucous membranes, rapid and difficult breathing, increased heart rates, tremors and coma after grazing hay containing 2500 ppm nitrate-nitrogen and 11 ppm nitrite nitrogen (Ozmen O *et al.*, 2003).

Kochia scoparia (L.) Schrader

[After Wilhelm Daniel Josef Koch, (1771–1849), German doctor and professor of botany and from Latin, *scoparius* = broom-like]

Physical description: It is a very dense, cypress-like bush which grows in the geographical zones spanning Central Asia and Japan. The stems are yellowish, glabrous, terete and ribbed. Leaves: simple, spiral, sessile, and without stipules. The blade is linear, glabrous, and small. The margin is entire.

Common names: Summer cypress, fire weed; fireball, Mexican firewood, *ti fu* (Chinese).

The blade shows a single pair of secondary nerves visible from below only. The flowers are small and yellow (Fig. 61).

Uses: In China and Japan, the seeds of *Kochia scoparia* (L.) Schrader are eaten to promote urination, to invigorate health, and to treat scurvy, impotency, gonorrhoea and kidney problems. A decoction of *Kochia scoparia* (L.) Schrader is drunk to counteract putrefaction and to promote urination. The aerial parts are used to treat digestive disorders.



Fig. 61. *Kochia scoparia* (L.) Schrader. From: KLU Herbarium 22097. Field Collector: G Murata. Geographical localization: Honshu, Pref. Hyogo: Oshio, Himeji-shi, seaside, Japan, 31 Oct 1971.

Pharmaceutical interest:

Anti-inflammatory and analgesic properties: The dried fruits of *Kochia scoparia* (L.) Schrader inhibit humoral immunity in experimental models of type I-IV allergy on account of an oleanolic saponin, momordicin Ic, which is also able to inhibit glucose and ethanol absorption in rats (Matsuda H *et al.*, 1997; Yoshikama M *et al.*, 1997). An extract of seeds displays peripheral antinociceptive effects (Matsuda H *et al.*, 1997a) and kochianosides I-IV are antiprurigen (Yoshikama M *et al.*, 1997a).

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Warning: *Kochia scoparia* (L.) Schrader like *Chenopodium album* L. has the tendency to accumulate high levels of nitrates when grown in fertilized lands. This results in pulmonary edema, hepatic necrosis, and kidney, epidermal and cerebral necrosis, as well as lacrimation, depression, anorexia, nystagmus, recumbency, episthotonos and death in cattle (Dickie CW *et al.*, 1979).

4. Family AMARANTHACEAE A. L. de Jussieu 1789 nom. conserv., the Amaranth Family

Physical description: The family Amaranthaceae consists of about 70 genera and 800 species of tropical herbs containing *triterpenoid saponins*. Leaves in Amaranthaceae are simple, without stipules, alternate or opposite, serrate or entire. The flowers are very small, without petals, and packed in spikes, racemes or panicles. The perianth consists of a few free and very thin sepals facing a few stamens, the filaments of which are united at the base in a cup or tube. The gynecium consists of 2–3 carpels united to form a 1-celled and superior ovary, containing 1–2 ovules attached to a basal placenta. The stigma is capitate, or bifid or trifid. The fruits are very small utricles, alkenes or capsules.



Pharmaceutical interest: Common examples of Amaranthaceae are *Celosia cristata* L. and *Amaranthus blitum* L. which are ornamental and palatable respectively. In the Asia-Pacific, Amaranthaceae are not only important for providing vegetables but also for providing about 20 species of medicinal plants used to resolve inflammation, stop dysentery, counteract putrefaction, promote urination, facilitate parturition and to check bleeding. Being occulted often, the family Amaranthaceae, however, offers an interesting field of pharmacological research and therapeutic developments. Of particular interest are oligosaccharides of possible chemotherapeutic value.

***Achyranthes aspera* L.**

[From Greek, *achyr* = barb, *anthe* = flower and from Latin, *asper* = rough]

Physical description: It is a tropical, upright, hairy, and branched herb which grows up to a height of 1.8 m in villages, orchards and sandy dunes. Leaves: simple, without stipules and 1.25 cm–4 cm × 1.5 cm–7.5 cm. The blade is more or less hairy and broadly elliptic. The petiole is 5 mm–1.25 cm long. The flowers are packed in 7 cm long, reddish-white, hairy, and terminal spikes. The flowers consist of 5 narrow, pointed and 5 mm long green sepals. The andrecium consists of 5 stamens which are joined at the base around the

Synonymy: *Pupalia genulata*,
Achyranthes indica.

Common names: Prickly chaff flower; *herbe d'Inde* (French); *ara songsang*, *nyarang* (Malay); *kivalamon* (Burmese); *nieou si* (Chinese); *adhoghanta* (among 30 others Sanskrit names); *unga*, *chichira*, *atkumah*, *latjira* (Indian).

ovary into a fringed cup. The fruits are cylindrical utricle containing black and glossy ellipsoid seeds (Fig. 62).

Pharmaceutical interest:

Antimicrobial properties: In regard to the antiseptic properties mentioned above, a number of experiments conducted *in vitro* and *in vivo* demonstrate that *Achyranthes aspera* L. is antimicrobial on account of at least 3 groups of probably synergistic series secondary metabolites: terpenes, alkaloids and phenolic compounds. The essential oil extracted from the shoots inhibits moderately the proliferation of *Aspergillus carneus* (minimum inhibiting concentration = 3000 ppm; Misra TN *et al.*, 1992). The seeds of *Achyranthes aspera* L contain a number of oleanolic triterpenoid saponins which inhibit the proliferation of *Bacillus subtilis*, *Escherichia coli* and *Salmonella typhimurium* (Sushil K *et al.*, 1997). Aporphinoid alkaloids from the stems inhibit the proliferation of *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Shigella dysenteriae* (Rahman RH *et al.*, 1996). A decoction of *Achyranthes aspera* L. is effective (30 mL twice daily) in the treatment of subacute and mild type reactions in leprosy patients (Ojha D *et al.*, 1966).

Steroidal properties: One might set up the hypothesis that the anti-inflammatory and diuretic properties of *Achyranthes aspera* L. involve a corticosteroid-based mechanism of action. In physiological conditions, corticosteroids are transferred to their cell

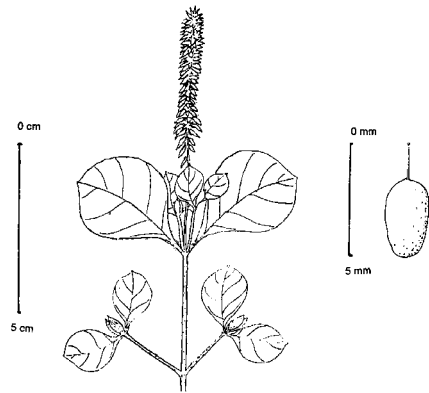


Fig. 62. *Achyranthes aspera* L.

Uses: In Indonesia, a paste of *Achyranthes aspera* L. mixed with the bark of *Alyxia stellata* (Roem.) et Schult. and the fruits of *Foeniculum vulgare* Gaertn. is applied to the body to treat convulsion. A decoction of this mixture is drunk to stop dysentery. *Achyranthes aspera* L is used to promote urination and it is an astringent remedy. In Malaysia, *Achyranthes aspera* L. is used to resolve inflamed parts, lower blood pressure and to counteract infection of the urinary tract. In the Solomon Islands, a paste made from the powdered leaves is applied to boils and the roots are used to treat swollen legs. In Vietnam, roasted leaves are used externally to heal burns and an infusion of the roots is ingested to mitigate colic. In India, a decoction of *Achyranthes aspera* L. (1 in 15; dose 30 mL to 60 mL) is drunk to promote urination and the seeds are eaten to treat piles. The white variety of *Achyranthes aspera* L. is said to be more efficient against piles, ascite and dysentery whereas the red variety is preferred for ulcers.

targets, in plasma, bound to a corticosteroid-binding globulin. Unbound or free corticosteroids enter the target-cells and bind to a cytoplasmic corticosteroid receptor. The dimer corticosteroid-receptor enters then the nucleus and binds to a DNA binding receptor and stimulates therefore the synthesis of specific proteins with physiological properties. A number of plant triterpenoids and steroids share with human steroid a cyclopentanoperhydrophenanthrene skeleton and are thereby able to interfere with the manifold physiological activities of steroidal hormones, hence exhibiting anti-inflammatory, diuretic, hypoglycaemic, estrogen antagonist, and abortifacient properties (Pakrashi A *et al.*, 1977; Wadhwa V *et al.*, 1986; Figs. 63–64). Normal and alloxan-induced diabetic rabbits fed with *Achyranthes aspera* L. or aqueous and methanolic extracts, develop a dose-dependent hypoglycaemia at doses of 2 g/Kg, 3 g/Kg, and 4 g/Kg (Akhtar MS *et al.*, 1991). The anti-inflammatory property of *Achyranthes aspera* L. could be on account of an inhibition of phospholipase A₂ activity through lipocortine, the synthesis of which is physiologically monitored by corticosteroids. The diuretic property of *Achyranthes aspera* L. may be attributed to an inhibition of the corticosteroid-induced synthesis of Na⁺-pumps of the distal nephron and collecting duct-cells. Finally, the hypoglycemic property of *Achyranthes aspera* L. may be on account of an inhibition of the liver corticoid-induced glucose synthesis, and in peripheral tissues, corticosteroid-induced decrease of glucose intake.

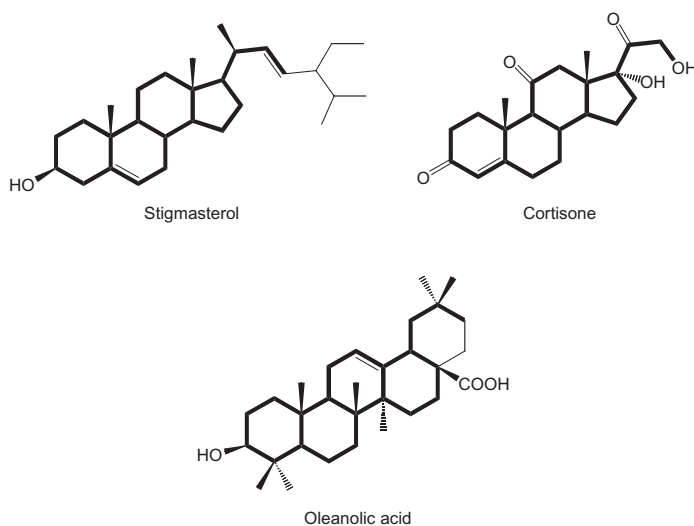


Fig. 63. Note the similitude of chemical structure of plant steroids (stigmasterol), cortisone and plant triterpenes (oleanolic acid).

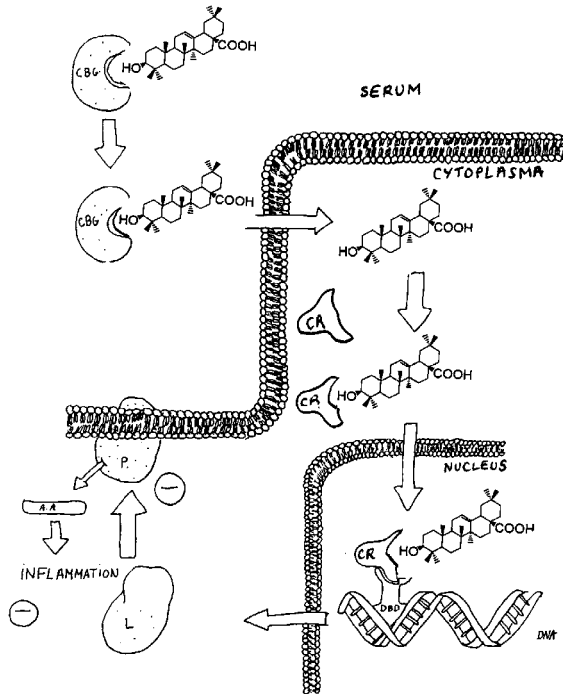


Fig. 64. Oleanolic acid (T) binds to corticosteroid-binding globulin (CBG), corticosteroid receptor (CR) or DNA-binding domain (DBD). Anti-inflammatory effect: stimulation of the synthesis of lipocortine (L) and therefore inhibition of phospholipase A_2 (P).

Antitumor properties: A methanolic extract of *Achyranthes aspera* L. inhibits the early expression by Raji cells of Epstein-Barr Virus (EBV) antigen induced by 12-*O*-tetradecanoylphorbol-13-acetate (TPA) and displays an anticarcinogenic property *in vivo* (Chakraborty A *et al.*, 2002). What is the active principle involved here?

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Achyranthes bidentata* Bl.**

[From Greek, *achyr* = barb, *anthe* = flower and from Latin, *bi* = two and *dentatus* = with teeth]

Physical description: It is a slender and perennial herb which grows to a height of 1 m. It is found in moist and shady grounds in India, Southeast Asia, China and Japan. The stems are quadrangular and pubescent, and develop regular large knee-shaped nodes, hence the common name of the plant. Leaves: simple, without stipules, opposite, 5 cm–12 cm × 3 cm–5 cm, acuminate, and tomentose on both surfaces. The inflorescences are terminal or axillary of 2 cm–10 cm long spikes with hairy pedicels, and ovate-oblong bracts with a ciliate margin. Each flower shows a pair of 2 bracteoles which are hairy, as long as the perianth, and 4 mm–5 mm long. The andrecium consists of 5 stamens. The fruits are utracles which are 3 mm in diameter (Fig. 65).

Synonymy: *Achyranthes mollicula*.

Common names: Ox knee; *niu xi* (Chinese).

Pharmaceutical interest: *Achyranthes bidentata* Bl. contains a series of oleanolic saponins which are probably responsible for the anti-inflammatory, diuretic and expectorant properties mentioned above. Note that ecdysterones characterized from *Achyranthes bidentata* Bl. promote the proliferation of osteoblast-like cells cultured *in vitro* (Gao XY *et al.*, 2000). *Achyranthes bidentata* Bl. is also known to produce emodin and physcion, which are laxative anthraquinones (Bishit G *et al.*, 1993). Other natural products characterized from this herb are

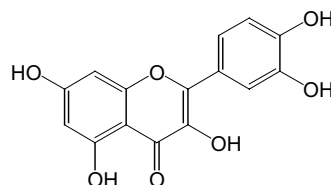
Uses: *Achyranthes bidentata* Bl. is used to promote urination and expectatory resolve inflamed parts and as an astringent remedy. In Indonesia, chewing the fresh leaves with *Areca catechu* treats malignant mouth ulcers. In Malaysia, *Achyranthes bidentata* Bl. is used to treat extreme anemia. In Vietnam, the roots are chewed to promote salivation. The roots of *Achyranthes bidentata* Bl. are included in the *Japanese Pharmacopoeia* (dose 5 g to 8 g as a decoction).



Fig. 65. *Achyranthes bidentata* Bl.

flavonoids glycosides: quercetin 3-*O*-rutinoside, quercetin 3-*O*-glucoside, kaempferol 3-*O*-glucoside, and caffeic acid (Nikolov S *et al.*, 1995), which abound in antimicrobial, anti-inflammatory, free radicals scavenger properties and cytotoxic properties.

Cytotoxic and antiviral properties: A methyl ester of achyranthoside characterized from *Achyranthes faurieri* inhibits the proliferation of human colon carcinoma (IC₅₀ = 5.2 μM) and murine melanoma (IC₅₀ = 8.2 μM) cell-lines (Ida Y *et al.*, 1994). Of recent interest is a series of polysaccharides, characterized from the roots of *Achyranthes bidentata* Bl. which inhibit the proliferation of sarcoma-180 cells and prolong



Quercetin

the survival of Ehrlich carcinoma-bearing mice, by enhancing both specific and non-specific immunological responses (Xiang DB *et al.*, 1993). An extract of *Achyranthes bidentata* Bl. causes the early expression of the Epstein-Barr (EBV) antigen in Raji cell-line (Zeng Y *et al.*, 1994). Polysaccharides characterized from *Achyranthes bidentata* Bl. display anti-Herpes Simplex Virus 1 property *in vitro* and immunomodulatory effects (Li ZK *et al.*, 1997; Zheng M *et al.*, 1997). It will be interesting to know whether further investigation on oligosaccharides from Amaranthaceae will disclose any anti-viral molecule of therapeutic value.

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Alternanthera sessilis (L.) R. Br.

[From Latin, *alternus* = every other and from Greek, *anthos* = flower and Latin *sessilis* = attached directly by the base]

Physical description: It is an annual tropical herb with 20 cm–50 cm long, prostrate and many branched stems. The nodes are covered with long white

Synonymy: *Alternanthera nodiflora* R. Br., *Telanthera amoena* R. Br., *Gomphrena sessilis*.

Common names: Carpet-weed; *rumpot aur*, *keremah bukit*, *kerumuk* (Malay); *pounanganni* (Tamil); *horngtyang wu* (Taiwanese).

hairs, and the internodes with a pair of longitudinal whorls of hairs. Leaves: 2 cm–6 cm, obtuse at the apex, remotely crenate and sessile. The inflorescences are axillary, globose and sessile white heads, with very small bracts and bracteoles. The flowers comprise of a 5-lobed perianth, each lobe is 2 mm–2.5 mm long and glabrous, consisting of 3 stamens and a few staminodes, hence the name of the genera. The fruits are obcordate and of obtusely margined utricles (Fig. 66).

Pharmaceutical interest:

Hepatoprotective property: The hepatoprotective property of *Alternanthera sessilis* (L.) R. Br. is substantiated in rodent poisoned experimentally with carbon tetrachloride (31.25 μ L/Kg, i.p.), paracetamol (600 mg/Kg, i.p.) and β -D-galactosamine (188 mg/Kg). In all the cases, the ingestion of the plant (300 mg/Kg) lowers the elevation of the serum levels of glutamate oxalic acetic transaminase [aspartate aminotransferase] (SGOT) and glutamate pyruvic acid transaminase [alanine aminotransferase] (SGPT) enzymatic activities, as well as improve the histopathological diagnosis of liver tissues (Lin SC *et al.*, 1994). Although the natural products responsible for the hepatoprotective property of *Alternanthera sessilis* (L.) R. Br. are yet unknown, one must think of choline, which has been characterized from the South American medicinal *Alternanthera pugens* (De Ruiz REL, 1993). As a matter of fact, choline is one of the B-complex vitamins essential for the metabolism of fats in the liver. Combined deficiency of choline and other methyl group donors cause hepatic cirrhosis. Choline is a precursor of methionine, used to counteract paracetamol poisoning.

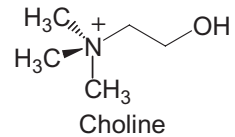
Cholinergic property: An aqueous extract of whole *Alternanthera pugens* contracts dose-dependently isolated portions of rabbit duodenum and



Fig. 66. *Alternanthera sessilis* (L.) R. Br.

Uses: In Indonesia: a decoction of *Alternanthera sessilis* (L.) R. Br. is drunk to stop dysentery and diarrhea. In Malaysia, the plant is used to heal wounds and applied to painful areas. A decoction of 30 g of the whole plant is drunk by Malays to stop dysentery, relieve the bowels of costiveness, treat jaundice, fever, urinary tract infection, tuberculosis and peptic ulcer, resolve sore throat and intestinal inflammation, and to mitigate toothache. In Taiwan, *Alternanthera sessilis* (L.) R. Br. is used to treat kidney diseases and haemoptysis, and to fight depression.

increases the mobility of gastrointestinal muscles in mice on possible account of choline (Garcia SB *et al.*, 1995). Choline is the precursor of acetylcholine, a neurotransmitter synthesized in the cholinergic nerve terminals by choline acetyltransferase. The binding of acetylcholine, released by presynaptic membranes to the muscarinic-receptors of the gastrointestinal smooth muscles, commands contraction, peristalsis of the smooth muscle and release of the gastric juice. An ethanolic extract of *Alternanthera pugens*, given to rats, displays a diuretic property comparable to the commercial furosemide (Lasix®; Calderon CP *et al.*, 1997).



Antiviral property: Amaranthaceae have attracted a great deal of interest because of their antiviral properties which are probably due to polysaccharides. An aqueous extract of *Alternanthera philoxeroides* inhibits the proliferation of the Human Immunodeficiency Virus (Zhang SM *et al.*, 1988) and the proliferation of the Haemorrhagic Fever Virus (Yang ZQ *et al.*, 1989). *Alternanthera brasiliiana*, *Alternanthera ficoidea* and *Amaranthus spinosus* L. inhibit the proliferation of the Aujeszky Virus in IB-RS-2 pig cell-line and the proliferation of the Bovine Diarrhea Virus in GBK bovine cell-lines (Koseki I *et al.*, 1990). An aqueous extract of *Alternanthera brasiliiana* inhibits the proliferation of the Herpes Simplex Virus *in vitro* (Lagrota MHC *et al.*, 1994).

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Aerva lanata (L.) Juss.

[From Arabic, *erwa* = *Aerva lanata* (L.) Juss. and from Latin, *lanatus* = woolly]

Physical description: It is a common tropical herb which grows to a height of 90 cm. The stems are terete and woolly. Leaves: simple, alternate, without stipules, and 1.8 cm–4 cm × 3 cm–4 mm. The blade is elliptic, obovate, obtuse or

Synonymy: *Achyranthes lanata* L.;
Aerva floribunda Wight.

Common names: Wool plant;
astmabayada (Sanskrit); *sirupulai*
 (Tamil).

acute, entire, pubescent above, and more or less woolly beneath. The petiole is short. The flowers are white or greenish and packed in small, dense, axillary, and woolly 5 mm–1 cm long heads or spikes, forming globose clusters. In these heads, the bracteoles are ovate and very small. The perianth consists of woolly, small and oblong sepals. The stamens are united into a tube with interposed staminodes shorter than the filaments, and the ovary is subglobose, and develops upward into a very small style and 2 stigmas. The fruits are very small utricle, containing a few sub-reniform, black, smooth and glossy seeds (Fig. 67).



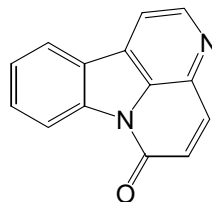
Fig. 67. *Aerva lanata* (L.) Juss.

Pharmaceutical interest: The anti-inflammatory and antidiabetes properties of *Aerva lanata* (L.) Juss. mentioned above are probably due to saponins or flavonoids glycosides. An aqueous extract and the fresh juice expressed from *Aerva lanata* (L.) Juss. inhibits carrageenan-induced edema in rodent (Amin KMY *et al.*, 1994) and an ethanolic extract of the plant protects rodent against alloxan poisoning (Vetrichelvan T *et al.*, 2002).

Uses: In Indonesia, an infusion of *Aerva lanata* (L.) Juss. is used to treat sudden swollen areas. In the Philippines, an infusion of *Aerva lanata* (L.) Juss. is drunk to promote urination and to treat gonorrhoea. In India, healers use *Aerva lanata* (L.) Juss. to treat renal and prostate ailments, as well as diabetes.

Of particular interest is canthine-6-one, characterized from *Aerva lanata* (L.) Juss., which may contribute to the antimicrobial and antitumoral properties displayed by a crude methanolic extract of this herb (Chowdhury D *et al.*, 2002; Zapesochayaya GG *et al.*, 1997). The presence of canthine-6-one in this plant is somewhat surprising and should stimulate further research on the psychotropic potential. Note that canthine-6-one is known to occur in members of the order Sapindales (Subclass Rosidae).

Narcissin (isorhamnetin-3-rutinoside), aervitrin (isohamnetin-3-rhamnosyl rutinoside), and a small amount of ecdysterone were characterized from *Aerva lanata* (L.) Juss. (Baltaev VA *et al.*, 1992; Pervykh LN *et al.*, 1992).



Canthine-6-one

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Warning: Caution must be taken as the pharmacological potential of this plant is unknown.

Amaranthus spinosus L.

[From Greek, *amarantos* = everlasting and *anthos* = flower and from Latin, *spina* = thorn]

Physical description: It is a tropical, invasive and prickly herb which grows to a height of 1 m. The stems are succulent and ribbed. Leaves: simple, 2 cm–8 cm × 6 mm–4 cm, without stipules and with 1 cm–2 cm long thin prickles in the leaf axis. The petiole is long and thin. The blade is oblong and oval, blunt at the apex with a very small hair-like top, and a narrow base. The flowers are very small and arranged in dense axillary or terminal spikes, developing sharply pointed bracts as long as, or longer than the 5 perianth lobes. The andrecium consists of 5 stamens. The fruits are very small and contain a few glossy dark seeds (Fig. 68).

Pharmaceutical interest: The pharmacological potential of *Amaranthus spinosus* L. remains unknown, although a host of evidence suggests that *Amaranthus* plants are likely to hold antiviral and anticancer properties.

Amaranthus spinosus L., *Alternanthera brasiliensis* and *Alternanthera*

Common names: Prickly amaranth, prickly blite, prickly pigweed; *amaranthe epineuse*, *blette epineuse*, *brede malabar* (French); *mullukkirai* (Tamil); *hinnu nwe subank* (Burmese); *alpamarisha* (Sanskrit); *phti ach mon* (Cambodian), *bayam berduri* (Malay).

Uses: In the Asia-Pacific, *Amaranthus spinosus* L. is principally used internally to promote urination. In Cambodia, the roots are used to treat rheumatism and fever, and these are added to mustard plasters to treat uterine tumors. In Indonesia, the roots of *Amaranthus spinosus* L. are used to stimulate menses and its crushed leaves are used to heal festering wounds. In Malaysia, *Amaranthus spinosus* L. is used to promote urination whereas a decoction of the roots is drunk to promote expectoration and to stimulate menses. The leaves are used internally to treat bronchitis and externally to heal boils. In the Philippines, its crushed leaves are applied to eczematous areas. In Vietnam, *Amaranthus spinosus* L. is used to promote milk secretion and urination and a poultice of the powdered leaves is applied to heal dog bites. In India, the roots of *Amaranthus spinosus* L. are used to treat gonorrhoea, menorrhagia and eczema.

ficoidea inhibit consistently the proliferation of the Aujeszky Virus in IB-RS-2 pig cell-line and the proliferation of the Bovine Diarrhea virus in GBK bovine cell-line (Koseki I *et al.*, 1990). An aqueous extract of *Amaranthus spinosus* L. contracts isolated rat uterine smooth muscles (Aye Tan *et al.*, 1995). An extract of *Amaranthus cruentus* inhibits the proliferation of colon and gastric carcinoma cells (Lee J *et al.*, 1996). Wistar albino rats fed with the seeds of *Amaranthus aesculentus* develop hypocholesterolaemia (Chaturvedi A *et al.*, 1993). Note that triterpenoid saponins may be responsible for medicinal properties of *Amaranthus spinosus* L. (see *Achyranthes aspera*).



Fig. 68. *Amaranthus spinosus* L.

An interesting feature of *Amaranthus* species is that they contain cysteine-enriched antifungal proteins (Cammue BPA *et al.*, 1993) and antimicrobial chitin-binding proteins (Bole MFC *et al.*, 1993). A number of glycoproteins (lectins) are useful tools in antigen-based diagnostic techniques. For example, amaranthine, a lectin characterized from *Amaranthus caudatus*, binds to the Thomsen-Friedemreich antigens which indicate foci of abnormal proliferation in familial colorectal cancer syndrome (Boland CR *et al.*, 1991).

References

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Warning: *Amaranthus spinosus* L. is edible and sold in Asian markets instead of spinach, but it causes anorexia, weight loss, diarrhea, petechiae, digestive hemorrhage and renal failure, if grown in highly nitrate fertilized lands (Lemos RA *et al.*, 1993).

Celosia argentea L.

[From Greek, *kelos* = burned and from Latin, *argentum* = silver]

Physical description: It is an annual tropical herb which grows to a height of 1 m in drains, vacant plots and by the roadside. The stems are terete and the upper part is often branched. Leaves: simple, 5 cm–8 cm × 1 cm–3 cm, alternate, and without stipules. The blade is lanceolate, ovate and sessile or not. The

Synonymy: *Celosia argentea*, *Celosia cristata*.

Common names: Wild cockscomb, Bombay yellow gold; *cresta de gallo*, *borlas* (Spanish); *barhichuda* (Sanskrit); *bayam* (Malay); *kyetmonk* (Burmese); *chi kuan* (Chinese); *palonpalongan* (Filipino).

apex is acute or acuminate, and the base is attenuate. The inflorescences are terminal and pinkish or white, 5 cm–8 cm × 1 cm–2.5 cm spikes. The flowers are 8 mm–10 mm × 2 mm, and comprise of a perianth of 5 lanceolate lobes and 5 stamens. The fruits are globose, and the circumscissile utricles containing a few black glossy seeds (Fig. 69).

Pharmaceutical interest:

Diuretic properties: Ethanol extracts of leaves and seeds inhibit the growth of bacterial burn pathogens cultured *in vitro* (Gnanamani A *et al.*, 2003), protect rodents against alloxan poisoning (Vetrichelvan T *et al.*, 2002) and promote urination in rodents as efficiently as hydrochlorothiazide (5 mg/Kg) standard. The seeds of *Celosia argentea* L. given per os (4 g) to 10 healthy human volunteers (male, 33–35 years old), increase significantly the secretion of urine (57%; Shah MB *et al.*, 1993).

Celosian: Of particular interest is the fact that an aqueous extract of seeds of *Celosia argentea* L. given intraperitoneally to animals infected with colon 26-L5 carcinoma cells, reduces significantly liver metastasis through the induction of cytokins (Hayakawa Y *et al.*, 1998). From this extract was characterized the celosian, which is an immunostimulating and hepatoprotector acidic polysaccharide. Celosian inhibits the elevation of GPT, GOT and bilirubin in carbon tetrachloride-induced liver injury in rats and suppresses mortality on fulminant hepatitis caused



Fig. 69. *Celosia argentea* L.



by β -D-galactosamine/lipopolysaccharide or caused by *Propionibacterium acnes* (LP5) in mice. Dose-dependent protection against chemical and immunological hepatitis is observed (Hase K *et al.*, 1996). Celosian stimulates the production of tumor necrosis factor α (TNF α), 1β and nitric oxide in macrophage cell-line (1774-1) in a concentration-dependent manner, and promotes the secretion of interleukin 1β in human mononuclear cells. Celosian enhances the production of interferon γ by concavalin A in mouse spleen cells (Hase K *et al.*, 1997).

Other pharmacological properties: The plant is also interesting because it produces a series of cyclic peptides, including celogentin A–C, and K which inhibit the polymerization of tubulin (Kobayashi J *et al.*, 2001; Suzuki *et al.*, 2004). The aerial part of *Celosia argentea* L. abound with flavonoids which may participate in the anti-inflammatory properties mentioned above. An extract of *Celosia argentea* L. examined on anti-DNP antibody response in mice suppresses the secretion of IgE antibody in certain allergic disorders (Imago K *et al.*, 1994). An aqueous extract of *Celosia argentea* L. displays an uterotonic property on isolated portions of rabbit and guinea-pig uterine horns (Shipochliev T, 1981).

Uses: *Celosia argentea* L. is used to treat hematological and gynecologic diseases, to resolve inflammation and to counteract putrefaction. In Indonesia, the flowering tops are used to check bleeding of the lungs. In Malaysia, a decoction of the red flowering tops is drunk to check white discharges, dysentery, bleeding of the mouth and nose, piles, to regulate menses, and to remove blood and proteins from urine. The whole plant is used to stop dysentery, regulate urination, heal broken bones, wounds and abscesses, and to resolve swollen parts. A paste made from the seeds is used to heal broken bones. The seeds are used to treat conjunctivitis and to lower blood pressure. In Cambodia, Laos and Vietnam, a lotion made from the seeds is applied to soothe the inflamed eyes. In China, the seeds are used to stop hemorrhage and menorrhagia, and to treat ophthalmia. In India, the seeds are eaten to treat diabetes.

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Cyathula prostrata* (L.) Bl.**

[From Greek, *cyathos* = a cup and from Latin, *sternere* = lay flat]

Synonymy: *Achyranthes prostrata* L.,
Pupalia prostrata Mart.

Common names: *Cyathula*; *mata kura* (Cook Islands); *tolomo'unga* (Tonga); *yaa phannguu daeng* (Thai); *dayang* (Filipino).

Uses: In China, the stems and leaves are used to relieve the bowels of costiveness. In Indonesia, the plant is used to treat cholera, fever, and bowel looseness. In Malaysia, the plant is applied externally to expel intestinal worms and to treat some skin affections. In the Philippines, the plant is used to facilitate digestion. In Taiwan, a decoction of the leaves is used to wash snake bites, and the roots are used to treat rheumatism, liver problems, dysentery, fever and dropsy.

Physical description: It is a prostrate and hairy herb which grows to a height of 1 m in a geographical zone spanning Africa, China, Australia and the Pacific Islands. The stems are round, articulate and swollen at the nodes. Leaves: opposite, without stipules, and 6.5 cm × 2.5 cm–2 cm × 8 cm. The blade is lanceolate, asymmetrical, 5 cm–2.5 cm × 1.5 cm–8 mm and the margin is entire and slightly wavy. The midrib is raised above and below, and the blade shows 5–6 pairs of secondary nerves. The inflorescences consist of terminal 2 mm long spikes of scaly flowers (Fig. 70).

Pharmaceutical interest: The medicinal properties of *Cyathula prostrata* (L.) Bl. remain unexplored. Note that this plant would be worth studying as a fructan of the graminan type characterized from *Cyathula officinalis* Kuan inhibits the growth of Lewis pulmonary carcinoma implanted in mice (Chen XM *et al.*, 2003).



Fig. 70. *Cyathula prostrata* (L.) Bl.

Reference

Chen XM, *et al.* (2003) *Carbohydr Res* **338**(11): 1235–1241.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Deeringia amaranthoides* (Lamk.) Merr.**

[After Georg Karl Deering, an English doctor, and from Latin, *amaranthoides* = amaranth-like]

Uses: In Indonesia, the juice squeezed from the roots is used as an ingredient of a mixture which is sniffed to clear congested nasal cavities. The leaves are used to treat inflamed sores and chicken pox maturations. In the Philippines, a decoction of the leaves is drunk to treat dysentery. In the Solomon Islands, the sap expressed from the plant is used to counteract skin putrefaction in pigs. The therapeutic potential of this plant is still yet to be discovered. A number of oleanolic saponins were characterized from the fruits (Sati OP *et al.*, 1990) and might be involved in the medicinal properties of this plant.

Synonymy: *Achyranthes amaranthoides* Lamk., *Deeringia baccata* Moq., *Digera arvensis* Forssk.

Common names: Deeringia.

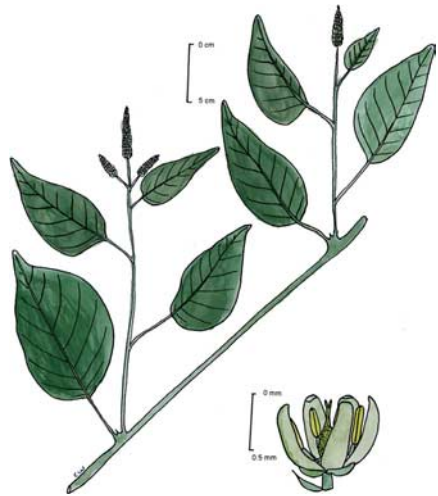


Fig. 71. *Deeringia amaranthoides* (Lamk.) Merr.

Physical description: It is a sprawling shrub which grows in the geographical zone spanning India to the Pacific Islands. The stems are terete and smooth. Leaves: simple, spiral, 3.5 cm × 2 cm–16 cm × 7 cm and without stipules. The petiole is 1.7 cm–4 cm long and thin. The blade is papery, asymmetric and 3.8 cm–2.2 cm × 6 cm × 12.5 cm. The apex is somewhat acuminate, the base is acute and asymmetrical and the margin is entire or serrulate. The midrib is sunken above and raised below, and the blade shows 4–8 pairs of secondary nerves. The inflorescences are terminal spikes. The flowers are very small and comprise of 5 bracts, 5 stamens and a pyriform gynoecium. The fruits are juicy, red and glossy (Fig. 71).

Reference

Sati OP, *et al.* (1990) *J Nat Prod* **53**(2): 466–469.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Gomphrena globosa* L.**

[From Latin, *gomphaena* = amaranth and *globulus* = globe]

Physical description: It is an ornamental, hairy and upright herb native to South America which grows to a height of 30 cm in several tropical countries. Leaves: opposite, simple, without stipules and 5 cm–10 cm long. The flowers are small and compressed into globose and terminal heads of 2.5 cm–4 cm in diameter, comprising of several rose, pink or white magenta bracts. The flowers consist of 5 lanceolate, acuminate and woolly sepals. The fruits are indehiscent utricles containing 1 round seed (Fig. 72).

Pharmaceutical interest: The therapeutic potential of *Gomphrena globosa* L. is still waiting to be discovered and would be worth assessing as a number of experiments conducted *in vitro* tend to demonstrate antimicrobial, molluscicidal and cytotoxic properties from the *Gomphrena* species.

Cytotoxic properties: A crude petroleum ether fraction of *Gomphrena martiana* and *Gomphrena boliviana*, two plants traditionally used in Argentina to treat cancer, inhibit the proliferation of sarcoma-180 tumors in mice (Pomilio AB *et al.*, 1991). The active principle of *Gomphrena martiana* is a lipophilic 5, 6, 7-trisubstituted flavone (Pomilio AB *et al.*, 1994) which also inhibits *Mycobacterium phlei* proliferation *in vitro* (Pomilio AB *et al.*, 1992).

Antimicrobial properties: An aqueous extract of *Gomphrena celosioides* inhibits the proliferation of *Staphylococcus aureus*, *Streptococcus pyogenes*, *Escherichia coli*, *Salmonella thyphi*, *Shigella dysenteriae*, *Pseudomonas aeruginosa* and *Candida albicans* cultured *in vitro* (Souza de C *et al.*, 1993). An extract of the roots of *Gomphrena macrocephala* inhibits the proliferation of adult snails of *Biomphalaria glabrata* (Yamamoto MM *et al.*, 1996). Recent investigations on *Gomphrena globosa* indicate the presence of saponins in

Common names: Globe amaranth, bachelor's buttons; *bunga butang* (Malay).



Fig. 72. *Gomphrena globosa* L.

Uses: In Malaysia, a decoction of the flowers of *Gomphrena globosa* L. is drunk to treat asthma, bronchitis and leucorrhea, check hemorrhage and nocturnal weeping of children and to soothe sore eyes. The fresh plant is boiled or macerated and applied to traumatic injuries and pyoderma.

the seeds which inhibit significantly ($IC_{50} = 3.5 \mu\text{g/mL}$) the formation of interleukin6 by osteoblastic cells (MC3T3-E10) without cytotoxicity *in vitro*. This property could be useful for the treatment of chronic rheumatoid arthritis, infection, cancer inflammation and osteoporosis.

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

5. Family MOLLUGINACEAE Hutchinson 1926, *nom. conserv.*, the Carpet - weed Family

Physical description: The family Molluginaceae consists of about 13 genera and nearly 100 species of herbs found mainly in tropical and subtropical regions. This family and the family Caryophyllaceae are very close to each other and have both evolved from a ranunculaceous ancestor. Both Molluginaceae and Caryophyllaceae are strongly hypogynous with distinct sepals and petals, and abound with triterpenoid saponins. The leaves of Molluginaceae are simple, opposite, alternate or whorled, with or without stipules. The inflorescences are cymes of little flowers which are hermaphrodite and regular. The flowers comprise of 4–5 sepals, persistent and free, and small petals. The andrecium comprises of 2–10 stamens, the filaments of which are free or variously connate at the base, and the anthers of which are tetrasporangiate, dithecal and open by longitudinal slits. The gynecium consists of 2–5 carpels which are united to form a compound, superior ovary with a distinct style. The ovary encloses a single to many ovules which are attached to axillary placentas. The fruits are capsules opening loculicidally or by transverse slits, are rarely indehiscent and commonly surrounded by a persistent calyx. The seeds are kidney-shaped and arillate.

Pharmaceutical interest: It will be interesting to learn whether or not more intensive future research will disclose any molecules of therapeutic interest from Molluginaceae. Most of the medicinal Molluginaceae used in the Asia-Pacific are part of the genus *Mollugo*: *Mollugo pentaphylla* L. (*Mollugo stricta* L.), *Mollugo hirta* Thunb. (*Glinus lotoides* L.), and *Mollugo oppositifolia* L. (*Glinus oppositifolius* (L.) A. DC., the properties of which are often attributed to saponins.

***Mollugo pentaphylla* L.**

[From Latin, *Mollugo* = an old name for the genus *Galium*, and from Greek, *pente* = five and *phullon* = leaf]

Synonymy: *Mollugo stricta* L.

Common name: Mollugo, Indian chickweed.

Physical description: It is an annual tiny weed found in the sandy coasts of China, Malaysia, Japan, Korea, China Solomon Islands and India, which grows to a height of 30 cm. Leaves: simple, 7 mm × 1.5 cm and whorled in groups of 2–5 at nodes. The petiole is indistinct, and the blade is the lanceolate and very thin. The flowers are very small, whitish and arranged in terminal or axillary inflorescences. The fruits are dehiscent capsules of 2 mm diameter with persistent sepals, containing black, 0.5 mm diameter kidney-shaped and microscopically muricate seeds (Fig. 73).

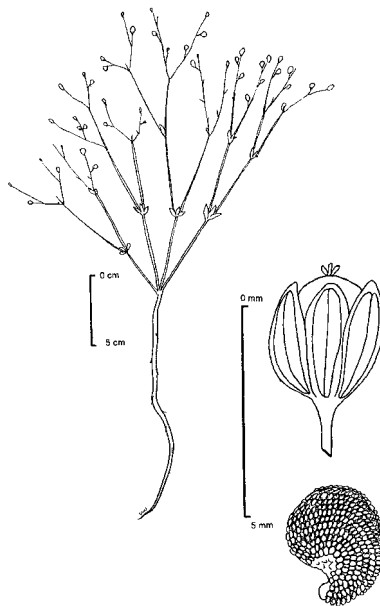
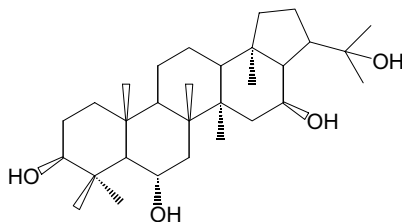


Fig. 73. *Mollugo pentaphylla* L.

Pharmaceutical interest:

One might set up the hypothesis that the healing properties mentioned above could be attributed to pentacyclic triterpenes. One such terpene is mollugogenol A, characterized from the aerial part of *Mollugo pentaphylla* L. as

Uses: In China, the plant is used to promote appetite and to treat eye diseases. In Malaysia, a paste of *Mollugo pentaphylla* L. is used to heal sores. In the Solomon Islands, the plant is burned to make smoke that repel mosquitoes.



Mollugogenol A

an antifungal principle, on account of the membrane damage as observed in spermatozoids (Hamburger M *et al.*, 1989, Rajasekaran M *et al.*, 1993). Other natural products characterized from *Mollugo pentaphylla* L. are flavones (Chopin J *et al.*, 1982; Jha OP *et al.*, 1984)

References

- Chopin J, *et al.* (1982) *Phytochem* **21**(9): 2367–2370.
Hamburger M, *et al.* (1989) *Phytochem* **28**(6): 1767–1768.
Jha OP, *et al.* (1984) *J Indian Chem Soc* **61**: 193–194.
Rajasekaran M, *et al.* (1993) *Contraception* **47**(4): 401–412.

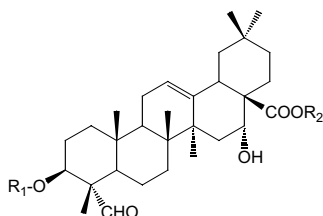
Warning: Caution must be taken as the toxic effects of this plant are unknown.

6. Family CARYOPHYLLACEAE A. L. de Jussieu 1789 *nom. conserv.*, the Pink Family

The Caryophyllaceae is a large family which consists of about 75 genera and 2000 species of cosmopolitan, annual or perennial herbs which abound with *pentacyclic triterpenoid saponins*. Caryophyllaceae are easily recognized in a field collection by their heart-shaped interpetiolar internodes. The leaves of Caryophyllaceae are simple and opposite, with stipules or without stipules. The flowers are actinomorphic, hypogynous, bisexual and commonly arranged in dichasial cymes or are solitary. The calyx comprises of 5 sepals which are free or form a tube. The corolla, if present, comprises of 5 petals. The andrecium consists of 5–10 stamens arranged in 1 or 2 whorls, with free filaments and tetrasporangiate and dithecal anthers opening by longitudinal slits. The gynecium is made of 2–5 carpels, forming a superior, sessile or shortly stipitate, single-celled or imperfectly divided ovary containing a central placenta, and developed upwards into free or connate styles. The fruits are dehiscent capsules opening by valves or apical teeth. The seeds are finely punctuated and curved.

Pharmaceutical interest: Belonging to the family Caryophyllaceae are a large number of herbs cultivated for decorative purposes such as *Dianthus barbatus* L. (pink, sweet William), *Gypsophila elegans* Bieb. (baby's breath, gypsophila) and *Dianthus caryophyllus* L. (carnation). Classical medicinal Caryophyllaceae are *Saponaria officinalis* L. (soapwort, bouncing bet, Fuller's herb), *Quillaja saponaria* Molina and *Gypsophila paniculata* (maiden's breath).

A decoction of the dried root of *Saponaria officinalis* L. (1 in 29; dose 15 mL–30 mL) has been used in Western medicine to promote expectoration and urination. *Quillaja saponaria* Molina. is occasionally used to make shampoo and is known to inhibit the intestinal absorption of cholesterol. Most medicinal Caryophyllaceae owe their properties to triterpenoid saponins, which are surface-acting agents and quite often irritating for mucosa. More interesting



R1: glucuronic acid, xylose, galactose

R2: fucose, acyl, xylose, apiose, rhamnose, glucose

Pentacyclic triterpenoid saponins of Caryophyllaceae: *Quillaja* saponin

are the hormonal potency of saponins aglycones and the immunomodulating and even antiviral property of a number of oligosaccharides or polysaccharides characterized from them. Nearly 30 species of Caryophyllaceae are used for medicinal purposes in the Asia-Pacific. Most of these are used internally to check hemorrhages, deurate, treat fever, promote milk secretion, abortion, delivery, urination and menses, and externally to remove malignant sores and to counteract putrefaction.

***Drymaria cordata* Willd.**

[From Latin, *cordis* = heart]

Physical description: It is an annual invasive weed native to Central America which grows to a height of 90 cm in damp shaded sites, often near streams or under shrubs, and other open fields. The stems are straggling, sometimes sub-scandent, angled, usually rooting at the lower nodes and hairy toward inflorescence. Leaves: simple and opposite. The stip-

Synonymy: *Holosteum cordatum* L.; *Drymaria cordata* subsp. *diandra* (Blume) J. A. Duke; *Drymaria diandra* Blume.

Common names: *Drymaria*, West Indian chickweed, tropical chickweed, whitesnow; *mourron blanc* (French); *pipili*, *pilipili* (Hawaii); *he lian dou cao* (Chinese).

ules are membranous, splitting into a few whitish setae. The petiole is 1 mm–2 mm long and channeled. The blade is papery, 1.2 cm × 2.5 cm–1.6 cm × 9 mm, glabrous, and kidney-shaped to cordate. The midrib is raised below. The blade shows 2 pairs of secondary nerves. The apex of the blade is round or obscurely acuminate, and the margin is entire. The inflorescences are cymose and the flower pedicels are 3 mm–5 mm long and covered with whitish hairs. The flowers are small and white. The calyx comprises of 5, 3-veined, glandular sepals which are lanceolate ovate, 2 mm–3.5 mm long and hairy. The corolla consists of 5 lanceolate, 2.5 mm long petals which

are deeply bifid and pure white. The andrecium comprises of 2–5 stamens which are shorter than the sepals. The gynecium consists of 3 styles connate at the base and is greenish yellow. The fruits are capsular, 2 mm–3 mm long, 3-valved and contain several dark brown, suborbicular, 1.5 mm long and regularly densely tuberculate seeds (Fig. 74).

Pharmaceutical interest: A methanol extract of *Drymaria cordata* Willd. displays a significant antitussive activity in a sulphur-dioxide cough-induced experiment, as efficiently as codeine phosphate (Mukherjee PK *et al.*, 1997). Note that this plant contains saponins and cyclic peptides (Yuan AX *et al.*, 1987; Ding Z *et al.*, 2000), the former being probably responsible for the antitussive property. It will be interesting to learn whether more intensive future research on the cyclic peptides of *Drymaria cordata* Willd will disclose any molecules of chemotherapeutic interest.

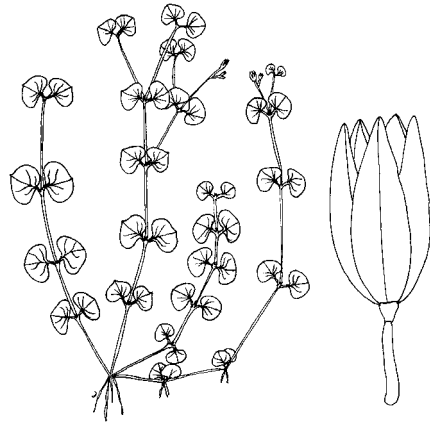


Fig. 74. *Drymaria cordata* Willd.
From: KLU Herbarium 21641. Field collector & botanical identification: J. B. Lowry, 30 Nov 1974. Geographical localization: Boh Tea Estate, Cameron Highlands, Malaysia.

Uses: In Indonesia, a paste made from the aerial part of *Drymaria cordata* Willd. mixed with lime is applied externally to counteract skin putrefaction. Indonesians drink the juice expressed from this plant to relieve the bowels of constiveness and to treat fever. In Papua New Guinea, *Drymaria cordata* Willd. is used to invigorate health. In Taiwan, a paste made from the aerial parts is applied externally to counteract snake-poisoning.

References

- Ding Z, *et al.* (2000) *Planta Med* **66**(4): 386–388.
Mukherjee PK, *et al.* (1997) *J Ethnopharmacol* **56**(1): 77–80.
Yuan AX, *et al.* (1987) *Chung Yao Tung Pao* **12**(1): 36–37.

Warning: Irritant and possibly allergenic properties have been ascribed to saponins in members of Caryophyllaceae. The toxic effects of this herb are unknown and its consumption is therefore hazardous.

***Polycarpaea corymbosa* Lamk.**

[From Greek, *polus* = many, *karpos* = fruit and *korumbos* = cluster]

Synonymy: *Achyranthes corymbosa* L.

Common names: Old man's cap; *pai t'ou weng*; *bai gu ding* (Chinese); *pak thow yoong* (Malay); *bhisatta* (Sanskrit); *nilaisedachi* (Tamil).

Physical description: It is a herb native to Africa which grows to a height of 45 cm. It is found throughout the tropics and subtropics, mostly on open, often moist, sandy soils, less often in grassy places on mountain slopes; from sea level to 1200 m. The stems are corymbose and slender, and the young ones are woolly. Leaves: simple, 8 mm–2 cm long, narrow linear and mucronate. The stipules are lanceolate, acute and single-nerved. The flowers are numerous and small, and arranged in dense, much branched, terminal cymes forming flat-topped heads. The pedicels of the flowers are woolly, and the bracts are 3 mm long, silvery-white, and bristle. The sepals are lanceolate, acute, 2 mm–4 mm long, scarious, membranous, hyaline, silvery-white, and much longer than both the petals and capsules. The petals are milky white or reddish, and broadly ovate. The andrecium consists of 5 stamens which are shorter than the petals. The gynecium comprises of a short style. The fruits are brown and ovoid capsules containing 5–13 glossy, flat and brown obscurely reticulate seeds which are 0.3 mm–0.5 mm in diameter (Fig. 75).

Uses: The inflorescences of *Polycarpaea corymbosa* Lamk. are sold in the Chinese pharmacies of Cambodia, Laos, Vietnam and Malaysia as an emollient and as astringent drugs. In India, *Polycarpaea corymbosa* Lamk. is used to treat strangury, urinary stones, inflammation, swollen parts and ulcers. Its ashes mixed with pepper is used to heal boils and ulcers (Ayurveda). Its pounded leaves are applied to boils and inflamed parts. The therapeutic potential of *Polycarpaea corymbosa* Lamk. remains unexplored.

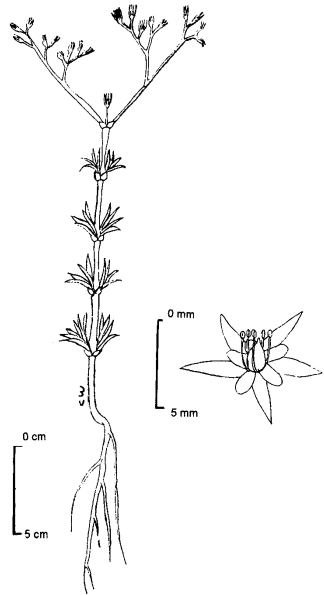


Fig. 75. *Polycarpaea corymbosa* Lamk.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Saponaria vaccaria* L.**

[From Latin, *saponaria* = soapy and *vaccaria* = cow herb]

Physical description: It is an annual herb which grows to a height of 60 cm. It is found in temperate and subtropical countries. The stems are somewhat pubescent. Leaves: 2.5 cm–6.3 cm × 6 mm–2 cm, sessile, and glabrous. The lower ones are oblong-acute and the upper ones are oblong-lanceolate, very acute and mucronate. The flowers are arranged in corymbose cymes with 2.5 cm–5 cm long pedicels and foliaceous bracts. The calyx is 1.2 cm long, ventricose in fruit, 5-nerved, scarious, and develops 5 teeth. The petals are rosy, obovate, and slightly emarginate. The claw of each petal is shortly exerted, and the limb is 1.2 cm long. The fruits are broadly ovoid capsules. The seeds are globose, black, and granulate.

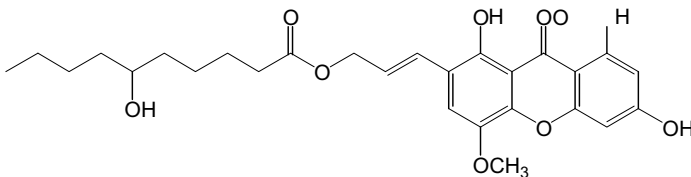
Synonymy: *Vaccaria pyramidata* Medic., *Saponaria perfoliata* Roxb., *Gypsophila vaccaria*.

Common names: Cow herb, cow cockle, soapwort, perfoliate soapwort; *gafis* (Arabic); *wang pu liu hsing* (Chinese); *blé de vache, copatte, saponaire à vache* (French); *cetino* (Italian); *vuong bat lieu hank* (Cambodia, Laos, Vietnamese).

Pharmaceutical interest:

Xanthenes: To date, the pharmacological potential of *Saponaria vaccaria* L. is unknown but the plant contains a xanthone called vaccaxanthone. Xanthenes, have attracted a great deal of interest on account of their antifungal, antibacterial, platelet aggregation inhibitors, anti-inflammatory and anti-Human Immunodeficiency Virus properties as well as their ability to inhibit the enzymatic activity of monoamine oxidase (MAO A and to a lesser extent of MAO B). What are the pharmacological properties of vaccaxanthone?

Uses: *Saponaria vaccaria* L. is used by the Chinese to heal furuncles and wounds, soothe inflamed parts, and to check bleeding. In Cambodia, Laos and Vietnam, *Saponaria vaccaria* L. is used to expel impurities. In India, *Saponaria vaccaria* L. is used to reduce spleen enlargement, regulate menses, heal ulcers, and to soothe inflamed parts and irritated skin. The juice expressed from the plant is used to treat fever and to invigorate health.



Vaccaxanthone

Antitumor properties: Of particular interest are cytotoxic ribosome-inactivating glycoproteins characterized from *Saponaria* species. Examples of such glycoproteins are saporin 6 and pyramidatine (Gasperi-Campani A *et al.*, 1991; Tecce R *et al.*, 1991). The seeds of *Saponaria vaccaria* L. contain pyramidatine, which is able to bind covalently to the anti-epidermal growth factor receptor monoclonal antibodies, and therefore inhibit significantly the proliferation of grafted human tumor cells in *nude* mice (Di Massimo AM *et al.*, 1997).

References

- Di Massimo AM, *et al.* (1997) *Br J Cancer* **75** (6): 822–828.
 Gasperi-Campani A, *et al.* (1991) *Anticancer Res* **11**(2): 1007–1011.
 Tecce R, *et al.* (1991) *Melanoma Res* **1**(2): 115–123.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Silene aprica Turcz.

[From Latin, *Silenus* = the foster father of Bacchus and *aprica* = sunny]

Synonymy: *Melandrium apricum* Rohrb., *Melandrium firmum* Rohrb.

Common names: Sunward silene.

Physical description: It is a herb which grows to a height of 60 cm. It is found in Japan, China and Korea. The stems are terete and pubescent at the nodes, and brownish-yellow. Leaves: simple, opposite and without stipules. The blade is sessile, lanceolate-linear, sheathing at the base, recurved and obscurely ciliate at the margin, and shows a midrib sunken above and raised below, and a few indistinct pairs of secondary nerves. The inflorescences are axillary and terminal cymes of 1 cm × 5 mm flowers. The calyx is tubular, very thin and 5-lobed. The corolla comprises of 5 petals. The fruits are dehiscent capsules embedded in the very thin persistent calyx and contain a few 0.5 mm long, muricate and black seeds (Fig. 76).

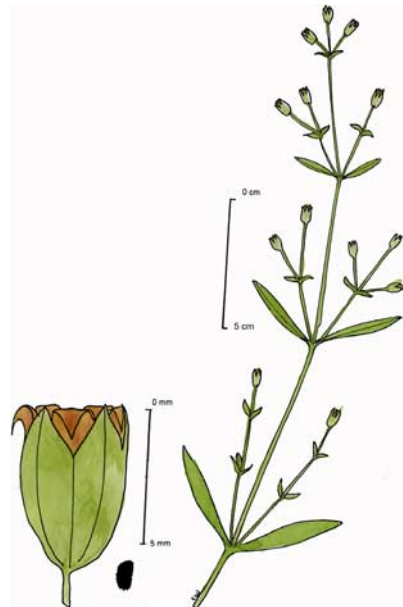


Fig. 76. *Silene aprica* Turcz.

From: KLU Herbarium 22534. Field collector & botanical identification: Tashiro, 16 May 1920. Geographical localization: Japan, Kyushu, Kagoshima Pref.: Kajiki.

Pharmaceutical interest: One might set up the hypothesis that the medicinal properties mentioned above are attributed to triterpenoid saponins of the oleanane type which abound in the plant (Glensk M *et al.*, 1999; Saatov Z *et al.*, 1990). *Silene* species are interesting

Uses: In China, *Silene aprica* Turcz. is used to normalize blood circulation and to treat gonorrhoea. In Korea, the plant is used to promote urination, and to treat breast cancer and of lactation problems.

because of their immunostimulating properties. Triterpene saponins characterized from *Silene fortunei* and *Silene jensiseensis* enhance granulocyte phagocytosis *in vitro* (Lacaille-Dubois MA *et al.*, 1997; 1999) and polysaccharides from *Silene vulgaris* boost the immune system (Popov SV *et al.*, 1999). Note that an infusion of *Silene saxifraga* is beneficial on urolithiasis in rats (Grases F *et al.*, 1994). A 50% ethanol extract of *Silene aprica* protects the liver of rats against carbon tetrachloride- and acetaminophen-induced injuries (Ko YJ *et al.*, 2002). Is choline involved here?

References

- Glensk M, *et al.* (1999) *J Nat Prod* **62**(5): 717–721.
 Grases F, *et al.* (1994) *Int Urology Nephrology* **26**(5): 507–511.
 Ko YJ, *et al.* (2002) *Am J Chin Med* **30**(2–3): 235–43.
 Popov SV, *et al.* (1999) *International J Immunopharmacol* **21**(9): 617–624.
 Saatov Z, *et al.* (1990) *Khim Prim Soedin* **26**(4): 405–407.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

C. Order POLYGONALES Lindley 1833

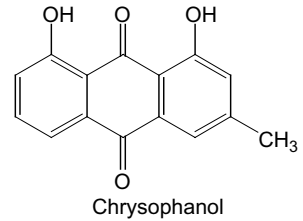
The order Polygonales consists of a single family: the family Polygonaceae.

1. Family POLYGONACEAE A. L. de Jussieu 1789 *nom. conserv.*, the Buckwheat Family

Physical description: This large North Temperate family consists of about 30 genera and 1000 species of rhizomatous succulent, tanniferous and bitter-tasting herbs, commonly producing *tannins*, oxalic acid, flavonoids and *anthraquinone glycosides*. Polygonaceae are easily recognizable in the fields by their stipules which are well-developed and united into a sheath or ochrea which surrounds the stems. The stems are often hollow, zigzag-shaped, reddish, tabbed and juicy. The leaves of Polygonaceae are simple, stipulate, often aristate, soft and alternate. The flowers are very small, hermaphrodite or unisexual, and actinomorphic. The perianth consists of 2–6 tepals arranged in 1–several whorls. The andrecium comprises of 2–9 stamens principally

arranged in 2–3 whorls, and the anthers are 2-celled and open lengthwise. The gynecium consists of 2–4, but principally 3 carpels united into a compound and 1-celled ovary, often triangular, which is attached to a nectary disc. The ovary develops upward 2–4, free styles and contains a solitary, basal and orthotopous ovule. The fruits are trigonous achenes containing a starchy seed.

Pharmaceutical interest: Classical examples of Polygonaceae are *Fagopyrum esculentum* Moench. (buckwheat, *blé noir*), which is used in Brittany (France) to make delicious flat cakes, and *Rheum raphaniticum* L. (garden rhubarb). A striking feature of Polygonaceae is the presence of both anthraquinone glycosides and tannins, the preponderancy of which will result in either laxative or/and antidiarrheal properties. For instance, the rhizomes of *Rheum palmatum* L. var. *tanquticum* Maxim. and *Rheum officinale* H. Bn. are laxative but in small doses the same rhizomes can stop diarrhea. *Polygonum bistorta* L., a tanniferous Polygonaceae, is used to stop diarrhea in Western medicine. Anthraquinone glycosides are laxative because they irritate the bowels and inhibit the active transfer of ions through the intestinal membranes. Anthraquinone glycosides decrease the resorption of water, sodium ions and chlorine ions by blockade of the sodium/potassium ATPase. Of recent interest is the discovery of resveratrol, a phenolic substance with chemopreventive properties in the *Polygonum* roots. In the Asia-Pacific, about 30 plant species of Polygonaceae are of medicinal value, mostly used to stop diarrhea, relieve bowels of costiveness, to expel intestinal worms, regulate menses, reduce liver discomfort, treat fever and skin infection, soothe inflammation and to invigorate health.



***Polygonum barbatum* L.**

[From Greek, *polus* = many and *gonos* = angled, and from Latin, *barbatus* = bearded]

Physical description: It is a perennial aquatic herb which grows to a height of 90 cm. It is found by the streamside, in wet areas, besides water and in the swamps of China, Taiwan, Bhutan, India, Myanmar, Nepal, the Philippines, Indonesia and Malaysia, from sea level to 1300 m. The stems grow from a rhizome, are reddish, pubescent, bitter and

Synonymy: *Pericardia barbata* (Linnaeus) H. Hara; *Pericardia omerostroma* (Ohki) Sasaki; *Polygonum kotoshoense* K. Ohki; *Polygonum omerostromum* Ohki.

Common names: Knotweed; *tebok seludang* (Malay); *mao liao* (Chinese).

sweet-sour-tasting. Leaves: simple, alternate and stipulate. The ochrea is tubular, 1.5 cm–2 cm long, membranous, and densely hispidulous. The petiole is 5 mm–8 mm long and densely hispidulous. The blade is lanceolate or elliptic-lanceolate, 7 cm–15 cm × 1.5 cm–4 cm, and pubescent. The base of the blade is cuneate, the margin is ciliate, and the apex is acuminate. The inflorescences are terminal, spicate, erect, 4 cm–8 cm, and comprise of several spikes aggregated like panicles. The flowers are small and comprise of a white or greenish perianth made of 5 elliptic 1.5 mm–2 mm long lobes. The andrecium consists of 5–8 pinkish stamens. The gynecium comprises of 3 styles and a few capitate stigmas. The fruits are black, ovoid, trigonous, 1.5 mm–2 mm long shiny achenes included in the perianth (Fig. 77).

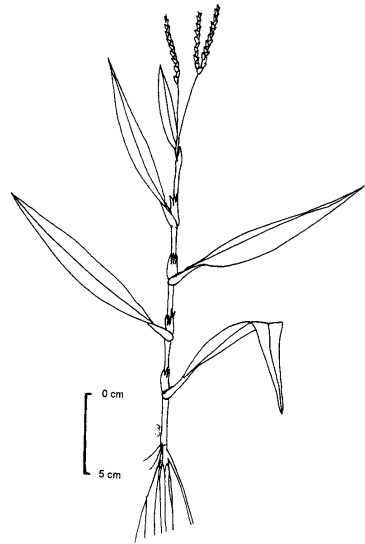


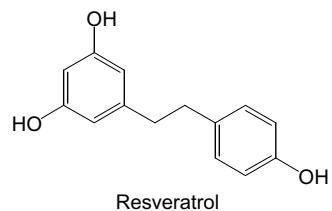
Fig. 77. *Polygonum barbatum* L.

Pharmaceutical interest:

Anti-inflammatory properties: An aqueous extract of *Polygonum punctatum* given orally at 300 mg/Kg–600 mg/Kg to rats inhibits carrageenan-induced oedema (Simoes CM *et al.*, 1989). This activity might be mediated by tannins or even resveratrol, characterized later from *Polygonum sp.*, which inhibit experimentally the enzymatic activity of rat polymorphonuclear leukocytes lipoxygenase and cyclo-oxygenase (Kimura Y *et al.*, 1985). Inhibitors of lipoxygenase and cyclo-oxygenase, key enzymes of the inflammatory process, are useful for treating inflammation. A classical example of cyclo-oxygenase inhibitor is aspirine, the forerunner of which is a natural product: salicin.

Uses: In Malaysia, the plant is used to invigorate health after childbirth and to expel intestinal worms. In Cambodia, Laos and Vietnam, the seeds of *Polygonum barbatum* L. are astringent and used to treat cholera, stop dysentery and to invigorate health.

Antiviral and antibacterial properties: An aqueous extract of *Polygonum punctatum* hampers the proliferation of Herpes Simplex Virus type-1 cultured *in vitro* (Kott V *et al.*, 1999). It would be interesting to find out the principles involved here. An aqueous extract of *Polygonum capitatum* decreases the death rate of mice



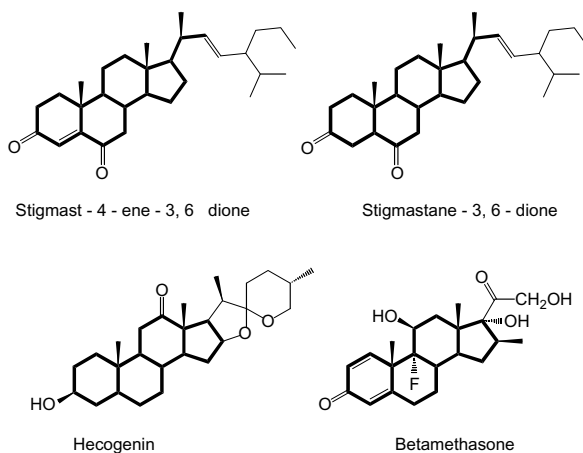


Fig. 78. Note the similitude of chemical structures of stigmast-4-ene-3, 6-dione, stigmastane-3, 6-dione, hecogenin and betamethasone.

experimentally infected with *Escherichia coli*, and the body temperature of infected rabbits (Ren G *et al.*, 1995).

References

- Kimura Y, *et al.* (1985) *Biochim Biophys Acta* **834**(2): 275–281.
 Kott V, *et al.* (1999) *J Ethnopharmacol* **64**(1): 79–84.
 Ren G, *et al.* (1995) *Chung Kuo Chung Yao Tsa Chih* **20**(2): 107–109.
 Simoes CM, *et al.* (1989) *J Pharm Belg* **44**(4): 275–284.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Polygonum chinense L.

[From Greek, *polus* = many and *gonos* = angled and from Latin, *chinense* = from China]

Physical description: It is a perennial, rhizomatous herb which grows to a height of 1 m in wet valleys, mixed forests, thickets in valleys, and the

Common names: Mountain knotweed, Chinese knotweed; *huo tan mu* (Chinese).

grassy mountain slopes of China, Taiwan, the Himalayas, Japan, India, Malaysia and Philippines, from sea level to 3000 m. The stems are ligneous at the base, multi-branched, pinkish, striate, glabrous or hispid and sour-tasting.

Leaves: simple and alternate. The ochrea is tubular, 1.5 cm–2.5 cm long, membranous, glabrous, veined and oblique at the apex. The petiole is 1 cm–2 cm long, and auriculate at the base. The blade is ovate, elliptic or lanceolate, 4 cm–16 cm × 1.5 cm–8 cm, and glabrous or hispid. The base of the blade is truncate or broadly cordate. The margin is entire, and the apex of the blade is shortly acuminate. The Inflorescences are long and thin axillary clusters of very small flowers. The flowers are white or pinkish and comprise of a perianth made of 5 ovate lobes which are accrescent in fruits. The andrecium consists of 8 stamens with blue anthers. The gynecium includes 3 styles which are connate at the base. The fruits are broadly ovate, trigonous, black achenes included in the perianth (Fig. 79).



Fig. 79. *Polygonum chinense* L.

Pharmaceutical interest: 25-R-spirost-4-ene-3, 12-dione, stigmast-4-ene-3, 6-dione, stigmastane-3, 6-dione, hecogenin and aurantiamide acetate characterized from this herb are anti-inflammatory and anti-allergic (Tsai PL *et al.*, 1998). Note the similitude of chemical structures of these steroids and the anti-inflammatory drug betamethazone (Fig. 78).

Uses: In China, *Polygonum chinense* L. is used internally to stop dysentery, expel impurities and to assuage headache. The plant is applied externally to the abdomen to assuage stomachache.

Reference

Tsai PL, *et al.* (1998) *Phytochem.* **49**(6): 1663–1666.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

IV. Subclass DILLENIIDAE Takhtajan 1966

The subclass Dilleniidae consists of 13 orders, 78 families and about 25 000 species of woody plants which are thought to have originated from the Magnoliidae early in the Upper Cretaceous (Appendix I). Dilleniidae are mostly trees with showy flowers which are hermaphrodite, with united carpels, and adapted to insect pollination. The chemical weapons used in this subclass to repel herbivorous animals insects, plants and microorganisms are diverse. Of pharmaceutical interest in this subclass are coumarins and oligostilbenes (Theales), naphthoquinones (Nepenthales), cucurbitacins (Malvales and Violales) and naphthylisoquinoline alkaloids (Violales). The order Dilleniales is a little transitional group of 2 families and about 400 primitive plant species which connects Illiciales and Theales (Appendix I).



A. Order DILLENIALES Huntchinson 1926

Most species in Dilleniales belong to the family Dilleniaceae.

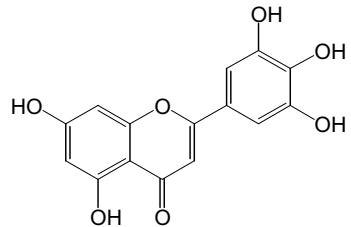
1. Family DILLENIACEAE Salisbury 1807 *nom. conserv.*, the *Dillenia* family

Physical description: The family Dilleniaceae consists of 10 genera and about 350 species of tropical trees, shrubs, climbers and herbs which are best developed in Australia. Dilleniaceae are so far known to abound with *tannins* and *saponins*. Note that flavonols (myricetin) and occasionally benzyloisoquinoline alkaloids are also known to occur in the family. The family Dilleniaceae is thought to connect Magnoliidae to the Dilleniidae. One must have probably observed the



botanical similitude between Illiciaceae (subclass Magnoliidae, order Illiciales) and Dilleniaceae. The leaves of Dilleniaceae are simple, alternate, without stipules, or winged and adnate to the petiole. The blade is serrate, leathery and shows several pairs of conspicuous secondary nerves. The flowers are yellow or white, perfect, hypogynous and showy. The calyx comprises of 3–20 spoon-shaped, deciduous and fleshy sepals originating in a centrifugal sequence and the corolla comprises of 2–5 very thin petals which are often crumpled in buds. The andrecium comprises of 5–20 stamens originating in centrifugal sequence. The gynecium consists of a single to 20 carpels arranged in a single whorl more or less united to form a compound ovary with distinct styles. The fruits are variable and the seeds are embedded in a juicy and showy aril.

Pharmaceutical interest: A classical example of Dilleniaceae is *Dillenia suffruticosa* (Griff.) Martelli (shrubby Dillenia), an invasive species native to Southeast Asia, which is widely grown as an ornamental shrub in tropical countries for its yellow flowers and red fruits. Not much is really known yet about the pharmacological potential of this family and it will be interesting to learn whether more intensive future research on this family will disclose any molecules of therapeutic interest. Note that betulinic acid is known to occur in this family. About 20 species of Dilleniaceae are used for medicinal purposes in the Asia-Pacific. These are often used to treat fever and cough, stop diarrhea, promote urination, and to wash hair and infected skin, mostly on account of the saponins and tannins.



Myricetin

***Acrotrema costatum* Jack**

[From Greek, *akros* = highest, and *trema* = aperture and from Latin, *costatus* = ribbed]

Physical characteristic: It is a brightly colored, medium-sized, rainforest herb of Malaysia, which develops from woody underground stems. Leaves: in rosette, simple, 12 cm–30 cm × 6 cm–12 cm, hairy, obovate, serrate, deep green, ribbed and penciled with red. The flowering stems stand up to a height of 10 cm and are covered with long reddish hair.

Common name: Yellow jungle star.

Uses: In Malaysia, *Acrotrema costatum* Jack is used to invigorate health after childbirth. Not much is known about the therapeutic potential of *Acrotrema costatum* Jack.

The inflorescences hold 8–10 bright yellow flowers. The flowers comprise of 5 red and hairy sepals, 5 yellow, showy, deciduous and very thin petals, stamens organized in 3 bundles and a gynecium consisting of 3 pistils. The fruits are 3 follicles, irregularly dehiscent (Fig. 80).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

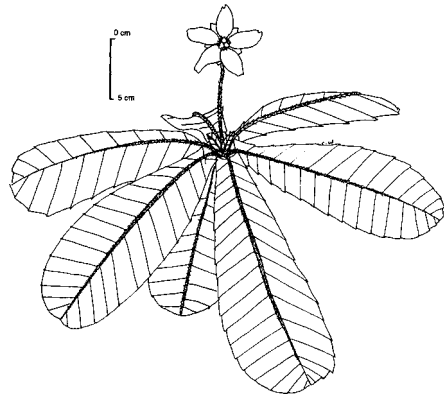


Fig. 80. *Acrotrema costatum* Jack.

***Dillenia excelsa* (Jack) Gilg**

[After J J Dillenius (1684–1747), a German botanist; and from Latin, *celsus* = lofty]

Synonymy: *Wormia excelsa* Jack, *Wormia tomentella* Mart.
Common names: *Simpoh ungu* (Malay).

Uses: In Indonesia, the leaves are applied to the head to treat fever and to assuage headache. The therapeutic potential of *Dillenia excelsa* (Jack) Gilg is unexplored til to date.

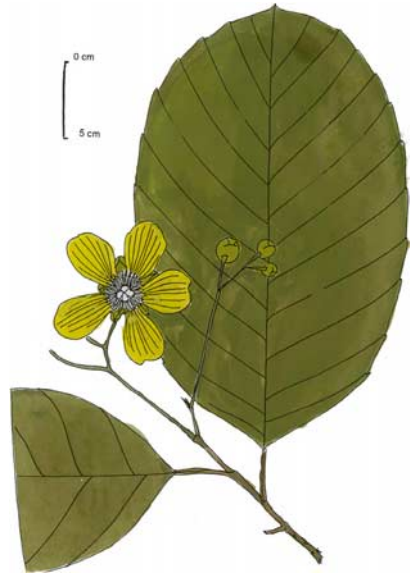


Fig. 81. *Dillenia excelsa* (Jack) Gilg. From: KLU Herbarium 006688. Flora of Malaya. Field collector: Benjamin C Stone, 13 Nov 1966. Geographical localization: Templer Park, Kanching, Malaysia, altitude: 750 ft. Botanical Identification: 10 Oct 1969, KM Kochummen.

Physical description: It is a tree which grows wild to a height of 15 m and a girth of 60 cm. It is found in the rainforests of Malaysia and Indonesia. The stems are terete, smooth and glabrous. Leaves: simple, spiral and without stipules. The petiole is 3 cm–3.3 cm long, thin and deeply channeled. The blade is 26 cm × 15.3 cm–11.5 cm × 16 cm, acute both at the base and at the apex, and has a margin that is laxly serrate. The blade

shows about 15 pairs of secondary nerves which are prominently raised above and below. The tertiary nerves are raised below the blade. The inflorescences are terminal cymes of fragrant flowers which are globose in buds, 1.5 cm in diameter and velvety. The calyx comprises of 5 ovate, 1 cm–2 cm × 9 mm–1 cm sepals which are velvety on the outside. The corolla consists of 5 petals which are very thin, nerved, yellow, measuring 4 cm × 2.5 cm. The stamens are numerous, linear and light mauve and the anthers are 7 mm long. The gynecium consists of 4, 1.5 cm × 5 mm, light mauve and free carpels (Fig. 81).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Dillenia indica* L.**

[After J J Dillenius (1684–1747), a German botanist; and from Latin, *indica* = from India]

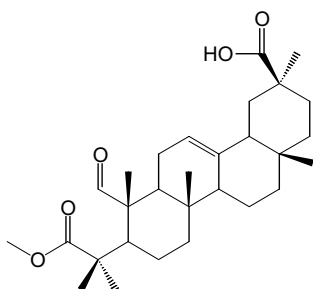
Synonymy: *Dillenia speciosa* Thunb.

Common names: Elephant apple tree, *simpoh*, *chimpu* (Malay).

Physical description: It is a magnificent tropical tree which grows to a height of 12 m, in the geographical zone spanning India to South China and Indonesia. The tree is truly magnificent and often grown for ornamental reasons. The bark is reddish and the stems are hairy. Leaves: simple, dark green, 20 cm–30 cm × 7 cm–10 cm, leathery, lanceolate to ovate-lanceolate, serrate, pubescent underneath and strongly ribbed with up to 40 pairs of secondary nerves. The flowers are 15 cm–20 cm, pure white, showy, and axillary on a stout 9 cm long pedicel. The sepals are orbicular, green, very succulent and persistent in fruits. The petals are pure white, obovate, oblong, deciduous and very thin. The andrecium consists of numerous reddish stamens. The gynecium comprises of 20 carpels. The fruits are edible, globose, 15 cm in diameter, green, very heavy, succulent and contain several heavy seeds (Fig. 82).



Fig. 82. *Dillenia indica* L.



Dillenic acid D

Uses: In Burma, the bark, fruits or leaves of *Dillenia indica* L. are used to combat fever. In Malaysia, the pulp of the fruit is used to manufacture shampoo.

Pharmaceutical interest: One might set the hypothesis that the fruit of *Dillenia indica* L. is used to wash hair on account of contains probably saponins. Saponins irritate the skin and are seldom used in cosmetics, but these are however safer than the present sulphated hydrocarbons which are known to be carcinogenic. The pharmacological potential of *Dillenia indica* L. is still awaiting experimental assessment. Note that dillenic acids A, B, C and D are oleanenes triterpenoids characterized from *Dillenia papuana*, which inhibit the growth of *Bacillus subtilis*, *Escherichia coli*, and *Micrococcus luteus* cultured *in vitro* (Nick *et al.*, 1994, 1995). (*Antioxidant activity of the extracts of fruits are antioxidant*, *Food Chem* **90** (4): 2005, 891–896, MdH Abdille, RP Singh, GK Jayaprakasha and BS Jena.)

References

- Nick, *et al.* (1994) *J Nat Prod* **57**(9): 1245–1250.
 Nick, *et al.* (1995) *Phytochem* **40**(6): 1691–1695.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Tetracera indica (Houtt. ex Christm. & Panz.) Merr.

[From Greek, *tettares* = four, *keras* = horn and from Latin, *Indica* = from India]

Physical description: It is a large woody rainforest climber found in Malaysia and Indonesia. Leaves: simple and alternate. The blade is broadest near the apex, round or acuminate, usually lobed near the tip,

and very rough to the touch. The inflorescences are very large, branched and spreading. The flower pedicels are 1.5 cm long. The flowers are white, fragrant and small. The calyx consists of 5 pink sepals. The corolla consists of 5 petals which are white and membranaceous. The andrecium consists of several pink

Synonymy: *Assa indica* Houtt. ex Christm. & Panz., *Tetracera assa* DC.

Common names: *Akar mempelas*, *mempelas*, *mempelas minyak* (Malay).

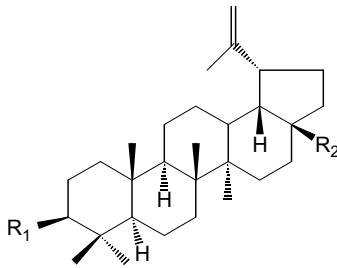
anthers. The gynecium is made of 2–4 ovaries which are distinct, smooth, glossy and ripening red (Fig. 83).

Uses: In Malaysia, a powder of *Tetracera indica* (Houtt. ex Christm. & Panz.) Merr. is used to soothe inflamed areas. In Indonesia, the sap is ingested to relieve cough and a paste made from the leaves is applied to poisonous bites.



Fig. 83. *Tetracera indica* (Houtt. ex Christm. & Panz.) Merr.

Pharmaceutical interest: The pharmacological potential of *Tetracera indica* (Houtt. ex Christm. & Panz.) Merr. is unexplored til to date. Note that betulinic acid, 3-cis-p-coumaroyl maslinic acid, and 3-trans-p-coumaroyl maslinic acid characterized from *Tetracera boiviniana* inhibit the enzymatic activity of DNA polymerase with IC_{50} values of $14\ \mu\text{M}$, $15\ \mu\text{M}$, and $4.2\ \mu\text{M}$ in the presence of bovine serum albumin and $6.5\ \mu\text{M}$, $7.5\ \mu\text{M}$, and $2.0\ \mu\text{M}$ without bovine serum albumin respectively, and enhance the effects of bleomycin in cultured P-388D1 cells (Ma J *et al.*, 1999).



Betulinic acid ($R_1 = \beta\ \text{OH}$, $R_2 = \text{COOH}$)

Reference

Ma J, *et al.* (1999) *J Nat Prod* **62**(12): 1660–1663.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

B. Order THEALES Lindley 1833

The order Theales consists of 18 families and about 3500 species of trees, shrubs, climbers and herbs, which are thought to have originated from the order Dilleniales (Appendix I). Theales have attracted a great deal of interest on account of their ability to elaborate a series of cytotoxic, antimicrobial and neuroactive phenolic substances. This order is a common ancestor for two major groups: one comprising Malvales, Lecythidales, Capparales, Violales and Nepenthales, and another group which includes Ericales, Ebenales and Primulales.



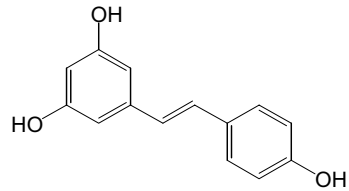
1. Family *DIPTEROCARPACEAE* Blume 1825 *nom. conserv.*, the *Meranti Family*

Physical description: The family Dipterocarpaceae consists of about 16 genera and nearly 600 species of tropical timber trees, some of which are the tallest of all Magnoliopsida, commonly accumulating resins (*triterpenes* and *sesquiterpenes*), tannins, proanthocyanidins and ellagic acid. The wood of Dipterocarpaceae is extremely hard and dense, and is of excellent quality. The leaves in this family are simple, stipulate, alternate, particularly thick and quite hard. The flowers are perfect and regular, and arranged in an axillary raceme or panicles. The calyx comprises of 5 imbricate sepals, and the corolla comprises of 5, distinct or connate, convolute in bud and spirally twisted petals. The andrecium consists of 10 trunks of bundles, 5–several, and is initiated in centrifugal sequence. The gynecium comprises of 2–5 carpels forming a compound, plurilocular ovary with axillary placentation. The fruits are dry, woody and quite often winged with the persistent sepals.

Pharmaceutical interest: Belonging to the family Dipterocarpaceae are several very valuable timber trees such as *Shorea robusta* Gaertn. (Saul tree). Dipterocarpaceae often produce resins: *Vateria indica* L. (piny resin, Indian copal, white dammar), *Dryobalanops aromatica* Gaertn. (Sumatra camphor tree), *Dipterocarpus turbinatus* Gaertn. (gurjun basalm, *garjan* or *kanyin* oil) and *Dipterocarpus tuberculatus* Roxb. (*eng* oil). The resin obtained from *Vateria indica* L., is used to make ointments, stop flatulence, treat bronchitis and piles, heal boils and to invigorate health. The resins (*gurjun*) obtained from

a number of species of plants classified within the genera *Dipterocarpus* are fixatives in perfumery and are used to prepare guaiazulene.

Dammar (*British Pharmaceutical Codex*, 1923) consists of the resins obtained from trees classified within the genus *Shorea*, *Hopea*, and *Balanocarpus*. Dammar is used to make varnishes, a mounting agent in microscopy and plaster masses. The nuts of *Shorea macrophylla* contain an edible fat, which can be used instead of cocoa butter in the manufacture of chocolates. In China, an oil obtained from the



Resveratrol

seeds of *Dipterocarpus lamellatus* was used to treat leprosy. There is an expanding body of evidence to suggest that oligomers of resveratrol and oligostilbenes of Dipterocarpaceae are remarkably cytotoxic and it will be interesting to learn whether more intensive future research on dipterocarps will disclose any molecules of chemotherapeutic interest. In Southeast Asia, about 20 Dipterocarpaceae plant species are medicinal. Note that the resins of dipterocarps are often used to heal wounds.

***Dipterocarpus alatus* Roxb.**

[From Greek, *dis* = two, *pteron* = wing, *karpos* = fruit and from Latin, *alatus* = having wings]

Synonymy: *Dipterocarpus incanus* Roxb., *Dipterocarpus gonopteris* Turcz.

Common names: *Kanyin* (Burmese); *yang khao* (Thai); *chhoeuteal trach* (Cambodian); *chhoeu teal thom* (Laos, Vietnamese).

Physical description: It is a resinous timber which grows to a height of 45 m and a girth of 4 m. It is found in the lowland tropical rainforest of Burma, Cambodia, Thailand, Malaysia, Laos and Vietnam. The bark is pale grey and the bole of 1 m diameter. Leaves: simple, alternate and stipulate. The stipules are 5 cm–9 cm long and covered with stellate hairs. The petiole is stout, 3.9 cm–2.5 cm long, woody, obscurely

Uses: The resin of *Dipterocarpus alatus* Roxb. is used externally to heal wounds and to counteract putrefaction in several Southeast Asian countries. In Cambodia, the bark is used to invigorate health, expel impurities, and to treat rheumatism and liver complaints, while the resin is used to heal ulcerated wounds. In India, the resin is used to treat gonorrhoea. In Cambodia, Laos, and Vietnam, the resin is used to heal ulcerous sores and to treat blenorrhagia. In Thailand, the bark is used to invigorate health and to mitigate toothache, while the resin is used to heal the wounds of cattle. The resin is used for varnishing. To date, the pharmacological potential of *Dipterocarpus alatus* Roxb. is unexplored.

flattened above, knee-shaped and cracked transversally near the base of the blade. The blade is ovate, thick, 10 cm × 20 cm–5.7 cm × 11.3 cm, glabrous on the surface and shows a few stellate hairs below. The apex of the blade is acute, the margin is wavy and recurved, and the blade shows 12–18 pairs of secondary nerves. The tertiary nerves are scalariform, visible from below, and obscure above. The flowers are arranged in axillary 3–7 flowered spikes. The calyx is tubular and 1 cm–1.5 cm long. The petals are 3 cm long and pubescent outside. The andrecium comprises of 30–32 stamens with flattened, 3.8 mm long filaments and 4.5 mm long anthers, the connectives of which produce a bristle of 3 mm–8 mm in length. The ovary is densely tomentose and the style 10 mm long. The fruits are 5-winged and somewhat bluish 2.5 cm–2.8 cm nuts with a pair of oblong, 12.5 cm × 2.6 cm–11 cm × 1.8 cm, hard, somewhat glaucous and 3-nerved wings (Fig. 84).

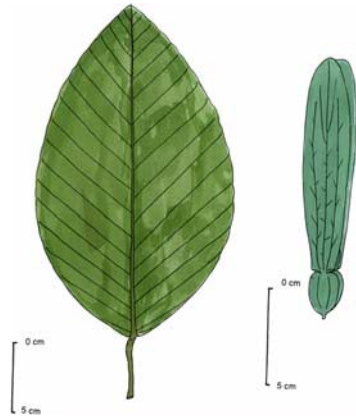


Fig. 84. *Dipterocarpus alatus* Roxb.

From: KLU Herbarium 12598. Plants of Cambodia. Field collector.: Benjamin C Stone, 21 Mar 1970. Geographical localization: Siem Reap, along route to Angkor Wat, Cambodia. Botanical Identification: Ashton 14 Feb 1973.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Dipterocarpus intricatus* Dyer**

[From Greek, *dis* = two, *pteron* = wing, *karpos* = fruit; and from Latin, *tricare* = tricks]

Physical description: It is a magnificent, heavily fruiting, small resinous tree which grows to height of 9 m and a girth of 22 cm. It is abundant in Cambodia and Thailand in degraded or semi-cultivated grounds. Leaves: simple and spiral. The petiole, inflorescences, young stems and leaves are characteristically woolly. The petiole is

Common name: *Krat* (Thai); *trach* (Cambodia); *dâu long* (Vietnamese).

Uses: In Cambodia, the bark of *Dipterocarpus intricatus* Dyer is used to treat rheumatism, but this property has not yet been confirmed experimentally.

1.5 cm–2.6 cm long. The blade is leathery, ovate, acute–round at apex, obscurely cordate at the base and the margin is slightly wavy. The blade shows a midrib that is raised above and sunken below, and 16–18 pairs of secondary nerves obscurely sunken above and raised below, as well as scalariform tertiary nerves. The inflorescences are axillary panicles. The fruits are 1 cm × 1.7 cm–1.5 cm × 1.4 cm nuts which are magenta, intricate and bearing a pair of 7.8 cm–10 cm × 2 cm–1.7 cm, single-nerved and oblong wings formed by persistent sepals (Fig. 85).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Dipterocarpus obtusifolius* Miq.**

[From Greek, *dis* = two, *pteron* = wing, *karpos* = fruit, from Latin, *obtusere* = obtuse and *folium* = leaf]

Physical description: It is a resinous timber which grows to a height of 15 m and a girth of 80 cm. It is common on the mountain ridges in the

Synonymy: *Dipterocarpus punctulatus* Pierre, *Dipterocarpus vestitus* Wallich ex Dyer

Common names: *Hiang* (Thai).

Uses: In Cambodia, Laos and Vietnam: the resin is used to mitigate abdominal discomfort. To date, the pharmacological potential of this plant is unexplored.

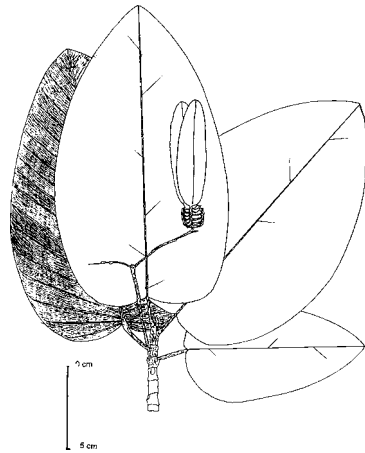


Fig. 85. *Dipterocarpus intricatus* Dyer. From: KLU Herbarium 12593. Plants of Cambodia. Geographical localization: 5 Km from Banteay Srei, nr. Angkor. Field collector: Benjamin C Stone, 21 Mar 1970. Botanical identification: Ashton 15 Feb 1973.

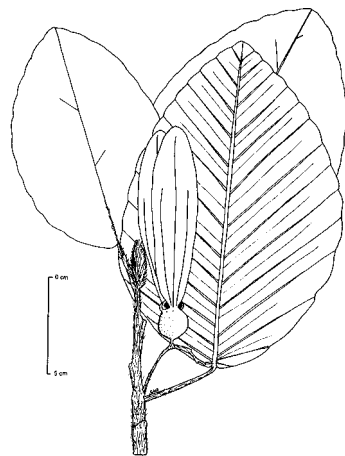


Fig. 86. *Dipterocarpus obtusifolius* Miq. From: KLU Herbarium 19004. The Forest Herbarium (BKF), Royal Forest Department. Flora of Thailand. Field collector & botanical identification: C. Chaloenphol, 12 Apr 1971. Geographical localization: Chaiphaphum, Thailand.

tropical rainforest of Thailand, Cambodia, Laos and Vietnam. The stems and petioles are woolly. Leaves: simple and spiral. The petiole is 3.5 cm–5.5 cm × 3 mm–4 mm. The blade is ovate, leathery, 14.7 cm × 9.7 cm–21.5 cm × 13.9 cm, acute at the apex and obscurely cordate at the base and wavy at the margin. The blade shows a midrib and 10–13 pairs of secondary nerves raised below and sunken above. Internerves are noticeable. The fruits are globose, smooth green nuts, measuring 2 cm–1.7 cm in diameter, with a pair of 1.5 cm–8.5 cm × 2.6 cm–2 cm, reddish and 3-nerved wings (Fig. 86).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Dryobalanops aromatica* Gaertn.**

[From Greek, *drys* = oak, *balanos* = nut, and *aromatikos* = aroma]

Physical description: It is large timber tree which is recognized miles away by its greyish looking foliage and the shape of its crown, which is best described as being like an umbrella. It is found in primary rainforests up to 800 feet above sea level, in Malaysia and Indonesia. This tree grows to a height of 50 m. Leaves: simple, spiral, up to 10 cm long, leathery, ovate and acuminate. The inflorescences consist of terminal 5 cm long panicles of white and fragrant flowers. The sepals are lanceolate acute, 7.5 mm long and scurfy. The petals are thin, lanceolate, acute, white, and as long as the sepals. The andrecium consists of 35–45 stamens, with short filaments and long narrow beaked anthers. The fruits are oblong, conic, and 2.5 cm long nuts, the sepals forming 8 cm long, obtuse, thick and reddish wings (Fig. 87).

The method of extracting camphor or *isi kapur* is to split the bark and pick the crystals out of the small cavities. Malays and Indonesians believe that

Synonymy: *Dryobalanops camphora* Colebr.

Common names: Malay camphor, Borneo camphor; *kapur barus*, *kapur*, *kayu kapur* (Malay); *apakva* (Sanskrit).

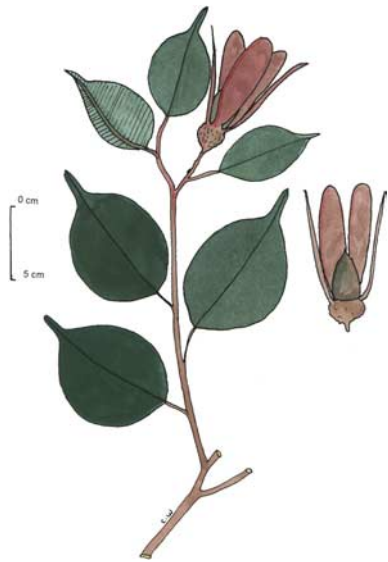
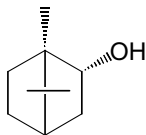


Fig. 87. *Dryobalanops aromatica* Gaertn.

the man who should collect the camphor should speak in a very respectful language, known only to old folks. Oil of camphor known to the Malays by the name of *minyah kapur* is obtained by making a small cut penetrating into the wood about 10 cm. The resin of *Dryobalanops aromatica* Gaertn. consists of borneol, camphor, terpineol and other terpenes. The wood contains among other things, dipterocarpol, β -sitosterol, and dryobalanone. Borneol and camphor are known to be responsible for contact dermatitis.

Pharmaceutical interest: Note that borneol of *Dryobalanops aromatica* inhibits the nicotinic receptor agonist 1,1-dimethyl-4-phenylpiperazinium iodide-induced secretion of [³H] norepinephrine by bovine adrenal chromaffin cells with an IC₅₀ of 70+/-12 μ M in a non-competitive way (Oh KS *et al.*, 2000; 2001, Park TJ *et al.*, 2003).



Borneol

Uses: The camphor of *Dryobalanops aromatica* Gaertn. was known from very early times. It is from the Malay word *kapur* that the word camphor is derived. This camphor was the only kind known in Europe in the Middle Ages and was the *καφουρα* of the later Greek physicians, who obtained knowledge of it through the Arab traders. It has been mentioned in a number of Arabian poems of the 6th century, and Marco Polo described it as being superior to any other and worth its weight in gold. In 1851, the price of this camphor in Borneo was 3 dollars a catty (95 shillings a pound), and in Canton 8 shillings a pound. Imported into China from very early times, it was valued for its ability to invigorate health, produce venereal desire, reduce inflammation and body temperature, stimulate appetite, and to aid the physiological pathways of the body. In Malaysia, the powdered oleoresin is used to heal wounds. Indonesians use the kernel of the fruit to assuage pain and to check bleeding. In Asia, camphor is used at funerals and magic ceremonies.

References

- Oh KS, *et al.* (2000) *Pharmacol Res* **42**(6): 559–564.
 Park TJ, *et al.* (2003) *Biochem Pharmacol* **65**(1): 83–90.

Warning: Camphor is irritating to the skin and causes keratitis. Large doses of it induce nausea, diarrhea and vomiting, dizziness, tension, hallucinations and mental confusion. The initial stimulation is followed by central nervous system depression which may involve seizures, coma or death due to respiratory failure.

***Hopea odorata* Roxb.**

[From Latin, *odorem* = odor]

Physical description: It is a resinous timber tree which grows to a height of 45 m and a girth of 1.20 m. This tree is found in the lowland tropical forests of Cambodia, Laos, Vietnam, Malaysia, Burma and Thailand, in deep, rich soils up to 300 m altitude and rarely far away from streams. The stems are smooth, terete and velvety when young. Leaves: simple and alternate. The petiole is 7 mm–1 cm long and somewhat curved, and velvety when young. The blade is ovate-lanceolate, leathery, 10 cm–20 cm long, slightly unequal at the base, and acute-acuminate at the apex. The margin is slightly wavy. The blade shows a midrib which is flat above, raised below and grooved. It has 9–12 pairs of indistinct secondary nerves, and scalariform tertiary nerves. Tufts of hairs can be observed at the axis made of secondary nerves and a midrib. The inflorescences consist of 15 cm long velvety axillary panicles. The female flowers are very small and velvety, and comprise of 5 pinkish petals, which are hairy on both sides, and an ovary gradually narrowed into a conical stylopodium and a long cylindrical style. The fruits are globose nuts of about 1 cm in diameter and bearing a pair of 2 long wings at the apex (Fig. 88).

Uses: In Burma, the resin of *Hopea odorata* Roxb. is used to check bleeding. In Cambodia, Laos, Cambodia, and Vietnam, the bark is used to treat gingivitis, toothache and incontinence. In Malaysia, the resin is used to heal wounds and sores.

Pharmaceutical interest: A butanolic extract of *Hopea odorata* Roxb. inhibits the proliferation of human hepatocellular carcinoma cells (Hep G2) cultured *in vitro* with an IC₅₀ value of 20.14 µg/mL (Norizah A *et al.*, 2000). Phenolic substances are most probably responsible for this activity, which has however to be further confirmed. Is resveratrol involved here?

Common names: *Merawan siput jantah, cengal pasir, cengal mas* (Malay), *thengan* (Burma), *koki* (Cambodia); *sao den* (Vietnam); *koki, mosau, thmar* (Cambodia); *kh'e:n* (Laos); *takhianthong, takhian-yai* (Thailand).

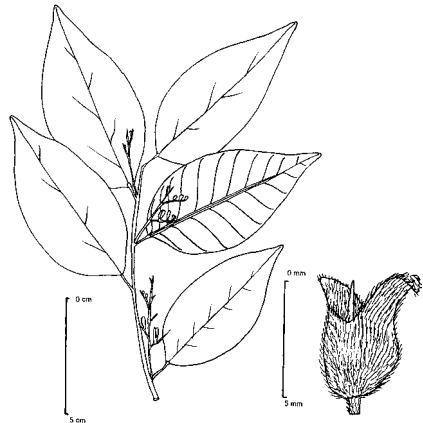


Fig. 88. *Hopea odorata* Roxb. From: KLU Herbarium 19038. Flora of Thailand. The Forest Herbarium (BKF), Royal Forest Department. Field collector & botanical identification: S. Phusomsaeng. 10 Apr 1971. Geographical localization: Pen; Trang Khao Chong, South Thailand.

Reference

Norizah A, *et al.* (2000), 10th Annual Scientific Meeting of the Malaysian Association of Clinical Biochemists, 14–15 August, Kuala Lumpur.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Shorea sumatrana (van. Sl. Ex Foxw) Sym.

[*Shorea* after Sir John Shore (1751–1834), Governor General of India (1793–1798); and Latin *sumatrana* = from Sumatra]

Physical description: It is a timber which grows to a height of 36 m and a girth of 2.5 m in the rainforest of Malaysia and Indonesia. The stem is smooth and glabrous, except for the young ones which are covered with a few stellate hairs. Leaves: simple, alternate and stipulate. The stipules are 4 mm × 2 mm, triangular, caducous and velvety, and the petiole is slightly channeled, glabrous, 1 cm–1.6 cm long, cracked transversally near the blade. The blade is hard, oblong-elliptic, leathery, heavy, and glabrous. The base is round and the apex acute. The margin is slightly wavy and recurved. The midrib and secondary nerves are sunken above the blade and raised beneath. The midrib is slightly channeled below and there are 9–10 pairs of secondary nerves. The tertiary nerves are hardly visible. The inflorescences consist of terminal or axillary panicles of 8 cm–10 cm long, covered with a few stellate hairs. Flower: the calyx is very small, velvety and comprises of 5 sepals of unequal size (1 mm–3 mm long). The corolla comprises of 5 petals which are reddish-yellow, linear,

Synonymy: *Isoptera borneensis* King non R. Scheffer ex Burck, *Isoptera sumatrana* v. Slooten ex Thorenaar.

Common names: *Sengkawang ayer* (Malay).

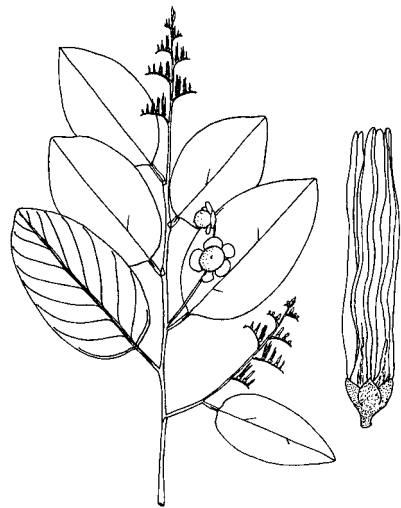


Fig. 89. *Shorea sumatrana* (van. Sl. Ex Foxw) Sym. From: KLU Herbarium 65301. Field collector: x. m. x., 17 Sep 1955. Geographical localization: Slong, Ulu Kelantan, near a stream, altitude 100 feet, Northeast Malaysia. Botanical identification: 14 Oct 1955, x.m.x. From KLU Herbarium 001517. Field collector: Mohd. Kasim Bin Rajab. Geographical localization: Kepong, F.R.I., Selangor. Roadside in front of nursery, 12 Jun 1963, West Malaysia. Botanical identification: Mohd. Kasim Bin Rajab & Ashton, 12 Feb 1973.

1.4 cm × 5 mm–1 mm, hairy below and contorted in buds. The fruits are glaucous, velvety and slightly acuminate 1.4 cm × 1.1 cm nuts surrounded by 5 round, woody, irregularly shaped, 5 mm–1 cm × 1 cm–7 mm persistent sepals (Fig. 89).

Pharmaceutical potential: To date, the pharmacological potential of *Shorea sumatrana* (van. Sl. Ex Foxw) Sym. is still unknown and it will be interesting to learn whether more intensive future research of this plant will disclose any molecules of chemotherapeutic interest.

Uses: In Indonesia, an oil expressed from the seeds is used externally to heal wounds and sores in the mouth.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

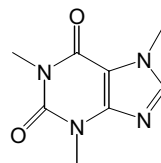
2. Family THEACEAE D.Don 1825 nom. conserv., the Tea Family

Physical description: The family Theaceae consists of 40 genera and 600 species of tropical and sub-tropical shrubs and trees commonly producing tannins, proanthocyanins, ellagic acid, saponins, caffeine and xanthenes. It is generally agreed that the family Theaceae is closely related to the family Dilleniaceae, except for the compound ovary and seeds that lack aril. The leaves are simple, alternate, crenate and without stipules. The flowers are showy, axillary, solitary, perfect and hypogynous, and comprise of 5 imbricate and free sepals, and 5 or more, free, imbricate, often white petals. The andrecium comprises of numerous stamens developing centrifugally with tetrasporangiate and dithecal anthers opening by longitudinal slits. The gynecium consists of 3–5 carpels united into a compound, 3–5 locular ovary with axillary placentation. The fruits are dehiscent capsules.



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Pharmaceutical interest: Classical examples of Theaceae are *Camellia sinensis* (L.) Kuntze. (Tea) and *Camellia japonica* L. (Camellia). In Southeast Asia, about 15 species of Theaceae are used for medicinal purposes, notably to stop hemorrhages and dysentery, and to treat skin diseases on account of their astringent properties. It will be interesting to learn whether more intensive future research on the phenolic compounds of this family will disclose any molecules of therapeutic interest.



Caffeine

***Camellia sinensis* (L.) O. Ktze.**

[After Kamel, 17th century Jesuit and botanist and from Latin, *sinensis* = from China]

Physical description: It is a shrub native to Asia and has been cultivated for ages in China and Japan. The bark is dark grey and the stems glabrous and terete. Leaves: simple, spiral and without stipules. The petiole is 4 mm–7 mm × 4 mm, channeled above, hairy and rugose. The blade is elliptic, rigid, 11 cm × 5 cm–12.5 cm × 5 cm. The margin is recurved and serrulate, and the blade shows 9–11 pairs of secondary nerves. The flowers are showy and axillary. The calyx consists of 5 sepals which are round, hard, 4 mm–5 mm in diameter, and finely ciliate. The corolla consists of 5 thin petals which are white, obovate, 1 cm × 1.2 cm, and somewhat pubescent beneath. The stamens are numerous and showy. The ovary is villous and develops 3 glabrous styles connected beyond the middle. The fruits are capsular, 3-lobed or irregularly shaped, glossy and green at first, dehiscent, and approximately 3 cm–4 cm in diameter. The seeds are smooth, brownish, globose and of 1.8 cm in diameter (Fig. 90).

Synonymy: *Thea sinensis* L., *Thea cochinchinensis* Lour., *Thea chinensis* Sims

Common names: Tea; *thé* (French); *letpet* (Burmese); *ming* (Chinese); *caolo* (Vietnamese); *cha* (Portuguese); *telayi* (Tamil).



Tea spread to Europe during the 17th century. In Occident, the most popular form of tea is black tea, prepared by drying, rolling and crushing fresh young leaves kept in a damp area to promote oxidation. Green teas are non-oxidized and are enjoyed in the Orient.

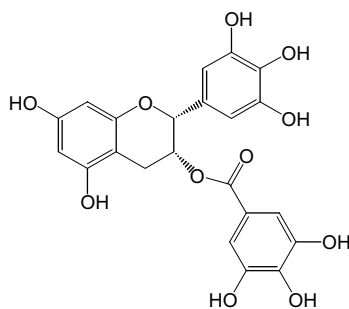
Fig. 90. *Camellia sinensis* (L.) Kuntze.

Pharmaceutical potential: The tonic property of *Camellia sinensis* (L.) Kuntze is mediated by caffeine, a purine alkaloid, which stimulates the cerebral cortex and has inotropic positive, relaxes the vessels and promote urination. A growing body of evidence indicates that flavans of *Camellia sinensis* (L.) Kuntze are of possible therapeutic interest.

Chemotherapeutic properties: One such compound is (–)-epigallocatechin-3-O-gallate abrogates the survival of xenograft tumors (Sintippour MR *et al.*, 2001). Catechins of tea are bactericidal towards *Streptococcus mutans* and *Streptococcus sobrinus* which are responsible for dental caries (Hamilton-Miller JMT *et al.*, 2001).

Anti-oxidant properties: Note also that the relative risk of incident myocardial infarction is lower in tea-drinkers (Geleijnse JM *et al.*, 2002) and tea lowers cholesterolaemia in animal models (Bursill C *et al.*, 2001). Black tea has anti-inflammatory properties (Chaudhuri AK *et al.*, 2005).

Uses: In Asia, an infusion of the leaves is used to make a drink (tea) to invigorate the mind and the heart, stop spasms and dysentery, treat fever cough, and nervous disorders, and to promote urination and digestion. In Europe, tea has been listed in the 1949 edition of the *British Pharmaceutical Codex* and is found in the 10th edition of the *French Pharmacopoeia*. Stuart reports the Pen Ts'ao Kang Mu as “tea clears the voice, gives brilliancy to the eyes, invigorates the constitution, improves the mental faculties, opens up the avenues of the body, promotes digestion, removes flatulence, and regulates the body temperature”. (Stuart GA, 1911).



(-) - Epigallocatechin - 3 - O - gallate

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 Hamilton-Miller JMT, *et al.* (2001) *J Med Microbiol* **50**(4): 299–302.
 Sintippour MR, *et al.* (2001) *Nutr Cancer* **40**(2): 142–150.

Warning: There is an expanding body of evidence to suggest that condensed catechin combined with smoking causes esophageal cancer. This effect apparently may be overcome by adding milk which binds to tannin preventing its deleterious effects. Note that tea is diuretic and contributes to dehydration.

3. Family **CLUSIACEAE** Lindley 1826 *nom. conserv.*, the **Mangosteen Family**

Physical description: The family Clusiaceae, or Guttiferae, consists of 50 genera and 1200 species of tropical plants which are thought to have originated from the family Theaceae. These are trees, climbers or herbs, exuding a sticky yellow gum resin and often contain proanthocyanidins, tannins, and various sorts of phenolic substances including *xanthones*. The leaves are simple, without stipules, decussate or whorled, principally entire, and often showing long, thin and parallel secondary nerves. The petiole is often clasping and small. The flowers are often showy, fragrant, unisexual, regular and hypogynous, joined together in terminal and cymose inflorescences, or less often solitary and terminal. The sepals are free and overlapping, and there are 2–14 free, imbricate or convolute overlapping petals. The andrecium consists of limited trunk-bundles of stamens initiated in a centrifugal sequence, and the anthers open by longitudinal slits. The gynecium comprises of 1 to several carpels forming a compound superior ovary with axillary placentation, including as many locules as carpels and a single style. The stigma is big, lobed or peltate. The fruits are berries, drupes or nuts, and the seeds are often oily.

Pharmaceutical interest: Classical examples of Clusiaceae are *Garcinia mangostana* L. (mangosteen fruit tree), *Mammea americana* L. (mammee-apple), *Pentadesma butyracea* Sabine (butter or tallow tree), *Garcinia kola* Heckle (bitter kola), *Garcinia morella*, *Calophyllum inophyllum* L. (Alexandrian laurel, Indian poon), *Mesua ferrea* (iron wood) and *Ascyrum hypericoides* (St. Andrew's cross). The yellow gum resin of *Garcinia hanburyi* Hook. f. (gamboges tree) was used (gamboje, *British Pharmaceutical Codex*,



1934) to relieve the bowels of costiveness (dose: 30 mg–60 mg). The solid fat expressed from the seeds of *Garcinia indica* (Thouars) Choisy or *kokum* butter (*Indian Pharmacopoeia*) has been used to make suppositories. The flowering tops of *Hypericum perforatum* L. (St. John's Wort) has been used to promote urination (*Hypericum*, *Russian Pharmacopoeia*, 1961, tincture prepared by

percolation with alcohol 40%). Most of the medicinal Clusiaceae have healing properties. The flowering tops *Hypericum perforatum* L. (St. John's Wort) although photosensitizing, are used to treat depression, and to heal wounds. In Ceylon, the oil of *Calophyllum calaba* L. is a remedy for irritated skin. The gum-resins of *Caraipa fasciculata* (Brazil) and *Clusia flava* Jacq. (West Indies) are used to heal wounds.

Of recent interest in this family are a series of neoflavonoids, prenylated xanthenes, dipyrano-coumarins, and quinones, which display experimentally monoamine oxidase (of MAO A and to a lesser extent of MAO B), antifungal, antibacterial, anti-platelet aggregation, anti-inflammatory and anti-Human Immunodeficiency Virus activities. Hypericin and calanolides characterized from the *Hypericum* species and *Calophyllum* species respectively, are undergoing clinical trials as anti-Human Immunodeficiency Virus drugs. The therapeutic development of natural products characterized from the family Clusiaceae would not be surprising. In Southeast Asia, about 50 species of plants classified within the family Clusiaceae are used for medicinal purposes. The resin is often used to treat skin diseases and to heal wounds whereas the bark is astringent.

***Calophyllum inophyllum* L.**

[From Greek, *kalos* = beautiful and *phullon* = leaf]

Physical description: It is a magnificent coastal, large tree which grows wild in the geographical zone spanning India to Fiji. It is often cultivated to decorate parks and roadsides. The bark is grey to fawn, with wide, shallow, markedly boat-shaped fissures and exudes a clear golden yellow sticky gum-resin. Leaves: simple, without stipules and decussate.

The blade is broadly elliptic-oblong, large (8 cm–16 cm × 4 cm–8 cm), rigid, glossy, and leathery. The apex is round or notched, the base tapered, and there are numerous, distinct, parallel and straight secondary nerves. The inflorescences are long (7 cm–8 cm) and axillary laxly flowered raceme. The flowers are delicate, showy (1 cm), and supported by long, thin (3 cm) and white pedicels. The 4 sepals and petals are whitish, ripening to brown, and are deciduous. The stamens are numerous and yellowish-red, inserted at the base of an ovoid, pinkish and superior ovary developing upward into a long and thin style. The fruits are globose, large, 2 cm in diameter, green drupes (Fig. 91).

Synonymy: *Calophyllum bitangor* Roxb.

Common names: Alexandrian laurel, Indian poon, sweet-scented Calophyllum; *calophylle faux tacamahac* (French); *bintangor laut* (Malay).

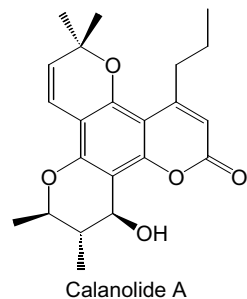
Uses: From the seeds of *Calophyllum inophyllum* L. is expressed the *dilo* oil, which is used to heal wounds and treat ringworms and infected skin. In Indonesia, the gum-resin is used make plasters. It is burned as incense, and is used to remove tumors. The bark is applied to swollen parts and is used to promote urination, remove blood from urine and treat gonorrhoea. A maceration of leaves is applied to the inflamed eyes. In the Philippines, the juice expressed from the leaves is used to heal hemorrhoids. In Cambodia, Laos, and Vietnam, the gum resin is used to heal ulcers and infected wounds. In India, the oil expressed from the seeds is used to soothe inflamed parts and exanthematous eruptions.



Fig. 91. *Calophyllum inophyllum* L.

Pharmaceutical interest: *Anti-HIV property:*

In regard to the antiviral property of *Calophyllum* species, a number of experiments conducted both *in vitro* and *in vivo* have clearly demonstrated that dipyrano-coumarins are able to inhibit the enzymatic activity of the Human Immunodeficiency Virus type-1 reverse-transcriptase. Calanolides A and B characterized from *Calophyllum lanigerum* inhibit Human Immunodeficiency Virus type-1 reverse-transcriptase as well as the replication and the cytopathicity of the Human Immunodeficiency Virus type-1 with respective EC_{50} values of $0.1 \mu\text{M}$ and $0.4 \mu\text{M}$ (Kashman Y *et al.*, 1992). From *Calophyllum inophyllum* L., costatolide, inophyllum P, and inophyllum B inhibit the replication of the Human Immunodeficiency Virus (Patil AD *et al.*, 1993; Spino C *et al.*, 1998). Reverse-transcriptase is a key enzyme in the life-cycle of the Human Immunodeficiency Virus and Retrovirus in general. Once the Human Immunodeficiency Virus binds to the CD_4 surface glycoprotein of a lymphocyte, the viral envelope fuses with the cytoplasmic membrane of the lymphocyte and the viral RNA is internalized into the lymphocyte where it starts to replicate.



The transcription of the viral RNA into DNA is set into motion by a viral reverse-transcriptase, which is a

heterodimer consisting of 61 KDa and 52 KDa subunits. The viral DNA synthesized is then integrated into the genome of the lymphocyte in a process dependent on a viral endonuclease. When the portion of viral DNA is activated, the genetic machinery of the host-cell is then used to replicate several new viruses which finally kill the cell. Reverse-transcriptase inhibitors have attracted a great deal of interest on account of their ability to treat Human Immunodeficiency Virus infection. One such compound is zidovudine (AZT®), which is a close structural analogue of thymidine, from which it differs by a 3-azido group instead of a 3'-hydroxyl group.

Another example is zalcitabine (ddC®), which is a close structural analogue of deoxycytidine, containing a hydrogen atom on the 3' carbon instead of a hydroxyl group. After phosphorylation, zidovudine is incorporated into the growing DNA chain via viral reverse-transcriptase. The absence of hydroxyl group on the 3' carbon causes chain termination and therefore inhibition of reverse-transcriptase (Fig. 92).

Other properties: A series of 4-phenylcoumarins, including calocoumarin A, inhibit the early expression by Raji cells of Epstein-Barr Virus (EBV) antigen induced by 12-*O*-tetradecanoylphorbol-13-acetate (TPA) and display an anti-carcinogenic property *in vivo*.

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Cratoxylum cochinchinense (Lour.) Bl.

[From Greek, *kratos* = strength and *xylon* = wood and from Latin, *cochinchinense* = from cochinchina]

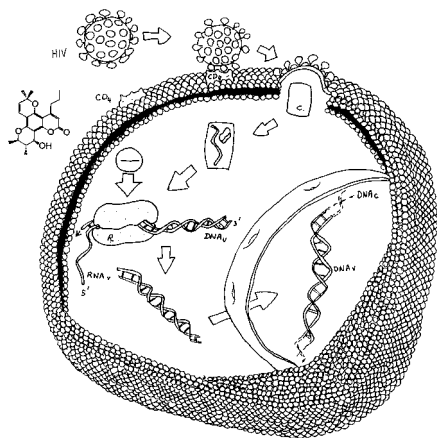


Fig. 92. Calanolide inhibits the enzymatic activity of reverse-transcriptase (R) and as a result the synthesis of the DNA (DNA v) from the RNA (RNA v) of the human immunodeficiency virus is abrogated. Capsid (C), DNA of the host-cell (DNAC).

Synonymy: *Cratoxylon polyanthum* Korth., *Cratoxylon ligustrinum* Bl.

Common names: *Derum seluchor*, *mampat* (Malay).

Physical description: It is a tree which grows to a height of 33 m and a girth of 1.80 m. It is found in the lowland forest from sea level to 500 m in the geographical area covering Malaysia, Burma, Cambodia, Laos, Vietnam, Thailand, the Philippines, South China, and Indonesia. The wood is very hard and durable. The bark is smooth, light buff, and peels off in angular pieces or in long strips. The inner bark is pale cream and the sapwood is yellowish-brown. The stems are greyish, glabrous, and cracked lengthwise. Leaves: simple, decussate and without stipules. The petiole is 2 mm–3 mm long, glabrous, flat above and somewhat very thinly edged. The blade is thin, elliptic to spatulate measuring 4.7 cm × 1.5 cm–8.4 cm × 3 cm. The apex of the blade is acute, the base is tapered, and the margin is entire and recurved. The blade shows 8–11 pairs of secondary nerves, which are indistinct, and a midrib sunken above and raised below. The flowers are dark red to pink and ephemeral. The fruits are solitary, axillary, green, fusiform, 7 mm × 1.2 cm capsules which beaked at the apex with the rest of the stigmas. The 4 sepals are persistent, fleshy, measuring 7 mm × 4 mm and covering two-thirds of the fruit's length. The fruits contain 6–8 seeds per locules (Fig. 93).

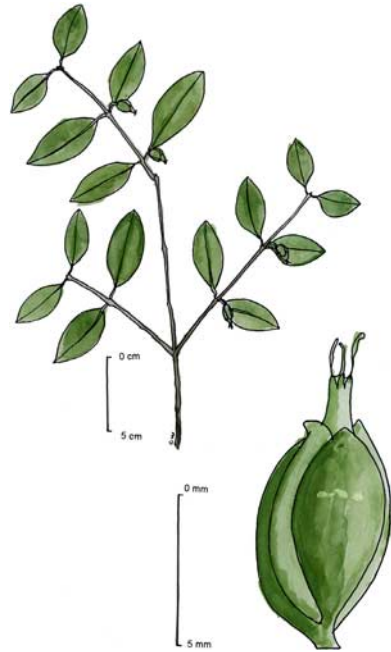
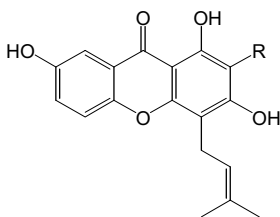


Fig. 93. *Cratoxylum cochinchinense* (Lour.) Bl. From: KLU Herbarium 34511. Flora of Malaya. Field collectors: Benjamin C Stone, SC Chin *et al.*, 2 June 1982. Altitude 100 m–500 m. Geographical localization: Kelantan, Bukit Baka Forest Reserve, Malaysia. Botanical identification: Benjamin C Stone, 1983.

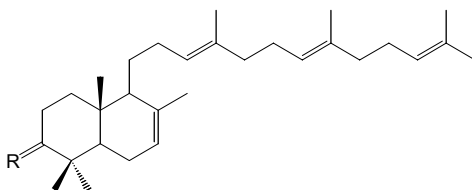
Pharmacological potential: The pharmacological potential of *Cratoxylum cochinchinense* (Lour.) Bl is to date unknown. Note however that this plant produces lupeol, (13E,17E)-polypoda-7,13,17,21-tetraen-3 β -ol, β -mangostin, 2-geranyl-1,3,7-trihydroxy-4-(3-methylbut-2-enyl)xanthone and 1,3,7-trihydroxy-2,4-di(3-methylbut-2-enyl)xanthone (Lien HD *et al.*, 1999). It

Uses: Malays and Indonesians use the leaves and the bark to treat skin diseases. A decoction of the bark is drunk to treat colic, and the resin is used to control itchiness.

will be interesting to learn whether more intensive future research on this family will disclose any molecules of therapeutic interest.



1,3,7-trihydroxy-2,4-di(3-methylbut-2-enyl)xanthone (R = Geranyl)



(13E,17E)-Polypoda-7,13,17,21-tetraen-3 β -ol (R = β OH)

Reference

Lien HD, *et al.* (1999) *Phytochemistry* **50**(3): 471–476.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Garcinia mangostana L.

[After L Garcin (1683–1751), French naturalist and from Malay, *mangustan* = mangosteen]

Physical description: It is a medium-sized tropical fruit tree probably native to South-east Asia. The bark is yellowish-brown; the inner bark exudates an opaque yellow gum resin. Leaves: simple, without stipules, and decussate. The petiole is 1 cm–2 cm long, stout, cracked and clasps the stems. The blade is ovate to ovate-oblong, leathery, and 6.5 cm–9.5 cm \times 3.5 cm–5.5 cm. The apex is acute, and the base is broadly wedge-shaped. The secondary nerves are slender, parallel, 2 mm apart and slightly joining into an intramarginal nerve. The flowers are terminal, the male one in racemes. The perianth consists of

Common names: Mangosteen; *mangostan* (French); *manggis*, *mangustan* (Malay).



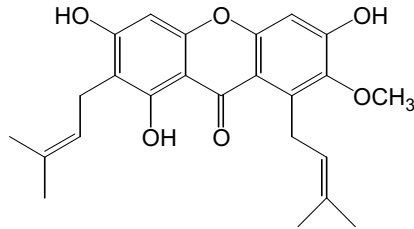
Fig. 94. *Garcinia mangostana* L. From: KLU Herbarium 18371. Flora of Malaya. Field collector & botanical identification: Lim Ah Lan, June 1973. Geographical localization: Serdang, Malaysia.

4 fleshy sepals and 4 petals. The stamens are numerous and form a slightly 4-lobed mass. The fruits are berries which ripen to magenta, 5 cm in diameter. Its apex is marked by adpressed stigma divided in wedge-shaped lobes. The seeds are embedded in a thick, whitish, edible and juicy pulp (Fig. 94).

Uses: By the year 1880, the husk of the fruit of *Garcinia mangostana* L., exported from the Straits, has become an astringent remedy of great repute which was used to stop diarrhea and dysentery. In Malaysia, a decoction of the roots is drunk to regulate menses. In Indonesia, the leaves and the bark are used to soothe ulcers in the mouth and to treat fever. Very small doses of gum resin are eaten to relieve the bowels of costiveness, but if taken in large doses, it will induce nausea, vomiting, colic, and death.

Pharmaceutical interest: *Mangostin:* The husk of the mangosteen abounds with prenylated xanthenes, which are principally represented by mangostin. Mangostin displays experimentally a remarkable range of pharmacological activities. It inhibits the enzymatic properties of HIV-1 protease (Xing SC *et al.*, 1996), cAMP phosphodiesterase (Chairungsilerd N *et al.*, 1996), calcium-dependent ATPases (Furukawa K *et al.*, 1996), cAMP-dependent protein kinase (Jinsart W *et al.*, 1992), and topoisomerase I and II (Tosa H *et al.*, 1997). In addition, mangostin blocks both histaminergic and serotonergic receptors (Chairungsilerd N *et al.*, 1996a), inhibits the proliferation of methicillin-resistant *Staphylococcus aureus* (Linuma L *et al.*, 1996) and other pathogen microorganisms (Gopalakrishnan G *et al.*, 1997) and is able to scavenge free radicals more efficiently than tocopherol (Yoshikawa M *et al.*, 1994).

Mangostin also inhibits the conversion of arachidonic acid into PGE₂ by cyclo-oxygenase in microsomal preparations (Nakatani K *et al.*, 2002). A benzenic extract of husk of mangosteen inhibits moderately the tumor-promoting property of teleocidin (Sakai S *et al.*, 1993). Is mangostin involved here?



α - Mangostin

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 Yoshikawa M, *et al.* (1994) *J Pharm Soc Jap* **114**(2): 129–133.

Warning: Large doses of resin induce nausea, vomiting, colic, and death.

Hypericum japonicum Thunb.

[From Greek, hyper = *above* and *eikon* = picture (the plant was hung above pictures to ward off evil spirit) and from Latin, *japonicum* = from Japan]

Physical description: It is a 30 cm long, erect or procumbent, light green, somewhat succulent herb which grows throughout Southeast Asia, in China, Japan, Australia, New Zealand, Ceylon, and in the Himalayas. It is found on wet soil, along waterfall paths and by the rivers. The stems are glabrous, smooth, and somewhat 4-winged. Leaves: simple, decussate, amplexicaul, and without stipules. The blade is elliptic, pellucid-punctuates underneath, and 4 mm × 1.5 mm–2 mm × 1 mm. The margin is entire and recurved; the midrib is raised above and below. The flowers are bright yellow, 6 mm–1 cm in diameter and arranged in elongate and dichotomous

Synonymy: *Sarothra japonica*.

Common name: Matted St John's Wort.

Uses: In China, *Hypericum japonicum* Thunb. is used to treat skin infection, infectious hepatitis, gastrointestinal disorders, and tumors, to counteract poisoning, soothe inflammation, and to heal abscesses. In Vietnam, the plant is used to heal wounds and leech bites. New Guinea: *Hypericum japonicum* Thunb. is part of a remedy used to treat malaria.

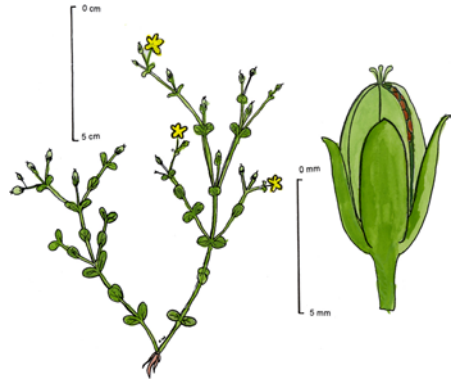
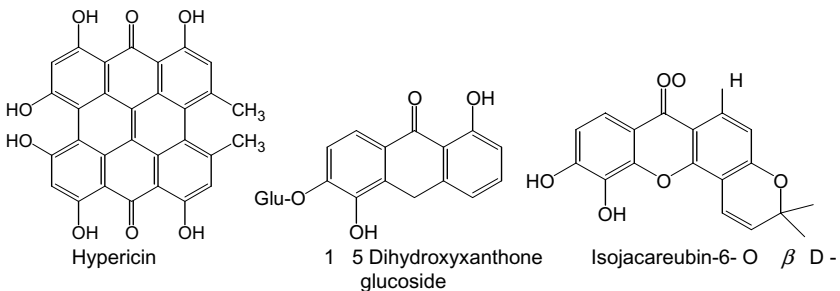


Fig. 95. *Hypericum japonicum* Thunb. From: KLU Herbarium 24155. Herbarium Jutlandicum (AAU), Botanisk Institut Aarhus Universitet. Flora of Thailand project, 4th Expedition 1972. Field collectors: Kai Larsen, Supee S Larsen, I Nielsen & T Santisuk. Eastern Thung Kra Mang. 16° 15' North–101° 30' East, altitude 800 m. Botanical identification: K Larsen.

cymes. The flower pedicels are 6 mm long and the bracts are linear-lanceolate. The sepals are lanceolate, acute and persistent, and there are 5 petals which are bright yellow and obovate. The andrecium consists of a few stamens, the filaments of which are slightly connate at the base. The ovary is single-celled, contains 3 parietal placentas and develops 3 styles upward.

The fruits are ovoid, 3-valved, dehiscent, and somewhat very thin, 6 mm × 3 mm capsules, containing numerous oblong, ribbed seeds that are 0.5 mm long (Fig. 95).

Pharmaceutical interest:



Antiviral properties: Like *Hypericum perforatum* L. (St. John's Wort), the constituent responsible for the red colour of the juice contained in the dots on the leaves and the flowers of *Hypericum japonicum* Thunb. is hypericin. This naphthodianthrone has attracted a great deal of interest on account of its antiretroviral properties, and it has even undergone clinical trials as an anti-HIV drug (Lavie G *et al.*, 1989). Hypericin is probably responsible for the anti-HSV-II activity observed by Zheng in 1989.

Other properties: The antimicrobial activity of *Hypericum japonicum* Thunb. is attributed to saroaspidin A, B, and C and sarothralin G (Ishiguro K *et al*, 1987; 1990). Note that the plant produces xanthenes, jacarellhyperols A and B, which inhibit Platelets Activation Factor-induced hypotension *in vivo* (Ishiguro K *et al*, 2002), as well as 1–5 dihydroxyxanthone-6-O- β -D-glucoside and iso-jacareubin, which promote and inhibit coagulation *in vitro* respectively (Wu QL *et al.*, 1998).

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Warning: Caution must be taken as the toxic effects of this plant are unknown. Hypericin is a photodynamic sensitizer responsible for cattle poisoning.

Mesua ferrea L.

[After J. Mesue (777–857), John of Damascus and from Latin, *ferrum* = iron]

Common names: Iron wood tree; *mesua naghas* (French); *penaga* (Malay); *nagkesara* (Indian & Sanskrit). *Penaga* is a word of Sanskrit origin and the tree has since time immemorial been cultivated in India for its important ceremonial uses.



Physical description: It is a magnificent tree native to India, which grows wild in Burma, Thailand, Indonesia and Malaysia. The wood is very hard, heavy and durable. The bark is dull brown with irregular fissures; the inner bark exudes a clear gum resin. Leaves: green but pinkish-red when young, simple, 6.5 cm–12 cm \times 1.5 cm–4 cm, without stipules and decussate. The blade is elliptic, medium sized, tapered at the apex and at the base, bluish below and greenish brown above; and the numerous secondary nerves are hardly visible on both sides. The flowers are showy, ephemeral, fragrant, white, 9 cm in diameter, solitary and axillary. The perianth consists of 4 sepals and petals, and the petals are whitish. The andrecium is showy and consists of several free

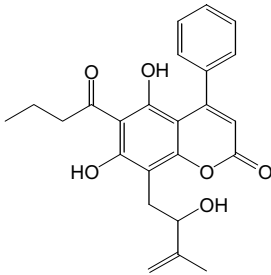
stamens. The gynecium consists of a 1-2-locular ovary, each locule containing 1–2 ovules attached to axillary placentas. The fruits are ellipsoid, shortly beaked, 3 cm in diameter, woody and seated on a persistent calyx, and contain 1–4, woody, glossy seeds with brightly colored partitions (Fig. 96).

Uses: In Burma, the flowers of *Mesua ferrea* L. are used to make an astringent tea and the leaves are used externally to counteract snake-poison. In Malaysia, a bath with these flowers is taken to invigorate health after childbirth. In Indonesia, the pounded seeds or the oil expressed from the seeds are used externally to heal wounds and to treat skin infection.

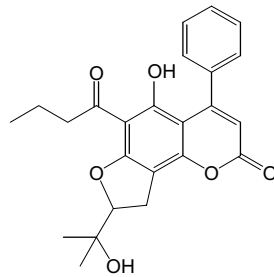


Fig. 96. *Mesua ferrea* L.

Pharmaceutical interest: *Coumarins:* Racemosol and mammea A/AC cyclo F extracted from *Mesua racemosa* are weakly cytotoxicity towards KB cells (Morel C *et al.*, 1999). It will be interesting to learn whether more intensive future research on *Mesua ferrea* L. will disclose any coumarins of chemotherapeutic interest.



Racemosol



Mammea A/AC cyclo F

Reference

Morel C, *et al.* (1999) *Phytochem* **50**(7): 1243–1247.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

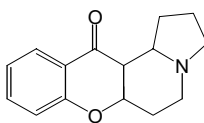
C. Order MALVALES Lindley 1833

The order Malvales consists of 5 families and 3500 species of soft-wooded and mucilaginous trees, shrubs, climbers, and herbs thought to have originated side by side with the Lecythidales from the Theales (Appendix I). All the families of this order, i.e. Elaeocarpaceae, Tiliaceae, Sterculiaceae, Bombacaceae and Malvaceae are allied. The Malvaceae, with about 1500 species and the Sterculiaceae with about 1000 species are the largest families. The *mucilages* of *Malva officinalis* L., family Malvaceae (marsh-mallow), *Sterculia urens* Roxb., family Sterculiaceae (Karaya gum) and *Tilia cordata* Mill., family Tiliaceae (lime tree) are historically of pharmaceutical usefulness. Note that the seeds often abound with a series of unusual cyclopropenyl fatty acids.

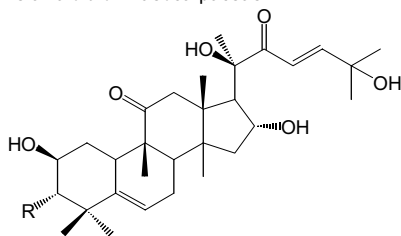


1. Family ELAEOCARPACEAE A. P. de Candolle 1824 nom. conserv., the Elaeocarpus Family

Physical description: The family Elaeocarpaceae is the most primitive family of the Malvales. It consists of 10 genera and 400 species of tropical trees, often containing *indolizidine alkaloids* derived from ornithine and oxygenated steroids known as *cucurbitacins*. In this family, the leaves are simple, often dark green and glossy on the surface alternate, simple, occasionally siphonostelic, minutely toothed, and stipulate. The petiole is long and often bends near the base of the blade. The inflorescences are racemes, panicles or dichasial cymes. The flowers are regular, perfect and hypogynous. The calyx comprises of 3–11, free or connate sepals connate at the base, and



Indolizidine alkaloid of Elaeocarpaceae



Cucurbitacin D (R = O)

valvate. The corolla comprises of 3–5 petals which are valvate and often fringed at the tip. Stamens are numerous and initiated in centrifugal sequence, and often organized into 5 antesealous groups. The gynecium consists of a single or more carpels united into a compound ovary, each locule containing a pair or several ovules attached to axillary placentas. The fruits are capsules or glossy drupes.

Pharmaceutical interest: Elaeocarpaceae are interesting because they elaborate both indolizidine alkaloids and cucurbitacins. Indolizidine alkaloids have attracted a great deal of interest because of their ability to inhibit the enzymatic activity of glucosidases on account of a structural similitude with glucose. Hence, there is some potential in exploring them further in the treatment of HIV, diabetes and cancer. Cucurbitacins are oxygenated steroids with chemotherapeutic potential which have been so far found in the family Cucurbitaceae and Begoniaceae. *Aceratium insulare* A.C., *Elaeocarpus grandiflorus* Smith., *Elaeocarpus madopetalus* Pierre, *Elaeocarpus petiolatus* Wall., *Elaeocarpus floribundus* Bl., *Elaeocarpus sphaericus* (Gaertn.) K. Sch. and *Muntingia calaruba* are used medicinally in the Asia-Pacific.

***Elaeocarpus grandiflorus* Smith**

[From Greek, *elaion* = oil and *karpos* = fruit, and from Latin, *grandis* = full-grown and *floris* = flower]

Physical description: It is a rain-forest tree found in Southeast Asia. Leaves: simple, without stipules and alternate. The petiole is 6 mm–3.5 cm long and slightly curved at the base and the apex. The blade is obovate, thinly leathery, and 7 cm–14 cm × 2 cm–5.5 cm. The apex is acute, the base is pointed, and the margin lobed. The blade shows 7–11 pairs of secondary nerves. The inflorescences are axillary 3.5 cm–10 cm long racemes. The flowers are pendulous, showy, 1 cm–1.3 cm long, and develop 5 petals. The fruits are narrowly fusiform, glossy and 1 cm × 3 cm drupes.

Synonymy: *Elaeocarpus hainanensis* Oliv. *sensu* Corner.

Common name: *Mendong* (Malay).

Uses: In Indonesia, a decoction of the fruits of *Elaeocarpus grandiflorus* Smith. is drunk to promote urination, whereas a decoction of the leaves is drunk to reduce urination. A poultice of the bark is applied externally to heal ulcers. The therapeutic potential of *Elaeocarpus grandiflorus* Smith. is still yet to be discovered.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Elaeocarpus sphaericus* (Gaertn.) K. Sch.**

[From Greek, *elaion* = oil and *karpos* = fruit, and from Latin, *sphaericus* = spherical]

Common names: Bead tree of India, ustram bead tree; *rudraksha* (Sanskrit).

Physical description: It is a tree which grows to a height of 15 m in India, Malaysia, Thailand, Indonesia, the Philippines, and the Pacific Islands. The stems are terete, brownish, lenticelled, smooth and glabrous, and the wood is whitish. Leaves: simple, spiral and without stipules. The petiole is 1.2 cm–1.4 cm long and channeled. The blade is 9 cm × 3 cm–6.7 cm × 1.8 cm, rigid and elliptic-spathulate. The margin is serrate and obscurely recurved. The apex of the blade is acute and the base is tapered. The midrib is flat above and raised below, and the blade shows 10–13 pairs of secondary nerves arching at the margin. The inflorescences are axillary, 4 cm–6.4 cm long racemes. The flower pedicels are 1.1 cm–1.3 cm long, thin and hairy. The flowers are numerous and fragrant. The calyx comprises of 5 caducous, linear, 1 cm long and hairy sepals. The corolla consists of 5, 1.7 cm × 2 mm, free, white, petals, the apex of which is 5-toothed, each tooth being 5.5 mm long and 3-fid. The ovary is velvety, globose and 2.5 mm in diameter, and develops upwards into a 1 cm long hairy style. The fruits are 2.5 cm in diameter, globose, purple and glossy drupes (Fig. 97).

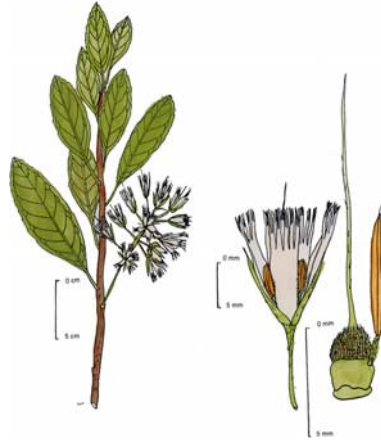


Fig. 97. *Elaeocarpus sphaericus* (Gaertn.) K. Sch. From: KLU Herbarium 005812. Flora of the Mariana Islands. College of Guam Herbarium. Field collector: Benjamin C Stone & J Long, 1 May 1964. Botanical identification: Benjamin C Stone 1968. Geographical localization Summit of Barridaga Hill, approx. 900 feet, limestone forest.

Pharmaceutical interest: Extracts of the fruits (50 mg/Kg–200 mg/Kg i.p, or 200 mg/Kg, *per os*) show significant anti-inflammatory, analgesic, barbiturate-hypnosis potentiation and antiulcerogenic activities in rats and protect guinea-pigs against the bronchospasm induced by histamine and acetylcholine aerosols (Singh *et al.*, 2000) through stabilization of the release of autacoids from mesenteric mast cells, substantiating

Uses: In India, the dried fruits of *Elaeocarpus sphaericus* (Gaertn.) K. Sch. are made into buttons and beads by the devotees of Siva, who believe “the beads to be Siva’s tears of rage at the effrontery of mankind”. The fruits are used to treat mental diseases, epilepsy, asthma, hypertension, arthritis, and liver diseases. In the Philippines, the bark is used to treat splenomegaly.

the efficacy of the plant against bronchial asthma (Singh RK *et al.*, 2000a). An acetone fraction of *Elaeocarpus sphaericus* displays a marked antimicrobial property (Singh RK *et al.*, 1999). A fraction of mixed fatty acids of *Elaeocarpus ganitrus* Roxb. inhibits experimentally-induced convulsion (Dasgupta A *et al.*, 1984). It will be interesting to know whether further research on this tree results in the discovery of neuroactive molecules.

References

- Dasgupta A, *et al.* (1984) *Indian J Physiol Pharmacol* **28**(3): 244–246.
 Singh RK, *et al.* (1999) *Phytother Res* **13**(5): 448–450.
 Singh RK, *et al.* (2000) *Phytotherapy Research* **14**(1): 36–39.
 Singh RK, *et al.* (2000a) *Phytomedicine* **7**(3): 205–207.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Elaeocarpus stipularis Bl.

[From Greek, *elaion* = oil and *karpos* = fruit, and from Latin, *stipula* = straw]

Common names: *Medang tijo, pulai pipit, pinang pergam* (Malay).

Physical description: It is a rainforest tree which grows to a height of 18 m in the rainforests of Malaysia, Borneo, Sumatra, the Philippines, and Java. Leaves: simple, alternate, stipulated, leathery, and 15 cm × 3 cm–7 cm. The petiole is 1.5 cm–2 cm long and curved at the base and the apex. The midrib is pubescent. The stipules are 6 mm long. The inflorescences are axillary racemes. The flowers are 7 mm across. The petals and sepals are lanceolate. The andrecium consists of 25 stamens which are red and showy. The ovary is hairy, globose and 3–5-locular. The fruits are smooth ovoid, glossy and 1 cm long glossy drupes (Fig. 98).

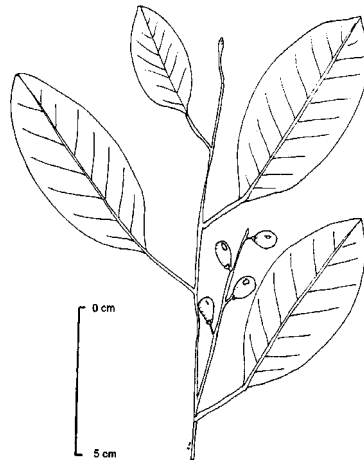


Fig. 98. *Elaeocarpus stipularis* Bl.

Pharmaceutical interest: It will be interesting to learn whether more intensive future research on *Elaeocarpus stipularis* Bl. will disclose any anti-inflammatory molecules.

Uses: In Malaysia, the leaves of *Elaeocarpus stipularis* Bl. are pulped and applied externally to soothe inflamed parts.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family BOMBACACEAE Kunth 1822 nom. conserv., the Kapok-tree Family

Physical description: The family Bombacaceae consists of about 25 genera and 200 species of soft-wooded trees widespread in tropical countries, especially in tropical America. The leaves are simple or palmate, alternate and stipulate; the stipules are deciduous. The flowers are large, hypogynous, and regular. The calyx comprises of 5 sepals which are free or connate at the base and valvate. The corolla consists of 5 petals which are free and convolute. The andrecium comprises of 5 to many stamens initiated in centrifugal sequence. The gynecium consists of 2–8 carpels united to form a compound ovary which encloses as many locules as carpels; with each locule containing 2 ovules or more which are attached to axil placentas. The style is entire or deeply lobed. The fruits are loculicidal capsules often containing arillate seeds. The seeds often contain cyclopropenyl fatty acids.

Pharmaceutical interest: Examples of Bombacaceae are *Durio zibethinus* Murr. (durian tree), *Ochroma pyramidale* (Cav.) Urban (balsa wood tree), *Adansonia digitata* L. (baobab) and *Ceiba pentandra* (L.) Gaertn. (kapok-tree). The resin of *Bombax malabaricum* DC. is the source of the gum of Malabar which is used in Asia for its tonic, aphrodisiac and haemostatic properties.



It will be interesting to learn whether more intensive future research on this family will disclose any molecules of therapeutic interest.

Durio zibethinus Murr.

[From Malay, *duri* = thorn and from Latin, *zibethum* = civet]

Physical description: It is a buttressed tree which grows to a height of 40 m. It is native to Sumatra and

Common names: Durian tree; *durian kampong* (Malay).

Borneo, and is cultivated for its valued fruits. The bark is greyish and the wood is yellowish-orange. Leaves: simple, spiral and without stipules. The petiole is 1.5 cm–2 cm long and obscurely winged. The blade is leathery, covered below with silvery or golden stellate scales, elliptic-oblong, and 10 cm–15 cm × 3.5 cm–4 cm. The midrib is sunken above and raised below, the blade shows 12–16 pairs of secondary nerves. The inflorescences consist of cauliflorous and scaly racemes. The flower pedicels are scaly, somewhat

winged and stout. The flower buds are globose, 1.3 cm × 1.1 cm, and fawn. The flowers are showy, ephemeral, 4 cm long, and comprise a tubular and 5-lobed calyx, and 5 white, spathulate, 2.5 cm × 1.5 cm caducous petals. The stamens are arranged in 5 free bundles and are numerous. The ovary is 5-ribbed and the stigma is protruding. The fruits are large (up to 25 cm × 20 cm), heavy, greenish-yellow, spiny and dehiscent capsules containing a few woody seeds embedded in a yellowish, creamy pulp noted for its fetid smell and agreeable taste (Fig. 99).

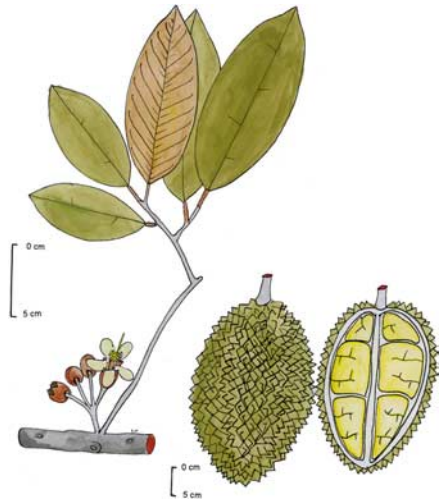


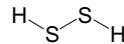
Fig. 99. *Durio zibethinus* Murr.

Uses: In Indonesia, the ash of burned capsules is used to abort a pregnancy and to promote menses, while the juice of the fruit is used to promote venereal desire. In Malaysia, a bath of the leaves is used to treat jaundice, and a decoction of the roots is used to break a fever. It is believed that drinking water from an empty capsule will lower the heat evolved after consumption of its flesh.

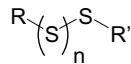
Pharmaceutical interest: The peculiar civet smell of durian is partly attributed to a series of polysulphides, hydrogen sulphide, 1, 1 diethoxane and ethyl-2-methylbutanoate (Moser R *et al.*, 1980; Fig. 100). The oil expressed from the seeds is used as a stabilizer in a patented pesticidal composition (Patent US 4892866). It will be interesting to learn whether more intensive future research on this family will disclose any molecules of therapeutic interest.



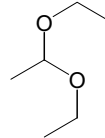
Hydrogene sulphide



Hydrodisulphide



Dialkylpolysulphide



1,1 - Diethoxyethane

Fig. 100. Some chemical principles responsible for the peculiar smell of durian.

D. Order LECYTHIDALES Cronquist 1957

The order Lecythidales consists of the single family Lecythidaceae which is thought to have originated from the Malvales, from the order Theales from where it has inherited the feature of using triterpenoid and tannins as chemical weapons (Appendix I).

1. Family LECYTHIDACEAE Poiteau 1825 *nom. conserv.*, the Brazil-nut Family

Physical description: The family Lecythidaceae consists of 20 genera and 400 species of soft-wooded tropical trees known to abound with *tannins* and *saponins*. In this family, the leaves are simple, alternate, commonly crowded at the tips of the stems, toothed, glossy, tapered at the base and without stipules. The flowers are ephemeral, epigynous, perfect, showy, and regular. The calyx consists of 2–12 valvate sepals. The corolla consists of 4–6 petals which are free, imbricate and thin. Note that the perianth and the andrecium are often fused and dropped together. The andrecium comprises of numerous stamens either inserted in centrifugal series or gathered in a very characteristic tongue-shaped and succulent body. The gynecium consists of 2–6 carpels united into a 2–6-locular, inferior ovary, each locule containing a single or many ovules attached to an axillary or a basal placenta. The fruits are capsular or drupaceous, large and marked at the apex by a conspicuous nectary disc.



Pharmaceutical interest: A classical example of Lecythidaceae is *Bertholletia excelsia* Humboldt & Bompland, the seeds of which are the commercial Brazil-nuts. Another example is *Couroupita guianensis* Aubl. (canon-ball tree), which is cultivated to decorate parks and other public areas in some tropical countries. In Southeast Asia, *Barringtonia acutangula* (L.) Gaertn.



(*Barringtonia luzonensis* (Presl) Vidal), *Barringtonia asiatica* (L.) Kurz. (*Barringtonia speciosa* J.R. & G. Forst., *Barringtonia butonica* Forst.), *Barringtonia racemosa* (L.) Spreng., *Barringtonia macrostachya* (Jack) Kurz (*Barringtonia cylindrostachya* Griff.), *Careya arborea* Roxb., *Careya sphaerica* Roxb., *Chydenanthus excelsus* (Bl.) Miers, (*Barringtonia vriesii* Teijs. & Binn.), and *Planchonia papuana* R. are used to treat various ailments, including diarrhea, skin problems and rheumatism. Note also that the seeds of several of these plants are used to catch fish on account of their stupefying saponins. It will be interesting to learn whether more intensive future research on this family will disclose any molecules of therapeutic interest such as cucurbitacins.

***Barringtonia acutangula* (L.) Gaertn.**

[After D. Barrington, an English naturalist of the 19th century, and from Latin, *acuere* = sharpen and *angulus* = angle]

Synonymy: *Barringtonia luzonensis* (Presl) Vidal.

Physical description: It is a small tree which grows by the river banks and fresh water mangroves, in the geographical zone spanning India to Papua New Guinea. The bark of its stem is greyish and cracked longitudinally. The wood is whitish and soft. Leaves: simple, spiral, without stipules and crowded at the apex of the stems. The petiole is 6 mm–1 cm long and flattened above. The blade is spatulate, 3.2 cm × 1.5 cm–4 cm × 7 cm, glossy, soft, and serrate. The midrib is raised above and below. The blade shows 7–9 pairs of secondary nerves which are sunken above and raised below. The tertiary nerves are visible and raised above the blade. The inflorescences are terminal and pendulous 20 cm–30 cm long racemes. The flowers are 6 mm long with a quadrangular receptacle, and have 4 sepals and a conspicuous nectary disk (Fig. 101).

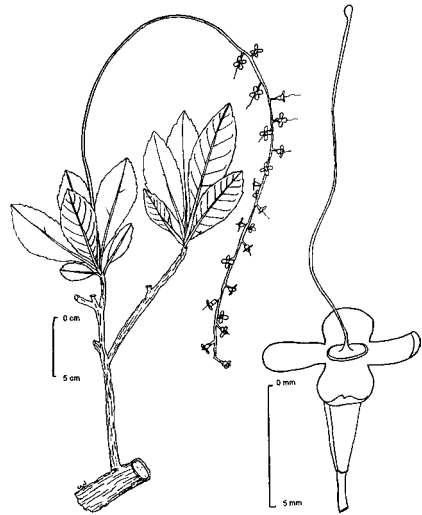
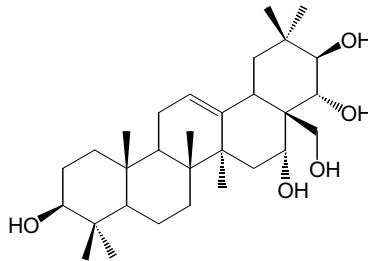


Fig. 101. *Barringtonia acutangula* (L.) Gaertn. From: KLU Herbarium 27518. Plants of Ceylon. Geographical localization: Eastern Province, Amparai District, ca. 3 miles Northwest of Maha Oya, altitude 50 m. 3 Dec 1974. Field collectors: Gerrit Davidse & DB Sumithraarachchi.

Pharmaceutical interest The medicinal properties mentioned above are yet to be confirmed, but one might suppose tannins confer bitterness and astringency to the plant. The ichthyotoxic property of the seeds are confirmed experimentally (Chakraborty DP *et al.*, 1972) and is probably attributed to a series of pentacyclic saponins which include barringtoside A (3-*O*- β -D-xylopyranosyl(1 \rightarrow 3)-[β -D-galactopyranosyl(1 \rightarrow 2)],- β D-glucuronopyranosyl barringtogenol C); barringtoside B, (3-*O*- β -D-xylopyranosyl(1 \rightarrow 3)] β -D-galactopyranosyl(1 \rightarrow 2)]- β D-glucuronopyranosyl-21-*O*-tigloyl-28-*O*-isobutyryl barringtogenol C); and barringtoside C (3-*O*- α -L-arabinopyranosyl(1 \rightarrow 3)-[β D-galactopyranosyl(1 \rightarrow 2)]- β D-glucuronopyranosyl barringtogenol C (Pal B.C. *et al.*, 1994).

Uses: In Burma, *Barringtonia acutangula* (L.) Gaertn. is used to promote appetite, to treat ophthalmia and diarrhea. In Laos, Cambodia, and Vietnam, *Barringtonia acutangula* (L.) Gaertn. is used to treat gingivitis, diarrhea, blenorrrhea, menorrhagia and malaria, counteract insect-poisoning, and to check bleeding. The seeds are also used there to stupefy fish. In the Philippines, *Barringtonia acutangula* (L.) Gaertn. is used to heal wounds and treat stomach problems.



Barringtogenol C

References

- Chakraborty DP, *et al.* (1972) *Indian J Exp Biol* 1(10): 78–80.
 Pal BC, *et al.* (1994) *Phytochem* 35(5): 1315–1318.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

D. Order NEPENTHALES Lindley 1833

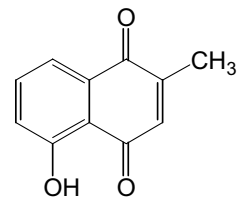
The order Nepenthales consists of the Droseraceae (100 species), Nepenthaceae (75 species) and Sarraceniaceae (15 species). Nepenthales are perennial herbs which have evolved with the Malvales from a common ancestry in Theales carnivorous plants forced to adapt habitats deficient in nitrogen (Appendix I). The main chemical weapons used in this order are *flavonoids* and *naphthoquinones*.

1. Family *NEPENTHACEAE* Dumortier 1829 *nom. conserv.*, the East Indian Pitcher-plant Family.

Physical description: The family Nepenthaceae consists of the single genus *Nepenthes*, with about 75 species of carnivorous, dioecious, tanniferous, erect or prostrate, often epiphytic herbs, which are thought to have originated from the order Theales. Nepenthaceae really stand apart in the Magnolopsida with their leaves which have evolved into pitchers used to trap insects as a source of nitrogen. The inflorescences are racemose or paniculate. The flowers are small, actinomorphic, hypogynous and unisexual. The calyx consists of 3–4 sepals which are imbricate, free, persistent, and glandular within. The andrecium comprises of 4–25 stamens, the filaments of which are united into a column, and the anthers of which are tetrasporangiate, open lengthwise and dithecal. The gynecium consists of 4 carpels facing the sepals which are united into a compound, 4-locular ovary, each locule containing numerous ovules attached to an axile placenta. The fruits are loculicidal capsules containing numerous seeds.



Pharmaceutical interest: Nepenthaceae are interesting because they produce *naphthoquinones* of pharmacological interest (these substances justify the regroupment of Nepenthaceae with the Sarracenaceae and Droseraceae in the order Nepenthales instead of within the order Aristolochiales where they are absent). One such naphthoquinone is plumbagin, which is cytotoxic, irritating and antimicrobial. In the Asia-Pacific, *Nepenthes ampullaria* Jack and *Nepenthes boschiana* Korth. are used for medicinal and magic purposes. Little is yet known about the pharmacological potential of the family Nepenthaceae.



Plumbagin

***Nepenthes ampullaria* Jack**

[From Greek, *nēpenthēs* = griefless and from Latin, *ampulla* = Roman 2-handled flask]

Physical description: It is a climber found in the rainforests of Malaysia and Indonesia. The stem is terete. Leaves: simple, pitcher-shaped, alternate, sessile and without stipules. The blade is elliptic-spathulate, leathery, 7 cm–20 cm × 2.4 cm–5.2 cm, and rusty tomentose below. The margin is entire and recurved. The midrib sunken above and raised below the blade. The apex of the blade extends into a 2 cm–7 cm long velvety tendril of terminated with or without a light green, broad, 7 cm × 5.8 cm–5.3 cm × 4 cm pitcher (Fig. 102).

Uses: In Malaysia, a decoction of the roots of *Nepenthes ampullaria* Jack is drunk to treat dysentery and to assuage stomachache.

Pharmaceutical interest: The pharmacological potential of *Nepenthes ampullaria* Jack is still waiting to be discovered. The use of this plant may be on account of its astringency. Note that a series of antimalarial naphthoquinones, including plumbagin, 2-methylnaphthazarin and droserone, have been characterized from the roots of *Nepenthes thorellii* (Likhitwitayamuid K *et al.*, 1998). Such naphthoquinones are probably present in *Nepenthes ampullaria* Jack.

Reference

Likhitwitayamuid K, *et al.* (1998) *Planta Med* **64**(3): 237–241.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family DROSERACEAE Salisbury 1808 nom. conserv., the Sundew Family.

Physical description: The family Droseraceae consists of 4 genera and about 100 species of discrete perennial herbs forming rosettes of leaves, which

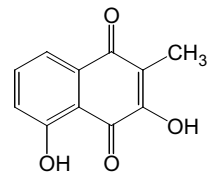
Common names: *Akar tekuyot* (Malay).



Fig. 102. *Nepenthes ampullaria* Jack. From: KLU Herbarium 32151. Flora of Malaya. University of Malaya Herbarium. Field collector & botanical identification: Benjamin C Stone, 23 Nov 1980. Geographical localization: Johor, Kota Tinggi, ridge forest, dipterocarps, altitude: 1000 ft Malaysia.

are often circinate in buds and usually covered with sticky stipitate glands or marginal bristles which entrap insects. *Naphthoquinones* and *flavonoids* are known to occur in this family. The inflorescences are simple and circinate cymes of bisexual flowers. The calyx comprises of 4–5 sepals which are imbricate and persistent. The corolla consists of 5 petals which are hypogynous and free. The anthers are 2-locular, extrorse, and open by longitudinal slits. The gynecium consists of 3–5 carpels united to form a compound and unilocular ovary containing 3 to numerous anatropous ovules attached to central or parietal placentas. The fruits are loculicidal capsules containing several spindle-shaped seeds.

Pharmaceutical interest: A classical example of Droseraceae is *Dionaea muscipula* (Venus's flytrap), which has attracted a great deal of interest on account of its leaves which entrap insects. Traditionally used in Europe to treat spasms, soothe and calm cough were *Drosera rotundifolia* L., *Drosera anglica* Huds. (*Drosera longifolia* L.) and *Drosera intermedia* Hayne (sundews, red roots). The air-dried entire *Drosera rotundifolia* (*Drosera*, *French Pharmacopoeia*, 1965) has been used to treat chronic bronchitis, asthma, and whooping cough, usually as tincture (1 in 5; dose 0.5 mL–2 mL). D naphthoquinones including plumbagin and droserone, which are irritating and antibacterial against a broad spectrum of Gram-positive and Gram-negative organisms, fungi and protozoa (*Leishmania*, *Plasmodium*). *Drosera burmannii* Vahl, *Drosera rotundifolia* L., *Drosera indica* L., and *Drosera peltata* Sm. are of medicinal value in Southeast Asia. Not much is yet known about the pharmacological potential of the family Droseraceae.



Droserone

Drosera burmannii Vahl

[From Greek, *droseros* = dewy and after N.L. Burmann, 18th century Dutch botanist]

Physical description: It is a little herb found in the wet grassland and sandy heaths of India, Japan, Malaysia, Australia, China, Cambodia, Ceylon, Thailand, Laos and Vietnam. The plant grows from a tiny reddish rosette of leaves. Leaves: small, 4 mm × 3 mm–6 mm × 16 mm, orbicular and covered with sticky, stipitate, moving, glittering and reddish glands. The inflorescences are cymes on top of 8 cm–13 cm tall erect stems. The flower pedicels are 2.5 mm long. The calyx is red and comprises of a few lanceolate and 2.5 mm × 1.5 mm sepals. The corolla is white and very thin. The anthers are yellow (Fig. 103).

Common names: *chin ti lo* (Chinese); *co troi ga* (Vietnam).

Uses: In China, *Drosera burmannii* Vahl is used to treat dysentery, scrofula and malaria. In Laos, Cambodia and Vietnam, *Drosera burmannii* Vahl is used to treat whooping cough and spasms.

Pharmaceutical interest: The medicinal properties of *Drosera burmannii* Vahl await experimentation. Note however that the antidysenteric property mentioned above could involve the astringency of tannins as well as antibacterial/antiplasmodial naphthoquinones, such as plumbagin from *Drosera peltata* which inhibits the growth of oral bacteria cultured *in vitro* (Didry N *et al.*, 1998).

Flavonoids: In regard to the antispasmodic properties of *Drosera* species, a number of experiments conducted *in vitro* tend to demonstrate that the binding of flavonoids to cholinergic and histaminic decreases the contraction of smooth muscles. As an example, ethanolic extract of *Drosera madagascariensis* (0.5 mg/mL–1 mg/mL) containing quercetin, isoquercitrin and hyperoside, relaxes isolated portions of guinea-pig ileum through cholinergic receptors and histamine H₁ receptors, respectively. Note that quercetin (IC₅₀ 0.8 μg/mL), hyperoside (IC₅₀ 0.15 μg/mL) and isoquercitrin (IC₅₀ 0.7 μg/mL) inhibit human neutrophil elastase with an IC₅₀ of 9.4 μg/mL (Melziq MF *et al.*, 2001).

References

- Didry N, *et al.* (1998) *J Ethnopharmacol* **60**(1): 91–96.
Melziq MF, *et al.* (2001) *Phytomed* **8**(3): 225–229.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

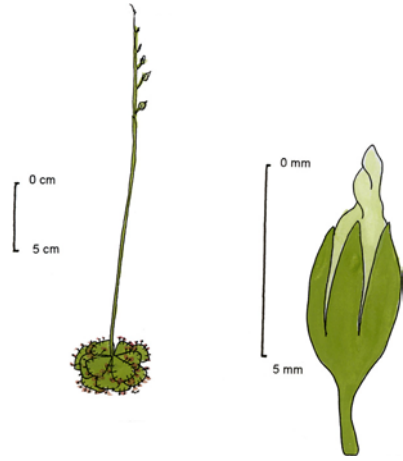
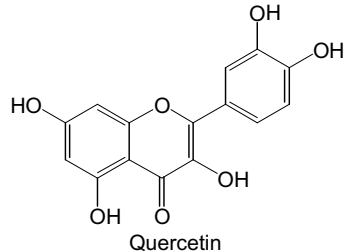


Fig. 103. *Drosera burmannii* Vahl. From: KLU Herbarium 12440. Plants of Cambodia. University of Malaya Herbarium. Field collector: Benjamin C Stone, 7 Mar 1970. Geographical localization: Mt. Kam Chai, Poporkville. Botanical identification: JE Vidal 2/1973.



***Drosera indica* L.**

[From Greek, *droseros* = dewy and from Latin, *indica* = from India]

Common name:

Uses: In Laos, Cambodia and Vietnam, *Drosera indica* L. is used to soothe callosities and corns. The pharmacological potential of *Drosera indica* L. is still waiting to be discovered.

Physical description: It is a tiny herb which grows to a length of 30 cm. It is found in India, Burma, China, Australia, Vietnam, Laos, and Cambodia. Leaves: alternate, simple, tentacle-shaped, 5 cm long, channeled, and covered with microscopic infundibuliform sticky and moving hairs. The inflorescences are axillary cymes of 5.5 cm–20 cm in length. The pedicels are 6 mm–13 mm long. The calyx consists of 5 oblong sepals united at the base, 1.5 mm long and hairy. The corolla consists of 3-lobed, white, 3.5 mm × 4 mm, and spatulate petals. The fruits are dehiscent 3-lobed capsules, which are smooth, glossy, and crowned with a few membranous fragments of corolla. The seeds are very small, black, and longitudinally ribbed (Fig. 104).

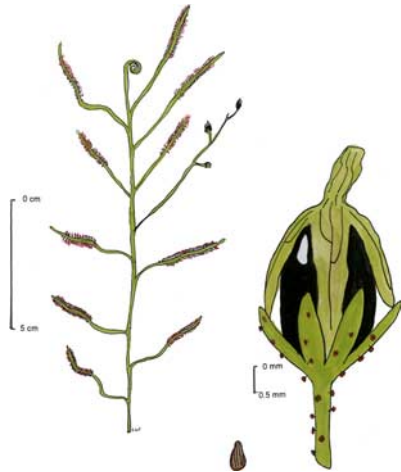


Fig. 104. *Drosera indica* L. From: KLU Herbarium 30687. The Forest Herbarium (BKF), Royal Forest Department. Flora of Thailand. Geographical localization: Burirum, altitude: 130 m, 27 Nov 1978. Field collectors: C Phengklai *et al.* Botanical identification: Shamlong.

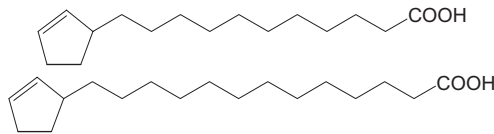
Warning: Caution must be taken as the toxic effects of this plant are unknown.

D. Order VIOLALES Lindley 1833

The order Violales consists of 24 families and about 5000 species of plants which are thought to have originated, alongside with the Capparales, from the order Theales, somewhere near to the Malvales (Appendix I). In regard to the chemical repellents used in this order Datisceae, Cucurbitaceae and Begoniaceae use steroidal saponins, Ancistrocladaceae and Dioncophyllaceae use of isoquinoline alkaloids and cyanogen glycosides and cyclopentenic fatty acids are common in Passifloraceae and Flacourtiaceae. The family Flacourtiaceae is the most archaic family of the order Violales and is thought to connect the Theales to the Violales.

1. Family FLACOURTIACEAE A. P. de Candolle 1824 nom. conserv., the Flacourtia Family

Physical description: The family Flacourtiaceae consists of 85 genera and more than 800 species of tropical trees or shrubs. The leaves are simple, alternate, and pellucid-dotted or lined, and the stipules are often deciduous. The flowers are dioecious or polygamous, and often hypogynous. The calyx comprises of 3–15 sepals which are free, imbricate and alternate with the petals. The corolla comprises of 3–15 petals which are free, imbricate, and occasionally not distinguishable from the sepals. The andrecium consists of several stamens arranged in bundles opposite to the petals. The anthers are 2-celled and open by longitudinal slits. The gynecium consists of 2–10 carpels forming a compound, superior, and single-celled ovary containing 2 to several ovules. The ovules are anatropous to amphitropous or orthotropous, and are attached to parietal placentas. The styles are free or united to varying degrees, and the stigmas are distinct. The fruits are berries, or capsules or drupes. The seeds are often embedded in an aril.



Hydnocarpic acid

Chaulmoogric acid

Pharmaceutical interest: The freshly expressed oil of the seeds of *Casearia sylvestris* (Brazil), *Hydnocarpus alcalae* C. DC. (Filipino), *Hydnocarpus anthelminticus* Pierre (*Iukrabo* or *ta fung tsze* seeds, Cambodia, Laos, Vietnam), *Hydnocarpus wightiana* (India), *Oncoba echinata* (*gorli* oil) and *Hydnocarpus kurzii* (King) Warb. (Chaulmoogra oil), has been used externally since a very remote period in time to treat leprosy. This oil contains a unique class of *cyclopentenic fatty acids*, such as chaulmoogric acid (13-cyclo-pent-2-enyl-n-tridecanoic acid), hydnocarpic acid and gorlic acid, which destroy *Mycobacterium leprae*. Another example of medicinal Flacourtiaceae is *Aphloia madagascariensis* Clos., which appears in a few proprietary drugs used to promote urination. About 20 species of plants classified within the family Flacourtiaceae are used for medicinal purposes in Southeast Asia. Note that the oil expressed from the seeds is often used to treat skin diseases.

Casearia grewiaefolia Vent.

[After J Caesarius (1642–1678), preacher in Dutch East India Company and from Latin, *grewiaefolia* = leaves like *Grewia*]

Physical description: It is a rainforest tree which grows to a height of 24 m and a girth of 180 cm. The stems are softly hairy and slightly zigzag-shaped.

Leaves: simple, stipulate, 10 cm × 3.5 cm and spiral. The stipules are deciduous. The blade is tomentose below, oblong, tapered at the apex and squarish at the base, and shows about 20 pairs secondary nerves. The inflorescences are clusters on stems behind leaves. The fruits are globose, ribbed, with persistent calyces, and contain a few seeds embedded in a juicy aril.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Synonymy: *Casearia hexagona* Decne, *Casearia laurina* Blume, *Casearia leucolepis* Turcz.

Common name: Big-leaved caesaria; *utong manok* (Indonesian).

Uses: In Cambodia, a decoction of the bark is drunk to invigorate health after childbirth. It will be interesting to learn whether a more intensive study on this plant will disclose any cytotoxic clerodane diterpenes such as casearvestrins reported *Casearia sylvestris* (Oberties NH *et al.*, 2002).

Reference

Oberties NH, *et al.* (2002) *J Nat Prod* **65**(2): 95–99.

Flacourtia rukam Zoll. & Mor.

[After E de Flacourt (1607–1660), a French Governor of Madagascar, and from Malay, *rukam* = *Flacourtia rukam* Zoll. & Mor.]

Uses: The ripe berries of *Flacourtia rukam* Zoll. & Mor. are acid and astringent, but rubbing them between the hands bruises the flesh and renders it sweet and palatable. In Indonesia, the sap expressed from young shoots is used to wash the eyes. In Malaysia, the juice expressed from the berries is ingested to stop diarrhea and dysentery. The sap expressed from the leaves is applied to inflamed eyelids. The powdered dried leaves are used to heal wounds. In the Philippines, a decoction of the roots is drunk to invigorate health after childbirth. The pharmacological properties of *Flacourtia rukam* Zoll. & Mor. are unknown til to date.

Synonymy: *Hiaingera grandiflora* Turez, *Flacourtia inermis* Merr.

Common name: Indian prune.

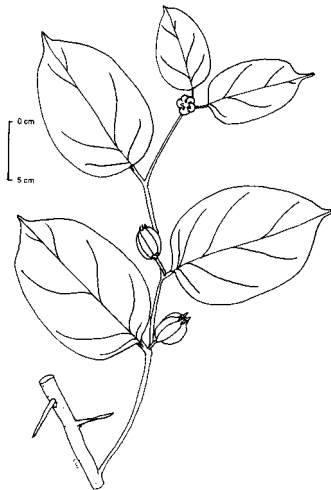


Fig. 105. *Flacourtia rukam* Zoll. & Mor.

Physical description: *Flacourtia rukam* Zoll. & Mor. or Indian prune is a small rainforest tree of Southeast Asia. The trunk and the stems are covered with strong and up to 4 cm long woody thorns. The bark is soft and yellowish, and the wood is hard, sappy and heavy. Leaves: simple, spiral, without stipules, and 11 cm–17 cm × 4 cm–10 cm. The blade is tapered at the apex into a 1 cm–2 cm long tail. The base of the blade is broadly wedge-shaped. The margin is lobed. The inflorescences are very small axillary clusters of whitish flowers. The fruits are glossy, red and 2.5 cm long, crowned with a ring of peg-like persistent styles (Fig. 105).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Hydnocarpus species

[From Greek, *hudron* = truffle and *karpos* = fruit]

Physical description: Forty species of Southeast Asian trees make up the genus

Common name: *Setumpol* (Malay).

