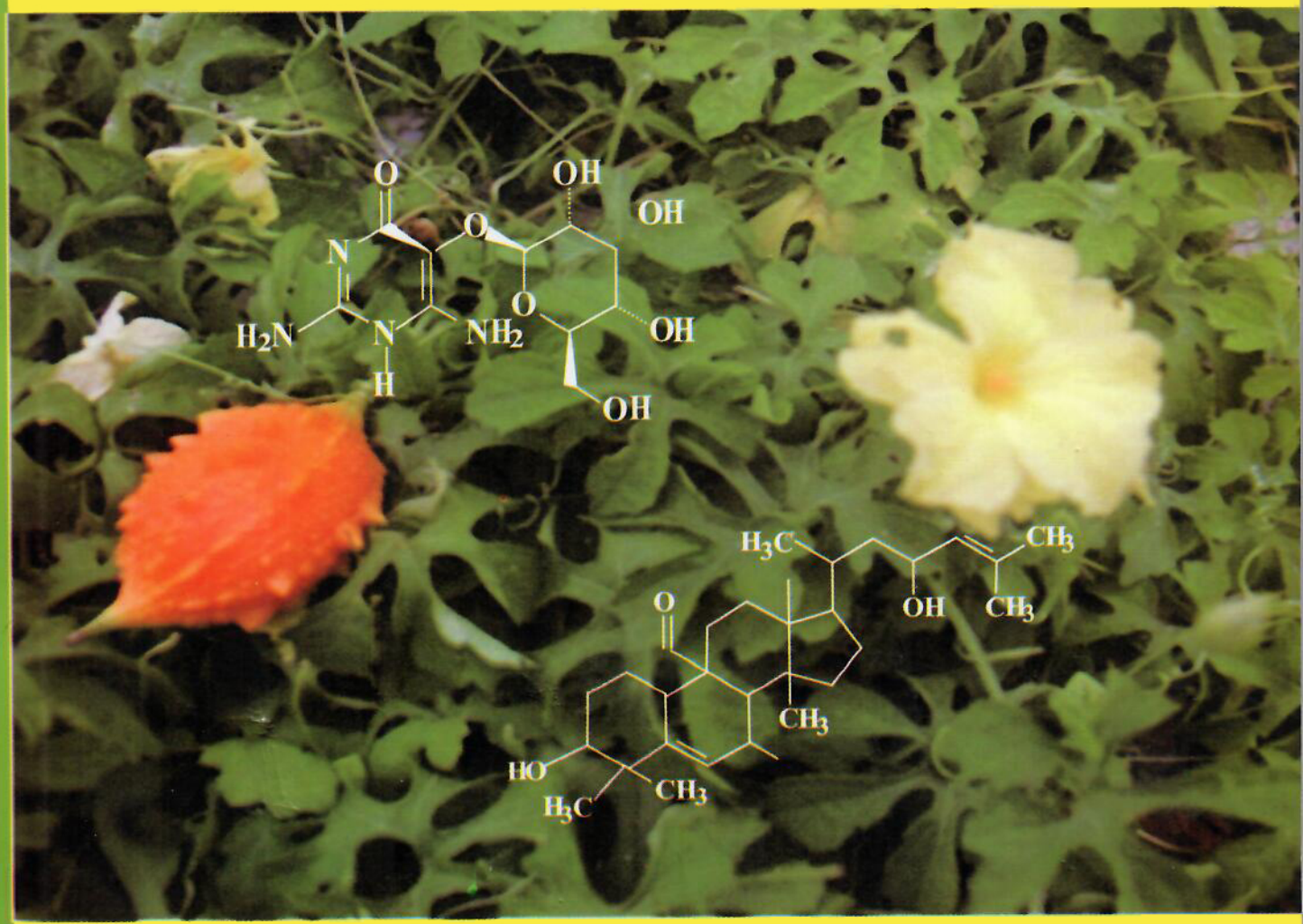
West African Herbal Pharmacopoeia



West African Health Organization

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FOREWORD

The use of medicinal plants for the treatment of disease dates back to antiquity. Through a combination of instinct, observation, taste, and experience, ancient men and women treated illness by using plants, animal parts, and minerals that were not part of their usual diet. Ancient man learned by trial and error to distinguish useful plants with beneficial effects from those that were harmful or not effective, and also which combinations or processing methods had to be used to gain consistent and optimal results. This knowledge of plant-derived remedies developed gradually and was passed on by word of mouth from generation to generation.

In the course of time, each community/tribe methodically collected information on medicinal plants and herbs and developed well-defined herbal pharmacopoeias. Indeed, well into the 20th century, much of the pharmacopoeia of conventional medicine was derived from the herbal lore of native peoples and even today many commonly used medicines are of plant origin.

Medicinal plants therefore constitute a vital resource that can be harnessed for both health and socioeconomic benefits. Nevertheless, but for the high cost of modern medicines, limited national health budgets and inadequate health facilities, which have compelled many governments to reconsider the advantages of traditional health care systems, the sector has remained largely ignored. Interestingly, with the renewed interest in herbal medicine, there are now growing concerns about their quality, safety and efficacy due to poor methods of preparation, the heavy microbial load characteristic of plants harvested from the wild, non-standardised dosages and limited scientific evidence.

In 1978, the World Health Assembly adopted *resolution WHA31.33 on Medicinal plants* which called upon WHO to coordinate the efforts of Member States to develop and apply scientific criteria and methods for proof of safety and efficacy of medicinal plant products, and develop international standards and specifications for identity, purity and strength, especially galenicals, and manufacturing practices. *Resolution WHA41.19 on Traditional medicine and medicinal plants* adopted in 1988 emphasised the need for international cooperation and coordination to establish a basis for the conservation of medicinal plants, in order to ensure that adequate quantities are available for the use of future generations. These resolutions formally brought the rational and sustainable use and conservation of medicinal plants into the arena of public health policy.

Concerns have also been raised about the unregulated exploitation of Africa's bio-resources, environmental degradation, deforestation, uncontrolled burning and poor agricultural practices leading to depletion of rare and threatened medicinal plant species. Unfortunately, for many countries in the WHO African Region, the necessary legislation for sustainable local production, conservation and protection of medicinal plant species, is limited and even where available, it is not enforced. For its part, the WHO has provided some tools and guidelines that countries could use to adapt to their specific situations to develop and utilize their indigenous systems of medicine. Of particular relevance here are the WHO Guidelines on Good Agricultural and Collection Practices; Guidelines on the conservation of medicinal plants and WHO Monographs on medicinal plants.

Some countries in the African Region have since used these tools, adopted national policies on conservation of medicinal plants or cultivated new medicinal plant varieties and compiled inventories of scientific information on medicinal plants.

Saving the African Region's medicinal plant resources vis-à-vis promoting the use of plant medicines for the treatment of diseases needs an effective, sustainable and coordinated strategy.

It is against this background that I endorse this herbal pharmacopoeia developed by the West African Health Organisation, a specialized health institution of the Economic Community of West African States (ECOWAS), which summarises and reviews the evidence base for some selected medicinal plants common to the ECOWAS member states and also outlines the quality control criteria needed for ensuring their identity, purity, and quality.

It is my hope that the ECOWAS Herbal Pharmacopoeia will receive the highest level of patronage from all the member states to improve access to quality health care for the people of the sub-region.

Dr Luis Gomes Sambo
WHO Regional Director for Africa
Brazzaville-Congo

PREFACE

The importance of traditional medicine in providing primary health care (PHC) was recognized by the Alma Ata Declaration adopted by the International Conference on PHC held at Alma Ata, USSR, in September 978. The Alma Ata Declaration called for “health for all by the year 2000”. This conference was followed in 1988 by another in Thailand, at which the Chiang Mai declaration to “save plants that save lives” was made.

For economic reasons as well as cultural preferences, many Africans use traditional medicine for their health needs, often simultaneously with conventional medical care. However, in many countries, there is still resistance to officially accepting traditional medicine. In large part, this resistance stems from the primary philosophical distinctions between conventional medicine, which is based on the results of experiments and views illness as the result of pathological agents, and traditional medicine, which accepts that disease can have supernatural causes and imbalance between the body, mind and soul.

As a result, one of the key activities of the 2009-2013 Strategic Plan of the West African Health Organisation (WAHO) is the promotion of research into traditional medicine as well as conservation and local production of medicinal plants, with the development of both national and sub-regional pharmacopeias as a sub-activity.

In pursuit of this objective, research data on West African medicinal plants was compiled and reviewed at a forum organized by WAHO in Ouagadougou in November 2008. Concurrently, a six-member Expert Committee was formed to serve as the nucleus for developing the 1st edition of the West African Herbal Pharmacopoeia. This committee, which had Prof Marian Ewurama Addy (Ghana) as the Chairperson, included Prof Jean-Baptiste Nikiema (Burkina Faso); Dr Pepas Vicente Natak (Guinea Bissau); Prof Mamadou Aliou Balde (Guinea Conakry); Prof Tony Elujoba (Nigeria) and Prof Emmanuel Bassene (Senegal). The Committee was given a two-year mandate to act as an advisory body to the Traditional Medicine programme of WAHO, making appropriate recommendations for developing the pharmacopoeia.

The first meeting of the Expert Committee was held in Accra in March, 2009 during which the format for presenting the pharmacopoeia monographs was revised and a list of 57 medicinal plants common to all the countries of the Economic Community of West African States (ECOWAS), was developed on the basis of an agreed criteria. This included medicinal plants commonly used in the ECOWAS sub-region; geographical distribution; availability of relevant data; priority diseases (malaria, hypertension, diabetes, HIV/AIDS, tuberculosis, sickle cell anaemia); and availability of scientific studies.

In addition, a roadmap for the project was discussed and it was recommended that in order to speed up the process for producing the pharmacopoeia, the WAHO Programme Officer for Traditional Medicine, Dr Kofi Busia should use all available resources (e.g. plant databases; textbooks, journals, pharmacopoeias, etc.) to compile a draft of all the monographs based on the revised format. The draft monographs was then to be sent to the appropriate Experts for further work. Based on consultations with some key stakeholders, four more experts, namely Prof Rokia Sanogo (Mali); Prof Olobayo Kunle (Nigeria); Dr Pierre Agbani (Benin) and Dr Kofi Annan (Ghana), were co-opted to the Expert Committee.

The Expert Committee reviewed the draft monographs and proposed methods for filling any identified gaps in a follow-up meeting held in Bamako-Mali, in June 2009 as per its first meeting recommendation. Subsequently, the Committee revised the first draft of all the monographs and proposed further steps for carrying out the rest of the work in Cotonou-Benin, in November 2009. It was agreed at this stage that experts had to redouble their efforts to ensure timely completion of the project.

In pursuit of the agreed road map, the Second draft of the monographs was reviewed in a follow-up meeting in Accra-Ghana in July 2010. Based on a recommendation that toxicity studies and safety data be included in all the monographs, the meeting was informed about the laboratories that had been identified to carry out the required studies. These were the National Institute for Pharmaceutical

Research and Development, Abuja-Nigeria; Department of Traditional Medicine of the National Institute of Public Health Research, Bamako-Mali and the Noguchi Memorial Institute for Medical Research, Accra-Ghana. For logistic convenience/reasons, the Malian institute, with Prof Rokia Sanogo as Principal Investigator, and the Toxicology Group of the Department of Pharmacology, Faculty of Pharmacy and Pharmaceutical Sciences of the Kwame Nkrumah University of Science and Technology, Kumasi-Ghana, led by Prof Charles Ansah and the Herbal Medicine Department of the same Faculty led by Dr Kofi Annan carried out the toxicity studies and safety data of all the monographs.

Since November 2010 marked the end of the two-year term of service of the Expert Committee, a meeting was called along the margins of the Annual Scientific Congress of Traditional Medicine Practitioners and Conventional Medicine Practitioners held in Lagos-Nigeria, to assess progress made on the work related to the development of the Herbal Pharmacopoeia since the last meeting in July 2010. The Committee made appropriate recommendations, which culminated in the reconstitution of the Expert Committee with Prof Tony Elujoba (Nigeria) as the new Chairperson. Subsequently, the new Committee completed the outstanding work on the monographs during two fora held in Dakar-Senegal in June and Lome-Togo in October 2011. These were then followed by an editorial working group meeting, which was held in Bobo Dioulasso in February 2012. The new Chairperson of the Expert Committee, Prof Tony Elujoba and Dr Kofi Annan volunteered to finalise the outstanding editorial work.

It is clear from the foregoing that the development of this document has been marked by remarkable dedication, resilience, purposefulness, selfless devotion and a genuine desire to improve traditional medicine practice in the sub-region.

I wish therefore to express the institution's gratitude to all those who contributed in various ways to ensure the success of the project. We are particularly grateful to all the experts, who despite their heavy engagements made huge sacrifices to ensure that the necessary work for the production of the monographs was carried out.

I would like to thank PROMETRA International for the immense technical support it offered through its representative Mr Charles Katty. And finally, I would like to extend WAHO's special gratitude to the World Health Organization, Regional Office for Africa for the exceptional technical support provided through the participation of its Regional Advisor on Traditional Medicine, Dr Ossy MJ Kasilo in most of the meetings held in the course of executing this project.

It is my hope that the spirit of collaboration exhibited in developing the pharmacopoeia will be sustained for the ultimate institutionalization of traditional medicine in the ECOWAS sub-region.

Dr Placido Cardoso
Director General
West Africa Health Organisation

INTRODUCTION

The World Health Organization (WHO) estimates that about 80% of the developing world's population use traditional medicine, particularly herbal medicines for their health care needs. In places such as Africa and Asia, herbs are even used as the first line of treatment for diseases such as malaria, diabetes, hypertension, sickle cell anaemia, dermatological disorders, and most recently, HIV/AIDS opportunistic infections. In fact, over 120 pharmaceutical products currently in use are plant-derived, and most of these originate from the tropical regions of the world including Africa.

The market for plant-based drugs is growing every year throughout the world, with the global trade thought to be about US$800 million per year. For example in 2003-2004 annual revenues in Western Europe reached US$ 5 billion, while in China sales totalled US$ 14 billion in 2005. In Brazil, Herbal medicine revenue in Brazil was US$ 160 million in 2007.

As a result, the WHO's "Health for all by the year 2000" initiative, recognised that programmes adopted in any of the developing countries would have no impact if it did not take into consideration the development and integration of traditional medicine into their primary health care programmes.

By this programme, the WHO recognized the peculiar circumstances that purtain in less industrialized countries with respect to traditional medicine and health care delivery. This recognition led to the WHO/UNICEF 1978 conference in Alma Ata, USSR, at which the participants resolved and specifically urged member states to:

i. initiate comprehensive programmes for the identification, evaluation, cultivation and conservation of medicinal plants used in traditional medicine;
ii. ensure quality control of drugs developed from plant remedies by using modern techniques and applying suitable standards and good manufacturing practices.

In pursuance of this commitment, the then Organization of African Unity, currently African Union, Heads of State and Government declared the period 2000-2010 as the Decade of African Traditional Medicine. This was later followed with the 2001 Abuja Declaration which called on the Member States to give priority to research on traditional medicines used for the management of HIV/AIDS, malaria, TB and other infectious diseases. The African Union Summit endorsed in Maputo in 2003 the WHO proposal to institute the African Traditional Medicine Day in Member States on 31st August of every year as part of a strategy to promote traditional medicine in health systems.

Further to these declarations, in 2007 the WHO Regional Committee for Africa declared research and development on traditional medicine as a priority on the occasion of the fifth African Traditional Medicine Day. In 2008, the *Ouagadougou Declaration on Primary Health Care and Health Systems in Africa* reiterated the Alma Ata Declaration of 1978 by calling on countries to set up sustainable mechanisms for increasing the availability, affordability and accessibility of essential medicines and the use of community-directed approaches and African traditional medicines. During the same year, representatives of WHO member states met in Beijing, China and adopted another declaration that called on governments to develop national policies on traditional medicine and to promote improved education, research and development in traditional medicine.

For Africa in particular, these initiatives undoubtedly marked key milestones in the efforts being made to mainstream and institutionalise traditional medicine into national health systems.

Africa has a rich diversity of plants, many of which have served as sources of medicines for millennia. Notable examples of some of these commercially-exploitable medicinal plants are *Rauwolfia vomitoria*, a major source of the tranquilizer and an antihypertensive agent, reserpine; *Zingiber officinale*, used for its carminative and anti-inflammatory properties; *Catharanthus roseus*, a source of the anti-tumour agents, vinblastine and vincristine and *Phytolacca dodecandra,* used as an effective molluscicide to control schistosomiasis. Other notable examples are *Pausinystalia yohimbe*, from Cameroon, Nigeria and Rwanda, which yields the alkaloid yohimbine, with stimulant and aphrodisiac

effects; *Harpagophytum procumbens*, produced as a crude drug by some countries in Southern Africa for its anti-rheumatic properties; *Ricinus communis*, which yields the laxative, castor oil; *Agave sisalana*, rich in hecogenin, employed for the partial synthesis of steroidal drugs such as corticosteroids and oral contraceptives; *Cinchona succirubra* which yields quinine, a key antimalarial drug and the antihypertensive herb, *Hibiscus sabdariffa*, which is exported from Sudan and Egypt, and primarily cultivated for the production of bast fibre from its stem.

Nevertheless, information on the therapeutic benefits of many of Africa's medicinal plants has not been systematically or comprehensively documented. Moreover, many of these plants have neither been rigorously evaluated nor properly standardized. In an attempt to address these drawbacks, there have been calls for improved and sustained collaboration between traditional medicine practitioners and conventional medicine practitioners and research scientists to provide validated information on the judicious use of herbal remedies.

Several African Governments have responded by initiating programmes aimed at promoting the sector. Throughout Africa, many health-oriented ministries are now encouraging the use of local medicinal plants, and have established appropriate departments to implement this policy. For example, in some parts of the African continent, traditional medicine practitioners have been included in educational campaigns and health promotion initiatives, especially on safe and hygienic practices, condom distribution and knowledge dissemination. In addition, natural product research and development programmes have been established to exploit the therapeutic benefits of medicinal plants used to treat conditions such as malaria, HIV/AIDS, sickle cell anaemia, hypertension, malnutrition and diabetes. Examples include the Centre for Scientific Research into Plant Medicine established in Ghana since 1975, the Centre for Research on Pharmacopoeia and Traditional Medicine in Rwanda, in 1982, the Department of Traditional Medicine at the National Institute for Public Health in Mali, in 1968, the "Village Chemist" outfit in the Department of Pharmacognosy of Obafemi Awolowo University, Ile-Ife, in Nigeria and the Institute of Traditional Medicine of the Muhimbili University College of Health Sciences, University of Dar-es-Salaam, Tanzania, in 1974.

Alongside these developments, there are calls for policymakers to support the development of pharmacopoeias that set modern standards for evaluating the quality, safety and efficacy of medicinal plants, and include information on correct identification, general description and morphological characteristics to safeguard public health.

In fact, the development and maintenance of quality assurance for medicinal plants goes as far back as the late 1400s, when pharmacists and botanists in Italy concerned about the potential of misbranding and adulteration produced what is considered today to be the first modern pharmacopeia. The first pharmacopeia in the English-speaking world, Pharmacopoeia Londoninsis, was published in 1618 in England and during the 18th and 19th Centuries many countries in Europe, notably Russia, Spain, Sweden and Germany, developed national pharmacopoeias. The United States had its first pharmacopoeia published in 1778, for the use of the military hospital of the United States Army.

More recently, there have been various attempts to develop pharmacopoeia monographs to define identity and quality criteria as well as provide therapeutic information. For example, The German Commission has been publishing therapeutic monographs since 1984 and the European Scientific Cooperative for Phytotherapy has been developing theirs since 1991. The World Health Organization has also published two volumes of monographs on herbs commonly used around the world.

At a time of wide public interest in herbal medicines, the need for up-to-date summaries of the available scientific knowledge on commonly used medicinal plants has never been greater.

WAHO's initiative to develop a Herbal Pharmacopoeia, spared on primarily by the aforementioned Declarations, is a response to the member states' lack of national pharmacopoeias as even as of today, only Ghana and Nigeria have national pharmacopoeias.

In developing the West African Herbal Pharmacopoeia, it was decided from the outset that its main focus would be on the health and safety of the patient. Every effort has therefore been made to provide relevant information on toxicity, identity and purity, macroscopic and microscopic characteristics, Thin Layer Chromatography (TLC) finger prints as well as ethnomedical usage and biological and pharmacological activity.

The ECOWAS Herbal Pharmacopoeia will serve traditional medicine practitioners, consumers, traditional medicine experts, programme managers, physicians, pharmacists, research scientists, students, health policy makers, development partners and non-governmental Organizations involved in the development of traditional medicine.

Compiled by experts drawn from the ECOWAS member states, the West African Herbal Pharmacopoeia comprises of 54 monographs of medicinal plants common to all the 15 countries of ECOWAS, and each is presented according to the format outlined below:

Names: botanical name with author; family; synonyms; common names; vernacular names (not more than 3 per country). For all the monographs, the botanical name is chosen for the title.

However, obtaining the three most common vernacular names for all the countries as originally proposed, proved the most difficult task, and as a result, many monographs are presented without the complete list of vernacular names.

General information (summary): plant description; ethnomedical uses; scientific, clinical and safety data

Description of the plant: whole and plant parts, especially parts with medicinal properties; fresh and dried parts if dried parts are used; pictures (good quality, high resolution); herbarium specimen number; habitat and geographical distribution; definition of the plant medicine (plant material of interest).

Chemical constituents: active and non-active constituent, but chemical structures are for only those compounds which are known to contribute the plant's activity.

Biological and pharmacological activities: experimental data; clinical data (where available).
Safety data: acute toxicity; sub chronic and chronic toxicity (where necessary); contraindications; precautions; adverse effects.

Therapeutic indications: authenticated claims.

Therapeutic actions: based on biological and pharmacological data.

Tests for identity and purity: moisture content; ash values; extractive values; chromatographic fingerprints; macroscopy and microscopy (qualitative and quantitative)-whole and powdered samples.

Dosages: obtained from such reputable texts as the United States Pharmacopoeia, which expresses the dose of infusions and decoctions as a weight to volume ratio of 1:20 (i.e. 1 part dried herb to 20 parts water). Thus the traditional therapeutic dose for infusions/decoctions is taken as 30 g dried herb in 600 ml of water, 60-200 ml three times a day, while the concentrations of tinctures are expressed as a weight to volume ratio (w:v.).

In general, many herbal medicine practitioners prefer to prescribe drop doses of 1:5 (i.e. 1 kg of herb in 5 litres of solvent) or even more dilute tinctures with formulations usually prescribed as 2.5-5 ml three times daily). Thus, except in a few exceptional cases, 1:5 tinctures are recommended throughout the text.

Storage conditions: based on information obtained from other texts.

References: scientific journals; books; technical reports; institutional publications; theses; information from Traditional Medicine best practices.

The West African Herbal Pharmacopoeia is a landmark document not only for the sub-region but also for the African continent at large. It is hoped that the national health authorities will make the ECOWAS Herbal Pharmacopoeia a legally binding document in the sub-region.

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ACKNOWLEDGEMENT

Traditional medicine remains the main source of health care for most rural populations in Africa. It is for this reason that the West African Health Organization, under its strategic plan, is committed to supporting the ECOWAS member states to improve the sector for its institutionalization in their health systems.

The development of the West African Herbal Pharmacopoeia as a means for promoting rational use of safe medicinal plants is a major achievement.

On behalf of the Director General of the West African Health Organisation, I wish to personally thank the following experts without whose contributions and support, this landmark document would not have been produced: Prof Marian Ewurama Addy (Ghana), Prof Jean-Baptiste Nikiema (Burkina Faso); Dr Pepas Vicente Natak (Guinea Bissau); Prof Mamadou Aliou Balde (Guinea Conakry); Prof Tony Elujoba (Nigeria); Prof Emmanuel Bassene (Senegal); Prof Rokia Sanogo (Mali); Prof Olobayo Kunle (Nigeria); Prof Charles Ansah (Ghana); Dr Pierre Agbani (Benin); Prof (Mrs) Edith Ajaiyeoba (Nigeria); Dr Kofi Annan (Ghana); Dr Ehoule Kroa (Cote d'Ivoire); Dr Koffi Koudouvo (Togo) and Dr Rokhaya Ndiaye Kande (Senegal).

Our sincere appreciation is extended to Dr Kofi Annan for providing all the TLC fingerprints and the beautiful photos of all the plants contained in this Pharmacopoeia; Prof Tony Elujoba, for his tireless efforts in getting the project completed and Dr Roch A. Houngnihin and Prof Drissa Diallo for doing the final editorial work on the french version.

This work has also benefited greatly from the contributions of many other experts and support staff whose details are shown in the appendix. We would like to thank them for their invaluable contributions at the different stages of the project.

Finally, we acknowledge with profound gratitude the technical support we received from the WHO/AFRO and PROMETRA international.

Dr Johanna Austin Benjamin
Director, Primary Health care and Disease Control

Acacia nilotica

Botanical name
Acacia nolitica (L.) Willd. ex Del. *var. nolitica*
Acacia nilotica var. adansonii

Family
Mimosaceae

Synonyms
Mimosa scorpioides L., *Mimosa arabica* Lam., *Acacia arabica* Willd., *Acacia adansonii* Guill. & Perott.

Common names
Egyptian mimosa (English), Gonakier, Acacia du Nil (French)

Vernacular names
Burkina Faso: Moore- Peg-nenga, Dioula-Baganayiri;Bogonan, Fulfulde-Gaoudi;Gawdi
Ghana: Akan – Odanwoma
Mali: Bambara – Bagana, Malinke – Bagana, Dogons – Barin
Nigeria: Hausa – Bagawura
Niger: Hausa – Bagaroua, Djerma – Baani
Senegal: Wolof – Gonaki, Serer – Nep Nep; Pular – Gaudi

Description of the plant
Spiny tree, up to 20 m high, with straight cylindrical, bole shape, up to 60 cm in diameter, and dense crown; bark, dark-brown to black, deeply fissured or cracked, with pinkish-grey slash, exuding a reddish resin; stems, olive green to brownish, tomentose to glabrous; thorns set in pairs at the base of the leaf, straight and thin when long, sometimes hooked when short, pale grey to white, 0.5-8(-15) cm long; leaves alternate, bipinnate, blue-shaded, 4-10 cm long, with 3-6 pair pinnae and 10-25(-30) pair of leaflet pair pinna, leaflets glabrous or more or less pubescent, oblong, 1.5-7 mm long; petiole often bearing 1(2) glands before the first pair of pinnae and others at the base of each pair of pinnae or only the terminal pair of pinnae, 3-6 (-8) cm long; inflorescence a fascicle of 1-4 pedicellate of glomerulus, bright yellow set at the base of a leaf, 1.2-1.5 cm in diameter; fruit flat or cylindrical pod, 1.5-2.2 cm long and 10-15 cm across, yellow to brown or greyish when ripe, usually containing 4-10 seeds; seeds brown, more or less flat and round, 6.5-9 mm in diameter.

Herbarium specimen number
Ghana: 132 (GC)
Mali: 498 (DMT)
Togo: TOGO04821

Habitat and geographical distribution
A. nilotica is widespread in the northern savanna regions, and its range extends from Mali to Sudan and Egypt. It requires a strong light environment for growth. Severe frost affects small seedlings as well as large trees. It is drought resistant and grows best on alluvial soils in plain, flat or gently undulating ground and in ravine areas. It is considered a serious weed in South Africa.

Plant material of interest
Fruit

Other parts used
Leaf, aerial part, stem-bark, root- bark

Definition of plant material of interest
Acacia consists of fresh or dried fruit of *Acacia nolitica* (L.) Willd. ex Del. *var. nolitica* (Mimosaceae).

Ethnomedical uses
nilotica is used in many cultures to treat bronchitis, chest pains, colds, diarrhoea, dysentery, fever, haemorrhage, leprosy, eye disorders, pneumonia, sore throat (Chhabra and Uiso, 1991; Watt 1962); syphilis (Kambizi and Afolayan 2001; Watt 1962); oral candidiasis; fungal skin infections (Lev and Amar, 2002; Srinivasan *et al*., 2001); malaria and toothache (Jain *et al*., 2005; Kubmarawa *et al.,* 2007). Bark decoction is used to treat pre-, intra- and post-partum complications (Kaingu *et al*., 2011) and the hot decoction of the root bark is used for gastrointestinal complications and babesiosis (Nanyingi *et al*., 2008). Fruits are used against scabies (Lev and Amar, 2000).

Biological and pharmacological activities

Chuabal *et al*. (2003) have reported the anti-inflammatory and antiheminthic activities of the plant. Tannin-containing extracts showed algicidal and molluscicidal effects against the fresh water snails *Bulinus truncatus* and *Biomphalaria pfeifferi* (Ayoub and Yankov, 1985) and aqueous extracts exhibited antibacterial properties *in vitro* (Abd El Nabi *et al.,* 1992). *In vivo* studies showed that the methanolic stem-bark, fruit and leaf extracts provided complete protection against castor oil-induced diarrhoea, which was comparable to the anti-diarrhoeal drug, loperamide (Agunu *et al.,* 2005). These extracts (0.5 to 3.0 mg/ml) exhibited a dose-dependent antidiarrhoeic effect on isolated rabbit jejunum with initial relaxation, which was quickly followed by contraction of the jejunum at 3.0 mg/ml (Agunu *et al*., 2005). Other studies have also shown that different extracts of the plant have antifungal and broad-spectrum antibacterial effects (Hamsa *et al*., 2006; Abd El Nabi *et al.,* 1992; Srinivasan *et al.,* 2001; Ahmad *et al.,* 1998). Different extracts of the root bark and fruits are reported to have antifungal activity particularly against yeasts and *Candida albicans* (Gupta and Bilgrami, 1970; Sinha and Anjana, 1984; Almagboul *et al*., 1988; Runyoro *et al*., 2006). Niloticane, a diterpene isolated from the bark showed antibacterial activity against Gram-positive bacteria *Bacillus subtilis* and *Staphylococcus aureus* (Eldeen *et al*., 2010). Sultana *et al.* (2007) also showed that the bark extracts have *in vitro* antioxidant capacity, whilst Shah *et al*. (1997) found the alcohol extracts to possess platelet aggregation antagonising effect in a dose-dependent manner. The methanolic extracts of the pods have been shown to be effective against HIV-PR (Bessong and Obi, 2006) and the fresh plant parts have been reported to be active against Hepatitis C virus (Hussein *et al*., 2000). Antiplasmodial activity of the ethyl acetate extract against different chloroquine resistant and sensitive strains of *Plasmodium falciparum* have been reported (El-Tahir *et al.,* 1999). Phenolic and polyphenolic-rich ether, ethyl acetate and acetone fractions from the bark demonstrated antimutagenic and cytotoxic effects in Ames assay (Kaur *et al.,* 2005).

Clinical data

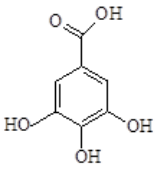
An investigation to assess the anti-microbial effect of rinsing with *Acacia nilotica* L. extract containing mouth rinse on supragingival plaque formation and development of gingivitis in comparison to control mouth rinse formulation using thirty volunteers was carried out. All subjects received a full mouth scaling and root planning (SRP) until almost zero plaque index (PI) were reached. Plaque index, gingival index (GI), gingival bleeding index (GBI) and modified lobene stain index (MLSI) were recorded at day zero, one week and two weeks following therapy. The volunteers were allotted equally into three groups as follows: Experimental group used *Acacia nilotica* mouth rinse; Positive control group used 0.2% chlorhexidine gluconate (CHX); Negative control group used a placebo. Samples of supragingival plaque were collected from each volunteer before SRP, and at one and two weeks after using mouth rinse. The herbal mouth rinse exhibited less (PI), (GI). (GBI) values when compared to placebo, but higher values in comparison to (CHX). The microbial inhibition was less than (CHX) but significantly higher than placebo, suggesting its antimicrobial activity (El-Menoufy *et al*., 2010).

Chemical constituents

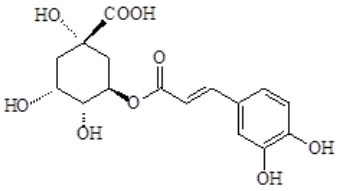
Tannins ([-]epigallocatechin galloyl esters), alkaloids, saponins, proteins (Kumaresan *et al.,* 1984; Ramana *et al.,* 2000; Sawe *et al*., 1998; Mlambo *et al.,* 2008).

Test for identity and purity

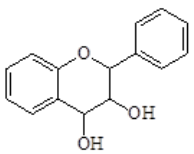
Moisture content: 5.56%
Total ash: 6.57%
Water soluble extractives: 47.69%



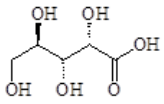
Gallic acid



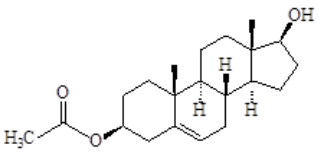
Chlorogenic acid



Leucoanthocyanidin



Arabic acid

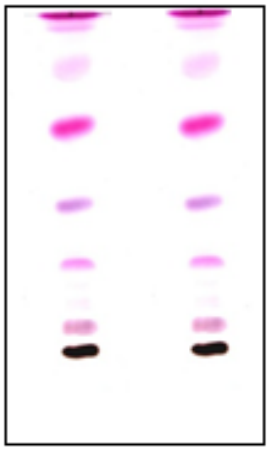


3-*beta*-acetoxy-17-*beta*-hydroxyandrost-5-ene

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of five characteristic spots with R_fs 0.84 (pink), 0.68 (pink), 0.45 (purple), 0.26 (pink) and 0.10 (pink)



Chromatogram

Macroscopy

Bark hard, dark brown or black, deeply fissured transversely and longitudinally, inner surface, reddish brown, longitudinally striated and fibrous; breaks with difficulty and exhibits a fibrous fracture; taste, astringent.

Microscopy

Transverse section of mature bark shows, 15-25 layered, thin-walled, slightly flattened mostly rectangular, brown coloured cork cells, a few lenticels formed by rupturing of cork cells; secondary cortical cells ovate to elongated, many tanniferous stone cells, variable in shape and size present in large groups; secondary phloem consists of sieve tubes, companion cells, fibres, crystal fibres and phloem parenchyma phloem fibres in many groups and thick-walled, phloem tissues filled with reddish or brown contents present; crystal fibres thick-walled, elongated, divided by transverse septa into segments, each contain a prismatic crystal of calcium oxalate, medullary rays uni to-multi- seriate run almost straight; ray cells elongated to polygonal, 20-24 cells high and 2-5 cells wide, crystals of calcium oxalate found scattered amongst the stone cells of secondary cortex and phloem parenchyma (Abid *et al*., 2005)

Powdered plant material

Powder reddish brown coloured, under microscope; many prismatic crystals of calcium oxalate, stone cells, both with narrow and wide lumen and striations and crystal fibres

Therapeutic actions

Molluscicidal, antifungal, antiviral, antibacterial, antidiarrheic, antiplasmodial, antiplatelet aggregatory, antihypertensive, antiheminthic antiinflammatory, immunomodulatory and antioxidant activities (Eldeen *et al*., 2010; Sultana *et al.,* 2007; Bessong and Obi, 2006; Hamsa *et al*., 2006; Runyoro *et al*., 2006; Agunu *et al*., 2005; Chuabal *et al*., 2003; Kambizi and Afolayan, 2001; Srinivasan *et al.,* 2001; Hussein *et al*., 2000).

Therapeutic indications

Infections, cough, inflammations, diarrhoea and pains.

Safety data

The LD_{50} of the aqueous fruit extract (*p.o*) over a period of 24 hours in mice was greater than 2000 mg/kg. In the subacute studies, no clinical signs of toxicity were observed after oral administration of the extract at 500 – 2000 mg/kg; p.o to male and female mice for 14 days.

Precautions for use

May cause a reduction in body weight

Adverse effects

Constipation, decreased heamoglobin levels

Contraindications

Pregnancy and lactation

Dosage and dosage forms

Decoction, concoction, ointment, poultice

Decoction: 30 g of dried leaves in 900 ml of water, boil until reduced to 600 ml, 1 teaspoon three times a day.

Storage

Store in a cool dry place

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Acacia senegal

Botanical name
Acacia senegal (L.) Willd

Family
Mimosaceae

Synonyms
Acacia verek Guill & Perr; *Mimosa senegal* L.

Common names
Gum Arabic tree (English); Gommier, Gommier blanc; Acacia du sénégal (French)

Vernacular names
Burkina Faso: Mooré – Gon-peélga, Dioula – Patuku, Fulfuldé – Patuki;debehi;délbi.
Cote d'Ivoire: Baule – Kundo
Ghana: Sisaala – Sofia, Hausa – Akovia, Akoura
Mali: Bambara – Patukill, Arabic – Askab, Noms – Patuki
Nigeria: Hausa – Dakwara
Niger: Hausa – Akkora
Senegal: Wolof – Verek, Serer- Ndongargavod

Description of the plant
Thorny shrub 6 to 7 m, with grey trunk, cracked, straight and sometimes with branches near the base; leaves oval shaped, bipinnate with 2-6 pairs of pinnae and 6-15 pairs of leaflets; inflorescence axillary; spikes with fragrant white flowers; pods are membranous plates of 11 cm by 2 cm, with 7 or 8 seeds flattened and circular beige.

Herbarium specimen number
Mali: 1796 (DMT)

Habitat and geographical distribution
Acacia senegal is found in the African sub-desert zone of Senegal to the Red Sea. In
Senegal, it grows in light Sahelean soils and is commonly found in the sandy coastlines of the islands of Saloum and Casamance in eastern Senegal and in the park of Niokolo-Koba (Fortin *et al.,* 2000).

Plant material of interest
Gum

Other parts used
Stem bark

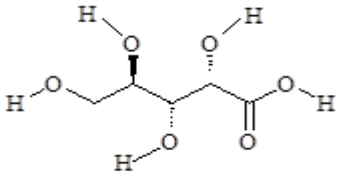
Definition of plant material of interest
Gum arabic consists of dried gummy exudate of *Acacia senegal* (L.) Willd (Mimosaceae).

Ethnomedical uses
The Moors and the Tuareg herdsmen harvest the plant for consumption. The latter use it to prepare a diet of milk, sugar, millet and dates (Fortin *et al.,* 2000). Various preparations of the plant are prescribed for chest pain, migraine, dysentery, diarhoea, stomachache and colic; it is also used in veterinary medicine (Tabuti *et al*., 2003; Kerharo and Adam, 1974). The gum exudate is used for the treatment of inflammations of the mucous membranes and externally as a dressing for burns, nipple sores and leprous nodules (Parveen *et al*., 2007). The flower and gum decoction is used to treat conjunctivitis, dermatitis, bleeding and wounds (Jain *et al*., 2005) and the leaves are believed to ward off evil spirits (Tabuti *et al*., 2003).

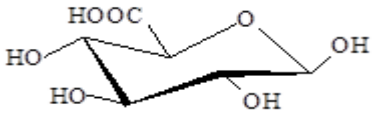
Biological and pharmacological activities
Antioxidant activity of extracts of the plant has been demonstrated by Marwah *et al.,* (2007).

Clinical data
When administered to hypercholesterolemic patients for periods ranging from 4 to 12 weeks, acacia gum had no effect on the level of any plasma lipid evaluated (Jensen *et al*., 1993; Haskell *et al*., 1992). At a concentration of 0.5%, acacia whole gum mixture also inhibited bacterial protease enzymes, suggesting acacia may be useful in limiting the development of periodontal disease. In addition, chewing an acacia-based gum for 7 days has been shown to reduce mean gingival and plaque scores compared to a sugar-free gum; the total differences in these scores was significant ($P < 0.05$) between groups suggesting that acacia gum primarily inhibits the early deposition of plaque (Gazi, 1991).

Chemical constituents
Complex mixture of glycoproteins and polysaccharides (arabic acid) and their calcium, magnesium and potassium salts; tannins (Kerharo and Adam, 1974).



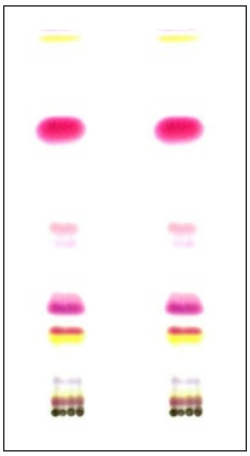
Arabic acid



Glucuronic acid

Test for identity and purity
Moisture content: 16.23%
Total ash: 9.46%
Water-soluble extractive: 53.40%

Chromatographic fingerprints
Chloroform extract
Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8] , detection in daylight, after a spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of six characteristic spots with R_fs 0.94 (yellow), 071 (pink), 0.48 (pink), 0.30 (purple), 0.25 (purple) and 0.22 (yellow).



Chromatogram

Macroscopy
Gum arabic appears in the form of tears rounded or oval, of variable sizes, usually 0.5 to 2 cm in diameter, whitish or yellowish white, opaque, due to the presence of numerous small cracks on the surface; easily broken into many small angular fragments with a transparent glass surface, shiny, practically odourless, sweetish and mucilaginous.

Microscopy
Gum arabic is white under the microscope with angular particles; no starch grains, a few particles of plant tissue and no mucilaginous cell walls.

Powdered plant material
Gum Arabic, an extracted gummy material, is an unorganized, acellular drug, devoid of any cellular organization.

Therapeutic actions
Expectorant, topical emollient, antinflammatory, mucous membrane protective, antihemorrhagic, vulnerary (Parveen *et al*., 2007; Jain *et al*., 2005; Fortin *et al.,* 2000).

Therapeutic indications
Diarrhoea, dysentery, cough, inflammation of mucous membranes, burns

Safety data
The LD_{50} of the aqueous extract of the gum (p.o) in mice was beyond 2000 mg/kg in 24 hours. In the subacute studies, no clinical signs of toxicity were observed after oral administration of the extract at 500 – 2000 mg/kg; *p.o* to male and female mice for 14 days.

Precautions for use
For use as a pharmaceutical formulation excipient, gum Arabic, must be used in the correct proportions in creams, emulsions and suspensions.

Adverse effects
Allergic reactions to the gum and powdered forms of acacia have been reported and include respiratory problems and skin lesions. Administration may cause renal and liver damage (Leung and Foster, 1980).

Contraindications
Its oral use in diarrhea must be medically supervised

Dosage forms
Present as a formulation component of infusions, suspensions, creams, emulsions and external or topical emmolients

Dosage
20 g per litre of boiling water (Fortin *et al.,* 2000).

Storage
Store in a cool dry place

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Adonsonia digitata

Botanical name
Adansonia digitata L.

Family
Bombacaceae

Synonyms
Adansonia sphaerocarpa A. Chev.

Common names
Baobab (English), Baobab (French)

Vernacular names
Burkina Faso: Mooré – Twèga, Dioula – Sira, Fulfuldé – bolbe;bouki
Ghana: Akan - Odadeē
Mali: Bambara - Zira, Manlinké- Sito, Dogon - Oro
Niger: Hausa – Kouka, Djerma – Kogna
Nigeria: Yoruba – Ose
Senegal: Wolof – Gui, Gouïe; Serer – Bàk, Diola – Bu Bak, Hausa – Kuka
Sierra leone: Fula – Sule, Kono – Sela, Madingo - Sida
Togo: Moba – Tokala, Ewe – Adidotsi, Nawdem – Todi

Description of the plant
A. digitata is a characteristic tree of size 15-20 m long; trunk very large and thick, about 20 m in diameter, hard, spongy, with large tortuous branches, usually spread out and contorted (Malgras, 1992); bark greyish brown and normally smooth but can often be variously folded and seamed from years of growth; leaves alternate, digitate with entire or denticulate margin, and composed of six to seven leaflets, obovate or ovate, acuminate, acute, slightly pubescent on the surface; flowers large, white, solitary, pendulous (10-20 cm), with very long stalks up to 80 cm (Malgras, 1992; Kerharo and Adam, 1974), flowers provided with two bracteoles bloom at night; fruits are capsules called monkey bread, which are oblong, ovoid or rounded, woody and hairy, 8-15 cm wide, suspended at the end of a long stalk (Malgras, 1992); fruit epicarp is greenish, at maturity contain numerous black hard seeds in a white floury pulp.

Herbarium specimen number
Ghana: A2083 (GC)
Mali: 2358 (DMT)
Togo: TOGO02476

Habitat and geographical distribution
A. digitata commonly grows in the thorny woodlands of the African savannas, which are characterised by low altitudes with limited annual rainfall such as the Sudano-Sahelian zone (600 to 900 mm annual rainfall). It is found in hot, dry woodland on stoney, well drained soils, in frost-free areas that receive low rainfall, but adapts to any soil (Le Flamboyant, 1993). *A. digitata* is resistant to fire, termite and drought, prefers a high water table and is very sensitive to waterlogging and frost. It is a protected species often planted and associated with human occupation (Giffard, 1974).

Plant material of interest
Leaf, fruit pulp

Other parts used
Stem bark and root

Definition of plant material of interest
Baobab consists of the dried leaf or dried white fruit pulp of *Adansonia digitata* (Bombacaceae).

Ethnomedical uses
A. digitata is used to treat general worm infestations, diarrhoea and abdominal pain (Diehl *et al*., 2004). Root or stem bark decoction is used as a disinfectant for chronic wounds. Juice from fresh stem bark is applied to small inflammated boils, whilst a powder mixed with *Lannea microcarpa* seed oil is applied to large boils (Inngjerdingen *et al*., 2004). Stem bark decoction is administered orally to treat infectious diseases such as sexually transmitted diseases (Magassouba *et al*., 2007). *A. digitata* is used for the treatment of fever, diarrhoea, haemoptysis, hiccups and urinary and digestive tract disorders

(Ribeiro *et al*., 2010; Van Wyk, 2008). Dried leaves are stored for 1-2 years in an airtight container pounded and strained and the resulting gum used as a remedy for tooth decay. Some healers recommend adding a dried snail shell before pounding the leaves. Decoction of the leaf is also used orally for the treatment of malaria (Nguta *et al*., 2010a; 2010b). In some parts of Africa, India, Sri Lanka and the West Indies malaria sufferers are said to take a mash containing dried baobab bark to treat the fever associated with the disease whilst the bark of the plant is used to treat tuberculosis, persistent cough, bronchitis and debility (Luo *et al*., 2011; Ribeiro *et al*., 2010).

Biological and pharmacological activities

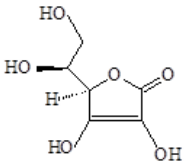
Aqeous, methanol and acetonitrile extracts of the flower showed promising anti-fungal activity against *Microsporum canis, Trichophyton rubrum* and *Epidermophyton floccosum* (Locher *et al*., 1995). Deeni and Sadiq (2002) have reported the *in vitro* antibacterial and antifungal activities of the methanolic leaf extract. Leaf extracts also exhibited anthelminthic activities (Diehl *et al*., 2004). *A. digitata* leaves, fruit-pulp and seeds have shown antiviral activity against influenza virus, herpes simplex virus and respiratory syncytial virus and polio. The plant has analgesic, anti-inflammatory and antipyretic properties. Ramadan *et al*. (1993) found that the fruit pulp of baobab has similar anti-inflammatory properties to phenylbutazone in rats. Leaf powder is an anti-asthmatic (Sallet *et al*., 1946). Intravenous administration of the leaf extract in animals caused a fall in carotid pressure and an increased respiratory rate with increasing amplitude. Several studies have reported the antioxidant capabilities of baobab fruit pulp, which is thought to be due its high vitamin C content (Lamien-Meda *et al*., 2008; Blomhoff *et al*., 2010). Besides having analgesic properties, the fruit pulp has also been shown to lower elevated body temperature without affecting normal body temperature (Ramadan *et al*., 1993). Al-Qarawi *et al*. (2003) have also reported that the fruit pulp has both hepatoprotective and hepatorestorative properties in Wistar male albino rats.

Clinical data

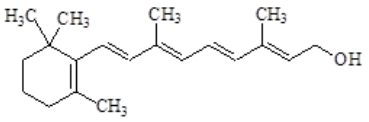
In a clinical study involving 160 children aged 8 months, the efficacy of a traditional decoction of dried baobab fruit with water and sugar was compared with the WHO standard solution used to treat children with acute diarrhoea. It was observed that although the WHO solution was superior to the baobab mixture, there was no statistical difference between the two solutions in terms of duration of diarrhoea and weight gain. In addition the baobab decoction was found to be an excellent nutrient source, more economical than the WHO solution and also easily available to poor communities (Tal-Dia *et al*., 1997).

Chemical constituents

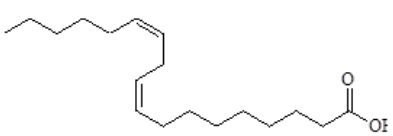
Vitamin A, B and C; minerals (calcium, phosphorus); mucilage; protein; cellulose; tannins, anthraquinones, saponins, pectins, sterols and triterpenes; amino acids (except cystine and tryptophan); organic acids (citric acid, tartaric acid, malic acid, stearic acid, linoleic acid, oleic acid, palmitic acid) (Gaiwe, 1989; Kerharo and Adam, 1974; Toury *et al*. 1957).



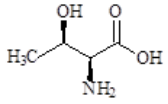
Vitamin C



Vitamin A



Linoleic acid



Threonine

Test for identity and purity

Moisture content: 12.00 -13.00%
Total ash: 7.00 - 9.00%
Water-soluble extractives: 5.20%
Alcohol-soluble (70%) extractives: 20.00%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8] , detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spots with R_fs 0.68 (pink), 0.48 (purple), 0.42 (pink) and 0.28 (pink).

Macroscopy

Leaves alternate, digitate with entire or denticulate margin, and composed of six to seven leaflets, obovate or ovate, acuminate, acute,

Chromatogram

slightly pubescent on the surface (Malgras, 1992; Kerharo and Adam, 1974); fruits are capsules which are oblong, ovoid or rounded, woody and hairy, 8-15 cm wide, fruit epicarp is greenish; numerous black hard seeds in a white floury pulp. The soft white pulp which is the main source of food and medicine is enclosed within the hard shell.

Microscopy

Fruit shell is composed of numerous lignified stone cells, heavily pitted vessels, lignified sclerenchymatous fibres; the pulp consists almost entirely of large unlignified polygonal or irregular, beaked parenchymatous cells containing numerous simple or compound, angular or spherical large starch grains with distinct striations and hila. Seed, with the brownish hard testa is composed of numerous stone cells and small vessel members; the white kernel consists of soft parenchymatous cells, numerous oil cells and a few unlignified fibres with pitted walls; crytalloids of numerous aleurone grains are present in some cells (Ghani and Agbejule, 1986).

Powdered plant material

Xylem vessels with pitted walls, numerous lignified stone cells staining red with phloroglucinol and hydrochloric acid, lignified schlerenchymatous fibres, plenty of large-sized starch grains which stain blue black with iodine solution; aleurone grains are seen numerous, there are parenchymatous cells in the field.

Therapeutic actions

Anti-asthmatic (Sallet *et al*. 1946), antibacterial and antifungal (Deeni and Sadiq, 2002), hypotensive, anti-histaminic, diaphoretic, antihemorrhagic, anti-diaphoretic (Malgras, 1992), antiheminthic and larvicidal (Diehl *et al*., 2004), antimalarial (Nguta *et al*., 2010b), analgesic, anti-inflammatory and antipyretic (Ribeiro *et al*., 2010).

Therapeutic indications

Asthma, constipation, inflammation, pain and fever, diarrhea, hemorrhage, malaria, weight loss diet

Safety data

The LD_{50} of the aqueous extract of the gum (*p.o*) in mice was beyond 2000 mg/kg in 24 hours. In the subacute studies, no clinical signs of toxicity were observed after oral administration of the extract at 500 – 2000 mg/kg; *p.o* to male and female mice for 14 days.

Precautions for use

In hypertensive subjects, the blood pressure must be monitored.

Adverse effects

May cause hypotension at high doses

Contraindications

It's use in diarrhea must be monitored

Dosage and dosage forms

Decoction

Decoction: 30 g of dried leaves in 900 ml of water, boil until reduced to 600 ml, 1 teaspoon three times a day.

Storage

Store in a cool dry place

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Ageratum conyzoides

Botanical name
Ageratum conyzoides L.

Family
Asteraceae

Synonyms
Ageratum latifolium Car., *A. cordifolium* Roxb, *A. album* Stend., A. *odoratum* Vilm., *A. hirsutum* Lam., *A. obtusifolium* Lam.

Common names
Australian Billy-goat weed, Goat weed, Mexican ageratum, Herbe de bouc (French).

Vernacular names
Burkina Faso: Dioula – Chou kolan, Fulfuldé – Kikalapurél;kisalapuré
Cote d'Ivoire: Baule – Kondre, Dan – Dussuo, Gagu – Maingue
Gambia: Fula Pulaar – Chikara – Pre, Manding Mandinka – Hatayajambo
Ghana: Akyem – Adwowakuro, Asante – Guakuro, Fante – Efumomoe
Guinea Bissau: Crioulo – Balquiama, Fula – Laboel, Mandinka – Boro
Guinea: Fula Pulaar – Kumba-Dongul
Liberia: Basa – Omalu-Ana, Mano – Dah Vo
Nigeria: Yuroba – Imi esu, Edo – Ebegho, Igbo – Ngwa
Senegal: Diola – Ekerkeda, Manding Bambara – Nun Gu, Wolof – Gobu
Sierra Leone: Kono – Yandigbene Yani, Krio – Wet-Ed-Lif, Susu Dyalonke-Khampu-Na.

Description of the plant
An erect, branched, softly hispid, annual herb, up to 1 m high; leaves opposite, arrangement decussate; ovate, setose-pubescent on nerves on lower surface, margin crenate, petiole slender, flower heads bluish-purple or whitish, small, abundant, in terminal cymes.

Herbarium specimen number
Ghana: A1847 (GC)
Nigeria: FHI108305
Togo: TOGO00775

Habitat and geographical distribution
A. cornyzoides grows widely in Northern Ghana and from Mali to Cameroon. It is commonly found in moist places or during rainy season in deserted villages and weedy areas including roadsides (Dokosi, 1998; GHP, 1992).

Plant material of interest
Fresh or dried leaf

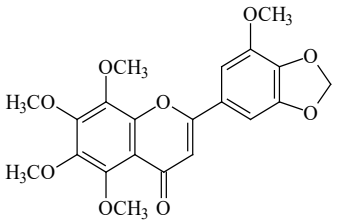
Other parts used
Root; whole plant

Definition of plant material of interest
Ageratum consists of fresh or dried leaf of *Ageratum conyzoides* L. (Asteraceae)

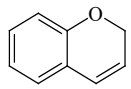
Ethnomedical uses
A. conyzoides is used in various parts of Africa, Asia and South America for treating a wide variety of diseases including mental illness, headache, colic, skin ulcers, cuts and wounds, burns and dyspnoea. It is used as a purgative, febrifuge, antienteralgic and antipyretic. In Nigeria the decoction of the plant is taken internally to treat diarrhoea and intestinal pain it is incorporated into traditional soaps prepared from the ashes of plants such as cocoa (*Theobroma cacao*) and from palm kernel shafts (*Elaeis guinensis*). In Kenya it is used as an antiasthmatic, antispasmodic and haemostatic, whilst in Brazilian folk medicine teas of *A. conyzoides* are taken as anti-inflammatory, analgesic, anti-diarrhoeic. In Vietnam it is used for gynaecologic complaints. Other folkloric uses include anti-itch, antitussive, vermifuge, antirheumatic and anticaries. The plant is most commonly used as a disinfectant and haemostic for wounds (Haensel *et al*, 1994). The application of the leaf sap on the hands of card players is believed to improve their luck (Durodola, 1977).

Biological and pharmacological activities

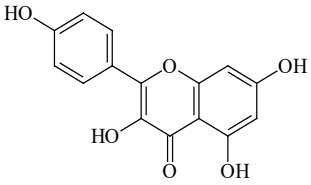
A. conyzoides has shown promising antiinflammatory, analgesic, antibacterial and wound healing properties in various experimental studies. Extracts of the crude root and aerial parts demonstrated neuromuscular blocking activity in isolated rat phrenic nerve-diaphragm. *A. conyzoides*'s extracts showed calcium channel blocking activity comparable to that of verapramil (Achola and Munenge, 1997*).* Aqueous leaf extracts had effective analgesic action in rats (Bioka *et al.,* 1993) and the ether and chloroform extracts showed activity against *Staphylococus aureus in vitro* (Durodola, 1977). Yamamoto *et al* (1991) found no antiinflammatory and analgesic properties *in vivo*, but an extract exhibited a partial agonist-type histamine-like activity *in vitro*. The methanolic extract of the whole plant showed antibacterial (*S. aureus, Bacillus subtilis, Escherichia coli* and *Pseudomonas aeruginosa*) properties (Almagboul *et al.,* 1985). Animal studies have demonstrated the herb's wound healing effects and an alcoholic extract caused a dose-dependent decline in radiation-induced mortality *in vivo* (Ganesh *et al.,* 2003). A local soap containing extracts of *A. conyzoides* and other medicinal plants such as Aloe, did not show any significant antibacterial and antifungal effect on test organisms (Moody *et al*., 2004).



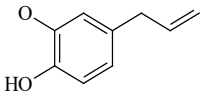
Conyzorygun



Chromene



Kaempferol



Eugenol

Clinical data

The leaf extract has been used in the treatment of chronic pain in osteoarthrotic patients. In Brazil, a water extract of the whole plant was given to human patients with arthritis; 66% reported a decrease in pain and inflammation and 24% reported an improvement in mobility after one week of treatment without side effects. (Marques *et al*., 1988).

Chemical constituents

Volatile oil (eugenol); chromenes; triterpenoids including sterols; flavonoids and phenolic compounds (conyzorigun, 5-methoxynobiletin, quercetin, kaempferol glycosides); alkaloids; benzofurans and tannins (Okunade, 2002; GHP, 1992; Gill, 1978).

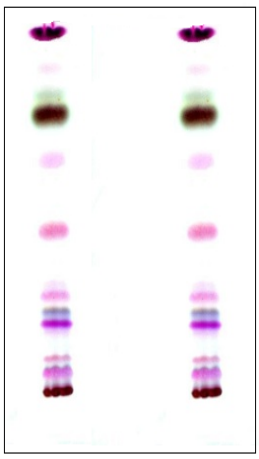
Test for identity and purity

Moisture content: not more than 9.60%
Total ash: 18.68%
Water-soluble extractives: 17.50%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of nine characteristic spots with R_fs 0.89 (pink), 0.81 (grey), 0.74 (brown), 0.42 (pink), 0.35 (pink), 0.26 (pink), 0.22 (ash), 0.19 (violet) and 0.09 (purple).



Chromatogram

Macroscopy

Simple leaf, 4-7 cm long and 2-5 cm broad, slender, petiolate, 1-3 cm long; shape ovate, broadly cuneate at base; margin crenate; apex acute; venation reticulate; hispid, colour green; odour strong, pungent; taste bitter.

Microscopy

Numerous twisted, clothing trichomes on upper surface, sparsely distributed on lower surface, glandular trichomes on upper surface; anisocytic stomata; oil cells visible. The transverse section shows a dorsiventral structure; epidermal cells

with warty cuticle; mesophyll cells interrupted in midrib region by collenchyma tissue both above and below the collateral vascular bundle, xylem lignified; oil droplets (yellowish) present in spongy mesophyll.

Powdered plant material
Greenish coloured; odour pungent; lamina fragments show trichomes, oil cells, anisocytic stomata, veins and veinlets with lignified xylem elements.

Therapeutic actions
Analgesic, emetic, antibacterial, anticoagulant, antihelminthic, anti-inflammatory, antimalarial, antioxidant, antirheumatic, depurative, febrifuge, haemostatic, insecticidal, purgative, radio-protective, stimulant and vulnerary (Ganesh *et al.,* 2003; Okunade, 2002; Sampson *et al.,* 2000; Durodola, 1977; GHP, 1992; Almagboul *et al.,*1985).

Therapeutic indications
Amoebiasis; anal prolapse; arthritis; beriberi; catarrh; cephalgia; conjunctivitis; colds; convulsions; crawcraw; diabetes; diarrhoea; dysentery; dyspepsia; dyspnoea; enteralgia; epistaxis; fever; flatulence; menstrual problems (pre-menstrual tension, amenorrheoa); primary and secondary female infertility; threatened abortion; urinary tract infections; wounds (GHP, 1992; Abena *et al.,* 1993; Mshana *et al.,* 2000).

Safety data
The LD_{50} of the aqueous extract of the leaves of the plant (*p.o*) is >2000 mg/kg over a 24 hour period in mice. In the subacute studies, no clinical signs of toxicity were observed after oral administration of the extract at 500 – 2000 mg/kg; p.o to male and female mice for 14 days. Higher doses (≥125 mg/kg) caused mortality of rats, and at doses of 50-100 mg/kg symptoms such as ataxia, sedation and a slight ptosis were observed (Ganesh *et al.,* 2003).

Precautions for use
Should be used with care in children and pregnant women.

Adverse effects
Although other animal studies have shown the plant to be safe, Trigo *et al.,* (1988) found several alkaloids, including licopsamine and 1, 2-desifropirrolizidinic and, which may induce hepatotoxicity.

Contraindications
Diabetes

Dosage and dosage forms
Decoction; Juice from bruised fresh leaves; Tincture; Capsules.
Infusion: 20-30 g of dry leaves per litre of water; take 3-4 teacups day
Decoction: 30-50 g per litre of water; take 3-4 teacups day
Tincture: 1:5 30% fresh alcohol, take 2-5 ml twice daily
Capsule: 1-2 g twice daily

Storage
Store in a cool dry place in sealed containers away from light

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Alchornea cordifolia

Botanical name
Alchornea cordifolia (Schum & Thonn) Müell

Family
Euphorbiaceae

Synonyms
Alchornea cordata Benth., *Schousboea cordifolia* Schum.& Thonn

Common names
English: Christmas bush, French: Arbre de djeman, Alchornéa cordiforme

Vernacular names
Burkina Faso: Dioula – kho sira;ko yira, Fulfuldé - Lahédi
Cote d'Ivoire: Baoulé – Agni, Akyé – N'dzin, Malinké – Koyira
Ghana: Akan – Ogyamma, Fante – Egyamma, Ga – Adangbe- Gboo
Mali: Bambara – Kô gira, Malinké – Kogira, Peulh – Holâta, Bulora
Nigeria: Hausa- Bambami, Igbo – Ububo, Yoruba – Ewe Ipa, Esinyin
Senegal: Wolof- Lah, Diola- Purger yéné, Serer-Ardana, Yira
Sierra Leone: Madingo – Yisai, Mende – Njekoi, Susu – Bolontha
Togo: Ewé – Avovlo, Ouatchi – Avovlo

Description of the plant
A. cordifolia is a small tree or many stemmed, almost climbing shrub up to 5 – 8 m high; stem armed with blunt spines; leaves long-petiolate; broadly ovate, cordate at base, apex shortly acuminate, entire or slightly dentate margin, stelate-puberulous or slightly glaberescent beneath, glands in axils on basal nerves; flowers greenish-white in lax pendulous spikes or raceme; styles long and permanent on the fruit; fruit two-celled, small, stellate pubescent.

Herbarium specimen number
Ghana: GC 42071
Mali: 00660 (DMT)
Nigeria: FHI 108437
Togo: TOGO03023

Habitat and geographical distribution
A. cordifolia is widely distributed throughout all countries of the West African region and across tropical Africa, in secondary forests usually near water, moist or marshy places.

Plant material of interest
Leaf

Other parts used
Stem bark, root and fruit

Definition of plant material of interest
Alchornea consists of the fresh or dried leaf of *Alchornea cordifolia* (Schum & Thonn) Müell (Euphorbiaceae).

Ethnomedical uses
A. cordifolia is commonly used in traditional medicine in Africa, in combination with other plants; all the plants parts are used. The leaves are used in many African countries for the treatment of microbial, inflammatory, and stress-related diseases (Neuwinger, 2000). The leaf decoction is taken for stomachache in Cote d'Ivoire and Burkina Faso, while a combination of the stem bark and the bark of *Symphonia lobuliffera* is used as an appetizer (Kerharo and Bouquet, 1950). The roots are used against leprosy (Abbiw, 1990) and the leaf powder has wound and ulcer cicatrisation properties (Kerharo and Bouquet, 1950). In Mali and Cote d'Ivoire the plant is used to treat malaria (Mustofa *et al*., 2000).

Biological and pharmacological activities
The leaf extracts demonstrated antimicrobial activities against *Echerichia coli*, *Citrobacta diversus*, *Salmonella enteritidis*, *Shigella flexneri* and *Staphylococcus aureus* (Tona *et al*., 1998). The antimicrobial activity of the stem bark has also been demonstrated against *Staphylococcus aureus, Bacillus subtilis, Echerichia coli* and *Klebsiella pneumoniae* (Ebi, 2000). The 50%

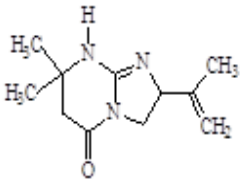
ethanolic leaf extract showed an *in vivo* dose dependent antibacterial activity against *Staphylococcus aureus*; intraperitonial administration of the extract at 25 to 200 mg/kg, signifiquantly increased the survival time of infected mice (Igbeneghu *et al*., 2007). Aqueous extracts were active against all the 21 bacterial strains tested and showed the highest levels of antibacterial activity with MIC's against methicillin-resistant *Staphylococcus aureus* in the range of 1.6-3.1 mg/ml (Pesewu *et al*., 2008). Barry *et al*. (2002) have also shown the plant's antifungual properties on *Microsporon canis* and *Trichophyton mentagrophytes*. Extracts of the plant exhibited antitripanosomal activity against *Trypanosoma congolense* and *Trypanosoma bruceï* at 200 µg/ml (Agbe *et al*., 1987) and the ethanol leaf extract showed an inhibitory activity against the K1 strain of *Plasmodium falciparum* with an IC_{50} value of 4.19 µg/ml (Togola, 2002). Ellagic acid, isolated from the same extract, showed a moderate activity against *P. falciparum*, with IC_{50} values between 0.2 and 0.5 µmol (Banzouzi *et al*., 2002). The 80% methanolic extract exhibited a pronounced antiplasmodial activity against *P. falciparum* Ghanaian strain with IC_{50} values ranging from 0.5 to 3.0 µg/ml (Mesia *et al*., 2008). Several extracts prepared from the root bark exhibited an antiamoebic activity with an IC_{50} below 100 µg/ml (Tona *et al*., 1998). The plant also possess *in vivo* antiinflammatory activity (Okoye *et al*. 2011; Mavar-Manga *et al*., 2008; Osadebe and Okoye, 2003), and a dose dependant antidiarrhoeal effect on mice (Agbor *et al*., 2004). Olaleye *et al*., (2006) reported the *in vivo* hepatoprotective activity of the hydro alcoholic leaf extract. The plant also afforded protection against oxidative stress (Olaleye and Rocha, 2007); the polyphenols obtained from the ethyl acetate extract showed potent antioxidant and anti elastate activities (Kouakou-Siransy *et al*., 2010). Umukoro and Aladeokin, (2010) showed that oral intake of the leaf extract at 100-400 kg/kg had anti-stress/anti-fatigue properties *in vivo*. The methanolic leaf extract at 500 mg/kg and 1000 mg/kg had antiulcer properties (Ngueleface *et al*., 2005). Ayisi and Nyadedzor, (2003) reported a significant antiviral activity on the replication processes of HIV-1. Histological changes in the pancreas was observed following administration of ethanolic leaf extract in alloxan-induced diabetic rats (Eliakim-Ikechukwu and Obri, 2009). The plant may be effective in increasing the elastic recoil of the aortic wall and may therefore reduce blood pressure (Eliakim-Ikechukwu and Obri, 2009). The flavonoid-rich fraction of extracts demonstrated an immunostimulant effect (Nworu *et al*., 2010a and Nworu *et al*., 2010b).