Hydnocarpus Gaertn. The bark of *Hydnocarpus* species is smooth. Leaves: simple, spiral and stipulate. The stipules are deciduous. The petiole is woody, transversally cracked, and bends at the base. The blade is leathery, asymmetric at the base, and the margin is entire. The inflorescences are small and cymose clusters of unisexual flowers. The calyx consists of 4–5 deciduous sepals. The corolla comprises of 4–5 petals which are papery and scaly inside at the base. The andrecium consists of 5 to several stamens. The ovary is sessile and encloses 3 placentas. The stigmas consist of 3–5 long branches. The fruits are large, rugose, and woody capsules containing several seeds packed in a pulp.

Pharmaceutical potentials:

Anti-mycobacterial properties:

The fixed oil expressed from the fresh ripe seeds of *Hydnocarpus wightiana*, *Hydnocarpus anthelminticus* Pierre, *Hydnocarpus kurzii* (King) Warb. (*Taraktogenos kurzii*) and *Hydnocar-*

Uses: In the Asia-Pacific, the oil expressed from the seeds of *Hydnocarpus anthelminticus* Pierre, *Hydnocarpus kurzii* (King) Warb., *Hydnocarpus hainanensis* Merr., and *Hydnocarpus alcalae* C. DC.) is applied externally to treat leprosy and other skin infections.

heterophylla is *Hydnocarpus* oil or chaulmoogra oil (*International Pharmacopoeia*, 1967). Chaulmoogra oil was the only effective treatment for leprosy for centuries until the recent arrival of chemotherapeutic agents. The active principles involved here are a series of unusual cyclopentenic unsaturated fatty acids such as chaulmoogric acid, the mode of action of which is still unknown. Both Wistar rats experimentally-wounded (Oommen ST *et al.*, 1999) and mice infected with resistant *Mycobacterium leprae*, recovered when fed with a mixture consisting of *Hydnocarpus* oil and dapsone (Desai AC *et al.*, 1977).

Healing properties: In regard to the dermatological property of *Hydnocarpus* oil, a number of experiments conducted both *in vitro* and *in vivo* tend to

demonstrate that the oil of *Hydnocarpus* heals wounds and could be of value for making cosmetics. *Hydnocarpus* oil increases body weight, strengthens collagen tissue and increases the production of hydroxyproline in male.

Other properties: Hydnowightin, hydnocarpin and neohydnocarpin, 3 flavolignans characterized from *Hydnocarpus wightiana*, lower both serum cholesterol and triglyceride levels in rodents. Hydnocarpin is also anti-inflammatory *in vivo*, and all the compounds annihilate the survival of a number of cancer cell-lines cultured *in vitro* (Sharma DK *et al.*, 1991). An alcoholic extract of the seeds of *Hydnocarpus wightiana* inhibits the proliferation of Human *Ascaris lumbricoides* cultured *in vitro* (Raj RK, 1975).

References

- Desai AC, *et al.* (1977) *Lepr India* **49**(3): 360–363.
 Oommen ST, *et al.* (1999) *Int J Lepr Other Mycobact Dis* **67**(2): 244–246.
 Raj RK, (1975) *Indian J Physiol Pharmacol* **19**(1).
 Sharma DK, *et al.* (1991) *J Nat Prod* **54**(5): 1298–1302.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Pangium edule Reinw.

[From Indonesian, *pangi* = a name and from Latin, *edule* = edible]

Physical description: It is a tree which grows to a height of 25 m and a girth of 45 cm. It is found wild or

Common name: *Kepayang* (Malay); *penace* (Indonesian).

Uses: In Indonesia, a cold water infusion of fresh leaves or seeds is applied externally to counteract putrefaction and expel parasites. In Indonesia, Malaysia, and Papua New Guinea, the seeds are eaten after careful preparation to remove cyanides. The plant is also used in Malaysia to preserve meat and the oil expressed from the seeds is used for food. It will be interesting to learn whether more intensive future research on this family will disclose any molecules of therapeutic interest.

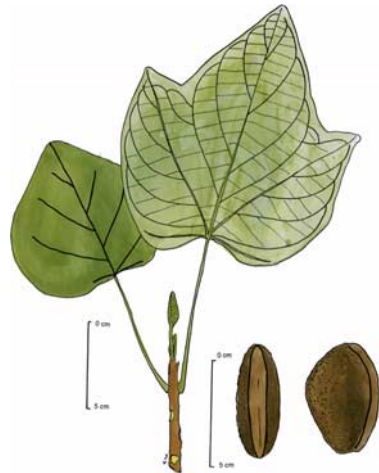


Fig. 106. *Pangium edule* Reinw. From: KLU Herbarium 043112. Herb. Lugd. Batav. Field collector & botanical identification: Avé 23.1.83. Geographical localization: Kampung Sekam, Northeast of Tapah, Perak, West Malaysia, 4°20' North–101°20' East, altitude 600 m. From: KLU Herbarium 039560. Flora of Sulawesi Selatan. Field collector & botanical identification: SC Chin, 13 June 1986. Geographical localization: Karaenta Park, near the 56 km milestone from Ujung Pandang.

cultivated throughout the Asia-Pacific where it has manifold uses. The bark is brown and smooth; the inner bark is orange-yellow. The stems are velvety when young. Leaves: simple, spiral, without stipules, crowded at the apex of the stems. The petiole is 9 cm–16 cm long and thin. The blade is 15.7 cm × 16.3 cm–24.1 cm × 26.3 cm, papery, glabrous, and cordate or somewhat 3-lobed, and the margin is recurved. The blade shows 6–9 pairs of secondary nerves and tertiary nerves which are scalariform. The flowers are 1.5 cm–2.5 cm long and green. The fruits are 9 cm–14 cm in diameter, scurfy, brownish, bluntly tipped at both ends, hanging from long pedicels of 8 cm–15 cm long, in groups and contain several 5.8 cm × 4.4 cm × 2 cm warty seeds (Fig. 106).

Warning: All parts of this plant and especially the seeds are poisonous because of hydrocyanic acid which is released from gyncardin. The bark and the leaves are used to poison fish, so that they rise to the surface to be harvested.

***Xylosma congesta* (Lour.) Merr.**

[From Greek, *xylos* = wood and *osma* = smells and from Latin, *congestionem* = congested]

Physical description: It is a small tree found in Southeast Asia and China. The stems are glabrous. Leaves: simple, rhomboid, 2.5 cm–3.5 cm, and obscurely serrate. The flowers are dioecious and arranged in axillary short cymes. The male flowers are 3 mm long, comprise of 5 imbricate sepals and several stamens. The fruits are globose berries containing several seeds.

Pharmaceutical interest: The therapeutic potential of this plant is unexplored yet. Xylosmacin, a phenyl glucoside, was characterized from *Xylosma velutina* by Cordell *et al.* (1977).

Synonymy: *Croton congestum* Lour., *Xylosma racemosum* Miq., *Xylosma japonicum* A. Grey, *Xylosma apactis* Koidz., *Xylosma congestum* (Lour.) Merr. *Xylosma senticosum*, *Myroxylum senticosum*.

Common names: *Tung ch'ing* (Chinese).

Uses: In China, the ash of the bark is mixed with water and the mixture is drunk to treat jaundice and tumors, heal scrofulous sores and to induce delivery in labor. The roots are used to facilitate parturition.

Reference

Cordell GA, *et al.* (1977) *Lloydia* **40**(4): 340–343.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family BIXACEAE Link. 1831 nom. conserv., the Lipstick-tree Family

Physical description: The family Bixaceae consists of 3 genera and about 20 species of tropical shrubs. In this family, the leaves are simple, alternate, stipulate, palmately nerved, lobed or compound. The flowers are hermaphrodite, showy, hypogynous and arranged in panicles or racemes. The calyx consists of 5 distinct, imbricate, deciduous sepals, and the corolla consists of 5 large, imbricate, and convolute petals. The andrecium consists of several stamens initiated in a centrifugal sequence, the anthers of which are horseshoe-shaped. The gynecium consists of 2–5 carpels forming a single-locular ovary containing several ovules attached to parietal placentas. The style is long and thin, and the stigma forked. A nectary disc is present. The fruits are densely echinate-setose or smooth, bi-valved capsules, containing several seeds the testa of which is succulent and red.

Pharmaceutical interest: The seeds of *Bixa orellana* L. (lipstick tree) contain annatto, which is a permitted dye for food, drugs and cosmetics. The estimated world production of annatto seeds is 4000 tons from Ecuador, India, Kenya and Peru. Although interest in annatto has dramatically declined with the advent of synthetic dyes, its use is steadily increasing since it is a non toxic food additive. Thus far, no molecule of pharmacological interest is known to exist in this family.

Bixa orellana L.

[From South American, *bixa* = *Bixa orellana* L.]

Physical description: It is a shrub or small evergreen tree native to northern South America. It is widely cultivated for its seeds or as an ornamental plant in the West Indies, tropical Asia and Africa. Leaves: simple and spiral. The petiole is 5 cm–7.5 cm long. The blade is 10 cm–20 cm × 6.3 cm–12.5 cm, dark green, ovate, acute or acuminate, truncate or subcordate at the base and glabrous. The flowers are 5 cm in diameter, showy, and arranged in terminal panicles. The pedicels are pubescent. The calyx consists of 2 small concave sepals and 3 large oblong sepals. The corolla comprises of 5 pinkish or white obovate petals which are very thin. The andrecium comprises of numerous stamens. The fruits are dehiscent, ovoid or subglobose capsules clothed in slender prickles and containing 15–20 trigonous seeds embedded in a bright red pulp (Fig. 107).

Common names: Annatto, lipstick tree; *thideng*, *thidin* (Burmese); *chompuh chralok* (Cambodian), *champu*, *xiem phung* (Chinese); *arnatto*, *roucou*, *roucouyer*, *anate* (French); *achiote*, *anate* (Filipino); *arnotto* (Portuguese); *sinduri*, *virpushpa* (Sanskrit); *avam* (Tamil).

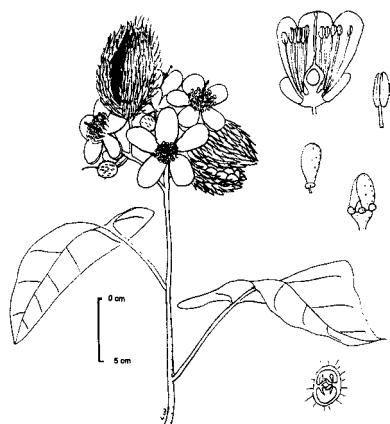
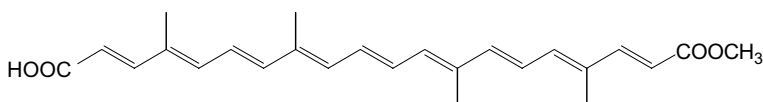


Fig. 107. *Bixa orellana* L.

Pharmaceutical interest: The coloring principle of annatto is bixin, a C_{24} -apocarotenoid first isolated in 1875, which represents 2.5% (dry weight) of the seeds. Annatto is extracted with water and used to dye food (European identification code E160b, maximum daily allowance: 2 mg/Kg). Like many other carotenoids, bixin is antioxidant and is able to scavenge free radicals.

In vitro bixin scavenges superoxide anions generated by the xanthine/xanthine oxidase more efficiently than lutein and β -carotene (Zhao W *et al.*, 1998). Irradiated rats (10Gy.) fed with bixin at 200 μ M/Kg have less lung collagen hydroxyproline and less serum and liver lipid peroxydation (Thremsiamma KC *et al.*, 1996). Trans-bixin characterized from annatto decreases the glycaemia in anaesthetized dogs. The electron microscopy of portions of pancreas and liver revealed damaged mitochondria and endoplasmic reticulum suggesting a possible risk of diabetes (Morrison EY *et al.*, 1991). Annatto intake results in a decrease of IgE production by rat spleen lymphocytes at 10 μ M (Kuramoto Y *et al.*, 1996). However, the absence of carcinogenic and anticarcinogenic effects of annatto in the rat liver medium-term assay has been observed (Agner AR *et al.*, 2004).

Uses: In Cambodia, the leaves of *Bixa orellana* L. are used to treat fever. In Indonesia, the water in which the leaves of *Bixa orellana* L. were rubbed is poured over the head of children to treat fever. In Malaysia, the leaves are used in a postpartum medicine. In the Philippines, the leaves are pounded in coconut oil and heated, then applied to the abdomen to relieve tympanites. A paste made from the fresh leaves is used to make a rubefacient remedy, and a decoction of the leaves is used to stop dysentery. The unripe fruits are used as an emollient to treat leprosy. A decoction of the bark is drunk to treat febrile catarrh. In Cambodia, Laos, and Vietnam, a lotion or a bath of the leaves is used to treat fever, and an infusion of the seeds is drunk to treat asthma and excessive secretion of mucus from the nasopharynx. An alcoholic extract of the seed coat is eaten to expel intestinal worms and relieve the bowels of costiveness. In Taiwan, the seeds are astringent and used to treat fever.



Bixin

References

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 Morrison EY, *et al.* (1991) *Trop Geogr Med* **43**(1–2): 184–188.
 Thremsiamma KC, *et al.* (1996) *Ind J Exp Biol* **34**(9): 845–847.
 Zhao W, *et al.* (1998) *Biochim Biophys Acta* **138**(1): 77–88.

Warning: The leaves and unripe fruits are said to irritate the skin and mucosa. Adverse reactions associated with annatto dye are possible and include urticaria and angiooedema. A patient developed urticaria, angiooedema and hypotension within 20 days following the ingestion of fibers containing annatto. The non-dialyzable fraction of annatto dye on SDS-PAGE demonstrated 2 proteins staining bands in the 50 KDa range.

3. Family **ANCISTROCLADACEAE** Walpers 1851 *nom. conserv.*, the *Ancistrocladus* Family

Physical description: The family Ancistrocladaceae is a little group of obscure woody climbers confined to the tropical rainforests of Southeast Asia, India and Africa. The leaves are simple, lanceolate, leathery and stipulate. The flowers are small, bisexual, and paniculate with recurved branches. The calyx is tubular, 5-lobed and accrescent in fruits. The corolla comprises of 5 contorted petals. The andrecium comprises of 5–10 stamens. The gynecium comprises of 3 carpels forming an inferior and single-celled ovary which encloses a sub-basal ovule. The ovary shows 3 styles at the apex. The stigma is enlarged and lobed. The fruits are winged nuts containing a few seeds.

Pharmaceutical interest: Ancistrocladaceae are interesting because they produce naphthylisoquinoline alkaloids. These very unusual alkaloids have attracted a great deal of interest on account of their activity against *Plasmodium falciparum*, the Human Immunodeficiency Virus and several sorts of cancer cell-lines. *Ancistrocladus heyneanus*, *Ancistrocladus barteri* and *Ancistrocladus tectorius* (Lour.) Merr., are used to treat malaria in several tropical countries.

***Ancistrocladus tectorius* (Lour.) Merr.**

[From Greek, *ancistr* = fish hook, *klados* = branch; and from Latin, *tectorius* = forming a covering]

Physical description: It is a climber found on the seashores of Thailand, Cambodia, Laos, Vietnam, Malaysia and Indonesia. The stems develop from the axil of hooks. Leaves: simple,

Synonymy: *Ancistrocladus pinangianus*.

Common names: *Akar julong hitam*; *lindah sapi* (Malay).

hard, lanceolate and 5 cm–10 cm × 15 cm–30 cm. The blade shows 7–10 pairs of secondary nerves. The inflorescences are axillary, long and thin panicles of small dark red flowers. The flowers consist of 5 sepals, 5 petals, 10 stamens, and a half inferior ovary. The fruits are nuts with persistent, asymmetrical, oblong, 5 cm × 1.5 cm, subspatulate, obtuse, and brown sepals (Fig. 108).

Uses: In Malaysia, a decoction of the roots of *Ancistrocladus tectorius* (Lour.) Merr. is drunk to stop dysentery and to treat malaria.

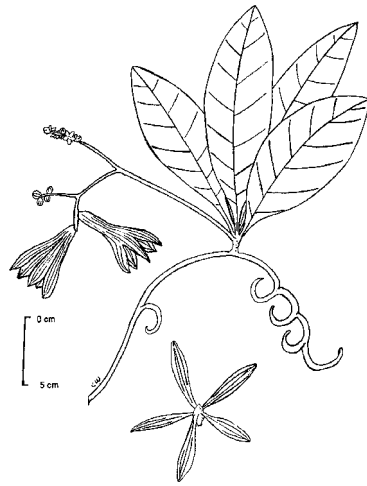


Fig. 108. *Ancistrocladus tectorius* (Lour.) Merr.

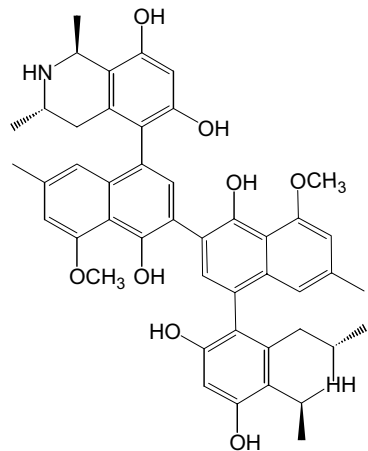
Pharmaceutical interest:

Antiplasmodial properties: In regard to the antiplasmodial properties of the *Ancistrocladus* species, a number of experiments conducted *in vitro* clearly demonstrate that naphthylisoquinoline alkaloids are the active principles. 10 µg/mL of a crude alkaloid fraction from *Ancistrocladus sp.* annihilates efficiently *Plasmodium berghei* cultured *in vitro* in human hepatoma cells (HepG2). Dichloromethane extracts of *Ancistrocladus abbreviatus* and *Ancistrocladus tectorius* (Lour.) Merr. exhibit levels of anti-plasmodial activities comparable to primaquine (25 µg/mL; 62.1% against 27.7%–70%; Francois G *et al.*, 1997). Small concentrations (about 2 µg/mL) of korupensamines A, B, C or D from the leaves of *Ancistrocladus korupensis* destroy *in vitro* half of the asexual erythrocyte stage of *Plasmodium falciparum* and *Plasmodium berghei* (Hallock YF *et al.*, 1997). Extracts of *Ancistrocladus abbreviatus*, *Ancistrocladus barteri* and purified naphthylisoquinoline alkaloids inhibit the asexual erythrocyte stage of *Plasmodium falciparum* (K1/chloroquine-resistant and NF 54/64, clone A1A9/chloroquine-sensitive; Francois G *et al.*, 1994). Note that betulinic acid, from *Ancistrocladus heyneanus* annihilates the asexual erythrocyte stage of *Plasmodium falciparum* cultured *in vitro* (Bringmann G *et al.*, 1997).

Antiviral properties: Michellamine B, D, E and F characterized from *Ancistrocladus korupensis* inhibit *in vitro* the replication of the Human Immunodeficiency Virus (Hallock YF *et al.*, 1997). Michellamine B acts at both stages of the Human Immunodeficiency Virus life cycle by inhibiting both reverse-transcriptase and the cells fusion in syncytium (Mac Mahon JB *et al.*, 1995). Michellamine B inhibits the killing of cells and viral replication in a variety of

human cell-lines and human peripheral blood leukocytes and monocytes. It acts against a panel of pharmacologically diverse laboratory and clinical strains of Human Immunodeficiency Virus type-1 including the AZT-resistant strain G-910-6, the pyridinone-resistant strain A-17 and a number of Human Immunodeficiency Virus type-2 strains (Boyd MR *et al.*, 1994).

Cytotoxic properties: Dioncophylline A, characterized from *Ancistrocladus abbreviatus* and from the closely related family Dioncophyllaceae, inhibit the proliferation of the National Cancer Institute panel of human tumor cell-lines (Hallock YF *et al.*, 1995) and annihilate *Biomphalaria glabra* (LD₅₀: 20 ppm).



Michellamine

References

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 Bringmann G, *et al.* (1997) *Planta Med* **63**(3): 255–257.
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 Francois G, *et al.* (1997) *Int J Parasitol* **27**(1): 29–32.
 Hallock Y, *et al.* (1997) *J Nat Prod* **60**(7): 677–683.
 Mac Mahon JB, *et al.* (1995) *Antimicrob Agents Chemother* **39**(2): 484–488.
 Manfredi KP, *et al.* (1991) *J Med Chem* **34**(12): 3402–3405.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

4. Family CARICACEAE Dumortier 1829, *nom. conserv.*, the Papaya Family

Physical description: The family Caricaceae consists of 4 genera and about 30 species of tropical and subtropical laticiferous soft-stemmed small trees and shrubs. The leaves of Caricaceae are alternate, large, long-petioled, digitately lobed or foliolate and without stipules. The inflorescences are cymose and axillary. The flowers are hermaphrodite or unisexual, regular and hypogynous. The calyx comprises of 5 very small sepals united into a lobed calyx. The corolla comprises of 5 petals united into a long and thin tube, the lobes of which are convolute or valvate. The andrecium consists of 2 whorls of 10 stamens, the filaments of which are attached to the corolla tube, free or connate at the base; and the anthers of which are tetrasporangiate and dithecal, and endowed with a shortly prolonged connective, and with pollen sacs opening by longitudinal slits. The gynecium consists of 5 carpels united into a compound 1-locular or spuriously 5-locular superior and sessile ovary, each locule containing several

ovules attached to parietal placentas. The fruits are large, smooth, green, and ovoid berries, containing several seeds with a succulent endosperm and a straight embryo. An example of Caricaceae is *Carica papaya* L., the fruits of which are palatable.

Common names: Papaya, melon tree; *figuier des iles*, *figuier des nègres*, *melon des tropiques*, *papayer* (French); *pimbosi*, *simbosi*, *thimbaw*, *timbosi* (Burmese); *lohong si phle* (Cambodian); *pohunbetek* (Malay); *chirbhita* (Sanskrit); *pappali* (Tamil).

***Carica papaya* L.**

[From Greek, *karike*, a kind of fig and from *papaya* = the Caribbean word for *Carica papaya* L.]

Physical description: It is a small fruit tree native to Central America. The bole is soft-wooded, marked with conspicuous leaf-scars and laticiferous. Leaves: 30 cm–60 cm, glabrous, palmatifid and palmatinerved. The petiole is about 30 cm long, fleshy and thin. The flowers are light yellow, slightly fragrant, and generally dioecious. The male flowers are arranged in long dropping panicles. The female flowers are arranged in short clusters. In the female flowers, the ovary is single-locular and the stigma is sessile, 5-lobed and lacinated. The fruits are succulent, indehiscent, single-celled, ovoid to oblong, greenish-yellow, smooth and 15 cm × 30 cm berries. The flesh is red, juicy and palatable. The seeds are numerous and black, and taste like capper (Figs. 109 & 110).



Pharmaceutical interest:

Papain: The latex of *Carica papaya* L. contains a mixture of cysteine proteinases, chiefly represented by papain, chymopapain and papayoproteinase Ω . Cysteine proteinases, which are responsible for a variety of cellular processes including the cartilage degradation in arthritis, the progression of Alzheimer's disease and cancer invasion, are of immense pharmacological



Fig. 109. *Carica papaya* L.



Fig. 110. *Carica papaya* L.

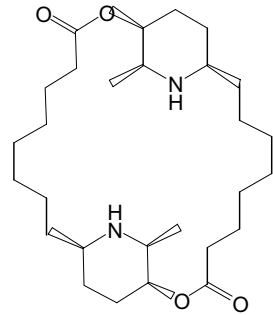
importance. Papain is a protein consisting of 212 amino acids with a molecular weight of about 23 000 Daltons. Pure chymopapain is a protein consisting of 218 amino acids whose structure and properties closely resemble those of papain. Chymopapain, currently available lyophilized, is injected into the intervertebral disc in order to cleave the proteoglycans to treat sciatica due to herniated lumbar disc when it resists other medical treatments. Papain, alone or in combination, is used to treat digestive gastric or duodenal insufficiency such as postprandial disorders or bloating (Digestozym[®]). Externally, it is used to treat mouth infection (Lysopain[®]) and peripheral venous disorders (Tromshin[®]), soothe inflammation (Panafil-White[®]), heal wounds, and to kill germs.

The anthelmintic property of the latex of *Carica papaya* L. is confirmed experimentally. Administration of a water suspension (2 g/Kg–8 g/Kg) of *Carica papaya* L. reduces by 55.5%–84.5% the number of *Heligmosomoides polygyrus* nematodes in necropsied Balb/c mice (Satrija F *et al.*, 1995). The plant abrogates the survival of *Haemonchus contortus* cultured *in vitro* (Hounzangbe-Adote MS *et al.*, 2005).

Uses: In Burma, the latex of *Carica papaya* L. is used to expel intestinal worms and to remove the false membrane of diphtheria. In Cambodia, the seeds are used to counteract insect poison, and a poultice of the roots is used to treat uterine tumors. The roots are used to control excessive menses and to expel urinary stones. In Indonesia, the latex is used to expel intestinal worms and to counteract snake-poison. The roots and the seeds are used to expel intestinal worms. In China, the pulp of the fruit is applied to swollen and inflamed feet. In Malaysia, a paste made from the roots is rubbed all over the body after childbirth, and the seeds are ingested in the early months of pregnancy to abort it. The latex is used to remove skin patches. In the state of Kelantan, the latex of the unripe fruit was used as a poison for criminal purposes. In Cambodia, Laos, and Vietnam, the latex is used to expel intestinal worms, remove warts and corns, and to treat eczema and psoriasis. The tree was spread all over the tropics by early Portuguese and Spaniards who discovered it in South America.

Antimicrobial properties: The ability of *Carica papaya* L. to inhibit the proliferation of *Candida albicans in vitro* (Giordani R *et al.*, 1996) is potentiated with fluconazole (Giordani R *et al.*, 1997). Papain taken *per os* reduces herpes Simplex Virus infection as efficiently as aciclovir (Zovirax®); (Kleine MW *et al.*, 1995).

Note that the leaves of *Carica papaya* L. contain carpaine, a piperidine alkaloid which reduces cardiac activity and annihilates amoeba.



Carpaine

References

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Warning: In high doses, papain is lethal. Death from hemorrhage following extensive destruction of the esophageal wall and the descending thoracic aorta resulted from the use of a papain suspension (1.2 g of papain over 12 hours period) to treat an obstruction caused by impacted meat (Holsinger JW *et al.*, 1968). The effect of the latex of *Carica papaya* L. on pregnancy is still a subject of controversy. A number of experiments conducted in animals in the seventies demonstrated that the latex of *Carica papaya* L. abrogated a pregnancy, but a standardized papain (800 mg/Kg) given *per os* to Wistar rats (800 mg/Kg) during blastogenesis (day 0–day 6) or embryogenesis (day 6–day 15) did not show any anti-implantation properties nor embryonic toxicity (Schmidt H., 1995). Induction of the reversible antifertility with crude ethanolic extract of the seeds of *Carica papaya* L. in albino male rats was however observed (Lohiya NK *et al.*, 1992). The same rats fed with 100 mg of the seeds of *Carica papaya per kilogram* of body weight developed degeneration of geminal epithelium, germ cells, and Leydig cells (Udoh P *et al.*, 1999).

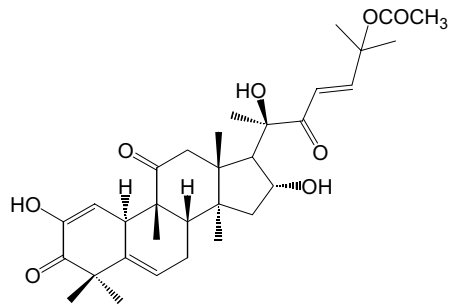
5. Family CUCURBITACEAE A. L. de Jussieu 1789 nom. conserv., the Cucumber family

Physical description: The family Cucurbitaceae consists of about 90 genera and 700 species of tendriferous and succulent climbers often abounding with

oxygenated Δ^5 - and Δ^7 -steroids (*cucurbitacins*), piperidine alkaloids and *pentacyclic triterpenoid saponins*. The leaves are simple, alternate and without stipules. The blade is often palmately lobed, rugose, and the petiole includes a crescent or ring of asymmetrical vascular bundles. The flowers are axillary, showy, unisexual and actinomorphic. The calyx is tubular, and the corolla is tubular or comprises of free petals. The andrecium consists of several stamens which are free or variously united, and 1 anther which is always single-celled. The gynecium consists of 3 carpels united to form a compound, unilocular inferior ovary containing several ovules attached to parietal placentas. The style is simple. The fruits are berries, often large and palatable, or capsules containing several flattened seeds without endosperm and often containing *ribosome inactivating proteins* which might hold pharmaceutical potential.



Pharmaceutical interest: Classical examples of Cucurbitaceae are *Cucumis sativus* L. (cucumber), *Cucumis melo* L. (melon) and *Citrullus lanatus* (Thunb.) Mansf. (Watermelon). Cucurbitaceae have attracted a great deal of interest on account of the production of cucurbitacins which are highly toxic (LD_{50} : 1 mg/Kg in mice by intraperitoneal injection), and imparted to the plants that contain them bitterness, and drastic laxative and emetic properties. Examples



Cucurbitacin E (elaterin)

of laxative drugs from Cucurbitaceae are *Bryonia cretica* L. *subsp. dioica* (Jacq.) Tutin (bryony), the dried pulp of *Citrullus colocynthis* (L.) Schrad. (bitter gourd) (*Colocynth*, *British Pharmaceutical Codex*, 1963) and the dried sediment which deposits in the juice of *Ecballium elaterium* (L.) A. Rich. (wild cucumber, squirting cucumber) (*Elaterium*, *British Pharmaceutical Codex*, 1934). The fresh seeds of *Cucurbita pepo* L. (pumpkin) (*Cucurbita*, *British Pharmaceutical Codex*, 1934) and *Cucurbita maxima* have long been used to expel intestinal worms. The oil expressed from the seeds has been used to treat benign prostate hypertrophy. Besides purgative properties, cucurbitacins are interesting because they exhibit a characteristic pattern of differential cytotoxicity, predominantly toward renal and brain tumors,

and melanoma, and are therefore worth exploring further. Cucurbitacin E (elaterin), the active principle of *Ecballium elaterium* (L.) A. Rich., annihilates efficiently the survival of prostate carcinoma cells cultured *in vitro* (IC_{50} : 7 nM–50 nM in 2–to 6–day exposures). The cytotoxicity of cucurbitacins is related to their ability to disrupt the F-actin cytoskeleton and thereby the division of cells. Note that Cucurbitaceae are also interesting for the proteins they contain in their roots and seeds. These proteins are abortifacient, antitumoral, ribosome inactivating, anti-HIV and immunomodulatory. It will be interesting to learn whether more intensive future research on Cucurbitaceae will disclose any molecules of chemotherapeutic interest. About 50 Cucurbitaceae plant species are medicinal in the Asia-Pacific, mostly on account of their steroidal and triterpenes contents. The fruits are mainly used to promote urination, soothe inflamed parts, check hemorrhages, counteract poisoning, treat fever diabetes, jaundice, and scabies, expel intestinal worms and to alleviate anxiety.

***Benincasa hispida* (Thunb.) Cogn.**

[After Count Giuseppe Benincasa, a 16th century Italian botanist who founded the Botanic Garden at Pisa, and from Latin, *hispidus* = bristly]

Synonymy: *Benincasa cerifera* Savi.

Common names: Ash pumpkin, tallow gourd; *kyaukpayon* (Burmese); *tung kua* (Chinese); *tougan* (Japanese); *terak bileng*, *terak sayak*, *lepo ga* (Malaysia); *abobora de agua* (Portuguese); *bi dao* (Cambodia, Laos, Vietnamese); *suphala* (Sanskrit); *pushini* (Tamil).

Physical description: It is a climber native to tropical Asia which is cultivated mainly in warm countries. The plant has a musky smell. The stems are angular, 3 mm–4 mm in diameter and hispid. Leaves: simple, alternate and without stipules. The petiole is 6 cm–8 cm × 2 mm and hispid. The blade is palmately 5-lobed, very thin, and hispid underneath. The blade is serrate, and shows 5–6 pairs of

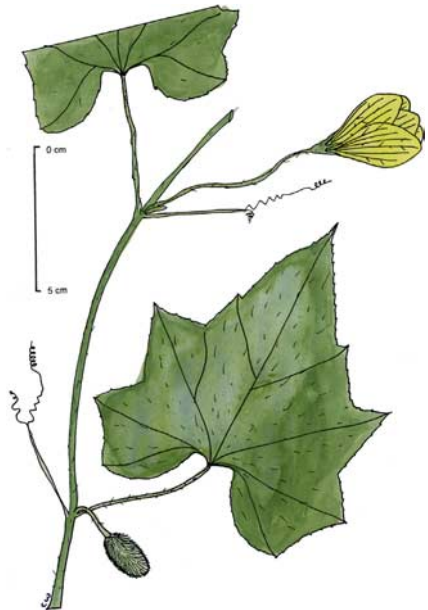


Fig. 111. *Benincasa hispida* (Thunb.) Cogn.

secondary nerves. The flowers are simple, axillary and showy. The flower pedicels are 5 cm–10 cm long and hispid. The calyx consists of 5 linear, 8 mm long hispid sepals. The corolla consists of 5 yellow, orbicular, very thin and showily nerved petals. The fruits are massive, 40 cm long, ovate berries covered with a dense chalky white powder (Fig. 111).

Pharmaceutical interest:

Antidiabetes properties: In regard to the antidiabetic property of *Benincasa hispida* (Thunb.) Cogn., a number of experiments conducted *in vivo* tend to demonstrate that the plant is inactive. An ethanolic extract of *Benincasa hispida* (Thunb.) administered at a dose of 250 mg/Kg orally to rats failed to lower blood sugar or to depress the peak value, after glucose load (Chandrasekar B *et al.*, 1989).

Central nervous properties: The quieting effect of *Benincasa hispida* (Thunb.) Cogn., which is probably mediated by some triterpenes or steroids, is not confirmed yet but Grover *et al.*, (2000), show that the fresh fruit juice of *Benincasa hispida* (Thunb.) Cogn. assuages symptoms of morphine withdrawal, such as the jumping response and diarrhea. It will be interesting to learn whether further research on neuroactive principles from *Benincasa hispida* (Thunb.) Cogn. and Cucurbitaceae in general, will disclose any molecule of therapeutic interest.

Properties on the immune system: The anti-inflammatory property of *Benincasa hispida* (Thunb.) Cogn. is confirmed experimentally and attributed to triterpenes. Alnusenol and multiflorenol, isolated from a methanolic extract of fruits of *Benincasa hispida* (Thunb.) Cogn. inhibit the release

Uses: In China, the fruits of *Benincasa hispida* (Thunb.) Cogn. are eaten to treat diabetes, dropsy and kidney diseases. The seeds are eaten to promote urination, relieve the bowels of costiveness, treat fever, heal hemorrhoids, and soothe inflamed intestines. The rind is eaten to promote urination and to invigorate the spleen. The pulp is used to promote urination, treat fever and as a demulcent. In India, the fruits are eaten to relieve the bowels of costiveness, promote urination and libido, check hemorrhages, treat strangury and expel urinary stones. The oil expressed from the seeds is soporific. In Indonesia, the fruits are eaten to invigorate health and to check hemorrhages. In Malaysia, the leaves are applied to bruises and a decoction of the fruit is drunk to combat hystero-epilepsy. In the Philippines, the fruits are eaten to treat disorders of the respiratory organs and applied to inflamed eyes.



of histamine from rat exudate cells induced by antigen-antibody reaction (Yoshizumi S *et al.*, 1998). In addition, a heteropolymer consisting of uronic acid, neutral sugars, protein, and phosphorus characterized from the hot water extract of the seeds of *Benincasa hispida* (Thunb.) Cogn. stimulates *in vitro* the development of peritoneal macrophages into antitumoral macrophages, and extend the survival period of mice bearing Meth A fibrosarcoma (Kamazawa Y *et al.*, 1985).

References

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 Grovers JK, *et al.* (2000) *Fitoter* **71**(6): 707–709.
 Yoshizumi S, *et al.* (1998) *Yakugaku Zasshi* **118**(5): 188–192.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Citrullus lanatus (Thunb.) Matsum. & Nak.

[From Latin, *citrullus* = diminutive of *citrus*, and *lana* = wool]

Synonymy: *Citrullus vulgaris* Schrad.

Common names: Watermelon; *paye* (Burma); *hsi kua* (Chinese); *pasteque* (French); *au lek* (Cambodia, Laos, Vietnam); *melao da India* (Portuguese); *chitra* (Sanskrit); *melon de agua* (Spanish); *cocomero* (Italian).



Physical description: It is an annual, woolly climber native to Africa which is cultivated in several warm countries for its edible fruits. Leaves: simple, spiral and without stipules. The petiole is pilose, 2.1 cm–5.7 cm long, thin, and sheathing at the base. The tendrils are axillary and bifid. The blade is deeply incised, rigid, woolly on both surfaces, and laxly serrate. The blade shows 3–5 pairs of secondary nerves which are flat above and slightly raised below. The flowers are 1 cm × 7 mm, axillary and solitary. The calyx consists of 5 lobes which are narrowly lanceolate and equal in length to the corolla. The corolla is yellow within and greenish outside, and the lobes are ovate-oblong and 5-nerved. The flower pedicels are 1 cm–1.8 cm long, slender, and woolly. The fruits are smooth, globose, greenish berries, measuring up to 40 cm in diameter. The flesh is reddish-pink, or white, juicy and palatable. The seeds are blackish, margined and glossy (Fig. 112).

Uses: In China, the pulp and the rind are eaten to treat diabetes and jaundice, and to expel impurities. The pulp is used to soothe an inflamed throat, heal sores in the mouth and to fight dependence on alcohol. In India, the unripe fruits are used to strengthen, promote libido and to treat jaundice and fever. The seeds are used to promote libido, and the leaves are used to check bleeding. In Indonesia, the fruits are used to assuage rheumatic pains. In Malaysia, the juice of the roots is used to check bleeding after an abortion. In Palau, the fruits are used to treat beriberi and cystitis. In Cambodia, Laos, and Vietnam, the pulp and rind are eaten to regulate motion.

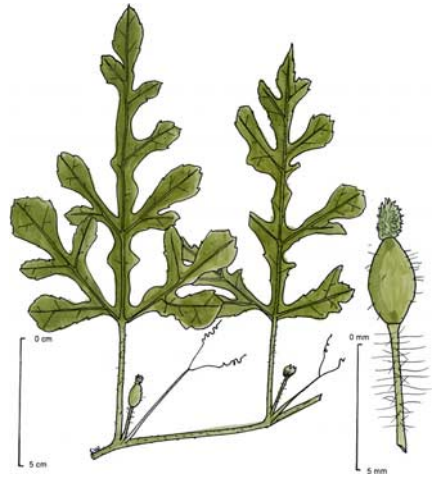


Fig. 112. *Citrullus lanatus* (Thunb.) Mansf. From: KLU 040742. Flora of the Northern Mariana Islands. Ex. University of Guam Herbarium. Field collector: C. Bjork, 14 May 1985. Geographical localization: cultivated in farmers fields between Agric. Station and Maqpo. Botanical identification: de Wilde, 1996.

Pharmaceutical interest: To date, there are no recent studies on the possible pharmacological properties of *Citrullus lanatus* (Thunb.) Mansf.

Some muscular and cardiovascular effects of α -elaterin-2-D-glucopyranoside isolated from *Citrullus colocynthis* (L.) Schrad. have been reported by Banerjee *et al.* (1976).

References

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 Cantor DS, *et al.* (1987) *Gastrointestinal Endoscopy* **38**(6): 734–735.
 Khanna SK, *et al.* (1992) *Gastrointestinal Endoscopy* **33**(2): 129.

Warning: A number of studies indicate that colon cancers can be induced by excessive consumption of *Citrullus lanatus* (Thunb.) Mansf. (Cantor DS *et al.*, 1987; Khanna SK *et al.*, 1992).

Lagenaria siceraria (Mol.) Standl.

[From Latin, *lagenaria* = shaped like a bottle and from Hebrew, *shekar* = strong fermented drink]

Physical description: It is a climber cultivated for its fruits which have manifold uses in the tropical regions. The plant has the greasy smell of a mild

Synonymy: *Lagenaria vulgaris* Ser.,
Lagenaria leucantha Rusby.

Common names: Bottle gourd;
gourde de pélerin (French); *businswai*
(Burma); *hu lu* (Chinese); *urong ka'*
dai, lepo ga'; (Kenyah); *cabaceira*
(Portuguese); *alabu* (Sanskrit);
calabeza vinatera (Spanish);
shorakkai (Tamil).

stink bug. The stems are smooth, hairy, and 5-angled. Leaves: simple, alternate and without stipules. The petiole is hairy and 3.4 cm × 1.3 cm–1 mm. The tendrils are hairy, bifid, and 3.3 cm–4.5 cm long. The blade is papery, hairy, somewhat 5-lobed, laxly serrate, and shows 2–3 pairs of secondary nerves which are slightly raised on both surfaces. The flowers are axillary, solitary, monoecious or dioecious. The flower pedicel is 8.2 cm × 1 mm and hairy. The calyx is conical, 2 cm long and hairy. The corolla is showy, whitish, and consists of 5 orbiculate and very thin 3 cm long petals. The andrecium consists of 3 stamens which are connate and included. The ovary is oblong and pubescent and encloses several ovules which are attached to parietal placentas, the style is short and produces upward 3-bifid stigmatic lobes. The fruits are 30 cm long, flask-shaped berries with a 20 cm long neck. The seeds are numerous, 1.6 cm–2 cm, white, compressed, and with marginal grooves. Although bitter, the young fruits, flowers and shoots are eaten. Fruits that have ripen are used to make floats, bottles and ladles (Fig. 113).

Pharmaceutical interest:

Lagenin: *Lagenaria siceraria* (Mol.) Standl. is known to contain a 20 KDa ribosome inactivating protein called

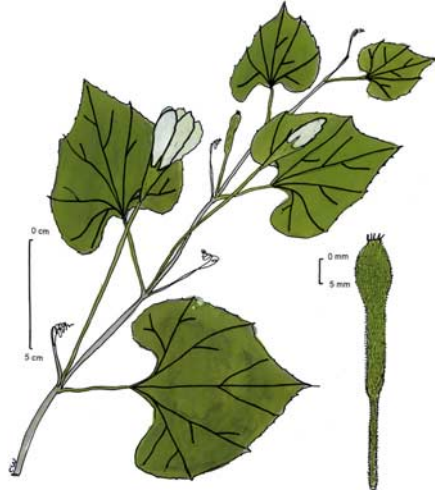


Fig. 113. *Lagenaria siceraria* (Mol.) Standl.

From: KLU Herbarium 28830. Flora of Sarawak. Field collector: Chin See Chun, 26 Feb 1977. Geographical localization: farm of Tua Kampong opposite Sungei Uket Bio' about 4½ miles up river from Long Selatong Ulu. Botanical identification: de Wilde 1996.

Uses: In China, Cambodia, Laos and Vietnam, the pulp of *Lagenaria siceraria* (Mol.) Standl. is used to treat fever, promote urination, and relieve the bowels of costiveness. In Malaysia, the pulp is eaten to treat colic and to counteract the putrefaction of the skin. In Indonesia, the juice squeezed from the young fruit is drunk to treat fever. In the Philippines, the green fruits are used to treat diseases of the breast or chest. The pulp is used to counteract poisoning, assuage cough and treat fever.

lagenin, which inhibits cell-free translation in rabbit reticulocyte system with an IC_{50} value of 0.21 nM. Lagenin exerts ribonuclease activity on yeast tRNA with an activity of 45 U/mg (Wang HX *et al.*, 2000).

Dietetic properties: A diet containing 5%, 10%, or 20% of *Lagenaria siceraria* (Mol.) Standl. lowers to 24% the incidence of 1,2-dimethylhydrazine-induced colonic carcinogenesis in mice (Furukawa K *et al.*, 1995).

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Wang HX, *et al.* (2000) *Life Sci* **67**(21): 2631–2638.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Luffa acutangula Roxb.

[From Arabic, *lufah* = *Luffa acutangula* Roxb., and from Latin, *acutus* = acute and *angulus* = angle]

Common names: *Thapwot* (Burmese); *ronung chung* (Cambodian); *jalini* (Sanskrit); *pekankai* (Tamil).

Physical description: It is a monoecious climber cultivated in many warm countries for its edible berries. The stems are 5-angled, hairy and rigid. Leaves: simple, alternate and without stipules. The petiole is channeled, hairy and 7 mm–2 cm long. The tendrils are slender and 3-fid. The blade is papery, 5-lobed, 5 cm × 6 cm–7 cm × 8.5 cm, and mottled with white spots on the surface and hairy underneath. The nerves are flat above and raised on the underside of the blade and the tertiary nerves are indistinct. The male flowers are arranged in axillary, 12–20 flowered racemes of 10 cm–15 cm long. The calyx is hairy, 1.3 cm long and consists of lanceolate 1 cm long sepals. The corolla comprises of 5 petals of 2 cm long, and is somewhat hairy, obovate, and yellow with green veins. The andrecium consists of 3 stamens. The female flowers are solitary, in the same axil as the males on 5 cm–10 cm long pedicels and comprise of an ovary which is strongly ribbed. The fruits are smooth, 10-ribbed, green, about 15 cm × 4 cm dull green berries (Fig. 114).



Uses: In Cambodia, Laos and Vietnam, the seeds are eaten to induce vomiting, stop hiccups, and relieve the bowels of costiveness. A paste made from the leaves is used to treat zozona. In India, the berries are used to treat fever, expel worms from intestines, and cure biliousness, asthma, and bronchitis. In Indonesia, the leaves are used to treat fever. In Malaysia, the juice is used after childbirth.

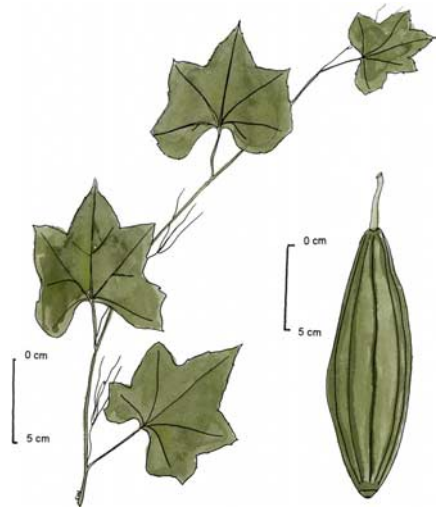


Fig. 114. *Luffa acutangula* Roxb. From: KLU Herbarium 041871. Flora of Malaya. Field collector: Rohani Bte Hassan, 21 Aug 1990. Geographical localization: Kampung Paloh, Kelantan, "Tanah Pamah". Botanical identification: de Wilde 1996.

Pharmaceutical interest:

Luffaculin: The seeds of *Luffa acutangula* Roxb. contain a ribosome inactivating protein, luffaculin, which is abortifacient, antitumor, and immunomodulatory (Ng TB *et al.*, 1992). The seeds are also known to contain cucurbitacins B and a number of oleanane-type triterpenes saponins (Barua AK *et al.*, 1958; Nagao T *et al.*, 1991).

References

- Barua AK, *et al.* (1958) *J Indian Chem Soc* **35**: 480–482.
 Nagao T, *et al.* (1991) *Chem Pharm Bull* **39**(3): 599–606.
 Ng TB, *et al.* (1992) *General Pharmacology* **23**(4): 579–590.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Momordica charantia L.

[From Latin, *mordēre* = bite]

Physical description: It is a slender annual climber cultivated in the tropical regions for its edible berries. The stems are hairy and 1 mm–2 mm in

diameter. Leaves: simple, alternate and without stipules. The petiole is 1 cm–2 cm long and hairy. The tendrils are opposite the leaves, and 1 cm–6 cm long. The blade is very thin, mottled with very small blackish spots below, hairy, 3.4 cm × 3.5 cm–2.9 cm × 3.7 cm and deeply 5–7-lobed. The nerves are sunken above, flat below and hairy. The margin is laxly toothed. The flowers are axillary, solitary, yellow and attached to 4 cm–10 cm long pedicels where small bracts are found at or below the middle. The calyx is campanulate, 5-lobed, hairy and 8 mm–10 mm long. The calyx lobes are 5 mm–6 mm long, elliptic and acute. The corolla is irregular and yellowish and consists of 5, 1.6 cm–3 cm long petals which are free, showily veined, hairy and rotate. The andrecium comprises of 3 stamens which are conduplicate. The ovary is fusiform and muricate, and develops upwards into a 3-lobed stigma. The fruits are edible, fusiform, muricate, bright orange when ripe, 5 cm–15 cm long, and cucumber-shaped berries containing several seeds. The seeds are 8 mm–13 mm long, compressed, corrugated on the margin, sculptured on both surfaces and embedded in a crimson aril (Fig. 115).

Pharmaceutical potential:

Antidiabetes properties: In regard to the antidiabetes properties of *Momordica charantia* L., a number of experiments conducted *in vivo* tend to demonstrate that intake of the fruits improves glucose tolerance. An extract of the fruit given for ten weeks lowers glycaemia in streptozocin-induced type I diabetic rats (Ahmed I *et al.*, 2001). The juice expressed from the fruit improves significantly the glucose tolerance of diabetic patients (Welihinda J *et al.*, 1986). The precise mechanism of action involved here is unknown but one could set the

Synonymy: *Momordica balsamina* *sensu* Blanco.

Common names: Wild basalm apple, bitter gourd, carilla fruit; *kyethenka* (Burma); *mreas* (Cambodian); *koo kwa kan* (Chinese); *pandipane* (French); *periah* (Malay); *pepino de Saõ Gregorio* (Portuguese); *karaka; patu* (Sanskrit); *pakal* (Tamil); *kho qua* (Vietnamese).

Uses: In China, the fruits of *Momordica charantia* L. are eaten to reduce body temperature, invigorate health, relieve the bowels of costiveness and stop flatulence. In Cambodia, the leaves are used to combat fever and delirium. In Indonesia, a decoction of the leaves is drunk to relieve the bowels of costiveness, treat liver diseases and expel intestinal worms. In India, the fruits are eaten to relieve the bowels of costiveness and expel intestinal worms. In Malaysia, the fruits are used to treat diabetes, and a poultice of the powdered leaves is applied to burns. A decoction of *Momordica charantia* L. is drunk to abort a pregnancy. In the Philippines, the juice expressed from the green fruit is drunk to treat chronic colitis and dysentery. In Cambodia, Laos and Vietnam, the cooked fruit is used to stop catarrh, flux and cough.

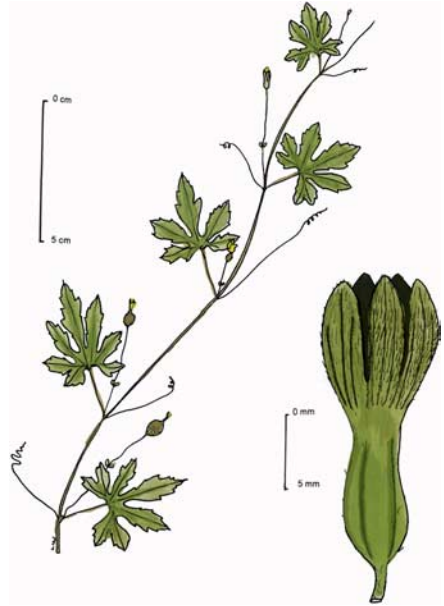
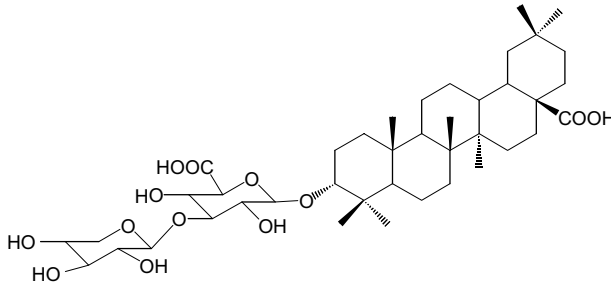


Fig. 115. *Momordica charantia* L. From: Delhi University Herbarium 004378. Field collector: PS Sabharwal, 8 Sep 1957. Altitude 500 ft. Geographical localization: Najafgarh, Delhi. Botanical identification: de Wilde 1996.

hypothesis that the hypoglycaemic property would not result from an insulin-mediated mechanism (Sarkar S *et al.*, 1996; Madsuda H *et al.*, 1997), but from a glucocorticoid-mediated by oleanolic acid saponins. Being structurally close to glucocorticoids, the triterpenes of *Momordica charantia* L. have the tendency to occupy glucocorticoid receptors and act thereby as glucocorticoid antagonist in two instances, hypoglycaemia and abortion. An example of glucocorticoid antagonist used in therapeutic is RU486 which causes abortion and eliminates carbohydrate intolerance in many subjects (Mantero F *et al.*, 1989). Another hypothesis is that, given *per os*, the triterpenes of *Momordica charantia* L. suppress the transfer of glucose from the stomach to the small intestine by inhibiting glucose transport at the brush border of the small intestine, as demonstrated with momordin Ic (Matsuda H *et al.*, 1998a).

Other steroidal properties: Oleanolic acid 3-*O*-monodesmoside characterized from *Momordica cochinchinensis* Spreng. exhibits antipruritic properties in mice (Matsuda H *et al.*, 1998). Petroleum ether, benzenic and alcohol extracts of the seeds of *Momordica charantia* L. given to rats at a dose

of 25 mg/100 g/day for 35 days, reduce the number of spermatocytes, spermatids and spermatozoa. The alcohol extract is more potent in its anti-spermatogen, antisteroidogen and androgen properties (Naseem MZ *et al.*, 1998).



Momordin I

Cytotoxic properties: *Momordica charantia* L. has attracted a great deal of interest on account of a series of oleanolic acid saponins known as momordin. Momordin are anticarcinogenic in rodents through the enzymes of biotransformation and detoxification (Ganguly C *et al.*, 2000). Oleanolic acid momordin I, Id and le reduce *in vitro* the Jun/Fos-DNA interaction which is a crucial factor in transmitting tumor-promoting signals from the extracellular environment to nuclear transmission machinery (Lee DK *et al.*, 1998). Topical application of an extract of peels of the fruits of *Momordica charantia* L. (100 μg /animal/day) reduces the proliferation of 7, 12-dimethylbenz-[a]-anthracene-induced skin papilloma in mice (Singh A *et al.*, 1998). Antimutagen principles characterized from the green fruit are identified as 3-O-[6'-O-palmitoyl]- β -D-glucosylstigmasta-5,25(27)-dien and its stearyl derivative. At a dosage range of 50.5 μg extract/g-12.5 μg extract/g in mice, the mixture reduces by about 80% the number of micronucleated polychromatic erythrocytes caused by mitomycin C. Structure-activity correlation studies suggest that the antimutagen property may reside in the peculiar lipid-like structure of the acylglucosylsterols. Ingestion of these compounds may result in their absorption in the plasma membrane lipid bilayer which would adversely affect the membrane permeability towards mitomycin C and disrupt the cellular property of the latter (Guevara AP *et al.*, 1990).

Antimicrobial properties: An extract of *Momordica charantia* L. inhibits the growth of *Mycobacterium tuberculosis* cultured *in vitro* (France AP *et al.*, 1998). The fruit of *Momordica charantia* L. contains a protein which inhibits, the enzymatic activity of HIV-1 reverse transcriptase *in vitro* (Jiratchariyakul W *et al.*, 2001).

References

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 Mantero F, *et al.* (1989) *The adrenal and hypertension: from cloning to clinic*. New York: Raven Press: 273–284.
 Naseem MZ, *et al.* (1998) *J Ethnopharmacol* **61**(1): 9–16.
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 Sarkar S, *et al.* (1996) *Pharmacol Res* **33**(1): 1–4.
 Singh A, *et al.* (1998) *Toxicol Lett* **94**(1): 37–46.
 Welihinda J, *et al.* (1986) *J Ethnopharmacol* **17**(3): 277–282.

Warning: The seeds of *Momordica charantia* L. must not be consumed during the early stage of pregnancy because they contain some proteins called momorcharins, which are teratogenic to the cultured mouse embryos at the early organogenesis stage (Chan WY *et al.*, 1986). An aqueous extract of *Momordica charantia* L. causes a statistical significant genotoxic effect in the plate incorporation assay using *Aspergillus nidulans* (Ramos Ruz A *et al.*, 1996).

***Momordica cochinchinensis* (Lour.) Spreng.**

[From Latin, *mordēre* = bite and *cochinchinensis* = from Cochinchina]

Physical description: It is a dioecious, stout and perennial climber which grows in India, Southeast Asia and China. The stems are pilose at the apex and rugose. Leaves: simple, alternate and without

Common names: *Samongnway* (Burma); *mu pieh tzu, fan muh pee* (Chinese); *day gae* (Vietnamese); *karka* (Sanskrit).

stipules. The petiole is 1.5 cm–2.7 cm long and thin, pilose at first, somewhat twisted, and channeled. The blade is cordate, leathery, 6 cm–12 cm × 7 cm–9 cm and molted with numerous microscopic 2–5-lobed bodies underneath. The margin is recurved and laxly toothed. The blade shows 4–8 pairs of secondary nerves. The tertiary nerves are scalariform, and the midrib is raised on both surfaces of the blade. The tendrils are axillary, spring-shaped and 4.5 cm–12 cm long. The inflorescences are axillary and solitary. The flower pedicels are 2.5 cm–15 cm long, angularly furrowed and pilose. The calyx is pilose, 5-lobed, 1.3 cm–1.6 cm long, and the sepals are oblong, lanceolate and acute.

The corolla is white, tinged with yellow, and consists of 5, 5.7 cm × 2.5 cm, obovate and oblong petals. The fruits are 4 cm–10 cm in diameter, globose, spiny red berries. The seeds are compressed and ovoid (Fig. 116).

Uses: In Burma, the seeds of *Momordica cochinchinensis* (Lour.) Spreng. are eaten to assuage chest pain. In China, the seeds are eaten to treat fluxes, liver diseases, hemorrhoids, breast cancer and malaria, and to heal wounds and ulcers. In Indonesia, the leaves are applied externally to swollen legs. In Laos, Cambodia and Vietnam, the seeds are used to counteract putrefaction of the skin. In the Philippines, the roots are used to produce soap.

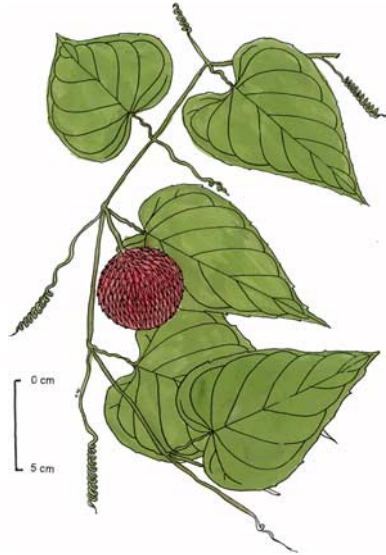


Fig. 116. *Momordica cochinchinensis* (Lour.) Spreng. From: KLU Herbarium 039071. Flora of Sulawesi Selatan. Field collector: SC Chin, 12 June 1986. Geographical localization: Maros, limestone Hills near Leangleang. Botanical identification: de Wide 1996.

Pharmaceutical interest:

Anti-inflammatory property: The anti-inflammatory property of *Momordica cochinchinensis* (Lour.) Spreng. is confirmed experimentally: oleanolic acid saponins isolated from the roots of *Momordica cochinchinensis* (Lour.) Spreng. reduce pruritus induced in mice (Matsuda H *et al.*, 1998).

Antitumor properties: The roots of *Momordica cochinchinensis* (Lour.) Spreng. contain a series of saponins with hemolytic properties, as well as ribosome inactivating proteins (Ng TB *et al.*, 1986; 1992). Momordin Id: 3 β -{([O- β -D-xylopyranosyl-(1 \rightarrow 2)-O-b-D-xylopyranosyl-(1 \rightarrow 3)]-O- β -D-glucopyran-uronosyl)oxy}-olean-12-ene-28-oic acid is present in the root of this plant, hence it has antitumoral potential (Noriaki K *et al.*, 1988).

References

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 Ng TB, *et al.* (1992) *General Pharmacology* **23**(4): 579–590.
 Ng TB, *et al.* (1986) *J Ethnopharmacol* **18**(1): 55–61.
 Noriaki K, *et al.* (1988) *Phytochem* **27**(11): 3585–3591.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Trichosanthes kirilowii* Maxim.**

[From Greek, *trikhos* = hair and *anthos* = flower]

Physical description: It is a climber found in Japan, Korea and China. The tendrils are 2–5-fid. Leaves: simple, exstipulate and spiral. The blade is broad ovate to orbiculate, remotely dentate or 3–7-lobed, cordate at the base, pilose and punctuate on both sides. The inflorescences are axillary 10 cm–20 cm long racemes. The bracts are obovate or ovate, and 2 cm–2.5 cm long. The flowers are ephemeral and dirty white. The corolla consists of 5 petals which are fringed at the apex. The fruits are oblong, 9 cm–10 cm, orange-yellow berries containing several ovate or oblong, 1.1 cm–1.4 cm × 8 mm–9 mm light brown seeds.

Common names: Chinese cucumber, Chinese snakegourd, *gua-lou tian-hua-fen* (Chinese).

Pharmaceutical interest:

Trichosanthin: *Trichosanthes* species are interesting because they produce a series of ribosome-inactivating proteins which might be of value in treating cancers and HIV. The roots of *Trichosanthes kirilowii* Maxim. are known, for instance, to contain trichosanthin, a 27 KDa single ribosome-inactivating protein consisting of 247 amino acids, which exhibits manifold pharmacological properties. Trichosantin is active against leukaemia (Takemoto DJ *et al.*, 1998) and has been described by some as a “promising anti-Human Immunodeficiency Virus”. Trichosanthin annihilates infected macrophages, and eliminate this major reservoir of Human Immunodeficiency Virus from the body. Since the discovery of its specific injurious properties on human placental trophoblasts in the 1970’s, trichosanthin has been used clinically in China to cause an abortion and to treat diseases of trophoblastic origin such as hydatiform mole, invasive mole and choriocarcinoma. Soon after the laboratory finding in 1989 by McGrath *et al.*, that it inhibits the replication of HIV-1 in both acutely infected T-lymphoblastoid cells and in chronically-infected macrophages, and selectively kills HIV-infected cells while leaving uninfected cells unharmed, clinical trials of trichosanthin as a potential treatment for HIV have been carried out in the States.

Uses: In China and Taiwan, a decoction of the roots is drunk to quench thirst, treat fever, and promote expectoration, urination and milk secretion. In Korea, the roots are used to promote expectoration, heal hemorrhoids and moisten dry skin.

Trichosanthin attacks the life cycle of the virus at an entirely different point from zidovudine (AZT®) and related drugs, and in other words, it has a unique mechanism of action complementary to other drugs. Clinical reports show that trichosanthin has some levels of properties on HIV patients and it has been suggested as a possible treatment that may fill the gap in the treatment of the Human Immunodeficiency Virus infection. Other substances of

interest are a series of multiflorane pentacyclic triterpenes which inhibit the early expression of Epstein-Barr Virus (EBV) antigen by Raji cells induced by 12-*O*-tetradecanoylphorbol-13-acetate (Akihisa T *et al.*, 2001).

Anti-tumor properties: The plant is known to elaborate trichomislin, a ribosome-inactivating protein, which induces apoptosis via mitochondria and the enzymatic activity of caspase-3 (Mi SL *et al.*, 2005).

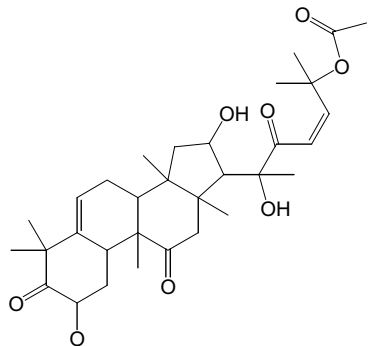
References

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 Takemoto DJ, *et al.* (1998) *Anticancer Res* **18**(1A): 357–361.
 Mi SL, *et al.* (2005) *Archives of Biochemistry and Biophysics* (43)2, 15: 258–265.

Warning: Side effects of trichosanthin observed during clinical trials include allergic reactions, neurotoxic effect and flu-like symptoms. Among them, the most dangerous complication seen with the drug is anaphylactic shock, a sudden, severe life-threatening allergic reaction that can kill within days. This reaction was experienced by 10–20 percent of people using the drug. Therefore, it is critical to modify the molecular structure of trichosanthin in order to decrease its side effects.

6. Family DATISCACEAE Lindley 1830 *nom. conserv.*, the *Datisca* Family

Physical description: The family Datisceae is a little family of 3 genera and 4 species of Asian perennial herbs and trees known to produce *flavonoids*. In this family, the leaves are simple or compound, alternate and without stipules. The flowers are unisexual. The male flowers comprise of a calyx of 4–8, free or united sepals in a lobed tube, a corolla of 0–8 petals, an andrecium of up to 25 stamens with tetrasporangiate anthers opening by longitudinal slits and dithecal. The female flowers comprise of a calyx of 3–8 sepals, and a gynecium of 3–8 carpels united to form a compound, unilocular, inferior ovary containing anatropous ovules attached to parietal placentas. The fruits are capsular, open apically between the persistent styles and contain several numerous, very small seeds with straight, cylindrical, oily and dicotyledonous embryos.



Datiscacin

Pharmaceutical interest: It will be interesting to learn whether more intensive future

research on this family will disclose any molecules of pharmaceutical interest such as cucurbitacins (datiscacin). *Octomeles sumatrana* Miq. and *Tetrameles nudiflora* R. Br. are used in the Asia-Pacific to treat abdominal disorders.

***Octomeles sumatrana* Miq.**

[From Latin, *octomele* = eight partite and *sumatrana* = from Sumatra]

Synonymy: *Octomeles moluccana* Teijsm. & Binnend. ex Hassk.

Common names: *Erima*, *binuang* (Malay); *benuang* (Indonesian); *limo* (Papua New Guinea).

Physical description: It is a timber tree found in Malaysia and Indonesia. The stems are smooth, glabrous and terete. Leaves: simple, spiral and without stipules. The petiole is quadrangular and 12.5 cm–10 cm × 3 mm–4 mm. The blade is ovate, glabrous, broadly elliptic-cordate, leathery, and 18.5 cm–19 cm × 13.5 cm–15 cm and wavy at the margin. The nervations are sunken above and raised below the blade, showing 7–9 pairs of secondary nerves and a few scalariform tertiary nerves. The inflorescences are long and terminal spikes. The fruits are dehiscent capsules containing many seeds and marked at the apex with a vestigial calyx tube (Fig. 117).

Uses: In Indonesia, the sap expressed from the young leaves of *Octomeles sumatrana* Miq. is used to assuage abdominal pain. In the Philippines, a decoction of the bark is drunk to invigorate health. The pharmacological potential of *Octomeles sumatrana* Miq. remains unexplored.

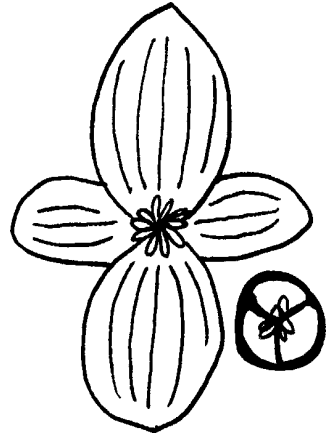


Fig. 117. *Octomeles sumatrana* Miq. From: KLU Herbarium 17557. Flora of Sabah. Botanical identification.: PS Ashton, March 1973.

7. Family BEGONIACEAE C. A. Agardh 1825, nom. conserv., the Begonia Family

Physical description: The family Begoniaceae consists principally of the large tropical genus *Begonia*, which consists of about 1000 species of succulent, sappy herbs and soft-stemmed shrubs. Begoniaceae are known to produce *cucurbitacins*, and *oxalic acid*. The leaves in this family are simple,

alternate, principally palmately veined and often palmately lobed, and toothed, and have large stipules. The flowers are unisexual and irregular, and arranged in axillary, cymose, occasionally long-pedunculate inflorescences. The perianth consists of up to 10 petaloid tepals. The andrecium comprises of 4 or more stamens originating in a centripetal sequence. The gynecium consists of 3 carpels forming a compound, inferior, plurilocular ovary containing several ovules attached to axillary placentas and developing upwards into a distinct style. The fruits are loculicidal capsules, or berries containing several small seeds. The structures of the andrecium and gynecium in the family Begoniaceae are unusual for members of the Violales. However, one could say that cucurbitacins justify the classification of Begoniaceae with the Cucurbitaceae and Datisceae in the order Violales, or at least their common Violales-Malvales ancestors.



Pharmaceutical interest: Many plants classified within the genera *Begonia* are cultivated to decorate gardens. Begoniaceae are interesting because they contain cucurbitacins which hold potential for the treatment of cancer (see p.). *Begonia evansia* Andr. (*Begonia discolor* Ait.), *Begonia fimbristipulata* Hance, *Begonia isoptera* Dryand. and *Begonia oblonga* Merr. are of medicinal value in the Asia-Pacific. Most of these herbs are used as a counter-irritant on account of the oxalic acid.

Begonia species

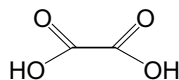
[From Michel Begon, a French administrator of Louis XIV King of France]

Physical description: The leaves of *Begonia* species are succulent, alternate, distichous, long-petiolate, stipulate, simple and cauline or from rhizomes. The blade is cordate at the base and very asymmetrical. The margin is toothed or lobed. The flowers are monoecious, in clusters of axillary cymes. The male flowers are actinomorphic or not, showy, pink, white or reddish. The perianth comprises of 4 tepals, the pair of outer ones large and petal-like. The andrecium comprises of several 2-celled and basifixied stamens forming a dense capitulum. The female flowers comprise of as many 2-lobed or branched styles as the locules. The stigmas are prominent, and the placentation in the ovary is axillary. The fruits are loculicidal or irregularly dehiscent asymmetrical 3-winged capsules containing several seeds which are very small.

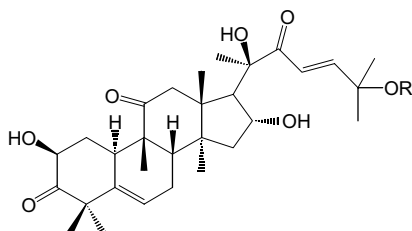
Pharmaceutical potential: A number of plants classified within the genus *Begonia* are counter-irritant. In Malaysia, *Begonia isoptera* Dryand. is pounded

and applied externally to assuage the discomfort caused by an enlarged spleen. A handful of *Begonia fimbristipulata* Hance is boiled in water and the decoction is used to relieve cough, stop haemoptysis, and to treat fever and pneumonia. A paste made from the same plant is applied to swollen parts, sprains and burns. In Papua New Guinea, the sap expressed from the leaves of *Begonia augustae* Irmsch. is used as a counter-irritant remedy to soothe inflamed areas. The ashes of the leaves of several *Begonia* species are applied to the umbilical cord, and the leaves are heated and applied to the skin to assuage abdominal pain. In the Philippines, the leaves of *Begonia oblonga* Merr. are used to counteract the toxic effect of *Dioscorea*. In the Solomon islands, a decoction of the leaves of the *Begonia* species is used to assuage stomach discomfort. In Cambodia, Laos, and Vietnam, the roots of the *Begonia* species are used to promote urination and milk secretion, and to relieve the bowels of costiveness.

Pharmaceutical interest: The counter-irritant property of the *Begonia* species is attributed to the crystals of oxalic acid which abound in the plant. Crystals of oxalic acid are sharp and irritate the mucosa and the epidermis. *Begonia* species have attracted a great deal of interest on account of cucurbitacins (see p.). An extract of *Begonia plejeba* displays a characteristic pattern of differential cytotoxicity profile predominantly toward renal and brain tumors and melanoma in the NCI human disease-oriented screening panel. Further fractionations resulted in the characterization of cucurbitacin B (Fuller RW *et al.*, 1994).



Oxalic acid

Cucurbitacin B (R= Ac)
Cucurbitacin D (R= H)

References

- Fuller RW, *et al.* (1994) *J Nat Prod* **57**(10): 1442–1445.
Paulsen E (1998) *Contact Dermatitis* **38**(1): 14–19.

Warning: Occupational dermatitis among gardeners and greenhouse workers who come into contact with the *Begonia* species is not rare (Paulsen E, 1998).

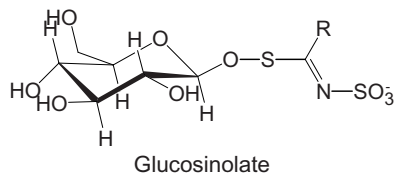
D. Order CAPPARALES Hutchinson 1926

The order Capparales consists of 5 families and nearly 4000 species of plants which are thought to have originated from the order Theales. By far, the largest family of the order Capparales is the family Brassicaceae which consists of about 3000 species of plants. Capparales are small trees, shrubs, climbers and herbs, the most characteristic chemical feature is the use of isothiocyanates as a chemical repellent. *Isothiocyanates* or mustard oils are liberated upon enzymatic hydrolysis of glucosinolates by an enzyme called myrosin. Isothiocyanates are interesting because they are cytotoxic, antimicrobial and irritating, hence the use of Capparales to make counter-irritant remedies.

1. Family CAPPARACEAE A. L. de Jussieu 1789 *nom. conserv.*, the Caper Family

Physical description: The family Capparaceae or Capparidaceae consists of about 45 genera and about 800 species of treelets, shrubs and herbs, which are principally xerophytic, pungent, tropical and subtropical, containing *isothiocyanates* (mustard oils), flavonoids, and occasionally pyrrolidine alkaloids. In this family, the leaves are alternate, opposite, simple or trifoliate or often palmately compound. The stipules are absent or very small. The flowers are bisexual, actinomorphic, hypogynous, axillary or terminal, solitary or in racemes. During plant collection, Capparales are easily recognizable by an elongated receptacle called gynophore or androgynophore. The calyx consists of 2–6 free, imbricate or valvate sepals, in 2 opposite, decussate pairs, or partially united, and distinct or connate below. The corolla comprises of up to 6 petals. The andrecium is often showy, and consists of several stamens initiated in a centrifugal sequence, with 2-celled and longitudinally dehiscent anthers. The gynecium consists of 2–12 carpels united to form a unilocular ovary which is sessile or supported by a long or short gynophore. The ovary encloses a few or many ovules attached to parietal placentas and develops upward into a single terminal style with a capitate or 2-lobed stigma. The fruits are pungent drupes or berries containing reniform or angular seeds.

Pharmaceutical interest: An example of Capparaceae is *Capparis spinosa*, the buds of which (caper) are palatable. *Glucosinolates* are anionic glycosides responsible for the characteristic aroma of capers and the number of edible Brassicaceae



(mustard, radish, and cabbage). Glucosinolates are suspected to be responsible for hypothyroidism, but their presence in the diet could have a protective effect against colon cancer. About 20 species of plants classified within the family Capparaceae are used medicinally in the Asia-Pacific. These are often used as counter-irritant remedies.

***Cleome gynandra* L.**

[From Greek, *kleome* = Ancient name for a mustard-like plant and *gunandros* = of doubtful sex]

Synonymy: *Gynandropsis gynandra* (L.) Briq., *Gynandropsis pentaphylla* DC.

Common names: Cat's whiskers, five-leaved cleome, bastard mustard; *maman hantu* (Malay); *pai hua ts'ai* (Chinese); *man ma tia* (Cambodia, Laos, Vietnamese); *pissat de chien* (French); *cincocinco, silisihan* (Filipino); *ajagandha, kabani* (Sanskrit); *veali, kadugu* (Tamil).

Physical description: It is an annual and upright branched herb which grows to a height of 1.2 m. It is native to East and Southeast China. The stems and branches are striate and more or less clothed in white hairs. The leaves are 3–5 foliate. The petiole is 5 mm–7.6 mm long with occasionally small distant prickles. The leaflets are subsessile, 2 cm–4 cm × 1.2 cm–2.5 cm, elliptic-obovate, obtuse, acute or acuminate, and pubescent on both sides. The margin is crenate-dentate or subentire. The flowers are corymbose and elongating into dense bracteate racemes. The flower pedicels are 1.2 cm–2 cm long, viscid and pubescent. The bracts are subsessile, trifoliate, and have small obovate leaflets. The sepals are lanceolate, glandular, pubescent green and have white veins. The corolla comprises of 5 petals which are 1.5 cm long, broad,

Uses: *Cleome gynandra* L. is a counter-irritant remedy. In China, the seeds are used to stop flatulence and a decoction of the plant is applied externally to treat piles and rheumatism. In Indonesia, the crushed leaves are applied externally to treat herpes, and the plant is used internally to promote expectoration and to stop flatulence. In Malaysia, the crushed leaves are applied externally to treat fever and rheumatism. A decoction of about 30 g of this plant is used to treat malaria, hepatitis, and leucorrhoea. The seeds are eaten to prevent a malarial attack. In the Philippines, the leaves are eaten to treat bilious disorders. In Taiwan, a decoction of *Cleome gynandra* L. is drunk to treat gonorrhoea and to stop dysentery. In Cambodia, Laos, and Vietnam, the roots are invigorating and antiscorbutic. The leaves are applied to the lumbar region to assuage pain in the loins. In India, half a teacup full of seeds given twice daily in a decoction, is eaten to treat convulsive infection, typhus, and fever. The leaves are used externally to heal boils.

obovate, with a long narrow claw and light pink. The gynophore is 2 cm–2.5 cm long. The stamens are purple and numerous. The ovary is linear-oblong and glandular, and the style is very small. The fruits are 5 cm–9 cm × 4 cm–5 cm capsules, which are viscid, pubescent, obliquely striated, and containing several seeds which are muricate and dark brown (Fig. 118).



Fig. 118. *Cleome gynandra* L.

Pharmaceutical interest: The counter-irritant property of *Cleome gynandra* L. is attributed to glucosinolates. When the leaves of any glucosinolate-containing plant are bruised, glucosinolates are hydrolyzed by a β -thioglucosidase enzyme (myrosin) into a number of extremely reactive, volatile and pungent isothiocyanates, which cause skin tingling and rubefaction, and upon prolonged contact with the skin vesication (Fig. 119). In addition, isothiocyanates capture iodide and prevent its uptake by the thyroid resulting in hypothyroidism and goiter. Isothiocyanates occur in *Brassica nigra* (L.) Koch. (family Brassicaceae), which has been used since ancient times to make cataplasms. The therapeutic potential of *Cleome gynandra* L. is open for pharmacological exploration.

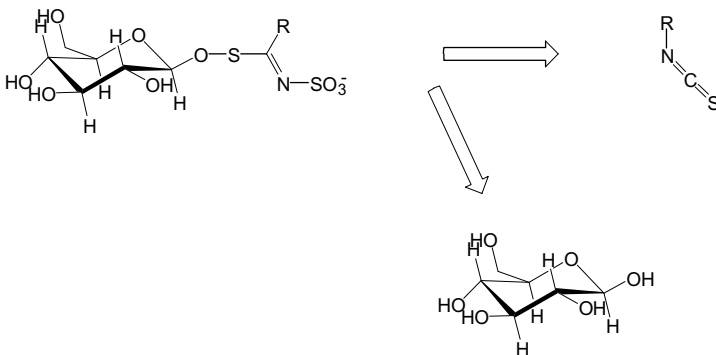


Fig. 119. Release of isothiocyanates from glucosinolates in Capparales.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Cleome viscosa* L.**

[From Greek, *kleome* = Ancient name for a mustard-like plant and from Latin, *viscum* = birdlime]

Physical description: It is a tropical, annual, upright, smelly and bitter herb which grows to a height of 30 cm–90 cm. The stems are grooved, and densely clothed in glandular and simple hairs. Leaves: 3–5 foliate. The petiole of the lower leaves is 2.5 cm–5 cm long and becomes shorter upward. The folioles are elliptic, oblong or obovate, acute or obtuse, and the terminal the largest (4.3 cm × 2.5 cm). The petiolules are short and hairy. The flowers are yellow, axillary, and organized into lax racemes. The flower pedicels are long and thin, terete, and hairy. The sepals are oblong, lanceolate, 1.2 cm long and conspicuously veined. The andrecium comprises of about 20 stamens. The fruits are 5 cm–6.3 cm × 4 mm, upright, hairy, obliquely striate and subglobose capsules containing several seeds (Fig. 120).



Fig. 120. *Cleome viscosa* L.

Synonymy: *Cleome icosandra* L., *Polinasia icosandra* (L.) Wight. & Arn., *Polanisia viscosa* DC., *Cleome chelidonii sensu* Burk. Dict. (fide Jacobs).

Common names: Sticky cleome; *herbe puante*, *brède puante* (French); *adityabhaktá*, *ankakánta* (Sanskrit).

Uses: *Cleome viscosa* L. is a counter-irritant remedy. In Malaysia, *Cleome viscosa* L. is used to stop flatulence. A decoction is drunk to treat intestinal discomfort, to stop diarrhea and to expel intestinal worms. Externally, the plant is used to assuage headache and to treat rheumatism. In the Philippines, *Cleome viscosa* L. is used to expel intestinal worms, and maggots from ulcers. A paste of the powdered leaves is used to assuage headache. In Taiwan, the plant is used to treat rheumatism and to expel intestinal worms, while externally, it is used to treat inflamed ears. In Cambodia, Laos, and Vietnam, an infusion is used to counteract putrefaction and the roots are used to treat scurvy. The vapor obtained from steaming a decoction of the whole plant is inhaled to assuage headache. In India, *Cleome viscosa* L. is used to promote digestion and urination relieve the bowels of costiveness, expel intestinal worms and to treat inflammation and fever.

Pharmaceutical interest: The counter-irritant property of *Cleome viscosa* L. is attributed to isothiocyanates (see *Cleome gynandra* L.).

Cytotoxicity: A number of flavonols characterized from *Polinasia dodecandra* annihilate efficiently the proliferation of brain cancer cells, non-small cell lung

cancer cells, small cell lung cancer cells, ovarian cancer cells, colon cancer cells, renal cancer cells, melanoma and leukemia cell-lines cultured *in vitro* with GI₅₀ values of the micro or nanomolar concentration

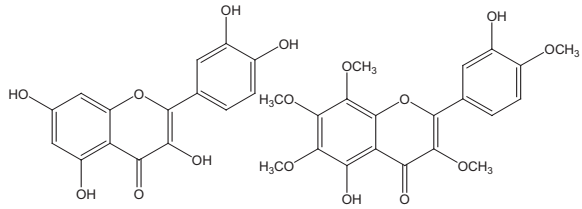


Fig. 121. Cytotoxic flavonoids from *Polinasia dodecandra*.

range (Shi Q *et al.*, 1995). Other cytotoxic natural products characterized from the *Cleome* species are triterpenes of the dammarane-type (Nagaya H *et al.*, 1997). One of these is polacandrin, characterized from *Polinasia dodecandra*, which inhibits the proliferation of KB (ED₅₀: 0.6 μ g/mL), the P388 (ED₅₀: 0.9 μ g/mL) and RPMI-7951 (ED₅₀: 0.62 μ g/mL) cell-lines (Shi Q *et al.*, 1992). It will be interesting to learn whether more intensive future research on *Cleome viscosa* L. will disclose any molecules of chemotherapeutic interest.

Other properties: Note that the antiseptic, antipyretic, analgesic and antidiarrheal properties of *Cleome viscosa* L. are confirmed experimentally in methanol and aqueous extracts of the plant. An aqueous extract inhibits the growth of *Aeromonas hydrophilla* and *Bacillus cereus* cultured *in vitro* (Perumal Samy R *et al.*, 1999). A methanol extract at doses of 200, 300, and 400 mg/Kg administered *per os* alleviates yeast-induced fever in rats in a dose-dependent manner and as efficiently as paracetamol given at 150 mg/Kg *per os* (Devi BP *et al.*, 2003). Given orally at doses of 100, 200, 400 mg/Kg this extract protects mice against several types of pain caused experimentally (Devi PB *et al.*, 2003a). It also inhibits castor-oil-induced diarrhea and prostaglandin E₂-induced diarrhea and reduces gastrointestinal motility in the charcoal meal test in rats. (Devi BP *et al.*, 2002). It will be interesting to know what are the principles involved here. Are these isothiocyanates? An extract of *Cleome droserifolia* reduces intestinal glucose absorption and increases peripheral and hepatic insulin sensitivity in tetracycline-induced diabetic albino rats and is described as “promising therapeutic value” in the treatment of diabetes mellitus (Nicola WG *et al.*, 1996).

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Capparis zeylanica* L.**

[From Greek, *kapparis* = caper and from Latin, *zeylanica* = from Ceylon]

Synonymy: *Capparis horrida* L. F.

Common names: *Nahmanitanget*, *nahmanithanjet*, *nwamanithanleyet* (Burmese); *govindi*, *kadambha* (Sanskrit); *indu*, *tonbai* (Tamil).

Physical description: It is a climbing shrub which grows in the geographical zone, spanning India and the Philippines. The branches are terete, and the young parts are rufous hairy. Leaves: 2.5 cm–7.5 cm × 1.8 cm–5 cm. The petiole is 6 mm long. Stipular hooked prickles are present. The blade is elliptic, oblong, obtuse, acute or retuse, and shows a long and stout midrib. The blade is narrow at the base, reticulately veined, glabrous and glossy above. The flowers are supra-axillary, solitary or grouped in twos or threes. The calyx comprises of 5, 9 mm long sepals which are densely rufous pubescent outside and very concave. The petals are twice as long as the sepals and densely rufous. The gynophore is 3.2 cm long. The ovary is ellipsoid and apiculate. The fruits are subglobose and 4 cm long capsules supported by a thick pedicel and containing several seeds (Fig. 122).

Pharmaceutical potential: The counter-irritant property of *Capparis zeylanica* L. is attributed to isothiocyanates (see *Cleome gynandra* L.). The therapeutic potential of *Capparis zeylanica* L. remains unexplored.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Uses: In Burma, *Capparis zeylanica* L. is a counter-irritant remedy. Internally, the bark is used to treat cholera and the root bark is used to promote digestion. In India, the roots of *Capparis zeylanica* L. are bitter, cooling, hepatoprotector and sedative (Ayurveda). The leaves are pounded and applied to boils, swollen parts and piles. In the Philippines, the leaves are rubbed with salt and applied to the head in order to assuage headache. In Cambodia, Laos, and Vietnam, *Capparis zeylanica* L. is invigorating, antiscorbutic and is used to treat gastritis.

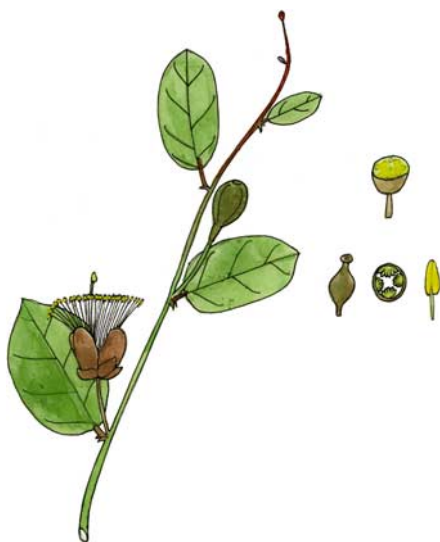


Fig. 122. *Capparis zeylanica* L.

***Crateva magna* (Lour.) DC.**

[After *kratevas*, a Greek root gatherer of antiquity and from Latin, *magnus* = great]

Physical description: It is a small and handsome riverside tree found in India, South China, Burma, and Malaysia. The bark is smooth; the inner bark mottled with yellow and white. The wood is white and hard. Leaves: deciduous with 3 folioles. The folioles are large elliptic, entire, glabrous, slightly bluish beneath, reticulately veined and 8 cm–17 cm × 4 cm–8 cm. The petiolules are 3 mm–6 mm long and the petiole 3.8 cm–7.6 cm long. The lateral folioles are oblique at the base, and the folioles show 10–15 pairs of secondary nerves. The flowers are arranged in long pediceled terminal heads, which are 5 cm large and showy. The flowers comprise of a disc-shaped receptacle, several green white ripening cream sepals, and 13–25 thread-like, pinkish purple and showy stamens. The fruits are globose, 4 cm long capsules supported by a 12 cm long gynophore. The seeds are numerous, horseshoe-shaped and embedded in a pulp (Fig. 123).

Synonymy: *Crateva nurvulana*
Buch-Ham.

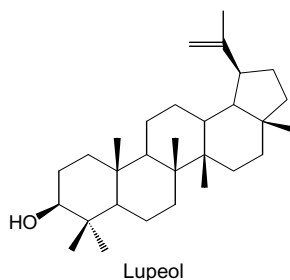
Common names: *Kadet* (Burma);
cadat, *dangla* (Malay); *ajapa*
(Sanskrit); *varanam* (Tamil).



Fig. 123. *Crateva magna* (Lour.) DC. From: KLU 36620. Field collector & botanical identification: Lynwood M. Hume, 10 Oct 1983. Geographical localization: Kg. Panji Alam, Kuala Terengganu, in house yard, apparently cultivated, altitude C. 10 m, East Malaysia.

Uses: In India, the bark of *Crateva magna* (Lour.) DC. is used to relieve the bowels of costiveness and to expel intestinal worms. The flowers are used to assuage liver congestion. In Indonesia, the bark of *Crateva magna* DC. is pounded with water and applied to the skin to treat fever and muscular pain. The leaves and other ingredients are used to make an external remedy to cure mental illnesses. In Malaysia, the leaves, the roots and the bark are boiled in oil and the mixture obtained is applied to the body to stop flatulence. The bark is bitter and flavoring, and the juice expressed from it is drunk to stimulate appetite and to relieve the bowels of costiveness. The leaves are counter-irritant.

Pharmaceutical interest: Lupeol isolated from the stem bark of *Crateva magna* (Lour.) DC. reduces the foot-pad thickness and complement activity in arthritic rats suggesting that the anti-inflammatory activity of triterpenes may be due to their anticomplementary activity (Geetha T *et al.*, 1999). Lupeol, given at 25 mg/Kg decreases the levels of lactate dehydrogenase, inorganic pyrophosphatase, alkaline phosphatase, γ -glutamyl transferase and β -glucuronidase in the urine of rats, experimentally poisoned with oxalic acid (Malini MM *et al.*, 1995).



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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Stixis scortechinii (King) Jacobs

[After Father Scortechini, botanist in Perak, Malaysia during the end of the 19th century]

Synonymy: *Roydsia scortechinii* King., *Roydsia parviflora* (non Griff.) King.

Uses: In Indonesia, the juice expressed from the roots is used to soothe sore eyes. It will be interesting to learn whether more intensive future research on *Stixis scortechinii* (King) Jacobs will disclose any molecules of therapeutic interest. This species will probably disappear before being assessed for pharmacology.

Physical description: It is a rare twin-ing shrub which grows to a height of 3 m–4 m tall in the rainforests of Sumatra and Malaysia. The stems are terete, smooth and lenticelled. Leaves:



Fig. 124. *Stixis scortechinii* (King) Jacobs. From: KLU Herbarium 4322. Field collector: LFH Merton, 14 July 1963, 3000 ft, Fraser's Hill, on the road from the Gap (Pahang) in a large climber on *Castanopsis*, Malaysia. Botanical identification: L.L. Forman, Royal Botanical Garden, Kew, 1974.

simple, without stipules and spiral. The petiole is 1 cm–1.4 cm long, terete, smooth, glabrous and curved toward the blade. The blade is oblong lanceolate, orbiculate, acute at the base, shortly acuminate at the apex, and 6.5 cm–9 cm × 4.5 cm–2.8 cm. The blade shows 5–6 pairs of secondary nerves which are arching at the margin. The inflorescences are stout and 15 cm–20 cm long terminal racemes. The fruits are green, hard, ovoid, smooth, 3.2 cm–3.5 cm × 2 cm–2.5 cm and very shortly apiculate at the apex, containing a single seed of about 2.4 cm (Fig. 124).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family BRASSICACEAE G. T. Burnett 1835 nom. conserv., the Mustard family

Physical description: The family Brassicaceae (or Cruciferae) consists of about 350 genera and 3000 species of annual and perennial pungent herbs. Brassicaceae are easily detectable by their cross-shaped corolla, hence the name crucifers. The pungency and crucifers are imparted to glucosinolates which release *isothiocyanates*. The leaves are simple, without stipules, and alternate or opposite. The blade is dissected, soft and dull green. The inflorescences are racemes of yellow or white, bisexual and actinomorphic flowers. The calyx consists of 4 free sepals which are imbricate in 2 opposite pairs. The corolla consists of 4 petals. The andrecium consists of 6 stamens, the 2 outer ones shorter than the 4 inner ones (tetradynamous). The anthers are 2-locular and open lengthwise. The gynecium consists of a pair of carpels united into a sessile and single-celled ovary divided by a wall and including several ovaries attached to 1–2 parietal placentas. The fruits are capsular.

Pharmaceutical interest: Belonging to the Brassicaceae family are a very large number of vegetables, such as *Brassica oleracea* L. (cabbage), *Brassica nigra* (L.) Koch. (mustard) and *Sinapis alba* L. (radish). *Cheiranthus cheiri* L. (wallflower) and *Lunaria rediviva* L. (honesty) are ornamental plants. Isothiocyanates irritate the skin and the mucosa and impart to Brassicaceae counter-irritant properties, hence the empirical use of mustard plasters in Western medicine. More recently, isothiocyanates have attracted a great deal of interest on account of their ability to boost the enzymatic activity of detoxification enzymes, including phase II enzyme, glutathione S-transferase (GST) and quinone reductase (QR), hence providing protection against cancer. One such isothiocyanate is 4-methylsulphinyl butyl isothiocyanate from broccoli which promotes the anticarcinogen marker enzyme quinone reductase in murine hepatoma Hepa cells. *Armoracia rusticana* (horseradish) and *Raphanus raphanistrum* (wild radish) can be fatal to livestock and are known to induce bloody vomiting and diarrhea in humans, after being ingested in excessive quantities. About 30 plant species of Brassicaceae are medicinal in the Asia-Pacific.

***Brassica juncea* (L.) Cosson**

[From Latin, *Brassica* = cabbage and *juncea* = rush-like]

Common names: Indian mustard; *moutarde de l'Inde*, *moutarde rouge* (French); *pak kai* (Malay); *mostaza* (Filipino); *mostarde da India* (Portuguese); *rajika* (Sanskrit); *kadugu* (Tamil).

Physical description: It is a herb which grows to a height of 40 cm–50 cm in India, Malaysia, East Asia, Africa, Madagascar, West Indies and South America. The stems are glabrous. Leaves: simple, spiral and without stipules. The petiole is 2 cm–8 cm long, and is longer, channeled and sheathing at the base of the stem. The blade is orbicular, glabrous and 12 cm × 5 cm–4 cm × 1 cm. The apex is obtuse, the margin is laxly toothed and the base is tapered. The blade shows 5–6 pairs of secondary nerves which are flat above and raised below. The inflorescences are terminal and axillary racemes of little yellow flowers. The fruits are capsular, long and thin and contain numerous seeds which are minute (Fig. 125).

Pharmaceutical interest:

Chemotherapeutic interest: The main constituent of the essential oil of *Brassica juncea* (L.) Cosson is allyl isothiocyanate. The antiseptic property of *Brassica juncea* (L.) Cosson is confirmed: the essential oil inhibits the growth of several bacteria and fungi cultured *in vitro* (Olivier C *et al.*, 1999; Nielsen PV *et al.*, 2000; Shin SW *et al.*,

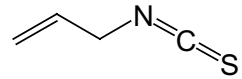


Fig. 125. *Brassica juncea* (L.) Cosson. From: KLU Herbarium 041790. Field Collector: Rohani Bte Hassan, 19 Sep 1990. Botanical identification: Ong HC. Geographical localization: cultivated in garden, Kuala Lumpur, Malaysia.

Uses: The seeds of *Brassica juncea* (L.) Cosson are pungent and are used in America, Japan, China and other countries to make mustard and oil (canola oil). Canola oil abounds in omega-3 fatty acids and has the potency to lower the risk of stroke. In China, the seeds are used to treat colds, rheumatism, lumbago, abscesses and stomach disorders. The leaves are used to soothe inflammation of the bladder and to stop hemorrhages. In Malaysia, the oil expressed from the seeds is used to treat skin eruptions and to heal ulcers.

2001) and inhibits proliferation of human prostate cancer cells by causing G2/M arrest and inducing apoptosis (Xiao D *et al.*, 2003).

Dietetic properties: In regard to the dietetic property, the seeds of *Brassica juncea* (L.) Cosson increase the levels of bile acids and neutral sterols in the liver and lowers the mean number of tumors in the colon and the intestine of rats intoxicated with 1, 2-dimethyl hydrazine (Khan BA *et al.*, 1996). The seeds lower the levels of serum cholesterol, low density lipoproteins, very low density lipoproteins, and increase high density lipoproteins in male albino rats fed for 90 days on a standard laboratory rat diet plus 20% coconut (Khan BA *et al.*, 1996a). Note that the essential oil of *Brassica juncea* (L.) Cosson has been used in cosmetics for hair control (Grdzeldze AM *et al.*, 1968).



Allyl isothiocyanate

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Capsella bursa-pastoris (L.) Medic.

[From Latin, *capsella* = little box and from *bursa* = sac and *pastorem* = shepherd]

Common names: Shepherd's purse, blind-weed, toy-wort, mother's head; *ch'i* (Chinese); *bourse à pasteur* (French); *te thai, dinh lich, co tam giac* (Cambodian, Laos, Vietnamese).

Physical description: It is an herb which grows to a height of 60 cm, mostly in temperate regions, in open ground, on walls and drains. The stems are terete, glabrous or hairy. Leaves: small and rosulate. The blade is oblong, acute or oblanceolate, and lobed or inciso-pinnatifid. The flowers are at first corymbose, then elongate into 20 cm–22.5 cm long racemes. The

Uses: *Capsella bursa-pastoris* is well-known in Europe and North America for its use to check bleeding, treat dropsy and promote urination. In China, the ashes of the roots and leaves are used to treat flux. A powder of the plant is used to soothe inflammation. The plant is used to improve liver health, stop dysentery, treat fever, promote urination and check bleeding. In Cambodia, Laos, and Vietnam, a decoction of the entire herb (6 g/day–12 g/day) is drunk to stop haemoptysis and uterine bleeding, and to treat pulmonary oedema and fever.

calyx comprises of 4 oblong and obtuse sepals. The corolla is cross-shaped, and consists of 2 pairs of white petals which are oblanceolate, and about half as long as the sepals. The fruits are heart-shaped flattened capsules which are notched at the apex, dehiscent, 9 mm × 4 mm–5 mm, and contain several (up to 30 000 per plant), ellipsoid, reddish brown and very small seeds (Fig. 126).

Pharmaceutical interest:

Acetylcholine: A curious feature of *Capsella bursa-pastoris* (L.) Medic. is that it contains acetylcholine. Acetylcholine is a neurotransmitter, responsible for the parasympathetic neuro-transmission in our organism. One might therefore set the hypothesis that the presence of acetylcholine could explain the diuretic property of the plant, by the activation of muscarinic receptors resulting in the contraction of the ureter and the bladder. Acetylcholine could also be responsible for the antifebrile properties of *Capsella bursa-pastoris*, since it is known to stimulate the secretion of sweat. An anti-ulcer property is also probable.

Chemotherapeutic interest: A benzenic extract of *Capsella bursa-pastoris* (L.) Medic. reduces the number of bacteria and yeasts cultured *in vitro* (El-Abyad MS *et al.*, 1990) on a probable account of luteolin-7-rutinoside and quercetin-3-rutinoside. An extract of the plant given to mice (0.14 g/Kg/d) experimentally infested with Ehrlich solid tumors reduces by 50%–80% the proliferation of tumors. Fumaric acid was characterized as the active principle and was able to annihilate efficiently the tumors at a dose of 10 mg/Kg/day. This compound is moderately toxic with a lethal dose 50% of 266 mg/Kg (Kuroda K *et al.*, 1976).

Other pharmacological properties: The plant is known to exert other manifold pharmacological properties. Extracts display diuretic, anti-inflammatory, anti-ulcer (Kuroda K *et al.*, 1969), cardiovascular (Kuroda K *et al.*, 1969a) and haemostatic properties (Kuroda K *et al.*, 1969b). The haemostatic principle is bursinic acid.

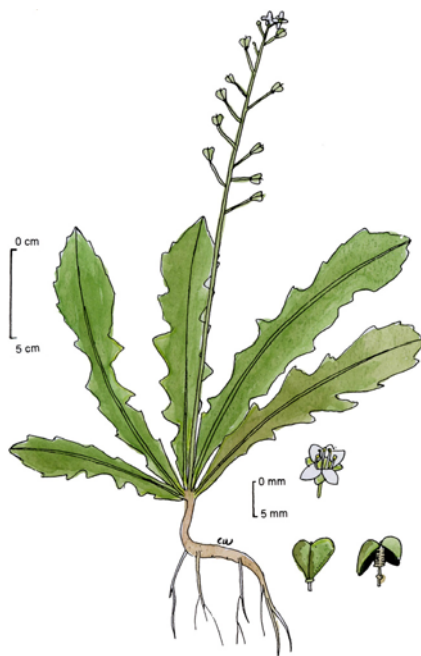
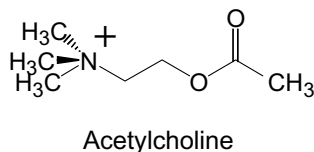


Fig. 126. *Capsella bursa-pastoris* (L.) Medic.



References

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 Kuroda K, *et al.* (1969) *Arch Int Pharmacodyn Ther* **178**(2): 392–399.
 Kuroda K, *et al.* (1969a) *Arch Int Pharmacodyn Ther* **178**(2): 382–391.
 Kuroda K, *et al.* (1969b) *Life Sci* **8**(5): 151–153.
 Kuroda K, *et al.* (1976) *Cancer Res* **36**(6): 1900–1903.

Warning: Note that this herb accumulates heavy metals when grown in town.

Cardamine hirsuta L.

[From Greek, name *kárdamon* = an Indian spice and from Latin, *hirsutus* = hairy]

Common name: Hairy bittercress.

Physical description: It is an invasive herb which grows to a height of 30 cm. It grows in vacant lots of land in several temperate countries. The stems are glabrous and erect from a rosette of leaves. Leaves: numerous, pinnately lobed, 2 cm–5 cm long, spiral and without stipules. The petiole is channeled and sheathing at the base, and subglabrous. The blade is glabrous or subglabrous and shows a few pairs of indistinct secondary nerves. The inflorescences are terminal or axillary, corymbose and 1 cm long racemes. The flowers are white and small. The calyx comprises of 2 pairs of sepals, which are subglabrous, and 2 mm × 0.5 mm long. The corolla consists of 2 pairs of petals which are very thin, and pure white. The fruits are 1 cm–2 cm × 1 mm capsules containing numerous seeds which are very small. The fruit pedicel is 4 mm–1 cm long pedicels (Fig. 127).

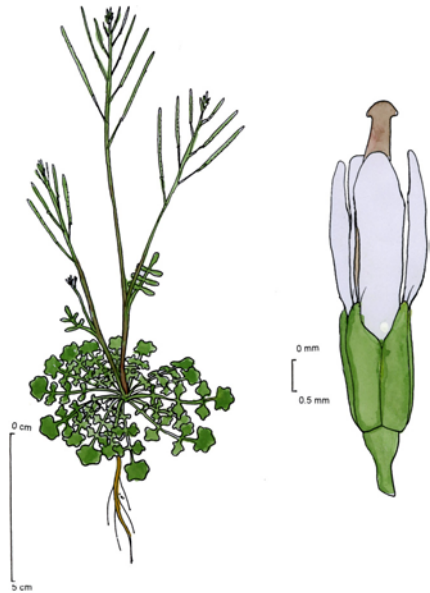


Fig. 127. *Cardamine hirsuta* L. From Herbarium 35014. Plants of Maryland. Field collector & botanical identification: JD Postman, 17 Mar 1974. Geographical localization Kensington, 3505 Astoria Road, in full sunlight.

Pharmaceutical interest: The pharmacological potential of *Cardamine hirsuta* L. remains unexplored. A methanolic extract of *Cardamine angulata* displays

antiviral activity against the Herpes Virus type 1 (McCutcheon AR *et al.*, 1995). *Cardamine opizii* has been used to treat diabetes (Kvetensky J, 1967). It will be interesting to learn whether further studies on *Cardamine hirsuta* L. will disclose any principles of pharmaceutical value.

Uses: In Laos, Vietnam, and Cambodia, *Cardamine hirsuta* L. is used to stop dysentery and to treat eye trouble. Note that the leaves are eaten in salads.

References

- Kvetensky J (1967) *Cas Lek Cesk* **106**(6): 163–165.
 McCutcheon AR, *et al.* (1995) *J Ethnopharmacol* **49**(2): 101–110.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Nasturtium indicum DC.

[From Latin, *nasus tortus* = twisted nose and *indicum* = from India]

Pharmaceutical interest: It is an invasive herb which grows to a height of 45 cm in Asia. The stems are succulent, glabrous or hairy, and terete. Leaves: simple, 7.5 cm × 2.5 cm and without stipules. The blade is ovate-lanceolate, and runcinate-dentate. The inflorescences are terminal and long racemes of several small and bright yellow flowers. The flower pedicels are 3 mm–6 mm long. The fruits are 1.2 cm–2 cm long capsules which are straight or slightly curved and contain several seeds. The seeds are very small, 2-seriate and red.

Synonymy: *Nasturtium madagascariense* Wight., *Sinapis divaricata* Roxb.

Common names: Indian cress; *cai cot xoi, dinh lich, lai hoang, thuy gioi thai* (Vietnamese).

Pharmaceutical interest: *Nasturtium indicum* DC. contains sinigrin, a glucosinolate, which is the precursor of allylthiocyanate (Pulverer G *et al.*, 1969). Sinigrin inhibits the initiation and promotion phases of 4-nitroquinoline 1-oxide-induced rat tongue cancer.

Uses: In Cambodia, Laos, and Vietnam, *Nasturtium indicum* DC. is used to promote urination, invigorate health and treat scurvy. The seeds are used to treat asthma.

References

- Derrick E, *et al.* (1997) *Br J Dermatol* **136**(2): 290–291.
 Hecht SS, *et al.* (1995) *Cancer Epidemiol Biomarkers Prev* **4**(8): 877–884.
 Pulverer G, *et al.* (1969) *Ger Med Mon* **14**(1): 27–30.

Warning: A number of plants classified within the genus *Nasturtium* cause contact dermatitis (Derrick E *et al.*, 1997).

***Nasturtium officinale* R. Br.**

[From *nasus tortus* = twisted nose and *officinale* = used in medicine]

Synonymy: *Nasturtium fontanum* Aschers.

Common names: Water-cress; *cresson aquatique* (French); *nasturzio* (Italian); *agriao* (Portuguese); *berro* (Spanish).

Physical description: It is a herb about 50 cm tall which grows mainly in the watery pastures of Europe and the temperate parts of Asia. The stems are succulent and glabrous. Leaves: spiral, without stipules, 4 cm–8 cm long and pinnately lobed. The petiole is sheathing at the base. It is channeled, the channel filled with hairs. The blade shows 4–5 pairs of opposite or sub-opposite lobes of 4 mm–1 cm in diameter and a terminal lobe which is obscurely 5-lobed. Each lobe shows 2–3 pairs of nerves, which are flat above and raised below. The inflorescences are terminal or axillary corymbs of very small flowers which comprise 4 sepals and 4 white petals (Fig. 128).

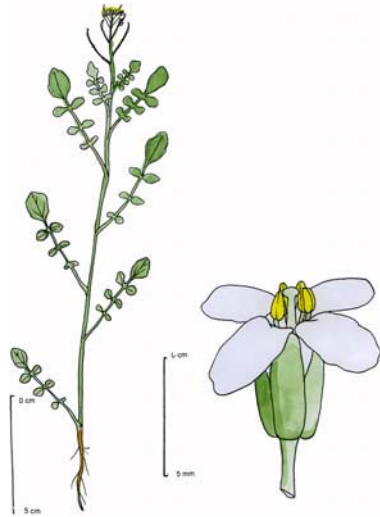


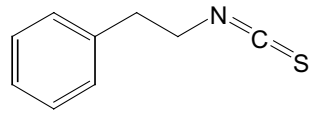
Fig. 128. *Nasturtium officinale* R. Br. From: KLU Herbarium 35336. Plants of Connecticut. Geographical localization: Collier Road, Hartford Co., Wethersfield. Field collector & botanical identification: Steven R Hill, 28 May 1981.

Pharmaceutical interest:

Antioxidant and anti-inflammatory properties: One might set the hypothesis that the anti-inflammatory properties of *Nasturtium officinale* R. Br. are possibly attributed to a synergistic action of flavonoids and isothiocyanates. A number of flavonoids isolated from *Nasturtium officinale* R. Br. inhibit the release of histamine, a mediator of inflammation, in antigen-stimulated RBL-2H3 cells *in vitro* experiment (Goda Y *et al.*, 1999). In addition, consumption of *Nasturtium officinale* R. Br. is known to decrease oxidative metabolism. The ingestion of *Nasturtium officinale* R. Br. reduces the oxidative metabolism of acetaminophen in a cross-over trial on human volunteers (Chen L *et al.*, 1996).

Uses: In China, *Nasturtium officinale* R. Br. is used to soothe inflamed lungs, throat and mouth. In Indonesia, the plant is used to treat scurvy. In Laos, Cambodia and Vietnam, the plant is used to treat scurvy and to promote urination.

Antitumor properties: In smokers, phenethyl isothiocyanate released upon the chewing of *Nasturtium officinale* R. Br. protects against lung cancer (Heschl SS *et al.*, 1995). It inhibits the oxidative metabolism of the tobacco-specific lung carcinogen 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone and lowers therefore the risks of lung cancer (Hecht SS *et al.*, 1995). Cruz (1970) reported a remarkable antimetabolic action of *Nasturtium officinale* R. Br. on some experimental tumors.



Phenethyl isothiocyanate

References

- Chen L, *et al.* (1996) *Clin Pharmacol Ther* **60**(6): 651–660.
 Cruz A (1970) *Hospital (Rio J.)* **77**(3): 943–952.
 Derrick E, *et al.* (1997) *Br J Dermatol* **136**(2): 290–291.
 Goda Y, *et al.* (1999) *Biol Pharm Bull* **22**(12): 1319–1326.
 Hecht SS, *et al.* (1995) *Cancer Epidemiology, Biomarkers & Prevention* **4**(8): 877–884.

Warning: A number of plants classified within the genus *Nasturtium* cause contact dermatitis (Derrick E *et al.*, 1997).

H. Order ERICALES Lindley 1833

The order Ericales consists of 8 families and about 4000 species of shrubs, treelets and herbs which are thought to have originated from the order Theales somewhere in the family Actinidiaceae (Appendix I). Ericales are mycotrophic, which means that they depend on mycorrhizal fungus to survive. Ericaceae is the largest family of Ericales.

1. Family EPACRIDACEAE R. Brown 1810 *nom. conserv.*, the *Epacris* Family

Physical description: The family Epacridaceae consists of 30 genera and 400 species of shrubs which are well-represented in Australia and New Zealand. It is known to produce ursolic acid, methylsalicylate, *iridoids*, tannins, *flavonoids* (foeniculin) and proanthocyanins. The leaves of Epacridaceae are simple, hard, and without stipules. The inflorescences are racemes. The flowers are perfect, regular and hypogynous. The perianth comprises of 5 sepals which are free and persistent in fruits, and a 5-lobed tubular corolla. The andrecium includes 5 stamens which alternate with the corolla lobes. The filaments are free and attached to the corolla tube. The anthers are bisporangiate, monotheical and open by longitudinal slits. The gynecium consists of 5 carpels united into a compound, plurilocular ovary with parietal placentas to which are attached several ovules. The fruits are loculicidal capsules or drupes.

Pharmaceutical interest: Belonging to the family Epacridaceae are several ornamental plants. The pharmacological potential of the family Epacridaceae is yet to be discovered and it will be interesting to learn whether more intensive future research on this family will disclose any molecules of therapeutic interest. *Styphelia Malayana* (Jack) J.J. Sm. (*Leucopogon Malayanus* Jack) is used in Malaysia for medicinal purposes.

***Leucopogon Malayanus* Jack**

[From Greek, *leukos* = white, *pogon* = beard, and from Latin, *malayanus* = From Malaya]

Synonymy: *Styphelia malayana* (Jack) J.J. Sm.

Common names: *Maki cina, atap, tasek timbul* (Malay).

Uses: In Malaysia, *Leucopogon malayanus* Jack is used to assuage body aches and stomach-ache. The pharmacological potential of *Leucopogon Malayanus* Jack is yet to be discovered.

Physical description: It is a shrub which grows to a height of 4 m in the mountains of Southeast Asia at 3000–4000 feet altitude. The stem bark is greyish, ashy, fairly hairy at the apex, deeply fissured and with numerous leaves-scars. Leaves: simple, spiral, sessile and without stipules. The blade is 2.5 cm–3.3 cm × 4 mm–5 mm, velvety below, elliptic-lanceolate, thick, acuminate at the apex and without nerves. The inflorescences are very small hairy spikes. The flowers comprise 5 mm–1 mm long sepals. The 5 petals of the corolla are 2 mm × 1 mm. The stigma is hairy at the base and 2 mm long. The fruits are little red and glossy berries (Fig. 129).

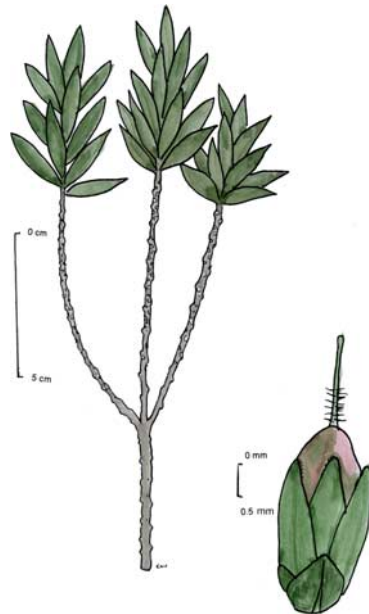


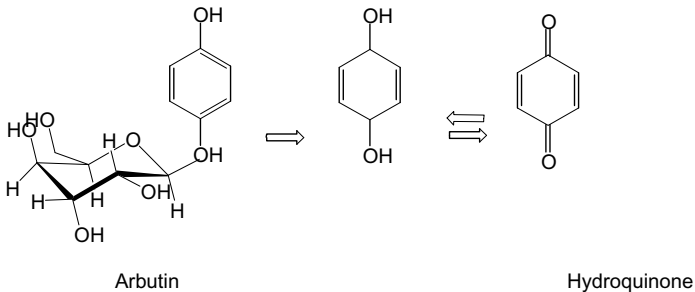
Fig. 129. *Leucopogon Malayanus* Jack.

From: KLU Herbarium 17228. Field Collector: 12 July 1971, SC Chin. Botanical Identification: Benjamin C Stone 1972. Geographical localization: Pahang, Genting Highlands, near Selangor border. In a dense Ericaceous mountain forest, Malaysia.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family ERICACEAE A. L. de Jussieu 1789 nom. conserv., the Heath Family

Physical description: The family Ericaceae consists of 125 genera and 3500 species of shrubs and treelets known to contain *iridoid*, *phenolic* glycosides and tannins. Ericaceae are widespread in temperate and subtropical regions and in tropical mountains. Note that the presence of iridoids in Ericaceae suggests that the family should be classified in the Asteridae rather than Dilleniidae. In this family the leaves are simple, small, firm and without stipules. The flowers are perfect, regular, hypogynous and arranged in bracteate racemes. The calyx and corolla consist of 3–7 sepals and petals. The corolla is tubular and often urceolate, and 5-lobed. The andrecium consists of 2 whorls of 5 stamens attached directly to a nectary disc. The anthers are dorsifixed, tetrasporangiate, dithecal and open by apical pores. The gynecium consists of 2–10 carpels united to form a compound and plurilocular ovary which encloses several ovules attached to axile (below) and parietal (above) placentas. The fruits are dehiscent capsules, berries or drupes. The seeds are small and winged.



Pharmaceutical interest: Belonging to the family Ericaceae are numerous outdoor shrubs and rock-garden plants such as *Rhododendron* and *Erica*. Other examples of useful Ericaceae are *Erica arborea* L. (briar root wood) and *Ledum groenlandicum* Oeder (Labrador tea). A number of Ericaceae, including *Arctostaphylos uva-ursi* (L.) Spreng. (Bearberry, *French Pharmacopoeia*, 10th Edition), *Arbutus unedo* L. (arbousier), *Chimaphila umbellata* Nutt. (herbe a pisser), *Calluna vulgaris* (L.) Hull. (Scotch heather) L. and *Erica cinerea* L. (twisted heath) are used in Western medicine to promote urination and to treat urinary tract infections. This property is attributed to phenol glycosides such as arbutin, the precursor of hydroquinone. Note that hydroquinone inhibits the synthesis of melanin and has been used more or less successfully to bleach the skin. *Gaultheria procumbens* L. (tea berry) is the source of wintergreen oil which is rich in methyl salicylate. The berries of *Vaccinium myrtillus* or blueberry, bilberry (*Myrtillus*, *Swiss Pharmacopoeia*, 1934) are used to extract anthocyanins. Note that several Ericaceae, especially the

Rhododendron species, are neurotoxic on account of unusual tetracyclic diterpenes known as grayanotoxins. Of recent interest are flavonoids from *Rhododendron dauricum* which demonstrated potent anti-HIV activity *in vitro*. About 20 species of plants classified within the family Ericaceae are used for medicinal purposes in the Asia-Pacific. These are often used to treat rheumatism and skin infection, and to stop itchiness.

***Lyonia ovalifolia* (Wall.) Drude**

[After J. Lyons, a Scottish-American horticulturist of the 19th century; and from Latin, *ovalis* = ovoid and *folium* = leaf]

Common names: Staggerbush;
aynar (Himalayan); *nejiki* (Japanese).

Physical description: It is a tree which grows in the mountains of India, China and Japan. It is very common in the Himalayas. The stems are smooth, greyish and rusty tomentose at the apex. Leaves: simple, alternate and without stipules. The petiole is 2 mm–6 mm long and rusty tomentose. The blade is papery, tomentose beneath, and 3.8 cm × 2.6 cm × 9 cm × 5.5 cm. The base of the blade is cordate and somewhat asymmetrical, the apex is acuminate, and the margin is obscurely wavy and recurved. The blade shows a midrib which is flat above and raised below, and 12–16 pairs of secondary nerves which are arching toward the apex. The tertiary nerves are scalariform and visible beneath. The inflorescences are terminal spikes of about 5 cm long (Fig. 130).

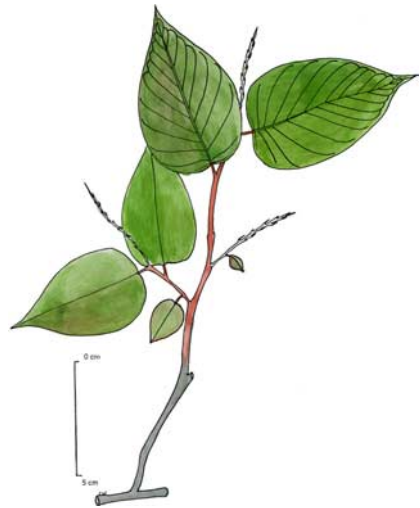


Fig. 130. *Lyonia ovalifolia* (Wall.) Drude. From: Flora of Malaya, 08010. Field collector: 4 May 1964, MED Poore. Geographical localization: altitude 6600 ft, Gunong Brinchang forest ridge, Cameron Highlands, Pahang, Malaysia. Botanical identification: FSP Ng.

Pharmaceutical interest: The toxic property of *Lyonia ovalifolia* (Wall.) Drude is most probably attributed to a series of diterpenes lyoniatoxins (lyoniols), which are known to occur in *Lyonia ovalifolia* Drude var. *elliptica* Hand.-Mazz. (Fukuma H *et al.*, 1969; Hikino H *et al.*, 1970; Yasue M *et al.*, 1970; 1971; 1974). The pharmacotoxicological properties of *Lyonia ovalifolia* (Wall.) Drude remains unexplored til to date.

Uses: In China, the leaves and fruits of *Lyonia ovalifolia* (Wall.) Drude are used to invigorate but are known to be toxic.

References

- Fukuma H, *et al.* (1969) *Yakugaku Zasshi* **89**(3): 382–388.
 Hikino H, *et al.* (1970) *Chem Pharm Bull* **18**(4): 852–854.
 Yasue M, *et al.* (1970) *Yakugaku Zasshi* **90**(7): 893–898.
 Yasue M, *et al.* (1971) *Yakugaku Zasshi* **91**(3): 358–362.
 Yasue M, *et al.* (1974) *Yakugaku Zasshi* **94**(10): 1349–1352.

Warning: This plant is toxic.

Rhododendron moulmainsense Hook

[From Greek, *rhodon* = rose and *dendron* = tree and *moulmainsense* = Moulmain]

Synonymy: *Rhododendron westlandii*

Common name: Moulmainense.
Westland's rhododendron

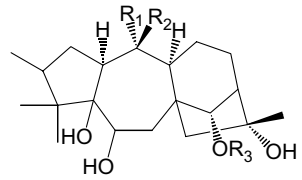
Physical description: It is a magnificent shrub which grows to a height of 2 m. It is found on open hillsides



Fig. 131. *Rhododendron moulmainsense* Hook. From: KLU Herbarium 375. Flora of Malaya. Field Collector: Benjamin C Stone 15 May 1969. Geographical localization: Gunong Jerai, (Kedah Peak) 2800 ft. Botanical Identification: FSP Ng, 11/74.

Uses: In Tibet, the honeys of *Rhododendron moulmainsense* Hook. are used for food and responsible for poisoning. The poisonous principles involved are a series of grayanotoxins (andromedotoxins) which occur in all parts of the *Rhododendron* species, including pollen. These diterpenes bind to the sodium channels in neurone membranes, increase the permeability of neurones to sodium ions, and hamper normal neurotransmission, hence resulting in a lowering of blood pressure, lack of coordination, convulsions, severe vertigo, hallucinations, bradycardia, feeling of retrosternal compression progressive paralysis and death by paralysis of the diaphragm (Von Malottki K *et al.*, 1996). Grayanotoxins are interesting because they inhibit the mitotic activity of lymphocytes at doses of 10^{-4} M and 10^{-3} M (Ascioglu M *et al.*, 1998). Other secondary metabolites of interest in the *Rhododendron* species are flavonoids, such as quercetin from *Rhododendron cinnabarium* which inhibits experimentally-induced production of tumor necrosis α and nitric oxide by macrophages (Manjeet KR *et al.*, 1999).

in forests and thickets from 1300 to 12 000 ft. in South China, (Southeast Tibet to Guangdong), Taiwan, Laos, Vietnam, Cambodia and Malaysia. The bark is grey, fissured longitudinally and glabrous. Leaves: simple, without stipules, sessile and spiral, and the young leaves reddish. The blade is elliptic, olive, glossy, lanceolate, glabrous, leathery and 10.4 cm–5.6 cm × 1.6 cm–3 cm. The margin is recurved, and the blade shows a few pairs of indistinct secondary nerves. The midrib is sunken above and raised below. The inflorescences are terminal and bracteate spikes of about 5 cm–6 cm long. The bracts are broad, 7 mm × 8 mm, acute and hairy at the margin. The flowers are mildly fragrant and showy. The corolla is pure white, or white flushed with yellow or pink, magenta or lilac, and is with or without a yellow or pale green blotch. The corolla is tubular and 5-lobed. The corolla tube is 8 mm × 3 mm and the lobes are elliptic, irregular, very thin and nerved. The andrecium consists of 10 stamens with 2 mm × 0.5 mm anthers. The filaments are 1.8 cm–2.3 cm long and pilose at the base. The ovary is fusiform, glabrous and 4 mm long. The style is 3 cm long. The fruits are capsules marked at the apex by vestigial styles (Fig. 131).



Grayanotoxin

References

- Ascioglu M, *et al.* (1998) *J Int Med Res* **21**(7): 140–143.
 Manjeet KR, *et al.* (1999) *Int J Immunopharmacol* **21**(7): 435–443.
 Von Malottki K, *et al.* (1996) *Deutsche Medizinische Wochenschrift* **121**(30): 936–938.

Warning: The plant is toxic.

Vaccinium vitis-idaea L.

[From Latin, *vaccinium* = whortleberry and *vitis-idaea* = vine of Mount Ida]

Common names: Lingonberry, cowberry, red whortleberry.

Physical description: It is a 7 cm–10 cm tall, woody and creeping herb found in China, Japan and Australia. The stems are microscopically hairy. Leaves: simple, spiral and without stipules. The petiole is 0.5 mm long. The blade is coffee-bean-like, broadly elliptic, notched at the apex, 7 mm × 4 mm–4 mm × 2 mm, and glabrous except for a few hairs

Uses: In China and Japan, *Vaccinium vitis-idaea* L. is used to treat gonorrhoea. The dried leaves (Cowberry leaf, *Japanese Pharmacopoeia*, 1961) are astringent and have been used as a domestic Japanese remedy for the treatment of diarrhea and rheumatic conditions. The plant contains arbutin, the forerunner of hydroquinone which is well known for its urinary antiseptic properties.

underneath. The midrib is sunken above. The margin is laxly serrate. The fruits are berries of 7 mm in diameter (Fig. 132).

Pharmaceutical interest:

Tannins: In regard to the antidiarrheal and anti-inflammatory properties mentioned above, one might set the hypothesis that condensed tannins such as cinnamtannin B1, proanthocyanidins A1 and epicatechin-(4 β → 6)-epicatechin-(4 β → 8, 2 β → O → 7)-catechin which display strong antioxidant properties experimentally (Ho KY *et al.*, 1999) are involved. Epicatechin-(4 β → 8)-epicatechin-(4 β → 8, 2 β → O → 7)-catechin inhibits the proliferation of the periodontal pathogen *Porphyromonas gingivalis* and *Porphyromonas intermedia* cultured *in vitro* (Ho KH *et al.*, 2001). Such tannins are notably present in tea. A water extract of *Vaccinium vitis-idaea* L. inhibits platelet activating factor-induced exocytose *in vitro*, thereby confirming the anti-inflammatory property (Tunon H *et al.*, 1995).

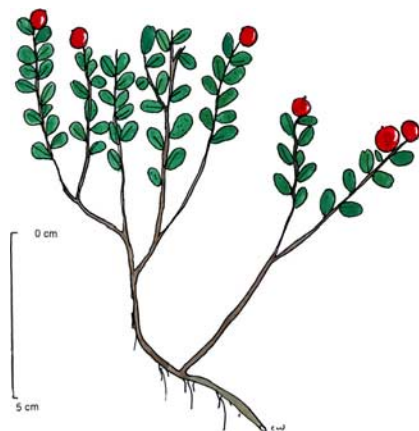
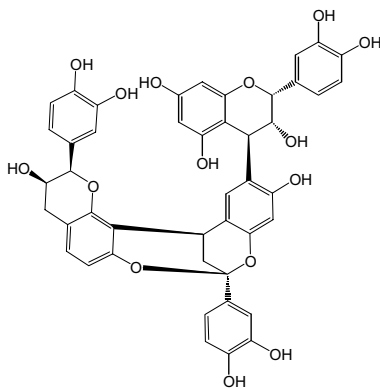


Fig. 132. *Vaccinium vitis-idaea* L.



Epicatechin - (4 β → 6) - epicatechin - (4 β → 8, 2 β → O → 7) - catechin

References

- Ho KY, *et al.* (1999) *J Pharm Pharmacol* **51**(9): 1075–1078.
 Ho KY, *et al.* (2001) *J Pharm Pharmacol* **53**(2): 187–191.
 Tunon H, *et al.* (1995) *J Ethnopharmacol* **48**(2): 61–76.

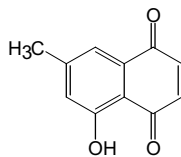
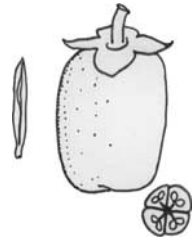
Warning: Caution must be taken as the toxic effects of this plant are unknown.

I. Order EBENALES Engler 1892

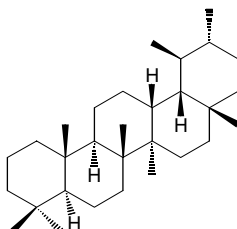
The order Ebenales consists of 5 families and about 1700 species of primitive trees and shrubs which are thought to have originated from the order Theales, alongside the Primulales (Appendix I). About a quarter of the species in Ebenales belong to the family Ebenaceae.

1. Family EBENACEAE Gurke in Engler & Prantl 1891 *nom. conserv.*, the Ebony Family

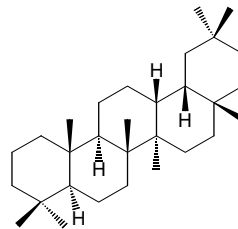
Physical description: The family Ebenaceae consists of 5 genera and about 450 species of tropical timbers and shrubs. The wood of Ebenaceae is very dense, hard and reddish. The wood contains notably 1,4 *naphthoquinones* (plumbagin and 7 – methyljuglone) that darken upon light exposure. Other notorious secondary metabolites of Ebenaceae are a series of *pentacyclic triterpenes* of the ursane and oleanane type, and some *lignans*. The leaves of Ebenaceae are simple, leathery, alternate and without stipules. The flowers are small, regular, hypogynous, and principally unisexual (dioecious). The calyx is 3–7-lobed, persistent, and often vestigial in fruits. The corolla is sympetalous, 3–7-lobed. The stamens are attached to the base of the corolla tube, and are usually twice as many as the corolla lobes. The gynecium consists of 2–10 carpels, forming a compound, plurilocular ovary containing several ovules attached to axile placentas. The fruits are very characteristic juicy or leathery berries marked at the base with a vestigial calyx.



7 Methyljuglone



Ursane



Oleanane

Pharmaceutical interest: Classical examples of Ebenaceae are *Diospyros ebenum* Konig. (ebony), *Diospyros virginianum* L. (persimmon) and *Diospyros kaki* L. f. (Japanese persimmon). Ebenaceae are interesting because they contain a series of antibacterial, antiviral, cytotoxic, monoamine oxidase-inhibitors and antioxidant monomer, dimmers and oligomers of naphthoquinones, and it would not be surprising should more intensive future research on this family disclose any molecules of therapeutic interest. About 20 species of Ebenaceae are used for medicinal purposes in the Asia-Pacific. Note that medicinal Ebenaceae are often used to expel intestinal worms and to treat viral infections.

***Diospyros argentea* Griff.**

[From Greek, *diospyros* = persimmon fruit and from Latin, *argentum* = silver]

Common name: Silver-leaved ebony;
bedil lalat (Malay).

Physical description: It is a lowland timber of Malaysia and Indonesia. The whole tree is covered in a golden irritating silky tomentum, except the upper side of the leaves and the bark. Leaves: simple, oblong, leathery, and 7 cm × 30 cm. The petiole is stout and up to 1.5 cm long. The base is round and the apex pointed. The midrib is deeply sunken above and conspicuously raised below. The secondary nerves are indistinct on both sides of the blade. The flowers are white. The fruits are 6 cm × 3 cm, velvety, golden-colored, and show 4 sepals at the base which are leathery (Fig. 133).



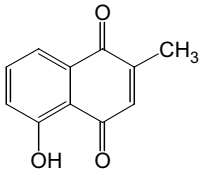
Fig. 133. *Diospyros argentea* Griff.

Pharmaceutical interest: To date, the pharmacological potential of *Diospyros argentea* Griff. is unexplored, but several naphthoquinones and pentacyclic triterpenes have thus far been characterized from the genus *Diospyros* (Mallavadhani UV *et al.*, 1998).

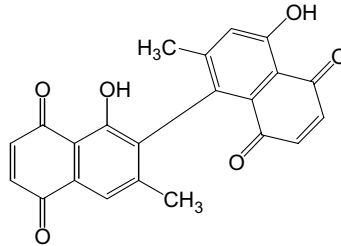
Uses: Malays burn the leaves of *Diospyros argentea* Griff. to repel mosquitoes and apply the pounded roots externally to treat herpes zoster.

Naphthoquinones: Cytotoxic, antibacterial and inhibit the enzymatic activity of monoamine oxidase. The cytotoxicity of naphthoquinones implies at least 3 synergistic mechanisms. Firstly, the quinone moiety has a chemical structure similar to ubiquinone, and interferes with the mitochondrial electron transport.

Secondly, the quinone moiety generates highly reactive free radicals (Lown JW, 1979). Thirdly, naphthoquinones are planar, and intercalate with DNA. An example of a naphthoquinone of therapeutic interest is atovaquone, which is used to treat malaria and *Pneumocystis carinii* infection. Examples of cytotoxic naphthoquinones are plumbagin, isodiospyrin and 8'-hydroxyisodiospyrin which inhibit significantly the proliferation of Hepa, KB, Colo-205 and HeLa cell-lines cultured *in vitro* (Kuo YH *et al.*, 1997).



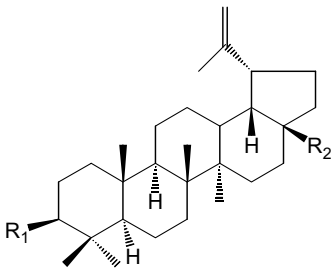
Plumbagin



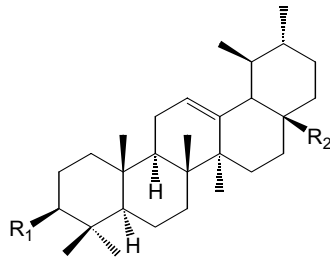
Isodiospyrin

Lemulinol A, a naphthoquinone characterized from the *Diospyros* species, inhibits mouse liver monoamine oxidase (MAO) activity. An aqueous extract of *Diospyros bateri* inhibits the proliferation of several sorts of Gram-positive and Gram-negative bacteria cultured *in vitro* (Odelola HA *et al.*, 1988).

Pentacyclic triterpenes: Betulin, betulinic acid and ursolic acid characterized from *Diospyros leukomelas*, inhibit inflammation (Recio MC *et al.*, 1999). Note that betulinic acid has interesting antiviral properties.



Lupeol $R_1 = \beta$ OH, $R_2 = \text{CH}_3$
 Betulin $R_1 = \beta$ OH, $R_2 = \text{CH}_2\text{OH}$
 Betulinic acid $R_1 = \beta$ OH, $R_2 = \text{COOH}$



α Amyrin $R_1 = \alpha$ OH, $R_2 = \text{CH}_3$
 Ursolic acid $R_1 = \alpha$ OH, $R_2 = \text{COOH}$

References

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 Kapadia GJ, *et al.* (1997) *J Natl Cancer Inst* **60**(3): 683–686.
 Kuo YH, *et al.* (1997) *Planta Med* **63**(4): 363–365.
 Lown JW (1979) *Mitomycin C: Current Status and New Developments*. New York: Academic Press.
 Mallavadhani UV, *et al.* (1998) *Phytochem* **49**(4): 901–951.
 Odelola HA, *et al.* (1988) *Afr J Med Scie* **17**(3): 167–170.
 Recio MC, *et al.* (1999) *Planta Med* **61**(1): 9–12.

Warning: 1,4 Naphthoquinones have an irritating odor, cause sneezing, purple color staining to the skin, and are vesicant. 50% of the rats that received weekly subcutaneous injections of a total aqueous extract of *Diospyros virginianum* L., developed tumors (Kapadia GJ *et al.*, 1978). Animals fed with *Diospyros virginiana*, were observed to develop gastric impaction, ulceration and perforation. (Cummings CA *et al.*, 1997).

Diospyros kaki L. f.

[From Greek, *diospyros* = persimmon fruit and from Japanese, *kaki* = *Diospyros kaki* L. f.]

Synonymy: *Diospyros chinensis* Bl.

Common names: Japanese persimmon, *shi* (Chinese).

Physical description: It is a fruit tree native to China, North India, and Japan. The wood is reddish. The stems are smooth, lenticelled, and hairy at the apex. Leaves: simple, alternate and without stipules. The petiole is 1.3 cm–1.5 cm long and hairy. The blade is 8 cm–10.5 cm × 6.4 cm–7.2 cm, membranaceous, hairy, ovate to broadly elliptic, dark green on the surface and lighter green underneath. The base of the blade is asymmetrical, and the margin is obscurely wavy. The midrib and secondary nerves are flat above and raised below. The flowers are axillary and solitary on 5 mm pedicels which are hairy. The fruits are yellow berries, which are leathery, glossy and approximately 7 cm in diameter (Fig. 134).

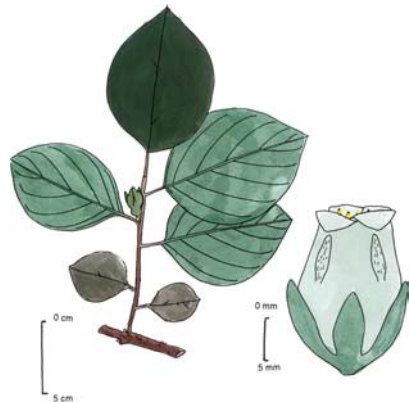


Fig. 134. *Diospyros kaki* L. f. From: KLU Herbarium 22485. Flora Japonica. Ex. Herbario Universitatis Kyotoensis. 1926. Kyoto. Field collector & botanical identification: Q Kadzumi. From: KLU Herbarium 33036, South China Institute of Botany, Academia Sinica. Kwangchou, China. Field collector & botanical identification: HG Yip, 7 Apr 1981. Geographical localization: Guangzhou, Guangdong, China.

Pharmaceutical interest:

Hypotensive property: The hypotensive property of *Diospyros kaki* L. f. is attributed to astralagin, kaempferol-3-*O*-(2''-*O*- galloyl)-glucoside, sisoquercitrin, quercetin-3-*O*-(2''-*O*-galloyl)-glucoside which inhibit the angiotensin-converting enzyme dose-dependently (Kameda K *et al.*, 1987).

Uses: In China, the juice expressed from the unripe fruits is drunk to lower blood pressure, check hemorrhage, relieve the bowels of costiveness and treat typhus. The bark and wood are used to heal wounds and ulcers. A decoction of the leaves is drunk to treat fever.

Cellular activities: Japanese persimmon extract, epicatechingallate, and epigallocatechin gallate inhibit the growth of human lymphoid leukaemia Molt 4 cells and calf thymus DNA α -polymerase (Achiwa Y *et al.*, 1997; Umekawa H *et al.*, 1999). Flavonoid glycosides and pentacyclic triterpenes isolated from the leaves protect human neutrophils against experimentally induced neutrophil generation and tyrosyl phosphorylation of proteins (Guang C *et al.*, 2002, Guang C *et al.*, 2002a). A water-soluble acidic arabinogalactan isolated from the leaves of *Diospyros kaki* L. f. stimulates LPS-induced B lymphocyte proliferation *in vitro* (Duan J *et al.*, 2003).

References

- Achiwa Y, *et al.* (1997) *Bioscience, Biotechnology & Biochemistry* **61**(7): 1009–1020.
 Duan J, *et al.* (2003) *Carbohydrate Research* **338**(12): 1291–1297.
 Guang C, *et al.* (2002) *Clinica Chimica Acta* **326**(1–2): 169–175.
 Guang C, *et al.* (2002a) *Clinica Chimica Acta* **320**(1–2): 11–16.
 Kameda K, *et al.* (1987) *J Nat Prod* **50**(4): 680–683.
 Umekawa H, *et al.* (1999) *Biochemistry & Molecular Biology International* **47**(5): 795–801.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Diospyros wallichii* K. & G. ex Williams**

[From Greek, *diospyros* = persimmon fruit and after Dr Nathaniel Wallich (1786–1854), a Danish plant hunter, botanist and physician]

Physical description: *Diospyros wallichii* K. & G. ex Williams is a timber which

Common name: *Pokok tuba buah.*

grows to a height of 15 m in lowlands up to 700 m, throughout Malaysia, Burma, Thailand, Sumatra and Borneo. The stems are glabrous, lenticelled and terete. Leaves: simple, alternate and without stipules. The petiole is stout, channeled above, glabrous and 1 cm–1.3 cm long. The blade is elliptic, lanceolate, 21 cm \times 7.8 cm–25.9 cm \times 8.2 cm, papery and glabrous. The base and the apex of the blade are acute, the margin is somewhat wavy and recurved. The midrib is deeply sunken above and raised below, and the blade shows

14–18 pairs of secondary nerves which are raised below, while arching and indistinct above. The tertiary nerves are scalariform. The inflorescences are axillary cymes of minute and velvety flowers. The fruits are brown, velvety, globose, and 2.5 cm–3 cm in diameter. The calyx is vestigial and woody (Fig. 135). The juice expressed from the fruit stains yellow and is very irritating to the skin.

Uses: In Malaysia, the leaves of *Diospyros wallichii* K. & G. ex Williams are used to treat yaws. The fruits are used to poison fish.

Pharmaceutical interest: To date, nothing is known about the therapeutic potential of *Diospyros wallichii* K. & G. ex Williams. The ichthyotoxicity of the fruits is probably attributed to saponins. The plant may have disappeared before being investigated for pharmacology.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

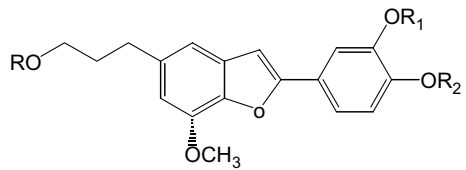
2. Family *STYRACACEAE* Dumortier 1829 *nom. conserv.*, the *Storax* Family

Physical description: The family Styracaceae consists of 10 genera and 150 species of tropical timber. The leaves of Styracaceae are simple, alternate, and without stipules. The flowers are perfect, regular, and hypogynous. The calyx is tubular and of 4–5-lobed. The corolla consists of 2–5 petals forming a tube. The andrecium comprises of 4–10 stamens in a single row, and the anthers are linear, tetrasporangiate, dithecal and open by longitudinal slits. The gynecium consists of 3–5 carpels united to form a compound, superior, and unilocular ovary containing several ovules attached to axile placentas. The fruits are capsular are marked by an opening.



Fig. 135. *Diospyros wallichii* K. & G. ex Williams. From: KLU 32792. The New York Botanical Garden. Economic Plants of Thailand. Field collectors and botanical identification: Tetsuo Koyama, PJ O' Connor. 4 Feb 1979. Geographical localization: Peninsular Thailand, Prov. Pangna, Kraburi District, Songphinong waterfall, 50 m alt., tropical forest.

Pharmaceutical interest: Styracaceae is the family of the *Styrax* species from which balsamic resins are obtained by an incision of the stems. The resins of *Styrax tonkinense* Pierre (Siam Benzoin, *British Pharmaceutical Codex*, 1959), *Styrax benzoin* Dryand. and *Styrax paralleloneurus* (Sumatra Benzoin, *British Pharmacopoeia*, 1948). have been used to make inhalations for the treatment of catarrh whereas *Styrax officinalis* L., is the source of storax. Of recent interest are antibacterial and antifungal



Nor-lignan

lignans characterized from the Brazilian *Styrax ferrugineus*. In the Asia-Pacific, *Alniphyllum fortunei* (Hemsl.) Perk., *Alniphyllum hainanense* Hay., *Styrax benzoin* Dryand., *Styrax tonkinense* Pierre, *Styrax benzoides* Craib are medicinal.

***Styrax benzoin* Dryand.**

[From Greek, *styrax* = *Styrax officinalis* and from Arabic, *luban jawi* = frankincense of Java]

Common name: Styrax tree, benzoin tree; *kemenyan* (Malay).

Physical description: It is a buttressed timber which grows to a height of 30 m in lowland rainforests up to 800 m in Malaysia and Indonesia. The bark is smooth, or finely cracked. The inner bark is soft and reddish and

Uses: Benzoin or the resin obtained by bruising then tapping the bark of *Styrax benzoin* Dryand. has long been used in Asian medicine. It is used to treat stroke, invigorate health after labor, assuage pain in the heart and abdomen, counteract putrefaction, promote libido and heal hemorrhoids. Benzoin contains a large amount of free benzoic acid and cinnamic acid.



Fig. 136. *Styrax benzoin* Dryand. From: KLU Herbarium 26425. Flora of Selangor. Comm. Ex. Herb. Hort. Bot. Sing. Geographical localization $4\frac{3}{4}$ m.s., Genting Highlands, Ulu Gombak, altitude: 3000 ft., 14 Jun 1973, Malaysia. Field collectors: Mohd Shah and Mohd Ali.

the sapwood is white. Leaves: simple, alternate and without stipules and 6 cm–20 cm × 2.5 cm–9 cm. The blade is glaucous and covered with a glaucous tomentum of starry hairs. The inflorescences are racemose or paniculate. The fruits are globose, glaucous and 2 cm–3.8 cm (Fig. 136).

Pharmaceutical interest: A number of lignans characterized from *Styrax ferrugineus* show antibacterial and antifungal properties (Pauletti PM *et al.*, 2000). These lignans are likely to be cytotoxic and antiviral, but this has yet to be confirmed. The fruits of *Styrax japonica* contain anti-sweet triterpenes saponins (Yoshikawa K *et al.*, 2000).

References

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Yoshikawa K, *et al.* (2000) *Chem Pharm Bull* (Tokyo) **48**(7): 1093–1096.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

J. Order PRIMULALES Lindley 1833

The order Primulales consists of 3 families and about 1900 species of shrubs and herbs close to Ericales and Ebenales, with which it shares the ability to use benzoquinones, triterpenoid saponins and flavonoids as chemical repellents (Appendix I). The largest family of this order is the Myrsinaceae with a thousand species. Besides the Myrsinaceae is the family Primulaceae, the family of *Primula veris* (cowslip, primrose), the flowers and the roots of which have been used to treat insomnia, stress, cough, and skin diseases in Western medicine. The therapeutic potential of Primulales is yet to be fully investigated.

1. Family MYRSINACEAE R. Brown 1810 *nom. conserv.*, the Myrsine family

Physical description: The family Myrsinaceae consists of 30 genera and approximately 1000 species of tropical trees, shrubs and herbs abounding with 1, 4-benzoquinones and saponins. The bark is smooth or lenticelled. The leaves in Myrsinaceae are simple, alternate, crenate, fleshy, glossy, and characteristically gland-dotted beneath the blade. The flowers are small, perfect, hypogynous or half epigynous sympetalous, and 5-merous. The calyx consists of 4–5 sepals which are free or connate at the base. The corolla is tubular or rotate. The andrecium consists of 5 stamens adnate to the corolla tube and opposite the petals. The gynecium consists of 3–5 carpels forming a compound single-celled and superior ovary developing upwards into a short style, and containing a few or numerous ovules attached to a free central placenta. The fruits are berries or drupes.

Pharmaceutical interest: Classical examples of Myrsinaceae are *Ardisia crenata* Sims (Christmas berry) and *Ardisia japonica* Bl. (Japanese Ardisia) which are ornamental. Myrsinaceae are interesting because they produce quinones and saponins which have so far displayed a large spectrum of pharmacological activities. Of particular interest are saponins characterized from *Myrsine africana* which could be of chemotherapeutic value. About 40 species of the plants classified within the family Myrsinaceae are used for medicinal purposes in the Asia-Pacific. Note that these plants are often used to treat uterine disorders and sore throat, and to assuage pains.

***Ardisia crispa* A. DC.**

[From Greek, *ardis* = sharp and from Latin, *crispus* = curled]

Physical description: It is a shrub which grows to a height of 3 m. It is found in the wilds or cultivated in vacant plots, open grounds, villages, seashores and the secondary rainforests of Southern Asia. Leaves: 10 cm × 4 cm, simple, alternate and without stipules. The petiole is slender. The blade is narrowly elliptic, tapered toward the apex and the base is dark green, glossy, and succulent. The margin is laxly crenate. The inflorescences are terminal. The flowers are small and whitish-pink. The calyx consists of 5 free sepals. The corolla is short and tubular, and consists of 5 spreading petals. The andrecium comprises of 5 short pediceled stamens with large anthers, with the entire structure forming a conspicuous cone around the style. The fruits are red, glossy, globose and 5 mm long berries (Fig. 137).

Synonymy: *Ardisia hortorum* Maxim.,
Ardisia crispa var. *angusta* Clarke,
Ardisia crenata Sims.

Common names: Village ardisia;
hens eye; *mata ayam* (Malay).

Pharmaceutical interest:

Anti-metastatic properties: *Ardisia crispa* A. DC produces 2-methoxy-6-tridecyl-1,4-benzoquinone which blocks

Uses: The roots of *Ardisia crispa* A. DC. are used in China to treat fever and to stop excessive salivation. In Malaysia, the juice expressed from the leaves is used to treat scurvy, and an infusion of the roots is drunk to treat fever and cough, and to stop dysentery. In Taiwan, *Ardisia crispa* A. DC. is used to promote urination.



Fig. 137. *Ardisia crispa* A. DC.

platelet aggregation, B16-F10 melanoma cell adhesion to extracellular matrix and B16-F10 melanoma cell invasion, and inhibits pulmonary metastasis and tumor growth by blocking integrin receptor (Fig. 138) (Kang HY *et al.*, 2001) Integrin receptors are transmembrane protein receptors which monitor platelet adhesion within the vasculature during clotting, apoptosis, proliferation, migration, spreading, and adhesion of tumor cells.

Ardisiaquinones: An interesting feature of the *Ardisia* species and Myrsinaceae in general is the production of a very unusual series of dimeric benzoquinones known as ardisiaquinones. Ardisiaquinone D, E and F characterized from *Ardisia sieboldii* inhibit the enzymatic activity 5-lipo-oxygenase, a key enzyme of pyrogenesis, hence the antifebrile properties mentioned above (Fukuyama Y *et al.*, 1995; Fukuyama Y *et al.*, 1993) Ardisiaquinones G, H and I from *Ardisia teysmannia* inhibit *in vitro* the first step of bacterial peptidoglycan synthesis with IC_{50} of $5 \mu M$, $26 \mu M$ and $16 \mu M$ respectively (Yang KL *et al.*, 2001). It will be interesting to learn whether more intensive future research on ardisiaquinones will disclose any molecules of therapeutic interest.

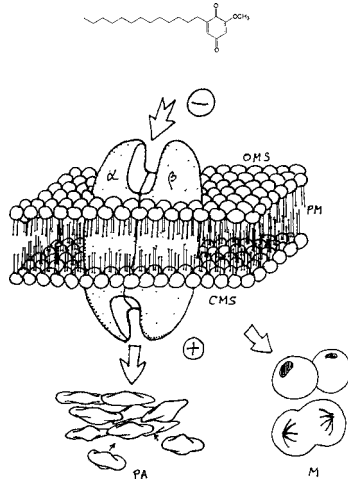
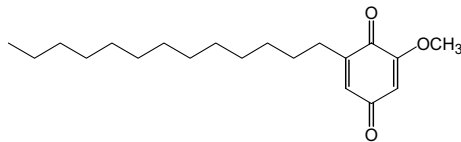
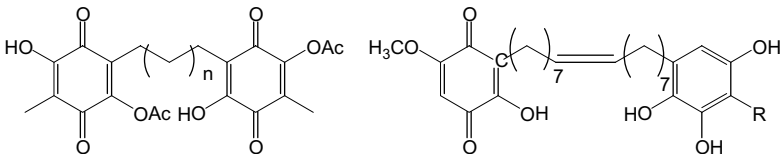


Fig. 138. Integrin 2-Methoxy-6-tridecyl-1,4-benzoquinone blocks integrin receptors and hampers therefore platelet adhesion (PA), apoptosis, proliferation, migration, spreading, and adhesion of tumor cells (M). OMS: outer membrane surface, CMS cytoplasmic membrane surface.



2 - Methoxy - 6 - tridecyl - 1,4 benzoquinone

Saponins: Note that *Ardisia crispa* A. DC. is known to contain ardisiacrispin A and B which contract isolated portions of uterus (Jansakul C *et al.*, 1987).



Ardisiaquinone G (n= 11)

Ardisiaquinone E (R= H)

References

- Fukuyama Y, *et al.* (1993) *Chem Pharm Bull* **41**(3): 561–565.
 Fukuyama Y, *et al.* (1995) *Chem Pharm Bull* **43**(8): 1391–1394.
 Kang YH, *et al.* (2001) *Int J Cancer* **93**(5): 736–740.
 Jasankul C, *et al.* (1987) *Planta Med* **53**(5): 400–409.
 Piacente S, *et al.* (1996) *J Nat Prod* **59**(6): 565–569.
 Yang KL, *et al.* (2001) *Phytochem* **58**(8): 1235–1238.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Embelia ribes Burm. f.

[From Singhalese, *aembilla* = *Embelia ribes* and from Arabic, *ribas* = sorrel]

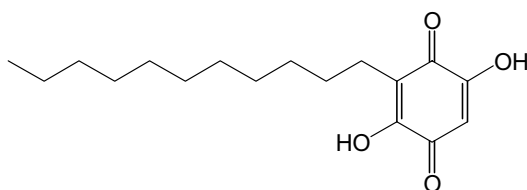
Common names: Common embelia; *akar sulur kerang* (Malay); *amogha* (Sanskrit).

Uses: The seeds of *Embelia ribes* Burm. f. are eaten to expel intestinal worms in several Asian countries. In Cambodia, Laos, and Vietnam, the seeds are used to expel intestinal worms. The dried leaves are used to heal pimples and boils. In India, the seeds are used to relieve the bowels of costiveness and to expel intestinal worms. *Embelia* (*British pharmaceutical Codex*, 1934), or the dried fruits which must contain about 2.5% of embelin, was used to expel intestinal worms (dose: 4 g–16 g; 60–240 grains) in Western medicine.



Physical description: It is a slender woody climber which grows in the geographical zone spanning India to South China. Leaves: simple, alternate and without stipules. The petiole is short. The blade is narrowly oval, 5 cm–10 cm × 1.5 cm–5 cm, and shows a few pairs of indistinct secondary nerves. The base of the blade is tapered and the apex pointed. The inflorescences are terminal racemes. The flowers are white or greenish, without a corolla tube. The fruits are black, succulent, tipped and 4 mm long berries (Fig. 139).

Fig. 139. *Embelia ribes* Burm.f. From: KLU Herbarium 35271. Flora of Malaya. Geographical localization: Rimbah Ilmu, University of Malaya. Woody climber. Field collector: Mustapha. Botanical Identification: BC Stone. 13 Apr 1978.



Embelin

Pharmaceutical interest:

Embelin: Embelin is interesting because it is anthelmintic, antibacterial, analgesic, antitumor, anti-inflammatory (Chitra M *et al.*, 1994) and binds to opioid μ - and κ -opioid receptors (Zutshi U *et al.*, 1989). Rats infected with 10 adult *Hymenolepsis diminuta* tapeworms recover with a diammonium salt of embelin given at 100 mg/kg (Bogh HO *et al.*, 1996). The precise mechanism of action of embelin remains an unanswered and interesting question. In an attempt to answer it, one might set the hypothesis that embelin acts on κ -receptors and therefore modifies the transfer of calcium ions through the cell membrane of helminthes. Praquizarantel is an example of a molecule which controls schistosomiasis and *Taenia sp.* infection through a mechanism involving the transfer of calcium ions. *Embelia ribes* Burm. f. is most probably antibacterial on account of embelin which exhibits significant inhibition against five and moderate activity against three strains of 12 bacteria cultured *in vitro* (Chitra M *et al.*, 2003). Potassium embelate subjected to subacute, chronic and reproductive toxicity tests in rodents and monkeys did not cause severe adverse properties (Johri RK *et al.*, 1990).

References

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Chitra M, *et al.* (1994) *Chemotherapy* **40**(2): 109–113.
Chitra M, *et al.* (2003) *Fitoter* **74**(4): 401–403.
Krishnaswamy M, *et al.* (1980) *Indian J Exp Biol* **18**(11): 1359–1360.
Gupta S, *et al.* (1989) *Contraception* **39**(3): 307–320.
Johri RK, *et al.* (1990) *Indian J Exp Biol* **28**(3): 213–217.
Low G, *et al.* (1985) *Toxicol Appl Pharmacol* **81**(2): 220–230.
Zutshi U, *et al.* (1989) *Indian J Exp Biol* **27**(7): 656–657.

Warning: A host of evidence suggests that embelin reduces fertility (Krishnaswamy M *et al.*, 1980; Gupta S *et al.*, 1989) and vision (Low G *et al.*, 1985).

***Labisia pumila* (Bl.) Benth. & Hook.**

[From Greek, *labis* = holder and from Latin, *pumilus* = dwarf]

Physical description: It is an understory herb found in the lowlands and hilly rainforests of the Asia-Pacific, which grows to a height of about 30 cm. Leaves: simple, spiral and exstipulate. The petiole is short and thick. The blade is lanceolate, fleshy, light green on the surface and purplish underneath, and slightly toothed. The inflorescences are 12 cm–20 cm long racemes of small and white campanulate flowers. The fruits are black berries (Fig. 140).

Uses: In Malaysia, the roots of *Labisia pumila* (Bl.) Benth. & Hook. are boiled to make a drink ingested to induce labor, stop flatulence and dysentery, regulate menstruation, treat venereal diseases and invigorate the uterus.

Pharmaceutical interest: The pharmacological potential of *Labisia pumila* (Bl.) F-Vill. & Naves remains unexplored, but it is quite possible that triterpenoid saponins, which are common in the Myrsinaceae, are responsible for the medicinal and especially uterus strengthening properties of this plant.

Synonymy: *Ardisia pumila* Bl., *Angiopetalum punctatum* Reinw., *Ardisia pumila* var. *alata* Scheff., *Labisia pothoina* Lindl., *Labisia pumila* (Bl.) F-Vill. & Naves, *Labisia pumila* var. *alata* (Scheff.) Mez, *Labisia punctata* (Reinw.) Airy-Shaw.

Common names: Common Labisia; *selusoh Fatimah*, *kacip Fatimah* (Malay).



Fig. 140. *Labisia pumila* (Bl.) Bth. & Hook.

Reference

Jamal JA (1999) Investigation of *Labisia pumila*: A Malay Traditional Herb for Pregnant Women. PhD Thesis. London.

Warning: Extracts of *Labisia pumila* (Bl.) F-Vill. & Naves promote the growth of endometrial estrogen dependent adenocarcinoma cells of the type Ishikawa var 1 cultured *in vitro* (Jamal, 1999).

V. Subclass ROSIDAE Takhtajan 1966

The subclass Rosidae is a large group which consists of 18 orders, 114 families, and about 58 000 species of trees, shrubs, herbs and climbers thought to have originated from the subclass Magnoliidae in the early Upper Cretaceous period (Appendix I). The chemical weapons used by Rosidae, especially the primitive ones, are *hydrolyzable tannins* inherited from Magnoliidae. Other noticeable secondary metabolites of Rosidae are cyanogen glycosides, triterpenes, alkaloids and iridoids. The leaves of Rosidae are pinnate, serrate, and stipulate. The flowers include a definite number of sepals and petals which are free and inserted in a nectary disc from which several stamens develop, initiating a centripetal sequence. The ovary in Rosidae comprises of 2 to several locules, containing 1 or 2 ovules per locule. Countless plant species from the Rosidae prove to be useful agricultural and pharmaceutical products. The order Rosales is the most archaic order of Rosidae and is a common ancestor to all other orders in this subclass.

A. Order ROSALES Lindley 1833

The order Rosales consists of 24 families and about 6600 species of cosmopolitan plants. The family Rosaceae of approximately 3000 species is by far the largest family in this order, followed by the family Crassulaceae of 900 species and the family Saxifragaceae. The Connaraceae is the oldest family in the Rosales.

1. FAMILY CONNARACEAE R. Brown in Tuckey 1818 *nom. conserv.*, the *Connarus* Family

Physical description: The family Connaraceae consists of about 20 genera and 350 species of tanniferous tropical trees, shrubs and climbers known to abound with tannins and 1,4-*benzoquinones* (rapanone). The leaves in this family are alternate, without stipules and pinnate. The inflorescences are terminal, pseudoterminal or axillary racemes or panicles. The flowers are hermaphrodite or unisexual, and actinomorphic or slightly zygomorphic. The calyx comprises of 5 coriaceous, free or slightly connate, and imbricate or valvate sepals. The corolla consists of 5 free imbricate petals. The andrecium consists of 5–10 stamens arranged in 2 whorls, with dithecal anthers opening by longitudinal slits. The gynecium is archaic as it consists of 5 free carpels, with only one being fertile, maturing into a dehiscent and often bright red capsule, containing a black or brown, glossy seed embedded in a colorful aril.

Pharmaceutical interest: The seeds of Connaraceae are known to be poisonous on account of a series of very unusual amino acids such as

L-methionine sulphoximine (glabrine, cnestine), which causes convulsion and death. The seeds of *Rourea glabra* mixed with corn mash have been used in tropical America for criminal purposes. About 10 species of the plants classified within the family Connaraceae are medicinal in the Asia-Pacific. These plants are often used to invigorate the uterus and to treat fever. It will be interesting to learn whether a more intensive study on Connaraceae will disclose any molecules of therapeutic interest.

***Agelaea trinervis* (Llanos) Merr.**

[From Greek, *agelios* = a herd and *tri* = 3 and *neuron* = nerve]

Physical description: It is a woody climber which grows to a length of 7 m in the primary and secondary rainforests of China, Cambodia, Indonesia, Laos, Malaysia, the Philippines, Thailand and Vietnam. The wood is reddish and the bark is dark grey. Leaves: 3-foliolate, spiral and without stipules. The rachis is 3 cm–10 cm long. The petiolules are stout. The folioles are coriaceous, elliptic, lanceolate, 6.5 cm–14 cm × 2.7 cm–7.2 cm. The margin is wavy and recurved. The blade shows 3–4 pairs of secondary nerves which are flat above and raised beneath. The inflorescences are axillary and velvety panicles. The flowers are 1 cm × 7 mm, and cream-colored with a red calyx. The fruits are dehiscent, 1 cm long follicles each containing a single seed which is black and glossy, and embedded in a yellow aril (Fig. 141).

Uses: In Malaysia, *Agelaea trinervis* (Llanos) Merr. is used to treat rheumatism and to stimulate venereal desire.

Pharmaceutical interest: The pharmacological potential of this plant and of the genus *Agelaea* in general is virtually unexplored. It will be interesting

Synonymy: *Agelaea wallichii* Hook f., *Castanola trinervis* Llanos, *Agelaea cambodiana* Pierre, *Agelaea wallichii* JD Hooker, *Castanola glabrifolia* Schellenberg, *Castanola obliqua* Schellenberg.

Common names: *Kalam malam* (Malay); *li dou teng* (Chinese).

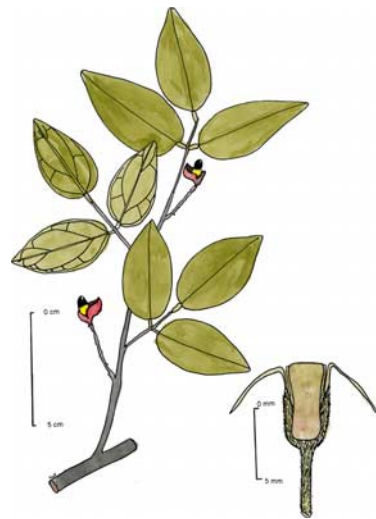


Fig. 141. *Agelaea trinervis* (Llanos) Merr. From: KLU Herbarium 11675. Flora of Malaya. Field collector and botanical identification: Benjamin C Stone. July 1970. Geographical localization: Pahang, Tasek Bera, low altitude.

to learn whether a more intensive study on *Agelaea* species will disclose any 1,4 benzoquinones of chemotherapeutic interest.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Cnestis palala* (Lour.) Merr.**

[From Greek, *knestis* = with irritant hairs]

Synonymy: *Thysanus palala* Lour.,
Cnestis ramiflora Griffith.

Common name: *Shi mao guo*
(Chinese).

Uses: In Malaysia, a decoction of the roots of *Cnestis palala* (Lour.) Merr. is drunk to treat malaria, assuage stomachache, normalize urination, aid recovery from childbirth and to resolve sprains.

Physical description: It is a woody streamside climber found in the rainforests of Hainan, Indonesia, Laos, Malaysia, Burma, Thailand and Vietnam. The wood is reddish and the bark is brown and fissured longitudinally. Leaves: 30 cm–50 cm long, spiral, without stipules, crowded at the apex of the stem, consisting of up to 14 pairs of folioles. The rachis is velvety. The folioles are velvety beneath, oblong, 2.2 cm × 3.8 cm and sessile. The base of the folioles is obscurely cordate, the apex rounded, and the midrib is sunken above and raised beneath. The blade shows up to 10 pairs of secondary nerves. The inflorescences are velvety and emerge all along the stem below the leafy crown. The sepals are red and velvety, and the petals are white, short and notched. The andrecium comprises of 10 stamens which are whitish. The gynecium consists of 5 free carpels (Fig. 142).

Pharmaceutical interest: Extracts of *Cnestis ferruginea* display anticonvulsant and antifungal properties experimentally (Declume C *et al.*, 1984; Le Grand A *et al.*, 1988).

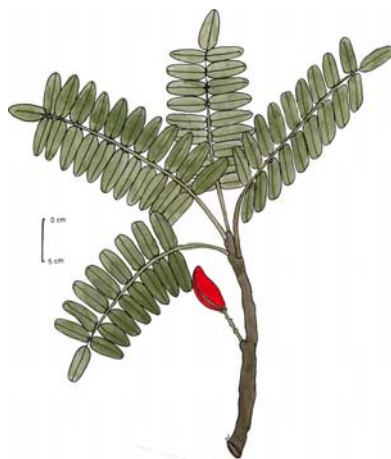
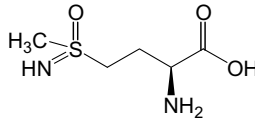


Fig. 142. *Cnestis palala* (Lour.) Merr. From: KLU Herbarium 32429. Field collector: WJJO de Wilde and Wilde- Duyfjes. 5 Aug 1979. Geographical localization: Sikundur Forest Reserve, c. 75 Km. West Northwest of Medan, c. 3° 55' North–98° 05' East; 50 m–100 m altitude, Besitang road, Km. 14 to Aceh border in recently logged forest. Botanical identification: M Goh WK, 27 July 1998.



L - Methionine sulphoximine

References

- Declume C, *et al.* (1984) *Annales Pharmaceutiques Françaises* **42**(1): 35–41.
 Jeannoda VL, *et al.* (1984) *Biochimie* **66**(7–8): 557–562.
 Le Grand A, *et al.* (1988) *J Ethnopharmacol* **229** 1): 25–31.
 Murakoshi I, *et al.* (1993) *Chem Pharm Bull* **41**(2): 388–390.

Warning: The seeds of *Cnestis palala* (Lour.) Merr. are poisonous on account of L — methionine sulfoximine which has also been isolated from the root bark of *Cnestis glabra* (Jeannoda VL *et al.*, 1984; Murakoshi I *et al.*, 1993).

Connarus monocarpus L.

[From Greek, *konaros* = a spring tree, *monos* = alone and *karpos* = fruit]

Physical description: It is a small shrub found in the South Asian rainforest. Leaves: pinnate, consists of 3–5. The petiolules are 3 mm–5 mm long. The folioles are glabrous, 7.5 cm–10 cm × 3.2 cm–4.5 cm, and show 3–5 pairs of secondary nerves. The blade is glossy, and elliptic or elliptic-lanceolate, round or acute at the base and the apex is obtusely acuminate. The flowers are 5 mm long and crowded in upright pyramidal densely pubescent terminal panicles. The flower pedicels are short, stout and articulate. The calyx consists of 5 ovate-oblong, subacute and densely pubescent sepals. The corolla comprises of 5 petals which are much longer than the sepals, linear-oblong and more or less pubescent outside. The andrecium comprises of 10 stamens. The gynecium includes 5 pubescent carpels, among which only a single one is perfect. The fruits are free, bright red follicles seated on a persistent but non-acrescent calyx (Fig. 143).

Synonym: *Connarus oligophyllus* Wall.

Common names: *Atlaket, kadaktalet, talet* (Burmese); *lemak lemak* (Malay), *sedippulikkodi* (Tamil).

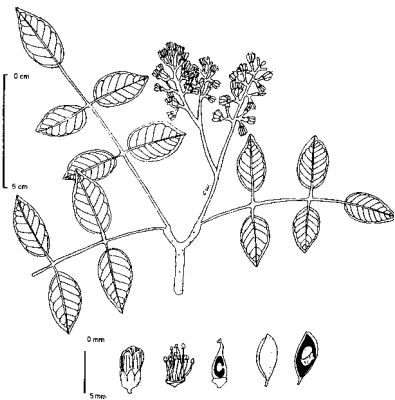
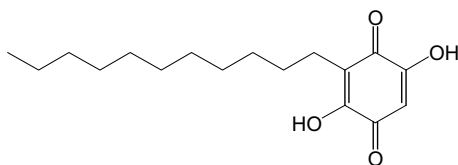
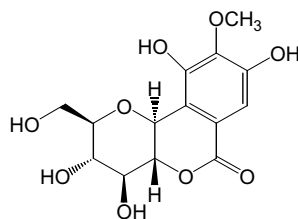


Fig. 143. *Connarus monocarpus* L.



Rapanone



Bergenin

Pharmaceutical interest: One might set the hypothesis that the anti-inflammatory property mentioned above could be attributed to bergenin and leucopelargonidin (Aiyar SN *et al.*, 1963), as well as rapanone. Note that *Connarus monocarpus* L. contains rapanone which is anthelmintic, oral contraceptive, antimicrobial and angiotensin-converting enzyme inhibitor ($IC_{50} = 36 \mu M$; Lund AK *et al.*, 1998; Calle J *et al.*, 2000). It will be interesting to learn whether more intensive future research on bergenin will disclose any therapeutic properties. Note that rapanone and bergenin occur also in the family Myrsinaceae. Do Myrsinaceae and Connaraceae share common ancestors in the Magnoliidae?

Uses: In Malaysia, the pounded roots are applied externally to soothe inflamed areas and a decoction of the bark is drunk to assuage stomachache. In India, a decoction of the bark is used to treat syphilis and the pulp of the fruit is applied to diseased eyes.

References

- Aiyar SN, *et al.* (1963) *Phytochem* **3**(2): 335–339.
 Calle J, *et al.* (2000) *J Ethnopharmacol* **71**(3): 521–525.
 Lund AK, *et al.* (1998) *Phytomed* **5**(3): 199–203.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Connarus semidecandrus Jack

[From Greek, *konaros* = a spring tree; from Latin, *semi* = half; and from Greek, *deka* = ten and *andro* = male]

Physical description: It is a climbing shrub found in Burma, Malaysia and Indonesia. Leaves: alternate, 18 cm–30 cm long and imparipinnate. The petiolules are 3 mm long. The folioles are coriaceous, oblong or elliptic-lanceolate,

Synonymy: *Connarus mutabilis* Bl., *Connarus neurocalyx* Planch.

Common names: *Akar kuaya*, *akar tanga burong*, *akar tukor nyamok*, *akar tupai tupai* (Malay).

cuneate, at the base and show 6–7 pairs of secondary nerves. The inflorescences are terminal, 15 cm–25 cm long panicles. The calyx consists of 5 sepals which are lanceolate and dotted with red spots. The corolla comprises of 5 lanceolate petals which are blunt and dotted with numerous red spots outside. The fruits are red follicles which are flattened. Each follicle contains a single seed which is glossy, black and embedded in a yellow aril.

Pharmaceutical interest: The therapeutic potential of *Connarus semidecandrus* Jack is awaiting discovery. Benzoquinones are probably involved in the antifebrile property mentioned above.

Uses: In Malaysia, the roots are used to treat fever. In the Philippines, a decoction of the root is ingested to strengthen the uterus.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Rourea minor (Gaertn.) Leenh.

[After Aroura in French Guiana and from Latin, *minor* = less]

Synonymy: *Rourea erecta* (Blco.) Merr., *Rourea humilis* Bl., *Rourea microphylla* Planch., *Santaloides floridum* O. Ktze., *Santaloides pulchellum* O. Ktze.

Physical description: It is a large woody vine or shrub found in India, Ceylon, South China, and Indonesia. The young stems are hairy. Leaves: simple or pinnate. The petiolules are 2 mm–6 mm long. The folioles are 1 cm–25 cm × 5 mm–10 cm. The blade is suborbicular or ovate or lanceolate, and thinly coriaceous, acuminate at the apex and acute or cordate at the base. The folioles show 4–10 pairs of secondary nerves. The inflorescences are 20 cm long racemes which are laxly branched, multi-flowered and glabrous. The calyx consists of 5 sepals which are 2 mm–4 mm long. The corolla consists of 5 petals which are 4 mm–7.5 mm long. The fruits are oblique-ovoid and 1 cm–3 cm × 3 mm–10 mm follicles (Fig. 144).

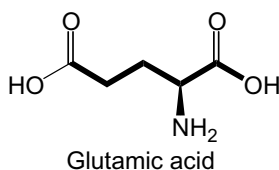
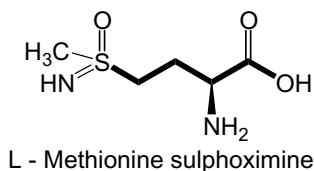


Fig. 144. *Rourea minor* (Gaertn.) Leenh.

Pharmaceutical interest:

L-Methionine sulphoximine: A common poison found in the Connaraceae and probably in *Rourea minor* (Gaertn.) Leenh. is L-methionine sulphoximine which (Jeannoda VL *et al.*, 1985). The mode of action of L-Methionine sulphoximine is based on the fact that it is shaped like L-glutamic acid (an excitatory amino acid) and acts as a false substrate for glutamine synthetase, which normally converts glutamic acid into glutamine. Glutamic acid accumulates in neurons and causes a continuous depolarization of dendrites, hence resulting in central nervous system disturbances and convulsions. L-Methionine sulphoximine lowers extracellular potassium during acute hyperammonaemia (Sugimoto H *et al.*, 1997).

Uses: In Malaysia, a decoction of the roots is drunk to treat fever, and the pounded roots are drunk to heal sores. In the Philippines, a decoction of the roots is used to invigorate the uterus, expel impurities, induce vomit and to kill wild dogs.