Clinical data

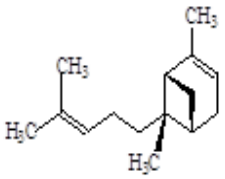
No information available

Chemical constituents

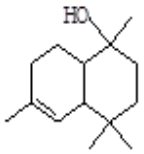
Alkaloids (eg. alchornine and related alkaloids); tannins, flavonoids and proanthocyanidins (Bennet, 1950; Paris, 1958; Pruja, 1987; Ogundipe *et al*., 2001; Ayisi and Nyadedzor, 2003; Kouakou-Siransy *et al*., 2010), cadinol, caryophylene, linalool and (E)-α-bergamotene (Okoye *et al*. 2011).



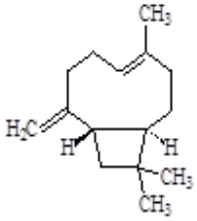
Alchornine



Endo-alpha-bergamotene



Cadinol



Caryophylene

Test for identity and purity

Moisture content: not more than 4.80%
Total ash: 5.60 %
Water-soluble extractives: not less than 22.80%
Alcohol-soluble (70%) extractives: not less than 22.03%

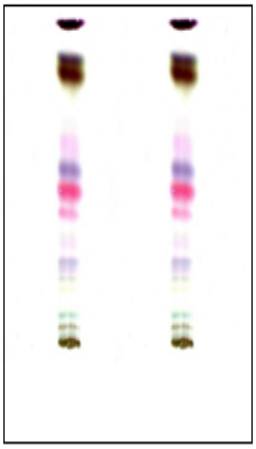
Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spots with R_fs 0.82 (brown), 0.54 (blue), 0.47 (pink) and 0.40 (pink).

Macroscopy

Simple leaf, arrangement alternate, petiolate; 10-28 cm long, 6-16cm broad, shape oval, base cordate, apex acuminate, margin dentate – entire



Chromatogram

colour green, petiole with red flush, odourless; taste bland to slightly bitter.

Microscopy
The surface view shows stelate trichomes with unicellular arms and unicellular clothing trichomes; warty epidermal cells, anisocytic stomata on lower surface, the transverse section shows a dorsoventral leaf arrangement; palisade layer two-celled with numerous rosette calcium oxalate crystals; mesophyll cells abound in the collenchyma tissue in midrib region in both upper and lower surfaces, spongy mesophyll with rosette crystals; vascular bundle bicollateral, bounded by shield-shaped lignified pericyclic fibres; xylem elements lignified.

Powdered plant material
Colour green; odourless; taste slightly bitter; numerous lignified reticulate xylem vessels and fibres; clothing unicellular and stellate trichomes with lignified bases; anisocytic stomata, prismatic and rosette crystals of calcium oxalate; veins with sheaths, prismatic crystals.

Therapeutic actions
Antimalarial, antidiarheal, antiinflamatory, antimicrobial, febrifuge, analgesic, vunerary, antitusive, antiinfective, antispasmodic

Therapeutic indications
Malaria, gastrointestinal disorders, fever, cough fracture, dysmenorrhea, wounds and stomatitis, and rheumatic pains

Safety data
The LD_{50} of the aqueous extract (*p.o*) of the leaves of the plant is >2000 mg/kg over a period of 24 hrs in mice. In the subacute studies, no clinical signs of toxicity were observed after oral administration of the extract at 500 – 2000 mg/kg; *p.o* to male and female mice for 14 days. The extract was well tolerated by the animals; no death was observed at oral doses of 500-4000 mg/kg (Umukoro and Aladeokin, 2010). Negative results were obtained in the bacterial reverse mutation test *in vitro*, suggesting it is potentially safe to use it at high doses (Hong and Lyu, 2011), with little or no tendency to evoke mutation in mammalian cells.

Precautions for use
Pregnancy, hypotension

Adverse effects
May cause gastrointestinal disturbances at high doses

Contraindications
Liver dysfunctions

Dosage and dosage forms
Decoction, tincture, infusion
Decoction: 30-50 g of dried leaves per one liter of water; 3-4 teacups daily
Infusion: 20-30 g of dried leaves per one liter of water; 3-4 teacups daily
Tincture**:** 1:5, 45% ethanol; 5 ml three times daily

Storage
Store in a cold dry place

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Allium sativum

Botanical name
Allium sativum L.

Family
Lilliaceae

Synonym
Porvium sativum Relib.

Common names
Garlic (English); Ail commun (French)

Vernacular names
Burkina Faso: Mooré – Gando;Layi, Dioula – Laii, Fulfuldé – Toumé
Ghana: Twi – Gyene Kankan, Ga Adangbe – Aya, Hausa – Tafarmuwa
Mali: Bambara – Tumé, Tamachek – Teskart
Nigeria: Hausa – Tafárnúúwáá, Igbo – Oy Ayón, Ayún, Yoruba – Àlubósa, Ayúu
Senegal: Wolof – Laji, Manding Bambara – Layi
Togo: Ewe – Ayo, Nima – Ayo, Ouatchi - Ayo

Description of the plant
An erect, hardy and bulbous perennial herb up to 60 cm in height, with a central bulb covered in scales in the axil, bulb consists of a number of cloves enclosed in a paper-like skin; leaves are long, flat and smooth, leaf blade is cylindrical, hollow, linear, flat and solid with an acute apex; spherical inflorescence with white to purplish-pink coloured flowers found on slender pedicels (Burkill 1995; Gill 1992).

Herbarium specimen number
Nigeria: FHI 107900

Habitat and geographical distribution
Originates from Central Asia, but now cultivated in many parts of the world, notably Europe, North Africa, Asia, and North America and the West African sub-region (GHP 2007; Burkill 1995; Adjanahoun *et al.,* 1991).

Plant material of interest
Bulb

Other parts used
Oil from bulb (ESCOP, 1999).

Definition of plant material of interest
Garlic consists of the whole bulb of *Allium sativum* L. (Lilliaceae)

Ethnomedical uses
Garlic is cholesterol-lowering, antihypertensive, anti-coagulant, anti-diarrhoeal, anti-dysenteric,

immune stimulant, stomachic, sudorific, expectorant, anthelmintic, counter-irritant, diuretic, broad spectrum antibiotic and anthelmintic. It is used externally for arthritis, corns, warts, neuralepia (Elujoba and Olawode, 2004; Gill 1992; Adjanahoun *et al.,* 1991), fever, cough, flatulence, ulcer, hoarseness, bronchitis and other respiratory problems, skin diseases, burns, earache and tonsilitis, rheumatism, tuberculosis, typhoid, diabetes, arteriosclerosis, hyperlipidaemia and in the prevention of atherosclerotic (age-dependent) vascular changes (WHO, 1999).

Biological and pharmacological activities
Several scientific studies have shown that garlic has antihyperlipidaemic, antihypertensive and anticoagulant properties (Auer *et al.,* 1990; Broche *et al.,* 1990; Barrie *et al.,* 1987). The herb's many therapeutic actions are attributed to the compound allicin and its metabolites. For example allicin and its corresponding sulphide inhibit the proliferation of several human non-leukaemia malignant cells *in vitro*. *In vitro* studies have shown that ajoene possesses anti-thrombotic, anti-microbial and cholesterol lowering properties; ajoene exhibited inhibitory effects on platelet activation (Apitz-Castro *et al.,* 1986), platelet binding to damaged blood vessel wall (Apitz-Castro *et al.,* 1994) and thrombus formation (Apitz-Castro *et al.,* 1992). It also prevented platelet loss from the blood, inhibited the lipooxygenase pathway, tyrosine phosphatase activity in human platelets (Srivastava and Tygi, 1993) and lowered cholesterol biosynthesis (Gebhardt *et al.,* 1994). The compounds, diallyl disulphide and diallyl trisulphide possess antiplatelet aggregation and

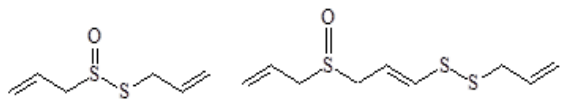
antithromboxane formation properties (Bordia *et al.,* 1998). Aqueous and organic garlic extracts inhibited platelet aggregation *in vivo* (Mohamed and Woodward, 1986). Garlic extracts reduce accumulation of cholesterol in blood vessels and the development of arteriosclerotic plaques in arterial wall in cholesterol-fed rabbits (Koscielny *et al.,* 1999; Effendy *et al.,* 1997). The extracts also exhibited anti-hypertensive effects, increased anticlotting activity, decreased blood viscosity, and improved cardiovascular function (Kendler, 1987). Garlic oil produced a marked reversal of the metabolic changes associated with isoproterenol-induced myocardial infarction (Saravanan and Prakash, 2004). Garlic extracts have shown larvicidal properties against Anopheles and Culicine larvae and high inhibitory activity against a range of pathogenic bacteria and fungus (Benkeblia 2004). Ajoene exhibited anti-mycotic, anti-microbial and anti-viral activities. Other *in vitro* and *in vivo* studies have also shown that garlic has broad spectrum antifungal effects (Davies and Perrie, 2003) and exhibited a synergistic activity with amphotericin B in inhibiting fungal growth (Tansley and Appleton, 1975). Extensive scientific investigations have shown that various commercial garlic products possess antiviral activities against a range of viruses including herpes simplex virus Types 1 and 2, influenza A and B viruses, human cytomegalovirus, vesicular stomatitis virus, rhinovirus, human immunodeficiency virus (HIV), viral pneumonia and rotavirus. Allicin has been shown to have antibacterial activity (Cavallito and Bailey, 1944). Numerous epidemiological, clinical and laboratory studies have demonstrated the role of garlic in cancer prevention (Bianchini and Vainio, 2001; Dorant *et al.,* 1996). Garlic oil, its powder and chemical constituents exhibited potent antibacterial effect on *Helicobacter pylori*, which may explain its supposed protectective effect against gastric cancer. The herb's chemopreventive properties have been attributed to the organosulphur compounds, which modulate the activity of several metabolising enzymes that activate or detoxify carcinogens and inhibit the formation of DNA adducts in several target tissues (Bianchini and Vainio, 2001). Diallyl disulfide has been shown to exhibit potent chemopreventative activity against colon, lung, and skin cancers.

Clinical data

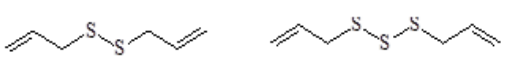
Garlic powder preparations have been shown to have lipid-lowering potential but decreased plasma viscosity, tissue plasminogen activator activity and the haematocrit level; increased the mean diameter of the arterioles by 4.2% and venules by 5.9% as compared with the controls; increased capillary erythrocyte flow rate and decreased plasma viscosity and plasma fibrinogen levels; caused reduction of serum lipid concentrations; significantly increased tissue plasminogen activator activity as compared with placebo; platelet aggregation induced by adenosine diphosphate and collagen was significantly inhibited 2 and 4 hours after garlic ingestion and remained lower for 7 to 14 days after treatment; decreased the percentage of circulating platelet aggregates and spontaneous platelet aggregation as compared with the placebo group and also decreased the average blood glucose (WHO, 1999). Several clinical reports and meta-analyses have revealed the cholesterol-lowering effects of raw garlic and some garlic supplements. It has been shown that garlic can decrease low-density lipoproteins and increase high-density lipoprotein levels (Ernst, 1987; Chang and Johnson, 1980). Topical application of ajoene produced significant clinical response in patients with skin basal cell carcinoma. Garlic was shown to stimulate immune effector cells including T- and natural killer cells (Bianchini and Vainio, 2001).

Chemical constituents

Volatile oil, consisting mainly of sulfur-containing substances such as diallyl sulphide, alliin, allicine and alliinase (Gill, 1992), vitamins A, B, C, D and E, ajoenes (Chevallier, 1996), oleo-resins; amino acids; minerals (germanium, calcium, copper, iron, potassium, magnesium, selenium, zinc); saponin; cyanogenic glycosides; thioglycosides and flavonoids (GHP, 1992); oleo-resins; amino acids; vitamins A, B, C and D (Newall *et al.,* 1996; Leung and Foster, 1996; GHP, 1992).



Allicin Ajoene



Diallyldisulphide Diallyltrisulphide

Test for identity and purity

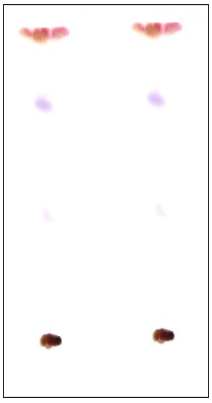
Moisture content: Not more than 7.00 %
Total ash: Not more than 5.00 %

Acid-insoluble ash: Not more than 1.00 %
Water-soluble extractives: Not less than 5.00 %
Alcohol-soluble (70%) extractives: Not less than 4.00 %

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8] , detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of one characteristic violet spot with R_fs, 0.75.



Chromatogram

Macroscopy

Garlic bulb, either fresh or carefully dried, consists of the main bulb surrounded by several secondary bulbs or cloves. There are several outer layers of protective leaves which tend to surround the inner sheath; the inner sheath encloses the cloves which are generally asymmetric in shape except the central ones. Up to more than 20 cloves can be so enclosed, numerous short roots are closely embedded; a sub-globular compound bulb, 4-6 cm broad; 8-15 bulblets, surrounded by 1-2 dry whitish membranous scales and attached to a flattened circular base; individual bulblets break off easily after removal of outer scales; known for its strong acrid, pungent, aromatic, disagreeable, characteristic alliaceous and persistent odour and strong taste, light purplish-brown, pale buff to grey in colour.

Microscopy

Both upper and lower epidermal cells appear as one layer in each case. The outer or upper epidermis is devoid of chlorophyll but contains lignified sclereids which are elongated and pitted, also long fibres measuring up to 500 µm in length and 3 µm in width; the cells of the dry scales contain rhomboid crystals of calcium oxalate. The upper epidermal cells, proximal to the dry scale layer, make up the single layer of rectangular to cubical cells, followed by several layers of large parenchymatous cells. Vascular bundles (xylem and phloem) are present as lignified, spiral and annular vessels. The lower epidermis has cells, smaller than those on the upper epidermis. Outer membranous scale consists of ground mass of parenchymatous cells containing prismatic crystals and starch, traversed by vascular elements; two scale coverings of individual bulblets: the outer one consists of straight-walled parenchymatous cells and few fibres, the inner one consists entirely of prosenchyma. The transverse section of the descaled bulb shows an outer body with epidermis consisting of lignified isodiametric sclereids, within cuticle, is the cortical parenchyma with few starch grains which show maltese crosses in polarised light, oil cells with yellowish contents scattered among the ground parenchyma; collateral vascular bundles consisting of slightly thickened and lignified spiral and annular vessels and unlignified phloem fibres with the parenchyma cells being dispersed in the ground tissue while an inner body consists of a fusiform body with tissue arrangement like the outer one, with an epidermis within which is the cortical tissue with oil cells and vascular bundles; an embryo-like body which is fusiform with the two ends folded over, filling up the central core of the bulblet with tissue arrangement like the outer body (GHP,1992).

Powdered plant material

Sclereids from the epidermal layers of the sheathing or protective leaves; epidermal cells of the inner cloves or bulblets are found with cutical cells of the lower surface, which are of smaller size than the upper epidermal cells; chips or fragments of lignified, spiral and annular vascular elements, few stomata and crystals of calcium oxalate. Pale buff to greyish or purplish white in colour, characteristic, aromatic, alliaceous and pungent odour and taste.

Therapeutic actions

Anti-hypertensive, antidiabetic, antithrombotic, antifungal, antioxidant, anticarcinogenic, antiasthmatic, immunomodulatory, antibacterial, antiinflammatory; antipyretic, antiscorbutic; antitussive, expectorant; GIT smooth muscle relaxant, antibacterial, digestive, anticoagulant; antihyperlipidaemic, carminative, diaphoretic, stomachic, antihyperhomocysteinemic (GHP,

1992; Abdullah *et al.,* 1989; Barrie *et al.,* 1987; Joshi *et al.,* 1987; Chadha, 1985; Watt and Breyer-Brandwijk, 1962).

Therapeutic indications
Atherosclerosis, gout, constipation, diabetes, diarrhoea, dysentery, earaches, headache, hypertension, leprosy, rheumatism, snakebites, symptoms of upper respiratory tract infections (e.g. cold, fever, coughs, bronchitis, sinus congestion); tuberculosis (Watt and Breyer-Brandwijk, 1962).

Safety data
The LD_{50} of the aqueous extract of plant bulb (*p.o*) in mice over a 24-hour period was beyond 2000 mg/kg. In the subacute studies, no clinical signs of toxicity were observed after oral administration of the extract at 500 – 2000 mg/kg; *p.o* to male and female mice for 14 days.

Precautions for use
Garlic should be taken with food (Corzo-Martinez *et al.,* 2007) because excessive doses, especially on an empty stomach, may cause stomach upsets, flatulence, heartburn, nausea and diarrhoea and changes in the intestinal flora which may increase the risk of postoperative bleeding (Benkeblia, 2004). Concomitant use with anticoagulants or medicines that prevent platelet aggregation (e.g. aspirin) may further prolong bleeding or clotting time (Gill, 1992).

Adverse effects
Garlic may cause bad breath and body odour; allergic dermatitis, burns, blisters and asthmatic effect (Jellin *et al.,* 2003; Brinker, 2001; Sunter, 1991; WHO, 1999).

Contraindications
Children below 12 years (can cause colic in babies), haemophilia, kidney disease, liver disease, prostate cancer, systemic lupus erythematosus; should be avoided in patients with diseased or damaged skin (Jellin *et al.,* 2003; Barnes *et al.,* 2002; Brinker, 2001; Sunter, 1991; Ernst, 1987; Boon and Smith, 1999).

Dosage and dosage forms
Intact bulb, decoction, tincture, tablets, capsules. Generally, the fresh bulb and the bulb oil can be given at 2-5 mg daily (or one fresh bulb or clove 1-2 times daily) while the dose for the powder is at 400-1200 mg daily and tincture of 1:5 in 60% alcohol is given at 5 ml three times daily. These are the particularly high doses when garlic is used as an antimicrobial, anthelmintic, antihypertensive, carminative, anti-lipidemic, antispasmodic, anti-diabetic and anti-inflammatory agent.

Storage
Store in a cool dry place protected from light and moisture.

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Aloe schweinfurthi

Botanical name
Aloe schweinfurthii Baker

Family
Lilliaceae

Synonyms
Aloe barteri Bak, *Aloe barteri var. lutea* Chev, *Aloe trivialis* Chev

Common name
West African giant aloe, Elephant's palm fond

Vernacular names
Ghana: Akan – Sereberebe, Brong – Nsesareso Abrobe
Nigeria: Fula Fulfulde – Balli Nyibi, Yuroba – Eti eerin anago, Hausa – Hantsar
Senegal: Bambara – Layi.
Togo: Ewe – Adi adi

Description of the plant
It is a succulent and perennial herb, acquiescent or with a short procumbent stem, leaf deflexed or only apices are recurved; greyish-green leaves with both surfaces spotted with whitish marks, lanceolate, long and promoted with acute apex, about 60-80 cm long, 6-8 cm broad at the base, whitish teeth margin but directed outwards the lower parts, teeth about l cm apart, turning red in maturity; stem 20-40 cm long; bracts are small, 4-7 mm and lanceolate; panicles with cylindrical racemes and sparsely branched inflorescence; 8-10 branches of panicles and penduncle. Simple but few branched racemes, filaments yellow, anthers orange; buds green and erect, stamens are pink (Odeleye, 2004; Burkill, 1995).

Hebarium specimen number
Nigeria: FHI 106875
Togo: TOGO11618

Habitat and geographical distribution
A perennial herb with a rosette of fleshy leaves; thrives in grassy places or moist savanna and distributed from Senegal to Nigeria and extending across Central Africa to Zambia and Malawi. It is a suckering plant of rocky hillside in Ghana, Niger, Nigeria to western Cameroons and to Sudan and the Congo basin. The plant is cultivated especially for its medicinal properties and ethnomedical uses (Odeleye, 2004; Burkill, 1995).

Plant material of interest
Whole leaf, yellow juice or the transparent colourless gel

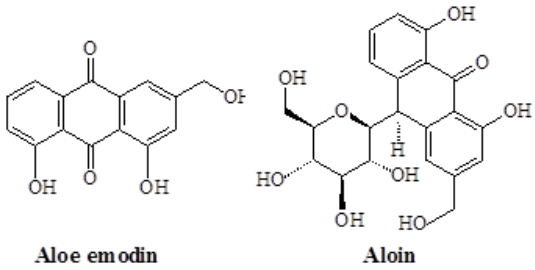
Definition of plant material of interest
West African giant aloe consists of whole leaf or the juice or gel from *Aloe schweinfurthii* Baker (Lilliaceae)

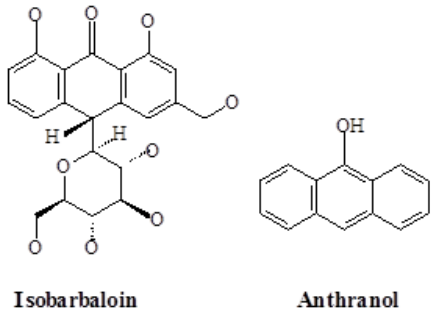
Ethnomedical uses
The plant is cultivated especially for the treatment of conditions such as intestinal and urinogenital disorders. It is applied, externally on sores, wounds and burns. The sap is added to drinking water for poultry and is said to protect them against avian cholera. The edible flowers are sometimes used as a culinary in soups (Odeleye, 2004; Burkill, 1995; Hutchinson and Dalziel, 1958).

Biological and pharmacological activities
The biological/pharmacological actions of this plant have not visibly entered into the literature. However, the yellow juice possessed laxative properties while the white gel healed burns and fresh wounds comparable to *Aloe vera* (unpublished data from the laboratories of Elujoba, AA).

Clinical data
No information available

Chemical constituents
There are two distinct parts of *Aloe schweinfurthii* containing completely different chemical constituents, which have not been studied. The yellow exudate principally consists of phenolic compounds, which include the purgative anthracene derivatives e.g. aloin while the chemical composition of the inner colourless parenchyma constituents have not been investigated (Odeleye 2004).





Tests for identity and purity

Moisture content: Not more than 93.00%
Total ash: Not more than 12.00 %
Acid insoluble ash: Not more than 2.00%
Water-soluble ash: Not less than 2.50 %
Water-soluble extractive: Not less than 36.00%
Alcohol-soluble (70%) extractive: Not less than 24.00 %

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spots with R_fs values of 0.77 (brown), 0.68 (pink), 0.45 (pink) and 0.25 (pink).

Chromatogram

Macroscopy

It is a perennial herb with fleshy leaves of about 60 cm long and 7.8 cm wide, toothed margins, plant suckering. It is fleshy, greyish-green, leaf surface spotted white, turning red in dry season. Peduncles 60-80 cm long, buds are erect, flowers pendulous, green in bud, tipped yellow, another orange.

Microscopy

Layers of cells and anomocytic/ranunculaceous stomata; fairly numerous on the upper surface but fewer and scattered in the lower surface; straight or slightly wavy anticlinal walls which are small and elongated in both upper and lower surfaces. The lower epidermal cells measure 55.2 to 131.3 µ long and 48.3 to 69.0 µ wide while cells of the upper surface measure 69.0 to 144.9 µ by 48.3 to 75.9 µ. Calcium oxalate crystals and trichomes are absent and the epidermal surfaces are glabrous. Transverse section shows absence of calcium oxalate. In the border of the central and outer cortical zones, are fibrovascular bundles, arranged parallel to epidermis at a distance within the mesophyll in the form of an ellipse. The xylem and phloem are thin-walled and spirally-shaped. Fibres are absent in the longitudinal section (Odeleye, 2004).

Powdered plant material

Anomocytic stomata: numerous stomata in some large fragments of the upper epidermis, fragments with fewer stomata come from lower surface; pieces of straight or slightly wavy epidermal, anticlinal-walled cells, small and elongated; no trichomes or calcium oxalate crystals; vascular bundle elements are spiral. Greenish-brown, chocolate brown in colour; patches of powdered leaf found on the surface when rubbed against one another. Characteristic, sour odour, taste nauseous and bitter (Odeleye, 2004).

Therapeutic actions

Laxative/purgative, antimicrobial and wound-healing

Therapeutic indications

Constipation, wounds, burns, ulcer, herpes and as topical antimicrobial agent (WHO, 1990).

Safety data

The LD_{50} of the aqueous extract of leaves of the plant (*p.o*) in mice over a 24-hour period was beyond 2000 mg/kg. In the subacute studies, no

clinical signs of toxicity were observed after oral administration of the extract at 500 – 2000 mg/kg; *p.o* to male and female mice for 14 days.

Precautions for use
Not to be taken on empty stomach

Adverse effects
Diarrhoea

Contraindications
West African giant aloe should not be used in patients with intestinal obstruction or stenosis, atony, severe dehydration with electrolyte depletion or chronic constipation, inflammatory intestinal diseases, ulcerative colitis, irritable bowel syndrome, children under 10 years of age. Not to be used in pregnancy or lactation.

Dosage and dosage forms
Decoction
Decoction: 30 g of dried leaves in 900 ml of water, boil until reduced to 600 ml, 1 teaspoon three times a day.

Storage
In a cool, dry place, protected from moisture and light

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Aloe vera

Botanical name
Aloe vera L.

Family
Lilliaceae

Synonyms
Aloe barbadensis Mill

Common name
Curacao aloe, French; *Aloés vulgaire*

Vernacular names
Burkina Faso: Kirma – Magno Gu Dondialé, Manding – Sinzé Toro, Bambara – Sogobahu
Cote d'Ivoire: Manding – Sinzé Toro, Maninka – Bamalagba, Senufo Dyimini – Nimbéléké.
Ghana: Akan – Sereberebe, Brong – Nsesareso Abrobe
Nigeria: Fula Fulfulde – Balli Nyibi Balli Nyiwa, Gwari – Omvi, Hausa – Zaabuwaa, Yoruba-eti eerin oyinbo
Senegal: Fula – Sogoba Hu, Bambara – Sogoba Bu, Maninka – Kadio Kandio.
Togo: Ewe – Adi Adi Gbe, Basari – Dissawede, Kabye – Sulefadium

Description of the plant
A small, stemless rosette of fleshy leaves, 30-40 cm in height; leaves are succulent, growing from the centre of the plant and can vary in length from 0.8 to 60 cm, the thick, fleshy leaves are able to store large amounts of water during the rainy season and are therefore able to survive throughout the drought in the dry season, lower leaves roselate and spreading or laying on surface of ground; pink or red perianth with pronounced basal swelling truncate at base, abruptly constricted above the ovary with narrowest part above half of the length from the base and enlarging to the throat; influorescence is simple or branched, either terminal or lateral, with flowers usually shades of orange or red but sometimes yellow or even white, reaching maturity when it measures 45-120 cm long and has a base of 7.5 cm or greater in diameter; fruit (where available) not exceeding 2.5 cm long (Burkill, 1995; Hutchinson and Dalziel, 1958; Renolds, 1966; Young, 1950).

Herbarium specimen number
Nigeria: FHI 106026

Habitat and geographical distribution
Aloe is a perennial herb native to southern and eastern Africa and subsequently introduced into

northern Africa, the Arabian Peninsula, China, Gibraltar, the Mediterranean countries and West Indies. It is commercially cultivated in Aruba, Bonaire, Maiti, India, South Africa, the United States of America and Venezuela and it is imported into some countries in Africa including West African sub-region where it is commonly grown in pots and flower beds for variety of local uses (WHO, 1991).

Plant material of interest
Whole leaf, yellow juice or the transparent colourless gel.

Definition of plant material of interest
Curacao aloe consists of the whole leaf, juice or transparent gel from *Aloe vera* L. (Lilliaceae).

Ethnomedical uses
Aloe vera is used in folkloric medicine to treat dermatitis, thermal and sun-burns, cystic ache, peptic ulcer, colds, tuberculosis, gonorrhoea, asthma, dysentery, headache, fungal infections and diabetes (Sample *et al.,* 2001; WHO, 1991; Ali *et al.,* 1990).

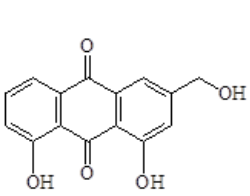
Biological and Pharmacological activities
Biological and chemical investigations have confirmed the wound-healing, antibacterial and antiinflammatory properties of *Aloe vera* (Davis, 1994; Udupa *et al.,* 1994, Bruce, 1967; Lorenzett *et al.,* 1964). Aloe-emodin is responsible for the antiviral and antifungal properties of the plant (Von Zyl and Viljoen, 2001).

Clinical data
The laxative effects of Aloe are due primarily to the 1, 8-dihydroxyanthracene glycosides, aloin A and B (formerly designated barbaloin). After oral

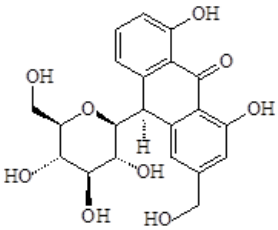
administration aloin A and B, which are not absorbed in the upper intestine, are hydrolysed in the colon by intestinal bacteria and then reduced to the active metabolites (the main active metabolite is aloe-emodin-9-anthrone), acts as a stimulant and irritant to the gastrointestinal tract. The laxative effect of Aloe is not generally observed before 6 hours after oral administration, and sometimes not until 24 or more hours after (WHO, 1999).

Chemical constituents

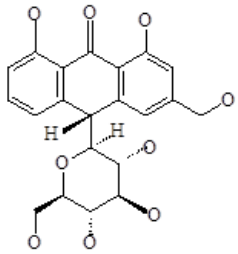
Phenolic compounds including anthraquinones and chromones; proteins, carbohydrate. (Davis, 1994; Udupa *et al.,* 1994, Bruce, 1967; Lorenzett *et al.,* 1964 ; Von Zyl and Viljoen, 2001).



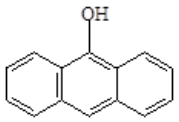
Aloe emodin



Aloin



Isobarbaloin



Anthranol

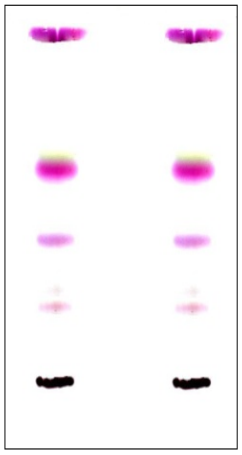
Tests for identity and purity

Moisture content: Not more than 12.00 %
Total ash: Not more than 11.00 %
Acid-insoluble ash: Not more than 2.00%
Water-soluble ash: Not less than 3.00%
Water-soluble extractives: Not less than 38.00%
Alcohol-soluble (70%) extractives: Not less than 25.00 %

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8] , detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of three characteristic spots with R_fs of 0.58 (pink), 0.39 (pink) and 0.21 (pink).



Chromatogram

Macroscopy

Succulent, almost sessile perennial herb, spiny margin with thin wall; leaves 30-50 cm long and 10 cm broad at the base, colour, pea green and spotted, when young, with whitish, elongated marks, leaves flat or slightly concave on the upper surface with greyish green colour; leaves have teeth, which are more crowded on the lower portion down and further apart below the apex; bracts are very small; flowers bright yellow to rich orange, tubular, 25 – 35 cm in length, arranged in a slender loose spike, stamens frequently project beyond the perianth tube, aculescent or nearly so and from the centre of the leaf rosette, arises a raceme 30 – 40 cm long (Odeleye, 2004; African Pharmacopoeia, 1985).

Microscopy

Epidermis of polygonal, tabular cells, covered with thick, striated cuticle, stomata anomocytic/ ranunculaceous; fibrovascular bundles, arranged parallel to epidermis at a short distance within the mesophyll in the form of an ellipse; vascular bundles accompanied by very large, elongated tubular and thin-walled pericyclic cells, containing the yellow exudates; trasverse section shows palisade cells and calcium oxalate crystals; palisade cells are small, round or cyclic shape. Xylem and phloem bundles are present (Odeleye, 2004).

Powdered plant material

Greenish-yellow to yellowish brown; patches of powder found on the surface when rubbed against one another; characteristic, sour taste, nauseous and bitter. Shows fragments with numerous minute acicular crystals of calcium oxalate, embedded in an amorphous matrix (Odeleye, 2004; African Pharmacopoeia, 1985).

Therapeutic actions
Anticancer, antiviral, cathartic, analgesic, antiinflammatory, antiprotozoal, antiparasitic, insecticidal and vulnerary.

Therapeutic indications
Burns, dermatitis, cystic ache, peptic ulcer, colds, tuberculosis, gonorrhoea, asthma, dysentery, headache, fungal infections and diabetes

Safety data
In a 24-hour acute toxicity assessment, the LD_{50} of the aqueous extract of leaves of the plant (*p.o*) in mice was greater than 2000 mg/kg. In the subacute studies, no clinical signs of toxicity were observed after oral administration of the extract at 500 – 2000 mg/kg; *p.o* to male and female mice for 14 days.

Precautions for use
Excessive or prolonged use may cause nephritis, gastritis, vomiting and diarrhoea, stained with blood and mucus.

Adverse effects
Gastritis, vomiting and diarrhea

Contraindications
Aloe should not be used in patients with intestinal obstruction or stenosis, atony, severe dehydration with electrolyte depletion or chronic constipation, inflammatory intestinal diseases, ulcerative colitis, irritable bowel syndrome, children under 10 years of age. Not to be used during pregnancy or lactation.

Dosage and dosage forms
Decoction, juice
Dried juice: 50-200mg orally for adults
Decoction: two tablespoonfuls daily before meals

Storage
To be stored in a cool, dry place, protected from moisture and light

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Alstonia boonei

Botanical name
Alstonia boonei De Willd.

Family
Apocynaceae

Synonym
Alstonia congolensis Engl.

Common names
Pattern wood; stool wood, French; Emien

Vernacular names
Burkina Faso: Fulfuldé – Moyatabél
Cote d'Ivoire: Abe – Onguie Honguie, Baule – Emien Miei, Kulango – Senuro
Ghana: Twi - Onyame Dua, Ga Adangbe – Sinu, Nzema – Nyamenlebaka
Guinea: Fula Pulaar – Leguere, Kissi – Tiendo, Loma – Zolo
Guinea-Bissau: Fula Pulaar – Bantera-Foro, Manding Mandinka–Bantam-Foro (D'o)
Liberia: Dan – Yung, Kru Guere (Krahn) – Gona-Tu
Nigeria: Edo – Ukhu, Engenni – Uguwa, Igbo – Egbu, Yoruba-ahun
Senegal: Banyun – Ti Keung, Diola – Bain, Fula Pulaar – Ataforo.
Sierra Leone: Mende – Kalo Wulo
Togo: Ewe – Nyami dua, Ouatchi – tonton, Mina - siaketekre

Description of the plant
A deciduous tree up to 35 m high, buttresses deep-fluted high and narrow; slash spotted white and light brown; latex copious, white; leaves in whorls at nodes; oblanceolate, apex rounded to acuminate, lateral veins prominent, almost at right angles to midrib; flowers white, lax terminal cymes; fruits paired, slender follicles up to 16 cm long; seeds with brown floss at each end.

Herbarium specimen number
Ghana: GC 45909
Togo: TOGO02006

Habitat and geographical distribution
Deciduous tree that grows to about 35 m; found in the forest zones of Ghana and throughout tropical Africa.

Plant material of interest
Stem bark

Other parts used
Leaf

Definition of plant material of interest
Alstonia consists of fresh or dried stem bark of *Alstonia boonei* De Willd (Apocyanaceae).

Ethnomedical uses
Alstonia boonei is used extensively in West and Central Africa for the treatment of malaria, fever, intestinal helminthes, rheumatism and hypertension (Abel and Busia, 2005; Betti, 2004; Sofowora, 1993). The stem bark is commonly used to treat malaria (Idowu *et al.,* 2010; Titanji *et al.,* 2008). An infusion of the bark is used as antivenom for snake bites; it is also used in treating painful micturation and rheumatic conditions (Asuzu and Anaga, 1991). The root and stem bark infusion is taken as a remedy for asthma. A liquid made from the stem bark and leaves is drunk to treat impotence. In Ghana, it is given for toothache and to women after delivery to aid in expelling the placenta. In Cote d'Ivoire and Burkina Faso, it is applied topically to reduce oedema and to clean suppurate sores and exposed fractures. In Nigeria, it is used for ulcers and in Cameroon and Liberia as a remedy for snake bite and arrow poison.

Biological and pharmacological activities
The stem bark of *A. boonei* has been reported to possess anti-inflammatory, analgesic and antipyretic activities (Olajide *et al.,* 2000). It exhibited blood schizonticidal activity on the chemosuppression obtained during the 4 day early infection test. A significant ($p<0.05$) activity was also recorded during established infection, which was comparable to the standard drug (chloroquine, 5 mg/kg/day) in the investigation carried out by Iyiola *et al*., (2011). Aqueous extract of the herb had a contractile effect on

both guinea pig ileum and rat stomach strip *in vivo*; the effect was more pronounced on rat stomach strip than on guinea pig ileum (Taiwo and Makinde, 1996). The stem bark extracts showed *in vitro* anti-complement (Taiwo *et al.,*1998), antiarthritic and analgesic effects in animal studies. The methanolic stem bark extracts inhibited carrageenan-induced paw oedema, cotton pellet granuloma and acetic acid induced vascular permeability (Olajide *et al.,* 2000). The alcoholic extract demonstrated protection against egg white-induced rat hind paw oedema (Osadebe, 2002). Extracts of *A. boonei* have potential antihelminthic effects by the ability to inhibit glutathione S-transferases from parasitic nematodes (Fakae *et al.,* 2000). The insecticidal properties of the aqueous extracts of the leaf and stem bark against the pink borer, *Sesamia calamistis* Hampson (Lepidoptera: Noctuidae), a major pest of maize have been demonstrated; both leaf and stem bark extracts caused a significant reduction in the weight of the larvae in a dose-related manner. (Oigiangbe *et a.l*, 2007). The antioxidant properties of *A. boonei* have been reported by Akinmoladun *et al.* (2007) and Taiwo *et al.,* (1998) also investigated the activity of the stem bark on human complement and polymorph nuclear leucocytes. The nephrotoxicity caused by the extract in guinea pigs and the reproductive effect of the methanolic extract in male rats have been reported. The extract was also shown to lower cholesterol level and lipoprotein cholesterol significantly, at $p< 0.05$ in animals administered with a dose of 50 mg and 200 mg/kg body weight (Oze *et al.,* 2007; 2008; Raji *et al.,* 2005). Odeku *et al* (2008) carried out formulation studies on the stem bark using a solid dosage form.

Clinical data

No information available

Chemical constituents

Alkaloids (echitamine, echitamidine, alstonine, alstonidine); triterpenoids (lupeol, ursolic acid, β-amyrin); tannins; iridoids (boonein, loganin); minerals (calcium, phosphorus, iron, sodium, potassium, and magnesium); ascorbic acid (Ojewole, 1984; Iwu, 1993).

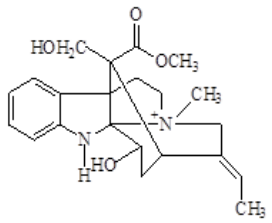
Tests for identity and purity

Moisture content: (Stem bark) 12.30%; (Leaf) 8.70%

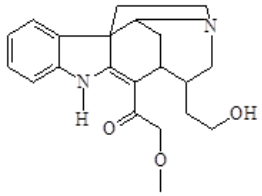
Total ash: (Stem bark) 8.00%; (Leaf) 8.30%

Water-soluble extractive: not less than 4.20%

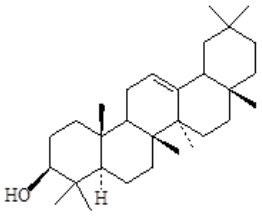
Alcohol-soluble (70%) extractive: 8.20%



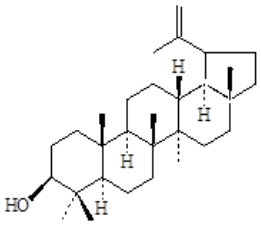
Echitamine



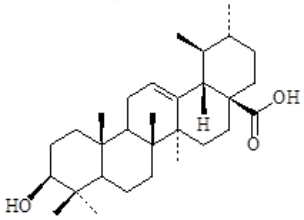
Echitamidine



Beta - amyrin



Lupeol

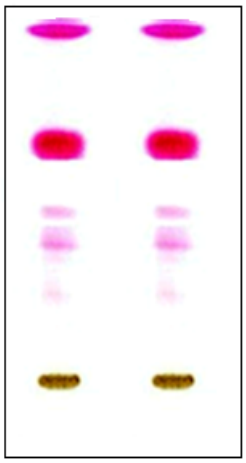


Ursolic acid

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic pink spots with R_fs values of 0.96, 0.65, 0.47 and 0.38.



Chromatogram

Macroscopy

The bark is greyish green and lenticellate on the outer surface and light yellow to cream on the inner surface; fracture short and splintery; odour

characteristic; taste bitter.

Microscopy
Transverse section of the bark shows exfoliating cork cells in elongatangentially radial rows; a single layer of cambial cells with reddish brown contents; cortex consists of ground mass of parenchymatous cells with solitary groups of lignified sclereids and groups of lignified pericyclic fibres; prismatic calcium oxalate crystals present in cortex, also latex cells; vascular cylinder bundle is interspersed with medullary rays; lignified fibres present in phloem region.

Powdered plant material
Colour buff to yellow; taste bitter; fragments of cork, calcium oxalate prisms, lignified fibres and sclereids present.

Therapeutic actions
Antipyretic; antiinflammatory; antirheumatic insecticidal, analgesic; antimalarial; antimicrobial (Olajide *et al.,* 2000; GHP, 1992, Oigiangbe, 2007).

Therapeutic indications
Rheumatoid arthritis; malaria; measles; boils; wounds; arterial hypertension; cataract; placenta retention; anaemia (Mshana *et al*., 2000; Taiwo *et al.,* 1998; GHP, 1992).

Safety data
The LD_{50} of the aqueous leaf extracts (*p.o*) in mice was>2000 mg/kg in 24 hours. In the subacute studies, no clinical signs of toxicity were observed after oral administration of the extract at 500 – 2000 mg/kg; *p.o* to male and female mice for 14 days. The herb is generally safe, although liver, kidney and spleen toxicity have been noted with the triterpenoids in laboratory experiments.

Precautions for use
Crude drugs containing alkaloids must be taken with care

Adverse effects
Excessive or prolonged use has been linked to conditions such as Steven
Johnson's syndrome.

Contraindications
Pregnancy and lactation, liver dysfunctions

Dosage and dosage forms
Decoction, tincture
Decoction: 30-50 g per litre of water; drink 3-4 cups a day.
Tincture: 1:5 in 45% alcohol; take 5 ml three times daily.

Storage
Store in a cool dark and dry place

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Argemone mexicana

Botanical name
Argemone mexicana L.

Family
Papaveraceae

Synonym
Argemone ochroleuca Sweet

Common names
Mexican poppy, Prickly poppy, Mexican prickly, Yellow poppy, Yellow thistle, Mexican thistle (English). Pivot épineux, Pavot du Mexique, tache de l'œil, Chardon du pays (French).

Vernacular names
Ghana: Akan- Akusiribie, Twi- Kokosakyi aduro
Mali: Bambara- Bozobo, Dogon- Aignètawa, Sonkeriai, Senoufo- Naka - taba
Senegal: Wolof- Garabu-mag, Diola- Fambora, Serer- Dahatu Fa N'Gol
Togo: Adja- Houétchègnon

Description of the plant
A. mexicana is a branched and erect annual herb, reaching 1 m in height, with a woody base; leaves are alternate and sessile, glabrous lanceolate with lobed and serrated edge, teeth are tipped with prickly spikes, ribs are alternate, thorns on the lower limb; flowers are terminal and can reach 2.5 to 5 cm in diameter with green sepals and bright yellow petals; fruits are ovoid capsules, rectangular with numerous spines erect or spreading; latex is yellow while the seed is dark brown, round and clear.

Herbarium specimen number
Mali: DMT – 0873
Nigeria: FHI 62256

Habitat and geographical distribution
Argemone mexicana is native to Mexico but is now found in many tropical countries of both hemispheres. The plant is widespread throughout Africa and occurs irregularly in the Sudano-Sahelian zone of West Africa.

Plant material of interest
Aerial parts without seeds, leaf

Other parts used
Root

Definition of plant material of interest
Prickly poppy consists of the fresh or dried aerial parts of *Argemone mexicana* L. (Papaveraceae).

Ethnomedical uses
The leaves are traditionally used in enteralgia, muscle pain, gonorrhoea, constipation, jaundice and liver malfunction, uncomplicated malaria, cough, toothache, eye pain, urethral discharge, hepatobiliary disorders, bilious, fevers, eczema, and haematuria. The juice is used as a sedative and antiemetic, and in the treatment of ear infections and eye diseases. Infused seeds as well as the aerial part are used as diuretic, purgative and diaphoretic. The oil is used in constipation, insomnia, skin infections and sores.

Biological and pharmacological activities
The entire plant has hypotensive, narcotic, diaphoretic and diuretic properties. The leaves and stems also have antibacterial, antiviral, spasmodic and stimulating effects. The extract of its capsules is a hypnotic and antitussive and the latex has anticoagulant properties. The methanol extract showed *in vitro* antiplasmodial activity comparable to that of *Artemisia annua* (Sangare, 2003; Diallo *et al*., 2006; Adjobimey *et al*. 2004). The aqueous and methanolic extracts of the leaves and seeds showed antibacterial activity against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli* and *Pseudomonas aeruginosa* (Bhattacharjee *et al*., 2006). The extract of the plant demonstrated promising anti-HIV activity in human cell lines and CD4 T cells CEM-GFP infected with HIV 1NL4.3. The crude extracts (hexane, ethyl acetate, acetone and methanol) of the leaves showed a dose-dependent antifeedant activity that could be exploited for mosquito control (Elango *et al*., 2011).

Clinical data

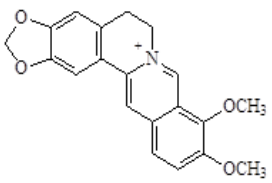
An observational clinical study confirmed the ethnomedical use of the decoction of the plant in the treatment of uncomplicated malaria in patients over 5 years, with 89% of adequate clinical response (Sidibé, 2006, Willcox *et al*, 2007). In a randomized, controlled trial, the decoction of the plant demonstrated clinical efficacy in the treatment of uncomplicated malaria, which compared well with a combination therapy based on artemisinin. In both groups, the progression to severe malaria, remained below 5% (Dakuo, 2008). It would therefore be possible to use the decoction as first-line treatment as a complement to standard treatment in areas of high malaria transmission (Graz *et al*., 2010).

Chemical constituents

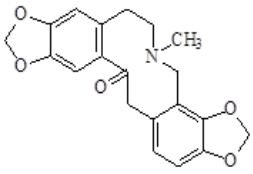
Tannins, benzoquinones, coumarins, mucilage, sterols, triterpenes and alkaloids (berberine; protopine, allocryptopine, benzophenanthridine, dihydrosanguinarine dihydrochelerithrine and chelerythrine); fat (ceryl alcohol, beta sitosterol), organic acids (tartaric acid, succinic acid, citric acid and malic acid), combined and free amino acids, monosaccharides (glucose and fructose) and minerals, and vitamin C; flavonoids (rutin and quercetin) (Singh *et al*. 2011; Rahman and Ilyas, 1961).

Tests for identity and purity

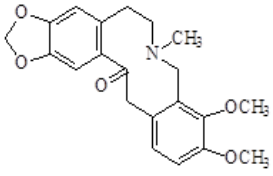
Moisture content: 6.53%
Total Ash: 17.33%
Water-soluble extractives: not less than 20.00%
Alcohol-soluble (70%) extractives: not less than 19.40%



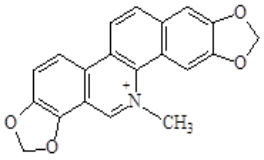
Berberine



Protopine



Allocryptopine

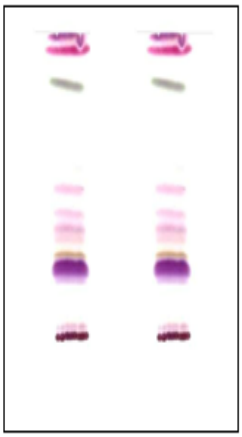


Sanguinarine

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spots with R_fs 0.83 (ash), 0.50 (pink), 0.41 (pink) and 0.23 (violet).



Chromatogram

Macroscopy

Powder green, tasteless, rough to touch with characteristic tobacco smell.

Microscopy

Groups of fibres with calcium oxalate crystals, spiral vessels, numerous crystals of calcium oxalate, fragments of a few skins.

Powdered plant material

Parenchyma cells of the leaf epidermis, fibres carrying calcium oxalate chrystals as identified under the general microscopical analysis; fragments of epidermal cells, xlylem fibres, spiral vessels and numerous free crystals of calcium oxalate.

Therapeutic actions

Hypotensive, narcotic, diaphoretic, diuretic, antibacterial, antiviral, vulnerary laxative, antiinflammatory, antitussive, anticoagulant, antiplasmodial, antifeedant and repellent (Sangare, 2003, Diallo *et al*., 2007; Adjobimey *et al*., 2004, Bhattacharjee *et al*., 2006; Elango *et al*., 2011).

Therapeutic indications

Uncomplicated malaria, dracontiasis

Safety data

The LD_{50} of the aqueous extract of aerial parts of the plant without the seeds (*p.o*) in mice over a period of 24 hours was beyond 2000 mg/kg. In

the subacute studies, no clinical signs of toxicity were observed after oral administration of the extract at 500 – 2000 mg/kg; *p.o* to male and female mice for 14 days. A previous study in Mali showed an LD_{50} of the decoction administered orally to mice for 72 hours was>3.205 g/kg. In a sub-chronic toxicity studies, repeated administration of 300 mg/kg of aqueous extract (*p.o*) for 30 days, did not affect the biochemical parameters of blood and liver and kidney in rats (Sanogo *et al*., 2008). The latex and seeds are toxic and can cause intestinal bleeding and death.

Precautions for use
Do not use beyond one week

Adverse effects
Vomiting, diarrhoea, swollen legs, rash, shortness of breath and in extreme cases, glaucoma, and cardiac arrest

Contraindications
Children and pregnant women

Dosage and dosage forms
Decoction
Leaf powder: 30 g in 500 ml of water for 30 min. Taken twice a day.

Storage
Store in a cool dry place away from light

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Willcox, M.L., Graz, B., Falquet, J., Sidibé, O. *et al*. (2007). *Argemone mexicana* decoction for treatement of uncomplicated falciparum malaria, Transaction of the Royal Society of Tropical Medicine and Hygiene 101:1190-1198.

Azadirachta indica

Botanical name
Azadirachta indica A. Juss

Family
Meliaceae

Synonyms
Melia azadirachta L., *Melia indica (A. Juss) Brandis*

Common names
Neem, Indian lilac; Margosa tree; Nim, French: Margousier;Nîm

Vernacular names
Burkina Faso: Mooré – Niim, Dioula – Nîmyiri, Fula Fulfuldé – Tirotiya;Goodji
Cote d'Ivoire: Akye – Djé Ndédzakoè , Ando' – Tchitchèndé
Gambia: Manding Mandinka – Yirinding Kunango
Ghana: Twi – Dua Gyane, Ewe – Liliti, Hausa – Dongo Yaro
Mali: Bambara - Mali yirini, Senoufo – Gnimitigue, Dyula – Goo-gay
Niger: Hausa - Dogon Yaro, Songhai – Méli, Djerma - Milleize.
Nigeria: Hausa – Dogonyaro, Kanuri – Gányá Nîm, Yoruba – Dongoyaro
Senegal: Manding Mandinka – Tubabo toboro, Soce-tubabo, Wolof – Dim dim i buki
Togo: Ewe – Sabuleti, Mina – Kiniti, Adja – Sablagbe

Description of the plant
indica is a tree that can reach 25 m high, straight – boled, with striped and fissured bark; alternate paripinnate leaves with about 5-8 pairs of asymmetrical leaflets at the base, long acuminate tip; ovate-lanceolate, margin coarsely serrated; inflorescence in axillary panicles; many flowered, flowers white, numerous and pedicellate, pedicels about 1.5 mm long, sepals ovate-sub orbicular about 1 mm long, petals white, petals oblanceolate, 5 to 6 mm long, anthers within lobe apex; fruit ellipsoid, fruit ovoid, one-seeded, glabrous, yellow when ripe. The plant can live up to about 200 years (Trewari, 1992).

Herbarium specimen number
Nigeria: FHI 107439
Togo: TOGO04647

Habitat and geographical distribution
Tropical evergreen tree; originates from India and Burma; grows in Southeast Asia and West Africa;

found commonly in the coastal and Northern Savanna areas of Ghana but found growing or cultivated both in the northern and southern parts of Nigeria. Now cultivated in the Caribbean and much of Central America (Trewari, 1992; GHP, 1992). Plant readily grows even without irrigation, in arid and semi arid regions and in poor sandy or stony soil where gardening or cultivation is normally impossible.

Plant material of interest
Leaf

Other parts used
Stem bark and seed

Definition of plant material of interest
Neem is the fresh or dried leaf of *Azadirachta indica* A.Juss. (Meliaceae).

Ethnomedical uses
indica is used for the treatment of malaria, cough, nausea, vomiting, fever, jaundice, gonorrhoea, intestinal worm infestation, skin disorders, boils, ulcers, eczema and leprosy in indigenous system of medicine.

Biological and pharmacological activities
Several pharmacological studies have been conducted to validate the medicinal properties of *A. indica*. Some neem compounds have been shown to possess a dose-dependent anti-feedant effect (Mitchell *et al.,* 1997). The leaves and stem bark of *A. indica* are used as antimalarial agents and their effectiveness has been confirmed by several laboratory studies (Aladesanmi *et al.,*1988; Ekanem 1978). The antimalarial properties have been variously attributed to

nimbolide (Rochanankij *et al.,* 1985) and another limonoid, gedunin (Khalid and Duddeck, 1989). Iwu and his co-workers (1986) suggested that neem extracts exerted their antimalarial action by causing a redox perturbation through the imposition of a very strong oxidant stress on the malaria parasites. In another study, ball shaped wood scrappings soaked in 5% neem oil diluted in acetone and placed in water storage overhead tanks controlled the breeding of *Anopheles stephensi* and *Aedes aegypti* in 45 days (Nagpal *et al.,* 1995). The oil components, particularly azadirachtin, have pesticidal potential (Koul *et al.,* 1990; Schmutterer *et al.,* 1990; Tanzubil *et al.,* 1990). Neem limonoids have larvicidal, pupicidal, adulticidal and antiovipositional activity and can therefore be beneficial in mosquito control programmes (Nathan *et al.,* 2005). The antiinflammatory properties of the plant have also been demonstrated in various studies. The water-soluble part of the alcoholic leaf extract showed antiinflammatory activity in the cotton pellet granuloma assay *in vivo* (Chattopadhway, 1998), antioxidant, hepatoprotective (Bhanwra *et al.,* 2000), anti-ulcer (Dorababu *et al.,* 2004), hypoglycaemic and negative chronotropic and inotropic properties (Khosla *et al.,* 2000). The leaf extract exhibited equipotent cardioprotective activity on isoprenalin induced myocardial necrosis in experimental animals as compared to vitamin E (Peer *et al.,* 2007). Oral intake of doses of 10-200 mg/kg of neem leaf extract produced anxiolytic effects comparable to that induced by diazepam (Jaiswal *et al.,* 1994). A dose-dependent hypotensive effect by the hydroalcoholic leaf extract has been reported (Chattopadhyay, 1997; Khanna *et al.,* 1995). Oral administration of the leaf extracts reduced blood sugar levels in normal and streptozocin-induced diabetic models, with the hypoglycaemic effect comparable to glibenclamide (Khosla *et al.,* 2000). The leaf extract blocked the effects of adrenaline on glucose metabolism and reduced peripheral glucose utilization in diabetic and normal rats (Chattopadhyay, 1996). An investigation of *A. indica*'s effects on cerebral reperfusion injury and long term cerebral hypoperfusion based on the reported antioxidant, anti-inflammatory and anxiolytic properties of the herb showed that administration of 500 mg/kg/day for 15 days significantly reduced hypoperfus on induced functional disturbances such as anxiety, learning and memory impairment (Yanpallewar, 2005).

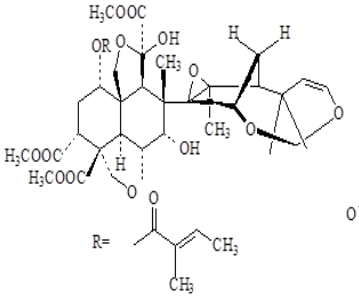
Neem extracts exhibited a dose-dependent anti-gastric ulcer activity in stressed rats. The extracts caused a decrease in ethanol induced gastric mucosal damage, an increase in the amount of adherent gastric mucus in stressed animals and also demonstrated significant anti-histaminic potential (Garg *et al.,* 1993). Bandyopadhyay *et al.,* (2002) investigated the gastro-protective properties of the stem bark extract of *A. indica* and attributed it to the ability to inhibit acid secretion *via* blockage of H^+/K^+-ATPase activity as well as the inhibition of oxidative damage of the gastric mucosa by blocking lipid peroxidation and scavenging endogenous hydroxyl radicals. Aqueous leaf extract was found to lower raised levels of serum liver enzymes and paracetamol induced liver necrosis (Bhanwra *et al.,* 2000). Khanna *et al.,* (1995) observed analgesic and sedative properties *in vivo* in *A. indica* extracts. Hydroalcoholic leaf extract caused a dose-dependent hypotensive effect (Chattopadhway, 1997) and oral administration of low doses (10-200 mg/kg) also showed anxiolytic effect comparable to that induced by diazepam (Jaiswal *et al.,* 1994). Oral administration of methanolic extract had significant antibacterial activity against the multi-drug-resistant *Vibrio cholerae* in mouse (Thakurta *et al.,* 2007). The ethanolic leaf extract demonstrated a much stronger anti-dermatophytic action compared to the aqueous extract *in vitro* (Venugopal and Venugopal, 1994), while the leaf, bark, cake and oil of the plant exhibited both dose and time dependent molluscicidal activities (Singh *et al.,* 1996). The ethanolic extracts of the seed have been shown to have anthelmintic effects (Hordegen *et al.,* 2006). *In vitro* studies showed that a herbal formulation, *praneem,* containing purified extracts of neem tree was effective against HIV and sexually transmitted disease pathogens, and also possessed contraceptive activity (Joshi *et al.,* 2005). The immune stimulating effects of the leaf extracts have been demonstrated *in vivo* (Ray *et al.,* 1996). The extracts potentiated antibody titres following typhoid H. antigen immunisation and induced delayed hypersensitivity following administration of tuberculin and DNCB to animals. Neem ethanolic extract has been shown to cause cell death of prostate cancer cells by inducing apoptosis (Kumar *et al.,* 2006). Haque and Baral (Haque and Baral, 2006) have also shown that pretreatment of mice with neem leaf preparation causes prophylactic growth inhibition of murine Ehrlich's carcinoma and B16 melanoma. The methanol extracts of the leaf also stimulated stem cell reproduction *in vitro* (Gonzalez-Garza, 2007).

Clinical data

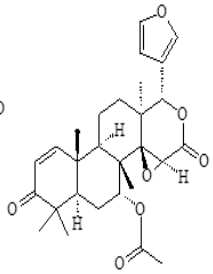
Topical application of a cream of *A. indica* on exposed body parts at the rate of 2.0 gm/person afforded protection against Aedes, culex and Anopheles mosquitoes (Dua *et al.,* 1995). In human trials, extracts stimulated humoral immunity by increasing antibody levels and cell mediated immunity by increasing total lymphocyte and T-cell count in 21 days (Ansari *et al.,* 1997). In a study conducted on males aged between 20-30 years over a 6-week period, dental gels containing neem extract were shown to have the ability to reduce plaque index and bacterial count than that of the control group (Pai *et al.,* 2004).

Chemical constituents

Alkaloids, tannins, coumarin, stigmasterol, flavonoids/polyphenols, saponins and sugar, Vitamin C. Triterpenes/meliaceous/limonoid compounds: azadirachtin, nimbolide, gedunin, salanin, other meliacins; diterpenes; carotenoids, reducing sugars and fixed oil present.



Azadirachtin



Gedunin

Tests for identity and purity

Moisture content: not more than 30.00%.
Total ash: Not more than 11.60%
Acid – insoluble ash: Not more than 1.20%
Water- soluble ash: Not less than 1.80%
Water-soluble extractive: Not less than 16.00%
Alcohol-soluble (70%) extractive: Not less than 22.00%
Palisade ratio: 4.5 – 6.20 – 7.8 (present only on upper surface)
Stomatal index: 5.0-12.8 (lower surface)
Stomatal number: 300 – 333 – 500
Vein-islet number: 2.5 – 3.0
Veinlet termination number: 26.0 – 28.0 (Elujoba and Olawode, 2004)

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8] , detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of three characteristic spots with R_fs of 0.45 (dark grey), 0.33 (pink) and 0.29 (green).

Chromatogram

Macroscopy

The compound leaves are paripinnate and alternate in arrangement, on each leaf, there may be up to 5-8 pairs of leaflets attached to the rachis through a small petiole, leaflets are ovate–lanceolate to lanceolate falcate in shape, asymmetrical at the base, long acuminate apex, coarsely serrated at the edges, occasionally lobed, with acuminate apex and glossy green (upper surface); up to about 11 cm long and 3cm broad, glabrous, the midrib is entire; fruit, ellipsoid, drupaceous, 1-seed, yellow, glabrous 1.2 to 2 cm long; taste slightly bitter; odour alliaceous (African Pharmacopoeia, 1985).

Microscopy

The surface view shows anomocytic stomata present on lower epidermis; occasional unicellular trichomes. The transverse section shows smooth cuticularised epidermis; anticlinal cell walls, almost straight; rosette crystals present in mesophyll; collenchyma interrupts mesophyll on both upper and lower surfaces in midrib region; vascular bundles strongly curved, and collateral; xylem vessels lignified; transverse section of the leaf midrib shows a bicollateral structure, characteristic of sub-epidermal masses of collenchyma on both surfaces, xylem takes the form of a strongly curved arc while both surfaces have smooth cuticles, epidermal cells with almost straight walls, particularly those of the upper epidermis; stomata anomocytic, present on the lower epidermis while absent on the upper epidermis; leaf contains no starch or calcium oxalate crystals (Ekejiuba, 1984).

Powdered plant material
Straight-walled epidermal cells; lamina pieces showing anomocytic stomata, collenchymatous cells, xylem vessels, lamina pieces show anomocytic stomata; epidermal cell walls straight; lignified vascular elements in veins and veinlets; rosette crystals, starch granules absent; colour greenish brown; taste slightly bitter; odour alliaceous

Therapeutic actions
Antiemetic, antifeedant (insecticide), antifungal, antiinflammatory, antimalarial, antiseptic (in medicated soaps), antipruritic; antipyretic, antiviral (systemically), anxiolytic, depurative, emmenagogue, galactogogue, hypoglycaemic, immune stimulant, vermifuge (GHP, 1992).

Therapeutic indications
Blood disorders, boils, constipation, dermatitis, diabetes mellitus, diarrhoea, dysentery, eczema; fever, hepatitis, hyperacidity, hypertension, intestinal helminthiasis, jaundice, lumbago, malaria, pharyngitis, pruritus; psoriasis, ringworm, scabies, ulcer; wounds (Dennis, 2002; Mshana *et al*., 2000; GHP, 1992).

Safety data
Animal studies (300-3000 mg/kg) in rats showed that the LD_{50} of the aqueous extract of the leaf of *Azardirachta indica* (*p.o*) was beyond 3000 mg/kg and there was no manifestation of clinical signs of toxicity over the period of the acute toxicity study. Changes in organ /body-weight ratios (doses > 100 mg/kg) and some haematological parameters at a dose of 3000 mg/kg were observed in a 14-day subacute study. Administration of the aqueous extract to rats (doses > 100 mg) resulted in increased levels of liver transaminases (ALT, AST and GGT, ALP) and reduced serum albumin. Renal function parameters were also affected.

Precautions for use
Caution should be taken in the administration of the aqueous extract in liver and renal disease. Neem extracts should not be taken for prolonged periods at high doses; limonoids show a very low toxicity, especially in oral administration. Toxic effects have been observed in animals grazing on neem leaf.