**References**

- Jeannoda VL, *et al.* (1985) *J Ethnopharmacol* **14**(1): 11–17.
Sugimoto H, *et al.* (1997) *J Cereb Blood Flow Metab* **17**: 44–49.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Roureopsis emarginata* (Jack) Merr.**

[After Aroura in French Guiana and from Latin, *marginata* = margined]

Physical description: It is a woody climber that grows in the rainforests of Burma, Malaysia and South China. The wood is yellowish-red and the bark is blackish. Leaves: imparipinnate, spiral, without stipules and consist of 4–6 pairs of folioles, including a terminal one. The rachis is 1.5 cm–7 cm long. The petiolules are indistinct. The folioles are lanceolate, 2.8 cm–3.2 cm × 8 cm–1.1 cm, and acute at the

Synonymy: *Roureopsis pubinervis* Planch.

base. The apex extends into a 1 cm long tail. The secondary nerves are inconspicuous. The inflorescences are axillary racemes. The fruits are dehiscent, 2.4 cm × 8 cm bright red follicles, each containing each a single seed (Fig. 145).

Uses: In Malaysia, the leaves of *Roureopsis emarginata* (Jack) Merr. are applied externally to treat fever and to assuage pain.

Pharmaceutical interest: The pharmacological properties of *Roureopsis emarginata* (Jack) Merr. are unknown. Antidiarrheal and antimicrobial properties are established from the extracts of *Roureopsis obliquifoliata* (Longanga O *et al.*, 2001; Otshudi AL *et al.*, 2000). Are tannins or benzoquinones involved as well?

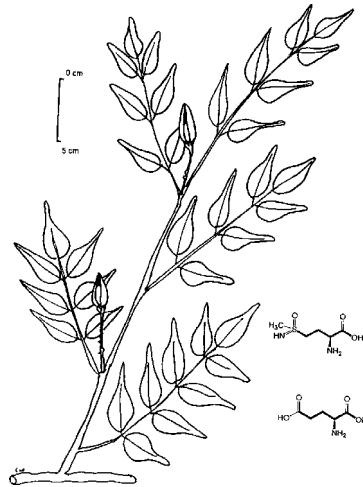


Fig. 145. *Roureopsis emarginata* (Jack) Merr. From: KLU Herbarium 32356. Field collectors: WJJO de Wilde & BEE de Wilde - Duyfjes. 5 Aug 1979. Geographical localization: Sikundur Forest Reserve, c. 75 Km. West Northwest of Medan, c. 3° 55' North–98° 05' East; 50–100 m alt., Besitang road, Km 14 to Aceh border in recently logged forest. Botanical identification: M Goh WK, 27 Jul 1998.

References

- Longanga O, *et al.* (2001) *Fitoter* **72**(3): 291–294.
 Otshudi AL, *et al.* (2000) *Phytomedicine* **7**(2): 167–172.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family CUNONIACEAE R. Brown. in Flinders 1814 nom. conserv., the Cunonia Family

Physical description: The family Cunoniaceae consists of 25 genera and 350 species of shrubs and trees, mostly native to the Southern Hemisphere. Cunoniaceae abound with *tannins*, proanthocyanins, ellagic acid and aluminum. The leaves of Cunoniaceae are pinnate and opposite. The folioles are serrate and the stipules are present and interpetiolar. The inflorescences are racemes or panicles. The flowers are small, regular, perfect, and hypogynous. The calyx consists of 4–5 free sepals and the petals are alternate, as numerous as, and smaller than the sepals. The andrecium comprises of 8–11

stamens, with versatile, inverted, tetrasporangiate, dithecal stamens opening by longitudinal slits. A nectary disc is present. The gynecium consists of 2–5 carpels, united in a plurilocular, superior ovary with independent styles, each locule enclosing 2 to several ovules attached on the axile or apical placentas. The fruits are capsular and contain several seeds which are small, winged or hairy.

Pharmaceutical interest: Very little is so far known about the pharmacological potential of Cunoniaceae. It will be interesting to learn whether a more intensive study on Cunoniaceae will disclose any tannins of therapeutic interest. *Weinmannia blumei* Planch. is used for medicinal purposes in Indonesia.

***Weinmannia blumei* Planch.**

[After JW Weinmann, a German herbalist of the 17th century and after Carl Ludwig von Blumen, early 18th century taxonomist]

Synonymy: *Weinmannia ledermannii* Schlechter, *Weinmannia papuana* Schlechter, *Weinmannia sundana* Miq.

Common names: Malayan mountain ash, *ki ringgit* (Indonesian); *sumu silan* (Malay).

Uses: Indonesians use the bark of *Weinmannia blumei* Planch. as an astringent remedy. The pharmacological potential of this plant is unexplored. Note that honeys of *Weinmannia racemosa* contain unusual terpenes.

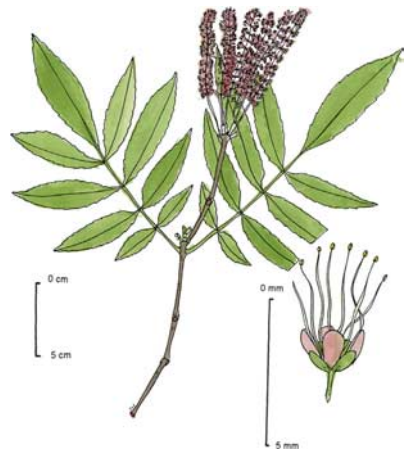


Fig. 146. *Weinmannia blumei* Planch. From: KLU 23704. Flora of Malaya. Herbarium Australiense C.S.I.R.O, Canberra, A.C.T. (CANB). Field collector and botanical identification.: RD Hoogland. 27 Mar 1975. Geographical Localization: common in forest on steep slope, altitude: 3700 ft. Bukit Fraser, along Road from the Gap, Selangor, Malaysia.

Physical description: It is a tree which grows to a height of 12 m in the rain-forests of Malaysia and Indonesia. The stems are smooth, lenticelled, somewhat articulate, and dark brown. The wood is reddish-brown. Leaves: simple, decussate and stipulate. The stipules are interpetiolar, kidney-shaped, 9 mm × 5 mm–2.3 cm × 1.5 cm, and leathery. The rachis is somewhat articulate, 7 cm–11.3 cm long and microscopically hairy. The folioles are

sessile, opposite, lanceolate, serrate, asymmetrical, leathery, 1.1 cm–3.5 cm × 4 cm–12 cm, and smaller toward the base of the rachis. The midrib is sunken above and raised below, and the secondary nerves are about a dozen. The inflorescences are pinkish, profusely blooming and showy. The calyx comprises of 4 sepals which are 1 mm long, hairy at the base and orbicular. The petals are 1 cm × 5 mm and glabrous. The andrecium is showy and comprises of 8 stamens, among which a few are aborted (Fig. 146).

References

- Broom JS, *et al.* (1992) *Tetrahedron Letter* **33**(41): 6201–6204.
 Ede ME, *et al.* (1993) *Tetrahedron Letter* **34**(42): 6795–6798.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

3. Family PITTOSPORACEAE R. Brown in Flinders 1814 *nom conserv.*, the *Pittosporum* Family

Physical description: The family Pittosporaceae consists of 9 genera and 200 species of shrubs and small trees that are widely distributed in the tropical and warm temperate parts of the world, especially in Australia. The array of chemical repellents in Pittosporaceae is broad and includes triterpenoid saponins, essential oils, polyacetylenic fatty acids, and proanthocyanins. About 150 species of Pittosporaceae belong to the single genus *Pittosporum*. The leaves of Pittosporaceae are simple, alternate, leathery, glossy, and without stipules. The inflorescences are axillary, cymose or racemose. The flowers are perfect, regular, hypogynous and pentamerous. The stamens alternate with the petals. The gynecium consists of 2–5 carpels united to form a compound, unilocular ovary with a single style and a capitate stigma. The ovary encloses numerous ovules attached to parietal placentas. The fruits are dehiscent capsules or berries. The seeds are often embedded in a viscous pulp and include a succulent, oily and proteinaceous endosperm.

Pharmaceutical interest: A classical example of Pittosporaceae is *Pittosporum tobira* (Thunb.) Ait. (Australian laurel) which is cultivated as an ornamental evergreen shrub. *Pittosporum tobira* (Thunb.) Ait., *Pittosporum ferrugineum* Ait., *Pittosporum pentandrum* (Blco.) Merr. and *Pittosporum resiniferum* Hesm. are used for medicinal purposes in the Asia-Pacific. To date, the pharmacological potential of the family Pittosporaceae remains unexplored.

***Pittosporum tobira* (Thunb.) Ait.**

[From Greek, *pitta* = resin and *spora* = seed and from Japanese, *tobira* = *Pittosporum tobira* (Thunb.) Ait.]

Common names: Australian laurel, mock orange, Japanese Pittosporum; *hai tong* (Chinese).

Physical description: The plant is native to Japan and China. The stems are terete, smooth and glabrous. Leaves: simple, alternate, crowded at the apex of the stems and without stipules. The petiole is 6 mm–1.5 cm long and channeled above. The blade is spatulate, coriaceous, 6 cm × 2.8 cm–12 cm × 4 cm, glossy, and dark green. The margin of the blade is wavy and recurved, and the midrib is deeply sunken above and raised below. The blade shows 7–9 pairs of secondary nerves. The inflorescences are 2.5 cm long axillary racemes of whitish flowers. The corolla is tubular and 5-lobed. The andrecium consists of 5 stamens alternating with the lobes. The fruits are capsular, 3-lobed, green, 1.5 cm × 1.3 cm, and dehiscent. The seeds are numerous and embedded in a viscous and bright red pulp (Fig. 147).

Pharmaceutical interest: An ethanol extract of the leaves of *Pittosporum phylliraeoides* DC. var. *microcarpa* S. Moore is antiviral against Ross River virus cultured *in vitro* (Semple SJ *et al.*, 1998).

Reference

Semple SJ, *et al.* (1998) *J Ethnopharmacol* 60(2): 163–172.

Warning: *Pittosporum tobira* (Thunb.) Ait. is toxic.

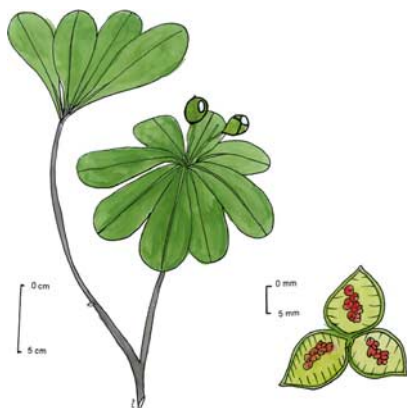


Fig. 147. *Pittosporum tobira* (Thunb.) Ait.

From: KLU Herbarium 037870. Ex. Herbarium of University of the Ryukyus. Geographical Localization: Okinawa: Yona Experim. Plantation of the Univ., Kunigami; along woodland path. 7 June 1984. Field Collector and Botanical Identification: Shimabuku. From: KLU 10418. Chiba, 30 Sep 1955.

Uses: In China, *Pittosporum tobira* (Thunb.) Ait. is used to stop dysentery, treat rheumatism and to strengthen dentition.

4. Family CRASSULACEAE A. P. de Candolle in Lamarck & de Candolle 1805 nom. conserv., the Stonecrop Family

Physical description: The family Crassulaceae consists of 25 genera and 900 species of perennial herbs found predominantly in the Northern Hemisphere and in Southern Africa. Crassulaceae have the tendency to accumulate water to survive in dry habitats. These plants are succulent and abound with tannins, oxalic acid, and an interesting series of *piperidine alkaloids* (*Sedum*, Fig. 148). The leaves in this family are simple, entire, without stipules, alternate, and opposite or whorled. The inflorescences are cymose or solitary. The flowers are bisexual, actinomorphic, and comprise of 4–5 sepals which are free or united into a tube. The corolla consists of 4–5, free or variously connate, and hypogynous petals. The andrecium consists of 4–10 stamens, the anthers of which are 2-celled, introrse and open longitudinally. The gynecium consists of 4–5 carpels which are free or slightly united. Each carpel is marked with a characteristic nectariferous appendage at the base and encloses several ovules attached to submarginal placentas. The fruits are free follicles containing several small seeds.

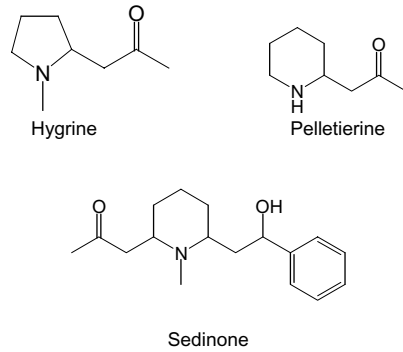


Fig. 148. Alkaloids from some Asian *Sedum* species.

Pharmaceutical interest: *Cotyledon umbilicus* (*Umbilicus pendulinus* de Cand.), *Sempervivum arboreum* L. (*Sempervivum africanum* Mill.) and *Sempervivum tectorium* L. have been used as counter-irritants in Western medicine since a very remote period in time. The counter-irritancy of Crassulaceae is attributed to crystals of oxalic acid which irritate the skin and mucosa. It will be interesting to learn whether a more intensive study on Crassulaceae will disclose any neuroactive piperidine alkaloids of therapeutic interest. In the Asia-Pacific, about 10 species of plants classified within the family Crassulaceae are of medicinal value and often used as counter-irritant remedies.

***Kalanchoe laciniata* (L.) DC**

[From Chinese, *kalanchoe* = Chinese name of *Kalanchoe* species and from Latin, *lacinia* = lappet]

Physical description: It is a herb which grows to a height of 90 cm–1.2 m in tropical Asia and Africa. The plant is ornamental and naturalized in several

Common names: *Joubarbe* (French); *setawar kampong* (Malay); *siemprevica* (Filipino); *hemasaraga* (Sanskrit); *malakalli* (Tamil); *nien to* (Cambodia, Laos, Vietnamese).

tropical countries. The stems are succulent, glabrous, and slightly branched. Leaves: simple, without stipules and 7.5 cm–10 cm long. The petiole is 2.5 cm–3.8 cm long, flattened above, succulent and amplexicaul. The blade is serrate, crenate or entire, glossy and pale glaucous. The inflorescences are paniculate cymes. The calyx is 3 mm–5 mm long and develops 4 lanceolate lobes. The corolla comprises of 4 orange petals which are lanceolate, acute or acuminate, glabrous or pubescent. A few hypogynous scales of 3 mm–4 mm are present. The fruits are 8 mm long follicles which are ventrally dehiscent.

Uses: The crushed leaves of *Kalanchoe laciniata* (L.) DC. are used to make counter-irritant remedies all over Asia. In Malaysia, a poultice of the powdered leaves is used to soothe inflammation, heal boils and wounds, and to treat cough and smallpox. *Kalanchoe laciniata* (L.) DC. mixed with *Andrographis paniculata* Nees is used to treat infected fingers. A decoction of the whole plant is drunk to assuage gastric pain and to treat heart discomfort. In India, the crushed leaves are applied to wounds, and used to soothe inflammation. The juice expressed from the leaves is drunk to treat bilious diarrhea and lithiasis. In the Philippines, the crushed leaves are used to assuage headache. In Cambodia, Laos, and Vietnam, the crushed leaves are applied externally to reduce body temperature and to heal ulcers.

Pharmaceutical interest: The counter-irritant property of *Kalanchoe laciniata* (L.) DC. is attributed to crystals of oxalic acid which irritate the skin. A number of plants classified within the genus *Kalanchoe* display antibacterial (Supteli EA *et al.*, 1980) and antiviral (Shirobokov VP *et al.*, 1981) properties *in vitro* but what are the principles involved?

References

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 Shirobokov VP, *et al.* (1981) *Antibiotiki* **26**(12): 897–900.
 Supteli EA, *et al.* (1980) *Mikrobiol Zh* **42**(1): 86–90.

Warning: Note that if ingested in excess, oxalic acid sequesters calcium, precipitates and obstructs the nephrons, hence causing renal failure. Other poisonous principles of *Kalanchoe* species are bufadienolides which are cardiotoxic (Masvingwe C *et al.*, 1997).

Kalanchoe pinnata (Lamk.) Pers

[From Chinese, *kalanchoe* = Chinese name of *Kalanchoe* species and from Latin, *pinnatus* = feathered]

Physical description: It is a herb which grows to a height of 30 m–1.2 m. The plant is native to tropical Africa and naturalized in several countries. The stems are obtusely 4-angled, succulent, glabrous, and the younger parts are reddish with white dots. Leaves: simple, without stipules, and decussate. The blade is ovoid, spoon-shaped, and the margin is crenate. The flowers are pendulous, and arranged in large spreading panicles. The pedicels are slender. The calyx is 2.5 cm–3.8 cm long, penciled with red lines, green at the base, pale green above, and develops 4 triangular lobes. The corolla is swollen and octagonal at the base, constricted in the middle, reddish purple, and develops 4 triangular lobes. The anthers are hastate and black, and the filaments are green at the base and pinkish below the anthers. Hypogynous scales subquadrate, free or adherent to the carpels are present. The fruits are follicles enclosed in the vestigial perianth which is papery. The seeds are small (Fig. 148).

Pharmaceutical interest:

Anti-inflammatory property: The juice given orally at a dose of 4 mL/Kg, protects guinea-pigs from death by asphyxia caused by 5 mg of histamine suggesting an anti-histaminic effect (Nassis CS *et al.*, 1992). *Kalanchoe pinnata* Pers. inhibits T-cell-mediated responses such as the mixed leukocyte reaction and the delayed type hypersensitivity reaction on account of the fatty acid mixtures of palmitic acid, stearic acid of arachidonic and behenic acids (Moraes VL *et al.*, 2000).

Other properties: An extract of leaves given orally at 8 mg per day protects

Synonymy: *Bryophyllum calycinum* Salisb.

Common names: *Yoekiyapinba* (Burmese); *gros pourpier clochette* (French); *sedingin* (Malay); *parnabija* (Sanskrit); *malaikalli* (Tamil).

Uses: *Kalanchoe pinnata* (Lamk.) Pers. is counter-irritant. In Malaysia, the juice expressed from this plant is mixed with honey and used to treat tonsillitis, mastitis, earache, inflammation and haemoptysis. In India, the bark is used to stop diarrhea, flatulence and vomiting, assuage pain and to counteract snake-and scorpion-poisoning. The leaves are applied externally to heal wounds and boils, and the plant is used to treat jaundice. In Cambodia, Laos, and Vietnam, a paste made from the powdered leaves is used to heal burns and to soothe scalds.



Fig. 148. (a) *Kalanchoe pinnata* (Lamk.) Pers.

BALB/c mice against *Leishmania amazonensis* (Da Silva SAG *et al.*, 1995). Bufadienolides of *Kalanchoe pinnata* (Lamk.) Pers. inhibits 12-*O*-tetradecanoylphorbol-13-acetate (TPA)-induced early expression of the Epstein-Barr Virus by Raji cells (Supratman U *et al.*, 2001). The hepatoprotective property of *Kalanchoe pinnata* (Lamk.) Pers. is confirmed as the juice of the leaves protects rats against carbon tetrachloride-induced hepatotoxicity (Yadav NP *et al.*, 2003).

References

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 Supratman U, *et al.* (2001) *Biosc Biotechnol Biochem* **65**(4): 947–949.
 Yadav NP, *et al.* (2003) *J Ethnopharmacol* **86**(2–3): 197–202.

Warning: *Kalanchoe pinnata* (Lamk.) Pers. is toxic.

Sedum alfredi Hance

[From Latin, *Sedum* = sedentary]

Synonymy: *Sedum morrisonense* Hay., *Sedum formosum*.

Physical description: It is a perennial seashore herb found in China and Taiwan which grows to a height of 15 cm. The stems are dichotomous and succulent. Leaves: simple, without stipules, and alternate or opposite. The blade is obovate to nearly orbicular, and 1.5 cm–2.2 cm × 8 mm–1.2 cm. The apex of the blade is broadly round and the base cuneate. The inflorescences are multiflowered and 5 cm–8 cm long cymes. The flowers are sessile, 1 cm long, yellow and show a few leaf-like bracts. The calyx consists of 5 sepals which are 2 mm–3 mm long, asymmetrical and linear-lanceolate. The corolla consists of 5 petals which are lanceolate, 6 mm–7 mm long and acuminate. The stamens are shorter than the petals. The gynecium consists of

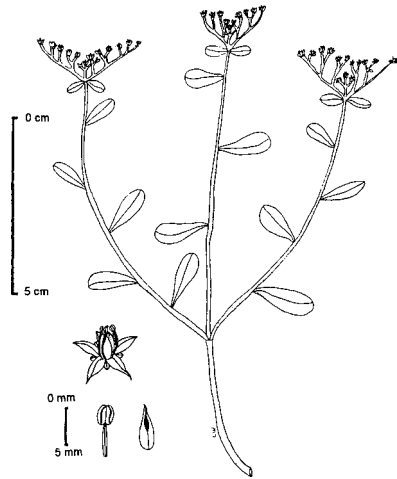


Fig. 149. *Sedum alfredi* Hance.

independent carpels, the fertile ones being upright, lanceolate, 5 mm–6 mm long and terminated by a 1 mm style at the apex. The fruits are follicles containing many seeds (Fig. 149).

Pharmaceutical potential: The pharmacological potential of *Sedum alfredi* is to date unknown but one might have a closer look at it as a crude alkaloid fraction of *Sedum sarmentosum* Bunge at various doses (50 µg/mL–150 µg/mL) for 24 or 48 h. inhibits dose-dependently the survival of murine hepatoma (BNL CL.2) and human hepatoma (HepG2) cells cultured *in vitro* (Kang TH *et al.*, 2000). In addition, a carbohydrate characterized from *Sedum spectabile* when condensed with acetone (helotylphin), destroys duck's Hepatitis B Virus and modulates immunity. Note that a number of polysaccharides characterized from *Sedum telephium* display anti-inflammatory and anticomplementary properties experimentally (Sendl A *et al.*, 1993). In general, Oligosaccharides and polysaccharides of the *Sedum* species and Crasulaceae may hide a stock house of pharmacological activities, but this has yet to be confirmed.

Uses: In China and Taiwan, a paste of *Sedum alfredi* Hance is used externally to heal burns and wounds.

References

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Sendl A, *et al.* (1993) *Phytochem* **34**(5): 1357–1362.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Sedum bulbiferum Mak.

[From Latin, *Sedum* = sedentary and *bolbos* = onion and *ferre* = to bear]

Physical description: It is a small and succulent herb found in China, Korea and Japan. The stems are glabrous and the internodes are rooting. Leaves: simple, spiral, sessile, opposite and without stipules. The blade is spatulate, 8 mm × 3 mm–1.5 cm × 5 mm, round at the apex and tapered at the base. The margin is serrulate with very small translucent scales. The inflorescences are terminal and axillary. The flowers are small and yellow. The fruits are translucent follicles (Fig. 150).

Synonymy: *Sedum alfredi* var. *bulbiferum* (Mak.) Frod.

Common names: Bulbiferous Stonecrop; *komochi mannengusa* (Japanese).

Uses: In China, *Sedum bulbiferum* Mak. is used externally to treat burns.

Pharmaceutical potential: The pharmacological potential of *Sedum bulbiferum* Mak. remains unexplored till to date. The plant is however known to contain pelletierine (Henk T *et al.*, 1996), a piperidine alkaloid also found in *Punica granatum* L. which has a specific action on tapeworms. Preparations from *Punica granatum* L. (family Punicaceae, order Myrtales, and subclass Rosidae) were used in Western medicine (*British Pharmaceutical Codex*, 1911) in doses of 3 to 5 decigrams to expel worms from the intestines.

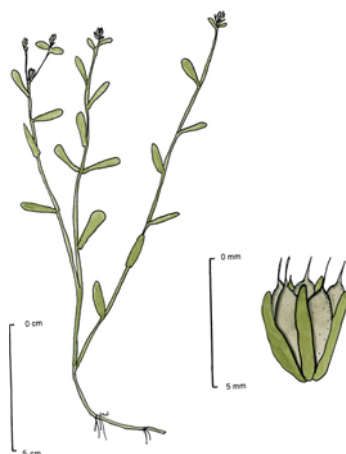


Fig. 150. *Sedum bulbiferum* Mak. From: Ex. Herbario Universitatis Tokyoensis. Geographical localization: Japan, Honshu: Gunma Pref., Hujjoka-shi, Nakajima; 25 June 1973. Field collector and botanical identification: Hideaki Ohba 73601.

Reference

Henk T, *et al.* (1996) *Phytochem* **41**(5): 1319–1324.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

B. Order FABALES Bromhead 1838

The order Fabales consists of 3 families and about 14 000 species of trees, shrubs, herbs and climbers thought to have originated from the order Rosales near the Connaraceae (Appendix I). In terms of the number of species, it is the largest group in the Rosidae and one of the largest in Magnoliopsida. Fabales are chemically diverse but often endowed with *tannins*, gums, several sorts of phenolic compounds, and several series of pyridine, *pyrrolizidine*, indole and *quinozilidine* alkaloids inherited from the Magnoliales via the Rosales. The flowers of Fabales are actinomorphic (family Mimosaceae) or zygomorphic (family Caesalpiaceae and family Fabaceae) and comprises of a corolla of 5 petals. The petals are valvate (family Mimosaceae) or imbricate with the adaxial one overlapped by a pair of lateral petals (family Caesalpiaceae) or imbricate with the adaxial petal overlapping the lateral petals (family Fabaceae). The fruits are pods. The seeds are starchy and oily, containing galactomannans

(polysaccharides of *D*-mannose and *D*-galactose), toxic non-protein amino acids, steroids and *lectins* (glycoproteins). Belonging to the order Fabales, are several medicinal plants, countless agricultural products and stock houses of poisonous plants. About 100 plant species in the Fabales are used for medicinal purposes in the Asia-Pacific. Note that most of these plants are used for their astringency.

1. Family **MIMOSACEAE** R. Brown in Flinders 1814 nom. conserv., the *Mimosa* Family

Physical description: The family Mimosaceae consists of 40 genera and about 2000 species of trees and shrubs but rarely herbs, which are often prickly. Mimosaceae are known to abound with tannins, mucilages, gums, and an unusual series of amino acids. The leaves of Mimosaceae are bipinnate and stipulate. The flowers are hermaphrodite, small, spicate, racemose or capitate, and actinomorphic. The calyx is tubular, valvate, and 5-lobed. The petals are small, valvate, free or connate, and hypogynous. The stamens are numerous, free or monadelphous, and often conspicuous. The anthers are small, 2-celled, open lengthwise, and marked with a deciduous gland at the apex. The gynecium consists of a single carpel forming a superior and single-locular ovary which encloses 2 to several ovaries attached to marginal placentas. The fruits are pods. The seeds are often glossy.



Pharmaceutical interest: Examples of Mimosaceae of economic value are *Acacia senegal* Willd. (Arabic gum), *Entada gigas* (L.) Fawc. and Rendle (cacao), *Propolis juliflora* DC. (mesquit tree), *Acacia melanoxylon* R. Br. (Australian blackwood) and *Xylia dolabriformis* Benth. (ironwood). It will be interesting to learn whether a more intensive study on Mimosaceae will disclose any molecules of therapeutic interest.

***Acacia farnesiana* (L.) Willd**

[From Latin, *acacia* = thorny and after 17th century Roman Cardinal Alessandro Farnese]

Synonymy: *Mimosa farnesiana* L.

Common name: Sponge tree; *acacia odorant* (French); *nanlonkyaing* (Burmese); *keo ta* (Vietnamese); *lasana* (Malay); *arimeda* (Sanskrit).

Physical description: It is an upright, multibranched, prickly tropical shrub native to tropical America which grows to a height of 4 m. Leaves: bipinnate and 5 cm–8 cm long, and comprise of 4–8 pairs of pinnae, each bearing 10–20 pairs of linear oblong and 4 mm–7 mm long folioles. The flowers are very small, fragrant, yellow and arranged in pedunculate, axillary, subglobose heads. The andrecium is showy and comprises of several stamens. The fruits are lanceolate, cylindrical, and 5 cm–7 cm × 1 cm–1.5 cm pods containing several seeds which are compressed and elliptic (Fig. 151).

Pharmaceutical interest: It is quite probable that most of the medicinal properties mentioned above are attributed to tannins. The anti-inflammatory and antiseptic properties of *Acacia farnesiana* (L.) Willd are confirmed experimentally: extracts of this plant inhibit moderately the proliferation of *Clostridium perfringens* (Sotohy SA *et al.*, 1995) and reduce inflammation in animals (Trivedi CP *et al.*, 1986).

Uses: In Burma, a paste of the root is used to expel parasites. In Indonesia, the plant is used to induce vomiting. In Malaysia, an infusion of the flowers and leaves is drunk to aid recovery from childbirth. The pounded roots are applied to the swollen parts. In the Philippines, a decoction of the bark is used to treat a prolapsed rectum and leucorrhoea. A decoction of the leaves is used to heal ulcers and wounds. In Vietnam, the crushed leaves are applied to heal ulcers and to soothe inflammation. In India, the gum is used to stimulate venereal desire and the bark is used to heal ulcers and to soothe inflammation. Cassie perfume is distilled from the flowers.



Fig. 151. *Acacia farnesiana* (L.) Willd.

References

- Sotohy SA, *et al.* (1995) *DTW Dtsch Tierarz H Wochenschr* **102**(9): 344–348.
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Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Adenanthera pavonina* L.**

[From Greek, *aden* = acorn and from Latin, *pavoninus* = peacock]

Common names: Red wood tree; Circassian seeds tree; *saga* (Malay); *bois noir rouge*, *crête de paon* (French); *kanduri batang* (Malay); *alalangat* (Filipino), *sem* (Tamil).

Physical description: It is a tree native to tropical Asia and Africa. The wood is used in cabinetry and is a source of red dye. Leaves: bipinnate, and stipulate and consist of 7–13 folioles. The folioles are oblong or ovate, 2.5 cm–4.5 cm × 1.5 cm–2.4 cm, obtuse and glabrous. The flowers are whitish and arranged into a spike-shaped raceme. The calyx is cup-shaped and deeply 5-lobed. The corolla consists of 5 lanceolate petals. The andrecium comprises of 10 stamens. The fruits are falcate, 12 cm long pods containing several discoid seeds which are red and glossy (Fig. 152).

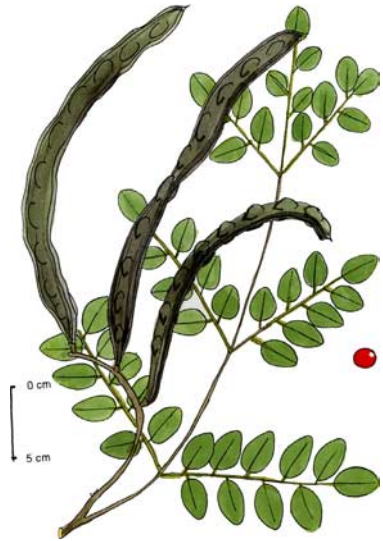


Fig. 152. *Adenanthera pavonina* L.

Pharmaceutical interest: To date not much is known about the pharmacological potential of *Adenanthera pavonina* L. The plant contains steroidal saponins and flavonoids (Misra G *et al.*, 1975; Gennaro A *et al.*, 1972). The seeds contain trypsin inhibitor proteins (Richardson M *et al.*, 1986).

Uses: In Burma, a paste made from the seeds of *Adenanthera pavonina* L. is applied externally. In Malaysia, the leaves are used to invigorate health. In India, a decoction of the leaves is used externally to treat chronic rheumatism, gout and impotence, and to treat bleeding. The seeds are used in necklaces.

References

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 Richardson M, *et al.* (1986) *Biochimica et Biophysica Acta (BBA)-Protein Structure and Molecular Enzymology* **872**(1–2): 134–140.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Entada phaseoloides* (L.) Merr.**

[From Malabari, *entada* = *Entada phaseoloides* (L.) Merr. and from Latin, *phaseoloides* = bean-like]

Physical description: It is a very stout, tropical, woody climber native to Asia. Leaves: bipinnate, stipulate and 20 cm–30 cm long. The rachis ends in a tendrill and shows 2 pairs of folioles per pinnae. The folioles are oblong or obovate, 2.5 cm–7 cm × 3 cm–4 cm long and coriaceous. The flowers are very small and arranged in an axillary and 15 cm long spikes. The calyx is campanulate. The corolla consists of 5 long equal narrow lobes. The andrecium comprises of 10 stamens. The ovary is sessile and contains many ovules. The style is filiform and the stigma concave. The pods are enormous, 35 cm–1.2 m × 7 cm–8 cm, heavy, woody, and strongly constricted between each seed. The seeds are compressed, glossy, woody and 5 cm × 3 cm × 8 mm (Fig. 153). The seeds floated across the Atlantic Ocean and washed up on to the shores of Northwestern Europe.



Fig. 153. *Entada phaseoloides* (L.) Merr.

Synonymy: *Entada scandens* (L.) Bth., *Lens phaseoloides* L., *Entada koshunensis* H. & K.

Common names: Giant rattle, lady nut; St Thomas bean, tupe; *beluru* (Malay); *calibeau* (French); *gannyin* (Burmese); *day bam bam* (Vietnamese), *gandoh* (Javanese); *gogo* (Filipino);

Uses: In Burma, the seeds of *Entada phaseoloides* (L.) Merr. are used to treat fever. In China, the seeds are used to heal hemorrhoids. In Indonesia, the roasted seeds are used to expel impurities after childbirth, assuage stomachache, and induce vomiting. The juice expressed from the stems is used to stop dysentery. In India, the seeds are used to aid recovery from childbirth, soothe inflammation, assuage pain in the loins and induce vomiting. In Malaysia, the pods are burned and the ash obtained is applied to the abdomen to treat internal discomfort. Pieces of sun-dried bark are macerated in water and the liquid obtained is used to wash the hair, heal wounds, and treat psoriasis and irritated skin. In the Philippines, a decoction of the roots is used to reduce abdomen rigidity. The seeds are pulped and applied to the abdomen to assuage colic. An infusion of the bark is used to treat infected skin. In Vietnam, the seeds are used to counteract poison, and to induce stupor and vomiting.

Pharmaceutical uses:

Antipyretic property: The antifebrile and anti-inflammatory properties mentioned above could be partially attributed to entadamide A and B, which inhibit experimentally the enzymatic activity of 5-lipo-oxygenase of RBL-1 cells at 10^{-4} g/mL (Ikegami F *et al.*, 1989). 5-Lipo-oxygenase is a key enzyme in the synthesis of autacoids at the very beginning of the inflammatory process.

Antiseptic property: In regard to the antiseptic property mentioned above, one might think of tannins. The different mechanisms proposed so far to explain tannin antimicrobial activity include the inhibition of extracellular microbial enzymes, deprivation of the substrates required for microbial growth or direct action on microbial metabolism through the inhibition of oxidative phosphorylation (Scalbert A *et al.*, 1991).

Antiparasitic properties: A butanolic fraction of the bark of *Entada phaseoloides* (L.) Merr. inhibits the proliferation of *Oncomelania quadrasi* cultured *in vitro* with LC₅₀ values ranging from 3.6 ppm to 3.8 ppm (Yasuraoka K *et al.*, 1977). *Entada abyssinica*, used in Africa to treat sleeping sickness, contains a clerodane diterpene which inhibits significantly the proliferation of *Trypanozoma brucei rhodesiense* cultured *in vitro* (Freiburghans F *et al.*, 1998). It will be interesting to learn whether further studies on *Entada phaseoloides* (L.) Merr. will disclose any clerodane diterpenes of chemotherapeutic interest.

References

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 Ikegami F, *et al.* (1989) *Chem Pharm Bull* **37**(7): 1932–1933.
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Warning: *Entada phaseoloides* (L.) Merr. is toxic.

Leucaena leucocephala (Lamk.) de Wit

[From Greek, *leukos* = white and *kephale* = head]

Physical description: It is a small tree native to tropical America. Leaves: bipinnate, stipulate and consists of 4–8 pinnae, and 10–20 pairs of folioles. The folioles are oblong to lanceolate, 7 mm–12 mm long, and glaucous below. A petiolar gland is usually present on the first pinnae of the petiole. The flowers are white and organized in dense, globose, solitary, and long pediceled axillary heads which are

Synonymy: *Leucaena glauca sensu* Bth., *Mimosa glauca* L.

Common names: Lead tree, white popinac; *petai cina*, *petai jawa* (Malay); *Santa Helena* (Filipino).

2 cm–5 cm in diameter. The calyx is 5-lobed. The corolla consists of 5 narrow petals. The andrecium comprises of 10 conspicuous stamens. The fruits are linear pods, which are membranaceous, flat, acuminate, 12 cm × 1 cm–18 cm × 1.5 cm and arranged in conspicuous bunches. Each pod contains 10–20 little seeds which are glossy and brown (Figs. 154 & 155).

Uses: In Burma, a paste made from the leaves of *Leucaena leucocephala* (Lamk.) de Wit is applied externally as an antidote for snake and insect bites. In Indonesia, the seeds are eaten to remove worms from the intestines and to treat diabetes. The leaves, pods and seeds are considered edible there. In Malaysia, a decoction of the seeds is drunk to expel intestinal worms, and to treat diabetes and hypertension. Malays and Filipinos drink a decoction of the roots to induce menses. In Taiwan, this plant is used as fodder. In India, the bark is used to assuage internal pain.

Pharmaceutical interest: The widespread use of *Leucaena leucocephala* (Lamk.) de Wit as a tropical forage crop on account of its resistance and richness in protein, vitamin K and carotene, has been partly hampered because of the high amounts of mimosine it is abound with.

Mimosine: Mimosine is a non-protein amino acid (*N*-(3-alanyl)-3-hydroxy-4-pyridone) derived from lysine, which is responsible for the toxicity of several plants classified within the genera *Mimosa* and *Leucaena*. Mimosine reversibly blocks cell cycle



Fig. 154. *Leucaena leucocephala* (Lamk.) de Wit.



Fig. 155. *Leucaena leucocephala* (Lamk.) de Wit.

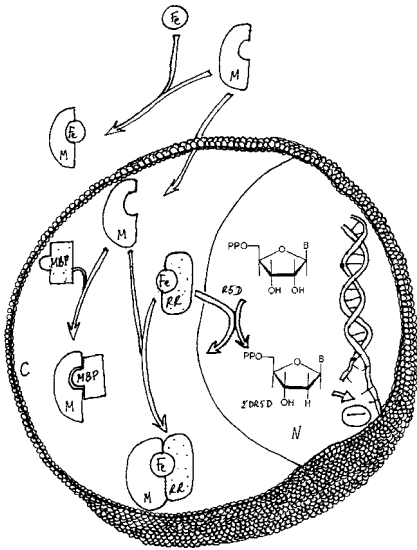


Fig. 156. Hypothetical mechanism of action by which mimosine blocks cell progression in G1: Mimosine added to the culture medium chelates iron in the medium which is therefore prevented from entering the cell (1). The rest of the mimosine enters the cell where it either binds to a mimosine binding protein (MBP) or chelates intracellular iron from iron-containing proteins such as ribonucleotide reductase (RR). The catalysis of the reduction (deoxygenation) of the ribose ring of ribonucleoside 5'-diphosphates (R5D) to yield 2'-deoxyribonucleoside 5'-diphosphates (2DR5D) in nucleotides by ribonucleotide reductase is inhibited because of iron chelating by mimosine, hence blockage of cell division.

progression in mammalian cells cultured *in vitro* in phase G1 and is used as a synchronization agent. The precise mechanism by which mimosine disrupts cellular proliferation remains controversial, and it has also been suggested that it blocks cell cycle progression by chelating iron (Fe^{2+}) from iron-dependent enzymes such as ribonucleotide reductase (Kulp KS *et al.*, 1996; Fig. 156). A single intragastric dose of mimosine to mice inhibits the intake of iodine 125 by the thyroid at the iodine-binding step (Hegarty MP *et al.*, 1979).

References

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 Vestena S, *et al.* (2001) *Plant Science* **161**: 597–604.

Warning: Mimosine ranging from 2% to 10% of diet induce in cattle cataract, goiter, lingual epithelial ulcerations, gingival atrophy, and follicular hyperplasia of the thyroid and teratogenicity (Vestena S *et al.*, 2001; Holmes JH *et al.*, 1981).

***Mimosa pudica* L.**

[From Greek, *mimos* = mime and from Latin, *pudere* = be ashamed]

Physical description: It is a poisonous, handsome, decumbent tropical herb native to South America. The stems are purplish, woody and prickly. Leaves: bipinnate, 2 cm–5 cm long and automatically closing after being touched. The folioles are numerous (5–26 pairs), 6 mm–1.6 cm × 1.5 mm–3 mm, and purple-margined. The flowers are very small and arranged in delicate pinkish heads. The corolla is 1.5 mm–2 mm long. The stamens are 4.5 mm–6 mm long and pink. The pods are 1 cm–2 cm × 4 mm, linear and slightly constricted between the seeds.

Pharmaceutical interest: *Mimosa pudica* L. inhibits the growth of Gram negative *Vibrio cholerae* cultured *in vitro* (Akinsinde KA *et al.*, 1995), hence confirming the antidiarrheal property of the plant. The antifertility property of *Mimosa pudica* L. is confirmed as a root powder given intragastrically at a dose of 150 mg/Kg body alters the oestrous cycle of female albino rats (Valsala S *et al.*, 2002). One could set the hypothesis that the invigorating property of the plant might be explained by effects on both glycaemia and depression. An ethanolic extract of the leaves given *per os* at a dose of 250 mg/Kg, elevates significantly the glycaemia in mice (Amalraj T *et al.*, 2002). An aqueous extract injected intraperitoneally in rats at doses ranging from 2 mg/Kg to 8 mg/Kg, displays a significant antidepressant action similar to the antidepressant action of the drugs desipramine and clomipramine (Molina M *et al.*, 1999). A decoction of the plant is anticonvulsant. Aqueous

Common names: Sensitive mimosa, sensitive plant; *putri malu* (Malay); *herbe chaste* (French); *mat co* (Vietnamese); *preah khlop* (Cambodian).



Uses: In Malaysia, a paste made from the powdered leaves of *Mimosa pudica* L. is used externally to soothe swollen parts and a decoction of the plant is drunk to purify the blood. In the Philippines, the roots are used to promote urination and stop dysentery, and a decoction of the plant is drunk to treat asthma. In Vietnam, a decoction of the leaves is drunk to invigorate. In Cambodia, the whole herb is used to expel vesical stones, and it is applied externally to treat oedema and rheumatism, assuage myalgia and to remove tumor of the uterus. In India, the roots are used to stop dysentery, inhibit fertility, soothe inflammation, purify the blood, treat jaundice, leprosy, smallpox and asthma, and to heal ulcers.

and alcoholic extracts of the dried roots of *Mimosa pudica* L. protect rodents against the toxic enzymes of *Naja kaouthia* venom (Mahanta M *et al.*, 2001). One might set the hypothesis that the antivenom property could have resulted from the inhibition of venom metalloproteinases by mimosine (see p. 350).

References

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Warning: *Mimosa pudica* L. is commonly responsible for acute and chronic livestock poisoning because of mimosine (see *Leucaena leucocephala* (Lamk.) de Wit). The plant is toxic.

Parkia speciosa Hassk

[From Latin, *speciosus* = beautiful]

Physical description: It is a tall rainforest tree found in Malaysia, Indonesia, and Thailand. The bark is smooth and reddish-brown. Leaves: bipinnate and 15 cm–30 cm long, pinnae 10–18 pairs, swollen at the base and finely hairy, folioles 20–35 pairs, sessile, linear lanceolate, and very 5 mm–6 mm × 2 mm–3 mm. The blade is acuminate at the apex, and the base is round and asymmetric. The flowers are pollinated by bats. The fruits are stout, green, glossy, fleshy, 30 cm–50 cm × 2 cm–4 cm, leathery, pods containing several pungent seeds which are about 1 cm long and packed each in a white membrane.

Common name: Stink bean, locust bean; *petai* (Malay); *peteh* (Indonesian); *sato* (Thai).

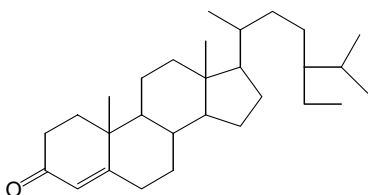


Pharmaceutical interest:

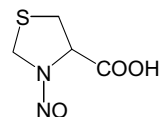
Dietetic properties: The seeds of *Parkia speciosa* Hassk contain several antibacterial cyclic polysulphides which are responsible for the pungent flavor (Gmelin *et al.*, 1981). The plant is known to contain thiazolidine-4-carboxylic acid, which protects the liver against toxic agents. It is also antiageing and an effective nitrite-trapping agent that

inhibits the formation of carcinogenic N-nitroso compounds (Susilo *et al.*, 1982). Stigmast-4-en-3-one characterized from a chloroform extract of the empty pods lowers glucose levels in alloxan-induced diabetic rats confirming thereby the antidiabetes property of the plant (Jamaluddin F *et al.*, 1995). The exact pharmacological mechanism of action of stigmast-4-en-3-one remains unknown, but a glucocorticoid-like mechanism is possible. Note that stigmast-4-en-3-one probably has hypercholesterolaemic properties as well.

Uses: In Indonesia and Malaysia, the seeds of *Parkia speciosa* Hassk. are eaten raw to treat diabetes and liver discomfort, and to expel intestinal worms. The seeds cause smelly urination when ingested.



Stigmast-4-en-3-one



Thiazolidine-4-carboxylic acid

References

- Gmelin R, *et al.* (1981) *Phytochem* **20**(11): 2521–2523.
 Jamaluddin F, *et al.* (1995) *Food Chemistry* **54**: 9–13.
 Susilo R, *et al.* (1982) *Z Naturforsch* **37c**: 584–586.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

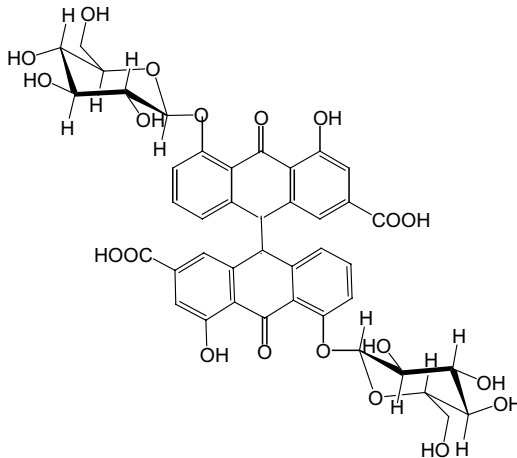
2. Family CAESALPINIACEAE R. Brown in Flinders 1814 nom. conserv., the Caesalpinia Family

Physical description: The family Caesalpiniaceae consists of about 150 genera and 2200 species of trees, shrubs and herbs, often producing *anthraquinone glycosides* and *tannins*. This family is the oldest family in the Fabales and is thought to have originated from the family Mimosaceae. The leaves of Caesalpiniaceae are pinnate, bipinnate or less frequently simple, and stipulate. The flowers are conspicuous, racemose, and zygomorphic. The calyx consists of 5 sepals which are imbricate and free. The



corolla consists of 5 petals, the adaxial petal overlapped by a pair of lateral petals. The andrecium consists of 10 stamens, the anthers of which are tetrasporangiate, dithecal, and open lengthwise or by a terminal or basal pore. The gynecium is curved and consists of a single carpel, forming a unilocular ovary containing 2 to several ovules attached on a marginal placenta. The fruits are pods.

Pharmaceutical interest: Classical examples of Caesalpiniaceae are *Erythrophloeum guineense* G. Don (*sassy bark*), *Hymenaea courbaril* L. (locust) and *Copaifera pubiflora* Benth. (purple heart wood). The pods of *Cassia senna* L. (Alexandrian senna) and *Cassia angustifolia* Vahl (Tinnevely senna) have been used from time immemorial to relieve the bowels of costiveness on account of laxative anthraquinone glycosides. *Tamarindus indica* L. (tamarind) has been used for the same purpose but on account of organic acids. Caroub flour, obtained from the seeds of *Ceratonia siliqua* L., is an effective absorbent to stop diarrhea in infants. The seeds of *Trigonella foenum graecum* L. (fenu-greek) are of dietetic value as the galactomannans they abound with lower glycaemia, cholesterolaemia and lipidaemia. Of relatively recent interest is cesalin characterized from *Caesalpinia gilliesi* which has been scheduled for use in pharmacology as a chemotherapeutic agent. Medicinal Caesalpiniaceae often owe their properties to laxative anthraquinones glycosides, tannins which are astringent, and saponins.



Sennoside A: a laxative anthraquinones glycoside from *Cassia senna* L.

***Bauhinia purpurea* L.**

[After Gaspard and Jean Bauhin, 16th century Swiss physicians and botanist and from Greek, *porphura* = shellfish yielding purple]

Physical description: It is a deciduous treelet native to India. The plant is ornamental and grown as such in the Asia-Pacific. Leaves: simple and stipulate. The blade is shaped like a butterfly, coriaceous, and 7 cm–10 cm and shows 9–11 pairs of secondary nerves. The flowers are showy, purplish and arranged in axillary or terminal racemes. The fruits are darkish pods which are 1.5 cm × 15 cm and woody.

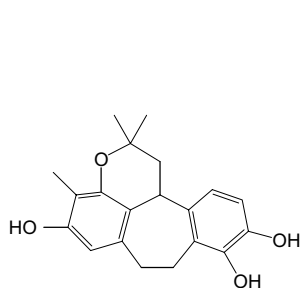
Synonymy: *Bauhinia castrata* Blanco.

Common names: Butterfly tree; *kupu kupu* (Malay); *mahahegani* (Burmese); *kalavilaichi* (Tamil).

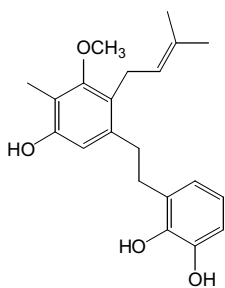
Pharmaceutical interest: Tannins are most probably responsible for the medicinal properties mentioned above. Note that daily administration of *Bauhinia purpurea* L. bark extract (2.5 mg/Kg) for 20 days stimulates thyroid function in female mice (Panda S *et al.*, 1999). Lectins are reported (Yamamoto K *et al.*, 1988).

Bauhinia purpurea L. will be worth investigating as the roots of *Bauhinia malabarica* contain racemosol, preracemosol A and preracemosol B, which moderately inhibit the proliferation of *Plasmodium falciparum* cultured *in vitro*. Racemosol inhibits the growth of KB and BC cells cultured *in vitro* with IC₅₀ of 15 µg/mL and 6.1 µg/mL respectively (Prasat P *et al.*, 2000).

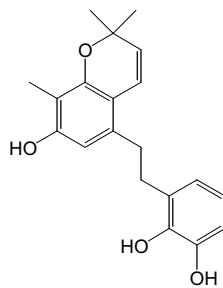
Uses: In India, the roots of *Bauhinia purpurea* L. are used to stop flatulence. The bark is used to stop diarrhea and heal ulcers. The flowers are eaten to relieve the bowels of costiveness and the bark or the roots and flowers are mixed with rice water and used to heal boils and abscesses. In Malaysia, the leaves are used to relieve the bowels of costiveness. A paste made from the powdered leaves is used to heal boils and soothe inflammation. In Vietnam, the roots are used to treat fever.



Racemosol
Preracemosol B



Preracemosol A



References

- Panda S, *et al.* (1999) *J Ethnopharmacol* **67**(2): 233–239.
 Prasat P, *et al.* (2000) *Phytochem* **55**: 349–352.
 Yamamoto K, *et al.* (1988) *FEBS Lett* **281**(1–2): 258–262.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Caesalpinia bonduc (L.) Roxb.

[After A Caesalpini, 1519–1603, an Italian physician and a botanist and from Persian, *finduk*]

Synonymy: *Caesalpinia crista* L.,
Caesalpinia bonducella (L.) Flem.

Common names: Nicker tree;
gorek (Malay); *yeux de bourique*
 (French); *pútikaranja* (Sanskrit);
akitmakit (Arabic).

Physical description: It is a scandent, prickly, woody and tropical climber which grows to a length of 10 m. The stems are lenticelled. Leaves: bipinnate and 1 m long. The rachis is prickly and shows several pairs of folioles which are elliptic-oblong, 2 cm–5 cm long, and obtuse or acute. The flowers are yellow and 1 cm long, arranged in axillary racemes. The fruits are 5 cm–10 cm, inflated, and prickly pods, each containing 1–2 subglobose and lead-colored seeds (Fig. 157).

Pharmaceutical interest: Extracts of this plant display antimicrobial, antivenom properties, as well as hypoglycaemic activity in rats (Datte JY *et al.*, 2001; Simin K *et al.*, 2001; Sharma SR *et al.*, 1997; Saeed MA *et al.*, 2001). It increases the contractile force dose-dependently in isolated portions of pregnant rat myometrium and an increase of contractile force in rat skeletal muscle via a possible role of cholinergic receptors (Datte JY *et al.*, 1998; 2004). It will be interesting to learn whether a more intensive study on the

Uses: In Indonesia, the roots of *Caesalpinia bonduc* (L.) Roxb. are chewed to stop diarrhea and the seeds are used to expel intestinal worms. In Malaysia, a poultice of the powdered leaves is applied to the abdomen to expel intestinal worms. In the Philippines, the powdered seeds are used to treat fever, invigorate health, promote digestion and relieve the bowels of costiveness. The seeds of *Caesalpinia bonduc* (L.) Roxb. were known as Ibn Sina and were later named *Frutex Globulorum* by *Georgius Everhardus Rumphius* (1628–1702). In 1868, the seeds were made official in the *Indian Pharmacopoeia*, and were used to invigorate health and to treat malarial fever. Clinical experiments conducted in 1886 (*Jour de Phar et de Chim.*, Août 1886) showed that 10–20 centigrams of seeds were as effective as quinine salt in treating malarial fever.

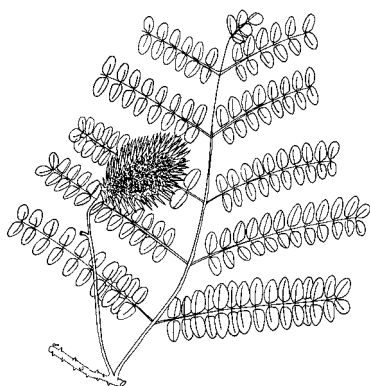
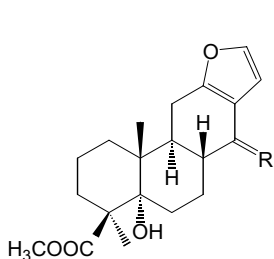


Fig. 157. *Caesalpinia bonduc* (L.) Roxb.

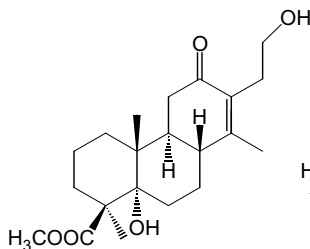
From: KLU 30912. Flora of Malaya. University of Malaya Herbarium. Field Collector: Omar bin Hamzah. 10 Nov 1979. Geographical Localization: Pulau Singa Besar, Pulau Langkawi. Botanical identification: AHB Loo. 27 July 1998. From: KLU Herbarium 31266. Field collector: Chia Lok Thye, 10 Nov 1979. Botanical identification: AHB Loo. 27 July 1998.

seeds of this plant will disclose any molecules of therapeutic interest. Note that the plant is known to produce bitter cassane diterpenes: caesalpinin, caesaldekanin C, F and G which are probably pharmacologically active (Peter S *et al.*, 1998), the pharmacological potential of which remains undiscovered.

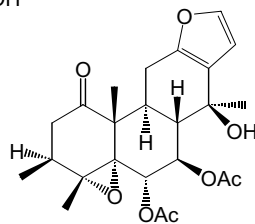


Caesaldekanin C (R= H, CH₃)

Caesaldekanin F (R= CH₃)



Caesaldekanin G



Caesalpinin

References

- Datte JY, *et al.* (2001) *Rev Med Pharm Afr* **15**: 51–57.
 Datte JY, *et al.* (1998) *J Ethnopharmacol* **60**(2): 149–155.
 Datte JY, *et al.* (2004) *Phytomedi* **11**(2–3): 235–241.
 Peter S, *et al.* (1998) *Phytochem* **47**(6): 1153–1155.
 Saeed MA, *et al.* (2001) *Fitoterapia* **72**(7): 807–809.
 Sharma SR, *et al.* (1997) *J Ethnopharmacol* **58**(1): 39–44.
 Simin K, *et al.* (2001) *Phytother Res* **15**(5): 437–440.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Caesalpinia sappan* L.**

[After A Caesalpini, 1519–1603, an Italian physician and a botanist; and from Tamil, *shappangam* = sappan wood]

Synonymy: *Caesalpinia minutiflora* Elmer.

Common names: Sappan wood; *bakkum* wood; *bois de sappan* (French); *sepang* (Malay); *to moc, cay vang* (Vietnamese); *tainniga* (Burmese); *sbeng* (Cambodian); *su fang mu* (Chinese); *palo de Brazil* (Spanish); *bakam* (Arabic); *pattanga* (Sanskrit).

Physical description: It is a prickly treelet found in South China, Taiwan, India, Malaysia, and Vietnam. The wood is red. Leaves: bipinnate and stipulate. The pinnae are opposite and show 10–12 pairs of folioles which are 1.2 cm long and marked with about 10–15 pairs of secondary nerves. The blade is elliptic and emarginated at the apex. The flowers are arranged in terminal panicles. The corolla comprises of 5 petals which are yellow and emarginated at the apex. The andrecium comprises of 10 pubescent stamens. The fruits are coriaceous, clog-shaped, 6 cm–9 cm and caudate (Fig. 158).

Pharmaceutical interest:

Flavonoids: Brazilin, brazilein, proto-sapparin E and a mixture of sterols characterized from *Caesalpinia sappan* L. display an anticomplementary property (Oh SR *et al.*, 1998). Brazilin is the principal constituent of *Caesalpinia sappan* L., it protects hepatocytes against BrCCl₃ poisoning (Moon

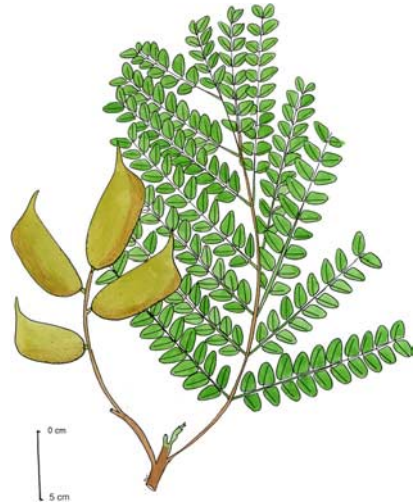
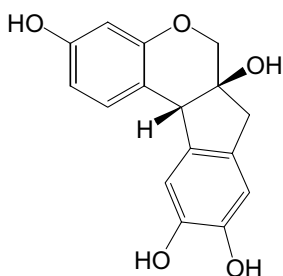


Fig. 158. *Caesalpinia sappan* L. From: KLU Herbarium 20813. University of Malaya Herbarium. Field collector and botanical identification.: M Naskar, Apr 1975. Geographical localization: Indian Botanic Garden, Calcutta.

Uses: In China, the wood of *Caesalpinia sappan* L. is used to heal wounds, stop hemorrhage and haemoptysis, regulate menses after childbirth, and soothe bruises. In Malaysia, the wood is used to expel impurities and to clean infected skin. A decoction of wood is used to stop haemoptysis and hemorrhage. In Vietnam, a decoction of about 15 g of wood is ingested daily to stop dysentery, intestinal and uterine hemorrhage, heal wounds and furuncles, regulate menses, soothe contusion, and treat impetigo and leucorrhoea. Externally *Caesalpinia sappan* L. is used as a shampoo.

CK *et al.*, 1992) and the immune system of mice against halothane (Choi SY *et al.*, 1997). Note also that brazilin inhibits the enzymatic activity of succinic semialdehyde reductase which is responsible for the degradation of GABA (Baek NI *et al.*, 2001). The anti-inflammatory principles of *Caesalpinia sappan* L. are known (Hikino H *et al.*, 1977). An extract of this plant inhibits dose-dependently the mobility of spermatozooids (Shi IM *et al.*, 1990). In regard to the haematological properties of the plant, (6*aS,cis*)-Malonic acid 3-acetoxy-6*a*9-bis-(2-methoxycarbonyl-acetoxy)-6,6*a*,7,11*b*-tetrahydro-indeno[2,1-*c*]chromen-10-yl ester methylester has antiplatelet activities (Lee GY *et al.*, 2005).



Brazilin

References

- Baek NI, *et al.* (2001) *Arch Pharm Res* **23**(4): 344–342.
 Choi SY, *et al.* (1997) *Planta Med* **63**(5): 405–408.
 Hikino H, *et al.* (1977) *Planta Med* **31**(3): 214–220.
 Lee GY, *et al.* (2005) *Thrombosis Research* **115**(4): 309–318.
 Moon CK, *et al.* (1992) *Drug Chem Toxicol* **15**(1): 81–91.
 Oh SR, *et al.* (1998) *Planta Med* **64**(5): 456–458.
 Shi IM, *et al.* (1990) *J Formos Med J Assoc* **89**(6): 466–469.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Cassia alata L.

[From Hebrew, *q' tsi' ah* = cut off bark and from Latin, *alatus* = having wings]

Physical description: It is a handsome, prickly shrub native to tropical America which grows to a height of 2 m. The plant is invasive. Leaves: stipulate. The stipules are triangular and persistent, pinnate, and 40 cm–60 cm long. The rachis is winged and holds 4–12 pairs of folioles which are oblong, round, and slightly coriaceous. The flowers are arranged in terminal and axillary upright and showy spike-shaped racemes. The calyx comprises of 5 sepals which are

Common names: Ringworm shrub, winged senna, ringworm senna, candelabra bush, craw craw plant, 7 golden candlesticks; *gelenggang besar*, *daun kurap* (Malay); *bois puant*, *herbe à dartres* (French); *timbo* (Burmese); *danghet* (Cambodian); *daun kurap* (Javanese); *acapulco* (Filipino); *dadrughna* (Sanskrit); *muong trao*, *cay lac* (Vietnamese).

Uses: *Cassia alata* L. is used throughout the Asia-Pacific to treat ringworm infection and to relieve the bowels of costiveness. In Malaysia, rolls of fresh leaves are rubbed on the skin to treat ringworm infection, and a paste made from the bark is used to soothe inflamed areas and shingles. In Vietnam, the leaves and stems are used to wash infected skin, relieve the bowels of costiveness, and to treat edema, herpes infection, hepatitis, and liver discomfort. The fresh leaves are used to treat ringworm infection, soothe inflammation, and treat impetigo. In the Philippines, the plant is used to treat herpes infection. In India, the leaves mixed with lime juice are used to treat ringworm infection.

spatulate, obtuse, and 1 cm long. The corolla comprises of 5 petals which are ovate, 1.5 cm long and form a globose, golden yellow and very conspicuous corolla. The andrecium comprises of 7 stamens and 3 staminodes. The fruits are winged pods which are linear and glabrous, and contain 50–60 triangular seeds (Figs. 159 & 160).

Pharmaceutical interest:

Antimicrobial property: Extracts of *Cassia alata* L. inhibit the growth of a large spectrum of bacteria and display a moderate antifungal property *in vitro*

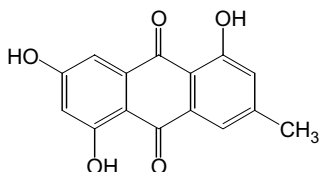


Fig. 159. *Cassia alata* L.



Fig. 160. *Cassia alata* L.

(Palanichamy S *et al.*, 1990; Ibrahim D *et al.*, 1995), thereby substantiating the antifungal use of this plant. *Cassia alata* L. contains chrysophanic acid and a number of anthraquinone glycosides which are most probably responsible for the antifungal and laxative properties of the plant. Note that a 10-year study on humans shows that an extract of the leaves of *Cassia alata* L. could be used to treat pityriasis versicolor infection (Damodaran S *et al.*, 1994).



1,5,7-Trihydroxy-3-methylantraquinone (alatinone)

References

- Damodaran S, *et al.* (1994) *J Ethnopharmacol* **42**(1): 19–23.
 Ibrahim D, *et al.* (1995) *J Ethnopharmacol* **45**(3): 151–156.
 Palanichamy S, *et al.* (1990) *J Ethnopharmacol* **29**(3): 337–340.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Cassia tora L.

[From Hebrew, *q' tsi' ah* = cut off bark and from Latin, *torus* = swelling]

Physical description: It is a common tropical herb which grows to a height of 1 m. Leaves: foetid, stipulate and consisting of 6 pairs of folioles. The stipules are linear and caducous. The folioles are obovate, apiculate, and 2 cm–5 cm long. A gland is present between the folioles of the first and second pairs. The flowers are arranged in axillary bracteated racemes. The calyx comprises of 5 sepals which are ovate, acute and 8 mm long. The corolla comprises of 5 petals which are obovate, and 1.2 cm–1.5 cm long. The andrecium comprises of 7 stamens and 3 staminodes. The ovary is long, conspicuous, and characteristically sickle-shaped. The pods are linear, quadrangular, 15 cm × 3 mm and contain 25–30 seeds which are very small (Fig. 161).

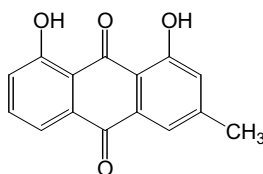
Common names: Sickie senna, sickie pod, coffee weed, foetid cassia; *gelenggang kecil* (Malay); *petite casse puante* (French); *dau giau* (Vietnamese); *dangwe* (Burmese); *chueh ming, tsao chueh* (Chinese); *thao quyet minh, muong ngu* (Vietnamese); *ayudham* and 10 other names (Sanskrit).



Fig. 161. *Cassia tora* L. From: KLU Herbarium, University of Hawaii and Bishop Museum, Natural Products from the Pacific Investigations. Geographical localization: Western Samoa, village garden area. Upolu, Lefaga: Savaia. 25 m elev. Field collector: ML Bristol 1 May 1962.

Pharmaceutical interest: *Cassia tora* L. contains a series of anthraquinones which are most probably responsible for the laxative and antiseptic properties mentioned above. Among these quinones are chrysophanol, chryso-obtusin, and aurantio-obtusin which protect *Salmonella typhimurium* against aflatoxin B₁-induced mutations (Choi JS *et al.*, 1997). An extract of *Cassia tora* L. inhibits significantly the proliferation of both chloroquine-resistant and chloroquine-sensitive *Plasmodium falciparum* (El-Tahir *et al.*, 1999). A methanolic extract of the leaves of *Cassia* sp. contracts the smooth muscles of guinea pig ileum and rabbit jejunum in a concentration-dependent manner, increases intestinal transit in mice dose-dependently, and exhibits antinociceptive activity in mice (Chidume FC *et al.*, 2002). What is the principle involved here? The seeds of *Cassia tora* L. lower the serum levels of lipid (Patil UK *et al.*, 2004).

Uses: In China, the seeds of *Cassia tora* L. are used to treat herpes infection, diseased eyes, and to heal infected sores. In Malaysia, the seeds are eaten to relieve the bowels of costiveness and lower blood pressure. A decoction of about 10 g of seeds is used to treat acute conjunctivitis. In Vietnam and in the Philippines, the plant is used to expel intestinal worms. In Vietnam, 10 g to 15 g of raw seeds are used to relieve the bowels of costiveness, and the roasted seeds are ingested to assuage headache, relieve the bowels of costiveness, control excessive urination, treat cough, insomnia, ophthalmia and ocular congestion, and to lower blood pressure. An alcoholic or vinegar maceration of the seeds is applied externally to treat eczema and mycosis. In India, a decoction of the leaves is drunk to relieve the bowels of costiveness. The seeds and leaves are used to treat ringworm infection and irritated skin. The gum (*panwar gum*) expressed from the seeds of *Cassia tora* L. has been tried as an emulsifying, suspending and binding agent for pharmaceutical technology (Joshi S *et al.*, 1964).



Chrysophanol

References

- Chidume FC, *et al.* (2002) *J Ethnopharmacol* 205–209.
 Choi JS, *et al.* (1997) *Planta Med* 63(1): 11–14.
 El-Tahir, *et al.* (1999) *Phytother Res* 13(6): 474–478.
 Joshi S, *et al.* (1964) *Indian J Pharm* 26, 78.
 Patil UK, *et al.* (2004) *J Ethnopharmacol* 90(2–3): 249–252.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Tamarindus indicus L.

[From Arabic, *tamr-hindi* = date of India and from Latin, *indicus* = from India]

Synonymy: *Tamarindus indica* L.

Common names: Tamarind tree;
asam jawa (Malay); *tamarindo de la India* (Spanish); *tamarinier* (French);
amlī and 30 other names (Sanskrit);
magi (Burmese).

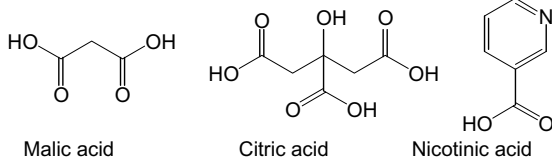
Physical description: It is a tropical tree native to Africa. The twigs are reddish. Leaves: pinnate and stipulate. The stipules are small and caducous. The leaves show 8–16 pairs of folioles which are elliptic, dark green, dull and 3.5 mm × 1.5 cm. The flowers are arranged in axillary panicles. The calyx is obconical and 4-lobed; the lobes are lanceolate and imbricate. The corolla comprises of 5 yellow or purplish red petals. The stamens are monadelphous, and only 3 are fertile. The fruits are sausage-like, slightly rugose, fawn-colored, elliptic, slightly falcate and 20 cm long. The seeds are glossy, squarish, brown, woody, and embedded in a pulp which is sourish brown and corrosive (Fig. 162).



Fig. 162. *Tamarindus indicus* L.

Pharmaceutical interest: Tamarind pulp contains pectin, several sorts of organic acids (tartaric, malic, citric), monoterpenes, nicotinic acid, cinnamates and carbohydrates. An extensive literature exists on tamarind. Note however the presence of immunomodulatory polysaccharides (Sreelekha TT *et al.*, 1993) and the presence of L-(-)-di-n-butyl malate which inhibit the proliferation of sea urchin embryo cells (Kobayashi A *et al.*, 1996).

Uses: The pulp is used to relieve the bowels of costiveness, lower body temperature and quench thirst. The bark is astringent. In Vietnam, the heart wood is used to treat liver disorder, stimulate appetite, promote urination and relieve the bowels of costiveness. In Indonesia, an oil prepared from the pods is used to soothe sprue and irritated skin, heal wounds and boils and to cause an abortion. Tamarind jams are used in Western medicine as laxative remedies.



References

- Kobayashi A, *et al.* (1996) *Z-Naturforsch-C* **51**(3-4): 233-242.
 Sreelekha TT, *et al.* (1993) *Anticancer Drug* **4**(2): 209-212.

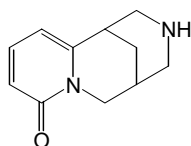
Warning: Tamarind juice is corrosive. The leaves are toxic.

3. Family FABACEAE Lindley 1836 *nom. conserv.*, the Pea or Bean Family

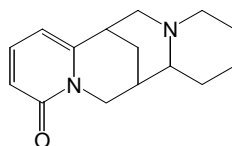
Physical description: The family Fabaceae consists of 400 genera and 10 000 species of herbs, shrubs and trees. Fabaceae are known to contain tannins, mucilages, *anthraquinones*, *isoflavonoids*, triterpenoid saponins, cyanogen glycosides, *quinolizidine*, *pyrrolizidine*, indole and simple tetrahydroisoquinoline alkaloids. The family Fabaceae is thought to have originated from the family Caesalpiniaceae and it is the most advanced family of the order Fabales. In this family, the leaves are simple or compound, and stipulate. The flowers are zygomorphic with the adaxial petal overlapping the lateral petals. The andrecium comprises of 10 stamens. The



gynecium consists of a single carpel forming a single-locular ovary. The fruits are pods.

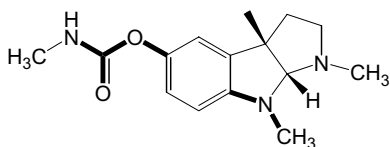


Cytisine

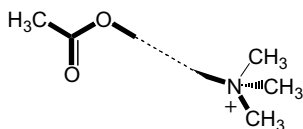


Sparteine

Pharmaceutical interest: Examples of useful products are *Pisum sativum* L. (peas), *Arachis hypogaea* L. (ground nuts), *Glycine max* (L.) Merr. (soya beans), and *Indigofera tinctoria* L. (indigo). A number of plants classified within the genera *Cytisus*, *Laburnum*, *Lupinus* and *Crotalaria* are toxic on account of quinolizidine alkaloids such as cytisine, sparteine and anagyryne. These alkaloids are strong agonists of nicotinic receptors, hence causing hypersalivation, burns in the mouth, vomiting, excitation, convulsion and death by respiratory arrest. One example is *Laburnum anagyroides* L. (golden chain tree) which is a leading cause of calls to poison control centers in Europe. *Cytisus scoparius* Link. (Scotch broom) contains sparteine which is used as a cardiac analeptic to treat stubborn cases of atrial fibrillation. A number of plant species from the genus *Lupinus* are responsible for untimely delivery in cattle on account of anagyryne, an alkaloid which contracts the uterus. *Melilotus officinalis* (yellow sweet clover), *Psoralea argophylla* (scurf pea), *Dipterix odorata* Willd. (Tonka bean) cause lethal hemorrhages on account of coumarins which inhibit blood clotting. *Dolichos lablab* (hyacinth bean), *Lotus corniculatus* (birdsfoot trefoil), *Phaseolus lunatus* (Lima bean), *Trifolium repens* (white clover) and *Vicia* owe their toxicity to cyanogen glycosides. Individuals genetically deficient in glucose-6-phosphate dehydrogenase develop severe haemolytic anemia (favism) after ingesting the beans of *Vicia faba*.



Physostigmine (eserine)



Acetylcholine

Classical examples of pharmaceutical products are *Physostigma venenosum* Balf. (Calabar bean), *Myroxylon balsamum* (L.) Harms (Tolu balsam) and *Glycyrrhiza glabra* L. (liquorice). *Physostigma venenosum* Balf. contains physostigmine which is used to treat myasthenia gravis and primary glaucoma. Physostigmine is structurally close to acetylcholine and inhibits the enzymatic

activity of cholinesterase, an enzyme responsible for the catabolism of acetylcholine into choline. Hundreds of plant species from Fabaceae are medicinal in the Asia-Pacific.

***Abrus precatorius* L.**

[From Arabic, *Abrus* = *Abrus precatorius* L. and from Latin, *precatorius* = pray]

Physical description: It is a perennial tropical climbing shrub. The stems are slender. Leaves: pinnate and 5 cm–8 cm long. The folioles are 20–40 in number, silky below, deciduous, membranaceous, rhomboid, and 2 cm–3 cm long. The flowers are small and arranged in dense axillary racemes. The calyx is campanulate and 5-lobed.

Uses: In Burma, the roots of *Abrus precatorius* L. are used to relieve cough and to adulterate liquorice. In China, the seeds are used to induce vomiting, relieve the bowels of costiveness, expel intestinal worms, stimulate the secretion of sweat, and promote expectoration. In Malaysia, a decoction of the leaves and roots is drunk to relieve cough. In Vietnam, a decoction of about 10 g of the roots, stems and leaves is drunk to treat fever, coryza and jaundice, relieve cough, and counteract poisoning. The seeds are used to treat infected skin, mastitis and galactophoritis, heal boils and soothe inflammation. A number of Asian women living in UK use the seeds to abort a pregnancy, even though these seeds are poisonous. Note that the seeds of *Abrus precatorius* L. were officially used in Western medicine (*Abrus*, *British Pharmaceutical Codex*, 1934).

Common names: Wild liquorice, Jamaica wild liquorice, Indian liquorice, jequirity bean, jumble beads, crab-eyes vine, coral pea, prayer beads, rosary pea; *arbre à chapelet* (French); *pokok memanjat*, *akar saga betina*, *akar belimbing* (Malay); *cam thao day*, *day chi chi* (Vietnamese).



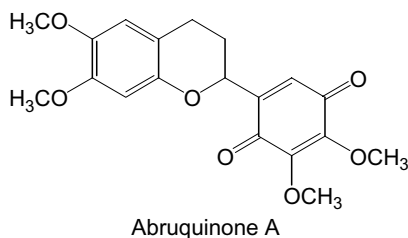
Fig. 163. *Abrus precatorius* L. From: KLU Herbarium 8633. Flora of the Caroline Islands. College of Guam Herbarium. Geographical localization: off road near teacher housing, Dinay, Southeast Yap. Climbing in trees of forest, 27 July 1966, ca 20 m. Field collectors: MW Cushing & FR Fosbery.

The corolla is reddish or whitish, and much exerted. The standard is ovate, acute and adheres below the staminal tube. The wings are narrow and the keel arcuate. The andrecium consists of 9 stamens which are united into a tube. The style is short and the stigma capitate. The pods are ellipsoid, 2.5 cm–4 cm long and contain 4–6 seeds. The seeds are round, glossy, woody, black and red and dreadfully toxic (Fig. 163).

Pharmaceutical interest:

Anti-inflammatory property: The anti-inflammatory property of *Abrus precatorius* L. is attributed to a number isoflavaquinones, such as abruquinone A which inhibits the aggregation of platelets, inflammation and allergy (Kuo SC *et al.*, 1995; Wang JP *et al.*, 1995; 1997). Other anti-inflammatory principles are triterpenes saponins (Anam EM *et al.*, 2001).

Antiviral: An aqueous extract of the seeds inhibited HIV-1 reverse-transcriptase *in vitro* (IC₅₀ = 60 µg/mL; El-Mekkawy S *et al.*, 1995).



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 Kuo SC, *et al.* (1995) *Planta Med* **61**(4): 307–312.
 Wang JP, *et al.* (1995) *European Journal of Pharmacology* **273**: 73–81.
 Wang JP, *et al.* (1997) *European Journal of Pharmacology* **319**: 131–136.

Warning: The seeds of *Abrus precatorius* L. contain abrin, a glycoprotein (phytoxin), which causes, if ingested, hemorrhage, inflammation, necrosis of the liver and kidneys, stomachache, diarrhea, coma, and agglutination of red blood cells, circulatory collapse and death (Hart M *et al.*, 1963).

Alysicarpus vaginalis (L.) DC.

[From Greek, *halusis* = chain and *karpos* = fruit and from Latin, *vagina* = sheath]

Physical description: It is an upright or ascending, densely hirsute tropical herb which grows to a height of 1.5 m in vacant plots of land. Leaves: simple

Synonymy: *Hedysarum nummularifolius* L., *Alysicarpus nummularifolius* (L.) DC.

Common names: *Akar seleguri* (Malay).

Uses: In Malaysia, a decoction of 10 g of *Alysicarpus vaginalis* (L.) DC. is drunk to relieve cough, treat mumps, stimulate appetite and protect against encephalitis. In Taiwan, a decoction of *Alysicarpus vaginalis* (L.) DC. is used to promote digestion. Not much is known about the therapeutic potential of *Alysicarpus vaginalis* (L.) DC. One might set the hypothesis that the uses mentioned above are attributed to tannins.

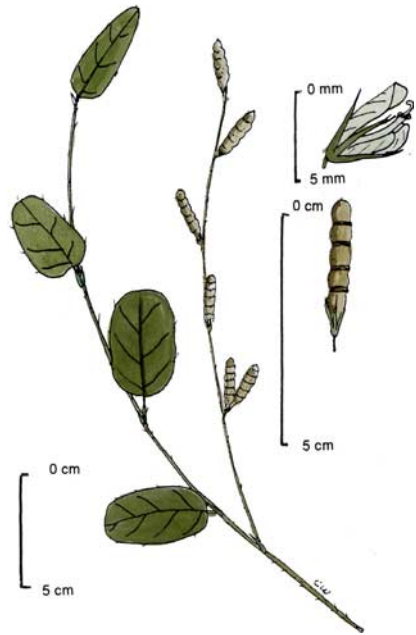


Fig. 164. *Alysicarpus vaginalis* (L.) DC.

and stipulate. The blade is hairy, elliptic, broad, retuse, lanceolate or round, and 1.5 cm–5 cm long. The stipules are scarious, striated and lanceolate. The flowers are 6 mm long, white, and loosely arranged in 10 cm–15 cm long and terminal racemes. The calyx is scarious and the sepals are deeply cleft. The corolla is white, the standard is broad, and the keels obtuse. The stamens are diadelphous and the anthers are uniform. The pods are cylindrical, 1.5 cm–2 cm long, rugose, puberulous and articulate in 5 indehiscent single-seeded parts (Fig. 164).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Erythrina subumbrans* (Hassk.) Merr.**

[From Greek, *eruthros* = red]

Physical description: It is a tree grown in Burma, Malaysia and the Philippines. The crown is upright. Leaves: trifoliolate and stipulate. The folioles are as long as they are broad, each with a pair of glands at the base. The flowers are conspicuous, scarlet with whitish stripes, 2.5 cm–5 cm long and arranged in racemes. The standard is large, and the wings and the

Synonymy: *Erythrina lithosperma* Miq.

Common names: Coral bean.

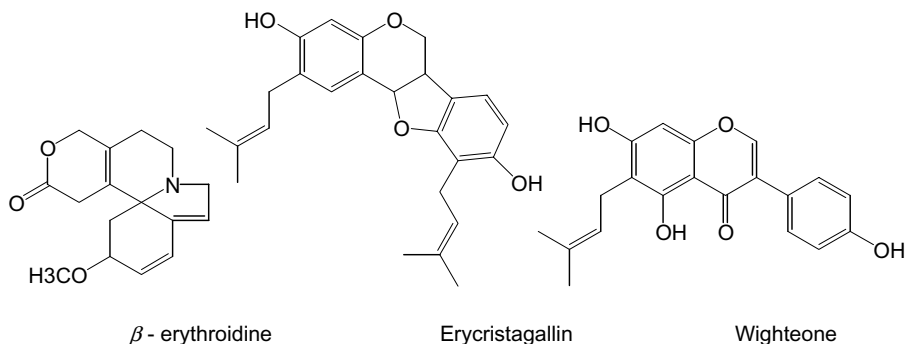
keel are short. The andrecium consists of 10 stamens which project beyond the keel. A single stamen is free and the other are united into a tube where 5 long stamens alternate with 4 short ones. The pods are 8 cm–16 cm × 1.5 cm, more or less constricted between seeds, with the lower half empty and seedless, while the upper half contain 2–3 seeds.

Pharmaceutical interest: The pharmacological potential of *Erythrina subumbrans* (Hassk.) Merr. remains unexplored till today, and will be worth studying as the *Erythrina* species are known to produce flavonoids and alkaloids of pharmacological interest.

Uses: In Indonesia, *Erythrina subumbrans* (Hassk.) Merr. is used as a post-partum remedy to check bleeding, soothe inflammation and assuage bowel discomfort. In Malaysia, the bark is used to relieve cough and stop vomiting.

Pterocarpan flavonoids: Erycrystalgallin from *Erythrina mildbraedii* inhibits carrageenan and phospholipase A₂-induced mouse paw oedema, ear oedema and inhibits chronic inflammation through the inhibition of arachidonic acid metabolism via 5-lipoxygenase pathway (Njamen D *et al.*, 2003). Phaseollidin from *Erythrina burana* displays cytotoxic properties (Dagne E *et al.*, 1993). Another cytotoxic flavonoid is wighteone from *Erythrina indica* which inhibits the growth of KB cells cultured *in vitro* with an IC₅₀ value of 0.78 μg/mL.

Isoquinoline alkaloids: Most *Erythrina* species contain tetracyclic isoquinoline alkaloids which paralyze the motor nerves. One such alkaloid is β-erythroidine, which has been used to anaesthetize (Dripps *et al.*, 1947).



References

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 Njamen D, *et al.* (2003) *European Journal of Pharmacology* **468**(1): 67–74.
 Nkengfack AE, *et al.* (2001) *Phytochem* **58**(7): 1113–1120.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Indigofera tinctoria* L.**

[From Greek, *indikon* = Indian dye; from Latin, *ferre* = bear; *tinctura* = dyeing]

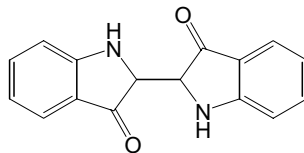
Physical description: It is a tropical shrub which grows to a height of 50 cm. The stems are silvery and hairy. Leaves: pinnate, 2.5 cm–5 cm, and stipulate. The folioles are 9–13 in number, obovate-oblong, 1.5 cm long and dry black. The inflorescences are axillary racemes which are nearly sessile and shorter than the leaves. The flowers are reddish-yellow and 4 mm–5 mm long. The calyx is campanulate and 5-lobed. The corolla comprises of an ovate to obovate standard and a straight keel spurred at the base. The pods are straight, 2.5 mm long and contain 8–10 seeds.

The dyeing principle of *Indigofera tinctoria* L. is indirubin. This natural product has been described as “useful in the treatment of chronic myelocytic leukaemia” (Han R, 1994). *Indigofera tinctoria* L. protects rats against D-galactosamine and carbon tetrachloride liver poisoning confirming the hepatoprotective effect of the plant (Sreepriya M *et al.*, 2001). Note that Swiss albino mice are protected against Dalton’s ascitic lymphoma by an intraperitoneal injection of 400 mg/Kg of an ethanolic extract of *Indigofera aspalathoides*. The leaves of *Indigofera oblongifolia* contain a number of antimicrobial and antifungal peptides (Daho MU *et al.*, 1999). *Indigofera spicata* (creeping indigo) contains indospicine which is a teratogen non-protein amino acid. An aqueous extract of the fruits of *Indigofera suffruticosa* Mill. destroys the liver of Balbc mice and increases the number of cells with aberrant chromosome (Ribeiro CR *et al.*, 1991).

Synonymy: *Indigofera glandulifera* Hayata

Common names: Dyer’s indigo; *indigotier tinctorial* (French); *nila* (Sanskrit).

Uses: Since ancient times, *Indigofera tinctoria* L. has been used as a dye called indigo or *Vitruvius Indicum* by Pliny. The process of preparing indigo was first reported in the 13th century by Marco Polo, but the plant itself was unknown to Europe until the close of the 16th century. In China, *Indigofera tinctoria* L. is used to assuage liver discomfort and to stop dysentery. In Malaysia, a paste of the plant is used to heal boils, and treat yaws and fever. In the Philippines, a decoction of the roots is drunk to expel stones from the kidneys. In Vietnam, the plant is used to soothe inflammation and contusion; the roots are used to promote urination; and the plant is used to check hemorrhage.



Indirubin

References

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 Ribeiro CR, *et al.* (1991) *Mem Instt Oswaldo Cruz* 86 Suppl. 2.
 Sreepriya M, *et al.* (2001) *Indian J Physiol Pharmacol* **45**(4): 428–434.

Warning: *Indigofera tinctoria* L. is most probably toxic.

***Pongamia pinnata* (L.) Merr.**

[From Malabar, *pongam* = *Pongamia pinnata* and from Latin, *pinnatus* = feathered]

Physical description: It is a coastal tree which grows in the geographical zone spanning Malaysia to Polynesia. Leaves: pinnate and stipulate. The folioles are 5–7, opposite, thinly coriaceous, oblong-ovate and 6 cm–10 cm × 3 cm–5 cm. The flowers are arranged in axillary racemes. The calyx is campanulate. The corolla is light purple and much exerted, the standard is broad, the keel obtuse, and the petals are cohering at the tip. The stamens are monadelphous, the upper filament free below. The anthers are oblong and versatile. The ovary is sessile and contains 2 to several ovules. The style is incurved and the stigma capitate. The pods are woody, flattened, oblong, indehiscent, and 6 cm × 2.5 cm–3 cm. The seeds are oily (Fig. 165).

Synonymy: *Cytisus pinnatus* L.,
Pongamia glabra Vent.

Common names: *Karanja* (Sanskrit);
mempari (Malay).



Fig. 165. *Pongamia pinnata* (L.) Merr.

Pharmaceutical interest: An extract of the root given intraperitoneally to rodents displays anti-inflammatory and analgesic properties at 50 mg/Kg (Singh RK *et al.*, 1997). The oil expressed from the seeds inhibits the growth of a large number of pathogenic bacteria at 500 μ g/mL (Baswa M *et al.*, 2001). An ethanolic extract of *Pongamia pinnata* (L.) Merr. destroys the *Plasmodium* species cultured *in vitro* (Simonsen HT *et al.*, 2001). Note that the plant is known to elaborate a series of furanoflavonoid glycosides (Ahmad G *et al.*, 2004).

Uses: The oil expressed from the seeds (*pongam* oil) of *Pongamia pinnata* (L.) Merr. is used externally to treat rheumatism and infection. In India, the roots are used to soothe inflammation and counteract putrefaction. A bath of the leaves is taken to soothe inflamed areas.

References

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 Singh RK, *et al.* (1997) *Indian J Exp Biol* **35**(8): 831–836.

Warning: *Pongamia pinnata* (L.) Merr. is toxic.

C. Order PROTEALES Lindley 1833

The Order Proteales consists of about 125 species of tanniferous shrubs and trees in 2 families: Proteaceae and Elaeagnaceae. Proteales are thought to have originated from the order Rosales (Appendix I).

1. Family ELAEAGNACEAE A. L. de Jussieu 1789 *nom. conserv.*, the Oleaster Family

Physical description: The family Elaeagnaceae consists of 3 genera and about 50 species of tanniferous shrubs so far known to produce *ellagic acid*, quebrachitol, saponins and indole alkaloids. The leaves of Elaeagnaceae are simple, alternate or opposite and without stipules. The blade and the stems are covered with starry hairs or scales. The flowers are perfect, 4-merous, strongly perigynous, and apetalous. The sepals and stamens develop from a hypanthium. The anthers are tetrasporangiate, dithecal and open by longitudinal slits. The gynecium consists of a single carpel forming a 1-locular ovary containing a solitary ovule. The fruit is succulent and often rich in ascorbic acid.

Pharmaceutical interest: An example of Elaeagnaceae is *Elaeagnus angustifolia* L. (Russian olive) which is planted for ornamental purposes in several temperate regions. Another example is *Elaeagnus multiflora*, the fruits of which

are used to make alcoholic beverages in Japan. To date, the pharmacological potential of the family Elaeagnaceae remains mostly unexplored. In the Asia-Pacific, *Elaeagnus pungens* Thunb. (*Elaeagnus simonii* Carr.), *Elaeagnus latifolia* L., *Elaeagnus philippensis* Perr. and *Hippophae rhamnoides* L. are medicinal.

***Elaeagnus latifolia* L.**

[From Greek, *elaion* = oil, *agnos* = name of tree and from Latin, *latus* = broad and *folium* = leaf]

Common names: *Mingu* (Burmese); *kulari* (Tamil).

Uses: In India and Burma, the fruits and the flowers of *Elaeagnus latifolia* L. are astringent. In India, the flowers are used to treat heart diseases. It will be interesting to learn whether a more intensive study on *Elaeagnus latifolia* L. will disclose will any molecules of therapeutic interest.

Physical description: It is a shrub found in the hilly parts of India, Ceylon, Malaysia, Indonesia, the Philippines and China. The stems are covered with starry scales. Leaves: simple, spiral and without stipules. The petiole is 6 mm–8 mm long, channeled, and scaly. The blade is thinly coriaceous, elliptic, scaly beneath and 2.9 cm–5.5 cm × 3.5 cm–1.5 cm. The midrib is sunken above and filled with scales. The inflorescences are cymose, short and scaly. The flowers are straw-colored and comprise of a 8 mm long scaly hypanthium from which 5 sepals which are ovate, acute and 3 mm long develop. The style is slender and scaly. The fruits are 1.4 cm × 1 cm–2.5 cm, ellipsoid, 8-ribbed with persistent lobes at the apex. The mesocarp is palatable and the seeds are 2 cm long (Fig. 166).

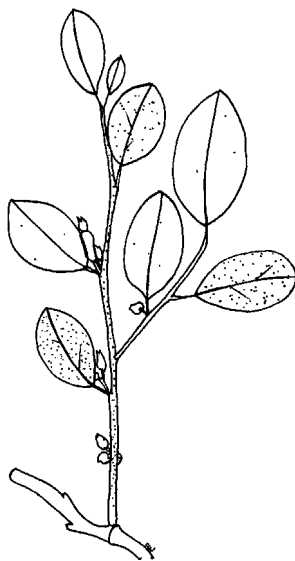


Fig. 166. *Elaeagnus latifolia* L. From: KLU Herbarium 27592. Plants of Ceylon. Field collector and botanical identification: Gerrit Davidse and AHM Jayasuriya. Geographical Localization: Central Province. Kandy District, ca. 9 mi Northeast of Hunnagiriya, near mile post 29/21, on the road to Mahiyangana. Secondary mountain forest along the road.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

D. Order MYRTALES Lindley 1833

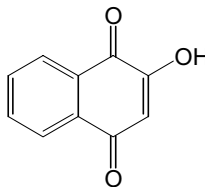
The order Myrtales consists of 12 families and more than 9000 species of tropical trees, shrubs, climbers and herbs thought to have originated from the order Rosales (Appendix I). About three-fourths of the species belong to the family Melastomataceae (4000) and to the family Myrtaceae (3000). The medicinal properties of Myrtales are often attributed to tannins or essential oils. Tannins are astringent, antioxidant, cytotoxic, antimicrobial but may cause neoplasia. *Essential oils* of several plants species classified within the family Myrtaceae are of therapeutic value: *Eucalyptus globulus* Labill. and *Eugenia aromatica* O. Ktze. (cloves).



1. Family LYTHRACEAE Jaume St.-Hilaire 1805 nom. conserv., the Loosestrife Family

Physical description: The family Lythraceae consists of about 24 genera and 500 species of herbs, shrubs and trees which abound with *tannins*, piperidine and quinolizidine alkaloids and quinones (anthraquinones and *naphthoquinones*). The leaves of Lythraceae are simple, opposite and without stipules. The flowers are often 4-, 6- or 8-merous, regular, actinomorphic, strongly perigynous, and have a prominent hypanthium. The sepals are valvate and united into a tube. The petals are free, crumpled in buds, alternate with the sepals and pinnately veined. The stamens are twice as numerous as the petals and organized into 2 whorls. The gynecium consists of 2–6 carpels forming a compound, superior and plurilocular ovary. The ovules are attached to axillary placentas. A nectary disc is present. The fruits are capsular, dehiscent, and contain several oily seeds.

Pharmaceutical interest: A classical example of Lythraceae is *Lawsonia inermis* L. (Henna, *British Pharmaceutical Codex* 1934) the dried leaves of which have been used to counteract putrefaction and to dye the skin and the hair since a remote period in time.



Lawsone

The dyeing principle of *Lawsonia inermis* L. is a naphthoquinones: lawsone. Other examples of Lythraceae are *Lagerstroemia indica* L. (crape-myrtle) and *Lythrum salicaria* L. (purple loosestrife), cultivated for decorative purposes. In Mexico, the leaves of *Heimia salicifolia* are fermented to make a beverage (*sinicuichi*) which causes euphoria and hallucination. About 10 species of the plants classified within the family Lythraceae are used for medicinal purposes in the Asia-Pacific mainly on account of their astringent properties.

***Ammannia baccifera* L.**

[After Paul Ammann, a 17th century German botanist and from Latin, *baccifer* = berry-bearing]

Physical description: It is a multi-branched annual herb found in the Asian paddy fields. The stems are often 4-angled. Leaves: opposite, simple, and membranaceous. The blade is oblanceolate to linear, 5 mm–5 cm × 1 mm–1 cm, narrowed at both ends and entire. The flowers are few, and arranged in dense axillary panicles. The calyx is 1 mm–2 mm long, and apetalous. The andrecium consists of 4 stamens with subglobose anthers. The fruits are globose, capsular and 1 mm–1.5 mm long.

Warning: *Ammannia baccifera* L. is toxic.

Synonymy: *Ammannia indica* Lam., *Ammannia baccifera* subsp. *baccifera* (L.) Koehne, *Ammannia discolor* Nakai, *Ammannia vesicatoria* Roxb.

Common names: Blistering ammannia; *kuranti* (Sanskrit); *kallarivi* (Tamil).

Uses: In the Philippines, the fresh leaves are bruised and applied to the skin to raise blisters and treat biliousness. In India, the leaves are used to stimulate appetite, relieve the bowels of costiveness, promote digestion, and stimulate venereal desire (Ayurveda). The pharmacological potential of this plant remains unexplored. Note that naphthoquinones might be responsible for the blistering properties described above.

***Lagerstroemia subcostata* Koehne**

[After M Lagerstroem, 1671–1759, a Swedish patron of science, and from Latin, *sub* = under and *costatus* = ribbed]

Physical description: It is a tree which grows to a height of 10 m in the lowland rainforests of Taiwan and central China. Leaves: simple, sessile, subopposite and membranaceous. The blade is oblong to obovate, 1.5 cm–4.8 cm × 1 cm–2.5 cm, ribbed

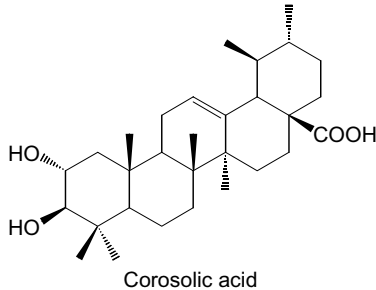
Synonymy: *Lagerstroemia subcostata* Koehne var. *haitella* Koehne, *Murtughas subcostata* Ktze., *Lagerstroemia unguiculosa* Koehne.

and acuminate and shows 3–10 pairs of secondary nerves. The flowers are arranged in conspicuous, terminal and hirsute panicles. The calyx is 5-lobed, the corolla comprises of 6 petals which are white, and 2 mm–6 mm long. The andrecium comprises of about 20 stamens. The fruits are 6 mm–8 mm long capsules opening longitudinally into 3–6 valves and containing several winged seeds.

Pharmaceutical interest: The pharmacological potential of *Lagerstroemia subcostata* Koehne remains unexplored. It will be worth investigating whether a petroleum ether extract of seeds of *Lagerstroemia speciosa* (L.) Pers. inhibits the proliferation of bacteria *in vitro* (Sinhabadu A *et al.*, 1994). The plant is known to contain ellagic acid which may be involved in the former property (Takahashi M *et al.*, 1977).

Uses: In Taiwan, *Lagerstroemia subcostata* Koehne is used to invigorate health and to treat fever.

Antidiabetes property: Note that *Lagerstroemia speciosa* (L.) Pers. is known to produce ellagitannins: lagerstroemin, flosin B and reginin A, which increase the glucose uptake of rat adipocytes, and a triterpene corosolic acid which promotes the glucose transport activator by Ehrlich ascites tumor cells (Murakami C *et al.*, 1993). The antidiabetic activity of an extract from the leaves of *Lagerstroemia speciosa* (L.) Pers. standardized to 1% corosolic acid (Glucosol[®]) is confirmed in a randomized clinical trial involving non-insulin-dependent diabetes mellitus (Judy VW *et al.*, 2003).



References

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 Takahashi M, *et al.* (1977) *Yakugaku Zasshi* 1977 Aug **97**(8): 880–882.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Woodfordia fruticosa* (L.) Kurz**

Synonymy: *Woodfordia floribunda* Salisb., *Lythrum fruticosum* L.

Common names: *Parvati* (Sanskrit); *velakkai* (Tamil).

Physical description: It is a shrub which grows to a height of to 2 m. It is native to Southeast Asia. The stems are terete and peeling. Leaves: simple, opposite, sessile and without stipules. The blade is lanceolate, thinly coriaceous, and 6.7 cm × 2.2 cm–5.5 cm × 1.4 cm. The midrib is sunken above and raised below. The blade shows 6–12 pairs of secondary nerves and the base of the blade is amplexicaul. The inflorescences are axillary cymes. The flowers are tubular, red and 2.5 cm–4 cm long. The calyx is 1.6 cm long, striated, covered with glandular dots and forming a bright red tube. The petals are longer than the sepals. The fruits are dehiscent capsules containing cuneate-ovoid, brown and small seeds (Fig. 167).

Pharmaceutical interest: An interesting feature of *Woodfordia fruticosa* (L.) Kurz is that it produces a series of cytotoxic hydrolysable tannins known as woodfordins (Yoshida T *et al.*, 1990). One such compound is woodfordin C (woodfructicosin), a dimeric hydrolysable tannin isolated from the leaves (Kadota S *et al.*, 1990) which inhibits the enzymatic activity of topoisomerase II more potently than adriamycin and etoposide, alleviates the survival of PC-1 cells cultured *in vitro* and protects rodents inoculated with colon 38 cells (Kuramochi-Motegi A *et al.*, 1992).

Uses: *Woodfordia fruticosa* (L.) Kurz is used for its astringent property. In Burma, the flowers of *Woodfordia fruticosa* (L.) Kurz are used to stop dysentery and colic. In Indonesia, *Woodfordia fruticosa* (L.) Kurz is used to stop dysentery, heal wounds, promote urination, treat sprue, and to remove blood from urine. In Malaysia, the flowers of *Woodfordia fruticosa* (L.) Kurz are used to promote fertility and treat smallpox. In India, the plant is used to calm uterus contractions, expel intestinal worms, to quench thirst, assuage toothache, stop dysentery, heal hemorrhoids and counteract snake poisoning.

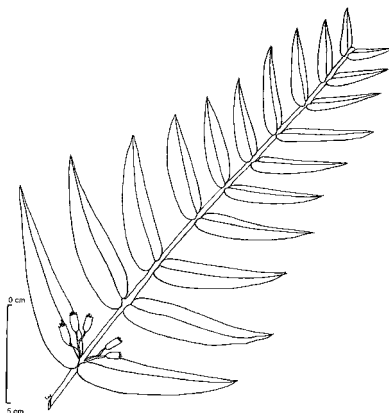
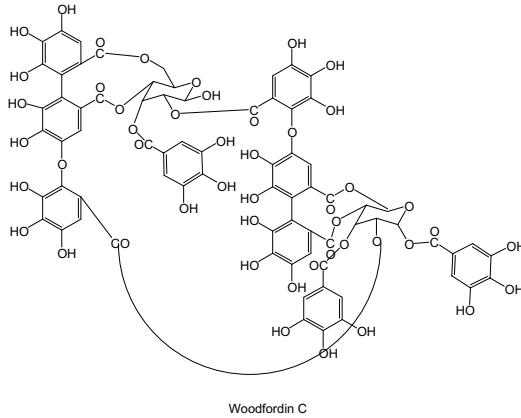


Fig. 167. *Woodfordia fruticosa* (L.) Kurz. From: KLU Herbarium 27553. Plants of Ceylon. Geographical Localization: UVA Province, Badulla District: Rawanaella waterfall, ca. 2 miles Southeast of Ella, at mile post 13, roadside, altitude: 750 m. 25 Nov 1974. Field collectors: Gerrit Davidse, DB Sumithraarachchi.



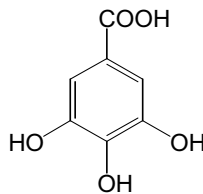
References

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 Kuramochi-Motegi A, *et al.* (1992) *Biochem Pharmacol* **44**(10): 1961–1965.
 Yoshida T, *et al.* (1990) *Chem Pharm Bull* **38**(5): 1210–1211.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family ONAGRACEAE A.L. de Jussieu 1798 *nom conserv.*, the Evening Primrose Family

Physical description: The family Onagraceae consists of 17 genera and 675 species of tanniferous herbs abounding with ellagic and *gallic acid*. The leaves are simple, opposite or alternate and without stipules. The flowers are hermaphrodite, actinomorphic, and often solitary. The calyx is adnate to the ovary, and 4–5-lobed and valvate. The corolla consists of 2–5, free petals which are contorted or imbricate. The andrecium comprises of as many stamens as, or twice as many as, the calyx lobes, and the anthers are 2-locular, and open lengthwise. The gynecium is inferior and 2–6 locular and contains 1 to several ovules attached to axile placentas. The fruits are capsules, berries or nuts containing numerous seeds.



Gallic acid

Pharmaceutical potential: A number of plants classified within the genera *Fushia* and *Clarkia* are cultivated for ornamental purposes. The fixed oil obtained from the seeds of *Oenothera biennis* or evening primrose oil is widely marketed as a dietary supplement for cosmetic purposes, and more specifically for the treatment of atopic eczema and premenstrual syndrome. Evening primrose has attracted a great deal of interest on account of its effects on diabetic neuropathy and rheumatoid arthritis. The pharmacological properties of evening primrose oil could be on account of γ -linolenic acid which is metabolized in arachidonic acid, an immediate precursor of some prostaglandins (Fig. 168). Gallic acid and ellagic acid released from hydrolysable tannins are cytotoxic and are often responsible for the antitumoral property of medicinal Onagraceae and Rosidae in general. One such plant is *Epilobium angustifolium*

L., which has been traditionally used in Eurasia, which inhibits the growth of prostatic epithelial cell line (PZ-HPV-7) cultured *in vitro*. *Epilobium tanguticum* Hauskn., *Epilobium angustifolium* L., *Ludwigia adscendens* (L.) Hara, *Ludwigia hyssopifolia* (D. Don) Exell, *Ludwigia octovalvis* (Jacq.) Raven, *Ludwigia prostrata* Roxb., and *Circaea alpina* L. are mildly astringent and used in the Asia-Pacific to check bleeding, heal wounds and boils, resolve swelling, stop dysentery, expel intestinal worms, counteract fungal infection, and to treat sprue and syphilis.

***Ludwigia hyssopifolia* (D. Don) Exell**

[From Greek, *hyssōpos* = hyssop and from Latin, *folium* = leaf]

Physical description: It is a multi-branched and succulent herb which grows to a height of 40 cm in Southeast

Asia and Papua New Guinea. The stems are glabrous and somewhat angular. Leaves: simple, spiral, sessile and without stipules. The blade is lanceolate,

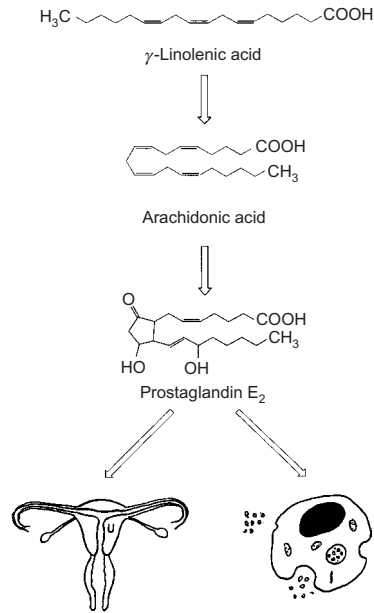


Fig. 168. Pharmacological basis of evening primrose oil: γ -linolenic acid is metabolized in arachidonic acid, an immediate precursor of prostaglandins which regulate uterus (U) contraction and inflammatory process (I).

Synonymy: *Jussiaea linifolia* Vahl, *Jussiaea tenella* Burm. f.

Uses: In Indonesia, *Ludwigia hyssopifolia* (D. Don) Exell is used to maturate pimples. In Laos, Cambodia, and Vietnam, *Ludwigia hyssopifolia* (D. Don) Exell is used to stop diarrhea and dysentery, and to treat enteritis and sprue. In Malaysia, the roots are used to treat syphilis. It will be interesting to learn whether a more intensive study on Connaraceae will disclose any molecules of therapeutic interest.



Fig. 169. *Ludwigia hyssopifolia* (D. Don) Exell.

membranaceous, 4.5 cm × 1.5 cm–2.8 cm × 6 mm, and the nervations are inconspicuous. The flowers are axillary, solitary, and characteristically long-necked, vertical and 7 mm–2 cm long. The calyx is 4-lobed and the corolla consists of 4 deciduous petals. The fruits are linear capsules containing numerous very small seeds. The calyx lobes are persistent at the apex of the capsules (Fig. 169).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

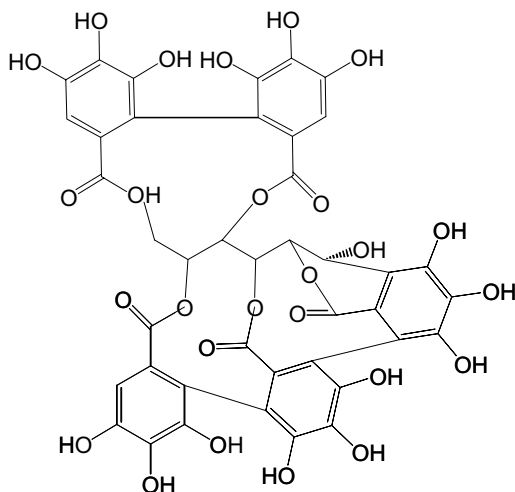
3. Family MELASTOMATACEAE A. L. de Jussieu 1789, *nom conserv.*, the Melastoma Family

Physical description: The family Melastomataceae is a vast group of 200 genera and about 4000 species of tropical herbs, shrubs and trees. The leaves in Melastomataceae are simple, opposite or verticillate and without stipules. In a field collection, Melastomataceae are easily recognizable by the blade which is marked with 3–9 longitudinal and parallel nerves. The flowers are hermaphrodite, often showy, and actinomorphic. The calyx is tubular, and the sepals are free or adnate to the ovary sometimes by septa-like connections. The



calyx lobes are imbricate or rarely valvate. The petals are imbricate, free, rarely united at the base, and a corona is usually present between the petals and the stamens. The stamens are as numerous or twice as numerous as the petals, and showy. The filaments are free, characteristically geniculate and inflexed.

The anthers are 2-locular, basifixed, and open by a single pore. The connectives are often appendaged. The ovary is inferior, 2-many locular and contains numerous ovules attached to axil placentas. The fruits are capsular or baccate and the seeds are very small.



Castalagin

Pharmaceutical interest: The leaves of *Miconia willdenowii* contain about 0.2% of caffeine and are used in Brazil to make tea. Several Asian ethnic groups use the fruits of the *Melastoma* species to blacken the teeth as a sign of sexual maturity, hence the word *Melastoma*. About thirty species of the plants classified within the family Melastomataceae are used for medicinal purposes in the Asia-Pacific. These are mostly astringent and used to stop diarrhea, check hemorrhages, heal and resolve infected or wounded skin, and for post-partum invigoration. It will be interesting to learn whether a more intensive study on Melastomataceae will disclose any molecules of therapeutic interest, especially tannins such as castalagin.

***Melastoma candidum* D. Don**

[From Greek, *melas* = black and *stoma* = mouth and from Latin, *candidus* = white]

Physical description: It is a common bush found in Asia. The stems are terete and hairy. Leaves: simple, opposite and

Common name: *Senduduk puteh* (Malay).

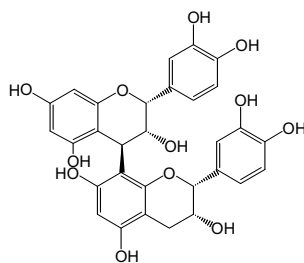
without stipules. The petiole is hairy, channeled and 7 mm–1.8 cm long. The blade is broadly lanceolate, hairy, coriaceous, 9.5 cm × 5.5 cm–7 cm × 4 cm and marked with 7 longitudinal nerves. The margin is recurved and wavy, and the tertiary nerves are conspicuous below. The inflorescences are terminal and the flowers white. The fruits are hairy and 1.2 cm × 8 mm (Fig. 170).



Fig. 170. *Melastoma candidum* D. Don.

Pharmaceutical interest: The medicinal properties of *Melastoma candidum* D. Don are attributed to tannins and flavonoids. Castalagin, procyanidin B-2 and helichryoid, characterized from the leaves of *Melastoma candidum* D. Don, lower blood pressure dose-dependently through a decrease of sympathetic tone in spontaneously hypertensive rats (Cheng JT *et al.*, 1993). Quercitrin, isoquercitrin, rutin, and quercetin, isolated from the leaves of *Melastoma candidum* D. Don, display free radical scavenging activity and inhibit MAO-B. with IC₅₀ values of 19.06, 11.64, 3.89, and 10.89 μM respectively (Lee MH *et al.*, 2001).

Uses: In Laos, Cambodia and Vietnam, *Melastoma candidum* D. Don is used to stop diarrhea, dysentery and leucorrhea. In Taiwan, a decoction of the stem and leaves of *Melastoma candidum* D. Don is drunk to treat fever and rickets.



Procyanidin B - 2

References

- Cheng T, *et al.* (1993) *Planta Med* **59**(5): 405–407.
 Lee MH, *et al.* (2001) *J Agr Food Chem* **49**(11): 5551–5555.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Memecylon edule* Roxb.**

[From Greek, *memecylon* = the fruit of *Arbutus unedo* and from Latin, *edule* = edible]

Common name: *Nipis kulit* (Malay).

Physical description: It is a handsome coastal shrub found in South-east Asia. The stems are terete and glabrous. Leaves: simple, opposite and without stipules. The petiole is grooved, 1 cm–1.5 cm long. The blade is elliptic-lanceolate, coriaceous, and 7.3 cm × 4.2 cm–8.6 cm × 5 cm. The midrib is sunken above and raised below. The inflorescences are axillary racemes. The fruits are pinkish, globose, open at the apex, 5 mm–7 mm in diameter (Fig. 171).

Pharmacological potential: The pharmacological potential of *Memecylon edule* Roxb. remains unexplored. Oral administration of an alcoholic extract of *Memecylon umbellatum* lowers the serum glucose level in glucose and alloxan-induced diabetic mice (Amalraj T *et al.*, 1998) on probable account of ellagic acid derivatives, flavonoids or tannins.



Fig. 171. *Memecylon edule* Roxb. From: KLU Herbarium 17138. Flora of Malaya. 19 Aug 1972. Geographical localization: Kedah, P. Langkawi, Pulau Timun, East end, head of rocky limestone beach, altitude: 10 ft. Field collector and botanical identification.: BCS Stone.

Uses: In Burma, the leaves of *Memecylon edule* Roxb. are used for their astringent properties. In Laos, Cambodia and Vietnam, *Memecylon edule* Roxb. is used to treat fever. In the Philippines, a variety of *Memecylon edule* Roxb. is used to promote menses and treat ophthalmia.

Reference

Amalraj T, *et al.* (1998) *J Ethnopharmacol* **62**(3): 247–250.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Phyllagathis rotundifolia* (Jack.) Bl.**

[From Greek, *phylla* = leaf, *agathis* = a ball of thread and from Latin, *rotundus* = circular]

Physical description: It is a creeping herb found in the shady and wet spots of the Malaysian rainforest. The stems are woody. Leaves: simple,

Uses: In Malaysia, *Phyllagathis rotundifolia* (Jack.) Bl. is used to invigorate health after childbirth, assuage stomachache, and treat malaria and fever. The pharmacological potential of *Phyllagathis rotundifolia* (Jack.) Bl. and of the plants classified within the genus *Phyllagathis* remains unexplored till today.



Fig. 172. *Phyllagathis rotundifolia* (Jack.) Bl.

spiral and without stipules. The blade is elliptic-circular, 6.9 cm × 5 cm–6.7 cm × 6.5 cm, characteristically darkish blue, somewhat fluorescent glossy on the surface, glaucous and velvety on the underneath. The base of the blade is cordate. The midrib and 6 parallel nerves are raised below and sunken above, and the tertiary nerves are raised below. The inflorescences are terminal racemes of about 1.5 cm long. The fruits are capsular, 4-angled, open at the apex and are 4 mm × 5 mm (Fig. 172).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Sonerila begoniaefolia* Ridl.**

[From Latin, *begoniaefolia* = Begonia-like leaves]

Physical description: It is a herb which grows to a height of 50 cm in the shady and wet spots of the Malaysian rainforest. The stems are quadrangular. Leaves: simple, alternate and without stipules. The petiole is reddish. The blade is asymmetrical, 4 cm × 2 cm–9 cm × 6 cm, glossy above and marked by 4 secondary nerves parallel to the midrib which is sunken above and raised below. The inflorescences are terminal. The fruits are 1 cm × 8 mm triangular capsules (Fig. 173).

Uses: In Malaysia, *Sonerila begoniaefolia* Ridl. is used to aid recovery from childbirth. It will be interesting to learn whether a more intensive study on *Sonerila begoniaefolia* Ridl. will disclose any molecules of therapeutic interest.



Fig. 173. *Sonerila begoniaefolia* Ridl.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

4. Family COMBRETACEAE R. Brown 1810 *nom. conserv.*, the Indian Almond Family

Physical description: The family Combretaceae consists of 20 genera and about 400 species of tropical trees and shrubs known to produce gums and *tannins*. The leaves are simple, without stipules, opposite, alternate or verticillate. The inflorescences are terminal and axillary racemes, spikes or a heads. The flowers are often small, unisexual or bisexual, and epigynous. The calyx comprises of 4–8 sepals, often appearing as valvate lobes on the hypanthium. The corolla comprises of up to 5 small, imbricate or valvate petals. The andrecium consists of 4–18 filaments inflexed in the buds, with versatile, tetrasporangiate and dithecal anthers opening by long longitudinal slits. The nectary disc is epigynous. The gynecium consists of 2–5 united carpels forming a 1-locular and inferior ovary containing 2–6 ovules, suspended from the apex of the ovary by slender funicles. The style is simple, and ends in a punctuate or seldom capitate stigma. The fruits are often winged and indehiscent, and contain pendulous seeds without endosperm.

Pharmaceutical interest: Examples of plants classified within the family Combretaceae are *Quisqualis indica* L. (Rangoon creeper) and *Terminalia cattapa* L. (Indian almond) which are medicinal and commonly grown to decorate gardens. *Terminalia chebula* Retz. (myrobalan) is used as a commercial source of tannins in India. Other examples are *Anogeissus latifolia* Wall. (gum *ghatti*), *Combretum butyrosom*, *Terminalia bellirica* Roxb. (*bahera* tree), *Terminalia tomentosa* W. & A. (*asan* wood), and *Terminalia angustifolia* Jacq. (*bois benzoïn*). About 30 Combretaceae plant species are medicinal in the Asia-Pacific, mainly on account of their astringent properties.

Quisqualis indica L.

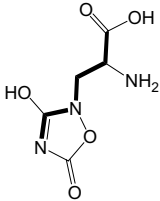
[From Latin, *quis* = who and *qualis* = what kind and *indica* = from India]

Physical description: It is a common ornamental climber native to Burma. Leaves: the petiole is 7.5 mm long. The blade is 7.5 cm–10 cm × 3.8 cm, elliptic, acuminate, and shows 6–8 pairs of secondary nerves. The blade is round, dark green, glabrous above and hairy beneath. The inflorescences are axillary or terminal spikes. The flowers are numerous, hanging down, 7.5 cm × 4 cm, initially white, then ripening into red. The calyx is tubular, pubescent, and develops 5 triangular lobes. The

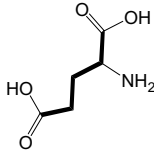
Synonymy: *Quisqualis sinensis* Lindl., *Quisqualis indica* L. var. *pubescens* (Burm.) Mak.

Common names: Rangoon jasmine, Rangoon creeper, Burma creeper, Chinese honeysuckle, drunken sailor; *dawchprincipalg* (Burmese); *shih chan tzu*, *shui chun tzu* (Chinese); *akar pontianak*, *akar suloh*, *belimbing hutan* (Malay); *liane vermifuge* (French); *irangunmalli* (Tamil); *su quan*, *qua giuim*, *day giuim*, *qua nac* (Vietnamese).

petals are elliptic lanceolate, acute, and 1.3 cm long. The fruits are ellipsoid, acutely 5-angled, glabrous, and brown and 3.2 cm long (Fig. 174).



Quisqualic acid



Glutamic Acid

Fig. 174. *Quisqualis indica* L.

Pharmaceutical interest: *Quisqualis indica* L. contains quisqualic acid: a non-protein amino acid which is ascaricidal and competes with glutamic acid to the metabotropic glutamate receptors, hence causing excitatory activity (Hansen JJ *et al.*, 1990). Quisqualic acid may be responsible for the antioccidal property displayed in an extract of *Quisqualis indica* L. (Youn HJ *et al.*, 2001).

References

- Hansen JJ, *et al.* (1990) *Med Res Rev* **10**(1): 55–94.
 Youn HJ, *et al.* (2001) *Vet Parasitol* **96**(4): 257–263.

Warning: *Quisqualis indica* L. is toxic.

Terminalia chebula Retz.

[From Latin, *terminus* = end]

Physical description: It is a tree which grows to a height of 30 m. It is found in India, Vietnam, Burma and Thailand. The bark is dark brown, 6 mm thick and the wood is very thick. The leaf-buds, twigs and young leaves are rusty hairy. Leaves: the petiole is 2 cm–5 cm long, pubescent

Uses: *Quisqualis indica* L. is principally known for its astringent and anthelmintic properties. In Indonesia, a decoction of the fruit is drunk to expel intestinal worms. In Malaysia, the fruits are eaten to expel intestinal worms, and a decoction of the fruit is given to children to stop diarrhea. The juice expressed from the leaves is used to heal boils and ulcers, and to treat ringworm infection and fever. The roots are used to relieve cough and hiccups. In the Philippines, the plant is used to treat diseases of the chest. In Vietnam, the fruit is used to expel intestinal worms and the roots are used to soothe rheumatism and assuage gastric discomfort.

Common names: Myrobalan, chebulic myrobalan; *pangah* (Burmese); *he lip* (Chinese); *srama* (Cambodian); *mirabolanos* (Portuguese); *abhaya, jaya* (Sanskrit); *amagola* (Tamil); *hara, hirala* (Indian); *chieu lieu, kha li lac* (Vietnamese).

with usually 2 glands near the top. The blade is 7 cm–20 cm × 4 cm–8 cm, glabrous when mature, elliptic, oblong, and shows 6–8 pairs of secondary nerves. The apex of the blade is acute, and the base is round or cordate. The inflorescences are terminal or axillary spikes. The flowers are hermaphrodite, 4 mm long, sessile, dull white or yellow and with a pungent odour. The calyx is campanulate, 3 mm long, flat at the base and 5-lobed. The fruits are pendulous, 2 cm–4 cm, almond-shaped, green, smooth, glabrous, and 5-ribbed drupes. The seeds are oblong (Fig. 175).

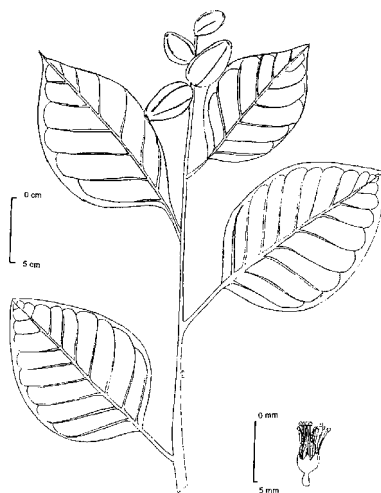


Fig. 175. *Terminalia chebula* Retz.

Pharmaceutical interest: The fruits contain about 20% to 40% of tannins, gallic acid, chebulic acid, β -sitosterol, anthraquinones and oils. Tannins and anthraquinones make the drug both astringent and laxative. The mature fruits are used to tan in India (100000 metric tons produced in 1981). Gallic acid displays cytotoxic (Pettit GR *et al.*, 1996) and hepatoprotective properties (Anand KK *et al.*, 1997). Gallic and chebulic acids are immunosuppressive on CTL-mediated cytotoxicity and inhibit the killing property of CD_8^+ CTL clone at $IC_{50} = 30 \mu M$ and $IC_{50} = 50 \mu M$ respectively, and the granule exocytose in response to anti- CD_3 (Hamada S *et al.*, 1997). Tannins extracted from *Terminalia chebula* Retz. do not cause mutations in *Salmonella thyphimurium* (Kaur S *et al.*, 1998). Tannins of the plant are antioxidant and radioprotector (Naik GH *et al.*, 2004).

Uses: The dried immature fruits of *Terminalia chebula* Retz. (Myrobalans, *British Pharmaceutical Codex*, 1934) are astringent and contain 20% to 40% of tannins. In Burma, the fruits are eaten to relieve the bowels of costiveness and to invigorate health. In China, the fruits are used to stop flatulence and promote expectoration. In India, the fruits are eaten to invigorate health, promote digestion and expectoration, soothe sore throat and inflamed areas, stop dysentery and vomiting, and to treat ascite (Ayurveda). In Indonesia, the fruits are astringent. In Malaysia, the fruits are used to check bleeding, assuage liver discomfort and stop dysentery. In Vietnam, the fruits are used to relieve the bowels of costiveness.

Antimicrobial properties: Extracts of *Terminalia chebula* Retz. inhibit the growth of fungi and bacteria cultured *in vitro* (Ahmad I *et al.*, 1998; Dutta BK *et al.*, 1998). Gallic acid inhibits the proliferation of a methicillin-resistant strain of

Staphylococcus aureus (Sato Y *et al.*, 1997). An extract of *Terminalia chebula* Retz. inhibits the replication of several sorts of viruses including the human cytomegalovirus (Yakawa TA *et al.*, 1996; Shiraki K *et al.*, 1998), the human immunodeficiency virus-1 (IC₅₀ = 50 µg/mL; El-Mekkawy S *et al.*, 1995) and the Herpes Simplex Virus type-1 (Kurokawa M *et al.*, 1995).

References

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Anand KK, *et al.* (1997) *Pharmacol Res* **36**(4): 315–321.
Dutta BK, *et al.* (1998) *Mycosis* **41**(11–12): 535–536.
El-Mekkawy S, *et al.* (1995) *Chem Pharm Bull Tokyo* **43**(4): 641–648.
Hamada S, *et al.* (1997) *Biol Pharm Bull* **20**(9): 1017–1019.
Kaur S, *et al.* (1998) *Mutat Res* **419**(1–3): 169–179.
Kurokawa M, *et al.* (1995) *Antiviral Res* **27**(1–2): 19–37.
Naik GH, *et al.* (2004) *Phytomed* **11**(6): 530–538.
Pettit GR, *et al.* (1996) *J Ethnopharmacol* **53**(2): 57–63.
Shiraki K, *et al.* (1998) *Nippon Raisho* **56**(1): 156–160.
Sato Y, *et al.* (1997) *Biol Pharm Bull* **20**(4): 401–404.
Yakawa TA, *et al.* (1996) *Antiviral Res* **32**(2): 63–70.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

D. Order CORNALES Lindley 1833

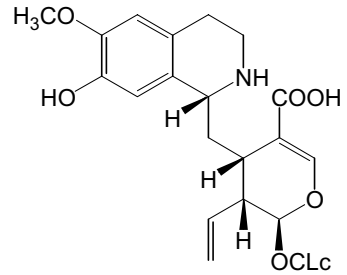
The order Cornales consists of 4 families and 150 species of plants thought to have originated from the order Rosales (Appendix I) and are known to produce iridoids, tannins, alkaloids, ellagic acid, proanthocyanins and triterpenoid saponins. The family Cornaceae with about 100 species is the largest family in this order.

1. Family ALANGIACEAE A.P. de Candolle 1828 *nom. conserv.*, the *Alangium* Family

Physical description: The family Alangiaceae consists of the single genus *Alangium* which groups about 20 species of trees and shrubs containing tannins, triterpenoid saponins and isoquinoline and indole monoterpene alkaloids. *Monoterpene indole alkaloids* are very rare in the Rosidae and common in the Asteridae. The leaves of Alangiaceae are simple, alternate and without stipules. The flowers are perfect, arranged in axillary cymes on articulated pedicels. The calyx is truncate or 4–10-lobed. The corolla consists of 4–10 petals which are linear, valvate, and recurved. The androecium consists of 4–40 stamens which are villous inside and free, and with 1–2-locular, linear anthers which open lengthwise. A cushion-shaped nectary disc is present.

The gynecium consists of a pair of carpels united into a compound, 1–2-locular inferior ovary containing a single ovule which is pendulous. The style is simple, clavate or 2–3-lobed. The fruits are drupes.

Pharmaceutical potential: Alangiaceae have attracted a great deal of interest on account of their ability to monoterpenoid alkaloids such as 6-*O*-methyl-*N*-deacetylpeposidic acid. *Alangium chinense* (Lour.) Harms, *Alangium faberi* Oliv., and *Alangium platanifolium* (Sieb. & Zucc.) Harms are medicinal in the Asia-Pacific. It will be interesting to learn whether a more intensive study on the Alangiaceae will disclose any alkaloids of chemotherapeutic interest.



6 - *O* - methyl - *N* - deacetylpeposidic acid

Alangium chinense (Lour.) Harms

[From Malabar, *alangi* = *Alangium chinense* (Lour.) Harms and from *chinense* = from China]

Synonymy: *Stydilum chinense* Lour.,
Marlea begoniaefolia Roxb.

Common name: *Chinese Alangium*;
ba jiao feng (Chinese)

Physical description: It is a tree which grows to a height of 20 m. It is found in the geographical zone spanning temperate India and China. The plant is ornamental. The stems are velvety when young. Leaves: simple, alternate and without stipules. The petiole is 8 mm–1.5 cm long. The blade is asymmetrical, begonia-like, rigid, velvety below and 12 cm × 7.5 cm–7 cm × 5.5 cm. The margin is somewhat wavy. The midrib is raised on both surfaces of the blade which shows 5–7 pairs of secondary nerves and scalariform tertiary nerves. The inflorescences are axillary cymes. The calyx is very small and indistinctly lobed. The corolla consists of 8 petals which are linear, velvety and valvate (Fig. 176).

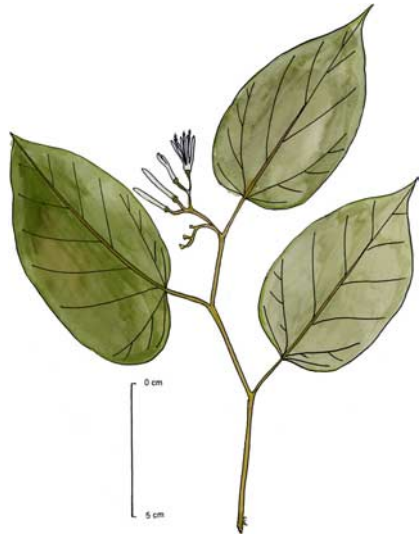


Fig. 176. *Alangium chinense* (Lour.) Harms.

Pharmaceutical interest: *Alangium chinense* (Lour.) Harms contains 6'-*O*-galloyl salicylic acid and 4', 6'-di-*O*-galloylsalicylic acid which are probably involved in the analgesic, antipyretic and anti-inflammatory properties described above (Itoh A *et al.*, 2000). The myorelaxant activity of *Alangium chinense* (Lour.) Harms is confirmed (Chang ZQ, 1981). β -Sitosterol and stigmasterol characterized from *Alangium platanifolium* bind to the central nervous system receptors *in vitro* and stigmasterol binds to the muscarinic receptors with IC_{50} of $8.52 \mu M$ (Min Z, 1998).

Uses: In China, *Alangium chinense* (Lour.) Harms is used to invigorate health, stop itching, assuage muscle pains, and to treat phthisis, fever and diseases of the bones and tendons. In Laos, Cambodia and Vietnam, the fruits are used to treat kidney diseases.

Cellular properties: An alkaloid extracted from *Alangium vitiense* inhibits the growth of L1210 leukemia, P388 and Gardner lymphosarcoma cell-lines (Mathe G *et al.*, 1978). A hypotensive alkaloid, choline and anthelmintic activity are reported from *Alangium lamarckii* (Dasgupta B, 1966; Pakrashi SC *et al.*, 1970; Dubey MP *et al.*, 1968). A methanolic extract of *Alangium salviifolium* inhibits the growth of a large spectra of Gram-positive and Gram-negative bacteria (Mosaddik MA *et al.*, 2000).

References

- Chang ZQ (1981) *Chung Yao Tung Pao* **6**(5): 34–36.
 Dasgupta B (1966) *Experientia* **22**(5): 287–288.
 Dubey MP, *et al.* (1968) *Indian J Physiol Pharmacol* **12**(1): 25–31.
 Itoh A, *et al.* (2000) *J Nat Prod* **63**(1): 95–98.
 Mathe G, *et al.* (1978) *Cancer Res* **38**(5): 1465–1467.
 Min Z (1998) *Planta Med* **64**(1): 8–11.
 Mosaddik MA, *et al.* (2000) *Fitoter* **71**(4): 447–449.
 Pakrashi SC, *et al.* (1970) *Experientia* **26**(9): 933–934.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family CORNACEAE Dumortier 1829 nom. conserv., the Dogwood Family

Physical description: The family Cornaceae consists of 11 genera and about 100 species of trees and shrubs known to contain inulin, tannins, ellagic acid, gallic acid, proanthocyanins, and *iridoids*. Note that iridoids are rare in the Rosidae and common in the Asteridae. The leaves in this family are opposite, alternate and mostly simple. The flowers are small, perfect or dioecious, actinomorphic, and arranged in dichotomous panicles or racemes of panicles. The calyx tube is adnate to the ovary and 4–5-lobed. The corolla comprises of 4–5 petals which are free, valvate or imbricate. The stamens are as numerous as the petals and alternate with them, and the anthers are 2-locular and open lengthwise.

The nectary disc is cushion-shaped, central in the male flower and epigynous in female flowers. The gynecium consists of 2–5 carpels united to form a compound, inferior ovary which comprises of as many locules as carpels. Each locule encloses a single ovule. The style is simple or lobed. The fruits are drupes or berries, containing a single 1–5 locular, longitudinally grooved stone.

Pharmaceutical interest: A classical example of Cornaceae is the ornamental garden shrub *Cornus mas* L. (Cornelian cherry wood). The barks of *Cornus pubescens* (dogwood) are used by the Indians in the Pacific Northwest to relieve the bowels of costiveness. *Cornus florida* (dogwood) has long been used by American Indians to treat fever and chills. *Aralidium pinnatifidum* Miq., *Cornus officinalis* Sieb. & Zucc., *Cornus macrophylla* wall., *Aucuba chinensis* Benth., *Aucuba japonica* Thunb., and *Helwingia chinensis* Batal. are medicinal in the Asia-Pacific. The pharmacological potential of the family Cornaceae is to date practically unknown despite the fact that the tannins of *Cornus canadensis* (dwarf cornel) inhibit the growth of several cancer cell-lines. It will be interesting to learn whether a more intensive study on Cornaceae will disclose any molecules of therapeutic interest. Are monoterpenoid indole or isoquinoline alkaloids present in this family?

***Aralidium pinnatifidum* Miq.**

[From Latin, *aralidium* = aralia-like and *pinnatus* = feathered]

Common names: *Balai, sebalai* or *selubat* (Malay).

Uses: In Malaysia, a paste made from the leaves of *Aralidium pinnatifidum* Miq. is used to produce skin irritation, treat rheumatism and fever, and heal boils. The therapeutic potential of this plant is still waiting to be discovered. By looking at the general medicinal pattern of the plant one might set the hypothesis that the plant is counter-irritant.



Fig. 177. *Aralidium pinnatifidum* Miq.

Physical description: It is a treelet found in the lowland rainforests of Thailand, Malaysia and Indonesia. Leaves: simple and deeply pinnately lobed. The petiole is 15 cm long and lenticelled, and the mature blade is 30 cm × 13 cm–80 cm × 26 cm. The inflorescences are 15 cm long panicles of several 2.5 mm long flowers. The fruits are dirty white berries which are 3.5 cm × 2.5 cm–1.5 cm × 2 cm, slightly asymmetric, ovoid. The seeds are broad, elliptic, 5-grooved and deeply ruminant (Fig. 177).

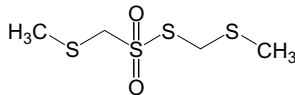
Warning: Caution must be taken as the toxic effects of this plant are unknown.

E. Order SANTALALES Lindley 1833

The order Santalales consists of 10 families and about 2000 species of plants, some of them being parasitic and without chlorophyll, and known to produce tannins, flavonoids and various sorts of *terpenes*. The order Santalales is thought to have originated side by side with the Rafflesiales from the Rosales from a common ancestor. Classical examples of Santalales are *Santalum album* (sandalwood) and *Viscum album* (mistletoe).

1. Family OLACACEAE Mirbel ex A. P. de Candolle 1824 nom. conserv., the Olax Family

Physical description: The family Olacaceae consists of about 30 genera and 250 species of plants which are widespread in the tropical and subtropical regions, producing tannins, cyanogenetic glycosides, acetylenic acids and flavonoids. The leaves are simple, alternate and without stipules. The flowers are small, regular, perfect, and hypogynous. The calyx is small, cupular, and lobed. The corolla consists of 3–6 petals which alternate with the calyx lobes, and are mostly valvate. The andrecium comprises of as many as and opposite the petals stamens. The gynecium comprises of 2–5 carpels united to form a compound, superior ovary, each locule containing a single ovule which is pendulous from a free and central placenta. The fruits are drupes or nuts in accrescent calyx.



2,4,5,7 - Tetrathiaoctane 4,4 dioxide

Physical description: An example of Olacaceae is *Ximenia americana* L. which is known for its valuable wood and to contain hydrocyanic acid which causes cyanide poisoning in cattle. An interesting biochemical feature of a number of plants classified within the genus *Scorodocarpus*, *Olax*, *Ochanostachys* and *Ximenia* is the presence of a series of polysulphides, such as 2,4,5,7-tetrathiaoctane 4,4-dioxide, similar to that of the *Allium* species (family Liliaceae, Order Liliales, Subclass Liliidae, Class Liliopsida) which are antimicrobial and cytotoxic. *Olax scandens* Roxb., *Anacolosa griffithii* Mast., *Ochanostachys amentacea* Mast., *Scorodocarpus borneensis* Becc., *Strombosia philippinensis* (Baill.) Rolfe and *Ximenia americana* L. are of medicinal value in the Asia-Pacific. To date the pharmacological potential of the family Olacaceae is virtually untouched.

***Olax scandens* Roxb.**

[From Latin, *scandere* = to climb]

Common names: *Ailu* (Burmese); *mallivepam* (Tamil).

Physical description: It is a tree which grows to a height of 15m on the seashores of India, Burma, Malaysia, Vietnam, China and Indonesia. The stems are terete, smooth, and glabrous. Leaves: simple, spiral, and without stipules. The petiole is 6 mm long, channeled and rugose. The blade is rigid, 4.4 cm × 3.4 cm–6 cm × 3.5 cm and elliptic. The midrib is sunken above and raised below. The blade shows 4–8 pairs of secondary nerves. The inflorescences are racemose and axillary. The flowers are very small, white, fragrant, and 6 mm long. The fruits are globose, 8 mm diameter drupes seated in a cupular calyx and obscurely marked at the apex by vestigial stigma (Fig. 178).

Uses: In Burma and India, the bark of *Olax scandens* Roxb. is used to combat fever.

Pharmaceutical interest:

Cholinergic property: The pharmacological potential of *Olax scandens* Roxb. is still waiting to be discovered, but one might set the hypothesis that the antifebrile effect of *Olax scandens* Roxb. could be based on a cholinergic mechanism since contractions of rat *fundus*, *antrum*, and rabbit *jejunum* induced by a methanol extract of *Olax gambecola* are inhibited by atropine and potentiated by physostigmine (Parry O *et al.*, 1986).

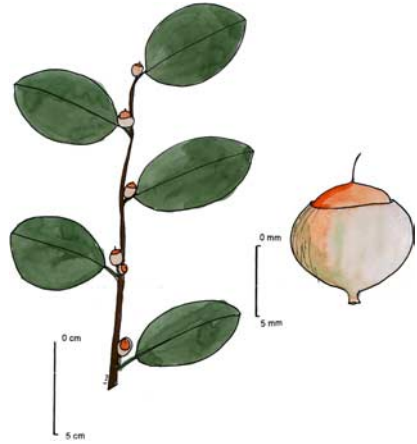


Fig. 178. *Olax scandens* Roxb. From: KLU 5134: Flora of Malaya. 7 Mar 1963. Geographical localization: Dungun 18 miles to Kuala Terengganu, road. In sandy area. Botanical identification: 15 Jan 1970.

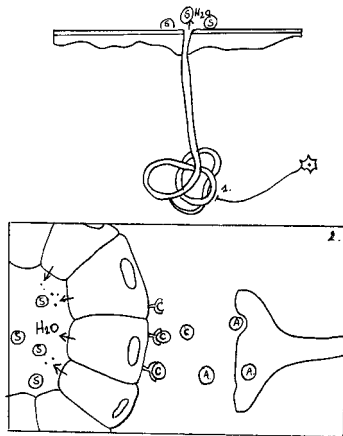


Fig. 179. Hypothetive mechanism of antipyretic activity of *Olax scandens* Roxb.: A cholinergic substance (C) promotes the secretion of sweat by the eccrine glands (E) which results in heat loss.

Under normal physiological conditions, acetylcholine commands the secretion of sweat to the eccrine glands which results in heat loss. The antipyretic activity of *Olox scandens* Roxb. could therefore result from the stimulation of sweating through cholinergic stimulation of the eccrine glands (Fig. 179) just like the muscarinic agonist pilocarpine which stimulates sweat glands and was once used to remove excess water and urea in nephritis. Note the presence of choline in the closely related Loranthaceae family. This mechanism is also valid for many other antifebrile Magnoliopsida.

Reference

Parry O, *et al.* (1986) *J Ethnopharmacol* **18**(1): 63–88.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Scorodocarpus borneensis Becc.

[From Greek, *scorodocarpus* = smelly fruit, and Latin, *borneensis* = from Borneo]

Common names: Wood garlic; *pokok kulim* (Malay).



Physical description: It is a massive timber which grows to a height of 25 m and a girth of 2 m. It is found in the rainforests of Malaysia and Indonesia. The forested areas where this tree grows, smell of garlic. The bark is brown and scaly, and the inner bark is pinkish-red, juicy and very smelly. Leaves: simple, spiral and without stipules. The petiole is 1.5 cm–1.8 cm long, curved at the apex and woody. The blade is glossy, greyish-green, rigid, obovate, and 24 cm × 9.2 cm–17 cm × 6.3 cm.

Fig. 180. From: KLU Herbarium 043271. The Herbarium Waraniset, East Kalimantan, Indonesia (Flora of East Kalimantan). Field collector: Ambri, Arifin, Arbainsyah. Botanical Identification: AA & Kessler. Geographical localization: Indonesia, East Kalimantan, KPC area, Bengalon, Projosamarea, Km 4, 117° 32' East - 00° 47' North, altitude: 40 m, 11 Apr 1990. Secondary forest.

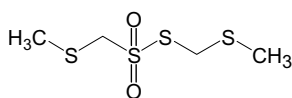
The apex of the blade is acuminate. The nervations are deeply sunken above and raised below. The blade shows 3–6 pairs of secondary nerves, and a few tertiary nerves below. The inflorescences are short axillary racemes. The flowers are greenish-white and 6 mm long. The fruits are green drupes of about 5 cm diameter, containing a single seed enclosed in a crustaceous shell. The seeds are oily and very smelly (Fig. 180).

Pharmaceutical interest:

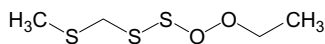
Polysulphides: The garlic smell and the anthelmintic properties of the seeds of *Scorodocarpus borneensis* Becc. are attributed to a very unusual series of polysulphides such as 2,4,5,7-tetrathiaoctane 4,4-dioxide

($\text{CH}_3\text{SCH}_2\text{SO}_2\text{SCH}_2\text{SCH}_3$), 5-thioxo-2,4,6-trithiaheptane 2,2-dioxide ($\text{CH}_3\text{SO}_2\text{CH}_2\text{SCSSCH}_3$), and O-ethyl S-methylthiomethyl thiosulphite ($\text{CH}_3\text{SCH}_2\text{SS}(\text{O})\text{OCH}_2\text{CH}_3$) which are drastically antimicrobial and cytotoxic (Lim H *et al.*, 1998). 2,4,5-trithiahexane, 2,4,5,7-tetrathiaoctane, and 2,4,5,7-tetrathiaoctane 2,2-dioxide, and 2,4,5,7-tetrathiaoctane 4,4-dioxide inhibit rabbit platelet aggregation induced by collagen, arachidonic acid, U46619, adenosine 5'-diphosphate, platelet aggregating factor, and thrombin. This effect is on account of the inhibition of the arachidonic acid metabolism and aggregation in association with the function of the platelet plasma membrane (Lim H *et al.*, 1999). Other substances characterized from the seeds are sesquiterpenes scodopin and cadalene- β -carboxylic acid, and a mixture of 3 tryptamine-type alkaloids, scorodocarpines A-C (Wiert C *et al.*, 2001).

Uses: The Malays of Perak use the fresh seeds as a substitute for garlic and as a medicine to remove ringworms. In Indonesia, the seeds are used to expel intestinal worms.



2,4,5,7 - Tetrathiaoctane 4,4 - dioxide



O - Ethyl S - Methylthiomethyl thiosulphite

References

- Lim H, *et al.* (1998) *Phytochem* **48**(5): 787–790.
 Lim H, *et al.* (1999) *Biosc Biotechnol Biotech* **63**(2): 298–301.
 Wiert C, *et al.* (2001) *Phytochem* **58**(4): 653–656.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family LORANTHACEAE A. L. de Jussieu 1808, *nom conserv.*, the Mistletoe Family

Physical description: The family Loranthaceae consists of about 70 genera and 700 species of tanniferous and parasitic plants known to produce phenolic acids, lignans, triterpenes, cyclitols, steroids and flavonoids glycosides (quercitrin), choline, tyramine, toxic polypeptides (viscotoxins) and glycoproteins (lectins). The leaves of Loranthaceae are simple, mostly opposite or whorled, sometimes reduced to scales, and without stipules. The blade is often characteristically somewhat spongy and glaucous, and often without distinct secondary nerves. The flowers are actinomorphic, uni- or bisexual, and often brightly colored. The calyx is adnate to the ovary, and annular or cupular. The petals are free or united into a tube, and often split down one side. The stamens are as numerous as the petals and inserted at the base of the corolla. The anthers are 2-locular. The gynecium consists of 3–4 carpels forming a compound, unilocular and inferior ovary containing 4–12 ovules attached to a free and basal central columnar placenta. The fruits are berries or drupes.

Pharmaceutical interest: A common example of Loranthaceae is *Viscum album* L. (mistletoe) which is used as a decoration during Christmas and has long been used by Celtic shamans. The berries of this plant contain a series of toxic amines and proteins which cause gastroenteritis if eaten in large quantities. Note that a number of the plants classified within the family Loranthaceae are used to strengthen the uterus after childbirth and that *Phoradendron serotinum* (American mistletoe) were long used by North American Indians as oxytotic agents, namely in arresting postpartum hemorrhages. About 20 species of the plants classified within the family Loranthaceae are used for medicinal purposes in the Asia-Pacific. One may have noticed that many of these medicinal plants are used to check post-partum hemorrhages, promote the secretion of milk, soothe the pregnant uterus and to make tea-like drinks. It will be interesting to learn whether a more intensive study on the family Loranthaceae will disclose any molecules of therapeutic interest.

***Macrosolen cochichinensis* (Lour.) van Tieghem**

[From Latin, *cochichinensis* = from Cochinchina]

Physical description: It is a Southeast Asian parasitic plant which grows on trees. The stems are rugose, terete and glabrous. Leaves: simple, opposite and without stipules. The petiole is 3 mm–6 mm long and flattened above. The blade is elliptic or lanceolate, thick, and shows a midrib sunken above and raised below. The inflorescences are axillary

Synonymy: *Elytranthe cochichinensis* G. Don, *Elytranthe globosa* G. Don.

racemes of about 2.5 cm long. The fruits are small berries seated on persistent calyx lobes and with a funnel-shaped body at the apex (Fig. 181).

Uses: In Laos, Cambodia and Vietnam, the leaves of *Macrosolen cochichinensis* (Lour.) Van Tieghem are used to make a tea-like drink, and the fruits are used to treat cough. In Malaysia, *Macrosolen cochichinensis* (Lour.) Van Tieghem is used to assuage headache, and to tighten the uterus after childbirth. To date, the pharmacological potential of *Macrosolen cochichinensis* (Lour.) Van Tieghem is undiscovered.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Dendrophthoe pentandra* (L.) Miq.**

[From Greek, *pente* = five and *andro* = male]

Synonymy: *Loranthus pentandrus* L.

Uses: In Laos, Cambodia and Vietnam, the leaves of *Dendrophthoe pentandra* (L.) Miq. are used to make a tea-like drink used to treat cough. In Malaysia, *Dendrophthoe pentandra* (L.) Miq. is used as a remedy to and recovery from childbirth, and to heal sores, wounds and ulcers. The pharmacological potential of this plant is yet to be discovered.

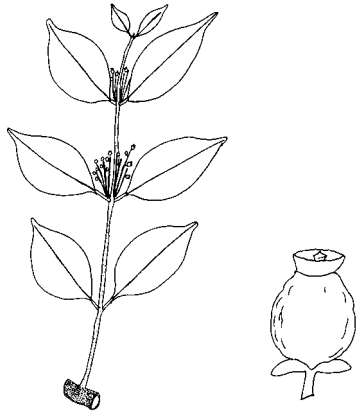


Fig. 181. *Macrosolen cochichinensis* (Lour.) van Tieghem. From: KLU 355111. Flora of Singapore. Comm. Ex. Herb. Hort. Bot. Sing. Geographical localization: Nec Soon, open forest margins bordering the swamp, along a stream, epiphytic, hemi-parasite. Altitude: 5 m. 23 Sep 1982. Field collector & botanical identification: JF Maxwell.



Fig. 182. *Dendrophthoe pentandra* (L.) Miq.

Physical description: It is a Southeast Asian parasitic plant which grows on trees. The stems are terete and glabrous. Leaves: simple, opposite and without stipules. The petiole is 1 cm × 3 cm–5 mm × 3 mm. The blade is fleshy, thick, somewhat leathery and spongy, elliptic-lanceolate, 11.7 cm × 4 mm–13 cm × 4.3 cm and exhibits a showy midrib. The inflorescences are short and axillary

racemes. The calyx is cupular and 3 mm long. The corolla is tubular, 1.5 cm–2 cm long and somewhat reddish. The petal lobes are linear, recurved downward and 5 mm–1 cm long. The stigma is showy and the andrecium comprises of 5 stamens. The fruits are red and succulent (Fig. 182).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

F. Order RAFFLESIALES Kerner 1891

The order Rafflesiales consists of 3 little families: Hydnoraceae, Mitrastemonaceae and Rafflesiaceae, and about 60 species of fleshy, parasitic, tropical herbs without chlorophyll. The order Rafflesiales is thought to have originated side by side with the Santalales from the Rosales in which they share a common ancestor (Appendix I).

1. Family RAFFLESIACEAE Dumortier 1829 *nom. conserv.*, the *Rafflesia* Family

Physical description: The family Rafflesiaceae consists of about 7 genera and 50 species of very unusual parasitic plants confined to the rainforests of Asia. The leaves are whorled and without normal stomata. The flowers, the largest in the Magnoliopsida, are fleshy, smelly, showily colored, and mostly unisexual. The perianth consists of 4–5 imbricate tepals. The andrecium consists of 5 to numerous stamens connate by their filaments into a tube surrounding the styler column, from which the anthers originate in 1 to several cycles. The gynecium consists of 4–8 carpels united into a compound, inferior or half inferior ovary crowned by a stout columnar style and containing several ovules attached to parietal placentas. The fruits are fleshy, dehiscent or not, and contain numerous small seeds.

Pharmaceutical interest: A classical example of Rafflesiaceae is *Rafflesia arnoldii* R. Br. from Sumatra which has the largest flowers in the world (1 m across). *Rafflesia hasseltii* Suring., *Rafflesia patma* Bl., and *Rhizanthus lowii* (Becc.) Harms are of medicinal value. It will be interesting to learn whether a more intensive study on the family Rafflesiaceae will disclose any molecules of therapeutic interest. Rafflesiaceae are an endangered species and their chance of survival is slim.

***Rafflesia hasseltii* Suring**

[After Sir Thomas Stamford Raffles, an 18th century patron of science and founder of the British colony at Singapore]

Physical description: It is a fleshy parasitic herb which grows attached to the roots of trees in the rainforests of Malaysia and Indonesia. The

Common name: Rafflesia.

Uses: In Malaysia, the dried buds are used to expedite delivery in and aid recovery from childbirth. The pharmacological potential of this plant is unknown.

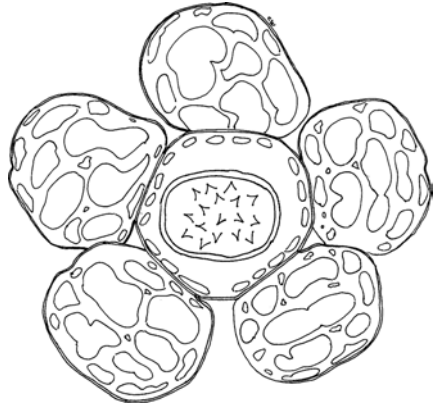


Fig. 183. *Rafflesia hasseltii* Suring.

buds are spherical, darkish and open noisily at night into giant flowers of about 60 cm to 1 m diameter which are whitish and penciled in red. The perianth comprises of 5–6, 25 cm × 16 cm tepals around a hollowed receptacle at the bottom of which are displayed a few finger shaped organs (Fig. 183).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

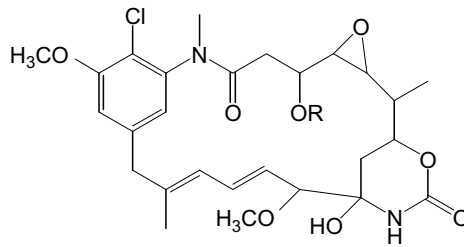
G. Order CELASTRALES Wettstein 1907

The order Celastrales consists of 11 families and about 2000 species of woody plants thought to have originated from the order Rosales (Appendix I), and known to produce *tannins*, lignans, triterpenes, sesquiterpenes, and alkaloids, including sesquiterpene, purine, pyridine and occasionally monoterpenoid isoquinolines alkaloids. The order Celastrales is thought to have originated with the Rhamnales from the Rosales in which they share a common ancestor. Celastraceae, Hippocrateaceae, Aquifoliaceae and Icacinaceae are fairly closely related. The Dichapetalaceae stand somewhat apart from the order families and are excluded by some authors from the Celastrales and referred to as the Euphorbiales. The presence of monoterpenoid isoquinolines in the Icacinaceae suggests that Celastrales and Cornales might have common ancestry in the Rosales.

1. Family CELASTRACEAE R. Brown in Flinders 1814 *nom. conserv.*, the Bittersweet Family

Physical description: The family Celastraceae consists of about 50 genera and 800 species of trees, shrubs and climbers, which are principally tropical, and often containing *phenethylamines*, pyridine, and purine alkaloids, triterpenes, *sesquiterpenes*, lignans, and cardenolides (*Euonymus*). The leaves of

Celastraceae are simple, often glossy and serrate, alternate or opposite, and with or without stipules. The inflorescences are terminal or axillary cymes. The flowers are hermaphrodite, small, actinomorphic, greenish or white, hypogynous and succulent. The perianth comprises of 5 sepals and 5 petals which are small, imbricate or rarely valvate. The andrecium consists of 5 stamens which are alternate with the petals, and inserted in or below the margin of a conspicuous nectary disc. The anthers are tetrasporangiate and dithecal. The gynecium consists of 2–5 carpels forming a superior, 2–5-locular ovary. The styles are terminal, short and capitate, and develop a 2–5-lobed stigma. The fruits are capsules, samaras, berries or drupes.



Maytansine (R= COCH(CH₃)N(CH₃)COCH₃)

Pharmaceutical interest: The leaves of *Catha edulis* Forsk. or *khat*, are used in a number of African and Arab countries to stimulate the intellect and to assuage hunger. The active principle of *khat* is (-) – cathinone, an epinephrine-like phenethylamine alkaloid derived from phenylalanine and tyrosine (Fig. 184). Another classical example of Celastraceae is the ornamental *Euonymus europaeus* L. (spindle tree), the fruits of which are poisonous. *Euonymus* (*British Pharmaceutical Codex*, 1954) consists of the dried root-bark of *Euonymus atropurpureus* and has been used as a tincture (0.6 mL–2.6 mL), a mild purgative and choleric. To date, pharmacological studies on

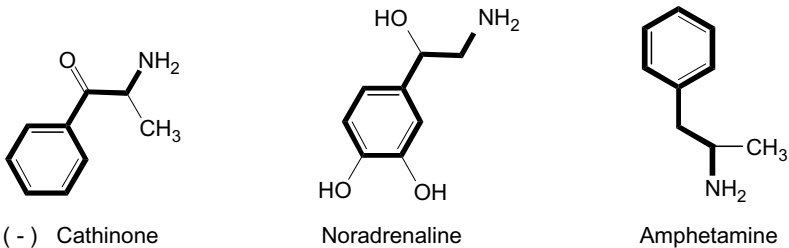
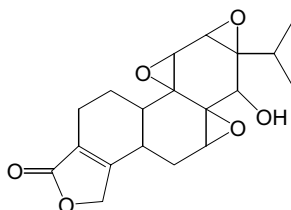


Fig. 184. Examples of neuroactive natural products characterized from the family Celastraceae. Similitude of chemical structure of (-) – cathinone, noradrenaline and amphetamine.

Celastraceae have provided very interesting results and the discovery of natural products of therapeutic interest is very probable in this family. A number of the plants classified within the genus *Maytenus* and *Puterlickia* contain macrocyclic alkaloids of possible bacterial origin, such as maytensine, which are able to inhibit experimentally the proliferation of tumors at very low dosage ($\mu\text{g}/\text{Kg}$ of animal body weight). Triptolide and triptdiolide, diterpenes characterized from *Tripterygium wilfordii* display potent antileukemic properties. About 30 plant species of Celastraceae are medicinal in the Asia-Pacific.



Triptolide

***Celastrus monospermoides* Loes.**

[From Greek, *kelastros* = the name of another tree and from *monos* = alone and *sperma* = seed]

Synonymy: *Celastrus malayensis* Ridl.

Uses: In Malaysia, the leaves of *Celastrus monospermoides* Loes. are applied externally to treat fever. The pharmacological potential of *Celastrus monospermoides* Loes. is unexplored.

Physical description: It is a woody climber which grows in the Malaysian rainforest. The stems are glabrous, terete and smooth. Leaves: simple, spiral and without stipules. The petiole is 1 cm–1.4 cm, thin, channeled and transversely striated. The blade is glossy above, glabrous,



Fig. 185. *Celastrus monospermoides* Loes. From: KLU Herbarium 13486: 15 Apr 1970, E Soepadmo. Botanical identification: Ding Hou, 9/1983. Geographical localization: Hill dipterocarps. Forest along Sungai Sempam, Raub, Pahang, Malaysia.

9.5 cm × 4.5 cm–10 cm × 5 cm, thick, elliptic, and serrate. The apex of the blade is slightly acuminate and the base acute. The midrib is sunken above and raised below, and the secondary nerves, about 7 pairs, are indistinct above. The inflorescences are axillary, 5 cm–10 cm long racemes. The fruits are 3-lobed, dehiscent, 1.5 cm × 1 cm capsules containing a seed which is embedded in a yellowish-orange aril (Fig. 185).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Celastrus paniculata* Willd.**

[From Greek, *kelastros* = the name of another tree and from Latin, *panus* = ear of millet]

Synonymy: *Celastrus paniculatus* Willd.

Common names: Black oil tree, climbing staff plant, intellect tree; *myinkounayoung* (Burmese); *may thee* (Cambodian); *amruta* (Sanskrit); *adibaricham* (Sanskrit); *day sang mau* (Vietnamese).

Physical description: It is a large and deciduous climber which grows in the geographical zone spanning India, China, Australia and New Caledonia. The stems are 20 cm in diameter and up to 18 m long. The twigs are fairly smooth reddish-brown and lenticelled. The bark is pale brown and 7.5 mm–1 cm thick. The inner bark is not fibrous. It is pink and finely streaked with red lines, which turns blue upon light exposure. Leaves: 6.3 cm–10 cm × 3.8 cm–7.5 cm, simple, spiral, without stipules. The petiole is 7.5 mm–1.5 cm long. The blade is thick, glabrous, broadly elliptic, ovate or obovate, and acuminate. The margin is crenate-serrate, and the secondary nerves arching. The flowers are 3.8 mm long, green, and arranged in terminal, deciduous, 5 cm–20 cm long panicles. The fruits are 3-lobed, bright yellow, 3–6-seeded, 1 cm–1.3 cm globose capsules which are depressed. The seeds are enclosed in a red aril (Fig. 186).

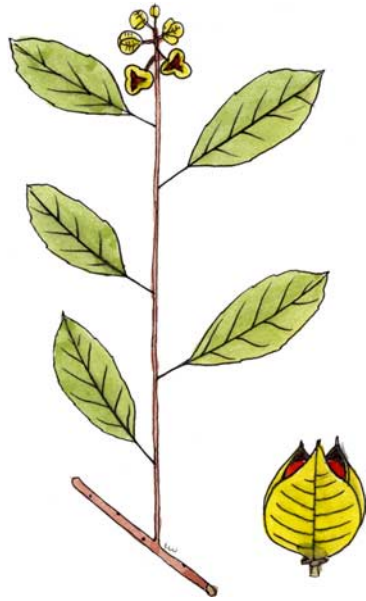


Fig. 186. *Celastrus paniculata* Willd.

Pharmaceutical interest:

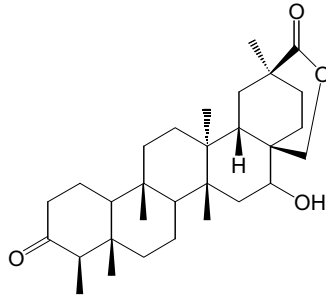
Psychoanaleptic property: The oil expressed from the seeds of *Celastrus paniculata* Willd. given *per os* (50 mg/Kg, 200 mg/Kg or 400 mg/Kg) to young adult rats for 14 days, completely reverses the scopolamine (0.5 mg/Kg)-induced impairment in a navigational memory test (Gattu M *et al.*, 1997). The same oil tested in a 2 compartment passive memory test improved the retention ability of albino rats. This effect is accompanied with a decrease in the brain content of norepinephrine, dopamine and serotonin (Nalimi K *et al.*, 1995). What is the active principle involved here? An alkaloid?

Uses: In Burma, the seeds of *Celastrus paniculata* Willd. are used to invigorate health, and the leaves are used to counteract opium poisoning. In India, the leaves are used to promote menstruation, and the seeds are used to relieve the bowels of costiveness, produce venereal desire and stimulate the intellect. In Indonesia, the leaves are used to stop dysentery. In the Philippines, the pulverized seeds are used to treat rheumatism and paralysis, and to invigorate health. In Vietnam, the oil expressed from the seeds is used to treat beriberi.

Anti-inflammatory and analgesic properties: A methanolic extract of the flowers of *Celastrus paniculata* Willd. displays both analgesic and anti-inflammatory properties *per os* in the hot water immersion test using mice and inhibits the paw oedema induced by carrageenan in rats (Ahmad F *et al.*, 1994). This anti-inflammatory property may involve a number of polyols or a number of flavonoids (anthocyanidins?) since both dulcitol (a hexahydric sugar alcohol) and (–)-epiafzelechin (a flavan-3-ol) characterized from *Celastrus orbiculatus* Thumb. are anti-inflammatory. Dulcinol improves significantly the collagen-caused arthritis in mice with a T-cell modifying property (Kobayashi Y *et al.*, 1997). (–)-Epiatzelechin inhibits dose-dependently cyclo-oxygenase with an IC₅₀ of 15 μM and significantly reduces the paw oedema induced by carrageenan in mice at 100 mg/Kg *per os* (Min KR *et al.*, 1999).

Cytotoxic and antiviral properties: The plants classified within the genus *Celastrus* are interesting because they often contain cytotoxic and/or antiviral sesquiterpenes and triterpenes. Sesquiterpenes characterized from *Celastrus stephanotriifolius* inhibit the development of tumors at low doses (Takaishi Y *et al.*, 1993). Maytenfolone A, a triterpene characterized from *Celastrus hindisii*, destroys efficiently HEPA-2B cells (ED₅₀: 2.3 μg/mL) and KB cells (ED₅₀: 3.8 μg/mL) cultured *in vitro*. B, another triterpene, celasdin B, inhibits the replication of the Human Immunodeficiency Virus in H9 lymphocytes with an EC₅₀ of 0.8 μg/mL (Kuo YH *et al.*, 1997). Furthermore, a number of sesquiterpenes characterized from the roots of *Celastrus orbiculatus* partially or completely reverse the resistance of KB-V1 and MCF7/ADR cells to adriamycin, vinblastine and taxol (Kim SE *et al.*, 1998; 1999). It will be interesting to learn whether a

more intensive study on *Celastrus paniculata* Willd. will disclose any terpenes of therapeutic interest.



Maytanfolone A (R=OH)

References

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Warning: An oily extract of the seeds of *Celastrus paniculata* Willd. causes vacuolization, germ cell depletion and the arrest of spermatogenesis in the testis of treated rats, suggesting an antifertility effect.

Euonymus alatus (Thunb.) Sieb.

[From Greek, *eu* = good and *onoma* = name and from Latin, *alatus* = wing]

Physical description: It is a shrub found in China, Korea and Japan which is often cultivated as an ornamental plant. The bark is greyish, and the stems are characteristically winged. Leaves: simple, opposite and without stipules. The petiole is very small, glabrous and channeled. The blade is 3.5 cm × 1.3 cm, thin, orbiculate, reddish, and shortly acuminate at the apex. The margin is serrulate. The midrib

Synonymy: *Euonymus thunbergianus* Bl., *Euonymus striatus* var. *alatus* Mak.

Common name: Winged Euonymus, cork bush, burning bush.

is raised on both surfaces, and the secondary nerves are indistinct. The flowers are solitary or cymose and axillary on 5 mm long pedicels. The corolla comprises of 4 petals which are irregular, ovate, yellow, small and nerved. The andrecium consists of 4 stamens which alternate with the petals. The nectary disc is showy and succulent (Fig. 187).

Uses: In China, the stem of *Euonymus alatus* (Thunb.) Sieb. is used to treat fever, expel intestinal worms, and regulate blood circulation and menses. In Korea, the stems are used to treat schizophrenia, check bleeding, lower blood pressure and assuage abdominal pain after parturition.

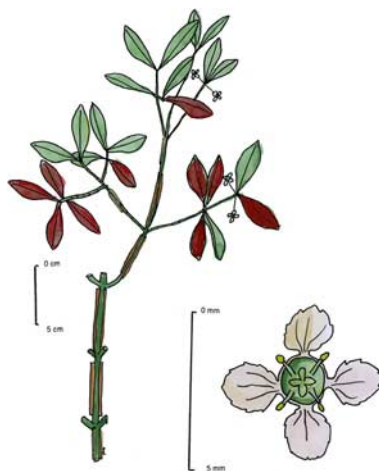


Fig. 187. *Euonymus alatus* (Thunb.) Sieb. From: KLU Herbarium 10108. Collection: 9 June 1965. Botanical identification: M Togashi. Geographical localization: Idzumino, Chino-shi, Pref. Nagano, Japan.

Pharmaceutical interest: Butanol and chloroform extracts of the stems of *Euonymus alatus* (Thunb.) Sieb. inhibit the growth of human hepatocellular carcinoma cell line, Hep3B cells with IC_{50} values of $65 \mu\text{g/mL}$ and $85 \mu\text{g/mL}$ respectively (Cha BY et al., 2003). *Euonymus alatus* (Thunb.) Sieb. increases the production of nitric oxide by macrophages. Note that nitric oxide is a potent derived effector molecule against tumors (Chung HS et al., 2002). *Euonymus alatus* (Thunb.) Sieb. lowers plasma HDL3-c level and slow down the progress of atherosclerosis (Wang W et al., 1991). It will be interesting to learn whether a more intensive study on *Euonymus alatus* (Thunb.) Sieb. will disclose any molecules of chemotherapeutic interest. Note that 3,4-dihydroxycinnamic acid from the plant inhibits the enzymatic activity of metalloproteinase inhibitor (Park WH et al., 2005).

References

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Gymnosporia spinosa* (Blco.) Merr. & Rolfe**

[From Greek, *gymnos* = naked, *spora* = spore and from Latin, *spina* = thorn]

Synonymy: *Catha spinosa* Forsk.,
Gymnosporia montana (Roth.) Benth.,
Celastrus senegalensis Lam.).

Common names: *Bahuphala*
(Sanskrit); *valuluvai* (Tamil).

Physical description: It is a shrub found in Southeast Asia. The stems when young are prickly. Leaves: drying yellowish, thick, and 3 cm–5 cm × 2 cm–3.8 cm. The petiole is 3 mm–10 cm long. The blade is elliptic or obovate, round at the apex, entire or crenulate, and tapered at the base. The inflorescences are axillary cymes. The flower pedicel is long and thin, and the bracts are small and lanceolate. The calyx lobes are very small, broadly elliptic-oblong, round at the apex, and ciliate. The petals are 3 mm long and elliptic-oblong. The filaments of the stamens are flattened and dilate at the base. The nectary disc is succulent and 10-lobed. The ovary is glabrous and orbicular. The style is fertile flowers and deeply 2–3-lobed. The fruits are 5 mm long globose capsules ripening into purple. The seeds are glabrous, chestnut brown, rugose and embedded in an aril (Fig. 188).

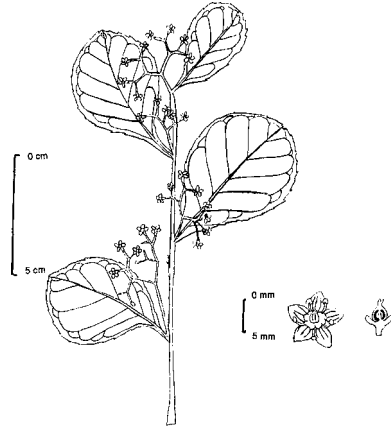


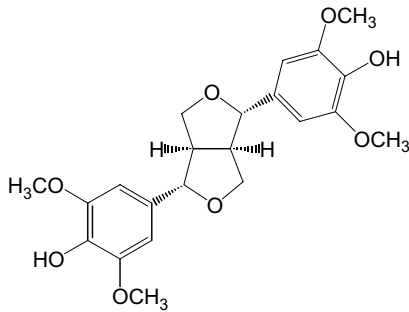
Fig. 188. *Gymnosporia spinosa* (Blco.) Merr. & Rolfe.

Pharmaceutical interest:

Hepatoprotective property: A methanolic extract of leaves of *Gymnosporia montana* lowers the enzymatic activity of transaminases, the level of lipid constituents and the level of orosumucoid in the serum, and the level of glycogen in the liver of animals poisoned with carbon tetrachloride (De S *et al.*, 1994).

Uses: In the Philippines, a decoction of the leaves of *Gymnosporia spinosa* (Blco.) Merr. & Rolfe is drunk to assuage headache. In India, the fruits are used to promote digestion, expel impurities, heal ulcers and piles, soothe inflammation and treat corneal opacities (Ayurveda), fever and biliousness.

Cellular property: The plants classified within the genus *Gymnosporia* are interesting because they contain compounds which are DNA strand-scission agents such as syringaldehyde, (–)-syringaresinol, (+)-catechin, and (+)-epicatechin characterized from *Gymnosporia trigyna* (Deng JZ *et al.*, 2000).



Syringaresinol

References

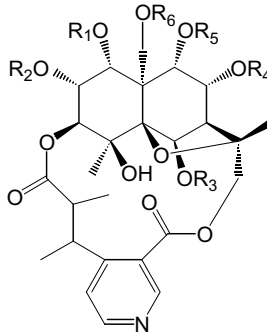
- De S, *et al.* (1994) *Planta Med* **60**(4): 301–304.
 Deng JZ, *et al.* (2000) *J Nat Prod* **63**(9): 1269–1272.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family HIPPOCRATEACEAE A. L. de Jussieu 1811 *nom. conserv.*, the Hippocratea Family

Physical description: The family Hippocrateaceae consists of the genera *Hippocratea* (100 species) and *Salacia* (200 species). Hippocrateaceae are tanniferous, tropical shrubs or climbers closely allied to the Celastraceae. The leaves of Hippocrateaceae are mostly opposite and simple and the stipules small or absent. The inflorescences are cymose. The flowers are small, hermaphrodite and actinomorphic. The calyx is small, and consists of 5 imbricate sepals. The corolla comprises of 5 petals which are imbricate or valvate. A cupular, conical or expanded nectary disk is present. The andrecium comprises of mostly 3 stamens which alternate with the petals. The gynecium consists of 3 carpels united to form a compound, superior, trilocular and somewhat triangular ovary containing 2–10 ovule per locule which are attached to axile placentas. The style is subulate or short and mostly 3-fid. The fruit are drupes, berries, or capsules. The seeds are compressed and often winged or angular.

Pharmaceutical interest: Hippocrateaceae are interesting because they produce sesquiterpene pyridine alkaloids that will be worth assessing for their cytotoxic and other pharmacological potential. *Hippocratea indica* Willd., *Salacia flavescens* Kurz, *Salacia grandiflora* Kurz, *Salacia macrophylla* Bl. and *Salacia prinoidea* (Willd.) DC. are medicinal in the Asia-Pacific. The roots of these plants are often used to promote menses and used to aid recovery from childbirth.



$R_1 = \text{Ac}$, $R_2 = \text{CNMP}$, $R_3 = \text{Ac}$, $R_4 = \text{COPh}$, $R_5 = \text{Ac}$, $R_6 = \text{Ac}$

***Salacia grandiflora* Kurz**

[From Latin, *grandis* = large and *flores* = flowers]

Physical description: It is a climbing shrub which grows in the rainforests of Malaysia. The stems are lenticelled and glabrous. Leaves: simple, subopposite and without stipules. The petiole is channeled above and 6 mm–8 mm \times 1.75 mm–2 mm long. The blade is rigid, elliptic-ovate, 18.5 cm–20.5 cm \times 6.7 cm–9.2 cm. The apex of the blade is apiculate and the base acute. The margin is recurved and somewhat wavy. The midrib is raised above and below. The blade shows 7–10 pairs of secondary nerves raised on both surfaces. The flowers are 2.5 mm long, pink and cauliflorous. The fruits are globose, 3.5 cm diameter berries containing several 3-lobed seeds of 2 cm length (Fig. 189).

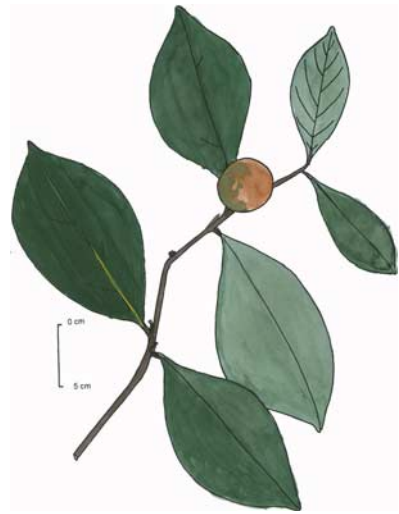


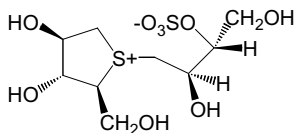
Fig. 189. *Salacia grandiflora* Kurz. From: KLU Herbarium 19209. Flora of Malaya. Field collector & botanical identification: SC Chin. Geographical Localization: Perak, Ipoh, Gunong Rapat, Limestone 100 m.

Pharmaceutical interest: To date, the pharmacological properties of *Salacia grandiflora* Kurz. are unknown.

Uses: In Malaysia, a decoction of the roots of *Salacia grandiflora* Kurz. is used to promote menses.

Antidiabetes properties: Note that the *Salacia* species are interesting because they produce various sorts of α -glucosidase, α -amylase, sucrase, isomaltase and aldose reductase inhibitors of possible therapeutic value for the treatment of diabetes. Examples of α -glucosidase inhibitors are sulphonium salacinol and kotalanol both characterized from *Salacia reticulata* and *Salacia oblonga*, which also strongly inhibit α -amylase and sucrase respectively (Yoshikawa M *et al.*, 1998; Matsuda H *et al.*, 1999; Ghavami A *et al.*, 2001). Mangiferin characterized from *Salacia reticulata* inhibits sucrase, isomaltase and aldose reductase with IC_{50} values of 87, 216, and $1.4 \mu\text{g/mL}$ (Yoshikawa M *et al.*, 2001). The friedelane-type triterpene kotalagenin 16-acetate characterized from *Salacia oblonga* inhibits aldose reductase (Matsuda H *et al.*, 1999).

Other properties: Quinone methides from *Salacia kraussii* display *in vitro* anti-malarial activity (Figueiredo JN *et al.*, 1998). The root bark powder of *Salacia oblonga* assuages the paw edema induced by carrageenan in male albino rats (Ismail TS *et al.*, 1997). Isoiguesterin, an antileukemic bisnortriterpene, was characterized from *Salacia madagascariensis*, a plant also known to have strong antimalarial properties *in vitro* (Gessler MC *et al.*, 1994).



Salacinol

References

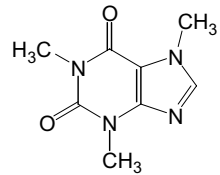
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Warning: Caution must be taken as the toxic effects of this plant are unknown.

3. Family *AQUIFOLIACEAE* Bartling 1830 *nom. conserv.*, the Holly Family

Physical description: The family Aquifoliaceae consists of 4 genera and about 400 species of cosmopolitan, evergreen trees and shrubs which are known to produce triterpenoid saponins, flavonoids, and purine or pyridine base alkaloids. The leaves in this family are simple, alternate, with or without stipules.

The flowers are actinomorphic and hermaphrodite or not. The inflorescences are cymose, fasciculate or seldom solitary. The calyx comprises of 4 sepals which are small and imbricate. The corolla consists of 4 petals which are imbricate or valvate and shortly connate at the base. The andrecium comprises of 4 stamens which are alternate with the petals, free and with dithecal and tetrasporangiate anthers opening by longitudinal slits. The gynecium consists of 4–6 carpels united to form a compound, superior ovary with as many locules as carpels, each locule containing 1 or 2 pendulous ovules. The style is terminal and short or indistinct. The fruits are berries containing as many stones as carpels, and they are poisonous.



Caffeine

Pharmaceutical interest: Classical examples of Aquifoliaceae are *Ilex aquifolium* L. (common holly) and *Ilex opaca* Aiton, which are extensively cultivated for use as Christmas decorations. A number of the plants classified within the genus *Ilex* contain *caffeine* and are used to make invigorating beverages — America: *Ilex paraguariensis* (*yerba de mate*, mate, Paraguay tea), *Ilex guayusa*; North America: *Ilex cassine* (*cassina*, *dahoon* holly), *Ilex verticillata* (winter berry) and Asia: *Ilex chinensis*. Note that there is an expanding body of evidence to suggest that a daily intake of *yerba de mate* promotes aerodigestive tumors. *Ilex asprella* Champ., *Ilex chinensis* Sims, *Ilex cornuta* Lindl., *Ilex yunnanensis* Franch., *Ilex godajan* (Coleb. Ex Wall.) Wall. and *Ilex wallichii* Hook f. are of medicinal value in the Asia-Pacific.

***Ilex pubescens* Hook. & Arn.**

[From Latin, *ilex* = *Quercus ilex* and from *pubescere* = soft down]

Synonymy: *Ilex trichoclada*.

Physical description: It is a small and evergreen rainforest shrub found in China and Taiwan. Leaves: 4 cm–5.5 cm × 1.5 cm–2 cm and simple. The blade is oblong or lanceolate, and the apex of the blade acute. The margin is subentire or remotely serrate. The secondary nerves are indistinct. The flowers are arranged in axillary cymes. The fruits are globose, 4 mm–5 mm berries containing 4–5 pyrenes.

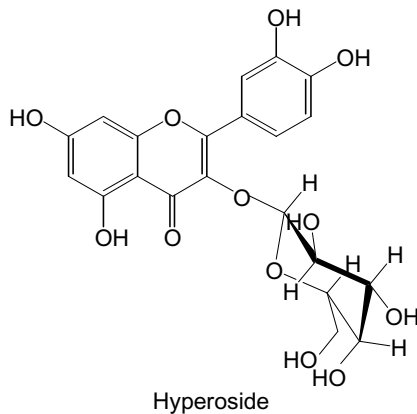
Uses: In China and Taiwan, a decoction of the leaves is drunk to invigorate health, stop flatulence, lower body temperature, expel impurities, promote urination and to abort a pregnancy. A paste made from the leaves is used to treat skin diseases, counteract snake-poisoning and heal poisoned wounds. In China, the plant is used to stimulate blood circulation and treat coronary diseases.

Pharmaceutical potential: Generally speaking, the *Ilex* species owe their pharmacological potential to tannins, flavonoids, triterpenoid saponins and purine bases (caffeine and theobromine).

Antioxidant/antiradical properties: Hyperoside, rutoside and chlorogenic acid characterized from *Ilex aquifolium* L. inhibit non-enzymatic lipid peroxydation in model membrane (Muller K *et al.*, 1998). The intraperitoneal injection of an aqueous extract of *Ilex paraguariensis* inhibits dose-dependently the oxidation of low density lipoproteins (Gugliucci A *et al.*, 1995). The same aqueous extract given to healthy humans who fasted, inhibits copper-induced autoxidation of low density lipoproteins in the whole plasma (Gugliucci A, 1996). This aqueous extract inhibits the contraction caused by methoxamine in a mesenteric arterial bed, and this effect is reversed by N-(G)-nitro-L-arginine methyl ester suggesting the involvement of nitrous oxide of endothelial reserve (Mucillo-Baisch AL *et al.*, 1998).

Cardiovascular properties: *Ilex pubescens* Hook. & Arn. is interesting because it contains a series of triterpenoid saponins such as ilexonin A, which could hold some potential for the treatment of cardiovascular diseases (Wang Z *et al.*, 1993). Ilexonin A inhibits the aggregation of platelets and calcium influx in platelets. Thrombin significantly reduces the level of platelet cyclic adenosine monophosphate (cAMP) while ilexonin A and the calcium-channel blocker verapamil antagonize this effect. Ilexonin A inhibits platelet phosphodiesterase more potently than verapamil, which is currently used to treat angina pectoris, hypertension and arrhythmia.

Other properties: Asprellic acids A and B, triterpenoids characterized from *Ilex asprella*, inhibit the growth of RPMI-(7951) cell-line (0.62 $\mu\text{g/mL}$ and 5.5 $\mu\text{g/mL}$) and KB cells (3.75 $\mu\text{g/mL}$ and 2.86 $\mu\text{g/mL}$) cultured *in vitro* (Kashiwada KL *et al.*, 1993). Ilexoside XLVIII and cynarasaponin C inhibit *in vitro* acyl



CoA cholesteryl acyl transferase, a key enzyme in the synthesis of cholesterol (Nishimura K *et al.*, 1999). Rotundic acid, a triterpene characterized from *Ilex integra*, inhibits *in vitro* the proliferation of a broad spectrum of microbes (Haraguchi H *et al.*, 1999). The antidepressant property of the plant has been substantiated experimentally in rodent (Xu C *et al.*, 2004).

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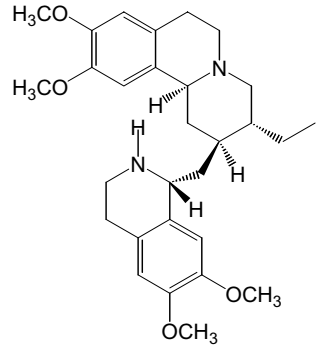
Warning: Caution must be taken as the toxic effects of this plant are unknown. Note that *Mate* solutions, which have become popular for their antioxidant/antiradical properties, are however mutagen in the Ames test (TA97, TA98, TA100, TA102 strains, 20 mg/plates to 50 mg/plates) and genotoxic (WP2s strain; Leitao AC *et al.*, 1994) showing that antioxidant/antiradical natural products can be noxious. Furthermore, a case-control study which includes 497 cases of lung cancer and the same number of controls, reveals that *mate* is associated with risks of upper aerodigestive tract cancer (De Stefani E *et al.*, 1996). A case-control study involving interviews with 111 incident cases and 222 controls shows a high mortality rate for bladder cancer, on account of black tobacco smoking and *mate* ingestion (De Stefani E *et al.*, 1991). The case of a young woman who developed a veino-occlusive disease after drinking *mate* over a number of years is reported by Mc Gee *et al.* (1976).

4. Family ICACINACEAE Miers 1851 *nom. conserv.*, the *Icacina* Family

Physical description: The family Icacinaceae consists of about 50 genera and 400 species of trees, shrubs and woody climbers of tropical distribution which are known to produce purine and *monoterpenoid isoquinoline alkaloids*, iridoids, saponins and proanthocyanins. The leaves are simple, alternate and without stipules. The flowers are hypogynous, actinomorphic, and perfect. The calyx is small, 4–5-lobed, and the lobes are imbricate or rarely valvate. The corolla is tubular or dialypetalous, and valvate. The stamens are as numerous as the petals and alternate with them. The anthers are tetrasporangiate and

dithecal, with free filaments which are hairy and borne on the corolla. The gynecium consists of 2–5 carpels united to form a compound, mostly single-locular ovary, containing a pair of pendulous ovules from near the top of the ovary. The style is short. The fruits are berries.

Pharmaceutical interest: A very interesting feature of Icacinaceae is the presence of monoterpenoid alkaloids, such as emetine, which are well-known for their emetic, amebicidal, antiviral and cytotoxic properties. It will be interesting to learn whether a more intensive study on the family Icacinaceae will disclose any monoterpenoid alkaloids of chemotherapeutic interest. *Gonocaryum subrostratum* Pierre, *Gonocaryum gracile* Miq., *Gonocaryum calleryanum* (Baill.) Becc., *Gomphandra quadrifida* (Bl.) Sleum. var. *angustifolia* (King) Sleum., *Gomphandra quadrifida* (Bl.) Sleum. var. *ovalifolia* (Ridl.) Sleum., and *Rhyticarium* sp. are used for medicinal purposes in the Asia-Pacific.



Emetine

***Gomphandra quadrifida* (Bl.) Sleum. var. *angustifolia* (King) Sleum.**

[From Greek, *gomphandros* = nail-like male and from Latin, *quadri* = four and *fidere* = cut]

Synonymy: *Gomphandra salicifolia* Ridl.

Uses: In Malaysia, a decoction of the leaves of *Gomphandra quadrifida* (Bl.) Sleum. var. *angustifolia* (King) Sleum. is drunk to aid recovery from childbirth. The pharmacological potential of *Gomphandra quadrifida* (Bl.) Sleum. var. *angustifolia* (King) Sleum. remains unexplored til today.

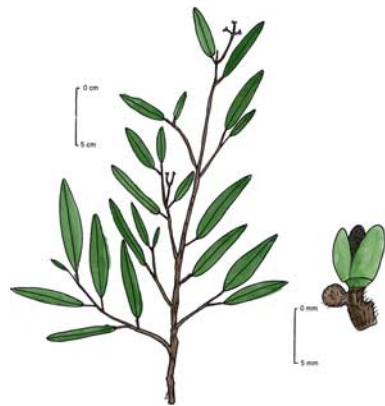


Fig. 190. *Gomphandra quadrifida* (Bl.) Sleum. var. *angustifolia* (King) Sleum. From: KLU Herbarium. Plants of Ulu Gombak. Geographical localization: Ulu Gombak, 16th mile, UM Field Studies Center, West Malaysia. Field collector: Benjamin C Stone, 10 Nov 1965. Botanical identification: H Sleumer/70 (RijkshHerbarium. Leiden).

Physical description: It is a small rainforest tree found in Malaysia. Leaves: simple, alternate and without stipules. The petiole is 4 mm–5 mm long and channeled. The blade

is elliptic-linear, rigid, 6.8 cm × 1.5 cm–6.6 cm × 1.6 cm. The apex of the blade is acuminate. The margin is wavy. The midrib is deeply sunken above and raised below. The blade shows 4–6 pairs of secondary nerves which are indistinct. The inflorescences are axillary and hairy cymes of 5 mm–2 cm long. The flowers are very small (Fig. 190).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

5. Family DICHAPETALACEAE Baillon in Martius 1886, nom. conserv., the Dichapetalum Family

Physical description: The family Dichapetalaceae is a small group of 3 genera and about 235 species of shrubs and woody climbers, principally found in Africa and known to produce *fluoroacetic acid* and pyridine alkaloids. The largest genera of Dichapetalaceae is the genus *Dichapetalum* with 200 plant species. The leaves are simple, alternate, stipulate and glandular. The inflorescences are cymes. The flowers are perfect, regular, hypogynous and characteristically fluffy and 5-merous. The stamens alternate with the petals. The anthers are dithecal and open longitudinally. The gynecium consists of 2–3 carpels united into a compound 2–3-locular ovary, each locule containing a pair of apical-axile, pendulous, and anatropous ovules. The style is simple. The fruits are berries containing a few seeds.

Pharmaceutical interest: An example of Dichapetalaceae is *Dichapetalum cymosum* the grazing of which causes high mortality in cattle and wild animals in South Africa. The *Dichapetalum* species abound with cardiotoxic fluoroacetic acids which irritate the skin, provoke a tingling sensation around the corners of the mouth and numbness of the face, and cause pulmonary congestion, oedema, froth in the airways and hemorrhagic gastroenteritis. In the Asia-Pacific, *Dichapetalum griffithii* (Hook. f.) Engl. is medicinal. The pharmacological potential of the family Dichapetalaceae remains unexplored.

***Dichapetalum griffithii* (Hook. f.) Engl.**

[From Latin, *petalum* = petals, and after Dr. William Griffith, a 19th century botanist and curator of the Botanic Garden in Calcutta]

Physical description: It is a climber found in the rubber estates and

Synonymy: *Chailletia griffithii* Hook. f.

Uses: In Malaysia, *Dichapetalum griffithii* (Hook. f.) Engl. is used as a post-partum remedy. The pharmacological potential of *Dichapetalum griffithii* (Hook. f.) Engl. is unknown. The seeds of *Dichapetalum toxicarium* contain long-chain fluoro-fatty acid and fluoroacetic acid, which causes death (10 mg/Kg) attributable to severe bradycardia (Tosaki A *et al.*, 1988).

villages of Malaysia and Indonesia. The stems are lenticelled and pilose at the apex. Leaves: alternate and simple. The petiole is 2 mm × 2 mm–3 mm and pilose. The blade is rigid, pilose beneath, and 20 cm × 7 cm–15 cm × 3 cm. The midrib is flat above and raised below. The blade shows 8–10 pairs of secondary nerves. The fruits are fluffy, yellow, axillary, globose, 1.5 cm × 1.7 cm–7 mm × 6 mm and seated in a persistent calyx (Fig. 191).

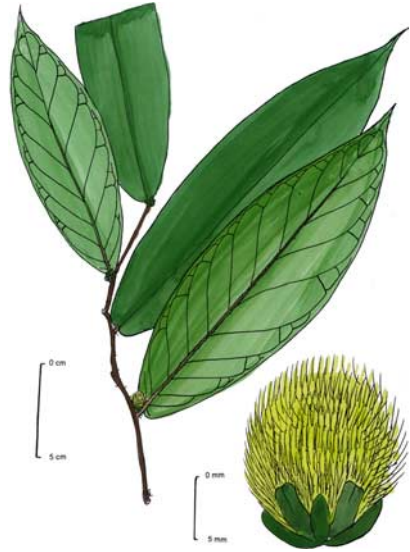
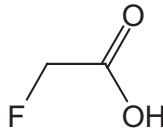


Fig. 191. *Dichapetalum griffithii* (Hook. f.) Engl. From: KLU 00317. Flora of Malaya. Field collector & botanical identification: M. Kassim, 23 Jan 1961. Geographical Localization: altitude: 250 feet, RRI Sungei Buloh.



Fluoroacetic acid

Reference

Tosaki A, *et al.* (1988) *Basic Research Cardiology* **83**(2): 158–166.

Warning: Caution must be taken as this plant is certainly poisonous on account of fluoroacetates.

H. Order EUPHORBIALES Lindley 1833

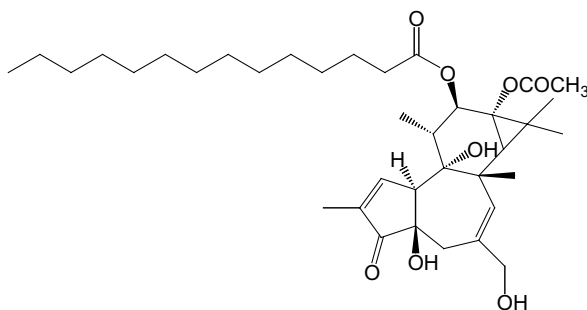
The order Euphorbiales consists of 4 families and about 8000 species of trees, shrubs, herbs and climbers which are thought to have originated from the order Celastrales (Appendix I).

1. Family EUPHORBIACEAE A. L. de Jussieu 1789 nom. conserv., the Spurge Family

Physical description: The family Euphorbiaceae consists of 300 genera and about 7500 species of trees, shrubs, herbs, climbers and even cactus-shaped plants, often exuding a milky poisonous latex, and known to produce *hydrolysable tannins*, aporphine, pyridine, indole, and tropane types alkaloids, *lignans*, phloroglucinol derivatives, various sorts of *terpenes*, ellagitannins, proanthocyanins and, *cyanogen glycosides*, anthraquinones and fatty acid epoxides. The leaves of Euphorbiaceae are simple or compound, alternate and stipulate or not. Several sorts of inflorescences occur in the family. The flowers are small and unisexual. The perianth is inconspicuous to seldom showy, and comprises of 5 tepals which are distinct or connate. The andrecium consists of 5 or more stamens which are tetrasporangiate, dithecal, and open by longitudinal slits. A nectary disc is present. The gynecium consists of 3 carpels forming a compound and 3-locular ovary with 3 distinct styles, each locule containing 1–2 ovules. The fruits are characteristically dehiscent trilobed capsules.



Pharmaceutical interest: A classical example of Euphorbiaceae is tapioca (*Manihot esculenta* Crantz), which is one of the dietary plants most anciently used by mankind. The seeds of *Ricinus communis* L. provide castor oil, which has been used since a remote period in time to relieve the bowels of costiveness. Rubber is prepared from the latex of *Hevea brasiliensis* Muell. Arg. (hevea rubber). Euphorbiaceae are often toxic. An example of toxic Euphorbiaceae is *Excoecaria oppositifolia*, the latex of which causes blindness and anaphylactic shock to the lumberjacks of Southeast Asia. At least 14 genera including *Aleurites*, *Croton*, *Euphorbia*, *Hippomane*, *Hura* and *Jatropha* owe their toxicity to complex diterpenoid esters of the tiglane, ingenane or daphnane type. Almost all of these compounds are drastic cathartics, causing intense contact inflammation, and are both tumor-promoting and anti-tumor agents. One such compound is 12-*O*-tetradecanoylphorbol-13-acetate, which is one of the most potent inducer of skin tumor in mice. As a pharmacological tool, it is valuable because it activates the phosphorylation enzyme, protein kinase C. Note that this diterpene displays interesting anti-HIV activity *in vitro*.



12 - O - tetradecanoylphorbol - 13 - acetate

Euphorbiaceae contain proteins (phytooxins), which are among the most violent existing poisons. One such protein is curcin from *Jatropha curcas*, and ricin from *Ricinus communis* L. Being often toxic, Euphorbiaceae should be used with caution in herbal remedies. Minor drugs still used are *Croton tiglium* (croton oil), and *Croton eleuteria* Benn. (*cascaquilla* bark). About 150 species of the plants classified within the family Euphorbiaceae are used for medicinal purposes in the Asia-Pacific. Most of these are used to relieve the bowels of costiveness, soothe inflammation, and promote urination and expectoration. It will be interesting to learn whether a more intensive study on Euphorbiaceae will disclose any molecules of therapeutic interest. Note that hydrolysable tannins and diterpenes are predominantly responsible for the medicinal properties of Euphorbiaceae.

***Acalypha indica* L.**

[From Greek, *a* = without, *kalyphos* = a cover and from Latin, *indica* = from India]

Physical description: It is a light green and smelly herb found in shady vacant plots in the tropical regions which grows to a height of 90 cm. It is slightly hairy and branched, and its odour is adored by cats. The stems are woody at the base. Leaves: simple and alternate. The petiole is 5 cm long. The blade is broadly ovate, 3 cm × 4.5 cm, and dentate. The base of the blade is wedge-shaped, and the apex blunt. The inflorescences are 2.5 cm–10 cm

Common names: Common acalypha; *cika mas*, *cika emas* (Malay); *kuppaimeni* (Tamil); *hierbal del cancer* (Spanish).



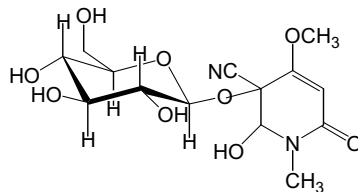


Fig. 192. *Acalypha indica* L.

long spikes, the lower part of which shows rather large and showy, green, conical and lobed bracts, concealing the female flowers. The male flowers consist of 4 sepals and 8 free stamens packed together at the apex of the spikes. The fruits are small 3-lobed capsules hidden in the bracts (Fig. 192).

Pharmaceutical interest: *Acalypha indica* L. elaborates a cyanogen glycoside: acalyphine, which is responsible for the smell and is possibly involved in some of the properties described above. Extracts of *Acalypha indica* L. display antimicrobial properties, and petroleum ether and ethanolic extracts of *Acalypha indica* L. (600 mg/Kg) inhibit the implantation in female albino rats (Camabadusuriy *et al.*, 1994; Lamabadusuriya SP *et al.*, 1994, Sellahewa K, 1994). This antifertility property is reversible upon withdrawal of the treatment of the extracts and could be of oestrogen origin (Hiremth SP *et al.*, 1999). Of recent interest is the neutralization potential of *Viper russelli russelli* (Russell's viper) venom by an ethanol extract of the leaves (Shirwaikar A *et al.*, 2004).

Uses: *Acalypha indica* L. is principally used to relieve the bowels of costiveness and to expel intestinal worms. The fresh or dried entire flowering plant (*Acalypha*, *British Pharmaceutical Codex*, 1934) was used in Western medicine to promote expectoration and to induce vomiting, in a way similar to ipecacuanha in the form of a liquid extract (1 in 1, dose 0.3 mL to 2 mL) or a tincture (1 in 8, dose 2 mL to 4 mL). In Malaysia, a decoction of the whole plant is drunk to expel intestinal worms. A decoction of the roots is drunk to treat asthma, pneumonia and rheumatism. In the Philippines, the juice expressed from the plant is used to promote expectoration and to induce vomiting. In Vietnam, the leaves are used to expel intestinal worms and the roots to relieve the bowels of costiveness. Note that the young shoots are often used as vegetables.



Acalyphine

References

- Camabadusuriy, *et al.* (1994) *Ceylon Med J* **39**(1): 45–46.
 Hiremath SP, *et al.* (1999) *J Ethnopharmacol* **67**(3): 253–258.
 Lamabadusuriya SP, *et al.* (1994) *Ceylon Med J* **39**(11): 46–47.
 Sellahewa K. (1994) *Ceylon Med J* **39**(3): 145.
 Shirwaikar A, *et al.* (2004) *J Ethnopharmacol* **94**(2–3): 267–273.

Warning: Excessive ingestion of this plant causes cyanide-like intoxication. Cases of haemolysis following the ingestion of *Acalypha indica* L. in G6PD deficient subjects are reported (Camabadusuriy *et al.*, 1994; Lamabadusuriya SP *et al.*, 1994; Sellahewa K, 1994).

Acalypha siamensis Oliv. ex Gage

[From Greek, *a* = without, *kalyphos* = a cover and from Latin, *siamensis* = from Siam]

Synonymy: *Acalypha evrardii* Gagnep.

Common name: *Kernam* (Malay).

Uses: In Malaysia, an infusion of the leaves is used to assuage bowel and kidney discomfort, and a paste made from the leaves is applied externally to treat fever. In Vietnam, an infusion of the leaves and flowers is drunk to promote urination. The therapeutic potential of *Acalypha siamensis* Oliv. ex Gage is unknown.



Fig. 193. *Acalypha siamensis* Oliv. ex Gage.

Physical description: It is a shrub found in Malaysia, India, Indochina, Thailand and Burma which is often cultivated as an ornamental plant. Leaves: simple, spiral, and 3.7 cm × 1.5 cm. The blade is pointed, glossy, and light green. The base is wedge-shaped. The margin is dentate, and the apex is acute. The inflorescences are short spikes with the male flowers above the female flowers at the base. The flowers are apetalous and without a nectary disc. The male flowers consist of 4 sepals and 8 free stamens. The female flowers consist of



3–5 sepals, and are characteristically enclosed in 5 mm bracts. The fruits are small 3-lobed spiny capsules splitting into 3 valves (Fig. 193).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Acalypha wilkesiana* M. A.**

[From Greek, *a* = without, *kalyphos* = a cover and after Admiral Charles Wilkes, 19th century American naval officer and explorer in the South Pacific]

Common names: Beef steak plant, copper plant; fire dragon.

Uses: In Malaysia, a beverage consisting of about 60 g of the leaves boiled in goat's milk is drunk to lower blood pressure, treat fever, relieve cough and heal pimples. It is said that about 10 g of the leaves boiled with sugar is used to treat thrombocytopenic purpura and allergic purpura.



Fig. 194. *Acalypha wilkesiana* M. A.

Physical description: It is a tropical bush which grows to a height of 1.5 m. It is cultivated for ornamental purposes all over the Asia-Pacific. Leaves: simple, spiral, and reddish. The inflorescences are spikes bearing male flowers at the top and female flowers at the base. The flowers are apetalous and without a nectary disc. The male flowers consist of 4 sepals and 8 free stamens. The female flowers are enclosed in a 5 mm bract. The fruits are small 3-lobed capsules splitting into 3 valves (Fig. 194).

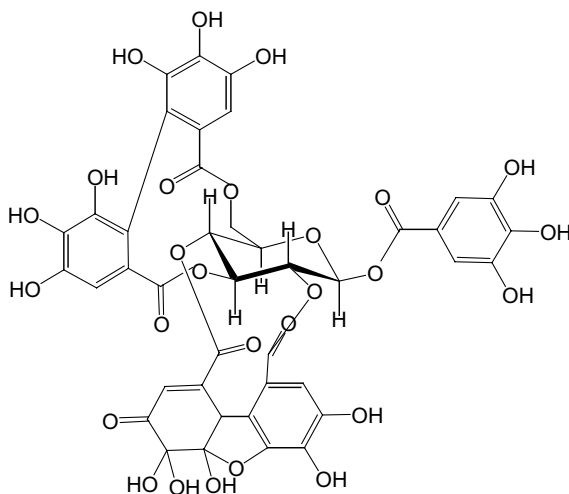
Pharmaceutical interest:

Antibacterial properties: Water and ethanolic extracts of the leaves of *Acalypha wilkesiana* M. A. inhibit moderately the proliferation of standard and local strains of bacteria and fungi including *Staphylococcus aureus*, *Trichophyton rubrum*, *Trichophyton mentagrophytes*, *Candida albicans* and *Aspergillus flavus* confirming thereby the antiseptic property of the plant. The ethanolic extract inhibits the proliferation of *Klebsiella pneumoniae* and *Proteus mirabilis*. The minimum inhibitory concentrations of these extracts range between 0.25 mg/mL and 32 mg/mL, while the minimum



cidal concentrations are between 1 mg/mL and 64 mg/mL. The aqueous extract is found to be static in action while the ethanolic extract is bactericidal in effect (Alade PI *et al.*, 1993).

Geraniin, gallic acid, and corilagin are the antimicrobial constituents of *Acalypha wilkesiana* M. A. and *Acalypha hispida* leaves (Adesina SK *et al.*, 2000). Note that geraniin is also known to lower blood pressure (see *Sapium sebiferum*). In addition, geraniin is known to decompose into gallic acid, ellagic acid and corilagin with boiling water. Gallic acid is cytotoxic.



Geraniin

Cytotoxic properties: Aqueous and ethanolic extracts of *Acalypha wilkesiana* M. A. seeds cause the apoptosis of lymphocytes and the generation of reactive oxygen intermediates. In granulocytes, the aqueous extract of the seeds induces an oxidative burst and enhances the phagocytosis of *Escherichia coli*. Both extracts stimulate the release of the pro-inflammatory cytokines tumor necrosis factor α and interleukin6, as well as T-cell-associated cytokines interleukin 5 and interferon γ (Bussing A *et al.*, 1999).

References

- Adesina SK, *et al.* (2000) *Phytother Res* **14**(5): 371–374.
 Alade PI, *et al.* (1993) *J Ethnopharmacol* **39**(3): 171–174.
 Bussing A, *et al.* (1999) *J Ethnopharmacol* **66**(3): 301–307.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Alchornea villosa* (Benth.) Muell.-Arg.**

[After S. Alchorne, 1727–1800, an English botanist; and from Latin, *villus* = shaggy hair]

Physical description: It is a treelet which grows to a height of 4 m in the primary rainforests of Malaysia and Indonesia. The stems are smooth, and hairy when young. Leaves: simple, spiral and stipulate. The stipules are linear, 5 mm–7 mm long, and hairy. The petiole is hairy, constricted at the base and of 1.5 cm–9.8 cm long. The blade is hairy, lanceolate, very thin, and 18.5 cm × 11.3 cm–5 cm × 1.6 cm. The margin is serrate. The apex of the blade is acuminate in a 1 cm–3.5 cm long tail. The base exhibits a pair of small stipules of about 5 mm × 1 mm and a pair of disc-shaped, 0.75 mm in diameter, occasional glands. The blade shows 5–10 pairs of secondary nerves and conspicuous scalariform tertiary nerves. The inflorescences are axillary spikes of 6.5 cm–15 cm in length. The fruits are green, woody, smooth, capsular, 2-lobed and develop at the apex 3 long stigma of 1.2 cm–1.5 cm (Fig. 195).

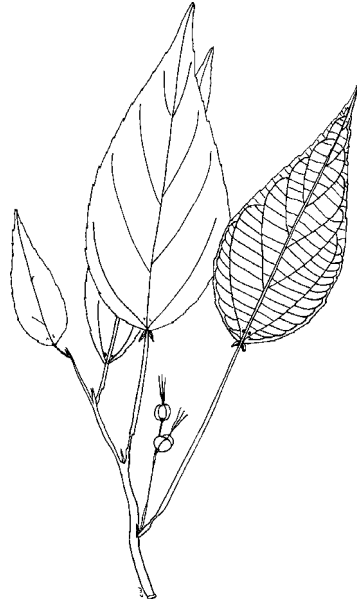
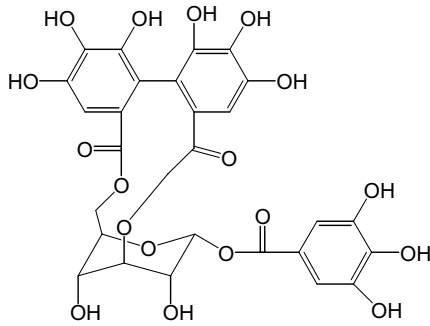


Fig. 195. *Alchornea villosa* (Benth.) Muell.-Arg. From: KLU Herbarium 33970. Flora of Johore, West Malaysia. Comm. Ex. Herb. Hort. Bot. SING. Field collector & botanical identification: JF Maxwell. 10 April 1982. Geographical localization: Kota Tinggi Waterfalls (Air Terjun).

Pharmaceutical interest: Headaches and dizziness are symptoms of hypertension, and one might set the hypothesis that the plant has hypotensive properties, but this has yet to be confirmed. In regard to the pharmaceutical potential of *Alchornea* species, a number of experiments conducted *in vitro* have demonstrated promising pharmaceutical properties. Extracts of *Alchornea cordifolia* inhibit the growth of a large spectrum of micro-organisms, *Plasmodium falciparum*, and *Trypanosoma sp.* cultured *in vitro* and relax portions of smooth muscles (Ogunbamila FO *et al.*, 1990; Okeke IN *et al.*, 1999; Mustofa *et al.*, 2000; Adewunmi CO *et al.*, 2001). Are ellagitannins such as isocorilagin or gallic acid known to occur in *Alchornea triplinervia*

Uses: In Indonesia, *Alchornea villosa* (Benth.) Muell.-Arg. is used to assuage headache, and to treat fever and dizziness. In Malaysia, the roots are used to relieve itch.

(Braca A *et al.*, 2002) involved here? Is *Alchornea villosa* (Benth.) Muell.-Arg. antimicrobial?



Isocorilagin

References

- Adewunmi CO, *et al.* (2001) *J Ethnopharmacol* **77**(1): 19–24.
 Braca A, *et al.* (2002) *Biochemical Systematics and Ecology* **30**(11): 1109–1111.
 Mustofa, *et al.* (2000) *J Ethnopharmacol* **73**(1–2): 145–151.
 Ogungbamila FO, *et al.* (1990) *Acta Pharm Nord* **2**(6): 421–422.
 Okeke IN, *et al.* (1999) *Phytoter Res* 13910: 67–69.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Aleurites moluccana (L.) Willd.

[From Greek, *Aleurites* = wheaten flour and from Latin, *moluccana* = from the Moluccas]

Physical description: It is a tree which grows to a height of 18 m and a girth of 50 cm. It grows in the geographic area spanning Malaysia and the Pacific Islands. When cut, the bark exudes a clear watery sap. The stems, petioles, and blades are covered with a whitish starry tomentum. Leaves: simple, spiral and without stipules. The petiole is 11.5 cm–15 cm and thin. The blade is lanceolate, rigid, 3–5-lobed, 7.8 cm × 4 cm–12.5 cm × 16.2 cm and marked at the base with a pair of 1 mm diameter, disc-shaped glands. The margin is recurved. The nervations are raised on both surfaces of the blade which shows 6–7 pairs of secondary nerves. The inflorescences are terminal panicles. The calyx is 2.5 mm long, 2–3-lobed and covered with a whitish starry tomentum. The corolla is 1.3 cm across,

Synonymy: *Aleurites triloba* Forst.

Common names: Candleberry tree; *aleurite des Moluques*, *bancoulier* (French); *tosikyasi* (Burmese); *shih leih* (Chinese); *wai-wai* (Fijian); *buah keras* (Malay); *akhota* (Sanskrit); *nattu-akhrotu* (Tamil).

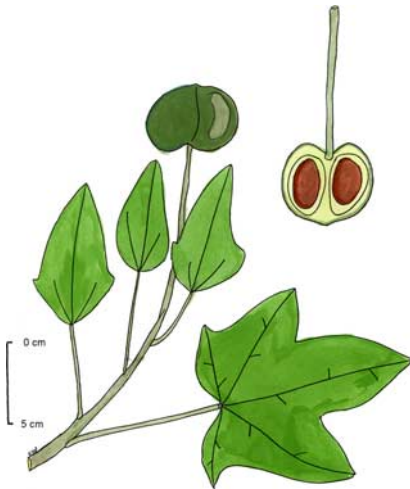


Fig. 196. *Aleurites moluccana* (L.) Willd. From: KLU Herbarium 9541. Flora of the Society Islands, Island of Raiatea, Bernice P Bishop Museum. Field collector & botanical identification: John W Moore, 26 Sep 1926. Geographical localization: in most shady valley 1 mile south of Uturoa, altitude 300 feet. From: KLU Herbarium 5886. Flora of Malaya. Field collector & botanical identification: Benjamin C Stone. 5 Mar 1966. Geographical localization: Serdang Agric. Expt. Station, Selangor, altitude: 200 feet.

smelly and dull-white. The fruits are woody, 5 cm–6.3 cm, olive-colored capsules containing a pair of oily seeds (Fig. 196).

Pharmaceutical interest: An extract of *Aleurites moluccana* (L.) Willd. inhibits the growth of *Staphylococcus aureus* and *Pseudomonas aeruginosa* (Locher CP *et al.*, 1995). It will be interesting to learn whether a more intensive study on this plant will disclose any molecules of therapeutic interest.

References

- Lin TJ, *et al.* (1996) *J of Toxicology — Clinical Toxicology* **34**(1): 87–92.
 Locher CP, *et al.* (1995) *J Ethnopharmacol* **49**(1): 23–32.
 Satyanarayana P, *et al.* (2001) *Fitoter* **72**(3): 304–306.

Uses: *Georgius Everhardus Rumphius* (1628–1702) states that the Javanese and Macassars make candles from the seeds which are either pounded and mixed with coconut, or simply strung on a piece of split bamboo. In India, where the tree was much cultivated, the seeds were known as Indian walnuts. Dr Rorke (Ann. de Thérap., 1859, p. 117) reported that 1 to 2 ounces of oil “acts as a mild and sure purgative”. In Indonesia, the bark of *Aleurites moluccana* (L.) Willd. is used to treat dysentery. In Malaysia, the seeds or the leaves are used to assuage headaches, heal ulcers and resolve swollen joints. The oil expressed from the seeds is used to treat sciatica. In the Philippines, the seeds are used to relieve the bowels of costiveness and treat cholera, while the leaves are used to treat rheumatism. The seeds of *Aleurites moluccana* (L.) Willd. are used to make soap and ointments. In India, the fruit is used to promote libido, invigorate health, expel worms from the intestines and to break fever. In Samoa, a dye extracted from the smoke of burned fruits is used to make tattoos. In the Sandwich Islands, the roots are used to dye native clothes. By the year 1890, the Sandwich Islands produced 10 000 gallons of oil from *Aleurites moluccana* (L.) Willd. which were exported to Europe to manufacture soap.

Warning: This plant is toxic on account of complex phorbol diterpenoid esters, such as 13-*O*-myristyl-20-*O*-acetyl-12-deoxyphorbol, which are known to display Epstein-Barr Virus (EBV)-activating/tumor-promoting potency (Satyanarayana P *et al.*, 2001). These irritating substances are most probably responsible for the counter-irritant and laxative property of the plant. Vomiting, abdominal pains and diarrhea were observed in school students who accidentally ingested the seeds of *Aleurites fordii* (Lin TJ *et al.*, 1996).

***Aporosa arborea* Muell.-Arg.**

[From Greek, *aporos* = difficult and from Latin, *arbor* = tree]

Physical description: It is a tree which grows to a height of 25 m in the lowland rainforests of Thailand, the Malay Peninsula, Sumatra, West Java and Borneo. The bark is smooth and greyish-brown. The stems are terete, smooth, and sparsely lenticelled. Leaves: simple, spiral and stipulate. The stipules are caducous. The petiole is 3.4 cm–3 cm

Synonymy: *Leiocarpus arboreus* Bl., *Leiocarpus arborescens* Hassk., *Aporosa arborescens* (Hassk.) Müll. Arg. *Daphniphyllum kingii* Hook. f., *Baccaurea forbesii* Pax & K.Hoffm.

Common names: *Plueak khao* (Thai).

long and obscurely channeled above and curved at both ends. The blade is oblong-elliptic to obovate, 13.5 cm–35 cm × 4.5 cm–15 cm, and papery. The base is round to acute, and basal glands are absent. The margin is slightly undulate, the marginal glands are small. The apex is acuminate to cuspidate. The midrib at the base is sparsely puberulous above. The midrib and the nerves are sparsely puberulous underneath. A few disc-like glands are present along the margin. The nervations are slightly sunken above, and raised underneath. The blade shows 10–12 pairs of secondary nerves as well as scalariform tertiary nerves. The inflorescences develop from below the leaves or from the stems. The male flowers are 0.4 mm–0.8 mm long and yellow. The flower pedicels are indistinct. The calyx consists of 4 or 5 sepals which are obovate and 0.5 mm–0.8 mm long. The andrecium comprises of a pair of stamens which are slightly exerted and 0.3 mm–0.4 mm long. The anthers are 0.2 mm long. The female flowers are 2 mm–5 mm long and attached to 1.5 mm–3 mm long pedicels. The calyx comprises of 5 sepals which are ovate, patent to slightly reflexed, and 0.6 mm–1 mm long. The ovary is globose, 3–4-locular and sparsely puberulous, and develops at the apex 3 stigmas of 0.7 mm–1.5 mm length, which are bifid. The fruits are ellipsoid to globose, red-yellow and 1.7 cm × 1.2 cm–1.5 cm × 7 mm and show vestigial stigmas at the apex and vestigial sepals at the base. The fruits contain 1–3 seeds embedded in a red aril (Fig. 197).

Pharmaceutical interest:

Uses: In Indonesia, *Aporosa arborea* Muell.-Arg. is used to invigorate and assuage articulation pains. In Malaysia, the roots are used to treat fever.

Antidiabetes properties: The pharmacological potential of *Aporosa arborea* Muell.-Arg. and of the genus *Aporosa* in general remains unexplored. Note that aqueous and alcoholic extracts of the root of *Aporosa lindleyana* (100 mg/kg) lower the levels of blood glucose of normal rats from 80.4 ± 2.7 mg% to 69.8 ± 2.0 mg% and 82.6 ± 1.9 to 70.8 ± 3.2 mg%, respectively 3 hr after oral administration of the extracts ($P < 0.001$). In addition, the extracts significantly lower blood glucose levels in alloxan induced diabetic rats from 306 ± 3.37 mg% to 160 ± 2.46 mg% and 328 ± 4.15 mg% to 152 ± 3.86 mg%, respectively 3 hr after oral administration of the extracts ($P < 0.001$) (Jayakar B *et al.*, 2003). Are tannins involved here?

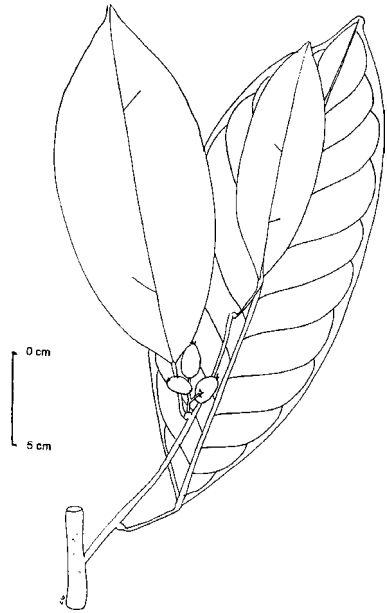


Fig. 197. *Aporosa arborea* Muell.-Arg. From: KLU Herbarium 005558. Flora of Malaya. University of Malaya Herbarium. Field collector: Benjamin C Stone. 20 June 1965. Geographical localization: Ulu Gombak, U.M. Biol. Field. Sta. Old Mixed secondary forest. Botanical identification: Feb 1970, T.W.

Reference

Jayakar B, *et al.* (2003) *J Ethnopharmacol* **84**(2–3): 247–249.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Breynia fruticosa* (L.) Hook. f.**

[After J Breynne, 1637–1697, of Danzing; and from Latin, *fruticosa* = shrubby]

Physical description: It is a shrub found in China, Vietnam, Laos, and Cambodia. The stems are greyish and glabrous; the wood is yellowish-orange. Leaves: simple, alternate and without stipules. The petiole is 1.5 mm–2 mm long and glabrous. The blade is 1.7 cm × 2.3 cm–1.8 cm × 3.3 cm, and

Uses: In china, *Breynia fruticosa* (L.) Hook. f. is used to heal abscesses, resolve inflammation, treat syphilis, counteract putrefaction of the skin and promote the secretion of milk. In Laos, Cambodia and Vietnam, the leaves are used to heal sores and cuts. To date, the pharmacological potential of this plant is unknown. Note that tannins could be involved in the medicinal properties described above.

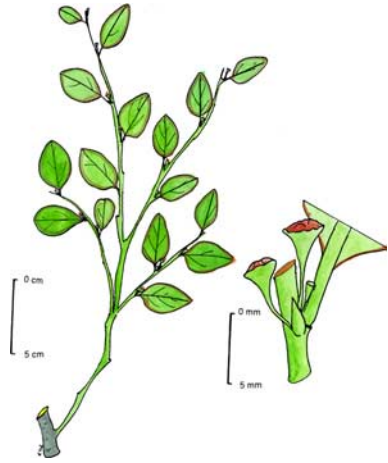


Fig. 198. *Breynia fruticosa* (L.) Hook. f. From: KLU Herbarium 33104. South China Institute of Botany, Academia Sinica, Kwangchow, China. Field collector: HG Yip. 7 Apr 1981. Geographical localization: Guangzhou, Guangdong, China, in plain.

variously shaped. The midrib is slightly raised below. The margin is entire and somewhat underlined, and the apex is acute-round and microscopically tipped. The inflorescences are very small and axillary cymes. The flowers are 4 mm long and conical (Fig. 198).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Breynia reclinata* (Muell. Arg.) Hook. f.**

[After J Breyne, 1637–1697, of Danzing; and from Latin, *reclinatus* = bending downwards]

Physical description: It is a shrub or scrambling bush of the lowland and the seashore of Malaysia and Thailand. Leaves: simple, alternate, thick, forming sprays of a few feet long; shaped-like pinnate leaves. The margin is recurved. The blade dries blackish above, green below, and the secondary nerves are darkish. The flowers are very small. The ovary is 3-locular and develops 3 styles at the apex. The fruits are small, 6-lined, succulent capsules tipped by 3 persistent styles, and splitting into 3 then 6 parts at a later stage. The seeds are flattened.

Common names: *Asin asin*, *hujan panas* (Malay).

Uses: In Malaysia, the leaves are pounded and applied externally to soothe inflamed parts, treat mumps, treat skin diseases, and combat fever.

Pharmaceutical interest: The anti-inflammatory and antipyretic properties of *Breynia reclinata* (Muell. Arg.) Hook. f. suggests a possible inhibition of the

synthesis of prostaglandins, leukotrienes and other mediators of inflammation, fever and clotting from arachidonic acid.

References

- Lin TJ, *et al.* (2002) *Vet Hum Toxicol* **44**(2): 87–88.
 Norhanom AW, *et al.* (1995) *Br J Cancer* **71**(4): 776–779.

Warning: Note that *Breynia coronata* Hk. f. promotes the formation of tumors experimentally (Norhanom AW *et al.*, 1995) and that *Beynia officinalis* is hepatotoxic (Lin TJ *et al.*, 2002).

***Bridelia penangiana* Hook. f.**

[After SE Bridel, 1761–1828, a botanist; and from Latin, *penangiana* = from Penang]

Physical description: It is a tree which grows to a height of 18 m and has a diameter of 90 cm. It is found in Malaysia, Burma, Vietnam, and Thailand. Leaves: simple, 12 cm × 6.2 cm, spiral and very shortly pediceled. The blade is scurfy below. The inflorescences form clusters with very small bracts. The flowers are 1 mm long. The stamens are joined into a small column. The fruits are ellipsoid, pointed, small, succulent and indehiscent drupes.

Common names: *Mata landak*, *kenidai* (Malay).

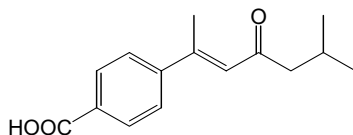
Uses: In Malaysia, a decoction of the leaves is used to soothe inflamed parts.

Pharmaceutical interest: The pharmacological potential of *Bridelia penangiana* Hook. f. is unexplored, although anti-inflammatory, antimicrobial, and smooth-muscle activities are observed in a number of plants classified within the genus *Bridelia*.

Anti-inflammatory properties: Rats fed with an aqueous extract of the stem bark of *Bridelia ferruginea* at doses ranging from 10 mg/Kg–80 mg/Kg are protected against paw edema induced by carrageenan, with an ID₅₀ value of 36 mg/Kg. This extract suppresses the formation of granulomatous tissue (Olajide OA *et al.*, 1999).

Antimicrobial and antiplasmodial properties: Aqueous and ethanolic extracts of *Bridelia ferruginea* inhibit the proliferation of hospital strains of *Staphylococcus aureus*, *Candida albicans* and *Staphylococcus epidermidis* (Irobi ON *et al.*, 1994). Ethanolic extract of *Bridelia cathartica* causes 50% inhibition of *Plasmodium falciparum* growth *in vitro* at 0.05 µg/mL (Jung A *et al.*, 1991). Extracts of the stem bark of *Bridelia retusa* contains bisabolane sesquiterpenes, such

as (E)-4-(1,5-dimethyl-3-oxo-1-hexenyl) benzoic acid, which inhibit the growth of *Cladosporium cladosporioides* (Jayasinghe L *et al.*, 2003).



(E)-4-(1,5-dimethyl-3-oxo-1-hexenyl) benzoic acid

Cardiovascular properties: An extract of *Bridelia ferruginea* inhibits experimentally-induced thrombosis in mice (Olajide OA *et al.*, 1999a). An aqueous extract of the leaves of *Bridelia atroviridis* contracts portions of rat uterus (Corallo MA *et al.*, 1991). A lyophilized decoction (10%) of the leaves of *Bridelia atroviridis* Muell. Arg. given at 15 mg/Kg and 30 mg/Kg to rats reduces the arterial pressure and the heart rate. This decoction acts directly on the heart through calcium channels (Corallo A *et al.*, 1997). An ethanol extract of the leaves of *Bridelia ferruginea* depresses the purinergic nerve mediated contraction of rat bladder smooth muscles dose-dependently, by possible blockade of the purinergic neurotransmission (Onoruwe O *et al.*, 2001).

References

- Corallo A, *et al.* (1991) *Fund and Clin Pharmacol* **5**(4): 319–329.
 Corallo A, *et al.* (1997) *J Ethnopharmacol* **57**(3): 189–196.
 Irobi ON, *et al.* (1994) *J Ethnopharmacol* **43**(3): 185–190.
 Jayasinghe L, *et al.* (2003) *Phytochemistry* **62**: 637–641.
 Jung A, *et al.* (1991) *J Ethnopharmacol* **33**(1–2): 79–83.
 Olajide OA, *et al.* (1999) *J Ethnopharmacol* **66**(1): 113–117.
 Olajide OA, *et al.* (1999a) *Phytother Res* **13**(3): 231–232.
 Ororuwe O, *et al.* (2001) *Fitoter* **72**(13) 230–235.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Bridelia stipularis (L.) Bl.

[After SE Bridel, 1761–1828, a botanist; and from Latin, *stipula* = straw]

Physical description: It is a scrambling shrub or tree which grows up to 8 m high in primary and secondary forests, often near rivers, swamps, seashore, mangrove in Sri Lanka, India, Nepal, Thailand, Malay Peninsula, Sumatra, Java, Sunda Islands, Borneo, and Philippines. The stems are obscurely lenticelled, zigzag-shaped and velvety at the apex. Leaves: alternate, simple and stipulate. The stipules are lanceolate-ovate,

Synonymy: *Clutia stipularis* L.,
Bridelia scandens (Roxb.) Willd.,
Bridelia dasycalyx Kurz.

3 mm–10 mm × 2 mm–4 mm, whitish to reddish brown pilose, and caducous. The petiole is 3 mm–9 mm long, and velvety. The blade is obovate-obovate, 5.6 cm × 2.6 cm–6.2 cm × 2.9 cm, chartaceous, and velvety beneath. The base is obtuse-rounded. The margin is crenate. The apex is rounded-acute. The midrib is sunken above and raised below. The blade shows 9–15 pairs of secondary nerves joining into a marginal vein, and the tertiary veins are scalariform. The inflorescences are glomerules often along leafless branches and spike-like or along branches with small leaves, and 1–6 flowers. The male flowers are cream to greenish or yellowish, and 6 mm–10 mm diameter. The female flowers are reddish green, and up to 12 mm in diameter. The sepals are triangular, 4 mm–5 mm × 2 mm–3 mm, and hairy. The petals are variable in shape, 1.5 mm–3 mm × 1 mm–2.5 mm, and cuneate to spatulate at the base and acute at the apex. The andrecium comprises of a 2 mm × 0.5 mm staminal column developing free filaments which are 1.5 mm long terminated with ellipsoid and purple anthers. The ovary is ovoid to globose, and 1.5 mm–2 mm in diameter. There is a pair of styles, joined basally together with stigmas of 1.5 mm–3 mm long, which are bifid. The fruits are capsular, leathery, 7 mm × 5 mm–9 mm × 6 mm, glossy, smooth, glabrous, 2-locular, and dull dark reddish to black with vestigial sepals at base. The seeds are very small and reddish-brown (Fig. 199).

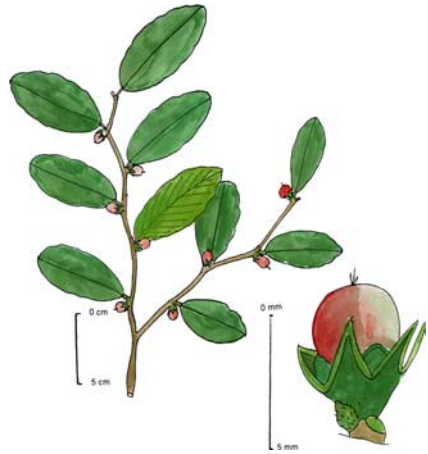


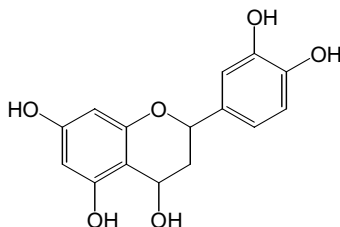
Fig. 199. *Bridelia stipularis* (L.) Bl. From: KLU Herbarium 040386. Smithsonian Institution, The United States National Herbarium, Philippines Islands. Field collector and botanical identification: EH Walber, 21 Dec 1957. Geographical localization: Bataan Peninsula: Dinalupihan, Olongapo road, Km. 126.

Pharmaceutical potential: The pharmacological potential of *Bridelia stipularis* (L.) Bl. is yet to be shown.

Antimicrobial properties: Note that it would be interesting to know whether the plant holds any antimicrobial properties as aqueous and ethanolic extracts of *Bridelia ferruginea* inhibit the proliferation of hospital strains of *Staphylococcus aureus*, *Candida albicans* and *Staphylococcus epidermidis* (Irobi ON *et al.*, 1994). The antimicrobial property, if any, of *Bridelia stipularis* (L.) Bl. could be mediated by some tannins or other phenolic substances, since the benzopyran luteoforol

Uses: In Malaysia, The leaves of *Bridelia stipularis* (L.) Bl. are used to heal venereal ulcers. In the Philippines, a decoction of the roots is drunk to invigorate the body.

(3', 4, 4', 5, 7-pentahydroxyflavan) characterized from the stem bark of *Bridelia crenulata* inhibits, dose-dependently, the growth of several strains of bacteria *in vitro* (Ramesh M *et al.*, 2001).



Luteoforol

References

- Irobi ON, *et al.* (1994) *J Ethnopharmacol* **43**(3): 185–190.
 Ramesh M, *et al.* (2001) *Fitoter* **72**(4): 409–411.

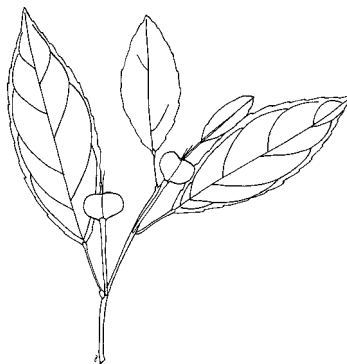
Warning: Caution must be taken as the toxic effects of this plant are unknown.

Cleidion spiciflorum (Burm. f.) Merr.

[From Greek, *cleidion* = a club and from Latin, *spica* = spike and *flores* = flower]

Synonymy: *Cleidion javanicum* Bl.

Uses: In the Philippines, *Cleidion spiciflorum* (Burm. f.) is used to relieve the bowels for costiveness, to assuage stomachaches as well as for abortion purposes. The pharmacological potentials of *Cleidion spiciflorum* (Burm. f.) and of the genus *Cleidion* in general, still remains yet to be discovered.



Physical description: It is a tree which grows to a height of 8 m in a geographical zone ranging from India to Papua New Guinea. The stems are yellowish, smooth, and glabrous. Leaves: simple, spiral and without stipules. The petiole is 1 cm–5.5 cm long,

Fig. 200. *Cleidion spiciflorum* (Burm. f.). From: KLU Herbarium 26632. Flora of Sarawak. University of Malaya Herbarium. Geographical localization: Vicinity of Niah caves, lowland flooded forest. Field collector & botanical identification: Benjamin C Stone, 18 Apr 1978; altitude below 100 m.

curved at both ends, and grooved above. The blade is papery, 2.3 cm–5.7 cm × 6 cm–16 cm, and elliptic-obovate. The apex is obscurely acuminate, and the base is acute. The margin is serrate, and the midrib is raised above, as well as beneath the blade, showing 4–6 pairs of secondary nerves raised on both surfaces. The fruits are solitary and axillary, 2.2 cm × 1.4 cm, capsules, the apex of which shows 1.7 cm long, thin vestigial stigmas. The fruits are attached to 3.3 cm–4 cm long pedicels (Fig. 200).

Warning: The fruits are poisonous.

***Codiaeum variegatum* (L.) Bl.**

[From the Malaysian name for *codebo* and from Latin, *varius* = various]

Common name: Croton.

Uses: In Indonesia, *Codiaeum variegatum* (L.) Bl. is used to relieve the bowels of costiveness. In Malaysia, the plant is used to heal syphilitic sores. In Papua New Guinea and the Solomons Islands, the plant is used to facilitate abortion and to heal infected sores. The plant was first studied by Dutch naturalist *Georgius Everhardus Rumphius* (1628–1702).



Fig. 201. *Codiaeum variegatum* (L.) Bl.

Physical description: It is a flamboyant ornamental shrub which grows to a height of 2 m. The plant is native to the Moluccan Islands, between the Philippines and Papua New Guinea.

The stem exudes an abundant white latex after an incision. Leaves: simple, spiral and without stipules. The petiole is 3.5 cm–2 cm long, obscurely curved at both ends and grooved. The blade is rigid, variegated in shape and color, 20 cm × 6 cm–11 cm × 6 mm, oblong or 3-lobed, yellow, green or red. The inflorescences are very small with axillary spikes of 6.5 cm–10 cm (Fig. 201).

Pharmaceutical interest: An extract of *Codiaeum variegatum* (L.) Bl. at low dose activates the Epstein-Barr virus (EBV) in human lymphoblastoid cell-line cultured *in vitro* and promotes the formation of tumors experimentally (Norhanom AW *et al.*, 1995).

References

- Hausen BM, *et al.* (1977) *Contact Dermatitis* 3(6): 289–292.
 Norhanom AW, *et al.* (1995) *Br J Cancer* 71(4): 776–779.

Warning: *Codiaeum variegatum* (L.) Bl. is toxic due to the presence of complex phorbol diterpenoid esters, which display Epstein-Barr virus (EBV)-activating/tumor-promoting potency. The latex of *Codiaeum variegatum* (L.) Bl. induces contact allergy (Hausen BM *et al.*, 1977).

Croton argyratus Bl.

[From Greek, *kroton* = thornberry, Palma-Christi and from Latin, *argentum* = silver]

Physical description: It is a tree 18 m in height and 90 cm in diameter, which grows in secondary rainforests of Malaysia, Burma, and Indonesia. Leaves: simple, drying bright orange, the lower surface of which is densely covered with peltate scales, and are 10 cm–15 cm × 15 cm–7.5 cm. The petiole is 6 cm long. The blade at the base shows a pair of very small glands. The flower comprises of 5 sepals, 5 petals and several stamens. The fruits are 3-lobed capsules (Fig. 202).

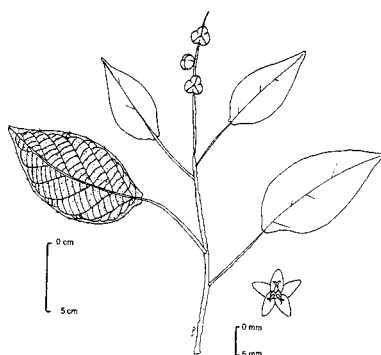


Fig. 202. *Croton argyratus* Bl.

Pharmaceutical interest:

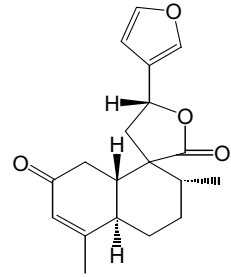
Trans-dehydrocrotonin: Trans-dehydrocrotonin, a clerodane diterpene characterized from *Croton cajucara* Benth. inhibits the development of ulcers caused by ethanol and stress in animals, and lowers glycemia in rats treated with alloxan (Farias RA *et al.*, 1997). Trans-dehydrocrotonin has a moderate acute toxicity LD₅₀: 878 mg/Kg, *per os*, in mice and inhibits the growth of HL60 cells cultured *in vitro* by inducing apoptosis (Anazetti MC *et al.*, 2003). It will be interesting to learn whether a more intensive study on *Croton argyratus* Bl. will reveal diterpenes of pharmacological interest.

Uses: In Malaysia, a decoction of the leaves of *Croton argyratus* Bl. is used to aid recovery from childbirth, and to stop diarrhea. The leaves are used to combat fever. In Vietnam, the leaves are boiled in water and the decoction obtained is drunk to invigorate the body.

Other properties: The aerial parts of *Croton ruizianus* contain a number of pregnane glycosides with proaggregating property (Piaciente S *et al.*, 1998). Aleuritic acid characterized from *Croton urucurana* Baillon inhibits the proliferation of *Staphylococcus aureus* and *Salmonella thyphimurium* (Peres MT *et al.*, 1997).

References

- Anazetti MC, *et al.* (2003) *Toxicology* **188**(2–3): 261–274.
 Farias RA, *et al.* (1997) *Planta Med* **63**(6): 558–560.
 Peres MT, *et al.* (1997) *J Ethnopharmacol* **56**(3): 223–226.
 Piaciente S, *et al.* (1998) *J Nat Prod* **61**(3): 318–322.



Dehydrocrotonin

Warning: The toxic principles of croton oil consist of phorbol esters diterpenes which cause intense inflammation by contact with the skin and promote the development of tumors. The oil expressed from the seeds of a number of plants classified within the genus *Croton* or croton oil is probably the most drastic and most irritating of all existing purgatives.

Croton cascarilloides Rausch.

[From Greek, *kroton* = thornberry, Palma-Christi]

Synonymy: *Croton cumingii* Muell. Arg.

Uses: In Taiwan, the roots are used to combat fever and to stop vomiting. The leaves are smoked instead of cigarettes. In Thailand, the bark and the roots are used to treat fever. Not much is known about the pharmacological and toxicological properties of this medicinal plant.



Fig. 203. *Croton cascarilloides* Rausch.

Physical description: It is a coastal shrub of Taiwan, Southern China, the Philippines and Malaysia. The stems are long and thin. Leaves: simple, clustered at the end of the branch let, thinly chartaceous, oblong-lanceolate, or ovate oblong, and 5 cm–11 cm × 2 cm–5 cm. The petiole is 2 cm–3 cm long. The apex of the blade is acute, the base, obtuse, and the undersurface covered with

silvery peltate scales. The fruits are globose capsules which are depressed, 3-lobed and 6 mm × 7 mm (Fig. 203).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Croton tiglium L.

[From Greek, *kroton* = thornberry, Palma – Christi and *tilos* = diarrhea]

Physical description: It is a shrub or small tree native to Indo-Malaysia and cultivated for medicinal use in the Asia-Pacific. Leaves: simple, very thin, ovate, and 5 cm–14 cm × 2 cm–7 cm. The petiole is 4 cm long and thin. The apex of the blade is acute, and the base obtuse. The male flowers are stellate hairy. The fruits are oblong or ellipsoid, 3-lobed, and 1 cm–1.5 cm × 2 cm. The seeds are oblong-ovoid (Fig. 204).

Uses: The sap of *Croton tiglium* L. is well-known to be a violent laxative. In Malaysia, the Kenyah of Sarawak crush the ripe fruits with a little ash to poison fish, whereas the Chinese of Pangkor apply crushed leaves on bruises. Ibn Sina calls the seeds *dand-el-sini*, suggesting its introduction from China via caravan routes through Central Asia. *Croton tiglium* L. was first described by Christoval Acosta in 1578. In Western medicine, the oil expressed from the seeds of *Croton tiglium* L. (Croton oil; *Oleum Tiglii*, *British Pharmaceutical Codex*, 1949) has been used to treat very severe constipation and externally to produce skin irritation (dose: 0.03 mL to 0.06 mL).

Common names: Purging croton, purgative croton, true croton, croton — oil plant; *tu' ba da' on* (Kenyah); *cemekian* (Malay); *ba dau*, *may vat*, *man de* (Vietnamese); *kanako* (Burmese); *jayapala* (Sanskrit); *nervalam* (Tamil).

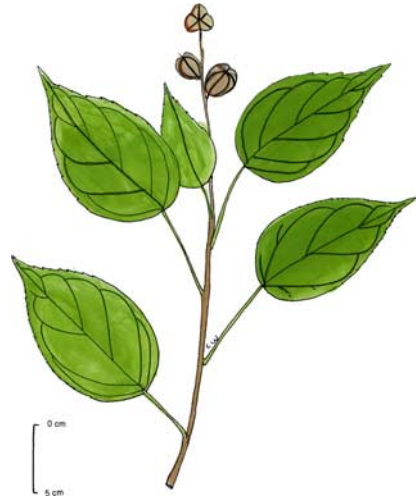


Fig. 204. *Croton tiglium* L. From: KLU Herbarium 038466. Flora of Sarawak. Field collector: SC Chin. 25 Apr 1980. Geographical localization: BARAM (IV Division): around Long Selatong Lepo Ga', Geneh Farms, cultivated on Polycarp's farm hut.

Pharmaceutical interest: Croton oil is a useful laboratory tool to induce skin tumors, inflammation and the early antigen expression of Epstein-Barr viral (EBV) in the Raji cell-line (Zeng Y *et al.*, 1994).

Chemotherapeutic interest: Besides toxic diterpenes, *Croton tiglium* L. contains isoguanosine, which inhibits the proliferation of both sarcoma-180 and

Ehrlich tumor in mice at an optimal dose of 96 mg/Kg/day and 48 mg/Kg/day, respectively (Kim JH *et al.*, 1994). 12-*O*-acetylphorbol-13-decanoate and 12-*O*-decanoylphorbol-13-(2-methylbutyrate) totally inhibit the replication and infectivity of the human immunodeficiency virus type-1 on MT-4 cells, at doses of 7.6 µg/mL and 7.81 µg/mL (Mekaway ES *et al.*, 2000).

References

- Hecker E (1968) *Cancer Res* **28**(11): 2338–2340.
 Kim JH, *et al.* (1994) *Arch Pharm Res* **17**(2): 115–118.
 Mekaway ES, *et al.* (2000) *Phytochem* **53**: 457–464.
 Van Duuren BL, *et al.* (1968) *Cancer Res* **28**(11): 2349–2356.
 Zeng Y, *et al.* (1994) *Biomed Environ Sci* **7**(1): 50–55.

Warning: Croton oil is drastically purgative and deadly poisonous, due to the presence of powerful tumor-promoting and vesicant phorbol esters diterpenes (Hecker E, 1968; Van Duuren BL *et al.*, 1968).

Euphorbia antiquorum L.

[From Latin, *Euphorbus* = physician to Juba II and from Latin, *antiquorum* = antique]

Common names: *Pyathal* (Burmese); *chanlat* (Cambodia); *simhunda* (Sanskrit), *shadurak* (Tamil).

Uses: In Burma, the latex of *Euphorbia antiquorum* L. is used to remove warts and to relieve the bowels of costiveness. In China, the plant is used to resolve inflammation and treat cholera. In Laos, Cambodia and Vietnam, the latex is used to induce vomiting, promote urination and relieve the bowels of costiveness. In Indonesia, the latex is used to relieve the bowels of costiveness, remove warts, resolve inflamed skin and assuage toothache. The pharmacological properties of *Euphorbia antiquorum* L. are known. One might set the hypothesis that the acidity of the latex is attributed to the complex phorbol diterpenoid esters.

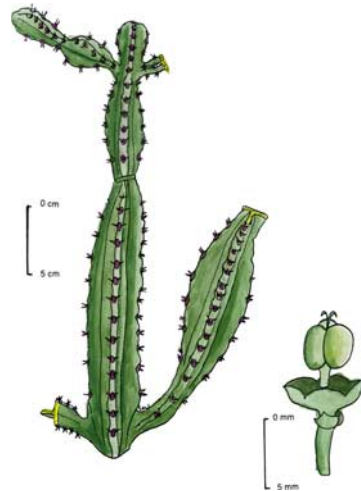


Fig. 205. *Euphorbia antiquorum*. From: KLU Herbarium 2175. Flora of Malaya. Field collector and botanical identification: J Boey 3 Nov 1971. Geographical localization: Pulau Langkawi, P. Bumbon Besar. From: KLU Herbarium 27555. Plants of Ceylon. Geographical localization: Central Province. Matale District: Erawalaga Mtn. just east of the Kandalama Tank and ca. 6 miles directly East of Dambulla, 29 Oct 1974. Field collectors: Gerrit Davidse and DB Sumithraarachchi. Botanical Identification: LC Wheeler, 1976.

Physical description: It is a cactus-shaped shrub which grows to a height of 4 m. It is native of Southeast Asia and cultivated as an ornamental plant. The stems are thorny, strongly 3-angled, and exude a copious milky latex upon an incision. The thorns are purple, occurring in pairs, and are straight and 2.5 mm–3 mm long. The flowers are solitary or cymose, and terminal on 8 mm–5 cm long pedicels. The gynecium is 3-lobed and 3 mm in diameter (Fig. 205).

Warning: The plant is toxic.

***Euphorbia hirta* L.**

[From Latin, *Euphorbus* = physician to King Juba II and from Latin, *hirta* = hairy]

Common names: *Euphorbia pilulifera* L., *Chamaesyce hirta* (L.) Millspaugh.

Common names: Hairy spurge, euphorbia herb, Australian snake weed, cat's hair, asthma plant; *gelang susu* (Malay); *amumpatchai* (Tamil).

Physical description: It is an annual herb which grows to a height of 40 cm in vacant plots of land, car parks by the roadsides. The plant produces an irritating milky latex. The stems are hirsute, reddish, subglabrous, scorpioid and pilose. Leaves: simple, stipulate. The stipules are pectinate, opposite, oblong, asymmetrical, and 2 cm–4 cm × 8 mm–1.5 cm. The petiole is 1 mm long. The apex of the blade is subacute, and the base round or obtuse. The margin is serrulate, often purplish above and pilose. The flowers are very small, densely packed between leaves into flower-shaped subcapitate and greenish cymes. The involucre is hairy outside. The fruits are capsular, 1 mm in diameter and puberulous. The seeds are ovoid, 0.7 mm long, and slightly transversely ribbed when dry (Fig. 206).

Uses: In Indonesia, the latex is used to treat ringworm infection and heal wounds. A decoction of this herb is used to treat asthma and assuage bronchial discomfort. The leaves are chewed to facilitate abortion, and the flowers are used to treat barrenness. In Malaysia, the latex is used to treat diseased eyes, heal wounds and soothe bruises. A decoction consisting of about 70 g of the fresh herb is drunk to promote urination, stop dysentery, remove blood from urine, assuage urethral pain and treat asthma. The plant is applied externally to treat dermatitis, eczema and irritated skin. A paste is used to soothe sores, and heal boils. In the Philippines, the leaves are mixed with those of *Datura metel* L. to make cigarettes which are smoked treat asthma. The plant is used to check bleeding, to calm a person, and stimulate the secretion of sweat. In Vietnam, *Euphorbia hirta* L. is used to stop dysentery. The dried entire *Euphorbia hirta* L. (*Euphorbia*, *British Pharmaceutical Codex*, 1954) was used in Britain in the form of a liquid extract (*Euphorbia Liquid Extract*, *British Pharmaceutical Codex*, 1949) in the treatment of cough or asthma.

Pharmaceutical interest:

Antiasthmatic properties: Relief of dyspnea in asthmatic patients given *Euphorbia hirta* L. was observed a century ago by Marsset (*Contrib. A l' Etude Bot. Phys. et Thérap. de l' Euphorbia pilulifera*. Paris. 1884) and Rosecrans Workman (*Therap Gaz*, 15 July 1890).

Diuretic properties: The diuretic property is confirmed in rats using acetazolamide and furosemide as standards: water and ethanolic extracts of the leaves at 50 mg/Kg and 100 mg/Kg, respectively promote urination. Like acetazolamide, the aqueous extract increases the urine excretion of Na⁺ ions, K⁺ ions, and carbonate (Johnson PB *et al.*, 1999).

Gastroenterological properties: An aqueous extract of a whole herb is antibacterial, antiamebic and antispasmodic (Tona L *et al.*, 1999). Good results have been obtained in treating 150 patients diagnosed with intestinal amebiasis by an alcoholic extract (Martin M *et al.*, 1964). A lyophilized extract inhibits diarrhea caused by castor oil, arachidonic acid, and prostaglandin E₂ on animals (Galvez J *et al.*, 1993).

Anxiolytic properties: The sedative and anxiolytic properties are confirmed *in vivo*. A lyophilized aqueous extract of *Euphorbia hirta* L. given to mice at 100 mg/Kg, decreases the behavioral parameters measured in a non-familiar environment, and at 12.5 mg/Kg and 25 mg/Kg, it reduces aggressiveness (Lanhers MC *et al.*, 1990). It will be interesting to learn whether a more intensive study on *Euphorbia hirta* L. will disclose any molecules of therapeutic interest.

Other properties: An extract of the plant abrogates the survival of *Plasmodium* cultured *in vitro* (Tona L *et al.*, 2004).

References

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 Martin M, *et al.* (1964) *Méd Trop* **24**: 250.
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Warning: Caution must be taken as the toxic effects of this plant are unknown.

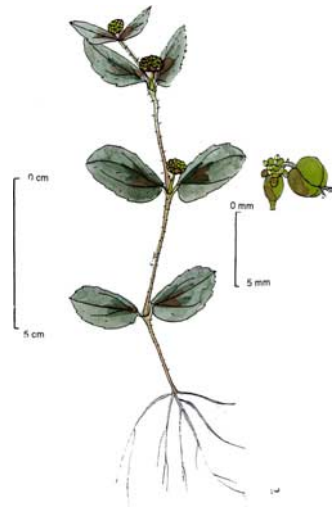


Fig. 206. *Euphorbia hirta* L.

***Excoecaria agallocha* L.**

[From Latin, *excoecare* = to deprive of sight and *agallochum* = a soft, resinous wood of highly aromatic smell, burnt in Asia as a perfume]

Common names: Blinding tree, tiger's milk tree; *arbre aveuglant* (French); *kayau* (Burma); *tuku* (Fiji); *buta buta*, *bebuta* (Malay); *buta de Philippinas* (Spanish); *agaru* (Sanskrit); *tillai-cheddi* (Tamil).

Uses: The sap of *Excoecaria agallocha* L. is well-known throughout the Asia-Pacific as corrosive and is applied externally as a counter-irritant remedy. In Burma, the leaves are used to treat epilepsy. In Indonesia, the oil distilled from the wood is used to assuage itchiness and skin affections. In Malaysia, the latex is used for criminal purposes. In Laos, Cambodia and Vietnam, the oil expressed from the seeds is applied externally to assuage itchiness. In the Philippines, the latex is used to heal ulcers and wounds occasioned by poisonous fish.

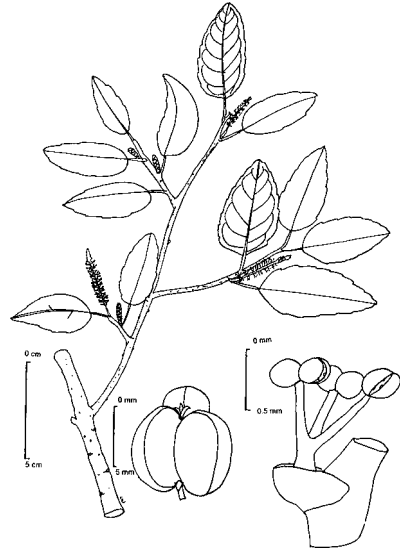


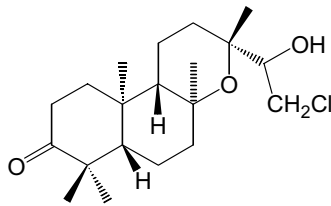
Fig. 207. *Excoecaria agallocha* L. From: KLU Herbarium 27930. Plants of Ceylon. Field Collectors: Gerrit Davidse & DB Sumithraarachchi, 3 Dec 1974. Geographical localization: Eastern Province, Batticaloa District ca. 4 miles Northwest of Batticaloa, altitude 3 mi. near mile post 4/6 on the road to Trincomalee. Botanical identification: LC Wheeler, 1976. From: KLU Herbarium 040755. Flora of the Northern Mariana Islands, University of Guam Herbarium, Tinian.

Physical description: It is a small, crooked, twisted, dioecious and leaning tree of about 3m–10m height which grows in the mangroves, tidal forest, beach, rocky shores and coastal forests of India, Ceylon, Mariana's Islands, Papua New Guinea, Malaysia, Fiji, Ryukyu Islands, Pacific Islands and New Caledonia. The trunk exudes an abundantly white latex which blisters the skin and causes temporary blindness. The stem bark is lenticelled and greyish. Leaves: dull, dark green above, and green below, spiral, and without stipules. The petiole is grooved, and 8 mm–1.6 cm long. The blade is elliptic-lanceolate to obovate, 2.3 cm × 3.6 cm–3.3 cm × 6 cm. The margin is serrate, and the midrib is sunken above and raised below. The flowers are very small, attached to short axillary and whitish spikes, occurring in small groups subtended by glanded and

overlapping bracts. The perianth comprises of 3 sepals. The male flowers have 3 stamens, and the female flowers have a 3-locular ovary, from which spread into 3 undivided styles joined at the base. The fruits are 3-lobed, woody, glabrous capsules, 7 mm–1 cm in diameter, which split into 3 bivalved parts, leaving a central, and winged column. Vestigial calyx and stigma are present. The seeds are ovoid, smooth and 3 mm × 2.5 mm (Fig. 207).

Pharmaceutical interest:

Diterpenes: The latex of *Excoecaria agallocha* L. owes its irritating property to several sorts of complex diterpenes of the tiglane and daphnane types. One such compound is 12-deoxyphorbol, 13-(3E, 5E-decadienoate) which was characterized as the anti-HIV principle of the leaves and stem of this plant (Erickson KL *et al.*, 1995). *Excoecaria agallocha* L. is also known to produce several diterpenes of the labdane, beyerane and kaurene types, which display anti-tumor activity and inhibit *in vitro* the activation of the Epstein-Barr virus (EBV) by 12-*O*-tetradecanoylphorbol-13-acetate (TPA). One such compound is ent-3 β -hydroxy-15-beyerene-2-one which displays anti-tumor promoting activity in mice against 7,12-dimethylbenzo[a]anthracene (Korishi T *et al.*, 1998). The roots contain a series of labdane diterpenes such as agallochin A, the pharmacological potential of which remains to be assessed (Anjaneyulu ASR *et al.*, 2000).



Agallochin A

References

- Anjaneyulu ASR, *et al.* (2000) *Phytochem* **55**: 981–901.
 Erickson KL, *et al.* (1995) *J Nat Prod* **58**(5): 769–772.
 Korishi T, *et al.* (1998) *Biol Pharm Bull* **21**(9): 993–996.
 Kumarasinghe SP, *et al.* (1998) *Aust J Derm* **39**(4): 275–276.

Warning: This plant is very toxic. The symptoms of *Excoecaria agallocha* L. skin and eye injuries have been described by Kumarasinghe *et al.* (1998).

***Glochidion littorale* Bl.**

[From Greek, *glochin* = a point and *litoralis* = shore]

Common name: *Ubah* (Malay).

Physical description: It is a shrub which grows up to 6 m high along the shores of India, Sri Lanka, Malaysia, Thailand, and Indonesia. The bark is dark brown and smooth. Leaves: simple, alternate and stipulate. The stipules are triangular, 1.3 mm–1.8 mm × 0.7 mm–2 mm and caducous. The petiole is woody, fissured horizontally, 3 mm–5 mm long and glabrous. The blade is dark green and glossy above, lighter green beneath, thick, elliptic to obovate, 2.2 cm–9.2 cm × 1.9 cm–5 cm; the base is rounded to shortly attenuate, slightly asymmetric. The margin is flat, and the apex is emarginate to rounded. The midrib is sunken above and raised below. The blade shows 4–6 pairs of secondary nerves raised beneath. The inflorescences are axillary. The calyx comprises of 6 sepals basally united, and the margin of which is usually hyaline. The male flowers are 4.5 mm–5.5 mm in diameter, on 5.5 mm–6 mm long pedicels; the calyx is light green, forming a tube of 0.8 mm–1 mm long; the lobes of which are elliptic to obovate, where the outer lobe is 3.6 mm–4.2 mm × 1.8 mm–1.9 mm, and the inner lobe is 3.2 mm–3.4 mm × 1.5 mm–1.6 mm, usually folded, and apically somewhat hooded. The andrecium consists of 5–6 stamens which are 1.1 mm long, with connective teeth that are 0.2 mm–0.3 mm long. The female flowers are 3 mm–3.5 mm in diameter, attached to 2 mm–6.5 mm long pedicels. The calyx consists of triangular to elliptic lobes of 1.3 mm–2.3 mm × 1.4 mm–2 mm; the inner lobes are elliptic of 1.3 mm–2.7 mm × 0.6 mm–2.7 mm. The ovary is 10–14-locular, 2.7 mm × 2.3 mm high, and longitudinally ribbed. The stigmas form a 2 mm long cone which is 11–14-dentate. The fruits are round, apically flattened and depressed in the center, and sometimes basally flattened. They are 1.4 cm–1.8 cm × 8 mm–1.3 cm, lobed, and pinkish-whitish to dark pink. The seeds are 6 mm × 4.5 mm and red in color (Fig. 208).

Pharmaceutical interest: It will be interesting to learn whether a more intensive study of the *Glochidion* species will disclose any molecules

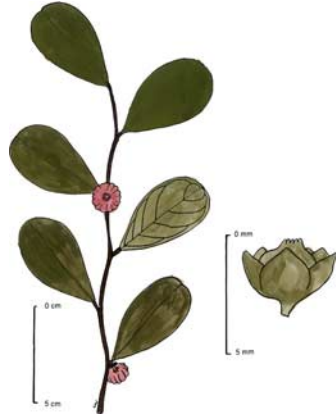


Fig. 208. *Glochidion littorale* Bl. From: KLU Herbarium 003089. Flora of Sarawak. Field collectors & botanical identification: J Carrick and IC Enoch. Geographical localization: Bako National Park, Tg. Paku Cliff, altitude: 0–100 feet, 24 Apr 1959.

Uses: In Malaysia, *Glochidion littorale* Bl. is used to stop dysentery and to assuage stomachache.

(tannins?) of therapeutic interest. Note that an extract of *Glochidion sp.* immobilizes brine shrimp at 100 mg/mL (Horgen FD *et al.*, 2001). Lignans and triterpenes are known to occur in *Glochidion* species (Otsuka H *et al.*, 2000; Otsuka H *et al.*, 2000a; Hui WH *et al.*, 1969).

References

- Horgen FD, *et al.* (2001) *Phytomedicine* **8**(1): 71–81.
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 Otsuka H, *et al.* (2000a) *Chem Pharm Bull* **48**(4): 547–551.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Glochidion rubrum Bl.

[From Greek, *glochion* = a point and from Latin, *ruber* = red]

Synonymy: *Glochidion fortunei*,
Glochidion obovatum.

Uses: In Vietnam, *Glochidion rubrum* Bl. is used to heal hemorrhoids. The therapeutic potential of this medicinal plant is yet to be explored, but one may think that tannins would be responsible for the anti-hemorrhoids property.

Physical description: It is a shrub of Vietnam, Malaysia, Indonesia and Taiwan. The stems are glabrous. Leaves: simple, alternate, obovate or oblong-ovate, and 3 cm–7 cm × 2 cm–3 cm. The petiole is 1.4 mm–2 mm long. The apex is obtuse and the base is acute. The blade shows about 5 pairs of secondary nerves. The male flowers consist of 6 sepals and 8 stamens connate into a column. The gynecium is stout and consists of 5 carpels, forming a compound and a 5-locular ovary. The fruits are capsular, depressed-globose, deeply sulcate, and 3.5 mm × 6 mm–1 cm long, showing 1.2 mm long vestigial styles at the apex (Fig. 209).

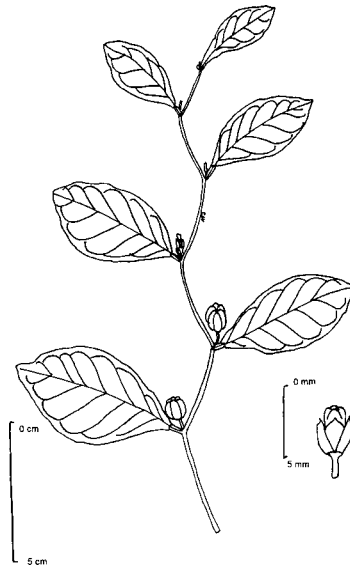


Fig. 209. *Glochidion rubrum* Bl.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Homonoia riparia* Lour.**

[From Greek, *Homonoia* = Greek Goddess and from Latin, *riparius* = riverbank]

Common name: *Kalire* (Batek).

Uses: In Indonesia, the sap of *Homonoia riparia* Lour. is used to strengthen loose teeth. In Laos, Vietnam and Cambodia, the leaves are used to assuage itchinness and to expel impurities. In Malaysia, the leaves and fruits of *Homonoia riparia* Lour. are used to treat skin diseases. In the Philippines, the leaves are applied externally to heal wounds inflicted by poisonous fish and the plant is also used to assuage toothache. In Thailand, the leaves are used to treat skin disease. The pharmacological potential of *Homonoia riparia* Lour. remains unexplored.

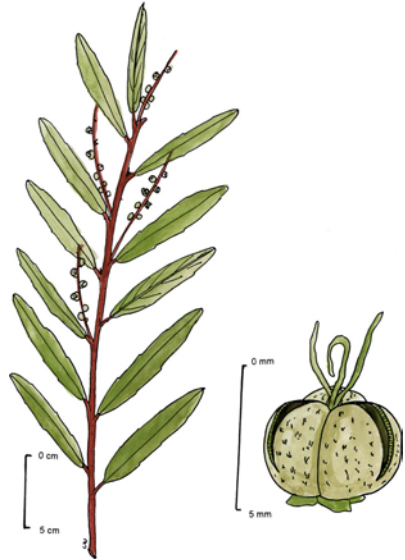


Fig. 210. *Homonoia riparia* Lour. From: KLU Herbarium 23995. The Forest Herbarium (BKF), Royal Forest Department. Flora of Thailand. Field collector and botanical identification: C Phengkhai. 20 Jun 1973. Geographical localization: Chanthrabari. From: KLU Herbarium 30436. Oxford University, Department of Botany, Forest Herbarium (FHO). Flora of Peninsular Malaysia. Field collector: CM Pannell, 12 Mar 1978. Geographical localization: Pahang, Taman Negara. Botanical identification: Benjamin C Stone.

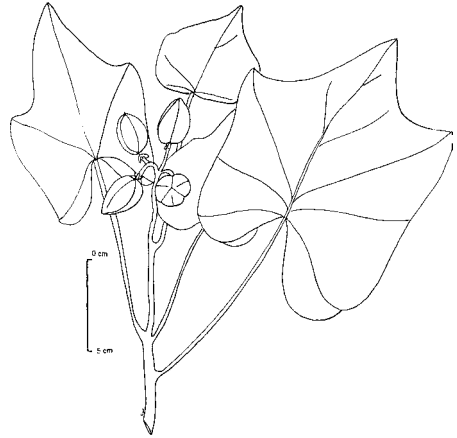
Physical description: It is a shrub which grows to a height of 2 m–3 m. It is commonly found along the riverbanks of Southern Asia. The bark is brownish-red, and the stems are lenticled and hairy or glabrous. Leaves: simple, stipulate and spiral. The stipules are linear, hairy and 4 mm long. The petiole is hairy, grooved and 4 mm–5 mm long. The blade is linear, 7.2 cm × 1.1 cm–9 cm × 9 mm, glabrous except at the midrib and shows 4–9 pairs of secondary nerves. The margin is laxly dentate. The inflorescences are axillary, hairy, and 5 cm–6 cm long. The flower buds are globose, 2.5 mm–3 mm long; when open, they show numerous stamens. The fruits are green, dehiscent and 3-lobed capsules of about 4.5 mm in diameter, topped with 3 vestigial styles which are 2 mm long. The seeds are globose and 2 mm in diameter (Fig. 210).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Jatropha curcas* L.**

[From Greek, *iatrós* = doctor; *trophé* = food; and *curcas* = the vernacular name for this plant]

Common name: Physic nut, purging nut tree; *jarak belanda* (Malay); *medicinier*, *haricot du Pérou*, *oignon d'Inde* (French); *kesugi* (Burmese); *lohong kvang sa* (Cambodia); *ma fong chou* (Chinese); *ricino mayor* (Portuguese); *chitra* (Sanskrit); *arbol de los pinones de Indias* (Spanish).



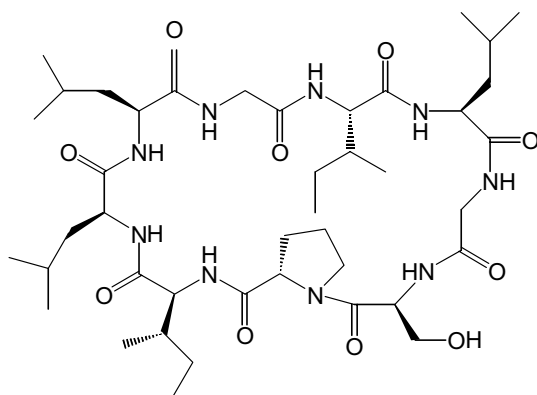
Physical description: It is a tropical shrub native to Mexico. The plant grows to a height of 3 m and produces an abundantly milky latex. The stems are smooth and covered with very small whitish lenticels. Leaves: simple, spiral and without stipules. The petiole is 12.2 cm–9 cm × 2 mm and thin. The blade is very thin and 5-lobed-cordate. The margin is somewhat wavy, the nerves are raised on both surfaces of the blade, and tertiary nerves are visible beneath. The inflorescences are terminal and about 8 cm long. The flowers are 6 mm × 7 mm, hermaphrodite, and with a honey-suckle-like fragrance. The sepals are diamond-shaped and accrescent in fruits. The andrecium comprises of 10 stamens which are joined together. The filaments are 3.5 mm long, and the anthers, 2 mm long. The corolla consists of 5 yellowish-green petals with white hairs. The fruits are 3-lobed fleshy capsules of about 2.5 cm in length. The seeds are brownish-black and 1.8 cm long (Fig. 211).

Fig. 211. *Jatropha curcas* L. From: KLU Herbarium 000606. Flora of Malaya. Field Collector and botanical identification: 5 Dec 1960. Geographical localization: Kampong Lubok, Pahang.



Pharmaceutical potential: In regard to the dermatological property of *Jatropha curcas* L., single topical dose treatment with 50 μ L of latex at dilutions 10%, 50% or 100% and multiple dose treatment with dilutions between 5% and 10% show a healing effect in Balb/c mice skin. However, multiple dose treatment with 50% or pure undiluted latex produces caustic lesions to the treated skin (Salas J *et al.*, 1994). Oral administration of an extract of fruit induces fetal resorption in pregnant rats, substantiating the abortifacient property (Goonasekaran MM *et al.*, 1995). Note that a water extract of the stems of *Jatropha curcas* L. inhibits strongly HIV-induced cytopathicity effects *in vitro* (Matsuse IT *et al.*, 1998). The latex of the plant contains a very unusual cyclopeptide known as curcacycline which enhances romatase activity of cyclophilin (Auvin C *et al.*, 1997). Cyclopeptides are quite rare in plants but common in marine invertebrates such as ascidia. Marine cyclopeptides have attracted a great deal of interest on account of their cytotoxic properties. This cyclopeptides are synthetized in ascidias by tiny algae. Is curcacycline B produced by a symbiotic microorganism as well?

Uses: The oil expressed from the seeds of *Jatropha curcas* L. (*Oleum Internale*) was formerly used in Western medicine to relieve the bowels of costiveness, to treat bleeding, and to heal wounds. In Burma, the seeds are used to relieve the bowels of costiveness. In Indonesia, the latex is used to alleviate itchiness, control bleeding, and treat eczema and ringworms. In the Philippines, the oil expressed from the seeds is used to relieve the bowels of costiveness and the latex, to assuage toothache. The plant is also used to treat cough and to stop diarrhea. In Laos, Cambodia and Vietnam, *Jatropha curcas* L. is used to facilitate abortion, alleviate itchiness and heal ulcers. In Malaysia, the latex is used to treat bleeding and heal wounds.



Curcacycline B

References

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 Salas J, *et al.* (1994) *Revista de Biología Tropical* **42**(1–2): 323–326.

Warning: The case of a child poisoned by the seeds is reported by Joubert *et al.* (1984). Nubian goats fed with this plant with 0.25 g/Kg/day–10 g/Kg/day shows liver congestion and necrosis, diarrhea, hemorrhages, edema of the lungs, hyperexcretion of fluid in serous cavities, a marked increase of glutamate oxaloacetate transaminase (GOT) in the serum, and die within 2 to 21 days (Adam SE *et al.*, 1975). The seeds of *Jatropha curcas* L. are toxic due to a toxalbumine named curcin.

Macaranga denticulata (Bl.) Muell.-Arg.

[From Malgash, *macaranga* = a native name of Madagascar and from Latin, *denticulus* = small tooth]

Synonymy: *Macaranga henricorum*
Hems.

Common names: *Mahang*, *meseapat*
(Malay).

Physical description: It is a treelet of secondary forest and neglected lands in the East Himalayas, China, Malaysia, and Indonesia. The stems are smooth, terete and rusty velvety at the apex. Leaves: simple, spiral and without stipules. The petiole is 4 cm–8 cm, slender, and velvety initially. The blade is broadly lanceolate, 12.1 cm × 15.2 cm–8.6 cm × 6.6 cm, velvety and mottled with numerous globose, translucent and with very small glands beneath. The apex extends upward into a 1.4 long tail. The margin is denticulate and recurved. The blade shows 8 to 9 pairs of secondary and scalariform tertiary nerves. The inflorescences are axillary and velvety panicles. The flowers are very small (Fig. 212).

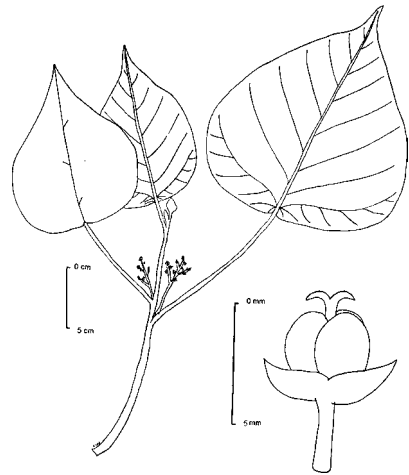
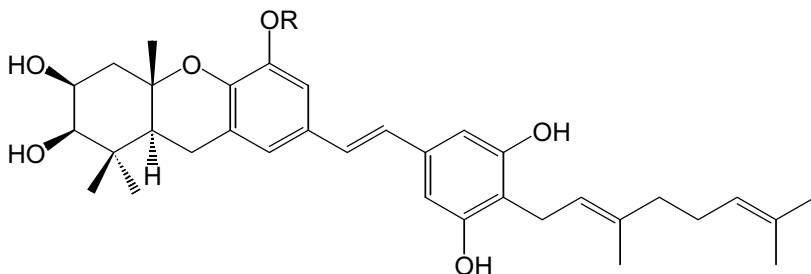


Fig. 212. *Macaranga denticulata* (Bl.) Muell.-Arg. From: KLU Herbarium 000863. Flora of Malaya. Field collector: MED Poore. 9 Sep 1961. Geographical localization: Ayer Hitam, Johor, swamp by the side of the road, Malaysia. Botanical identification: 2/7 Whitmore.

Pharmaceutical interest:

Cytotoxic properties: The *Macaranga* species have attracted a great deal of interest on account of the presence of prenylated stilbenes which are drastically cytotoxic. One such stilbene is mappain from the leaves of *Macaranga mappa* which inhibits the growth of both drug-sensitive SK-OV-3 and drug-resistant SKVLB-1 ovarian cell lines at doses of the micromolar range (Van der Vaaden, 2001). Other examples are schweinfurthins A, B and C, isolated from *Macaranga schweinfurthii*, which display a cytotoxic pattern similar to that of stelletins and cephalotatins in the NCI-60-cell screen (Beutter JA *et al.*, 1998). It will be interesting to learn whether a more intensive study on *Macaranga denticulata* (Bl.) Muell.-Arg. will reveal any prenylated stilbenes of chemotherapeutic value.

Uses: In China, *Macaranga denticulata* (Bl.) Muell. – Arg. is used to expel impurities, treat paralysis and aid recovery from childbirth. In Laos, Cambodia and Vietnam, the plant is used to aid recovery from childbirth. In Malaysia, the plant is used to aid recovery from childbirth and to counteract putrefaction of the skin.



Schweinfurthin A (R= H); B (R= CH₃)

References

- Beutter JA, *et al.* (1998) *J Nat Prod* **61**(12): 1509–1512.
 Van der Vaaden (2001) *J Nat Prod* **64**(1): 103–105.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Mallotus philippensis* (Lamk.) Muell. Arg.**

[From Latin, *Mallotus* = woolly]

Synonymy: *Croton philippense* Lam.

Common name: *Kamala tree; balek* (Malay).

Physical description: It is a small, bushy tree which grows to a height of 9 m, in a geographical zone spanning the West Himalayas, Ceylon, Formosa, Southern China, New Guinea, Solomon Islands and Australia. The plant is found in forest fringes and open places or limestone. The stems, young leaves and inflorescences are covered with scarlet glands. Leaves: simple, spiral, and stipulate. The petiole is 5 cm long and slender. The blade is ovate, trinerved, and 5 cm–20 cm × 1 cm–5 cm. The margin is entire or sinuate-lobed, and the lower surface glaucous, puberulous and covered with scarlet glands. The apex is acuminate and the base is acute. Tertiary nerves are scalariform. The flowers are arranged in axillary racemes. The stigmas are characteristically plumose. The calyx is 5-lobed. The andrecium comprises of several stamens. The fruits are depressed, globose, trisulcate, 6 mm–7 mm-diameter capsules and covered with scarlet glands (Fig. 213).

In Burma, *kamala* powder is used to relieve the bowels of costiveness. In China, a decoction of capsules and the leaves is taken to treat cold; while



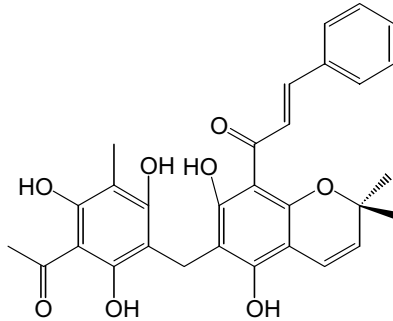
Fig. 213. *Mallotus philippensis* (Lamk.) Muell. Arg.

Uses: The drug or *kamala* powder is a dull, reddish-brown, tasteless and odorless powder, used to expel intestinal worms from ancient times. The Arab physicians became acquainted with it at an early date, and through them, it appeared to have reached Europe, and to have been known to the Greek physicians in the 7th century. This powder consists of red radiating groups of unicellular curved trichomes which cover particularly the capsules (*kamala*, *Glandulae Rottlerae*, *British Pharmaceutical Codex*, 1934). Ibn Sina writes: "It is a grain like sand, red, . . . hot and dry in the third degree."

kamala powder is used to expel intestinal worms. In Indonesia, *kamala* powder is used to expel intestinal worms. In Malaysia, the leaves are used to prevent bed-wetting in children. In India, *kamala* powder is used to expel intestinal worms and relieve the bowels of costiveness. *Kamala* powder is used by Asians living in Britain to expel intestinal worms, relieve the bowels of costiveness, facilitate abortion and treat skin diseases. Kamala powder has long been used to dye red silk.

Pharmaceutical interest:

Rottlerin: The dyeing principles of *kamala* powder are phloroglucinol derivatives: rottlerin (mallotoxin) and isorottlerin. Aqueous and ethanolic extracts of leaves of *Mallotus philippensis* (Lamk.) Muell. Arg. inhibit the spontaneous mobility of *Setaria cervie* microfilariae with an LC_{50} value of 18 ng/mL and LC_{90} : 20 ng/mL (Singh R *et al.*, 1997). This property is most probably due to the presence of rottlerin, which is known to destroy intestinal worms efficiently, possibly through inhibition of calmodulin-dependent protein kinase III (Parmer TG *et al.*, 1997) that phosphorylates a number of substrates that regulate the proliferation of cells upon mitogen stimulation.



Rottlerin

References

- Parmer TG, *et al.* (1997) *Cell Proliferation Differ* **8**(3): 327–334.
 Singh R, *et al.* (1997) *Indian J Physiol Pharmacol* **41**(4): 397–403.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Melanolepis multiglandulosa* (Bl.) Reichb. F. & Zoll.**

[From Greek, *melas* = black, *lepis* = scale and from Latin, *multus* = many and *glandula* = gland]

Synonymy: *Melanolepis moluccana* Pax & K. Hoffm., *Mallotus moluccanus* Muell.-Arg.

Common names: It is a dioecious tree which grows to a height of 10m in the secondary forest and neglected lands of Southeast Asia, Ryuku Island, Formosa and Bismarcks. The stems are terete, smooth and covered with stellate hairs. Leaves: simple, spiral and without stipules. The petiole is 5.3 cm–13.3 cm × 2 mm, velvety and constricted at the base. The blade is broadly lanceolate, subglabrous above, velvety below, and 9.8 cm–16.3 cm × 9.5 cm–14 cm. The apex is acuminate. The base is acute and marked with somewhat accrescent structures. The margin is dentate. The nerves are flat above and raised beneath the blade, and the tertiary nerves are visible beneath. The male flowers are arranged in axillary and velvety spikes of 15 cm–18.7 cm in length. The flower buds are globose and 4 mm in diameter, and attached to 2.5 mm–7 mm long pedicels. The female flowers are arranged in stout, hairy and 20 cm long spikes. The fruits are 3-lobed dehiscent capsules which are 1 cm in diameter. The seeds are black, 4 mm in diameter and apiculate (Fig. 214).

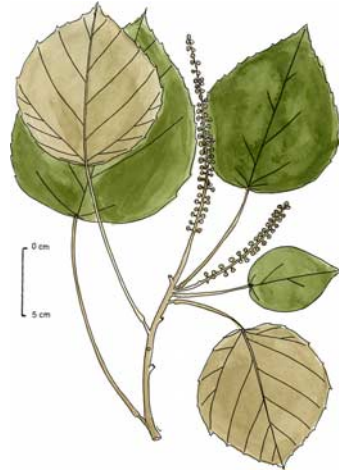


Fig. 214. *Melanolepis multiglandulosa* (Bl.) Reichb. f. & Zoll. From: KLU 19319. Flora of Malaya. University of Malaya Herbarium. Field collector and botanical identification: SC Chin. 13 Mar 1971. Geographical localization: Perak, Lenggong District, Kampong Gelok, Gua Putri limestone hill, male, several present, Malaysia. From: KLU Herbarium 22080, Ex. Herbario Universitatis Kyotoensis. Flora of Japan. Field collector and botanical identification: Murata and H Tabata, 8 Aug 1974. Geographical localization Ryukyu (Pref. Okinawa) Isl. Iriomote: near Funaura, Japan.

Uses: In Indonesia, *Melanolepis multiglandulosa* (Bl.) Reichb. f. & Zoll. is used to alleviate itchiness, treat cough and assuage toothache. In the Philippines, the leaves are used to treat headache and promote sweating. The pharmacological potentials of *Melanolepis multiglandulosa* (Bl.) Reichb. f. & Zoll. are yet to be revealed.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Phyllanthus emblica* L.**

[From Greek, *phullon* = leaf and *anthos* = flower and from Bengalese, *amlaki* = *Phyllanthus emblica* L.]

Synonymy: *Emblica officinalis* Gaertn., *Emblica pectinata* Ridl.

Common names: Emblic myrobalan; *emblic officinal* (French); *amlaj* (Arabic); *amala* (Persian); *pokok melaka* (Malay); *alma khushk* (Indian).

Physical description: It is a medium-sized lowland rainforest tree which grows in a geographical zone ranging from India to South China. The bark is greyish-red. The inner bark is sappy and pink, and the heart wood is purple brown. The stems are more or less rusty scurfy. The flowers are 2 mm long and arranged in dense axillary clusters. Leaves: simple, alternate, looking like pinnate, and 7 mm–1.3 mm × 4 mm–2.5 cm. The calyx of comprises of 6 sepals in 2 whorls. A nectary disc is present and the styles are free and spreading. The fruits are round, succulent, and sourish, greening yellow capsules (Fig. 215).

Pharmaceutical interest: The fruit of *Phyllanthus emblica* L. contains vitamin C which is 20 times more than in orange, and plenty of tannins.

Antimicrobial properties: A bioassay-guided fractionation of a methanolic extract of fruits of *Phyllanthus emblica* L., resulted in the characterization of gallitannins: putrajivain A, 1, 6-di-O-galloyl- β -D-glucose, and digallic acid which strongly inhibit the enzymatic activity of the human immunodeficiency virus type-1 reverse-transcriptase *in vitro* with an IC₅₀ of

Uses: In Burma, the juice expressed from the fruits of *Phyllanthus emblica* L. is drunk to relieve the bowels of costiveness, and to soothe inflamed eyes. The bark and roots are astringent. In China, the roots are used to lower body temperature and to expel impurities. The leaves and fruits are used to soothe inflammation and to combat fever. In Indonesia, a decoction of the fruits is drunk to check bloody flux, soothe inflammation and combat fever. In Malaysia, a decoction of the leaves is used to soothe inflammation and to combat fever. In Vietnam, the leaves are used to combat fever. The fruits are used to stop diarrhea and colic. In India, the leaves and the fruit are used to soothe inflammation and to combat fever. The fruits are used to invigorate the liver. The flowers are used by Asians living in Britain to soothe sores, stop dysentery, promote urination, relieve the bowels of costiveness, soothe inflammation and treat scurvy.

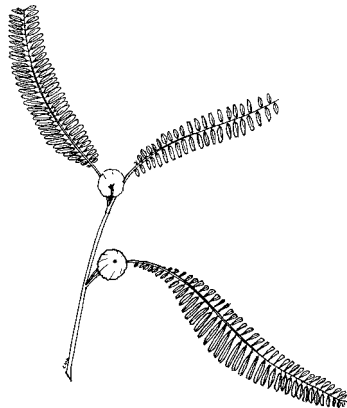
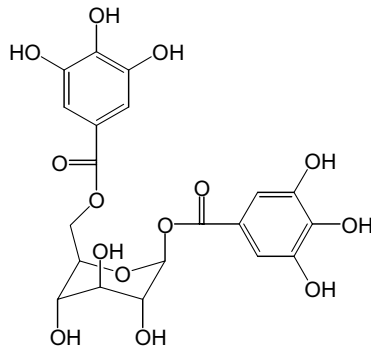


Fig. 215. *Phyllanthus emblica* L.

3.9 μM , 270 μM and 200 μM , respectively (El-Mekkawy S *et al.*, 1995). *Phyllanthus emblica* L. contains gallic acid (El-Mekkawy S *et al.*, 1995) which is a well-known cytotoxic and antibacterial natural product. Extracts of this plant inhibit the growth of *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Staphylococcus aureus* (Valsaraj R *et al.*, 1997; Ahmad I *et al.*, 1998) and fungi (Dutta BK *et al.*, 1998) cultured *in vitro*.



1,6 - di - O - galloyl - β - D glucose

Antiradical and antioxidant properties: The presence of both hydrolysable tannins and vitamin C in the fruits of *Phyllanthus emblica* L. suggests a strong antioxidant/antiradical property which might be responsible for the anti-inflammatory, hepatoprotector and anti-tumor properties so far displayed by this plant experimentally. An extract of *Phyllanthus emblica* L. (50 $\mu\text{g}/\text{mL}$) hampers, by 90%, the migration of human polymorphonuclear leukocytes induced by leukotriene B₄, and reduces by 25%, the degranulation induced by N-formyl-L-methionyl-L-leucyl-L-phenylalanine (Ihantola-Vormisto A *et al.*, 1997). This extract also inhibits lipid peroxidation in bovine brain liposomes with an IC₅₀ value of 13 $\mu\text{g}/\text{mL}$ (Kumar KCS *et al.*, 1999) and the development of liver tumors caused by N-nitrosodiethylamine (Jeena KJ *et al.*, 1999) and protects mice against 3,4-benzo-[a]-pyrene (Nandi P *et al.*, 1997).

References

- Ahmad I, *et al.* (1998) *J Ethnopharmacol* **62**(2): 185–193.
 Dutta BK, *et al.* (1998) *Mycosis* **41**(11–12): 535–536.
 El-Mekkawy S, *et al.* (1995) *Chem Pharm Bull* **43**(4): 641–648.
 Ihantola-Vormisto A, *et al.* (1997) *Planta Med* **63**(6): 518–524.
 Jeena KJ, *et al.* (1999) *Cancer Lett* **136**(1): 11–16.
 Kumar KCS, *et al.* (1999) *J Ethnopharmacol* **64**(2): 135–139.
 Nandi P, *et al.* (1997) *Br J Cancer* **76**(6): 1279–1283.
 Valsaraj R, *et al.* (1997) *J Ethnopharmacol* **58**: 75–83.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Phyllanthus niruri* L.**

[From Greek, *phullon* = leaf and *anthos* = flower and from Latin, *niruri* = referring to the diuretic properties of the plant]

Synonymy: *Phyllanthus amarus*
Schum. et Thonn.

Common names: *Dukong anak*
(Malay); *bhummy-ámali* (Sanskrit); *yerba de quininic* (Puerto-Rico).

Physical description: It is an invasive tropical annual weed which grows to a height of 50 cm. The stems are glabrous and much branched and reddish. Leaves: simple, alternate, light green, stipulate. The stipules are very small and acute. The petiole is indistinct. The blade is 5 mm–9 mm × 3 mm–4 mm, and oblong-elliptic. The apex and the base is round. The margin is entire and glabrous. The male flowers are very small, often found in groups of 2 or 3 in the 1–4 lowest axils, and comprise of 3 stamens. The female flowers are much larger, solitary, in higher axils, and with ovate sepals. The fruits are tiny capsules which are depressed globose, 3-lobed and smooth. The seeds are very small and longitudinally ribbed (Fig. 216).

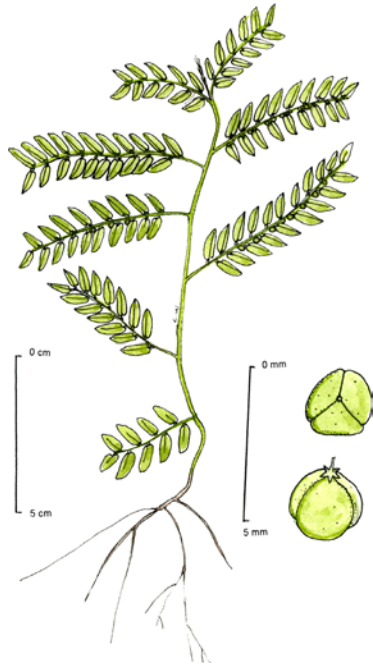


Fig. 216. *Phyllanthus niruri* L.

Pharmaceutical interest: *Phyllanthus niruri* L. is interesting because it produces a series of ellagitannins among which are geraniin and repandusinic acid A (Foo LY *et al.*, 1995); these are responsible for the medicinal properties of the plant and the anti-inflammatory, cytotoxic and antiviral properties observed so far.

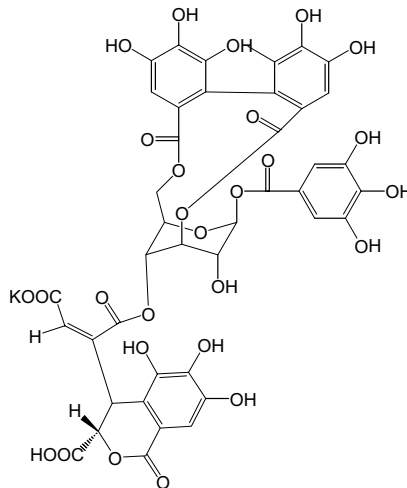
Anti-inflammatory properties: A methanolic extract of *Phyllanthus niruri* L. at 50 mg/Kg, 200 mg/Kg, and 1000 mg/Kg body weight protects rodents against

Uses: *Phyllanthus niruri* L. is the *Herba Moeris Alba* of Georgius Everhardus Rumphius. From China to Indonesia, a decoction of this herb is drunk to promote urination and dissolve urinary stones. Malays and Indonesians use *Phyllanthus niruri* L. to promote expectoration, treat fever, promote menses, stop diarrhea, and soothe inflammation. Malays use the leaves to stimulate appetite in children. In India, the plant is used to promote urination, combat fever and treat jaundice.

gastric lesion induced by intragastric administration of absolute ethanol (8 ml/kg), thereby confirming the anti-inflammatory property of the plant (Raphael KR *et al.*, 2003).

Cytotoxic properties: An aqueous extract of *Phyllanthus niruri* L. protects mice against 20-methylcholanthrene (20-MC)-induced sarcoma development and increases the survival of tumor carrying mice; it prolonged the life span of Dalton's lymphoma ascites and Ehrlich ascites carcinoma bearing mice, and reduces the volume of transplanted solid tumors (Rajeshkumar NV *et al.*, 2002).

Antiviral properties: Extracts of *Phyllanthus niruri* L. inhibit the enzymatic activity of hepatitis B virus DNA polymerase *in vitro* and lower virus levels *in vivo* (Blumberg BS *et al.*, 1990), substantiating the use of the plant against jaundice. An aqueous extract of *Phyllanthus niruri* L. inhibits the enzymatic activity of the human immunodeficiency virus type-1 reverse-transcriptase, due to the presence of repandusinic acid A monosodium salt (ID₅₀: 0.05 μM on HIV-1-RT). Repandusinic A, as low as 10.1 μM, inhibits the cytopathogenicity in MT-4 cells caused by the human immunodeficiency virus type-1. 4.5 μM of repandusinic acid A inhibits the formation of giant-cell caused by the human immunodeficiency virus type-1. Repandusinic acid A (2.5 μM) inhibits, up to 90%, the production of p24 antigen in a clone of H9 lymphocytes (Ogata T *et al.*, 1992). Aqueous and alcohol-based extracts of *Phyllanthus amarus* inhibit human immunodeficiency virus type 1 replication in HeLa CD4+ cells, with EC₅₀ values ranging from 0.9 to 7.6 μg/ml, attributed to the presence of geraniin and corilagin (0.24 μg/ml). Human immunodeficiency virus type 1 replication is also blocked in CD4+ lymphoid cells with comparable EC₅₀ values (Notka F *et al.*, 1999).



Repandusinic acid A

Other pharmacological properties: The litholytic property of *Phyllanthus niruri* L. is confirmed experimentally: An aqueous extract inhibits the internalization of oxalic acid by Madin–Darby canine kidneys cells (Campos AH *et al.*, 1999). Phyllanthin and hypophyllanthin, characterized from a hexane extract of *Phyllanthus niruri* L., protected cultured hepatocytes of rats against carbon tetrachloride and β -D-galactosamine (Syamasundar KV *et al.*, 1992).

References

- Blumberg BS, *et al.* (1990) *Vaccine* **8**(1): S74–S78.
 Campos AH, *et al.* (1999) *Nephron* **81**(4): 393–397.
 Tonka F, *et al.* (1999) *Antiviral Res* **58**: 175–186.
 Ogata T, *et al.* (1992) *HIV infection Res Hum Retrovirus* **8**(11): 1937–1944.
 Raphael KR, *et al.* (2003) *J Ethnopharmacol* **87**(2–3): 193–197.
 Rajeshkumar NV, *et al.* (2002) *J Ethnopharmacol* **81**(1): 17–22.
 Syamasundar KV, *et al.* (1992) *J Ethnopharmacol* **14**(1): 41–44.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Ricinus communis L.

[From Latin, *ricinus* = a Mediterranean sheep tick, and *communis* = common]

Common names: Castor bean, Palma Christi, castor oil plant; *jarak* (Malay); *slung deng, ma puong* (Vietnamese); *arandi* (Hindi); *am anakkam chedi* (Tamil); *eramda* (Sanskrit).

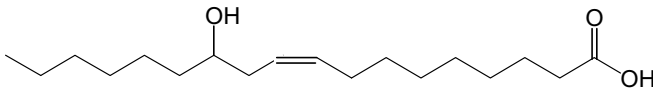
Physical description: It is a stout and common shrub of tropical vacant plots native to India. Leaves: simple and spiral. The petiole is 20 cm long. The blade is palmate, serrate, 25 cm in diameter, and glaucous below. The fruits are glaucous, 3-lobed, and prickly, 1.5 cm-diameter capsules. The seeds are 8 mm–1.8 cm × 4 mm–1.2 cm, smooth, grey, brown or black (Fig. 217).



Fig. 217. *Ricinus communis* L.

Pharmaceutical interest: The seeds of *Ricinus communis* L. contain 46%–53% of a fixed oil, which consists of the glycosides of ricinoleic, isoricinoleic, stearic and dihydroxystearic acids. The purgative property of this oil is probably owing to free ricinoleic acid, which is released by hydrolysis in the duodenum. The seeds also contain ricin which is a teratogen and inhibits the proliferation of tumors. Ricin consists of 2 polypeptide chains A and B; chain B is a glycoprotein which binds to the terminal galactosyl residues on cell surfaces, whereas chain A inactivates the 28s subunit of the ribosomes. Several experiments and a few preclinical trials have shown the potential of ricin in immunomediated anti-tumoral, antiviral and neurological mechanisms.

Uses: The oil (castor oil) expressed from the seeds of *Ricinus communis* L. has been used to relieve the bowels of costiveness many decades ago. For instance, castor oil mixed with beer was a standard practice to relieve the bowels of costiveness for ancient Egyptians. This plant has been cultivated in Southern Europe at a very early date. It is the *kiki* of Herodotus and the *κροθων* of Theophrastus. Castor oil, once widely used to relieve the bowels of costiveness, is now more restricted in use, occasionally being used in hospital to counteract poison and to prepare intestines for examination. The leaves are often used to produce skin irritation. In China, a decoction of the leaves is used promote expectoration and to expel impurities.



Ricinoleic acid

Reference

Cooper, *et al.* (1964) *Amer Industr Hyg Ass J* **25**: 431.

Warning: Cooper *et al.* (1964) reported the case of workers suffering from serious allergies, after handling cakes left after expression of castor oil. Ricin causes nausea, spasms, purgation, kidneys discomfort, convulsion and death. Two to four seeds seriously poison an adult, whereas 8 of them would prove to be fatal.

***Sapium sebiferum* (L.) Roxb.**

[From Latin, *sapium* = a plant name, *sebum* = fat and *fer* = producing]

Synonymy: *Croton sebiferus* L., *Triadica sebifera* (L.), *Stillingia sebifera* Michx.

Common name: Chinese tallowtree.

Physical description: It is an invasive treelet of Southern China and Taiwan. The latex is abundant and poisonous. The stems are glabrous, slender and terete. Leaves: very thin, rhomboid-ovate, and 5 cm–9 cm. The petiole is 2 cm–5 cm long. The blade is shortly acuminate at the apex. The base is acute and shows a pair of glands. The margin is entire. The inflorescences are 7 cm–12 cm long spikes which are yellowish. The male flowers are at the apex and the female ones are at the base of the spike. The fruits are nearly globose, 1.5 cm × 7 mm, glaucous, fleshy capsules, turning black and mucronate at the apex. The seeds are 6.5 mm, white and waxy (Fig. 218).

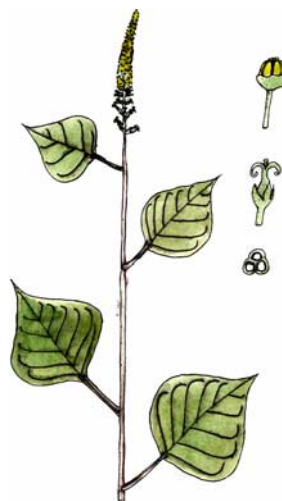
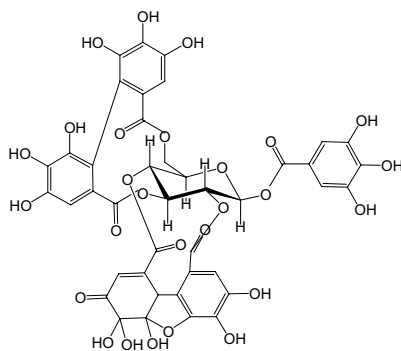


Fig. 218. *Sapium sebiferum* (L.) Roxb.



Geraniin

Pharmaceutical interest: *Triadica sebiferum* (L.) Roxb. contains geraniin and 6-*O*-galloyl-*D*-glucose, which are hypotensive in spontaneously hypertensive rats (Chen GT *et al.*, 1994; Hsu FL *et al.*, 1994). *Sapium baccatum* is known to produce an alkaloid,

Uses: The wax expressed from the seeds of *Triadica sebiferum* (L.) Roxb. is used to relieve the bowels of costiveness and to promote urination in several Asian countries. In Vietnam, the seeds are used to treat hair and skin diseases.

buckittingine, which inhibits paw edema induced by carrageenan, and fever, induced by yeast in rats (Panthong A *et al.*, 1998).

References

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 Cheng GT, *et al.* (1994) *J Pharm Pharmacol* **46**(1): 46–49.
 Hsu FL, *et al.* (1994) *J Nat Prod* **57**(2): 306–312.
 Panthong A, *et al.* (1998) *Plant a Med* **64**(6): 530–535.

Warning: Toxic phorbol esters are known to occur in the seeds (Brooks G *et al.*, 1987).

Sauropus androgynus (L.) Merr.

[From Latin, *saura* = lizard and from Greek *pous* = foot and *androgynos* = hermaphrodite]

Common name: Common sauropus, sweet leaf bush.

Physical description: It is a small Southeast Asian shrub of open fields and gardens. The stems are terete, smooth and glabrous. Leaves: simple, alternate and exstipulate. The petiole is 2.5 mm–8 mm long and deeply fissured transversally. The blade is lanceolate, dull dark green, aromatic when crushed, mottled beneath with numerous irregular blackish spots and 4.5 cm–5.4 cm × 1.5 cm. The blade show 6–8 pairs of secondary nerves. The inflorescences are axillary. The flowers are 5 mm in diameter and fragrant. The perianth consists of 2 series of 3 dark red tepals, the outer being 3 mm × 2 mm and the inner being smaller. The fruits are 1.4 cm in diameter, greenish-white and 3-lobed fleshy capsules with vestigial tepals (Fig. 219).

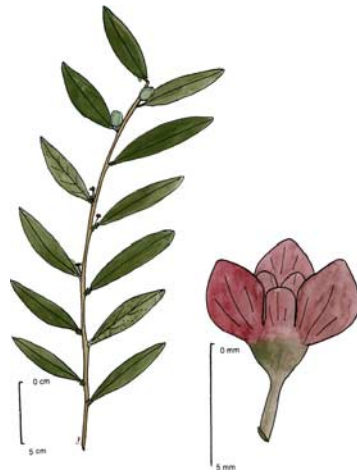


Fig. 219. *Sauropus androgynus* (L.) Merr.

Pharmaceutical interest: The pharmacological potential of *Sauropus androgynus* (L.) Merr. is yet unknown. The leaves contain a great amount of tocopherol (Chin LS *et al.*, 2001). Note that the plant contains some lignans such as (+)-syringaresinol di-*O*- β -glucopyranoside.

Uses: In Laos, Cambodia and Vietnam, the roots of *Sauropus androgynus* (L.) Merr. are used to combat fever. In Malaysia, *Sauropus androgynus* (L.) Merr. is used to promote urination, heal ulcerated nose, treat yaws and resolve sore eyes. The leaves are eaten throughout the Asia-Pacific as a vegetable.

References

- Chang Y, *et al.* (1998) *Am J Resp Clin Care Med* **157**(2): 594–598.
Chin LS, *et al.* (2001) *J Agr Food Chem* **49**(6): 3101–3105.

Warning: Since 1994, an endemic of chronic obstructive pulmonary disease has developed in Taiwan after intake of *Sauropus androgynus* (L.) Merr. to reduce body weight. Biopsy of lung specimens from the patients revealed bronchiolitis obliterans. A few patients died, but many developed protracted chronic respiratory failure. As the chronic debilitation and ineffective conventional treatments, single lung transplants were performed as the last resort in four patients. The excised lungs revealed focal fibromuscular sclerosis and obliteration of bronchial arteries in the wall of large bronchi (Chang Y *et al.*, 1998).

I. Order LINALES Cronquist 1957

The order Linales consists of 5 families and about 550 species of woody or herbaceous plants are believed to have originated, by development, from the order Rosales, alongside with the Polygalales and Sapindales (Appendix I). Linales are known to produce ellagic acid, proanthocyanidins, and occasionally tropane alkaloids. Classical examples of Linales are *Erythroxylum coca* Lam., the source of cocaine, and *Linum usitatissimum* L., a traditional source of fiber and oil.

1. Family IXONANTHACEAE Exell & Mendonça 1951 *nom. conserv.*, the *Ixonanthes* Family

Physical description: The family Ixonanthaceae consists of 5 genera and about 30 species of tropical trees or shrub known to produce *saponins*. The leaves are alternate, spiral, simple, entire or merely lobed, and the stipules small or wanting. The flowers are perfect, hypogynous, regular and 5-merous. The sepals are imbricate, and the petals, imbricate or convolute. The andrecium comprises of 5–20 stamens inserted around a well-developed nectary disc. The anthers are tetrasporangiate, dithecal and open by longitudinal slits. The

gynecium consists of 2–5 carpels forming a compound and plurilocular ovary, containing several ovules attached to an axile-apical placenta. The style develops a capitate stigma. The fruits are septicidal capsules containing several arillate or winged seeds.

Pharmaceutical potential: It will be interesting to learn whether a more intensive study of this family will reveal any alkaloids of therapeutic interest. *Ixonanthes icosandra* Jack is of medicinal value in the Asia-Pacific.

***Ixonanthes icosandra* Jack**

[From Greek, *ixos* = birdlime, *anthos* = flower, *eikosi* = twenty and *andros* = male]

Common name: *Pagar anak* (Malay).

Physical description: It is a small suckering and buttressed lowland rainforest tree of Sumatra and Malaysia. The bark is greyish-brown and smooth. The inner bark is dark-red, fibrous and exudes a cream-colored sapwood. The wood is dark, purplish brown, very leathery and heavy. The stems are smooth or rugose. Leaves: simple, spiral, pale green, glossy, soft, and with very small stipules. The petiole is 5 mm–1 cm long and swollen at the base. The blade is spatulate, 5 cm–2.5 cm × 20 cm–7.5 cm. The margin is lobed or wavy. The blade shows up to 20 pairs of secondary nerves. The flowers are 8 mm long, arranged in axillary racemes, and greenish yellow to white in color. The sepals and petals are free, leathery and 4–5. The andrecium comprises of 14–18 stamens which are protruding and originate from a showy nectary disc. The fruits are striated, smooth, 8 mm–2.5 cm, conical capsules splitting into 5 valves and seated on a vestigial perianth. The seeds are orange, very small, and embedded in a white, 3-lobed and succulent aril (Fig. 220).

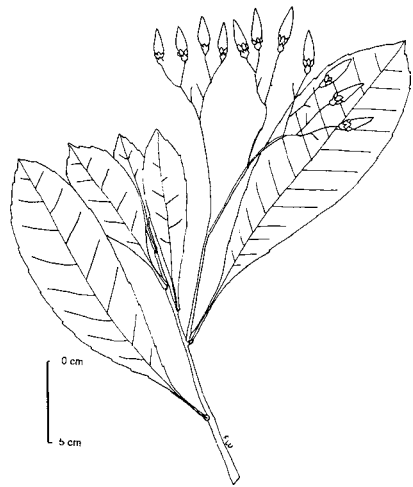


Fig. 220. *Ixonanthes icosandra* Jack.

Pharmaceutical interest: In Malaysia, a paste of the leaves is used to assuage headache, and a decoction of the roots is drunk to alleviate cough. The pharmacological potential of this plant remains unexplored. Are saponins involved in the expectorating property mentioned above?

Warning: Caution must be taken as the toxic effects of this plant are unknown.

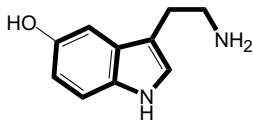
J. Order POLYGALALES Bentham & Hooker 1862

The order Polygalales consists of 7 families and about 2300 species of woody or herbaceous plants, believed to have originated from the order Rosales alongside Linales and Sapindales. The Polygalales and Linales are regarded as a pair of closely related offshoots from the Rosales (Appendix I). Polygalales are known to abound with pentacyclic triterpenoid saponins, tannins and indole alkaloids. Most of the medicinal plants classified within the order Polygalales are used to counteract putrefaction, alleviate cough and soothe inflammation, their effectiveness being attributed to the presence of surface-acting pentacyclic triterpenoid saponins that act against microbes, dissolve mucus and reduce inflammation.

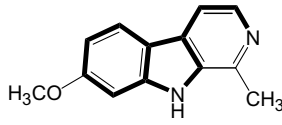
1. Family MALPIGHIACEAE A. L. de Jussieu 1789 *nom. conserv.*, the Barbados cherry Family

Physical description: The family Malpighiaceae consists of about 60 genera and 1200 species of climbers, shrubs or treelets native to tropical regions and well developed in South America. They are known to contain tannins, proanthocyanins, and *indole alkaloids*. The Malpighiaceae is the most archaic family of the Polygalales and form a link between this order and the Linales, but are not considered ancestral to the rest of the Polygalales. The stems are covered with characteristic appressed hairs. The leaves are mostly opposite, simple glandular and stipulate. The stipules are free or connate and often conspicuous. The flowers are perfect and actinomorphic. The calyx comprises of 5 sepals which are mostly imbricate and often biglandular outside. The corolla consists of 5 petals, which are characteristically clawed, serrate and convolute, and often fringed. The andrecium comprises of 10 hypogynous stamens, the filaments of which are connate at the base, and the anthers mostly tetrasporangiate, dithecal and opening by longitudinal slits. The gynecium comprises of 3 carpels united to form a compound, 3-locular ovary, with each locule containing a single ovule attached to axil placentas. The style is free or basally connate. The fruits are samaras, nuts or drupaceous.

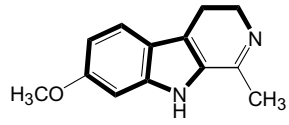
Pharmaceutical interest: A classical example of Malpighiaceae is *Malpighia glabra* L. (Barbados cherry) the drupes of which are palatable and well known to contain large amounts of ascorbic acid. Malpighiaceae have attracted a great deal of interest due to the indole alkaloids which are neuroactive. Thus far, these alkaloids are found in *Banisteria caapi*, *Banisteria inebrians*, *Banisteria quitensis*, *Banisteria rusbyana* and *Tetrapteris methystica*, which are used to make a narcotic drink known as *caapi* in Brazil, *yage* in Columbia, and



Serotonine



Harmine



Harmaline

Fig. 221. Examples of neuroactive indole alkaloids from the family Malpighiaceae. Note the similitude of chemical structure between: harmine and harmaline and serotonin.

ayahuasca in Ecuador, Peru and Bolivia, and which is an important item of Amazonian religious ceremonies. The legend says that *Ayahuasca* or the “liana of the spirit”, was given by the gods to the first Amazonians on hearth to escape reality and to discover some wonderful worlds where they would communicate with their ancestors. The participant shut their eyes, background music is played, and soon bright colors, wild animals, and unknown sceneries are seen in considerable detail (*Plants of the Gods*, Schultes RE and Hofmann A, 1979, New York: McGraw-Hill). The hallucinogenic and telepathic property of *ayahuasca* is due to the presence of harmine (banisterine, telepathine) and harmaline, the chemical structure of which is very much similar to serotonin and act as a 5-hydroxytryptaminergic receptor agonist (Fig. 221). *Hiptage benghalensis* (L.) Kurz in used for medicinal purposes in the Asia-Pacific. It will be interesting to learn whether a more intensive study of the Malpighiaceae will reveal any alkaloids of value for the treatment of depression and anxiety disorders.

***Hiptage benghalensis* Kurz**

[From Greek, *hiptamai* = to fly and from Latin, *benghalensis* = from Bengal]

Physical description: It is a large, woody climber of India, Burma, Malaysia, Thailand, China and the Philippines. The stems are terete, peeling and lenticelled. Leaves: simple, opposite, and without stipules. The petiole is 6 mm–1 cm long, stout and flat above. The blade is dark

Synonymy: *Banisteria benghalensis* L., *Hiptage madablota* Gaertn., *Gaertnera racemosa* Roxb.

Common names: *Liane a fleur d'orange* (French); *bimve* (Burmese); *kamuka* (Sanskrit); *adigam* (Tamil).

green above, elliptic, leathery, and 9.6 cm × 3.8 cm–10.2 cm × 4.8 cm. The apex is acuminate. The margin is recurved and the blade shows 5–6 pairs of indistinct secondary nerves. The inflorescences are axillary racemes of about 5 cm long. The calyx shows a large gland at the base, and comprises of 5 sepals which are red, velvety, 4 mm × 3 mm, and oval. The petals are white, showily

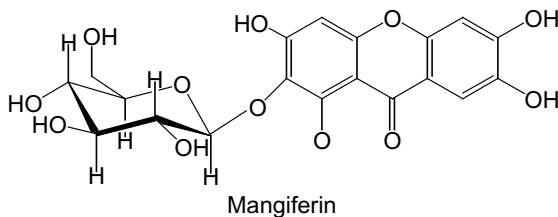
fringed and 1 cm × 5 mm, with the reception of one petal which has a large and yellow center. The andrecium comprises of 10 stamens of unequal length (Fig. 222).

Uses: In Burma, the leaves of *Hiptage benghalensis* (L.) Kurz are used to treat skin diseases. In Indonesia, the bark is used to heal wounds. In India, *Hiptage benghalensis* (L.) Kurz is used to treat cough, asthma, leprosy, to heal and to quench thirst.

Pharmaceutical potential: The pharmacological potentials of *Hiptage benghalensis* Kurz still remain unexplored, but one might set the hypothesis that the above mentioned uses can be attributed to the presence of mangiferin (Finnegan RA *et al.*, 1968), which is known to be anti-inflammatory, hepatoprotective, antioxidant, and antimicrobial (Shibnath G *et al.*, 1996; Zu XM *et al.*, 1993).



Fig. 222. *Hiptage benghalensis* (L.) Kurz. From: KLU Herbarium 33107. South China Institute of Botany, Academia Sinica. Kwangchow, China. Field collector: HG Yip, 23 March 1981. Geographical localization: Guangzhou, Guangdong, China, in plain.



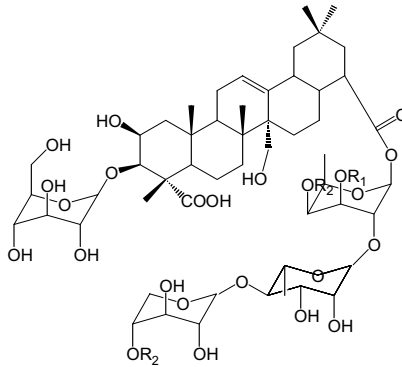
References

- Finnegan RA, *et al.* (1968) *J Pharm Sci* **57**(6):1039–1040.
 Shibnath G, *et al.* (1996) *Ind J Chem* **35**(6): 561–566.
 Zu XM, *et al.* (1993) *C K Y L H P* **14**(5): 452–454.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family POLYGALACEAE R. Brown in Flinders 1814 nom. conserv., the Milkwort Family

Physical description: The family Polygalaceae consists of 10 families and 750 species of herbs, shrubs or woody climbers known to abound with *pentacyclic triterpenoid saponins*. About two-thirds of the species belong to the single genus *Polygala*. The leaves of Polygalaceae are simple, alternate, entire and without stipules. The flowers are perfect, hypogynous, papilionaceous, and arranged into spikes, racemes or a panicle. The calyx comprises of 5 sepals which are free, imbricate, with the inner 2 often petaloid. The corolla comprises of 3–5, free petals, characteristically adnate to the stamens into a tube. The andrecium is monadelphous and consists of 2 whorls of 4 stamens, the anthers of which open by apical pores. A nectary disc is often present. The gynecium consists of 2–8 carpels joining to form a compound and plurilocular ovary, with each locule containing a single ovule attached to an axil placenta. The style is curved and 2-lobed. The fruits are nuts, drupes, samaras or loculicidal capsules. The seeds are often hairy and endowed with a caruncle.



Polygalasaponin XLII (R1 = H, R2 = (E) 3,4 dimethoxycinnamoyl, R3 = H)

Pharmaceutical interest: The roots of *Polygala nyikensis* in Malawi, *Polygala tenuifolia* in China and Japan, and *Polygala senega* L. in North America have been used to treat skin diseases, alleviate cough, counteract snake-poison and invigorate the body since many decades ago. The roots of *Polygala senega* L. were first used in 1734 to treat pneumonia in several Western countries. In the Asia-Pacific, about 10 species of plants classified within the family Polygalaceae are medicinal. Note that these plants are often used to counteract putrefaction, treat cough, asthma, bronchitis, promote fertility and to treat cerebral dysfunctions.

***Epirixanthes elongata* Bl.**

[From Latin, *xanthus* = yellow and *longus* = long]

Physical description: It is a little flesh-colored, mycoparasitic herb of the rainforests of Malaysia and Indonesia. Leaves: simple and reduced to very small scales. The flowers and tiny, 5-merous, and flesh-colored, and arranged in terminal and slender racemes. The andrecium comprises of 5 stamens, whose filaments are arranged in a sheath. The fruits are flattened, reniform and capsular (Fig. 223).

Synonymy: *Epirixanthes cylindrica*.

Common names: *Cinway* (Orang Asli); *cenduwai* (Malay).

Uses: In Malaysia, the Orang Asli use the plant to perform “magical love ceremonies.” In Indonesia, the plant is believed to render men and chicken sterile. It will be interesting to learn whether a more intensive study of *Epirixanthes elongata* Bl. will reveal any molecules of therapeutic interest.



Fig. 223. *Epirixanthes elongata* Bl. From: Flora of Malaya. Geographical localization: Kelantan, uic. Upper Sungei Lebir, Malaysia. Field collector: Kirk Endicott, Sep-Oct 1975. Botanical identification: Benjamin C Stone.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Polygala brachystachya* Bl.**

[From Greek, *poly* = many and *gala* = milk and *brachis* = short and *stachya* = flower spikes]

Common name: Creeping Malayan milkwort.

Physical description: It is a tiny and handsome herb of vacant plots of Malaysia. Leaves: linear, simple, without stipules and 2 mm × 4 mm. The inflorescences are 5 cm long spikes, attached with very few yellowish-white flowers (Fig. 224).

Uses: In Malaysia, *Polygala brachystachya* Bl. is used to counteract snake-poison.

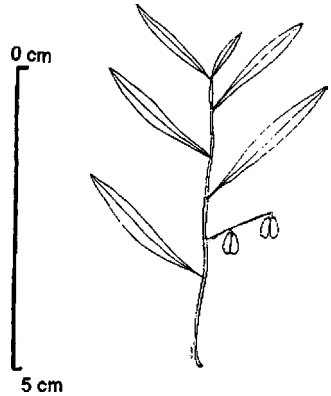


Fig. 224. *Polygala brachystachya*.

Pharmaceutical interest: The therapeutic potential of this plant remains unknown. Of recent interest is polygalasaponin, a kind of saponin characterized from *Polygala tenuifolia*, which displays dopamine and serotonin antagonist properties *in vivo* (Chung IW *et al.* 2002). Saponins and most

probably their aglycones may be responsible for the neuroactive properties of a number of medicinal plants classified within the family Polygalaceae.

Reference

Chung IW, *et al.* (2002) *Pharmacol Biochem Behav* **71**(1–2): 191–195.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Salomonina cantoniensis Lour.

[From Latin, *cantoniensis* = from Canton]

Synonymy: *Salomonina cantoniensis* Lour.

Common name: Common salomonina; *rumpu buak* (Malay).

Uses: In Indonesia, a paste of *Salomonina cantoniensis* Lour. is used to treat thrush. The pharmacological potential of this plant remains unexplored.



Fig. 225. *Salomonina cantoniensis* Lour.

Physical description: It is a succulent, mycoparasitic herb which grows to a height of 15 cm. It is found in wet grassy spots of tropical Asia. The stems are winged. Leaves: simple, alternate, and without stipules. The petiole is indistinct. The blade is cordate, fleshy, dark green with 3 parallel nerves. The base is broadly lanceolate, and the apex pointed. The flowers are very small, pinkish to purple, and arranged in terminal and slender racemes. The andrecium comprises of 5 stamens with their pedicels joining in the middle. The fruits are very small capsules (Fig. 225).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

K. Order SAPINDALES Bentham & Hooker 1862

The order Sapindales consists of 15 families and about 5400 species of trees, shrubs, climbers or herbs which are thought to have originated by development from the Rosales, near to the Cunoniaceae, together with the Linales and Polygalales. Sapindales are known to contain series of bitter

oxygenated triterpenes (*limonoids, quassinoids*), essential oils, phenolic compounds including biflavonoids, coumarins, tannins, and several types of alkaloids. More than half of these species belong to only two families: the Sapindaceae and the Rutaceae.

1. Family BURSERACEAE Kunth 1824 nom. conserv., the Frankincense Family

Physical description: The family Burseraceae consists of about 20 genera and 600 species of resinous and dioecious tropical trees known to produce several types of *triterpenes*, lignans, and aromatic and occasionally irritating *gum-resins*. The leaves of Burseraceae are alternate or spiral, pinnately compound and seldom stipulated. The folioles are often falcate, glandular, leathery, dark green and glossy. The flowers are regular, hypogynous, small, often unisexual and 5-merous. The sepals and petals are imbricate; the sepals are connate below; and the petals are free. The stamens are characteristically bicyclic and their filaments are free and borne within a well-developed nectary disc. The anthers are tetrasporangiate, dithecal and open by longitudinal slits. The gynecium comprises of 3–5 carpels joining to form a compound, plurilocular ovary with a terminal style and a capitate stigma. Each locule comprises of a pair of pendulous and epitropous ovules, attached to axil placentas. The fruits are large berries or stout dehiscent capsules containing numerous winged seeds.

Pharmaceutical interest: A number of plants classified within the family Burseraceae are of economic values. *Commiphora abyssinica* (Berg) Engl. and *Boswellia carteri* Birdw. (Biblical incense, olibanum) provide myrrh and frankincense, respectively. Myrrh has been used to heal wounds, relieve nasal congestion, and oral pains. Opopanax (bissabol, scented bdellium) is produced by *Boswellia erythraea* Engl. var. *glabrescens* Engl., and like frankincense, is used as a fixative and perfume. Other examples are *Bursera simaruba* (L.) Sarg. (gumbo limbo, naked Indian), a common tropical American tree, and *Aucoumea klaineana* Pierre, of tropical Africa, which furnishes the Gaboon mahogany used to make precious furniture. Elemi (*British Pharmaceutical Codex*, 1934) or Manila elemi, is a gum-resin exuded through the bark of *Canarium luzonicum* (Miq.) A. Gray or *Canarium commune*, which has once been used to make paints, varnishes, soap and elemi oil (by distillation), and in the form of an ointment (20%), was used to invigorate the body as well. In the Asia-Pacific, about 20 species of Burseraceae are medicinal, especially to promote digestion, and heal wounds, and for fumigation purposes. The fruits are nutritious. The pharmacological potential of the family Burseraceae has yet to be fully evaluated and it will be interesting to learn whether further study of this family will reveal any molecules of therapeutic interest.

***Canarium littorale* Bl.**

[From Moluccan name *kenari* and from Latin, *littoralis* = littoral]

Synonymy: *Canarium serricuspe* Miq.

Common names: *Kedondong bulan* (Malay), *ma kok khon* (Thai).

Physical description: It is a common lowland buttressed tree with a diameter of 30 and grows to a height of 25 m in the rainforests of Thailand, Cambodia, Laos, Vietnam, Indonesia and Malaysia. The bark is light grey, smooth, and with a few adpressed scales. The inner bark is red and fibrous. The wood is hard, dense and white. Leaves: spiral, without stipules, imparipinnate, and 30 cm–60 cm long. The petiolules are 5 mm–9 mm long, fissured transversely, and woody. The rachis carries 2–4 pairs of lateral folioles which are leathery, oblong-lanceolate and velvety below. The base is asymmetrical. The apex is acuminate and the margin serrate. The blade shows 13–20 pairs of secondary nerves and tertiary nerves below are showy. The inflorescences are terminal racemes. The calyx is green, the corolla is pink, and the fruits are characteristically ovoid, light green or glaucous, smooth, broadly 3-angled and 5 cm × 3.5 cm–5.5 cm × 4 cm (Fig. 226).

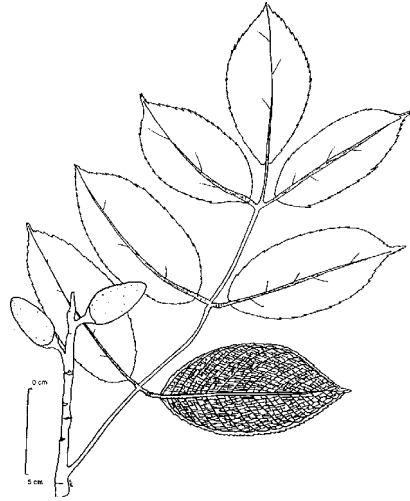
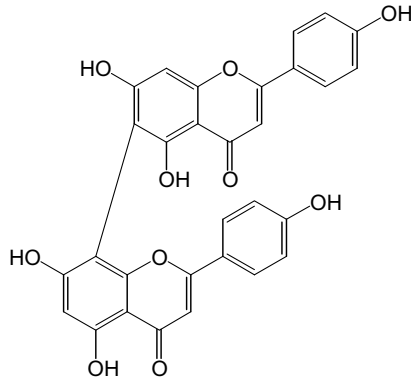


Fig. 226. *Canarium littorale* Bl. From: Herbarium FRIM 7062. Field collector and botanical identification: PF Cockburn. 10 Sep 1967. Geographical localization: S.E. Kelantan, Sungai Lebir, 2 miles South Kuala Sepia, Malaysia.

Pharmaceutical potential: To date, reports on the pharmacological potentials of *Canarium littorale* Bl. and other *Canarium* species in general are few. Note, however, the hepatoprotective property of biflavonoids and ursane-type triterpenes (Anand KK *et al.*, 1992; Tamai M *et al.*, 1989). One such biflavonoid is agathisflavone (50 mg–100 mg *per os*), characterized from *Canarium manii* which protects mice poisoned with carbon tetrachloride experimentally (Anand KK *et al.*, 1992).

Uses: In Indonesia, the bark of *Canarium littorale* Bl. is used to make a decoction taken to heal hemorrhoids.



Agathisflavone

References

Anand KK, *et al.* (1992) *Planta Med* **58**(6): 493–495.

Tamai M, *et al.* (1989) *Planta Med* **55**(10): 44–47.

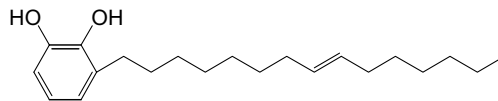
Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family ANACARDIACEAE Lindley 1830 *nom. conserv.*, the Sumac Family

Physical description: The family Anacardiaceae consists of about 60 genera and 600 species of tropical trees, climbers or shrubs often exuding an extremely vesicant sap, and known to produce tannins and several sorts of phenolic compounds. The leaves are alternate, rarely opposite, simple or compound, without stipules, often thick and showing straight secondary nerves. The inflorescences are panicles. The flowers are small, white or green, comprises of 5 sepals, 5 petals and 10 stamens originating from the base of a well-developed 5-lobed nectary disc. The anthers are tetrasporangiate and dithecal, and open by longitudinal slits. The gynecium consists of 1–5 carpels forming a 1–3-locular ovary, with each locule containing a single ovule. The styles are bi- or trifid. The fruits are drupaceous and often edible (*Mangifera indica* L.), often kidney-shaped, occasionally with enlarged persistent sepals (*Gluta species*) or an enlarged and succulent pedicel (*Anacardium species*).

Pharmaceutical interest: Classical examples of Anacardiaceae are *Pistacia lentiscus* var. *chia* (that produces mastic), *Rhus coriaria* (dyeing and tanning Sumac), *Rhus succedanea* (Japanese wax tree) and the edible *Pistacia vera* (pistachio nut). The dried berries of *Rhus glabra* (Pennsylvanian sumac)

were formerly used as a mouthwash in the form of a decoction or a liquid extract mixed with glycerin, water and potassium chlorate (Rhus, *British Pharmaceutical Codex*, 1934). *Anacardium melanorrhoea* (rengas tree), *Toxicodendron vernis* (poison sumac) and *Toxicodendron radicans* (poison ivy), are currently responsible for life threatening allergic reactions. As a matter of fact, repeated contacts with any part of a number of Anacardiaceae are shortly followed by edema, pruritus, burning, stinging sensation, erythematous macules, papules, vesicles, exudation, crusting and death with anaphylactic shock. The poisonous principles are long chain substituted phenolic substances: The *urushiols* (3-pentadecylcatechol) act as powerful haptens that mediate a delayed hypersensitivity response. Apart from causing allergy, these phenolic substances inhibit the enzymatic activity of phospholipase A₂, cyclo-oxygenase, 5-lipo-oxygenase and prostaglandine synthetase which are responsible for the inflammatory process, and display antitumor, molluscicidal, antifungal and antibacterial properties. Other examples of anacardiaceous, pharmacologically active natural products are anti-inflammatory and analgesic tannins, angiotensin-converting enzyme inhibitor terpenoids, and anti-human Immunodeficiency virus flavonoids. In the Asia-Pacific, about 20 species of plants classified within the family Anacardiaceae, including *Anacardium occidentale* L. (cashew-nut) and *Mangifera indica* L. (mango), are of medicinal value. These plants are principally used to make astringent medicines.



Urushiol

***Anacardium occidentale* L.**

[From Latin, *anacardium* = name used for the heart-shaped fruit of an Indian tree and *occidentale* = from Occident]

Physical description: It is a low, tropical, sprawling, evergreen fruit tree, causing irritation, with a heavy crown of dull green, upright, blunt, leathery

Common names: Cashew-nut tree; *anacardier* (French); *gajus*, *jambu golok*, *keterek* (Malay).

leaves which are 3 cm–10 cm × 5 cm–15 cm. The bark exudes a resinous and acrid sap which blackens on exposure to air. The wood exudes a yellow gum which can cause blisters. The wood (acajou) is used for house and boat building. The petiole is 1 cm–2 cm long and flattened on the upper side blade which is obovate. The apex of the blade is blunt and often notched, with a base that tapers off. The blade shows 10–18 pairs of secondary nerves. The flowers are



Fig. 227. *Anacardium occidentale* L.

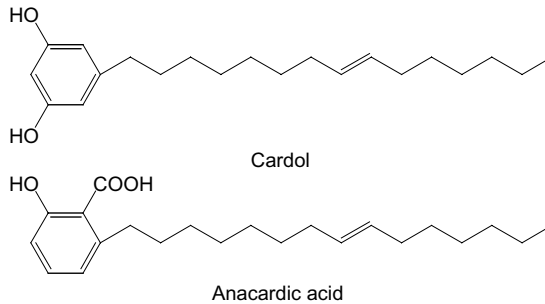
very small, with a sickly-sweet odor and arranged in terminal panicles. The corolla comprises of 5 petals which are greenish-white, and ripening to a rose pink with red striped petals. The fruits are 2 cm–3 cm long, greyish brown with a leathery shell. The pedicels are swollen, succulent, palatable, cushion-shaped, glossy, pink or red, pulpy, fragrant and 3 cm–6 cm long (Fig. 227).

Pharmaceutical interest:

Anacardic acids: Anacardic acids characterized from *Anacardium occidentale* L. are interesting because they inhibit α -glucosidase, prostaglandine synthetase, and the oxidation of L-(3,4)-dihydroxyphenylalanine (L-dopa) by tyrosinase [monophenol monooxygenase] (Kubo I *et al.*, 1994; Toyomizu M *et al.*, 1993). Anacardic acids, cardols, methyl cardols and cardananol also inhibit the proliferation of *Streptococcus mutans* and *Propionibacterium acnes* cultured *in vitro* (Kubo I *et al.*, 1992). Furthermore, anacardic acids, cardols and methylcardols inhibit the proliferation of BT-20 breast and HeLa epitheloid cervix carcinoma cells (Kubo I *et al.*, 1993). Tannins of *Anacardium occidentale* L. protect rodents against paw edema caused by carrageenan (Mota ML *et al.*, 1985). Although a number of studies have

Uses: In Indonesia, the juice expressed from the pedicel is used as a mouthwash and to treat quinsy. In Malaysia, a decoction of the bark is drunk to stop diarrhea, and an oil prepared by boiling the pericarps in water is used to treat rheumatism. The exudate of pericarps is used to remove warts, callosities and corns. It is one of the first fruit trees to be distributed throughout the tropics by the early Portuguese and Spanish adventurers.

demonstrated the molluscicidal property of cashew-nut, one must think that dermatitis could be caused by water treated with cashew nut.



Carcinogenicity: A petroleum ether extract of cashew-nut shell tested using the Ame's test (*Salmonella thyphimurium* TA 1535, TA100, TA98) is not mutagen up to a concentration of 0.003%. Carcinogenicity evaluated using a 2-stage skin tumorigenesis model, does not show any tumor-initiating potency at a concentration of 10%, while it could be a weak inducer at a concentration of 5%. This extract is not carcinogenic on mouse skin tumor model, when applied with benzo-[a]-pyrene up to a period of 20 weeks (George J *et al.*, 1997).

Antidiabetes properties: Aqueous extract of *Anacardium occidentale* L. given *per os* at 175 mg/Kg/day for 2 days, protect rats against streptozocin-induced diabetes (Kamtchouing P *et al.*, 1998).

References

- Georges J, *et al.* (1997) *Cancer Lett* **112**(1): 11–16.
 Kamtchouing P, *et al.* (1998) *J Ethnopharmacol* **62**(2): 95–99.
 Kubo I, *et al.* (1992) *J Agr Food Chem* **4**(6): 1012–1015.
 Kubo I, *et al.* (1994) *J Nat Prod* **57**(4) 545–551.
 Mota ML, *et al.* (1985) *J Ethnopharmacol* **15**(5): 289–300.
 Toyomizu M, *et al.* (1993) *Phytother Res* **7**(3): 252–254.

Warning: Cashew nut is harmful if it is not roasted.

***Camposperma brevipetiolata* Volk.**

[From Greek, *kamptein* = to bend, *sperma* = seed and from Latin, *brevis* = short and *petiolus* = stalk]

Physical description: It is a tree which grows to a height of 12m in the low-land swampy rainforests of Southeast Asia, Eastward Solomon Islands, and Papua New Guinea. The bark is shallowly fissured. The inner bark is

Common name: *Terentang* (Malay)

Uses: In Papua New Guinea, the yellow sapwood produced by the wood of *Camposperma brevipetiolata* Volk. or tigas oil, is applied to the body to repel lice and fleas. The pharmacological potentials of *Camposperma brevipetiolata* Volk. remain unexplored. Note that *Camposperma panamense* destroys *Plasmodium falciparum* cultured *in vitro* (Weniger B *et al.*, 2001).

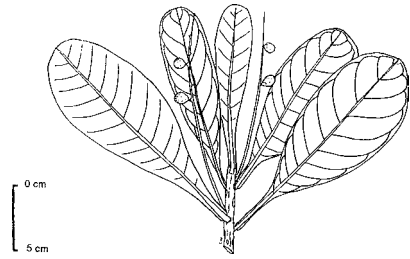


Fig. 228. *Camposperma brevipetiolata* Volk.

light grey and reddish and the wood light, soft, of commercial value and yields a yellowish sapwood. Leaves: simple, spiral, arranged in groups at the apex of stems, and without stipules. The petiole is 2 mm–3 mm long, stout, and channeled. The blade is spatulate, leathery, 12 cm × 3 cm–23 cm × 7.5 cm, dark green and glossy above and light green below. The margin is entire and recurved. The midrib is flattened above and raised below. The blade shows 10–13 pairs of well-developed secondary nerves on both sides, as well as a network of tertiary nerves. The inflorescences are axillary racemes of tiny greenish flowers. The fruits are ovoid, small, and green with red patches (Fig. 228).

Reference

Weniger B, *et al.* (2001) *J Ethnopharmacol* **78** (2–3): 193–200.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Cotinus coggygia Scop.

[From Greek, *kotinos* = wild olive tree and *kokkugia* = *Cotinus coggygia* Scop.]

Physical description: It is an ornamental tree of temperate Asian countries, the crown of which display a magnificent red color in autumn. The stems are smooth and terete, and the wood is yellowish.

Common name: Smoke-tree.

Leaves: simple, without stipules and spiral. The petiole is 1 cm–3 cm long. The blade is obovate-oblong, rigid, and 5 cm × 3 cm–6 cm × 4 cm. The margin is entire and wavy. The inflorescences are terminal and lax panicles. The flowers are 1 mm long, and held by pedicels covered with very small purplish hairs (Fig. 229).

Uses: In China, the wood is used to promote secretion of bile, combat fever and treat diseased eyes.

Pharmaceutical interest: The medicinal properties of *Cotinus coggygia* Scop. could be attributed to the presence of fisetin, disulphuretin, sulphuretin, sulphurein, gallic acid, methyl gallate and pentagalloyl glucose, which are known to occur in this plant (Du HQ, 1983; Westenburg HE *et al.*, 2000). The cholagogue property of *Cotinus coggygia* Scop. is confirmed experimentally, as syrup of the plant protects the liver against chemical damages, lowers the tension of choledochal sphincter, increases the bile flow and raises the body immunity (Shen Q *et al.*, 1991). The tannins of *Cotinus coggygia* Scop. are antioxidant (Ivanova D *et al.*, 2005).

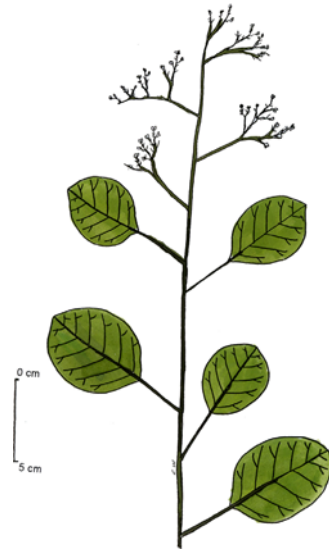
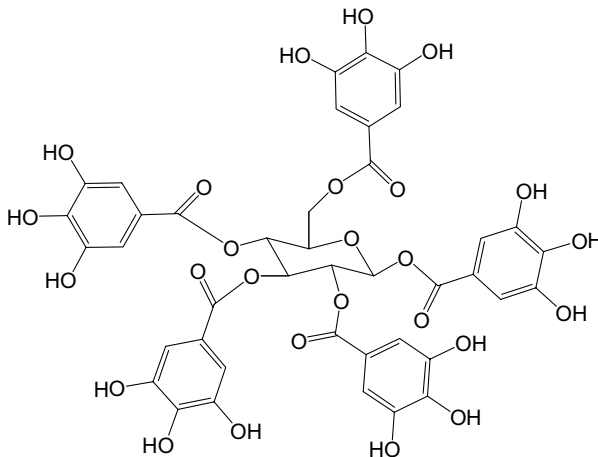
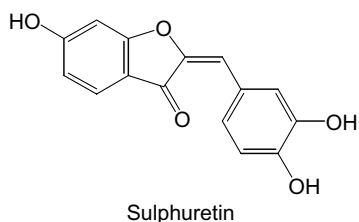


Fig. 229. *Cotinus coggygia* Scop. From: KLU 31486, Herbarium Carleton College Ottawa, Carleton University K1S5B6. Field collector: Willman, 24 June 1980. Geographical localization: Braeside Ave., Ottawa, Ontario, USA.



1,2,3,4,6 - Pentagalloyl - β - D-glucose



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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Mangifera foetida Lour.

[From Latin, *mangifera* = mango-bearing and *fetēre* = stink]

Common names: *Macak* (Malay).

Uses: In Indonesia, the seeds of *Mangifera foetida* Lour. are used to treat itchiness. The pharmacological potential of *Mangifera foetida* Lour. is still yet to be discovered.

Physical description: It is a fruit tree which grows to a height of 8 m and has a girth of 35 cm. It is found wild or cultivated in Malaysia and Indonesia. The stems are smooth and terete. Leaves: simple, spiral and without stipules. The petiole is woody, channeled, stout, and 3 cm–5 cm long. The blade is oblong-lanceolate, leathery, glossy, and 7 cm × 19 cm – 8 cm × 22 cm. The inflorescences are terminal racemes of tiny fragrant flowers. The flowers comprise of a red calyx, a pinkish corolla, and a bright yellow ovary. The fruits are edible drupes (Fig. 230).

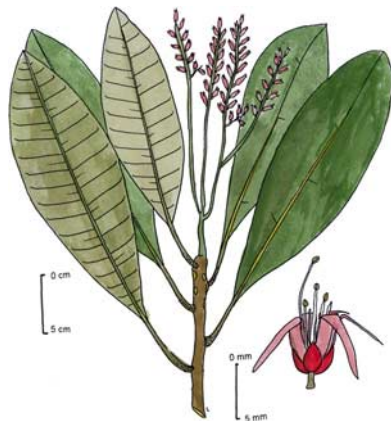


Fig. 230. *Mangifera foetida* Lour. From: KLU Herbarium 043449. Herb. Lugd. Batav. Ex. Herb. Leiden. Leg.: W. Avé. 17 Jan 1983. Geographical localization: Kampong. Sekam, Northeast of Tapah, Perak, West Malaysia: 4° 20' North–101° 20' East, altitude: 460 m.

Warning: The sap is toxic.

***Mangifera indica* L.**

[From Latin, *mangifera* = mango-bearing and *indica* = from India]

Common name: Mango tree; *manguier* (French); *mempelan, buah mangga* (Malay); *amra* (Sanskrit).

Physical description: It is a fruit tree which grows to a height of 8 m. It has been cultivated since ancient times, so its origin is uncertain; but it is believed to have originated in the monsoon belt of India or Indochina. The bark is greyish, fissured and exudes a sticky resin. Leaves: simple, 12 cm–30 cm × 4 cm–9 cm, typically narrowly elliptic or lanceolate, pointed, slightly leathery, and with wavy edges and showy nervations. The flowers are very small, greenish-yellow or white, fragrant and arranged in yellowish-pink panicles that are showy. The fruits (mango) are large drupes, more or less kidney-shaped, green initially, then ripening to a yellow color. The pulp is palatable and yellow to orange, and the seed is elongated, fibrous and flattened (Fig. 231).



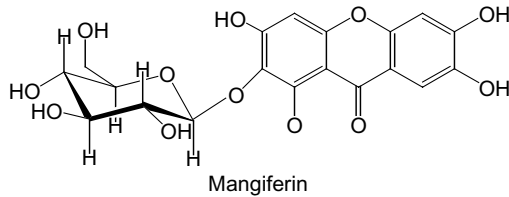
Fig. 231. *Mangifera indica* L.

Pharmaceutical interest:

Mangiferin: *Mangifera indica* L. is interesting because it contains a C-glucosylxanthone called mangiferin which is anti-inflammatory and hepatoprotective and scavenges peroxy and alkoxy free radicals experimentally (Shibnath G *et al.*, 1996). Mangiferin inhibits plaque formation in HeLa cells (EC₅₀: 111.7 µg/mL) and the replicative yield (EC₉₀: 33 µg/mL, EC₉₉: 80 µg/mL) of the herpes simplex virus type-2 (Zu XM *et al.*, 1993).

Uses: In China, the pulp of the fruit is eaten to stimulate blood circulation. In Burma, the peel of the fruits is used to invigorate the body. In the Philippines, the raw seeds are used to expel intestinal worms, while the roasted seeds are used to stop diarrhea. In Palau, dried slices of unripe fruits are used to counteract putrefaction of the blood and a paste of the powdered leaves is used to remove warts and to stop bleeding. In India, the seeds are used to treat diarrhea.

Antimicrobial and cytotoxic properties: A methanolic extract of bark of *Mangifera indica* L. alleviates human breast cancer cell-lines cultured *in vitro* (Muanza DN *et al.*, 1995) and significantly hampers the proliferation of chemically-induced skin, liver and colon tumors in mice (Serrame E *et al.*, 1995). An aqueous extract inhibits the growth of *Staphylococcus aureus* and



Proteus vulgaris but does not act on *Escherichia coli* and *Klebsiella* (Sairam K *et al.*, 2003). Mangiferin possesses antibacterial activity *in vivo* against specific periodontal pathogens, such as *Prevotella intermedia* and *Porphyromonas gingivalis* (Bairy I *et al.*, 2002).

Other pharmacological properties: An extract of *Mangifera indica* L. given *per os* (250 mg/Kg) significantly lowers glycemia in normal and diabetic rats (Sharma SR *et al.*, 1997). Note that an extract of the bark inhibits α -glucosidase activity with an IC_{50} value of 314 μ g/mL (Prashanth D *et al.*, 2001). A number of lectins characterized from the seeds of *Mangifera indica* L. are able to agglutinate *Brucella* species and *Yersinia enterocolitica* and are useful tools in agglutination tests (Kaluzewski S *et al.*, 1997). Aqueous and methanolic extracts of seeds of *Mangifera indica* L. given orally (250 mg/Kg) protect mice against castor oil and magnesium sulphate induced diarrhea, as effectively as the standard drug loperamide.

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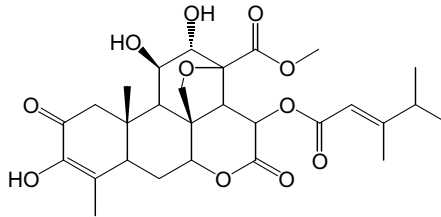
3. Family SIMAROUBACEAE A. P. de Candolle 1811 nom. conserv., the Quassia Family

Physical description: The family Simaroubaceae (or Simarubaceae) consists of about 25 genera and 150 species of tropical trees and shrubs closely allied to the Meliaceae, Rutaceae and Burseraceae. Simaroubaceae are known to abound with a series of complex oxygenated triterpenoids known as *quassinoids* and *limonoids*, β -*carboline alkaloids* and *furanocoumarins*. Simaroubaceae are, like Meliaceae, easily recognizable in field studies by their the leaves which are compound, elongated, spiral, without stipules and

crowded at the apex of the bole, which is regularly marked with round scars. The inflorescences are axillary or terminal racemes of tiny, regular, hypogynous, often unisexual, and 3-8-merous flowers. The calyx includes 5 sepals which are connate towards the base. The corolla comprises of 5 petals which are free petals, imbricate or valvate. The andrecium comprises of 10 stamens, arranged in 2 whorls and inserted at the base of a well-developed nectary disc. The gynecium consists of 2–5 carpels united into a plurilocular ovary, with each locule containing a single ovule attached to axil placentas. Each carpel develops upward into 1–5 styles. The fruits are capsular or samaras or occasionally drupes or berries.

Pharmaceutical potential:

Quassinoids and limonoids: A classical example of ornamental Simaroubaceae is *Ailanthus altissima* (Mill.) Swingle (tree of heaven). Quassinoids and limonoids impart to Simaroubaceae an intense bitterness used in Western medicine to promote digestion and appetite. *Quassia amara* L. (Surinam quassia) has been used as a bitter tonic. The dried stem wood of *Picrasma excelsa* (*Aeschrion Excelsa*, *Picraena excelsa*) was used (infusion 1–20 in cold water) to promote digestion, stimulate appetite, expel intestinal worms, and treat pediculosis (Quassia, *British Pharmaceutical Codex*, 1973). A decoction or infusion (1 in 20) of the dried root bark of *Simaruba amara* (*Simaruba officinalis*) has been used to stimulate appetite, and to curb diarrhea (Simaruba, *British Pharmaceutical Codex*, 1934).



Bruceantine

In regard to the pharmacological properties of Simaroubaceae, a number of experiments conducted *in vitro* and *in vivo* have demonstrated that quassinoids of *Brucea*, *Ailanthus*, *Simarouba*, *Castela* and *Simaba* species are cytotoxic, antiviral, anti-inflammatory and amebicidal. Bruceantin, for instance, inhibits the growth of a large panel of cancer cells cultured *in vitro*. Several quassinoids are antimalarial *in vitro* at very low doses ($IC_{50} < 0.02 \mu\text{g/mL}$). Glaucarubin is one such example. It is a glycoside obtained from the fruit of *Simaruba glauca*, which has been used to treat intestinal amebiasis (3 mg/Kg/day in divided doses for 5–10 days). Glaucarubin (Martindale, 1967), obtained from the fruits of *Simaruba glauca*, has been used to treat intestinal amebiasis at a dose of 3 mg/Kg daily for 10 days. In the Asia-Pacific,

Ailanthus altissima (Mill.) Swingle (*Ailanthus glandulosa* Desf., *Ailanthus giraldii* Dode), *Brucea javanica* (L.) Merr. (*Brucea amarissima* (Lour.) Desv. ex Gomes, *Brucea sumatrana* Roxb., *Gonus amarissimus* Lour.), *Eurycoma longifolia* Jack, *Harrisonia perforata* (Blco.) Merr. (*Harrisonia paucijuga* (Benn.) Oliv.), *Picrasma javanica* Bl., *Picrasma quassinoides* (D. Don) Benn. (*Picrasma alanthoides* (Bge.) Planch.), *Quassia indica* (Gaertn.) Nootobom (*Samadera indica* Gaertn.), and *Soulamea amara* Lamk. are of medicinal value. These are often used to treat amebiasis and malaria, to counteract putrefaction and to combat fever. It will be interesting to learn whether a more intensive study of the Simaroubaceae will reveal any molecules of chemotherapeutic interest.

***Brucea javanica* (L.) Merr.**

[After J Bruce, 1730–1794, a Scottish scholar and explorer and from Latin, *javanica* = from Java]

Synonymy: *Brucea amarissima* (Lour.) Desv. ex Gomes, *Brucea sumatrana* Roxb., *Gonus amarissimus* Lour.

Common name: Java Brucea; *ladah pahit* (Malay); *ya dan zi* (Chinese).



Physical description: It is a tree which grows to a height of 10 m in a geographical zone ranging from India to New Guinea. Leaves: 20 cm–50 cm, without stipules, and compound. The blade consists of 3–15 pairs of oblong, lanceolate or ovate, 1.5 cm–5 cm × 3.5 cm–11 cm folioles which are sparsely, hairy above and lobed. The petiolules are 2 mm–9 mm long. The flowers are unisexual, arranged in axillary panicles which are greenish-white, greenish-red or purplish. The calyx comprises of 4 sepals joined at the base. The corolla comprises of 4 petals. The nectary disc is thick and 4-lobed. The andrecium consists of 4 stamens in male flowers. The gynecium consists of 4 carpels which are free, with each containing a single ovule. The fruits are black, glossy drupes which are 4 mm–5 mm long (Fig. 232).



Fig. 232. *Brucea javanica* (L.) Merr.

Pharmaceutical interest:

Antiplasmodial properties: A series of quassinoids, characterized from *Brucea javanica* (L.) Merr., inhibit the proliferation of chloroquine-resistant *Plasmodium falciparum* strain (KI), cultured *in vitro* with IC₅₀ values between 0.046 $\mu\text{g/mL}$ –0.0008 $\mu\text{g/mL}$. Such a series also protect mice experimentally infected with *Plasmodium berghei*. However, all quassinoids tested *in vivo* are toxic (O'Neill MJ *et al.*, 1987).

Cytotoxic properties: Bruceosides D, E, and F, characterized from *Brucea javanica* (L.) Merr., selectively destroy leukemia and non-small cell lung, colon, central nervous system, melanoma, and ovarian cancer cell-lines (Ohnishi S *et al.*, 1985). Bruceoside C efficiently promotes the survival of KB, A549, RPMI, and TE-671 tumor cell-lines (Fukamiya N *et al.*, 1992). The 50% effective dose (ED₅₀) for the quassinoids characterized from *Brucea javanica* (L.) Merr. tested against KB ranges from 0.008 $\mu\text{g/mL}$ for bruceantin to 5 $\mu\text{g/mL}$ for bruceolide (Anderson MM *et al.*, 1991). Bruceantin has been tested clinically. This compound inhibits the synthesis of proteins and has a strong antileukemic property. A lignan known as guaiacylglycerol- β -O-6'-(2-methoxy) cinnamyl alcohol ether, and quassinoids such as brusatol, dehydrobrusatol, yadanzolide C, and the terpenoid, blumenol A, from *Brucea javanica* (L.) Merr. cause cell differentiation of human promyelocytic leukemia (HL-60) cells (Luyengi L *et al.*, 1996).