Adverse effects
None reported and none expected if taken in therapeutic doses

Contraindications
Known renal and/ or hepatic disease, hypoglycaemia, elderly and children; pregnancy and lactation.

Dosage and dosage forms
Decoction; tincture; liquid extract.
Decoction: 30 g dried leaves in 900 ml water; simmer until reduced to 600 ml; 1 teacup three times daily; tincture- 1:5 in 45% alcohol, 5 ml three times daily
Liquid extract 1:2 in 45% alcohol, 2.5 ml three times daily

Storage
Store in a cool dry place

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Balanites aegyptiaca

Botanical name
Balanites aegyptiaca (L.) Del.

Family
Zygophyllaceae

Synonyms
Ximenia aegyptiaca L., *Agialida senegalensis* van Tiegh., *Agialida barteri* van Tiegh., *Balanites ziziphoides* mildbr & Schlechter

Common names
Soap berry tree, Thorn tree (English); Desert date, Dattier du désert (French)

Vernacular names
Burkina Faso: Mooré – kyéguelga, Dioula – Zèkènè, Fulfulde – Tannê;yoléteki
Ghana: Dagaare – Gongo
Mali: Bambara – Zèkènè; Dogon – Mono, Noms – Tale
Senegal: Wolof – Sump; Serer – Model, lol; Arabe – Hadjlidj
Togo: Gourmantche – Konkonlangpag; Moba – Okopakbo

Description of the plant
Thorny tree, deciduous, up to 8 metres high, with large and complex branching; well defined trunk, straight or slightly twisted, greyish-brown bark, fissured longitudinally; numerous branches, with straight spines 2-7 cm; young secondary branches are green, pubescent and also thorny; inflorescence is indeterminate, comprises of 5 to 12 flowers arranged on a pubescent stem, of variable length; fruit is a fleshy drupe 1 to 2.5 cm long, oval oblong, silky-pubescent surface and greenish-white with a single seed inside; blooms from March to May and fruits from July to October.

Herbarium specimen number
Mali: 2015
Togo:TOGO09436

Habitat and geographical distribution
The desert date palm occurs mainly in tropical Africa, particularly in central and Western Sahara, and the Far East. It originated from the Mediterranean *via* Egypt and grows well in sandy soil and on all types of geographical landscapes: depressions, valleys, plains, and even mountains.

Plant material of interest
Fruit

Other parts used
Stem bark

Definition of plant material of interest
Balanites consists of the fruit of *Balanites aegyptiaca* (L.) Del. (Zygophyllaceae)

Ethnomedical uses
In the Sahel, the leaves and fruits are used as food during the dry season and during lean periods. The leaves are dried and processed into powder for use in preparing sauce (Cook *et al.,* 1998; Lockett *et al*., 2000). Edible oil is extracted from the kernels (Kamel and Koskinen, 1995). The fruit extract is added to porridge and eaten by nursing mothers to stimulate milk production, and the nuts are eaten to treat pain and discomfort associated with excessive intestinal motility and bloating (Lockett *et al.,* 2000). *B. aegyptiaca* is one of the most palatable forage species for domestic grazing animals (Toutain, 1980; Savadogo, 2004). The root bark is crushed, added to water, soaked and drunk for its purgative effect (Koch *et al*., 2005). The seeds are used to treat cancers and hydrocoele (Abubakar *et al*., 2007). The stem and root barks are powdered and mixed with other species, and then boiled with water for use against oral candidiasis (Runyoro *et al*., 2006a). The stem bark is macerated in warm water, and the resulting extract taken for asthma, dry cough and chest infections (Maregesi *et al*., 2007) Some medicinal preparations are made with essential oils extracted from parts of *B. aegyptiaca* (Said *et al*., 2002). The leaves of the plant and young branches are macerated and applied fresh as poultice on wounds (Said *et al*., 2002). The powdered root of the plant is dissolved in water,

and then used as a bath to treat measles. It is also taken as tea against uterine fibroids (Tabuti *et al*., 2003), or made into a paste and applied to bleeding gums or inserted into the cavity of painful tooth three times per day until recovery (Tapsoba and Deschamps, 2005).

Biological and pharmacological activities

The whole plant is used as antiparastic, antihelminthic, antipyretic, fish poison, abortifacient and molluscicide (Iwu, 1993). A dose of 20 mg/kg of the aqueous extract of the fruit mesocarp was as effective an antihelminthic against the worm *Fasciola gigantica* as a 9 g/kg dose of albendazole (Koko *et al*., 2000) and 200 mg/kg of the same extract was also effective against *Schistosoma mansoni* infected mice (Koko *et al*., 2005). The fruit mesocarp extract also showed significant antidiabetic activity in streptozotocin-induced diabetic mice. The effect has been attributed to the steroidal saponins (Kamel *et al*., 1991).The mixture of saponins isolated from the seeds, balanitines 6 and 7, has anti-cancerous activity in human cells (Gnoula *et al*., 2008). The fresh leaves, dried barks and roots were reported to be active against *Bacillus subtilis*, *Penicillium crustosum*, *Saccharomyces cerevisiae*, *Epilachna varivestis*, *Biomphalaria glabrata* and *Lymnaea natalensis* (Taniguchi *et al*., 1978; Liu and Nakanishi, 1982) and the saponin fraction from the mesocarp of the plant had a weak activity against *Aedes aegypti*, *Aspergillus niger* and *Candida albicans* (Saeed *et al*., 1995). Fruit and root bark have strong activities on *Candida albicans* (Nanyingi *et al*., 2008; Runyoro, *et al*., 2006b; Saeed *et al*., 1995). The fruit extract also has immune modulatory properties *in vitro* (Koko *et al*., 2008).

Clinical data

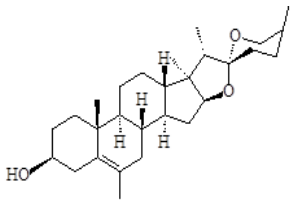
No information available

Chemical constituents

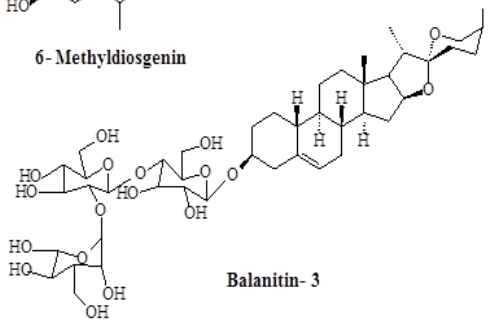
Protein, carbohydrates (Nour *et al*., 1986); saponins (balanitin-3, 6-methyldiosgenin, balanitoside; (Kamel 1998; Hosny *et al.,* 1992), pregnane glycosides (Kamel and Koskinen, 1995).

Tests for identity and purity

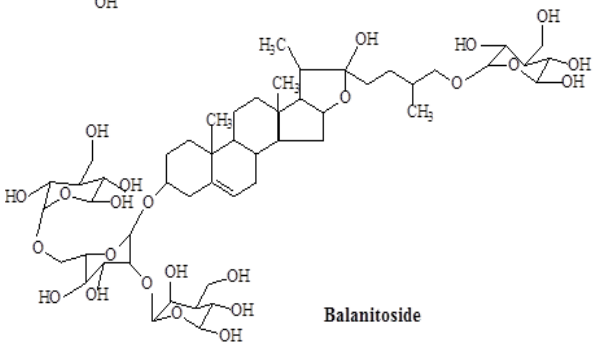
Moisture content: not more than 8.45%
Total ash: 12.21%
Water-soluble extractives: not more than 16.30%
Alcohol-soluble (70%) extractives: not less than 14.89%



6- Methyldiosgenin



Balanitin- 3

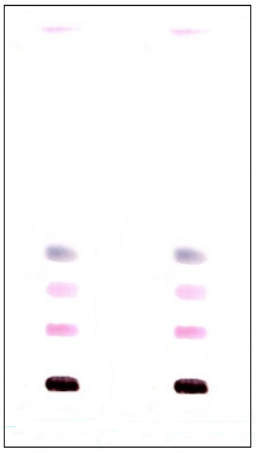


Balanitoside

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 oC)/chloroform [2:8] , detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of three characteristic spots with R_fs 0.40 (ash), 0.31 (pink) and 0. 027 (pink).



Chromatogram

Macroscopy
Stem bark flat or channelled pieces; outer bark with vertical cracks, lenticellate; colour yellowish grey; inner bark with fine vertical striations; colour buff; fracture short; odour characteristic; taste bitter (GHP, 2007).

Microscopy
The sectional views (transverse and longitudinal sections) show thin-walled lignified cork: cells; outer cells show exfoliations; thin three-layered cambial cells separate the cork layer from the cortex; cortex consists of isolated groups of numerous sclereids with thickened lignified walls and small lumen, two types of sclereids-isodiametric and elongated cells; large rosette crystals occur in some cortical parenchyma; phloem tissue consists of parenchyma and broad medullary rays with prismatic calcium oxalate crystals, lignified phloem fibres occur in isolated groups among the phloem parenchyma (GHP, 2007).

Powdered plant material
Buff-coloured; odour sternutatory; taste bitter; numerous sclereids, isodiametric and elongated, lignified; long fibres both lignified and unlignifed; few cork cells, rosette and prismatic calcium oxalate crystals; starch grains (GHP, 2007).

Therapeutic actions
Antidiabetic (Kamel *et al*., 1991). antihelminthic (Koko *et al*., 2000; Koko *et al*., 2005), anticancer (Gnoula *et al*., 2008); antipyretic, molluscicidal (Iwu, 1993), antibacterial (Taniguchi *et al*., 1978; Liu and Nakanishi, 1982), antifungal (Saeed *et al*., 1995; Speroni *et al*., 2004); anti-nflammatory, antimicrobial (Speroni *et al*., 2004; Runyoro *et al*., 2006b; Nanying *et al*., 2008) and immunmodulatory (Koko *et al*., 2008).

Therepeutic indications
Constipation, diabetes, schistomiasis

Safety data
Animal studies in rats (300-3000 mg/kg) showed that the LD_{50} of the aqueous extract of the stem bark was >3000 mg/kg. An increase in AST but a decrease in ALT was detected in rats. This may not necessarily indicate hepatotoxicity as AST increase is associated with damage to other tissues in the body apart from the liver. No serious adverse effects on liver and kidney functions were observed in the H/E sections. Increased WBC count was observed at doses ≥100 mg/kg and MCH at doses >3000 mg/kg. The use of the aqueous extract of the stem bark of the plant within the recommended dose may be of no serious safety concern.

Precautions for use
The blood glucose of the patient should be monitored.

Adverse effects
May induce hypoglycaemia

Contraindications
Hypoglycaemia

Dosage and dosage forms
Decoction; ointment; tincture
Decoction: 30-50 g per litre of water; take 3-5 teacupful daily
Tincture: 1:5 in 50% alcohol; 5 ml three times a day.

Storage
Store in a cool dry place

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Bridelia ferruginea

Botanical name
Bridelia ferruginea Benth.

Family
Euphorbiaceae

Synonyms
Bridelia micrantha var. *ferruginea* (Benth) Müll

Common name
Bridelia

Vernacular names
Benin: Baatonun- Bemebenku, Gbe Fo – Honsukokué , Yoruba – Nago Hira
Burkina Faso: Mooré – Ambriaka, Dioula– sagoui;sagwann baboni, Fulfuldé–kojuteki;daafi
Cote d'Ivoire: Manding Maninka– Saba / Sagba, Senufo– Dyimini – Nakurugo
Ghana: Tw – Opam fufuo, Ga Adamgbe – Flatsho, Hausa– Kisni
Guinea: Fula Pulaar – Dafi, Manding Maninka– Baboni, Maninka– Sagba
Mali: Bambara – Saguan, Noms – Daafi, Senoufo – Gnirin-o-tigue
Nigeria: Yoruba – Ira odan, Eepo ira; Ibo – Oha, Hausa – Kisni
Sierra Leone: Susu – Tholinyi, Kissi – Sindio, Hono – Bembeh
Togo: Ewe – Akamati, Bassar – N'tchintchi, Lamba – Kolu

Description of the plant
It is a small non-laticiferous, scaly tree or shrub that grows to about 4-15 m tall and up to 1.5 m in girth, branching is low, often bears spines and may be slash crimson coloured; leaves may be small to medium-sized, simple, petiolate with stipules, oval-lanceolate, tomentose, deciduous, alternate or sometimes sub-alternately, spiral, lamina broadly elliptic, with entire margin and an acuminate or acute apex (GHP, 1992); cuticles oblong or oval, irregularly more or less dentate, upper epidermis pubescent; about 3.8-10.0 cm long and 2.5-6.4 cm wide with slightly wavy edges; shortly and abruptly acuminate, stalk usually 1-2.5 cm long, robust and densely hairy; pinnately veined, veins beneath form a dense and prominent network, sometimes sparsely hairy and occasionally with the hairs obscuring the undersurface of the leaf; inflorescence, many flowered in glomerules, axillary, very dense, male flowers yellowish-green, pedicelate, pedicel, 1.5-2 mm long; female flowers subsessile with 3 short, 2-pronged styles, 0.6 cm across, the greenish yellow sepals have very small and

narrow petals; each flower cluster, usually consists of male and female; good fragrance; fruits drupe-shaped, unilocular, oblong or sometimes subglobulose with green pericarp, red then black-blue at maturity; fruits sometimes obovoid, 0.8 cm long, more usually ellipsoid, 0.6 cm long, very persistent on the branches; stem-bark, dark grey cracked, rough, often markedly scaly, slash is thin and red, branches are long, sometimes thorny, thin, sometimes equipped with short, sharp spines; branchlets are rusty and pubescent; twigs are usually covered with short, often rust-coloured hairs (Adjanahoun *et al.,* 1991; Okunji,1987).

Herbarium specimen number
Ghana: GC 7714
Nigeria: FHI 107453
Togo: TOGO03072

Habitat and geographical distribution
Occurs commonly in the Guinea savannah and coastal plains of Africa, particularly Burkina Faso, Cote d'Ivoire, Ghana, Nigeria and Togo as well as Asia and Australia (GHP, 1992).

Plant material of interest
Leaf and stem-bark
Other parts used
Root bark

Definition of plant material of interest
Bridelia consists of the leaf or stem bark of *Bridelia ferruginea* Benth. (Euphorbiaceae).

Ethnomedical uses
Bacterial infections; diabetes, arthritis, bruises, boils, dislocation, burns, paediatric illnesses

(especially malarial fever), dysentery, diabetes, thrush (mycotic stomatitis) in children, antidote for snake bites; gonorrhoea; helminthiasis; malaria; trypanosomes; inflammations sexually transmitted diseases (Okpekon *et al.,* 2004; Olajide *et al.,* 2003; Irobi *et al.,* 1994; Narayan, 1994; Iwu, 1993; Hentchoya, 1991; Oliver-Bever,1960; Dalziel, 1937).

Biological and pharmacological activities

A crude extract of the plant as well as pure rutin, lowered the fasting blood glucose (FBS) of New Zealand white rabbits by up to 20% within 30 minutes of administration, rising to 35% within one and a half hours, and remaining at this level for up to 3 hours (Addae-Mensah and Munenge, 1989). It was observed that the extracts were more effective than the normal dose of the antidiabetic drug, glibenclamide, (0.13 mg/kg), but were less effective than insulin. However, in a manner statistically similar to insulin, the rutin-containing extract was able to inhibit artificially induced acute hyperglycaemia. A daily administration of a leaf decoction of the plant resulted in significant reduction of blood sugar levels (Iwu, 1986; Githens,1949). The leaf extracts showed hypoglycaemic effects, but were less effective in alloxan-induced diabetes (Githens, 1949; Iwu, 1980, 1986). Aqueous and ethanolic extracts of the plants have been shown to have antisickling activity (Mpiana *et al.,* 2007). Extracts of the plants have shown cytotoxic and cytostatic activity (Rashid *et al.,* 2000). Extracts of *B. ferruginea* have shown antimicrobial, anti-HIV and antispasmodic activities (Cimanga *et al.,* 1999; Akinpelu and Olorunmola, 2000; Muanza *et al*., 1995; Onoruvwe *et al.,* 2001). The biflavanol and the quinic acid derivatives have been shown to inhibit the complement system (Cimanga *et al.,* 1999; Stryer, 1995). The flavonoids quercetin, quercitrin and rutin have also been found to have antiviral effects against coxsackie, *Herpes simplex*, measles, parainfluenza and polio viruses (Addae-Mensah, 1992). *B. ferruginea*'s flavonoids showed xanthine oxidase inhibiting and superoxide scavenging activity at very low (micromolar) concentrations *in vitro* (Cimanga *et al.,* 2001; Gabor, 1986). The ethyl acetate, hexane and methanol leaf extracts have all been shown to be effective against *Bacillus subtilis, Echerichia coli, Pseudomonas frutescens, Staphylococcus aureus* and *Streptococcus faecalis* (Talla *et al.,* 2002) while the aqueous and ethanolic powdered bark extracts were found to exhibit antifungal activity against *Candida albicans*, and antibacterial activity against *E. coli, Klebsiella sp., Proteus vulgaris, P. mirabilis S. aureus, S. epidermidis, S. lactis* and *S. pyogenes* (Irobi *et al.,* 1994). The aqueous extract of the stem bark caused a significant inhibition of the carrageenan-induced rat paw oedema, but the activity diminished in the mouse paw oedema. The extract also suppressed the granulomatous tissue formation characteristic of chronic inflammation (Olajide *et al.,* 1999). Aqueous extracts of the stem bark showed antiinflammatory activity possibly mediated through down-regulation of TNFα (Olajide, *et al*, 2003). Six African medicinal plants including *Azadiractha indica*, *B. ferruginea*, *Commiphora molmol*, *Garcinia kola* and *Curcuma longa* demonstrated antithrombotic effect *in vivo* (Olumayokun, 1999). The effect of the plant extract on lipopolysaccharide (LPS)-induced septic shock and vascular permeability on the dorsal part of mice skin, showed that pre-treatment with about 10-80 mg/kg of the extract inhibited the septic shock syndrome in mice in a dose-dependent manner, with an 80 mg/kg dose found to be as effective as 100 mg/kg of the drug pentoxifylline. The same dosage range of the extract (10-80 mg/kg) also reduced LPS-induced dye leakage in the skin of mice. Ethanolic leaf and stem bark extracts showed neuromuscular activity (Onoruvwe *et al.,* 2001; 1994). Extracts of the plants have shown cytotoxic and cytostatic activity (Rashid *et al.,* 2000).

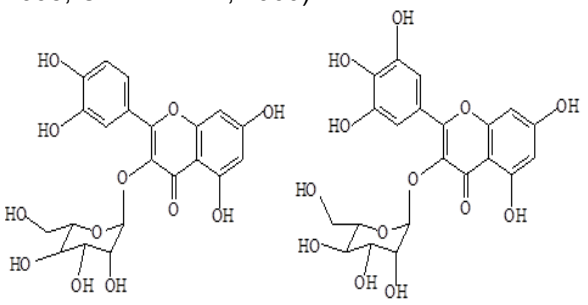
Clinical data

Administration of a leaf decoction to a 49 year old female diabetic patient caused her fasting blood sugar level to fall from 242 mg/dl to about 120 mg/dl after 12 weeks, remaining at this level for eight weeks (Addae-Mensah, 1992). A 45-year old hypertensive woman, who had diabetes diagnosed on routine examination had her fasting blood sugar level of 370 mg/dl reduced to 250 mg/dl after one week and continued to fall until it normalised after eleven weeks on immediate administration of *B. ferruginea*. No medication was prescribed for her hypertension, but her blood pressure fell from 180/90 to 140/90 during the treatment period (Addae-Mensah, 1992; Ampofo, 1977). Aqueous extracts of the leaves were able to normalise the fasting blood glucose levels and helped in eliminating glycosuria of patients with maturity onset diabetes (Iwu, 1993).

Chemical constituents

Flavonoids (bridelilactone and bridelilactoside, apigenin and kaempferol, gallocatechin-(4-O-7-

epigallocatechin, quercetin-3, 3-methylether,3,5-dicaffeoylquinic acid, quercetin 3,7,3,4-tetramethylether, quercetin 3-O-glucoside, rutin, myricitrin, myricetin-3-O-β-glucoside, ferrugin, biflavanol (gallocatechin-[4-O-7]-epigallocatechin); triterpenes, steroids, tannins, saponins; triterpenoids, lignans; phenols and tannins (Cimanga *et al.,* 2001, Rashid *et al.,* 2000; Addae-Mensah and Achenbach, 1985; Irobi *et al.,* 1994; GHP, 1992; de-Bruyne *et al.,* 1998; Oliver-Bever, 1960).



Quercitrin Myricitrin

Tests for identity and purity

Moisture content (African Pharmacopoeia, 1985): Not more than 25.00%
Total ash: Not more than 14.60%
Acid-insoluble ash: Not more than 1.80%
Water-soluble ash: Not less than 1.30%
Water-soluble extractive: Not less than 31.40%
Alcohol-solube (70%) extractive: Not less than 31.40%

Chromatographic fingerprints

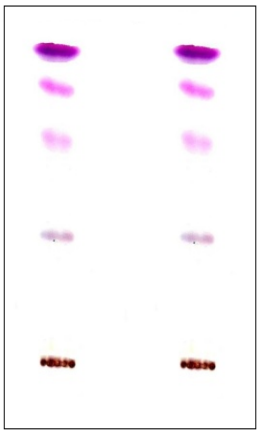
Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2: 8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100 - 110°C for 5-10 min. Presence of four characteristic spots with R_fs values of 0.92 (violet), 0.81 (pink), 0.65 (pink) and 0.37 (purple).

Macroscopy

Leaf: the leaf is simple, alternate; shortly petiolate, entire margin, 3.8-10 cm long and 2.5-6.4 cm wide, shortly acuminate or acute apex; base symmetrical; glabrous texture papery; mid-rib projects strongly on its lower side, moderately on its upper side and transversed by vascular strands, formed by an arch of collateral vascular bundles, colour green; faintly aromatic odour; taste bland or tasteless or slightly sweetish.

Stem bark: dark greyisg in colour, scaly, reddish



Chromatogram

interiorly; characteristically appearing in the open herb markets as short cut-pieces.

Microscopy

Leaf: Dorsiventral with abundant fragments of lamina cells in sectional view, showing the upper epidermis with no stomata, presence of thin cuticle; palisade layer is single and cells are closely packed; lower epidermis is covered with fairly thick smooth cuticle and consists of cells, similar to the upper epidermis; trichomes are multicellular; covering hairs, non-glandular, stomata are few, paracytic, surrounded by 2-3 subsidiary cells; mesophyll is parenchymatous, vascular bundles with phloem consisting of soft, thin walled elements, the xylem vessels, with groups of parenchyma cells in between; idioblasts of microsphenoidal crystals of calcium oxalate, abundant in the mesophyll and a few ones scattered in the parenchyma and the phloem; midrib at the upper epidermis consists of polygonal, straight-walled cells with thick cuticle.

Stem bark: Transverse section of the bark shows coastal and intercoastal regions which are filled with sclerenchymatous cells and interspersed with various crystals of calcium oxalate. The bark surrounds the parenchymatous cells which also contain crystals of calcium oxalate. Anticlinal walls of parenchymatous cells are mostly straight, occasionally undulate and contain large quantities of tannins. The radial tangential section shows diffuse ray tissues which are heterogenous and multiseriate. Medullary rays contain calcium oxalate. Length of rays 0.15± 0.07 mm and width of ray 0.085± 0.02 mm.

Powdered plant material

Leaf: Greenish; odour nil; taste bland; fragments of lamina show trichomes on veins and veinlets; numerous simple starch grains; lignified fibres,

vessels, veins and veinlet fragments. Abundant fragments of the lamina cells in surface view; cells with thin sinous anticlinal walls of the upper epidermis, slightly thick-walled lower epidermal cells with fragments of hairs, few paracytic stomata; and scattered polygonal, straight-walled cells of the upper epidermis; midrib with thick cuticle

Stem-bark: Intervascular, pitted vessels that are alternate and large, few 9.8 µ – 33.6 µ. Fibres are of different sizes from 21 µ to 50 µ. Some fibres contain prismatic crystals of calcium oxalate.

Therapeutic actions

Antidiabetic; antihypertensive; antiviral, anti-HIV, antibacterial, antifungal, anti-inflammatory, antispasmodic; antipyretic and analgesic, anthelmintic; anti-tumour; diuretic.

Therapeutic indications

Arthritis; diabetes mellitus; diarrhoea; gastrointestinal and urogenital disorders (e.g. syphilis); glossitis; gout; headaches; helminthiasis; oral thrush (mouth wash); oliguria; polio virus; rheumatic pains (Mshana, 2000; Addae-Mensah, 1992; GHP, 1992; Ayensu, 1978).

Safety data

The LD_{50} of the aqueous extract of the leaves was > 3000 mg/kg in rats. In acute toxicity studies (300-3000 mg/kg), no significant changes in body-weight or organ body-weight ratios was observed in rats; no clinical signs of toxicity were observed in the acute study. At the highest dose (3000 mg/kg), GGT and serum creatinine levels were raised significantly.

Precautions for use

Caution should be taken in the administration of the aqueous extract in patients with compromised liver and renal function.

Adverse effects

Excessive dose may lead to hypoglycaemia

Contraindications

Known renal and/ or hepatic patients, hypoglycaemia, elderly and children.

Dosage and dosage forms

Decoction; infusion and tincture

Infusion: 20 g of dried leaf per litre of water; brew for 15 minutes and take 3-4 cups a day; *Decoction:* boil 30 g of dried leaf in one litre of water for 15 minutes; drink 3-5 cups a day; *Tincture:* 1:5 in 30% alcohol; 5 ml three times daily.

Storage

Store in a cool, dry place

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Carica papaya

Botanical name
Carica papaya L.

Family
Caricaceae

Synonyms
Carica hermaphrodita Blanco; *Carica mamaya* Vellon

Common names
Pawpaw; melon tree, mummy apple, Papaya (English), Papayer (French)

Vernacular names
Burkina Faso: Bissa – Nassara-krou, Mossi – P apaï, Moore–Budebalod;bogfiré,Fulfuldé- Mãndjé
Cote d'Ivoire: Abbey – Oloko, Akye - M'bomou, baoule – Oflè
Gambia: Mandinka – Papiya, Fulla – Budi baga, Wollof – Papakayo
Ghana: Akan – Brofre, Ga-Dangbe – Akpakpa, Ewe – Adiba
Mali: Bambara – Mandje, Dogons – Ane sara kambe, Senoufo – Manli
Nigeria: Hausa – Gwanda, gwadda, Yoruba – Igi-Ibepè; Ibo – ogede ojo.
Togo: Ewe – Adibati, Mina – Adubati, Akasselem – Brofude
Senegal: Wolof – Papayo, Peuhl – papaya, papayo, Diola – bum papa
Sierra leone: Mandigo – Sida, Mende – Fakali, Hono – Sela

Description of the plant
A soft-wooded, straight, generally unbranched tree; up to 5-6 m high with conspicuous leaf scars on a hollow stem; leaves are large, palmate, sometimes reaching a metre in diameter and grouped at the top of the stem, petiole is long, hollow and robust; inflorescences axillary cymes; unisexual flowers white or greenish dioecious, flowers occasionally hermaphrodite, unisexual male and female flowers on different plants; male flowers gamopetalous and tassel, female flowers, large, polypetalous, sub-sessile; fruits are oblong or oblong oval up to 30 cm long and 7-11 cm wide with fleshy mesocarp, yellow or gold when ripe; green when unripe.

Herbarium specimen number
Côte d'Ivoire: 5634, 6244 (Herbier du Centre National de Floristique)
Ghana: GC 801
Nigeria: FHI 107430
Togo: TOGO0340

Habitat and geographical distribution
Native to tropical America and cultivated in many other tropical regions, less commonly grown in the Sahel (probably due to water shortage). Cultivated plant in home gardens and farms.

Plant material of interest
Leaf, fruit or root

Other parts used
Seed

Definition of plant material of interest
Pawpaw consists of leaf or fruit or root of *Carica papaya* L. (Caricaceae).

Ethnomedical uses
The uses of the plant are numerous (African Pharmacopoeia, 1985; Ake Asse, 2001). The infusion of fresh or dried leaves is used to treat against febrile illness. The leaf decoction is used to treat hernia, malaria, urogenital pain, gonorrhoea and cancer. Fumes from the leaves are also used to treat asthma. The root paste is dissolved in warm water and used as an enema to treat abdominal pain. It is also mixed with palm oil and used as a poultice to treat whitlow. The root is macerated in cold water and used as a mouthwash against dental caries. The macerated roots are also used orally against urethritis (painful urination), typhoid, fever, and as a laxative. The roots may also be macerated in palm wine or decocted and drunk to treat dysentery and gonorrhoea. The roots and leaves are used as diuretics. The decoction of the unripe fruit is a remedy for jaundice, sickle cell anaemia and hepatitis. The crushed unripe fruit is applied topically to treat boils and the infusion of the dried

seed powder is taken on an empty stomach as an anthelmintic.

Biological and pharmacological activities

Many scientific studies have been undertaken to validate some of the plant's much-acclaimed pharmacological actions including antimicrobial (amoebicide, bacteriostatic); stomachic, vermifuge; galactogogue; oxytoxic; digestive; styptic; wound-healing and carminative (GHP 1992; Pamplona-Roger, 1998). Alcohol and butanol extracts of the dried leaves showed spasmolytic activity on isolated guinea pig ileum (Kambu *et al*., 1990). The ethanol extract of the dried leaf administered intraperitoneally to rats showed an analgesic, anticonvulsant, skeletal muscle relaxant, positive chronotropic and tranquilizing effects (Gupta *et al*., 1990). At low dose, carpaine reduces heart contractions and thus lowers blood pressure, but at high doses, it produces vasoconstriction (Oliver-Bever, 1960). The alkaloid of leaves, carpaine showed diuretic and amoebicidal properties and the hydroalcoholic extract of the root has shown *in vitro* activity against *Neisseria gonorrhoeae* (Caceres, 1992; Caceres *et al*., 1995). The purified protein fractions obtained separately from fresh endocarp, epicarp, seed, fruit and fresh leaves showed *in vitro* activity against *Bacillus cereus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Shigella flexneri Staphylococcus aureus, Proteus vulgaris* and *Salmonella typhimurium* (Argueta,1994; Emeruwa, 1982), whilst the pure methanolic fruit extract showed anti-inflammatory effect (Yasukawa *et al*., 1993). Osato *et al*. (1993) also reported the *in vitro* bacteriostatic properties of the juice from the pulp of unripe fruit and seed against *Bacillus subtilis*, *Enterobacter cloacae*, *Escherichia coli*, *Klebsiella pneumoniae, Proteus vulgaris, Pseudomonas aeruginosa, Salmonella typhi* and *Staphylococcus aureus.* Extracts from the same parts also showed antioxidant activity comparable to those of soybean paste miso, rice bran and baker's yeast (Osato *et al*., 1993). The 95% ethanolic root extract showed antibacterial activity *in vitro* against *Escherichia coli* and *Staphylococcus aureus* (George and Pandali, 1949); the aqueous extract had *in vitro* anti-candida effect (Gundidza, 1986). Latex from different parts of the plant has been shown to possess *in vitro* antifungal activity against *Candida albicans* (Giordani *et al*. (1996; Giordani *et al*., 1991). Chen *et al* (1981) found that the latex of the green fruit afforded protection against stomach ulcers by reducing histamine-induced acid secretion in rats (Chen *et al*., 1981). The milky juice of the unripe fruits contain the proteolytic enzyme "papain", which is composed of the compounds papain and chymopapain (Oliver-Bever, 1960). Papain's tenderising properties, usually when combined with alkali (e.g. borax or potassium carbonate), have been utilised in the treatment of boils, corns, cutaneous tubercles, eczema, freckles, sinuses, warts and tumours. It has the ability to coagulate milk and to digest the fibrous tissue of flesh in both acid and alkali media and has been used to treat ulcers and as an anti-inflammatory agent to reduce swelling, fever and adhesions after surgery. Its derivative, chymopapain is sometimes used intravenously in orthopaedic surgery to dissolve the nucleus of the intervertebral disc in cases of herniated lumbar or trapped nerves (Pamplona-Roger, 1998).

Clinical data

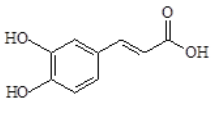
Trials have shown that daily application of the marshed pulp to infected burns is effective in desloughing necrotic tissue and preventing infection of burn wounds (Starley *et al*., 1999). Topical application of the unripe fruit promoted desloughing, granulation and healing and reduced odour in chronic skin ulcers, being more effective than other topical applications (Hewitt *et al*., 2000).

Chemical contituents

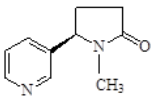
Phenyl-propanoids (caffeic acid), alkaloids (carpaine 9 dihydrocarpaine I and II, pseudo-carpaïne, cotinine, myosmine, nicotine, choline, pyridine, carpasamine); cyanogenic glucoside (Nahrstedt, 1987); alkaloids: carpaine, nicotine; xylitol and saponins; carotenoids (β-carotene, ε-carotene, cryptoxanthin), lycopene, annins; α-linolenic acid, benzenoid, benzaldehyde, benzyl glucosinolate, methyl salicylate, sulfur compounds, isothiocyanate benzyl; protein: papain, chimopapaine A, ω-protease, vitamins A, C and E2, minerals: potassium, mainly calcium, iron, phosphorus; sterols (β-sitosterol; dehydroavenosterol, compesterol, cholesterol, stigmasterol); fatty acids (palmitic, stearic, oleic, linoleic acids); phosphatides; pectin, citric acid (Silvaraj and Pal, 1982; Tang, 1971; Hegnauer, 1973; Duke, 1992; Duke, 1986; Kambu *et al*., 1990; Moneret *et al*., 1985; Kermanshai *et al*., 2001; Hashem *et al*., 1980; Pickersgill, 1990; Duke and Atchley, 1986; Idstein *et al*., 1985; Argueta *et al*., 1994; Kerharo and Adam, 1974).

Tests for identity and purity

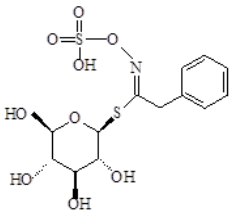
Moisture content: 83.00% (immature)
Total ash: not more than 43.20% (immature)



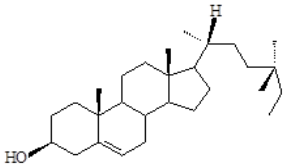
Caffeic acid



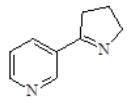
Cotinine



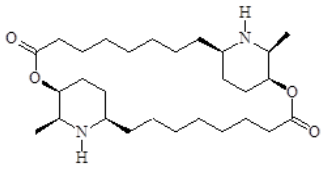
Benzyl glucosinolate



Compesterol



Myosmine



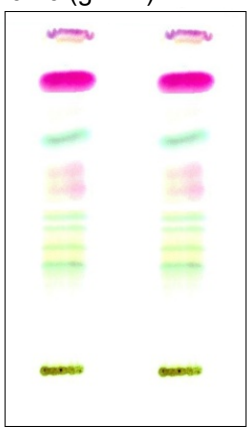
Carpaine

Acid-insoluble ash: not more than 3.70% (immature)
Water-soluble ash: not less than 33.20% (immature)
Water-soluble extractive: not less than 6.30% (immature)
Alcohol-soluble 70% extractive: not less than 2.20% (immature)
(Afr.Pharmacopoeia, 1985; Odukoya and Elujoba, 2004)

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of five characteristic spots with R_fs 0.92 (pink), 0.80, 0.60, 0.55 and 0.40 (green).



Chromatogram

Macroscopy

The fruit is berry, about 15-22 cm long and 7-11 cm broad, oblong to oblong-ovate in shape, dark-green when unripe, latex-containing pericarp, becoming yellow-orange on ripening, the latex disappears on ripening; numerous greyish unripe seeds, black when ripe, with parietal placentation; epicarp is leathery, mesocarp is fleshy and orange-coloured when ripe and green when unripe. The endocarp is unidentified (African Pharmacopoeia, 1985).

Microscopy

The epidermis of the pericarp consists of polygonal isodiametric cells with straight anticlinal walls, stomata, rare and of the ranunculaceous type; no hairs; mesocarp, formed of several layers of thin-walled parenchymatous cells; the outermost layer is more or less tangentially elongated and with smaller cells; inner layer consists of large rounded or oval parenchymatous cells; vascular strands formed of narrow, non-lignified, spiral vessels and a patch of phloem; mesocarp shows numerous anastomosing laticiferous vessels, containing a substance, staining yellow with iodine and a few starch granules; calcium oxalate crystals are absent; transverse section shows an outer membranous layer with starch grains, bounding stellate projections which form the testa; the testa itself shows four distinct layers: an outer sclerenchymatous tissue forming the projections, latex vessels are present in this tissue; a region with lactiferous cells occur next to this layer followed on the inner side by a compact layer of cork-like tissue; the endosperm comprises parenchymatous cells with globoid bodies (African Pharmacopoeia, 1985).

Powdered plant material

Polygonal isodiametric cells from the epidermis; thin-walled and rounded or oval parenchymatous cells of the mesocarp; spiral vessel members; while stomata and starch granules are few.

Therapeutic actions

Antibacterial, antiulcer, diuretic, antifungal, antihelminthic, analgesic, antinflammatory, vulnerary, amoebicidal and anticonvulsant. (Caceres, 1992, Caceres *et al*., 1995; Emeruwa, 1982, George and Pandali, 1949; Argueta, 1994; Osato *et al*., 1993; Gundidza, 1986; Giordani *et al*., 1991; Kambu *et al*., 1990; Gupta *et al*., 1990; Oliver-Bever, 1960; Yasukawa *et al*., 1993; Chen *et al*., 1981; Starley, 1999; Grandvaux, 1986; Phillipson and O'Neill 1987).

Therapeutic indications
Colitis, chronic constipation, dysentery, hypertension, toothache, pharyngitis, urinary retention, skin ulcer, guinea worm, jaundice, irritable bowel syndrome, ascariasis, intestinal helminthiasis (pinworm, tapeworm), dystocia; urinary retention, dracontiasis, kerosene poisoning, fever; wounds, amoebiasis (Mshana *et al*., 2000; GHP, 1992).

Safety data
Animal studies in male rats (*p.o*) showed that the LD_{50} of the aqueous leaf extract was > 3000 mg/kg. There was no evidence of clinical toxicity in the 24-hour monitoring following single dose treatment of 300-3000 mg/kg. Repeated dosing for 14 days did not affect the blood and its cellular elements. Liver and renal function was also normal. Based on this study there is no safety concern in the use of the aqueous extract of *Carica papaya.* The ethanol extract of the green fruit administered intraperitoneally into mice gave an LD_{50} of 325.2 mg/Kg (Nahrstedt, 1987). Intravenous administration of chymopapain gave LD_{50} of 79 mg/kg in mice, 120 mg/ g in rats, 15 mg/kg in rabbits and 16.7 mg/kg in dogs. After injection of in situ chymopapain for the treatment of herniated discs, anaphylactic shock was observed in 1% of patients (Moneret Vautrin *et al*., 1985). Oral administration of 10ml/kg of the aqueous extract of the root (10 g macerated in 500 ml of water) to mice for 14 days showed no obvious signs of toxicity (Sripanidkulchai *et al*, 2001). A preparation of the fruit applied to the lower back (2 g/50 cm^2) of rabbits for five consecutive days did not cause dermal irritation (Garcia-Gonzalez *et al*., 2001), but the aqueous seed extracts produced irreversible infertility in male albino rats due to decreased sperm motility (Charles, 1988).

Precautions for use
Papain may cause abortion in early pregnancy and it is thought to have the ability to dissolve a protein responsible for adhesion of the fertilized egg in the lining of the uterus (Adebiyi *et al*. 2002).

Adverse effects
In excessive doses, the extract of the plant can cause irreversible uterine tocolysis probably due to a toxic effect of benzyl isothiocyanate in the myometrium (Adebiyi *et al*., 2003). The plant is well tolerated in children (Starley *et al*., 1999), however, anaphylactic reactions to papain have been reported (Duke, 1985). The clinical symptoms of allergy to papain have been reported in some patients (De Clerck *et al*., 2007). Hepatotoxicity of the methanol extract of the seed has been reported (Udoh and Udoh, 2005; Adebiyi and Adaikan, 2005). Latex containing papain has been reported to induce chest pain, gastritis, rhinitis, yellowing of the palms, skin irritation and blistering, anaphylactic shock and severe asthma (Blanco *et al*., 1998, Blumenthal *et al*. 1998; Badin *et al*., 1978).

Contraindications
Pregnancy and lactation; hypotension, aniticoagulant drugs such as coumadin, warfarin, miradon and anisindione (Shaw, 1997; Shulman, 1997).

Dosage and dosage forms
Decoction; infusion; tincture; latex
Decoction: 30 g of dried leaves in 900 ml of water, boil until reduced to 600 ml, 1 teaspoon three times a day. Infusion: 30 g of dried leaves in 600 ml of water, 1 teaspoon three times a day 1:5 tincture in alcohol 50% 5 ml times a day; latex: 10-20 g mixed with honey and warm water after every meal; the fresh latex of green fruit, with a dose of 4 to 8 g (1 to 2 tablespoons for children) and 8 to 16 g (2 to 4 tablespoons for adults), diluted in a little water, or mixed with 3 or 4 tablespoons of honey.

Storage
Store in a cool dry place

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Botanical name
Cinchona pubescens Vahl.

Family
Rubiaceae

Synonyms
Cinchona succirubra Pavon ex Klotzsch

Common names
Quinine (English), Quinquina/quinine rouge (French)

Vernacular names
Nigeria: Yoruba – Kinin

Description of the plant
The genus *Cinchona pubescens,* among about forty species in the family Rubiaceae, is native to the tropical Andes forests of western South America but now widely cultivated in many tropical countries for its market value and particularly due to the content of quinine, an antimalarial constituent. Large shrubs or small tree with evergreen foliage, growing to 15-20 m high; leaves are opposite, rounded to lanceolate and 10 – 40 cm long; the tree produces white, pink, or yellow flowers in terminal panicles; fruit is a small capsule containing numerous seeds.

Habitat and geographical distribution
The plant originated from South America, and was introduced and cultivated (at an altitude of between 600-3300 m) in the humid tropics of Africa and Madagascar (African Pharmacopoeia, 1985).

Plant material of interest
Dried stem bark

Definition of plant material of interest
Cinchona consists of the dried stem bark of *Cinchona pubecens* Vahl. (Rubiaceae)

Ethnomedical uses
Cinchona originated from the Countess of Chinchon, wife of a Viceroy of Peru, who was cured of a type of malaria fever with the bark of the cinchona tree in 1638. The name cinchona comes from "kina-kina" meaning "bark bark" in Peru. Quinine, obtained from the bark, was first proposed for sale in England in 1658 and was made official in the British Pharmacopoeia in 1677. The cinchona bark was included in many formulations in Europe, such as "Countess's powder", "Jesuit's powder". Besides malaria, the

bark was also used to treat fever, indigestion, diseases of the mouth and throat, and cancer.

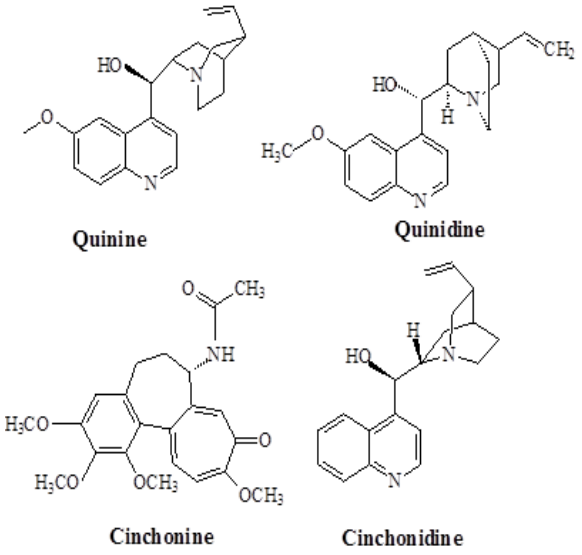
Biological and pharmacological activities
Small doses of Cinchona bark extract has astringent, tonic and bitter properties. At high doses, the extracts produce antimalarial and antipyretic action. Quinine is cytotoxic and therefore anti-protozoal, especially against the causative agent of malaria. It acts mainly on the asexual erythrocytic forms (schizonticide). At high doses, quinine causes sensory disturbances (tinnitus, vertigo, diplopia) and oxytocin release (risk of abortion). Quinidine is an antiarrhythmic compound, decreasing the excitability of the heart by reducing its permeability to potassium ion. Crude extracts and fractions from the bark of the plant is active against the 3D7 strain of chloroquine sensitive *P. falciparum in vitro* (IC_{50} <10 µg/ml), but not active on *P. berghei in vivo* (do Ce'u of Madureira *et al*., 2002). The plant is tonic, bitter, appetizer and digestive stimulant. One of the polysaccharides from the bark is cytotoxic. At high doses, it causes thrombocytopenia (Jäger *et al*. 2007; Buddenhagen *et al*., 2004). The dichloromethane/methanol (1:1) extract showed a cytotoxic activity against breast cancer cells (Kaileh *et al*., 2007). The bark decoction is administered orally as an antipyretic and as appetite stimulant in the treatment of malaria (Hanlidou *et al*., 2004). The leaves are used against fever, headaches and respiratory infections (Kaileh *et al*., 2007).

Clinical data
Clinical studies have shown that effective dose of

natural quinine bark extract elicited the same antimalarial activity as an effective dose of the synthesized quinine drug. A recent use for quinine drugs has been for the treatment of muscle spasms and leg cramps. A 1998 study documented the beneficial effects of natural quinine bark for leg cramps, with tinnitus being the only documented side effect. In 2002, a double-blind placebo study was undertaken in which 98 people with nocturnal leg cramps were given 400 mg of quinine daily for 2 weeks. The results stated that quinine administered at this dose effectively reduced the frequency, intensity, and pain of leg cramps without relevant side-effects (http://www.rain-tree.com).

Chemical constituents

Quinine, quininidine, cinchonine and cinchonidine (African Pharmacopoeia, 1985); aricine, caffeic acid, cinchophyllamine, cinchotannic acid, cinchotine, conquinamine, cuscamidine, cuscamine, cusconidine, cusconine, epicatechin, javanine, paricine, proanthocyanidins, quinacimine, quinamine, quinic acid, quinicine, quinovic acid, quinovine and sucirubine (www. rain-Tree.com: Tropical plant Data Base sept, 2009).



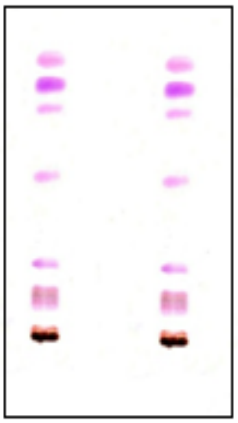
Tests for identity and purity

Moisture content: not more than 8.35%
Total ash: 9.42%
Water-soluble extractive: not less than 3.45%
Alcohol-soluble (70%) extractive: not less than 12.35%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8] , detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of five characteristic spots with R_fs 0.82 (pink), 0.75 (pink), 0.68 (pink), 0.48 (pink) and 0.21 (pink).



Chromatogram

Macroscopy

The bark is brownish and gives a dark red vapour when heated dry. It has a bitter taste.

Microscopy

Calcium oxalate microcrystals occasionally in idioblast. Large lignified fibres, yellowish when not stained with conspicuous pits and striations. Thin walled cork cells with brown contents.

Powdered plant material

The powdered bark contains small starch grains. Scattered microcrystalline calcium oxalate crystals. Large isolated fibres with pits and striations. Sclerieds very occasional, abundant thin walled cork cells with brown contents.

Therapeutic actions

Antimalarial, antipyretic, astringent, tonic, bitter antipyretic. antiarrhythmic, appetizer

Therapeutic indications

Malaria, fever, marked as somachic bitter tonic, insufficient digestive secretions (Jäger *et al*., 2007).

Safety data

24-hour acute studies in mice (*p.o*) showed that, the LD_{50} of the aqueous extract of the stem bark of the plant was >2000 mg/kg. Sub-acute studies did not show any clinical signs of toxicity after treatment of male and female mice (500 to 2000 mg/kg; *p. o*) for 14 days.

Precautions for use
Alkaloid containing crude drugs must be administered with caution

Adverse effects
Over-consumption causes "quinisme" (tinnitus with or without stupor, dizziness, temporary hearing loss), up to a fatal coma.

Contraindications
Pregnancy and patients who are hypersensitive to the cinchona alkaloids

Dosage and dosage forms
Extractum Cinchonae Fluidum (cinchona fluid extract)
Extractum Cinchonae siccum
compound cinchona tincture)
The appropriate doses of cinchona depend on several factors such as the user's age, health, and several other conditions.

Storage
Store in a cool dry place away from light

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Cryptolepis sanguinolenta

Botanical name
Cryptolepis sanguinolenta (Lindl.) Schlt

Family
Periplocaceae/Asclepiadaceae

Synonyms
Pergularia sanguinolenta Lindl; *C. triangularis* N.E. Br.

Common names
Ghana quinine; yellow – dye root, French;Quinine du Ghana

Vernacular names
Cote d'Ivoire: Anyi – Alui Okle
Ghana: Twi – Nibima, Ewe – Kadze, Hausa – Gangaman
Guinea Bissau: Banyan – Konit, Diola – Fu Lemok, Vulgar Balanta – Butnacimbore
Guinea: Fula Pulaar – Delboi, Manding Bambara – Uiduloia, Maninka – Nombon
Nigeria: Hausa – Gangamaa, Igbo (Ogwashi) – Kpolokoto
Senegal: Balanta–Butnasimbor, Diola Flup–Ahayte Buka Ka, Bambara – Vidukokoy
Sierra Leone: Koranko – Firabantikpa, Mende – Kpokoyangole
Togo: Ewe – Kedze, Ouatchi – Anotsidzen, Mina – Kadzen.

Description of the plant
Thin-stemmed twining or scrambling shrub; leaves elliptic, oblong-elliptic, apex acute to shortly acuminate, base symmetrical, petiolate, up to 7 cm long and 3 cm wide, glabrous; inflorescence cyme, lateral on branch shoots; few flowered, corolla tube up to 5 mm long, yellow; fruits pair of follicles linear; seeds with, long silky hairs. The dried plant is sweet-scented and the root has a bitter taste.

Herbarium specimen number
Ghana: GC 47510
Togo: TOGO02215

Habitat and geographical distribution
Indigenous to Africa and found in places such as Central, Eastern, and Western Africa (Tona *et al.,* 1998; Silva *et al.,* 1996; Oliver-Bever, 1986). Commonly grows in scattered open spaces, usually among forest clearings (Luo *et al.,* 1998; GHP, 1992).

Plant material of interest
Root

Other parts used
Leaf and stem

Definition of plant material of interest
Ghana quinine consists of the fresh or dried root of *Cryptolepis sanguinolenta* (Lindl.) Schlt (Periplocaceae)

Ethnomedical uses
Aqueous extract of cryptolepis is used by the Fulani traditional healers in Guinea-Bissau to treat jaundice and hepatitis (Oliver-Bever, 1986). In Zaire and the Casamance district of Senegal, infusions of the roots are used in the treatment of stomach and intestinal disorders (Silva *et al.*, 1996; Kerharo and Adam, 1974). In Ghana, dried root decoctions of the herb, prepared by boiling the powdered root in water, are used in treating various forms of fever, malaria, urinary and upper respiratory tract infections, rheumatism and venereal diseases. An aqueous decoction of the root bark is used in Congolese traditional medicine for the treatment of amoebiasis (Boye, 1989).

Biological and pharmacological activities
Scientific investigations have demonstrated a wide range of phytopharmacological actions of *C. sanguinolenta*, consistent with its traditional usage. The root has been variously used as an antimalarial, antihypertensive, antiinflammatory, antimicrobial and antihyperglycaemic agent. *C. sanguinolenta* has shown activity against *Campylobacter* infection and *V. cholera* (Sawer, 1995). Extracts of the plant have been found to be effective against *Entamoeba histolytica in vitro* (Tona *et al.,* 1998). Cryptolepine showed stronger activity than the antibiotics, co-trimazole

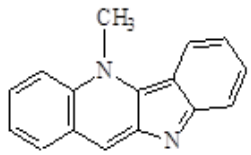
and sulphamethoxazole but just as effective as ampicillin (Paulo *et al.,* 1994b). The compound has also shown significant antihypertensive and antipyretic effects in dogs (Raymond-Hamet, 1938). The plant has demonstrated antimicrobial (schistosomes) and antifungal activity (Iwu, 1993). Aqueous extracts have been shown to be less effective than the ethanolic extracts in some of the anti-malarial and antibacterial studies (Cimanga *et al.,* 1997; Boye, 1989). An aqueous ethanolic root bark extract showed potent antibacterial, anticomplement and moderate antiviral activities but no antifungal effect could be detected (Cimanga *et al.,* 1996). Other studies have shown *C. sanguinolenta* extracts to have *in vitro* antiinflammatory and antihyperglycaemic effects (Bierer, *et al.,* 1998; Bamgbose and Noamesi, 1981). The root infusions are used in Zaire and Senegal in the treatment of stomach and intestinal disorders (Sofowora, 1982; Kerharo and Adam, 1974). An aqueous decoction of the root bark is used in Congo for the treatment of amoebiasis (Tona, *et al.,* 1998).

Clinical data

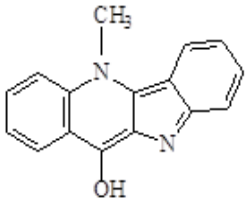
Clinical trials conducted in Ghana on the anti-malarial efficacy of the herb gave promising results (Boye, 1989; Boye and Ampofo, 1990).

Chemical Constituents

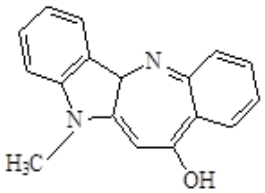
Cryptolepine, quindoline, a phenolic derivative of cryptolepine and two other uncharacterised alkaloids (Addy, 2003; Bierer *et al.,* 1998; Paulo *et al.,* 1995; Dwuma-Badu *et al.,* 1978; Gellert *et al.,* 1951).



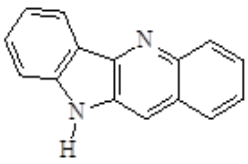
Cryptolepine



Hydroxycryptolepine



Cryptoheptine



Quindoline

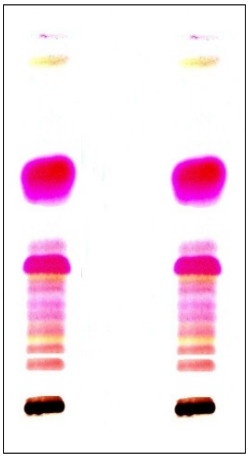
Tests for identity and purity

Moisture content: not more than 9.20%
Total ash: 8.90%
Water-soluble extractive: not less than 20.20%
Alcohol-soluble (70%) extractive: not less than 11.90%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of three characteristic spots with R_fs 0.92 (yellow), 0.72 (pink) and 0.45 (pink).



Chromatogram

Macroscopy

Root tortuous, branching with little or no rootlets; outer surface yellowish-brown, longitudinally ridged, occasional cracks or exfoliations; fracture smooth; transverse surface yellow; odour faint, bitter.

Microscopy

Transverse section shows 5 – 8 rows of thin-walled cork cells with yellowish-brown; secondary cortex about two thirds the diameter of the root, thin-walled polygonal parenchyma cells up to 1.0 μm diameter with simple and compound starch grains 0.05 – 0.18 μm; phloem parenchyma and sieve tubes separate cortex from wood, wood consists of lignified thickened vessels, fibres and tracheids, vessels 0.23 – 1.27 μm diameter, fibres 0.05 – 0.27 μm diameter.

Powdered plant material

Colour yellow; taste bitter; cork cells; parenchyma with starch grains abundant; lignified xylem elements of vessels and fibres abundant.

Therapeutic actions
Antibacterial; antiinflammatory; antimalarial (chloroquine-sensitive and chloroquine-resistant strains); antipyretic; antiviral; hypoglycaemic;hypotensive (Addy, 2003; GHP, 1992; Iwu, 1993; Silva, 1996; Brierer, 1998).

Therapeutic indications
Abdominal colic; amoebiasis; diarrhoea; fevers; hypertension; microbial infections; malaria; rheumatism; stomach aches; urinary (*Candida*) and upper respiratory tract infections and venereal diseases (Mshana *et al.,* 2000; Iwu 1993; Boye and Ampofo, 1990; Wright *et al.,* 1996; Boakye-Yiadom, 1979).

Safety data
In animal studies using rats, the LD_{50} was >3000 mg/kg and treatment did not cause changes in body weight or organ/body – weight ratios. The aqueous extract caused a dose-dependent increase in pentobarbitone sleeping time in rats in both 24-hour and 14-day subacute studies (Ansah *et al*., 2008). Additionally, the aqueous extract provoked a decrease in the spontaneous activity in mice using the activity cage (Ansah *et al*., 2008). Increased number of platelets and neutrophils was observed but there were no serious adverse effects on the liver or the kidney. Anxiogenic activity of the aqueous extract has been demonstrated in mice (Ansah *et al*., 2008). The aqueous extract is cytotoxic to mammalian cells in *vitro*. The cytotoxic activity of the major alkaloid cryptolepine is believed to be due to interaction with DNA (Bonjean *et al*., 1988) and binding to topoisomerase II (Bonjean *et al*., 1988). The aqueous extract affects reproduction and foetal development in mice through intrauterine growth inhibition, reduction in female and male fertility.

Precautions for use
Pregnancy should be excluded in the administration of the aqueous extract. Care should be taken when driving or operating machinery.

Adverse effects
Results from animal studies suggest that the aqueous extract may cause sedation, low sperm count and possible spontaneous abortion in overdosage but this has not been demonstrated in humans.

Contraindications
Pregnancy, low sperm count, gastric ulceration

Dosage and dosage forms
Decoction; infusion; tincture.
Infusion: 2.5 g teabag of root bark soaked in 150 ml (1 cup) of boiling water; steep for 5-10 minutes (Boye, 2002). Decoction: 40 g per litre of water, 3-5 teacupfuls daily
Tincture: 1:5 in 45% alcohol, 5 ml three times daily

Storage
Store in a cool dry place.

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Cymbopogon citratus

Botanical name
Cymbopogon citratus (DC.) Stapf.

Family
Poaceae

Synonyms
Andropogon citratus DC

Common names
Fever herb; Citronnelles (F). Lemon grass, French; citronelle, verveine des indes

Vernacular names
Burkina Faso: Dioula – Bin boulou;citroneli, Fulfuldé – Wuluundé
Gambia: Manding Mandinka – Kanyang Yallo
Ghana: Fante – Ti-Ahaban, Ga-Adangbe – Ti-Ba, Ewe – Tighe.
Guinea: Konyagi – I-Dɛl Tɛgag
Guinea-Bissau: Crioulo – Belgata,
Mali: Bambara– Bin boulou, Senoufo–Cafi- gna
Nigeria: Ibibio – Myoyaka Makara, Igbo (Owerri) – Achara Ehi, Yoruba – Kooko Oba.
Sierra Leone: Bulom(Kim) – Pei-Poto, Kono – Pu-Lumbi, Mendu – Pu-Lumbe.
Senegal: Bambara – cè kala
Togo: Ewe– Tsigbe, Ouatchi– Gbehoin, Mina – Fifaglass

Description of the plant
It is a stout, aromatic, coarsely perennial herb, 2 m high or more, rarely flowering, robust with odoriferous, aromatic light green leaves standing on adventitious roots; lower glumes of sessile spikelet, narrowly lanceolate, almost flat to deeply concave, with the bottom of the depression rounded and wingless at the apex. Leaf-blades are linear to filiform, narrowing at the base; leaves are fragrant, taping at the ends; 70 cm long and 5 – 15 mm broad, margins are scabrous and prominent midrib underneath; inflorescence is in panicles (Burkill, 1985).

Herbarium specimen number
Nigeria: FHI 107437
Togo: TOGO10749

Habitat and geographical distribution
Native to tropical Asia and cultivated in homes as medicinal herb; grown as an ornamental and horticultural plant in compounds, along roadsides and also embankments and on hillsides to check erosion.

Plant material of interest
Fresh or dried leaf

Other parts used
Flower

Definition of plant material of interest
Lemon grass is a fresh or dried leaf of *Cymbopogon citratus* L. (Poaceae).

Ethnomedical uses
C. citratus is used as an antimalarial, diuretic, stomachic tonic, febrifuge emmenagogue, antiseptic; anxiolytic, hypnotic; anticonvulsant, hypotensive, anticatarrhal and antiheumatic in African Traditional Medicine (African Pharmacopoiea, 1985; Burkill, 1985; Kerharo and Adam, 1974; Oliver, 1959). It is indicated for cough, lumbago, sprains, ringworm, athlete's foot; malaria, fever, jaundice, throat and chest infections, moderate-to-severe pain, hypertension, diabetes mellitus, obesity, nervous and gastrointestinal disturbances (Adeneye and Agbaje, 2007; Blanco *et al*., 2007; Tchoumbougnang *et al*., 2005; Onabanjo *et al*., 1993; Gill, 1992; Carlini *et al*., 1986).

Biological and pharmacological activities
A cream made from the plant was effective against ringworm and clinical isolates of four dermatophytes *in vitro* (Wannissorn *et al*., 1996; Lima *et al*., 1993). In a two-day trial on an experimental bird's skin, ointment and cream formulations containing lemongrass oil exhibited mosquito repellent actions comparable to that of a commercial mosquito repellent (Oyedele *et al*., 2002). The essential oil also has antibacterial activity (Wannissorn *et al*., 2005). The geranial

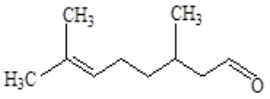
and neral components individually showed broad – spectrum antibacterial action but myrcene did not show any observable antibacterial activity on its own (Onawunmi *et al*., 1984). The essential oil also possessed antinociceptive action while oral and intraperitoneal administration of the oil increased the reaction time to thermal stimuli and strongly inhibited the acetic acid – induced writhings in mice. The opioid antagonist naloxone inhibited the oil's central antinociceptive action (Viana *et al*., 2000). Extracts of the plant have also been shown to have topical analgesic effects (Lorenzetti *et al*., 1991). *In vivo* studies have shown that the essential oil possessed anxiolytic, sedative and anticonvulsive (Blanco *et al*., 2007) as well as antimicrobial and antioxidant effects (Saccheti *et al.,* 2005) and an inhibitory effect on the diethylnitrosamine – induced early phase hepatocarcinogenesis in rats (Puatanachokchai *et al*., 2002). Leaf extracts of *C. citratus* showed antidiabetic effects *in vivo*. A daily oral intake of 125 – 500 mg/kg of aqueous fresh leaf extract of the plant reduced fasting plasma glucose and lipid parameters in normal, male Wistar rats for 42 days. The extract raised the plasma HDL-cholesterol level, but plasma triglycerides levels remained unchanged (Adeneye and Agbaje, 2007). Extracts of the plant exhibited endothelium – d ependent vasorelaxation on isolated perfused mesenteric artery preparation (Carbajal *et al*., 1989) and the ethanolic leaf extract has also been reported to have anti – mutagenic and anti-carcinogenic properties (Suaeyun *et al*, 1997; Vinitketkurmnuen *et al*., 1994).

Clinical data

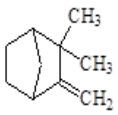
In preliminary study, lemongrass infusion had beneficial effects for the treatment of oral candidiasis in patients with HIV/AIDS Suboptimal human clinical trials have also been conducted on lemongrass, evaluating its effects for conditions like hyperlipidemia and anxiety. One study investigated lemongrass oil capsules in reducing cholesterol in hypercholesterolemic patients and found no significant benefit. Another study by Leite *et al.* (1986) showed no effect of lemongrass when used for anxiety.

Chemical constituents

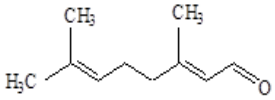
Volatile oil constituents (e.g. cymbopogone, cymbopogonol, citral, geraniol, citronellal, camphene and related monoterpenes, triterpenes and sesquiterpenes); alkaloids, saponins, flavonoids, tannins and simple sugars (Onabanjo *et al*., 1993; GHP, 1992; Hanson *et al*., 1976).



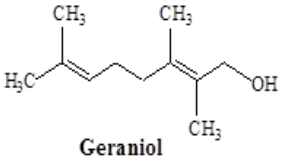
Citronellal



Camphene



Citral



Geraniol

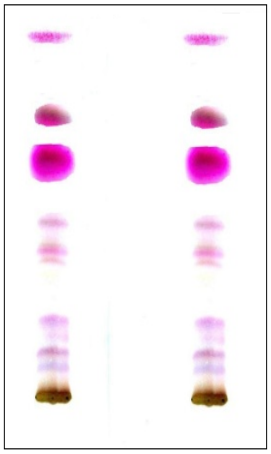
Tests for identity and purity

Moisture Content: (African Pharmacopoeiea, 1986): Not more than 68%
Total ash: Not more than 8.10%
Acid-insoluble ash: Not more than 0.90%
Water-soluble ash: Not less than 2.50%
Water-soluble extractive: Not less than 7.00%
Alcohol-soluble (70%) extractive: Not less than 9.20%
Stomata index: 30.8
Volatile oil content: not less than 0.75%.
(Elujoba and Odeleye, 2005; Odukoya *et al*., 1987).

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 oC)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100–110°C for 5 – 10 min. Presence of four characteristic spots with R_fs 0.90 (purple), 0.74 (purple), 0.62 (purple) and 0.47 (purple).