Uses: The dried fruits of *Brucea javanica* (L.) Merr. or Macassar kernels have been used to treat hemorrhoids, chronic dysentery, diarrhea and amebiasis since ancient times. In China, the fruits are used to treat amebic dysentery, stimulate appetite, and relieve the bowels of costiveness. A decoction is used to remove tumors. In Indonesia, the fruits are used to check bleeding. In Malaysia, the roots and fruits are used to stop dysentery and to combat fever. A paste of the leaves is used to deflate enlarged spleens, remove dandruff, assuage pain, treat ringworm infection, heal boils and counteract centipede bites. In the Philippines, the seeds are used to assuage stomachache.

Antimycobacterial property: Dihydrobruceantin characterized from *Brucea antidysenterica* is antimycobacterial *in vitro* (Rahman S *et al.*, 1997).

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Eurycoma longifolia* Jack**

[From Greek, *eurus* = broad and *kome* = hairs of the head and from Latin, *longus* = long and *folium* = leaf]

Synonymy: *Crassula pinnata* sensu Lour. non L. f.

Common names: *Tongkat Ali*, *bidara pahit* (Malay); *ba binh*, *hau phat* (Vietnamese).

Physical description: It is a treelet of Malaysia, Cambodia, Sumatra and Borneo. The plant is overexploited for its roots and is on the verge of extinction. The wood is whitish and very bitter. Leaves: compound and 1 m long. The folioles are numerous, slightly pointed, sessile, and attached to the rachis with a prominent joint. The base of the folioles is asymmetric. The inflorescences are axillary and tomentose panicles of tiny unisexual flowers. The calyx is 5–6-lobed. The corolla comprises of 5–6 petals which are hairy on both sides and twice as long as wide. The andrecium comprises of 5–6 stamens. The stigmas are 1 mm long. The nectary disc is indistinct. The gynecium consists of 5–6 free carpels. The fruits are ellipsoid and 1 cm–1.7 cm × 5 mm–1.2 cm drupes (Fig. 233).

Pharmaceutical interest:

Cytotoxic properties: *Eurycoma longifolia* Jack is interesting because it produces 14,15- β -dihydroxyklaineanone, which inhibits tumor promotion by Epstein–Barr virus activation, at an IC_{50} value of = 5 μ M; longilactone, which inhibits the growth of

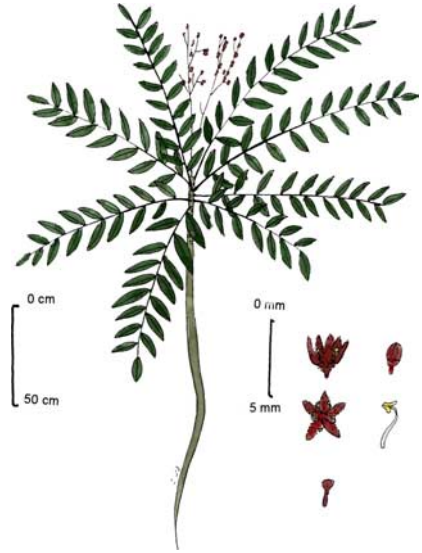
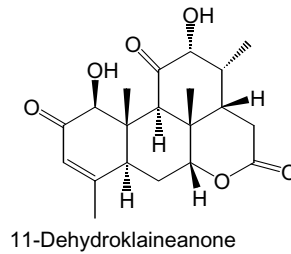
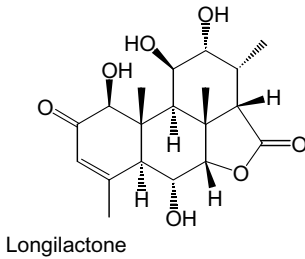


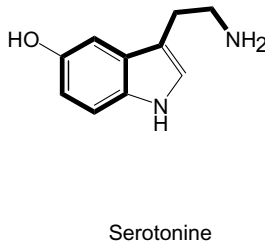
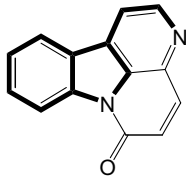
Fig. 233. *Eurycoma longifolia* Jack.

Uses: In Cambodia, the roots are used to counteract poison, combat fever, and treat jaundice, dropsy and cachexia. In Indonesia, the root bark and root are used to combat fever, stop diarrhea and soothe swollen parts. In Malaysia, the root bark is used to combat fever, invigorate the body, and heal wounds and ulcers; the plant is used to treat dropsy, ascite and to counteract poison. The wood of the roots is cut in small pieces which are boiled in water to make a drink which is taken by men as aphrodisiac. In Vietnam, *Eurycoma longifolia* Jack is used to combat fever, promote digestion, expel intestinal worms, treat dysentery, counteract poison and treat lumbago.

schistosomes cultured *in vitro* at a concentration of 200 $\mu\text{g/mL}$; and 11-dehydroklaineaneone and 15- β -O-acetyl-14-hydroxyklaineaneone, which are plasmodicidal at a C_{50} value of 2 $\mu\text{g/mL}$ (Jiwajinda S *et al.*, 2003). Canthine-6-ones and eurycomanone, characterized from the root of this plant, inhibit the growth of several types of human cancer cells *in vitro* (Kardono LB *et al.*, 1991). Note that canthine-6-one is a β -carboline alkaloids known to be cytotoxic and antimicrobial.



Other properties: A number of publications have attempted to substantiate the aphrodisiac claim of *Eurycoma longifolia* Jack. For example, male rats receiving up to 800 mg/Kg of the plant daily for 10 days, display a dose-dependent increase in mounting frequency but not in erection or ejaculations (Ang HH *et al.*, 1997).



One might set the hypothesis that canthine alkaloids binds to serotonin receptors, which are involved in the control of sexual behavior.

References

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Warning: Caution must be taken as the plant is toxic. Extracts of the plant stimulate the growth of prostate tumors in rodents.

***Harrisonia perforata* (Blco.) Merr.**

[After Harrison = an unknown Englishman; and from Latin, *perforare* = make holes]

Synonymy: *Harrisonia perforata* (Blanco) Merr., *Harrisonia paucijuga* (Benn.) Merr., *Harrisonia bennettii* Hk. f., *Harrisonia brounii* Juss.

Common names: *Niu jin guo* (Chinese).

Physical description: It is a rare, scandent, aromatic and prickly shrub of Southeast Asian calcareous secondary rainforest and of Southeast China. Leaves: pinnate, with a narrowly winged rachis and very small petiolules which supports 3–10 folioles which are 1 cm–2 cm × 5 mm–1.5 cm. The flowers are bisexual, 4–5-merous, and comprise of 8–10 stamens which are inserted at the base of a nectary disc. The gynecium is 4–5-lobed, with a knob-shaped stigma. The fruits are globose, of 1.1 cm–1.5 cm × 4 mm–9 mm drupes. (Fig. 234).

Pharmaceutical potential:

Antiplasmodial properties: An extract of *Harrisonia abyssinica* inhibits the proliferation of chloroquine-resistant strain of *Plasmodium falciparum* Dd2 at an IC₅₀ value of 4.7 μg/mL; and the chloroquine-sensitive strain of *Plasmodium falciparum* 3D7 at an IC₅₀ value of 10 μg/mL; (El-Tahir A *et al.*, 1999). This extract inhibits the proliferation of a broad spectrum of bacteria as well (Fabry W *et al.*, 1998). Are limonoids involved here?

Other properties: *Harrisonia perforata* contains a series of limonoids including perforatinolone and perforatin, gallic acid (Sung TV *et al.*, 1994) and several

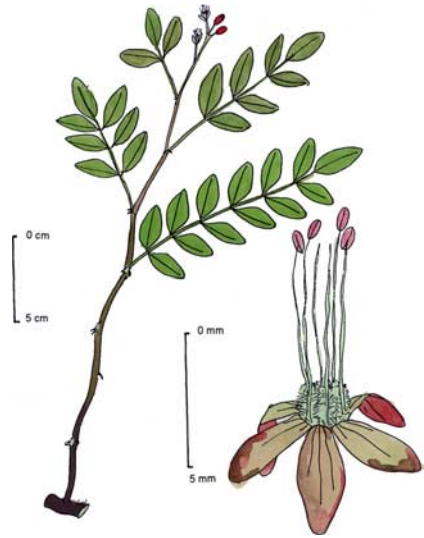
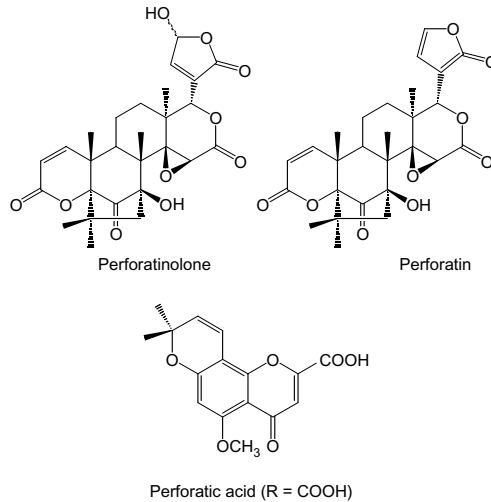


Fig. 234. *Harrisonia perforata* (Blanco) Merr. From: KLU Herbarium 34828. Flora of Sulawesi (Celebes), Indonesian – Dutch Expedition 1979, sponsored by WOTRO. Ex. Herb. Leiden. Botanical identification: H.P.N. Field collector: van Balgooy, date: 22 Apr 1979. Geographical localization: Central Sulawesi: 0° 30′–1° 30′ South–119° 30′–120° 30′ East., hills above Donggala, altitude: 100 m, secondary forest on dry calcareous soil.

Uses: *Harrisonia perforata* (Blanco) Merr. is used to treat amebic dysentery. In Vietnam, it is used to treat itchiness. In Indonesia and the Philippines, the plant is used to treat dysentery, diarrhea and cholera. In China, the root of this plant is used to prevent and treat malaria and boils.

types of chromones, such as perforatic acid (Takana T *et al.*, 1995; Wang MX *et al.*, 1983; 1984).



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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Picrasma javanica Bl.

[From Greek, *pikrasmos* = bitter plant and from Latin, *javanica* = from Java]

Physical description: It is a rainforest tree which grows to a height of 24 m and has a girth of 150 cm. The plant is found spanning Southeast Asia, Papua New Guinea and the Solomon islands. The bole is fluted, and the bark is dark, smooth, brittle with bitter, with the inner bark, yellowish with brownish sapwood. Leaves: compound, stipulate and fragrant. The stipules are leafy. The blade comprises of 5–7 medium-sized and very thin folioles attached to 7 mm long petiolules. The flowers are 4 and numerous and whitish, and comprise of a thick nectary disc and a few free carpels, each containing a single ovule. The fruits are green, red or blue drupes (Fig. 235).

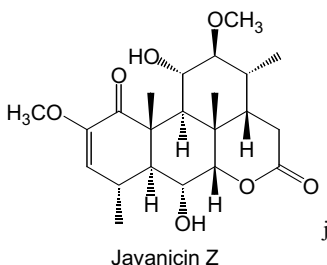
Common names: *Yee num* (Thai); *nalis* (Filipino).

Uses: The bark of *Picrasma javanica* Bl. is used in Java and Burma, instead of quinine to treat malaria.

Pharmaceutical interest: The antimalarial property of *Picrasma javanica* Bl. is not confirmed experimentally, but picrasane-type quassinoids and β -carboline alkaloids, with possible antiplasmodial properties, are known to occur in the plant (Koike K *et al.*, 1994; Ohmoto T *et al.*, 1989, Yoshikawa M *et al.*, 1993). Extracts of *Picrasma javanica* Bl. showed antibacterial activity *in vitro* (Khan MR *et al.*, 2001). It will be interesting to learn whether a more intensive study of the chemical constituents of this plant will reveal any molecules of therapeutic interest.



Fig. 235. *Picrasma javanica* Bl.



References

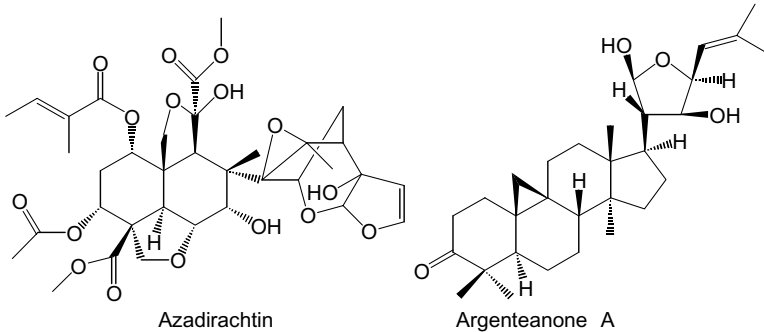
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Warning: Caution must be taken as the toxic effects of this plant are unknown.

4. Family MELIACEAE A. L. DE Jussieu 1789 *nom. conserv.*, the Mahogany Family

Physical description: The family Meliaceae consists of 51 genera and 550 species of tropical trees known to produce bitter oxygenated triterpenoids, including *limonoids* and *furanocoumarins*. Meliaceae are closely related to the Simaroubaceae and Rutaceae. The wood is dense, hard and of commercial value. The bark is bitter and astringent. The leaves are pinnate, alternate or

spiral. The inflorescence are axillary racemes of numerous tiny flowers. The calyx comprises of 3–5 valvate sepals. The corolla comprises of 3–5 petals alternate with the sepals. The andrecium is characteristically tubular and comprises of 6–10 stamens, the anthers of which are tetrasporangiate and dithecal. The gynecium consists of 2–5 carpels joining to form a compound, plurilocular ovary, with each locule containing a pair of ovules attached to axil placenta. The fruits are septicial or loculicial capsules that are occasionally berries or drupes, containing several seeds which are often winged.



Pharmaceutical interest: To the family Meliaceae belong a number of timbers such as *Swietenia mahogani* (L.) Jacq. (mahogany) and *Cedrela odorata* L. A classical example of medicinal Meliaceae is *Azadirachta indica* A. Juss. (*Azadirachta*, *Indian Pharmaceutical Codex*) or margosa, neem, the dried stem bark, root bark and leaves of which were used in India as a bitter and antiperiodic remedies, usually as an infusion (1 in 20; dose 4–8 mL). An oil expressed from the seeds (neem or margosa oil) has been used as a hair tonic and in skin diseases. From this species native to India has been characterized azadirachtin, a modified triterpene, which has been the focus of attention for its insecticidal properties. The limonoids of Meliaceae have attracted a great deal of interest due to their cytotoxic properties. One such limonoid is argenteanone from *Aglaiia argentea*, which inhibits the growth of KB cells at an IC_{50} value of 7.5 mg/mL. In the Asia-Pacific, *Aglaiia odorata* Lour., *Aphanamyxis rohituka* (Roxb.) Pierre, *Aphanamyxis grandifolia* Bl. (*Amoora aphanamyxis* Roem. & Schult.), *Azadirachta indica* A. Juss. (*Melia azedarach* L.), *Sandoricum koejape* (Burm. f.) Merr. (*Sandoricum indicum* Cav., *Sandoricum nervosum* Bl.). *Toona sinensis* (Juss.) Roem., *Toona surenii* (Bl.) Merr., *Trichilia connaroides* (Wight & Arn.) var. *microcarpa* (Pierre) Bentvelzen, *Chukrasia tabularis* A. Juss., *Walurea elata* Pierre, *Chisocheton penduliflorus* Planch. ex Hiern and *Swietenia mahogani* (L.) Jacq. are of medicinal value. Note that these plant species are often used to invigorate the body and to expel vermin. It will be interesting of

learn whether a more intensive study of Meliaceae will reveal any molecules of therapeutic interest.

***Swietenia mahogani* (L.) Jacq.**

[After Gerard van Swieten (1700–1772), Dutch botanist and physician to the Empress Maria Theresa, and from Mayan, *mahogani* = *Swietenia mahogani* (L.) Jacq.]

Synonymy: *Swietenia candolei* Pittier, *Swietenia krikovii* Gleason, *Swietenia belizensis* Lundel, *Swietenia macrophylla* King var. *marabaensis* Ledoux et Lobato, *Swietenia tessmanii* Harms.

Common name: Mahogany.

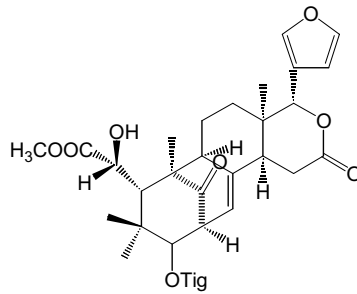
Physical description: It is a timber which grows to a height of 35 m and has a 2 m-diameter girth. The plant is native to South America and has been extensively planted in the Asia-Pacific and the Pacific, for the quality of its wood and the beauty of its massive crown. The bark is grey and smooth when the tree is young, turning ridged and flaky when older. Leaves: paripinnate, alternate, and 30 cm–35 cm long. The blade consists of 4–6 pairs of glossy, dark green, asymmetrical, 5 cm–8 cm × 3 cm – 6 cm folioles showing well-defined nervations. The flowers are very small and white, in large, 10–20 cm long panicles. The fruits are brownish, warty, 5-lobed, 12 cm–15 cm × 5 cm–8 cm capsules that split into valves. The capsules contain numerous woody, glossy, hand-made-like, smooth winged seeds of about 8 cm × 1.5 cm, tightly packed around a central columella [Fig. 235(a)].



Fig. 235. (a) *Swietenia mahogani* (L.) Jacq.

Pharmaceutical interest: The seeds of *Swietenia mahogani* Jacq. contain a series of limonoids, including swietenin-related swietemahonin A, D, E, and G and 3-O-acetylswietenolide and 6-O-acetylswietenolide which are very probably responsible for the uses mentioned above. These limonoids inhibit platelet-activating factor (PAF)-induced platelet aggregation, in *in vitro* and *in vivo* assays (Ekimoto H *et al.*, 1991). Extracts of *Swietenia mahogani* Jacq. display high antimicrobial and antiplasmodial activities *in vitro* (Goun E *et al.*, 2003; Munoz V *et al.*, 2000).

Uses: In Malaysia, a decoction of the seeds of *Swietenia mahogani* (L.) Jacq. is drunk to treat diabetes and to lower blood pressure.



Swietenin

References

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 Goun E, *et al.* (2003) *Fitoter* **74**(6): 592–596.
 Ekimoto H, *et al.* (1991) *Planta Med* **57**(1): 56–58.
 Munoz V, *et al.* (2000) *J Ethnopharmacol* **69**(2): 139–155.
 Saad MMG, *et al.* (2003) *Tetrahedron* **59**: 8027–8033.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

5. Family RUTACEAE A. L. de Jussieu 1789 *nom. conserv.*, the Rue Family

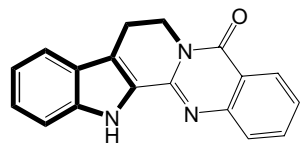
Physical description: The family Rutaceae consists of 150 genera and 1500 species of treelets or shrubs closely allied to Simaroubaceae and Meliaceae. Rutaceae are known to abound with *essential oils* (limonene), bitter oxygenated triterpenes (*limonoids*), essential oils, *flavonoids* (hesperidin), furanocoumarins, and several types of alkaloids, notably *carbazole* and *acridone* alkaloids. The leaves of Rutaceae are mostly compound, spiral, alternate or opposite, without stipules and the petiole is often winged or knee-shaped. Rutaceae are identifiable in field study by close examination of the blade which is dotted with translucent essential oil cells. Crushing leaves of Rutaceae often releases a lemon-like fragrance. The flowers are hermaphrodite, pure white and ephemeral. The calyx consists of 4–5 sepals which are imbricate, free or connate. The corolla is made of 4–5 petals which bend downwards. The andrecium



is more or less tubular and consists of 4–10 stamens which originate from a conspicuous nectary disc dotted with translucent essential oil cells. The gynecium consists of 4–5 carpels joined together into a compound, plurilocular and superior ovary, with each locule containing 1–2 ovules attached to axil placentas. The styles are free or connate. The stigma is protruding and globose. The fruits are baccate, succulent (hesperidia) or capsular.

Pharmaceutical interest: To the family Rutaceae belong several fruit trees and countless medicinal plants. *Citrus limon* (L.) Burm. f. (lemon), *Citrus aurantium* L. (sour orange), *Citrus sinensis* (L.) Osbeck (sweet orange), and *Citrus aurantifolia* (Chaism.) Swingle (lime), the oil of which is aromatic and of pharmaceutical value as a flavoring agent. The oil obtained by mechanical means from the fresh peel of the fresh orange *Citrus sinensis* (Orange oil, *Oleum Aurantii*, *British Pharmaceutical Codex*, 1963) has been used as a flavoring agent and in perfumery. Bergamot oil (*Oleum Bergamottae*, *British Pharmaceutical Codex*, 1949), obtained by expression from the fresh peel of the fruit of *Citrus bergamia*, has been used in perfumery in preparations for the hair (Cologne Spirit or *Spiritus Coloniensis*). Lemon oil (*Oleum Limonis*, *British Pharmaceutical Codex*, 1963), obtained by expression of fresh lemon peel (*Citrus limon*, *Citrus limonia*, *Citrus medica*), is carminative and used as a flavoring agent. The dry peel of *Citrus aurantium* (*Aurantii Cortex Siccatus*, *British Pharmacopoeia*, 1963) has been used as a flavoring agent and for its bitter and carminative properties. Of relative therapeutic importance are *Pilocarpus jaborandi* Holmes, *Ruta graveolens* L., *Agathosma betulina*, *Peganum harmala*, *Zanthoxylum americanum* and *Zanthoxylum clavaherculis*. *Pilocarpus jaborandi* Holmes produces an imidazole alkaloid, pilocarpine, which is occasionally used to treat glaucoma. An infusion of *Ruta graveolens* L. (common rue, herb of grace) has been used in Western medicine to promote menses. The oil of rue has also been used to stop spasms, and to produce skin irritation (Rue, *British Pharmaceutical Codex*, 1934). The dried leaves of *Agathosma betulina* (*Barosma betulina* or *buchu*) were used to promote urination. The dried seeds of *Peganum harmala* (wild rue) were used in India to expel intestinal worms and to induce drowsiness. The dried bark of *Zanthoxylum americanum* (northern prickly ash) and *Zanthoxylum clavaherculis* (southern prickly ash) have been used to treat flatulence (Zanthoxylum, toothache bark, Xanthoxylum, *British Pharmaceutical Codex*, 1934). The leaves of *Murraya koenigii* (curry leaves) are used to flavor Asian food.

In regard to pharmacological potentials, a number of experiments conducted *in vitro* and *in vivo* have demonstrated that Rutaceae is a storehouse of cytotoxic, antimicrobial, neuroactive, and musculotropic quinoleic alkaloids derived from anthranilic acid. Examples of such alkaloids are acronycine and rutaecarpine

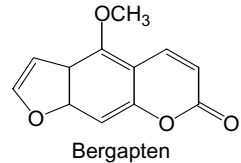


Rutaecarpine

characterized from *Acronychia baueri* Scott and *Euodia rutaecarpa* Hook. f., respectively.

Acronycine is cytotoxic and has undergone clinical trials, whereas rutaecarpine is uterotonic. Allocryptopine, an alkaloid characterized from *Fagara coca* and *Zanthoxylum brachycanthum* is more effective than quinidine in controlling atrial arrhythmia. Investigating the family Rutaceae for pharmacologically active natural products should be a fruitful task.

Furanocoumarins and especially bergapten are responsible of skin injuries after sun exposure through biochemical processes, which are still obscure. Bergamot oil, expressed from *Citrus aurantium* L. ssp. *bergamia* (Wight. and Arnott) Engler, causes after contact and sunlight exposure blisters and vesicles. The photodynamic sensitizing properties of furanocoumarins have been used to treat psoriasis but there are risks of gastrointestinal disorders, photosensitization and cancer. Note that a growing body of evidence suggests that coumarins of Rutaceae have potential for the treatment of tumors.



About 50 species of plants classified within the family Rutaceae are of medicinal value in the Asia-Pacific. Note that many of these plants are used to treat diseases of the respiratory tract, infections, to combat fever, and to promote digestion often on account of their essential oils.

***Acronychia laurifolia* Bl.**

[From Greek, *akros* = apical and *onux* = claw and from Latin, *laurus* = laurel and *folium* = leaf]

Synonymy: *Acronychia pedunculata* Miq., *Gela lanceolata* Lour.

Common names: Claw flowered laurel, laka wood; *bai bai* (Vietnamese); *chiang chen hsiang* (Chinese); *gambadak*, *mentua* (Malay); *muttainari* (Tamil).

Physical description: It is a tree of the lowland rainforest of Southeast Asia. Leaves: opposite, simple and entire. The blade is elliptic to oblong-elliptic, obscurely dotted with oil cells, leathery, and 5 cm–2.5 cm × 15 cm–5 cm. The blade shows 14–18

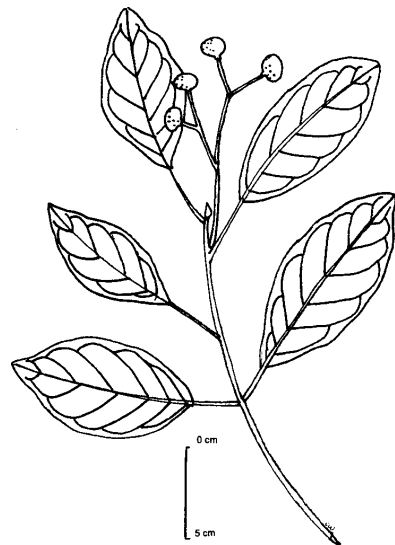


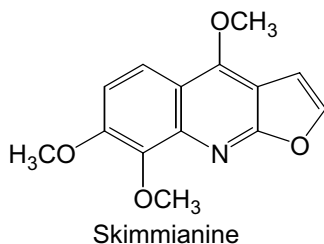
Fig. 236. *Acronychia laurifolia* Bl.

pairs of secondary nerves and prominent reticulations on both sides. The flowers are very small and arranged in axillary cymes. The sepals are triangular; the petals, lanceolate and hairy within; and the andrecium comprises of 8 stamens. The fruits are globose, green or cream and 4-locular hesperidia. The seeds are ovoid and black (Fig. 236).

Pharmaceutical interest:

Cytotoxic properties: *Acronychia* species are interesting because they produce a series of quinoline alkaloids which are cytotoxic. One such alkaloid is acronycine, first characterized from *Acronychia baueri*, which promotes the survival and multiplication of several types of cancer cell-lines cultured *in vitro* (it is, however, inactive in phase I). A bioassay-guided fragmentation of a methanolic root extract of *Acronychia laurifolia* Bl., using KB-V1 + human tumor cell-line, resulted in the characterization of a series of quinoline alkaloids, including evolitrine, skimmianine, kokusagine and maculosidine, which are mildly cytotoxic (Cui B *et al.*, 1999). Note that skimmianine is phototoxic, like furanocoumarins. 5,3-dihydroxy-3,6,7,8,4'-pentamethoxyflavone, characterized from *Acronychia porteri* Hook. f., inhibits the proliferation of KB cells cultured *in vitro* at an IC_{50} value of $1.2 \mu M$ (Lichius J *et al.*, 1994).

Uses: In China, the wood of *Acronychia laurifolia* Bl. is applied externally to treat bleeding. In Vietnam, a resin obtained from the roots is applied externally to assuage rheumatism pain. The bark and the leaves are used to soothe inflamed parts, to invigorate the body and to treat intestinal discomfort. In India, the leaves are used to treat smallpox.



References

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Lichius J, *et al.* (1994) *J Nat Prod* **5**: 1012–1016.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Atalantia monophylla* DC.**

[From Greek, *atalanta* = atalanta of the golden apples, *monos* = alone and *phullon* = leaf]

Common names: Wild lime; *merlimau* (Malay); *manaw phee* (Thai).

Uses: In Vietnam, the leaves of *Atalantia monophylla* DC. are used to treat diseases of the respiratory tract. In India, the oil expressed from the fruit is used to treat chronic rheumatism and paralysis. The juice expressed from the leaves is applied externally to treat hemiplegia.

Physical description: It is a prickly treelet of Southeast Asia. Leaves: simple, fragrant and alternate. The petiole is indistinct and shows at the base, a pair of little thorns. The blade is leathery, smooth, dotted with oil cells, and ovate to lanceolate. The base is acute, and the apex characteristically notched. The flowers are axillary; the calyx splits into a pair of irregular lobes; and the stamens are joined together into a tube. The fruits are small, globular, yellow, and succulent hesperidia (Fig. 237).

Pharmaceutical interest: Anti-herpes simplex virus type-2 (HSV-2)-guided fractionation of the leaves of *Atalantia monophylla* DC. resulted in the identification of pyropheophorbide (Chansakaow S *et al.*, 1996). The plant is also known to produce limonoids and acridone alkaloids (Dreyer DLR *et al.*, 1976; Gururaj H *et al.*, 1981). No recent reports on the pharmacological potential are available on this interesting medicinal species.

References

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

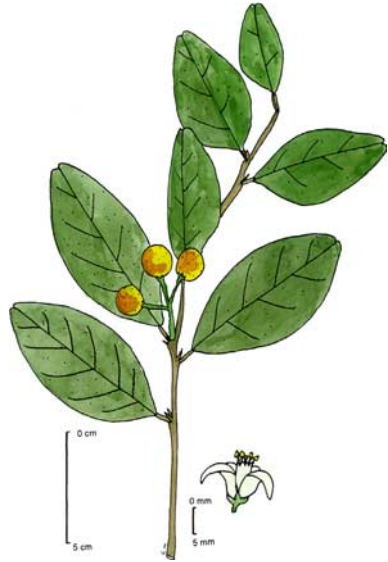


Fig. 237. *Atalantia monophylla* DC.

***Citrus grandis* (L.) Osbeck**

[From Latin, *citrus* = citron and *grandis* = large]

Synonymy: *Citrus maxima* (Burm.) Merr., *Citrus decumana* L.

Common names: Shaddock, Thai grapefruit; *limau bali*, *limau besar*, *limau betawi*, *limau serdadu* (Malay); *pamplemousse doux des Antilles* (French); *you, you zi* (Chinese); *riesenorange* (German); *pampaleone* (Italian); *jeruk bali* (Indonesian); *bhogate* (Nepalese).



Fig. 238. *Citrus grandis* (L.) Osbeck.

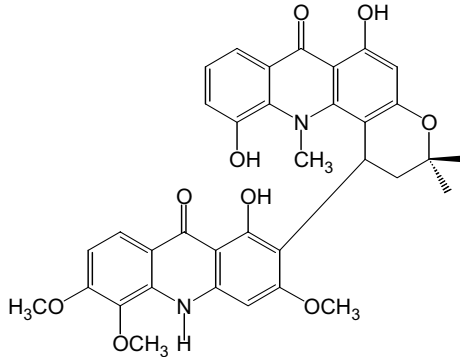
Physical description: It is a fruit tree native to Malaysia which is cultivated in southern China, southern Thailand, Taiwan, Japan, Indonesia, New Guinea and Tahiti. The first seeds are believed to have been brought to the New World late in the 17th Century by Captain Shaddock on his way to England and who stopped at Barbados. The tree grows to a height of 15m. The bole is not straight. The bark is greyish. The stems are angular, greenish, and hairy with single axillary spines at the apex. Leaves: simple and alternate. The petiole is broadly winged. The blade is ovate, ovate-oblong, or elliptic, 5 cm–20 cm × 2 cm–12 cm, leathery, glossy above, dull and minutely hairy beneath. The flowers are fragrant, solitary or packed in clusters by 2 to 10 in the leaf axils, or sometimes by 10 to 15 in the terminal 10 cm–30 cm long racemes. The calyx comprises of 4–5 sepals which are hairy. The corolla comprises of 4 to 5 petals. The petals are yellowish-white, 1.5 cm–3.5 cm long and somewhat hairy outside and dotted with yellow-green glands. The andrecium consists of 4–5 stamens which are prominent and grouped in a few bundles. The nectary disc is short and ring-like. The fruits are giant hesperidia which are pear-shaped, and to 30 cm in diameter (Figs. 238 and 239).



Fig. 239. *Citrus grandis* (L.) Osbeck.

Pharmaceutical interest: The peel of *Citrus grandis* (L.) Osbeck abound with neohesperidoside flavanones and essential oils which are responsible for their carminative and anti-inflammatory properties. Note that flavonoids of *Citrus* or citroflavonoids are of value for the treatment of vascular disorders (Hesperidin, Martindale, 1967). *Citrus grandis* (L.) Osbeck is also known to produce coumarins, limonoids, and acridone alkaloids (Wu TS *et al.*, 1993; 1996). It will be interesting to learn whether a more intensive study of the acridone alkaloids of this plant, such as buntanbismine, will reveal any molecules of therapeutic interest.

Uses: In the Asia-Pacific, a decoction of the leaves, flowers, and rind of *Citrus grandis* (L.) Osbeck are used to treat epilepsy, chorea and convulsive coughing. A hot leaf decoction is applied to swellings and ulcers. The fruit juice is drunk to combat fever. In China, the peel is used to promote digestion, stop vomiting, treat cholera, assuage itchiness and heal boils. A decoction of the leaves is used to dispel humors and assuage inflammation. In Laos, Cambodia and Vietnam, the dried young fruits are used to promote digestion. In the Philippines, an infusion of leaves, flowers and peel is used to treat anxiety.



Buntanbismine

References

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 Wu TS, *et al.* (1993) *Phytochem* 36(1): 217–219.
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Warning: The plant has a number of photodynamic sensitizing psoralens (Allan K *et al.*, 2002).

***Clausena excavata* Burm. f.**

[After Clausen, a botanist, and from Latin, *cavus* = hollow]

Synonymy: *Clausena lunulata* Hay.,
Clausena moringerae, *Lawsonia*
falcata Lour.

Common names: *Seitnan* (Burmese);
santhrok damney (Cambodian);
cherek hitam, *chenama* (Malay).

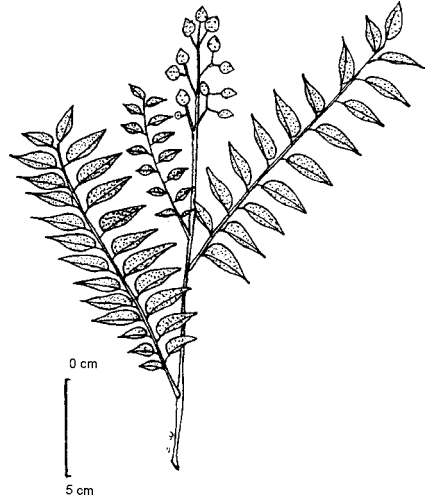


Fig. 240. *Clausena excavata* Burm. f.

Physical description: It is a treelet which grows to a height of 4 m. It is found wild or cultivated in a geographical area which covers India through Southeast Asia. The stem is smooth and darkish. The wood is whitish. Leaves: pinnate, fragrant, consisting of up to 30 pairs of folioles. The folioles are 3 cm × 8 cm and conspicuously dotted with oil cells. The inflorescences are terminal panicles of small flowers which are white and fragrant. The flowers consist of 5 sepals, 5 petals, and up to 10 stamens. The fruits are small, globular and succulent, reddish herperidia (Fig. 240).

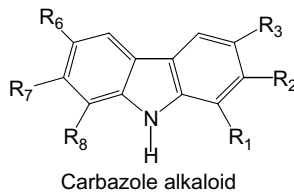
Pharmaceutical interest:

Antiplatelet aggregating and analgesic properties: Clausine D and F, 2, 4-prenylcarbazole alkaloids, characterized from the stem bark of *Clausena excavata* Burm. f., inhibit significantly the aggregation of platelets (Wu TS *et al.*, 1992). Further studies have resulted in the characterization of a series of 4-prenylcarbazole alkaloids, which inhibit the aggregation of platelets and causing vasoconstriction (Wu TS *et al.*, 1996). The ethanolic extract of *Clausena excavata* Burm. f., leaves, given orally at doses of 125 µg/Kg, 250 µg/Kg and 500 µg/Kg body weights, respectively protect mice against the pain caused by acetic acid (Rahman MT *et al.*, 2002). One might set the hypothesis that the antifebrile and anti-inflammatory properties are due to

Uses: In Indonesia, the leaves are used to expel worms and to combat fever. In Malaysia, this plant is applied externally to treat skin diseases. In Taiwan, a decoction of the roots is used to combat fever. In Vietnam, *Clausena excavata* Burm. f. is used to promote menses, and to invigorate the body. In Cambodia, the stems are bitter, taken as a tonic and or used as an astringent. In India, *Clausena excavata* Burm. f. is used to promote urination and to treat flatulence.

the inhibition of the enzymatic activity of cyclo-oxygenases by alkaloids. Note that an extract of wood exhibits immunomodulatory properties (Manosroi A *et al.*, 2004).

Antitumor properties: A number of clauslactones, furanone-coumarins, characterized from the leaves and stems of *Clausena excavata* Burm. f. inhibit the early expression of Epstein-Barr virus (EBV) antigen induced by 12-*O*-tetradecanoylphorbol-13-acetate (TPA) on the surface of Raji cells, indicating an antitumor potential (Takemura Y *et al.*, 2000; Ho C *et al.*, 2000). Clausemine A, isolated from the stem and root bark of *Clausena excavata* Burm. f., is cytotoxic against a variety of human cancer cell-lines cultured *in vitro*. (Zhang A *et al.*, 2000). Note that carbazole alkaloids are planar and therefore possibly intercalating agents.



Antimicrobial properties: Dentatin, nor-dentatin, clausenidin, 3-formyl-carbazole, mukonal, 3-methoxycarbonylcarbazole, 2-hydroxy-3-formyl-7-methoxycarbazole and clauszoline J, characterized from *Clausena excavata*, exhibit antimycobacterial activity at minimum inhibiting concentrations values of 50 $\mu\text{g/mL}$, 100 $\mu\text{g/mL}$, and 200 $\mu\text{g/mL}$, respectively. 3-Formyl-carbazole, mukonal, 3-methoxycarbonylcarbazole, and 2-hydroxy-3-formyl-7-methoxycarbazole show antifungal activity at IC_{50} values of 13.6 $\mu\text{g/mL}$, 29.3 $\mu\text{g/mL}$, 9.5 $\mu\text{g/mL}$ and 2.8 $\mu\text{g/mL}$, respectively (Sunthitikawinsakul A *et al.*, 2003). It will be interesting to learn whether a more intensive study of the antiviral properties of carbazoles of *Clausena* species and Rutaceae in general will reveal any molecules of therapeutic usefulness.

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 Takemura Y, *et al.* (2000) *Chem Pharm Bull* (Tokyo) **48**(4): 582–584.
 Wu TS, *et al.* (1992) *Chem Pharm Bull* (Tokyo) **40**(4): 1069–1071.
 Wu TS, *et al.* (1996) *Phytochem* **43**(1): 133–140.
 Zhang A, *et al.* (2000) *Bioorgan Med Chem Lett* **10**(10): 1021–1023.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Euodia latifolia* DC.**

[From Greek, *eu* = good and *odion* = smell and from Latin, *latus* = broad and *folium* = leaf]

Synonymy: *Euodia accedens* Bl.

Common name: *Pepau* (Malay).

Uses: In Malaysia and Indonesia, the leaves of *Euodia latifolia* DC. are applied externally to combat fever.

Physical description: It is a tree which grows to a height of 8 m in the jungle paths and riversides of the Malaysian, Thai, Javanese and Moluccan rainforests. The young stems are obscurely 4-angled, tawny hairy, and slightly compressed at the nodes. Leaves: trifoliolate, oblong elliptic, 10 cm–25 cm × 5 cm–10 cm, and softly hairy on both surfaces. The apex of the blade is acuminate and the base, asymmetric. The folioles are broadly elliptic, light green, leathery, tomentose on both surface, and shows 10–18 pairs of secondary nerves. The inflorescences are cymes of tiny flowers. The fruits are 2–4 globose, oblong and slightly compressed papery follicles (Fig. 241).

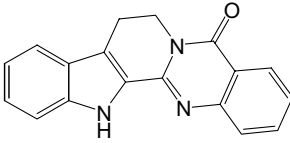


Fig. 241. *Euodia latifolia* DC.

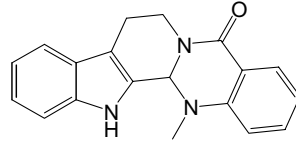
Pharmaceutical interest: *Euodia* species have attracted a great deal of a interest on account of a series of planar quinazolinocarboline alkaloids such as rutaecarpine. The therapeutic potential of *Euodia latifolia* DC. remains unexplored.

Cardiovascular properties: Rutaecarpine characterized from *Euodia rutaecarpa*, relaxes vascular smooth muscles from rat thoracic aorta, and muscle strips from rabbit internal anal sphincter (Jian JK *et al.*, 2000). It is also an effective antiplatelet agent *in vivo*. (Sheu JR *et al.*, 2000). Rutaecarpine and evodiamine show positive inotropic and chronotropic effects on the guinea-pig isolated atria (Kobayashi Y *et al.*, 2001). Evodiamine protects mice against liver and lung metastasis (Ogasawara M *et al.*, 2002). One might set the hypothesis that the antiplatelets activity of rutaecarpine and carboline alkaloid in general can be attributed to the inhibition of cyclo-oxygenase-2 and cyclo-oxygenase-1, as demonstrated *in vitro* at an IC₅₀ of 0.28 μM and 8.7 μM,

respectively (Moon TC *et al.*, 1999). Such a mechanism of action would also explain the antifebrile and anti-inflammatory properties of Rutaceae.



Rutaecarpine



Evodiamine

Antiviral properties: A bioassay-guided fractionation of an extract of *Euodia roxburghiana* resulted in the characterization of quinoline alkaloids: buchapine 1 and 2, which protect CEM-SS cells from the human immunodeficiency virus type-1 *in vitro*, at an EC₅₀ of 0.94 mM and 1.64 mM, respectively (Mc Cormick JL *et al.*, 1996). Is rutaecarpine involved here?

References

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 Moon TC, *et al.* (1999) *Inflamm Res* **48**(12): 621–625.
 Ogasawara M, *et al.* (2002) *Biol Pharm Bull* **25**(11): 1491–1493.
 Sheu JR, *et al.* (2000) *Br J Haematol* **110**(1): 110–115.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Micromelum hirsutum Oliv.

[From Greek, *mikro* = small, *melon* = apple and from Latin, *hirsutus* = hairy]

Physical description: It is a low rainforest shrub of Southeast Asia. Leaves: compound and spiral. The blade comprises of 2–3 pairs of folioles which are hairy, ovate and obscurely dotted with oil cells. The base of the folioles is asymmetric. The margin is slightly dentate. The flowers are arranged in terminal and hairy panicles, comprising of 5 sepals, 5 petals, and 10 stamens. The fruits are hairy hesperidia dotted with oil cells (Fig. 242).

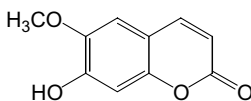


Fig. 242. *Micromelum hirsutum* Oliv.

Pharmaceutical interest:

Cytotoxic properties: The therapeutic potential of *Micromelum hirsutum* Oliv. would be worth being assessed as *Micromelum* species are known to produce cytotoxic coumarins. An extract of *Micromelum integerrimum* (Buch.-Ham. ex Coleb.) M. Roem. inhibits the proliferation of P388 lymphocytic leukemia cells in mice. Further fractionation of this extracts resulted in the characterization of coumarins: micromelin and scopoletin (Cassady JM *et al.*, 1979). Micromarin-A, B, C, F, G, and H have been characterized from the stems of *Micromelum minutum* Wight. et Arn (Ito C *et al.*, 2000); these are very probably cytotoxic.

Uses: In Indonesia and Malaysia, the pounded leaves are applied externally to treat skin diseases and to soothe inflamed parts. A decoction of the roots is used to combat fever. Malays chew a bit of leaves to treat vertigo and use a tea of the leaves to treat gout.



Scopoletin

References

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Cassady JM, *et al.* (1979) *J Nat Prod* **42**(3): 274–278.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Murraya paniculata* (L.) Jack**

[After J. A. Murray, 1740–1791, a pupil of Linnaeus, and from Latin, *panus* = ear of millet]

Physical description: It is a common ornamental shrub of Asia, Southeast Asia and Australia. Leaves: alternate, small, and pinnate. The blade consists of 3–7 folioles. The folioles are alternate spatulate, 2 cm × 1.4 cm, dark green, leathery, obscurely dotted, and glossy. The inflorescences are arranged in terminal or axillary panicles of showy, pure white and fragrant flowers. The corolla consists of 5 sepals and 5 petals, the latter overlapping. The andrecium comprises of 10 stamens

Synonymy: *Murraya exotica* L.

Common names: *Kemuning* (Malay); *makay* (Burmese); *shan fan* (Chinese); *buis de Chine* (French); *cut gie* (Vietnamese).



Fig. 243. *Murraya paniculata* (L.) Jack.



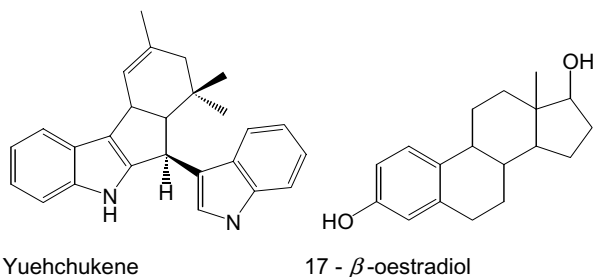
Uses: In China, a decoction of the leaves is used to assuage stomachache, check dysentery and counteract putrefaction. In Vietnam, the leaves are used to stop dysentery and combat fever. In Malaysia, the leaves are used to assuage toothache. In the Philippines, the leaves are used to promote menses, invigorate the body, and stop diarrhea and dysentery, where the bark is used to stop diarrhea.

with slightly flattened filaments around a well-developed nectary disc. The gynecium consists of 2–5 carpels, joined together to form a plurilocular ovary, with each locule containing a pair of ovules. The style is long, slender and the stigma, globular. The fruits are small, hesperidia with a mucilaginous pulp, and they turn from green to reddish (Fig. 243).

Pharmaceutical interest:

Estrogenic properties: *Murraya paniculata* (L.) Jack produces yuehchukene, a bisindole alkaloid (Kong YC *et al.*, 1985), which inhibits 100% of gestation when given *per os* or subcutaneously to female mice at a dosage of 2 mg/Kg/day or 4 mg/Kg/day on day 1–3 of gestation. At a dosage of 2 mg/Kg/day or 4 mg/Kg/day for 3 days, it increases the uterine weight in immature mice (Wang NG *et al.*, 1990). Yuehchukene is both estrogenic and antiestrogenic, although structurally rather different from oestradiol. It binds to rat, mice and MCF-7 cell estrogen receptors with a relative binding affinity of 1/150 to 1/300, hence the estrogenic activities. It has been suggested that the free indole moiety of catabolized yuehchukene induces estradiol-2-hydroxylase which is responsible for the catabolism of estrogen (Ng PC *et al.*, 1994). It will be interesting to learn whether a more intensive study of bis-indoles from the genus *Murraya*

will reveal any molecules of therapeutic interest for the treatment of estrogen dependent-cancers.



Other pharmacological properties: Murranganone and paniculatin characterized from the leaves inhibit the enzymatic activity of cholinesterase inhibitors, hence the gastralgic mentioned above (Chowdhury MI *et al.*, 2002). 9-Formyl-3-methylcarbazole, characterized from *Murraya koenigii* (curry), inhibits moderately the proliferation of both mouse melanoma B16 and adriamycin-resistant mouse leukemia cell-lines cultured *in vitro* (Chakrabarty M *et al.*, 1997). The leaves of *Murraya koenigii* given to high fat diet-induced rat, reduced the peroxidation level to a beneficial extent (Khan BA *et al.*, 1997).

References

- Chakrabarty M, *et al.* (1997) *Phytochem* **46**(4): 751–755.
 Chowdhury MI, *et al.* (2002) *Planta Med* **68**(1): 81–83.
 Khan BA, *et al.* (1997) *Indian J Exp Biol* **35**(2): 148–150.
 Kong YC, *et al.* (1985) *Planta Med* **4**: 304–307.
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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Paramignya scandens* (Griff.) Craib. var. *ridleyi

[From Greek, *paramignunai* = to mix in and from Latin, *scandere* = climb]

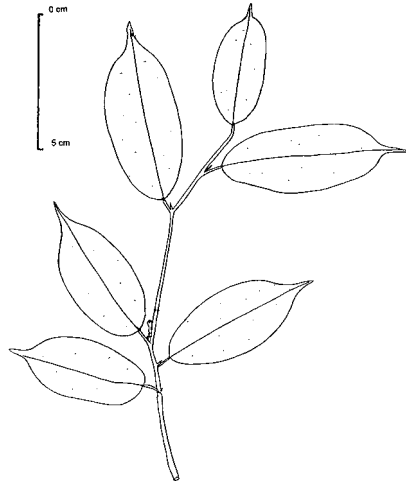
Physical description: It is a woody climber of the Malaysian rainforest. The stems are glabrous or scurfy, slender and prickly, and the bark is whitish.

Leaves: simple and exstipulate. The petiole is curved and 5 mm long. The blade is obscurely dotted with oil cells, very thin, 5 cm–7.5 cm \times 1.25 cm and blunt with a short tip at the apex. The base of the blade is rounded, hairy below, and

Synonymy: *Paramignya ridleyi* Burkill,
Paramignya griffithii Hk. f.

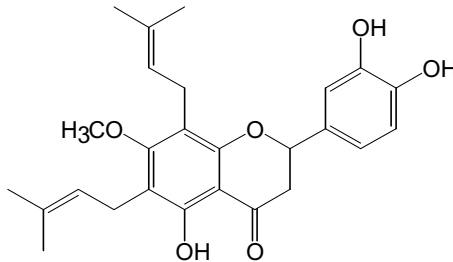
shows 6 pairs of secondary nerves. The flowers are white, fragrant, solitary, axillary, and 5-merous. The sepals are rounded and hairy and the petals are linear oblong, 1 cm long, and white. The ovary is hairy except for the style. The fruits are globular and ovoid hesperidia minutely dotted with oil cells, blunt at the apex and 8 mm long. The fruits contain a pair of large flattish seeds (Fig. 244).

Uses: In Malaysia, a decoction of the roots is drunk to assuage abdominal discomfort, while a decoction of the whole plant is used to treat syphilis.



Pharmaceutical interest: The therapeutic potential of this climber remains unexplored. The plant is known to produce a series of prenylated flavanones such as amoradicin, the pharmacological properties of which are not yet known. Are these flavonoid antibacterial and/or cytotoxic? (Wattanapiromsakul C *et al.*, 2000).

Fig. 244. *Paramigyna scandens* (Griff.) Craib. From: KLU Herbarium 13253. Flora of Malaya. Dec 1970. Penang. Field collector: JR Lewis. Botanical identification: Benjamin C Stone.



Amoradicin

Reference

Wattanapiromsakul C, *et al.* (2000) *Phytochem* **55**: 269–273.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Zanthoxylum nitidum* (Roxb.) DC.**

[From Greek, *zanthos* = yellow and *xylon* = wood and *nitidum* = glossy]

Synonymy: *Zanthoxylum hirtellum* Ridl., *Zanthoxylum torvum* F. Muell., *Fagara nitida* Roxb.

Common name: Prickly ash; *hantu duri* (Malay).

Physical description: It is an aromatic climbing shrub of the rainforests of Malaysia, India, south China, Vietnam, Cambodia, Laos, Thailand, Indonesia and the Philippines. The bark is pale brown, smooth, and thin. The wood is light yellow. The stems are armed with solid woody prickles. Leaves: alternate and pinnate. The petiole is very narrowly winged. The blade consists of 5–9 pairs of folioles. The inflorescences are axillary panicles of little 4–5 merous flowers. The fruits consist of 4–5 follicles containing ovoid-subglobose glossy and blackish-brown seeds (Fig. 245).



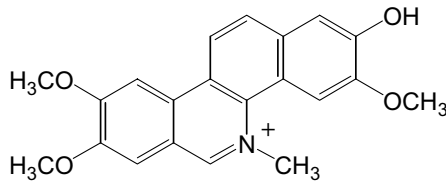
Fig. 245. *Zanthoxylum nitidum* (Roxb.) DC.

Pharmaceutical interest:

Cytotoxic properties: *Zanthoxylum* species are interesting for producing series of cytotoxic benzophenanthridine alkaloids, such as fagaronine characterized from *Fagara zanthoxyloides*, and nitidine characterized from *Fagara macrophylla* and *Zanthoxylum nitidum*. Nitidine was selected for therapeutic development based on its exceptional antileukemic property, but its use was discontinued as it was too toxic.

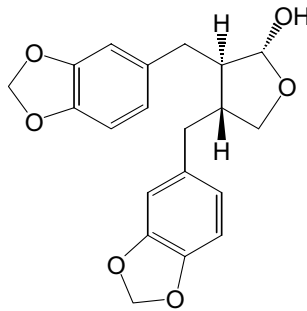
Uses: The fruits are often used to assuage toothache. In China, the fruits are used to treat cholera and expel intestinal worms. In Taiwan, a decoction of the leaves is drunk to combat fever. The fruits are used to combat fever, invigorate the body and promote menses. The dried pericarp of the dried fruit of various *Zanthoxylum* species were official in Japan (*Zanthoxylum* Fruit, *Japanese Pharmacopoeia*, 1961)

Other pharmacological properties: An extract of *Fagara zanthoxyloides* inhibits the proliferation of cariogen bacteria (Taiwo O *et al.*, 1999). Berberine,



Fagaronine

characterized from *Zanthoxylum clava-herculis*, is known to be a broad spectrum antibacterial isoquinoline alkaloid. Allocryptotine characterized from *Zanthoxylum brachycanthum* is more effective than quinidine for treating atrial arrhythmia. Crystal-8, a natural product characterized from *Zanthoxylum nitidum* (Roxb.) DC, displayed an analgesic property (Hong GX *et al.*, 1983).



Cubebin

Note that Cubebin, a dibenzylbutyrolactone lignan isolated from the crude hexane extract of the leaves of *Zanthoxylum naranjillo*, protects rats against edema induced by carrageenan and prostaglandin PGE₂, and protects mice against pain caused by both acetic acid and PGI₂ in mice (Bastos JK *et al.*, 2001). One might set the hypothesis that the antifebrile and anti-inflammatory uses mentioned above involve inhibition of cyclo-oxygenases via alkaloids.

References

- Bastos JK, *et al.* *J Ethnopharmacol* **75**: 279–282.
 Hong GX, *et al.* (1983) *Yao Hsueh Hsueh Pao* **18**(3): 227–230.
 Taiwo O, *et al.* (1999) *Phytother Res* **13**(8): 675–679.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

L. Order GERANIALES Lindley 1833

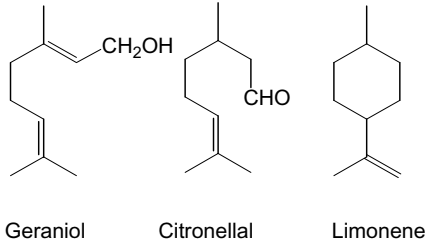
The order Geraniales consists of 5 families and about 2600 species of herbs and shrubs, believed to have originated through development from the order Sapindales (Appendix I). The main chemical weapons used in Geraniales are *hydrolysable tannins* inherited from the Rosales via the Sapindales. The largest families of this order are the Oxalidaceae (900 species), Balsaminaceae (900 species), and Geraniaceae (700 species).

1. Family GERANIACEAE A. L. de Jussieu 1789 *nom. conserv.*, the Geranium Family

Physical description: The family Geraniaceae consists of 11 genera and about 700 species of herbs or shrubs known to produce *hydrolysable tannins*, and essential oils. Geraniaceae are widespread in temperate and warm-temperate regions. The largest genera are *Geranium* (300 species) and *Pelargonium* (250 species). The leaves of Geraniaceae are alternate or opposite, mostly lobate, dissected or compound, and stipulate. The stipules are often paired. The flowers are hermaphrodite, actinomorphic, axillary, and solitary to subumbellate. The calyx comprises of 4–5 vestigial sepals which are free or connate to the middle. The sepals are imbricate or, rarely, valvate, with the dorsal one sometimes spurred. The corolla consists of 5 petals which are imbricate. The andrecium consists of 12–15 stamens. The filaments are connate at the base. The anthers are 2-locular and open lengthwise. The gynecium consists mostly of 5 carpels joining to form a compound and plurilocular lobed or grooved ovary, with each locule containing 1–2 ovules, superposed, pendulous and attached to axile placentas. A single style with distinct stigmas is present. The fruits usually consist of 5 mericarps, with each enclosing a single seed. The mericarps separate elastically and acropetaly from a vestigial central column.

Pharmaceutical interest: A large number of Geraniaceae are ornamental. The so-called bedding and greenhouse “Geranium” is in fact a *Pelargonium*. In regard to pharmaceutical interest, the volatile oil obtained by distillation of the aerial part of various *Pelargonium* species, including *Pelargonium graveolens*., has been used in Western countries to make perfumed cosmetics (Geranium Oil, *British Pharmaceutical Codex*, 1959). The very distinctive fragrance of geranium oil is attributed to a subtle mixture of terpenes, including geraniol, linalool, citronellal and limonene, which cause contact dermatitis in sensitive individuals. To date, the pharmacological potentials of Geraniaceae are virtually unexplored and one might say that antiviral and cytotoxic principles are yet awaiting discovery. *Erodium stephanianum* Willd., *Geranium*

japonicum Franch. & Sav., *Geranium maximowiczii* Regel & Maack, *Geranium soboliferum* Kom., *Geranium wildfordii* Maxim., *Geranium sibiricum* L., and *Geranium nepalense* Sweet are used in China, Korea and Japan to assuage pain and to resolve inflammation.



Geranium nepalense Sweet

[From Greek, *geranos* = crane and from Latin, *nepalense* = from Nepal]

Common names: Nepalese crane's bill; *mang miao*, *mang niu* (Chinese); *bhanda* (Hindi).

Physical description: It is a perennial herb which grows to a height of 60 cm. The plant is common in India, Ceylon, China, Japan and Himalaya. The stems are prostrate, and hairy at the apex. Leaves: opposite, simple, and stipulate. The stipules are lanceolate, suglabrous, and 2.5 mm × 1 mm. The petiole is 2.5 cm–4.5 cm long, slender and hairy. The blade is 3-lobed, with each lobe being deeply incised, subglabrous above and below and 2.4 cm × 3 cm–1.8 cm × 2 cm. The margin is recurved. The secondary nerves are indistinct above and raised below. The inflorescences are axillary or terminal and solitary. The flower pedicels are hairy and 1.5 cm–2 cm long. The flowers are small and purplish; the calyx comprises of 5 sepals

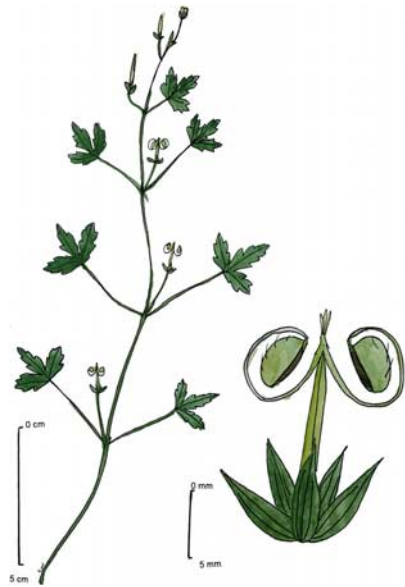
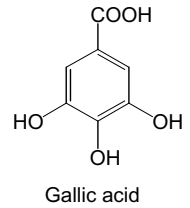


Fig. 246. *Geranium nepalense* Sweet. From: Delhi University Herbarium 004332. Geographical localization: A long way to Mossy Falls-Mussoorie, altitude: 1000 feet, India, 18 Sep 1957. Field collector & botanical identification: PS Sabbarwal.

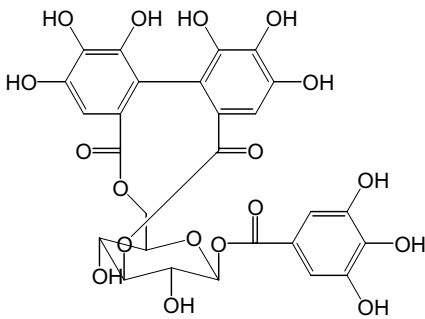
which are lanceolate, hairy, 3 mm × 1.5 mm and 3-nerved. The petals are 5 mm × 2 mm. The gynecium is fusiform and hairy, containing 5 stigmas at the apex. The fruits are capsular, fusiform, and open explosively, from a central column of about 1 cm long and 1 mm diameter. The seeds are ellipsoid, brown, alveolate and 2 mm × 1.2 mm (Fig. 246).



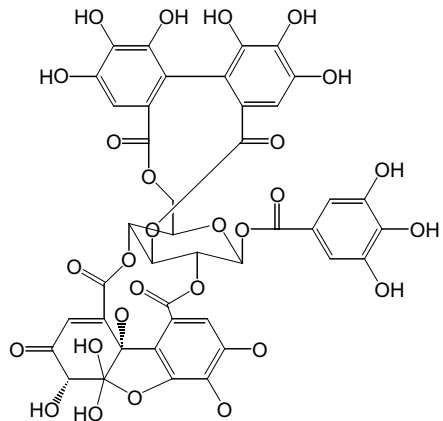
Pharmaceutical interest: The pharmacological properties of *Geranium nepalense* Sweet are unexplored, but one might set the hypothesis that hydrolysable tannins, which abound in *Geranium* species such as ellagin and corilagin, are responsible for the uses mentioned above and for the biological activities measured so far in *Geranium* species.

Uses: In China, *Geranium nepalense* Sweet is used to promote blood circulation, strengthen bones and tendons, assuage pain, and treat rheumatism and nervous diseases.

Antiviral and antibacterial properties: Extracts of *Geranium sanguineum* L. inhibit the growth of the herpes simplex virus-1 (HIV-1) (Serkedjieva J *et al.*, 1999). A methanolic extract of *Geranium phaeum* inhibits the enzymatic activity of HIV-1-reverse-transcriptase at an IC₅₀ value of 0.067 mg/mL (MLinaric A *et al.*, 2000), probably due to the presence of geraniin and corilagin, which inhibit the replication of human immunodeficiency virus type-1 in HeLa CD4+ cells at an EC₅₀ value of 0.24 μg/mL (Notka F *et al.*, 1999). *Geranium* extracts protect mice against Gram-negative *Klebsiella pneumoniae* infection (Ivancheva S *et al.*, 1992).



Corilagin



Geraniin

Antioxidant properties: Note that a series of phenolic substances, characterized from the aerial parts of *Geranium pratense* subsp. *finitum*, are found to be effective against free radical-induced impairment of endothelium-dependent relaxation in isolated rat aorta (Akdemir ZS *et al.*, 2001). Are tannins hypotensive due to their anti-oxidant properties? Do they scavenge nitric oxide?

Anti-inflammatory properties: In regard to the antirheumatic property mentioned above, geraniin inhibits tumor necrosis factor- α (TNF- α) at an IC₅₀ value of 43 μ M for geraniin. It also inhibits okadaic acid tumor promotion in a two-stage carcinogenesis experiment on mouse skin (Fujiki H *et al.*, 2003).

References

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Ivancheva S, *et al.* (1992) *Basic Life Sci* **59**: 717–726.
MLinaric A, *et al.* (2000) *Pharmazie* **55**(1): 75–77.
Notka F, *et al.* (1999) *Antiviral Research* **58**: 175–186.
Serkedjieva J, *et al.* (1999) *J Ethnopharmacol* **64**(1): 59–68.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family BALSAMINACEAE A. Richard 1822 *nom. conserv.*, the Touch-me-not Family

Physical description: The family Balsaminaceae consists of 2 genera and about 600 species of herbs native to Africa and tropical Asia. Balsaminaceae are known to produce *naphthoquinones*. The leaves in this family are simple, entire or merely lobed, alternate, opposite or whorled and obscurely stipulate. The inflorescences are terminal or axillary, solitary or small umbelliform cymes. The flowers are blue, white, pink, or yellow, hypogenous, strongly irregular and resupinate. The calyx consists of 3–5 petaloid sepals, with the 2 upper ones obsolete, the lowest ones petaloid, and one of them forms a conspicuous retrorse spur. The corolla is tubular and 5-lobed. The andrecium consists of 5 stamens supported by short filaments, forming a deciduous calyptra over the ovary. The gynecium consists of 4–5 carpels joining to form a compound 4–5-locular ovary, with each locule containing a number of ovules (*Impatiens*) or a single one (*Hydrocera*) attached to axil placentas. The fruits are capsules which are explosively dehiscent (*Impatiens*) or drupes (*Hydrocera*).

Pharmaceutical interest: A number of plants classified within the genus *Impatiens* are used to decorate gardens. *Impatiens balsamina* L., *Impatiens platypetala* Lindl. and *Impatiens mooreana* Schltr. are of medicinal value in the Asia-Pacific. It will be interesting to learn whether a more intensive study of Balsaminaceae will reveal any naphthoquinones of chemotherapeutic interest.

***Impatiens balsamina* L.**

[From Latin, *impatiens* = impatient and *balsamum* = balsam]

Common names: Balsam plant; *bunga embung* (Malay); *dandalet*, *panshit* (Burmese); *feng hsien* (Chinese); *balsamien* (Dutch); *balsamine des jardins*, *jalousie*, *merveille à fleurs jaune* (French); *adornos* (Spanish).

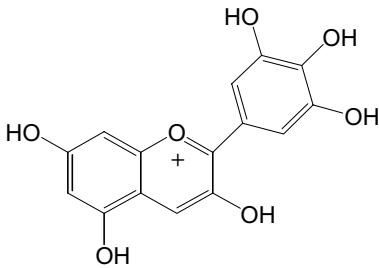
Physical description: It is an annual herb native to India. It grows to a height of 90 cm. The stems are succulent, glabrous or pubescent, and slightly branched. Leaves: simple, alternate, and 15 cm long. The blade is lanceolate, acuminate, deeply serrate, and glabrous. The flowers are pink and showy. The sepals are very small and ovate and develop a short or long and incurved spur. The corolla comprises of small orbicular and horned standard, broad wings, and round lateral lobes; the terminal one is sessile, and very large. The lip is small, boat-shaped, and mucronate. The fruits are hairy and capsular and contain several seeds which are reticulate (Fig. 247).



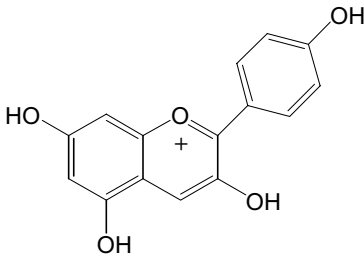
Fig. 247. *Impatiens balsamina* L.

Pharmaceutical interest:

Anti-inflammatory properties: The anti-inflammatory property of *Impatiens balsamina* L. is confirmed *in vitro* and involves anthocyanidins, coumarins and quinones. An ethanolic extract of flowers of *Impatiens balsamina* L. shows, *in vivo*, antianaphylactic, antipruritic and antihistaminic properties (Fukomo H *et al.*, 1995; Ishiguno K *et al.*, 1992). The aerial parts and especially the flowers and stems of *Impatiens balsamina* L. contain pelargonidine, delphinidine, cyanidine or malvidine, which are well-known to decrease capillary permeability and fragility and are therefore used to treat edema. These anthocyanidins are probably effective due to their ability to scavenge free radicals. It is also thought to be due to the collagen of the vascular wall in the control of the permeability of that wall, which may involve an inhibition of the proteolytic degradation enzymes (elastase, collagenase). This “vitamin P” property led to the use of anthocyaninin-containing drugs for the symptomatic treatment of venous insufficiency and capillary fragility (phlebology, proctology or gynecology).



Delphinidine



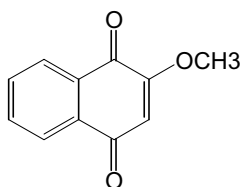
Pelargonidine

Dinaphthofuran-7-12-dione derivatives, namely balsaminones A and B, and a 2-methoxy-1,4-naphthoquinone characterized from the pericarp of *Impatiens balsamina* L., are antipruritic (Ishiguno K *et al.*, 1998), by a probable inhibition of the

platelet activating factor (Oku H *et al.*, 1999). Furthermore, *Impatiens balsamina* L. contains a number of coumarins such as scopoletin, which exert anti-inflammatory and analgesic properties (see *Justicia gendarussa*). Note that scopoletin is cytotoxic (see *Micromelum hirsutum* Oliv.).

Other pharmacological properties: A series of closely related cysteine-rich peptides, characterized from the seeds, inhibit the proliferation of several types of fungi and bacteria, while not being cytotoxic to cultured human cells, thereby substantiating their antiseptic property (Tailor RH *et al.*, 1997). Note also that 2-methoxy-1,4-naphthoquinone inhibits the growth of a large number of gram-positive and gram-negative bacteria and fungi cultured *in vitro* (Yang X *et al.* 2001).

Uses: In China, the seeds of *Impatiens balsamina* L. are used to facilitate difficult labor, assuage puerperal pain, regulate menses, combat cough, stop hiccups and counteract poisoning. Mixed with arsenious acid, the seeds are used in extracting teeth. A decoction of the older parts of the plant is drunk to dispel humors, clean abscesses, and soothe swollen parts of. The stems are used to promote blood circulation, assuage pain, and to treat rheumatism and cramp. In Malaysia, the seeds are used in the treatment of gastrointestinal cancer and to dislodge fish or chicken bones lodged in the throat. A decoction of the flowers is used to counteract putrefaction, stop vomiting, promote urination and to invigorate the body. A lotion of the fresh leaves is used to treat eczema and soothe irritated skin. In India, the flowers are used to combat fever, invigorate the body, and heal burns and scalds. In Malaysia, Indonesia and the Philippines, a paste of the leaves is used to treat whitlow and heal wounds. In Vietnam, a decoction of the leaves is used to stimulate hair growth and to wash the hair.



2 - Methoxy - 1,4 - naphthoquinone

3-hydroxy-2-[3-hydroxy-1,4-dioxo(2-naphthyl)]ethyl naphthalene-1,4-dione, characterized from an ethanolic extract of the aerial parts of *Impatiens balsamina* L., inhibits significantly testosterone 5 α -reductase (Ishiguro K *et al.*, 2000), hence its anti-hair loss medicinal properties.

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 Yang X, *et al.* (2001) *Phytother Res* **15**(8): 676–680.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

M. Order APIALES Nakai 1930

The order Apiales consists of 2 closely related families: the Araliaceae and Apiaceae, and about 3700 species of plants believed to have originated through development from the order Sapindales (Appendix I). Apiales are easily recognizable in field collection by their umbels or globose heads. The chemical weapons used here are piperidine alkaloids (*Conium maculatum*, Apiaceae); saponins (*Panax* species, Araliaceae); essential oils (*Pimpinella anisum*, Apiaceae); furanocoumarins; and acetylenic fatty acid. The family Araliaceae is the oldest family of the Apiales and the ancestor of the Apiaceae.

1. Family ARALIACEAE A. L. de Jussieu 1789 *nom. conserv.*, the Ginseng Family

Physical description: The family Araliaceae consists of about 70 genera and 700 species of tropical trees, shrubs, woody climbers or herbs containing *tetracyclic triterpenoid saponins*, *acetylenic fatty acids*, and sesquiterpenes. The leaves of Araliaceae are large and very characteristically palmatilobed or pinnately compound. The leaves of Araliaceae are palmatilobed, exstipulate

and spiral. The petiole is slender and clasping the stem. The flowers are small, regular, and arranged in racemes or panicle heads; the calyx is indistinct; and the petals and stamens are arranged in groups of 5. A nectary disc is present. The gynecium consists of 2–5 or more carpels, joining to form a compound and inferior ovary containing as many locules as carpels, with each locule containing a single, apical, axillary, pendulous and epitropous ovule. The fruits are drupaceous or dry. The seeds are oily.

Pharmaceutical interest: To the family Araliaceae belong *Panax ginseng* C. A. Meyer (ginseng); *Panax quinquefolium* L. (American ginseng); *Panax notoginseng* Burk. (*san-chi* ginseng); *Panax pseudoginseng* Wall. species *Japonicus* Hara: *Panax japonicus* CA Meyer (Japanese or *chikusetsu* ginseng); *Panax pseudoginseng* Wall. species *himalaicus* (Himalayan ginseng); and *Eleutherococcus senticosus* Maxim: *Acanthopanax senticosus* (Siberian ginseng), which are all routinely used to invigorate the body and as a cure-all and universal remedy for panacea (Greek $\pi\alpha\nu\alpha\kappa\epsilon$ = remedy from where *Panax*) by millions of peoples since ancient times. Examples of ornamental Araliaceae are *Hedera helix* L. (common ivy), *Schefflera* species and *Polyscias* species. In the Asia-Pacific, about 50 species of the plants species classified within the family Araliaceae are medicinal. Note that most of these plants are used to counteract putrefaction, combat fever, promote expectoration and invigorate the body.

***Panax ginseng* C. A. Meyer**

[From Greek, *panakeia* = universal remedy and Chinese, *jen shen* = Human plant]

Common names: *Panax ginseng* C. A. Meyer or ginseng, Korean ginseng; *jen shen*, *shen ts'ao*, *t'u-ching* (Chinese).

Physical description: It is a small rhizomatous herb which grows in the mountain zone, ranging from Nepal to Manchuria, and from eastern Siberia to Korea. The stems are pitted. Leaves: palmately lobed and consisting of 5 folioles which are slightly crenate. The flowers are white, small and arranged in an umbel. The fruits are red glossy berries (Fig. 248).

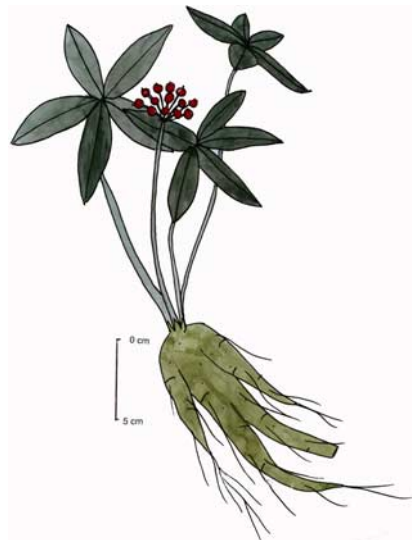


Fig. 248. *Panax ginseng* C. A. Meyer.

Ginseng is used to invigorate the body, treat flatulence, soothe inflammation, stimulate venereal desire, calm the mind and fight forgetfulness. Many products containing ginseng are available, especially for the symptomatic treatment of functional asthenia (Pharmaton®). Ginseng is incorporated in the B. H. P. (1990) and in the *British Herbal Compendium* (Vol. 1, 1992).

Pharmaceutical potential: The medicinal properties of *Panax ginseng* C. A. Meyer result principally from the synergistic effect of 3 types of natural products: triterpenoid saponins, polyacetylenes fatty acids and polysaccharides.

Triterpenoid saponins: Oleanane and dammarane triterpenoid saponins act through their glucocorticoid-shaped chemical structure and their ability to stimulate the production of nitric oxide, which is a potent vasodilator.

Cytotoxic properties: Ginsenoside Rh-(2) inhibits *in vitro* the proliferation of a number of human ovarian cancer cells

lines dose-dependently (10 μ M–60 μ M). Given *per os* to mice experimentally infected with human ovarian cancer cells (HRA), it acts without harmful side-effects in a way comparable to cis-diamminedichloroplatinium (II) (cisplatin), an alkylating agent widely used to treat ovarian cancers (Nakata H *et al.*, 1998).

Glucocorticoid properties: Ginsenoside Rg-(1) competes with glucocorticoid receptors for dexamethasone [³H] binding (1 μ M–10 μ M; Lee YJ *et al.*, 1997). The differentiation of teratocarcinoma (F9) cells into phenotypic normal endothelium-like cells caused by ginsenoside Rh-(1) is inhibited by the glucocorticoid antagonist RU 486 (Lee YN *et al.*, 1996; Kim YS *et al.*, 1998).

Cardiovascular properties: A single injection of ginsenosides to animals, results in an endogenous production of nitric oxide, through stimulation of the kidneys nitric oxide synthetase (Han SW *et al.*, 1996). *In vivo*, ginsenosides protect animals against myocardial ischemia/reperfusion damage with an increase of

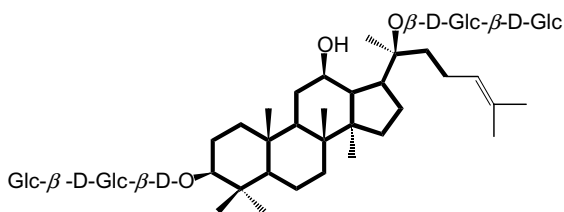
Uses: Ginseng is said to have been used as a medicine in China and Tibet since ancient times (2000 B. C.–3000 B. C.). Its use was formerly reserved for emperors, their households and conferred by imperial favor upon high and useful officers. The plant was collected at night, as the berries reflect moonlight. The name ginseng comes from *jen shen* which means “human plant”. Other names are *t'u ching*: “spirit of the ground”; *shen ts'ao*: “divine plant”; and *t'u ching*: “terrestrial essence.” The legend says that during the Sui dynasty (581–601 A. D.), at Shantang in China, human-shaped roots were systematically found in haunted places. Chinese people hold this plant in an extremely great esteem and would spend fortunes to get the reputed roots. Ginseng is claimed to be “*tonic to the five viscera, quieting the animal spirit, establishing the soul, allaying fears, expelling evil effluvia, lightening the eyes, opening up the heart, benefiting the understanding, invigorating the body and prolonging life*” (Stuart GA, 1911).

(6)-keto-prostaglandine ($\text{F}_{1\alpha}$) and a decrease of lipid peroxydation. In perfused rabbit lung *in situ* and isolated aortic rabbit aortic rings, ginsenosides protect the pulmonary and aortic endothelia against electrolysis-induced free radicals injuries. Rb-(1) and Rg-(1) relax pulmonary vessels; however, this effect is eliminated by nitro-L-arginine: an inhibitor of the nitric oxide synthetase. Furthermore, in cultured bovine aortic endothelial cells, ginsenosides stimulate the conversion of [^{14}C]-L-arginine into [^{14}C]-L-citrulline, indicating the release of nitric oxide (Chen X *et al.*, 1996). Therefore, one might set the hypothesis that the cardiovascular and hence aphrodisiac properties of *Panax ginseng* C. A. Meyer is a result of the release of nitric oxide caused by triterpenoid saponins. Nitric oxide inhibits coronary spasms, thrombosis and improves the penile venous flow regulation.

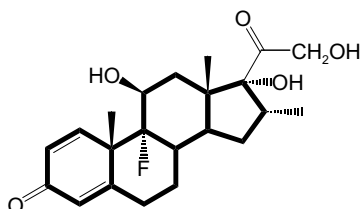
Central nervous system activities: In regard to the cerebral properties of *Panax ginseng* C. A. Meyer, a number of experiments have clearly demonstrated that triterpenoid saponins of ginseng have potent neurotrophic properties. For instance, addition of a crude saponin extract to neurons promotes neurite extension (Sugaya A *et al.*, 1998). Furthermore, malinylginsenoside stimulates the growth of neurons cultured *in vitro* (Nishiyama N *et al.*, 1994). The psychotropic property of ginsenosides could result both from a cholinergic effect and from the control of intracellular levels of cyclic adenosine monophosphate (cAMP) through adenosine monophosphate phosphodiesterase (Stancheva SL *et al.*, 1993). Ginsenoside Rb-(1) from *Panax quinquefolium* L. (American ginseng) improves memory and learning by expressing choline acetyltransferase in the basal forebrain and the nerve growth factor in the hippocampus (Salim KN *et al.*, 1997).

Other pharmacological properties: saponins, characterized from *Panax ginseng* C. A. Meyer, inhibit the secretion of catecholamine from cells stimulated by acetylcholine through nicotinic receptors (Tachikawa E *et al.*, 1997). A number of saponins characterized from the stem and the leaves of *Panax ginseng* C. A. Meyer, noncompetitively antagonize the dose-response curve of noradrenaline, potassium chloride, and calcium chloride on isolated aortic strips of rabbits, as well as inhibit the intracellular and extracellular calcium-dependent contraction of the aortic strips caused by noradrenaline, suggesting a verapamil-like effect (Guan L *et al.*, 1996). A number of ginsenosides reduce acetylcholine-evoked sodium influx and catecholamine secretion in bovine adrenal chromaffin cells (Tachikawa E *et al.*, 1995).

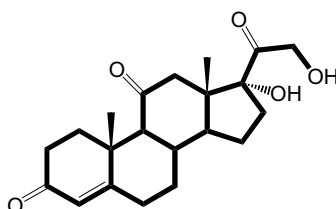
Polyacetylene fatty acids: Polyacetylene fatty acids such as panaxydol, panaxydiol and panaxytriol are cytotoxic and thrombolytic. Panaxytriol, for example, inhibits the proliferation of a number of tumor cell-lines (Matsunaga H *et al.*, 1989), through a possible inhibition of the mitochondrial respiration



Ginsenoside Rb - (1)

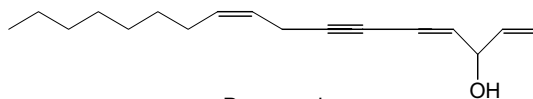


Dexamethazone



Cortisone

(Matsunaga H *et al.*, 1995) and potentiates the cytotoxicity of mitomycin C (Mitomycin C Kyowa®) which is used to treat gastrointestinal and breast cancers (Matsunaga H *et al.*, 1994). Panaxynol (0.1 mg/mL) inhibits the aggregation of washed platelets caused by collagen, arachidonic acid, adenosine diphosphate, ionophore (A23187), platelet activating factor and thrombin (Teng CM *et al.*, 1989).



Panaxynol

Polysaccharides: The polysaccharides of *Panax ginseng* C. A. Meyer stimulate the immune system. Ginsan, an acidic polysaccharide, promotes the proliferation of lymphocytes T and B (Lee YS *et al.*, 1997) and inhibits the incidence of benzo-[a]-pyrene-induced autochthonous lung tumor in mice, by stimulation of interleukin2, interleukin2 α , interferon γ and GM – CSF. It inhibits pulmonary metastasis of melanoma cells (B-16 and F-10) and generated LAK-cells from both NK-cells and T-cells (Kim KH *et al.*, 1998). Ginsenan-PA and ginsenan-PB show a reticuloendothelial system potentiating property in a carbon clearance test and pronounced anticomplementary property and an alkaline phosphatase property in a dose-dependent manner (Tomoda M *et al.*, 1993). Ginsenan S-II-A induces the production of interleukin8 by human monocytes and THP-(1)-cells (Sonoda Y *et al.*, 1998).

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Hedera rhombea (Miq.) Bean

[From Latin, *hedera* = ivy and from Greek, *rhombos* = rhomb]

Synonymy: *Hedera japonica* Tobl.

Physical description: It is an ever-green climbing shrub of Japan. Leaves: simple, spiral and without stipules. The petiole is 11 cm–4 cm long. The blade is hairy, rigid, 7.5 cm × 4.2 cm–3 cm × 1 cm, and elliptic-lanceolate, showing 3 pairs of secondary nerves that are showy above. The midrib is raised on both sides. The margin is entire and recurved. The inflorescences are terminal umbels sustained by a 5 mm–1.7 cm hairy pedicel. The fruits are 6 mm × 4 mm, glaucous-black, glossy, and hairy (Fig. 249).

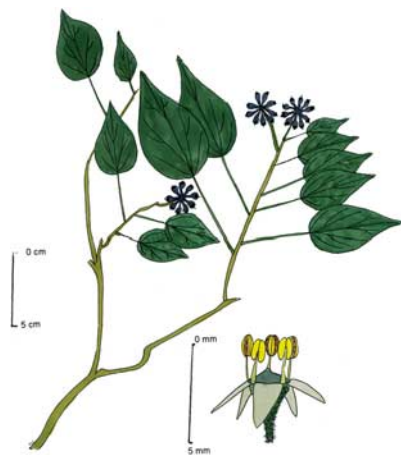
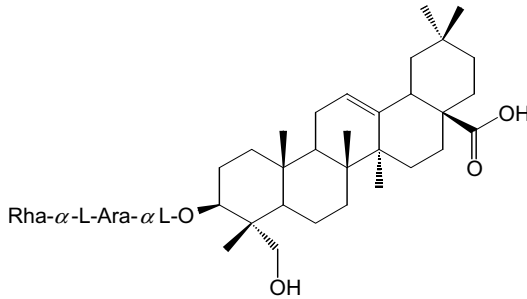


Fig. 249. *Hedera rhombea* (Miq.). From: KLU Herbarium 30727. Field collector: H Ohba & S Akiyama, 25 Dec 1978, Japan, C Honshu: Kanagawa Pref. Zushi - shi, Jinmuji - Mt. Takatori.

Pharmaceutical interest: The plant contains the monodesmosidic triterpenoid, saponin α -hederin, which is widespread in the genus *Hedera*. This saponin protects lymphocytes cultured *in vitro* against mutation caused by doxorubicin, as well as inhibits the growth of mouse B16 melanoma cells and noncancer mouse 3T3 fibroblasts cultured *in vitro* (Amara-Mokabe YA *et al.*, 1996; Danloy S *et al.*, 1994). It also modifies the cellular contents and cell membrane of *Candida albicans* after 24 hours of exposure (Moulin-Traffort J *et al.*, 1998).

Uses: In Japan, *Hedera rhombea* (Miq.) is used to treat nose bleeding.



α - Hederin

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Polyscias scutellaria (Burm. f) Fosberg

[From Latin, scutellaria = shield-shaped and from Greek, *polus* = many and *skia* = shade]

Physical description: It is a common ornamental shrub of the Asia-Pacific which grows to a height of 1.75m. The plant has a pungent smell. The bark is pale grey and the wood, white. Leaves: simple, without stipules and spiral. The petiole is channeled and 3cm-6cm long. The blade is spoon-shaped, glossy,

Synonymy: *Nothopanax scutellaria* (Burm f.) Merr., *Nothopanax cochleatus* Miq., *Panax cochleatus*.

20 cm × 28 cm–5.5 cm × 8 cm, papery, and ovate to reniform. The base of the blade is cordate. The margin is laxly crenate and the apex round, and a very small tooth is present between each lobe. The blade shows 6–7 pairs of secondary nerves. The inflorescences are 19 cm–30 cm long lax panicles of 8 mm diameter umbels, consisting of about 12 tiny and yellowish flowers suspended on 4 mm long pedicels (Fig. 250).

Uses: In Indonesia, *Polyscias scutellaria* (Burm. f) Fosberg is used to promote perspiration, growth of hair, urination, and to resolve inflammation. In Malaysia, the leaves of *Polyscias scutellaria* (Burm. f) Fosberg are used to heal ulcers. In the Philippines, *Polyscias scutellaria* (Burm. f) Fosberg is used to promote urination.

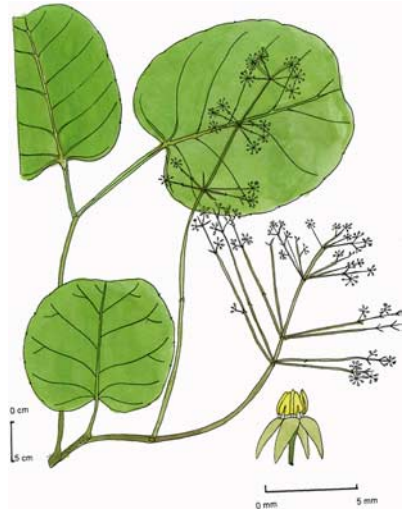
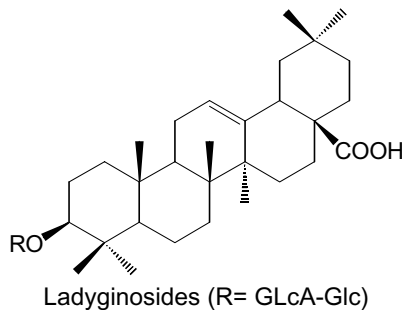


Fig. 250. *Polyscias scutellaria* (Burm. f) Fosberg.

Pharmaceutical interest: The pharmacological potential of this plant remains unexplored. The medicinal properties of *Polyscias scutellaria* (Burm. f) Fosberg are probably due to a series of dammarane- and oleanane-type triterpenoid saponins such as ladyginosides, which are known to occur in other members of the genus *Polyscias*.



Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Schefflera elliptica* (Bl.) Harms**

[After Jacob Chricheck h Scheffler, 18th century German botanist and from Greek, *elleipsis* = regular oval]

Synonymy: *Schefflera venulosa sensu* Ridley, *Schefflera micrantha* (Miq.) Ridley, *Schefflera minimiflora* Ridley.

Uses: In Indonesia, the wood of *Schefflera elliptica* (Bl.) Harms is used to assuage toothache. The pharmacological potential of *Schefflera elliptica* (Bl.) Harms remains unexplored. Note that the analgesic property of this plant is very probably due to the presence of saponins.

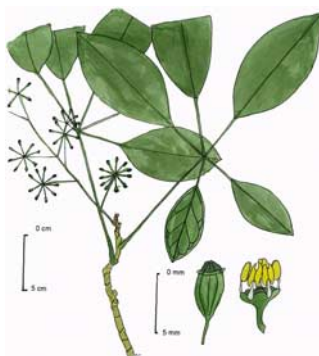


Fig. 251. *Schefflera elliptica* (Bl.) Harms. From: KLU Herbarium 10909. Field collector: BC Stone. 24 Feb 1970. Pulau Langkawi: Pantai Pasir Hitam. On the beach. Botanical identification: 1977 DG Frodin.

Physical description: *Schefflera elliptica* (Bl.) Harms is a woody climber or straggling shrub with broadly spreading and sometimes drooping stems. The plant is often epiphytic of coastal, mangrove and lowland forests, riversides and limestone boulders of Thailand and Malaysia. The stems are fissured. Leaves: spiral, without stipules and palmately lobed. The blade comprises of 4–6 folioles. The petiole is 7.5 cm–16 cm long and the petiolules are 2.5 cm–7 cm long, and curved at base. The margin of the folioles is slightly wavy and recurved. The midrib is sunken on both sides of the blade. The inflorescences are terminal racemes of globose umbellules. The flower pedicels are 2 cm–3 cm long. The flowers are very small and white. The fruits are 3 mm × 2 mm, 5–6-locular, pale orange at first then turning blackish (Fig. 251).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Schefflera octophylla* (Lour.) Harms**

[After Jacob Chricheck h Scheffler, 18th century German botanist and from Greek, *okto* = eight and *phullon* = leaf]

Physical description: It is a treelet of China, Vietnam, India, Taiwan and the Ryuku Islands. Leaves: of variable size and 6–8 foliolate. The petiolules are 1.5 cm–5 cm long. The petiole is 8 cm–25 cm long. The folioles are leathery, finely stellate pubescent on both

Synonymy: *Aralia octophylla* Lour., *Heptapleurum octophylla* (Lour.) Benth., *Agalma lutchuense* Nak., *Heptapleurum octophyllum* Bth. & Hook., *Heptapleurum rigidum* Seem.

Common name: Schefflera.

surface, and 7 cm–17 cm × 3 cm–6 cm. The blade is acute or slightly acuminate at the apex and the base is attenuate to round. The margin is entire. The folioles show about 8 pairs of secondary nerves. The inflorescences are 25 cm long, many-flowered and terminal umbels. The fruits are globose and small, with a conspicuous nectary disc at the apex (Fig. 252).

Pharmaceutical interest: One might set the hypothesis that the medicinal properties mentioned above are most probably due to the presence of ursane, oleanane and lupane triterpenoids saponins. For instance, asiatic acid and its asiaticoside, characterized from *Schefflera octophylla* (Lour.) Harms bark (Sung TV *et al.*, 1992), are responsible for the anti-inflammatory property of *Centella asiatica* L. (family Apiaceae). Other active principles are polyacetylenes fatty acids such as falcarinol, falcarindiol, falcarinone and dehydrofalcarinone, which might not only contribute to the medicinal and the irritating properties of a number of plants classified within the genus *Schefflera* (Hausen BM *et al.*, 1987; Gnob M *et al.*, 1998). An ethanolic extract of leaves and roots

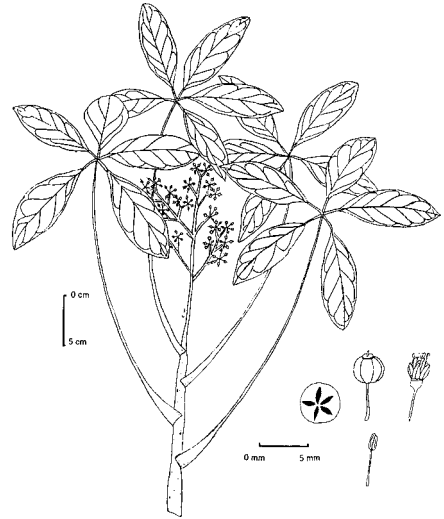
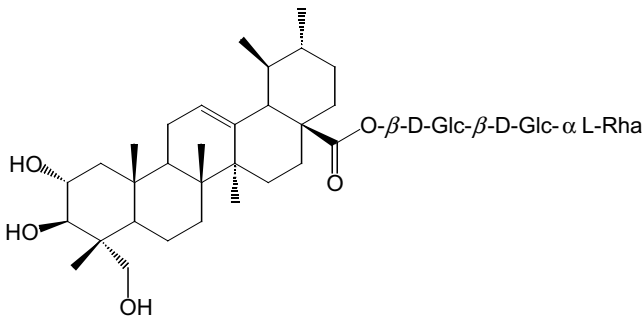


Fig. 252. *Schefflera octophylla* (Lour.) Harms.

Uses: In China, *Schefflera octophylla* (Lour.) Harms is used to soothe irritated skin, contusion and to treat athlete's foot. A decoction of the roots is used to treat flue, and a tincture is used to treat rheumatism. In Malaysia, a decoction of *Schefflera heterophylla* (Seem.) Harms is used to aid recovery from childbirth. In Vietnam, the bark and leaves are used to promote urination and the ashes of the plant are used to treat dropsy.



Asiaticoside

of *Schefflera bodinieri* bind to a number of receptors of the central nervous system, this effect being attributed to the presence of triterpenoid and oligosaccharides (Zhu M *et al.*, 1999).

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

IV. Subclass ASTERIDAE Takhtajan 1966

The subclass Asteridae is the most advanced subclass of Dicotyledons. It consists of 11 orders, 49 families, and nearly 60 000 species of plants believed to have originated through development from or near to the order Rosales during the Tertiary period (Appendix I). In terms of the number of species, the subclass Asteridae is about the same size as that of the subclass Rosidae, but in terms of the number of families, it is surpassed by those of both the subclass Rosidae and subclass Dilleniidae. Approximately a third of the species belong to the very successful family Asteraceae, which is the largest and most evolved family of the class Magnoliopsida, and one of the two largest families of the division Magnoliophyta. The general botanical tendency observed in Asteridae is a fusion of sepals, petals and carpels into tubular perianth and single ovaries. The chemical weapons used in this Subclass are mostly *monoterpenoid indole alkaloids*, *pyrrolizidine alkaloids*, *iridoid glycosides*, *phenylethanoid glycosides*, cardiotoxic glycosides, naphthoquinones, diterpenes, *sesquiterpenes* and acetylene fatty acids. The order Gentianales is primitive in the Asteridae and is a common ancestor for the Rubiales, Dipsacales and Asterales (Appendix I).



A. Order GENTIANALES Lindley 1833

The order Gentianales consists of 6 families and about 5500 species of plants, believed to have originated from the order Rosales (Appendix I).

1. Family LOGANIACEAE Martius 1827 nom. conserv., the Logania Family

Physical description: The family Loganiaceae consists of about 20 genera and 500 species of tropical trees, shrubs or climbers known to abound with *iridoid glycosides* and *monoterpenoid indole alkaloids*, formed by the condensation of tryptamine and secologanin (an iridoid). The leaves of Loganiaceae are simple, opposite, entire, and stipulate. The stipules are interpetiolar. The flowers are showy, often solitary, perfect, and regular. The calyx comprises of 4–5 connate sepals. The corolla is tubular and develops 5 (or more) imbricate, convolute or valvate lobes. The andrecium comprises of as many stamens as, and alternate with, the corolla lobes; the anthers are dithecal, tetrasporangiate, and open by longitudinal slits. The gynecium consists of 2–3 carpels, forming a 2–3-locular superior ovary, with each locule containing several ovules attached to axil placentas. The fruits are capsular, berries, or drupes.

Pharmaceutical interest: Classical examples of pharmaceutical products from Loganiaceae are the dried ripe seeds of *Strychnos nux-vomica* L. (Nux Vomica, *British Pharmacopoeia*, 1963) and *Strychnos ignatii* (Ignatia, *British Pharmaceutical Codex*, 1934), which have been used as bitter and as ingredients of purgative pills and tablets. The bitterness of the *Strychnos* species is attributed to the presence of series of monoterpenoid indole alkaloids, such as strychnine (*British Pharmaceutical Codex*, 1959) and brucine which are freakishly poisonous. The dried rhizome and roots of *Gelsemium sempervirens* (Gelsemium, *British Pharmaceutical Codex*, 1963), containing not less than 0.32% of gelsemine, has been used as a tincture to treat migraine (Gelsemium Tincture, *British Pharmaceutical Codex*, 1963). Note that *Gelsemium sempervirens* (L.) Ait. f (evening trumpet-flower) is a common ornamental garden plant in North America. Another example of medicinal Loganiaceae is *Gelsemium nitidum* (American yellow jasmine), the roots of which are occasionally used to assuage headache. In the Asia-Pacific, about 20 species of Loganiaceae are of medicinal value and often used to invigorate the body, counteract putrefaction, treat eye diseases and expel worms from intestines.

***Fagraea fragrans* Roxb.**

[After JT Fagraeus, 1729–1747, a Swedish naturalist, and from Latin, *fragrare* = smell sweet]

Physical description: It is a tree which grows to a height of 30 m. It is found wild or cultivated in a geographical zone

Synonymy: *Fagraea cochinchinesis* (Lour) A. Chev., *Cyrtophyllum peregrinum* Bl.

Common name: *Tembusu* (Malay); *anan* (Burmese).



Fig. 253. *Fagraea fragrans* Roxb.

spanning from India to the Philippines. The wood is of commercial value. The bark is dark brown and deeply fissured.

The inner bark is brown and the sap, yellow. The stems are smooth and glabrous. Leaves: simple, opposite and joined together to form an ochrea, which usually splits into a pair of axillary scales. The petiole is 1.25 cm–2 cm long. The blade is elliptic, thinly coriaceous, and 5 cm–13 cm × 2 cm–5.5 cm. The apex is pointed, and the base is acute. The margin is entire and recurved, the midrib is raised on both surfaces, and the blade shows 8–10 pairs of secondary nerves which are visible from underneath only. The inflorescences are axillary dichotomous cymes, 6.5 cm–7 cm long. The flowers are axillary, fragrant, 2 cm wide, and creamy white. The calyx is 5 mm long and comprises of 5 broad and translucent lobes. The corolla tube is 8 mm–1 cm long and 5-lobed. The andrecium consists of 5 stamens with very thin filaments. The style is 2 cm long. The fruits are 8 mm long, orange and glossy berries (Fig. 253).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Strychnos nux-vomica* L.**

[From Greek, *strukhnos* = kind of nightshade and from Latin, *nux* = a nut and *vomere* = to vomit]

Physical description: It is a tree native to Southeast Asia which grows in tropical Asia to a height of 15 m. The bark is light grey and warty, and the inner bark is straw-colored. Leaves: simple and decussate. The petiole is channeled, 8 mm–1 cm long and somewhat curved at the base. The blade is rigid, showily 3-nerved, variously shaped, and broadly elliptic to round and 6.2 cm × 3.7 cm–9.8 cm × 6.8 cm. The apex is round, acute or notched, and the

Uses: In Cambodia, drinking an infusion of the bark is believed “to give long life.” In Malaysia, a decoction of the bark is drunk to treat malaria, and a decoction of the leaves is drunk to treat the condition of blood in stools. In the Philippines, a decoction of the bark is used to combat fever. In Vietnam, a decoction of the bark is used to soothe inflamed parts. There is not a vestige of pharmacological study on this valuable plant. It will be interesting to learn whether a more intensive study of this plant will reveal any molecules of therapeutic interest.

Common name: Strychnine tree, poison nut, nux vomica, nux vomica tree.

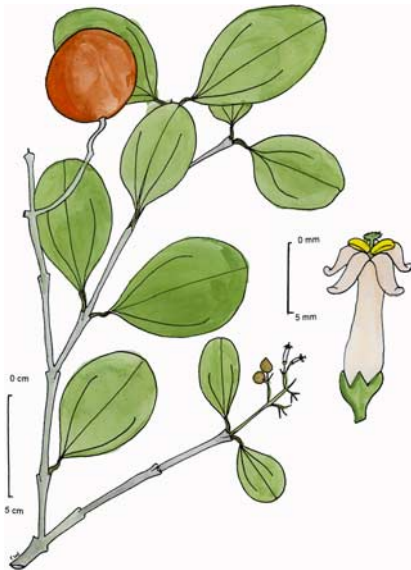


Fig. 254. *Strychnos nux-vomica* L. From: KLU 27536. Plants of Ceylon. Geographical localization: North Province, Anuradhapura District, 8 miles Southwest of Anuradhapura, along the road to Puttalam, 31 Oct 1974, altitude: 90 m. Field collectors: Gerrit Davidse & Sumithraarachchi. From: KLU 333000 Flora of India. Ex. Herb. Ludg. Batav. Field collector and botanical identification: WF Rodenburg. 18 March 1978. Geographical localization: India, Andhra Pradesh, Mahabubnagar District, Rasul Cheruvu, 15 Km South of Achampet, 16°, 15' North-78°, 38' East., altitude: 1600 ft, open forest around lake.

base is wedge-shaped. The midrib is flat to sunken above. The inflorescences are terminal panicles of about 3.3 cm–3.5 cm in length. The calyx is very small. The corolla is tubular, 9 mm–1 cm long, drying black, and produces 5 tiny lobes which bend downwards. The style is 1 cm long and protruding. The fruits are globose, smooth, 2.9 cm–4 cm in diameter, glossy and orange-brown. The seeds are numerous, disc-shaped, flat and 2 cm in diameter (Fig. 254).

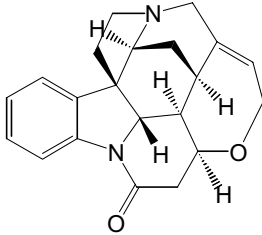
Pharmaceutical interest:

Strychnine: The seeds of *Strychnos nux-vomica* L. are toxic due to the presence of strychnine, an indole alkaloid first characterized in 1817 by Pelletier and Caventou. Strychnine was formerly used to stimulate blood circulation in surgical shock, but its use is now more restricted to promoting breathing in poisoning cases, as in small doses, it enhances the motor response of the spinal reflex.

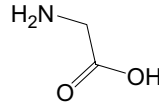
Nux Vomica (*British Pharmacopoeia*, 1963) consists of the dried ripe seeds containing not less than 1.2% of strychnine. It was used in Western medicine as a bitter tonic and as an ingredient in purgative pills and tablets. The seeds of *Strychnos nux-vomica* L. are used

Uses: In China, the seeds are eaten to combat fever, assuage headache, treat diseases of the eyes, skin, and abdominal swellings and to heal sores. In Laos, Cambodia and Vietnam, the seeds are eaten to promote vomiting and to combat fever. The bark is used to heal leprosy ulcers. The sap of *Strychnos nux-vomica* L. is used by the *Orang Asli* of Malaysia to make arrow-poison.

to treat eyes diseases, their effectiveness probably due to the presence of strychnine, which is known to increase the ability to discriminate colors and intensities of illumination, and particularly to increase the area of the blue visual field. It was also once used to treat amblyopia.



Strychnine



Glycine

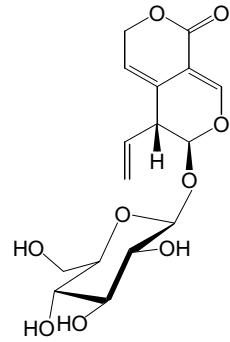
Warning: In regard to the toxic effect of *Nux Vomica*, ingestion of a single seed will cause tremors and slight twitching of the limbs, followed by sudden convulsions of all the muscles. The body becomes arched backwards in hyperextension with the legs and arms extended, and the feet turned inwards. The facial muscles produce a characteristic grinning expression known as “*risus sardonicus*.” Death from medullary paralysis usually follows the second or fifth seizure. The convulsions are mediated spinally and believed to result from a blockade of inhibitory glycinergic sites. Antidotes for strychnine poisoning are short acting barbiturates and muscle relaxing drugs.

2. Family GENTIANACEAE A. L. de Jussieu 1789 nom. conserv., the Gentian Family

Physical description: The family Gentianaceae consists of about 75 genera and about 1000 species of annual or perennial herbs, often mycorrhizal, related to the Loganiaceae but more recent, and cosmopolitan in distribution, and known to produce *xanthon*es and *iridoid glycosides*. The largest genus is the genus *Gentiana* which includes about 400 species. The leaves of Gentianaceae are simple, opposite, without stipules, often connate at the base or connected by a transverse line. The flowers are perfect, actinomorphic, showy, and bright colored. The calyx is tubular or made of free imbricate sepals. The corolla is tubular, 4–12-lobed, with the lobes contorted or very rarely imbricate. The stamens are inserted into the corolla, being as many as the lobes, alternating with them and comprising of 2-locular anthers that open lengthwise. The gynecium consists of a pair of carpels joined together to form a superior and single-locular ovary, containing a pair of parietal placentas adnate to the

septa to which numerous ovules are attached. The style is simple. The fruits are capsular and contain numerous seeds with copious endosperm.

Pharmaceutical interest: *Sabatia angularis* (American centaury), *Centaurium erythraea* Rafn. [(European centaury), the dried fermented rhizome and root of *Gentiana lutea* L. (yellow gentian) (Gentian, *British Pharmacopoeia*, 1963)], *Gentiana catesbaei*, *Gentiana macrophylla*, *Gentiana punctata*, and *Gentiana purpurea*, have all been used in Western medicine to promote appetite. Their effectiveness is attributed to the presence of iridoid glucosides, which impart an intense bitterness to the drug. A classical iridoid glycoside in the Gentianaceae is gentiopicroside. The dried flowering tops of the common centaury *Centaurium minus* (*Centaurium umbellatum*, *Erythraea centaurium*) and other species of *Centaurium* (Petite Centaurée, *French Pharmacopoeia*, 1965) have been used as a bitter tonic in the form of liquid extracts (1 in 1; dose 2 mL to 4 mL) and infusions (1 in 20; dose 30 mL to 60 mL). *Centaurium beyrichii* (rock centaury) and *Centaurium calycosum* (Buckley centaury) are poisonous to cattles. An interesting chemical feature of Gentianaceae is the production of xanthenes, namely aglycones and *O*-glycosides; the distribution of which is quite restricted to a few families in the Magnoliopsida. Xanthenes have attracted a great deal of interest because of their ability to inhibit the enzymatic activity of monoamine oxidase. Besides, xanthenes are known to inhibit microbial infection, inflammation and platelet aggregation. Approximately 20 plant species classified within the family Gentianaceae are medicinal in the Asia-Pacific. These are often used to invigorate the body, combat fever, stimulate appetite and urination, relieve the bowels of costiveness and counteract putrefaction of the skin. *Swertia chirayita* (Roxb.) Lyons is one of them.



Gentiopicroside

***Swertia chirayita* (Roxb.) Lyons**

[After Emanuel Sweert, 16th century Dutch botanist and from Sanskrit, *chiratika* = *Swertia chirayita* (Roxb.) Lyons]

Physical description: It is a herb native to India which grows to a height of 80 cm. The stems are somewhat quadrangular or obscurely winged and glabrous, and the internodes are 2.4 cm–2.5 cm long. Leaves: bitter, simple, decussate, sessile and without stipules. The blade is linear, lanceolate, membranaceous, glabrous,

Synonymy: *Swertia chirata* Buch. - Ham., *Agathotes cherayta* D.Don, *Ophelia chirata* Griseb., *Swertia chiretta*.

Common names: *Sekhagi* (Burmese); *chiratika* (Sanskrit); *nilavembo* (Tamil).

3.5 cm × 6 mm–1.6 cm × 3 mm, and shows a midrib sunken above and raised below, without secondary nerves. The inflorescences are terminal or axillary cymes of 2 cm–2.5 cm in length, the pedicels of which are 5 mm–1.4 cm long. The calyx consists of 4 sepals which are lanceolate, free, and 1 mm × 4 mm–7 mm. The corolla is contortate in buds and comprises of 4 petals which are very thin, yellow, 7 mm–8 mm × 2 mm and are glandular at the base. The andrecium comprises of 4 stamens which alternate with the petals, with filaments which are 4 mm long. The ovary is fusiform, and the stigma is 2-lobed and 5 mm × 1.5 mm. The fruits are capsular (Fig. 255).

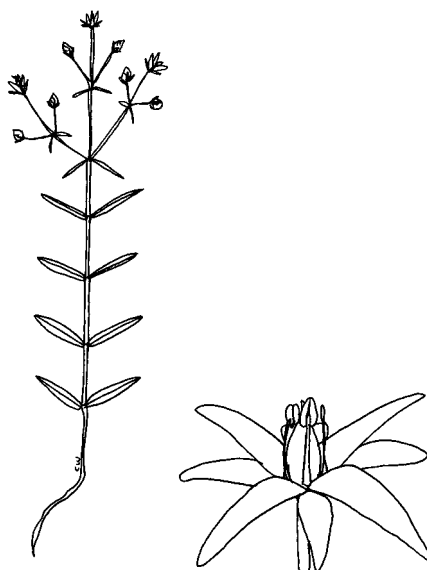
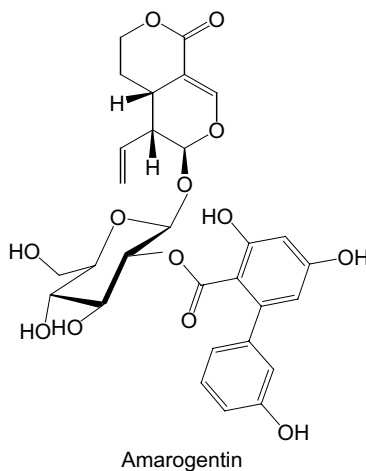


Fig. 255. *Swertia chirayita* (Roxb.) Lyons. From: Delhi University Herbarium 004363. Geographical localization: Musoorie, Uttar Pradesh, India. 20 Sep 1960, altitude: 6800 ft, rain fall 60° 90°. Field collector: H Singh. Botanical Identification: S Jelan.

Uses: In Burma: *Swertia chirayita* (Roxb.) Lyons is used to combat fever, invigorate the body and relieve the bowels of costiveness. In Laos, Cambodia, Vietnam, and Malaysia, *Swertia chirayita* (Roxb.) Lyons is used to combat fever. In India, *Swertia chirayita* (Roxb.) Lyons is used to combat fever, expel intestinal worms, relieve the bowels of costiveness, promote the secretion of milk, resolve inflammation, heal ulcers, treat asthma, invigorate the body and assuage vomiting in pregnancy. A tincture of *Swertia chirayita* (Roxb.) Lyons (Tincture of Chirata, *British Pharmaceutical Codex*, 1934) prepared by percolating 10 g of the dried and flowering plant with alcohol (60%) to 100 mL, has been used in Western medicine (dose 2 mL–4 mL) to promote digestion and appetite.



Pharmaceutical interest: The bitter tonic property of *Swertia chirayita* (Roxb.) Lyons is imparted to series of iridoid glycosides, including amarogentin

and swertiamarin. Amarogentin inhibits the enzymatic activity of DNA-topoisomerase I and might hold some potential as an anticancer agent (Ray S *et al.*, 1996; Bhattacharya SK *et al.*, 1976). Extracts of the plant protect rat hepatocytes cultured *in vitro* against carbon tetrachloride and paracetamol poisoning (Reen RK *et al.*, 2001).

An ethanolic extract of *Swertia chirayita* (Roxb.) Lyons lowers blood glucose levels in alloxan diabetic albino rats. (Ajit K *et al.*, 2003). The active principle is not known, but one might suspect a lipophilic substance, as maximal activity is reported from hexanic fractions (Sekar BC *et al.*, 1987). Could it be a xanthone with α -glucosidase inhibitory activity?

References

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Bhattacharya SK, *et al.* (1976) *J Pharm Sc* **65**(10): 1547–1549.
Ray S, *et al.* (1996) *J Nat Prod* **59**(1): 27–29.
Reen RK, *et al.* (2001) *J Ethnopharmacol* **75**(2–3): 239–247.
Sekar BC, *et al.* (1987) *J Ethnopharmacol* **21**(2): 175–181.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

3. Family APOCYNACEAE A. L. de Jussieu 1789 *nom. conserv.*, the Dogbane Family

Physical description: The family Apocynaceae consists of about 250 genera and 2000 species of soft wooded tropical trees, shrubs, woody climber or herbs known to abound with *indole alkaloids*, cardiotonic glycosides, steroidal alkaloids and iridoid glycosides. The key features required to recognize Apocynaceae in field collection are opposite waxy leaves without interpetiolar stipules, as well as an abundant white latex and conspicuous contorted flowers which are usually pure white. The flowers are showy, regular, and

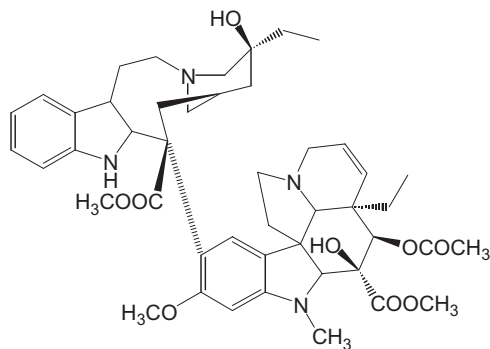


slightly fragrant. The calyx tube is 5-lobed. The corolla is tubular and develops 5 contorted lobes. The inflorescences are cymes or cymose panicles. The stamens are inserted into the corolla. They are the same in number as the lobes, and alternating with them and comprising of 2-locular anthers that open lengthwise. The gynecium consists of a pair of carpels joining to form a superior, 2-locular or unilocular or 2-carpellate ovary, each containing 2 or more

ovules. The fruits are pairs of berries, drupes or follicles containing several winged or tufted seeds.

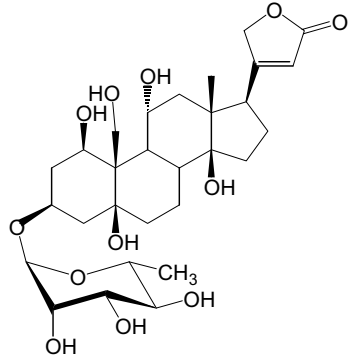
Pharmaceutical interest: Examples of plants classified within the Apocynaceae family include the *Plumeria* species (frangipani), *Thevetia peruviana* (Pers.) K. Schum. (yellow oleander) and *Nerium oleander* L. (oleander), which are commonly used to decorate tropical gardens.

Indole alkaloids: The most remarkable characteristic of the Apocynaceae family, and more specifically of the subfamily Plumerioideae, namely Plumerieae (*Alstonia*, *Aspidosperma*, *Catharanthus*), Tabernaemontaneae (*Crioceras*, *Tabernaemontana*, *Tabernanthe*, *Voacanga*), Rauwolfieae (*Ochrosia*, *Rauwolfia*, *Kopsia*, *Vallesia*), and Carissae (*Hunteria*, *Melodinus*, *Picralima*), is the elaboration of the series of binary complex monoterpene indole alkaloids of therapeutic usefulness. Both vinblastine and vincristine, from *Catharanthus roseus* G. Don, interfere with the assembly of the mitotic spindle and are included in combination chemotherapy protocols for the treatment of acute leukemia, lymphoma, and a number of solid tumors such as breast and lung cancers. Vinblastine (Velbe[®]) is particularly useful for treating Hodgkin's disease, whereas vincristine sulphate (Oncovin[®]) is used to treat acute leukemia in children. A classical example of Apocynaceae used in Western medicine is *Rauwolfia serpentina* (L.) Benth. ex Kurz (Rauwolfia, *British Pharmaceutical Codex*, 1963). The dried roots contains reserpine, an indole alkaloid which has been used in the 60s as a neuroleptic and hypotensive drug to block the adrenergic transmission by depleting noradrenaline from sympathetic neurons. Ibogaine from *Tabernanthe iboga* is another example of neuroactive alkaloid which protects the *N*-methyl-aspartate (NMDA) neuron receptors against excessive release of excitatory amino acids and therefore represents a potential therapeutic agent for the treatment of Alzheimer's disease, Huntington chorea and other brain damages.



Vinblastine

Cardiotonic glycosides: Apocynaceae from the genus *Acokanthera*, *Adenium*, *Cerbera*, *Nerium*, *Strophanthus* and *Thevetia* are dreadfully poisonous, due to the presence of cardiotonic glycosides. One such compound is ouabain (Ouabain, *British Pharmacopoeia*, 1958) from the seeds of *Strophanthus gratus*, or from the wood of *Acokanthera schimperi* or *Acokanthera ouabaio*, used to treat acute congestive heart failures.



Ouabain

Steroidal alkaloids: A number of plants classified within the subfamily Apocynoideae (*Funtumia*, *Holarrhena*, *Kibatalia* and *Malouetia*) elaborate steroidal alkaloids of relative therapeutic value. A preparation made from the bark of *Holarrhena antidysenterica* (Roxb.) Wall. (*Holarrhena*, *British Pharmaceutical Codex*, 1949) or from its active constituent: conessine (Conessine, *French Pharmacopoeia*, 1965), is used to treat amebic dysentery.

Iridoid glycosides: Iridoids glycosides, which are common in the Asteridae, have attracted some levels of attention due to their cytotoxic, molluscicidal and antimicrobial properties.

About 80 species of Apocynaceae in the Asia-Pacific are of medicinal value. Note that the latex of many of these plant species is used to treat gastrointestinal ailments, combat fever and pains, and treat diabetes and infectious diseases.

***Aganosma marginata* (Roxb.) G. Don**

[From Latin, *marginis* = margin]

Physical description: It is a laticiferous, climbing shrub which grows on the rocks by the sea, found in a geographical zone spanning from India to the southern part of Southeast Asia and China. Leaves: simples, 5 cm–12 cm × 2 cm–4 cm, and without stipules. The petiole is 3 mm–5 mm long. The blade is very thin, oblong, lanceolate, acuminate, and glabrous, showing 12–16 pairs of conspicuous secondary nerves arching in an intramarginal nerve. The inflorescences are puberulous, terminal and axillary, cymes that are 5 cm–10 cm long. The flower pedicels are 2.5 cm–5 cm long. The calyx lobes are lanceolate,

Synonymy: *Echites acuminata* Roxb., nom illeg., *Aganosma acuminata* (Roxb.) G. Don.

Common names: *Sekati lima*, *sakat lima* (Malay); *xiang hua teng* (Chinese); *mai pit*, *thom waa* (Thai).

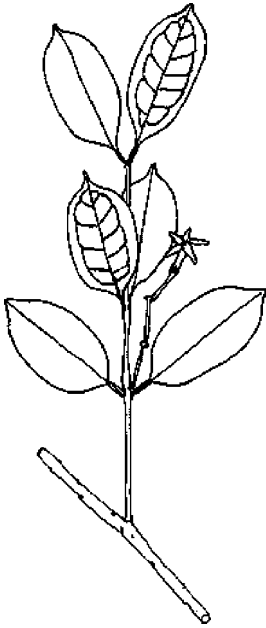


Fig. 256. *Aganosma marginata* (Roxb.) G. Don.

Uses: A number of plants classified under the genus *Aganosma* are used to invigorate the body, promote urination and combat fever in the Asia-Pacific. In Malaysia, a decoction of the roots of *Aganosma marginata* (Roxb.) G. Don is drunk to combat fever, regulate menses, promote urination and aid recovery from childbirth. In India, *Aganosma dichotoma* K. Schum. is emetic, anthelmintic, and useful for treating bronchitis, leprosy, and diseases of the mouth. The flowers are used for treating eyes diseases and biliousness. *Aganosma calycina* A. DC. is heaty, used as a tonic to treat bile and blood disorders. In Thailand, an infusion of the leaves, flowers and fruits of *Aganosma marginata* (Roxb.) G. Don is drunk to treat flatulence and to promote urination. The plant is used to combat fever. The therapeutic potential of *Aganosma marginata* (Roxb.) G. Don is still yet to be discovered.

acuminate, and 4 mm long. The corolla tube is cylindrical, enlarged at the base, 1.25 cm–2 cm long and pure white. The anthers are sagitate and connive, and adhere to form a columnar stigma. The nectary disc is 5-lobed. The fruits are pairs of 15 cm–40 cm × 2 mm–5 mm follicles filled with linear oblong and plumed seeds (Fig. 256).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Allamanda cathartica* L.**

[After Dr. Allamand who sent seeds of the plant to Linnaeus and from Greek, *kathartikos* = purgative]

Physical description: It is a common garden and street ornamental climbing shrub of the Asia-Pacific which is native to South America. It grows to a height of 4 m. The stems are terete, smooth and exude an abundant milky latex when incised. Leaves: simple, verticillate by 3–5, sessile, without stipules, glabrous beneath, leathery, and glossy. The blade is 8 cm–15 cm × 4 cm–5 cm,

Common names: Yellow allamanda; *bunga telur raja* (Malay), *jaharsontakka* (Sanskrit); *jasmin d'amarille*, *orélie de la Guyane*, *alamande* (French).

and oblong-lanceolate. The base of the blade is acute, while the apex is acuminate. The flowers are golden yellow. The corolla is tubular, 3 cm × 2 cm, inflated, 5-lobed, with the lobes being round, 2 cm long and contorted in buds. The fruits are spiny capsules (Fig. 257).

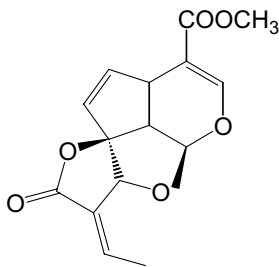
Uses: The leaves of *Allamanda cathartica* L. are used in a number of Asian countries to treat costiveness of the bowels, and to induce vomiting. In Indonesia, the latex is introduced into hollowed teeth to assuage pain. In India, the leaves are used to relieve the bowels of costiveness; the bark is to treat ascite; and the roots is to counteract snake-poisoning.



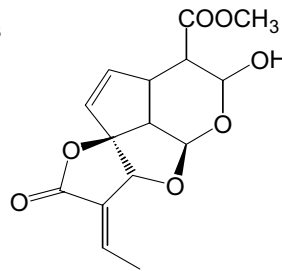
Fig. 257. *Allamanda cathartica* L.

Pharmaceutical interest:

Chemotherapeutic properties: Extracts of *Allamanda cathartica* L. inhibit the proliferation of *Klebsiella* sp., *Staphylococcus* sp., and fungi cultured *in vitro* (Kumar A *et al.*, 1995; Collier WA *et al.*, 1950). The plant is known to produce a series of iridoid glycosides, such as allamandin which are antileukemic (Kupchan SM *et al.*, 1974), tumor-inhibiting and molluscicidal. A cytotoxic-guided fractionation of an ethyl acetate extract of the leaves using Sc-(7) yeast strain, resulted in the characterization of isoplumericin and plumericin (Abdel-Kader MS *et al.*, 1997). Isoplumericin and plumericin are antimicrobial and molluscicidal (Hamburger MO *et al.*, 1991).



Plumericin



Allamandin

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 Kumar A, *et al.* (1995) *J Liv World* **2**(1): 27–30.
 Kupchman SM, *et al.* (1974) *J Org Chem* **39**(17): 2477–2482.

Warning: The plant is toxic and cause dermatitis (Allen PH *et al.*, 1943).

Alyxia stellata (Forst.) Roem. et Schult.

[From Greek, *halusis* = chain and from Latin, *stella* = star]

Synonymy: *Alyxia reinwardtii* Bl.,
Alyxia lucida Wall. Roxb.

Common names: *Mempelasari*,
pelasari, *mempelas hari*, *mempelas*
 (Malay).

Physical description: It is a woody climber of the Asia-Pacific which grows wild on seashores. The plant is also cultivated for its fragrance. Leaves: simple, 4 cm–8 cm × 2.5 cm–3 cm, without stipules, and whorled by 3–4. The petiole is 5 mm long. The blade is rigid, elliptic and obovate. The base of the blade is narrowed and the secondary nerves are indistinct. The inflorescences are many-flowered and umbellate. The pubescent cymes. The calyx is 5-lobed, the lobes being linear and pubescent. The corolla is white with an orange throat, star-shaped, tubular, 7 mm long, oblong and develops 5 contortate lobes. The stamens are inserted above the middle of the corolla tube. The style is filiform. The stigma is oblong. The fruits are black, purplish, ellipsoidal, 1.25 cm long and pulpy drupes (Fig. 258).

Uses: In Indonesia, *Alyxia stellata* (Forst.) Roem. et Schult. is used to give flavor to medicinal mixtures, promote digestion, and stop spasms, flatulence and diarrhea. In Malaysia, the dried bark is placed among clothes to perfume them. The leaves are mixed with onions and cooked in a plantain leave to offer an internal remedy for thrush. The plant is used to promote digestion, and to treat shingles as well as sterility associated with irregular menses. A decoction of leaves is drunk to treat leucorrhoea and to stop dysentery. A decoction of roots is drunk to aid recovery from childbirth. An infusion of either the bark and leaves or flowers and leaves is used to treat gonorrhoea and to stop dysentery. The plant is also used to calm the mind, combat fever, treat dimness of vision, heal buboes and burn, and assuage pain of bones. In Vietnam, a number of plants classified under the genus *Alyxia* are burned as incense, as well as to assuage headache. *Alyxia stellata* (Forst.) Roem. et Schult. was listed in the *Netherlands's Pharmacopoeia*.

Pharmaceutical potential: Extracts of *Alyxia stellata* (Forst.) Roem. et Schult are able to inhibit the synthesis of melanin, tyrosinase, plasmin and trypsin, and hence have been patented as skin-lightening and rough-skin preventing cosmetics. A number of 3-hydroxycoumarin glycosides were characterized from the inner bark of *Alyxia reinwardti* var. *lucida* (Lin LJ *et al.*, 1993), and one might set the hypothesis that these coumarins are responsible for the anti-inflammatory, analgesic and antifebrile properties mentioned above (see p.).

Reference

Lin LJ, *et al.* (1993) *Phytochem* **34**(3): 825–830.

Warning: The bitter sap of this plant is used to induce vomiting.

Alstonia scholaris (L.) R. Br.

[After C Alston, 1685–1760, a Scottish botanist and from Latin, *scholaris* = school]

Common names: *Basong, pulai, rejang* (Malay); *lettok, lettop, taungmek, toungmayobeng* (Burmese); *popéal khe* (Cambodian); *ditaa* (Filipino); *alstonie des écoliers* (French).

Physical description: It is a tree which grows to a height of 18 m. The plant is found in the lowland and mountain (1000 m) rainforests of India, the Asia-Pacific, Southern China and Queensland. The bole is straight and was formerly used to make slates for schools. The bark is smooth, blackish or dark brown and exudes a bitter milky latex. The inner bark is bright yellow. The crown is umbrella shaped and the stems are copiously lenticelled. Leaves: simple, without stipules, pendulous, 5–8 forming terminal whorls. The petiole is 1 cm–2 cm long, stout and channeled above, the secondary nerves are numerous, showy, several, straight, parallel and at right angle from the midrib. The blade is thick, oblong-lanceolate or obovate, 7 cm–17 cm × 3 cm–6 cm obtuse or shortly acuminate, dark green above and pale bluish below. The flowers are greenish white and ephemeral.



Fig. 258. *Alyxia stellata* (Forst.) Roem. et Schult.





Fig. 259. *Alstonia scholaris* (L.) R. Br.

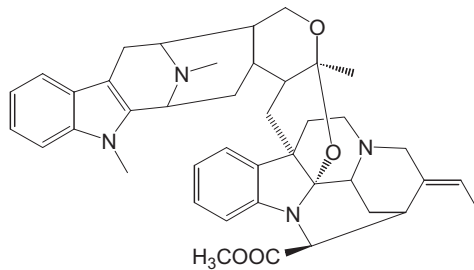
The calyx is 2.5 mm–3 mm long. The corolla is 5 mm × 8 mm long and 5-lobed, dirty white and very thin. The fruits consist of pairs of 30 cm–60 cm × 3 mm, cylindrical, pendulous, pair follicles containing numerous 5 mm long seeds (Fig. 259).

Pharmaceutical interest:

Antiprotozoal properties: In regard to the antiprotozoal properties of *Alstonia scholaris* (L.) Br., a number of experiments conducted both *in vitro* and *in vivo* have clearly demonstrated that the dimeric indole alkaloids of the bark alleviate the survival of *Plasmodium* and *Leishmania* species. One such alkaloid is echitamine which inhibits moderately the proliferation of *Plasmodium falciparum* cultured *in vitro* (Wright CW *et al.*, 1993). Petroleum ether and methanolic extracts of *Alstonia scholaris* (L.) Br. given to mice infected with *Plasmodium berghei* display dose-dependent improvement of the condition and prolong mortality (Gandhi M *et al.*, 1990). A crude extract of *Alstonia angustifolia* annihilates *Plasmodium falciparum* K1 strain at an IC₅₀ value of 0.35 μg/mL (Said IM *et al.*, 1992). Macrocarpamine, macralstonine and villastonine characterized

Uses: In Cambodia, the bark is used to promote menses and to treat chronic paludism with the enlargement of the spleen and liver discomfort. In Indonesia, the plant is used to stop diarrhea, treat diabetes and heal hemorrhoids. An infusion of the young leaves is drunk to treat beriberi. The leaf tips roasted with coconut are used to treat stomatitis. In Malaysia, the plant is used to treat malaria. The latex is used to assuage toothache. A decoction of the bark is drunk to combat fever, invigorate the body, stimulate appetite, and treat yaws. In Burma, the latex is used to heal ulcers. In India, the bark is used to promote milk secretion and to treat cancer. In the Philippines, the plant is used internally to combat fever, stop dysentery, heal wounds, and treat epilepsy. In Vietnam, the bark is used to treat chronic malaria with enlarged spleen, while the leaves are used to promote milk secretion. The bark of *Alstonia scholaris* (L.) R. Br. has been used in Western medicine (*British Pharmacopoeia*, 1914) as an antimalarial drug.

from *Alstonia angustifolia*, inhibit the proliferation of *Entamoeba histolytica* and *Plasmodium falciparum* cultured *in vitro*, but are 4–8 times less potent than emetine and chloroquine (Wright CW *et al.*, 1992). An extract of *Alstonia scholaris* (L.) Br. inhibits more than 75% (1 g/Kg/day, 5 days) of *Leishmania donovani* in golden hamsters (Singh UK *et al.*, 1992). An extract of the bark of *Alstonia boonei* bark paralyzes dose-dependently the larvae of *Trichostrongylus columbriformis* cultured *in vitro*, at an ED₅₀ value of 0.52 mg/mL at 24 hours (Asuzu I *et al.*, 1996). Echitamine affects both cellular and mitochondrial respiration, leading to the reduction of the cellular energy pool and, therefore, results in a loss of viability of cells (Saraswathi V *et al.*, 1998). One should ascertain that this mechanism imparts to *Alstonia* alkaloids, antiplasmodial properties and cytotoxic properties.



Villastonine

Cytotoxic properties: Echitamine and villastonine are cytotoxic. Using an SRB assay, a methanol extract of the roots of *Alstonia macrophylla* is shown to inhibit the proliferation of human lung cancer cell-lines MOR-P (adenocarcinoma) and COR L-(23) (large cell carcinoma), the effect of which is attributed to the presence of villastonine, which destroys both cell-lines at IC₅₀ value inferior to 5 μ M (Keawpradub N *et al.*, 1997).

Echitamine chloride, in combination with vitamin A, destroys efficiently Ehrlich ascite carcinoma cells cultured *in vitro* (Wiswanathan S *et al.*, 1997), and lowers the serum to normal levels of glycoproteins and glucosidases which are higher in sarcoma-180 tumors-bearing mice, indicating a possible anti-cancer property (Saraswathi V *et al.*, 1998). When given subcutaneously at a dose of 5 mg/Kg, echitamine alters the impaired drug detoxifying system which is observed in the sarcoma-180-bearing mice (Saraswathi V *et al.*, 1999).

Other pharmacological properties:

Oestrogenic: An extract injected into different groups of immature female mice (0.1 mL equivalent to 2 g of crude/mouse/day, 5 days), increases the mammary glands and uterovarian structures in comparison with the control group.

Oestrogen standards groups injected with stilboestrol dipropionate displays a similar property (Biswas D *et al.*, 1994).

Hepatoprotective: Aqueous extracts of bark significantly lower the elevation of serum transaminases and mitigate the histopathological changes caused by carbon tetrachloride (32 µg/Kg), acetaminophen (600 mg/Kg) or β-D-galactosamine (288 mg/Kg) (Lin S *et al.*, 1996).

Enzymatic activity: Strictamine inhibits the enzymatic activity of monoamine oxidase and displays an antidepressant property (Battacharya SK *et al.*, 1979). Extracts of *Alstonia scholaris* (L.) Br. that inhibits the enzymatic activity of tyrosine kinase, aging and promote collagen formation are included in patented cosmetic preparations.

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 Said IM, *et al.* (1992) *J Nat Prod* **55**(9): 1323–1324.
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 Saraswathi V, *et al.* (1999) *Cancer Biochem Biophys* **17**(1–2): 79–88.
 Singha UK, *et al.* (1992) *Int J Pharmacog* **30**(4): 289–295.
 Viswanathan S, *et al.* (1997) *Int J Pharmacol* **29**(4): 244–249.
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 Wright CW, *et al.* (1993) *J Ethnopharmacol* **40**(1): 41–45.

Warning: Caution must be taken as the plant is toxic (Baliga MS *et al.*, 2004).

Catharanthus roseus (L.) G. Don

[From Latin, *catharanthus* = pure flower and *roseus* = rose-colored]

Physical description: It is a herb which grows to a height of 40 cm–80 cm. The plant is native to Madagascar and is widely distributed throughout the Asia-Pacific as an ornamental plant. The stems are woody at the base and exude an abundant milky latex upon incision. Leaves: simple, decussate, succulent, and without stipules. The petiole is 5 mm–6 mm long and shows a pair of glands near the stem. The blade is 2.5 cm–9 cm × 1 cm–2.5 cm, oblong,

Synonymy: *Vinca rosea* L.,
Lochnera rosea (L.) Reichenbach.

Common names: Periwinkle,
Madagascar periwinkle; *kemunting*
cina (Malay); *thenbanmahnyoban*
(Burmese); *pervenche de*
Madagascar (French).

glossy, obovate, and often dark green. The base of the blade is acute and the apex is round or mucronate. The margin is entire. The midrib is distinct and white. The flowers are showy, pink, or purple or white (var. *albus*) or white with a red eye (var. *ocellatus*). The corolla is tubular, 2.5 cm–3 cm long, and develops 5 lobes which are contorted, broad and apiculate. The fruits consist of pairs of greenish succulent follicles, 2 cm–3 cm long (Fig. 260).

Pharmaceutical interest: Attempts to ascertain the antidiabetic property of *Catharanthus roseus* G. Don in the sixties led first to the observation by Canadian workers that leave extracts caused leucopenia in rats. Eli Lilly researchers undertook further intensive phytochemical studies, which resulted in the characterization of at least 60 alkaloids. A number of these alkaloids, such as ajmalicine, serpentine, and tetrahydroalstonine also occur in other genera. Of special interest is a series of 20 binary indole alkaloids and especially vincristine and vinblastine which are used to treat acute leukemia, lymphoma and a number of solid tumors (breast and lung cancers). Vinblastine sulphate (Velbe[®]) is used to treat generalized Hodgkin's disease and chorionepithelioma; whereas vincristine sulphate (Oncovin[®]) is used clinically to treat leukemia in children. Both vinblastine and vincristine inhibit the polymerization of the mitotic spindle which is in charge of separating chromosome pairs during cell division. The resulting effect is a blockage of mitosis in metaphase and therefore inhibition of



Fig. 260. *Catharanthus roseus* G. Don.

Uses: *Catharanthus roseus* (L.) G. Don is used in the Asia-Pacific, India, South Africa and Queensland to treat diabetes. In India, the juice expressed from the leaves is used to heal wasp stings. In Malaysia, a decoction of 30 g of the plant is drunk to treat diabetes and enteritis, stop dysentery, assuage menstrual pain, lower blood pressure, and treat insomnia and cancer. The crushed leaves are applied to scalds, burns, sores, mumps, swollen neck, tonsillitis and insects bites. In the Philippines, a decoction of the roots is drunk to promote menses, to aid abortion, and treat diabetes. In Vietnam, the plant is used to combat fever, promote menses and expel impurities after childbirth. The petiole and the leaves are more specifically used to regulate menses and the roots of the white variety are used to treat diabetes and malaria.

further tumor proliferation. Note that inhibition of the assembly of microtubule is responsible for neurological disorders including headache, neuritis, loss of tendon reflexes and depression.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Cerbera odollam* Gaertn.**

[From Greek, *Kerberos* = 3-headed dog guarding the entrance to Hades and from Greek, *Adullam*]

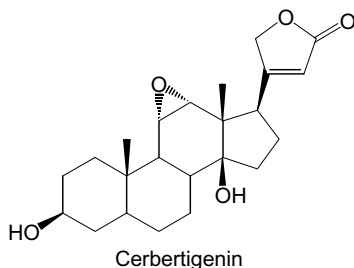
Common names: *Kalwah* (Burmese); *betah* (Java); *beluta, pong-pong, betak betak, bebuta* (Malay).

Physical description: It is a medium-sized seashore tree of India, the Asia-Pacific, China, Australia and the Pacific Islands. The bark is smooth, grey, lenticelled and exudes an acrid milky latex. The stems are whorled, stout, and marked with leaf scars. Leaves: simple, few, without stipules, spiral, packed at the end of the stems and 12 cm–16 cm × 3 cm–5 cm. The petiole is 2 cm–3.8 cm long. The blade is succulent, dark green, glossy, lanceolate, or oblong-lanceolate and shows 15–25 pairs of secondary nerves at almost right angle with the midrib. The flowers are arranged in terminal, 5 cm–15 cm, paniculate cymes. The bracts are colored, 1.3 cm–2.5 cm long, oblong and acute. The calyx is glabrous, and 5-lobed; the lobe are 2 cm–2.5 cm long, linear, oblong and acute. The corolla is tubular, with the tube being 1.3 cm–2 cm long and shorter than the lobes which are contorted and pointed. The throat is nearly closed by 5 pubescent projecting wing-like ribs. The fruits are 10 cm long, apple-shaped, green or purplish glossy drupes. The fibrous husk which



Fig. 261. *Cerbera odollam* Gaertn.

envelopes the seed is a common sight among the flotsam of the Asia-Pacific (Fig. 261).



Uses: *Cerbera odollam* Gaertn. has the typical pattern of medicinal uses of poisonous plants: laxative, emetic and counter-irritant. In India, the seeds are eaten to induce drowsiness and to kill wild dogs. In Indonesia, the oil expressed from the seeds is used to soothe inflamed parts and rheumatism. In Malaysia, a paste of the fruit is used to treat rheumatism in the legs. In the Philippines, the oil expressed from the seeds is used to treat rheumatism.

Pharmaceutical interest: The poisonous principles of *Cerbera odollam* Gaertn. are cardiac glycosides such as cerberin, which comprises of a tetracyclic steroidal aglycone of the (C₂₃) cardenolide type. Only a few pharmacotoxicological studies of the seeds of *Cerbera odollam* Gaertn. are reported (Guruswami MN *et al.*, 1970).

Central nervous properties: Note that there is an expanding body of evidences to suggest that cardenolides act on the central nervous system. The precise mechanism involved here is unknown and one should try to ascertain it. An extract of the leaves of *Cerbera odollam* Gaertn. at a dose lower than 14.5 g/Kg (intraperitoneal injection), decreases the spontaneous motor property, increases the reaction time to a thermal stimulus, lowers the duration of pentylenetetrazole-induced tonic seizures and mortality, and potentiates the hypnotic effect sodium pentobarbital in mice (Hien TT *et al.*, 1991).

References

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 Guruswami MN, *et al.* (1970) *Ind J Med Sci* **24**(2): 82–87.
 Hien TT, *et al.* (1991) *J Ethnopharmacol* **34**(2–3): 2201–2206.

Warning: Ingestion of the seeds is followed shortly by vomiting, purging, collapse and death (Gaillard Y *et al.*, 2004).

Chonemorpha fragrans (Moon) Alston

[From Latin, *fragrare* = smell sweet]

Physical description: It is a shrub which grows to a height of 3 m. The stems are terete and lenticelled. Leaves: simple, opposite and without stipules. The

Synonymy: *Chonemorpha macrophylla* G. Don, *Chonemorpha penangensis* Ridl., *Chonemorpha rheedi* Ridl.

Common names: *Akar gerip merah* (Malay).

Uses: In India, a decoction of *Chonemorpha fragrans* (Moon) Alston is drunk to treat amebic dysentery.

petiole is channeled and 5 cm–6 cm long. The blade is round, pubescent below, leathery, and 16 cm–14 cm × 15 cm–13 cm. The blade shows 10 pairs of secondary nerves which are sunken above and raised below, with scalariform tertiary nerves. The fruits consist of pairs of follicles which are woody, lanceolate, and 17 cm × 1 cm (Fig. 262).

Pharmaceutical interest: The amebicidal principle of *Chonemorpha fragrans* (Moon) Alston is chonemorphine. This steroidal alkaloid cures 100% of experimental hepatic infection in golden hamsters at 100 mg/Kg × 4 and clears 90% of the intestinal infection in weanling Wistar rats at 200 mg/Kg × 4 (Chatterjee DK *et al.*, 1987).

Reference

Chatterjee DK, *et al.* (1987) *Parasitol Res* **74**(1): 30–33.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Holarrhena antidysenterica (Roxb.) Wall.

[From Greek, *anti* = against and *dysenteria* = dysentery]

Physical description: It is a treelet tree of India, Burma, Malaysia, Thailand, Vietnam, Cambodia and Laos. The stems are glabrous, lenticelled,

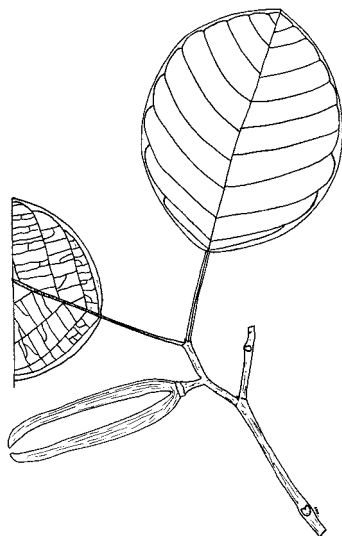


Fig. 262. *Chonemorpha fragrans* (Moon) Alston. From: KLU 039088. Field collector: SC Chin, 14 June 1986. Botanical Identification: David Middleton. 1993. Geographical localization: Gunung Kamaseh, on a massive limestone range near Kampung Lambatorang, Sulawesi.

Common name: *Conessie* (French); *tivraja* (Arabic); *letongkyi* (Burmese); *kurchi* (Indian); *indra* (Sanskrit).

Uses: In Cambodia, Laos, Vietnam and India, the latex of *Holarrhena antidysenterica* (Roxb.) Wall. is used to treat conjunctivitis, dysentery and cholera; stop hemorrhages; and to heal. The bark has been used in India as a talisman “against enemies” as well as treat dysentery since a very remote period of time. The latex is added to cow’s milk, left to stand overnight and drunk to treat dysentery. In Thailand, the plant is used to expel intestinal worms, treat tuberculosis, favus, dysentery, combat fever, and promote menses. *Holarrhena antidysenterica* (Roxb.) Wall. was known to Persians and Arabs traders and possibly to the Greeks.

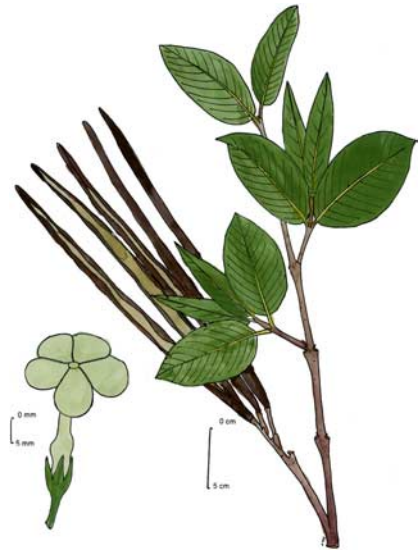
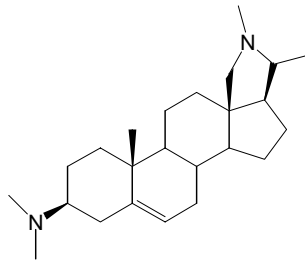


Fig. 263. *Holarrhena antidysenterica* (Roxb.) Wall. From: KLU 10005. Field collector: Benjamin C Stone, 24 Feb 1968. Geographical localization: Maharashtra State, Bombay, dry hillsides above estuary between China Creek and Thara, India. Botanical identification: NA Irani.

laticiferous, purplish and distinctly swollen at the nodes. Leaves: simple, decussate and without stipules. The petiole is 1 mm–2 mm long. The blade is papery, oblong, lanceolate, and 5 cm–7 cm × 2.5 cm–3 cm. The margin is wavy. The midrib is flattened on both surfaces of the blade, showing 11–14 pairs of secondary nerves. The inflorescences are terminal cymes about 1.5 cm long. The calyx is indistinct and comprises of 5 triangular lobes. The corolla is tubular, the tube being swollen at the base, and with 5 round lobes which are 8 mm × 4 mm. The fruits consist of pairs of fusiform, 25 cm-long follicles filled with comose seeds (Fig. 263).

Pharmaceutical interest: *Holarrhena antidysenterica* (Roxb.) Wall. is known to elaborate a series of steroidal alkaloids such as conessine and kurchicine (Gosh *et al.*, 1928; Siddiqui *et al.*, 1932; Begum S *et al.*, 1993). The dried bark from the stem and roots containing not less than 2% of total alkaloids (*Holarrhena*, *British Pharmaceutical Codex*, 1949), has been used in the form of a liquid extract to treat amebic dysentery. Conessine hydrobromide (*French Pharmacopoeia*, 1965) has been used to treat amebic dysentery, but it has been withdrawn due to its severe neuropsychopathic effects (Adam ARD, 1953). An extract of the plant inhibits the growth of enterohemorrhagic *Escherichia coli* (Voravuthikunchai S *et al.*, 2004). Are steroidal alkaloids involved here?



Conessine

References

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 Begum S, et al. (1993) *Heterocycles* 36: 4717–4723.
 Siddiqui, et al. (1932) *J Ind Chem Soc* 9: 553–563.
 Voravuthikunchai S, et al. (2004) *J Ethnopharmacol* 94(1): 49–54.

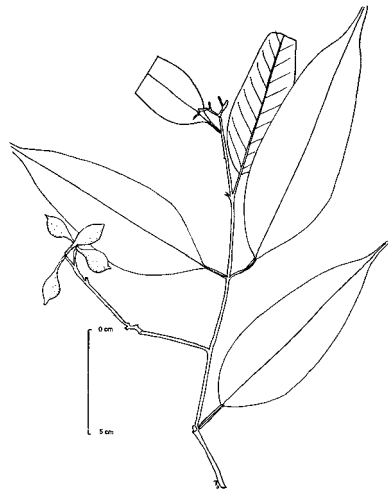
Warning: The plant is toxic.

Hunteria zeylanica (Retz.) Gardn. & Thw.

[From Latin, *zeylanica* = from Ceylon]

Synonymy: *Hunteria corymbosa* Roxb., *Hunteria roxburghiana* sensu Ridl.

Common names: *Kemuning hutan* (Malay); *lahoi* (Indonesian).



Physical description: It is a tree which grows to a height of 18 m high and a girth of 40 cm. It is found in the rainforest of Malaysia and Thailand. The bark is smooth and grey. Leaves: simple, decussate and without stipules. The petiole is 1 cm–1.4 cm long, thin and channeled. The blade is 13.5 cm × 5 cm–14.5 cm × 4.5 cm, and obovate-lanceolate. The apex of the blade is caudate in a 1 cm–1.5 cm long tail. The midrib is raised above and sunken below. The margin is wavy

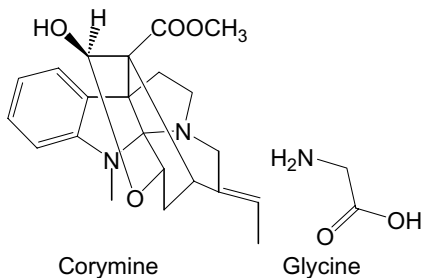
Fig. 264. *Hunteria zeylanica* (Retz.) Gardn. & Thw. From: KLU 1658. Field collector: 17 Apr 1970, E. Soepadmo. Geographical localization: Sungai Sempam, Raub, Pahang, altitude: 2000 ft, Malaysia. Botanical identification: Margraf, 1973.

and obscurely recurved. The blade shows about 20 pairs of secondary nerves. The flowers are yellowish-green. The fruits consist of pairs of yellowish, 2.3 cm × 1.1 cm–1 cm × 1.2 cm follicle that beaked at the apex (Fig. 264).

Pharmaceutical interest:

Glycinergic properties: Corymine extracted from the leaves of *Hunteria zeylanica* (Retz.) Gardn. & Thw. is interesting because it potentiates the convulsions induced either by strychnine or picrotoxin, at doses of 2, 8 and 15 mg/Kg in mice (Leewanich P *et al.*, 1996) and inhibits glycine-gated chlorine-channels by interacting with a site different from that of 4,4'-diisothiocyanostilbene-2,2'-disulfonic acid (Leewanich P *et al.*, 1998).

Uses: In Malaysia, the latex of *Hunteria zeylanica* (Retz.) Gardn. & Thw. is used to treat yaws.



Anti-inflammatory and antipyretic properties: Alkaloids are very likely to be involved in the medicinal use mentioned above, as a crude alkaloid fraction extracted from the bark at doses of 300 μ g/mL inhibits the production of leukotriene C4 by 5-lipoxygenase by 50% in A23187-stimulated rat mast cells (Reanmongkol W *et al.*, 1995). Strictosidinic acid given to rodent displays antinociceptive effect in the writhing test and lowers the fever induced by yeasts (Reanmongkol W *et al.*, 2000).

References

- Leewanich P, *et al.* (1996) *Biological & Pharmaceutical Bulletin* **19**(3): 394–399.
 Leewanich P, *et al.* (1998) *European Journal of Pharmacology* **348**(2–3): 271–277.
 Reanmongkol W, *et al.* (1995) *Biol Pharm Bull* **18**: 910–912.
 Reanmongkol W, *et al.* (2000) *Pharmaceutical Biology* **38**(1): 68–73.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Kopsia fruticosa* (Ker.) DC.**

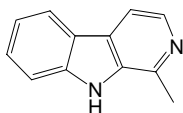
[After J Kops, 1765–1849, the first editor of the Dutch Flora Batavia; and *fruticosum* = bush]

Common name: Kopsia.

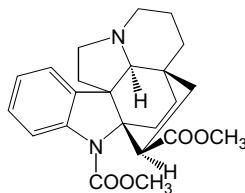
Physical description: It is shrub which grows to a height of 3 m tall. The plant is native to Burma, being an ornamental plant in the Asia-Pacific. The stems are ash-colored to white and laticiferous. Leaves: simple, few, without stipules, decussate, 8 cm–20 cm × 3 cm–7 cm, and yellowish green. The blade is elliptic, papery, and shows a distinct blunt apical tail marked at the apex by a gland. The blade shows 8–13 pairs of secondary nerves and a midrib sunken above and raised below. The flowers are showy, pink with a crimson throat, fading white and arranged in dense and terminal clusters. The corolla is tubular, with the tube being long and thin and developing 5 contorted lobes. The fruits consist of pairs of follicles which are triangular, 1 cm × 6 mm, finely hairy and dehiscent (Fig. 265).



Fig. 265. *Kopsia fruticosa* (Ker.) DC.



Harmane



Pleiocarpine

Pharmaceutical interest: *Kopsia* species have attracted a great deal of interest on account of their ability to elaborate series of monoterpenoid indole alkaloids (Kam T *et al.*, 1999; 2004). Rhazinilam characterized from *Kopsia singaporensis* Ridley, stimulates *in vitro* the spiralization of tubulin in a way similar to vincristine but shows no activity *in vivo*. The cytotoxicity of vincristine is enhanced in a concentration-dependent manner in drug resistant KB cells by kopsiflorine (10 µg/mL) characterized from *Kopsia* sp. (Rho MC *et al.*, 1999). Injection of kopsingine (0.2 mg/Kg–10 mg/Kg) characterized from *Kopsia teoi* lowers the arterial blood pressure and heart rate in anesthetized spontaneously hypertensive rats in

Uses: In Malaysia, the pounded roots of *Kopsia fruticosa* (Ker.) DC. are used to heal syphilitic ulceration of the nose.

a manner similar to normotensive controls (Mok S *et al.*, 1998). Harmane, pleiocarpine and buchtienine from *Kopsia griffithi* are leishmaniacidal (Kam T *et al.*, 1999).

References

- Kam T, *et al.* (1999) *Phytochem* **50**(1): 75–79.
 Kam T, *et al.* (2004) *Phytochem* **65**(14): 2119–2122.
 Mok S, *et al.* (1998) *J Nat Prod* **61**(3): 328–332.
 Rho MC, *et al.* (1999) *Planta Med* **65**(4): 307–310.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Leuconotis eugeniifolius A. DC.

[From Greek, *leukos* = white and from Latin, *eugeniifolius* = *Eugenia* — like leaves]

Common names: *Akar getah garah* (Malay).

Physical description: It is a woody climber of the rainforests of Malaysia and Indonesia. Leaves: simple, decussate and without stipules. The petiole is 1.5 cm long, velvety and channeled. The blade is oblong-lanceolate, dark green, glossy, papery, velvety below, and 10 cm × 2.8 cm–11 cm × 3.5 cm. The base of the blade is round and the apex is cuspidate in a 1 cm long tail. The margin is wavy and slightly recurved. The midrib is sunken above and raised below. The blade shows 12 pairs of secondary nerves which are indistinct above and showy below. The secondary nerves are connected by a conspicuous intramarginal nerve. The fruits are solitary, axillary, globose, and 1 cm–2 cm in diameter. The fruit pedicel is 2 cm long (Fig. 266).

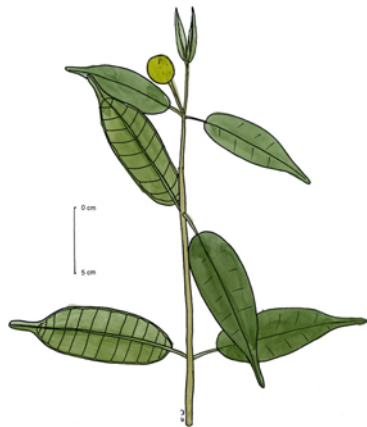


Fig. 266. *Leuconotis eugeniifolius* A. DC. From: KLU 6213. Field collector: Benjamin C Stone. 12 Feb 1967. Botanical identification: Markgraf. Geographical localization: Pahang, 500 ft., Bentong Sungai Pertin, Malaysia.

Pharmaceutical interest: The pharmacological potential of *Leuconotis eugeniifolius* A. DC. is unexplored. A number of indole alkaloids, including yohimbine, are known to occur in the leaves and stems of *Leuconotis eugeniifolius* A. DC. (Abe F *et al.*, 1999).

Uses: In Indonesia, the latex of *Leuconotis eugeniifolius* A. DC. is used to expel worms. In Malaysia, the latex is used to treat yaws.

Reference

Abe F, *et al.* (1999) *Phytochem* **35**(1): 169–172.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Nerium oleander L.

[From Greek, *nerion* = *Neriumoleander* L. and from Latin, *olea* = olive]

Common names: Oleander, rose laurel; *bunga Jepun* (Malay).

Physical description: It is a shrub which grows to a height of 2 m. The plant is native to southern Europe and cultivated as an ornamental item. The stems are sappy. Leaves: simple, without stipules and arranged in whorls of 3. The petiole is short and thick. The blade is narrow, linear, leathery, dark green, 10 cm–30 cm × 1 cm–3 cm and shows several pairs of secondary nerves. The flowers are showy, pink. The flowers are fragrant, 2 cm in diameter, pink, red or white according to the variety and arranged in terminal clusters. The fruits consist of pairs of cylindrical, 15 cm–25 cm long follicles (Fig. 268).



Fig. 267. *Nerium oleander* L.

Pharmaceutical interest:

Cardiovascular properties: The main symptoms of Oleander poisoning are gastrointestinal irritation, a marked hyperkalemia, A-V block, ventricular dysrhythmia, and if the dose is too high, death (Markov AK *et al.*, 1999). Oleandrin and related derivatives (the glycoside of gitoxigenin and 4-*O*- β -*D*-digitalose) are responsible for life threatening intoxication and digoxin-like cardiotoxic properties.

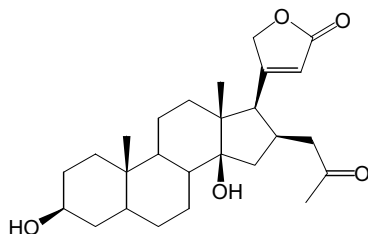
These steroidal glycosides (1.5% in the leaves) consist of tetracyclic aglycones of the (C₂₃) cardenolide type. Oleandrin is listed in the *Russian Pharmacopoeia* (100 μ g/tablet) for the treatment of low pulse pressure. Oleandrin and other cardenolides such as digoxin (Lanoxin[®]) inhibit the myocytes membrane Na⁺/K⁺

Uses: In the Asia-Pacific, *Nerium oleander* L. is used to invigorate the heart and to promote urination. In Indonesia, decoction of the leaves in oil is used to destroy maggots found in wounds. In the Philippines, the bark and leaves are mixed with oil and used to treat herpes infection. In Vietnam, the plant is used to treat mycosis and to soothe inflamed parts.

ATPases. As a result, the myocardial contraction forces are increased and the heart rate is decreased. These two pharmacological effects are of value in treating patients diagnosed with supraventricular tachycardia and heart failure. A methanolic extract of the leaves given at doses of 1 mg/mL–2.5 mg/mL, increases both the spontaneous and electrically-induced contraction of rat vas deferent and guinea-pig ileum without inhibition by the adrenergic blocking agent tolazoline. This extract inhibits electrically-stimulated neurogen twitch skin responses of rat phrenic nerve diaphragm preparations and the rate of spontaneously beating atria (Mazumder PK *et al.*, 1996).

Neurological properties: A number of glycosides characterized from *Nerium oleander* L. are anxiolytic in rodent (Siddiqui BS *et al.*, 1997; Begum S *et al.*, 1999). The precise central mechanism of action of cardenolides and, more generally, of triterpenoid saponins (Sokolov SY, 1986) is an enigma and it is possible that further investigation will result in the discovery of original neuropharmacological pathways.

Chemotherapeutic properties: A fraction of the plant is several orders of magnitude more molluscicidal than niclosamine, formothion and phorate against *Lymnea acuminata* (Singh S *et al.*, 1997). *cis*-Karenin ($IC_{50} = 15 \mu\text{g/mL}$) and *trans*-karenin ($IC_{50} = 7.5 \mu\text{g/mL}$), 2 pentacyclic triterpenoids characterized from *Nerium oleander* L. destroy significantly KB cells cultured *in vitro* (Siddiqui BS *et al.*, 1995). Note that Oleandrin inhibits 12-*O*-tetradecanoylphorbol-13-acetate-induced skin tumor promotion (Afaq F *et al.*, 2004).



Oleandrigenin

Oleandrin inhibits experimentally the activation of NF- κ B and activator protein-1 and their associated kinases. Natural products which can suppress the activation of nuclear factor κ B (NF- κ B) and activator protein-1 (AP-1) might have the potential to block tumorigenesis and inflammation. Oleandrin blocks the activation of NF- κ B by the tumor necrosis factor α , both in concentration- and time-dependent manner. This property is mediated through the inhibition of phosphorylation and degradation of I κ B α , an inhibitor of NF- κ B. Oleandrin blocks the activation of NF- κ B caused by phorbol ester and lipopolysaccharide.

It blocks the activation of AP-1 caused by the tumor necrosis factor α and other agents, and inhibits the activation of c-Jun NH₂-terminal kinase caused by the tumor necrosis factor α . This may provide a molecular basis for the ability of oleandrin to suppress inflammation and perhaps tumorigenesis (Manna SK *et al.*, 2000).

References

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 Singh S, *et al.* (1997) *Fitoter* **68**(6): 545–546.
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Warning: The plant is toxic.

Ochrosia oppositifolia (Lam.) K. Schum.

[From Greek, *ōkhros* = yellow and from Latin, *oppositus* = opposite and *folium* = leaf]

Synonymy: *Neisosperma oppositifolium* (Lam.) Fosb. & Sach., *Calpicarpum oppositifolium* (Lam.) Boiteau, *Cerbera oppositifolia* Lam., *Lactaria salubris* Raf., *Neisosperma oppositifolia* (Lam.) Fosb. & Sach., *Ochrosia salubris* (Raf.) Blume., *Ochrosia borbonica* Gmel.

Physical description: It is a tree which grows to a height of 6 m and has a girth of 45 cm. The plant is found on the sandy seashores of Malaysia, Indonesia and Polynesia. Leaves: simple, without stipules and whorled. The petiole is 2.5 cm–3 cm long and channeled. The blade is spatulate, glossy, leathery, and 10 cm × 4 cm–14 cm × 8 cm. The apex of the blade is slightly acuminate. The margin is slightly recurved. The blade shows 17–20 pairs of secondary nerves. The fruits consist of pairs of 7 cm × 3.5 cm, ovoid, smooth, succulent follicles, beaked at the apex (Fig. 268).

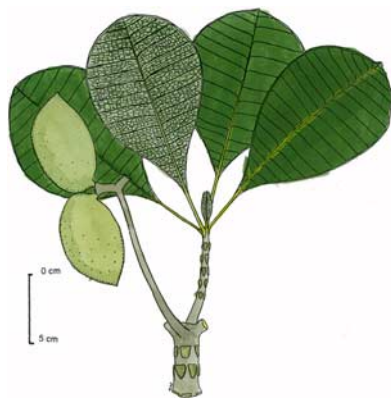
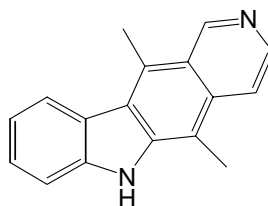


Fig. 268. *Ochrosia oppositifolia* (Lam.) K. Schum.

Uses: In Indonesia, the roots of *Ochrosia oppositifolia* (Lam.) K. Schum. are used to promote digestion, appetite and counteract seafood poisoning. *Georgius Everadius Rumphius* states that the roots are used to counteract poisonous fish and crustacean digestive poisoning.



Ellipticine

Pharmaceutical interest:

Cytotoxic and antiplasmodial properties: An interesting feature of *Ochrosia* species is that they elaborate indole alkaloids (Peube-Locou N *et al.*, 1972) which are of chemotherapeutic value, such as ellipticine and 9-methoxyellipticine. These alkaloids are planar and impede the enzymatic activity of topoisomerase II by DNA intercalation. 9-hydroxy-2-*N*-ellipticinium obtained by quaternarization of 9-hydroxyellipticine, is a semisynthetic derivative anticancer agent of clinical value in a number of forms of breast cancer. A methanol extract of the stem bark of *Ochrosia glomerata* inhibits *Plasmodium falciparum* *in vitro* at an IC₅₀ value of less than 10 µg/mL (Horgen FD *et al.*, 2001).

References

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 Peube-Locou N, *et al.* (1972) *Ann Pharm Fr* **30**(12): 821–826.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Parameria laevigata (Juss.) Moldenke

[From Latin, *laevus* = left]

Physical description: It is a large rainforest climber which grows to a length of 3 m long. The plant is found in a geographical zone spanning from India to Indonesia. The stems are smooth, slender and pubescent at the apex. Leaves: simple, decussate and without stipules. The petiole is 2 mm–4 mm long and thin. The blade is lanceolate and 6.4 cm × 2.4 cm–2.7 cm × 1 cm. The apex is acuminate in a 1 cm long tail. The midrib is sunken below, and flat or raised above. The margin is slightly wavy and obscurely recurved. The blade shows 5–7 pairs of secondary nerves

Synonymy: *Ecdysanthera glandulifera* A. DC., *Parameria barbata* (Bl.) K. Schum., *Parameria glandulifera* Benth., *Parameria vulneraria* Radlk.

Common names: *Akar serapat puteh* (Malay); *gembor* (Javanese).

and scalariform tertiary nerves. The flowers are tiny and arranged in terminal cymes. The calyx is pale green, tubular and shows 5 lobes which are contorted, hairy and broad. The corolla is 3 mm long, creamy with the throat being pale yellow. The fruits consist of pairs of thin, articulate follicles filled with comose seeds (Fig. 269).

Uses: In Cambodia, Laos and Vietnam: *Parameria laevigata* (Juss.) Moldenke is used to treat fever, rheumatism, renal diseases, to promote digestion, and to stop dysentery. In Malaysia and Indonesia, a decoction of the bark is used to tighten the uterus after childbirth and to counteract putrefaction of the skin. In the Philippines, *Parameria laevigata* (Juss.) Moldenke is used to counteract putrefaction of the skin, to resolve inflammation, to soothe itchiness, promote menses and to treat skin diseases.

Pharmaceutical interest: The pharmacological potential of *Parameria laevigata* (Juss.) Moldenke remains unexplored. One might set the hypothesis that the medicinal properties mentioned above involve the astringency of proanthocyanidins (Kohei K *et al.*, 2001). It will be interesting to learn whether a more intensive study on this plant will reveal any molecules of therapeutic interest.

Reference

Kohei K, *et al.* (2001) *Chem Pharm Bull* **49**(5): 551–557.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

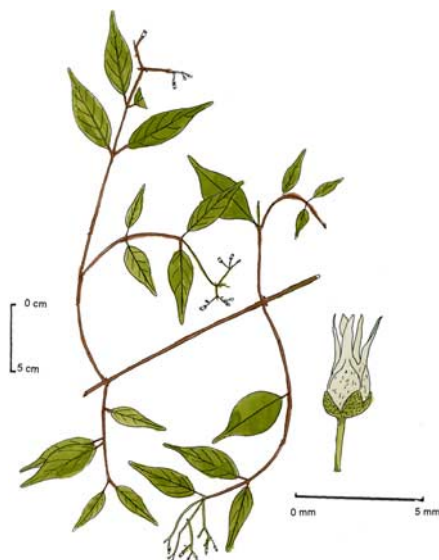


Fig. 269. *Parameria laevigata* (Juss.) Moldenke. From: KLU 043389. Field collector & botanical identification: AJM Leeunwenberg. 28 Nov 1994. Geographical localization: Indonesia, Kalimantan Timor, Waraniset area, off Km 1.5 Waraniset-Semai Road Forest, altitude: 50 m, 1° 07' South–117° 00' East.

Plumieria rubra* L. *sensu lato

[After Charles Plumier, a 17th century French botanist; and from Latin, *ruber* = red]

Synonymy: *Plumieria acuminata* Ait., *Plumieria acutifolia* Poir., *Plumieria alba* L., *Plumieria singaporensis*.

Common names: Frangipani, jasmine tree, pagoda tree temple flower; *bois de lait*, *frangipanier* (French); *ilattalari* (Tamil); *devaganagalu* (Sanskrit); *chinachampac*, *taroksaga*, *tayopsagah* (Burmese); *champeï* (Cambodian); *bunga kubur*, *kanbodia*, *chempaka* (Malay).

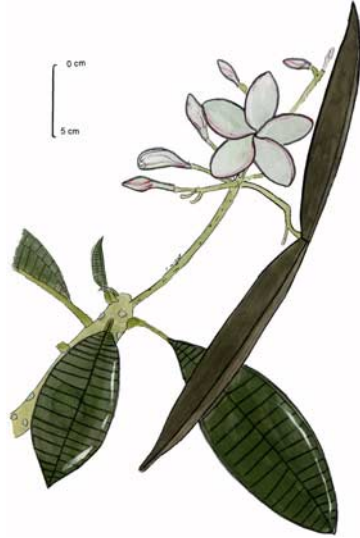
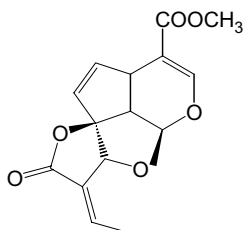


Fig. 270. *Plumieria rubra* L. *sensu lato*.

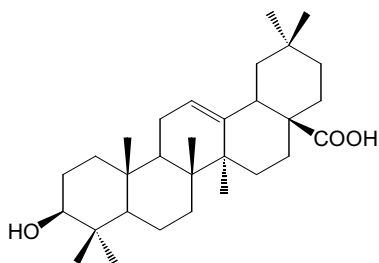
Physical description: It is a magnificent ornamental tree native to South America. The bark is pale ash-colored and soft, and exudes an abundant pure white latex. Leaves: simple, without stipules, few, and spirally inserted at the apex of the twigs. The petiole is stout, channeled above, and 2 cm–7 cm long. The blade is thick, glossy, oblong, lanceolate, or spatulate, and 14 cm–30 cm × 5 cm–10 cm. The apex of the blade is acute, round or shortly acuminate. The blade shows about 20 pairs of secondary nerves. The flowers are showy, slightly fragrant and arranged in terminal pedunculate corymbs. The corolla is tubular and 5-lobed, pure white or white tinged with pink or red. The fruits consist of pairs of follicles which are fusiform, leathery, smooth, 25 cm × 2 cm and filled with planoconvex and winged seeds (Fig. 270).

Pharmaceutical interest:

Cytotoxic properties: Stem bark and leaves extracts of *Plumieria rubra* increase the life span (>22%) of rodent experimentally infected with sarcoma-180 cells (Sundarrao K *et al.*, 1993). The juice expressed from the leaves of *Plumieria acuminata* inhibits the formation of experimental skin, liver and colon tumors (Serrame E *et al.*, 1995). *Plumieria* species are known to elaborate series of cytotoxic iridoids, such as plumericin and isoplumericin (Boros LA *et al.*, 1991; Abdel Kader MS *et al.*, 1997; Hamburger MO *et al.*, 1991). Fulvoplumierin and allamandin from the bark of *Plumieria rubra*, enhance the survival of a panel of cell-lines composed of murine lymphocyte leukemia, P388 and a number of human cancer cell-lines (breast, colon, fibrosarcoma, lung, melanoma, KB), cultured *in vitro*.



Plumericin



Oleanolic acid

Antimicrobial properties: Fulvoplumerin inhibits the enzymatic activity of the human immunodeficiency virus type-1 reverse transcriptase at an IC_{50} value of $45 \mu\text{g/mL}$ (Tan GT *et al.*, 1991).

Other antimicrobial principles so far isolated from *Plumieria* species are series of triterpenoids such as lupeol, taraxasteryl acetate, oleanolic acid, α -amyrin and rubrinol. Rubrinol inhibits the proliferation of *Bacillus anthracis*, *Pseudomonas aeruginosa* and *Corynebacterium pseudodiphtherium* cultured *in vitro* (Margis A *et al.*, 1994).

Other pharmacological properties: Stimast-7-enol, lupeol and ursolic acid reduced by 80%, 57% and 76% respectively, and the formation of micronucleated polychromatic erythrocytes by mitomycin in mice (Guevana AP *et al.*, 1996). Fulvoplumericin, ursolic and oleanolic acid inhibit the enzymatic activity of human ligase I (hLI) without disrupting the DNA relaxation, suggesting an allosteric effect caused by conformational change (Tan GT *et al.*, 1996).

Uses: The bark and roots of *Plumieria rubra* L. *sensu lato* are principally used to relieve the bowels of costiveness, while the latex is counter-irritant. In Cambodia, the wood is used to expel intestinal worms. An infusion of the roots is drunk to relieve the bowels of costiveness. The bark is used to treat blenorrhoea. In Indonesia, a decoction of the bark is drunk to relieve the bowels of costiveness and to promote urination. The latex is inserted in hollowed teeth to assuage toothache, as well as applied to the cracks on the soles and abscesses. The leaves or the juice expressed from the leaves are mixed with pounded chalk and used to treat lumbago. In the Philippines, a decoction of the bark is drunk to relieve the bowels of costiveness, promote menses and to combat fever. In Papua New Guinea, the latex is used to counteract snake-poisoning. In Palau, the bark or latex is used to treat leprosy. In Malaysia, the roots are boiled and the decoction is used to soothe venereal sores. A decoction of the bark and leaves is drunk to treat asthma, relieve the bowels of costiveness and to combat fever. The latex boiled in coconut oil is used to soothe inflamed parts. In India, the root bark is bitter, pungent, acrid, tonic and is used to treat leprosy, ascite flatulence, relieve the bowels of costiveness and soothe irritated skin.

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Pottsia laxiflora (Bl.) O. Ktze.

[After John Potts, a 19th century gardener and collector in China and Bengal for the Horticultural Society of London; and from Latin, *laxus* = lax and *flores* = flower]

Synonymy: *Pottsia cantoniensis*
Hook. & Arn.

Common names: *Tembelekan*
(Javanese).

Uses: In China, the leaves of *Pottsia laxiflora* (Bl.) O. Ktze. are used to heal boils. It will be interesting to learn whether a study of this plant will reveal any molecules of therapeutic interest.

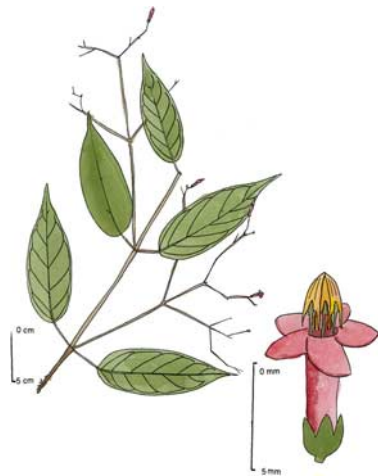


Fig. 271. *Pottsia laxiflora* (Bl.) O. Ktze. From: KLU 36705. Field collector: Kai and Supee S Larsen. Geographical localization: Southeast of Kanchanaburi, West of Sri Sawat. Botanical identification: Middleton, 1995.

Physical description: It is a slender, laticiferous climber of tropical Asia. The stems are terete and pubescent. Leaves: simple, decussate and without stipules. The petiole is 2 cm long. The blade is oblong-lanceolate, papery, 5 cm–8 cm × 3 cm × 2.5 cm and show 6 pairs of secondary nerves. The apex of the blade is acuminate. The inflorescences are lax axillary panicles. The flowers are 8 mm long. The calyx is indistinctly 5-lobed. The corolla is tubular, 5-lobed and reddish. The anthers are connate and showy. The fruits consist of pairs of linear follicles containing comose seeds (Fig. 271).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Rauwolfia serpentina* Benth.**

[After L. Rauwolf, 1540–1596, a traveler in the Middle East, introduced coffee in Europe; from French, *serpent* = snake]

Common names: Rauwolfia, rauwolfia, snakeroot; *bongmaiza* (Burmese); *ahibhuka* (among 30 other Sanskrit names); *sovannamilbori* (Tamil).

Physical description: It is a little shrub which grows in India, Burma, Thailand, Sumatra and Java. The bark is pale grey. Leaves: simple, few, without stipules and arranged in whorls of 3. The petiole is 8 mm long. The blade is 7 cm–20 cm × 2 cm–7 cm, lanceolate, acute or acuminate, and shows 8–10 pairs of secondary nerves. The flowers are white, often tinged with purple and arranged in many flowered and irregular corymbose cymes. The cymes are 5 cm–12.5 cm long, fleshy, and endowed with 3 mm–6 mm long bright red pedicels. The bracts beneath the pedicels are triangular, acute and 1 mm–1.5 mm long. The calyx is glabrous, bright red and comprises of 5 lobes which are lanceolate and 2.5 mm long. The corolla is tubular, 1 cm–1.3 cm long and shows 5 lobes which are 3 mm long, elliptic-oblong and round at the apex. A discrete cup-shaped nectary disc is present. The fruits are purplish, black-ovoid and 6 mm long drupes (Fig. 272).

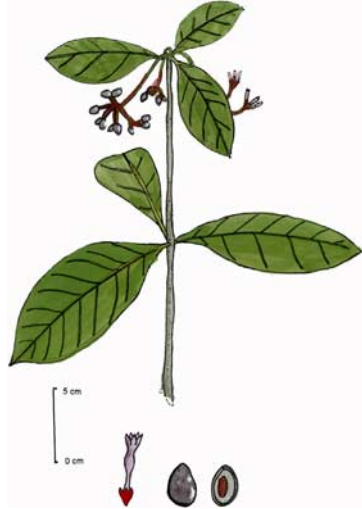
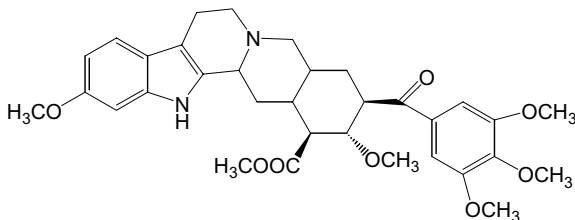


Fig. 272. *Rauwolfia serpentina* Benth.

Pharmaceutical interest: The roots of *Rauwolfia serpentina* Benth. contain a series of about 30 alkaloids (0.5%–2.5%), principally indoles, which can be classified into 3 principal chemical groups: yohimbane, heteroyohimbane and dihydroindole.



Reserpine

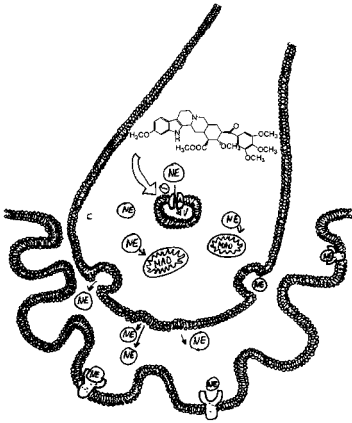


Fig. 273. Mechanism of action of reserpine. Reserpine (R) chelates the magnesium ions necessary for the magnesium-dependent ATPase (A) to store actively noradrenaline (NE) in the presynaptic storage vesicles (V). Noradrenaline leaks into the cytoplasm (C) of the neuron, where it is naturally destroyed by monoamine oxidase (MAO). The gradual depletion of noradrenaline from sympathetic neurons paralyzes the adrenergic transmission.

Yohimbane alkaloids: Among the yohimbane group, reserpine and rescinnamine are the most therapeutically important. Reserpine was formally used to lower blood pressure. It chelates the magnesium ions

necessary for the magnesium-dependent ATPase to catalyze the storage of noradrenaline into the presynaptic storage vesicles of neurons. The storage of noradrenaline being thereby altered, noradrenaline leaks into the cytoplasm of the neuron where it is naturally destroyed by monoamine oxidase. The gradual depletion of noradrenaline from the sympathetic neurons paralyzes the adrenergic transmission, which controls the smooth muscles of the blood vessels and heart, resulting finally in a lower blood pressure. Meanwhile, the central nervous system lacks dopamine and 5-hydroxytryptamine, and tends to develop depression and psychotic behaviors in humans (Fig. 274). Although reserpine has been replaced by more manageable drugs, it is still prescribed in a number of countries to lower blood pressure (Serpasil[®], Sandril[®], Neo-Serp[®]); the powdered roots are still used occasionally as well (Raudixin[®], Rautrax[®]).

Uses: The roots of *Rauwolfia serpentina* Benth. have been used in Ayurvedic medicine since ancient times to expel intestinal worms, heal ulcers and to counteract snake-poisoning. A decoction of the roots is used to increase uterine contraction in childbirth. In Konkan, the roots mixed with *Aristolochia indica* L. are chewed to treat cholera. The roots mixed with 2 parts of root bark of *Holarrhena antidysenterica* (Roxb.) Wall. and 3 parts of *Jatropha curcas* and milk is drunk to treat colic. A mixture consisting of *Andrographis paniculata* Nees, ginger and black salt is used to combat fever. In Bombay, most of the laborers from the southern Konkan keep a small amount of roots of *Rauwolfia serpentina* Benth. to assuage painful discomfort of the bowels, such as colic, biliousness, cholera, dysentery and intestinal worms. The plant has been used in Western medicine to combat fever, calm the mind and to aid abortion. *Rauwolfia* (*British Pharmaceutical Codex*, 1963) consists of the dried roots of *Rauwolfia serpentina* Benth., containing not less than 0.15% of reserpine-like alkaloids, has been used to treat hypertension; the average dosage being 200 mg–400 mg daily.

Whether reserpine is responsible for breast neoplastic developments (Jick H *et al.*, 1975) or not (Labarthe DR *et al.*, 1980), is a subject of controversy. However, serpentine stabilizes topoisomerase II-DNA covalent complex and stimulates the cutting of DNA by topoisomerase II (Dassonneville L *et al.*, 1999). Note that the presence of yohimbine, a selective inhibitor of the presynaptic α_2 -adrenergic receptors, is hypertensive at low dose and hypotensive at high dose. Clinical trials designed to define the usefulness of yohimbine to elaborate venereal desire (Yohimbine Houde®), do not provide conclusive results.

Heteroyohimbane and dihydroindole alkaloids: The heteroyohimbane group is represented by ajmalicine, a dihydroindole derivative, which occurs in *Catharanthus roseus* G. Don. Ajmalicine, or raubasine, is an α -blocking anti-spasmodic natural product which has been used to treat peripheral and cerebral vascular disorders.

References

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 Jick H, *et al.* (1975) *J Am Med Ass* **233**: 896.
 Labarthe DL, *et al.* (1980) *J Am Med Ass* **343**: 2034.

Warning: The plant is toxic.

Rauvolfia verticillata (Lour.) Baillon

[After L. Rauwolf, 1540–1596, a traveler to the Middle East, introduced coffee into Europe; from Latin, *verticillus* = whorl of spindle]

Synonymy: *Rauvolfia chinense* (Hance) Hesml.

Physical description: It is a laticiferous shrub which grows to a height of 2 m in open areas and pathways in Ceylon, Indonesia, Malaysia, Taiwan and China. The stems are green with brown lenticels. Leaves: simple, decussate and without stipules. The petiole is sheathing at the base, 1 cm – 2 cm long and channeled. The blade is 19 cm × 6 cm–10 cm × 3 cm, obovate-spathulate, very thin, and dull green above and bluish below. The midrib is flat above and raised below. The base is tapering, the apex is cuspidate and the margin is wavy. The blade shows

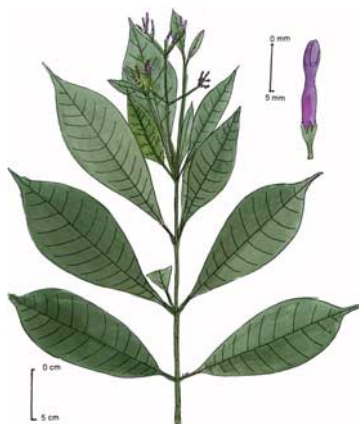


Fig. 274. *Rauvolfia verticillata* (Lour.) Baillon. From: KLU 36617. Field collector & botanical identification: Lynwood M Hume, 17 Aug 1983. Geographical localization: Pulau Duyong Besar, Kuala Terengganu, Malaysia.

10–12 pairs of secondary nerves. The flowers are 1.5 cm × 8 mm, pinkish, and tubular. The corolla develops 5 lobes around a hairy throat. The fruits are red, ovoid, succulent, and 1 cm long. The seeds are 9 mm × 5 mm, light brown and wrinkled (Fig. 274).

Reference

Lim M, *et al.* (1985) *Yao Hsueh Hsueh Pao* 20(3): 198–202.

Warning: The plant is toxic.

Strophanthus caudatus (Burm. f) Kurz.

[From Greek, *strophes* = twisted cord, *anthos* = flower and from Latin, *cauda* = tail]

Synonymy: *Strophanthus dichotomus* DC.

Physical description: It is a laticiferous forest climber of Burma, Laos, Cambodia, Vietnam, Thailand and Malaysia. The stems are lenticelled. Leaves: simple, decussate and without stipules. The petiole is 5 mm long and channeled. The blade is obovate-spathulate, 6.5 cm × 4.3 cm–9.8 cm × 5 cm and leathery. The midrib is flat above and raised below. The apex is shortly acuminate and the blade shows 8–pairs of secondary nerves which are indistinct above. The flowers are grouped into terminal cymes. The calyx consists of 5 calyx lobes which are 4 mm long and pink in color. The corolla is infundibuliform and white, and develops 5 lobes which are 10 cm–11 cm long (Fig. 275).

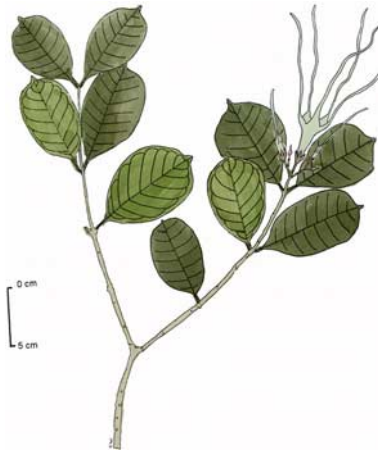


Fig. 275. *Strophanthus caudatus* (Burm. f.) Kurz. From: Herbarium 4005. Field collector: Millard, 1962. Geographical localization: Kepong, Malaysia. Botanical identification: DJ Middleton, 20 Feb 1995.

Pharmaceutical interest: The poisonous property of *Strophanthus caudatus* (Burm. f) Kurz. is most probably due to the presence of cardiac glycosides of the cardenolides type, which are well known to abound in the *Strophanthus*

Uses: In China: *Rauvolfia verticillata* (Lour.) Baillon is used to treat hypertension. In Taiwan, the plant is used to kill insects. There is no recent evaluation of the pharmacological potentials of *Rauvolfia verticillata* (Lour.) Baillon. Note that the plant elaborates a number of alkaloids, including reserpine and yohimbine (Lim MA *et al.*, 1985), hence the uses mentioned above.

species. The seeds of *Strophanthus kombé* contain 7%–10% of a mixture of cardiac glycosides, known as strophanthin K (*British Pharmaceutical Codex*, 1954). It has an action on the heart similar to that of digitalis, but it is absorbed more rapidly and is less cumulative. The dried seeds of *Strophanthus kombé* have been used in Western medicine to make a cardiotoxic remedy (*Strophanthus extract*, *British Pharmaceutical Codex*, 1934), to be taken orally at doses ranging from 15 mg–60 mg. Other examples of *Strophanthus* species of pharmaceutical value are *Strophanthus gratus* and *Strophanthus sarmentosus*, the seeds of the former containing 4%–8% of ouabain.

Uses: In Burma, the latex of *Strophanthus caudatus* (Burm. f) Kurz. is used to make arrow poison. In Laos, Cambodia, and Vietnam, the latex of *Strophanthus caudatus* (Burm. f) Kurz. is used to poison fish.

Warning: The plant is toxic.

***Tabernaemontana divaricata* (L.) Burk.**

[After JT Mueller or Tabernaemontanus, a German botanist of the 16th century; and from Greek, *di* = double and Latin, *varicus* = straddling]

Synonymy: *Ervatamia coronaria* (L.) Stapf, *Tabernaemontana coronaria* (L.) Willd.

Common names: Wax flower; pinwheel flower; *bunga cina*, *bunga susu*, *manda kaki*, *susun kepala*, *susu ayam* (Malay); *zalat* (Burmese); *nandi* (Sanskrit); *valamburi* (Tamil).



Fig. 276. *Tabernaemontana divaricata* (L.) Burk.

Physical description: It is a laticiferous shrub which grows to a height of 2.5 m, and is native to India. It is also grown as an ornamental plant.

The bark is whitish-grey. Leaves: simple, soft, without stipules, opposite and 7 cm–16 cm × 2 cm–5 cm. The petiole is small. The blade is elliptic-lanceolate and glossy. The apex is acuminate and the margin is wavy. The flowers are showy, pure white and arranged in cymes at branch bifurcation. The flower pedicels are 5 cm long. The calyx is 3 mm–4 mm long. The corolla develops 5 lobes which are white, broadly ovate, and 2.5 cm–5 cm long. The corolla tube is 1.8 cm–3 cm long and swollen at the base. The stamens are included and inserted below the middle of the corolla tube. The anthers are free, acute

and bilobed. The gynecium consists of a pair of distinct carpels. The fruits consist of a pair of 2 cm–4 cm × 1 cm, glabrous, orange or red beaked follicles. The seeds are 7.5 mm in diameter and embedded in a red and waxy aril (Fig. 276).

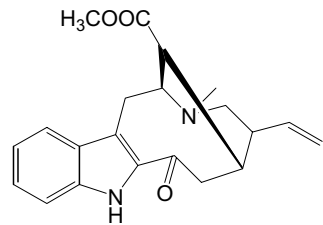
Pharmaceutical interest: The roots and stem bark of the *Tabernaemontana* species contain a series of cytotoxic, anti-inflammatory, analgesic, hypotensive, anti-infectious and neurotrophic monoterpene indole alkaloids (Van Beek TA *et al.*, 1984), which are responsible for most of the medicinal properties described above.

Cytotoxic properties: Conoduramine, conodurine, coronaridine, gabunine and vobasine from *Tabernaemontana holstii* are cytotoxic (Kingston DG *et al.*, 1977). Voacangine and voacamine from the latex of *Tabernaemontana arborea* inhibit the proliferation of P388 cells cultured *in vitro* (Kingston DG *et al.*, 1978). Coronaridine, conoduramine and voacamine from the stem bark of *Tabernaemontana laeta* enhance the cytotoxicity of vinblastine against multidrug-resistant KB cells and inhibit 10 human tumor cell-lines cultured *in vitro* (You M *et al.*, 1994).

Anti-inflammatory properties: A crude extract of the leaves of *Tabernaemontana australis* inhibits Ehrlich's carcinoma and sarcoma-180 tumors in mice, and exerts anti-inflammatory and analgesic properties in the subplantar carrageenan-induced edema test and in the acid-induced abdominal writhing test (Rates SMK *et al.*, 1993). Other anti-inflammatory and analgesic properties are shown by alcoholic and aqueous extracts of the stem manifested by the bark of *Tabernaemontana divaricata* (L.)

Burk, from which were characterized coronaridine, heyneanine, voacamine, voacristine, voaphylline, vobasine, tabersonine, and the anti-inflammatory and analgesic salicylic acid.

Uses: In Indonesia, the roots of *Tabernaemontana divaricata* (L.) Burk. are used to counteract poison, treat lumbago, gravel, stop diarrhea and assuage abdominal discomfort. The latex is used to make arrow-poison. In Malaysia, an infusion of leaves is bechic. The pounded roots are used to treat eye diseases. When mixed with other ingredients, they are snuffed to heal syphilitic ulceration of the nose. In Vietnam, a decoction of the roots is used to combat fever. In India, the roots are used to treat biliousness and diseases of the blood. The plant is also used to promote menses, increase venereal desire, invigorate the body, relieve the bowels of costiveness, assuage pain as well as toothache.



Vobasine

Neuroleptic properties: An alcoholic extract of *Tabernaemontana divaricata* (L.) Burk increases the sleeping time induced by pentobarbital (Henrique AT *et al.*, 1996). Intravenous injection of roots, stems, leaves and flower extracts of *Tabernaemontana divaricata* (L.) Burk. and *Tabernaemontana pandacaqui* causes sedation, results in lowering of the respiration and decreased skeletal muscle tone in rodents. Most extracts displaying the analgesic property are root and stem bark extracts (Taesotikul T *et al.*, 1989).

Cardiovascular properties: *Tabernaemontana dichotoma* elaborates stem-madenine, perivine, vobasine, coronaridine and dichomine, which are hypotensive and a muscle relaxant (Perera P *et al.*, 1985). Intravenous injection of an ethanolic extract of stems, leaves and flowers of *Tabernaemontana pandacaqui* results in lowering of the blood pressure in rats. At high 100 mg/Kg–300 mg/Kg, flower extracts cause a transient hypertensive effect preceding hypotension. On the heart, chronotropic negative and inotropic negative responses are observed. Intravenous injection of a crude alkaloidal fraction of *Tabernaemontana pandacaqui* causes 2 consecutive hypotensive and bradychardiac responses in rodents (Taesotikul T *et al.*, 1998). The exact molecular basis of cardiovascular activity remains unknown, but one might think of a parasympathetic involvement as an extract of the plant inhibiting the enzymatic activity of acetylcholinesterase (Ingkaninan K *et al.*, 2003).

Antileishmanial and antibacterial properties: *N*-demethylconodurine characterized from *Tabernaemontana van heurkii*, inhibits the proliferation of *Leishmania braziliensis* (10 μ g/mL). In infected Balb/c mice, *N*-demethylconodurine is inactive, whereas conoduridine is less active than *N*-methylglucamine antimonate, a drug of choice to treat leishmaniasis. Both conodurine and conoduramine inhibit the proliferation of *Bacillus subtilis*, *Escherichia coli*, *Mycobacterium smegmatis*, *Pseudomonas aeruginosa* and *Staphylococcus aureus* cultured *in vitro*. Tabersonine and ibogaine inhibit the proliferation of *Bacillus subtilis* (Achenbach H *et al.*, 1997; Van Beek TA *et al.*, 1985), while voacangine inhibits the proliferation of *Mycobacterium tuberculosis*.

References

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Kingston DG, *et al.* (1977) *J Pharm Sc* **66**(8): 1135–1138.
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Perera P, *et al.* (1985) *J Ethnopharmacol* **13**(2): 165–173.
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Warning: The plant is toxic.

***Thevetia peruviana* (Pers.) K. Schum.**

[After Andre Thevet, a 16th century French monk and plant collector; and from Latin, *peruviana* = from Peru]

Synonymy: *Thevetia neriifolia* Juss.,
Thevetia peruviana K. Schum.

Common names: Bastard oleander,
exile oleander, yellow oleander;
guinnyeh (Malay); *noix de serpent*
(French); *hpayoungban, molamiyapan*
(Burmese).

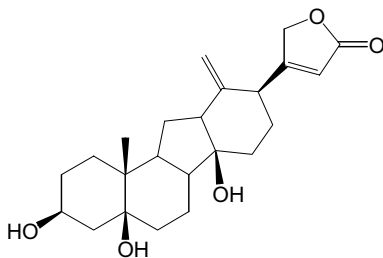


Fig. 277. *Thevetia peruviana* (Pers.) K. Schum.

Physical description: It is a tree which grows to height of 6 m. The plant is native to South America. The bark is light grey and the wood, white and soft.

The stems exude an abundant milky latex upon incision. Leaves: simple, few, without stipules, and spirally-arranged. The petiole is indistinct. The blade is linear, 7 cm–13 cm × 5 mm–1 cm, and glossy. The flowers are showy, 5 cm long and arranged in a few flowered and terminal cymes. The calyx is 5 mm–6 mm long, 5-lobed and persists in fruit. The corolla is golden-yellow, funnel-shaped, 6 cm long, and 5-lobed. The lobes are contorted and overlapping to the left in buds. The throat shows 5 scales arching over the 5 stamens which are inserted at the base of the corolla. A nectary disc is present. The ovary is superior and consists of a pair of free carpels united by their styles. The stigma is broad and angular. The fruits are green, glossy, broadly obovate, 4 cm in diameter, and contain a corky endocarp itself, of up to 4 seeds (Fig. 277).

Pharmaceutical interest: The seeds of *Thevetia peruviana* (Pers.) K. Schum.



Thevetiosigenin

Uses: *Thevetia peruviana* (Pers.) K. Schum is poisonous and principally used to induce vomiting and to relieve the bowels of costiveness. In India, this plant is bitter, pungent, acrid and astringent to the bowel. It is used to treat urethral discharge, expel intestinal worms, treat skin diseases, heal wounds and piles, assuage eyes discomfort and soothe inflamed parts of the body. The plant is used to combat fever in Burma, the Philippines and in the Palau.

are known to abound with cardiac glycosides of the cardenolide type: thevetosides and gentiobiosyl-thevetosides of digitoxigenin (thevetin B). Thevetin is digitalis-like in action, and is effective 4 to 6 hours after being taken *per os*. It has been used in continental Europe and is considered particularly useful for treating mild myocardial insufficiency, as well as digitalis-intolerance. Slow injection of peruvosides which are related to thevetin (600 μg to 900 μg) into the pulmonary artery in patients with congestive heart failures, results in an immediate and marked positive inotropic and negative chronotropic effect. It is effective in patients with congestive heart failures who received 2.4 mg followed by an average maintenance dose of 600 μg (Bhatia ML *et al.*, 1970).

References

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 Bose TK, *et al.* (1999) *J Indian Med Assoc* **97**(10): 407–410.
 Pahwa R, *et al.* (1990) *Vet Hum Toxicol* **32**(6): 561–564.

Warning: In regard to the poisonous properties of the plant, rats fed with the seeds are quickly subject to limb paralysis, rolling, circular flailing of the tail, convulsion, tremor, collapse and death accompanied by reduction of blood cells and glycemia, and an increase of SGOT. Histopathological observations are inflammatory and degenerative changes of the liver and kidneys (Pahwa R *et al.*, 1990). The symptoms of yellow oleander seed-poisoning studied in 300 patients from 1986–1990 in Sri Lanka, showed that 6–8 hours after ingestion of the plant, patients suffer from vomiting, palpitation, arrhythmia, and occasionally death with perivascular hemorrhages and focal myocardial edema (Bose TK *et al.*, 1999).

Trachelospermum jasminoides (Lindl.) Lem.

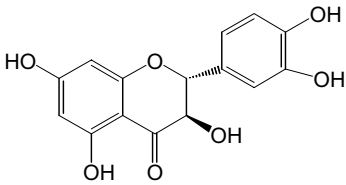
[From Greek, *trakhçlos* = neck and *sperma* = seed and *jasminoides* = jasmine-like]

Physical description: It is a climber native to China, which is cultivated as an ornamental plant. The stems are terete, lenticelled, slender and laticiferous. Leaves: simple, decussate and without stipules. The petiole is 2 mm long and velvety. The blade is rigid, elliptic-lanceolate and 3 cm \times 2 cm–5 cm \times 2.5 cm. The margin is recurved. The apex is obscurely notched. The midrib is sunken above and raised below and the blade shows 5–7 pairs of secondary nerves. The flowers are small, white, star-shaped and fragrant. The fruits consist of pairs of 7 cm \times 2 mm follicles (Fig. 278).

Synonymy: *Rynchospermum jasminoides* Lindl.

Common names: Confederate jasmine, star jasmine.

Uses: In China, *Trachelospermum jasminoides* (Lindl.) Lem. is used to promote menses, invigorate the body, heal abscesses and wounds, and treat rheumatism, carcinomatous growth and sciatica.

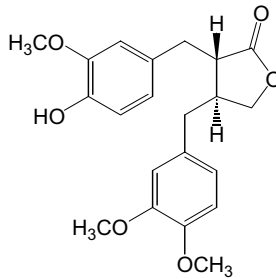


Taxifolin



Fig. 278. *Trachelospermum jasminoides* (Lindl.) Lem. From: KLU 042775. Field collector: Luo Lin - Bo. 7 Aug 1994. Geographical localization: Xining Co., 26° 4' North–110.8° East, altitude: 500m, Hunan, China.

Pharmaceutical interest: An ethanol extract of the stem of the *Trachelospermum jasminoides* (Lindl.) Lem. inhibits the enzymatic activity of both cyclooxygenase I and phospholipase A₂ at IC₅₀ values of 35 μg/mL and IC₅₀ 33 mg/mL, respectively (Li RW *et al.*, 2003). The anti-inflammatory property of the plant could be attributed to the presence of lignans, such as arctigenin, which are known to occur in *Trachelospermum* species along with flavonoids such as taxifolin (Sakushima A *et al.*, 1988).



Arctigenin

References

- Li RW, *et al.* (2003) *J Ethnopharmacol* **85**(1): 61–67.
 Sakushima A, *et al.* (1988) *Phytochem* **27**: 3948–3950.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

4. Family ASCLEPIADACEAE R. Brown 1810 *nom. conserv.*, the Milkweed Family

Physical description: The family Asclepiadaceae consists of about 250 genera and 2000 species of laticiferous tropical shrubs, herbs and climbers known to elaborate *cardiotonic glycosides*, indole, piperidine and *phenanthroindolizidine*. The leaves of Asclepiadaceae are simple, without stipules, opposite, whorled or alternate. The inflorescences are solitary or terminal or axillary umbels, umbellate cymes, or racemes. The flowers are very characteristic as they comprise of a unique type of organs known as pollinia. The calyx contains tiny glands at the base of the lobes inside. The corolla is tubular and 5-contorted lobes. The andrecium consists of 5 stamens, the filaments of which usually connate into a staminal tube. The ovary is superior and consists of a pair of distinct carpels, enclosed within the staminal tube. The styles joined together to form a style table. The fruits are constituted of a pair of follicles, each filled with comose seeds.

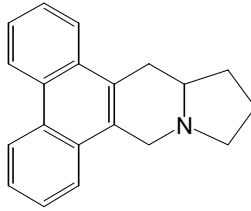


Pharmaceutical interest: Examples of medicinal Asclepiadaceae are *Calotropis gigantea* (Willd.) Dry. ex WT. Ait. (yercum or madar fiber), and *Marsdenia tenacissima* W. and A. (*bahjmahal* hemp). The dried roots of *Hemidesmus indicus* (*Hemidesmus*, *British Pharmaceutical Codex*, 1934) have been used to treat syphilis, rheumatism, psoriasis and eczema in Western medicine.

Cardenolides: An interesting feature of *Asclepias*, *Calotropis*, *Carissa*, *Cryptostegia*, *Gomphocarpus*, *Menabea*, *Periploca* and *Xysmalobium* species, is that they abound with unusual cardiac glycosides of the pregnane type. One such glycoside is periplocin (*British Pharmaceutical Codex*, 1967), characterized from the bark of *Periploca graeca*, which has been in to Russia as a remedy for the treatment of cardiac insufficiency (1 mL ampoule of 0.25 mg). Cardenolides characterized from *Cryptostegia grandiflora* (rubber vine, pink allamanda) and *Parquetina nigrescens* display an interesting array of pharmacological activities. It will be interesting to learn whether a more intensive study on this family discloses any pregnane glycosides of chemotherapeutic interest.

Phenanthroindolizidine alkaloids: Asclepiadaceae have attracted a great deal of interest on account of phenanthroindolizidine alkaloids, which might hold some potential for the treatment of cancer. Tylocrebine, from *Tylophora crebiflora* showed promising signs of anti-tumor properties, but heavy side effects precluded to the continuation of further clinical studies. Note that the latex and the leaves of Asclepiadaceae are often used to make arrow-poison, to

counteract putrefaction, to assuage pain, to combat fever, to induce vomiting and to relieve the bowels of costiveness. In the Asia-Pacific, about 50 Asclepiadaceae plant species are used for medicinal purposes. Among these are *Asclepias curassavica* L., *Calotropis gigantea* (Willd.) Dry. ex WT. Ait, *Cynanchum caudatum* (Miq.) Maxim., *Dischidia rafflesiana* Wall., *Marsdenia tinctoria* (Roxb.) R. Br., *Oxystelma esculentum* (L. f.) R. Br., *Sarcolobus globulus* Wall., and *Tylophora tenuis* Bl.



Phenanthroindolizidine

***Asclepias curassavica* L.**

[From Greek, *Asklepios* = God of healing and from Latin, *curassavica* = from Curacao]

Common name: Milkweed.

Physical description: It is a bushy herb native to Tropical America, which grows to a height of 1 m. The plant is ornamental. Leaves: simple, opposite, without stipules. The blade is 6 cm–15 cm × 1.2 cm–2.5 cm, very thin, lanceolate, acuminate at the apex and tapering at the base. The flowers are arranged in axillary or terminal 12-flowered umbels which are 5 cm long. The flower pedicels are 1.3 cm long. The calyx is deeply 5-lobed. The corolla tube is scarlet and 5 mm long. The staminal column is orange. The pollen masses are pendulous, solitary in anther-cell and with caudicles. The fruits are pairs of lanceolate of 7.5 cm–9 cm long follicles (Fig. 279).

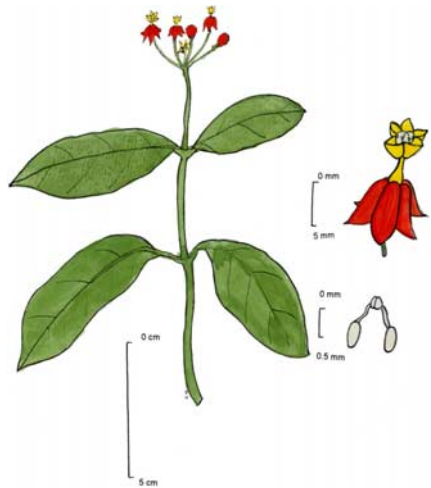


Fig. 279. *Asclepias curassavica* L.

Pharmaceutical interest: The latex of *Asclepias curassavica* L. is caustic, laxative, emetic, deforms and empties the cytoplasm content of *Candida albicans* (Moulin-Traffort J *et al.*, 1990). The plant is known to contain asclepin, a cardenolide, which is inotropic positive and more active than G-strophantin, digoxin (Lanoxin®), digitoxin and digitoxigenin (Patnaik GK *et al.*, 1978). A number of glycosides characterized from *Asclepias amplexicaulis* and *Asclepias albicans* inhibit the proliferation of cancer cells cultured *in vitro* (Piatak DM *et al.*, 1985) and might hold some potential against cancer (Koike K *et al.*, 1980).

Uses: In Burma, the roots are used to induce vomiting and to relieve the bowels of costiveness. In China, the roots are used to induce vomiting and to relieve the bowels of costiveness, the juice expressed from the leaves is used to stimulate the secretion of sweat. The pounded leaves are used to heal wounds and to soothe sores. In Malaysia, a paste of the flowers is used to assuage headaches. In Vietnam, The roots are used to induce vomiting and the juice expressed from the leaves is used to treat dysentery. In the Philippines, the roots are used to induce vomiting.

References

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 Koike K, *et al.* (1980) *Chem Pharm Bull Tokyo* **28**(2): 401–405.
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 Patnaik GK, *et al.* (1978) *Arzneimittelforschung* **28**(8): 1368–1372.
 Piatak DM, *et al.* (1985) *J Nat Prod* **48**(3): 470–471.

Warning: The latex induces corneal edema (Chakraborty S *et al.*, 1995).

Calotropis gigantea (Willd.) Dry. ex WT. Ait

[From Greek, *kallos* = beauty and *trepō* = turn and from Latin, *gigantis* = gigantic]

Physical description: It is a laticiferous shrub native to India, which grows to a height of 1.5 m–2 m on tropical seashores. The plant is covered with a tomentum of glaucous hairs. Leaves: simple, few, without stipules, decussate, leathery, elliptic, oblong-cordate and 10 cm–20 cm × 5 cm–10 cm long. The petiole is very short. The inflorescences are umbellate, with 5 cm–7 cm long cymes which originate from the stem between the petioles. The pedicel is 2.5 cm–10 cm

Common names: Crown flower, madar, giant milkweed; *maioh*, *mayo*, *mayobeng*, *mayobin*, *mayomayopin*, *mayopin* (Burmese); *algodonde*, *seda* (Spanish); *Asclépiade gigantesque*, *faux arbre de soie*, *mercure végétale* (French); *waduri* (Javanese), *kapok d' Eritrea* (Italian); *beduri*, *lembega*, *bunga hantu* (Malay); *aditya* (among 40 other Sanskrit name); *arkkam* (Tamil); *madar*, *mudar*, *wara* (Indian).

long. The flowers are stout, thick,

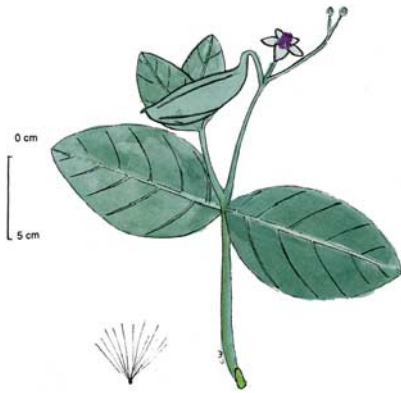


Fig. 280. *Calotropis gigantea* (Willd.) Dry. ex WT. Ait.

toy-shaped, white and lilac, and 2.5 cm long. The calyx is 5-lobed. The corolla develops 5 lobes which are broad, thick and valvate. The corona consists of 5 succulent organs which comprises of an upcurved spur and a pair of auricles at the base adnate to the column.

The anthers are short and horny. The ovary consists of a pair of carpels. The style is long and thin, and the stigma pentagonal and tabular. The fruits consist of pairs of ovoid and 5 cm × 8 cm follicles, containing several comose seeds (Fig. 280).

Pharmaceutical interest:

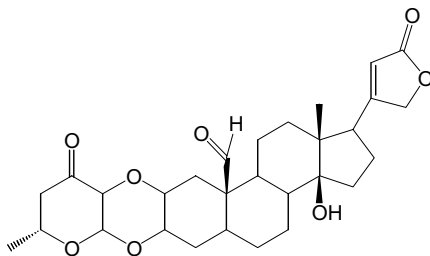
Anti-inflammatory properties: A simple dose of an aqueous suspension of latex of *Calotropis procera* is effective to a significant level against acute inflammation responses on carrageenan-and formalin-induced paw oedema model (Kumar VL *et al.*, 1994). An ethanolic extract of flowers of *Calotropis procera* alleviates paw edema caused by carrageenan, by 37%, and lowers fever in rats by 40%. It is moderately active in the writhing test using acetic acid and a dose-dependent effect on the release of prostaglandins is observed (Mascolo N *et al.*, 1988). What are the active principles involved here?

Chemotherapeutic properties: Extract of *Calotropis gigantea* (Willd.) Dry. ex WT. Ait inhibit the proliferation of a number of bacteria cultured *in vitro* (Mascolo N *et al.*, 1988). An extract of leaves of the plant inhibits the enzymatic activity of mitochondrial malate dehydrogenase of a filarial worm: *Setaria digitata* (Banu MJ *et al.*, 1992). Extracts of *Calotropis procera* are cytotoxicity

Uses: In Burma, the latex is eaten to relieve the bowels of costiveness, and applied externally to treat leprosy. In Indonesia, the latex is used to heal boils and pimples, to assuage toothache, and to soothe inflammation. In Malaysia, the smokes of the burned leaves are inhaled to heal syphilitic ulceration of the nose. The latex is used to assuage toothache and to heal wounds. A decoction of the flowers and leaves is drunk to invigorate health. In the Philippines, the bark and latex are used internally to expel intestinal worms. In Vietnam, the leaves are used to soothe sores. The root bark is used to treat syphilis and leprosy, and small doses of root bark are used to invigorate health, and to combat fever. The dried root bark of *Calotropis gigantea* (Willd.) Dry. ex WT. Ait (Calotropis, *British Pharmaceutical Codex*, 1934) has been used in Western medicine to induce vomiting (dose: 2 g to 4 g), and to promote expectoration (dose: 200 mg to 600 mg).

(IC₅₀ = 1.4 µg/mL) against Colo-320 tumor cells, using the microtubule tetrazolium assay (Smith HF *et al.*, 1995).

Cardiovascular properties: Calotropine and frugoside characterized from the roots of *Calotropis gigantea* (Willd.) Dry. ex WT. Ait display similar cell-line selectivity to those of digoxin and ouabain: toxic to human cell-line but not to mouse at 2 µg/mL (Kiuchi F *et al.*, 1998). Extracts of the plant protect dogs against experimentally-induced arrhythmia (Kulkarni SD *et al.*, 1976). The roots are known to abound with oxypregnane-oligoglycoside, known as calotroposides A and B which are parasympathomimetic (Kitagawa I *et al.*, 1992).



Oxypregnane aglycone

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 Kumar VL, *et al.* (1994) *J Ethnopharmacol* **44**(2): 123–125.
 Mascolo N, *et al.* (1988) *J Ethnopharmacol* **22**(2): 211–221.
 Smith HF, *et al.* (1995) *J Ethnopharmacol* **47**(2): 75–84.

Warning: The plant is toxic.

Cynanchum caudatum (Miq.) Maxim.

[From Greek, *kyon* = dog and *ancho* = to strangle, and from Latin, *cauda* = tail]

Physical description: It is a climber native to Japan and China. The plant is ornamental. The stems are smooth, glabrous and end into tendrils. Leaves:

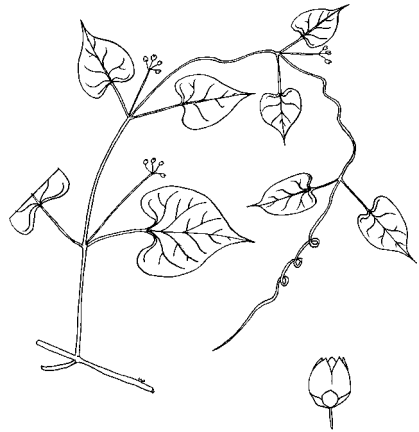
simple, opposite and without stipules. The petiole is 7 cm–4 cm long, channeled and sheathing at the base. The blade is 7.5 cm × 4.5 cm–13.5 cm × 9.5 cm, cordate, caudate, papery, glaucous below and dark green above and shows 5 pairs of secondary nerves. The inflorescences are axillary umbels of 10 tiny flowers. The flower pedicel is 7.5 cm–11 cm long. The calyx consists of

Common name: *Ikema* (Japanese).

5 sepals which are triangular. The corolla shows 5 lobes which are white, triangular, and 2 mm long (Fig. 281).

Uses: *Cynanchum caudatum* (Miq.)

Maxim. is principally used in Japan to promote urination. The plant is regarded by Japanese as a panacea. In China, the leaves and roots are eaten. The roots are peeled, sliced, boiled in several changes of water to remove poison; washed and boiled again until it is very thoroughly cooked.



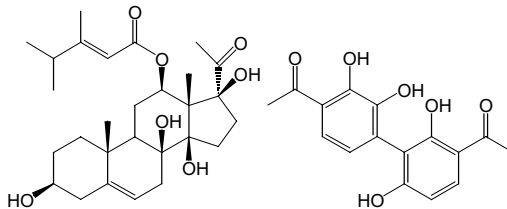
Pharmaceutical interest: *Cynanchum caudatum* (Miq.) Maxim. is known to abound with pregnane saponins and steroidal alkaloids (Lee DV *et al.*, 2000; Warashina T *et al.*, 1995).

Fig. 281. *Cynanchum caudatum* (Miq.)

Maxim. From: KLU Herbarium 14115. Field collectors: 27 July 1964, H. Kanai & T. Yamashita. Geographical localization: Sakai Pass-Yoraido, Nakawa-Mura, Minamiazumigun, Nagano Pref., altitude 2000 m, Japan.

Cytotoxic properties: *Cynanchum* species are interesting because they elaborate alkaloids and steroidal glycosides, which are powerful cytotoxic agents. A phenanthroindolizidine N-oxide alkaloid characterized from *Cynanchum vince-toxicum* inhibits the growth of drug-sensitive KB-3-1 and multidrug resistant KB-V1 cancer cell-lines (Staerk D *et al.*, 2000). C-21 steroidal glycosides auriculosides A and B, isolated from the root of *Cynanchum auriculatum*, inhibit the growth of adenocarcinoma cell (Hce-8693), human prostatic carcinoma cell (PC3), human cervical squamous carcinoma cell (HeLa) and human lung carcinoma cell (PAA)(Zhang RS *et al.*, 2000).

Hepatoprotective properties: Cynandione A from *Cynanchum wilfordii* protects cultured hepatocytes against carbon tetrachloride, and cortical neurones against H₂O₂, L-glutamate and kainic acid (Lee MK *et al.*, 2000; 2000a).



Auriculosides aglycone

Cynandione A

References

- Lee DV, *et al.* (2000) *Planta Med* 480–482.
 Lee MK, *et al.* (2000) *J Pharm Pharmacol* 52(3): 341–345.
 Lee MK, *et al.* (2000a) *J Neurosci Res* 59(2): 259–264.
 Staerk D, *et al.* (2000) *J Nat Prod* 63(11): 1584–1586.
 Warashina T, *et al.* (1995) *Phytochem* 39(1): 199–204.
 Zhang RS, *et al.* (2000) *Tetrahedron Lett* 56: 3875–3879.

Warning: The plant is toxic.

Dischidia rafflesiana Wall.

[After Sir Thomas Stamford Raffles, 18th century patron of science and founder of the British colony in Singapore]

Physical description: It is a herb which grows to a height of 50 cm. The plant grows on a tree by the sea covering Asia–Pacific, India and Australia. The stems are woody, creeping and rooting. Leaves: simple, very thick, without stipules, opposite, yellowish

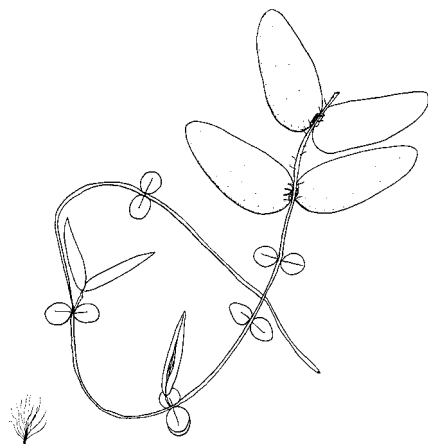


Fig. 282. *Dischidia rafflesiana* Wall. From: Herbarium 25272. Flora of Sarawak. Geographical localization: Bako National Park, Malaysia. Field collector: B C Stone. 29 Aug 1977. Botanical identification: T Liushultz. 9 March 2000.

Common names: Flower pot plant, Malayan urn vine, *akar kul*, *akar bano* (Malay).

Uses: In Indonesia, the leaves of *Dischidia imbricata* (Bl.) Stend. are heated and applied externally to heal feet injuries, whereas gonorrhoea, *Dischidia nummularia* R. Br. is used to heal painful wounds caused by certain poisonous fish; the leaves and latex are used to treat sprue. In Malaysia, the roots of *Dischidia rafflesiana* Wall. are chewed with *Areca catechu* L. (betel nut) to alleviate cough. In Vietnam, an infusion of *Dischidia acuminata* Cost. is used to treat blenorhoea and to promote urination. In the Philippines, the leaves of *Dischidia platyphylla* Schltr. are used to counteract putrefaction, and a poultice of *Dischidia purpurea* Merr. or an oily preparation obit is used to treat eczema and herpes infection. A paste of *Dischidia vidalii* Becc. is mixed with salt to treat goiter.

with purple undersides when exposed to light, and light green in damp shady spots. The blade is urn- or clog-shaped, 6 cm–12 cm × 5 cm, or flat orbicular and 2.5 cm × 2.5 cm. The inflorescences are racemes of 6–8 tiny flowers. The calyx is hairy with lanceolate lobes. The corolla is yellow, urceolate, pubescent and develops 5 villous lobes. The corona lobes are spatulate. The fruits consist of pairs of narrow, curved, acuminate and large follicles which are 7.5 cm–12 cm long (Fig. 282).

Pharmaceutical interest: It would be interesting to learn whether *Dischidia rafflesiana* Wall and *Dischidia* species will disclose any steroid glycosides or quinones of therapeutic interest.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Marsdenia tinctoria (Roxb.) R. Br.

[After William Marsden (1754–1836), Secretary to the East India Company in Sumatra and afterwards First Secretary to the Admiralty and from Latin, *tinctura* = dyeing]

Common name: Marsdenia; *akar tarum* (Malay); *akar sanam* (Indonesia).

Physical description: It is a shrub which grows to a height of 1 m height. The stems are terete, glabrous and smooth stems. Leaves: simple, opposite and without stipules. The petiole is 1 cm–3 cm long and channeled. The blade is very thin, 7.7 cm × 5 cm–11.5 cm × 6 cm and is darkish blue in color. The base of the blade is obscurely cordate and marked with tiny hooked bodies. The apex is acute to acuminate. The margin is recurved. The midrib and secondary nerves are sunk above and raised below. The tertiary nerves are scalariform and conspicuously prominent below. The inflorescences are many flowered panicles 1–2 cm long. The flowers are 2 mm long and yellow in color (Fig. 283).

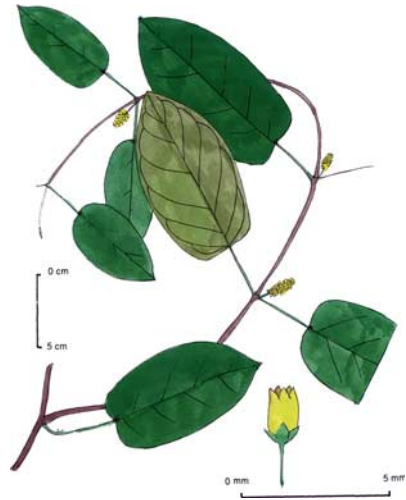


Fig. 283. *Marsdenia tinctoria* (Roxb.) R. Br. From: KLU Herbarium 19370. Field collector: 3 Aug 1970, See Chung. Botanical identification: SC Chin, 5 March 1971. Geographical localization: Selangor, Templer Park, at the base of Bukit Takun, exposed limestone, altitude: 300', Malaysia.

Pharmaceutical interest: The pharmacological property of *Marsdenia tinctoria* (Roxb.) R. Br. is unexplored, but there is a likelihood that it elaborates steroidal glycosides. Note that the number of chromones and quinones are known to occur in *Marsdenia tinctoria* var. *tomentosa* (Ito K *et al.*, 1978).

Reference

Ito K, *et al.* (1978) *Yakugaku Zasshi* **98**(9): 1285–1287.

Uses: In Indonesia, the leaves of *Marsdenia tinctoria* (Roxb.) R. Br. are used to assuage stomachache and to promote hair growth. In Malaysia, the plant is used by the Ibans to make a dye by soaking the leaves in the water. The dried stem bark of *Marsdenia condurango* (Condurango, *British Pharmaceutical Codex*, 1934), has been used as an aromatic, bitter and gastric sedative in the form of a tincture (1 in 1; dose 0.5 mL–4 mL).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Metaplexis japonica (Thunb.) Mak.

[From Greek, *meta* = with, *plēxis* = stroke and from Latin, *japonica* = from Japan]

Synonymy: *Marsdenia stauntonii*

Roem. & Schult., *Metaplexis chinensis* Decne., *Metaplexis stauntonii* Schult., *Pergularia japonica* Thunb., *Urostelma chinense* Bunge

Common names: Rough potato; *lo mo chia* (Chinese).

Physical description: It is a climber of China, Japan, Korea and Vietnam. The stems are glabrous, smooth, and terete. Leaves: simple, opposite and without stipules. The petiole is 1.5 cm–4 cm long and sheathing at the base. The blade is papery, cordate, 4 cm × 8 cm, somewhat glaucous below and shows 4–7 pairs of secondary nerves. The inflorescences are axillary, 5–12 flowered, 2.5 cm–5 cm long racemes. The flowers are tiny and white. The calyx consists of 5 triangular and 2 mm–3 mm long sepals. The corolla is tubular, 5-lobed and velvety inside. The style is showy (Fig. 284).

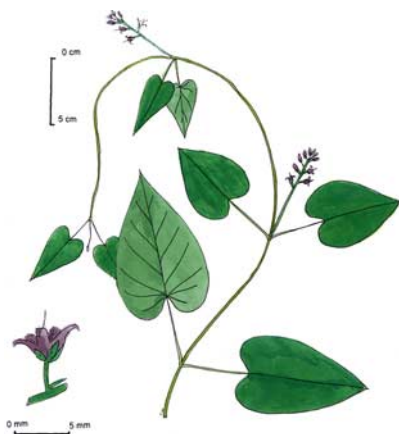
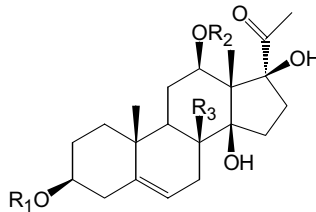


Fig. 284. *Metaplexis japonica* (Thunb.) Mak. From: KLU Herbarium 22524. Field collector: S. Takagi. 5 Aug 1921. Geographical localization: Japan, Honshū. Kyōto Prefecture: Yoshida, Kyōto, Japan.

Pharmaceutical interest: One might set the hypothesis that the uses mentioned might involve pregnane glycosides, which are known to abound in the plant (Mitsubishi H *et al.*, 1966; Warashina T *et al.*, 1998) It would be interesting to observe whether a more intensive study on this plant would disclose any pregnane glycosides or aglycones of therapeutic interest.

Uses: In China and Japan, the seeds of *Metaplexis japonica* (Thunb.) Mak. are used to invigorate health, to heal ulcers, wounds, insect bites and to treat bleeding. The leaves are used to heal wounds and to reduce swellings. In Vietnam, the seeds are used to promote the production of hormones and to check hemorrhages.



- 12 O Acetylpergularin (R₂= Ac; R₃= H)
 Metaplexigenin (R₂= Ac; R₃= OH)
 Deacetylmetaplexigenin (R₂= H; R₃= OH)

References

- Mitsubishi H, *et al.* (1966) *Chem Pharm Bull* (Tokyo) **14**(7): 717–726.
 Warashina T, *et al.* (1998) *Phytochem* **49**(7): 2103–2108.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Oxystelma esculentum (L. f.) R. Br.

[From Greek, *oxy* = pointed and *stelma* = crown and from Latin, *esculentus* = fit for food]

Physical description: It is a perennial climber of the stream banks and forests up to 900 m altitude of India, Ceylon, Indonesia and China. Leaves: simple, opposite and without stipules.

Common names: *Kulappalai* (Ceylon); *dugdhi* (Sanskrit); *usippalai* (Tamil).

The petiole is 4 mm–7 mm long. The blade is linear, papery, 2 cm × 7.5 cm–4 mm × 5 mm; the midrib is showy and the secondary nerves are indistinct. The flowers are large, strikingly handsome, arranged in pedunculate lateral subumbellate or racemose few-flowered cymes that are 3 cm–4 cm long. The calyx is 3 mm long and 5-lobed. The corolla is infundibuliform, pale rose

or whitish, 1.4 cm–1.7 cm in diameter. The style is slightly convex at the apex. The flower pedicel is 4 cm long. The fruits consist of pairs of ovoid lanceolate follicles that are 3.8 cm–6.3 cm long, filled with numerous seeds which are long and flat (Fig. 285).

Uses: In Cambodia, Laos and Vietnam, *Oxystelma esculentum* (L. f.) R. Br. is used to heal ulcers and to treat jaundice. In Indonesia, the plant is used to treat cholera. In India, the plant is used to promote urination, venereal desire, to relieve the bowels from costiveness, to expel intestinal worms and to treat leucoderma, jaundice and bronchitis. The follicles are eaten.

Pharmaceutical interest: A number of cardiac glycosides have been characterized from *Oxystelma esculentum* (L. f.) R. Br. (Srivastava S *et al.*, 1991). The pharmacological potential of this plant remains unexplored.

Reference

Srivastava S, *et al.* (1991) *Phytochem* **30**(1): 301–303.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Sarcobolus globulus Wall.

[From Greek, *sarkos* = flesh and *lobos* = lobe and from Latin, *globosus* = globe]

Physical description: It is a poisonous climber of Malaysia. Leaves: simple, opposite, without stipules, succulent, leathery, and ovate or ovate-oblong. The petiole is 1.2 cm. The blade is 7 cm–10 cm × 1 cm–3 cm. The apex of the blade is acuminate and the base is round. The blade shows 5–7 pairs of secondary nerves. The flower pedicel is thick. The flowers are numerous, light purple and 1 cm in diameter. The corolla is tubular, 5-lobed, and the lobes are contorted,

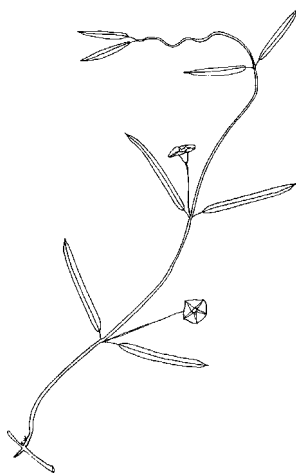


Fig. 285. *Oxystelma esculentum* (L. f.) R. Br. From: KLU 29049. Field collectors: Gerrit Davidse & DB Sumithraarachchi. 7 Dec 1974. Geographical localization: altitude 3 m, Northern Province, Mannar District, c.a. 8 miles Northeast of Mantai along the road to Pooneryu, near mile marker, Ceylon.

Common names: *Akar batu pelir kambing* (Malay).

orbicular and pubescent inside. The andrecium consists of 5 stamens, the filaments of which are connate into a short tube. The anthers are broad with a spatulate appendage. The gynaecium consists of a pair of distinct carpels. The style ends in a 5-angled stigma. The fruits consist of pairs of follicles which are 10cm in diameter, brownish, globose and woody. The pericarp is 1.2 cm thick. The seeds are obovate, flat and margined (Fig. 286).

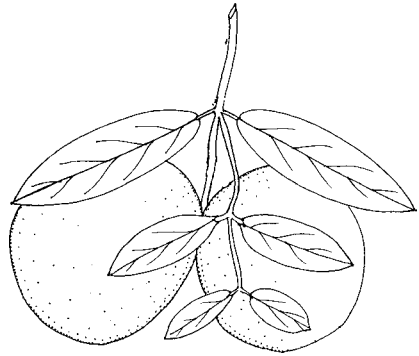


Fig. 286. *Sarcolobus globulus* Wall.

Pharmacological interest: A total glycoside extract of *Sarcolobus globulus* Wall. tested on the rat phrenic nerve-diaphragm, chick biventer cervicis and frog rectus abdominis, inhibits electrical field-stimulated twitching and depressed the log dose-response curve of contractures caused by acetylcholine and carbachol (3 mg/mL; Mustafa MR *et al.*, 1990). Furthermore, this extract inhibits the contraction of guinea-pig ileal longitudinal muscles and *Taenia coli* preparation induced by acetylcholine, histamine and potassium chloride. Low concentrations of both the extract and verapamil induce a similar displacement of the dose-response curve to calcium (0.3 mM–30 mM) and dose-dependently inhibits potassium chloride-induced contraction, thereby suggesting an inhibition of the calcium influx (Mustafa MR, 1993).

Uses: *Sarcolobus globulus* Wall. is principally used in Malaysia where the leaves are mixed with the nuts, *Aleurite moluccana*, to treat rheumatic joints, dengue and to combat fever. The seeds are lethal to human, but coconut water acts as an antidote.

References

- Mustafa MR, *et al.* (1990) *Toxicon* **28**(10): 1237–1239.
Mustafa MR, (1993) *Toxicon* **31**(1): 67–74.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Tylophora tenuis Bl.

[From Greek, *tulos* = knob and *phēro* = bear and from Latin, *tenuis* = thin]

Physical description: It is a climber of the tidal rivers of India, Malaysia, Borneo and Java. Leaves: simple,

Common name: *Akar saput tunggal* (Malay & Indonesian).

Uses: In Indonesia, the leaves of *Tylophora cissoides* Bl. f. are used to assuage abdominal pain and to treat thrush. In Malaysia, the leaves of *Tylophora tenuis* Bl. are used to soothe inflamed parts. In the Philippines, a decoction of the roots of *Tylophora brevipes* (Turcz.) F. Vill. is drunk to induce vomiting, to promote menses, to treat flatulence, to combat fever, to promote expectoration and to assuage stomachache. The leaves of *Tylophora perrottetiana* Decne are used to heal wounds. In India, both *Tylophora asthmatica* Wight. and Arn. and *Tylophora indica* are used to treat asthma.



Fig. 287. *Tylophora tenuis* Bl.

opposite, 2 cm–5 cm × 1 cm–2.5 cm, succulent, without stipules, and very thin. The petiole is 1.2 cm long. The blade is lanceolate or ovate-lanceolate and round at the base. The inflorescences are 8 cm long panicles, originating from the stems between the petioles. The calyx lobes are lanceolate. The corolla is tubular, 5-lobed, rotate and small. The corona consists of small succulent tubercles, adnate to and radiating from the base of the stamens. The staminal column originates from the base of the corolla. The fruits consist of pairs of lanceolate, dagger-shaped, 5 cm–8 cm long acuminate follicles containing several comose seeds (Fig. 287).

Pharmaceutical interest: *Tylophora* species have attracted a great deal of interest on account of their tendency to elaborate series of phenanthroindolizidine alkaloids such as tylocrebine, which behave pharmacologically like glucocorticoids. Such a property is conceivable since the chemical structure of tylocrebine, for instance, is relatively similar to the chemical structure our own steroids, hence confirming experimentally the anti-asthma and anti-inflammatory properties (Fig. 289).

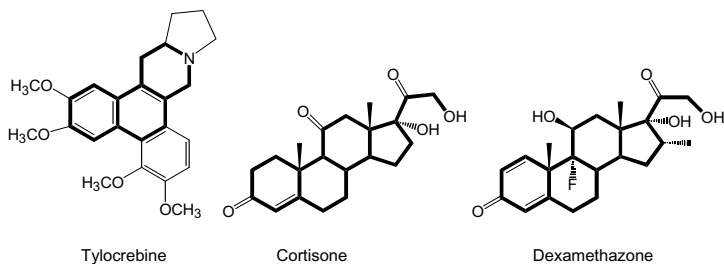


Fig. 289. Note the similitude of chemical structure between tylocrebine cortisone and dexamethasone.

Anti-asthma and anti-inflammatory properties: The efficacy of *Tylophora indica* to treat asthma is confirmed (Thiruvengadam KV *et al.*, 1978) in a *per os* double blind clinical trial (Gupta S *et al.*, 1979). Tylophorine, the major phenanthroindolizidine alkaloid of *Tylophora indica* displays *in vivo* anti-inflammatory and anxiolytic properties (Gopalakrishnana C *et al.*, 1979). The latter effect is known as the side effect of corticosteroid therapy. Ethanolic extracts of *Tylophora indica* tested on delayed-type hypersensitivity, humoral response to sheep blood cells, skin allograft rejection, and phagocytic activity of the reticuloendothelial system in mice, boost the phagocytic function while cutting down the humoral component of the immune system (Atal CK *et al.*, 1986). Extracts of *Tylophora asthmatica* Wight. antagonize the dexamethasone/hypophysectomy-induced suppression of pituitary on activity of the adrenals, suggesting a direct stimulating effect of the adrenal cortex synthesis of corticosteroids (Udupa AL *et al.*, 1991). Phenanthroindolizidine involve both immune and endocrine systems, thus appearing as potential antiasthmatic therapeutic drugs and may represent an interesting material in the understanding of the mode of action of glucocorticoid on asthma.

Tylogenine, a steroidal aglycone characterized from *Tylophora sylvatica* displays anti-allergenic properties (Gnabre JN *et al.*, 1994) and inhibits the release of basophilic mediators, induced by immunoglobulin E for allergic reaction and the release of serotonin by basophile cells ($IC_{50} = 39 \mu M$; $P < 0.05$) more potently than dexamethasone ($IC_{50} = 912 \mu M$). In the human leukocyte-dependent histamine release test, tylogenine ($IC_{50} = 49 \mu M$; $P < 0.05$) acts more potently than dexamethasone ($IC_{50} = 257 \mu M$).

Other pharmacological properties: Acetyltlylophoroside and tylogenine, 2 steroids, inhibit the enzymatic activity of Na^+/K^+ -ATPase, in spite of having chemical structures different from cardiac glycosides (Gnabre JN *et al.*, 1993). Extracts of leaves and stem of *Tylophora indica* have anti-cancer properties (Chitnis MP *et al.*, 1972).

References

- Atal CK, *et al.* (1986) *J Ethnopharmacol* **18**(2): 133–141.
Chitnis MP, *et al.* (1972) *Indian J Med Res* **60**(3): 359–362.
Gnabre JN, *et al.* (1993) *Gen Pharmacol* **24**(5): 1107–1113.
Gnabre JN, *et al.* (1994) *Int J Immunopharmacol* **16**(8): 641–650.
Gopalakrishnana C, *et al.* (1979) *Ind J Med Res* **69**: 513–520.
Gupta S, *et al.* (1979) *Indian J Med Res* **69**: 981–989.
Thiruvengadam KV, *et al.* (1978) *J Ind Med Assoc* **71**(1): 172–176.
Udupa AL, *et al.* (1991) *Planta Med* **57**(5): 409–413.

Warning: Cautions must be taken as the toxic effects of this plant are unknown. Tylocrebine is a skin vesicant.

B. Order SOLANALES Lindley 1833

The order Solanales consists of 8 families and about 5000 species of herbs, shrubs or climbers which are thought to have originated from the Lamiales, during the Post Eocene period from an ancestry near to or in the Gentianales (Appendix I). The chemical weapons used in this order are *tropane alkaloids*, derived from ornithine, steroidal alkaloids, indole alkaloids and lignans. More than four fifths of Solanales species belong to the family Solanaceae and the family Convolvulaceae.

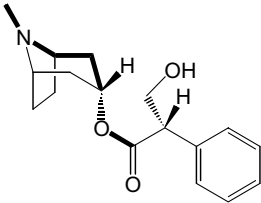
1. Family SOLANACEAE A. L. de Jussieu 1789 nom. Conserv., the Potato Family

Physical description: The family Solanaceae consists of about 85 genera and 2800 species of prickly herbs, shrubs, climbers or small trees, well represented in South America. Solanaceae are known to elaborate *tropane alkaloids* derived from ornithine, pyridine and *steroidal alkaloids*. The leaves of Solanaceae are alternate, simple, often soft, dull green and without stipules. The flowers are hermaphrodite and actinomorphic. The calyx is 4–6-lobed and persistent in fruit. The corolla is tubular, infundibuliform, showy, 5-lobed with the lobes folded, contortate or valvate. The andrecium consists of 5 stamens attached to the corolla, the anthers of which are 2-locular and open lengthwise or by apical pores. The gynecium consists of a pair of carpels united into a 2-locular ovary, with each locule containing several ovules attached axile placentas. The fruits are berries or capsular.

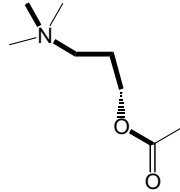


Pharmaceutical interest: Classical examples of Solanaceae are *Solanum tuberosum* L. (potato), *Lycopersicum esculentum* Mill. (tomato), *Nicotiana tabacum* L. (tobacco) and *Capsicum frutescens* L. (chilies). Notorious examples of pharmaceutical Solanales are *Datura stramonium* L., *Datura metel* L., *Atropa belladonna* L. and *Hyoscyamus niger* L., and *Mandragora officinalis* L., the tropane alkaloids of which are parasympatholytic. Hyoscyamine is formed from dried leaves or leaves and other aerial parts of *Atropa belladonna* L., collected when the plants are flowering and containing not less than 0.3% of alkaloids (Belladonna Herb, *British Pharmacopoeia*, 1963), and from dried leaves and flowering tops of *Datura stramonium* L., containing not less than 0.25% of alkaloids (Stramonium, *British Pharmacopoeia*, 1963). The dried leaves and flowering tops of *Hyoscyamus niger* L., containing not less than 0.05% of alkaloids, formed as hyoscyamine (*Hyoscyamus*, *British Pharmacopoeia*, 1963),

are used in Western medicine to treat intestinal colic, gastric ulcer, spasmodic asthma, whooping cough, bladder and urethral spasms, on account of hyoscyamine. Hyoscyamine is a parasympatholytic tropane alkaloid, which exerts a selective blocking action on muscarinic receptors, resulting in mydriasis, tachycardia, decreased production of saliva, sweat, gastric juice, constipation and the inability to urinate.



Hyoscyamine



Acetylcholine

In the Asia-Pacific, *Capsicum annum* L., *Capsicum frutescens* L., *Datura metel* L., *Datura stramonium* L., *Lycium chinense* Mill., *Lycopersicon esculentum* Mill., *Nicotiana tabacum* L., *Physalis* species, *Scopolia japonica* Maxim. and *Solanum* species are used to treat various sorts of ailments. Note that chilies produce adenocarcinomas in the abdomen of rodent.

***Datura stramonium* L.**

[From Sanskrit, *dhatura* = *Datura stramonium* L. and the Greek, *strychnomanikon* = causing madness]

Synonymy: *Datura tatula* L.

Common names: Thorn apple; jimsonweed; Jamestown weed; stinkweed; devil's apple; devil's trumpet; mad apple and apple of Peru; *dhatura*, (Sanskrit), *ummatta* (Tamil).



Physical description: It is an invasive annual shrubby herb which grows to a height ranging from 60 cm to 1.5 m. The plant is native to India, imported to Europe and to the temperate parts of North America. The stems are stout, coarse, terete, succulent, purplish or pale green and subglabrous or hairy. Leaves: simple, alternate, without stipules and smelly when bruised. The petiole is 1 cm–5 cm long. The blade is membranaceous, asymmetrical, 11.6 cm × 7.4 cm–5.5 cm × 2.5 cm, coarsely toothed, subglabrous or farinose, green or purplish and shows 5–6 pairs of secondary nerves. The flowers are

solitary, terminal, on a 1 cm long hairy pedicel. The calyx is tubular, 4 cm × 1 cm, 5-lobed, the lobes triangular and 4 mm × 2 mm. The corolla is tubular, showy, 10.5 cm × 5.5 cm, white or purplish pink and obscurely 5-lobed. The fruits are spiny, 4-lobed, 5 cm × 3 cm capsules which open from the apex when ripe. The seeds are dark, pitted and show tiny wrinkles (Fig. 288).

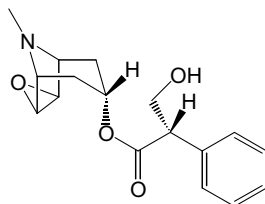


Fig. 288. *Datura stramonium* L.

Uses: In Burma, the seeds are used to induce narcosis. In China, the flowers are used to assuage pains, treat asthma, bechic, skin troubles, swollen feet, prolapse of the rectum and nervous disorders. The leaves are smoked to treat asthma and to assuage pains. In the Philippines, the plant is used for criminal purposes.

Pharmaceutical interest: The medicinal and toxic properties of *Datura stramonium* L. are contributed to parasympatholytic tropane alkaloid atropine and hyoscine (scopolamine), the crystalline mixture of which has been used as an agent to cause mydriasis (Daturine, *British Pharmaceutical Codex*, 1923).

Scopolamine hydrobromide has been used for the treatment of Parkinsonism, for the prevention of motion sickness (Transderm Scop®), to dilate pupils for eyes examination (Isopto® Hyoscine), and as an ingredient of analgesic medication. An extract of the plant proves to be antimicrobial (Eftekhar F *et al.*, 2005).



Hyoscine (scopolamine)

Reference

Eftekhari F, *et al.* (2005) *Fitoter* **76**(1): 118–120.

Warning: Symptoms of *Datura stramonium* L. poisoning include intense thirst, headaches, nausea, fever, high blood pressure, dry mucous membranes, difficulty in swallowing and speaking, blurred visions, photophobia, hyperthermia, confusion, agitation, combative behavior and hallucinations.

Physalis angulata L.

[From Greek, *physa* = bladder and from Latin, *angulata* = angular]

Synonymy: *Physalis capsicifolia*,
Physalis lanceifolia, *Physalis*
ramosissima.

Common names: Cape gooseberry, wild tomato, winter cherry, Chinese lantern plant; *pai chiang* (Chinese); *camates* (Filipino); *kospeli* (Fiji); *tamaru ha'ari* (French Polynesia); *tomate chaca* (Guam-Chamorro); *bubeubedul* (Palau); *vivao* (Samoa); *polopa* (Tonga).

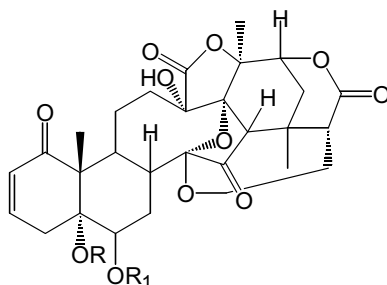


Fig. 289. *Physalis angulata* L.

Physical description: It is a common herb native to Tropical America, which grows to a height of 1 m in vacant plots of land and by roadsides. The stems are angled, purplish green and succulent. Leaves: simple, spiral, finely puberulous, and without stipule. The petiole is 8 mm–2 cm long. The blade is membranaceous, lanceolate, asymmetrical, dentate, 6.5 cm × 3 cm – 4.5 cm × 2 cm and shows 4–5 pairs of arching secondary nerves. The flowers are solitary and axile. The calyx is tubular, 4 mm–6 mm long and 5-lobed; the lobes being triangular. The corolla is yellow, 1 cm long, infundibuliform, 5-lobed and shows brownish spots at the base of fused petals. The andrecium consists of 5 stamens with 1 mm–2 mm long blue anthers. The fruits are 5-angled, lantern-shaped, membranaceous, angular, 2.7 cm × 2 cm capsules with 5 tiny calyx lobes developing at the apex. The seeds are 1.7 mm long, flat, yellowish, and reniform (Fig. 289).

Pharmaceutical interest: A noteworthy feature of *Physalis angulata* L., is the elaboration of unusual series of cytotoxic, antimicrobial, and possibly parasitocidal, highly oxygenated 16,24-cyclo-secosteroids known as physalins (Row L *et al.*, 1978). These steroids might have sexual hormone potentials, but this is yet to be confirmed.

Uses: In the Solomons Island, the seeds of *Physalis angulata* L. are used to treat sterility.



Physalin I

Cytotoxic properties: Physalins B and F inhibit the growth of several human leukemia cells cultured *in vitro*: K562 (erythroleukemia), APM1840 (acute T lymphoid leukemia), HL-60 (acute promyelocytic leukemia), KG-1 (acute myeloid leukemia), CTV1 (acute monocytic leukemia) and B cell (acute B lymphoid leukemia) (Chiang HC *et al.*, 1992). Withangulatin A acts on topoisomerase II to induce topoisomerase II-mediated DNA damage *in vitro* (Juang JK *et al.*, 1989). A flavonol glycoside, myricetin 3-*O*-neohesperidoside inhibits the growth of murine leukemia cell line P-388, the epidermoid carcinoma of the nasopharynx KB-16 cells. The lung adenocarcinoma A-549 is cultured *in vitro* with ED₅₀ values of 0.048 $\mu\text{g}/\text{mL}$, 0.50 $\mu\text{g}/\text{mL}$ and 0.55 $\mu\text{g}/\text{mL}$, respectively (Ismail N *et al.*, 2001).

Antibacterial and antiparasitocidal properties: Physalin D abrogates the survival of *Mycobacterium tuberculosis* H(37)Rv strain with an MIC value of 32 $\mu\text{g}/\text{mL}$ (Januario AH *et al.*, 2002). Extracts of the plant annihilate *Neisseria gonorrhoeae* (Caceres A *et al.*, 1995) and *Trypanosoma brucei rhodesiense* (Freiburhaus F *et al.*, 1996). An extract of the plant also inhibits the growth of *Streptococcus mutans* (Hwang JK *et al.*, 2004).

Other pharmacological properties: Physalins B, F and G lower nitric oxide, tumour necrosis factor (TNF)- α , interleukin-6 and interleukin-12 releases by macrophages, stimulated with lipopolysaccharide and interferon- γ (Soares MBP *et al.*, 2003). It would be interesting to identify the underlying principle of whether nitric oxide is of therapeutic interest.

References

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 Freiburghaus F, *et al.* (1996) *J Ethnopharmacol* **55**(1): 1–11.
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 Row L, *et al.* (1978) *Phytochem* **17**: 1641.
 Soares MBP, *et al.* (2003) *European Journal of Pharmacology* **459** Issue 1 Pages 107–112.
 Juang JK, *et al.* (1989) *Biochem Biophys Res Commun* **159**(3): 1128–1134.

Warning: Cautions must be taken as the toxic effects of this plant are unknown.

Solanum torvum Sw.

[From Latin, *Solanum* = nightshade]

Common names: Turkey berry, Thai eggplant; *terung pipit* (Malay); *tiyung satik* (Bidayu); *kayangyin* (Burmese); *sundai* (Tamil); *barabihi* (Nepalese).



Fig. 290. *Solanum torvum* Sw.

Physical description: It is a shrub which grows to a height of 2 m, wild or cultivated in India, the Asia-Pacific, China, and South America. The stems are spiny and velvety. Leaves: simple, alternate and without stipules. The petiole is tomentose, 1.5 cm–2.5 cm long and channeled. The blade is palmately lobed, membranaceous, 8.5 cm × 7 cm × 13 cm × 10 cm, tomentose below and subglabrous above and shows 4–6 pairs of secondary nerves which are raised on both sides. The base of the blade is asymmetrical. The inflorescences are axillary cymes. The flowers are white

and attached to 6 mm–1.5 cm long pedicels. The calyx is green, tomentose, membranaceous, 5-lobed, the lobes being 3 mm × 2 mm. The corolla is white, membranaceous, and 5-lobed. The corolla lobes are triangular and 1 cm × 2 mm–3 mm. The andrecium consists of 5 stamens, the anthers of which are bright yellow, showy and adnate one to another. The fruits are green, globose berries of about 1.7 cm in diameter, and are palatable albeit sourish (Fig. 290).

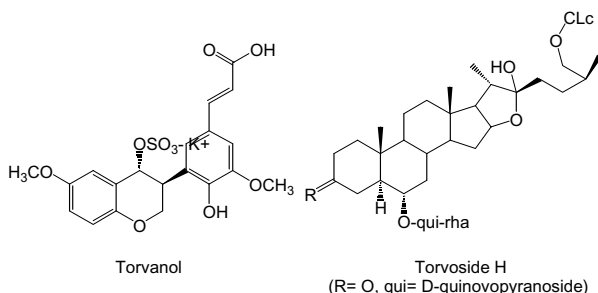


Pharmaceutical interest: *Solanum torvum* Sw. is known to elaborate a series of steroidal glycosides called torvosides, which may be involved in the medicinal uses mentioned above.

Antimicrobial properties: Isoflavonoid torvanol A, and torvoside H, characterized from *Solanum torvum* Sw.

inhibit the growth of Herpes Simplex Virus type 1 with IC₅₀ values of 9.6 μg/mL and 23.2 μg/mL respectively (Arthan D *et al.*, 2002).

Uses: In Malaysia, a paste of roots of *Solanum torvum* Sw. is used to soothe cracked feet. In the Philippines, a decoction of roots is drunk to counteract poisoning and to curb bleeding after childbirth. In India, the fruits are used to treat swollen spleen and liver.



Note that the methanolic extract of the fruit of *Solanum torvum* Sw. inhibits the growth of a broad spectrum of human and animal bacteria that are clinically isolated (Chah KF *et al.*, 2000). The plant is antifungal (Gousset C *et al.*, 2005).

References

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 Chah KF, *et al.* (2000) *Fitoter* **71**(2): 187–189.
 Gousset C, *et al.* (2005) *Plant Science* **168**(2): 319–327.

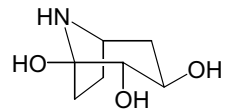
Warning: Balachandran B *et al.* (1995) reports that mice fed with 100 mg/animal/day for 12 months, develop hepatic haemangiomas.

2. Family CONVULVACEAE A. L. de Jussieu 1789 nom. conserv., the Morning - glory Family

Physical description: The family Convolvulaceae consists of 50 genera and 1500 species of tuberous climbers, known to elaborate *glucosins*, *lignans*, *indole* and *tropane* alkaloids and polyhydroxytropanes, derived from ornithine. The leaves of Convolvulaceae are simple, often cordate at the base, without stipules, entire and lobed. Convolvulaceae are easily recognizable by their flowers which are infundibuliform. The sepals are free, imbricate and persistent in fruits. The andrecium consists of 5 stamens which originate from the base of the corolla tube and alternate with the lobes. The anthers are 2-celled and open in terms of length. The gynecium consists of 2–5 carpels forming a superior and 1–4-locular ovary above a nectary disc, with each locule containing 1 or 2 ovules attached to the basal or basal-axile placentas. The fruits are indehiscent, succulent or capsular. The seeds are occasionally hairy and curved.



Pharmaceutical interest: An example of Convolvulaceae is *Ipomoea batatas* (L.) Lamk. (i.e., sweet potato). The tubers of which are edible and have been used as a source of pharmaceutical starch in Japan. Glucosin impart to *Ipomoea orizabensis* (*Ipomoea*, *British Pharmaceutical Codex*, 1963), *Ipomoea purga* (Wender.) Hayne (Jalap, *British Pharmaceutical Codex*, 1963),



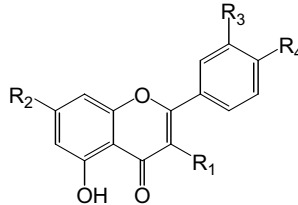
Calystegine A₃

Convolvulus scammonia L. (scammony), *Operculina turpethum* (L.) Silva Manso, *Operculina macrocarpa* (*Ipomoea tuberosa*; Brazilian Jalap, *Portuguese Pharmacopoeia*, 1936) and *Ipomoea hederacea* (*British Pharmaceutical Codex*, 1949), drastic laxative properties. An interesting feature of Convolvulaceae is their tendency to elaborate lysergic acid diethylamide-like indole alkaloids (Fig. 293). One such alkaloid is ergine from the seeds of *Rivea corymbosa* (L.) Hall (*ololiuqui*) and *Ipomoea violacea* L. (*tlitlitzin*) which have been used by South American shaman as a hallucinogenic drug. Of recent interest are polyhydroxytropanes glucosidase inhibitors, known as calystegines, which are powerfully antiviral. Approximately fifty plant species from this family are used for medicinal purposes in the Asia-Pacific. Note that many of these plants are used to purge the bowels, to invigorate health, to treat dropsy, to heal sores and broken bones, to counteract gynecologic putrefaction, to expel intestinal worms, to heal hemorrhoids and to assuage headache.

et al., 1999) and/or scopoletin, constitutes to the anti-inflammatory properties mentioned above. Scopoletin is known to be anti-inflammatory, analgesic (Zhu H *et al.*, 1989) and antirheumatic (Ye HZ *et al.*, 1981).

Note that the oral administration of the ethanolic extract of the roots of *Argyreia speciosa* at the doses of 50 mg/Kg, 100 mg/Kg and 200 mg/Kg in mice, dose-dependently potentiates the delayed-type hypersensitivity reaction induced by both sheep red blood cells and oxazolone (Gokhale AB *et al.*, 2003). Hexadecanyl p-hydroxycinnamic acid and scopoletin, characterized from the roots of *Argyreia speciosa*, inhibit the proliferation of *Alternaria alternata* (Shukla YN *et al.*, 1999).

Uses: In Malaysia, the juice expressed from the leaves of *Argyreia mollis* (Burm. f.) Choisy is used to soothe inflamed eyes. The fresh leaves are incorporated for use as a preventive medicine.



Quercetin 7-methyl ether-3,3'-disulfate
(R1= SO₃Na, R2= OCH₃, R3= OSO₃Na, R4= OH)

References

- Gokhale AB, *et al.* (2003) *J Ethnopharmacol* **84**: 109–114.
 Mann P, *et al.* (1999) *Phytochem* **50**: 267–271.
 Shukla YN, *et al.* (1999) *J Ethnopharmacol* **67**(20): 241–245.
 Ye HZ, *et al.* (1981) *Chung Ts'ao Yao* **12**: 5–7.
 Zhu H, *et al.* (1989) *Zhongcaoyao* **15**: 462–465.

Warning: The seeds contain ergoline alkaloids.

Erycibe malaccensis C. B. Clarke

[From Greek, *erusbibe* = mildew and from Latin, *malaccensis* = from Malacca]

Physical description: It is a climber of the lowland rainforest of Malaysia and Indonesia. Leaves: simple, without stipules, and large. The petiole is 5 mm long and pubescent. The blade is 7 cm–8 cm × 3 cm, elliptic-oblong, shortly acuminate, tapering base, papery and shows 5–6 pairs of secondary nerves. The

Common name: *Akar serawan jantan* (Malay).

Uses: In Malaysia, a paste of leaves is used to soothe sores and to assuage headache. The pharmacological potential of this plant is unknown. Baogongteng A, characterized from *Erycibe obtusifolia* Benth., is a cholinergic tropane alkaloid used clinically to cause myosis in China (Ding WG *et al.*, 1993).

inflorescences are axillary, pubescent and 5–6-flowered cymes. The calyx comprises of 5 sepals which are orbicular, leathery and hairy. The corolla is 7 mm long and white. The andrecium consists of 5 stamens which are short, included and adnate to the throat. The ovary is globose, 1-celled and contains 4 ovules. The stigma is large and sessile.

The fruits are ellipsoid, orange ripening-purple drupes (Fig. 292).



Fig. 292. *Erycibe malaccensis* C. B. Clarke.

References

- Ding WG, *et al.* (1993) *Yao Hsueh Hsueh Pao* 28(4): 302–306.
 Hsu HY, *et al.* (1998) *J Ethnopharmacol* 62(2): 101–105.

Warning: Caution must be taken as the toxic effects of this plant are unknown. Intraperitoneal injection of *Erycibe obtusifolia* Benth. to mice is followed shortly by death (Hsu HY *et al.*, 1998).

Erycibe rheedii Bl.

[From Greek, *erisibe* = mildew]

Physical description: It is a woody climber which grows in the lowland rainforest of Malaysia and Indonesia. The stems are terete, smooth and glabrous. Leaves: simple, spiral and without stipules. The petiole is stout, 1.5 cm–2 cm × 3 mm, channeled and rugose. The blade is thick, 21 cm × 7.2 cm–20.5 cm × 9 cm, acuminate and obscurely notched at the apex. The margin is wavy and recurved. The blade shows 8–9 pairs of secondary nerves.

Synonymy: *Erycibe angulata* Prain

Uses: In Indonesia, *Erycibe rheedii* Bl. is applied externally to accelerate healing. The pharmacological potential of this plant is unexplored.

The inflorescences are axillary and velvety panicles. The corolla is 5-lobed and white (Fig. 293).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Evolvulus alsinoides* L.**

[From Latin, *evolvulus* = unrolled]

Common names: Slender dwarf morning glory; *vishnukranta* (Sanskrit); *shankpushpi* (Indian); *tu ding dui*; *yuan bian zhong* (Chinese).

Uses: In India, *Evolvulus alsinoides* L. is used to strengthen the brain, improve memory, combat fever, promote hair growth, treat dysentery and asthma, improve complexion, rejuvenate the skin, and to expel intestinal worms. In the Philippines, the plant is used to expel intestinal worms, combat fever, and to relieve the bowels of costiveness.

Physical description: It is a creeping and invasive perennial herb that grows to a length of 30 cm in grassy areas, roadsides and open grounds of the Asia-Pacific. The stems are terete and pilose. Leaves: simple, spiral, without stipules and sessile. The blade is linear-oblong, subglabrous, 1 cm × 3 mm–8 mm × 2 mm and slightly acuminate at the apex. The inflorescences are axillary and hairy cymes of 2 cm–2.7 cm long. The calyx comprises of 5 sepals which are linear and hairy. The corolla is light blue in color. The ovary develops 4 conspicuous styles (Fig. 294).

Pharmaceutical interest:

Anti-inflammatory property: The antiasthmatic property of *Evolvulus alsinoides* L. remains unconfirmed, but a crude extract of *Evolvulus alsinoides* L. protects rats against experimentally induced inflammation, oedema and

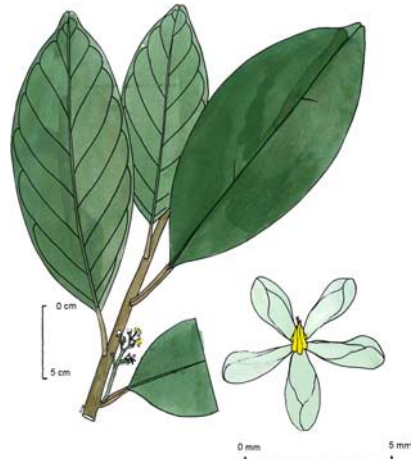


Fig. 293. *Erycibe rheedii* Bl. From: KLU Herbarium 000295. Flora of Malaya. Field collector: 9 Aug 1960, MED Poore. Geographical localization: Johore, Ayer Hitam, Malaysia. Botanical identification: Benjamin C Stone 7/80.



Fig. 294. *Evolvulus alsinoides* L.

causes immunosuppression (Ganju L *et al.*, 2003). Note that the supposedly rejuvenating property of the plant might possibly be due to an antioxidant activity. An ethanolic extract of *Evolvulus alsinoides* is antioxidant in the 2,2'-azinobis-3-ethyl-benzothiazoline-6-sulfonic acid radical cation decolorization assay with IC₅₀ values of 33.39 µg/mL, and a water infusion inhibits spontaneous lipid peroxidation of rat brain homogenate, with IC₅₀ values of 89.23 µg/mL (Auddy B *et al.*, 2003).

References

- Auddy B, *et al.* (2003) *J Ethnopharmacol* **84**(2–3): 131–138.
 Ganju L, *et al.* (2003) *Biomed Pharmacoth* **57**(7): 296–300.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Ipomoea aquatica Forssk.

[From Greek, *ips* = worm and *homoios* = like and from Latin, *aqua* = water]

Synonymy: *Ipomoea reptans* (Linn.) Poir.

Common names: Chinese water spinach, water spinach; *kankung* (Indonesian, Malay), *patate aquatique* (French); *vilucchio d'acqua* (Italian); *wasserspinat* (German); *cancon* (Portuguese); *weng cai*, *kong xin cai*, *tong cai*, *ong choi*, *yung ts'ai* (Chinese); *kalmua* (Hindi); *asagaona* (Japanese); *trâkuön*, *rau muong* (Vietnamese); *bôngz*, *phak bung* (Laotian); *trakuo* (Cambodian); *tangkong* (Filipino); *vallai kirai*, *koilanga* (Tamil); *kalaka* (Sanskrit); *phak bung* (Thai).

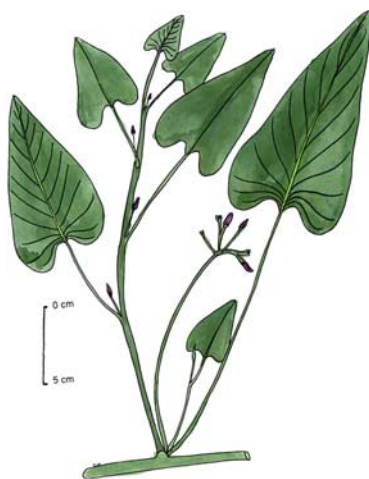


Fig. 295. *Ipomoea aquatica* Forssk. From: KLU Herbarium 041845. Field collector: Rohani Bte Hassan. Botanical Identification: Ong HC Geographical localization: Kampung Kubur Datum, cultivated, Malaysia. 20 Aug 1990.

Physical description: It is an aquatic vegetable of Asia–Pacific which grows to a height of 50 cm. The stems are glabrous, creeping and succulent.

Leaves: simple, spiral and without stipules. The petiole is 4.5 cm–18 cm long. The blade is aristate, dark green, dull, membranaceous, 9.5 cm × 5 cm–14.5 cm × 7 cm, and displays approximately 12 pairs of secondary nerves which are indistinct. The inflorescences are axillary cymes. The calyx consists

of 5 sepals which are 6 mm–8 mm long and oblong-lanceolate. The corolla is 4.5 cm–5 cm, infundibuliform, pure white and pinkish in the throat. The fruits are 8 mm long capsules, containing 2–4 seeds which are pubescent (Fig. 295).

Pharmaceutical interest: An aqueous extract of *Ipomoea aquatica* Forssk. lowers the glycaemia of Wistar male rats as effectively as tolbutamide, substantiating the antidiabetes element mentioned above (Malalavidhane S *et al.*, 2000; 2001), What is the active constituent?. One might think of polyhydroxytropene α -glucosidase inhibitors. The anti-inflammatory property of *Ipomoea aquatica* Forssk. could be attributed to the N-trans-and N-cis-feruloyltyramines, which inhibit the synthesis of prostaglandins (Tseng CF *et al.*, 1992).

Uses: In Cambodia, *Ipomoea aquatica* Forssk. is used to treat ringworm infection, combat fever, and to treat asthma. In China, the plant is used to relieve the bowels of costiveness, to counteract the putrefaction of the skin and uterus, to invigorate health, to treat food poisoning and cough. In Indonesia, the plant is used to treat asthma, to calm and to heal boils and hemorrhoids. In the Philippines, *Ipomoea aquatica* Forssk. is used to treat diabetes.

References

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 Malalavidhane S, *et al.* (2001) *Phytother Res* 2001 Nov; **15**(7): 635–637.
 Tseng CF, *et al.* (1992) *Chem Pharm Bull* **40**(2): 396–400.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Ipomoea cairica (L.) Sweet

[From Greek, *ips* = worm and *homoios* = like and Latin, *cairica* = from Cairo, Egypt]

Synonymy: *Ipomoea palmata* Forssk.

Common names: Cairo morning glory, coastal morning glory; *wasovivi* (Fiji); *wu zhao long* (Chinese).

Physical description: It is a slender perennial climber which grows to a length of 1.5 m. The stems are terete, smooth, sappy and develop tendrils. Leaves: simple, spiral and without stipules. The petiole is 6.5 cm–7 cm long. The blade is palmate, very thin,



3 cm–4.9 cm × 1.6 cm–1.8 cm, and comprises of 5 folioles with 2 folioles at the base, bilobed. The margin is serrulate. The folioles display about 8 pairs of secondary nerves. The inflorescences are axillary and solitary. The flower pedicels are 5 cm–7 cm long. The calyx consists of 5 lobes which are 4 mm × 5 mm. The corolla is infundibuliform, 3 cm × 4 cm and pinkish in color (Fig. 296).

Pharmaceutical interest:

Anti-HIV property: *Ipomoea cairica* (L.) Sweet is interesting because it elaborates lignans such as arctigenin and trachelogenin, which inhibit strongly the replication of the Human Immunodeficiency Virus type 1 (strain HTLV-III-B) *in vitro*, as well as the expression of proteins p17 and p24 by possible inhibition of topoisomerase II activity, involved in virus replication (Schroder HC *et al.*, 1990). Lignans such as arctigenin and trachelogenin are known for their antitumor (Paska C *et al.*, 1998) and calcium antagonist activities (Ichikawa *et al.*, 1986). An extract of *Ipomoea cairica* (L.) Sweet protects the mice moderately against the poisonous effect of the venom of *Bothrops atrox* (Otero R *et al.*, 2000). One might envisage that the Convolvulaceae is a source of lignans with potentials for treating viral infection.

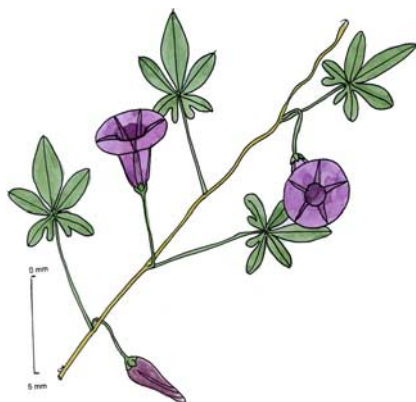
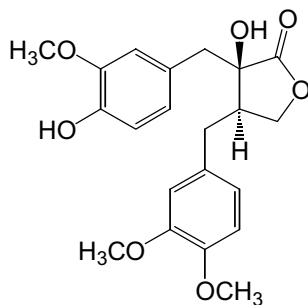


Fig. 296. *Ipomoea cairica* (L.) Sweet.

Uses: In China: *Ipomoea cairica* (L.) Sweet is used to relieve the bowels from costiveness. The laxative property of *Ipomoea cairica* (L.) Sweet is probably caused by lignans.



Trachelogenin

References

- Ichikawa K, *et al.* (1986) *Chem Pharm Bull* **34**(8): 3514.
 Otero R, *et al.* (2000) *J Ethnopharmacol* **73**(1–2): 233–241.
 Paska C, *et al.* (1998) *Toxicology Letter* (Suppl. 1) **95**: 153.
 Schroder HC, *et al.* (1990) *Zeitschrift fur Naturforschung Section C* **45**(11–12): 1215–1221.

Warning: Cautions must be taken as the toxic effects of this plant are unknown.

Ipomoea pes - caprae (L.) R. Br.

[From Greek, *ips* = worm and *homoios* and from Latin, *pes* = foot and *caprae* = goat]

Synonymy: *Ipomoea biloba* Forssk., *Ipomoea bilobata*, *Ipomoea turpenthum*.

Common names: Goat's foot creeper; *tapak kuda* (Malay & Javanese); *pinlaikazum* (Burmese); *trakuon kantek* (Cambodian); *patate de mer* (French); *manmatha* (Sanskrit); *adambu* (Tamil), *Pak bung tale* (Thai).

Physical description: It is a common tropical coastal creeping herb. The plant grows to a height of 3 m. Leaves: 2.5 cm × 10 cm, simple and alternate. The petiole is 2.5 cm–10 cm long. The blade is succulent, soft, light-green, glossy and cordate. The inflorescences are 1–3-flowered cymes. The calyx consists of 5 sepals which are ovate and blunt. The corolla is showy, infundibuliform, 5 cm and mauve-pink in color. The andrecium comprises of 5 stamens with filiform filaments. The ovary is 1–3-locular and includes 4–6 ovules. The style is filiform. The fruits are 1.2 cm long capsules containing several hairy seeds (Figs. 297 & 298).

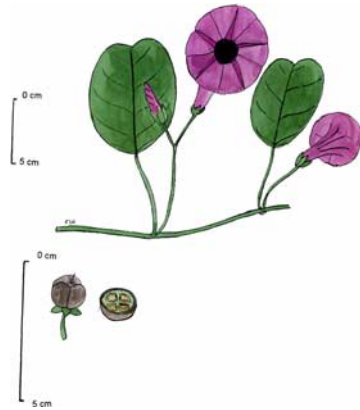


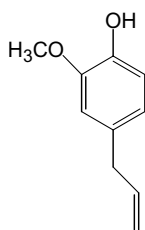
Fig. 297. *Ipomoea pes - caprae* (L.) R. Br.



Fig. 298. *Ipomoea pes - caprae* (L.) R. Br.

Pharmaceutical interest:

Anti-inflammatory and analgesic properties: Eugenol ($IC_{50} = 9.2 \mu M$) and 4-vinyl-guaiacol ($IC_{50} = 18 \mu M$) characterized from *Ipomoea pes-caprae* (L.) R. Br. inhibit the synthesis of prostaglandin *in vitro* (Ponprayoon U *et al.*, 1991). A methanolic extract presents a calculated ID_{50} value of 33.8 mg/Kg intraperitoneally in the writhing test and inhibits both phases of pain (neurogen and inflammatory) in the formalin test with ID_{50} values of 37.7 mg/Kg and 12.5 mg/Kg respectively (de Souza MM *et al.*, 2000).



Eugenol

Other pharmacological properties: β -damascenone and E-phytol characterized from this plant are as anti-spasmodic as papaverine (Pongprayoon U *et al.*, 1992). An extract is clinically effective toward dermatitis caused by venomous jellyfish. It inhibits *in vitro* the action of a series of jellyfish venom with IC_{50} values ranging from 0.3 mg/mL to 0.8 mg/mL (Pongprayoon U *et al.*, 1992). An extract of this plant inhibits ADP-induced human platelet serotonin release *in vitro* and ADP-induced aggregation (Rogers KL *et al.*, 2000).

References

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 Ponprayoon U, *et al.* (1991) *Planta Med* **57**(6): 515–518.
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 Rogers KL, *et al.* (2000) *Eur J Pharm Sci* **9**(4): 355–363.

Uses: In Burma, an infusion of *Ipomoea pes-caprae* (L.) R. Br mixed with rusted iron is drunk to check gynecologic hemorrhages and the vapor obtained from the boiled leaves is used to heal hemorrhoids. In India, the plant is used to cool and to relieve the bowels from costiveness. In Indonesia, a paste of the powdered leaves is used to counteract putrefaction and the young leaves are applied externally to heal injured feet. The sap of the young leaves is used to assuage abdominal cramps. In Malaysia, the juice extracted from *Ipomoea pes-caprae* (L.) R. B is used to counteract the toxicity of fish poisoning. The plants are also used as a remedy for hemorrhoids and to check gynecologic hemorrhages. In Palau, the boiled juice is used to treat rheumatism. In Papua New Guinea, a decoction of the leaves is used to heal sores. In the Philippines, the leaves are used to treat mycosis and rheumatism. In the Solomon Island, the leaves are prepared as a drink to improve digestion. In Vietnam, *Ipomoea pes-caprae* (L.) R. Br is used to soften the skin.

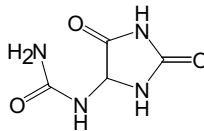
Warning: Caution must be taken as the toxic effects of this plant are unknown.

C. Order LAMIALES Bromhead 1838

The order Lamiales consists of 4 families and about 7800 species of herbaceous plants, which are thought to have originated from the Solanales during the Post Eocene period, from an ancestry near to or in the Gentianales. The chemical weapons used here are *iridoid glycosides* and *lignans* (Appendix I), inherited from the Gentianales. Note that Lamiales differ from Solanales by producing iridoids, but seldom by using alkaloid weapons, and by the zygomorphic specialization for pollination by specific insects or birds. Boraginaceae have appeared during the Oligocene and is the oldest family in Lamiales. It stands somewhat apart, both chemically and physically, from the Verbenaceae and Lamiaceae.

1. Family BORAGINACEAE A. L. de Jussieu 1789 *nom. conserv.*, the Borage Family

Physical description: The family Boraginaceae consists of about 100 genera and 2000 species of trees, shrubs or herbs well represented in Southern Europe, Asia and North America. Boraginaceae are known to elaborate silicic acid, allantoin, hepatotoxic pyrrolizidine alkaloids derived from ornithine, prenylated naphthoquinones (alkannin), inulin-type fructans and tannins but lack of iridoids. The stems are terete and covered with bristly calcified or silified hairs. The leaves of Boraginaceae are simple, covered with bristly calcified or silified hairs, alternate, and without stipules. The inflorescences are scorpioid cymes. The flowers are showy, star-shaped, actinomorphic and principally hermaphrodite. The calyx, corolla and andrecium comprise of 4–6 sepals, petals and stamens respectively. The anthers are 2-celled, open in terms of length and are attached to the corolla tube, and alternate with the lobes. Whether a nectary disc is present or not, the corolla tube shows hairy appendages (fornices) at the apex, opposite to the lobes in the Sub-Family Boraginoidae. The gynecium consists of a pair of carpels relatively united in a superior, 4-locular ovary with each locule containing a single ovule attached to axile placenta. The style is gynobasic. The fruits are nutlets, berries or drupes.

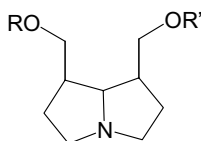


Allantoin

Pharmaceutical interest: A classical example of Boraginaceae is *Myosotis* (forget-me-not). To the Boraginaceae belongs a number of medicinal plants

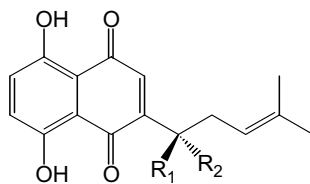
such as *Caccinia glauca* (gaozaban), *Cordia latifolia* (bara-lasora), *Heliotropium indicum* L., *Cynoglossum officinale* (hound's tongue), *Pulmonaria officinale*, *Symphytum officinale* L. (common comfrey) and *Borago officinalis* L. (borage). The dried roots of *Cynoglossum officinale* (Cynoglossum Root, *Spanish Pharmacopoeia*, 1954) have been used in Western medicine to soothe inflammation, to treat cough and to curb diarrhea. The dried roots and rhizomes of *Symphytum officinale* (Comfrey, *British Pharmaceutical Codex*, 1934), which contain *allantoin*, have been used to heal wounds and ulcer. Allantoin promotes the proliferation of cells and is used to manufacture cosmetics.

Pyrrrolizidine alkaloids: *Teucrium*, *Heliotropium* and *Symphytum* species are known to cause loss of appetite, abdominal pain, high levels of transaminases, ascite, edema of the extremities, hepatomegaly, cirrhosis and a death rate of 20%–30% due to hepatotoxic pyrrrolizidine alkaloids.



Pyrrrolizidine alkaloid

Naphthoquinones: Boraginaceae have attracted a great deal of interest due to their ability to elaborate prenylated naphthoquinones. Alkannin from *Alkanna tinctoria* Tausch. (alkanna) and *Lithospermum erythrorhizon* Sieb. & Zucc. are antibacterial and cytotoxic, given their ability to inhibit the enzymatic activity of topoisomerase. It would be interesting to note whether a more intensive study on this family would disclose any quinones of therapeutic interest.



(R-) Shikonin ($R_1 = \text{OH}$, $R_2 = \text{H}$)

(S-) Alkannin ($R_1 = \text{H}$, $R_2 = \text{OH}$)

In the Asia-Pacific, approximately 30 species of Boraginaceae are used for medicinal purposes. Note that these plants are often used to combat fever,

stop diarrhea, heal wounds and boils, assuage pains, resolve swellings, and to treat several sorts of viral infections.

***Carmona microphylla* (Lamk.) Don**

[After B. S. Carmona = a Spanish botanical artist of the 18th century and from Greek, *mikros* = small and *phullon* = leaf]

Synonymy: *Ehretia buxifolia* Roxb., *Ehretia macrophylla* Lamk., *Carmona retusa* (Vahl), Masam. *Cordia retusa* Vahl, *Ehretia dentata* Courchet.

Common names: Fukien tea, Ceylon boxwood; *pala* (Hindi); *kuruvingi* (Tamil).

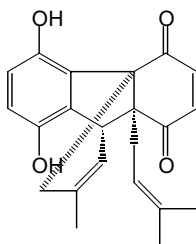


Fig. 299. *Carmona macrophylla* (Lamk.) Don.

Physical description: It is a shrub which grows to a height of 2 m. The stems are terete, woody, smooth, reddish and subglabrous. Leaves: simple, spirally arranged in groups of 4–6 or solitary. The petiole is indistinct. The blade is leathery, hairy, spatulate, 2 cm × 7 mm–5 cm × 2 cm, glossy, dark green above, dentate and shows a few pairs of secondary nerves. The inflorescences are axillary cymes that are few-flowered. The calyx comprises of 5 linear, hairy and 3.5 mm long sepals which are persistent in fruits. The corolla is white and shows 5 lobes which are 3 mm × 1 mm. The stamens are exserted. The style is bifid. The fruits are glossy, scarlet berries that are 4 mm in diameter, while the apex is pointed in a vestigial style (Fig. 299).

Pharmaceutical interest: *Carmona microphylla* (Lamk.) Don is interesting because it elaborates a series of quinonoid xanthenes, including ehretianone and microphyllone. Ehretianone protects mice against the venom of *Echis carinatus* (Selvanayagam ZE *et al.*, 1996). Microphyllone inhibits the activation of rat basophiles stimulated by antigens (Yamamura S *et al.*, 1995). The concomitance of both antipyretic activity and antivenom activity in *Carmona macrophylla* (Lamk.) Don suggest the inhibition of phospholipase A₂ or other enzymes involved in the metabolism of autacoids. However, this is yet to be confirmed experimentally.

Uses: In Indonesia, *Carmona microphylla* (Lamk.) Don is given as a depurative after childbirth, used to combat fever and to treat diarrhea with blood. In the Philippines, the plant is used to combat fever and to treat stomach discomfort.



Microphyllone

References

Selvanayagam ZE, *et al.* (1996) *J Nat Prod* **59**(7): 664–667.

Yamamura S, *et al.* (1995) *Phytochem* **39**(1): 105–110.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Cordia dichotoma Forst. f.

[After V. Cordus, 1515–1544, a German botanist and from Greek, *dikho* = asunder]

Synonymy: *Cordia dichotoma* Forst. f., *Cordia myxa* auct. non. L., *Cordia obliqua* Willd., *Argyreia arborea* Lour.

Common names: Fragrant manjack; *sekundah*, *sekendai* (Malay); *leshora* (India).

Physical description: It is a tree which grows to a height of 12 m in a geographical zone spanning from China to New Caledonia. Leaves: 5 cm–8 cm × 3 cm–5 cm, simple, somehow succulent and dull green. The petiole is 2.5 cm long and thin. The blade is ovate. The apex is subacute or blunt. The base is round or subcordate.

The inflorescences are 1.2 cm long trigonous cymes. The calyx is campanulate and 5 mm long. The corolla is white, tubular and 5-lobed. The andrecium

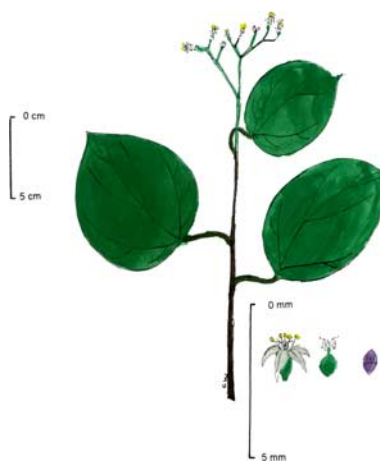


Fig. 300. *Cordia dichotoma* Forst. f.

consists of 5 stamens attached to the corolla. The ovary is superior, 2-locular with 1 ovule per locule. The fruits are ellipsoid, light-pink, 1.2 cm and bear very glutinous berries (Fig. 300).

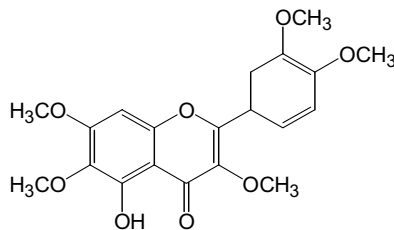
Pharmaceutical interest: Therapeutic potential of *Cordia dichotoma* Forst. f is unexplored and would be worthwhile investigating, as a number of interesting pharmacological properties have been measured in the genus, *Cordia*.

Antiviral properties: An aqueous extract of leaves of *Cordia spinescens* protects MT-4 cells against the Human Immunodeficiency Virus type 1 ($IC_{50} = 15.5 \mu\text{g/mL}$). The extract inhibits the formation of giant

T-cells ($IC_{50} = 62.5 \mu\text{g/mL}$) and the enzymatic activity of Human Immunodeficiency Virus protease with an IC_{50} value of $100 \mu\text{g/mL}$ (Matsuse IT *et al.*, 1999).

Anti-inflammatory properties: One might set the hypothesis that the anti-inflammatory property is on the account of flavonoids, flavonols, quinones or other phenolic compounds, which are known to inhibit the enzymatic activity of lipo-oxygenase, cyclo-oxygenase, and to scavenge free radicals. Note that the fruit of *Cordia myxa* inhibits acetic acid-induced colitis in rats via antioxidant effects (Al-Awadi FM *et al.*, 2001). Artemetin, or 5-hydroxy-3,6,7,3',4'-pentamethoxyflavone characterized from *Cordia verbenacea* DC. protects rats against carrageenan-induced paw edema (102.6 mg/Kg – 153.9 mg/Kg), similar to calcium phenylbutazone (50 mg/Kg ; Sertie JA *et al.*, 1990). Oral administration of a lyophilized extract of leaves of *Cordia verbenacea* DC. (1.24 mg/Kg) inhibits nystatin-induced edema in rodent. Topically, this extract (0.09 mg/ear

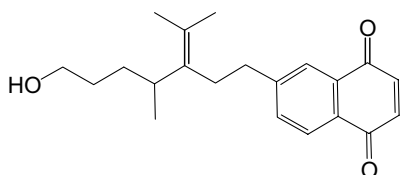
Uses: In Burma, the bark of *Cordia dichotoma* Forst. f is used to treat catarrh and the fruit is used to cool. In Vietnam, Indonesia and the Philippines, the powdered seeds are used to treat skin eruptions. In Indonesia, the juice extracted from the leaves is used to lower the body temperature. A decoction of the stems is used to aid recovery from childbirth and to assuage bowels discomfort. In the Philippines, the bark is used to maturate boils and to soothe swollen parts.



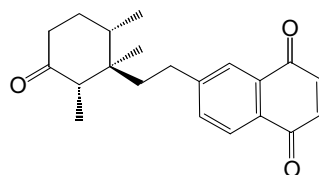
Artemetin

mice) is more effective than naproxen (1 mg/Kg) in reducing croton oil-induced ear edema (Sertie JE *et al.*, 1991). Robinin, rutin, datiscoside, hesperidin, dehydrorobinetin, chlorogenic acid and caffeic acid from *Cordia francisci*, *Cordia myxa* and *Cordia serratifolia* exhibit significant analgesic, anti-inflammatory and antiarthritic properties in rats (Ficarra R *et al.*, 1995).

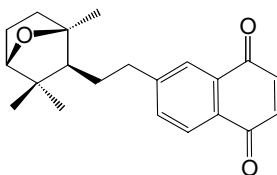
Antifungal properties: *Cordia* species are interesting because they elaborate antifungal naphthoquinones, such as cordiaquinones A, B, J and K (loset JR *et al.*, 1998; 2000; Yajima A *et al.*, 2003), 1-(3'-methoxypropanoyl)-2,4,5-trimethoxybenzene and a prenylated hydroquinone: 2-(2Z)-(3-hydroxy-3,7-dimethylocta-2,6-dienyl)-1,4 – benzenediol (loset JR *et al.*, 2000a).



Cordiaquinone A



Cordiaquinone B



Cordiaquinone J

References

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 Ficarra R, *et al.* (1995) *Farmaco* **50**(4): 245–256.
 loset JR, *et al.* (1998) *Phytochem* **47**(5): 729–734.
 loset JR, *et al.* (2000) *Phytochem* **53**(5): 613–617.
 loset JR, *et al.* (2000a) *J Nat Prod* **63**(3): 424–426.
 Matsuse IT, *et al.* (1999) *J Ethnopharmacol* **64**(1): 15–22.
 Sertie JA, *et al.* (1990) *Planta Med* **56**(5): 439–443.
 Sertie JE, *et al.* (1991) *J Ethnopharmacol* **31**(2): 239–247.
 Yajima A, *et al.* (2003) *Tetrahedron Letters* **44**: 6915–6918.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Heliotropium indicum* L.**

[From Greek, *helios* = sun and *trope* = turning and from Latin, *indicum* = from India]

Synonymy: *Tiaridium indicum* (L.) Lehm

Common names: Indian heliotrope; Indian turnsole; *rumpus ekor kunching*, *seri bumi*, *jinkin kala* (Malay).



Fig. 301. *Heliotropium indicum* L.

Physical description: It is a herb which grows annually to a height of 50 cm. It grows by coast-lines, drains and in vacant plots. Leaves: simple, 3 cm–5 cm × 1.5 cm–5 cm, and alternate. The petiole is 1.25 cm long. The blade is ovate or ovate-lanceolate. The apex is acute and the base is cordate. The inflorescences are 5 cm long spikes-shaped like cat's tails. The flowers are tubular, pale purple to white with a yellow throat. The fruits are 4 tiny, conical, pear-shaped and beaked pyrenes (Fig. 301).

Pharmaceutical interest:

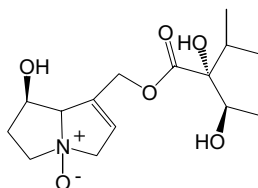
Antimicrobial properties: The anti-infectious property of *Heliotropium indicum* L. is probably owing to pyrrolizidine alkaloids, quinones or triterpenes. Heliotropiones A and B characterized from *Heliotropium ovalifolium*, inhibit the growth of *Candida albicans* and *Cladosporium cucumerinum* (Guatera A *et al.*, 2001). Epifriedenyl acetate characterized from *Heliotropium marifolium* has significant antimicrobial properties (Singh B *et al.*, 2001). Extracts of *Heliotropium ellipticum* and *Heliotropium bursiferum* inhibit the proliferation of a number of bacteria cultured *in vitro* (Jain SC *et al.*, 1987; Marquina G *et al.*, 1989).

Uses: In Burma, a decoction of the plant is used to treat gonorrhoea. In Indonesia, an infusion of the leaves is used to soothe mouth sprue. In Malaysia, a paste of the plant is used to reduce urination, to counteract putrefaction, to treat pyoderma and ringworm infection, and to soothe irritated skin. The plant is used to combat fever, to soothe inflammation, to treat orchitis, pneumonia and pulmonary abscesses, to heal ulcers and to assuage liver discomfort. In the Philippines, a decoction of the dried roots is drunk to promote menses. The seeds are used to promote digestion and the leaves are used to treat cholera, malaria, to counteract putrefaction and to heal wounds.

Cytotoxic properties: Pyrrolizidine alkaloids have anti-tumor properties but their potential are limited, considering their toxicity. One example is indicine-*N*-oxide from *Heliotropium indicum* L. which possesses a significant anti-tumor

property. 9-Angeloylretronecine-*N*-oxide characterized from *Heliotropium bur-siferum* destroys KB cells (Marquina G *et al.*, 1982).

Other pharmacological properties: The roots of *Heliotropium indicum* L. contain rapanone, a quinone related to embelin which is a potential contraceptive agent.



Indicine - *N* - oxide

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 Marquina G, *et al.* (1982) *Farmazie* **43**(1): 55–56.
 Marquina G, *et al.* (1989) *Farmazie* **44**(12): 870–872.
 Tandon HD, *et al.* (1993) *Food Addit Contam* **10**(1): 105–113.
 Wahome WM, *et al.* (1994) *Vet Hum Toxicol* **36**(4): 295–297.

Warning: *Heliotropium* species have the tendency to accumulate pyrrolizidine alkaloids (Tandon HD *et al.*, 1993; Chauvin P *et al.*, 1993). Intraperitoneal injection of *Heliotropium scottae* Rendle in mice (LD₅₀: 3 g/Kg) is followed shortly by excitement, prostration, rapid breathing, gasping for breath and ultimately death (Wahome WM *et al.*, 1994).

2. Family VERBENACEAE Jaume St. - Hilaire 1805 nom. conserv., the Verbena Family

Physical description: The family Verbenaceae consists of about 100 genera and 2600 species of herbs, climbers, shrubs or trees closely allied to the Lamiaceae. Verbenaceae are known to elaborate a series of *iridoids glycosides*, phenolic glycosides (orobanchin), flavonoids, triterpenes and naphthoquinones (lapachol). The young stems of Verbenaceae are commonly quadrangular. The leaves are compound, decussate, without stipules and opposite. The inflorescences are often terminal and racemose. The flowers are perfect, zygomorphic and small. The calyx is tubular and 5-lobed. The corolla is tubular, 5-lobed and often bilabiate. The



andrecium consists of 4 stamens, the anthers of which are dithecal, tetrasporangiate and open by longitudinal slits. The filaments are attached to the corolla and alternate with the lobes. The gynecium consists of a pair of 2 carpels united to form a 4 locular ovary, with each locule enclosing a single ovule attached to the axile placentas. The fruits are berries or capsular.

Pharmaceutical interest: A common example of Verbenaceae is *Lantana camara* (yellow sage, common Lantana), the fruits of which have been responsible for children poisoning. The toxic principles are pentacyclic triterpene derivatives, lantadene A and B which provoke cholestasis, hepatic necrosis, gastroenteritis with bloody, watery feces, weakness, paralysis of the limbs and death in three to four days. Another example is *Tectona grandis* L. f., commercially known as teak wood. The dried leaves of *Aloysia triphylla* (L'Hérit.) Britt. (*Lippia citriodorata* H.B. and K.) or lemon verbena is used to treat digestive and nervous ailments. *Verbena officinalis* L. (*French Pharmacopoeia*) is traditionally used to promote urination and to soothe inflamed skin. This was known at the time of the Roman emperor Theodosius (4th century AD) to remove tumors. *Vitex agnus-castus* L. (chaste tree) has been used medicinally since the Greek time, and is still used to treat premenstrual syndrome and menopause. Approximately 50 species of plants classified within the family Verbenaceae are of medicinal value in the Asia-Pacific. To date, the pharmacological potential of this large family is yet to be explored.

***Vitex negundo* L.**

[From Latin, *vitex* = a plant name and from Indian, *nirgundi* = *Vitex negundo* L.]

Physical description: It is a treelet of the Asia-Pacific, India, China and Ceylon. The bark is grey and the stems are quadrangular and velvet. Leaves: decussate, 3–5 foliolate and without stipules. The petiole is 3.7 cm–5 cm long, channeled and velvety. The folioles are lanceolate, asymmetrical, 8.5 cm × 1.5 cm–5.5 cm × 1 cm, velvety, and glaucous below. The blade shows 9–13 pairs of secondary nerves. The inflorescences are terminal, conical and velvety panicles of about 20 cm long. The calyx is 3 mm long, white, velvety and produces 5 triangular lobes which are 0.8 mm–1 mm long. The corolla is 1 cm long, bluish purple, velvety on the outside and hairy on the inside. The upper corolla lip is 2 mm long and bifid. The lower lip is 5 mm long and 3-lobed. The stamens are hairy at the

Synonymy: *Vitex spicata* Lour., *Vitex paniculata* Lamk.

Common names: Indian privet; *lenggundi* (Malay); *kiyubantin* (Burmese); *king tze, mu ching* (Chinese); *agnocasto* (Filipino); *nochi* (Tamil); *suvaha* (Sanskrit).

base. The ovary is glabrous. The stigma is forked. The fruits are berries 6 mm diameter which ripens when it is glossy black (Fig. 302).

Uses: In Cambodia, Laos and Vietnam, *Vitex negundo* L. is used to heal wounds, and to treat beri-beri and paralysis. In China, the plant is used to treat cough, cholera, beri-beri and dropsy, combat fever, invigorate health, and to treat dysentery. In India, the plant is used to promote digestion, expel intestinal worms, promote hair growth, soothe inflammation, treat asthma, counteract snake-poisoning, invigorate health, and to combat fever. In the Philippines, it is used to promote milk secretion and menses. In India, the plant is used to soothe inflammation and to calm itching.



Fig. 302. *Vitex negundo* L. From: KLU Herbarium 28415. Plants of Ceylon. Geographical localization: North Central Province: Polonnaruwa District: 3 miles Southwest of Elahera, near mile marker 12/5, Ceylon. 10 Oct 1974, altitude: 400 ft–500 ft. Field collector: G Davidse. Botanical Identification: HN Moldenke 1976.

Pharmaceutical interest:

Anti-inflammatory properties: The anti-inflammatory property of *Vitex negundo* L. is confirmed: a water extract of the leaves protects rats against carrageenan- and formaldehyde-induced paw edema, and assuage pain in the hot plate test. The leaves inhibit antihistamine and prostaglandin synthesis, stabilize membrane and fight oxidation (Dharmasiri MG *et al.*, 2003). The methanolic extracts of the roots, *Vitex negundo* L., protects rodent against the venoms of *Vipera russellii* and *Naja kaouthia* (Alam MI *et al.*, 2003). The concomitance of both anti-inflammatory and anti-venom properties suggest that the inhibition of phospholipase A₂ that has yet to be confirmed. Flavonoids or steroids are likely to be involved in this instance.

Oestrogenic properties: Note that a number of plants classified within the genus *Vitex* are used to control birth and to treat gynecological disorders. Most of these contain ecdysteroids, the hormonal and especially gynecological effect of which remains to be clarified. Clinical trials show that the fruits of *Vitex agnus-castus* are effective in the treatment of premenstrual syndrome (Schellenberg R *et al.*, 2001). Note that ecdysteroids are structurally close to our steroid hormones and are anabolic (Fig. 306).

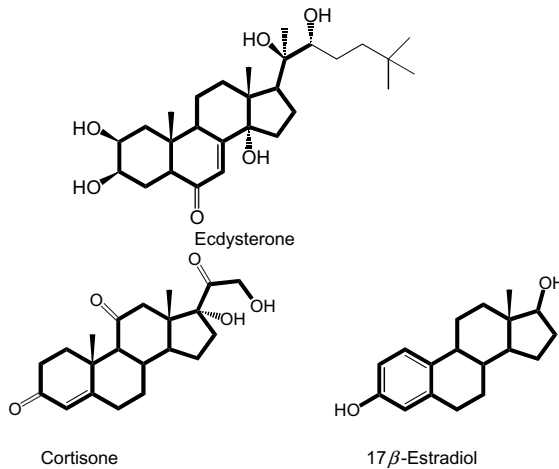


Fig. 306. Note the structural similitude between cortisone, 17 β -Estradiol and ecdysterone.

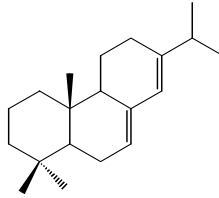
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 Schellenberg R, *et al.* (2001) *British Medical J* **322**(7279): 134–137.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

3. Family LAMIACEAE Lindley 1836 *nom. conserv.*, the Mint Family

Physical description: The family Lamiaceae (or Labiatea or Labiae) consists of approximately 200 genera and 3200 species of herbs or shrubs. Lamiaceae are covered with glandular trichomes containing *volatile oils*. The stems are quadrangular, pithy and not uncommonly reddish. The leaves of Lamiaceae are simple, decussate or whorled and without stipules. The margin of the blades is crenate or toothed. The inflorescences are cymose and axillary. The flowers are perfect and zygomorphic. The calyx is tubular, bilobed and consists of 5 variously united sepals which persist in fruits. The corolla is tubular, blue or white, bilobed and consists of 5 imbricate lobes. The andrecium consists of 2–4 stamens which are adnate to the corolla. The gynecium consists of a pair of carpels forming a 4-locular and superior ovary, with each locule containing a single ovule attached to a basal axile placenta. The style originates from the inner base of the carpels (gynobasic) and the stigma is bifid. The fruits consist of 4 achene-like nutlets which are packed in the calyx.



Abietane

Pharmaceutical interest: To the family Lamiaceae, belongs a stock house of carminative, antiseptic and spasmolytic products. Classical examples of medicinal Lamiaceae are *Mentha piperita*, (Peppermint, *British Pharmaceutical Codex*, 1954), *Mentha viridis* L., *Mentha spicata* (Spearmint Oil, *British Pharmaceutical Codex*, 1963), *Lavandula intermedia*, *Lavandula officinalis* (Lavender Oil, *British Pharmaceutical Codex*, 1963), *Hyssopus officinalis* L. (Hyssop, *Portuguese Pharmacopoeia*, 1936), *Thymus vulgaris* L. (Thyme Oil, *British Pharmaceutical Codex*, 1949), *Salvia officinalis* (Sage, *British Pharmaceutical Codex*, 1934), *Rosmarinus officinalis* L. (Rosemary Oil, *British Pharmaceutical Codex*, 1963), and *Origanum vulgare* or marjoram (Origanum, *Polish Pharmacopoeia*, 1954). *Amaracus dictamnus* was used by ancient Greeks to heal wounds. *Cedronella triphylla* Moench., *Clinopodium laevigatum*, *Glechoma hederaceum*, *Satureja douglasii* (Benth.) Briq. (*yerba buena*), *Sideritis thuzans* and *Stachys officinalis* Trevis. are used to invigorate health throughout the world, whereas *Pogostemon heyneanus* Bth. provides patchouli oil.

Of recent interest are a number of sulphated *polysaccharides* characterized from *Prunella vulgaris* L. (heal-all, summer wither herb) which inhibit the replication of the Human Immunodeficiency Virus. Note that the family Lamiaceae is a prolific reserve of *abietane-type diterpenes* pigments which are either quinones or quinone methides. About 60 species of plants classified within the family Lamiaceae are used for medicinal purposes in the Asia-Pacific. Note that these plants are often used to facilitate digestion, assuage spasms, counteract putrefaction, to promote urination and to regulate menses.

***Ajuga decumbens* Thunb.**

[From Greek, *a* = without and *jugum* = yoke and from Latin, *cumbere* = lie]

Physical description: It is a little herb of Japan and China. The stems are succulent, quadrangular, decumbent and subglabrous. Leaves: opposite, decussate, without stipules and sessile. The blade is spatulate, dull dark green above, hairy, very thin, and 9 mm × 7 mm–6 cm × 1.5 cm. The margin is laxly toothed. The blade shows 3–4 pairs of

Common name: *Kiran sou* (Japanese).

indistinct secondary nerves. The inflorescences are axillary clusters. The calyx is 5 mm long, hairy and 5-lobed. The corolla is tubular, purple, bilobed and about 1 cm long. The stamens are didynamous. The ovary is obscurely 4-lobed and the style bifid. The fruits consist of 4 nutlets which are ovoid and reticulated (Fig. 303).

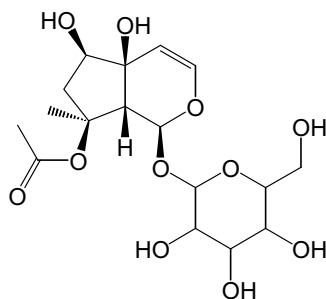
Uses: In China, *Ajuga decumbens* Thunb. is used to assuage pains, resolve blood clots, combat fever, stop diarrhea, and to treat eye troubles and bladder diseases. In Japan, *Ajuga decumbens* Thunb. is official and used to resolve insect bites, burns, cuts, tumors, to assuage stomachaches and to treat diarrhea, fungal infection and colic.



Fig. 303. *Ajuga decumbens* Thunb. From: KLU 30785. Ex. Herbario Universitatis Tokyoensis. Geographical localization: Japan, C Honshu: Saitama Prefecture: Iruma - Gun, Kuroyama, altitude: 200 m, 27 Apr 1978. Field collector & botanical identification: H Ohashi, H Ohba, Y Tateishi, J Murata.

Pharmaceutical interest:

Cytotoxic properties: The antitumor property of *Ajuga decumbens* Thunb. is owing to the element 8-*O*-acetylharpagide, with potent antitumour-promoting activities on a mouse-skin *in vivo*. This iridoid glycoside displays remarkable inhibitory effects on a two-stage carcinogenesis test of mouse skin tumors and protects mice against hepatic tumors (Konoshima T *et al.*, 2000; Takasaki M *et al.*, 1999).



8- O Acetylharpagide

Cardiovascular properties: 8-*O*-acetylharpagide from *Ajuga reptans* contracts isolated portions of guinea pigs smooth muscle (Breschi MC *et al.*, 1992). The phytoecdysteroidal content of *Ajuga decumbens* Thunb. could be of interest, as phytoecdysteroids isolated *Ajuga turkestanica* (Rgl) increase the haemoglobin contents of erythrocytes and markedly stimulate the secretion of bile in normal rats. One of these ecdysteroids is turkesterone which stimulates the regeneration of erythrocytes in phenylhydrazine anemia, similar to the well-known steroidal anabolic drug nerobol (Syrov VN *et al.*, 1986; 1997).

Antimicrobial properties: A diterpene isolated from the fresh whole *Ajuga lupulina* inhibits the growth of Gram-negative bacilli, *Pseudomonas aeruginosa* and *Escherichia coli* (Chen H *et al.*, 1997). A petroleum ether extract of aerial parts of *Ajuga remota* inhibits the growth of several of pathogen fungi cultured *in vitro* (Kariba RM, 2001). Ergosterol-5, 8-endoperoxide characterized from the aerial parts of *Ajuga remota* Benth. is strongly active against *Mycobacterium tuberculosis* with an MIC value 1 µg/mL against (Cantrell CL *et al.*, 1999). A flavone of *Ajuga decumbens* Thumb. inhibits the enzymatic activity of Human Immunodeficiency Virus reverse transcriptase (Tang X *et al.*, 1994).

References

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 Syrov VN, *et al.* (1997) *Eksperimentalnaia i Klinicheskaia Farmakologija* **60**(3): 41–44.
 Syrov VN, *et al.* (1986) *Farmakologija i Toksikologija* **49**(3): 100–103.
 Tang X, *et al.* (1994) *J Tradit Chin Med* **14**(1): 10–13.
 Takasaki M, *et al.* (1999) *J Nat Prod* **62**(7): 972–975.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Coleus scutellarioides (L.) Benth.

[From Greek, *coleus* = sheath and Latin, *scutellarioides* = Like the genus *Scutellaria*]

Physical description: It is a herb native to the Southeast part of Africa. The plant is aromatic and grown as ornamental in the Asia-Pacific. The stems are quadrangular. Leaves: simple, 2.5 cm–7.5 cm × 1 cm–5 cm,

Synonymy: *Coleus atropurpureus* Benth., *Coleus blumei* Benth., *Plectranthus scutellarioides* (L.) R. Br., *Solenostemon scutellarioides*, *Coleus blumei* var. *verschaffeltii*, *Ocimum scutellarioides* L.

Common names: Common coleus; *ati-ati* (Malay); *jawer kotok* (Indonesian).

Uses: In Indonesia, the juice extracted from the leaves is drunk believing to threaten abortion. A decoction is used to heal hemorrhoids, promote menses, expel impurities after childbirth, and to soothe inflamed eyes. In Malaysia, a decoction of the leaves or the juice extracted from the leaves is drunk to stop flatulence, to treat congestion of the liver, to assuage heart and liver pain, to treat smallpox, to soothe swollen parts and to induce vomiting. In the Philippines, a paste of leaves is used to assuage headache and to soothe bruises. In Vietnam, the plant is pectoral.



Fig. 304. *Coleus scutellarioides* (L.) Benth.

without stipules and decussate. The petiole is up to 7.5 cm long. The blade is lozenge-shaped, and variously colored according to the variety. The base of the blade is broadly round and the apex is tapered. The margin is crenate. The flowers are arranged in 10 cm–20 cm long spikes. The calyx is bilobed, 3 mm long with the upper lip broad and round, and the lower one, bifid. The corolla tube is blue with a white tube, 6 mm long, bilobed, with the lower lobe in boat-shaped. The andrecium comprises of 4 stamens. The fruit consists of 4 seeds enclosed in accrescent calyx (Fig. 304).

Pharmaceutical interest: The pharmacological properties of *Coleus scutellarioides* (L.) Benth. are unknown.

Cardiovascular properties: *Coleus* species have attracted a great deal of interest due to forskoline (or coleonol) characterized from *Coleus forskohlii* (Willd.) Brig. Forskoline is a diterpene that shows encouraging signs in the treatment of hypertension, heart failure and asthma. The precise mechanism of the action of this diterpene is based on its ability to boost the enzymatic activity of activated adenylate cyclase, hence increasing the intracellular cyclic adenosine monophosphate (AMPC) (Marone G *et al.*, 1987; Tsukawaki M *et al.*, 1987).

The increase of cyclic monophosphate adenosine in the cardiac muscle cells results in an inotropic positive effect, whereas the increase of the cyclic adenosine monophosphate in the smooth muscle cells causes relaxation (bronchioles, vessels; Fig. 305). Forskoline given to dogs and cats causes a positive inotropic activity and lowers their blood pressure (Lindner E *et al.*, 1978).

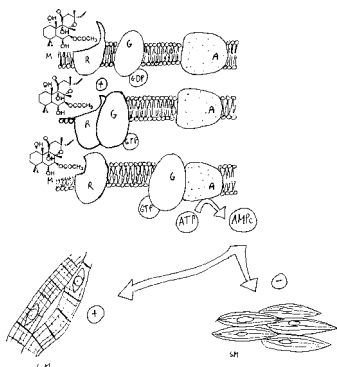
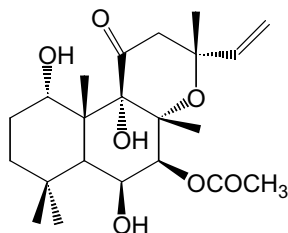


Fig. 305. Mechanism of action of forskoline: forskoline binds to an extracellular receptor (R) which activates adenylate cyclase (A) in cell membrane (M) through the protein G (G). Increase of intracellular cyclic adenosine monophosphate (AMPc), hence contraction of the cardiac muscle cells (CM). The relaxation of the smooth muscle cells (SM) of the bronchioles and vessels.

Cytotoxic properties: Forskoline ($82 \mu\text{g}/\text{mouse}$) given by intraperitoneal injection 30 minutes or 60 minutes prior to the tail vein injection of cultured B16-F10 cells (2×10^5 cells/mouse– 3×10^5 cells/mouse), cut tumor colonization in lungs by more than 70%. Similar results are obtained in 3 separate experiments. These findings raise the possibility that forskoline could be useful in preventing the proliferation of cancer metastasis (Argawal KC *et al.*, 1983).



Forskoline

References

- Argawal KC, *et al.* (1983) *Int J Cancer* **32**(6): 801–804.
 Bryld LE, *et al.* (1997) *Am J Contact Derm* **8**(1): 8–9.
 Marone G, *et al.* (1987) *Biochem Pharmacol* **36**(1): 13–20.
 Tsukawaki M, *et al.* (1987) *Lung* **165**(4): 225–237.

Warning: A 65-year-old woman having *Coleus scutellarioides* (L.) Benth. as houseplant developed facial dermatitis (Bryld LE, 1997). Caution must be taken, as the systemic toxic effects of this plant are unknown.

***Glechoma hederacea* L.**

[From the Greek, *glechon* = a kind of mint and from Latin, *hederacea* = pertaining to ivy]

Synonymy: *Nepeta glechoma* Benth., *Glechoma hederacea* L. var. *parviflora* (Benth.) House, *Nepeta hederacea* (L.) Trevisan, *Glechoma hederacea* L. var. *micrantha* Moric.

Common names: Creeping charlie, ground ivy; *lierre terrestre* (French).

Physical description: It is a herb native to Eurasia which has spread to North Temperate countries. The plant is invasive and found in abandoned fields, open disturbed areas and pastures. The stems are creeping, quadrangular, smooth and subglabrous. Leaves: simple, opposite and without stipules. The petiole is 4.5 cm–8 mm long and sheathing at the base. The blade is reniform, subglabrous, very thin and 2.5 cm × 1.3 cm–1.2 cm × 1.5 cm. Both sides of the blade are microscopically mottled with black spots. The margin is crenate and recurved. The inflorescences are in axillary, few-flowered clusters. The calyx is tubular, ribbed, hairy, 5-lobed, and 5 mm × 2 mm. The corolla is 7 mm–1 cm long, purplish in color, and the stigma is bifid (Fig. 306).



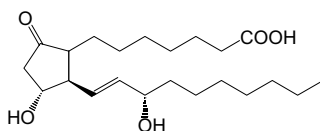
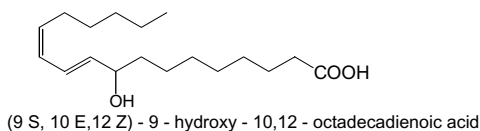
Fig. 306. *Glechoma hederacea* L. From: KLU Herbarium 35606. Plants of Maryland. Field collector & botanical identification: LM Mac Intosh, 21 Apr 1980, Montgomery Co.: Takoma Park, yard at 7303 and 7307 Piney Branch Road, in woods, United States of America.

Pharmaceutical interest:***Antipyretic and analgesic properties:***

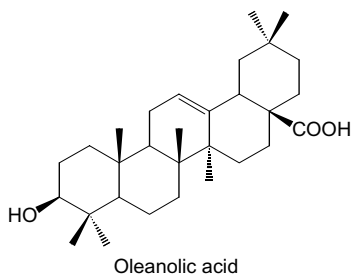
In general, *Glechoma hederacea* L. and Lamiaceae have the interesting tendency to elaborate long chains of unsaturated and hydroxylated fatty acids with anti-inflammatory, analgesic and antipyretic potentials. One such fatty acid is 9-hydroxy-10, 12-octadecadienoic acid (9S, 10E, 12Z) in Kuhn H *et al.* (1989), which increases the enzymatic activity of adenylate cyclase in platelet membrane by approximately threefold (EC₅₀ value of 10–20 μM), and also via the blockade of

Uses: In China, Taiwan and Japan: *Glechoma hederacea* L. is used to combat fever, to assuage pain, to treat colds, to invigorate and to expel impurities. *Glechoma hederacea* L. was official in France (*French Pharmacopoeia*, 10th Edition).

prostaglandin E₁ (PGE₁) and prostaglandin D₂ (PGD₂) receptors (Henry DY *et al.*, 1987).

Prostaglandin E₁

Cytotoxic properties: Ursolic acid and oleanolic acid isolated from *Glechoma hederacea* L.; inhibit Epstein-Barr virus (EBV) activation induced by 12-O-tetradecanoylphorbol-13-acetate, and also the tumor progression in the skin of a mouse, as efficiently as retinoic acid. (Tokuda H *et al.*, 1986).



References

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 Kuhn H, *et al.* (1989) *Eur J Biochem* **186**(1–2): 155–162.
 Tokuda H, *et al.* (1986) *Cancer Lett* **33**(3): 279–285.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Hyptis suaveolens Poit.

[From Greek, *huptios* = turned back and from Latin, *suavis* = sweet]

Physical description: It is a shrub with a height of 3 m. The plant is invasive, hairy, aromatic and suitable for growth in sunny and dry places. The stems are woody at base,

Common names: Wild basil, hyptis, chan, wild spikenard; *ruku-ruku* (Malay); *hyptis à odeur*, *gros baume*; *mumutun* (Guam).

Uses: In China, *Hyptis suaveolens* Poit. is used to combat fever and to invigorate health. In Malaysia, a decoction of 15 g of dried herb is used to combat fever, assuage headache and to promote digestion; the plant is used externally to soothe skin rashes, eczema and to resolve swellings. In the Philippines, the plant is used to stop spasms, treat rheumatism, promote menses as well as to invigorate health. A decoction of the plant is used to assuage stomachache and to treat dysentery. In Taiwan, the aerial parts are used to assuage pain and skin discomfort, whereas in Vietnam, the plant is used to increase milk secretion.

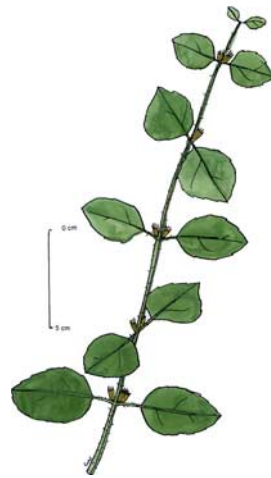
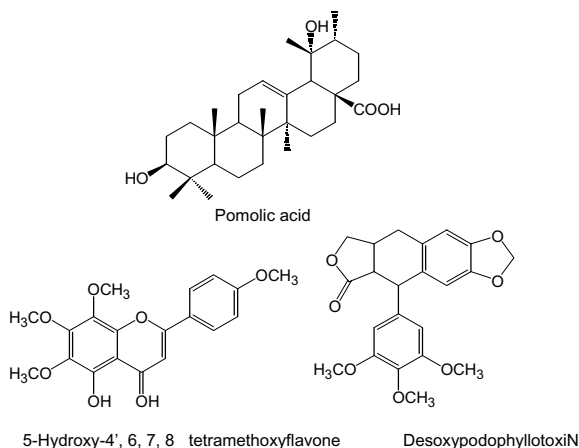


Fig. 307. *Hyptis suaveolens* Poit. From: KLU Herbarium 19283. Flora of Malaya. Field collector & botanical identification: SC Chin, 10 March 1971. Geographical localization: Perak, Tambun area, within the hot spring enclosure, at the foot of limestone cliff, on limestone debris, fairly open ground, Malaysia.

quadrangular, pithy and hairy. Leaves: simple, 2.5 cm–7.5 cm × 1.25 cm–5 cm without stipules and decussate. The petiole is slender, hairy and 2 cm–3 cm long. The blade is broad at the base and acute at the apex, densely hairy at the bottom and the margin is lobed. The inflorescences are of small axillary cymes. The calyx is tubular, hairy, 10 mm long and ribbed. The corolla is tubular, blue, tiny and bilobed. The fruits consist of 4 pyrenes enclosed in the calyx tube which is accrescent (Fig. 307).

Pharmaceutical interest: To date, the pharmacological potential of *Hyptis suaveolens* Poit. remains unexplored. *Hyptis* species have attracted a great deal of interest on the basis of their ability to elaborate antimicrobial and cytotoxic principles.

Antimicrobial properties: Crude extracts of *Hyptis suaveolens* Poit. inhibit the growth of *Candida albicans* moderately and several Gram-positive and Gram-negative bacteria, as well as keratinophilic fungi cultured *in vivo* (Qureshi S *et al.*, 1997; Rojas A *et al.*, 1992), on the possible account of 1,8-cineole, sabinene, limonene, bicyclogermacrene and β -phellandrene (Azevedo NR *et al.*, 2001). Oleanolic acid and pomolic acid characterized from *Hyptis capitata* (whole plant) inhibit the replication of the Human Immunodeficiency Virus type 1 in acutely infected H9 lymphocytes with EC₅₀ values of 1.7 μ g/mL and 1.4 μ g/mL respectively (Kashiwada Y *et al.*, 1998).



Cytotoxic properties: The general tendency in terms of cytotoxic principles in *Hyptis* species and Lamiaceae are triterpenes, lignans and flavonoids. Ursolic acid from *Hyptis capitata* (Lee KH *et al.*, 1988) and desoxypodophyllotoxin, 5-hydroxy-4', 6, 7, 8-tetramethoxyflavone and 5-hydroxy-4', 3, 6, 7, 8-pentamethoxyflavone from *Hyptis tomentosa* are cytotoxic (Kingston DG *et al.*, 1979).

5-Methoxydehydropodophyllotoxin, dehydro- β -peltatin methyl ether (P388 ED₅₀ 1.8 μ g/mL), dehydropodophyllotoxin, deoxydehydropodophyllotoxin, (–)-yatein, 4'-demethyldeoxypodophyllotoxin, isodeoxypodophyllotoxin, deoxypicropodophyllin and apopicropodophyllin from *Hyptis verticillata* inhibit the proliferation of breast, colon, fibrosarcoma, lung, prostate, KB and KB-VI (a) multi-drug resistant cell-lines, and murine lymphocyte leukaemia (P388) cell-lines and sideritoflavone alleviate the survival of KB cells with an ED₅₀ value of 1.6 μ g/mL (Novelo M *et al.*, 1993). Note that the seeds contain a protease inhibitor (Aguirre C *et al.*, 2004).

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- Rojas A, *et al.* (1992) *J Ethnopharmacol* **35**(3): 275–283.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Leucas zeylanica* R. Br.**

[From Greek, *leukos* = white and from Latin, *zeylanica* = from Ceylon]

Common names: Malayan catnip; Ceylon leucas, *ketumbak* (Malay); *herbe tombée* (French); *pache – pache* (Javanese); *fiŋwocao* (Chinese). *geta thumba* (Sri Lankan).

Uses: In Malaysia, a decoction of *Leucas zeylanica* R. Br. is drunk to treat cold, expel intestinal worms, alleviate cough and to promote digestion. A poultice is used to soothe inflamed parts, to assuage headache and to expel intestinal worms. The juice expressed from the plant is used to heal syphilitic ulceration of the nose, and to treat skin diseases and leucorrhoea. In China, the plant is used to treat cough. It would be interesting to discover whether a more intensive study on this plant discloses any molecules of therapeutic interest.



Physical description: It is a herb which grows to a height of 30 cm in neglected lands and roadsides in a geographical zone spanning India, the Asia-Pacific and China. The stems are quadrangular, succulent and subglabrous. Leaves: simple, packed at the apex of the stems, 3 cm–7.5 cm × 5 mm–1.5 cm, without stipules and decussate. The petiole is indistinct. The blade is lanceolate, subglabrous and shows about 4–6 pairs of secondary nerves which are sunken above and raised below. The margin is laxly lobed and recurved. The inflorescences are of dense, few-flowered terminal heads. The flowers are pure white in color and hairy at the base. The corolla is bilobed with the lower lobe much larger and indistinctly bifid. The calyx is tubular, subglabrous and shows 8 tiny lobes. The corolla is hairy, pure white, bilobed, with the lower lobe much longer and broader. The andrecium consists of 2 pairs of stamens. The fruits consist of 4 tiny nutlets packed in the accrescent calyx (Fig. 308).



Fig. 308. *Leucas zeylanica* R. Br.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Ocimum basilicum* L.**

[From Greek, *Ocimum* = to smell and *basilikos* = royal remedy]

Common names: Sweet basil; *selaseh, ruku-ruku* (Malay); *balanoi* (Filipino); *hung que* (Vietnam); *pesto* (Italian); *pistou, basilic* (French); *tirunitru-pachchai* (Tamil); *arjaka* (Sanskrit).

Physical description: It is a little shrub native to Africa and Asia. The plant is cultivated for its aroma. The stems are purplish or green, squarish, succulent and glabrous; but hairy and woody at the base. Leaves: simple, decussate, without stipules and 2.5 cm–9 cm × 1.25 cm–5 cm. The petiole is 1.5 cm–2 cm long and hairy. The blade is lanceolate, succulent, light green or purplish, glossy and shows 4–6 pairs of secondary nerves. The margin is serrate or entire. The flowers are arranged in 7 cm–20 cm long cylindrical racemes. The calyx is hairy, purplish or green, 4 mm long, bilobed, with an broad and round upper lobe, and a lower lobe with 4 tiny teeth. The corolla is white or purplish, bilobed with the lower lobe projecting forward and relatively flat, whilst the upper lobe has 4 blunt teeth. The andrecium consists of 4 stamens in 2 pairs. The style is pinkish. The fruits consist of 4 nutlets which are included in the accrescent calyx (Fig. 309).

Physical description:

Carminative and antimicrobial properties: The carminative and antimicrobial properties of *Ocimum basilicum* L. are constituted by an essential oil which contains approximately 70% of

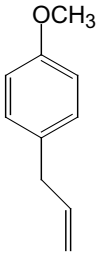


Fig. 309. *Ocimum basilicum* L.

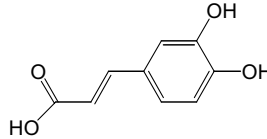
Uses: In China, the leaves are used to invigorate health, treat flatulence, heal ulcers, curb vomiting, remove nasal polyps and to cure hiccups. The seeds are used to assuage eyes discomfort and to heal ulcers. In Indonesia, the seeds are used to relieve the bowels of costiveness. In Malaysia, the juice expressed from the leaves is used to alleviate cough. A decoction is used to aid recovery from childbirth, promote menses and to combat fever. The seeds are used to combat fever. In Vietnam, the plant is used in perfume making, to invigorate health, treat dysentery and to combat fever. The ashes of the roots are used to treat skin diseases. *Ocimum basilicum* L. is listed in the *French Pharmacopoeia*, 1989 and known of Dioskurides as *ωκκίμων*.

estragol, as well as small amounts of cineol, fenchol, linalool methyleugenol and limonene. The antimicrobial property might also be mediated by p-coumaric acid and caffeic acid, elaborated by the plant. Note that limonene has anticarcinogenic properties.

Anti-inflammatory properties: Fixed oil of *Ocimum basilicum* L. inhibits carrageenan-induced arachidonic acid and leukotriene-induced paw edema; the castor oil-induced diarrhea in rats is made possible by blockade of the enzymatic activity of both cyclo-oxygenase and lipo-oxygenase (Singh S, 1999). An aqueous extract protects rats against gastric ulcers caused by aspirin in rats (Akhtar MS *et al.*, 1989). Note that caffeic acid displays significant analgesic, anti-inflammatory and antiarthritic properties in rats (Ficarra R *et al.*, 1995).



Estragol



Caffeic acid

References

- Akhtar MS, *et al.* (1989) *J Ethnopharmacol* **27**(1–2): 163–176.
 Ficarra R, *et al.* (1995) *Farmaco* **50**(4): 245–256.
 Singh S, (1999) *Indian J Exp Biol* **37**(3): 248–252.

Warning: Caution must be taken as the toxic effects of this plant are unknown. However, the plant is known to contain tryptophane, which is toxic at a dose of 0.25 g/Kg–0.35 g/Kg and quercetin, which may interact with bovine papilloma virus type 4, leading to malignant epithelial papillomas in the upper alimentary tract. Estragol and other phenylpropanoids are known to cause liver cancer in rats.

Orthosiphon stamineus Bth.

[From Greek, *orthos* = straight and *siphon* = tube and from Latin, *staminis* = thread]

Physical description: It is a perennial herb of 1 m height. It is native to Southeast Asia and cultivated as an ornamental or medicinal plant in several tropical countries. The stems are quadrangular, purplish, pithy and glabrous.

Synonymy: *Orthosiphon grandiflorus* Bold., *Orthosiphon aristatus* (Bl.) Miq., *Orthosiphon spicatus* (Thunb.) Bak.

Common names: Java tea, kidneys tea plant; *misai kuching* (Malay); *ya nuat maeo, rau meo, cay bac* (Thailand); *moustaches de chats* (French), *kumi ni pusi* (Fiji), *chemadecharebub* (Palau), *ava pusi* (Samoa), *kava 'i pusi* (Tonga)



Uses: *Orthosiphon stamineus* Bth. is principally used to promote urination. In Indonesia and Malaysia, a decoction of leaves is drunk to alleviate bladder and kidneys discomfort, as well as to treat arteriosclerosis, gout and rheumatism. In Vietnam, an infusion of 15 g–40 g of the plant is drunk to promote urination, treat edema, control eruptive fever, and to treat influenza, rheumatism, hepatitis, jaundice and biliary lithiasis. In India, the plant is mixed with *Andrographis paniculata* Nees to treat diabetes.



Leaves: simple, without stipules and decussate. The petiole is 1 cm–2 cm long and purplish. The blade is 5 cm × 2.5 cm, lozenge-shaped, glabrous, dark green above, paler below, and tapering at the base. The blade shows 5–6 pairs of secondary nerves. The margin is broadly toothed. The inflorescences are terminal and purplish, of 6 cm–10 cm conical racemes. The flowers are showy, white and club-shaped in buds. The calyx is green, 5 mm long, and 2-lobed. The upper lobe is broad and round, while the lower lobe shows 4 tiny teeth. The



Fig. 310. *Orthosiphon stamineus* Bth.

corolla is tubular, the tube hairy and bilobed, and the lower lobe is longer than that of the upper one. The stamens are 5 cm long, recurved and thrust forth showily (Fig. 310).

Pharmaceutical interest:

Diuretic properties: Hydroalcoholic extracts of *Orthosiphon stamineus* Bth. promote urination and the secretion of Na⁺ ions in rats (Beaux D *et al.*, 1999). The plant is known to contain nitric oxide inhibitory diterpene, neoorthosiphonone A, sensing cardiovascular potentials (Awale S *et al.*, 2004).

References

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 Beaux D, *et al.* (1999) *Phytother Res* **13**(3): 222–225.
 Matsubara T, *et al.* (1999) *Biol Pharm Bull* **22**(10): 1083–1088.
 Nathrudee S, *et al.* (1999) *Bulletin of Department of Medical Sciences* **41**(1): 41–54.
 Ohashi K, *et al.* (2000) *Yakugaku Zasshi* **120**(5): 474–482.

Warning: An extract lowers the serum levels of sodium, increases the enzymatic activity of alkaline phosphatase and promotes hydrocalyx in rats (Nathrudee S *et al.*, 1999).

Prunella vulgaris L.

[From German, *prunella* = quince and from Latin, *vulgus* = common people]

Physical description: It is a herb which grows to a height of approximately 25 cm tall. The plant is native to Europe, Asia and North America where it grows wild in temperate pastures, by the roadsides and in vacant plots of land. The stems are quadrangular, green, stoloniferous, succulent and glabrous except younger parts. Leaves: simple, decussate and without stipules. The petiole is 2.2 cm–9 cm long, subglabrous, and channeled. The blade is oblong-elliptic, 4.5 cm × 2.3 cm–5.3 cm × 2.5 cm, very thin and subglabrous. The margin is wavy. The blade shows 3–4 pairs of secondary nerves which are indistinct. The inflorescences are terminal, bracteate and of few-flowered spikes. The bracts are 5 mm × 7 mm, broadly acuminate and hairy. The calyx is nerved, 7 mm × 2.5 mm, hairy and bilobed. The upper lip is 3-lobed. The corolla is tubular, bilobed, purple and 1 cm–1.5 cm long. The stigma is bilobed. The seeds are smooth, ovoid and 2 mm × 1 mm (Fig. 311).

Synonymy: *Prunella asiatica* Nak.

Common name: Self-heal.

Pharmaceutical interest:

Uses: In China, Taiwan and Japan, *Prunella vulgaris* L. is used to combat fever, invigorate the liver, lower blood pressure, promote urination, heal boils, resolve conjunctiva, and to treat infection. In Cambodia, Laos and Vietnam, the plant is used to treat intestinal diseases and diseases of the lungs, as well as scrofula. In Korea, *Prunella vulgaris* L. is used to stop diarrhea, heal abscesses and ulceration.

Anti-inflammatory properties: The anti-inflammatory property of *Prunella vulgaris* L. is confirmed, possibly involving some triterpenes. An aqueous extract of *Prunella vulgaris* L., at doses ranging from 0.005 g/Kg–1 g/Kg, protects rats against immediate-type allergic reactions (Shin TY *et al.*, 2001). 2α , 3α -dihydroxyursolic acid characterized from *Prunella vulgaris* L., inhibits the release of β -hexosaminidase from the cultured RBL-2H3 cells in a dose-dependent manner with an IC_{50} value of $57\ \mu\text{M}$. Ursolic acid and 2α -hydroxyursolic acid inhibit the production of nitric oxide from cultured murine macrophages, RAW 264.7 cells with IC_{50} values of 17 and $27\ \mu\text{M}$, respectively (Ryu SY *et al.*, 2000). A phenolic extract of the plant reduces oxidative stress in hereditary hypertriglyceridemic rats, fed with a high-sucrose diet (Skottova N *et al.*, 2004).

Antiviral properties: An extract of the spike of *Prunella vulgaris* L. displays anti-HIV activity at the adsorption and reverse transcription stages (Kaguyama S *et al.*, 2000) on probable account of an anionic polysaccharide, which is active against another retrovirus, Herpes Simplex Virus types 1 and 2 (HSV-1 and HSV-2). This saccharide is inactive against Cytomegalovirus, the Human Influenza Virus types A and B, the Poliovirus type 1 or the Vesicular Stomatitis Virus *in vitro*. The 50% plaque reduction dose of the polysaccharide for Herpes Simplex Virus 1 and 2 is $10\ \mu\text{g/mL}$. This polysaccharide also inhibits clinical isolates and known acyclovir-resistant (TK-deficient or polymerase-defective) strains of HSV-1 and HSV-2 (Xu HX *et al.*, 1999). A polysaccharide fraction abrogates the expression of Herpes Simplex Virus antigen in Vero cells

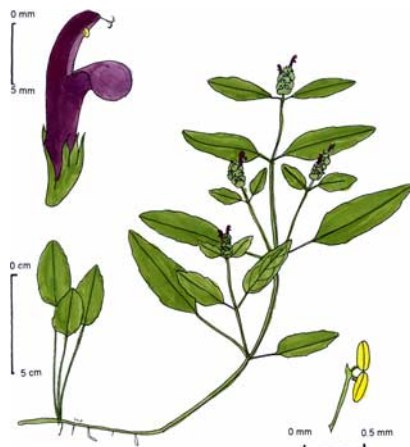


Fig. 311. *Prunella vulgaris* L. From: KLU Herbarium 35433. Plants of Virginia, University of Maryland Herbarium, College Park, Maryland, USA. Field collector & botanical identification: Mary Kay Schaaf. 6 Sep 1980. Geographical localization: Virginia, Fairfax City, intersection of Estel Road and Barlow Road. Wooded area. United States of America.

(Chi-Ming CL *et al.*, 2004). The plant inhibits Human Immunodeficiency Virus type 1, the 6-helix bundle formation in gp41 (Shuwen L *et al.*, 2002).

References

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 Ryu SY, *et al.* (2000) *Planta Med* **66**(4): 358–360.
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 Xu HX, *et al.* (1999) *Antiviral Res* **44**(1): 43–54.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

D. Order SCROFULARIALES Lindley 1833

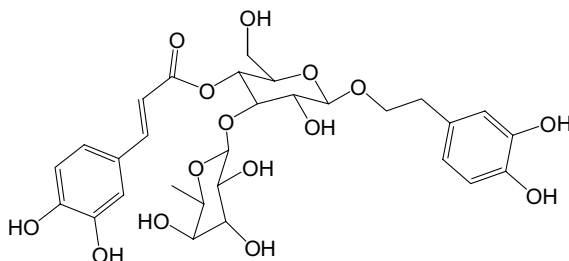
The order Scrophulariales consists of 12 families and more than 11 000 species of herbs, shrubs and occasionally trees, thought to have originated near or in the Gentianales (Appendix I). Chemically speaking, Scrophulariales differ from the Solanales by producing *iridoid glycosides*, *phenylethanoid glycosides*. Classical examples of Scrophulariales of pharmaceutical interest are *Digitalis purpurea* L. (purple foxglove) and *Digitalis lanata* Ehrh. (Grecian foxglove), the cardenolides of which, namely digitoxin and digoxin, are used to increase the force of myocardial contraction.



1. Family BUDDLEJACEAE Wilhelm 1910 *nom. conserv.*, the Butterfly – bush Family.

Physical description: The family Buddlejaceae consists of about 10 genera and 150 species of tropical and sub-tropical shrub or trees commonly producing orobanchin, iridoids and flavonoid glycosides, phenylethanoid glycosides, and saponins. The leaves of Buddlejaceae are opposite, simple, and stipulate. The flowers are hermaphrodite, zygomorphic and tubular. The calyx is 4–5 lobed. The corolla is tubular, 4–5 lobed and the lobes are imbricate. The andrecium consists of 4-stamens which are attached to the corolla tube and are alternate to the lobes. The anthers are tetrasporangiate, dithecal and open by longitudinal slits. The gynecium consists of a pair of carpels united to form

a compound superior 2-locular ovary, where each locule containing numerous ovules is attached to the axile placentas. The style is solitary, terminal with a capitate or bilobed stigma. The fruits are septicial capsules. The seeds are winged and small.



Verbascoside

Pharmaceutical interest: The largest genus of Buddlejaceae is the genus *Buddleja* (butterfly-bush) with 100 plant species in both the Old and New World, some of them cultivated a plant garden. To date, the state of knowledge on the pharmacology of Buddlejaceae is vestigial. Caffeoyl phenylethanoid glycosides, such as verbascoside isolated from *Buddleja officinalis* Maxim., might hold some potential as antioxidant. Note that a number of *Buddleja* species are used as topical antiseptic and diuretic. In the Asia-Pacific, *Buddleja asiatica* Lour., *Buddleja lindleyana* Fortune (*Buddleja curviflora* sensu Stuart, non H. & A., *Buddleja japonica* sensu read, non Hemsl.), *Buddleja officinalis* Maxim. and *Buddleja albiflora* Hemsl. are medicinal. It would be interesting to learn whether a more intensive study on this family discloses any molecules of therapeutic interest.

***Buddleja asiatica* Lour.**

[After Rev. Adam Buddle 17th century English botanist, and from Latin, *asiatica* = from Asia]

Physical description: It is a shrub which grows to a height of 4 m. The plant is found in the wet pastures, mountain forests, roadsides and waste areas of China, Indonesia, Malaysia, Nepal, India to South China, Taiwan, the Philippines, Thailand, Vietnam and Micronesia. The stems are smooth, quadrangular, and velvety when young. Leaves: simple and decussate. The petiole is 6 mm–8 mm long, thin, channeled and velvety. The blade is lanceolate, velvety

Synonymy: *Buddleia asiatica* Lour.

Common names: Dog tail; *dauk fou*, *hua tuan*, *kai bok* (Thai); *huelo 'ilio* (Hawaii).

Uses: In Burma, the roots of *Buddleja asiatica* Lour. are used to invigorate health. In Laos, Cambodia, and Vietnam, the plant is given to pregnant women. In the Philippines, the plant is used to aid abortion, treat skin diseases and to calm babies.

below, subglabrous above, 12.2 cm × 3.1 cm–11.5 cm × 2.5 cm, papery, and somewhat asymmetrical. It shows 8–12 pairs of secondary nerves. The base of the blade is tapering. The margin is serrate and the apex is acuminate. The inflorescences are of terminal spikes which are slender, white and 20 cm long. The flowers are tubular and 5 mm long. The calyx is 2 mm × 1 mm, velvety, and produces 5 triangular lobes which are 5 mm long. The corolla is 2 mm long, tubular, and produces 5 broad 1 mm × 1 mm lobes (Fig. 312).



Fig. 312. *Buddleja asiatica* Lour. From: KLU Herbarium 23942, The Forest Herbarium (BKF), Royal Forest Department. Flora of Thailand. Geographical localization: Kanchanaburi, March 1973. Field collector: C Phengklai *et al.* Botanical identification: T Smitinaud.

Pharmaceutical interest: To date, the pharmacological properties of *Buddleja asiatica* Lour. remain unexplored. Note that the invigorating and aborting properties mentioned above, might be owing to bitter iridoids or antioxidant verbascoside like compounds and saponins respectively. Antioxidant flavonoids and caffeic acid derivatives characterized from *Buddleja globosa* protect fibroblast against hydrogen peroxide (Mensah AY *et al.*, 2001). Are the dermatological potentials of *Buddleja asiatica* Lour. a result of antioxidant principles?

Reference

Mensah AY, *et al.* (2001) *Ethnopharmacol* **77**(2–3): 219–226.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family GESNERIACEAE Dumortier 1822 *nom. conserv.*, the Gesneriad Family

Physical description: The family Gesneriaceae consists of about 120 genera and 2500 species of tropical rainforest understorey herbs, shrubs and trees, closely allied to the Scrophulariaceae, and known to produce orobanchin, caffeoyl *phenylethanoid glycosides* (verbascoside). The leaves are simple,

opposite, often lobed or toothed, occasionally asymmetrical, the smaller one is stipule-shaped and without stipules. The flowers are perfect, tubular, usually zygomorphic, often large and showy, and often solitary in the axil of the leaves. The calyx comprises of 5 sepals which are free or united into a lobed tube. The corolla consists of 5 petals united in a bilabiate tube. The andrecium comprises of 4 stamens arranged in asymmetrical pairs attached to the corolla tube and alternate with the lobes. 1–3 staminodes are often present in place of 1–3 stamens. The gynecium consists of a pair of carpels forming a compound that is superior or inferior single-locular ovary, each locule containing several ovules attached to 2 parietal placentas. The stigma is bilobed. The fruits are loculicidal or septicidal capsules or berries containing several small seeds.



Pharmaceutical interest: A number of plants classified within the genera *Gloxinia*, *Achimenes*, *Sinningia* and *Streptocarpus* are cultivated for decorative purposes. Little is actually known of the therapeutic potential of this large family. Caffeoyle phenylethanoid glycosides might hold some antioxidant potentials. Approximately twenty plants classified within the family Gesneriaceae are of medicinal purposes in the Asia-Pacific. These are often used to counteract the putrefaction of the skin, to combat fever and to resolve inflammation.

***Aeschynanthus radicans* Jack**

[From Greek, *aischyno* = ashamed and *anthos* = flowers, and from Latin, *radix* = root]

Physical description: It is an epiphyte climber that grows in the angles of branches in the rainforest of Malaysian peninsula, preferably near streams and water falls. The plant is used as pot ornamental. The stems are hairy and rooting. Leaves: simples, opposite, and without stipules. The petiole is 2 mm long, hairy, and obscurely channeled. The blade is hairy, succulent to spongy, obovate of 1.5 cm × 1 cm–2.4 cm × 1.4 cm, and is free from

Synonymy: *Trichosporum radicans* Nees.

Common names: Lipstick plant; *akar berenas*, *akar rambai daun* (Malay).

Uses: In Malaysia, the leaves of *Aeschynanthus radicans* Jack are used to assuage headaches. The pharmacological potential of this plant is unexplored yet.

nervations except for the midrib below. The flowers are showy and axillary. The calyx is about 1.5 cm–2 cm long, leathery, dark purplish, 5-lobed and persistent in fruits. The corolla is bright red, tubular, 3 cm–5 cm long and bilobed. The fruits consist of pairs of hooked and membranaceous foliicles of size 20 cm × 4 mm (Fig. 313).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Cyrtandra cupulata* Ridl.**

[From Greek, *kyrtos*—arched, *andros* = male and from Latin, *cūpa* = cask]

Common names: *Meroyan kabut*; *bebangun* (Malay).

Physical description: *Cyrtandra cupulata* Ridl. is a herb which often grows on mossy rocks near streams and on dripping banks, to a height of 1 m in the shady forest of Malaysia. The upper shoots and the lower surface of the leaves are covered with golden brown hairs. The stems are succulent and juicy. Leaves: simple, opposite and without stipules. The petiole is sheathing at the base, 1 cm–2 cm × 2 mm–3 mm, channeled above and hairy. The blade is soft, spatulate, dark green above and pale green beneath, 20 cm × 7 cm–8 cm – 3 cm and shows 11–13 pairs of secondary nerves. The margin is serrate. The inflorescences are axillary and are characteristically enclosed in a 2.5 cm × 3 cm–3.5 cm × 1.8 cm, dull white, cupular, extremely thin and ephemeral bracts. The flowers are dull white, tubular, streaked with pale red and yellow in the throat, and 3.5 cm × 2.5 cm. The fruits are green, erect, fusiform, succulent, 1.7 cm × 4 mm–2.5 cm–4 mm and rugose (Figs. 314 & 315).

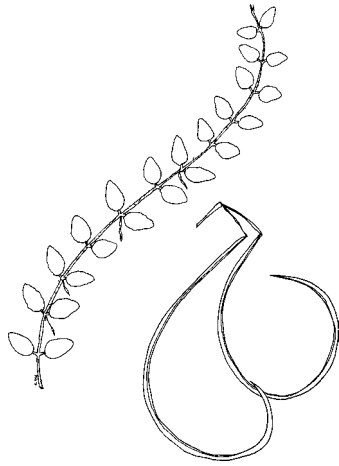


Fig. 313. *Aeschynanthus radicans* Jack. From: KLU Herbarium 003107. Field collectors: J Carrick & IC Enoch. 24 Apr 1959. Geographical localization: altitude 0' – 100', Bako National Park, Tg. Paku Cliff, Malaysia.



Fig. 314. *Cyrtandra cupulata* Ridl.

Uses: In Malaysia, *Cyrtandra cupulata* Ridl. is used to promote recovery from childbirth and to combat fever. The Orang Asli people drink a decoction of the roots to prevent further pregnancies. This remedy is only effective after childbirth. The decoction is drunk for several days following birth, and it is said to permanently prevent further pregnancies.

Pharmaceutical interest: It would be interesting to know whether the medicinal properties mentioned above could be confirmed experimentally. Note that a crude methanolic extract of the leaves of *Cyrtandra cupulata* Ridl. inhibits moderately both estrogens-dependent CaOV-3 and MCF-7 cell-lines cultured *in vitro* and exhibits antioxidant capacity. Does the plant contain phytoestrogens?

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Cyrtandra pendula* Ridl.**

[From Greek, *kyrtos* = arched, *andros* = male Latin, *pendulus* = pendulous]

Common names: Creeping sausage – berry; *asam batu*, *meroyan panas* (Malay).

Physical description: It is a common creeping rainforest herb of Malaysia. Leaves: simple, opposite, dark green above and often barred with white and scurfy when young. The petiole is 7 cm–20 cm long. The blade is 10 cm–25 cm × 5 cm–10 cm. The margin is lobed or not, broadly ovate to nearly round and pointed at the apex. The flowers are pendulous, whitish-creamy,



Fig. 315. *Cyrtandra cupulata* Ridl.



Fig. 316. *Cyrtandra pendula* Bl.

and arranged in bracteate heads at the apex of a 10 cm long pedicel. The corolla is tubular, 2.5 cm–3 cm long, hairy on the outside, white with purplish or reddish spots on the inside. The fruits are berries of 1 cm in diameter (Fig. 316).

Uses: In Malaysia, *Cyrtandra pendula* Ridl. is used to aid recovery from childbirth and to combat fever. The therapeutic potential of *Cyrtandra pendula* Ridl. remains unexplored.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Didymocarpus crinitus* Jack**

[From Latin, *didymocarpus* = pair of fruits and *crinitus* = hairy]

Synonymy: *Didymocarpus crinita*, *Henckelia crinitus*.

Common name: Feather-leaved *Didymocarpus*; *meroyan kerbau* (Malay).

Uses: In Malaysia, a poultice of *Didymocarpus crinitus* Jack is used to heal wounds. The roots are used to promote recovery from childbirth. The medicinal property of *Didymocarpus crinitus* Jack has yet to be confirmed.



Physical description: It is a common rainforest herb of Malaysia and Indonesia. The stems are woody, purplish, hairy, usually short, with the leaves crowded at the apex. Leaves: simple, long and narrow, 15 cm × 3 cm, pointed and broadest above the middle and tapering at the base. The margin is toothed. The blade is hairy, soft, dull and runs down to the stem in a shaggy fringe and shows about 20 pairs of secondary nerves. The flowers are attached at the apex of a 2.5 cm–10 cm-long pedicel. The sepals are small, narrow and hairy. The corolla is tubular, bilabiate, 3 cm long, white or pale pinkish blue, and penciled with a pair of yellow lines in the throat. The fruits are needle-like capsules that are 5 cm–7 cm long (Fig. 317).



Fig. 317. *Didymocarpus crinitus* Jack.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Didymocarpus platypus* C. B. Clarke**

[From Latin, *didymocarpus* = pair of fruits and *platypus* = broad footed]

Synonymy: *Henckelia platypus*.

Common names: *Julong rimba*; *semboyen* (Malay).

Uses: In Malaysia, a decoction of roots of *Didymocarpus platypus* C. B. Clarke is used to treat cough. The medicinal property of *Didymocarpus platypus* C. B. Clarke remains unexplored. Are the antitussive property owing to glycosides?



Fig. 318. *Didymocarpus platypus* C. B. Clarke.

Physical description: It is an understory herb of the rainforest of Malaysia which grows from a rosette of leaves. Leaves: simple, spiral, sessile and without stipules. The blade is thin, 22 cm × 7 cm–6 cm × 2 cm, regularly subglabrous; each hair occupies a patch of blade from a conspicuous dot, showing approximately 20 pairs of secondary nerves. The flowers are white and tubular, and attached at the apex of velvety pedicels which are 2 cm–4 cm long. The fruits are elongated capsules of about 7 cm long (Fig. 318).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

3. Family ACANTHACEAE A. L. de Jussieu 1789 nom. conserv., the Acanthus Family

Physical description: The family Acanthaceae is a large group of 300 genera and 2500 species of tropical herbs closely allied to the Scrophulariaceae. Acanthaceae are so far known to elaborate orobanchin, *iridoid glycosides* and *phenylethanoid glycosides*, *diterpenes* and aryl naphthalide *lignans*. The leaves of Acanthaceae are simple, opposite and without stipules. The calyx is tubular and 5-lobed; the lobes imbricate or valvate. The corolla is tubular, zygomorphic, bilabiate, and 5-lobed. The androecium consists of



2 or 4 stamens attached to the corolla tube and alternating with the lobes. The anthers are tetrasporangiate, dithecal and open by longitudinal slits. The gynecium consists of a pair of median carpels united in a 2-locular and superior ovary, each locule containing several ovules. The fruits are upright, club-like explosively dehiscent capsules containing several seeds with an enlarged and specialized funiculus, developed into a jaculator.

Pharmaceutical interest: A number of plants classified within the genera *Acanthus*, *Alephandra*, *Barleria*, *Cossandra*, *Eranthemum*, *Fittonia*, *Justicia*, *Strobilanthes* and *Thunbergia* are ornamental. Examples of medicinal Acanthaceae are *Adhatoda vasica* (*arusha*, *vasaka*) and *Andrographis paniculata* Nees (*Kalmegh*), which are listed in the *Indian Pharmacopoeia*, 1955. *Adhatoda vasica* is used to promote expectoration. *Andrographis paniculata* Nees has been incorporated in several health products but one must ascertain its side effects. *Asteracantha* (*Indian Pharmaceutical Codex*, 1967) consists of *Hygrophila spinosa* (*Asteracantha longifolia*), a decoction of which (1 in 10, dose: 15 mL–60 mL) has been used to promote urination in Western medicine. About 50 species of plants classified within the family Acanthaceae are used in the Asia-Pacific for medicinal purposes. Note that these plants are often used to soothe inflammation, to combat fever, to promote urination, to heal boils and wounds occasioned by poisonous animals, to treat cough and liver discomfort.