Chromatogram

Macroscopy

A perennial grass, rarely annual, herb with fragrant, aromatic leaves (lemon like), heavily scented, forming compact tufts, reaching about 1 – 2 m high; leaves borne on the culm, erect, sheath and laminal sheath surround the base of next higher leaf on culm, sheath is tubular and split on side opposite lamina; leaves are non-auriculate and usually bright green, pubescent, long and narrow, veins are normally parallel, leaf blades linear to broad with parallel venation; leaf margin is pubescent, entire with an attenuate apex, narrowing at the base, up to 60 cm long or more and up to 15cm broad; leaf blades linear or broad with parallel venation; lower leaf sheaths have characteristic wavy bloom; the plant rarely flowers, the floral shaft being 1.5 to 1.75 m long and of numerous ramifications; rhizomatous culms are 15 – 250 cm high, herbaceous and unbranched above; culm nodes are glabrous and culm internodes solid; shoots are aromatic (Folorunso *et al*., 2005; Odukoya, 1984; Kerharo and Adams, 1974).

Microscopy

Typical microscopic features of a grass/monocotyledonous species; epidermal cells of the upper surface consist of tabular, irregularly-shaped parenchymatous cells while the lower epidermis consists of similar cells containing calcium oxalate prismatic crystals; dome – shaped stomata are found on the lower surface, while the longitudinal section shows cells with sinnous walls, containing crystals of calcium oxalate; trichomes of monoseriate, multicellular, covering types; vascular elements of annular and reticulate thickening abound with conspicuous costal and intercostal zones in the abaxial surface; prickle hairs are present on the costal zone, 2.75 – 3.75 µ long with intercostal prickles of 1µ long; stomata, paracytic and solitary or in between intercostal prickles or microhairs; stomata are 1.75 – 2 µ long, 1.5 – 1.75 µ wide, being 1 or 2 parallel rows occurring in the intercostal zone; microhairs of the panicoid type present on costal and intercostal zones, 2 – 2.5 µ long, 0.5-0.75µ wide when uniseriate; few biseriate microhairs present; long cells similar in shape costally and intercostally 5.5 – 7.5 µ long, and wavy;short cells present on intercostal zone 0.5 – 0.75 µ long containing light yellowish tannins; on the adaxial surface, the costal and intercostal zones are conspicuous; in the transverse section, the leaf blade is adaxially flat with a conspicuous midrib; leaf is amphistomatic while the vascular bundles are bicollateral and arranged linearly across the lamina; sclerenchyma, osteosclerids or macrosclerids surround the vascular bundles; metaxylem measures 1.25 – 2.25 µ wide and 2.25 – 3 µ long; mesophyll is not differentiated into either palisade or spongy type, but consists of polygonal cells; costal intercostals regions are present in the tangential longitudinal section of the leaf; the costal region is sandwiched between the vessels and the sieve tubes; linear anomocytic stomata in 1 or 2 rows occur in the intercostal regions; few uniseriate non-glandular trichomes (microhair), 2.5 – 3 µ long on the epidermis are in the intercostal regions; prickles are present on both the abaxial and adaxial surfaces, 3.25 – 5.7 µ wide and 3.25 – 8.25 µ long; vessel members are annular with simple perforations; parenchyma cells are rectangular occasionally; end walls are generally perpendicular, occasionally oblique and 5 – 7.5 µ long; anticlinal walls are straight; druses and tannins are present with starch grains in the parenchyma cells of both costal and intercostal regions (Odukoya, 1984).

Powdered plant material

Lignified fibres appear with wide lumen, narrowing at the ends; more or less elongated parenchyma cells, stomata anomocytic, linearly arranged in-between the parenchyma cells; polyhydric calcium oxalate crystals; prickles from 3,25 to 8.25 µ in length; fragments of vascular bundle tissues (xylem and phloem), of annular and reticulate thickening, and unlignified with bordered pitted vessels; non-glandular, covering, trichomes, plenty of oil globules in the field of view; light-green in colour, aromatic (lemon-like) odour and characteristic taste (Folorunso *et al*., 2005).

Therapeutic actions

Analgesic; antiasthmatic (prophylactic); anticatarrhal; antidiarrhoeal; antibacterial, antidiabetic; antifungal; antirheumatic; carminative; diuretic; febrifuge; vasodilatory, antinociceptive, sedative, anxiolytic; insect repellant (lemon grass oil); sudorific (Dokosi, 1998; Ayittey-Smith, 1989).

Therapeutic indications

Asthma; catarrh; cholera; cosmetics adjuvant; diarrhoea; fever; rheumatism; ringworm.

Safety data

LD_{50} of the aqueous leaf extract in rats (p.o) was > 3000 mg/kg. No evidence of toxicity in female

rats used for the study. No effect on blood, renal or hepatic system. The aqueous leaf extract is safe based on the present study.

Precautions for use
The volatile oil (*Cymbopogon* oil), obtained by steam distillation of the fresh leaves when used as flavouring agent or as antimicrobial drug preparation, must be regulated to prevent possible undue toxicity.

Adverse effects
Large and prolonged doses may irritate the digestive tract.

Contraindication
Pregnancy and lactation

Dosage and dosage forms
Decoction: 30 g dried herb in 900 ml water; simmer until reduced to 600 ml; 1 teacup three times daily.
Infusion: 30 g dried herb in 600 ml of water; 1 teacup three times daily.
Tincture: 1:5 in 45% alcohol; 5 ml three times daily.

Storage
Store in well closed containers in a cool dry place away from light

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Euphorbia hirta

Botanical name
Euphorbia hirta L.

Family
Euphorbiaceae

Synonyms
Euphorbia pilulifera L., *E. capitata* Lam., *Chamaesyce hirta* (L) Millsp

Common names
Australian asthma herb, Queensland asthma weed, pills bearing spurge, cat's hair, milkweed, Hairy spurge (English), Euphorbe hérissée;petit euphorbe (French)

Vernacular names
Burkina Faso: Moore – Wal-biisum, Fulafulde – Intan boũgâdjé; èn èngil, Dioula – Ntugansin
Cote d'Ivoire: Baule – Adododo, Gagu – Tao Moa, Kru Bete – Blableg-Ware
Ghana: Akan – Kakaweadwe, Ewe – Notsigbe, Nzema – Aakuba
Guinea-Bissau: Fula Pulaar – Taquelpolhe
Liberia: Mano – To A Gbondo
Mali: Dogon – Peleguere Djimi, Bambara – Dabadaba Bileni
Nigeria: Yoruba–Emile, irawo'le,Fula Fulfulde–Endamyel, Hausa– Noonon Kurciyaa
Senegal: Badyara – Makoreselu, Diola Flup – Ku Tim, Fula Pulaar – En Engil
Sierra Leone: Limba – Funkele, Loko – Bumbuŋgo, Mende- Bɛlɛji
Togo: Ewe – Anonsikan, Akasselem – Melandjebe, Ouatchi – Nostika

Description of the plant
The plant is slender, often growing close to the ground. Herbaceous or erect or prostrate, 20 – 40 cm high, pubescent; with annual stems, some are perennial; covered with yellowish bristly hairs, especially in the younger parts. The older parts have reddish-purple patches. Leaves are all strictly opposite, usually markedly unequal at the base; obliquely ovate to lanceolate, rounded on one side, oblong-obovate, 2 to 5 cm long and 2 cm wide; minutely dentate or serrulate; acute apex, stipules present; asymmetrical, inflorescence in compact axillary tufts and terminal glomerulus. Small yellowish flowers; male or bisexual, ovary and capsule hairy, involucres, borne in dense, rather long pedunculate. Fruits are small, yellowish, hairy, three-celled capsules about 1 mm in diameter. Each carpel is distantly keeled with a single,

reddish, four-sided transversely wrinkled seed (NHP, 2008; GHP, 1992).

Herbarium specimen number
Ghana: GC 47751
Nigeria: FHI 107438
Togo: TOGO03188

Habitat and geographical distribution
Common weed in towns and villages near drains, roadsides and waste places; indigenous to India and most tropical countries.

Plant material of interest
Fresh or dried leaf or aerial tops

Other parts used
Whole plant

Definition of plant material of interest
Australian asthma herb consists of fresh or dried leaf of *Euphorbia hirta* L. (Euphorbiaceae)

Ethnomedical uses
Used in the treatment of fever and scorpion sting, cough, bronchial and paroxysmal asthma, amoebic dysentery, hay fever and worm infestations (NHP, 2008). In China, the plant is used to treat dysentery, athlete's foot and other skin conditions.

Biological and pharmacological activities
Aqueous extracts of the plant strongly reduced the release of prostaglandins I_2, E_2 and D_2. The extracts also inhibited platelet aggregation and depressed the formation of carrageenin induced rat paw oedema (Hiermann and Bucar, 1994). Aqueous and ethanolic leaf extracts exhibited a

similar diuretic effect to that of acetazolamide; the extracts produced time – dependent increase in urine output (Johnson *et al.,* 1999). The aqueous leaf extract caused a decrease in gastrointestinal motility in normal rats and reduced the effect of castor oil-induced diarrhoea in mice (Hore *et al.,* 2006). The lyophilized decoction of the plant had antidiarrhoeic activity in castor oil, arachidonic acid and prostaglandin E_2-induced diarrhoea (Galvez *et al.,* 1993). The ethanol extracts have been found to be non-cytotoxic and effective antibacterial agents (Vijaya *et al.,* 1995). Ethanolic extracts of the aerial parts exhibited a broad spectrum antimicrobial activity, particularly against *Escherichia coli, Proteus vulgaris, Pseudomonas aeruginosa and Staphylococcus aureus* (Sudhakar *et al.,* 2006). The plant has been shown to be effective i*n vitro* and *in vivo* and clinically, against Entamoeba, the causative agent of amoebic dysentery (Evans, 2002). *E. hirta* whole plant preparation is sold in Mali for the treatment of this condition (Keita, 1994). Aqueous and serially purified latex extracts have potent molluscicidal activity (Singh *et al.,* 2004). Orally administered doses of 100 – 400 mg/kg per day of ethanol and dichloromethane extracts of the whole plant produced a significant chemosuppression of parasitaemia in mice infected with *P. berghei berghei* (Baslas and Agarwal, 1980) and a high antiplasmodial activity (IC_{50} < 3g/ml) (Tona *et al.,* 2004). The plant possessed sedative, anxiolytic, central analgesic, antipyretic and antiphlogistic effects (Singh *et al.,* 2004).

Clinical data

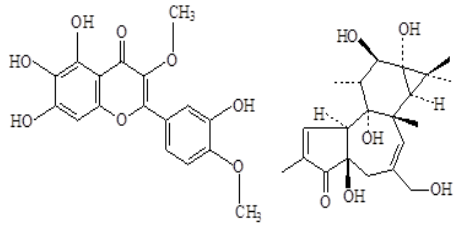
A clinical trial in Senegal showed that *E. hirta* is effective for treating amoebic dysentery (Ridet and Chartol, 1964).

Chemical constituents

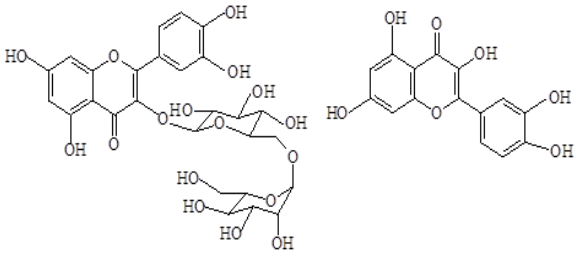
Diterpenes (phorbol esters); triterpenes (including phytosterols, i.e. *β*-sitosterol, *β*-amyrin, stigmasterol, campesterol); flavonoids (quercitrin, quercitol, myriscitrin); hydrolysable tannins (euphorbins A-E); aromatic acids (shikimic and related acids); alkaloids, coumarins, anthocyanins and saponins (GHP, 1992).

Tests for identity and purity

Total Ash: Not more than 13.60%
Acid-insoluble ash: Not more than 3.00%
Water-soluble ash: Not less than 3.00%
Water-soluble extractive: Not less than 17.00%
Alcohol-soluble (70%) extractive: Not less than 11.50%



Quercitin Phorbol



Rutin Quercetin

Palisade ratio: 3.30 – 4.38 –5.50
Stomatal index: 8.03 - 22.60 (upper surface); 18.80 - 25.00 (lower surface)
Stomatal number: 100 – 250 –400 (upper surface); 300 – 317 – 400 (lower surface)
Vein-islet number: 2.00 - 3.50
Veinlet termination number: 11.00 – 14.50

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8] , detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of two characteristic spots with R_fs 0.59 (pink) and 0.31 (purple).

Chromatogram

Macroscopy
The stem is cylindrical, often reddish or white with a milky juice; hairy stem, oppositely arranged simple leaves, oblong – lanceolate, 2 – 4 cm long, 0.3 – 1.5 cm broad, shortly petiolate, minutely dentate, apex acute; base asymmetric, margin minutely dentate or serrate; apex acute; base asymmetric and hairy on both surfaces; green with purple flush or dark green in colour, odourless; taste bland, flowers in axils of the leaf as dense round clusters or terminal cymes, apex is acuminate; fruit is trilocular and wringled, seed four-sided (GHP, 1992).

Microscopy
Surface view shows multicellular, uniseriate trichomes on both sides of leaf, some with collapsed cells, cicatrices present; the transverse section of the leaf shows a bifacial structure with both epidermal surfaces having smooth cuticle, upper epidermis consists of almost straight anticlinal walls while the lower epidermis is wavy, stomata of anomocytic type are present on both surfaces; more abundant on the lower surface; midrib region lacks collenchymatous tissue; single palisade layer; latex cells and canals occur around vascular bundles of veins including midrib; xylem vessels lignified, starch grains in mesophyll; layer of modified parenchyma immediately surrounds each vascular bundle as a peculiar characteristic of the leaf; trichomes are scattered all over the leaf, uniseriate, 3-6 celled, slightly curved, with thin warty walls, about 243.3 to 695 microns in length; idioblasts differ markedly from ordinary cells in form, size and content (GHP, 1992).

Powdered plant material
Colour green; starch occurs in large amounts; isolated latex droplets present, also in cells; long multicellular trichomes; lignified elements of vascular bundles (xylem vessels), fibres unlignified. Diagnostic features include anomocytic/anisocytic stomata; unicellular, warty, uniseriate hairs, some in fragments; epidermal cells with wavy and straight anticlinal walls, fragments of vascular elements.

Therapeutic actions
Antiasthmatic; anthelminthic; antiinflammatory; antimicrobial; antipyretic; antispasmodic (respiratory tract) (Ayitey-Smith, 1989); anxiolytic; bronchodilator; galactogogue; pectoral; sedative (GHP, 1992; Lanhers *et al.,* 1990; 1991).

Therapeutic indications
Amoebiasis; asthma; bronchitis; catarrh; constipation; cough; diarrhoea; dracontiasis; euneresis;, colic, dysentery, genito-urinary; gonorrhoea; hay fever; impotence (mild); intestinal obstruction; threatened abortion; upper respiratory laryngeal spasm; visual disturbance; vomiting (Singh *et al.,* 2004; Tona *et al.,* 1999a; GHP, 1992).

Safety data
LD_{50} of the aqueous leaf extract in rats was > 3000 mg/kg. No significant changes in Organ/Body Weight Ratios and haematology. Increased AST and ALT levels were observed in acute studies (300-3000 mg/kg) in rats but no significant adverse effects on kidney function.

Precautions for use
Caution should be taken in the administration of the aqueous extract in patients with compromised liver function and the unconfirmed carcinogenic effect due to the content of phorbol esters.

Adverse effects
Nausea, vomiting and allergic reactions

Contraindications
Pregnancy and lactation, bronchodilators, known hepatobiliary patients, elderly and children.

Dosage and dosage forms
Decoction; infusion; juice from fresh leaves; liquid extract; tincture.
Infusion: 20-30 g of dried plant per litre of water; drink 3-4 cups daily.
Decoction: 30-50 g of dried leaves; drink 3-4 cups daily.
Liquid extract (BPC 1949): 1:1 in 45% alcohol; 0.12-0.3ml three times a day.
Tincture (BPC 1923): 1:5 in 60% alcohol, take 0.6-2ml three times a day.

Storage
Store in a cool dry place and protected from light

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Hallea stipulosa

Botanical name
Hallea stipulosa (DC.) Leroy

Family
Rubiaceae

Synonyms
Fleroya stipumosa (DC) Y.F. Deng, Mitragyna stipulosa (DC.) Kuntze, *Nauclea stipulosa* DC., *Nauclea macrophylla* Perr. & Lepr. ex DC., *Nauclea bracteosa* Welw., *Mitragyna chevalieri* K.Krause

Common names
African linden, Abura (English); Tilleul d'Afrique, Bahia (French)

Vernacular names
Ghana: Akan – Subaha Akoa, Nzema – Baya
Guinea Conakry: Pular – Maninka Kouranko, Pöpö – Soussou Föfè, Kissi – Pawe
Liberia: Kru – Boh
Senegal: Diola – Bubagala

Desccription of the plant
Tree up to 15 – 20 m tall and cylindrical shaft without buttresses up to 1 m in diameter;bark, very thick and scaly, dense crown with several tufts; leaves simple, opposite, slightly leathery, elliptic, broad, and measuring 10 to 50 cm long; tap root system; spike inflorescence composed of numerous small globular flowers tight white calyx; fruit small spherical capsules.

Herbarium specimen number
Ghana: GC 7625

Habitat and geographical distribution
Species growing in areas periodically flooded, savannas and near temporary ponds. Occurs in tropical Africa (Guinea, Mauritania, Senegal, Cameroon, Chad, Sudan).

Plant material of interest
Stem bark and leaf

Definition of plant material of interest
Hallea consists of the stem bark or leaf of *Hallea stipulosa* (DC.) Leroy (Rubiaceae)

Ethnomedicinal uses
In Cote d'Ivoire, the bark is prescribed for the treatment of gonorrhea (Bouquet and Debray, 1974). In Guinea the decoction of the stem bark is used as a diuretic, antiseptic and anti-infective; the infusion is used in the treatment of female infertility and the leaves as a topical antiseptic for wounds (Magassouba *et al*., 2007). In Ghana, the

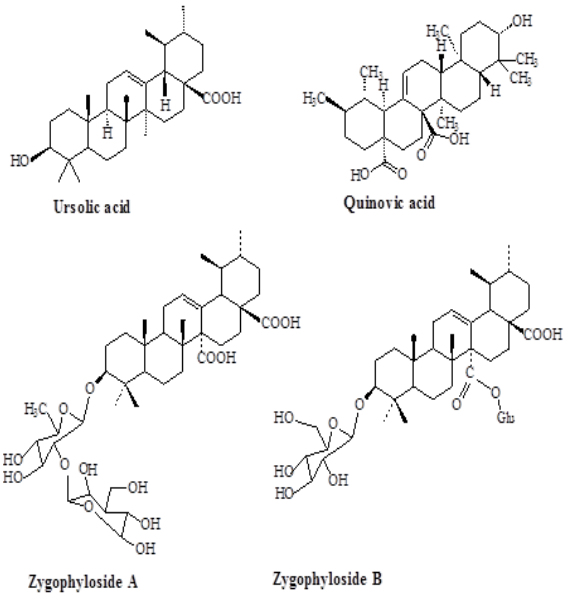
decoction of the dried stem bark, administered orally is very effective against Guinea worm (Comley, 1990). The decoction is used to treat malaria in adults (Kohler *et al*., 2002), while the bark is used for the treatment of genital, urinary and worm infestations (Adjahonoun *et al*., 1974; Wome, 1985).

Biological and pharmacological activities
The antimalarial activity of the lipophilic fraction from the stem bark, the roots and leaves has been demonstrated on *Plasmodium falciparum* strain with IC_{50} of 36.1 µ/ml, 48.7 µ/ml and 20.4 – 32.6 µ/ml, respectively. However, another study reported that the lipophilic fractions of the stem bark or root were inactive at IC_{50}> 50.0 µg/ ml (Kohler *et al*., 2002). The 40% aqueous ethanolic stem bark extracts showed antibacterial activity against *Vibrio cholera* (Akinsinde and Olukoya, 1995).

Clinical data
No information available

Chemical constituents
Many triterpenes were isolated from the plant including α-amyrin, quinovic acid--3-O-β-D-quinovopyranoside-27-O-β-D-glucopyranosyl; quinovic acid, ursolic acid, quinovin C glycoside, acid-3-O-acetyl-β ursolic; quinovic-acid-3-O-β-D-glucopyranoside; oleanolic acid; zygophyloside B, zygophyloside D, daucosterol (Fatima *et al*. 2002; Tapondju *et al*., 2002).

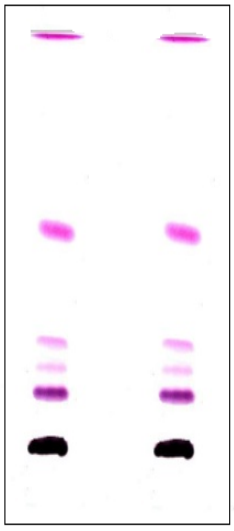
Tests for identity and purity
Moisture content:8.85%(stem bark)8.36%(leaves)
Total ash: 4.80% (stem bark) 6.00% (leaves)
Water- soluble extractive: 9.40% (stem bark)
9.01% (leaves)



Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100 - 110°C for 5-10 min. Presence of four characteristic spots with R_fs 0.60 (pink), 0.30 (pink), 0.25 (pink) and 0.20 (purple).



Chromatogram

Macroscopy

Leaf green, when fresh, simple with a long petiole; lamina 15-45 cm long, 8-15 cm broad; elliptic in shape; margin entire; apex is obtuse, leaf base cuneate or round, reticulate venation, glabrous but pubescent on the nerves beneath, fleshy texture with a prominent midrib.

Microscopy

The adaxial epidermal surface has straight anticlinal walls with many oil globules and sclereids; no stomata and trichomes; abaxial surface has many sclereids and stomata which are of diacytic and paracytic types (thus the leaf is hypostomatic); transverse section of leaf is dorsiventral with 2 layers of compactly arranged epidermal cells on the ventral side covered by a thin cuticle; upper epidermis is followed by a single layer of palisade tissues; spongy mesophyll loosely arranged with many intercellular spaces; mid-rib has prominent concave protuberance bearing 3-7 celled long, multicellular covering-type trichomes with conical heads; vascular bundles dome shaped with 3-4 celled xylem. Calcium oxalates (i.e. raphides) are present on the adaxial surface and in the cortex region.

Powdered plant material

Parenchymatous cells of the epidermis; many floating oil globules, stone cells or sclereids, stomata of diacytic or paracytic types, some palisade parenchyma cells, the trichomes are covering type, multicellular and conical heads, xylem vessels, calsium oxalate crystals

Therapeutic actions

Antimalarial, antibacterial

Therapeutic indications

Malaria, cholera, anaemia, wounds

Safety data

Twenty-four hour acute studies in mice (p.o) showed that, the LD_{50} of the aqueous extract of the leaves of the plant is >2000 mg/kg. Sub-acute studies did not show any clinical signs of toxicity after treatment of male and female mice (500 to 2000 mg/kg; *p. o*) for 14 days. The sub-chronic administration of aqueous extract of a mixture containing the plant did not affect weight gain in rats over time or the mean wet weight of organs. There were significant variations in the biochemical, hematological and urinalysis data compared to the control rats. There were no changes in the morphology of liver, kidney, lung and heart tissues at doses of 28, 280 and 560 mg/kg per day (Martey *et al*. 2010).

Precautions for use

Do not exceed the recommended doses

Adverse effects
Large doses may cause gastrointestinal disturbances

Contraindications
Pregnancy and lactation

Dosage and dosage forms
Decoction, Infusion
Decoction: 30 g of dried plant material in 900 ml water; boil until reduced to 600 ml; two tablespoonfuls three times daily.

Storage
Store in a cool dry place

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Harrisonia abyssinica

Botanical name
Harrisonia abyssinica Oliv.

Family
Simaroubaceae

Synonyms
Harrisonia occidentalis Engl., *Zanthoxylum guineense* Stapf.

Common names
Baingou (French)

Vernacular names
Ghana: Asante – Fintinko,
Guinea Conakry: Kpèlè – Zhinwuon Nyegolo
Cote d'Ivoire: Anyi – Baingu
Nigeria: Hausa – Arujere
Sierra Leone: Kissi – Mama Kundu
Togo: Ewe – Xedja, Mina – Hedjan, Adja – Xedjatsi

Description of the plant
Highly branched shrub, sometimes climbing, reaching 8 m high; bark light brown or grey with long, flexible branches; leaves alternate, odd-pinnate compound, comprise of 2 to 7 pairs of leaflets up to 25 cm long; inflorescences axillary or terminal panicle, erect, glabrous or hairy, 2 to 14 cm long; flowers bisexual, regular, 4 to 6 lobes, glabrous; fruit depressed, globose, berry red or black at maturity with 4-8 lobes.

Herbarium specimen number
Ghana: GC 47015
Togo: TOGO08458

Habitat and geographical distribution
Dry evergreen forest patches or xerophytic (in Savannah). It is often found in coastal regions.

Plant material of interest
Leaf or stem bark

Other parts used
Root bark

Definition of plant material of interest
Harrisonia consists of the leaf or stem bark of *Harrisonia abyssinica* Oliv. (Simaroubaceae).

Ethnomedical uses
The powdered root bark and root decoction or infusion is used against venereal diseases, fever, malaria, diarrhoea, intestinal worms, urinary diseases, gonorrhea, stomach and tooth ache. Leaves with seeds of *Aframomum melegueta*, kaolin and salt is effective against vaginal

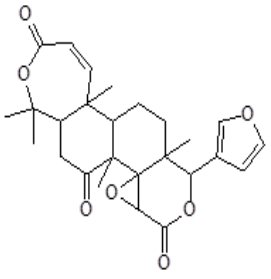
discharge. The roots are chewed with palm kernel as an aphrodisiac (Balde, 1990), while the root decoction is used against malaria, gonorrhoea, tuberculosis and schistosomiasis. The decoction of young roots is effective against dizziness, insomnia, nausea, vomiting, orchitis and tuberculosis. The decoction can also cause abortion (Kirira *et al*., 2006; Hassanali *et al*., 1987).

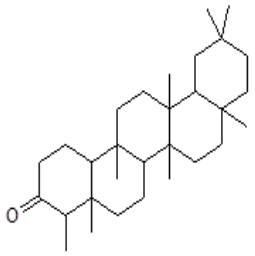
Biological and pharmacological activities
Numerous studies have demonstrated the antiplasmodial activity of the plant against strains of *Plasmodium falciparum* (Tahir *et al*., 1999). The methanolic leaf and stem bark extracts exhibited antiplasmodial properties with IC_{50} of 50-60 µ/ml and 4.7 g/ml respectively. The aqueous and chloroform root extracts were inactive against *Plasmodium* strains (Spencer *et al*., 1947). The methanol extract of the leaves was active against *Mycobacterium phlei* (Anani *et al*., 2002), while the ethanol and chloroformic extracts of the root also showed activity against *Mycobacterium fortuitum* with MIC greater than 1 mg/ml (Balde *et al*., 1995). The leaf extract was found to be active against *Bacillus subtilis*, *Staphylococcus aureus* but inactive against *E. coli*, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* (Anani *et al*., 2002) and the methanolic root bark extract showed activity against *Helicobacter pylori* with MIC of 250 µ/ml (Fabry *et al*., 1996). The extracts of the plant have been studied on other pests and vectors; the ethanolic stem bark extract was inactive in mice experimentally infected with *Schistosoma mansoni* (Balde *et al*., 1989) although nonpolar extracts showed high toxicity against *Biomphalaria glabrata*. The methanolic root-bark extract (0.03%) demonstrated activity against *Candida albicans* (Sawhney *et al*., 1978)

whereas the methanolic leaf extract was inactive against the same species and other fungal strains (Anani *et al*., 2002). The methanolic leaf extract of a sample obtained from Togo was active against *Herpes simplex* (250 µ/ml), Sindbis virus (500 µ/ml) and poliovirus (500 g/ml) (Hudson *et al*., 2000). The aqueous, ethanolic and chloroformic extracts of the root bark showed a moderate to marked activity against *Herpes simplex* type 1, Coxsackie B2 and Semliki forest (Balde *et al*., 1995).

Clinical data
No information available

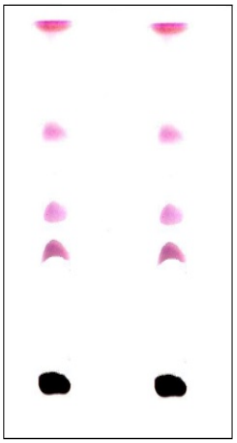
Chemical constituents
Steroids/triterpenes: sitosterol, stigmasterol, campesterol, poriferasterol; stigmastenone, stigmastatrienone, sitostenone, friedelanone; methylcholestenone; cycloabyssinone (Balde *et al*., 2000); limonoids: obacunone; harrisonine; acetoxyharrisonine; diacetoxyharrisonine; pedonine; atalantolide; dehydroriciopsine (Okorie, 1982, Liu *et al*., 1982; Rajab *et al*., 1997, 1999; Chabbra *et al*., 1984, Nakanishi, 1982, Hassanali, 1987 ; Rajab *et al*., 1999; Rugutt *et al*., 2001; Balde *et al*., 1987, 1988) ; quassinoide: perforaquassine A (Rajab *et al*., 1999); chromones: alloptaeroxylline; hydroxymethyl alloptaeroxylline; peucenine (Okorie, 1982; Balde *et al*., 1987); terpenoid (prenylated polyketides): oumarone, bissaone, aissatone, dalandaone (Balde *et al*., 2001); fatty acids; anthocanidines, polysaccharides, polyuronides (Balde, 1990); anthocyanidins, saponins, essential oils (Chhabra *et al*., 1984).


Obacunone


Friedelanone

Tests for identity and purity
Water content: 8.35% (Stem bark)
Total ash value: 9.42% (Stem bark)
Water-soluble extractive: not less than 10.96% (stem bark)

Chromatographic fingerprints
Chloroform extract
Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8] , detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spots with R_f sof 0.92 (pink), 0.69 (purple), 0.47 (purple) and 0.34 (purple).


Chromatogram

Macroscopy
Leaf is green when fresh; compound and shortly petiolate; lamina 3-5 cm long, 1-2 cm broad; oblanceolate to elliptic in shape; margin entire; apex is round or slightly acuminate, leaf base is attenuate, venation is reticulate, leaf surface is glabrous above but pubescent beneath, texture is papery with a prominent midrib.

Microscopy
Epidermal cells have undulating anticlinal walls on the adaxial surface and straight to wavy on the abaxial; cells are striated; both surfaces have many oil globules; short unicellular trichomes with multicellular base as well as stellate trichomes; some of the cells on the abaxial surface are lignified; leaf dorsiventral in transverse section, single-layered epidermis on both surfaces with thick cuticle; epidermal cells are cuboid-rectangular in shape and are compactly arranged; lower epidermis is also single layered with thin cuticle and many paracytic stomata, hence the leaf is hypostomatic; mesophyll is differentiated into palisade and spongy parenchyma with 2 layers of palisade parenchyma adjoined to the upper epidermis; spongy tissues are isodiametric, 3-4 cells thick and loosely connected; mid-rib shows narrow protuberance at the ventral side and 2 layers of epidermis; protuberance on the dorsal side is wide; 3-4 celled multicellular trichomes are

present on the protuberances; vascular bundles are centrally placed with 4-6 celled xylem forming a convex arc for the phloem.

Powdered plant material
Wavy epidermal parenchymatous cells, short unicellular covering and stellate trichomes, xylem vessels, some palisade cells are seen

Therapeutic actions
Antimalarial, antibacterial, antifungal, antiviral (Anani *et al*., 2002; Hudson *et al*., 2000; Fabry *et al*., 1998; Balde *et al*., 1995; Balde *et al*., 1990; Sawhney *et al*., 1978).

Therapeutic indications
Malaria, infections

Safety data
The LD_{50} of the aqueous stem bark (*p.o*) extract in mice was >2000 mg/kg in 24 hours; no clinical signs of toxicity were observed after treatment of male and female mice (500 to 2000 mg/kg; *p.o*) for 14 days.

Precautions for use
Do not exceed the stated doses

Adverse effects
May cause headache and dizziness

Contraindications
Pregnancy and lactation

Dosage and dosage forms
Decoction, infusion
Decoction: 30 g of dried plant material in 900 ml water; boil until reduced to 600 ml; two tablespoonfuls three times daily.

Storage
Store in a cool dry place away from light

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Hibiscus sabdariffa

Botanical name
Hibiscus sabdariffa L.