***Acanthus ebracteatus* Valh**

[From Greek, *akantha* = thorn and Latin, *ebracteatus* = without bracts]

Common names: Sea holly; *jeruju hitam* (Malay); *daruju* (Javanese); *nguek-pla-mor* (Thai).

Physical description: It is a prickly herb of the tidal mangroves of the Asia-Pacific. Leaves: stiff, oblong, simple, sub-opposite and exstipulate. The petiole is 1.5 cm long. The blade is 12 cm–18 cm × 4 cm–6 cm, leathery, lobed, dark green and glossy. The flowers are arranged in terminal and upright spikes of 20 cm long. The sepals are broad and round. The corolla is bifid, 2.5 cm long, the lower lip broad, curved downward, whitish with a blue central bar. The andrecium consists of 4 stamens. The fruits are capsular, 2 cm long, brown and enclose 4 large seeds (Fig. 319).



Fig. 319. *Acanthus ebracteatus* Valh.

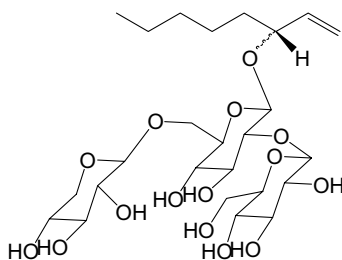
Pharmaceutical interest:

Anti-inflammatory properties: An aqueous extract of the plant lowers the production of eicosanoid (Laupattarakasem P *et al.*, 2003). One might think the megastigmanes, flavonoid, aliphatic alcohols such as ebracteoside B and benzoxazinoid glycosides which

occur in the plant or even iridoid or phenylethanoid glycosides (Kanchanapoon T *et al.*, 2001), are involved in the anti-inflammatory properties via the inhibition of the enzymatic activity of phospholipases or cyclo-oxygenases.

Extracts of *Acanthus ebracteatus* Vahl. do not cause mutations in the *Salmonella thyphimurium* strains TA98 and TA100 (Rojanapo W *et al.*, 1990).

Uses: In Malaysia, 2–3 seeds of *Acanthus ebracteatus* Valh are swallowed to expel intestinal worms. A paste of the seeds is used to counteract putrefaction. A decoction of the leaves is drunk to alleviate cough. The roots are used to treat shingles. In Thailand, the leaves are used to treat arthritis.



Ebracteoside B

The plant is interesting because it elaborates a series of pharmacologically active polysaccharides (Hokputsa S *et al.*, 2004).

References

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 Kanchanapoon T, *et al.* (2001) *Phytochem* **58**(5): 811–817.
 Laupattarakasem, *et al.* (2003) *J Ethnopharmacol* **85**(2–3): 207–215.
 Rojanapo W, *et al.* (1990) *Basic Life Sci* **52**: 447–452.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Acanthus ilicifolius* L.**

[From Greek, *akantha* = thorn and Latin, *ilicifolius* = Holly-like leaves]

Physical description: It is a prickly herb of the tidal mangroves of the Asia-Pacific. The stems are upright, branched, cylindrical, stout and glabrous.

Synonymy: *Dilivaria ilicifolia*.

Common names: Sea holly, medicinal Acanthus of Java; *jeruju puteh* (Malay) *feuille Saintes d'Acanthe* (French); *kaya*, *khaya*, *kayoro* (Burmese); *lao chu li* (Chinese); *harikusa* (Sanskrit); *attumulli* (Tamil); *nguak pla maw* (Thai).



Fig. 320. *Acanthus ilicifolius* L.

Leaves: simple, opposite and without stipules. The petiole is 3 mm–1.5 cm with a pair of stipule-shaped prickles at base. The blade is 7.5 cm–15 cm × 4 cm–7 cm, oblong lanceolate, and develops apical and marginal prickles. The flowers are arranged in a few-flowered and 6 cm–30 cm long spikes. The calyx is 1 cm–1.5 cm long. The corolla is tubular, 3 cm–4.5 cm long, develops a characteristic obovate, shortly 3-lobed, 2.5 cm long and bluish purple lilac lip barred with a yellow band. The fruits are 2 cm–3 cm long capsules containing a few kidney-shaped seeds (Fig. 320).

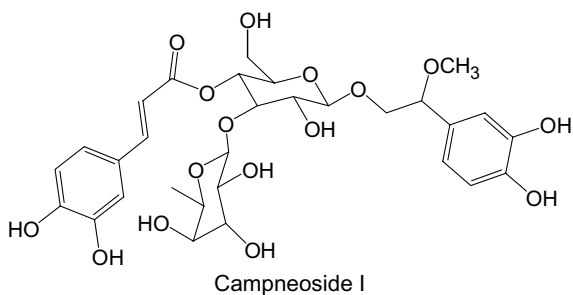
Pharmaceutical interest:

Anti-inflammatory properties: The anti-inflammatory property of *Acanthus ilicifolius* L. is substantiated experimentally (Agshikar NV *et al.*, 1979). Do iridoids or phenylethanoid glycosides, such as campneoside I, (Wu J *et al.*, 2003) play a part?

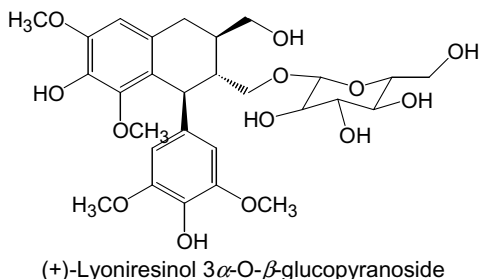
Leishmaniacydal properties: A benzoxazinone characterized from the leaves alleviates the survival of *Leishmania donovani* as potently as (LC₅₀: 40 μg/mL) pentamidine (Pentacarinat®), a drug of choice in the treatment of *Pneumocystis carinii* infection developed in patients infected with the Human Immunodeficiency Virus (Kapil A *et al.*, 1994).

Cytotoxic properties: An alcoholic extract of *Acanthus ilicifolius* L. protects rodent against skin papilloma, ascites tumor and inhibits the growth of lung fibroblast (L-929) cells cultured *in vitro* with an IC₅₀ value of 18 μg/mL (Babu BH *et al.*, 2002).

Uses: In Vietnam, the plant is used to promote urination and to treat asthma. In Indonesia, the roots are used to heal wounds caused by poisoned arrows. In Burma, the shoots are used to counteract snake's poison. The leaves are used to treat rheumatism. In the Philippines, a decoction of roots and leaves is drunk to treat asthma. A paste of the powdered leaves is used to soothe inflamed parts. The stems are used to relieve the bowels of costiveness. In Malaysia, a decoction of 150 g of roots is drunk to treat cancer, asthma and to alleviate cough.



It will be interesting to learn of the active principle involved, since lignans such as (+)-lyoniresinol 3 α -O- β -glucopyranoside, occur in the plant (Kanchanapoom T *et al.*, 2001). Does polysaccharide occur in the plant as well?



References

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 Babu BH, *et al.* (2002) *J Ethnopharmacol* **79**(1): 27–33.
 Kanchanapoom T, *et al.* (2001) *Phytochem* **56**: 369–372.
 Kapil A, *et al.* (1994) *Planta Med* **62**(2): 187–188.
 Wu J, *et al.* (2003) *Phytochem* **63**: 491–495.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Andrographis paniculata Nees

[From Greek, *andro* = male, *graphis* = paint and from Latin, *panus* = ear of millet]

Physical description: It is an annual, dark green, upright herb of the Asia-Pacific which grows to a height of 1 m. The stems are glabrous and somewhat

Common names: Creat, snake herb; *pokok cerita*, *hempedu pahit*, *hempedu bumi* (Malay); *bidara*, *sadilata*, *sambiloto* (Javanese); *kiorai*, *kipeurat*, *takila* (Sunda); *kalmegh* (Indian); *kirata* (Sanskrit); *fatalaijun* (Thai).

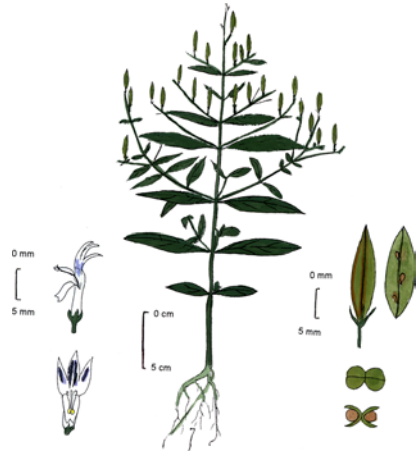
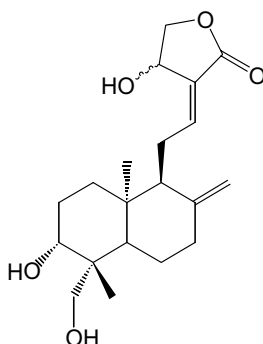


Fig. 321. *Andrographis paniculata* Nees.

squarish and articulated. Leaves: simple, opposite and exstipulate. The blade is dark green, bitter, glossy, simple, lanceolate, opposite, and 4 cm–8 cm × 1.3 cm–2.5 cm. The flowers are small, white, arranged in terminal or axillary panicles. The bracts are small and lanceolate. The calyx lobes are linear, 5, hairy, persistent in fruits, and 2.5 mm–3 mm long. The corolla is white, 9 mm–1.2 cm long and penciled with purple. The upper corolla lip is trifid. The fruits are upright, fusiform, capsular and contain 2–4 round seeds (Fig. 321).

Pharmaceutical interest: The dried leaves of *Andrographis paniculata* Nees have been listed in the *British Pharmaceutical Codex* (1949) and *Indian Pharmacopoeia* (1955). An aqueous extract of *Andrographis paniculata* Nees (*Indian Pharmacopoeia*, 1955) has been taken orally to invigorate health. This extract was prepared by boiling the plant with water (about 1 in 2), concentrating the menstruum and adding fennel oil (2%), ajowan oil (2%) and alcohol (55%–60%), and adjusting to contain 0.5% of andrographolide (dose 0.5 mL to 1 mL). Most of the medicinal properties mentioned above are due to a series of diterpenes, including andrographolide, which have by far displayed an interesting array of pharmacological activities.

Uses: *Andrographis paniculata* Nees has been used from ancient times in Ayurvedic medicine to assuage liver discomfort and to treat dysentery. Externally, the plant is used to treat skin diseases, heal boils, counteract snake's poison and to soothe swollen parts. *Andrographis paniculata* Nees mixed with *Orthosiphon stamineus* Bth. is used to treat diabetes. A decoction of the aerial parts is drunk to treat dysentery, regulate menses, lower blood pressure and to assuage liver discomfort.



Hepatoprotector properties: In regard to the hepatoprotective properties of the plant, a number of experiment conducted both *in vitro* and *in vivo* have clearly demonstrated that andrographolide protects hepatocytes against paracetamol (3 g/Kg, *per os*), β -D-galactosamine (800 mg/Kg, intraperitoneally; Handa SS *et al.*, 1990) and carbon tetrachloride (5 mL/Kg). (Choudhury BR *et al.*, 1984).

Cardiovascular properties: *Andrographis paniculata* Nees inhibits arteriosclerosis and iliac artery stenosis caused by both deendothelisation, high cholesterol diet and restenosis following angiopathy in rabbits, more efficiently than Ω_3 polyunsaturated fatty acids, such as Maxepa[®] which is prescribed to patients with high risks of ischemic heart diseases (Wan DW *et al.*, 1994). A refined extract of *Andrographis paniculata* Ness given to dogs (slow bolus intravenous injection, 1 mg/Kg followed by 80 μ g/Kg/min) prevent ischemic injuries (Go Z *et al.*, 1996). An aqueous extract lowers the systolic pressure in spontaneously hypertensive rat, by possibly reducing the levels of angiotensin-converting enzyme in plasma, and free radicals levels in the kidneys (Zhang CY *et al.*, 1996). A preparation of flavones, characterized from the roots, boosts the synthesis of prostaglandin I₂, inhibits the production of thromboxane A₂ and stimulates the synthesis of cyclic adenosine monophosphate (cAMP) in platelets. The overall effects of these flavonoids are the inhibition of platelet aggregation and the formation of thrombin which are responsible for myocardial infarctions (Zhao YH *et al.*, 1991).

Antiviral properties: An extract of leaves inhibits the replication of the Human Immunodeficiency Virus type 1 (Okate T *et al.*, 1995). Dehydroandrographolide succinic acid monoester inhibits the replication of the Human Immunodeficiency Virus type 1 *in vitro* (1.6 μ g/mL–3 μ g/mL; Chang RS *et al.*, 1991). The results of a controlled double blind clinically demonstrate that tablets containing

extracts of *Andrographis paniculata* Nees prevent cold (Cacere DD *et al.*, 1997).

Other pharmacological properties: Extracts of *Andrographis paniculata* Nees and andrographolide accelerate the digestion and intestinal absorption of carbohydrates by activating lactase, maltase, and sucrase disaccharidases (Choudhury BR *et al.*, 1985). A water decoction of the leaves alleviates the survival of microfilaria of *Dipetalonema reconditum* cultured *in vitro*, whereas 3 subcutaneous injections of the extract (10.06 mg/Kg) reduce the number of microfilariae in infected dog's blood by more than 85% (Dutta A *et al.*, 1982). *Andrographis paniculata* Nees has antimicrobial and immunostimulating properties. In mice, andrographolide stimulates the antigen specific antibody responses and Delayed-type Hypersensitivity (DTH) to sheep red blood cells (Puri A *et al.*, 1993). Andrographolide and neoandrographolide curb diarrhea as efficiently as loperamide (Imodium®), in animals experimentally infected with *Escherichia coli* (Gupta S *et al.*, 1990).

References

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 Zhao YH, *et al.* (1991) *Chin Med J Engl* **104**(9): 770–775.
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 Zoha MS, *et al.* (1989) *Bangl Med Res Counc Bull* **15**(1): 34–37.

Warning: A sun-dried powder of *Andrographis paniculata* Nees mixed with the food (2 g/Kg/day) given to female mice for a duration of 6 weeks, inhibits all the pregnancies when mated with fertile males, which did not receive the plant (Zoha MS *et al.*, 1989). Dry leaves powder given *per os* to albino rat males (20 mg/day) for 60 days, abrogates spermatogenesis and induces degenerative changes in seminiferous tubules, regression in Leydig cells and epididymis (Akbarsha MA *et al.*, 1990). Note that an testicular toxicity on male rats was reported in another publication (Burgos RA *et al.*, 1997).

***Asystasia gangetica* (L.) T. Anders.**

[From Greek, *gaggēs* = of the Ganges]

Synonymy: *Asystasia coromandeliana*, *Justicia gangetica*, *Asystasia bojeriana*.

Common names: Chinese violet; coromandel, Ganges primrose, Philippine violet; *peypatchotti* (Ceylon).



Physical description: It is a perennial creeping herb native to India. The plant is invasive and found in crops, vacant plots of land, roadsides, riversides and the gardens of tropical Asia, Africa, and the Pacific Islands. The stems are squarish, glabrous and somehow articulate. Leaves: simple, without stipules, opposite, and soft. The blade is broadly lanceolate and about 5 cm × 3 cm, and shows approximately 5 pairs of secondary nerves. The flowers are white, scentless and arranged in terminal or axillary cymes. The calyx is 7 mm–9 mm long and develops 5 pointed lobes. The corolla is 1 cm–1.5 cm long, tubular, whitish or purplish according to the variety; the lower lip curving downward and colored with a purple horse-shoe.

The andrecium comprises of 4 stamens adnate to the corolla tube. The fruits are green, explosively dehiscent, and vertically capsular of about 2 cm long, containing a pair of round and smooth seeds.

Pharmaceutical interest: The anti-inflammatory property of *Asystasia gangetica* (L.) T. Anders. is confirmed: extracts of leaves relax histamine-precontracted tracheal strips, display anti-inflammatory and anti asthmatic activities (Akah PA *et al.*, 2003). Could iridoid glycosides or phenylethanoid glycosides be involved as well?

Uses: *Asystasia gangetica* (L.) T. Anders. is used to expel intestinal worms and to soothe inflammation. In Malaysia, the juice expressed from the leaves is drunk to expel intestinal worms. A paste of the plant is used to counteract snake's poison, to treat rheumatism and to soothe swollen parts. In Vietnam and the Philippines, the plant is astringent. In India, the plant is used to expel intestinal worms, soothe swollen parts and to treat rheumatism.

Reference

Akah PA, *et al.* (2003) *J Ethnopharmacol* **89**(1): 25–36.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Barleria prionitis* L.**

[After 17th century French botanist, Jacques Barrelier]

Physical description: It is a prickly shrub which grows to a height of 90 cm. The plant is native to Tropical East Africa and Asia; spanning Australia, Pacific islands and South America as an ornamental plant. The prickles are 1.5 cm–2 cm long, axillary and straight. Leaves: simple, opposite and without stipules. The blade is 5 cm–12 cm × 2 cm–3 cm, ciliate, pubescent beneath, cuneate at the base and shows a thorn at the apex. The corolla is 2 cm–3 cm long, yellow, and sparsely pubescent on the outside. The corolla lobes are oblong-ovate. The fruits are 1.5 cm–1.8 cm long and ovoid capsular. The seeds are globose, 5 mm–7 mm in diameter and pubescent.

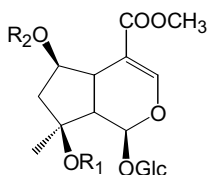
Common names: *Barleria*, porcupine flower; *hempedu landak* (Malay); *jhinti* (Hindi); *vanamulli* (Tamil); *amlana* (Sanskrit); *espinosa amarilla* (Spanish); *picanier jaune* (French).

Pharmaceutical interest:

Anti-inflammatory properties: The anti-inflammatory property of *Barleria prionitis* L. is confirmed: an aqueous fraction containing acetyl barlerin, barlerin and shazhiside methyl ester inhibit carrageenan-, histamine- and dextran-induced inflammation. It also exhibits anti-arthritis activity in adjuvant-induced polyarthritis test in rats, the permeability of vessels and hampers the migration of leucocytes (Singh B *et al.*, 2003).

Cytotoxic properties: 6-*O*-*trans*-p-Coumaroyl-8-*O*-acetylshanzhiside methyl ester and 6-*O*-*cis*-p-coumaroyl-8-*O*-acetylshanzhiside methyl ester from *Barleria prionitis* L. alleviate the replication of the Respiratory Syncytial Virus with EC₅₀ of 2.46 μg/mL and 42.2 μg/mL respectively (Chen JL *et al.*, 1998).

Uses: In Indonesia, the powder of the roots of *Barleria prionitis* L. mixed with lime juice is used to treat ringworm infection. In Malaysia, the plant is used to counteract snake's poison, to treat shingles and to heal traumatic injuries. In Malaysia and Indonesia, a paste of the leaves and other ingredients is used to assuage liver discomfort, to soothe inflamed parts, to assuage backache and to invigorate breathing. The juice expressed from the leaves is used to prevent skin cracking and to relieve the bowels from costiveness. In the Philippines, a decoction of the leaves is used to combat fever, whereas in Thailand, the roots are used to combat fever.



Acetyl barlerin ($R_1 = R_2 = \text{Ac}$)
 Barlerin ($R_1 = \text{Ac}, R_2 = \text{H}$)
 Shazhiside methyl ester ($R_1 = R_2 = \text{H}$)

References

Chen JL, *et al.* (1998) *J Nat Prod* **61**(10): 1295–1297.
 Singh B, *et al.* (2003) *J Ethnopharmacol* **85**: 187–193.

Warning: Oral administration of an extract of roots of *Barleria prionitis* L. to the male rats lower their fertility.

Graptophyllum pictum (L.) Griffith

[From Greek, *graptos* = painted and *phullon* = leaf and from Latin, *pictum* = variegated]

Physical description: It is a shrub which grows to a height of 1.5 m. The plant is native to Papua New Guinea and is grown to be ornamental. Leaves: simple, opposite, and without stipules. The blade is 8 cm–20 cm × 3 cm–13 cm, oblong-lanceolate, cuneate at the base, variegated with white and undulate. The flowers are arranged in axillary panicles of 3 cm–12 cm long. The calyx is 3 mm long. The corolla is tubular, dark red and 2 cm–3 cm long.

Pharmaceutical interest: An ethanolic extract of leaves of *Graptophyllum pictum* (L.) Griffith given *per os* to rodent displays anti-inflammatory and analgesic properties (Ozaki Y *et al.*, 1989) in which iridoid glycosides or phenylethanoid glycosides might be involved.

Synonymy: *Justicia picta*, *Graptophyllum hortense*.

Common names: Caricature plant; *benalu* (Malay); *daun ungu* (Indonesian); *bai tawng* (Thai); *morado* (Filipino).

Uses: In Malaysia, a decoction of the leaves is drunk to relieve the bowels of costiveness, heal hemorrhoids, expel gallstone, and to assuage liver discomfort. A paste of the leaves is applied externally to heal cuts, wounds, and ulcers, and to soothe the swollen parts. The juice expressed from the plant is used to assuage earache.

Reference

Ozaki Y, et al. (1989) *Chem Pharm Bull Tokyo* **37**(10): 2799–2802.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Hemigraphis alternata (Burm. f.) T. Anders.

[From Greek, *hemi* = half and *graphis* = paintbrush and from Latin, *alter* = other]

Synonymy: *Hemigraphis colorata* (Burm. f.) Hall. f., *Ruellia alternata* Burm. f., *Blechum cordatum* Leonard, *Ruellia colorata* Blume.

Common names: Red Ivy, red flame Ivy; *kemoja batu* (Malay).

Uses: In Indonesia, *Hemigraphis alternata* (Burm. f.) T. Anders. is used to promote urination, check hemorrhages, stop dysentery, treat venereal diseases, and to heal hemorrhoids. The pharmacological properties of *Hemigraphis alternata* (Burm. f.) T. Anders. remain unexplored.

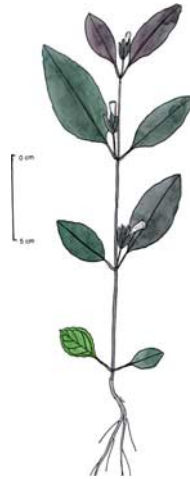


Fig. 322. *Hemigraphis alternata* (Burm. f.) T. Anders. From: KLU Herbarium 36555. Geographical localization: Pulau Duyong Besar, Kuala Terengganu, in Pathside in coconut, center of island, altitude: sea level, Malaysia. 7 Oct 1983. Field collector: Lynwood M Hume, (duplicate Singapore).

Physical description: It is a herb of 30 cm long. The plant is native to Java and is cultivated as a ground cover in the Asia-Pacific. The stems are recumbent, quadrangular, and purplish especially at nodes. The internodes are 5 cm–7 cm long. Leaves: simple, decussate, opposite and without stipules. In a pair, one leaf is much larger than that of the other. The petiole is long, obscurely curved at the base and 8 mm–1.3 cm long. The blade is dark green above, light green below or purplish below, hairy, oblong-lanceolate and 2.2 cm–7 cm × 1.4 cm–2.5 cm. The margin is wavy and slightly recurved. The midrib is raised above and below. The blade shows 5–6 pairs of secondary nerves. The inflorescences are axillary and hairy. The calyx comprises of 5 sepals which are linear, and hairy. The corolla is tubular, 1.7 cm long, 5-lobed, and white with purple penciling. The stamens are didynamous. The style is curved and the stigma is thread-like and 3 mm long. The ovary is 2.5 mm × 0.8 mm and hairy (Fig. 322).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Hygrophila angustifolia* R. Br.**

[From Greek, *hugros* = wet and *philo* = love, and from Latin, *angustus* = narrow and *folium* = leaf]

Common names: Two temples plant; *keremak batu* (Malay).

Uses: In Malaysia, the leaves of *Hygrophila angustifolia* R. Br. are used to heal wounds, resolve swelling of boils and to assuage headache.

Physical description: It is a herb which grows to a height of 1.5 m. The plant is found in wet soils, riverbanks and paddy fields in a geographical zone which covers India, Southern China, and the Asia-Pacific. The stems are woody, articulate, quadrangular and smooth, and the internodes are 1.5 cm–4 cm long. Leaves: opposite, simple without stipules and of variable size. The blade is lanceolate–spathulate, leathery, narrow, microscopically molted and 7 mm – –2.5 cm × 2 mm–1.1 cm. The blade is wavy at the margin and shows a midrib and 8–13 pairs of secondary nerves. The inflorescences are fusiform, axillary clusters of 1.5 cm × 2 mm, explosively dehiscent capsules in persistent calyx. The seeds are numerous, flat, 1 mm diameter seeds and each carried on hooks (Fig. 323).

Pharmaceutical interest: The pharmacological properties of *Hygrophila angustifolia* R. Br. remain unexplored til today.

Cellular properties: A petroleum ether extract of roots of *Hygrophila spinosa* increases the life span and normalized the hematological values of mice infested with Sarcoma-180 (Mazumdar UK *et al.*, 1997). In addition, *Hygrophila spinosa* significantly increases hemoglobin, haematocrit and serum iron of anemic animals, thereby confirming the haemotinic properties (Gomes A *et al.*, 2001). n-Hexaconasol characterized from *Hygrophila erecta* promotes the growth of neurite and the collaterals of cultured neurones, and displays the immunostimulating properties *in vitro* (Borg J *et al.*, 1987; Moosbrugger I *et al.*, 1992).

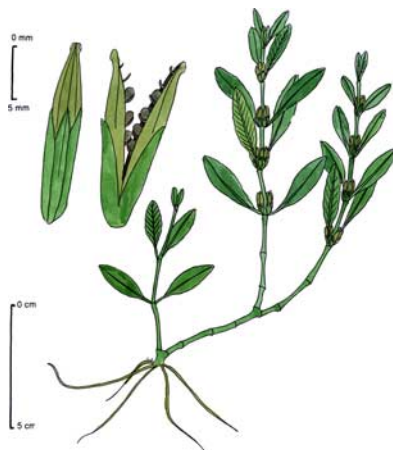
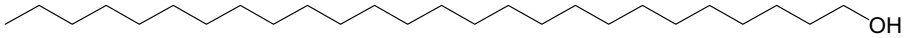


Fig. 323. *Hygrophila angustifolia* R. Br. From: KLU Herbarium 29902. Field collector & botanical identification: Benjamin C Stone. 12 Nov 1979. Geographical localization: Ayer Panas, Pulau Langkawi, altitude: 50 m, herb in wet groundy paddy field, Malaysia.



n - Hexacosanol

References

- Borg J, *et al.* (1987) *FEBS Letters* **2/3**(2): 406–410.
 Gomes A, *et al.* (2001) *Indian J Exp Biol* **39**(4): 381–382.
 Mazumdar UK, *et al.* (1997) *Indian J Exp Biol* **35**(5): 473–477.
 Moosbrugger I, *et al.* (1992) *Int J Immunopharmacol* **14**(2): 293–302.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Justicia gendarussa Burm. f.

[After James Justice, 18th century Scottish botanist and from Javanese, *gandaroesa* = *Justicia gendarussa* Burm. f.]

Synonymy: *Gendarussa vulgaris*,
Justicia nigricans.

Common names: Willow-leaved;
 water-willow; *genda rusa* (Malay);
bavanet, bawanet (Burmese); *ch'in*
ch'iu (Chinese); *gandaroesa*
 (Javanese); *guérit petite colique*
 (French); *indrani* (Sanskrit);
karunochi (Tamil).



Fig. 324. *Justicia gendarussa* Burm. f.

Physical description: It is a bush which grows to a height of 2 m. It is grown to be an ornamental plant. The stems and petioles are smooth and purplish. Leaves: simple, decussate, 7 cm–14 cm × 1 cm–2 cm, and exstipulate. The petiole is 1 cm–2 cm long. The blade is oblong-lanceolate, bluish below and with characteristic dark purplish nerves. The flowers are arranged in terminal spikes of 2 cm–4 cm long. The sepals are narrow. The corolla is tubular, 2 cm long, greenish white and shows a recurved trifid limb (Fig. 324).

Pharmaceutical interest: It would be interesting to observe whether a more intensive study on this plant would disclose any anti-inflammatory or cytotoxic principles.

Anti-inflammatory properties: The anti-inflammatory property of *Justicia gendarussa* Burm. f. is likely to be due to coumarins, as hydroalcoholic extract (200 mg/Kg–400 mg/Kg), coumarin (2.5 mg/Kg–5 mg/Kg) and umbelliferone (1 mg/Kg–2.5 mg/Kg) obtained from *Justicia pectoralis* Jacq., assuage the pain caused by acetic acid in mice (Linós CS *et al.*, 1997). Coumarin and umbelliferone characterized from *Justicia pectoralis* Jacq. exhibit smooth muscle relaxant property (Mac Rae WD *et al.*, 1984).

Cytotoxic properties: Justiciresinol, a lignan characterized from *Justicia glauca*, inhibits moderately the growth of 3 human cell-lines (Subbarajii GV *et al.*, 1991). An extract of aerial part of *Justicia grandifolia* displays a DNA-intercalating property (Gupta MP *et al.*, 1996).

Uses: In Indonesia, *Justicia gendarussa* Burm. f. is used to induce vomiting. In Malaysia, a decoction of 50 g of roots is used to treat rheumatic arthritis; boiled with ginger rhizome and lime, it is used to alleviate bleeding cough. A decoction of the leaves is used to combat fever, promote menses, assuage stomach discomfort, check haemoptysis, alleviate cough, treat asthma, and to relieve the bowels of costiveness. The fresh leaves are pounded and used externally to treat pyoderma, lumbago and rheumatism. A paste of leaves mixed with vinegar is used to assuage toothache. *Justicia gendarussa* Burm. f. is also used during the hot stages of malaria to combat fever and to treat leucorrhoea. In Vietnam, the plant is used to resolve tumors, promote appetite, and to invigorate health. In India, the plant is used to treat bronchitis, soothe inflammation, and to promote digestion.

References

- Chen C, *et al.* (1996) *J Nat Prod* **59**(12).
 Gupta MP, *et al.* (1996) *Int J Pharmacog* **27**(4): 713–722.
 Linós CS, *et al.* (1997) *Phytother Res* **11**(3): 211–215.
 Mac Rae WD, *et al.* (1984) *J Ethnopharmacol* **12**(1): 93–111.
 Subbarajii GV, *et al.* (1991) *J Nat Prod* **54**(6): 1639–1641.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

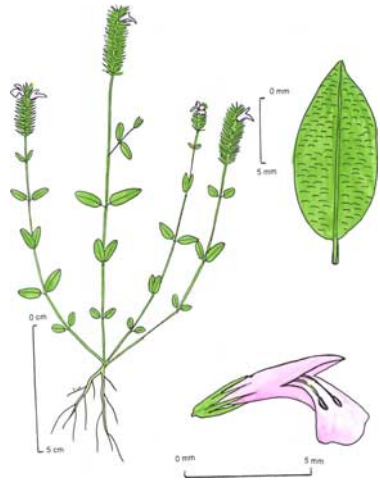
Justicia procumbens L.

[After James Justice, 18th century Scottish botanist From Latin, *cumbere* = lie]

Physical description: It is a procumbent herb which grows to a height of 60 cm. The plant is native to tropical America and widespread in India, Ceylon, Burma, Laos, Vietnam, Thailand, Malaysia, Taiwan and China. The stems are quadrangular, and articulate. The internodes are 2 cm long. Leaves: simple, decussate, and

Common names: Trailing water willow, *chueh ch'uang* (Chinese); *pitpapada* (Tamil).

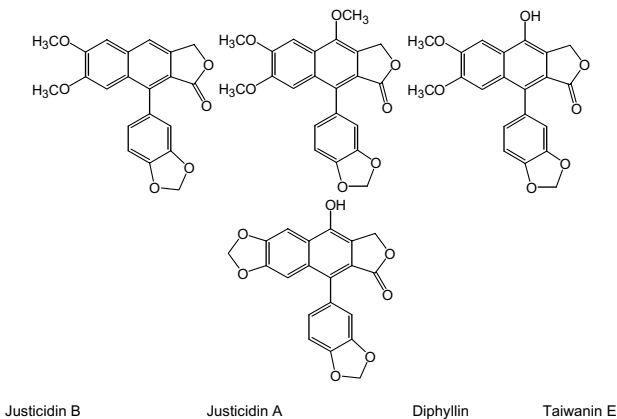
without stipules. The petiole is 1 mm–2 mm long and somewhat channeled. The blade is elliptic, 1 cm × 4 mm, shows 3–5 pairs of secondary nerves and microscopically mottled with boomerang-shaped bodies. The inflorescences are terminal and few-flowered spikes of about 1 cm–4 cm long. The calyx consists of 5 linear lobes. The corolla is tubular, pinkish and 6 mm long. The lower lip is shortly 3-lobed. The fruits are fusiform 4 mm × 1.5 mm capsules (Fig. 325).



Uses: In China, *Justicia procumbens* L. is used to treat lumbago, backache and flatulence. In Taiwan, the plant is used to treat dysentery and to wash the eyes. In the Philippines, the plant is used to treat skin diseases.

Fig. 325. *Justicia procumbens* L. From: Flora of Ceylon 07305. Geographical localization: dry patana, Ceylon. Field collector: J Carrick, 24 Jan 1964. Botanical identification: Bot. Gons Peradeniya.

Pharmaceutical interest: The medicinal properties of *Justicia procumbens* L. have not been confirmed yet. However, the plant is known to produce a series of aryl naphthalide lignans such as justicidin A and diphyllin, which are cytotoxic and inhibit the replication of the Vesicular Stomatitis Virus (Asano J. *et al.*, 1996; Fukiyama N *et al.*, 1986). Neojusticin A, Naphthalide lignans and taiwanin E methyl ether inhibit the aggregation of platelets (Chen CC *et al.*, 1996).



References

- Asano J, *et al.* (1996) *Phytochem* **42**(3): 713–717.
 Chen CC, *et al.* (1996) *J Nat Prod* **59**(12): 1149–1150.
 Fukiyama N, *et al.* (1986) *J Nat Prod* **49**(2): 348–350.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Lepidagathis incurva D. Don

[From Greek, *lepida* = elegant and *agathis* = a ball of thread and from Latin, *curvare* = curve]

Synonymy: *Lepidagathis hyalina* Nees.

Common names: *Kentut rimba*
(Malay).

Physical description: It is a forest understorey herb which grows to a height of 60 cm. The plant is found in India, the Asia-Pacific and Southern China. The stems are woody, purplish with grey ridges, quadrangular, glabrous and articulate. Leaves: simple, decussate and without stipules. The petiole is 6 mm–1.5 cm long. The blade is lanceolate-deltoid, asymmetrical, dark green above, chartaceous and 1.3 cm–3.4 cm × 1 cm–3.4 cm. The base of the blade is asymmetrical and shows 5–6 pairs of secondary nerves. The inflorescences are spikes with numerous hairy bracts. The flowers are dull orange but white in buds. The fruits are capsular (Fig. 326).

Pharmaceutical interest: Some flavonoid glycosides, such as 6-hydroxy-luteolin-7-*O*-apioside are known to occur in *Lepidagathis cristata* (Ranganathan R *et al.*, 1980), as well as a rather unusual immunosuppressive, prenylated indole alkaloid: cristatin A (Ravikanth V *et al.*, 2001).

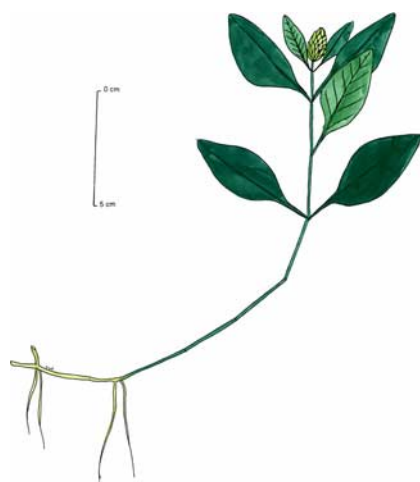
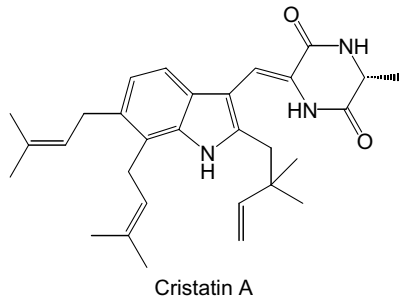


Fig. 326. *Lepidagathis* sp. From: KLU Herbarium 36755. Botanisk Institut, Aarhus Universitet, Herbarium Jutlandia [AAU], Aarhus, Denmark. Flora of Thailand. Field collectors: 11 March 1974, Kai Larsen & Supee S. Larsen. Geographical localization: Peninsula, Trang: Khao Pap Pa, evergreen forest, 7° 25' North-99° 35' East, altitude: 300 m, Thailand.

Uses: In China, *Lepidagathis incurva* D. Don is used to promote digestion. In Malaysia, the plant is used to treat cough. The pharmacological potential of *Lepidagathis incurva* D. Don remains unexplored.



References

- Ranganathan R, *et al.* (1980) *Phytochem* **19**: 2505–2506.
 Ravikanth V, *et al.* (2001) *Phytochem* **58**: 1263–1266.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Peristrophe roxburghiana (Schult.) Bremek

[From Greek, *peri* = around and *strephein* = to turn and After William Roxburgh, 18th century Scottish botanist]

Synonymy: *Peristrophe tinctoria* Nees,
Peristrophe bivalvis Merr.

Common names: *Malapudak* (Malay);
noja (Javanese).

Uses: In Malaysia, the pounded leaves of *Peristrophe roxburghiana* (Schult.) Bremek are used to soothe swollen parts, painful sprain and to treat skin diseases. The plant is used to treat pulmonary tuberculosis, hepatitis and to stop haemoptysis. The therapeutic potential of *Peristrophe roxburghiana* (Schult.) Bremek remains unexplored.

Physical description: It is a creeping rainforest herb which grows in India and the Asia-Pacific. The stems are glabrous. Leaves: simple, opposite, without stipules, dark green, glossy, and

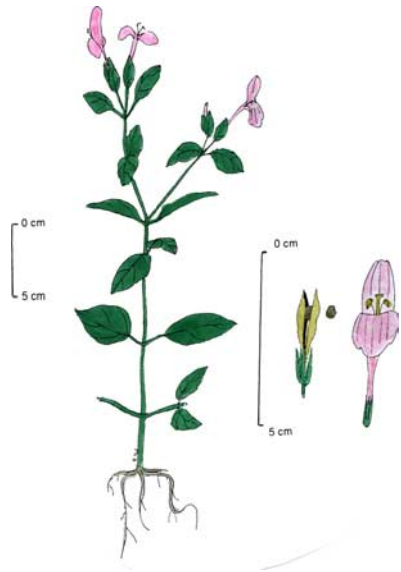


Fig. 327. *Peristrophe roxburghiana* (Schult.) Bremek.

broadly elliptic. The inflorescences are terminal cymes. The flowers are showy, growing to a height of 4 cm long, mauve and with a pair of equal ovoid lips. The fruits are upright capsules enclosing a pair of 2 seeds (Fig. 327).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Pseuderanthemum graciliflorum* Nees**

[From Latin, *pseuderanthemum* = false *eranthemum* and *gracilis* = long and *flos* = flower]

Synonymy: *Eranthemum graciliflorum* Nees, *Eranthemum malaccense* Radlk., *Eranthemum album* Radlk.

Common names: *Pokok tampang puteri, kemoja hutan* (Malay); *rong mei* (Thai).

Uses: In Malaysia, the plant is used to promote recovery from childbirth and to counteract putrefaction. To date, the pharmacological properties of *Pseuderanthemum graciliflorum* Nees remains unexplored.

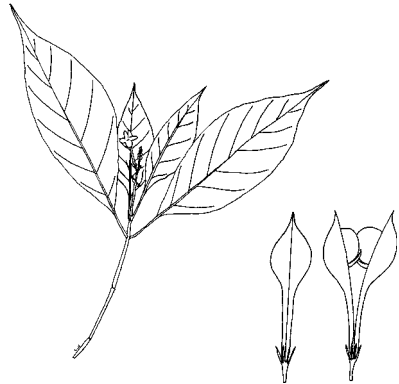


Fig. 328. *Pseuderanthemum graciliflorum* Nees. From: KLU Herbarium 7807. Flora of Malaya. Kedah, Pulau Langkawi, altitude: 25'. Geographical localization: Dayan Bunting Limestone, Malaysia. Field collector: Benjamin C Stone, 10 May 1967. Botanical identification: Singapore.

Physical description: *Pseuderanthemum graciliflorum* Nees is a shrub which grows to a height of 1.5 m. The plant is found on limestones, stream banks, and seashores rocks of Asia-Pacific. The stems are quadrangular, articulate and glabrous. The internodes are 4 cm long. Leaves: simple, decussate and without stipules. The petiole is 2 mm–2 cm long and slightly curved at base. The blade is lanceolate, chartaceous, 2.5 cm–15 cm × 8 mm–4.5 cm and is covered above by microscopic linear and short dots. The apex of the blade is caudate in a 1 cm–2 cm long tail. The margin is somewhat wavy. The blade shows 5–7 pairs of secondary nerves. The inflorescences are terminal racemes. The calyx is tiny and 5-lobed. The lobes are linear. The flowers are lilac-violet, 2.5 cm long, the lower lip penciled with a central oblong white patch. The fruits are 2 cm long dehiscent capsules of containing a pair of seeds. The seeds are of 2 mm diameter and sustained by hooks (Fig. 328).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Rhinacanthus nasutus* (L.) Kurz.**

[From Greek, *ákantha* = thorn and *rhinos* = nose and from Latin, *nasutus* = large-nosed]

Physical description: It is a shrub which grows to a height of 1 m. It is grown as an ornamental plant throughout Asia-pacific. The stems are smooth, articulate and glabrous. Leaves: simple, opposite and without stipules. The petiole is 5 mm–1 cm long. The blade is oblong-lanceolate and 3 cm–12 cm × 1 cm–5 cm. The corolla tube is white and tubular. The lower lip is showily 3-lobed. The upper one is very much smaller. The fruits are capsular.

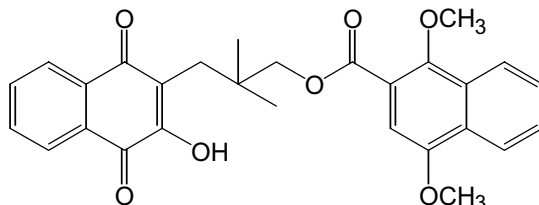
Common names: *Ubat kurap* (Malay); *tong pan chang* (Thai).

Pharmaceutical interest:

Naphthoquinones: Rhinacanthin Q, a naphthoquinone characterized from *Rhinacanthus nasutus* (L.) Kurz is cytotoxic and inhibits the aggregation of platelets (Wu TS *et al.*, 1998). Other naphthoquinones of interest characterized from this plant are rhinacanthin C and D which inhibit the replication of the Human Cytomegalovirus with IC₅₀ values of 0.02 µg/mL and 0.22 µg/mL respectively (Sendi A *et al.*, 1996) and 3,4-dihydro-3, 3-dimethyl-2H-naphtho-[2,3-β]-pyran-5,10-dione, which is antifungal (Kodama O *et al.*, 1993). It would be interesting to know what is the precise molecular mechanism involved here.

Uses: In Malaysia, the pounded roots mixed with vinegar or alcohol are used to treat herpetic-like eruption. For the same purpose, the leaves are applied with benzoin and sulphur. In Indonesia, the flowers and young leaves are rubbed with vinegar and lime to treat skin diseases.

Lignans: Rhinacanthins E and F inhibit the replication of the Influenza Virus type A (Kernam MR *et al.*, 1997).



Rhinacanthin Q

References

- Kernam MR, *et al.* (1997) *J Nat Prod* **60**(6): 635–637.
 Kodama O, *et al.* (1993) *J Nat Prod* **56**(2): 292–294.
 Sendi A, *et al.* (1996) *J Nat Prod* **59**(8): 808–811.
 Wu TS, *et al.* (1998) *Phytochem* **49**(7): 2001–2003.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Ruellia repens L.

[After Jean Ruel, 16th century French botanist and From Latin, *reperere* = creep]

Common names: Ruellia; *daun patok tuau*, *akar keremak* (Malay).

Uses: In China, *Ruellia repens* L. is used to treat cough, heal wounds, ulcers, assuage toothache and stomachache. In Laos, Cambodia, Malaysia and Vietnam, the plant is used as above and for cooling purposes.

Physical description: It is a herb which grows in the open fields and waste lands in the Asia-Pacific and Southern China. The stems are dichotomous, quadrangular, glabrous, articulate, and swollen at the nodes. The internodes are 6 cm long. Leaves: simple, decussate, and without stipules. The petiole is 1 cm long. The blade is lanceolate, 4.5 cm–6 cm × 2 cm, slightly asymmetrical at the base, papery, and shows 5–7 pairs of secondary nerves. The flowers are terminal, purple, 1 cm long and 5-lobed. The fruits are capsular, 1 cm long and explosively dehiscent, containing numerous seeds. The seeds are 3 mm in diameter, discoid and marked with whitish rind (Fig. 329).

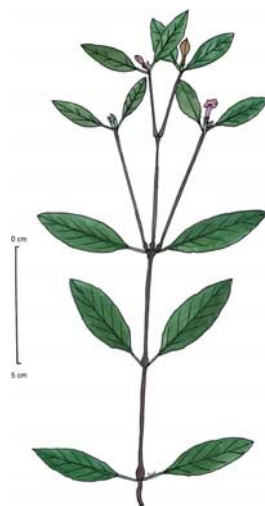


Fig. 329. *Ruellia repens* L. From: KLU Herbarium 18289. Flora of Malaya. Field collector: Chin See Chung. 12 Nov 1970. Geographical localization: Langkawi, Ayer Hangat and Tg Ru limestone outcrop, Altitude: 5 m, Malaysia.

Pharmaceutical interest: The medicinal properties of *Ruellia repens* L. are not confirmed yet, but methanolic, ethyl acetate and aqueous extracts of *Ruellia praetermissa* contract dose-dependently ileal strips with IC₅₀ values of 360 μg/mL, 425 μg/mL, and 540 μg/mL respectively. This effect is antagonized by atropine, suggesting a mode of action involving the cholinergic system (Salah AM *et al.*, 2000). Note that some cholinergic mechanisms may be

involved in the analgesic and antipyretic effects of *Ruellia repens* L. A number of long chain hydrocarbons and sterols are known to occur in *Ruellia tuberosa* (Behari M *et al.*, 1981; Misra NT *et al.*, 1997).

References

- Behari M, *et al.* (1981) *J Indian Chem Soc* **58**: 176–177.
 Misra NT, *et al.* (1997) *Indian J Chem Sect B* **36**(12): 1194–1197.
 Salah AM, *et al.* (2000) *J Ethnopharmacol* **72**(1–2): 269–272.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Staurogyne setigera (Nees) O. Ktze.

[From Latin, *setiger* = bristly]

Common name: *Rumput kerak rimba* (Malay).

Uses: In Malaysia, *Staurogyne setigera* (Nees) O. Ktze. is used to heal the sores in the mouth, while a decoction of leaves and roots is drunk to stop diarrhea.

Physical description: It is an erect-decumbent herb of the waterfalls, stream banks, and swampy shady forests of Malaysia and Indonesia. The stems are terete and hairy. Leaves: simple, decussate and without stipules. The petiole is 3 mm–4 cm long. The blade is dark green above, light green underneath, chartaceous, spathulate-lanceolate, 10 cm × 2.5 cm–5 cm × 1.5 cm, and shows 7–8 pairs of secondary nerves. The inflorescences are terminal racemes. The calyx consists of 5 sepals which are hairy and 1 cm long. The corolla is tubular, 5-lobed, brownish white in color (Fig. 330).

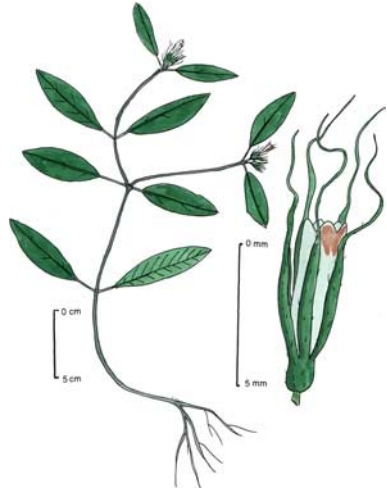
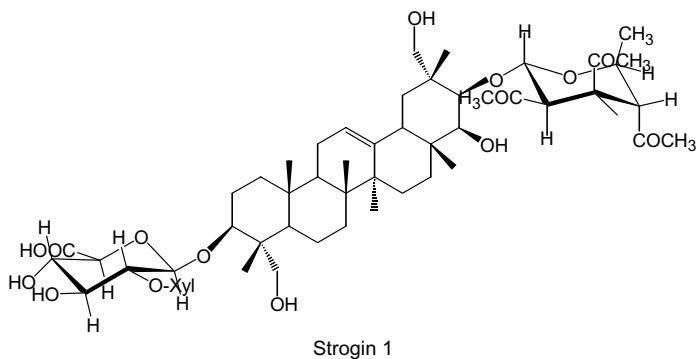


Fig. 330. *Staurogyne setigera* (Nees) O. Ktze. From: KLU Herbarium 34459. Flora of Singapore, The Herbarium, Botanic Garden Singapore. Geographical localization: Nee Soon swamp forest margins, along the pipe line, shaded stream zone, altitude: 5 m., Singapore. Field collector: JF Maxwell, 3 Dec 1981.

Pharmaceutical interest: The pharmacological properties of *Staurogyne setigera* (Nees) O. Ktze. remain unexplored. However, note the presence of



sweet tasting oleanane triterpenoid saponins such as strogin 1 in *Staurogyne merguensis* (Hiura A *et al.*, 1996).

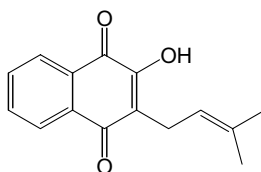
Reference

Hiura A, *et al.* (1996) *Phytochem* **43**(5): 1023–1027.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

4. Family BIGNONIACEAE A. L. de Jussieu 1789 nom. conserv., the Trumpet-creeper Family

Physical description: The family Bignoniaceae consists of 100 genera and 800 species of tropical trees, shrubs and climbers, closely allied to the Scrophulariaceae which is best developed in Tropical America, and known to elaborate prenylated naphthoquinones, and phenolic and iridoid glycosides. The wood is light yellow and soft. The bark is smooth. The stems are marked with whitish interpetiolar glandular zones. The leaves are pinnately 1–3 compound, without stipules and opposite or occasionally whorled. The flowers are showy, hermaphrodite, bell-shaped and zygomorphic. The inflorescences are cymose or racemose. The calyx is tubular, 5-lobed or truncate. The corolla is tubular, and develops a pair of upper lobes and 3 lower lobes. The andrecium consists of 5 stamens which are attached to the corolla tube. The nectary disc is annular or cupular. The gynecium consists of a pair of carpels united to form a superior and 2-locular ovary, with each locule containing several ovules attached to axile placentas. The style is long. The stigma is bilobed. The fruits are bivalved, septicidal or loculicidal capsules containing several seeds. The seeds are flat with extremely thin and translucent wings.

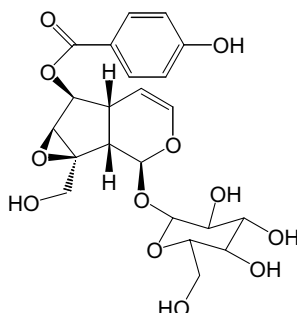


Lapachol

Pharmaceutical interest: Classical examples of Bignoniaceae are *Spathodea* species (flame-tree), *Jacaranda* species, *Catalpa* species, *Paulownia* species (empress-tree), *Campsis radicans* and *Bignonia* species (trumpet creeper), which are common tropical ornamental Bignoniaceae.

Naphthoquinones: There is an expanding body of evidences to suggest that the naphthoquinone of Bignoniaceae might hold some potential as cytotoxic, antiviral or antiparasmodial agents. Jacaranone characterized from *Jacaranda caucana* and lapachol characterized from *Stereospermum kunthianum* have displayed interesting pharmacological properties.

Other principles: Of other interests are iridoid glycosides, such as catalposide from *catalpa ovata* G. Don, which inhibit the productions of tumor necrosis factor- α interleukin-1 β , and interleukin-6, as well as the activation of nuclear factor κ B in RAW 264.7 macrophages, activated with lipopolysaccharide. This is an attractive candidate for adjunctive therapy in Gram-negative bacterial infections.



Catalposide

In the Asia-Pacific, *Campsis grandiflora* (Thunb.) K. Schum., *Catalpa ovata* G. Don, *Crescentia alata* HBK., *Oroxylum indicum* (L.) Vent., *Pajanelia longifolia* (Willd.) K. Schum. (*Pajanelia multijuga* DC.), *Incarvillea sinensis*

Lamk., *Markhamia stipulata* (Wall.) Seem., *Stereospermum chelonoides* DC., *Stereospermum fimbriatum* (Wall.) DC., *Spathodea campanulata* P. Beauv., *Millingtonia hortensis* L.f., and *Dolichandrone spathacea* (L. f.) K. Schum. are of medicinal value. The discovery of clinical agents from this family is probable.

***Dolichandrone spathacea* (L. f.) K. Schum.**

[From Greek, *dolichos* = long, *andro* = male and *spathē* = broad blade]

Synonymy: *Dolichandrone rheedii* Seem., *Spathodea rheedii* Spreng.

Common names: *Thakutma* (Burmese); *vilpadri* (Ceylonese); *pokok kulo* (Malay).

Uses: In Indonesia, the leaves of *Dolichandrone spathacea* (L. f.) K. Schum. are used to treat thrush. In the Philippines, *Dolichandrone spathacea* (L. f.) K. Schum. is used to treat nervous diseases and flatulence. The pharmacological potentials of this interesting plant remain unexplored.

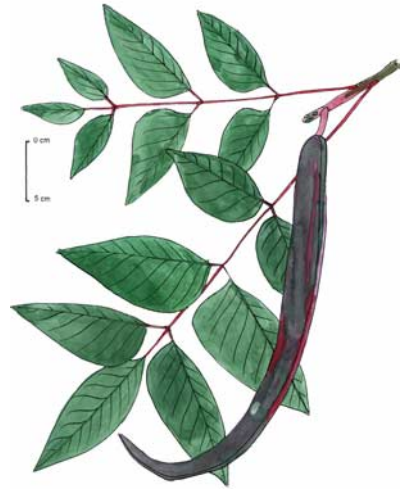


Fig. 331. *Dolichandrone spathacea* (L. f.) K. Schum. From: KLU Herbarium 35316. Field collector & botanical identification: A. Gentry. 18 Aug 1981. Geographical localization: Sarawak, edge of Sarawak river near Kuching, ca. 20 m altitude, Malaysia.

Physical description: It is a tree which grows to height of 9 m. The plant grows wild in the riverbanks, swamps, coastal forests and mangroves of the Asia-Pacific and Pacific Islands. The stems are lenticelled and marked with conspicuous ovoid scars left by fallen leaves. Leaves: imparipinnate, 20 cm–50 cm long, spiral and without stipules. The blade consists of 3–4 pairs of folioles attached to 5 mm–1 cm long petiolules. The folioles are papery, strongly asymmetrical, and show 5–9 pairs of secondary nerves. The flowers are long, tubular and white, arranged in groups of 3–4 on short stout and erect pedicels. The calyx is tubular and more than 5 cm long. The corolla is 15 cm long, cylindrical, funnel-shaped with a 6.3 cm–7.5 cm diameter limb, and rounded lobes with crenate margin. The fruits are hanging dark green to purplish brown, 25 cm–50 cm long and sickle-shaped dehiscent capsules filled with 1.5 cm flat, rectangular and white seeds overlapping in many rows (Fig. 331).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Oroxylum indicum* (L.) Vent.**

[From Greek, *oros* = mountain, *xylos* = wood and from Latin, *indicum* = from India]

Common names: Trumpet flowers, broken bones, midday marvel; *bulai*, *begak*, *bongelai kayu*, *bonlai johar*, *juar* (Malay); *arala* (among 40 other Sanskrit names); *achi*, *vanga adanthay* (Tamil); *nuc nac*, *nam hoang ba*, *poe ta lop* (Vietnamese).

Uses: In China, the seeds of *Oroxylum indicum* (L.) Vent. are used to assuage liver and stomach discomfort, and to heal ulcers and boils. In Burma, Vietnam and the Philippines, the bark is used to treat dysentery and rheumatism. In Malaysia, a decoction of the leaves is drunk to assuage stomach discomfort, treat rheumatism and to heal wounds. In Thailand, the fruits are consumed as vegetables, whereas the stem bark is used to treat arthritis.

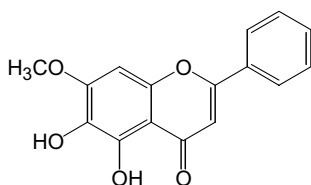


Fig. 332. *Oroxylum indicum* (L.) Vent.

Physical description: It is a tree which grows to a height of 12 m by the rivers, roads and in the swamps, geographically spanning India and Southern China. The tree has a very special look. The bark is light brown, fissured, soft, exudes a green juice and often shows several corky lenticels. Leaves: 90 cm–1.5 m, 2–3-pinnate and with opposite pinnae. The rachis is very stout and cylindrical. The petiolules are 6 mm–1.5 cm long. The folioles are 6.3 cm–12.5 cm × 3.8 cm–10 cm, ovate or elliptic, acuminate, glabrous, and round at the base. The flowers are numerous with a foxy stink and are arranged in large upright racemes at the apex of the bole. The racemes are 30 cm–60 cm long. The calyx is 2.5 cm × 2 cm, ephemeral, leathery, campanulate and glabrous. The corolla is lurid-purple on the outside and greenish on the inside, 10 cm long, succulent and develops 5 lobes. The corolla lobes are 3.8 cm long and crisped at the margin. The andrecium consists of 5 stamens, of which a single one is shorter than the rest. The filaments are hairy at the base. The fruits are 6 mm–1.2 m × 5 cm–9 cm × 8 mm, tapering, straight, with flat capsules containing several seeds. The seeds are 7 cm × 3.5 cm and winged (Fig. 332).

Pharmaceutical interest: Oroxilin A (5, 7-hydroxy-6-methoxyflavone) and chrysin and ursolic acid characterized from the fruits of *Oroxylum indicum* (L.) Vent. are antioxidant in the xanthine-xanthine oxidase assay system (Jiwajinda S *et al.*, 2002). Note that *Oroxylum indicum* (L.) Vent. contains

aloe-emodin, which is a well-known laxative and antileukaemic anthraquinone (Kupchman SM *et al.*, 1976).



Oroxylin A

References

- Jiwajinda S, *et al.* (2002) *Asian Pac J Cancer Prev* **3**(3): 215–223.
Kupchman SM, *et al.* (1976) *Lloydia* **39**: 223.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Spathodea campanulata P. Beauv.

[From Greek, *spathē* = broad blade and from Latin, *campana* = bell]

Physical description: It is a common ornamental tree which grows to a height of 10 m. The bole and stems are showily marked with leaf-scars. The bark is greyish, smooth and lenticled. Leaves: imparipinnate, 10 cm–30 cm long, spiral, without stipules and comprises of 4–6 pairs of folioles which are subopposite, curved and shows 4–6 pairs of secondary nerves. The margin of the blade is recurved. The inflorescences are terminal velvety racemes. The flower buds are clog-shaped. The corolla is funnel-shaped, 10 cm long, very showily red, and membranaceous. The fruits are upright brownish, fusiform follicles of about 15 cm–20 cm long, containing numerous seeds which are flat and winged (Fig. 333).



Fig. 333. *Spathodea campanulata* P. Beauv.

Pharmaceutical interest: Fractions obtained from a decoction of stem bark of *Spathodea campanulata* P. Beauv. display hypoglycaemic,

Uses: In Laos, Cambodia and Vietnam, the flowers of *Spathodea campanulata* P. Beauv. are used to heal ulcers.

anticomplementary, antimalarial and anti-HIV in mice (Madinke JM *et al.*, 1989; Niyonzima G *et al.*, 1999). Are naphthoquinones the active principles involved in this instance?

References

- Madinke JM, *et al.* (1989) *Planta Medica* **54**(2): 122–125.
 Niyonzima G, *et al.* (1999) *Phytomed* **6**(1): 45–49.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Stereospermum fimbriatum (Wall.) DC.

[From Greek, *stereo* = hard, *sperma* = seeds and from Latin, *fimbriatus* = fringed]

Common names: *Lumpoyang*, *chacha*, *chichah* (Malay).

Physical description: It is a medium-sized deciduous rainforest tree which grows in a geographical zone, ranging from Burma to South of Malaysia. The inner bark shows white and yellow spots. The sap is yellowish. Leaves: imparipinnate, and 30 cm–60 cm long. The rachis is covered with yellowish and sticky hairs. The blade consists of 7–9 pairs of folioles which are 7.5 cm–15 cm × 3 cm–5 cm. The apex of each foliole is acuminate, while the base is asymmetric. The inflorescences are 30 cm long clusters of pinkish flowers. The calyx is tubular campanulate, on the pubescent on the outside, 1.2 cm long and develops short pointed lobes. The corolla is pale lilac, 3 cm × 7 cm, and funnel-shaped. The andrecium comprises of 4 stamens. The fruits are curved, 30 cm–60 cm × 1.2 cm, cylindrical and dehiscent capsules filled with several trigonous, winged seeds that are 2.5 cm × 6 mm (Fig. 334).

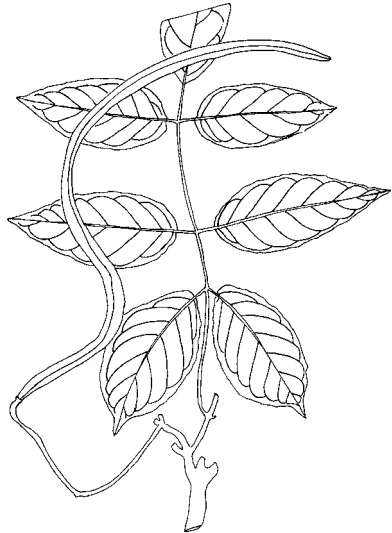


Fig. 334. *Stereospermum fimbriatum* (Wall.) DC.

Pharmaceutical interest: It would be interesting to learn whether a more intensive study on this plant would disclose any naphthoquinones of chemotherapeutic interest. Naphthoquinones are known in general to have antibacterial, fungicidal, cytotoxic, antiprotozoal and antiviral properties.

Lapachol, characterized from *Stereospermum kunthianum*, gave false hopes as a chemotherapeutic candidate (Block JB *et al.*, 1974; Consolacao DM *et al.*, 1975) because of heavy side effects during clinical trials. Currently, no natural naphthoquinones are marketed for therapy and only a limited number of galenicals (*Drosera* species) are used. A number of naphthoquinones, including lapachol, characterized from *Tabebuia barbata* or *palo de arco* used medicinally in South America, inhibit the proliferation of A549 human lung adenocarcinoma, MCF7 human breast carcinoma and HT29 human

colon cancer cell-lines cultured *in vitro*. Naphthoquinones inhibit the transport of electrons in rat liver mitochondria (Colman DST *et al.*, 1997), suggesting a possible cytotoxic mitochondrial mechanism. Other naphthoquinones incubated *in vitro* with blood forms of *Plasmodium falciparum* (72 hours) completely inhibit the proliferation at low concentration (20 μ M) and destroy drug resistant strains of *Plasmodium* more efficiently than chloroquine, nivaquine and quinine (Carvalho LH *et al.*, 1988).

Uses: In Malaysia, a decoction of the roots of *Stereospermum fimbriatum* (Wall.) DC. is used to promote recovery from childbirth. The juice expressed from the leaves or a paste of young leaves are used to assuage earache and to soothe irritated skin and inflamed parts. In Vietnam and Burma, the roots and leaves of *Stereospermum chenoloides* DC. are used to combat fever. The root bark and flowers of *Stereospermum chenoloides* DC. or *paral, kashta-patali*, are used by Asians living in Britain to cool, to promote urination, to invigorate health, and to assuage chest, brain and liver discomfort. In India, the flowers of *Stereospermum suaveolens* are used to cool, to promote urination and to produce venereal desire.

References

- Block JB, *et al.* (1974) *Cancer Chemother Repts* 4: 27.
Consolacao DM, *et al.* (1975) *J Med Chem* 18: 1159.
Carvalho LH, *et al.* (1988) *Braz J Med Biol Res* 21(3): 485–487.
Colman DST, *et al.* (1997) *Acta Cient Venez* 48(1): 42–46.

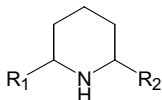
Warning: Caution must be taken as the toxic effects of this plant are unknown.

E. Order CAMPANULALES Lindley 1833

The order Campanulales consists of 7 families and approximately 2500 species of plants thought to have originated from or near the order Solanales (Appendix I). Both Solanales and Campanulales elaborate series of alkaloids from lysine. Most species in this order belong to the Campanulaceae.

1. Family CAMPANULACEAE A. L. de Jussieu 1789 nom. conserv., the Bellflower Family

The family Campanulaceae consists of 70 genera and 2000 species of herbs, known to produce inulin, piperidine alkaloids (Lobelioideae subfamily), poly-acetylenic fatty acids, pentacyclic triterpenoid saponins and tannins. The leaves are simple, alternate or opposite and without stipules. The flowers are showy, actinomorphic, tubular and epigynous. The calyx comprises of 5 lobes which are imbricate or valvate. The corolla is tubular and bell-shaped, 5-lobed, the lobes being valvate. The andrecium consists of 5 stamens alternate with the corolla lobes. A nectary disc is present. The gynecium consists of 2–3 carpels united to form a compound 2–3-locular, with each locule containing several ovules attached to the axile placentas. The fruits are capsules which are often enveloped in the persistent calyx.



Piperidine alkaloid of *Lobelia* species

Pharmaceutical interest: Classical examples of Lobeliaceae are *Campanula medium* L. (Canterbury Bell) and *Campanula rotundifolia* L. (bluebell). An example of medicinal Lobeliaceae is *Lobelia inflata* L. or Indian tobacco (Lobelia, *British Pharmaceutical Codex*, 1963); an annual herb indigenous to the eastern USA and Canada, the aerial parts of which contains lobeline, which is nicotinic antagonist piperidine alkaloid which has been used as a respiratory stimulant for resuscitation of newborn and as a smoking deterrent. Other examples of medicinal Lobeliaceae are *Lobelia nicotianifolia* and *Lobelia chinensis* Lour., which are used in India and China respectively. *Codonopsis lancifolia* (Roxb.) Moeliono, *Laurentia longiflora* (L.) Peterm., *Lobelia angulata* Forst., *Lobelia chinensis* Lour. and *Wahlenbergia marginata* (Thunb.) DC. are medicinal in the Asia-Pacific.

***Codonopsis lancifolia* (Roxb.) Moeliono**

[From Latin, *codonopsis* = bell-shaped, *lancea* = lance and *folium* = leaf]

Physical description: It is a herb which grows wild in China and Taiwan, by the roadsides and in the open forests. The stems are terete and glabrous. Leaves: simple, opposite

Synonymy: *Campanumoea axillaris* Oliv., *Campanumoea lanceolata* Siebold & Zucc., *Glosocomia hortensis* Rupr., *Glosocomia lanceolata* Regel.

and without stipules. The petiole is pilose and 3.5 mm long. The blade is lanceolate, serrate, asymmetrical, 7 cm × 1.8 cm–5.2 cm × 1 cm, and pilose beneath. The blade shows 5–6 pairs of secondary nerves. The calyx is tubular and produces 5 linear lobes which are 5 mm long. The corolla is tubular, lilac, 5–6 lobed, 5 mm × 9 mm at the apex of green and glossy receptacle. The andrecium consists of 5 stamens united into a tube, from which arises a 5–6 lobed and yellow stigmas. The fruits are very thin capsules embedded in the accrescent calyx, containing several 0.1 mm diameter, disc-shaped and light brown seeds (Fig. 335).

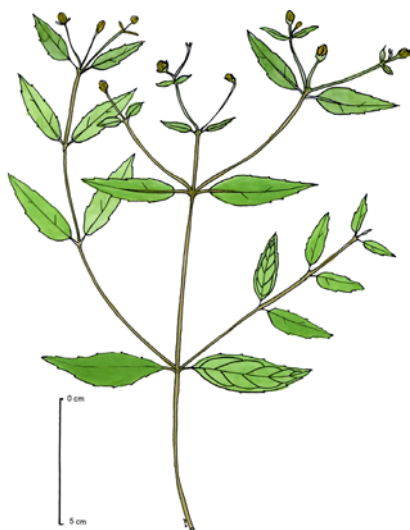


Fig. 335. *Codonopsis lancifolia* (Roxb.) Moeliono. From: KLU Herbarium 33466. Field Collector: V. Balgooy. Geographical localization: Sulawesi, 0° 30' North–119° 30'–120° 30' East, road to Lake Lind. c. 60 Km South South-east of Palu in mixed rain forest.

Uses: In China, *Codonopsis lancifolia* (Roxb.) Moeliono is used to invigorate the kidneys and to treat vomiting.

Pharmaceutical interest: The pharmacological properties of *Codonopsis lancifolia* (Roxb.) Moeliono remain unexplored. Note that a powder of *Codonopsis eupolyphaga* given to mice for 4 weeks lowers the Lee's index, the weight of fat cushion and the fat index, lowers the blood levels of cholesterol, triglycerides and glucose similar to fenfluramin, but without influence on appetite and bowel movement (Wang W *et al.*, 1997). Extracts of *Codonopsis pilulosa* display anti-ulcer, immunomodulatory and cardioprotective effects *in vivo* (Wang S *et al.*, 1990; Wang ZT *et al.*, 1996; Wang ZT *et al.*, 1997). A polysaccharide-enriched fraction from the roots of *Codonopsis pilosula* root shows immunomodulatory effects (Wang ZT *et al.*, 1995).

References

- Wang S, *et al.* (1990) *Chung Hsi I chieh Ho Tsa Chih* **10**(7): 391–394.
 Wang ZT, *et al.* (1995) *General Pharmacology: The Vascular System* **27**(8): 1347–1350.
 Wang W, *et al.* (1997) *Chung Kuo Chung Hsi I Chieh Ho Tsa Chih* **17**(12): 739–741.
 Wang ZT, *et al.* (1996) *Gen Pharmacol* **27**(8): 1347–1350.
 Wang ZT, *et al.* (1997) *Gen Pharmacol* **28**(3): 469–473.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Laurentia longiflora* (L.) Peterm.**

[From Latin, *longus* = long and *flos* = flower]

Synonymy: *Isotoma longiflora* Presl., *Hippobroma longiflora* Don., *Lobelia longiflora* L.

Common names: Star of Bethlehem; longflower Laurentia; *lidah payau* (Malay); *kendali*, *sangkobak* (Indonesian); *pua hōkū* (Hawai'i); *udel ra badrei* (Palau).



Fig. 336. *Laurentia longiflora* (L.) Peterm.

Physical description: It is a herb native to Tropical America, which grows to a height of 30 cm in shady and wet open lands of the Asia-Pacific. The stems are pubescent and exude a milky sap when cut. Leaves: simple, spiral, sessile and without stipules. The blade is glabrous above and subglabrous beneath, lanceolate, dentate, 13.4 cm × 1.4 cm–2.2 cm, dark green, tapering and sheathing. The inflorescences are axillary and solitary. The calyx is tubular, 5 mm–7 mm long, hairy and 5-lobed. The corolla is tubular, pure white, showy, the tube is 10 cm × 3 mm and produces 5 linear lobes which are 1.7 cm × 2.5 mm. The andrecium consists of 5 stamens which are grouped at one side of the corolla (Fig. 336).

Pharmaceutical interest: In Indonesia, a paste of leaves is applied to aching teeth as counter irritant. The pharmacological property of *Laurentia longiflora* (L.) Peterm. remains unexplored.

Warning: All parts of the plant are dreadfully toxic due to an alkaloid called isotomine. After handling the plant, small amount of the sap that comes in contact with the eye can cause blindness. In larger dosage, the poison causes vomiting, paralysis of the voluntary muscles, rapid and feeble heartbeat and irregular respiration.

***Lobelia angulata* Forst.**

[After Mathias de L'Obel, 16th century Belgian botanist and From Latin, *angularis* = angle]

Physical description: It is a perennial herb which grows to a length of 60 cm long in damp fields at an altitude of 500 m–2300 m in India, China,

Synonymy: *Pratia begonifolia* Lindl., *Pratia nummularia* Kurz.

Common names: Lobelia.

Taiwan, Malaysia, Burma, Thailand, South America, Australia and New Zealand. The roots are adventitious. The stems are terete, thin, and pilose. Leaves: alternate, without stipules and simple. The petiole is 2 mm–6 mm long, grooved and pilose. The blade is papery, pilose, round-cordate, and 9 mm × 14 cm–6 mm × 8 mm and shows 2–4 obscure secondary nerves and a conspicuous midrib. The margin is serrate. The flowers are axillary and pinkish or white and shows 5 lanceolate–oblong lobes grouped at one side of the corolla. The fruits are magenta, 1 cm in diameter, indehiscent pinkish capsules that are crowned with 5 linear persistent calyx lobes, containing numerous tiny seeds (Fig. 337).

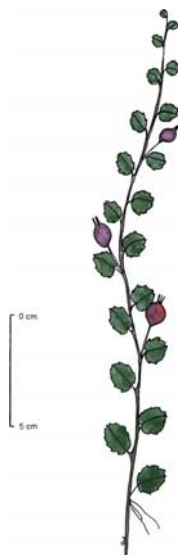
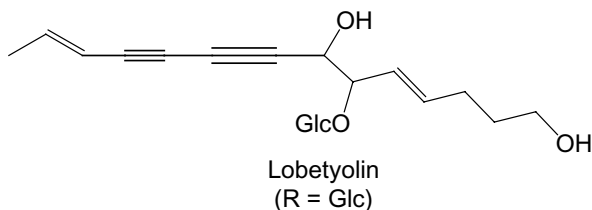


Fig. 337. *Lobelia angulata* Forst. From: KLU Herbarium 27432. Field Collectors: Benjamin C Stone & D Frotin. 17 Dec 1977. Geographical localization: Pahang, G Ulu Kali summit area, prostrate herb on open disturbed ground, Malaysia. Botanical Identification: Benjamin C Stone 3/79.

Pharmaceutical interest: The pharmacological properties of *Lobelia angulata* Forst. remain unexplored till today. However, one might set the hypothesis on the anti-inflammatory property mentioned above based on flavonoids such as diosmin, linarin, apigenin 7-*O*-rutinoside, and luteolin 7-*O*-rutinoside, which are known to occur in the plant. Note that the plant is also known to elaborate a polyacetylenic glucoside: lobetyolin (Matsuura *et al.*, 2000).

Uses: In China, a decoction of *Lobelia angulata* Forst. is used to promote sweat. In Taiwan, the whole plant is used to counteract putrefaction, treat contusion, cough and inflammation. The plant is used to resolve swellings, ulcers and to treat malaria. In Indonesia, the leaves are used to treat sprue.



Reference

Matsuura, *et al.* (2000) *Natural Medicines* 54: 44.

Warning: Clinical signs of *Lobelia* poisoning are vomiting, weakness, heart-burn, weak pulse, breathing difficulties, and collapse.

Lobelia chinensis Lour.

[After Mathias de L'Obel, 16th century Belgian botanist and from Latin, *chinensis* = from China]

Synonymy: *Lobelia radicans* Thunb., *Pratia radicans* G. Don.

Common names: Chinese cardinal flower, Chinese lobelia.

Physical description: It is a herb which grows perennially in China, North Thailand, Vietnam, Japan and Taiwan. The stems are decumbent and creeping. Leaves: simple and alternate. The blade is narrowly elliptical or lanceolate, and 1 cm–2 cm × 2 cm–5 mm. The apex of the blade is acute. The margin is entire or very finely denticulate. The flowers are solitary in the upper axillary branches and are attached to 1.5 cm–3 cm long pedicels. The calyx lobes are 3 mm–4 mm long, narrowly deltoid with very finely lobed margins. The corolla is white to rose-purple, consisting of 5 lanceolate–oblong lobes which are grouped at one side of the corolla.

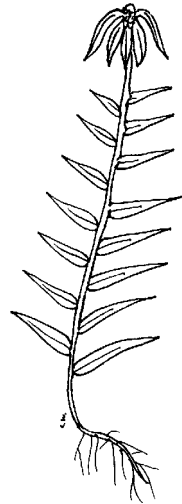
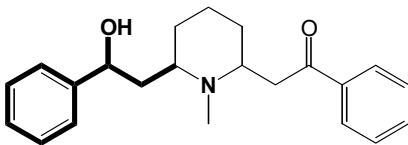
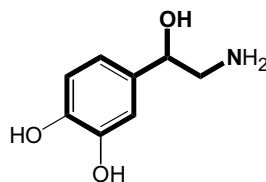


Fig. 338. *Lobelia chinensis* Lour.

The andrecium consists of 5 stamens, the filaments of which are united into a tube near the top. A pair of anthers bear a tuft of hairs at the apex. The style is 8 mm long. The stigma is 3-lobed. The fruits are conical and 5 mm–7 mm long capsules containing several ovate, smooth and reddish seeds (Fig. 338).



Lobeline



Adrenaline

Pharmaceutical interest: *Lobelia chinensis* Lour. contains lobeline, a piperidine alkaloid which is the active constituent of *Lobelia inflata* L.

Ganglionic activity: Lobeline enhances and accelerates respiratory movement by improving the reactivity of the brain stem centers to carbon dioxide, which acts by a reflex mechanism involving the carotid chemoreceptors. It is a ganglionic invigorating and a β -adrenergic bronchodilator. Previously given (parenteral injection) for resuscitation after asphyxia and especially to treat apnea in new born, it is no longer used, considering the substantial side effects and a poor therapeutic index.

Smoking cessation: Lobeline is still found in smoking cessation products (Lobatox[®], Stopsmoke[®], Cig-Ridettes[®]) and in preparations for the symptomatic treatment of bronchopulmonary ailments (Lobelia Compound[®]). A number of reviews of antismoking therapy generally consider lobeline to have little benefit with placebo (Gourlay SG *et al.*, 1990). Lobeline may not be *sensu stricto* a nicotinic agonist. Lobeline inhibits *in vitro* [³H]-dihydratetabenazine, binding with an IC₅₀ value of 0.9 μ M, suggesting a possible interaction with dihydratetabenazine on vesicular monoamine transporter T₂, therefore inhibiting the dopamine uptake to synaptic vesicles (Teng L *et al.*, 1998). The depletion of dopamine caused by lobeline may explain the hypotensive use of *Lobelia chinensis* Lour. The use of lobeline to treat Huntington's chorea and other neurological disorders could also be evaluated.

Other pharmacological properties: The leaves of *Lobelia inflata* L. contain a triterpenoid: β -amyrin palmitate, which displays similar properties as that of antidepressant mianserin (Bolvidon[®]) and imipramine (Tofranil[®]) in mice (Subarnas A *et al.*, 1993). An ethanolic extract of *Lobelia laxiflora* L. applied to carrageenan-induced acute inflammation in mice, suppresses edema at a dose of 100 mg/Kg in connection with the complementary system, since non-alkaloidal fractions and alkaloidal fractions inhibit *in vitro* human serum complement (Philipov S *et al.*, 1998). Two pyrrolidine alkaloids, radicamines A and B characterized from *Lobelia chinensis* Lour. inhibit alpha-glucosidase (Shibano M *et al.*, 2001).

Uses: In China, a decoction of *Lobelia chinensis* Lour. is drunk to promote urination, relieve the bowels of costiveness, invigorate breathing, treat asthma, lower blood pressure, and to check hemorrhage. A paste is used to counteract putrefaction, soothe swollen parts, treat ascite, heal insect bites and to counteract snake-poisoning. In Thailand, the plant is used to treat asthma. In Vietnam, the roots are used to expel impurities, to soothe inflammation and to treat syphilis.

References

- Gourlay SG, *et al.* (1990) *Med J Aust* **153**: 699–707.
 Philipov S, *et al.* (1998) *Z Naturforsch C* **53**(5–6): 311–317.
 Shibano M, *et al.* (2001) *Chem Pharm Bull (Tokyo)* **49**(10): 1362–1365.
 Subarnas A, *et al.* (1993) *J Pharm Pharmacol* **45**(6): 545–550.
 Teng L, *et al.* (1998) *J Neurochem* **71**(1): 258–265.

Warning: Signs of *Lobelia* poisoning are vomiting, weakness, heartburn, weak pulse, breathing difficulties, and collapse.

Wahlenbergia marginata (Thunb.) DC.

[After Georg Goran Wahlenberg, 19th century Swedish professor of botany and from Latin, *margo* = margin]

Synonymy: *Wahlenbergia gracilis* DC., *Campanula gracilis* G. Forst.

Common names: Southern rockbell.

Uses: In Cambodia, Laos, and Vietnam, *Wahlenbergia marginata* (Thunb.) DC. is used to treat pulmonary diseases. In Indonesia, the plant is used to treat skin eruption.

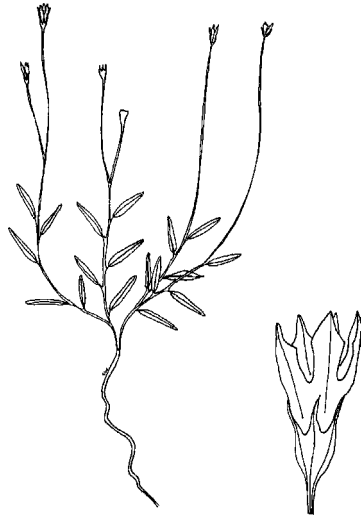
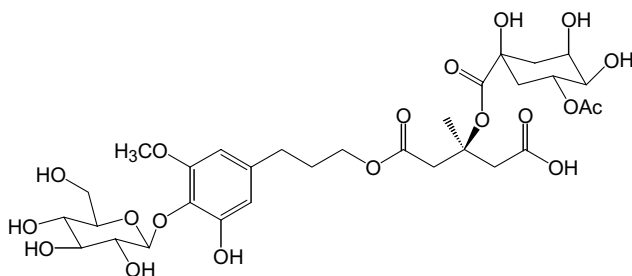


Fig. 339. *Wahlenbergia marginata* (Thunb.) DC. From: KLU Herbarium 14125. Field collector & botanical identification: Nakaike. 15 June 1969. Geographical localization: Japan, open place near seashore, Shizuoka Pref., Numazu-shi, Senbonhama.

Physical description: It is a slender herb which grows to a height of 50 cm in a geographical area, ranging from India to Papua New Guinea, Australia and Japan. Leaves: spiral, simple, without stipules and sessile. The blade is lanceolate-linear, 1.7 cm × 1 mm–2 cm × 2 mm, laxly serrate and recurved. The calyx is 5-lobed and 4 mm long, the lobes being triangular. The corolla is tubular, 5-lobed, purplish, 5 mm × 8 mm. The fruits are conical, membranaceous, 5-lobed, indehiscent, 8 mm × 4 mm capsules filled with numerous tiny seeds (Fig. 339).

Pharmaceutical interest: The pharmacological property of *Wahlenbergia marginata* (Thunb.) DC. remain unexplored. However, the plant is known to



Wahlenoside B

produce a series of phenylpropanoids glycosides such as wahlenoside B (Tan RX *et al.*, 1998) and lobetyolin (Ma WG *et al.*, 1997).

References

- Ma WG, *et al.* (1997) *Phytochem* **45**(2): 411–415.
 Tan RX, *et al.* (1998) *Phytochem* **48**(7): 1245–1250.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family GOODENIACEAE R. Brown 1810 *nom. conserv.*, the Goodenia Family

Physical description: The family Goodeniaceae consists of approximately 14 genera and 300 species of perennial herbs and soft-wooded shrubs well represented in Australia and known to elaborate inulin, iridoid glycosides and saponins. The leaves are simple, mostly alternate, fleshy and glossy without stipules. The inflorescences are cymose, racemose or solitary. The flowers are perfect. The calyx is tubular and mostly 5-lobed. The corolla is tubular, bilabiate, and produces 5 lobes which are grouped at one side. The andrecium consists of 5 stamens with tetrasporangiate and dithecal anthers. The gynecium consists of a pair of carpels forming a compound, mostly inferior and 2-locular ovary with each locule containing 1–several ovules attached to axile placentas. The fruits are capsular or succulent. *Scaevola taccada* (Gaertn.) Roxb. is used in the Asia-Pacific to treat a number of ailments. The pharmacological properties of the plants classified within the family Goodeniaceae remain yet to be explored.

Scaevola taccada (Gaertn.) Roxb.

[From Latin, *scaevola* = left-handed]

Physical description: It is a shrub native to the coasts around the Indian and western Pacific oceans; commonly found on seashores, sandy sites behind

Synonymy: *Scaevola frutescens* Krause, *Scaevola koenigii* Vahl, *Scaevola sericea* Forst., *Lobelia sericea* (Vahl)Kuntze var. *koenigii* (Vahl)Kuntze, *Scaevola sericea* Vahl.

Common names: Scaevola, half flower, beach naupaka; *dudulan* (Javanese); *ambong-ambong*, *bong-bong* (Thai); *orpinletan* (Burmese); *vellamuttagam* (Tamil).



the shores and on rocky shore side cliffs, often forming dense thickets which grows to a height of 6 m. The stems are succulent, glabrous and smooth. Leaves: simple, sessile, spiral and without stipules. The blade is succulent, glossy, glabrous, spatulate and 20.5 cm × 6.5 cm–23.5 cm × 7.8 cm. Tufts of silky white hairs are present at the base of the leaves. The inflorescences are axillary dichotomous cymes which are 7 cm–9 cm long. The flowers are showy, whitish and 1.6 cm–1.8 cm long. The calyx is conical, 2 mm × 7 mm, hairy and produces 5 linear lobes of about 2.5 mm long. The corolla is characteristically hemitubular, 1 cm–1.3 cm long and produces 5 valvate lobes. The andrecium consists of 5 stamens. The style is 2 cm long. The fruits are globose, large, greenish-white, lobed, succulent berries, crowned with the 5 calyx lobes and containing rough and bony stones (Figs. 340 & 341).



Fig. 340. *Scaevola taccada* (Gaertn.) Roxb.



Fig. 341. *Scaevola taccada* (Gaertn.) Roxb.

Pharmaceutical interest:

Antiviral: An extract of *Scaevola taccata* (Gaertn.) Roxb. inhibits selectively the replication of Herpes Simplex Virus 1 and 2 Vesicular Stomatitis Virus, as well as a mild anti-fungal activity *in vitro* (Locher CP *et al.*, 1995). Note that an extract of *Scaevola spinescens* inhibits the replication of the human cytomegalovirus (Semple SJ *et al.*, 1998) It would be interesting to learn of the antiviral principle of *Scaevola taccata* (Gaertn.) Roxb. Is iridoid glycoside possible?

Uses: In the Caroline Islands, the leaves are used to invigorate health and to promote venereal desire. In Indonesia, *Scaevola taccata* (Gaertn.) Roxb. is used to counteract seafood poisoning, and treat diarrhea and beriberi. Rumphius stated that the juice expressed from the berries was instilled by the Amboynans into the eyes, to clear off opacities and take away dimness of vision. In Malaysia, the leaves are used to promote digestion and to assuage headache. In Papua New Guinea, the leaves are used to heal sores. In the Philippines, a decoction of the roots is drunk to treat dysentery and syphilis.

References

- Locher CP, *et al.* (1995) *J Ethnopharmacol* **49**(1): 23–32.
 Semple SJ, *et al.* (1998) *J Ethnopharmacol* **60**(2): 163–172.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

F. Order RUBIALES Bentham & Hooker 1873

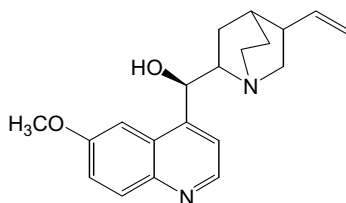
This order consists of the family Rubiaceae.

1. Family RUBIACEAE A. L. de Jussieu 1789 nom conserv., the Madder Family

The family Rubiaceae consists of about 450 genera and 6500 species of tropical and sub-tropical trees, shrubs, climbers and herbs, which are thought to have originated by development from the order Gentianales. The chemical weapons used here are iridoid glycosides (Sub-family Ixoroideae), monoterpenoid alkaloids, tannins, and anthraquinones. The leaves of Rubiaceae are simple, decussate and show very characteristic interpetiolar stipules. The flowers are showy,



perfect, cymose or packed in globose spikes. The calyx is small, consisting of 4–5 lobes adnate to the ovary. The corolla is tubular, regular, and often white; consists of 3–5 connate, contorted, imbricate or valvate lobes. The andrecium consists of 4–5 stamens attached to the edge of the corolla, and alternate with the corolla lobes. The anthers are 2-celled and open in terms of length. The gynecium consists of a pair of carpels united into an inferior, 2 or plurilocular ovary with each locule containing a single or several ovules attached to axile placentas. The stigma is bifid, showy and protruding. The fruits are capsules, berries, or drupes often crowned at the top by the calyx.



Quinine

Pharmaceutical interest: Classical examples of Rubiaceae are *Coffea arabica* (Arabica coffee), *Coffea liberica* and *Coffea canephora* (robusta coffee). The kernel of the dried ripe seed roasted til deep brown in color with a characteristic aroma, is consumed in coffee by millions of people daily. *Ixora chinensis* (garden ixora) is another type belonging to the group of Rubiaceae.

Monoterpenoid indole alkaloids: *Cephaelis*, *Nauclea*, *Cinchona*, *Mitragyna*, *Corynanthe*, *Pausinystalia*, *Uncaria*, *Pogonopus* and *Remijia* species are interesting because they produce monoterpenoid indole and quinoline alkaloids, some of which are being used in therapeutic medicine. Examples of such alkaloids are quinine, emetine and mitragynine. The dried bark of cultivated trees of *Cinchona calisaya* (yellow cinchona bark), *Cinchona ledgeriana* (ledger bark), *Cinchona officinalis* (pale cinchona bark, crown or Loxa bark) and *Cinchona succirubra* (red cinchona bark), containing not less than 6% of total alkaloids, quinine (*Cinchona*, *British Pharmaceutical Codex*, 1963) has been used in Western medicine as bitter stomachic. Quinine is a monoterpenoid quinoline alkaloids of indolic origin which suppresses the asexual cycle of the development of malaria parasites in the erythrocytes, and has been used as sulphate, bisulphate, hydrochloride or dihydrochloride to prevent and control overt attacks of malaria. The dried root of *Cephaëlis ipecacuanha* (Brot.) A. Rich. (*uragoga ipecacuanha*, Brazilian ipecacuanha) or *Cephaëlis acuminata* Karsten (Cartagena ipecacuanha) (Ipecacuanha, *British Pharmacopeia*, 1963) containing not less than 2% of alkaloids calculated

as emetine, has been used in small dosages as expectorant in acute bronchitis and in large dosages to induce vomiting in the treatment of poisoning. Emetine has been used as hydrochloride to treat amebiasis. Mitragynine from *Mitragyna speciosa* (Korth.) Havil., may also be of help in fighting opioid addiction.

A dried aqueous extract of the leaves and young shoots of *Uncaria gambier* (Hunt.) Roxb. (Catechu, *British Pharmaceutical Codex*, 1963), has been used with chalk in mixture form, in the treatment of diarrhea on account of its astringent property. The discovery of natural products of therapeutic value from this huge family is most probable. Approximately 120 species of plants classified within the family Rubiaceae are used in the Asia-Pacific for medicinal purposes.

***Borreria articularis* (L. F.) F. N. Williams**

[After William Borrer (1781–1862) a British botanist and from Latin, *articulatus* = articulate]

Synonymy: *Borreria hispida* K. Schum., *Spermacoce flexuosa* Lour., *Spermacoce hispida* L.

Common names: Harsh-leaved button weed; *rumput susur* (Malay); *kertas watu* (Javanese).

Physical description: It is a common herb of sandy and waste lands or seashores of the tropical and sub-world. The stems are quadrangular and fleshy. Leaves: simple, decussate and hairy. The stipules are interpetiolar and form a cup with bristle on their edges. The blade is 1.2 cm–2 cm × 2 cm–8 mm, blunt at the apex and tapering at the base. The flowers are tiny and arranged in small axillary heads. The calyx consists of 4 sepals. The corolla is tubular, white or pink, and 4-lobed. The fruits are splitting hairy capsules crowned with sepals (Fig. 342).

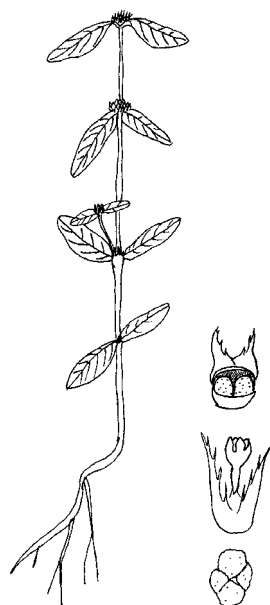
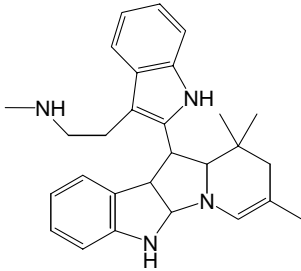


Fig. 342. *Borreria articularis* (L. F.) F. N. Williams.

Pharmaceutical interest: The therapeutic potential of this common herb remains unexplored. Note that *Borreria verticillata* produces borreverine, an



Borreverine

alkaloid that inhibits the growth of Gram-positive cocci at a dose inferior to $6 \mu\text{g/mL}$ (Maynard G *et al.*, 1980). This alkaloid could be responsible for the antibacterial activity of *Borreria ocymoides* (Ebana RW *et al.*, 1991), and for the antiseptic property of *Borreria articularis* (LF) FN Williams.

Uses: *Borreria articularis* (L. F.) F. N. Williams is astringent. In China, the plant is used to combat fever. In Indonesia, an infusion of the plant is drunk to expel urinary stones. In Malaysia, a poultice is used to soothe sores, wounds and to assuage headache. In the Philippines, a decoction of the leaves is used to heal hemorrhoids, whereas a decoction of the root is used to wash the mouth. In Vietnam, *Borreria articularis* (L. F.) F. N. Williams is used to relieve the bowels of costiveness and to induce vomiting. In India, a decoction of the plant is used to combat fever. The seeds are used instead of coffee, and vapors are inhaled to expel tooth worms.

References

Ebana RW, *et al.* (1991) *J Applied Bacteriol* **7**(5): 398–402.

Maynard G, *et al.* (1980) *Comptes Rendus des Sceances de la Societe de Biologie et de ses Filiales* **174**(5): 925–928.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Canthium horridum Bl.

[From Latin, *horridus* = frightful]

Physical description: It is a scrambling rainforest shrub of Asia-Pacific which grows to a height of 3 m. Leaves: simple, decussate and stipulate. The stipules are triangular and interpetiolar. A pair of thorn is present at the axis of leaves. The blade is 3 cm long, hairy below, showing 3–4 pairs of secondary nerves. The corolla lobes are valvate. The stigma is bilobed. The fruits are bilobed and compressed (Fig. 343).

Synonymy: *Canthium parvifolium* Roxb., *Plectronia horrida* K. Schum., *Plectronia parvifolia* Bth. & Hook.

Common names: *Bulang* (Malay); *betu* (Javanese); *lep rawk* (Thai).

Uses: In Indonesia, *Canthium horridum* Bl. is used to soothe inflamed eyes. In Malaysia, it is used to heal wounds, soothe inflamed eyes, and to promote recovery from childbirth. In the Philippines, a decoction of the leaves and the bark is drunk to promote menses. In Vietnam, the bark and the young stems are used to treat dysentery. It would be interesting researching whether *Canthium horridum* Bl. has any pharmaceutical potential.

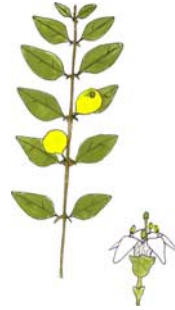


Fig. 343. *Canthium horridum* Bl.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Coptosapelta tomentosa* (Bl.) Val. ex K. Heyne**

[From Latin, *tomentum* = padding of wool]

Physical description: It is a climbing shrub of the rainforest and the riversides of the Asia-Pacific. The stems are woody. Leaves: 5 cm × 10 cm, simple, decussate wooly. The stipules are interpetiolar and triangular. The petiole is wooly and small. The blade is glossy green and at the top, elliptical-ovate or oblong, shows 4–5 pairs of secondary nerves, and is shortly acuminate at the apex. The calyx tube is wooly, small and 5-lobed. The corolla is tubular, wooly, white or orange and narrowly 5-lobed. The andrecium consists of 5 protruding stamens. The fruits are globose and in yellow capsules, broad and splitting at the apex.

Common names: Common perual; *sebasoh akar* (Malay).

Uses: In Malaysia, the roots of *Coptosapelta tomentosa* (Bl.) Val. ex K. Heyne are used to expel intestinal worms, to assuage colic, to combat fever, to heal syphilitic ulceration of the nose and to promote recovery from childbirth. The therapeutic potential of this plant remains unexplored.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Gynochthodes sublanceolata* Miq.**

[From Latin, *sub* = partially and *lanceolata* = lance-shaped]

Physical description: It is a woody climber of the riversides of Malaysia. The stems are rooting at nodes. Leaves: simple, decussate, drying black, leathery,

Common names: Malayan lumpwort or *akar sulong* (Malay).

Uses: In Malaysia, a decoction of the leaves and the roots of *Gynochthodes sublanceolata* Miq. is drunk to assuage stomachache. The therapeutic potential of this plant remains unexplored.

dark green, 5 cm–10 cm × 1 cm–3 cm and stipulate. The petiole is 5 mm long. The blade is elliptic, tapering at the base and pointed at the apex. The flowers are arranged into small axillary inflorescences. The calyx tube is cup-shaped, short and slightly lobed. The corolla tube is whitish to purplish, woolly on the inside and develops 5 lobes which are longer than the tube itself. The andrecium consists of 5 stamens. The style is bifid. The fruits are round, succulent, greenish to greyish and contain 2–4 seeds (Fig. 344).



Fig. 344. *Gynochthodes sublanceolata* Miq.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

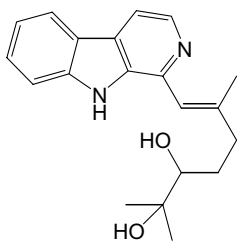
***Hedyotis capitellata* Wall. ex G. Don.**

[From Greek, *hedys* = sweet and *otos* = ear and from Latin, *capitellata* = with small heads]

Physical description: It is a climber common to the jungle paths of Asia-Pacific. The stems are long, brittle, quadrangular or terete. Leaves: 5 cm–6 cm × 2 cm–2.5 cm, simple, decussate. The stipules are interpetiolar, lobed and triangular. The petiole is indistinct. The blade is oblong, lanceolate and shows 3–4 pairs of secondary nerves. The inflorescences are axillary, long and globose heads of flowers. The flowers are very small and yellowish-green to white in color. The calyx tube is 4-lobed. The corolla tube develops 4 narrow lobes which are hairy on the inside (Fig. 345).

Common names: Climbing hedyotis; *akar lidah jin, seketan, pokok merian peca darah* (Malay); *cây dạ câm* (Vietnamese).

Uses: In Malaysia, a paste of *Hedyotis capitellata* Wall. ex G. Don. is used to counteract snake-poisoning, heal broken bones and to soothe inflammation. A decoction of the roots is used to invigorate health and to promote digestion. A decoction of the whole plant is used to treat colic, assuage heartburn, treat dysentery and lumbago, and to promote recovery from childbirth.



Capiletine



Fig. 345. *Hedyotis capitellata* Wall. ex G. Don.

Cellular properties: An extract of *Hedyotis corymbosa* protects rats hepatocytes against carbon tetrachloride (Chiu HF *et al.*, 1988). *Hedyotis diffusa*, a medicinal plant used in Taiwan, inhibits the proliferation of sarcoma cells in mice (Lia LL *et al.*, 1979). 125 mg/mL of *Hedyotis diffusa* inhibits the damage to DNA in lymphocytes caused by cigarette tar (Han F *et al.*, 1997). A number of flavonoid glycosides characterized from *Hedyotis capitellata* Wall. ex G. Don., protect rat cortical cells cultured *in vitro* against L-glutamate poisoning (Kim Y *et al.*, 2001). Note that *Hedyotis capitellata* Wall. ex G. Don. is known to produce a series of β -carboline alkaloids such as capiletine, the pharmacological potential of which still requires to be further assessed (Phuong NM *et al.*, 1999).

References

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 Han F, *et al.* (1997) *Chung Hua Yu Fang I Hsueh Tsa Chih* **31**(2): 71–74.
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 Phuong NM, *et al.* (1999) *Phytochem* **52**: 1725–1729.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Hydnophytum formicarum* Jack**

[From Greek, *hudnon* = truffle, *phyton* = plant and from Latin, *formica* = ants]

Common names: Baboon's head; *dedalu api laut*, *kepala berok* (Malay); *hua*; *roi ru* (Thai).

Uses: In the Philippines, a decoction of the tubers is drunk to assuage liver and intestinal discomfort. The therapeutic potential of this plant remains unexplored.

Physical description: It is an epiphytic coastal herb which grows in a geographical zone, spanning Indonesia, Malaysia, the Philippines and Papua New Guinea. The plant grows from a large tuber which is channeled inside and inhabited by ants. The tuber is monstrously-shaped, with roots from its base and a few adjoining branches from its top. Leaves: very thick, succulent, 5 cm–15 cm × 2.5 cm–6 cm, simple, decussate and stipulate. The petiole is short and thick. The blade is ovate to elliptic, extremely thick and lanceolate. The flowers are grouped in small and axillary clusters. The calyx is cup-shaped. The corolla consists of a short tube hairy inside and is 4-lobed. The lobes are half as long as the tube itself. The fruits are orangy-red pulpy berries (Fig. 346).

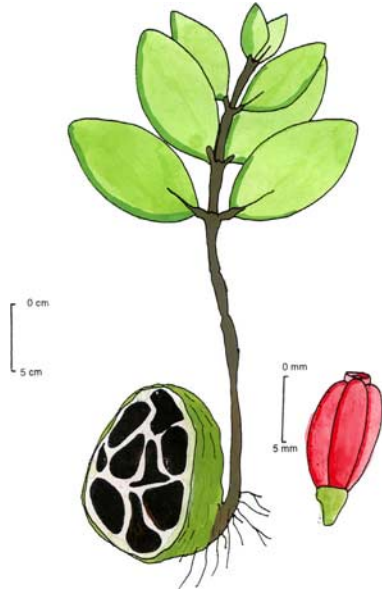


Fig. 346. *Hydnophytum formicarum* Jack.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Lasianthus stipularis* Bl.**

[From Greek, *lasio* = woolly, *anthos* = flower and from Latin, *stipula* = straw]

Physical description: It is a herb of jungle paths and seashores of the Asia-Pacific. Leaves: simple, large 10 cm–22 cm × 2.5 cm–7 cm, decussate and stipulate. The stipules are 1 cm long, broadly triangular and conceal the flowers. The blade is obovate to elliptic, broadest

Common names: Stipulate wool-flower; *ubat barah* (Malay).

above the middle, while tapering at the base and marked at the apex with a sharp tip. The flowers are sessile and enclosed in narrow and hairy bracts. The corolla is tubular white and 4-lobed. The fruits are glossy, 4 mm blue berries (Fig. 347).

Uses: In Malaysia, the leaves of *Lasianthus stipularis* Bl. are used to treat a disease called “noises in the head”. The therapeutic potential of *Lasianthus stipularis* Bl. remains unexplored.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Morinda citrifolia* L.**

[From Latin, *morus* = mulberry, *Indus* = from India, *citrus* = citron and *folium* = leaf]

Common names: Indian mulberry; *gaiu* (Vietnamese); *tombongaso* (Filipino); *ashyuka* (Sanskrit); *mengkudu daun besar* (Malay); *nonu* (Samoa), *mangalwe* (Caroline Island).

Physical description: It is a tree which grows to a height of 9 m in a geographical zone, ranging from India to Polynesia. The bark is greyish-brown and shallowly fissured. The inner bark is yellowish-red. Leaves: simple, 10 cm–15 cm × 20 cm–30 cm, decussate and stipulate. The stipules are interpetiolar, triangular to round. The petiole is 1 cm long. The blade is broadly elliptic to obovate, glossy, soft, succulent and shows 5–8 pairs of secondary nerves. The flowers are white, small and characteristically fused into solitary and succulent, mulberry-shaped 8 mm–3 cm long green heads. The corolla is tubular, 1 cm–1.2 cm long, hairy at the throat inside and develops 4–5 valvate lobes. The sigma is bifid. The fruits are succulent, light greyish-green and smelly syncarps that is yellowish when ripe (Fig. 348).



Fig. 347. *Lasianthus stipularis* Bl.



Uses: All parts of *Morinda citrifolia* L. are used to treat dysentery. The leaves are used to alleviate cough, nausea and to assuage colic. The ripe fruits are palatable and used to alleviate cough, combat fever, expel intestinal worms, promote urination, treat diabetes, gynecologic diseases, asthma and lumbago. The roots are used to counteract putrefaction and to lower blood pressure. In Vietnam, the backed fruits are used to treat dysentery, asthma and to promote menses.



Fig. 348. *Morinda citrifolia* L.

Pharmaceutical interest:

Central analgesic properties: A lyophilized aqueous extract of the roots of *Morinda citrifolia* L. is dose-dependent analgesic in the writhing and hot-plate tests. This effect is inhibited by Naloxone. The extract at high dosages decreases all behavioral parameters in the two compartment tests: the light/dark choice situation test and the staircase tests, together with the induced sleeping time (Younos C *et al.*, 1990).

Antitumor properties: The juice expressed from the fruits of *Morinda citrifolia* L. contains a polysaccharide which significantly enhances the duration of the survival of the inbred syngeneic LLC tumor-bearing mice. Concomitant treatment with 2 immunosuppressive agents: 2-chloroadenosin or cyclosporine, lowers this property, thereby substantiating an immunomodulatory mechanism. This polysaccharide stimulates the release of a number of mediators from murine effectors cells, including tumor necrosis factor α , interleukin1 β , interleukin10, interleukin12p70, interferon γ and nitric oxide, but has no effect on interleukin2 and suppresses the release of interleukin4. This polysaccharide improves survival time and the curative property when combined with suboptimal doses of standard chemotherapeutic agents: adriamycin, cisplatin, 5-fluorouracil and vincristine, suggesting a clinical application (Hurazumi A *et al.*, 1999). An anthraquinone identified as damnacanthal and characterized from a chloroformic extract of the roots of *Morinda citrifolia* L., causes normal morphology and cytoskeleton structure in K-rasts-NRK cells at permissive temperature, without changing the amount and localization of Ras. The effect of damnacanthal is reversible. The compound has no effect on the morphology of RSVts-NRK cells, expressing the src oncogene (Hiramatsu T *et al.*, 1993).

References

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 Hirazumi A, *et al.* (1999) *Phytother Res* **13**(5): 380–387.
 Mueller BA, *et al.* (2000) *Am J Kidneys Dis* **35**(2): 310–312.
 Younos C, *et al.* (1990) *Planta Med* **56**(5): 430–434.

Warning: One must know that the juice expressed from the fruits of *Morinda elliptica* L. (noni juice) should not be given to individuals undergoing low potassium diet. A man with chronic renal insufficiency has developed a hyperkalemia after drinking the juice of *Morinda citrifolia* L. The potassium concentration in the juice samples was determined and found to be 56.3 mEq/L (Mueller BA *et al.*, 2000).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Morinda umbellata L.

[From Latin, *morus* = mulberry, *Indus* = from India, *umbella* = sunshade]

Common names: Button fruit climber, seven wells, common Indian mulberry; *ji yan teug*, yang jiao teug (Chinese); *mengkudu kecil*, *mengkudu akar* (Malay); *daruharidra* (Sanskrit); *noonakai* (Tamil); *yo yaan* (Thai); *nháu tán*, *day dat* (Vietnamese).



Fig. 349. *Morinda umbellata* L.

Physical description: It is a coastal climber of the Asia-Pacific. Leaves: simple, decussate, 5 cm–12 cm × 2 cm–5 cm and stipulate. The stipules are interpetiolar. The petiole is 1 cm long. The blade is elliptical, shows 5–6 pairs of secondary nerves, acute at the apex and tapering at the base. The flowers are arranged in a umbel-shaped cluster of 5–12 heads. The corolla is greenish-white, very small, 4-lobed with a hairy mouth. The fruits are small and succulent syncarps that are bright orange in color, turning black when dried (Fig. 349).

Uses: In Vietnam, the leaves and roots of *Morinda umbellata* L. are used to stop dysentery. The therapeutic potential of this plant remains unexplored. Note that the plant is known to produce anthraquinones (Burnett AR *et al.*, 1968).

Reference

- Burnett AR, *et al.* (1968) *Phytochem* **7**(8): 1421–1422.

***Mussaenda mutabilis* Hook. f.**

[From Sinhalese, *mussenda* = *Mussaenda* species and Latin, *mutabilis* = liable to change]

Synonymy: *Mussaenda variabilis* Hemis.

Common names: Star mussaenda; *balek adap* (Malay).

Uses: In Malaysia, a decoction of the leaves of *Mussaenda mutabilis* Hook. f. is used to combat fever. A decoction of the roots is drunk to alleviate cough. *Mussaenda* species are known to produce saponins and iridoid glycosides. Are saponins responsible for the antitussive and antipyretic properties of this plant?

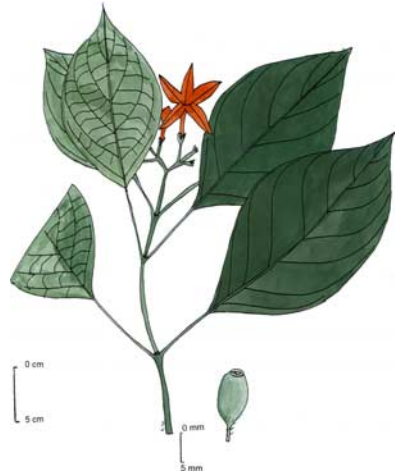


Fig. 350. *Mussaenda mutabilis* Hook. f.

Physical description: It is a bush of Malaysian jungle paths. Leaves: simple, 5 cm–13 cm × 15 cm–25 cm, decussate and stipulate. The stipules are interpetiolar. The petiole is 3 cm long. The blade is elliptic, oblong, acuminate showing approximately 9 pairs of secondary nerves. The flowers are showy, 5 cm in diameter and arranged in terminal inflorescences. The calyx consists of 5 narrow sepals that are 1 cm long. The corolla is red, orange or yellow, swollen near the throat and star-shaped. The fruits are oblong berries (Fig. 350).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Mitragyna speciosa* (Korth.) Havil.**

[From Latin, *mitragyna* = mitriform female organ and *speciosus* = beautiful]

Physical description: It is a timber tree which grows to a height of 25 m in the lowland forests of Malaysia, Thailand, Indonesia, the Philippines and New Guinea, by the streams and swamps. The bark is smooth and grey. The inner bark is pinkish. Leaves: simple, 3 cm–20 cm × 2 cm–12 cm, decussate and stipulate. The stipules are lanceolate and 1 cm × 4 cm. The blade is thick, elliptic, ovate or obovate, slightly hairy below, shows 11–17 pairs of conspicuous secondary nerves, pointed at the

Common names: *Ketong* (Malay); *krathom*, *ithang*, *kakuam*, *thom* (Thai); *puri* (Indonesian).

apex and round at the base. The flowers are grouped in solitary, globose and 9 mm–1.3 cm heads. The interfloral bracteoles are 4 mm–6 mm long, pale, hairy and conceal the calyces of flower buds in the young stage. The calyx is 2 mm long. The corolla is tubular, yellow, hairy on the inside of the throat and develops 5 valvate lobes. The fruiting heads are 2 cm–3 cm in diameter and consist of several, 7 mm–9 mm × 4 mm–5 mm fruitlets. The seed are 1 mm long with a papery wing at each end (Fig. 351).

Uses: In Burma, the leaves cause drowsiness. In Malaysia, the leaves are chewed or infused to make a drink ingested to fight addiction to opium. The leaves are used to heal wounds and enter in an external remedy to treat enlarged spleen. In Thailand, the leaves are chewed to assuage addiction to opium and to invigorate health.

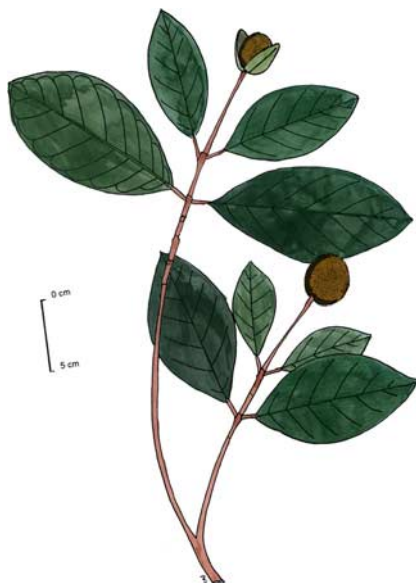
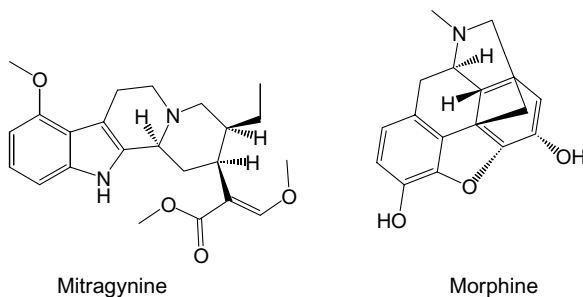


Fig. 351. *Mitragyna speciosa* (Korth.) Havil. From: KLU Herbarium 25409. Flora of Terengganu. Comm. Ex. Herb. Hort. Bot. Sing. Geographical localization: Jungle path to Gunong Tebu, Jabi, altitude: 2000 ft Malaysia. Field collectors & botanical identification: Mohd. Shah, Ahmad Shukor, Mahmud Awang, 1 June 1974.

Pharmaceutical interest: *Mitragyna speciosa* (Korth.) Havil. is interesting because it produces several sorts of monoterpenoid indole alkaloids (Beckett AH *et al.*, 1966), among which mitragynine binds to μ - and δ -opioid receptors, responsible for the control of morphine addiction and pain.



Morphine addiction: Mitragynine (1 nM–3 μ M) inhibits the contractions of ileum portions elicited by electrical stimulation with a pD2 value of 6.91 \pm 0.04

(n = 5). Naloxone (10 nM–300 nM) reverses the inhibitory effect of mitragynine on electrically-stimulated contraction and shifts the concentration-response curve of mitragynine to the right. Mitragynine (3 μ M–10 μ M) inhibits naloxone-precipitated withdrawal contraction, following a brief (5 min) exposure of the ileum to morphine (Watanabe K *et al.*, 1997).

Central analgesic properties: Intracerebroventricular injection of mitragynine (10 μ g) protects mice against the pain caused experimentally in the tail-pinch and hot-plate tests, but these effects are annihilated by the selective μ -opioid antagonist cyprodime (1 μ g–10 μ g) and the pretreatment with the selective μ_1 -opioid antagonist naloxonazine (1 μ g–3 μ g) and the selective δ -opioid antagonist naltrindole (1 ng–5 ng) (Fig. 352). Nor-binaltorphimine, a selective κ -opioid antagonist, significantly attenuates the analgesic property of mitragynine in the tail-pinch test, but not in the hot-plate test at the dose of 1 μ g (Thongpradichote S *et al.*, 1998). 7-Hydroxymitragynine is analgesic orally in mice (Matsumoto K *et al.*, 2004).

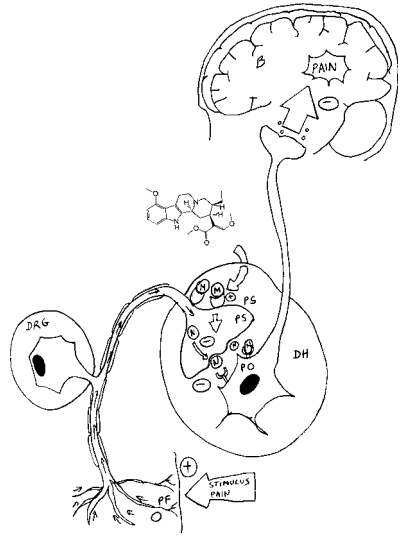


Fig. 352. Mechanism of analgesic action of mitragynine. Mitragynine (M) binds to μ - and δ -opioid receptors which mediate pain. PF: pain fiber, DRG: dorsal root ganglion, PS: pre-synaptic, PO: post-synaptic, DH: dorsal horn, N: neurotransmitter, B: brain.

References

- Beckett AH, *et al.* (1966) *Planta Med* **14**(3): 27–288.
 Matsumoto K, *et al.* (2004) *Life Sciences* **74**(17): 2143–2155.
 Thongpradichote S, *et al.* (1998) *Life Sci* **62**(16): 1371–1378.
 Watanabe K, *et al.* (1997) *Life Sci* **60**(12): 933–942.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Nauclea officinalis (Pierre ex Pitard) Merr. & Chun

[From Greek, *nauclea* = small ship, and from Latin, *officinalis* = used in medicine]

Physical description: It is a timber tree which grows to a height of 30 m

Synonymy: *Nauclea junghuhnii* (Miq.) Merr., *Sarcocephalus junghuhnii* Miq.

Common names: *Bangkal*, *mengkal* (Malay).

and a girth of 70 cm in the forest swamps of Malaysia, Vietnam, Indonesia and Southern China. The bark is fissured and greyish-brown to reddish-brown in color. The inner bark is yellow and ripen brown upon light exposure. The sap is pale yellow. The stems are dry black. Leaves: simple, 4 cm–25 cm × 2 cm–14 cm, decussate and stipulate. The stipules are interpetiolar, ovate elliptic, plane, 2.5 cm–1.4 cm, adpressed together, and deciduous. The petiole is 4 mm–2 cm long. The blade is rigid, glabrous, elliptic, oblong, shows 4–10 pairs of secondary nerves sunken above. The apex of the blade is acuminate with a short tip. The inflorescences are terminal and globose, 8 mm–2.5 cm in diameter, with the flowering heads attached to pedicels that are 1 cm–6 cm long. The calyx lobes are 1 mm long and densely brown hairy. The corolla tube is 3.5 mm long, and 4–5-lobed. The stigma is protruding and 4 mm long (Fig. 353).

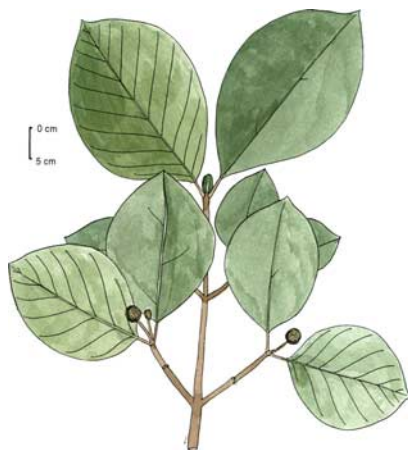
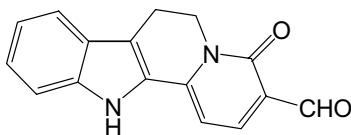


Fig. 353. *Nauclea officinalis* (Pierre ex Pitard) Merr. & Chun. From: KLU Herbarium 22951. Flora of Sabah. Herbarium of the Forest Department, Sandakan. Field collector: GHS Wood. 21 Apr 1954. Geographical localization: B.B.T., Annual Licence area Kalabakan, 30 miles West Northwest Tawau. Lowland rain-forest on undulating well drained ground, Sabah.

Pharmaceutical interest: To date, the pharmacological potential of *Nauclea officinalis* (Pierre ex Pitard) Merr. & Chun remains unexplored.

Note that the medicinal property mentioned above might be attributed to indole alkaloids such as nauclefidine, known to occur in *Nauclea* species.

Uses: In the Philippines, the bark is used to assuage menstrual discomforts.



Nauclefidine

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Ophiorrhiza communis* Ridl.**

[From Greek, *ophis* = snake, *rhiza* = root and Latin, *communis* = common]

Synonymy: *Ophiorrhiza singaporensis*, *Ophiorrhiza discolor*, *Ophiorrhiza major* Ridl.

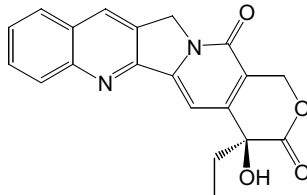
Common name: Snakeroot; *pokok peparu* (Malaysia).

Uses: In Malaysia, a paste of *Ophiorrhiza communis* Ridl. is used to heal wounds, treat enlarged spleen and to alleviate cough.

Physical description: It is a little herb which grows in the rainforest of Malaysia. Leaves: simple, asymmetrical, thin, decussate and stipulate. The stipules are interpetiolar. The blade is 4 cm–15 cm × 3 cm–10 cm, oval elliptic and pointed at the apex. The inflorescences are terminal and deer antlers-like. The calyx is tiny and 5-lobed. The corolla is white or pinkish and 5-lobed. The andrecium consists of 5 stamens. The fruits are capsular, heart-shaped, containing several tiny seeds and open at the apex (Fig. 354).



Fig. 354. *Ophiorrhiza communis* Ridl. From: KLU Herbarium 20567. Flora of Malaya. Field collector: CS Chung. 25 Sep 1970. Geographical localization: Selangor, Gua Batu limestone hill, on Northeast slope, Malaysia, altitude: 300 ft. Botanical identification: Samsuri bin Ahmad.



Camptothecin

Pharmaceutical interest: *Ophiorrhiza* species have attracted a great deal of interest with regard to their tendency to elaborate antiviral and cytotoxic monoterpenoid quinoline alkaloids. One such alkaloid is camptothecin

from *Ophiorrhiza mungos* (Tafur S *et al.*, 1976), which is also known to occur in the Subclass Rosidae: *Camptotheca acuminata* Decsne. (Family Nyssaceae, Order Cornales), and *Nothapodytes fetida* (Wight.) Sleumer (Family Icacinaceae, Order Celastrales). Although camptothecin inhibits the growth of a broad-spectrum of cancer cells, it is too toxic for clinical uses. 10-Hydroxycamptothecin is more active than camptothecin and is used in China to treat cancer of the neck and the head.

***Paederia foetida* L.**

[From Latin, *paedor* = filth and *fetidus* = stinking]

Synonymy: *Paederia scandens* Lour., *Paederia chinensis* Hance, *Paederia tomentosa* Blume.

Common names: Lesser Malayan stinkwort, skunk vine; *akar sekentut* (Malay); *bala* (Sanskrit).

Physical description: It is an invasive tropical, slender and skunk-smelling climber, native to the Asia-Pacific. Leaves: simple, glossy, dark green, decussate, 5 cm–7.5 cm × 2.5 cm–4 cm and stipulate. The stipules are interpetiolar. The petiole is up to 3 cm long. The blade is oval, elliptic and shows a few pairs of indistinct secondary nerves. The inflorescences are few-flowered and loose from the ends of the stems. The calyx is very small and 4–5-lobed. The corolla is bell-shaped, 4–5-lobed, 1 cm long, mealy-hairy on the outside, white or pink in color with a purplish throat. The fruits are globular and covered with a thin, shiny, brittle skin (Fig. 355).

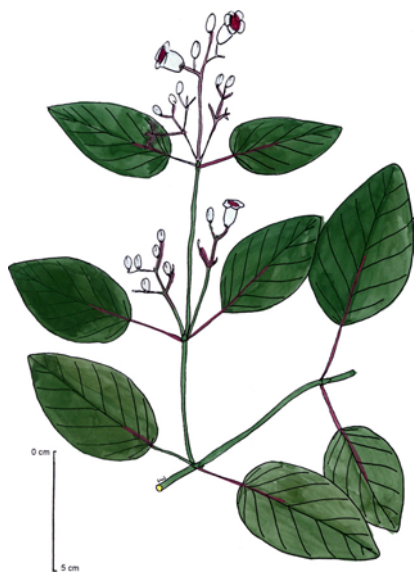


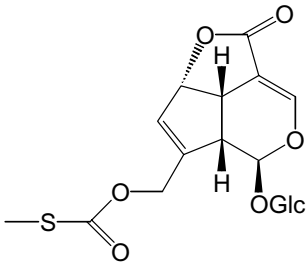
Fig. 355. *Paederia foetida* L. From: KLU Herbarium 9960. Flora of the Hawaiian Islands. No 3150. Herbarium of Benjamin C Stone. Field collection and botanical identification: 9 Dec 1959. Geographical localization: Oahu: Tantalus Trail, 2000 ft., Hawaii. Introduced.

Pharmaceutical interest:

Anti-inflammatory properties: A butanolic fraction of a methanolic extract of the defatted leaves of *Paederia foetida* L. inhibits significantly the formation of the granulation tissue in cotton-pellet-implanted rats. This fraction inhibits the enzymatic activity of liver aspartate transaminase, without affecting serum

aspartate transaminase and reduces the level of serum orosomucoid as well (De S *et al.*, 1994).

Antitumor properties: Note that paederoside characterized from *Paederia foetida* L. is potently antitumoral *in vitro* (Kamalia GJ *et al.*, 1996).



Paederoside

Uses: In Burma, *Paederia foetida* L. is used to treat rheumatism. In China, the plant is used to treat paralysis and to increase fertility. The leaves are used to treat flatulence. The entire plant is used to heal insect bites. A decoction of the roots mixed with pig's feet is used to stimulate blood circulation and to assuage the rheumatism pain in elderly people. In Vietnam, the leaves are used to promote urination and to combat fever. The leaves and root are used to invigorate health, promote digestion, treat flatulence and to soothe inflammation. In India, *Paederia foetida* L. is used to stimulate venereal desire, promote urination, and menses, and to treat rheumatism.

References

- De S, *et al.* (1994) *J Ethnopharmacol* **43**(1): 31–38.
Kamalia GJ, *et al.* (1996) *Cancer Lett* **102**(1–2): 223–225.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Prismatomeris tetrandra (Roxb.) K. Schk.

[From Greek, *prismatos* = serrate and *meros* = part and Latin, *tetrandra* = 4 anthers]

Physical description: It is a treelet which grows to a height of 3 m in the rainforest, rocky seashores and limestones of Vietnam, Burma, Thailand and Malaysia. The stems show internodes with a median longitudinal ridge ending between each pair of petioles. Leaves: simple, chartaceous decussate and stipulate. The stipules are interpetiolar, triangular and bifid at the apex. The blade is ovate and elliptic and shows 6–10 pairs of secondary nerves and tertiary nerves. The inflorescences are terminal and axillary clusters. The flower pedicels are 6 mm–2.1 cm long. The calyx cup is fringed. The corolla is

Synonymy: *Prismatomeris albiflora* Thaw. non King, *Prismatomeris malayana* Ridl.

Common names: *Son kraal*, *duck kai dam* (Thai).

tubular and develops 4–5 valvate, linear and white lobes. The ovary is 2-celled, the style is filiform and the stigma is bilobed. The fruits are globose and contain 1–2 seeds marked with a lateral groove (Fig. 356).

Uses: In Malaysia, a paste of the leaves is used to heal wounds. In Vietnam, an infusion of the wood is drunk to invigorate health and to expel impurities. The pharmacological potential of *Prismatomeris tetrandra* (Roxb.) K. Schk. remains unexplored. Note that the plant is known to produce anthraquinones (Lee HH, 1969).

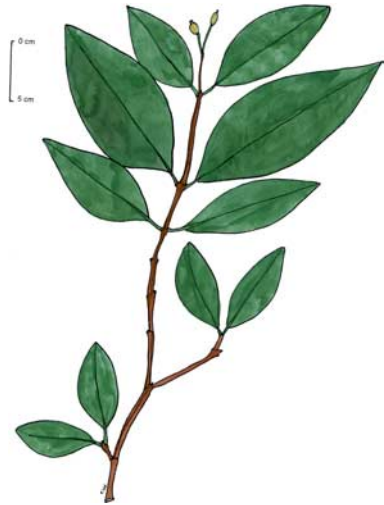
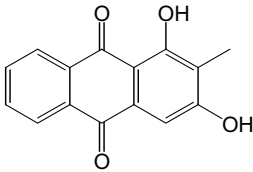


Fig. 356. *Prismatomeris tetrandra* (Roxb.) K. Schk. From: KLU Herbarium 19990. Flora of Malaya. Field collector & botanical identification: Benjamin C Stone. 24 May 1974. Geographical localization: Pulau Tioman, 5 m., rocky headland just North of Kampong Take, Malaysia.

Reference

Lee HH, (1969) *Phytochem* **8**(2): 501–503.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Psychotria curviflora Wall.

[From Greek, *psyche* = soul, *trope* = food and from Latin, *curves* = curved and *floris* = flower]

Physical description: It is a shrub which grows to a height of 3 m in the lowland and the rain forests of the hills in the Asia-Pacific. Leaves: simple, 6 cm–20 cm × 2.5 cm–7 cm and dark green, dull, decussate and stipulate. The stipules are short, broad and interpetiolar. The petiole is 3 cm long. The blade is purplish below, glossy above, broadest above the middle, soft, tapering at the base, and acuminate at the apex with a showy tip. The inflorescences are short, terminal, characteristically

Synonymy: *Castalia chartaceus* Crib, *Castalia curviflora* auct.

Common names: *Jarum-jarum* (Malay); *kid cores ungu* (Indonesian); *kemp kola*, *keo san* (Thai).

Uses: In Malaysia, a poultice of the powdered leaves is used to assuage headache, alleviate cough, stop convulsion and to heal wounds. A decoction of the roots is drunk to alleviate cough. In Vietnam, an infusion of the leaves is used to combat fever. Monoterpenoid indole alkaloids are most likely the underlying medicinal principles of this plant, while the pharmacological potential of the plant remains unexplored.



Fig. 357. *Psychotria curviflora* Wall.

succulent, white or purplish. The calyx is 5-lobed and purplish. The corolla is tubular, small, curved, thick, whitish with a yellow mouth and 5-lobed. The andrecium consists of 5 stamens. The fruits are round, 5 mm in diameter, black, glossy, and juicy berries (Fig. 357).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Randia esculenta* (Lour.) Merr.**

[After Isaac Rand, 18th century London apothecary and director of the Chelsea Physic Garden and from Latin, *esculentus* = fit for food]

Physical description: It is a treelet of the lowland and the rainforests of the hills of the Asia-Pacific. Leaves: simple, decussate and stipulate. The stipules are interpetiolar, narrowly triangular, cuspidate and 2 mm–4 mm long. A pair of 1 cm long prickles is present on the leaf axil. The blade is elliptic to ovate, 3 cm–12 cm × 1 cm–5 cm, pointed at the apex and hairy below. The blade shows 4–9 pairs of secondary nerves. The inflorescences are terminal. The corolla is 2 cm–5 cm long, yellowish, 5-lobed with the lobes at 1 cm–3 cm long. The andrecium consists of 5 stamens which are longer than the corolla tube. The fruits are 1 cm–2 cm long berries, embedded in the persistent calyx cup and containing 5 mm–7 mm of triangular seeds.

Synonymy: *Randia fasciculata* DC.,
Genipap esculenta Lour.

Common name: *Akar duri* (Malay).

Uses: In Malaysia, a paste of the powdered leaves is applied externally to heal wounds and to soothe sores. In Vietnam, a decoction of the wood is used to stop convulsion and to treat nervous diseases. The juice expressed from the roots is used to combat fever. The prickles are used to treat bleeding and to regulate menses.

Pharmaceutical interest: The therapeutic potential of *Randia esculenta* (Lour.) Merr. remains unexplored. Note that oral administration of *Randia siamensis* dose-dependently protects rodent against the pain occasioned in the writhing and in the hot plate tests (Reanmongkol W *et al.*, 1994). *Randia* species are known to produce iridoid glycosides such as randinose (Hamerski L *et al.*, 2003).

References

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Reanmongkol W, *et al.* (1994) *Biol Pharm Bull* **17**(9): 1206–1209.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Rennellia speciosa (Roxb.) Hook. f.

[After J. Rennell, 1742–1830, English oceanographer and from Latin, *speciosus* = beautiful]

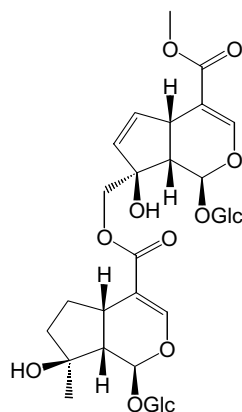
Synonymy: *Morinda speciosa* Roxb.

Common name: *Mengkudu rimba* (Malay).

Uses: In Malaysia, a decoction of the bark or roots is used to treat dropsy and to assuage pain in the bones. A decoction of the leaves and roots is used to treat rheumatism. The therapeutic potential of *Rennellia speciosa* (Roxb.) Hook. f. remains unexplored.

Physical description: It is a treelet of the lowland rainforest of the Asia-Pacific. Leaves: simple, decussate and stipulate. The stipules are interpetiolar, broad and bifid. The petiole is 1 cm–2.5 cm long. The blade is broad above the middle, 10 cm × 25 cm, tapering at the base and acuminate. The inflorescences are heads consisting of approximately 3 flowers which are purple and show prominent bilobed stigmas. The fruiting heads are purplish round, and 1 cm in diameter (Fig. 358).

Warning: Caution must be taken as the toxic effects of this plant are unknown.



Randinose



Fig. 358. *Rennellia speciosa* (Roxb.) Hook. f.

***Scyphiphora hydrophyllacea* Gaertn. f.**

[From Greek, *skyphos* = cup, *phora* = bearing, *hūdor* = water, *phullon* = leaf and *skuphos* = footless drinking-cup with two handles not higher than rim]

Synonymy: *Epithinia* Jack, *Psychotria philippensis* Cham. & Schlechtd., *Ixora manila* Blanco, *Hydnophytum costatum* Drake.

Common names: Sea-cup; *chingam* (Malay), *nilad* (Filipino).

Uses: Indonesia: an infusion of the leaves is drunk to mitigate abdominal discomfort. In India, the roots are used for scent and the fruits are eaten as food. It would be interesting to observe whether a more intensive study on this plant would disclose any molecules of therapeutic interest.

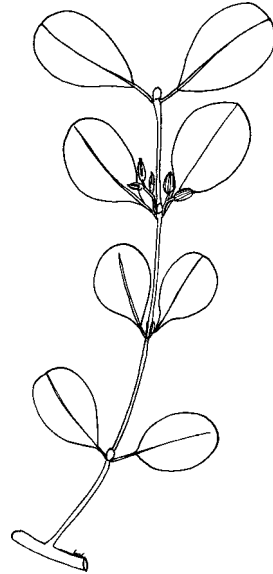


Fig. 359. *Scyphiphora hydrophyllacea* Gaertn. f. From: KLU Herbarium 8269. Flora of Malaya. Field collector: J. Dransfield. 20 Oct 1967. Geographical localization: Pulau Ketam, Port Swettenham, on seawater edge of mangrove swamp, Malaysia.

Physical description: It is a bush of the tidal mangroves, ranging from India to Pacific Islands. The stems are reddish and smooth. Leaves: succulent, simple, decussate and stipulate. The stipules are interpetiolar and orbicular. The petiole is 2.5 cm–3 cm long. The blade is glossy above, light green below, broadly spathulate, and 2.5 cm–5 cm × 2.5–3 cm. The inflorescences are small and axillary clusters. The corolla tube is white, pinkish, 5 mm long and 4-lobed, the lobes pointing downwards. The fruits are 5 mm long, ovoid, 6–8-grooved and white when ripen (Fig. 359).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Urophyllum glabrum* Wall.**

[From Greek, *oura* = tail and *phullon* = leaf and from Latin, *glaber* = free from hair]

Physical description: It is a shrub which grows to a height of 5 in the lowlands to the lower hilly forests of Malaysia, Thailand, and Indonesia. Leaves: simple,

Synonymy: *Urophyllum arboreum* (Reinw. ex Bl.) Korth.

Common names: Common urophyllum; *pokok kekar*, *merembong jantan* (Malay); *ki chengkeh* (Indonesian).

Uses: In Malaysia, a maceration of the leaves is used to combat fever. In Indonesia, the leaves are used to flavor food and to treat a number of diseases. The therapeutic potential of *Urophyllum glabrum* Wall. remains unexplored.

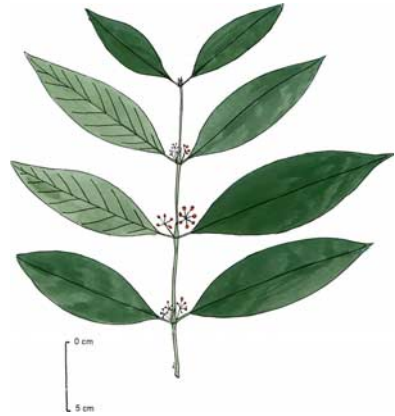


Fig. 360. *Urophyllum glabrum* Wall. From: KLU Herbarium 33982. Flora of Singapore. Geographical localization: Bukit Timah Nature Reserve, along Tabah valley, shaded evergreen forest, altitude: 50 m., Singapore. 16 Apr 1982. Field collector: JF Maxwell.

with a clove-like odour, 10 cm–17 cm × 5 cm–6 cm, thick, decussate and stipulate. The stipules are interpetiolar and lanceolate. The petiole is 1.25 cm long. The blade is leathery, elliptical, tapering at the base and acuminate at the apex showing 5–10 pairs of secondary nerves. The inflorescences are discrete axillary few-flowered globose heads. The calyx is cup-shaped and 2 mm long. The corolla is yellowish-green and 5-lobed. The fruits are round, 4 mm in diameter and bright orange in color (Fig. 360).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

G. Order DIPSACALES Lindley 1833

The order Dipsacales consists of 4 families and about 1000 species of herbs, climbers and shrubs thought to have originated from the order Rubiales (Appendix I), from which they inherit iridoid glycosides, alkaloids and saponins. A classical example of medicinal Dipsacales is *Valeriana officinalis* (Valerian, *British Pharmaceutical Codex*, 1963). The dried rhizomes and the roots offer a remedy for anxiety and indigestion.

1. Family CAPRIFOLIACEAE. L. de Jussieu 1789 nom. conserv., the Honeysuckle Family

Physical description: The family Caprifoliaceae consists of approximately 15 genera and 400 species of North temperate, boreal and tropical (mountains) shrubs and climbers, known to abound with biflavonoids, pentacyclic

triterpenoid saponins, phenylethanoid glycosides and iridoid glycosides. The leaves in this family are simple, opposite, entirely or deeply divided and without stipules. The flowers are hermaphrodite, actinomorphic or zygomorphic, and epigynous. The inflorescences are cymose. The calyx is 4–5-merous, adnate to the ovary and accrescent in fruits. The corolla is tubular and develops 2–5 lobes which are imbricate or valvate. The stamens are attached to the corolla tube and alternate with the corolla lobes. The anthers are dorsifixed, versatile and open by longitudinal slits. The gynecium consists of 2–8 carpels forming a compound and inferior ovary containing 2–8 locules, containing several ovules attached to axil placentas. The style is terminal and often long with a capitate or lobed stigma. The fruits are capsular, berries or drupes.

Pharmaceutical interest: Classical examples of Caprifoliaceae are ornamental plants such as *Sambucus nigra* L. (common elder), *Sambucus canadensis* L. (American elder), and *Symphoricarpos rivularis* Suksd. (snow-berry) and *Lonicera periclymenum* L. (honey-suckle). The dried root-bark of *Viburnum prunifolium* (Viburnum, *British Pharmaceutical Codex*, 1949) has been used in Western medicine to treat dysmenorrhea and its supposedly sedative effect on uterus in the form of a liquid extract (1 in 1; dose of 4 mL–8 mL). The dried bark of *Viburnum opulus* (Viburnum Opulus, *Polish Pharmacopoeia*, 1954) has been used in the treatment of functional uterine disorders. The dried corollas and stamens of *Sambucus nigra* L. (Sambucus, *British Pharmaceutical Codex*, 1949) have been used as a vehicle for eye and skin lotions, while the fruits are to promote urination. Approximately 15 species of plants in the Caprifoliaceae are used for medicinal purposes in the Asia-Pacific. Note that these plants are often used to treat skin diseases including infection.

***Lonicera japonica* Thunb.**

[After Adam Lonitzer, 16th century German botanist and from Latin, *japonica* = from Japan]

Physical description: It is a climbing shrub native to Asia. The young stems and leaves are tomentose. Leaves: simple, opposite and exstipulate. The petiole is 5 mm long and pubescent. The blade is elliptic, 3 cm–8 cm × 2 cm–3 cm, chartaceous, truncate at the base, obtuse or cordate. The flowers are axillary, white, and yellow when ripe. The corolla is tubular, 2 cm long, thin, bilobed, the upper lobe with 4 teeth. The andrecium comprises of 5 stamens which are exerted. The style is long and exerted. The fruits are globose and black (Fig. 361).

Synonymy: *Lonicera chinensis* Wats., *Lonicera brachypoda* DC. var. *repens* Sieb.

Common names: Japanese honeysuckle; *kim ngam*, *day nhan dong* (Vietnamese).

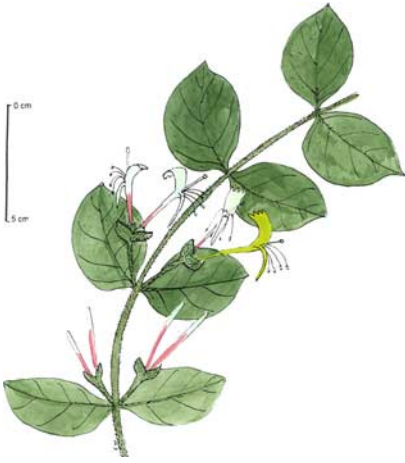
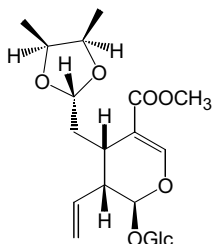


Fig. 361. *Lonicera japonica* Thunb.

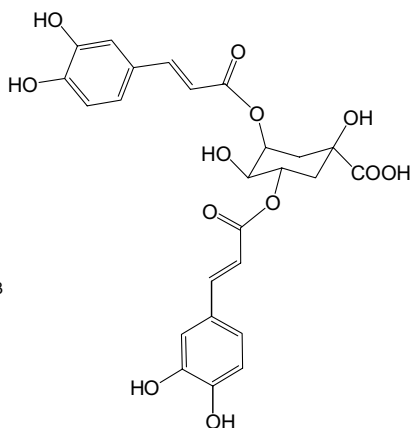
Uses: In China, the flowers of *Lonicera japonica* Thunb. are used to cool and to heal boils and carbuncles. The ashes of flowers are used to treat dysentery. The stems are used to assuage the pain of bones and to heal boils. The plant is also used to soothe intestinal inflammation and sore throat, heal stomach ulcers and painful hemorrhoids, and to expel impurities. In Malaysia, a decoction of dried flowers is drunk cool to combat fever, assuage headache and to heal boils. A distillate of flowers is used to assuage stomachaches. In Vietnam, a decoction of 10 g–20 g of stems or 4 g–8 g of flowers is used to heal boils, treat syphilis, rheumatism, impetigo, urticaria, allergic rhinitis, malaria, erythema, measles, combat fever and to curb diarrhea and dysentery.

Pharmaceutical interest: The oil obtained by from the distillation of the flowers of *Lonicera japonica* Thunb. contains linalool, geraniol, aromadendrene and eugenol (Chang WC *et al.*, 1998), containing antiseptic and analgesic properties mentioned above. *Lonicera japonica* Thunb. elaborates a number of iridoid glycosides such as loniceracetalide A (Kakuda R *et al.*, 2000), and triterpenoid saponins, which may also contribute to the medicinal properties. Saponins characterized from *Lonicera fulvotomentosa* protect rodent against cadmium-induced liver poisoning (Liu YP *et al.*, 1992).

Anti-inflammatory properties: The anti-inflammatory and antipyretic property of *Lonicera japonica* Thunb. is confirmed and involves a biflavonoid that inhibits the enzymatic activity of rat platelet phospholipase A₂ with an IC₅₀ value of 3 μM in an irreversible, concentration- and pH-dependent manner (Chang HW *et al.*, 1994). Phenylethanoid glycosides of *Lonicera japonica* Thunb. such as 3, 5-di-*O*-caffeoylquinic acid inhibit the enzymatic activity of reverse transcriptase activity of the Human Immunodeficiency Virus type 1, with an IC₅₀ value of 1.16 μM (Chang CW *et al.*, 1995) and may also contribute to the anti-inflammatory element of this plant, similar to saponins and iridoid glycosides. Note that an aqueous extract of flowers of *Lonicera japonica* Thunb. inhibits lipopolysaccharide-induced inflammation through the regulation of NF-κ B activation (Lee JH *et al.*, 2001). Luteolin inhibits the production of TNF-α-induced interleukin-8 human colon epithelial cells (Kim JA *et al.*, 2005).



Loniceracetalide A



3, 5-di-O - caffeoylquinic acid

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 Liu YP, *et al.* (1992) *C K Y L H P* **13**(3): 213–217.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Viburnum dilatatum Thunb.

[From Latin, *viburnum* = a plant name and *dilatatum* = expanded]

Physical description: It is a deciduous shrub native to Japan, grown in several Temperate countries as an ornamental plant. The stems are velvety when young and lenticled. Leaves: simple, opposite and without stipules. The petiole is 1 cm–1.2 cm long and velvety. The blade is pubescent, papery, 4.7 cm × 2.8 cm–7.4 cm × 5.7 cm, orbiculate-elliptic. The base of the blade is round-cordate and the apex is shortly acuminate. The blade shows 7–9 pairs of secondary nerves. The margin is serrate, the midrib sunken and filled with hairs above. The inflorescences are terminal, showy and velvety panicles. The flowers are white and very small. The calyx comprises of 5 sepals which are velvety. The corolla is tubular, pubescent and 5 lobed and the lobes are round.

Common names: Linden Viburnum, linden arrow-wood; *jia mi* (Chinese).

The andrecium comprises of 5 stamens. The fruits are small, bright red and glossy (Fig. 362).

Uses: In China: *Viburnum dilatatum* Thunb. is used to expel intestinal worms and to heal infected wounds.

Pharmaceutical interest:

Antioxidant properties: The juice expressed from the fruits of *Viburnum dilatatum* Thunb. shows strong antioxidant activity, inhibits gastric ulcer formation, lowers plasma, liver and stomach concentrations of lipid peroxide, lowers the activities of plasma lactic dehydrogenase, amylase and the creatine phosphokinase in rats when experimentally stressed (Iwai K *et al.*, 2001), due to phenylethanoid glycosides, iridoid glycosides or flavonoids.

The plant is known to produce unusual dammarane-type triterpenes called viburnols, such as viburnol K (Machida K *et al.*, 1997), which might involve the anthelmintic property of *Viburnum dilatatum* Thunb., but this has yet to be confirmed.

Other pharmacological properties: Ursolic acid isolated from the aerial parts of *Viburnum juncundum* Morton is cytotoxic towards 3 human cancer cell lines cultured *in vitro* (Rios MY *et al.*, 2001). A number of water-soluble polysaccharides isolated from the berries *Viburnum opulus* enhance phagocytosis

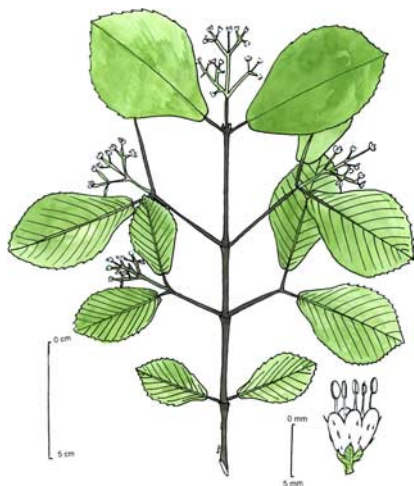
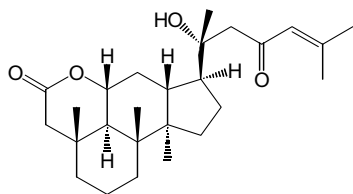
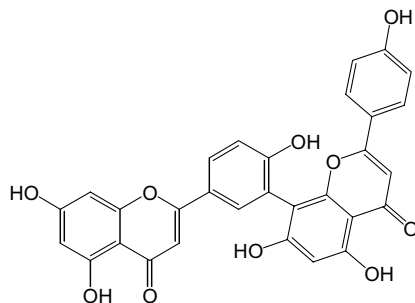


Fig. 362. *Viburnum dilatatum* Thunb. From Herbarium 14160. Field collector: H Ohashi, T Nakaïke & Y Tateishi. 14 June 1970. Geographical localization: Japan, Shizuoka Pref., Izu Penin., Tanaga-gun, altitude: 400 m.



Viburnol K



Amentoflavone

and in particular, the phagocytic index, and boost the secretion of lysosomal enzymes with peritoneal macrophages (Ovodova RG *et al.*, 2000). Methanol and ethyl acetate leaf extracts of *Viburnum toronis* Killip et Smith relax uterine and are analgesic at dosages of 250 mg/Kg (Calle J *et al.*, 1999), confirming the empirical use of *Viburnum* species as myometrium sedative. Amentoflavone, a biflavonoid extracted from *Viburnum lantana* L., inhibits the enzymatic activity of human platelet cAMP phosphodiesterase with an IC₅₀ value of 22.0 μM (Beretz A *et al.*, 1986).

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

H. Order ASTERALES Lindley 1833

This order consists of a single family: Asteraceae, thought to have originated in or near the Rubiales along with the Dipsacales (Appendix I). In terms of evolution, Asteraceae is the final outshoot in Magnoliopsida.

1. Family ASTERACEAE Dumortier 1822 *nom. conserv.*, the Aster Family

Physical description: The family Asteraceae or Compositae consists of approximately 1100 genera and 20 000 species of herbs which are cosmopolitan. The chemical weapons used here are a series of *sesquiterpene lactones*, *polyacetylenic fatty acids*, and *pyrrolizidine alkaloids* and flavonoids. The leaves are simple, without stipules, alternate or opposite. The most characteristic botanical feature of Asteraceae is a flower-like inflorescence known as capitulum. The capitulum consists of a receptacle onto which several tiny flowers known as florets are inserted. These florets are epigynous, ligulate or conical.

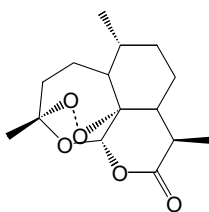


The calyx is thread-like and forms a pappus. The corolla is tubular and 4–5-lobed. The andrecium consists of 4–5 stamens which are epipetalous and

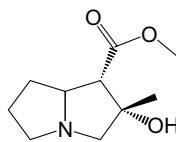
included in the corolla tube. The andrecium consists of a few stamens which are free. The anthers are 2-celled and open longitudinally, and are connate into a tube. The gynecium consists of a pair of carpels, forming an inferior and unilocular ovary containing a single anatropous ovule attached to a basal placenta. The style is bifid in bisexual flowers. The fruits are small, dry and indehiscent achenes crowned with a persistent pappus.

Pharmaceutical interest: The family Asteraceae is a prolific reserve of ornamental plants. Common examples of Asteraceae are *Helianthus annuus* L. (sunflower) and *Chrysanthemum cinerariaefolium* (Trev.) Vis. (pyrethrum). Among which *Chamaemelum nobile* (L.) All. (Roman chamomile), *Achillea millefolium* L. (yarrow), *Chamomilla recutita* (L.) Rauschert and *Calendula officinalis* L. *Cichorium intybus* L. (chicory), *Taraxacum officinale* Weber (dandelion), *Cynara scolymus* L. (artichoke), and *Silybum marianum* (L.) Gaertn. (St. Mary thistle) and are used to assuage liver discomfort.

Sesquiterpene lactones: Sesquiterpene lactones impart a bitter taste. These are unevenly spread in the family Asteraceae and have exhibited a broad array of pharmacological activities and properties such as antibacterial, anti-fungal, antiparasites, anthelmintic, antiphlogistic, cytotoxic and antispasmodic. *Artemisia annua* L. (wormwood, *qinghaosu*) has been used in China since A.D. 317 to treat malaria. It contains artemisinin, a sesquiterpene lactone used to treat chloroquine-resistant *Plasmodium falciparum* infection. Examples of cytotoxic sesquiterpene lactones are baccharin, characterized from *Baccharis megapotamica*, elephantopin characterized from *Elephantopus elatus*, helenalin characterized from *Helenium autumnale* and liatrin characterized from *Liatris chapmanii*.



Artemisinin



Tussilagin

Pyrrolizidine alkaloids: Asteraceae have the tendency to be poisonous given the pyrrolizidine alkaloids which are drastically hepatotoxic. One such alkaloid is tussilagine from *Tussilago farfara* L., *Eupatorium cannabinum* L. (hemp agrimony), *Senecio jacoboea* L. (European ragwort) and *Senecio vulgaris* L. (common groundsel).

Polyacetylenic fatty acids: These acids present in the family Asteraceae, differ from the polyacetylenic fatty acids of Campanulaceae and Araliaceae in terms of cyclic, aromatic or heterocyclic end-groups. These are antimicrobial, cytotoxic, nematocidal, ichthyotoxic and are present notably in *Arctium lappa* (burdock) and *Echinacea* species used to counteract putrefaction and to heal wounds.

One might be surprised that such a large and interesting family is not the source of a couple of therapeutic molecules yet. It is worth exploring further the family for oligo or polysaccharides or even peptides of chemotherapeutic value. Note that *Tanacetum parthenium* (L.) Schultz-Bip. (feverfew) prevents acute attack of headache in double blind clinical trials. Approximately 150 species of plants classified within the family Asteraceae are used for medicinal purposes in the Asia-Pacific.

***Adenostemma lavenia* (L.) O. Ktze.**

[From Latin, *adenostemma* = glandular crown]

Synonymy: *Adenostemma viscosum* Forst., *Verbesina lavenia* Linn.

Common names: Common medicine plant, club wort; *rumput tahi babi*, *sumbong gajah*, *rumput pasir* (Malay); *daun tempel daging boton* (Filipino); *tuyenhung* (Vietnamese); *pepepepe* (Samoan).

Physical description: It is a herb which grows to a height of 30 cm. The plant is found in open, wet places along streams, in forest and in thickets, from sea level to an altitude of 1800 m. The stems are branched and are relatively pubescent. Leaves: simple, opposite, without stipules. The petiole is 5 mm–6 cm long. The blade tapers at the base, serrate, 10 cm–15 cm × 5 cm–8 cm, extremely thin, ovate-acuminate, and deltoid. The inflorescences are lax, 15 cm long, spreading to the capitula in terminal

Uses: In Indonesia, the pounded leaves are used to heal burns. A lotion of leaves is used to stimulate hair growth. The sap expressed from the leaves mixed with *Centella asiatica* L., and *Phyllanthus niruri* L. is drunk to assuage colic. In Malaysia, a poultice of the powdered leaves is used to treat vertigo, assuage headache, curb diarrhea and to combat fever. The sap expressed from the leaves is used to heal syphilitic ulceration of the nose and to soothe inflamed eyes. A decoction of the leaves is used to improve skin complexion. A decoction of the roots is used to assuage stomachache. In Taiwan, the liquid obtained in boiling the leaves with liquors is used to soothe swollen parts and to stimulate blood circulation. The therapeutic potential of *Adenostemma lavenia* (L.) O. Ktze. remains unexplored. Note that the plant is known to produce *ent-11- α -hydroxy-19-kauranoic acids* (Cheng PC *et al.*, 1979). Kaurane diterpenes are interesting, having the tendency to induce apoptosis.

corymbose cymes. The flowers are white, 5 mm long and 5-lobed. The fruits are 5-ribbed and glandular achenes (Fig. 363).

Reference

Cheng PC, *et al.* (1979) *J Nat Prod* **42**: 183.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

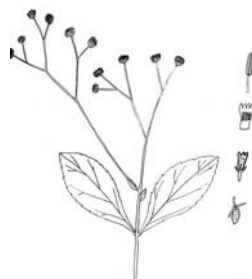


Fig. 363. *Adenostemma lavenia* (L.) O. Ktze.

Ageratum conyzoides L.

[From Latin, *ageratum* = a plant that does not wither readily and *conyzoides* = resembling to conyza]

Common names: White weed, appa grass, conyzoid floss-flower, bastard agrimony, common cocklebur; *tahi ayam*, *tombok jantan*, *sianggit*, *ara batu* (Malay); *babadotan* (Indonesian); *herbe à madame* (French); *cay cut lon*, *bu xich*, *cohoi* (Vietnamese).

Physical description: It is a common tropical invasive herb which grows 90 cm annually. The stems are terete and hairy. Leaves: simple, exstipulate, opposite below, and alternate upward. The petiole is 5 mm–2.5 cm long. The blade is very thin, 2.5 cm–7 cm long, ovate or cuneate and shows 2–3 pairs of secondary nerves. The apex of the blade is acute and the margin is serrate. The inflorescences are 5 mm in diameter with the capitula arranged in corymbs. The involucre is campanulate and comprise of 2–3 whorls of linear bracts. The flowers are white. The style is purple. The calyx lobes are lanceolate, acuminate and hairy. The fruits consist of black, hairy achenes with persistent calyx lobes (Fig. 364).



Fig. 364. *Ageratum conyzoides* L.

Pharmaceutical interest:

Antimicrobial properties: The essential oil of *Ageratum conyzoides* L. inhibits the proliferation of several Gram-positive and Gram-negative bacteria and fungi cultured *in vitro* (Pattnaik S *et al.*, 1996).

Cardiovascular properties: An aqueous extract of *Ageratum conyzoides* L. given *per os* (0.1 g/Kg to 5 g/Kg) calms and lowers the spontaneous motility of rodent. The sleeping time caused by sodium pentobarbital (50 mg/Kg, intraperitoneal injection) in mice is not altered by previous treatment with the aqueous extract (2 g/Kg, *per os*). In isolated guinea pig ilea, the aqueous extract (0.01 mg/mL–10 mg/mL) contracts dose-dependently ileal smooth muscle portions and this effect is blocked by diphenhydramine (10 nM) and reduced by 32% in the presence of atropine (10 nM). *In vitro* the extract displays histamine-like property (Yamamoto LA *et al.*, 1991). An extract of the leaves of *Ageratum conyzoides* L. changed the electrocardiogram, the atrial impulse velocity and the coronary vessels, resistance of isolated guinea pig hearts (Garcia EA *et al.*, 1999). Is the principle involved one of pyrrolizidine alkaloid?

Uses: In Indonesia, a decoction or a paste of the roots is used to combat fever. In India, a paste of the powdered leaves is used to heal wounds and to check bleeding. The juice expressed from the root is drunk to expel urinary stones. In Malaysia, a poultice of the powdered leaves is used to curb diarrhea. In the Philippines, the leaves are used to treat flatulence. In Taiwan, an infusion of *Ageratum conyzoides* L. is drunk to treat gonorrhoea. The leaves pounded with lime or cooking oil are used to heal cuts, wounds, sores, boils, abscesses, bites, and to soothe contusion, swollen parts and irritable skin. In Vietnam, the juice expressed from the fresh plant is used to check uterine hemorrhage, to treat allergic rhinitis and sinusitis. A hair wash consisting of a decoction of the fresh *Ageratum conyzoides* L. is used to perfume and to soften the hair, as well as to remove dandruff.

Other properties: Anti-inflammatory and chronic toxicity study of the leaves of *Ageratum conyzoides* L. in rats are reported by Moura *et al.* (2005).

References

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Warning: *Ageratum conyzoides* L. contains hepatotoxic pyrrolizidine alkaloids.

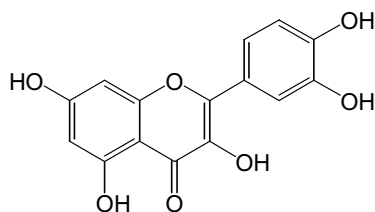
Artemisia vulgaris L.

[After the Greek Goddess *Artemis* and from Latin, *vulgus* = common people]

Physical description: It is a perennial herb which grows to height of 2.4 m. The young stems are terete and pubescent. Leaves: simple, alternate, without

Common names: Indian wormwood, mugwort, fleabane, felon herb, mothwort, sailor's tobacco; *ai* (Chinese); *bijvoet* (Dutch); *armoise*, *ceinture de St. Jean*, *herbe à cent goûts*, *herbe de St. Jean* (French); *alsei* (German); *amarella* (Italian); *baru cina*, *hiya*, *daun hia*, *bunga ayam hutan bateh* (Malay); *Santa Maria* (Filipino); *barha* (Sanskrit); *artemisia* (Spanish); *tirunama* (Tamil); *cuu ngai da* (Vietnamese).

stipules, pinnately lobed, dark green above, white-grey and pubescent below. The upper leaves are small, trifid or entire. The inflorescences are pendulous and terminal racemes of tiny whitish capitula. The flowers are greenish-yellow. The achenes are tiny, oblong and ellipsoid (Fig. 365).



Quercetin

Pharmaceutical interest:

Chemotherapeutic properties: The genus *Artemisia* received growing attention presumably owing to the discovery of artemisinin, an antimalarial endoperoxidic sesquiterpene lactone characterized from *Artemisia annua* L. (Fesen HR *et al.*, 1994; Tan RX *et al.*, 1998). Sesquiterpene lactone of the guaianolides, secoguaienolides and eudesmanolides types and phenylchromenes inhibit the proliferation of several cancer cell-lines cultured *in vitro* (Jiang JY *et al.*, 1993). α -Santonin and β -santonin are antibacterial and antiprotozoal. They decrease rat temperature similar to that of dopamine (Martin ML *et al.*,



Fig. 365. *Artemisia vulgaris* L.

Uses: In Indonesia, the leaves are used to heal ulcers and to soothe sores. In the Philippines, the leaves are used during childbirth. The aerial parts are used to invigorate health, to treat flatulence and to promote digestion. In Vietnam, a decoction of 6–12 g of the entire plant is drunk to regulate menses, treat leucorrhoea, rheumatism, impetigo, check hemorrhagic dysentery, haemoptysis, epistaxis, regulate menses, curb vomiting, colic and to assuage neuralgia. The young leaves are used to assuage headache and pain. In Europe, the plant is used to treat flatulence and to assuage pain during menses. *Artemisia vulgaris* L. is official in France.

1988). Quercetin inhibits the replication of the Human Immunodeficiency Virus cultured in H9 lymphocytes (Ju CQ *et al.*, 1994).

Hepatoprotective property: 3- α -Hydroxycavotagenone, 3- β -hydroxycarvotagenone, esculin and scopoletin are hepatoprotective (Kim YS *et al.*, 1995). Note that coumarins are anti-inflammatory and analgesic. It would be interesting to research whether further studies on the coagulating properties of the plant would disclose any oligo – or polysaccharides of therapeutic interest.

References

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Bidens pilosa L.

[From Latin, *bis* = twice and *dens* = tooth and *pilus* = hair]

Synonymy: *Bidens odorata* Cav., *Bidens pilosa* L. var. *bimucronata* (Turcz.) Schultz-Bip., *Bidens pilosa* L. var. *minor* (Blume) Sherff.

Common names: Hairy beggarticks, Spanish needle; *kuei chen ts'ao* (Chinese); *rumpul juala, kanching baju* (Malay); *cue ao, quay cham thao* (Vietnamese).

Physical description: It is a herb which grows to a height of 60 cm. The stems are glabrous or pilose. Leaves: trifid or tripartite, opposite, without stipules, and 7.5 cm long. The petiole is 1.2 cm–7.5 cm long. The blade is ovate to lanceolate and serrate. The inflorescences consist of a capitula of 8 mm–1 cm in diameter. The flowers are yellowish white. The bracts are

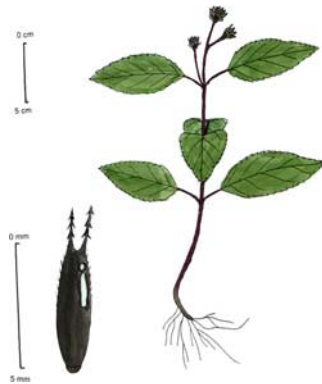


Fig. 366. *Bidens pilosa* L. From: KLU Herbarium 040585. Flora of the Hawaiian Islands. Herbarium of Bernice P. Bishop Museum. Geographical localization: Oahu, Waianae Mts., Central Lualualei, below Kanehoa, foot of cliffs, Hawaii. Herb of valley 2, altitude: 450 m. Field collector: 1 June 1932. E Christophersen. Botanical Identification: FR Ganders, 8 Jan 1985.

oblong with scarious edges. The fruits consist of black, long, narrow, ribbed and 5 mm long achenes. The pappus consists of retrorsely-bearded prickles (Fig. 366).

Pharmaceutical interest:

Chemotherapeutic properties: A methanolic extract of *Bidens pilosa* L. displays a potent antimicrobial property *in vitro* against Gram-positive bacteria (Rabe T *et al.*, 1997). A chalcone ester glycoside characterized from *Bidens leucantha* inhibits moderately the replication of the Human Immunodeficiency Virus (De Tommasi N *et al.*, 1997). Chloroformic and butanolic fractions (50 µg/mL) of *Bidens pilosa* L. inhibit up to 90% of the proliferation of *Plasmodium falciparum* cultured *in vitro*

and lowered parasitaemia in mice (Brandas MG *et al.*, 1997). A water extract of *Bidens pilosa* var. *minor* inhibits the growth of a number of leukaemia cell-lines cultured *in vitro* at dosages ranging from 145 µg/mL to 586 µg/mL (Chang JS *et al.*, 2001). An extract of the plant is chemopreventive (Chiang YM *et al.*, 2004).

Gastro-intestinal properties: An aqueous extract of *Bidens pilosa* L. alleviates dose-dependently the contraction caused by potassium chloride (60 µM) and noradrenaline (10^{-5} M) on aortic strips with intact and physically damaged endothelium (Dimo T *et al.*, 1998). Extracts of *Bidens pilosa* L. inhibit the enzymatic activity of cyclo-oxygenase *in vitro* (Jager K *et al.*, 1996) and counteract liver carbon tetrachloride- and acetaminophen-poisoning mice (Chin HW *et al.*, 1996). An ethanolic extract (0.5 g/Kg–2 g/Kg) decreases the gastric juice volume, acid secretion and pepsin secretion in pylorus ligated rats. This extract protects the stomach against indomethacine-induced and ethanol-induced hemorrhagic lesions. This extract inhibits gastric hemorrhagic lesions caused by ethanol, with an effective dose of 2 g/Kg being more potent than sucralfate (400 mg/Kg). In contrast, ranitidine (50 mg/Kg) failed to lower these lesions (Alvarez A *et al.*, 1999). These gastric effects could be related to cyclo-oxygenase.

Antidiabetes properties: *In vivo* bioassay-guided fractionation of an alcohol extract of the aerial parts of *Bidens pilosa* Sch. Bip. var. *radiata*, using C57 BL/Ks-db/db mice as a model for type 2 diabetes, resulted in the characterization of 2 polyacetylenic glucosides: 2-β-D-glucopyranosyloxy-1-hydroxy-5(E)-tridecene-7,9,11-triynone and 3-β-D-glucopyranosyloxy-1-hydroxy-6(E)-tetradecene-8,10,12-triynone (Ubillas RP *et al.*, 2000). It would be

Uses: In China, a decoction of the leaves mixed with rice wine is used to invigorate health after choking, assuage lung discomfort and to check bleeding. In Vietnam, a poultice is used to counteract putrefaction of the eyes. In Malaysia, the leaves are chewed or applied to the gums to assuage toothache. A decoction of the plant is bechic. In Solomon Islands, the roots are used to assuage stomachache.

interesting to understand the exact molecular mechanism in which these glycosides lower the serum levels of glycemia.

References

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Blumea balsamifera (L.) DC.

[From Latin, *balsamum* = balsam and *ferre* = bear]

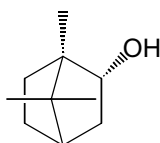
Synonymy: *Blumea grandis* DC.,
Baccharis salvia Lour.

Common names: *ngai* camphor;
ponmathei (Burmese); *baimat*
(Cambodian); *ai na hsiang* (Chinese);
capa, *sembong*, *sapu* (Malay);
camphrée (French); *dai bi*, *tu bi*
(Vietnamese).

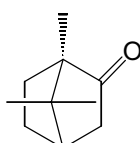
Physical description: It is a shrub which grows to a height of 3 m. The plant is found in a geographical zone, ranging from India to Southern China. Leaves: simple, without stipules and alternate. The petiole is 2.5 cm long. The blade is 7 cm–13 cm × 2.5 cm–5 cm, extremely thin, elliptic-lanceolate, serrate-dentate and hairy beneath. The inflorescences consist of 5 mm long capitula in large terminal panicles. The ray-florets are female, filiform and 2–3-lobed. The disc-florets are few and bisexual. The involucre is ovoid. The bracts are linear acuminate and hairy. The fruits consist of 10-ribbed achenes with red pappus (Fig. 367).



Fig. 367. *Blumea balsamifera* (L.) DC.



Borneol



Camphor



Cineole

Pharmaceutical interest: *Ngai* camphor consists of a mixture of borneol, camphor and cineole which are antibacterial, carminative, antispasmodic and vulnerary. 5, 3', 5'-Trihydroxy-7-methoxy-dihydro-flavone from *Blumea balsamifera* (L.) DC. protects rats against carbon tetrachloride intoxication (Xu SB *et al.*, 1993). Note that the flavonoids from the plant scavenge the free radicals (Nessa F *et al.*, 2004).

References

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Uses: The plant is a source of an aromatic resin known as *ngai* camphor. In China, Taiwan and Japan, *ngai* camphor is used to combat fever, treat flatulence, promote expectoration and to counteract putrefaction. In Indonesia, the leaves are used to promote urination and to invigorate health. In Malaysia, a decoction of the leaves is drunk to treat beriberi, lumbago, rheumatism and to promote recovery from childbirth. The crushed leaves are used to check bleeding, to heal wounds and to assuage headache. In Vietnam, a decoction of 6g–12g of leaves is drunk to treat coryza and influenza, combat fever, alleviate cough and to promote digestion. A poultice of leaves is used to heal hemorrhoids and an alcoholic extracts is used to treat rheumatism.

Carpesium abrotanoides L.

[From Greek, *habrótonon* = *Artemisia abrotanum*]

Physical description: It is a wild herb which grows to a height of 80 cm in Asia. The stems are terete, ribbed and velvety. Leaves: simple, spiral and without stipules. The petiole is very short, channeled and velvety. The blade is lanceolate, serrate, papery, velvety

Common names: Pig's head; *tianming jing* (Chinese); *yabutabako* (Japanese).

Synonymy: *Carpesium thunbergianum* Sieb. & Zucc.

below, 2.5 cm–8 cm × 6 mm–2.6 cm and shows 3–5 pairs of secondary nerves. The inflorescences are axillary capitula which are velvety and bracteate (Fig. 368).

Uses: In China and Taiwan, the plant is used internally to treat sore throat, induce vomiting, relieve the bowels from costiveness, facilitate expectoration and to expel intestinal worms. A paste of the plant is applied to boils, abscesses, and the bites occasioned by insects and dogs. The shoots and leaves are eaten as salad. In Cambodia, Laos and Vietnam, the plant is used to relieve the bowels of costiveness and to treat lung diseases.



Fig. 368. *Carpesium abrotanoides* L. From: KLU Herbarium 042745. Plants of Hunan (China). Geographical localization: Xining Co., 26° 4' North–110° 8' East, altitude: 400 m, China. 21 Aug 1994.

Pharmaceutical interest: One might hypothesize that the medicinal properties of *Carpesium abrotanoides* L. are partly attributed to the sesquiterpene lactones which are known to abound in *Carpesium* species.

Anti-inflammatory properties: 2β , 5-epoxy-5,10-dihydroxy- 6α -angeloyloxy- 9β -isobutyloxy-germacran- 8α ,12-olide from *Carpesium divaricatum* decrease lipopolysaccharide/interferon- γ (LPS/IFN-gamma)-induced nitric oxide production in RAW 264.7 macrophages, in a concentration-dependent manner with an IC_{50} value of 2.16 μ M (Kim EJ *et al.*, 2001).

Antibacterial and cytotoxic properties: Antibacterial sesquiterpene lactones are known to be present in the roots of *Carpesium cernuum* L. (Zee OP *et al.*, 1998). Four sesquiterpene lactones of the germacranolide type, cardivins A, B, C and D, characterized from the aerial parts of *Carpesium divaricatum*, are cytotoxic towards the human tumor cells, A-549 (non-small cell lung), SK-OV-3 (ovary), SK-MEL-2 (skin), XF-498 (central nervous system), and HCT-15 (colon) (Kim DK *et al.*, 1997). Two acyclic diterpenes (2E,10E)-1,12-dihydroxy-18-acetoxy-3,7,15-trimethylhexadeca-2,10,14-triene and 12(S)-hydroxygeranylgeraniol, isolated from the aerial parts of *Carpesium divaricatum*, are cytotoxic against human tumor cell lines, A549, SK-OV-3, SK-MEL-2, XF498, and HCT15, cultured *in vitro* with ED_{50} values ranging from 4.3 μ g/mL–10.2 μ g/mL and 4.1 μ g/mL–8.3 μ g/mL respectively (Zee OP *et al.*, 1999). It would be interesting to learn whether a more intensive study on this plant would disclose any sesquiterpene lactones of chemotherapeutic interest.

References

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Dichrocephala latifolia (Lamk.) DC.

[From Greek, *di* = two and *chrōs* = colour and *kephalē* = head, and from Latin, *latus* = broad and *folium* = leaf]

Synonymy: *Dichrocephala bicolor* (Roth) Schlect., *Cotula latifolia* Pers., *Grangea latifolia* Lam. ex Poir., *Dichrocephala integrifolia* (L.f.) O.K.

Common name: *Cho kè* (Vietnam).

Physical description: It is a herb which grows to a height of 40 cm in Southeast Asia, South China, Australia and Pacific Islands. The stems are subglabrous and somewhat angular. Leaves: simple, spiral, and without stipules. The petiole is channeled, hairy and 3 mm–9 mm long. The blade is hairy, obovate, 3.8 cm × 2.5 cm–1.2 cm × 8 mm. The base is hastate. The margin is serrate. The midrib is filled with hairs. The blade shows 3–5 pairs of secondary nerves. The inflorescences are terminal racemes of globose purplish capitula (Fig. 369).

Pharmaceutical interest: 3, 4-Dicaffeoylquinic acid and 5-caffeoylquinic acid isolated from *Dichrocephala latifolia* (Lamk.) DC. enhance the proliferation of human mononuclear cells and the production of interferon- γ

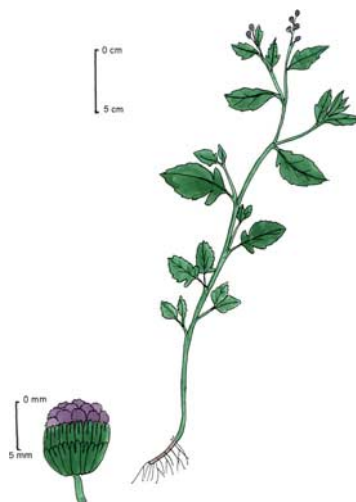


Fig. 369. *Dichrocephala latifolia* (Lamk.) DC. From: KLU Herbarium 9139. Field collector & botanical identification: JMB Smith. 12 Aug 1967. Geographical localization: Mt. Kinabalu, altitude: 11 000 ft, near Panar, Laban huts, herb growing near huts in open site cleared of shrub and tree, Sabah.

Uses: In Indonesia, *Dichrocephala latifolia* (Lamk.) DC. is used to promote urination and the secretion of sweat. In Taiwan, the plant is used to resolve swelling and to heal ulcers. In Cambodia, Laos and Vietnam, the plant is used to heal bites occasioned by insects and to counteract putrefaction of the genital parts.

(Lin C *et al.*, 1999). Essential oils, obtained by distillation from the leaves and the flowers of *Dichrocephala latifolia* (Lamk.) DC., contain sesquiterpenes with germacrene-D in it (Kuiate JR *et al.*, 1999).

Reference

Kuiate JR, *et al.* (1999) *Fragrance Journal* 14(6): 419–420.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Eclipta prostrata (L.) L.

[From Latin, *sternere* = lay flat]

Synonymy: *Eclipta erecta* L., *Eclipta alba* (L.) Hassk., *Verbesina alba* L., *Verbesina prostrata* L.

Common names: White heads, false daisy; *aring aring*, *rumpu beu*, *kurumak jantan* (Malay); *chin han lien ts'ao* (Chinese); *ajagara* (Sanskrit); *kaikeshi* (Tamil); *balari* (Hindi); *muc*, *nho noi*, *nha cha chat* (Vietnamese); *takasaburou* (Japanese); *éclipte blanche* (French); *hierba de tajo* (Spanish); *miri mapua* (Cook Islands); *tamudu* (Fiji); *deberebelela tengadidik* (Palau)



Fig. 370. *Eclipta prostrata* (L.) L.

Physical description: It is a creeping herb which grows annually to a height of 30 cm. The plant is found in drains, marsh and swampy roadsides of India, Southeast Asia, China, Japan, Taiwan, Pacific Islands, and South and North America. The stems are purple, succulent, hairy and characteristically swollen between the nodes. Leaves: simple, 2.5 cm–7.5 cm × 5 mm–7 mm, hairy, without stipules and opposite. The petiole is short.

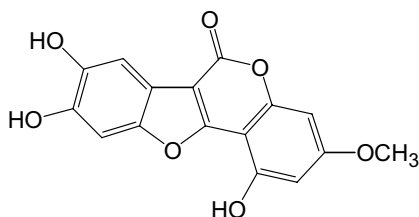
The blade is linear, oblong, lanceolate, denticulate, hirsute on both sides and narrowed at both ends. The flowers are arranged in axillary capitula attached to pedicels that are 2.5 cm–3 cm long. The capitula are 5 mm–9 mm in diameter, rayed white and sunflower-shaped. The involucre is campanulate; the bracts are brown green and are longer than the flowers. The flower receptacle is flat and discoid. The ray flowers show small entire or bifid white ligules. The fruits consist of subcompressed and triangular achenes (Fig. 370).

Pharmaceutical interest:

Anti-inflammatory property: Polar extracts of *Eclipta prostrata* (L.) L. inhibit the effects of *Bothrops jaraca* and *Calloselasma rhodostoma* venoms and abrogates the enzymatic activity of phospholipase A₂ of crotoxin *in vitro*, given coumarin: wedelolactone (Melo PA *et al.*, 1994; Pithayanukul P *et al.*, 2004). One might hypothesize that the anti-inflammatory and anti-febrile properties mentioned are the result of a direct inhibition of phospholipase A₂, cyclo-oxygenase or prostaglandines synthetase activities by wedelactone, which is known to inhibit trypsin *in vitro* with an IC₅₀ value of 2.9 μg/mL (Syed SD *et al.*, 2003). A methanol extract is immunomodulatory (Jayathirtha MG *et al.*, 2004).

Uses: In China, the juice expressed from the leaves of *Eclipta prostrata* (L.) L. is used to keep the hair black and to stimulate its growth. The pounded plant is used to check bleeding, to heal wounds and burn, and to soothe contusion. A decoction of the plant is used to check bleeding and to invigorate health. In India, *Eclipta prostrata* (L.) L. is used to invigorate health and to assuage hepatic and spleen discomfort. In Malaysia, the plant is used to promote recovery from childbirth. In the Philippines, the plant is used to assuage liver discomfort. In Vietnam, *Eclipta prostrata* (L.) L. is used to treat mycosis, assuage lung discomfort, treat asthma, bronchitis and to invigorate breathing.

Note that the plant is known to elaborate a series of cytotoxic steroidal alkaloids (Abdel-Kader MS *et al.*, 1998). An aqueous extract of the plant protects rats against carbon tetrachloride poisoning (Saxena AK *et al.*, 1993).



Wedelolactone

References

- Abdel-Kader MS, *et al.* (1998) *J Nat Prod* **61**(10): 1202–1208.
 Jayathirtha MG, *et al.* (2004) *J Ethnopharmacol* **90**(2–3): 347–352.
 Melo PA, *et al.* (1994) *Toxicol* **32**(50): 595–603.
 Saxena AK, *et al.* (1993) *J Ethnopharmacol* **40**(3): 155–161.
 Syed SD, *et al.* (2003) *Phytother Res* **17**(4): 420–421.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Elephantopus scaber* L.**

[From Latin, *elephantopus* = elephant foot and *scaber* = rough]

Common names: *Katoopin* (Burmese); *ku di dan* (Chinese); *pied d'éléphant*, *lastron marron* (French); *darvi* (Sanskrit); *anashovah* (Tamil); *teng khia* (Taiwan); *dila dila* (Filipino).

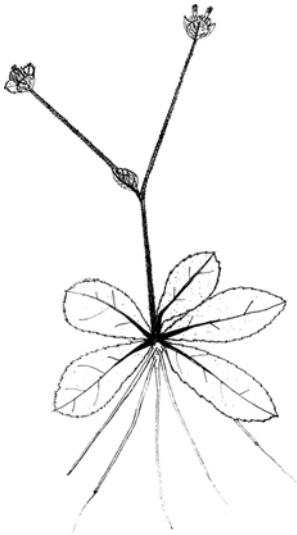


Fig. 371. *Elephantopus scaber* L.

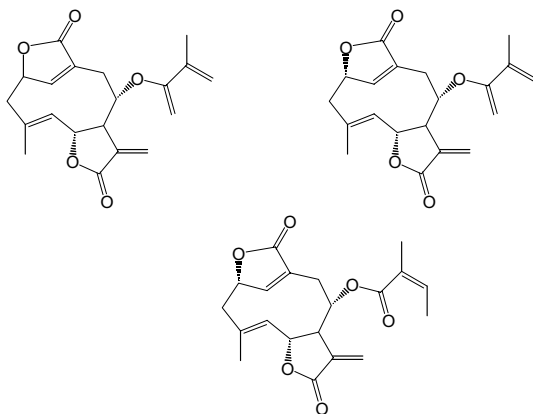
Uses: In Burma, a decoction of the stems and leaves is drunk to regulate menses. In Malaysia, the scraping of the roots in betel quid is used to curb vomiting and the leaves are eaten as salad by Chinese. In Vietnam, the plant is used to promote urination and recovery from childbirth. A decoction of the entire plant is used to treat pulmonary diseases and to soothe inflamed parts. A decoction of the leaves is used to treat venereal diseases. In India, the plant is used to invigorate health, relieve the bowels from costiveness, assuage pain, soothe inflammation and to stimulate venereal desire. In the Philippines, the plant is used to combat fever and to promote urination. In Taiwan, the roots are used to assuage pain in the chest. In Indonesia, the roots pounded in water are used to treat leucorrhoea and anemia. The plant is used to promote urination and to combat fever. In China, the plant is used to promote urination and to soothe inflammation.

Physical description: It is a tropical herb which grows to a height of 1 m in vacant plots, open jungle paths and villages of the Asia-Pacific. The roots are tubercular, and the stems are rigid, terete and hairy. The stems are rigid. Leaves: simple, without stipules, forming a characteristic rosette on the ground and alternating upwards. The petiole is short and hairy. The blade is obovate, oblong, obtuse, margin crenulated, hairy and 5 cm–10 cm × 1.2 cm–3 cm. The inflorescences are 1.2 cm–2 cm, terminal capitula with a pair of leaf like outer bracts. The bracts are oblong, acute, about 8, green and hairy. The flowers are 4-lobed, and whitish-pink. The calyx is bristly and prickly. The fruits consist of 10-ribbed achenes. The pappus consists of 5 prickly bristles (Fig. 371).

Pharmaceutical interest:

Anti-inflammatory and hepatoprotector properties: The anti-inflammatory property of *Elephantopus scaber* L. is confirmed: *teng khia u*, a Taiwanese drug consisting of *Elephantopus scaber* L., *Elephantopus mollis* H. B. K. and *Pseudoelephantopus spicatus* (Juss.) Rohr., reduces acute arthritis caused by carrageenan (Chin CT *et al.*, 1999) significantly and lowers the serum levels of glutamate oxalic acetic transaminase [aspartate aminotransferase] (SGOT) and glutamate pyruvic acid transaminase [alanine aminotransferase] (SGPT) in animals, poisoned with β -D-galactosamine and acetaminophen (Lin C *et al.*, 1995).

Cytotoxic properties: *Elephantopus* species are interesting because they produce germacranolide sesquiterpenes which are cytotoxic, such as elephantopin characterized from *Elephantopus elatus* (Kupchan SM *et al.*, 1969). *Elephantopus scaber* L. contain cytotoxic germacranolide sesquiterpenes (But PPH *et al.*, 1997), the cytotoxicity of which would be worthwhile testing.



deoxyelephantopin

isodeoxyelephantopin

scabertopin

References

- But PPH, *et al.* (1997) *Phytochem* **44**(1): 113–116.
 Chin CT, *et al.* (1999) *J Ethnopharmacol* **64**: 84–85.
 Kupchan SM, *et al.* (1969) *J Org Chem* **34**(12): 3867–3875.
 Lin C, *et al.* (1995) *J Ethnopharmacol* **45**(2): 113–123.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Emilia sonchifolia* (L.) DC.**

[From Latin, *sonchifolia* = having leaves like *Sonchus*]

Synonymy: *Cacalia sonchifolia* L., *Senecio sonchifolius* Moench, *Emilia javanica* (Burm. f.) C. B. Rob.

Common names: Cupiol's shaving brush; *hong pei ts'ao* (Chinese); *petit lastron* (French); *ketumbit*, *katumbit jantan*, *satunbak merah* (Malay); *chua le*, *la mat gjoj* (Vietnamese); *fua lele*, *fua lele lili'i* (Samoa).

Physical description: It is a herb which grows to a height of 30 cm by the roadsides and vacant plots of lands in Southeast Asia and Pacific Islands. Leaves: simple, somewhat fleshy and without stipules. The basal leaves are pinnatifid and 5 cm–10 cm long. The cauline leaves are hastate or linear, lobed or pinnate, sessile and auricular. The inflorescences are solitary capitula, 3 cm long and thin pedicels. The involucre is cylindrical, apple green, with asymmetrical, linear oblong lobes and bracts in 1 whorl. The flowers are bisexual, tubular and white. The limb is rose pink. The stamens and styles are pink tipped crimson. The fruits are achenes which are hairy, brownish and with tiny series of white prickles between the ribs (Fig. 372).

Pharmaceutical interest: The anti-inflammatory property of *Emilia sonchifolia* (L.) DC. is confirmed: aqueous and methanolic extracts of *Emilia sonchifolia* (L.) DC. protect rodent against paw edema (Muko KN *et al.*, 2000). Note that a methanolic extract of this plant inhibits the growth of Dalton's lymphoma, Ehrlich ascites carcinoma and mouse lung fibroblast cells

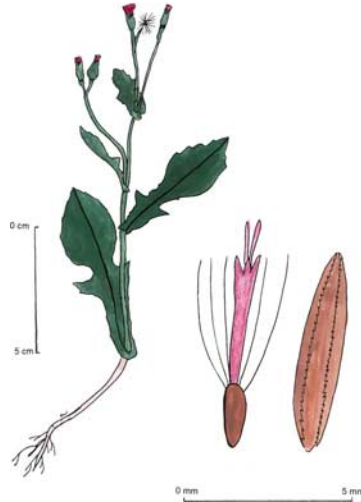


Fig. 372. *Emilia sonchifolia* (L.) DC. From: KLU Herbarium 36545. Flora of Malaya. Coll.: Lynwood M. Hume. 30 Oct 1983. Geographical localization: K. Terengganu, bought in central market, sold as green vegetable, Malaysia.

Uses: In China, a decoction of *Emilia sonchifolia* (L.) DC. is drunk to treat dysentery and used externally to heal abscesses, burns, soothe scalds and to treat numbness. In Indonesia, the roots are used to curb diarrhea and the juice expressed from the leaves is mixed with alcohol to apply externally to assuage backaches and to treat lumbago. In Malaysia, *Emilia sonchifolia* (L.) DC. is a remedy for phthisis and cough. The plant is also eaten as salad. In the Philippines, it is used to combat fever, to heal cuts and ulcers.

(L-929) cultured *in vitro* and extends the life span of tumor-bearing mice (Shylesh BS *et al.*, 2000). Could pyrrolizidine alkaloids or sesquiterpene lactones be detected?

References

- Muko KN, *et al.* (2000) *Fitoter* **71**(1): 65–68.
 Shylesh BS, *et al.* (2000) *J Ethnopharmacol* **73**(3): 495–500.

Warning: The plant contain hepatotoxic pyrrolizidine alkaloids.

Eupatorium fortunei Turcz.

[After Mithridates Eupator, King of Pontus about 115 BC and after Robert Fortune, 19th century Scottish horticulturist and collector in China]

Synonymy: *Eupatorium stoechadosmum* Hances.

Common names: Fortune eupatorium; *man tuoi*, *trach lan*, *lan thao* (Vietnamese); *pei lan* (Chinese).

Uses: In China, *Eupatorium fortunei* Turcz. is bitter, pungent, used to treat heat stroke with headache, combat fever, to stimulate the secretion of sweat and to freshen breath. In Japan, a decoction of the roots is drunk to regulate menses. In Vietnam, 10 g–20 g of the dried aerial parts are used to combat fever, assuage menstrual discomfort, treat colic following parturition, stop hematometra, treat edema, trauma, vertigo, furunculosis and impetigo.

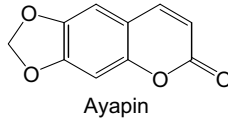


Fig. 373. *Eupatorium fortunei* Turcz.

Physical description: It is a perennial shrubby herb which grows in open lands and forest paths of China, Japan and Vietnam. The young stems are purplish and sulcate. Leaves: simple, without stipules, opposite and scented when crushed. The blade is oblong, acute and the margin is serrate. The inflorescences are dense terminal and axillary corymbs of several purplish capitula. The fruits are small and black achenes (Fig. 373).

Pharmaceutical interest: Note that the dried leaves of *Eupatorium triplinerve* or *Eupatorium ayapana* (Ayapana, *Indian Pharmacopoeia*, 1955) contains 2 haemostatic principles, 6,7-methylenedioxy coumarin (ayapin) and ayapanin. *Eupatorium ayapana* is used as a liquid extract (2 mL to 6 mL) to invigorate

health, combat fever and to check bleeding. *Eupatorium fortunei* Turcz. is known to produce expectorant principles (Cai DG, 1983) and several sorts of thymol derivatives (Tori M *et al.*, 2001). It would be interesting to determine whether a more intensive study on this plant would disclose any molecules of therapeutic interest such as ayapin.



References

- Cai DG, (1983) *Zhong Yao Tong Bao* **8**(6): 30–31.
 Tori M, *et al.* (2001) *J Nat Prod* **64**(8): 1048–51.

Warning: The plant contains probably hepatotoxic pyrrolizidine alkaloids.

Eupatorium odoratum L.

[After Mithridates Eupator, King of Pontus about 115 BC and from Latin, *odoratum* = fragrant]

Common names: Jack-in-the-bush; *pokok german* (Malay); *cỏ lào* (Vietnamese).

Uses: *Eupatorium odoratum* L. is used in Vietnam to heal wounds and burns.



Fig. 374. *Eupatorium odoratum* L.

Physical description: It is a shrubby tropical herb native to America, which grows to a height of 1.5 m on roadsides and open places of Southeast Asia and the Asia-Pacific. Leaves: simple, opposite, fragrant and exstipulate. The petiole is indistinct. The blade is deltoid, 5 cm–10 cm × 2.5 cm–1.25 cm, dull green, serrate and pointed at the apex. The inflorescences are terminal cymes of elongated capitula, consisting of several tubular, 8 mm long with whitish florets. The fruits are narrow, 5 mm long and angled achenes with a pappus of fine whitish bristles (Fig. 374).

Pharmaceutical interest:

Healing properties: An extract of *Eupatorium odoratum* L. inhibits the contraction of collagen lattice by human dermal fibroblasts and enhances the

proliferation of fibroblasts and endothelial cells (Phan TT *et al.*, 1996; 1998). Could polysaccharide be present in?

Other pharmacological properties: An ethanolic extract of *Eupatorium odoratum* inhibits *in vitro* the proliferation of a number of strains of *Neisseria gonorrhoea*, collected from symptomatic patients (Cacares A *et al.*, 1995).

References

- Cacares A, *et al.* (1995) *J Ethnopharmacol* **48**(2): 85–88.
 Phan TT, *et al.* (1996) *J Altern Complement Med* **2**(3): 335–343.
 Phan TT, *et al.* (1998) *Plast Reconstr Surg* **101**(3): 756–765.

Warning: The plant may contain hepatotoxic pyrrolizidine alkaloids.

Galinsoga parviflora Cav.

[Named for Mariano Martinez Galinsoga, 18th century Spanish physician and from Latin, *parviflora* = small flowers]

Synonymy: *Galinsoga parviflora* Cav. var. *semicalva* Gray, *Galinsoga semicalva* (Gray) St. John & White.

Common names: Gallant soldier, small-flower galinsoga, frenchweed, yellow weed, quickweed; *bribil* (Java); *galinsoga à petite fleurs* (French).

Uses: In Indonesia, *Galinsoga parviflora* Cav. is used to resolve inflammation. The pharmacological potential of *Galinsoga parviflora* Cav. remains unexplored.

Physical description: It is an annual and erect herb native to tropical America, growing to a height of 30 cm tall in urban areas, trails, open rocky sites or pastures of the Asia-Pacific from sea level to 1800 m. The stems are subglabrous, ribbed and fibrous. Leaves: simple, 2.6 cm–3.2 cm × 1.3 cm–1.6 cm, opposite and without stipules. The petiole is long and thin. The blade is lanceolate, serrate, obovate, showing 2–3 pairs originating from the base of the blade which is acute. The inflorescences are terminal yellow and white, globose capitula of approximately 5 mm in diameter attached to hairy pedicels of variable length (Fig. 375).

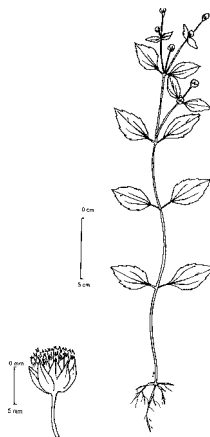


Fig. 375. *Galinsoga parviflora* Cav. From: Delhi University Herbarium 004389. Geographical localization: New Delhi. 5 Sep 1957.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Gnaphalium luteo-album* L.**

[From Greek, *gnaphalion* = a plant whose soft white leaves are used as cushion stuffing and from Latin, *luteus* = orange-colored and *albus* = white]

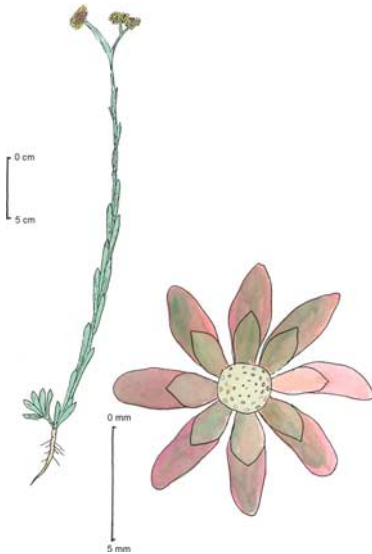


Fig. 376. *Gnaphalium luteo-album* L. From: KLU Herbarium 037112. Herbarium of Bernice P. Bishop Museum. Plants of New Zealand. Geographical localization: North Island, Waitemata County. Milford, Wairau Creek Estuary. Map. N38283701. 36°, 46' South-174°, 46' East, New Zealand. 20 March 1981. Field collector: EB Bangerter.

Synonymy: *Pseudognaphalium luteo-album* (L.) Hilliard & Burt *Gnaphalium affine* G. Don, *Gnaphalium multiceps* Wall., *Gnaphalium dichotomum* Blanco, *Gnaphalium indicum* F.-Vill., *Gnaphalium multiceps* Elm., *Xeranthemum staehelina* Blanco.

Common names: Jersey cudweed; *byaingchepui* (Burmese); *badok* (Filipino); *immortelle marrone* (La Reunion).

Uses: In China, *Gnaphalium luteo-album* L. is used to combat fever, treat malaria, lung diseases, lower blood pressure, assuage stomachache, heal intestinal ulcers and wounds. In India, the leaves are astringent and vulnerary. In Malaysia, a decoction of 30 g of the plant is used to combat fever, treat malaria, lung diseases, rheumatism and to lower blood pressure. *Gnaphalium dioicum* (*Gnaphalium*, *French Pharmacopoeia*, 1967) and *Gnaphalium uliginosum* (*Herba Gnaphalii Uliginosi*, *Russian Pharmacopoeia*, 1967) have been used in Western medicine to alleviate cough and to soothe bruises.

Physical description: It is a herb which grows to a height of 45 cm only. The plant is cosmopolitan. Leaves: sessile, 2.5 cm–6.3 cm × 3 mm–1.3 cm. The blade is spatulate, oblong, obtuse and wooly, and the margin is mucronate. The inflorescences are orange or white glistening heads, arranged in dense and leafless corymbose clusters. The involucre bracts are straw colored. The fruits consist of oblong and papillate achenes (Fig. 376).

Pharmaceutical interest: None of the medicinal properties mentioned above have been confirmed. Note that the plant is known to elaborate polysaccharide which increases the enzymatic activity of alkaline phosphatase in mouse calvarial osteoblast-like MC3T3-E1 cells. This enhances the expression of alkaline

phosphatase and MMP13 genes and thus the maturation of the collagenous extracellular matrix, a prerequisite for mineralization (Aoshima Y *et al.*, 2003).

Reference

Aoshima Y, *et al.* (2003) *Biosci Biotechnol Biochem* **67**(10): 2068–2074.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Gynura procumbens (Lour.) Merr.

[From Greek, *gyne* = femelle, *uro* = tail and from Latin, *cumbere* = lay oneself]

Synonymy: *Gynura sarmentosa* DC., *Calacia procumbens* Lour., *Cacalia procumbens* Lour., *Cacalia sarmentosa* Bl., *Cacalia sarracenic* Blanco, *Gynura affinis*.

Common names: Purple passion vine; *akar sebiak* (Malay); *sabungai* (Filipino).

Uses: In Indonesia, *Gynura procumbens* (Lour.) Merr. is used to assuage kidneys discomfort. In Vietnam, the plant is used to combat fever. In Thailand, the plant is used to soothe inflammation, rheumatism and to treat viral ailments.



Fig. 377. *Gynura procumbens* (Lour.) Merr.

Physical description: It is a climber which grows in thickets along the streams and in the vacant plots of land of Southeast Asia from sea level to 1500 m. It is a common house ornamental plant. The stems are glabrous. Leaves: simple and without stipules. The petiole is 2 mm–8 mm long. The blade is 2.5 cm–7.5 cm × 8 mm–2.5 cm, succulent, elliptic, glossy with purplish hairs, and lanceolate. The base of the blade is cuneate. The margin is purplish, dentate or incised. The blade shows a midrib and 3–5 pairs of secondary nerves. The inflorescences consist of 1.2 cm–1.5 cm long disc-shaped capitula, arranged in long pendulous cymes on puberulous pedicels. The involucre are purple. The bracts are narrow and arranged in a single whorl of approximately 10 bracts. The flowers are bisexual and orange. The style is long, thin and hairy. The fruits consist of 10-ribbed achenes with white and puberulous pappus (Fig. 377).

Pharmaceutical interest: An ethanolic extract of the leaves of *Gynura procumbens* (Lour.) Merr. at single doses (*per os*) of 50 mg/Kg, 150 mg/Kg and 300 mg/Kg, significantly lowers the serum levels of glucose in diabetic rats, without affecting the glycemia of normal rats. The extract lowers the cholesterolaemia and triglyceridemia of rats (Zhang XF *et al.*, 2000). An extract of the plant protects mice against the inflammation caused by croton oil (0.75 mg/ear) just as efficient as a 6 mg/ear of hydrocortisone 21-hemisuccinate sodium salt (Iskander MR *et al.*, 2002). Note that the medicinal properties mentioned above could be attributed to the mineralocorticoid-like steroid.

References

Iskander MR, *et al.* (2002) *Plant Foods Hum Nutr* **57**(3–4): 233–244.
Zhang XF, *et al.* (2000) *Singapore Med J* **41**(1): 9–13.

Warning: *Gynura* species contain hepatotoxic pyrrolizidine alkaloids.

Pluchea indica (L.) Less.

[After Abbé Noel-Antoine Pluche, 18th century French naturalist and from Latin, *indica* = from India]

Synonymy: *Baccharis indica* L.

Common names: Indian fleabane, Indian pluchea, Indian camphorweed; *beluntas* (Malay); *luntas* (Javanese); *kayu* (Burmese); *pras anbok* (Cambodian); *cuc tan, cay luc, tu bi* (Vietnamese); *kalapini* (Filipino); *khlu* (Thai).



Fig. 378. *Pluchea indica* (L.) Less.

Physical description: It is a shrub of the wetlands, mangroves, swamps, tidal flats and fishponds of India, South China, Taiwan, Southeast Asia, Australia and Pacific Islands. It grows to a height of 1.5 m. The stems are terete, woody, green or purplish and glabrous. Leaves: simple, without stipules and alternate. The blade is 2.5 cm × 5 mm, dentate, considerably thin, obovate, acuminate and narrow at the base. The inflorescences are small capitula arranged in terminal corymbose cymes of 5 cm long. The flowers are white or purple. The pappus is 2 mm long and white (Fig. 378).

Pharmaceutical interest:

Anti-inflammatory properties: In regard to the anti-inflammatory properties of *Pluchea indica* (L.) Less., a methanolic fraction of a chloroformic extract of defatted roots inhibits significantly the inflammations caused by carrageenan, histamine, serotonin, hyaluronidase and sodium urate. The fraction inhibits the exudation of proteins and the migration of leukocytes, as well as carrageenan- and cotton pellet-induced granuloma formation and turpentine-induced joint edema and adjuvant-induced polyarthritis (Sen T *et al.*, 1991) This fraction protects the stomach of rats poisoned with indomethacine, alcohol and indomethacine-alcohol against ulceration, and reduces the gastric and acidity levels in rats (Sen T *et al.*, 1993). It would be interesting to discover the underlying principle involved in this instance.

Sedative properties: 50 mg/Kg–100mg/Kg of an extract of roots given *per os* reduces the locomotor activity and extends the dose-dependent pentobarbital sleep of mice. The extract suppresses social isolation-induced aggressive behaviors, but is inactive against pentylenetetrazole-induced convulsion, motor coordination or nociceptive response in group-housed mice. These results suggest that the extract attenuates the pathophysiological changes caused by social isolation stress in mice and in part by the GABAergic system (Thongpraditchote S *et al.*, 1996).

References

- Sen T, *et al.* (1991) *J Ethnopharmacol* **33**(1–2): 135–141.
Sen T, *et al.* (1993) *Life Sci* **52**(8): 717–743.
Thongpraditchote S, *et al.* (1996) *Biol Pharm Bull* **19**(3): 379–383.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Uses: In Indonesia, the juice expressed from the leaves of *Pluchea indica* (L.) Less. is drunk to treat dysentery. An infusion of the plant is used to treat leucorrhoea. The crushed leaves mixed with salt are used to freshen breath or perspiration. In Malaysia, a decoction of *Pluchea indica* (L.) Less. is used to combat fever. The sap expressed from the leaves is used to treat dysentery. A poultice of leaves is applied externally to treat ulcers and to soothe sores. In Vietnam, a decoction of 8g–16g of *Pluchea indica* (L.) Less. is used to soothe inflammation. The roots are used to combat fever, assuage headache, treat rheumatism, lumbago, osteodynia, soothe sprain, treat dysentery and to promote digestion. A decoction of fresh leaves is inhaled to treat cold and is used to soothe inflamed parts. The powdered leaves mixed with beeswax or castor oil are used to heal fractures.

***Saussurea lappa* C. B. Clarke**

Physical description: It is a robust perennial herb which grows to a height of 1.5 m. It is found on the open slopes of the valleys, Kashmir and the Northwest Himalayan region up to 4000 m. Leaves: simple, 60 cm–1.2 m at the base and triangular. The cauline leaves are smaller, either pediceled or not, with a pair of clasping lobes at the base. The petiole is winged. The blade is considerably thin, irregularly lobed and of variable sizes. The inflorescences are axillary, tall clusters of rigid, globose and 2.5 cm–3.8 cm long capitula. The bracts are rigid and glabrous. The corolla is 2 cm long, tubular, dark blue, purple or black. The stamens are free. The fruits consist of 8 mm long achenes with a single rib on each face and a 1.7 cm long pappus.

Pharmaceutical interest: *Saussurea lappa* C. B. has attracted a great deal of interest owing to its ability to elaborate a series of sesquiterpenes lactones which could alter the release of pro-inflammatory mediators and hence the anti-asthmatic, anti-inflammatory and antitumoral properties experimentally displayed.

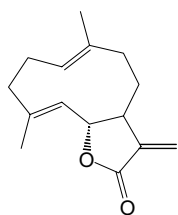
Anti-asthmatic properties: The anti-asthmatic property of *Saussurea lappa* C. B. Clarke is confirmed experimentally. A crude methanolic extract of the roots of *Saussurea lappa* C. B. Clarke inhibits the production of tumor necrosis factor α , in murine macrophage-like cell (RAW264.7 cells) given cynaropicrin, reynosin, and santamarine. The molar concentrations of cynaropicrin, reynosin and santamarine, inhibiting 50% (IC₅₀) of tumor necrosis factor α , are 2.86 $\mu\text{g}/\text{mL}$ (8.24 μM), 21.7 $\mu\text{g}/\text{mL}$ (87.4 μM), and 26.2 $\mu\text{g}/\text{mL}$ (105 μM) respectively. Treatment with sulphhydryl (SH) compounds such as L-cysteine, dithiothreitol and 2-mercaptoethanol abrogate the inhibitory effect of cynaropicrin on tumor

Synonymy: *Aucklandia costus*.

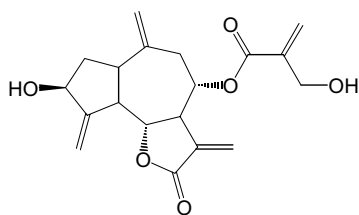
Common names: Costus, Kuth; *puchok* (Malay); *kushta* (Sanskrit), *mu xiang* (Chinese).

Uses: The dried roots of *Saussurea lappa* C. B. Clarke were officinal in India (*Saussurea*, *Indian Pharmacopoeia*, 1955), used to counteract putrefaction, treat flatulence, promote expectoration, urination, and a widely claimed "remarkable effect in controlling bronchial asthma". It has been administered as a liquid extract (1 in 1 with alcohol 90%, dose 0.6 mL to 1.5 mL). In China, the roots are used to promote digestion, to treat flatulence, to stop spasms and diarrhea. In Vietnam, Cambodia and Laos, the plant is used to treat respiratory infection. In Malaysia, the plant is used to invigorate health, to relieve the bowels of costiveness, combat fever and to counteract putrefaction. The roots are cut into small pieces and shipped to Rome and China where they are used as a culinary spice and a perfume as well. The price of Costus in Rome is stated by Pliny to have been 5 denarii per pound.

necrosis factor α production, suggesting an inhibitory effect mediated through conjugation with SH-groups of the target proteins (Cho JY *et al.*, 1998).



Costunolide



Cynaropicrin

Anti-inflammatory properties: *In vitro*, cynaropicrin strongly inhibits the release of tumor necrosis factor α from lipopolysaccharide-stimulated murine macrophage. It efficiently attenuates the production of nitric oxide, released from lipopolysaccharide- and interferon γ -stimulated RAW264.7 cells dose-dependently. In addition, cynaropicrin dose-dependently suppresses the proliferation of lymphocytes from splenocytes and interleukin2-sensitive cytotoxic lymphocytes T, CTLL2 cells, stimulated by lipopolysaccharide, concanavalin A, phytohaemagglutinin and interleukin2. These results suggest that cynaropicrin may contribute to the anti-inflammatory response by inhibiting the production of inflammatory mediators and the proliferation of lymphocytes (Cho YJ *et al.*, 2000). Reynosin inhibits CINC1 (cytokine-induced neutrophil chemoattractant 1) induction in lipopolysaccharide-stimulated rat kidneys epithelioid NRK52E cells. Reynosin displays a dose-dependent inhibition on CINC1 induction in lipopolysaccharide-stimulated NRK52E cells, where 50% of inhibitory effect was shown at a concentration of approximately 1 μ M (Jung JH *et al.*, 1998). Note that arctigenin inhibits the enzymatic activity of MAP kinases and AP-1 activation via potent MKK inhibition (Cho MK *et al.*, 2004a).

Antitumor properties: Cynaropicrin exhibits cytotoxic and pro-apoptotic activities towards leukocyte cancer cell lines (Cho JY *et al.*, 2004). A crude extract of *Saussurea lappa* C. B. Clarke, causing lethality to brine shrimp larvae, was investigated for its causative components by a bioassay-guided fractionation. This resulted in the characterization of a series of C₁₇-polyene alcohols identified as shikokiols, previously characterized from *Cirsium nipponicum* and *Centaurea aegyptica*. These C₁₇-polyene alcohols inhibit the proliferation of A549, SK-OV-3, SK-MEL-2, XF498, and HCT15 human tumor cell-lines (Jungh JH *et al.*, 1998) moderately. *Saussurea lappa* C. B. Clarke induces G2-growth arrest and apoptosis in AGS gastric cancer cells (Ko SG *et al.*, 2004).

Antiviral property: Costunolide and dehydrocostus lactone characterized from *Saussurea lappa* C. B. Clarke inhibit the expression of the hepatitis B surface

antigen in Human hepatoma Hep3B cells, but have little effect on the viability of the cells. Both costunolide and dehydrocostus lactone suppress the hepatitis B surface antigen production by Hep3B cells dose-dependently with IC_{50} of $1 \mu\text{M}$ and $2 \mu\text{M}$, respectively. Northern blotting analysis show that the suppression of hepatitis B surface antigen gene expression by both costunolide and dehydrocostus lactone are principally at the mRNA level. Furthermore, the suppressive effect of costunolide and dehydrocostus lactone on hepatitis B surface antigen and hepatitis B antigen, a marker for hepatitis B viral genome replication in Human liver cells, is observed in another Human hepatoma cell-line HepA2 which was derived from HepG2 cells by transfecting a tandem repeat Hepatitis B Virus DNA. Similarly, the mRNA of hepatitis B surface antigen in HepA2 cells is suppressed by these compounds. These findings suggest that costunolide and dehydrocostus lactone might hold some potential for the treatment of hepatitis B (Chen HC *et al.*, 1995). Besides, costunolide inhibits the expression of interleukin- 1β by down-regulation of AP-1 and MAPK activity in LPS-stimulated RAW 264.7 cells (Kang JS *et al.*, 2004).

Anti-trypanosomal properties: An extract of the plant abrogates the survival of *Trypanosoma cruzi* (Lirussi D *et al.*, 2004).

References

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Lirussi D, *et al.* (2004) *Fitoter* **75**(7–8): 718–723.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Spilanthes acmella* (L.) Murr.**

[From the Greek, *spilos* = spot and *anthos* = flower and from Latin, *acmella* = little point]

Physical description: It is a herb which grows to a height of 30 cm in open waste places, old clearings and at low and medium altitudes. The stems are glabrous, fleshy and purplish. Leaves: simple, without stipules and opposite. The petiole is 2 mm–7 mm long. The blade is 1.5 cm–3 cm long, ovate-lanceolate, sub-acute, crenate, and shows a single pair of secondary nerves. The base of the blade is cuneate. The inflorescences consist of ovoid, conical,

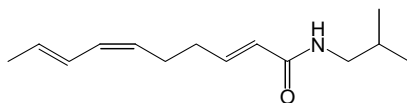
7 mm long capitula which are reddish-brown at the apex and yellow at the base. The flower pedicels are 2.5–7 cm long. The involucre bracts are arranged in 2 whorls. The outer floret female flowers are very small. The disc-floret are tubular and 4–5-lobed. The fruits consist of triquetous or compressed achenes.

Pharmaceutical interest: The diuretic property of this plant is confirmed (Ratnasooriya WD *et al.*, 2004). Note that an hexanic extract of *Spilanthes acmella* var. *oleracea* injected intraperitoneally to male Wistar rats 100 mg/Kg to 150 mg/Kg, induces full tonic-clonic generalized convulsion dose-dependently with electrographic seizures in the electroencephalogram (Moreira VM *et al.*, 1989). 3 *N*-isobutyl amides: spilanthol, undeca-2E,7Z,9E-trienoic acid isobutylamide and undeca-2E-en-8,10-diynoic acid isobutylamide from *Spilanthes acmella* destroy the larvae of *Aedes aegyptii* and *Helicoverpa zea* neonates at 12.5 μ /mL and 250 μ /mL respectively (Ramsewak RS *et al.*, 1999).

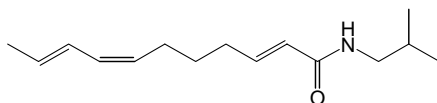
Synonymy: *Spilanthes paniculata* Wall. ex DC. *Verbesina acmella* Linn., *Spilanthes lobata* Blanco.

Common names: Para cress, toothache plant; *heukala* (Burmese); *pokok getang kerbau, kerabu, galang, gutang* (Malay); *biri* (Filipino); *herbe de Malacca, cresson des Indes* (French); *cuc ao, ngo ao* (Vietnamese).

Uses: *Spilanthes acmella* (L.) Murr. is used to assuage toothache. In Indonesia, the heads of *Spilanthes acmella* (L.) Merr. are used to assuage pain and chewed to promote the secretion of saliva. In Malaysia, the capitula are used to assuage toothache. In Papua New Guinea, the roots are used to assuage toothache. In the Philippines, the roots are used to relieve the bowels from costiveness. An infusion of *Spilanthes acmella* (L.) Murr. is used to soothe inflamed parts, treat psoriasis, promote urination and to expel vesical stones. In Vietnam, the plant is used to stop dysentery and to treat scurvy. The leaves are used to assuage headache.



N - Isobutylamides



Undeca-2E-en-8,10-diynoic acid isobutylamide

References

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Synedrella nodiflora (L.) Gaertn.

[From Latin, *nodus* = node and *flos* = flower]

Synonymy: *Verbesina nodiflora*.

Common names: Cinderella node weed, porter bush, pig grass *rumput babi* (Malay); *ngaroiarui* (Cook Islands); *cerbatana* (Spanish).

Uses: In Malaysia, *Synedrella nodiflora* (L.) Gaertn. is applied externally to soothe inflammation and to assuage headache. The juice, expressed from the leaves mixed with the seeds of *Nigella sativa*, is used to assuage ear-ache. In India, the leaves are used to treat rheumatism.



Fig. 379. *Synedrella nodiflora* (L.) Gaertn.

Physical description: It is a glabrous, scaberulous and wiry herb native to America, growing to a height of 60 cm around houses and along roadsides of the Asia-Pacific. Leaves: simple, without stipules and opposite. The petiole is 2 mm–9 mm long. The blade is 1.5 cm–7.5 cm × 6 mm–3 cm, ovate, glossy, soft, dentate, and acute at the apex and shows a few pairs of secondary nerves. The flowers are very small and yellowish. The ray-florets develop broad limbs. The disc florets are 4-lobed. The pappus shows a few bristles. The fruits are horned achenes (Fig. 379).

Pharmaceutical interest: The anti-inflammatory property of *Synedrella nodiflora* (L.) Gaertn. is confirmed, as the plant abrogates carrageenan-induced inflammation given *per os* at a dose of 40 mg/Kg, as effective as reference drugs phenylbutazone (80 mg/Kg) and indomethacine (3 mg/Kg; Abad MJ *et al.*, 1996). The exact mechanism by which *Synedrella nudiflora* (L.) Gaertn. is anti-inflammatory is still a mystery. However, steroids is likely to be present as the plant contains oestradiol (Mannan A *et al.*, 1978).

References

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

Vernonia cinerea (L.) Less.

[After W. Vernon, a British botanist of the 18th century, and from Latin, *cineris* = ashes]

Common names: Ash-colored fleabane; common vernonia; *cenderong hari*, *concong hari*, *bujong semalam*, *ekor kudah*, *rumpit sabasi*, *rumpit susor*, *tahi babi* (Malay); *vernonia cendre* (French); *devida* (Sanskrit); *sahadevi* (Tamil).

Uses: In Vietnam, *Vernonia cinerea* (L.) Less. is used to combat fever, to treat dysentery, to soothe inflammation and to assuage skin discomfort. In Malaysia, a decoction of the leaves is used to assuage colic. A decoction of roots is drunk to assuage stomachache and to stop diarrhea. In Indonesia, the juice expressed from the roots is used to alleviate cough. In the Philippines, the leaves are used to heal wounds and to treat skin infection.

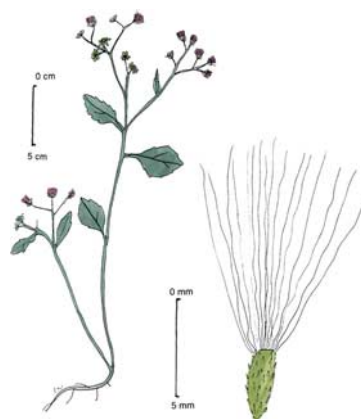


Fig. 380. *Vernonia cinerea* (L.) Less.

From: Delhi University Herbarium 004364. Geographical localization: University Campus, Delhi, India. Feb 1957. Det.: HY Mohan Ram.

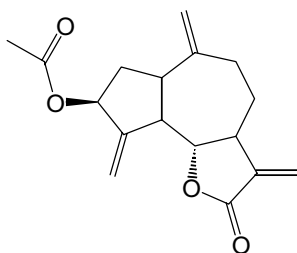
Physical description: It is a herb which grows to a height of 90 cm. The plant is found in vacant plots, waste ground, in garden and by the roadsides. Leaves: simple, few, without stipules and alternate. The petiole in lower leaves is 2.5 mm–1.2 cm long. The blade is 3 cm–7.5 cm × 6 mm–1.2 cm, considerably thin, toothed, ovate or lanceolate. The inflorescences are tubular capitula which are purple-mauve, 5 mm–6 mm × 2.5 mm and arranged in loose and terminal corymbs. The involucre is ovoid or hemispheric. The bracts are arranged in many whorls, the innermost longest, green, tipped red, hairy, linear, lanceolate and acuminate. The corolla is tubular and develops 5 narrow lobes. The pappus is white and prickly, consisting of several hairs arranged in 2 rows. The achenes are distinctly ribbed (Fig. 380).

Pharmaceutical interest:

Anti-inflammatory properties: An alcoholic extract of flower of *Vernonia cinerea* (L.) Less. given *per os* to arthritic rats, reverses paw volume, body and tissue weights and serum and tissue enzyme activity of ALT, AST, ACP and cathepsin-D. This extract reverses the major histopathological changes in the hind paws of the arthritic rats (Latha RM *et al.*, 1998). Is it possible to find sesquiterpenes in this instance?

Antiparasiticial properties: An interesting feature of a *Vernonia* species is that they elaborate several sorts of antiprotozoal metabolites. For example, 16,17-dihydrobrachycalxolide-germacrane dilactone (Oketch-Rabah HA *et al.*, 1998) and 5-methylcoumarins characterized from *Vernonia brachycalyx*, inhibit the proliferation of both *Leishmania major* and *Plasmodium falciparum* grown *in vitro* (Oketch-Rabah HA *et al.*, 1997). Lupeol characterized from *Vernonia brasiliensis* (L.) abrogates the proliferation of *Plasmodium falciparum* cultured *in vitro* (25 µg/mL; Alves TM *et al.*, 1997). An extract of *Vernonia subuligera* strongly inhibits the proliferation of *Trypanosoma brucei rhodesiense*, cultured *in vitro* (Freiburghaus F *et al.*, 1996).

Antifungal properties: Note that *Vernonia arborea* is known to produce an anti-fungal sesquiterpene, zaluzanin D (Krishna KGN *et al.*, 2003).



Zaluzanin D

References

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Xanthium strumarium* L.**

[From Latin, *xanthium* = yellow and *strumarium* = swelling]

Synonymy: *Xanthium japonicum* Widder, *Xanthium sibiricum* Patrin ex Widder.

Common names: Bur-weed, common cocklebur, ditch-bur, louse-bur, broad cocklebur; *chosa*, *koupi* (Burmese); *his erh* (Chinese); *petit glouteron*, *herbe aux écrouelles* (French); *anjang*, *buah anjang* (Malay); *arishta* (Sanskrit); *chota-gokhru* (Hindi), *ke dau ngua*, *phat ma* (Vietnamese).



Fig. 381. *Xanthium strumarium* L.

Physical description: It is a herb of a height of 60 cm in vacant plots, roadsides and rice fields. Leaves: simple, without stipules and alternate. The blade is 5 cm–10 cm × 2.5 cm–5 cm, triangular-cordate or orbicular-lobed. The base of the blade is cuneate and the margin lobed. The inflorescences consist of capitula arranged in terminal or axillary racemes. The capitula are 5 mm long and globose. The involucre of bisexual capitula consists of short bracts, whereas the involucres of female capitula are ovoid or oblong. The fruits consist of ovate achenes, covered with characteristic hooked bristles (Fig. 381).

Pharmaceutical interest: The stem of *Xanthium strumarium* L. lowers the serum level of glucose in normoglycemic rats (Dhar *et al.*, 1968).

Uses: In China, the fruits of *Xanthium strumarium* L. are used to invigorate health, soothe inflammation, promote urination, combat fever, stop spasms, treat sinusitis, headache and to counteract putrefaction. In Korea, the fruits are used to treat rheumatism and to soothe inflamed parts. In Malaysia, *Xanthium strumarium* L. is used to counteract post-natal infection. In Vietnam, a decoction of 6 g–12 g of fruits of *Xanthium strumarium* L. is used to treat furunculosis, impetigo, rhinitis, urticaria, goiter, rheumatism, mycosis, heal ulcers, assuage cramp, toothache and headache, soothe sore throat, and to treat dysentery. In India, the entire herb is used to cool, to calm, to sweat, and to promote urination and the secretion of saliva. The leaves are used to treat malaria and the fruits are used to treat smallpox. The roots are used to treat cancer.

A methanolic extract is antimicrobial (Jawad *et al.*, 1988) and a crude 50% ethanolic extract of leaves of *Xanthium strumarium* destroys *Trypanosoma evansi* grown *in vitro* and *in vivo* (Talakal TS *et al.*, 1995).

References

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 Talakal TS, *et al.* (1995) *J Ethnopharmacol* **49**: 141–145.
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Warning: *Xanthium strumarium* L. contains a poisonous glycoside known as carboxyatractyloside. Clinical symptoms of *Xanthium strumarium* L. poisoning include hyper excitability, blindness, tense musculature, spastic gaits with heads held high and ears upright, ascite and a firm, pale liver. Histopathological observations show mottled hemorrhagical pattern on cut surface of liver, marked centro lobular degeneration and necrosis (Witte ST *et al.*, 1990).

Wedelia biflora DC.

[After Georg Wolfgang Wedel, 18th century German Professor of Botany at Jena and from Latin, *bi* = twice and *flos* = flower]

Synonymy: *Adenostemma biflorum* Less., *Melanthera biflora* (L.) Wild., *Verbesina biflora* L., *Wollastonia biflora* (L.) DC., *Spilanthes acmella* Blanco, *Spilanthes peregrina* Blanco, *Stemmodontia biflora* W.F. Wight, *Wollastonia biflora* DC.

Common names: Wedelia, beach sunflower *sarunei*, *serenah*, *sunai laut* (Malay); *hagonoi* (Filipino); *verba de Maluco* (Spanish).



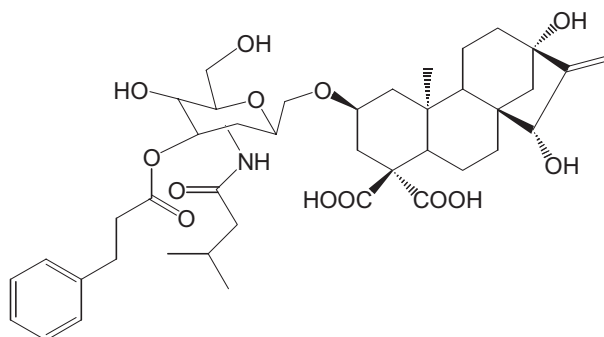
Fig. 382. *Wedelia biflora* DC.

Physical description: It is a common scrambling, shrubby herb of the Southeast Asia, Ceylon, and Pacific tidal mud, abundant in thickets at the back end of beaches and along tidal streams. The young stems are hispid.

Leaves: simple, without stipules and opposite. The blade is 5 cm–10 cm × 3 cm–5 cm, ovate-lanceolate, acuminate, serrate, broad, even at the base. The inflorescences are 1.25 cm long, usually solitary and orangy-yellow. The involucre are hemispheric, arranged in 2 whorls of oblong and pubescent bracts. The ray-florets are showy, female and ligulate. The disc-florets are unisexual, tubular and 5-lobed. The achenes are triquetous and hairy (Fig. 382).

Uses: In Malaysia, a paste of the leaves *Wedelia biflora* DC. is used to heal sores, wounds, insect bites, soothe swelling and inflamed parts. The juice expressed from the leaves, mixed with cow's milk, is drunk to invigorate health. In the Philippines, a decoction of the fresh roots is drunk to promote menses and urination. The roots are used to promote digestion. The leaves are used to promote urination and assuage stomachache. In Thailand, the plant is used to assuage headache.

Pharmaceutical interest: The pharmacological potential of this plant remains unexplored. It would be interesting to learn whether a more intensive study on this plant would disclose any molecules of pharmacological interest such as wedeloside, a kaurane aminoglycoside glucoside, characterized from *Wedelia asperima*, which is a powerful inhibitor and ligand of the mitochondrial ADP/ATP carrier (Klingenberg M *et al.*, 1985).



Wedeloside

Reference

Klingenberg M, *et al.* (1985) *FEBS* **189**(2): 245–249.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Part II: Class LILIOPSIDA Cronquist, Takhtajan & Zimmermann 1966, the Monocotyledons

The class Liliopsida consists of 5 subclasses, 19 orders, 65 families and approximately 50 000 species of herbaceous plants, thought to have originated by development from aquatic Magnoliopsids during the Lower Cretaceous (Appendix I). It is like that Liliopsida originate in or near the Nymphaeales or from an extinct transitional family. Note that Liliopsida are seldom tanniferous but mostly saponiferous. The *Arecidae* is one of the most primitive subclass in the Liliopsida.

I. Subclass *ARECIDAE* Takhtajan 1966

The subclass *Arecidae* consists of 4 orders, 5 families and approximately 5600 species of herbs, shrubs, climbers, or trees, with more than half belonging to the order *Arecales*, consisting of the single family *Arecaceae* (palms). Pyridine or indole alkaloids, steroidal saponins, C-glycosyl flavones and oxalic acid are known to occur in this subclass.

A. Order *ARALES* Lindley 1833

The order *Arales* consists of 2 families: *Araceae* and *Lemnaceae*. These are herbs, shrubs and climbers, the organs of which often abound with oxalic acid.

1. Family *ARACEAE* A. L. de Jussieu 1789 *nom. conserv.* *the Arum Family*

Physical description: The family *Araceae* consists of approximately 110 genera and 1800 species of tropical poisonous and bitter succulent herbs, growing from creeping or tuberous rhizomes or corms. *Araceae* are well-known for accumulating oxalic acid and to elaborate pyridine or indole alkaloids and steroidal saponins. The leaves are solitary, few, alternate, usually with a basally sheathing petiole and an expandate, simple, entire to variously cleft, perforate or compound blade. The flowers are small, often stinky and typically arranged in a spadix enclosed in a spathe, either bisexual or all alike, or unisexual and monoecious. The male flowers are packed in the upper part of the spadix. The female



are packed below. The perianth is present in bisexual flowers and consists of 4–6 lobes. The andrecium is hypogenous and consists of 2–8 stamens opposite the perianth lobes. The ovary is superior or immersed in the spadix and 1-several locular. The style and placentation are variously organized. The fruits are berries containing 1-several seeds embedded in a copious endosperm.

Pharmaceutical interest: Examples of Araceae are *Colocasia antiquorum* Schott (coco biscuits) and *Amorphophallus campanulatus* Bl. (elephant-foot yam), the rhizomes of which are prized for their dietary value, although the presence of oxalic acid makes preliminary cooking compulsory. *Arum maculatum* (lord and ladies, arum, cuckoopint, wake robin) and *Zantedeschia aethiopica* (lily of the Nile) are cultivated to decorate gardens, while *Amorphophallus titanum* (Becc.) is a breath-taking rainforest plant of Borneo.

Classical examples of medicinal Araceae are *Acorus calamus* (sweet flag) and *Cryptocoryne spiralis* (Indian ipecacuanha). The flour of the rhizomes of *Amorphophallus konjac* Koch. is commercialized as adjunct in low-calorie diets and to control cholesterolaemia and arteriosclerosis. Approximately 50 species of plants classified within the family Araceae are of medicinal value in the Asia-pacific, many of which are counter irritant.

***Acorus calamus* L.**

[From Greek, *akoron* = sweet flag and from Latin, *calamus* = reed]

Common names: Sweet flag, calamus; *jeringu*, *deringu* (Malay), *bach*, *gora bach* (Indian); *acore vrai* (French); *vácha*, *jatilá* (Sanskrit).

Physical description: It is a herb which grows perennially to a height of 2 m. The plant is found on the edges of ponds, stream banks and swamps in Europe, Asia and America. The rhizome is 2 cm × 20 cm and very fragrant. Leaves: dark green, glossy, ensiform, upright, reddish at the base and 90 cm–2 m × 1.8 cm–3.75 cm. The spathe is 15 cm–75 cm long, ensiform, upright and continuous with the pedicel. The spadix is green, sessile, cylindrical and densely flowered and 5 cm–10 cm long. The perianth consists of 6 orbicular sepals. The andrecium includes 6 stamens with reniform anthers. The ovary is conical, 2–3-locular and encloses several ovules. The fruit is a berry (Fig. 383). Several varieties exist, including *Acorus calamus* L. var. *americanus*

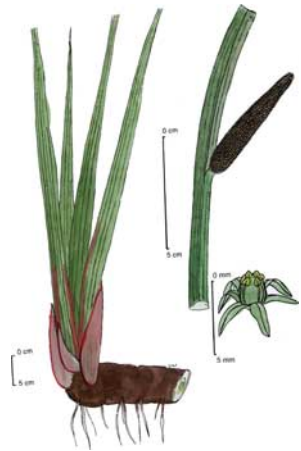


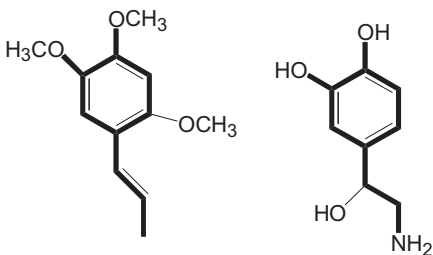
Fig. 383. *Acorus calamus* L.

Several varieties exist, including *Acorus calamus* L. var. *americanus*

(Raf.) Wulff (America), *Acorus calamus* L. var. *calamus* L. (Europe) and *Acorus calamus* L. var. *angustata* Bess. (India).

Pharmaceutical interest: *Neurological properties:* The rhizome of *Acorus calamus* L. contains an essential oil (2%–9%), consisting of a mixture of phenylpropanoids, including asarone. Note that the chemical structure of asarone has some level of similarities with catecholamines such as noradrenaline. Asarone has calming, antiulcer, antisclerosing and hypocholesterolaemic properties (Danilevskii NF *et al.*, 1982; Menon MK *et al.*, 1967; Garduno L *et al.*, 1997). Thus, *Acorus calamus* L. may have some neuropharmacological potentials (Belova LF *et al.*, 1985; Dhallas NS *et al.*, 1968; Maj J *et al.*, 1966). An aqueous extract of dry rhizome of *Acorus gramineus* competes experimentally with [³H]SCH-23390 and [³H]YM-09151-2 for specific binding to the striatal dopamine D1 and D2 receptors. In addition, the extract competes with [³H] muscinol for specific binding to the γ amino butyric acid (GABA) receptors of the cortex (Liao F *et al.*, 1998).

Uses: The rhizome of *Acorus calamus* L. has been used since ancient times to promote appetite and digestion, to invigorate health and to stop spasms and flatulence. Ibn Sina called this herb *waj* and Dioskurides *ακρορον*. A description of *Acorus calamus* L. is given in the *Theatrum Botanicum* of J. Parkinson (1640). The rhizome has since been listed in a number of Western *Pharmacopoeia* and *Codices*. Calamus (*British Pharmaceutical Codex*, 1934) has been used to promote appetite and digestion in the form of an infusion (1 to 10 of boiling water; dose of 15 mL–30 mL) or tincture (1 in 5; dose of 2 mL–4 mL). The volatile oil is used in perfumery. In the Asia-Pacific, the rhizome is principally used to invigorate health, soothe inflammation and to treat skin infection and lumbago. In China, it is used to combat fever, to stop spasms and to treat anxiety. The juice expressed from the rhizome is used externally to heal buboes, carbuncles, treat deafness and to soothe inflamed eyes. In Indonesia, the rhizome is used to induce vomiting; mixed with the bark *Cinchona*, it can also be used to combat fever. In Malaysia, the rhizome is used to invigorate health, promote digestion and appetite, treat flatulence, spasms, convulsion and to combat fever. The juice expressed from the rhizome is used to heal buboes, and lumbago and to recover from childbirth. In the Philippines, the rhizome is used to promote appetite, induce vomiting, combat fever, promote digestion and to soothe inflammation. In Taiwan, a bath of rhizomes is used to stimulate blood circulation. In Vietnam, the rhizome is used to invigorate health and to promote digestion.



Asarone

Noradrenaline

An ethanolic extract of the plant given to rodent shows some effects in electroshock, isolation-induced aggressive behavior (Vohora SB *et al.*, 1990). Note that the plant interferes with the enzymatic activity of cholinesterase (Oh MH *et al.*, 2004).

Other properties: Phenylpropanoids abrogate the survival of *Toxocaria canis* (Sugimoto N *et al.*, 1995) moderately. The essential oil L. contains thermophilin (dimethoxybenzoquinone) which is antimicrobial.

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 Sugimoto N, *et al.* (1995) *Biol Pharm Bull* **18**(4): 605–609.
 Vohora SB, *et al.* (1998) *J Ethnopharmacol* **61**(3): 185–193.

Warning: In general, Asarone and phenylpropanoids tend to be hepatocarcinogen and mutagen (Goggelman W *et al.*, 1983), and they cause duodenal tumors. The toxicity of asarone resulted in the banishment of *Acorus calamus* L. products in the U.S., limited concentrations in Europe and raised concerns about the toxicity of phenylpropanoids, common in spices.

***Aglaonema oblongifolium* (Roxb.) Kunth.**

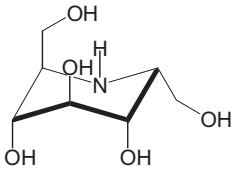
[From Greek, *aglaonema* = spear and from Latin, *longus* = long and *folium* = leaf]

Physical description: It is an erect herb which grows to a height of 1 m tall in shady and wet spots of the Asia-Pacific. Leaves: the petiole is channeled and 8 cm–12 cm long. The blade is 40 cm–60 cm × 6 cm–9.5 cm, soft and shows 6–10 pairs of secondary nerves. The inflorescences are axillary pediceled heads; each head consists of 10 glossy berries which are bright-orange when ripe. The berries are 1.8 cm × 5 mm, marked at the apex by a tiny disk. The pedicel is 7 cm long (Fig. 384).

Synonymy: *Aglaonema mananthifolium* Bl.

Common name: *Daun lidah gajah* (Malay).

Uses: In Indonesia, the leaves of *Aglaonema oblongifolium* (Roxb.) Kunth. are used to resolve swollen joints. In the Philippines, the juice expressed from the plant is used to treat skin diseases.



α -Homonojirimycin

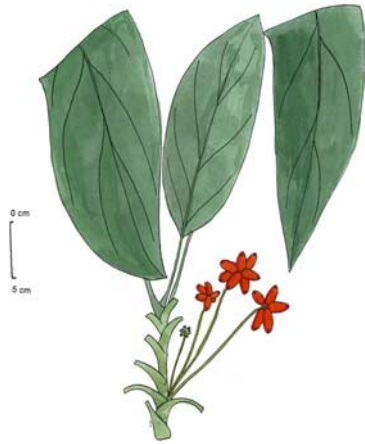


Fig. 384. *Aglaonema oblongifolium* (Roxb.) Kunth. From: KLU 18497. Field collector & botanical identification: SC Chin. 4 Nov 1971. Geographical localization: Kedah, Langkawi, North East on Pulau Langgun, on limestone, Malaysia.

Pharmaceutical interest: *Aglaonema* species have attracted tremendous interest on their ability to elaborate nitrogen-containing α -glucosidase inhibitors such as α -homonojirimycin and 1-deoxynojirimycin, which are currently assessed for their antidiabetic properties (Martin OR *et al.*, 1999; Nojima H *et al.*, 1997; 1998). Glucosidase are involved in intestinal digestion, post-prandial processing of glycoproteins and in the lysosomal catabolism of glucoconjugates. Glucosidase inhibitors may have therapeutic potentials in the treatment of viral infections, cancer and diabetes.

References

- Martin OR, *et al.* (1999) *Bioorg Med Chem Lett* **9**(21): 3171–3174.
 Nojima H, *et al.* (1997) *J Nat Prod* **60**(2): 98–101.
 Nojima H, *et al.* (1998) *J Nat Prod* **61**(3): 397–400.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Alocasia macrorrhiza (L.) G. Don

[From Greek, *kolokasia* = lotus root, *macros* = long and *rhiza* = root]

Physical description: It is a robust, succulent, herbaceous plant, native to Ceylon but spreaded to the entire Asia-Pacific. The petioles are long, stout and upright.

Common names: Giant taro; *keladi*, *birah*, *sebaring* (Malay); *sente* (Javanese).

Uses: *Alocasia macrorrhiza* (L.) G. Don is a counter irritant remedy. In Indonesia, the leaves and tubers are used to assuage pain on the joints and to heal wounds. In Malaysia and Papua New Guinea, the juice expressed from the plant is used to heal stings. In the Philippines, the dried petioles are heated and used to assuage toothache. In Taiwan, the tubers are pounded and used to soothe swollen parts. In Vietnam and Cambodia, the tubers are used to promote urination, to soothe inflamed parts, heal boils and to treat rheumatism, diseased palms and apoplexy.



Fig. 385. *Alocasia macrorrhiza* (L.) G. Don.

Leaf: very large, peltate and connate for one tenth of its length. The spathe is pediceled. The base is convoluted and constricted above. The spadix develops cylindrical appendages and includes a large male portion and a short female portion. The ovary is oblong. The style and stigma are globose. The fruits are berries with large seeds (Fig. 385).

Pharmaceutical interest: The tubers of *Alocasia macrorrhiza* (L.) G. Don contain a trypsin/chymotrypsin inhibitor protein (Argall ME *et al.*, 1994; Sumathi S *et al.*, 1977) and an 11 kDa anti-fungal protein: alocasin, which displays anti-fungal activity against *Botrytis cinerea* and lowers the enzymatic activity of Human Immunodeficiency Virus type 1 reverse transcriptase (Wang XH *et al.*, 2003).

References

- Argall ME, *et al.* (1994) *Biochem Biophys Acta* **1204**(2): 189–194.
 Chan TY, *et al.* (1995) *Human Exp Toxicol* **14**(9): 727–728.
 Lin TS, *et al.* (1998) *Vet Hum Toxicol* **40**(2): 93–95.
 Sumathi S, *et al.* (1977) *Biochem Biophys Acta* **485**(1): 167–178.
 Wang XH, *et al.* (2003) *Protein Expression and Purification* **28**(1): 9–14.

Warning: *Alocasia macrorrhiza* (L.) G. Don and several other plants classified within the family Araceae, contain crystals of oxalic acid that give rise to severe discomfort if ingested. The ingestion of raw tubers is followed shortly by pain, numbness, nausea, sore throat, salivation, dysphonia, oral ulcers, swollen lips,

and occasional death by asphyxiation (Chan TY *et al.*, 1995; Lin TJ *et al.*, 1998). Oxalic acid produces skin irritation, thus counteracting the irritation caused by inflammation, swollen parts and stings.

***Arisaema japonicum* Bl.**

[From Latin, *arisaema* = arum-like and blood color and *japonicum* = from Japan]

Common names: Japanese Arisaema;
tian nan xing (Chinese).

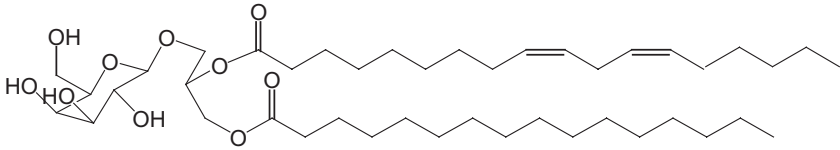
Uses: In Japan, China and Taiwan, the tuber is used to invigorate health, promote expectoration, quiet convulsions, resolve swellings and abscesses, assuage pains and to treat numbness.



Fig. 386. *Arisaema japonicum* Bl. From: Herbarium 10155. Field collector & botanical identification: Makoto Togashi. 1 June 1965. Geographical localization: Seriu-Togeiin Kibune-Yama, North of Kyoto, Japan.

Physical description: *Arisaema japonicum* Bl. is a tuberose, stinky, succulent herb which grows to a height of 60 cm. The plant is found in the shady open grounds of Japan, China and Taiwan. Leaves: deeply incised into very thin lobes which are 9 cm–6 cm × 2 cm–17 cm. The inflorescences are terminal spadix of 12.5 cm × 2.5 cm, enveloped in a conical spathe. The fruits are bright red shiny berries which are 5 mm in diameter (Fig. 386).

Pharmaceutical interest: The pharmacological potential of *Arisaema japonicum* Bl. remains unexplored. Two lectins, *Arisaema consanguineum* Schott and *Arisaema curvatum* Kunth, purified from the tubers induce the proliferation of Human peripheral blood mononuclear cells in the [³H]-thymidine uptake assay (Shangary S *et al.*, 1996). A number of hepatoprotector cerebrosides, characterized from *Arisaema amurense*, as well as 1, 2-*O*-diacyl-3-*O*-β-*D*-galactopyranosyl glycerols and 1, 2-*O*-diacyl-3-*O*-[α-*D*-galactopyranosyl-(1''->6')-*O*-β-*D*-galactopyranosyl] glycerols, display interesting cytotoxic properties against P388 and DLD-1 (Jun JH *et al.*, 1996; Jun JH *et al.*, 1996a).



1, 2-O-diacyl-3-O- β -D-galactopyranosyl glycerol

References

- Jun JH, *et al.* (1996) *Phytochem* **42**(2): 447–452.
 Jun JH, *et al.* (1996a) *J Nat Prod* **59**(3): 319–322.
 Shangary S, *et al.* (1996) *Immunol Invest* **25**(4): 273–278.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Pistia stratiotes L.

[From Latin, *pistia* = water and *stratiotes* = soldier]

Common names: Water lettuce, water soldier; *kambiang* (Malay), *kapu-kapu* (Javanese); *chauk* (Thai); *pensée d'eau*, *pourprier de Madagascar* (French); *fou ping* (Chinese); *khali* (Sanskrit); *agasata-marai* (Tamil).

Physical description: It is a considerably invasive floating, starry, aquatic plant of the rivers, ponds and roadside irrigation ditch of the tropical world. The roots are long, thin and hairy. Leaves: in rosette, bitter, simple, spatulate, succulent, thick, glaucous, 5-nerved, 3.5 cm \times 2.5 cm–20 cm \times 7 cm and notched at the apex. The spathe is indistinct, white, hairy, approximately 1.3 cm long, obliquely campanulate, gibbous, contracted about in the middle but dilated and nearly orbicular above. The spadix is short and yellow (Fig. 387).

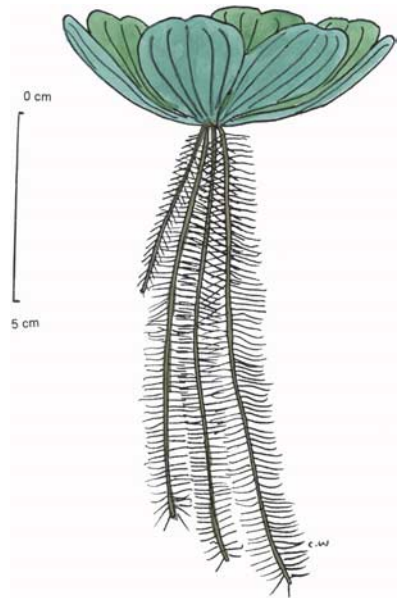
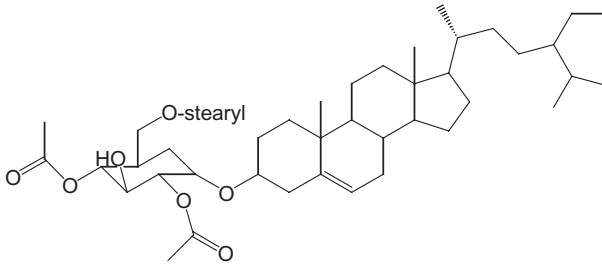


Fig. 387. *Pistia stratiotes* L.

Pharmaceutical interest: The pharmacological potential of *Pistia stratiotes* L. remains unexplored. The plant elaborates a series of sitosterol and stigmastane glycosides, attributing to its medicinal uses (Greca de M *et al.*, 1991; Monaco P *et al.*, 1991).

Uses: In China, *Pistia stratiotes* L. is used to promote menses, heal boils, syphilitic sores and ulcers, and to resolve contusions and swellings. In Indonesia, the plant is used to promote urination and to treat dysentery. In Papua New Guinea, the roots are used to stimulate the venereal desire of women.



Sitosterol glycoside

References

- Greca de M, *et al.* (1991) *Phytochem* **30**(7): 2422–2424.
 Monaco P, *et al.* (1991) *Phytochem* **30**(7): 2420–2421.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Raphidophora minor Hook. f.

[From Greek, *raphia* = needle, *phora* = bearing and from Latin, *minor* = less]

Physical description: It is a climber of the mangrove belt of Malaysia. The stems are green, stoloniferous, somewhat articulate and succulent. Leaves:

simple, held on a vertical plane above the axis and stipulate. The stipules are caducous with the color and texture of a brown onion skin. The petiole is channeled and 2 cm–2.5 cm long. The blade is 14.5 cm–11.5 cm × 2.8 cm–2.5 cm, pale green, glossy below and shows numerous lateral nerves. The spadix is green and 2 cm × 5 mm. The stigma scars are purplish black (Fig. 388).

Common name: *Kelemoyang akar* (Malay).

Uses: In Malaysia, a decoction of leaves and roots of *Raphidophora minor* Hook. f. is used in delayed confinements. To date, the pharmacological potential of *Raphidophora minor* Hk. f. remains unknown. An interesting feature of *Raphidophora*, *Monstera* and *Philodendron* species is their inflorescences, capable of containing huge amounts of tyramine and dopamine, with concentrations varying from 1 mg to 4 mg of each amine per gram of fresh plant. It could also be of potential value in combating Parkinsonism (Ponchet M *et al.*, 1982).

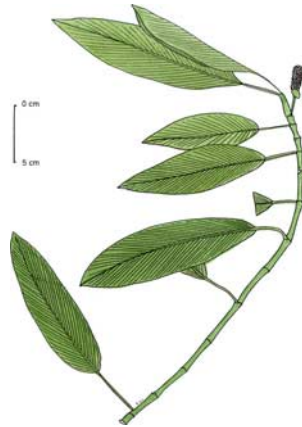
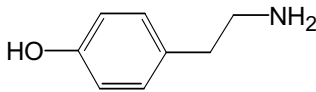
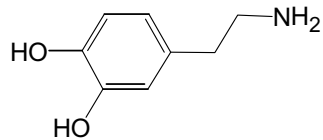


Fig. 388. *Raphidophora minor* Hook. f. From: KLU 36618. Geographical localization: Pulau Duyong Besar, Kuala Terengganu, on a coconut palm trunk, Malaysia. Field collector: Lynwood M Hume, 30 Dec 1983.



Tyramine



Dopamine

Reference

Ponchet M, *et al.* (1982) *Phytochem* **21**(12): 2865–2870.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

II. Subclass COMMELINIDAE Takhtajan 1966

The subclass Commelinidae consists of 7 orders and 16 families. Approximately 15 000 species of herbaceous plants, belong to the family Poaceae. Together, the family Poaceae and the family Cyperaceae total four-fifths of the species. The order Commelinales is the most archaic order of the subclass Commelinidae. Oxalic acid, flavone C-glycoside and saponins are common in this order.

A. Order COMMELINALES Lindley 1833

The order Commelinales consists of 4 families and approximately 1000 species of herbaceous plants. Little is known of the therapeutic potential of this order. The family Commelinaceae, with approximately 700 species, is by far the largest family of this order.

1. Family COMMELINACEAE R. Brown 1810, *nom. conserv.*, the Spiderwort Family

Physical description: The family Commelinaceae consists of 50 genera and 700 species of tropical and perennial herbs which grow well on wet soils. Commelinaceae are known to elaborate flavone C-glycosides and anthocyanidins. The stems are often articulate, stoloniferous and characterized by tubular bracts. The flowers are hypogynous, trimerous, hermaphrodite and actinomorphic. The inflorescences are axillary clusters or terminal cymes or panicles, occasionally within a folded boat-shaped bract. The perianth consists of 2 whorls of imbricate and free tepals blue or white in color; the outer whorl is sepal-like whereas the inner whorl is petal-like. The andrecium consists of 2 whorls of 3 long stamens often hairy at the base. The anthers are basifixied or versatile with an expanded connective, tetrasporangiate, dithecal and open longitudinal slits. The gynecium consists of 3 carpels that are superior and united into a compound and a 3-locular ovary. The style is terminal and simple with a small stigma. The fruits are loculicidally dehiscent, either capsular or succulent. The seeds are muricate, ridged or reticulate, showing a disc-shaped callosity that is indicative of the embryo's position.



Pharmaceutical interest: An example of medicinal Commelinaceae is *Murdannia edulis* (*musli siyah*), used by Asian residing in Britain to invigorate health, regulate urination and to treat asthma and colic. A number of plants classified within the family Commelinaceae have been investigated for their therapeutic potential. *Rhoeo spathacea* (oyster plan) contains dopamine and could be of potential value in combating Parkinsonism. There is an expanding body of evidence to suggest that α -glucosidase inhibitors isolated from Commelinaceae prove positive in the treatment of diabetes. Approximately 20 species of Commelinaceae are medicinal in the Asia-pacific. Note that many of these plants are used to heal and soothe injured skin.

***Aneilema medicum* (Lour.) Kostel.**

[From Latin, *medicus* = physician]

Synonymy: *Aneilema loureiroi* Hance.

Uses: In Indonesia, *Aneilema medicum* (Lour.) Kostel. is used to treat cough, asthma, strangury and difficulty in urination. In Laos, the plant is used to treat yellow fever and to relieve the bowels of costiveness. In Vietnam, it is used to maturate boils. In general, the pharmacological potential of *Aneilema medicum* (Lour.) Kostel. and of the genus *Aneilema* is virtually unexplored.

Physical description: It is a herb which grows to a height of 25 cm. The roots are tuberous and the stems are subglabrous and upright. Leaves: simple, without stipules, spiral, dark green above and lighter green beneath, lustrous on both the surface and the subglabrous. There are 7–8 parallel nerves, raised above but flattened below. The margin is laxly ciliate and the blade is linear, papery and 5.5 cm–12 cm × 1.4 cm–1.9 cm. The inflorescences are terminal and bracteate. The bracts are 12 mm × 4 mm. The sepals are 2 mm × 6 mm, acuminate and persistent in fruits. The fruits are capsular and papery (Fig. 389).



Fig. 389. *Aneilema medicum* (Lour.) Kostel. From: KLU Herbarium 32199. Field collector & botanical identification: KC Ting, KL Shi. 24 Apr 1964. Geographical localization: Ding-Hu Shan, Guangdong in plain, in meadow, by roadside, altitude: 80 m, China.

***Commelina nudiflora* L.**

[After two 17th century Dutch botanists: Johan and Caspar Commelin and from Latin, *nudus* = naked and *flos* = flower]

Physical description: It is a herb which grows to a length of 90 cm. The plant is found in India, Ceylon and

Synonymy: *Murdannia nudiflora* (L.) Brenan, *Aneilema nudiflorum* (L.) Wall., *Aneilema malabaricum* (L.) Merr.

Common names: *Pulau aur*, *rumpit kukupu*, *tapak eti* (Malay); *katsapriya* (Sanskrit).

Uses: *Commelina nudiflora* L. is used to soothe inflammation. In Malaysia, a poultice of this herb is used to heal sores. In Vietnam, the roots are used to combat fever, to stop dysentery and to treat strangury. In Indonesia, the juice expressed from the stems is used to heal wounds. In the Philippines, this herb is used to heal wounds and to treat mycosis. In India, the plant is used to mature boils.

Malaysia. The stems are diffuse and rooting at the nodes. Leaves: simple, sessile, 3.8 cm–7.5 cm × 1.5 cm–1.7 cm, lanceolate or obovate, ciliate, acute or acuminate, and glabrous or puberulous. The petiole is 1 cm–1.6 cm long, spread or upright. The spathe is 2 cm–3.2 cm long. The inflorescences are 1–3-flowered cymes. The flowers are 1.3 cm–1.7 cm, consisting of a pair of interior tepals which are obovate and blue, while the external tepals are sessile, orbicular and pale blue. The ovary is 3-locular, 2 locules with a pair of ovules and the third one with a single ovule. The fruits are 5 mm in diameter, oblong, rigid, reticulate capsules containing a few seeds which are oblong cylindrical and brown (Fig. 390).

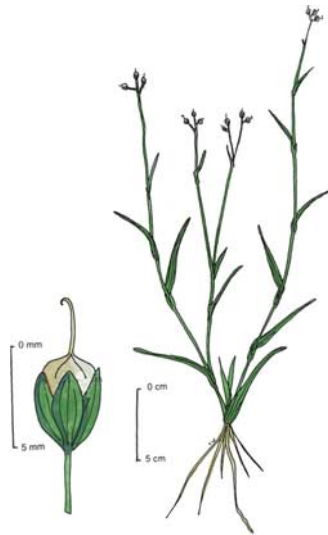


Fig. 390. *Commelina nudiflora* L. From: KLU Herbarium 043601. Field collector: Saliyah Abd Wahab. 28 July 1994. Botanical Identification: En Sulaiman. Geographical localization: Malaysia, MARDI, Jalan Kebun.

Pharmaceutical interest: The plant is interesting because it elaborates α -glucosidase inhibitors, including 2,5-dihydroxymethyl-3, 4-dihydroxypyrrolidine, 1-deoxymannojirimycin, 1 deoxynojirimycin, α -homonojirimycin and 7-O- β -D-glucopyranosyl α -homonojirimycin (Kim HS *et al.*, 1999). A methanolic extract of *Commelina coelestris* protects mice against experimental diarrhea induced by castor oil and magnesium sulfate (Zavala MA *et al.*, 1998). p-Hydroxycinnamic acid and D-mannitol characterized from *Commelina communis* L. are antibacterial and antitussive respectively (Tang XY *et al.*, 1994). The pharmacological potential of *Commelina nudiflora* remains an unanswered question.

References

- Kim HS, *et al.* (1999) *Planta Med* **65**(5): 437–439.
 Tang XY, *et al.* (1994) *Chung Kuo Chung Yao Tsa Chih* **19**(5): 297–298.
 Zavala MA, *et al.* (1998) *J Ethnopharmacol* **61**(1): 41–47.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Floscopa scandens* Lour.**

[From Latin, *flos* = flower, *cupa* = cup and *scandere* = climb]

Synonymy: *Tradescantia rufa* Presl., *Floscopa rufa* Hassk., *Tradescantia geniculata* Blanco.

Common names: *Pudag labuyo* (Filipino), *aur aur*, *rumput kumpai tikus*, *rumput tapak eti* (Malay).

Uses: In Malaysia, *Floscopa scandens* Lour. is used to promote recovery from childbirth. In India, the juice expressed from the stems is used to soothe sore eyes. The therapeutic potential of *Floscopa scandens* Lour. and the genus *Floscopa* remains unexplored.

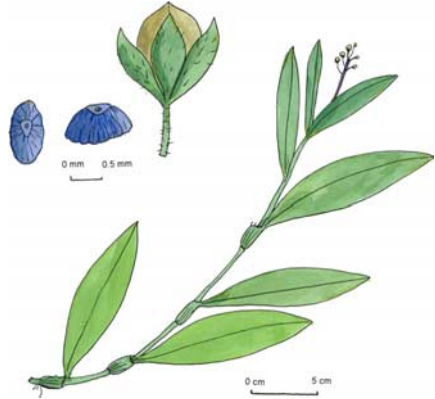


Fig. 391. *Floscopa scandens* Lour. From: KLU Herbarium 036938. Herbarium Jutlandicum (A.A.O.), Botanisk Institut Aarhus Universitet. Flora of Thailand Project. 3rd Expedition 1970. Field collectors: Ch Charoenphol, Kai Larsen & E. Warncke. Geographical localization: in swamp, Khao Yai National Park, Khao Khieo evergreen forest, 14° 21' North–101° 22' East, altitude: 1200 m–1300 m o. s. l., Thailand. Botanical Identification: Kai Larsen.

Pharmaceutical interest: It is a herb of India, Nepal, Ceylon, Malaysia, Asia and tropical Australia. The stems are creeping or ascending. Leaves: elliptic, lanceolate or linear-lanceolate, acute, and edge ciliate. The inflorescences are 2.5 cm–7.5 cm long, dense, viscid, hairy panicles with a pinkish rachis. The calyx consists of 3 sepals which are oblong and free. The corolla is made of 3 petals which are pink, free and obovate. The andrecium includes 6 stamens. The ovary is 2-locular with each locule containing a single ovule. The style is simple. The fruits are 2-locular, crustaceous and loculicidal capsules. The seeds are hemispheric (Fig. 391).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Forrestia griffithii* C.B. Clarke**

[After George Forrest, 20th century plant hunter. After Dr. William Griffith, 19th century botanist and curator of the Botanic Garden in Calcutta]

Physical description: It is a herb with a height of 1.5 m long. The plant is found in the rainforest of Southeast Asia. The

Common name: *Setawar hutan* (Malay).

Uses: In Malaysia, a decoction of roots is used to combat fever. The pharmacological potential of *Forrestia griffithii* C.B. Clarke and the genus *Forrestia* remains unexplored.

stems are juicy, creeping articulated and regularly covered with 2 cm–3 cm long of tubular bracts. Leaves: 27.5 cm × 5.3 cm–25 cm × 6.2 cm–25 cm, spiral, lanceolate, velvety and cuspidate. The blade shows about 20 pairs of nerves raised. The inflorescences are cauliflorous and globular heads. The fruits are glossy, 1 cm × 7 mm, purple dehiscent capsule containing a few bright orange seeds. The sepals are vestigial in fruits and are 3 mm–5 mm long (Fig. 392).



Fig. 392. *Forrestia griffithii* C.B. Clarke.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

B. Order ERIOCAULALES Nakai 1930

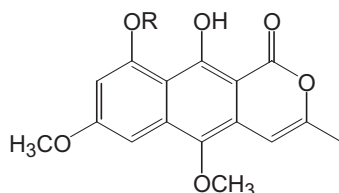
The order Eriocaulales is thought to have originated from the order Commelinales and consists of the single family Eriocaulaceae.

1. Family ERIOCAULACEAE Desvaux 1828 *nom. conserv.*, the Pipewort Family

Physical description: The family Eriocaulaceae consists of 13 genera and 1200 species of tropical herbs, the vast majority of which belong to the genera *Paepalanthus* (500 species), *Eriocaulon* (400 species) and *Syngonanthus* (200 species). The leaves are alternate and packed at the base of a long scape supporting a characteristic terminal racemose head. The flowers are small, unisexual, both sexes in the same head and trimerous. The perianth lobes are more or less connate. The anthers are introrse, tetrasporangiate and dithecal. The gynecium consists of 3 carpels united to form a compound, 3-locular and superior ovary with each locule containing a single ovary which is ventral-apical and pendulous. The fruits are loculicidal capsules.

Pharmaceutical interest: An interesting feature of the genus *Paepalanthus* is the production of antimicrobial and cytotoxic unusual series of

naphthopyranone glycosides. One such compound is paepalantine-9-O- β -D-glucopyranoside isolated from *Paepalanthus vellozioides*. Approximately 10 species of the plants classified within the genus *Eriocaulon* are mainly to treat eye diseases, headaches and inflammation in Southeast Asia, Taiwan, Korea and China.



Paepalantine 9 O β D glucopyranoside (R= Glc)

Eriocaulon australe R. Br.

[From Greek, *erio* = woolly, *caulon* = stem and Latin, *australis* = austral]

Common names: Hairy pipewort; *kai* (Yapese).

Uses: In China, *Eriocaulon australe* R. Br. is used to treat eye inflammation, sore throat, toothache, to clam, to combat fever and to promote urination. The pharmacological potential of *Eriocaulon australe* R. Br. and of the large genus *Eriocaulon* remains unexplored. Note that flavonoids, known to occur in the genus, might be involved in the anti-inflammatory property of the plant.

Physical description: It is a herb which grows to a height of 30 cm. The plant is found in marshy ground, swamp area, ponds, ditches, edges of mangrove swamps and roadside damps of the Asia-Pacific. The roots are fibrous and whitish. The stems are coriaceous, glabrous, 19.5 cm–25.5 cm long, and somewhat quadrangular or winged. Leaves: simple, linear, thin, glabrous, and 18 cm \times 5 mm–4 cm \times 2 mm

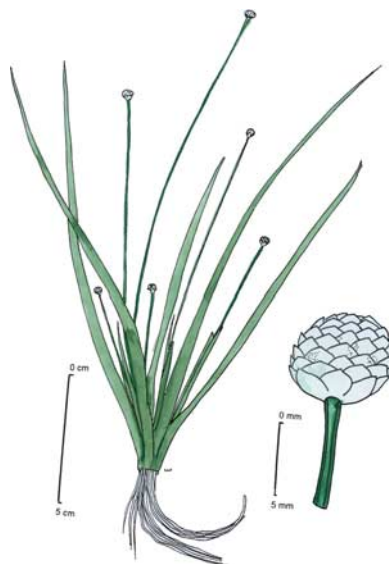


Fig. 393. *Eriocaulon australe* R. Br.

terminal and globose heads. The inflorescences are 3 mm–5 mm × 4 mm–5 mm. The heads are scaly and microscopically covered with a white indumentum (Fig. 393).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

C. Order RESTIONALES J. H. Schaffner 1929

The order Restionales is thought to have originated from the order Commelinales, and consists of 4 families and approximately 450 species of tropical herbs. The family Restionaceae is the largest family of this order with 400 species. The pharmacological potential of restionales remains unexplored.

1. Family FLAGELLARIACEAE Dumortier 1829 *nom. conserv.*, the *Flagellaria* Family

Physical description: The Family Flagellariaceae consists of the single genus *Flagellaria*, with 3 species of climbers native to tropical regions and known to produce cyanogenetic glycosides. The leaves are alternate, simple, characterized by a stoloniferous apex tip. The inflorescences are terminal panicles. The flowers are small, sessile, perfect, regular, trimerous and hypogynous. The perianth consists of 6 tepals in 2 cycles. The andrecium consists of 6 stamens which are free. The anthers are basifixied, sagitate, tetrasporangiate, dithecal and open by longitudinal slits. The gynecium comprises of 3 carpels united to form a compound, superior, 3-locular ovary with each locule containing a single ovule attached to an axile placenta. The styles are free or connate. The fruits are small drupes or berries. *Flagellaria indica* L. is quite often used to wash the hair and promote hair growth in the Asia-pacific, on a probable account of its hair-shaped tendrils. The present state of knowledge on the pharmacological properties of Restionales is virtually non-existent.

Flagellaria indica L.

[From Latin, *flagella* = wheep and *indica* = from India]

Physical description: It is a climber which grows to a length of 1.5 m throughout the mudflats, sandy beaches, and mangrove swamps of Southeast Asia, India, Ceylon and Africa. Leaves: glabrous, simple, 9 cm × 7 mm–4.2 cm × 5 mm, leathery, alternate and grass-like.

Common names: Indian rattan lily, rattan creeper, wild rattan; *rotan tikus* (Malay); *wala* (Javanese); *wai ling*, *wai yap chak* (Thai); *balingay* (Filipino); *panambuvalli* (Tamil).

Uses: In Indonesia, the tendrils are used to wash and promote the growth of hair. In Laos, Cambodia and Vietnam, the leaves are astringent and vulnerary. In Malaysia and the Philippines, *Flagellaria indica* L. is used to promote urination, to treat cholera and to assuage headache. In Malaysia, the plant is used to wash the hair and to treat pox. In Papua New Guinea, the plant is used as a contraceptive for women.



Fig. 394. *Flagellaria indica* L.

The apex extends into a long tendril. The inflorescences are terminal panicles of small and white flowers. The tepals are 2.5 mm long and broadly ovate. The anthers are 2 mm long, deeply bifid at base. The fruits are globose, bright orange, 5 mm in diameter and somewhat 3-lobed. The stigma and tepals are vestigial in fruits (Fig. 394).

Warning: The fruits are toxic.

D. Order CYPERALES G. T. Burnet 1835

The order Cyperales consists of 2 very large families of herbs: the family Cyperaceae and the family Poaceae, which have both originated from the Commelinales. Cyperales are perennial or less often annual herbs generally known to elaborate C-glycosylflavones and tricin. The leaves are linear and arranged in 2–3 whorls and an adaxial ligule is often present at the juncture of sheath and blade. The flowers are perfect or unisexual, subtended by a chaffy bract, and born in a characteristic spike or spikelet. The perianth consists of 1–3 bracts. The andrecium is made of 3 anthers. The gynecium consists of 2–4 carpels forming a superior compound and a single-locular ovary. The style develops several stigmatic branches. The fruits are indehiscent and dry, containing a single starchy seed.

1. Family CYPERACEAE A. L. de Jussieu 1789 nom conserv., the Sedge family

Physical description: The family Cyperaceae consists of 70 genera and nearly 4000 species of rhizomatous herbs, known to elaborate series of *quinones*, *C-glycosylflavones*, tricin, 5-methoxy-methylflavones, proanthocyanidins and *indole alkaloids*. The stems of Cyperaceae are often sharply

angled and bear leaves which are simple, alternate, arranged in 3 whorls, and endowed with a closed sheath at the apex. The flowers are arranged in spikes or spikelets. The perianth consists of 1 to several bristles. The andrecium consists of 1–6 stamens which open longitudinally, and are tetrasporangiate and dithecal. The gynecium consists of 2–3 carpels forming a compound, unilocular, and superior ovary. The fruits are trigonous or lenticled achenes.

Pharmaceutical interest: Formerly official in a number of Western pharmacopoeia were the rhizomes of *Carex arenaria* and *Cyperus rotundus*. *Cyperus papyrus* was used to make paper in ancient Egypt. Cyperaceae are interesting because they contain heteropolymers of *resveratrol*, which might be of chemotherapeutic interest. Approximately 20 species of plants classified within the family Cyperaceae are used for medicinal purposes in the Asia-Pacific.

***Bulbostylis barbata* (Rottb.) Kunth.**

[From Greek, *bolbos* = bulb, *stylis* = small pillar, and from Latin, *barba* = beard]

Synonymy: *Bulbostylis fimbriata* (Nees) C.B. Clarke, *Fimbristylis barbata* (Rottb.) Benth., *Isolepis fimbriata* (Nees) Steud.

Common name: Watergrass.

Uses: In the Philippines, a decoction of *Bulbostylis barbata* (Rottb.) Kunth. is drunk to treat dysentery. The pharmacological potential of *Bulbostylis barbata* (Rottb.) Kunth. remains unexplored.

Physical description: It is an erect or prostrate, beard-looking herb which grows annually to a height of 30 cm. The plant is found in sandy areas, dunes and stream banks of the Asia-Pacific. The stems are quadrangular, glabrous, and 0.5 mm in diameter. Leaves: linear and up to 30 cm long. The inflorescences are brownish umbelliform spikelets of 5 mm–10 mm × 5 mm–10 mm. The flower comprises of a 3-fid stigma. The fruits are 2 mm–5 mm long utricles which are somewhat bulbous. The seeds are 3-lobed, muricate and 0.5 mm in diameter (Fig. 395).

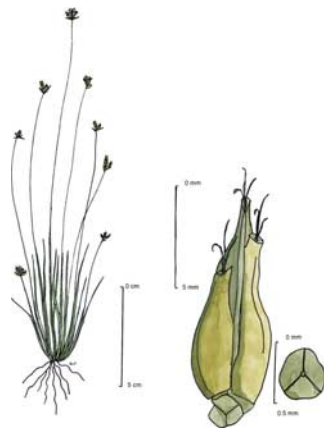


Fig. 395. *Bulbostylis barbata* (Rottb.) Kunth. From: KLU 26016. Flora of Thailand Project. Expedition, Jul–Aug 1966. Field collectors: Kai Larsen, T Smitinand & E Warncke. Botanical identification: JH Kern. Geographical localization: Rachaburi, Huai Yang, sandy area behind beach, Thailand.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Cyperus brevifolius* (Rottb.) Hassk.**

[From Greek, *kuperos* = sedge, and from Latin, *brevis* = short and *folium* = leaf]

Uses: Ibn Sina and other Arabian and Persian physicians use this plant to promote urination, menses and to combat fever. *Cyperus brevifolius* (Rottb.) Hassk. is the *κυπερος* of Dioskurides, the *Juncus Triangularis* of Pliny and is mentioned in the Iliad (21, 355) and Odyssey (4, 603). In China, *Cyperus brevifolius* (Rottb.) Hassk. is used to expel intestinal worms, counteract poisoning, treat dysentery, regulate menses and to assuage stomachache from ancient times. In Malaysia, the leaves are used to stop diarrhea and a poultice of the rhizomes is used to heal leg ulcers. The therapeutic potential of this herb remains unexplored.

Synonymy: *Kyllinga brevifolia* Rottb.

Common names: *Rumput tuki* (Malay); *mustaka* (Sanskrit); *korai* (Tamil).

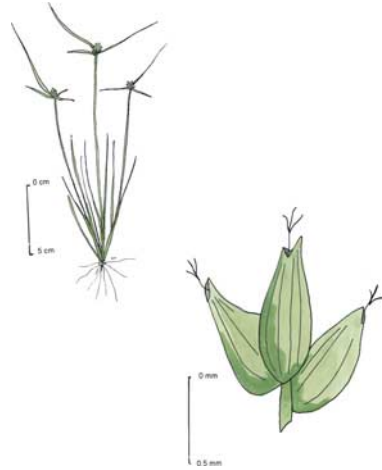


Fig. 396. *Cyperus brevifolius* (Rottb.) Hassk.

Physical description: It is a little roadside herb which grows to a high of 30 cm in the Asia-Pacific. The stems are glabrous and angular. The plant develops from a 7.5 cm–10 cm long rhizome. The culms are distant and 10 cm–30 cm long. Leaves: narrow and 15 cm–20 cm long. The lowest glumes are short, by groups of 3 and 4, lanceolate and lobed. The style is forked. The inflorescences are 5 mm in diameter globose spikelets. The flowers are numerous and 1 mm–1.5 mm long. The fruits are nuts compressed laterally (Fig. 396).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Cyperus cyperinus* (Retz.) Suring**

[From Greek, *kuperos* = sedge]

Physical description: It is a herb which grows to a height of 60 cm tall. The stems are triangular, 2 mm in diameter and rigid.

Synonymy: *Mariscus cyperinus* (Retz.) Vahl.

Uses: In China, a decoction of *Cyperus cyperinus* (Retz.) Suring. is used to counteract the putrefaction of the skin. The therapeutic potential of this herb remains unexplored.

Leaves: linear, pinkish at the base, 17 cm × 4 mm–8 cm × 3 mm. The inflorescences are 2.3 cm × 1 cm–1.7 cm × 7 mm terminal umbels of spikelets. The fruits are fusiform utricles of about 4 mm long (Fig. 397).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

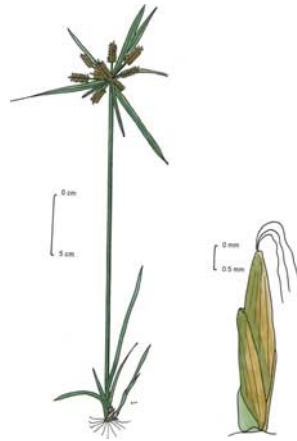


Fig. 397. *Cyperus cyperinus* (Retz.) Suring.

Cyperus rotundus L.

[From Greek, *kuperos* = sedge and Latin, *rotundus* = rounded]

Common names: Nut grass, coco grass; *rumput halia hitam*, *rumput teki* (Malay); *co gau*, *sa thao* (Vietnamese).

Physical description: It is a herb which grows perennially from a reddish-brown aromatic rhizome. The culms are upright, 15 cm–60 cm long and slender. Leaves: narrow, 6 cm–20 cm long, sheathing and single-nerved. The inflorescences are simple, 2.5 cm–4.5 cm long, umbels made of 4–6 dark red, 1.5 cm–2.5 cm long spikes. The glumes are distichous, narrow, lanceolate, subacute and imbricate. The rachis is winged. The style is ellipsoid angular and greyish. The fruits are trigonous nuts (Fig. 398).

Pharmaceutical interest: *Cyperus rotundus* is interesting because it contains patchoulenone, caryophyllene α -oxide, and 4,7-dimethyl-1-tetralone which are antimalarial ($EC_{50} = 10^{-4} M$ – $10^{-6} M$). The

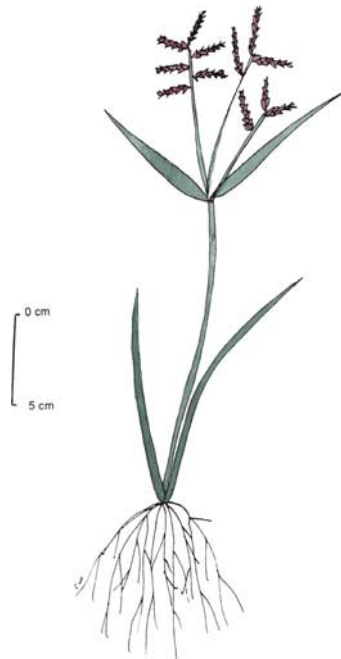
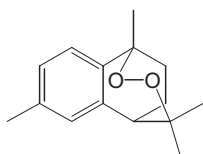


Fig. 398. *Cyperus rotundus* L.

endoperoxide sesquiterpene 10,12-peroxycalamenene displays the strongest activity with an EC_{50} value of 2.33×10^{-6} M (Thebtaranonth C *et al.*, 1995). - (-) - Rotundene and (+)-cyperadione are known to occur in the essential oil of this plant (Sonwa MM *et al.*, 2001).



10, 12 - Peroxycalamenene

Uses: In Malaysia, the rhizome is smoked to assuage pain of the nose. A decoction of approximately 10g of the rhizome is drunk to abrogate menstrual pain, stomachache, and to stop nausea. A lotion of the plant is used to soothe inflamed parts. In Vietnam, a decoction of the rhizome is used to regulate menses, assuage stomachache, promote digestion, stop diarrhea and vomiting. The rhizome of *Cyperus rotundus* and the seeds are used to soothe inflammation, combat fever, curb vomiting and to lower blood pressure.

References

- Sonwa MM, *et al.* (2001) *Phytochem* **58**(5): 799–810.
Thebtaranonth C, *et al.* (1995) *Phytochem* **40**(1): 125–128.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Eleocharis dulcis (Burm. f.) Trin. ex Henschel

[From Greek, *eleios* = marsh and *charis* = grace and from Latin, *dulcis* = sweet]

Synonymy: *Eleocharis plantaginea* R. Br., *Eleocharis tuberosa* Scult., *Surpus tuberosus* Roxb.

Common name: *Tike* (Javanese).

Uses: In China, *Eleocharis dulcis* (Burm. f.) Trin. ex Henschel is used to treat measles, eye diseases, flu, to combat fever, counteract poisoning, check hemorrhage and to promote urination. The pharmacological properties of *Eleocharis dulcis* (Burm. f.) Trin. ex Henschel remain unexplored.

Physical description: It is an asparagus-like, tuberous, aquatic erect which

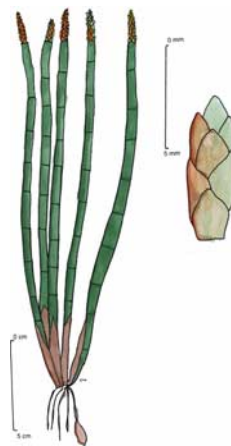


Fig. 399. *Eleocharis dulcis* (Burm. f.) Trin. ex Henschel. From: KLU Herbarium 043626. Flora of Malaya. Field collector: Zuraini Mohammad, 5 Dec 1993. Botanical identification: Baki Bakar. Geographical localization: Kau. Mardi-Tg. Karang, Malaysia.

grows to a height of 1 m in flooded roadsides and open waters of Tropical Asia, China and Pacific Islands. The tubers are edibles and the stems are articulate, green and 5 mm in diameter. The inflorescences are terminal spikes of about 1 cm long. The glumes are yellowish–green and the stamens are whitish. The fruits are considerably thin, scaly and approximately 2 mm × 1 mm utricles (Fig. 399).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Fimbristylis miliacea

[From Latin, *fimbriata* = fringed, *stylus* = style, and *miliacea* = pertaining to millet]

Synonymy: *Fimbristylis littoralis* Gaudich., *Scirpus miliaceus* Linn., *Scirpus niloticus* Blanco, *Trichelostylis miliacea* Nees & Arn., *Isolepis miliacea* Presl.

Common names: Lesser fimbristylis, grass like Fimbristylis; *rumpu tahi kerbau* (Malay).

Uses: In Malaysia, *Fimbristylis miliacea* is used to combat fever. In Taiwan, the plant is used to counteract snake's poisoning. The pharmacological properties of *Fimbristylis miliacea* remain unexplored.



Fig. 400. *Fimbristylis miliacea*. From: KLU 036775. Botanisk Institut Aarhus Universitet. Flora of Thailand. Field collectors: 1974, Kai Larsen & Supee S Larsen. Geographical localization: Northern: Maehongson: Khun Yuam, 600–700 m altitude, 18° 15' North–98° East, in Dipterocarp forest, wet land, Thailand.

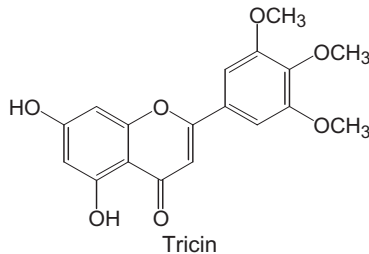
Physical description: It is a herb native to tropical America which grows to a height of 60 cm in wet land and grassy water courses of the Asia-Pacific. Leaves: linear, sheathing from the base of the stem and up to 30 cm long. The inflorescences are terminal racemes of 4 cm long of globose spikelets of 2.5 mm × 1.5 mm. The bracts are 1.8 cm–3 mm and linear. The fruits are 0.8 mm–1 mm long utricles (Fig. 400).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

2. Family POACEAE Barnhart 1895 nom. conserv., the Grass family

Physical description: The family Poaceae (Graminae or Graminaceae) is a huge family of approximately 500 genera and 8000 species of herbaceous plants known to produce a stockhouse of alkaloids, saponins, cyanogen glycosides, phenolic acids, coumarins, C-glycosylflavones, tricin and terpenes. The family Poaceae is by far the most important family of plants to the Human society by providing food for man and it is also the principal forage for countless grazing animals. The leaves show parallel nerves, are solitary at the nodes, and consist of sheath, a ligule and a blade. The flowers are bisexual or unisexual, hardly visible and arranged in a complex inflorescence, including a spikelet with a pair of subopposite small bracts (glumes) at the base. The perianth consists of 1–6 tepals. The andrecium includes a few stamens, the anthers of which are long, basifixied, tetrasporangiate and dithecal. The gynecium consists of 2–3 carpels forming a superior compound and single-locular ovary, enclosing an ovule which is subapical to nearly basal. The stigma is forked. The fruits are caryopsis with a thin pericarp adnate to the seeds that are starchy.

Pharmaceutical interest: Examples of Poaceae are *Triticum* species (wheat), *Zea mais* L. (corn), *Avena sativa* L. (oat), *Saccharum officinarum* L. (sugar cane), *Sorghum bicolor* L. (sorghum), *Hordeum vulgare* L. (barley) and *Poa* species (bluegrass). Wheat bran, representing approximately 20% of the weight of caryopsis, has become popular in normalizing bowels transit and in lowering cholesterolemia. The starch obtained from wheat, rice and corn is of interest to pharmacies. An interesting feature of *Andropogon* species, *Cymbopogon citratus* (DC.) Stapf and *Vetiveria zizanioides* is that they elaborate essential oils used in manufacturing perfumes. Tabasheer, a concretion of almost pure silicic acid produced by bamboos, is used by Asians to treat various ailments. The pharmacological potentials of this very large family are practically unknown. However, a number of plants classified within the family Poaceae, are known to contain antibiotic principles. About a hundred species of plants classified within the family Poaceae are used for medicinal purposes in



the Asia-Pacific. These are frequently used to combat fever, promote urination, invigorate health, assuage cough, promote digestion, treat skin diseases, and to check hemorrhages. *Oryza* species (rice) and *Bambusa* species (bamboos) are of considerable importance in Asia.

***Apluda mutica* L.**

[From Latin, *apluda* = chaff and *mutica* = blunt]

Synonymy: *Andropogon glaucus* Retz., *Apluda aristata* L., *Apluda cumiingii* Buse ex de Vriese, *Apluda geniculata* Roxb.

Common names: Gluten-rice grass; *bhanjura* (Indian).

Uses: In China: *Apluda mutica* L. is used to heal wounds occasioned by snake bites, sores and to counteract fungal infections. The pharmacological potential of *Apluda mutica* L. remains unexplored.

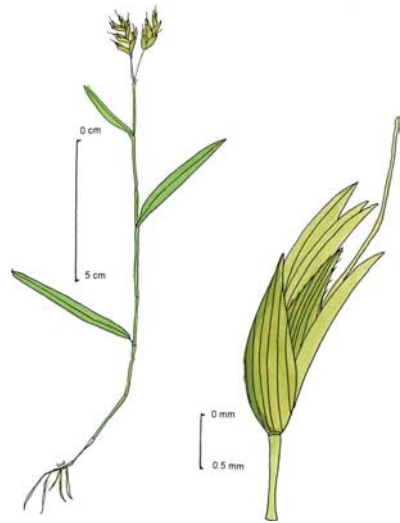


Fig. 401. *Apluda mutica* L. From: KLU Herbarium 28030. Plants of Ceylon. Field collector and botanical identification: Gerrit Davidse, DB Sumithraarachchi. 6 Dec 1974. Geographical localization: Northern Province, Jaffna District, ca. 4 miles of Jaffna along the coastal road on showy mounds composed of shells and sand, altitude: 15 m, Ceylon.

Physical description: It is a herb which grows to a height of 1 m on limestone rocks, grassy places in dunes and coasts of India, Ceylon, South-east Asia and China. The stems are glabrous, long and 1 mm in diameter and somewhat pinkish when dry. Leaf: linear-lanceolate, hairy and 5.5 cm × 2 mm–8 cm × 7 mm × 3 mm. The sheath is glabrous and 2.6 cm–3.8 cm long. The internodes are 11.2 cm–5.5 cm long. The inflorescences are 2.5 cm–4 cm long terminal spikes (Fig. 401).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Arthraxon hispidus* (Thunb.) Mak.**

[From Greek, *arthr* = segment, *axon* = axis and from Latin, *hispidus* = bristly]

Physical description: It is an aquatic herb native to tropical Asia which grows to a height of 40 cm in wet grassy areas and roadsides. The stems are long

Synonymy: *Arthraxon hispidus* var. *cryptatherus* (Thunb.) Makino (Hack.) Honda.

Common names: Hairy jointgrass, small carpgrass, Greek grass, joint headed arthraxon.

Uses: In China, the stem and leaves of *Arthraxon hispidus* (Thunb.) Mak. are used to alleviate cough and to counteract putrefaction of the skin. The pharmacological potential of *Arthraxon hispidus* (Thunb.) Mak. remains unexplored.

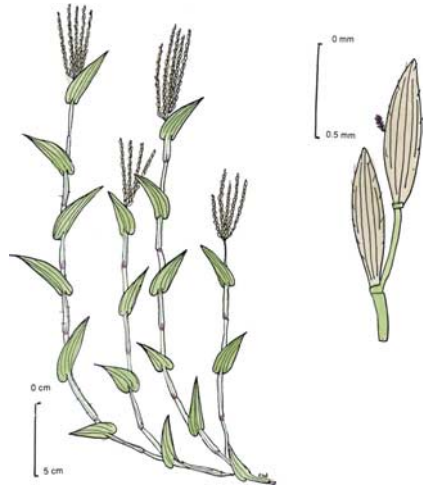


Fig. 402. *Arthraxon hispidus* (Thunb.) Mak. From: KLU Herbarium 17930. Ex. Herb. Universitatis Tokyoensis. Field collectors & botanical identification: H Ohba & Y Tateishi. 24 Sep 1971. Geographical localization: Japan, Saitama Pref., Hannoo-shi, Yamazaki, altitude: 200 m, abundant in sunny grassland faced to river.

and thin and the internodes are 3.5 cm–7.5 cm long. Leaves: the blade is lanceolate, somewhat succulent, subglabrous and 3 cm × 1.1 cm–5.5 cm × 1.4 cm. The base of the blade is cordate. The blade shows 11–12 nerves. The margin is ciliate. The sheath is 1.7 cm–3 cm long, pilose (hairs to 1 mm long) and shows a tuft or ring of hairs at the base. The inflorescences are terminal groups of 2.5 cm–3.5 cm long purplish spikes (Fig. 402).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Bambusa multiplex* (Lour.) Raeusch.**

[From Indian, *mambu* = bamboo and from Latin, *multus* = many and *plicis* = fold]

Physical description: It is a bamboo which grows to a height of 8 m. The plant is native to China and widely distributed in cultivation. The tuft of subequal branches at each node is very acutely held upwards.

The culms are golden and green striped, 1 cm diameter, slightly white–waxy, glabrous, green and with internodes to 30 cm long. Leaves: the sheath shows

Synonymy: *Bambusa nana* Roxb.

Common names: Alphonse Karr, hedge bamboo; *buloh pagar* (Malaysia); *pring chendani* (Javanese).

Uses: In Malaysia, the stems of *Bambusa multiplex* (Lour.) Raeusch. are used to threaten abortion. The pharmacological potential of this bamboo remains unexplored.

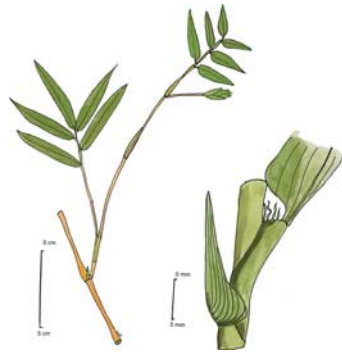


Fig. 403. *Bambusa multiplex* (Lour.) Raeusch.

indistinct auricles. The ligule is consists of 4–5 hairs of about 1 mm long. The blade is erect, 6 cm × 1 cm, glabrous with 1 mm–2 mm auricles which have 2 mm–3 mm fine bristles, and shows about 12 nerves (Fig. 403).

Warning: Tawny or red hairs on the sheaths of bamboo stems could cause mechanical injury to the skin and gastrointestinal tract.

***Chrysopogon aciculatus* (Retz.) Trin.**

[From Greek, *khrusos* = gold and *pogon* = herb from Latin, *aciculatus* = needle-like]

Synonymy: *Andropogon aciculatus* Retz.

Common names: Love grass, *rumpup jarum*, *kemuncup* (Malay).

Uses: In China and Taiwan, *Chrysopogon aciculatus* (Retz.) Trin. is used to counteract snake's poisoning. In Indonesia, an infusion of the plant is used to counteract poisoning. In Laos, Cambodia and Vietnam, the seeds are eaten to expel intestinal worms. In Malaysia, the plant is used to treat rheumatism. In the Philippines, the plant is used to promote urination. The pharmacological properties remain unknown till to date.

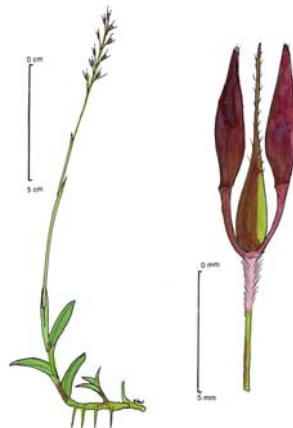


Fig. 404. *Chrysopogon aciculatus* (Retz.) Trin.

Physical description: It is a herb which grows to a height of 40 cm tall. The plant is found on the roadsides and grassy areas from China to Australia. The stems are glabrous, smooth, terete and about 1 mm in diameter. Leaves: the blade is glabrous, 5 cm × 3 mm–2.3 cm × 3 mm, lanceolate and shows 7 distinct

nerves. The margin is ciliate. The inflorescences are terminal and somewhat purplish 4 cm–6 cm long spikes (Fig. 404).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Coix lacryma-jobi* L.**

[From Greek, *coix* = palm and Latin, *lacrima* = tear and *jobi* = of Job]

Common names: Job's tears; *larmes de Job* (French); *damu Ayúb* (Arab); *cheik* (Burma); *Ee yin*, *kiai li* (Chinese); *mulai tikus* (Malay); *saga* (Samoa); *gavedu* (Sanskrit).

Physical description: It is a herb which grows to a height of 2.5 m in a geographical area, ranging from India to China and Pacific Islands. It is found in open fields, grassy areas, moist hillside and swampy areas. The stems are flattened, rigid and somewhat bamboo-like. Leaves: the blade is rigid and 50 cm × 3.8 cm–15 cm × 2 cm, cordate at the base, and shows about 8 lateral nerves. The fruits are characteristically porcelain-like, glaucous-white than black, tear-shaped, 8 mm × 1.1 cm, glossy berries that are open at the apex. The fruit pedicel is 1.5 cm–5.2 cm long (Fig. 405).

Pharmaceutical interest:

Anti-inflammatory properties: The anti-inflammatory properties of the fruits of *Coix lacryma-jobi* L. are confirmed: a methanol extract of seeds inhibits nitric oxide and oxygen production by murine macrophage-like RAW 264.7 cells mediated via suppression of inducible nitric oxide synthase mRNA expression (Seo WG *et al.*, 2000). Benzoxazinoids isolated



Fig. 405. *Coix lacryma-jobi* L.

Uses: The Arab travelers in the East became acquainted with the fruits and named them “*Damu Dáud*” (David's tears) and afterward *Damu Ayúb* (Job's tears). Es-Ságháni, who died about the year 1260, mentions them in the *Obáb* as strengthening and diuretic. The Arabs introduced the plant in Spain and Portugal, where it became naturalized as “*lagrima de Job*”. The fruits of *Coix lacryma-jobi* L. are used as food, to promote urination, appetite, to combat fever, to treat anxiety, rheumatism, dropsy, gonorrhoea and to remove warts throughout China, Japan, India and Southeast Asia. In India, the fruits are used to loose weight, to strengthen and to promote urination, while the roots are used to assuage menstrual discomforts.

from the roots, inhibit the release of histamine from rat mast cells, stimulated with concanavalin A and sensitized with immunoglobulin E. (Otsuka H *et al.*, 1988).

Dietetic properties: There is an expanding body of evidences to suggest that the consumption of fruits of *Coix lacryma-jobi* L. could be of dietetic value, since it lowers fibrinogen levels and fibrinolytic activity in Wister rats (Check JB *et al.*, 1995). The fruits protect Sprague-Dawley male rats against plasma and liver hypercholesterolemia experimentally by lard-enriched diet (Park Y *et al.*, 1988). Note that a number of glycans with hypoglycaemic activity are known to occur in the seeds (Takahashi M *et al.*, 1986).

Neurological properties: The quieting property of *Coix lacryma-jobi* L. could be attributed to coixol (6-methoxybenzoxazolone), which displays central muscle relaxant and anti-convulsing effects. When administered intraperitoneally at dose of 50 mg/Kg–100 mg/Kg, it decreases locomotor activities and produce hypothermia in rats. Coixol potentiates thiopental-induced sleep and attenuates the writhing syndrome induced by 1% acetic acid and increases the threshold to jumping response induced by foot shock (Takahashi M *et al.*, 1986).

Other pharmacological properties: Coixenolide extracted from the fruits of *Coix lacryma-jobi* L. inhibits the growth of tumors (Ukita T *et al.*, 1961).

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Ukita T, *et al.* (1961) *Chem Pharm Bull* **9**, 43.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Cymbopogon citratus (DC.) Stapf

[From Greek, *kymbe* = boat and *pogon* = beard and from Latin, *citrus* = citron]

Physical description: It is a fragrant, aromatic herb which grows to a height of 1.6 m. Leaves: the blade is lanceolate, linear and 15 cm–60 cm × 1 cm–2 cm. The plant has been cultivated for the production of Lemon Grass Oil in India, Ceylon, and Malaysia (Fig. 406).

Synonymy: *Andropogon citratus* DC., *Andropogon nardus* L. var. *ceriferus* Hack., *Andropogon schoenanthus* sensu Lour.

Common names: Lemon grass, ginger grass, citronella grass; *chiendent-citron* (French); *ágya ghas* (Hindi); *váshna pulla* (Tamil); *sa, hurong mao* (Vietnamese); *chakai* (Thai); *sere* (Javanese).



Fig. 406. *Cymbopogon citratus*.

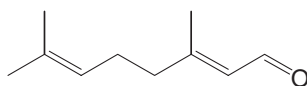
Uses: In the Asia-Pacific the leaves of *Cymbopogon citratus* (DC.) Stapf are often used in aromatic baths to resolve swelling, as a perfume, to promote blood circulation, treat skin diseases, heal ulcers and sores. In China, the plant is used to invigorate health, promote digestion, treat asthma, cough, cold, and to clear the voice. In Malaysia, the plant is used to promote urination and to promote recovery from childbirth, and it is believed that "diamonds can be found below the roots". In the Palau Islands, the plant is used to combat fever. In the Philippines, *Cymbopogon citratus* (DC.) Stapf is used to promote urination. Asians living in UK use this plant to promote sweating, to invigorate health and to improve digestion.

Pharmaceutical interest: *Cymbopogon* species have the tendency to elaborate subtle mixtures of monoterpenes including citral, geraniol, and citronellal, which impart to the plant a very distinctive fragrance. Citronella Oil (*British Pharmaceutical Codex*, 1963) from *Cymbopogon nardus* or *Cymbopogon winterianus* is used as a constituent of insect repellents, perfumes, soaps and brilliantine. Lemon Grass Oil (*British Pharmaceutical Codex*, 1954) obtained from *Cymbopogon flexuosus* and *Cymbopogon citratus* was formerly used to promote digestion and to manufacture perfumes. Its chief constituent Lemon Grass Oil is rubefacient.

Anti-inflammatory and diuretic properties: A decoction of leaves of *Cymbopogon citratus* (DC.) Stapf displays dose-dependent hypotensive, diuretic and anti-inflammatory properties when given *per os* to animals (Carbajal D *et al.*, 1989).

Analgesic properties: Lemon grass oil increases the reaction time to thermal stimuli both after oral (25 mg/Kg) and intraperitoneal (25 mg/Kg–100 mg/Kg) administration. Fifty mg/Kg to 200 mg/Kg of lemon grass oil given *per os*

or intraperitoneally strongly inhibits the acetic acid-induced writhing in mice. In the formalin test, 50 mg/Kg–200 mg/Kg of lemon grass oil given intraperitoneally, inhibits preferentially the second phase of the response. The opioid antagonist naloxone blocks the central antinociceptive effect of lemon grass oil, suggesting that lemon grass oil acts both at the peripheral and the central levels (Viana GS *et al.*, 2000).



Citral

Antitumor properties: There is an expanding body of evidence to suggest that citral prevents the formation of tumors. Lemon Grass oil protects 344 male Fischer rats partially hepatectomized against diethylnitrosamine-induced (intraperitoneal doses of 100 mg/Kg body weight) early phase hepatocarcinogenesis (Puatanachokchai R *et al.*, 2001). Note that citral (3, 7-dimethyl-2, 6-octadienal) isolated from a methanol extract of lemon-grass induces glutathione *S*-transferase activity (that detoxifies polycyclic aromatic hydrocarbons) in rat normal liver epithelial cell-line, RL34 cells cultured *in vitro* (Nakamura Y *et al.*, 2003). Extracts of lemon grass significantly inhibit the formation of aberrant crypt foci in the colon mucosa, inhibits fecal β -glucuronidase competitively and displays antioxidant property (Suaeyun R *et al.*, 1997).

Cardiovascular properties: An aqueous extract of the plant shows some levels of activity on isolated hearts of rats (Gazola R *et al.*, 2004).

References

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 Gazola R, *et al.* (2004) *Pharmacol Res* **50**(5): 477–480.
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 Mendelsohn HV, (1946) *Arch Derm Syph* **53**: 94.
 Nakamura Y, *et al.* (2003) *Biochem Biophys Res Comm* **302**(3): 593–600.
 Suaeyun R, *et al.* (1997) *Carcinogenesis* **18**(5): 949–955.
 Viana GS, *et al.* (2000) *J Ethnopharmacol* **70**(3): 323–327.

Warning: Vesicular dermatitis of the face, forearms and ankles appeared in workers who were exposed to a cargo of Lemon Grass Oil on board a ship (Mendelsohn, 1946).

***Cynodon dactylon* (L.) Pers.**

[From Greek, *kuōn* = dog, *odontos* = tooth and *daktulos* = finger]

Common names: Creeping dog's tooth grass; *chiendent pied de poule* (French); *guna* (Sanskrit); *grama comun* (Spanish); *rumput minyak* (Malay); *arugampillu* (Tamil).

Physical description: It is an invasive herb of the sandy coastal area, coast roads, sandy mangrove sedge area and dry sandy coasts of the Asia-Pacific. The stems are long and stoloniferous. The internodes are 1 cm–1.5 cm long. The plant is creeping and forms a matted tuft with long and thin erect or ascending flowering branches which are 7.5 cm–30 cm long. Leaves: small, rigid, alternate and glabrous. The sheath is 5 mm–8 mm long. A few hairs are present at the junction between blade and sheath. The blade is 1.3 cm–9 mm × 3 mm–4 mm, without midrib and with a microscopically serrate margin. The inflorescences consist of 2–6 purplish spikelets which are 1.4 cm–3 cm long. The involucre glume is lanceolate, acute to subulate-mucronulate, with the lower one being 1 mm–1.6 mm long and the upper one being slightly longer. The floral glume is obliquely oblong and approximately 2 mm long. The anthers are oblong and 1 mm long (Fig. 407).

Pharmaceutical interest: Oral administration of a decoction of *Cynodon dactylon* protects rabbits against hyperglycemia, caused by subcutaneous injection of 50% dextrose solution at a dose of 4 mL/Kg of weight (Ramos R *et al.*, 1992).

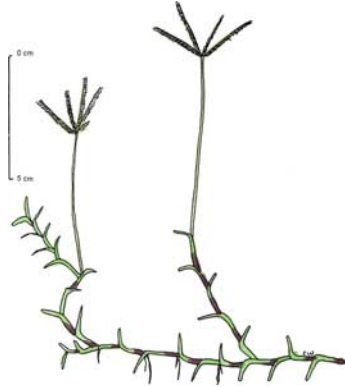


Fig. 407. *Cynodon dactylon* (L.) Pers. From: KLU Herbarium 35293. Flora of Singapore. The Herbarium, Botanic Garden Singapore. Geographical localization: near Km. 13, West Coast Road, open waste area, Singapore, altitude: 2 m, date: 1 Feb 1983. Field collector & botanical identification: JF Maxwell.

Uses: *Cynodon dactylon* (L.) Pers. is deified by the Hindus who believe that a nymph dwells in the plant. In the Atharva-Veda, it is thus addressed “*May Dūrva...from the water of life, which has a hundred roots and a hundred stems, efface a hundred of my sins, and prolong my existence on earth a hundred years*”. It is used in India to treat hallucinations, epileptic fits, fatigue, leprosy, skin diseases, dysentery and epistaxis. In China, *Cynodon dactylon* (L.) Pers. is used to remove impurities, promote the production of blood after hemorrhages and to resolve swelling. In Laos, Cambodia and Vietnam, the plant is used to promote urination and appetite, combat fever and to assuage stomachache. In the Philippines, the plant is used to promote urination and to treat gynecological-urinary diseases.

Reference

Ramos R, *et al.* (1992) *Arch Med Res* **23**(1): 59–64.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Eleusine indica (L.) Gaertn. f

[From Greek, *Eleusinos* = Demeter, celebrated at Eleusis in Attica and from Latin, *indica* = from India]

Physical description: It is a tufted annual tropical grass which grows to a height of 60 cm common in sunny disturbed places in lawns and along dirty roads and tracks up to 900 m elevation. The plant is native to the Old World Tropics and is naturalized in the New World. The stems are flattened and glabrous. Leaves: straight, flattened, keeled, slightly hairy along margin and at the base. The sheath is 1 cm long. The blade is 6 cm–30 cm × 3 mm–8 mm, and glabrous. The midrib and upper margin are scabrous. The inflorescences consist of 2–7 terminal, one sided spikes which 0.3 cm–0.7 cm long (Fig. 408).

Common names: Goose grass, crab-grass, wire grass, sword grass; *rumpit sambau* (Malay); *co man trau, thanh tam* (Vietnamese); *singnomyet* (Burmese); *choeung kras* (Cambodian).

Uses: In Malaysia, the juice expressed from *Eleusine indica* (L.) Gaertn. f is used to promote menses after childbirth, to treat encephalitis, heat stroke, malaria, uterus and rectum prolapse, leucorrhea and dysentery. In the Philippines, a decoction of the fresh plant is drunk to promote urination and to treat dysentery. In Vietnam, a decoction of 60 g–100 g of this herb is drunk to assuage liver discomfort, stomachache, promote urination, treat influenza and to lower blood pressure. In Cambodia, the whole plant is used to combat fever. The therapeutic potential of *Eleusine indica* (L.) Gaertn. remains unexplored. Note that *Eleusine* species are known to produce flavonoids such as vitexin and triclin (Hilu KW *et al.*, 1978).

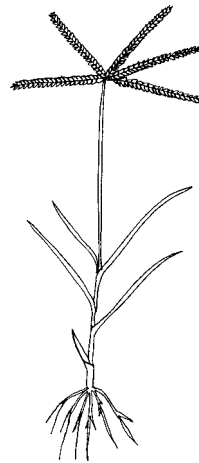


Fig. 408. *Eleusine indica* (L.) Gaertn. f.

Reference

Hilu KW, *et al.* (1978) *Biochem Sys Ecol* **6**(3): 247–249.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Imperata cylindrica* (L.) P. Beauv.**

[From Latin, *imperata* = imperial and from Greek, *kulindros* = cylinder]

Synonymy: *Imperata arundinacea* Cyr., *Saccharum spicatum sensu* Lour., *Saccharum cylindricum* Lamk.

Common names: Red baron, Japanese blood grass, satin grass, dog's tail grass; *lalang*, *along-along* (Malay).

Uses: The rhizome is used to combat fever, treat influenza, remove the presence of blood in the urine, internal haemorrhage, haemoptysis, to treat oedema, jaundice, to alleviate cough and to assuage kidneys discomfort. In Malaysia, the rhizome is used to expel impurities. In Vietnam, a bath of rhizomes is used to soothe inflamed parts.

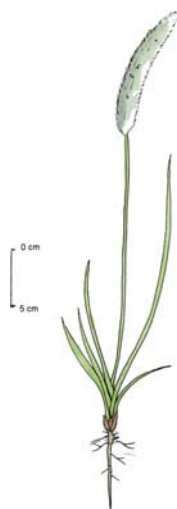


Fig. 409. *Imperata cylindrica* (L.) P. Beauv.

Physical description: It is a rhizomatous herb growing in a geographical zone, spanning Korea and Australia. Leaves: the blade is linear to lanceolate, 5 mm–1 cm × 10 cm–18 cm and green. The inflorescences are white and fluffy spikes of approximately 10 cm long (Fig. 409).

Pharmaceutical interest:

Cardiovascular properties: *Imperata cylindrica* (L.) P. Beauv. produces cylindrene, a sesquiterpene, which inhibits the contraction of vascular smooth muscle (Matsunaga K *et al.*, 1994); cylindol A, which inhibits the enzymatic activity 5-lipo-oxygenase (Matsunaga K *et al.*, 1994a); graminone B, a lignan, which inhibits the contraction of rabbit aorta (Matsunaga K *et al.*, 1994b) and imperanene, which inhibits the aggregation of platelets (Matsunaga K *et al.*, 1995).

Other pharmacological properties: A number of polysaccharides characterized from a water-soluble crude extract of this grass, boost the proliferation of murine splenocytes (Pinilla V *et al.*, 1999). An extract of the rhizome of *Imperata cylindrica* (L.) P. Beauv. inhibits the urination of rats (Sripanidkulchai B *et al.*, 2000).

References

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 Matsunaga K, *et al.* (1994b) *J Nat Prod* **57**(12): 1734–1736.
 Matsunaga K, *et al.* (1995) *J Nat Prod* **58**(1): 138–139.
 Pinilla V, *et al.* (1999) *Planta Med* **65**(6): 548–552.
 Sripanidkulchai B, *et al.* (2000) *J Ethnopharmacol* **75**(2–3): 185–190.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

Lophaterum gracile Brongn.

[From Latin, *lopha* = crested, *gracilis* = long and thin]

Synonymy: *Lophaterum elatum* Zoll.,
Bambusa puberula sensu Stuart.

Common names: Common lophatherum;
rumput kelurut (Malay).

Uses: In China, Taiwan and Korea, *Lophaterum gracile* Brongn. is used to combat fever, relieve the bowels of costiveness, promote urination, remove impurities from the lungs, check bleeding, resolve inflammation, threaten abortion, induce labour and to treat anxiety. In Malaysia, the swollen part of the roots is used to strengthen and to invigorate health. The pharmacological potentials of *Lophaterum gracile* Brongn. remain unexplored til to date.

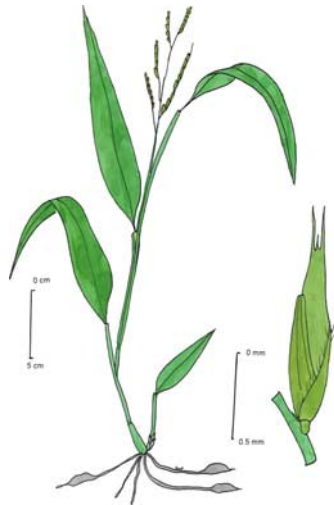


Fig. 410. *Lophaterum gracile* Brongn.

Physical description: It is a herb which grows to a height of 1.5 m. The plant is found in sunny disturbed areas, gardens, stream banks and plantations in Southeast Asia, China, Taiwan, Australia, and Ceylon. The roots are swollen and the swellings are 1.5 cm × 4 mm. Leaves: the sheath is pilose, ribbed, and 3 cm–10.5 cm. The blade is lanceolate, microscopically areolate above, pilose, considerably thin and 16.5 cm × 1.8 cm–1.2 cm × 12.5 cm. The blade shows 4 lateral nerves which are indistinct and tiny tertiary nerves that are present. The margin is microscopically serrate. The inflorescences are terminal group of 10.5 cm–11 cm long spikes (Fig. 410).

Warning: Caution must be taken as the toxic effects of this plant are unknown.

III. Subclass ZINGIBERIDAE Cronquist 1978

The subclass Zingiberidae consists of 2 orders, 9 families and approximately 3800 species of herbs. The order Bromeliales and the order Zingiberales are of approximately equal size in terms of the number of species; however, all of the order Bromeliales belong to the single family Bromeliaceae.

A. Order BROMELIALES Lindley 1833

1. Family BROMELIACEAE A. L. de Jussieu 1789 nom. conserv., the Bromeliad Family

Physical description: The family Bromeliaceae consists of approximately 45 genera and 2000 species of epiphytic herbs, principally native to tropical America, containing papain-like proteolytic enzymes and occasionally steroidal saponins. The leaves are arranged in dense clusters; they are long, strap-shaped, stiff, spinulose-lobed, and often colored at the base. The flowers are hermaphrodite or unisexual, regular, trimerous and packed in terminal heads, spikes or panicles with colourfull bracts. The ovary consists of 3 carpels united into a compound, 3-locular, superior, or inferior ovary relatively embedded in the infructescence, with each locule containing several ovules. The style is often trifid. The stigma is papillate. The fruits are capsular or succulent. The seeds are winged or plumose in capsular fruits. An example of the plant classified within the family Bromeliaceae is *Ananas comosus* (L.) Merr. (*Ananas sativus*) or pineapple, the infructescence of which is palatable (Fig. 411).



Fig. 411. *Ananas comosus* (L.) Merr.

***Ananas comosus* (L.) Merr.**

[From Greek, *komē* = hair of head]

Physical description: It is a stout, herbaceous plant native to tropical America. The stems are erect and 50 cm–1.5 m long. Leaves: numerous, 1 m–1.5 m × 5 cm–7 cm, finely toothed and acuminate. The flowers are perfect and arranged in the axil of the bracts. The calyx consists of 3 short sepals. The corolla comprises of 3 petals that are purple, free with a pair of scales at the base. The andrecium consists of 6 stamens. The ovary is inferior and the style is filiform. The fruits are conical, spirally-arranged into large ovoid, succulent palatable infructescences crowned with persistent bracts.

Pharmaceutical interest: The ripe fruit and the stems of *Ananas comosus* (L.) Merr. contain a series of proteolytic enzymes known as bromelains. In clinical trial, 75 patients

with bruises of the face and haematomes of the orbits, lips, ears, chests and arms, were given bromelains 4 times a day. Within 4 days, bruises had disappeared in 58 of the given bromelains, but only in 10 of the 72 controls (Blonstein GL *et al.*, 1969). Bromelains enteric coated tablets are used to treat post-traumatic and post-operative edema (*per os*, 5 00 000 UI/day). These are occasionally combined with antibiotics or pancreatic enzymes (trypsin, amylase, and lipase) in the treatment of exocrine hepatic insufficiency and are considered for the symptomatic treatment of dyspepsia. Bromelains enter in several preparations for respiratory tract disorders (Bequipecto[®]), digestive insufficiency (Globase[®]); vascular disorders (Flebostop[®]); muscular and joint pain (Bio-disc[®]). Literature regarding the pharmacological properties of bromelains are readily available (Lotz-Winter H, 1990).

References

- Blonstein GL, *et al.* (1969) *Practitioner* 203–206.
 Lotz-Winter H, (1990) *Planta Med* 56: 249–253.

Synonymy: *Ananas sativus* Schult., *Ananassa sativa* Lind.

Common names: Pineapple, *nannati* (Burmese); *mneas* (Cambodian); *nanas* (Malay); *pina* (Filipino); *ama* (Sanskrit); *anassapalamss* (Tamil); *anasas*, *chardon du Brésil* (French).

Uses: *Ananas comosus* (L.) Merr. was first made known in Europe through Hernandez in 1513. In Indonesia, the fruit is used to promote digestion and to soothe sore throat. In Malaysia, the juice expressed from the green fruit is used to threaten abortion, relieve the bowels of costiveness and to expel intestinal worms. A decoction of the leaves is used to treat venereal diseases. In Vietnam, the fruit is used to expel impurities when ripe, promote urination, expel stones from the kidneys and to treat gonorrhoea.

IV. Subclass LILIIDAE Takhtajan 1966

The subclass Liliidae consists of 2 orders, 19 families and approximately 25 000 species of bulbous herbs mostly evolved in the Liliopsida (Appendix I). More than four-fifths of the species belong to only 2 families, the family Liliaceae and the family Orchidaceae. Alkaloids and steroidal saponins are often used as chemical repellants. The order Liliales is primitive in Liliidae and consists of 15 families and 8000 species.

A. Order LILIALES Lindley 1833

1. Family AMARYLLIDACEAE J. St. HILAIRE

Physical description: The family Amaryllidaceae consists of approximately 90 genera and 100 species of daffodil-like herbs. Amaryllidaceae are characterized by their flowers which are solitary or umbellate, showy, consist of 6 tepals, 6 stamens and an inferior tri-locular ovary. The fruits are capsular or succulent, containing a number of seeds.

Pharmaceutical interest: *Narcissus*, *Amaryllis* and *Hymenocallis* are cultivated to decorate gardens. Ingestion of the bulb of Amaryllidaceae causes hypersalivation, vomiting, diarrhea, paralysis, collapse and death due to isoquinoline alkaloids, known as the “Amaryllidaceae alkaloids”. These alkaloids are specific of the family Amaryllidaceae and have anticancer, anticholinesterase, analgesic and antispasmodic properties. One such alkaloid is pancrastatine which has displayed a remarkable array of cytotoxicity and has undergone preclinical developments. Another interesting feature of Amaryllidaceae is that they elaborate mannose-specific lectins to inhibit the proliferation of the Human Immunodeficiency Virus. In strictly botanical sense, *Agave americana* L. and *Curculigo latifolia* Dryand. belong to the Agavaceae and Hypoxidaceae respectively. Their active principles are steroidal saponins. In the Asia-Pacific, approximately 20 plant species of Amaryllidaceae are medicinal.

***Agave americana* L.**

[From Latin, *agave* = noble and *americana* = from America]

Physical description: It is a large, robust, and stemless herb native to Mexico and is one of the most common ornamental species in tropical countries. Leaves: 1 m–1.80 m × 12 cm–20 cm × 1 cm–6 cm, inserted just above a very broad base contracted into a relatively distinct collar. The blade is succulent, decumbent, recurved and often with penciled longitudinal white or

Common names: American aloe or century plant; *duri landak* (Malay).

Uses: In Malaysia, the juice expressed from the leaves could alleviate cough. The plant is used to assuage stomachache, painful erection in gonorrhoea sufferers, and to treat scurvy and cancer. A poultice of the powdered leaves is used to heal sores, boils and to assuage other skin discomfort. In Vietnam, the juice expressed from the leaves is used to promote urination and defecation. The heart of the plant is used to heal wounds and to soothe sores.

yellow bands. The flowers are trimerous, actinomorphic, smelly and densely crowded at the top of a 4.5 m–8 m height fleshy panicle. The corolla is yellowish-green, funnel-shaped and 1.5 cm–2 cm long. The fruits are dehiscent and 4 cm long capsules containing several glossy seeds (Fig. 412).

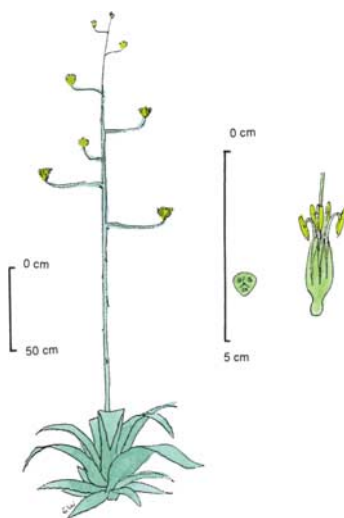
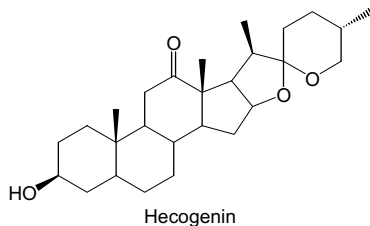


Fig. 412. *Agave americana* L.

Pharmaceutical interest: The leaves of *Agave sisalana* yield the sisal fiber and the fermented juice of *Agave tequilana* is used to concoct the Mexican *pulque* beverage. The medicinal properties of *Agave americana* L. are attributed to steroidal saponins in the plant. These are natural surface-acting agents that dissolve microbes, mucus and blood cells, promote urination and soothe inflammation.

Anti-inflammatory properties: A lyophilized aqueous extract of *Agave americana* L. injected to rats (200 mg–300 mg, intraperitoneal injection) abrogates significantly, carrageenan-induced edema and doses of genins (total steroidal saponins, hecogenin and tigogenin), equivalent to the lyophilized aqueous extract that inhibits carrageenan-induced edema more efficiently than indomethacine (5 mg/Kg, intraperitoneal injection), without any harmful effect on the gastric mucosa (Peana AT *et al.*, 1997). Saponins of *Agave* species provide after industrial hydrolysis hecogenin and tigogenin that are affordable raw materials for the synthesis of steroidal hormones including corticosteroids, used in the treatment of inflammation.



Another useful application of *Agave* species is their possible use in treating waters abounding in *Biomphalaria*, which is the specific intermediate host mollusk of *Schistosoma* parasites (Brazelli V *et al.*, 1995; Ferrer-Lopez JR *et al.*, 1993). Note that an extract of the plant inhibits the enzymatic activity of angiotensin converting enzyme (Duncan AC *et al.*, 2004).

References

- Brazelli V, *et al.* (1995) *Contact Derm* **33**(1): 60–61.
 Duncan AC, *et al.* (2004) *J Ethnopharmacol* **68**(1–3): 63–70.
 Ferrer-Lopez JR, *et al.* (1993) *Rev Cubana Med Trop* **45**(2): 118–121.
 Peanat T, *et al.* (1997) *Planta Med* **63**(3): 199–202.

Warning: Although the soap-like juice of *Agave americana* L. appears to be an attractive material for cosmetics, one should know that saponins often cause dermatitis (Kerner J *et al.*, 1973).

Crinum asiaticum L.

[From Greek, *krinon* = lily and from Latin, *asiaticum* = from Asia]

Common names: Seashore crinum, poison bulb, or *bakong*, *bawang tanah*, or *bawang hutan* (Malays); *lतालotalo* (Samoa, Fiji); *viavia* (Fiji); *piga-palayi* (Guam).

Physical description: It is a herb which grows wild or cultivated to a height of 1 m from a 5 cm × 10 cm–10 cm × 25 cm bulb in a geographical zone, spanning South-east Asia and Polynesia. Leaves: succulent, rosette of light green leaves of 50 cm × 15 cm with a tapering apex, and wavy and translucent margins. The inflorescences are on top of a stout, 90 cm long stem which supports an umbel-like group of 12–40 white flowers, each supported by a 2.5 cm long pedicel, enclosed initially in a pair of light green, 4 cm long bracts. The perianth tube is membranaceous, light green, 10 cm long and develops 6 lobes of 5 cm length. The andrecium consists of 6 stamens joined to the mouth of the tube. The anthers are brownish and elongated; the filaments are thin and white. The fruits are pale, green and succulent capsules containing a few large and green seeds (Fig. 413).

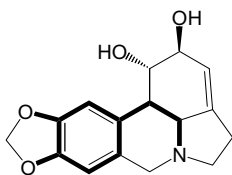


Fig. 413. *Crinum asiaticum* L.

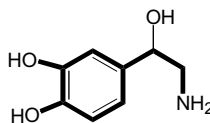
Pharmaceutical interest: *Crinum* species are intriguing as they elaborate a highly unusual series of isoquinoline alkaloids.

Lycorine: Lycorine characterized from *Sternbergia clusiana* relaxes dose-dependently isolated epinephrine-pre-contracted guinea pig pulmonary arteries. It also increases both the contractility and the rate of isolated perfused hearts. These properties are inhibited by propranolol and suggest a β -adrenergic receptor stimulation (Abdalla S *et al.*, 1993). Lycorine is more active than aspirin in the analgesic modified Koster's test (Tanker M *et al.*, 1996). The vasodilating and analgesic properties of lycorine are not surprising, since isoquinoline alkaloids, such as papaverine, relax and smooth the muscles as well as assuage pain. Lycorine, characterized from *Brunsvigia littoralis*, is both antimalarial and cytotoxic (Campbell WE *et al.*, 1998).

Uses: The medicinal profile of *Crinum asiaticum* L. is the one of the most poisonous plants: emetic and counter-irritant. In Indonesia, the oiled and heated leaves are used to treat strangury and to heal wounds occasioned by poisoned arrows, bites, and stings. In Malaysia, a poultice of the powdered leaves is used to soothe swelling, swollen joints, to treat lumbago, to assuage pain and headache and to combat fever. In Papua New Guinea, the juice expressed from the bulb is used to treat gonorrhoea. In the Philippines, the bulbs are crushed and applied externally and the leaves are emollient. In the Northwest of Solomon Islands, the bulbs are used at child-birth and the leaves are used to soothe inflammation.

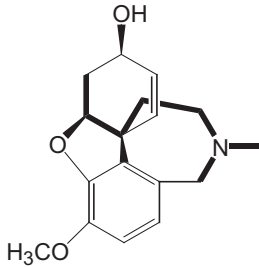


Lycorine

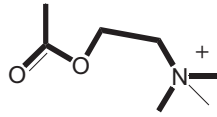


Noradrenaline

Gаланthamine: Galanthamine, characterized from *Galanthus woronowii* (Caucasian snowdrop), has been used in Russia to treat myasthenia, myopathy, curare poisoning, motor and sensory impairment, traumatic injuries of the nervous system at doses of 2.5 mg–10 mg subcutaneously (*Drugs and Medicinal preparations*, V/O Medexport, Moscow, 4th Ed., 1963). Galanthamine, like physostigmine, is a reversible and competitive inhibitor of acetylcholinesterase with high lipid solubility. Galanthamine improves the cognition in a number of learning and memory tests (Harvey AL, 1995) and might be used to treat Alzheimer's disease, associated with a loss of acetylcholine in the nucleus basalis.



Galanthamine



Acetylcholine

Others: Pretazettine and lycorenine destroy Molt-4 lymphoid cells and HepG2 hepatoma cells cultured *in vitro* (Weninger B *et al.*, 1995). Lycoricidine inhibits *in vitro* the development of RNA-containing Flaviviruses (Japanese Encephalitis, Yellow Break Fever, and Dengue Virus) and Bunyaviruses (Punta Toro, Rift Valley Break Fever Viruses; Gabrielsen B *et al.*, 1992). *Crinamine:* Crinamine displays cytotoxic and antimalarial properties, and inhibits the proliferation of *Bacillus cereus* and *Pseudomonas aeruginosa* cultured *in vitro* (Adesanya SA *et al.*, 1992).

Of recent interest is a glutamine-rich antifungal peptide with immunomodulatory and antiproliferative activities (Chu KT *et al.*, 2004).

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Warning: The plant is extremely toxic.

Curculigo latifolia Dryand.

[From Latin, *curculio* = a kind of weevil and *latus* = broad and *folium* = leaf]

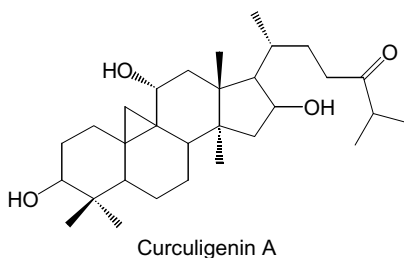
Physical description: It is a large tufted and herbaceous rainforest herb, which grows wild in a geographical

Common names: Weevil-wort, palm grass; *lumba* (Malay).

zone, spanning India and Sumatra. Leaves: hard, dark green and shiny. The blade is lanceolate, broadest at the middle and tapering, hairy or not, 90 cm × 15 cm, occasionally purple in the below, with several longitudinal ribs. The flowers are bright yellow, 1.5 cm long and arranged in scapose umbels supported by spathe-shaped bracts and 30 cm–60 cm long stems. The perianth is tubular and consists of 6 tepals. The andrecium consists of 6 stamens. The gynecium consists of a 2-celled ovary. The fruits are edible, sweet, whitish, beaked and hairy berries of 2.5 cm long.

Pharmaceutical interest: The sweet taste of the fruit of *Curculigo latifolia* Dryand. is attributed to curculin, which has a sweetening, taste-modifying non-functional mannose-binding lectin (Yamashita H *et al.*, 1995). The invigorating property of *Curculigo latifolia* Dryand. could be due to the immunological reinforcement mediated by a number of cycloartane saponins, since curculigosaponin G and curculoside experimentally display thymotrophic and immunostimulating properties (Xu JP *et al.*, 1992; Yamusaki K *et al.*, 1994). *In vitro*, an extract of rhizome inhibits the proliferation of the Hepatitis B Virus (Fan T *et al.*, 1996), thereby substantiating the traditional use of this plant for the treatment of jaundice.

Uses: In Malaysia, the fruit of *Curculigo latifolia* Dryand. is used to promote appetite and to give a sweet taste to the water. A decoction of the fruit and flowers is used to promote digestion and urination. A decoction of the rhizome is used to stop menorrhagia, combat fever and to soothe inflamed eyes. In China, *Curculigo latifolia* Dryand. is used to produce venereal desire and to invigorate health.



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Warning: Caution must be taken as the toxic effects of this plant are unknown.

***Narcissus tazetta* L.**

[From Greek, *narkē* = numbness and from Latin, *tazetta* = little cup]

Common name: Chinese daffodil.

Uses: In China and Japan, the bulb is used to heal ulcers and boils, calm the itching, assuage pain, treat eye diseases and to resolve swellings. The flowers are used to combat fever.

Physical description: It is a poisonous, bulbous and succulent herb which grows wild in China and Japan. Leaves: simple, 23 cm × 1 cm and somewhat cylindrical and succulent. The inflorescences are cymose and initially enveloped in a membrane. The flowers are bright yellow, 5-lobed, and 2 cm × 3 cm. (Fig. 414).

Pharmaceutical interest:

Analgesic properties: An ethanolic extract of the bulbs of *Narcissus tazetta* L. inhibits dose-dependently, in mice, the abdominal contractions induced by p-benzoquinone at doses of 5 mg/Kg, 50 mg/Kg, 100 mg/Kg or 200 mg/Kg, subcutaneously, but has no analgesic effect in the hot-plate test (Cakici I *et al.*, 1997).

Antiviral properties: An ethanolic extract of bulbs of *Narcissus tazetta* L. inhibits the plaque formation of Bovine Rhinotracheitis Virus and Equine Rhinopneumonitis Virus cultured *in vitro* (Kelling CL *et al.*, 1976). An alkaloidal extract of *Narcissus tazetta* L. inhibits DNA polymerase of Avian myeloblastosis Virus (Papas TS *et al.*, 1973).

Cytotoxic property: Two cytotoxic alkaloids N-methyl-8,9-methylenedioxy-phenanthridinium methylsulfate and N-methyl-8,9-methylenedioxy-phenanthridinium malate are known to occur in the fresh flowers of *Narcissus tazetta* L. (Youssef DT *et al.*, 2001). Note that lycorine, pseudolycorine, galanthamine, haemanthamine, tazettine and pretazettine are present as well (Abdallah OM *et al.*, 1993).

Other properties: A number of hemagglutinating mannose-binding dimeric lectins were isolated from the bulb of *Narcissus tazetta* L. (Ooi LS *et al.*, 2000).

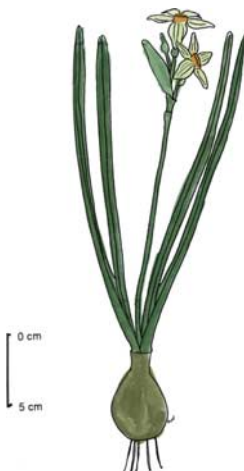
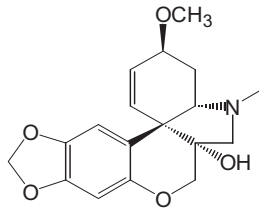


Fig. 414. *Narcissus tazetta* L.



Tazettine

References

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Warning: The plant is very toxic.

2. Family IRIDACEAE A. L. de Jussieu *nom. conserv.*, the Iris Family

Physical description: The family Iridaceae consists of 80 genera and approximately 1500 species of toxic, rhizomatous, or bulbous perennial and cosmopolitan herbs most abundant in Africa. It is also known to produce saponins, mangiferin, quinones (naphthoquinones and anthraquinones), terpenoids (mono-, sesqui-, di- and tetra-terpenoids) and flavonoids (anthocyanidins, flavones, flavonols and isoflavones). The leaves are lanceolate, often crowded at the base of the stem, while sheathing at the base. The flowers are bisexual, actinomorphic, with straight perianth-tube, or the tube curved with an oblong limb, or completely zygomorphic. The perianth is petaloid and consists of 2 whorls of 3 subequal and similar or different tepals. The andrecium consists of 3 stamens opposite to the outer perianth lobes, with free or partially connate filaments and 2-celled anthers opening extrorsely or laterally by slits lengthwise. The gynecium consists of 3 carpels forming an inferior and 1–3-locular ovary, with each locule containing several anatropous ovules attached to axile placentas. The style is long, thin and 3-lobed. The fruits are loculicidal capsules containing several seeds with a copious endosperm.

Pharmaceutical interest: Examples of plants classified within the family Iridaceae are *Iris germanica* L. (orris oil), *Iris versicolor* (blue flag) and *Crocus sativus* L. (saffron). The rhizomes of the European *Iris florentina* (see Gerard J, The Herbal, 1597), *Iris germanica* and *Iris pallida* and the North American *Iris*

versicolor (blue flag), have been used since ancient times to relieve the bowels of costiveness and to induce vomiting. The roasted seeds of a number of plants classified within the genus *Iris* were used to adulterate coffee. Plumbagin (monohydroxynaphthoquinones) has been characterized from the leaves and the rhizomes of a number of Iridaceae. In Southeast Asia, 10 species of plants classified within the family Iridaceae are used for medicinal purposes.

***Belamcanda chinensis* (L.) DC.**

[From Asian, *belamcanda* = *Belamcanda chinensis* (L.) DC. and from Latin, *chinensis* = from China]



Fig. 415. *Belamcanda chinensis* (L.) DC.

Physical description: It is an ornamental herb which grows wild in a geographical zone, spanning India, China and Japan. Leaves: succulent, rosette of dark green leaves of 20 cm × 1.5 cm with a tapering apex. The corolla consists of 6 orange tepals with red spots, and is whitish at the base. The andrecium comprises of 6 stamens. The gynecium consists of 3 carpels united into a 3-locular ovary. The fruits are green and succulent capsules containing several seeds (Fig. 415).

Synonymy: *Belamcanda punctata* Moench., *Ixia chinensis* L., *Pardanthus chinensis* Ker-Gawl., *Pardanthus dichotomus sinensis* sensu Hubotter.

Common names: Leopard lily, black berry lily, leopard flower; *bunga kipas* (Malay); *re quat, xa can, loui dong, co quat phu* (Vietnamese); *she kon, she kan* (Chinese).

Uses: In China, the rhizome of *Belamcanda chinensis* (L.) DC. is used to combat fever, promote urination and menses, expel impurities, relieve the bowels of costiveness, treat tonsillitis, laryngitis, asthma, gonorrhoea, alleviate cough, and to assuage stomachache, spleen and liver discomfort. In Malaysia, a decoction of 10 g of the rhizome is used to promote menses, to treat mumps and to soothe the sore throat. A decoction of the roots and leaves is used in baths after childbirth. In Vietnam, a decoction of 10 g–20 g of the rhizomes is to alleviate cough, soothe sore throat, treat tonsillitis, laryngitis, pertussis, mastitis, combat fever, regulate menses and urination, and to counteract snake poisoning.

Pharmaceutical interest:

Anti-inflammatory properties: Tectorigenin and tectoridin, 2 steroids characterized from the rhizome of *Belamcanda chinensis* (L.) DC. suppress the production of prostaglandin E₂ by rat peritoneal macrophages, stimulated by the protein kinase C activator, 12-*O*-tetradecanoylphorbol-13-acetate or the endomembrane Ca²⁺-ATPase inhibitor: thapsigargin. Tectorigenin inhibits the production of prostaglandin E₂ more efficiently than tectoridin. Neither compound inhibits the release of radioproperty from [³H]arachidonic acid-labeled macrophages stimulated by 12-*O*-tetradecanoylphorbol-13-acetate or thapsigargin (Kim YP *et al.*, 1999). Note that tectorigenin inhibits the growth of a number of fungi classified within the genus *Trichophyton*, at least, the inhibiting concentration ranging from 3.12 mg/mL to 6.25 mg/ML (Oh KB *et al.*, 2001).

Hormonal property: The causative components for the gynecological use mentioned above are hypothesized to be steroids, since tectorigenin displays some levels of activity on estrogen receptors (Seidlová-Wuttke D *et al.*, 2004).

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Warning: Caution must be taken as the toxic effects of this plant are unknown.

**3. Family TACCACEAE Dumortier 1829 nom. Conserv.,
the Tacca Family**

Physical description: The family Taccaceae consists of the genus *Tacca* with approximately 10 species, pantropical in distribution, but best developed in Southeast Asia and Polynesia. These are rhizomatous herbs with long petiolate and basal leaves, known to accumulate raphides of calcium oxalate. The flowers are borne in an involucre, cymose umbel at the apex stems, epigynous, and trimerous. The perianth comprises of 6 tepals in 2 whorls; the andrecium consists of 2 whorls of 3 stamens. The gynecium consists of 3 carpels united to form a compound, unilocular, 6-ribbed inferior ovary with intruded parietal placentas, where several ovules are attached. The fruits are berries.

Pharmaceutical interest: The tubers of *Tacca leontopetaloides* (L.) Kuntze are the source of an arrowroot starch. In Southeast Asia, *Tacca leontopetaloides* (L.) O. Ktze. (*Tacca pinnatifida* Forst.), *Tacca integrifolia* Ker Gawler (*Tacca cristata* Jack), *Tacca palmata* Bl. and *Tacca plantaginea* Hance are of medicinal value and are often counter irritant.

***Tacca integrifolia* Ker-Gawl**

[From Malay, *taka* = *Tacca* species and from Latin, *integrifolia* = entire leaves]

Synonymy: *Ataccia integrifolia* (Ker-Gawl) Presl; *Tacca cristata* Jack; *Tacca laevis* Roxb.

Common names: White bat plant, black lily; *keladi murai*, *kelemoyang ayer* (Malay).

Physical description: It is a herb which grows in the mountain jungle paths of China Bangladesh, Bhutan, Cambodia, East India, Indonesia, Laos, West Malaysia, Burma, Pakistan, Sri Lanka, Thailand, and Vietnam. The rhizomes are cylindrical and thick. Leaves: the blade is oblong-lanceolate to oblong-elliptic, 50 cm–5 cm × 18.5 cm–21 cm. The base is cuneate, the apex is acuminate or caudate. The scape is 55 cm long. The involucral bracts are 4, 2 outer sessile, narrowly deltoid-ovate and 2 inner long petiolate, spatulate and thin. The perianth is purplish black; tubular, 1 cm–2 cm long and comprises of 6 in 2 whorls, the outer ones narrowly oblong and the inner ones are broadly obovate. The filaments are spatulate at the apex. The style is short; and the stigma deeply 3-lobed. The fruits are berries which are narrowly ellipsoid, approximately 2 cm long, fleshy, 6-ridged, with persistent perianth lobes (Figs. 416 & 417).

Pharmaceutical interest: To date, the pharmacological potential of *Tacca integrifolia* Ker-Gawl remains unknown. Note that spirostanol saponins, characterized from the tubers of *Tacca chantrieri* André, inhibit the growth of HL-60 cells cultured *in vitro* with IC₅₀ value below 10 µg/mL (Yokosuka A *et al.*, 2002) and that taccalonolides are known to occur in *Tacca plantaginea* Hance (Shen J *et al.*, 1996). It would be interesting to know

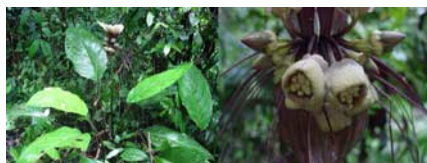


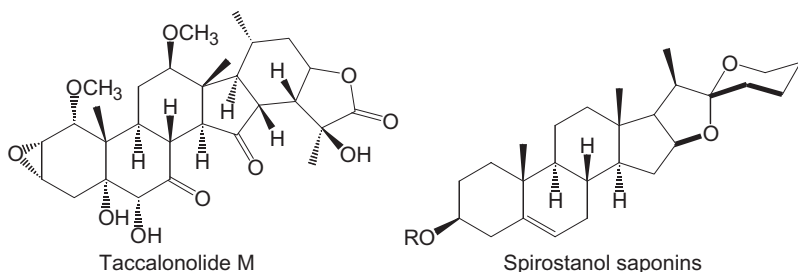
Fig. 416. *Tacca integrifolia* Ker-Gawl.



Fig. 417. *Tacca integrifolia* Ker-Gawl.

Uses: In Malaysia, a paste of tubers of *Tacca integrifolia* Ker-Gawl is applied to rash caused by insects.

whether a more intensive study of *Tacca integrifolia* Ker-Gawl would disclose any molecules of therapeutic interest.



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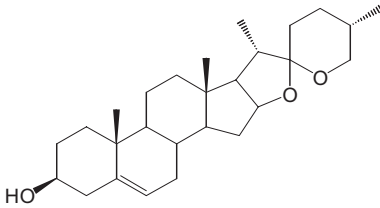
Warning: Caution must be taken as the toxic effects of this plant are unknown.

4. Family *DIOSCOREACEAE* R. Brown 1810 *nom. conserv.*, the Yam family

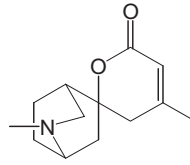
Physical description: The family Dioscoreaceae consists of approximately 6 genera and 650 species of tropical climbers growing from rhizomes or tubers. It is known to produce raphides of calcium oxalate, steroidal saponins, some alkaloids, chelidonic acid and tannins. The family is dominated by the large genus *Dioscorea* consisting of 600 species of plants. The leaves are simple and alternate. The blade is often cordate and the petiole is twisted, long and thin. The inflorescences are racemes or panicles. The flowers are small, perfect or unisexual, regular, epigynous, and trimerous. The perianth consists of 6 tepals and the andrecium comprises of 6 stamens in 2 cycles. The anthers are tetrasporangiate, dithecal and open by longitudinal slits. The gynecium consists of 3 carpels united to form a compound, inferior, 3-locular ovary with each locule containing 2 to a couple of anatropous, bitegmic and crassinucellar ovules, attached to axile placentas. The styles are free. The fruits are capsular, dehiscent and characteristically 3-winged. The seeds are winged and with copious endosperm.

Pharmaceutical interest: *Dioscorea alata* L., *Dioscorea oppositifolia* Thunb. (*Dioscorea batatas* Decne) and *Dioscorea esculenta* (Lour.) Burk. have been cultivated since ancient times for their edible starchy tubers (yams). These tubers are sometimes voluminous and are very rich in starch, containing a steroidal saponins that provide after hydrolysis diosgenin, a raw material

for the manufacture of steroidal hormones. The consumption of the raw tuber of *Dioscorea* may often result in painful mouth burning, gastrointestinal upset and convulsions, owing to an alkaloid termed dioscorine, derived from nicotinic acid. This alkaloid is poisonous and the tubers must be thoroughly washed in a long and tedious process, for the tuber to be edible when cooked. In Southeast Asia, *Dioscorea bulbifera* L., *Dioscorea hispida* Dennst., *Dioscorea japonica* Thunb., *Dioscorea oppositifolia* Thunb., *Dioscorea tokoro* Mak., *Dioscorea quinqueloba* Thunb., *Dioscorea alata* L., *Dioscorea esculenta* Burk. and *Dioscorea filiformis* Bl. are of medicinal values. The tubers are often used to maturate boils, heal sores, counteract snake poisoning and putrefaction, assuage rheumatic pains, treat leprosy, invigorate health and to treat kidney diseases.



Diosgenin



Dioscorine

***Dioscorea hispida* Dennst.**

[After Dioskurides, 1st century Greek physicist and from Latin, *hispidus* = bristly]

Physical description: It is a climber of Southeast Asia. The stems are subglabrous, smooth and covered with a few small prickles. The tubers are large and lobed. Leaves: simple, alternate and without stipules. The petiole is long and thin with a few prickles and 7.5 cm–30 cm. The blade

Synonymy: *Dioscorea daemonia* Roxb., *Dioscorea hirsuta* Bl., *Dioscorea triphylla* sensu Gimlette.

Common names: Strangle cake, *choo ay oo* (Chinese); *ubi akar*, *ubi gadong* (Malay); *pashpoli* (Sanskrit).

is trifoliolate, hairy to subglabrous on the below and extremely thin. The folioles are 10.5 cm–25 cm × 5.4 cm–17 cm, the petiolules are hairy, 5 mm long and channeled. A tuft of hairs occupies the axil which is made of the petiole and the stems. The central foliole shows 3 main nerves and the lateral folioles show 5 nerves and an asymmetrical base. The tertiary nerves are scalariform and showy below. The flowers are arranged in dense cylindrical pedunculate 6 mm–8 mm long spikes, arranged in clusters along a relatively prickly, pubescent or

Uses: In Burma, the fresh tubers are used as poison and as food after being washed and steamed in earthen pots. In China, the tubers are used to treat skin diseases and to mature boils. In Indonesia and Malaysia, the juice expressed from the tubers is mixed with the sap of *Antiaris toxicaria* to make arrow poison. In Malaysia, *Dioscorea hispida* Dennst. is used to heal feet sores, and to remove corns, calluses whitlow and so forth. In the Philippines, the leaves of *Begonia oblonga* Merr. are eaten as an antidote for *Dioscorea hispida* Dennst., while the tuber is used to assuage rheumatic pains.



Fig. 418. *Dioscorea hispida* Dennst. From: KLU Herbarium 20463. Flora of Malaya. Field collector & botanical identification: JB Lowry. 17 Aug 1974. Geographical localization: Ulu Berang, Orang Asli Kampung at edge of hills, Negeri Sembilan, Malaysia.

villous rachis of a 15 cm–45 cm long. The perianth is 3 mm in diameter; the lobes are broadly oblong with the outer 3 shorter and the inner 3 ones somewhat succulent. The andrecium comprises of 6 stamens. The infructescences are long racemes of 3-winged, smooth, glossy, oblong and green capsules of 4.5 cm × 2.5 cm, containing winged seeds (Fig. 418).

Pharmaceutical interest:

Cytotoxic properties: A growing body of evidences suggests that the steroidal saponins produced by a number of plants classified within the genus *Dioscorea*, may represent new cytotoxic weapons in chemotherapy. A prosapogenin A of dioscin, dioscin and gracillin, isolated from *Dioscorea coiletti* var. *hypoglauca*, displays cytotoxic activity against the cancer cell-line K562 *in vitro* (Hu K *et al.*, 1996). Methyl protogracillin, a furostanol saponin isolated from the tuber of the same plant, is cytotoxic against all the tested cell-lines from leukemia and solid tumors in the NCI's human cancer panel. Unlike many existing cytotoxic substances tested so far, it is particularly toxic against colon cancer line KM12, central nervous system cancer line U251, melanoma lines MALME-3M and M14, renal cancer lines 786-0 and UO-31 and the breast cancer line MDA-MB-231 with $GI_{50} < \text{or} = 2.0 \mu\text{M}$, suggesting a new mechanism of anticancer activity (Hu K *et al.*, 2001). T

Antibacterial properties: A tuber bark extracts of *Dioscorea sylvatica* inhibits the growth of Gram-negative *Escherichia coli* and extracts of *Dioscorea dregeana* were active against *Pseudomonas aeruginosa* (Kelmanson JE *et al.*, 2000).

β -Sitosterol, characterized from the peels of *Dioscorea alata*, inhibits the elongation of germ-tubes of *Fusarium moniliforme* (Aderiye BI *et al.*, 1996).

Other properties: Dioscoretine isolated from a methanol extract of tubers of *Dioscorea dumetorum*, administered (20 mg/Kg (i.p.) on normal and alloxan diabetic rabbits reduces the level of glucose in blood (Iwu MM *et al.*, 1990). Anabolic properties of furostanol saponins from *Dioscorea deltoidea* wall. are observed experimentally (Dubinskaia VA *et al.*, 1998).

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Hu K, *et al.* (1996) *Planta Med* **62**(6): 573–575.
Hu K, *et al.* (2001) *Anti Cancer Drug* **12**(6): 541–547.
Iwu MM, *et al.* (1990) *Planta Med* **56**(3): 264–287.
Kelmanson JE, *et al.* (2000) *J Ethnopharmacol* **69**(3): 241–246.

Warning: The tuber of *Dioscorea hispida* Dennst. is very toxic due to dioscorine. Careful preparation is needed before consumption. Very thin slices of the tuber are to be washed in fresh water, vinegar and salt water, and dried rotating them in the sun after each process. Consumption of carelessly washed tubers results in dizziness, vomiting, suffocation, exhaustion and death.

B. Order ORCHIDALES Bromhead 1838

The order Orchidales is thought to have originated from the order Liliales and is the most evolved order of the class Liliopsida. It consists of 4 families and approximately 15 000 species of mycotrophic and often epiphyte herbs, most of which belonging to the family Orchidaceae.

1. Family BURMANNIACEAE Blume 1827 *nom. conserv.*, the *Burmannia* Family

Physical description: The family Burmanniaceae consists of 20 genera and 130 species of mycotrophic annual or perennial herbs of tropical distribution. The leaves are simple, entire and clustered at the base of the stem. The inflorescences are terminal cymes or racemes, or solitary. The flowers are regular, perfect, the perianth is tubular, mostly 6-lobed and 3-winged. The andrecium consists of 6 stamens opposite the lobes. The anthers are tetrasporangiate, dithecal and open by transverse lateral slits. The gynecium consists of 3 carpels united to form a compound unilocular or tri-locular inferior ovary. The fruits are capsular, winged and circumscissile. The seeds are numerous and tiny. The pharmacological potential of this family has not been studied. *Burmannia*

disticha L. is the only representative of this family of medicinal value in South-east Asia.

***Burmannia disticha* L.**

[Named after N.L. Burmann, 18th century Dutch botanist and from Greek, *di* = two and *stikhos* = line]

Common name: Burmannia.

Uses: In Cambodia, Laos and Vietnam, *Burmannia disticha* L. is used to promote menses. The pharmacological potentials of *Burmannia disticha* L. and of the genus *Burmannia* remain unexplored.

Physical description: It is an erect herb which grows to height of 40 cm–50 cm on the dampy roadsides, banks, ditches, dry areas in heath formation and dampy moist ground of Southeast Asia. The scapes are erect from short-leaved basal rosette of approximately 15 linear, 4 cm × 5 mm–8 cm × 1 cm leaves. The inflorescences are terminal cymes. The flowers are violet-blue, 1.5 cm × 7 mm, considerably thin, tubular and 3-winged (Fig. 419).

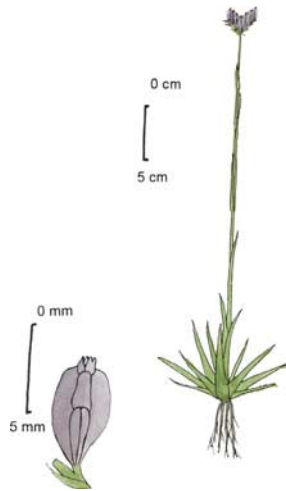


Fig. 419. *Burmannia disticha* L. From: KLU 20968. Field collector & botanical identification: Gordon Smith. 13 May 1969. Altitude: 2500'–3900' feet upward, damp roadside banks, Kedah, Malaysia.

Warning: Caution must be taken as the toxic effects of this plant are unknown.

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