Family
Malvaceae

Synonyms
Hibiscus digitatus Cav.; *Hibiscus gossypiifolius*; Mill., *Hibiscus sanguineus* Griff.; *Sabdariffa rubra* Kostel

Common names
Red Sorrel, Karkade, Roselle, Hibiscus, Sudan tea, Zobo (English), l'Oiselle de Guinée, thé rose d'Abyssinie, oseille rouge (French)

Vernacular names
Burkina Faso: Bobo – Yoro, Fulfuldé – Follere; pôllê, Dioula – Dah wiléni, Mooré – bito ou wegderé
Gambia: Fula Pulaar – Foleray, Manding Mandinka – Dawaso, Wolof – Bissab
Ghana: Dagbani – Dibemre, Hausa –Yakuwa, Konkomba – Tingyanbam
Guinea: Basari – Yamen, Fula Pulaar – Folere Ba Di, Konyagi – Yavetyan
Guinea-Bissau: Balanta – Mbatu, Crioulo – Baguiche, Manding Mandinka - Cutcha
Mali: Dogon – Handjibane, Bambara – Dah Bileni, Senoufo – Tangnire
Niger: Dende – Jisima, Songhai – Jisima
Nigeria: Fula Fulfulde – Dorongu, Hausa – Abin Kan, Yoruba – Amukan, isapa
Senegal: Vulgar – Bassap, Tukulor – Folerebadi, Bambara – Da Kumu
Sierra Leone: Bulom – Satoɛ, Koranko – Dagbami, Krio – Sakpa
Togo: Ewe – Anyegba, Mina – Gnatu, Kabye – Gnotu

Description of the plant
A tropical, annual plant, 150–210 cm tall, making a broad clump of branches from the base; originally from West Africa; lobed, reddish leaves; stems also reddish, nearly or quite glabrous. The most important edible part is the fleshy sepal or calyx, intensely red, tastes acidic, and harvested before developing into woody matter. The calyx is the part that is left over after the bloom. Leaves are ovate and undivided, stems are 7.2-9.6 cm across, leaves are 3-lobed or parted, and lobes measure 2.4 cm or more, normally broad and crenate-serrate or dendate. Flowers axillary, solitary and nearly sessile. Corolla, yellow and twice as long as its thickness. Fruits, ovoid, pubescent and 1.2-1.8 cm long (GHP, 2007).

Herbarium specimen number
Ghana: GC 53222
Nigeria: FHI 86659
Togo: 04434

Habitat and geographical distribution
The plant originates from Sudan, Egypt and Southeast Asia. It grows well in the savanna areas of Nigeria where it now constitutes a popular beverage called "zobo" and is commonly taken as a drink.

Plant material of interest
Calyx and calyculus

Other parts used
None

Definition of plant material of interest
Hibiscus is the dried calyx and calyculus of *Hibiscus sabdariffa* L. (Malvaceae).

Ethnomedical uses
The dry calyx of this plant possesses great commercial value because of its use as a plant colorant for food and drugs, but principally due to its use as beverage and, recently, for its antihypertensive properties (Haji-Faradi and Haji-Tarkhani, 1999). The plant is a tropical beverage used commonly in folk medicines to treat hypertension, pyrexia, inflammation, liver disorders, kidney and urinary bladder stones, and obesity (Liu *et al*., 2006). Its leaves are commonly used as a diuretic, sedative and refrigerant, and its fruits are considered to be an anti-scorbutic. The calyces are commonly prepared as a drink and used as a mild diuretic, a colorectal, an intestinal anti-septic, a mild

laxative, and as an aid in heart and nerve conditions, to lower blood pressure and to treat calcified arteries (Ajay *et al.*, 2007; Onyenekwe *et al.*, 1999).

Biological and pharmacological activities

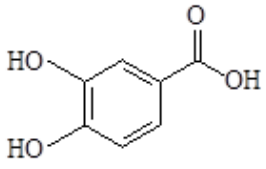
It is most probably spasmolytic and may protect against angina pectoris. It can be used to facilitate weight gain. Studies have confirmed its ethnomedical use as an antihypertensive (Carvajal-Zarrabal *et al.*, 2005; Hansawasdi *et al.*, 2001). The aqueous extracts of the calyx of *H. sabdariffa* in anaesthetized rats caused a dose-dependent decrease in mean arterial pressure (Hirupanich *et al.*, 2006). Sectioning of the right and left vagal nerves did not have a significant effect on the fall in mean arterial pressure. Cholinergic blockade with 0.2 mg kg^{-1} atropine and histaminergic blockade with 1 mg kg^{-1} cimetidine and 15 mg kg^{-1} promethazine significantly attenuated the hypotensive response (Hirupanich *et al.*, 2006). The dried flower extracts possessed antioxidant activity and protected rat hepatocytes from t-BHP-induced cytotoxicity and genotoxicity (Christian *et al.*, 2006; Falade *et al.,* 2005). A lectin, reacting with T, Tn, and Th polyagglutinable red blood cells present in an extract from the seed of the plant was found to be a useful addition to those available for distinguishing various types of red blood cell polyagglutinability. Topical application of protocatechuic acid isolated from the plant (5, 10 or 20 mmol) to mice which were initiated with benzo[α]pyrene (B[α]P), 5 minutes prior to TPA (15 nmol) treatment twice weekly, for 20 weeks, significantly inhibited the incidence of tumours, while all the mice in the TPA-treated group developed tumours. The same doses of PCA also reduced the formation of hydrogen peroxide in the mouse skin. These results indicate that PCA possesses chemo-preventive potential (Herrera-Arellano *et al.*, 2004).

Clinical data

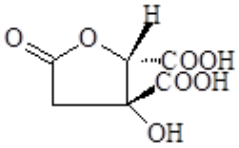
The urine of 36 healthy subjects, after consumption of the flower juice, showed a decrease of creatinine, uric acid, citrate, tartrate, calcium, sodium, potassium and phosphate but not oxalate (Carvajal-Zarrabal *et al.*, 2005). This could help the treatment and prevention of renal stones.

Chemical constituents

Tannin (catechin), anthocyanin (delphinidin and cyanidin), iron, calcium, zinc; aluminum, chromium, copper, iron, hibiscus acid, protocatechuic acid, heterogeneous acid polysaccharides, phenolic compounds, flavonoids, *β*-carotene, riboflavin, thiamine, niacin, and the ascorbic, malic and hibiscic acids.



Protocatechuic acid



Hibiscus acid

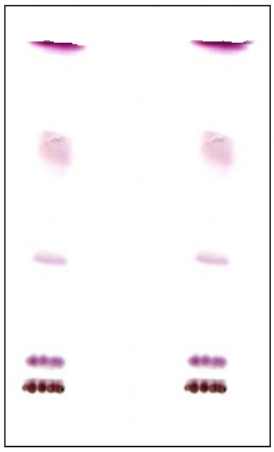
Tests for identity and purity

Moisture content: Not more than 12.00%
Total ash: Not more than 10.00%
Acid – insoluble ash: Not more than 1.50 %
Water-soluble extractive: Not less than 40.00%
pH of decoction: 3.20

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of two charateristic spots with R_fs of 0.37 (purple) and 0.08 (violet).



Chromatogram

Macroscopy

The calyx is wine in colour, gamosepalous, actinomorphic with valvate aestivation. The calyx is coriaceous.

Microscopy

Epidermal cells are thin and polygonal; parenchyma cells are polygonal 1.5-16 µ in diameter, with straight anticlinal walls; vascular

bundles are collateral and linearly arranged; xylem vessels are annular, abundant druses are conspicuous; chromoplasts present as black spots and tannins as light yellow; druse crystals also occur in the parenchymatous cells; monohydric and trihydric crystals are rarely present (NHP, 2008).

Powdered plant material
Parenchymatous cells of the epidermis, vessel members mostly of annular thickening; aqueous suspension of powdered material gives blue colouration to ferric chloride solution.

Therapeutic actions
Antiseptic, aphrodisiac, astringent, resolvent, cholagogue, digestive, diuretic, stomachic, mild laxative, sedative, antihypertensive, antitussive and uricosuric (Perry, 1980).

Therapeutic indications
Gastrointestinal disorders, drunkenness, hypercholesterolemia, kidney stone, liver damage (Hirunpanich *et al*., 2006; Morton, 1987).

Safety data
The LD_{50} of the aqueous leaf extracts (*p.o*) in mice was >2000 mg/kg in 24 hours; no clinical signs of toxicity were observed after treatment of male and female mice (500 to 2000 mg/kg; p.o) for 14 days.

Precautions for use
Prolonged consumption in man could produce toxic effects (Alarcon-Aguilar, 2007). Results of histopathological studies on animals showed that prolonged usage of the extract in high doses could cause liver injury while the effect was mild at small dose levels. Though the average consumption of 150–180 mg/kg per day appears safe, the extracts should be taken with caution (Alarcon-Aguilar *et al*., 2007).

Adverse effects
Excessive use may cause gastrointestinal disturbances in some patients

Contraindications
Pregnancy and lactation; Patients with liver disease

Dosage and dosage forms
Decoction
"Zobo" is a popular drink among the native communities in West Africa with no specific dosage regime. Generally for decoction, 30 g of dried calyx in 900 ml of water, boil until reduced to 600 ml, 1 teaspoon three times a day.

Storage
In a cool dry place, protected from light and moisture.

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Hymenocardia acida

Botanical name
Hymenocardia acida Tul.

Family
Hymenocardiaceae

Synomyms
Hymenocardia mollis Pax.

Common names
Heart-fruit (English), Cœurs-volants (French),

Vernacular names
Burkina Faso: Dioula – Grengeni; komoni; tanyaro, Fulfuldé – samatahi;gnohi;péléti
Ghana: Akan – Duakokowa, Brong – Sabrakyi
Mali: Bambara – Grègnéni, Malinké – Diegbè, Pular – Pellitoro
Senegal: Wolof – Enkélèn

Description of the plant
The generic name *Hymenocardia* is derived from the Greek words 'hymen' - membrane and 'kardia '- heart, in reference to the heart-shaped fruits which have a transparent membrane (hymen). The specific name *acida* describes the sour taste of its fruits (Burkill, 1994). *H. acida* is a small savanna tree or shrub about 9 m high; branchlets become rusty brown as the bark peels; the bole is short, often flattened and usually crooked; branches form a fairly heavy, somewhat rounded crown; bark smooth or flaky, pinkish-brown when fresh but becoming pale brown or grey later; leaves thin, leathery, elliptic-oblong up to 8.75 cm long and 3.75 cm broad, usually pubescent when young with a dense mat of fine hairs and with golden glands beneath, apex obtuse to rounded, base obtuse; petiole slender, up to 1.8 cm long; flowers unisexual, male flowers reddish-yellow occurring in clusters of spikes up to 6.5 cm long; calyx cupular, red, anthers creamy white, female flowers green, placed on axils of leafy lateral branches and bearing a prominent crimson stigma spreading about 1.25 cm; fruit compressed, obcordate and reddish-brown, 2.5 cm long and 2.5-3.75 cm broad, developing in pairs along one edge, each with a thin pale brown nearly square wing; seed flattened, glossy brown.

Herbarium specimen number
Ghana: GC 45069

Habitat and geographical distribution
The plant is found in the Sudanese and Guinean savannas, on land more or less sandy, loamy or clay. Also present in savanna and deciduous

woodlands, often on lakeside dunes. Occurs in tropical Africa from Senegal to Cameroun.

Plant material of interest
Leaf

Other parts used
Stem-bark, root-bark

Definition of the plant material of interest
Hymenocardia is the fresh or dried leaf of *Hymenocardia acida* Tul. (Hymenocardiaceae).

Ethnomedicinal uses
The leaf decoction is used to treat malaria (Vonthron-Senecheau *et al*., 2003), diabetes and skin ulcers (Igoli and Gray, 2008). The decoction of the roots is used as a mouthwash against caries and bad breath (Kerharo and Adam, 1974); it is hypotensive, antipyretic and antimalarial (Bernard, 2001) and also used to treat sickle cell crises (Mpiana *et al*. , 2007), stomatitis, diarrhoea, dysentery, gastric ulcers, colic and painful periods (Ukwe, 1997). When mixed with honey, the leaf decoction is used to treat digestive disorders (Ukwe, 1997). The infused mixture of bark and leaves is used against respiratory disorders, hypertension, epilepsy and insanity (Basilevskaia, 1969; Diallo, 2002).

Biological and pharmacological activities
The plant extracts showed antimicrobial activity against *Staphylococcus aureus* and *Bacillus cereus*. The extract was inactive against the Gram-negative bacteria and fungi tested. The aqueous extract has anti-inflammatory and anticomplement properties. It interferes with both classical and alternative pathways of the complement system with MICs of 13.32 and

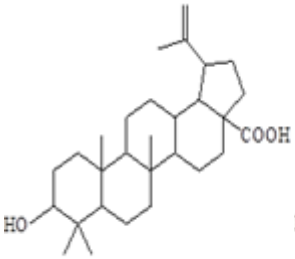
60.34 mg/ml (Balde *et al*., 1996). Mpiana *et al*., (2007) showed that the plant has significant antisickling activity. The observed diuretic effect of the aqueous extract was comparable to furosemide. The hydroalcoholic extract exhibited antioxidant properties (3038 ± 66 µmol TE / g) similar to chlorogenic acid (3165 ± 186 micromol TE/g) and superior to the ethanol extract of Rosemary (591 ± 20 µmol TE/g) [Duval and Baldi, 2010]. The aqueous extracts possessed a vasorelaxant effect due partly to a direct action on the contractile apparatus and also by stimulation of the vascular endothelium (Duval and Balde, 2010), while the dichloromethane extract of the leafy twigs showed a significant anti-trypanosomal activity and moderate activity against *Plasmodium falciparum in vitro*. The crude extract of the root showed significant anthelmintic activity against the intestinal parasite *Haemonchus contortus*. An ethanolic extract of the roots showed a significant antibacterial activity against *Klebsiella pneumoniae, Staphylococcus aureus, Streptococcus mutans* and *Salmonella enterica in vitro*, as well as spasmolytic and anti-inflammatory activities *in vivo* in mice and rats.

Clinical data

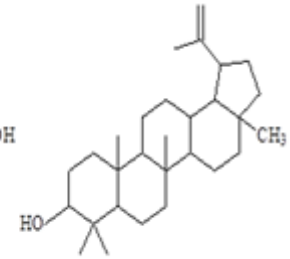
Clinical studies confirmed the antihypertensive effects of the extracts and improved dosage forms (tea bags, capsules microspheres) [Duval and Baldé, 2010].

Chemical constituents

Sterols, proanthocyanidins, coumarins, flavonoids, triterpenoids (betulinic acid and lupeol) (Diallo, 2004); alkaloid (hymenocardine peptide) (Pai *et al*. 1968); tannins.



Betulinic acid



Lupeol

Tests for identity and purity

Moiture content: 9.90%
Total ash: 4.25%
Water-soluble extractive values: 8.17%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8] , detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic pink spots with R_fs 0.65, 0.34, 0.31 and 0.21.

Chromatogram

Macroscopy

Leaf green when fresh, simple and shortly petiolate; lamina 4-8cm long, 1.5-4 cm broad; elliptic and oblong in shape; margin entire; apex obtuse, leaf base is round and venation reticulate, leaf surface glabrous, young leaves are pubescent at the base; texture is fleshy with a prominent midrib.

Microscopy

Leaf adaxial epidermal surface, straight, polygonal cells, heavily lignified and stomata absent, striations visible, unicellular, non-glandular trichomes at the surface edges, abaxial surface has straight, undulating to round anticlinal walls, glandular, multicellular trichomes, sometimes peltate; isobilateral; epidermis, single-layered with hypodermal cells; cell shape is polygonal and the mesophyll is undifferentiated, transverse section passing through the mid rib, showing protuberances on both ventral and dorsal sides; thick cuticle at the grooves and vascular bundles in five bunches at the centre, xylem vessles surrounding the phloem.

Powdered plant material

Parenchymatous cells of straight polygonal walls, unicellular, covering trichomes, xylem vessels

Therapeutic actions

Antihypertensive, antimalarial, antimicrobial, antiinflammatory, antisickling, diuretic, antioxidant, vasorelaxant.

Therapeutic indications
Arterial hypertension, malaria, diabetes, impotence, diarrhoea, dysentery, gastric ulcers, colic, painful menstruation, sickle cell disease, trypanosomiasis (Sara *et al*., 2004; Ukwe, 1997; Mpiana *et al*., 2007; Igoli and Gray, 2008; Vonthron-Senecheau *et al*., 2003; Igoli *et al*., 2005).

Safety data
In a 24-hour acute study, the LD_{50} of the aqueous leaf extracts (*p.o*) in mice>2000 mg/kg; no clinical signs of toxicity were observed after treatment of male and female mice (500 to 2000 mg/kg: *p.o*) for 14 days.

Precautions for use
Do not exceed the recommended doses

Adverse effects
Excessive dose may cause gastrointestinal disturbances

Contraindications
Patients with postural hypotention

Dosage and dosage forms
Decoction: Boil about 90 g of leaves in 500 ml water for about 30 minutes. Take 1 cup (about 75 ml) 3 X per day (per-os)

Storage
Store in a cool dry place

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Khaya senegalensis

Botanical name
Khaya senegalensis A. Juss.

Family
Meliaceae

Synonyms
Swietenia senegalensis Lam.

Common names
Dry zone mahogany, mahogany, African cedar (English); Cailcedrat du Sénégal, Acajou du Senegal (French)

Vernacular names
Burkina Faso: Mooré – kuka, Dioula – Djala, Fulfuldé – kayi;kayl
Cote d'Ivoire: Malinké – Jala
Ghana: Twi – Kuntunkuri, Fante – Okum, Ewé-Logo
Mali: Bambara – Jala, Dogon – Pell, Peulh – Kaille
Nigeria: Yoruba – Oganwo, Hausa – Madaci, Ibo – Ono onu
Senegal: Serer - N'garin, Wolof – Hay, Diola – Bu ririt
Togo: Ewé – Mahougen, Ouachi – Mahougani

Description of the plant
It is a tree of up to 40 m high with a girth of about 4 m, branching into 2-3 main limbs at about 8 m, giving a wide spread crown; compound pinnate leaves, leaflets 6-8 pairs, elliptic-lanceolate, opposite, glabrous; inflorescence, conspicuous panicles; flowers cream-coloured (Adegbola, 1986).

Herbarium specimen number
Ghana: UIH 13757
Mali: 0731 DMT
Nigeria: 107447 FHI

Habitat and geographical distribution
Widely distributed in the savanna forests of Africa.

Plant material of interest
Stem-bark

Other parts used
Bark, Leaf, root

Definition of plant material of interest
Mahogany consists of the fresh or dried stem bark of *Khaya senegalensis* A. Juss (Meliaceae).

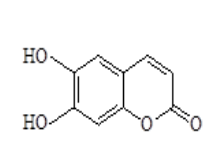
Ethnomedicinal uses
The bitter stem bark is used as a remedy for fever. The decoction or fresh bark macerated in cold water or the dried bark, pulverized and mixed with salt is taken in small doses every other day. The bark is used as stomachic and bitter tonic, depurative, vermifuge and taenicide to treat syphilis. The bark and crushed seeds are used as emmenagogue. Cold infusion of the bark is given to horses as a tonic to improve appetite and to cattle suffering from liver fluke. Dried pulverized bark is used as a dressing for ulcers on the backs of camels and horses (Adesogan *et al*., 1967; Androulakis *et al*., 2006).

Biological and pharmacological activities
A limonoid from the aqueous extracts of the stem bark and leaves exhibited a strong antisickling activity (Fall *et al*., 1999). Local application of ointments made from the hydro-alcoholic extract of the bark on laboratory animals showed that the plant has anti-inflammatory activity. An extract of the bark also showed the anti-proliferative and pro-apoptotic effects on cancer cell lines (Androulakis *et al*., 2006). Extracts were more potent against *Culex annulirostris,* hexane and ethanol were the best solvents for the extraction of the essential oils (Shaalan *et al*., 2006). The anthelmintic constituents of the bark extract demonstrated both *in vitro* and *in vivo* activity against gastrointestinal nematodes of sheep (Ademola *et al*., 2009). Koko *et al*. (2008) reported the *in vitro* immunomodulating properties of ethanolic bark and leaf extracts. Alcoholic extracts at a dose of 2 g/kg caused depression, sedation and reduced locomotor activity in mice; it also protected 70% of the mice against leptazol-induced convulsions. 3α,7α-

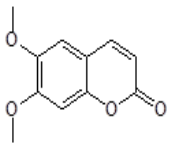
dideacetylkhivorin limonoid, isolated from the methanol extract, showed significant growth inhibitory activities against MCF-7, SiHa and Caco-2 cells with IC_{50} values in the range of 0.07-0.14 µ (Zhang *et al*., 2007). Oral administration of ethanolic stem bark extract (2 mg/kg) in rats, significantly increased the activities of liver alkaline phosphatase, alanine aminotransferase and aspartate aminotransferase compared with the control. The results indicate that the ethanolic stem bark extract has the ability to induce synthesis of the liver enzymes (Yakubu *et al*., 2005).

Clinical data
No information available

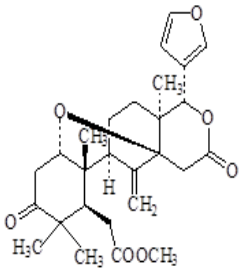
Chemical constituents
Limonoids (methyl angolensate, khayalenoids A and B), 2, 6-dihydroxybenzoquinone, capsterol, stigmasterol and β-sitosterol; scopoletin, scoparone and aeculetin (Yuan *et al*. 2009; Zhang *et al*., 2009).



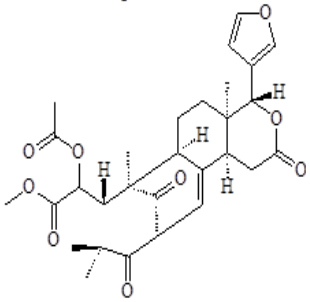
Aesculetin



Scoparone



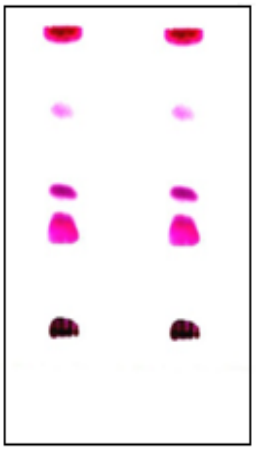
Methyl angolensate



Khayalenoid E

Tests for identity and purity
Moisture content: Not more than 5.10%
Total ash*:* 20.07%
Acid–insoluble ash*:* Not more than 1.00%.
Water soluble ash*:* Not less than 0.60%.
Water-soluble extractives: Not less than 16.69%.
Alcohol-soluble (70%) extractives: Not less than 15.75%.

Chromatographic fingerprints
Chloroform extract
Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of three characteristic spots with R_fs 0.68 (pink), 0.45 (pink) and 0.32 (pink).



Chromatogram

Macroscopy
Stem-bark occurs usually in chips or curved pieces, up to 2 cm thick; outer surface, rough, reddish brown with grey and white patches; inner surface brown, finely longitudinally striated; fracture, fibrous in the inner portion and granular in the outer portion**.**

Microscopy
Cork cells with lignified sclereids in groups in the cork layer, radially elongated with narrow lumens. Layers of cork cells are filled with calcium oxalate prisms immediately next to the beginning of the parenchyma, phloem and vascular rays; sieve plates are thick-walled; cluster crystals of calcium oxalate are scattered throughout the parenchyma; phloem fibres, 151-411–1430 µ in length, 14-20-35 µ in width; calcium oxalate prisms, 11-46 x 7-35 x 7-18 µ in length, breadth and height, respectively; calcium oxalate rosettes, 5-14-39 µ in diameter; stone cells, 52 – 275 x 52-119 µ; medullary rays are 2 cells or more wide, with rectangular thin-walled cells bounded by groups of phloem fibres alternating with parenchyma.

Powdered plant material
Powdered bark is reddish brown, characterized by isolated, curved and straight phloem fibres, calcium oxalate prisms and rosettes, stone cells; fragments of cork cells and parenchyma tissue.

Therapeutic actions
Antisickling, anti-inflammatory, anti-proliferative, anthelminthic, antimalarial, antimicrobial, antioxidant

Therapeutic indications
Anaemia, arthritis, boils, fever, chicken-pox, convulsion, chronic weakness, general debility, haemorrhoids, headache, heat rash; intestinal helminthiasis, loss of appetite, malaria, sexually transmitted disease, ulcer, worms (Mshana *et al*., 2000; Dennis, 2002; GHP, 1992).

Safety data
In a 24-hour acute study, the LD_{50} of the aqueous stem bark extracts (*p.o*) in mice was >2000 mg/kg. Sub-acute studies did not show any clinical signs of toxicity after treatment of male and female mice (500 to 2000 mg/kg; *p.o*) for 14 days. The oral daily administration of aqueous stem bark extract at the doses 10, 20, and 40 mg/kg, to rats for 28 days showed that the plant may be potentially toxic (Abubakar *et al*., 2010). Prolonged (28 days) oral administration of the aqueous stem bark extracts at 100-2000 mg/kg to four-week old chicks was relatively safe (Nwosu *et al*., 2011). Long term administration of the ethanolic extract exerted more deleterious effect on the kidney (Adebayo *et al* 2003).

Precautions for use
May interfere with the metabolism of some drugs in the liver because of its antihepatoxic and hepatic detoxification properties. The ethanolic extract of *Khaya senegalensis* exerted more deleterious effect on the kidney when administered continuously over a prolonged period than a short one and this will adversely affect the functioning of the kidney (Adebayo *et al*., 2003).

Adverse effects
Respiratory failure, myodegeneration, disruption of mitochondrial structure

Contraindications
High doses may cause weak limbs, reduced locomotor activity and severe hypothermia.Potential abortifacient.

Dosage and dosage forms
Decoction, tincture
Decoction: 30 g of roasted ground seeds in 900 ml water; simmer until reduced to 600 ml; 1 teacup three times daily
Tincture: 1:5 in 50% alcohol 5 ml three times daily.

Storage
Store in a cool dry place

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Lawsonia inermis

Botanical name
Lawsonia inermis L.

Family
Lythraceae

Synonyms
Lawsonia alba Lam.

Common names
Henna, Egyptian privet (English); Henné (French)

Vernacular names
Burkina Faso: Mooré – Lalé, Dioula – Djabi, Fulfuldé – Djabe;Lêlla
Ghana: Dagbani – Z abella, Hausa – Lalle
Mali: Bambara – Dabé, Maninka- Dyabi, Pular – Dyabè, Sérère – Fuden
Nigeria: Yoruba – Laali
Senegal: Soussou – Laali, Wolof – Fuden, Malinké – Djabi

Description of the plant
Shrub 2 to 9 m tall, highly branched and slender branches; bark smooth, white and fibrous; leaves simple, opposite and entire, glabrous, sessile to subsessile and pinnately veined; inflorescence a terminal panicle, pyramidal, 10 to 25 cm long; very fragrant flowers bisexual, white and hairless; fruit capsuloid ball 8 mm in diameter, glabrous, indehiscent and light brown at maturity.

Herbarium specimen number
Ghana: GC 577

Habitat and geographical distribution
The plant is widely distributed from Iran and Pakistan to Western India. It can also be found in the Mediterranean, tropical, subtropical and Sahelian regions of Africa (Aweke *et al*., 2005). It is cultivated mainly in home gardens and near houses preferably in sandy soils.

Plant material of interest
Leaf

Other parts
Stem-bark, root, flower

Definition of plant material of interest.
Hena consists of the leaf of *Lawsonia inermis* L. (Lythraceae).

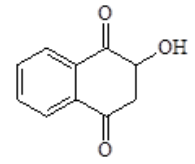
Ethnomedicinal uses
The plant is an emmenagogue and abortifacient. The infused leaves are used against

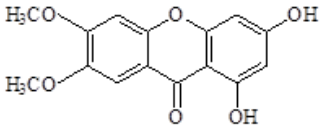
trypanosomiasis (Aweke *et al*., 2005) and the leaf decoction is used to treat malaria (Loua, 2004).

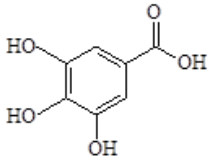
Biological and pharmacological activities
Henna extracts showed molluscicidal activity against *Lymnaea acuminata* and *Indoplanorbis exustus* (Singh and Singh, 2001; Okpekon *et al*., 2004). A leaf extract showed anti-tumour and tuberculostatic effects *in vivo*. The extract showed a broad fungitoxic spectrum of various dermatophytes, which was attributed to lawsone. Preparations of the plant showed antifertility activity. Lawsonia possesses *in vitro* antimicrobial activity against a broad spectrum of bacterial strains (such as *Shigella sonnei*) and against *C. albicans* (Habbal *et al*., 2005). Ethanolic extract of the plant has significant healing effects and an inhibitory activity on protein glycation (Sultana *et al*., 2008). Ethanolic, aqueous and methanolic leaf extracts have shown modest reverse transcriptase inhibitory activity (Suthienkul *et al*., 1993). The tuberculostatic activity of the plant has been demonstrated *in vitro* and *in vivo* (Sharma, 1990), whilst the stem bark extract has been shown to have fungistatic and fungicidal properties (Singh and Pandey, 1989; Tripathi *et al*., 1978). The *in vitro* hypoglycaemic activity of the methanol extract was demonstrated by Arayne *et al*., (2007) and Mikhaeil *et al*., (2004) showed that the extract's antioxidant properties were comparable to that of ascorbic acid. Many other properties have been attributed to the compound lawsone and constituents such as the flavonoids (luteolin, acacetine), gallic acid, carbohydrates (Aweke *et al*., 2005). These properties include antipyretic, anti-inflammatory and analgesic (Ali *et al*., 1995).

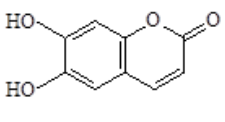
Clinical data
No information available

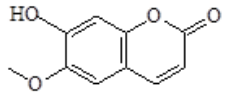
Chemical constituents
Quinones (lawsone and 2-hydroxy-1,4-naphthoquinone, lawsoniaside, 1,4-naphthoquinone, isoplumbagine); xanthones (laxanthones); flavonoids (luteolin, luteolin-glycosides, acacetine, apigenin-glycosides); tannins; coumarins (lacoumarine, scopoletin, esculetin, fraxetine); naphthalene derivatives (1,2-dihydroxy-4-glucosylnapthalene, diglucosyloxy-1.4-2-hydroxynaphthalene 1,3-dihydroxy-naphthalene, 4-glucosyloxy-1 ,2-dihydroxynapthalene); sterols (β-sitosterol, stigmasterol, daucosterol); pentacyclic triterpenes (hennadiol, lupeol, betulin betulinic acid); essential oils.

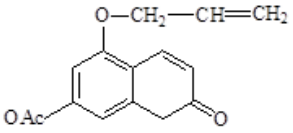

Lawsone


Laxathone 1


Gallic acid

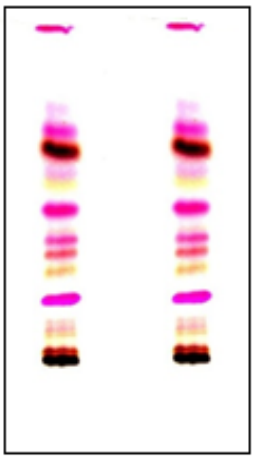

Esculetin


Scopoletin


Lacoumarin

Tests for identity and purity
Moisture content: not more than 7.30%
Total ash: 8.32%
Water-soluble extractive: not less than 11.20%
Alcohol-soluble (70%) extractive: not less than 9.52%

Chromatographic fingerprint
Chloroform extract
Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8] , detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of five characteristic spots with R_fs 0.68 (pink), 0.61 (reddish brown), 0.45 (pink), 0.35 (pink) and 0.20 (pink).


Chromatogram of

Macroscopy
Leaves coriaceous, glabrous, greenish-brown, oblong or broadly lanceolate, symmetrical base, margin entire and acute to acuminate, 2-3 cm long and 1-2 cm wide, shortly petiolate, petiole being concavo-convex; pinnately veined, reticulate, lateral veins leave the midrib at an angle of 60 to the leaves.

Microscopy
Isobilateral leaves with 2-3 rows of palisade cells adhering to the upper epidermis and 1-2 rows adhering to the lower epidermis with a narrow and spongy mesophyll containing idioblasts with groups of crystals of calcium oxalate; upper epidermis consists of polygonal cells of the same diameter with straight anticlinal walls with few anomocytic stomata and covered with a striated cuticle; cells of the upper epidermas, but the stomata are more common and slightly sinuous anticlinal walls. In the region of the midrib vascular cord is surrounded by an arc of pericyclic fibers, cords and bicollateral vascular bundles. Bands of sub-epidermal collenchyma are present.

Powdered plant material
Dark green with a weak characteristic odour and an astringent taste, slightly bitter; showing fragments of upper and lower epidermal cells covered with a striated cuticle and stomata, anomocytic, groups of crystals of calcium oxalate, many palisade cells, spiral vessels, ringed and crosslinked; fragments of lignified pericyclic fibres with thick walls, a narrow lumen and sharp peaks.

Therapeutic actions
Antimalarial, trypanocidal, molluscicidal, tuberculostatic, fungitoxic, antitumour, antimicrobial, antipyretic, anti-inflammatory, analgesic, healing (Singh and Singh, 2001; Okpekon *et al*., 2004; Loua, 2004; Aweke *et al*., 2005; Habbal *et al*., 2005; Ali *et al*., 1995).

Therapeutic indications
Malaria, tuberculosis, bacterial and fungal infections

Safety data
The LD_{50} of the aqueous leaf extract was found to be >3000 mg/kg in rats. In subacute studies of repeated administration (300-3000 mg/kg) for 14 days, no serious adverse effects were seen on blood and its cellular elements, body weight or organ body weight ratios. There was no effect of the aqueous extract on renal function and the effect on liver function was considered to be mild. Contact allergy (skin) has been reported with pure henna (Polat *et al*., 2009). The cytotoxicity of henna and lawsone has been demonstrated (Sauriasari *et al*., 2007). The use of henna can have side effects such as haemolytic anemia in case of glucose-6-phosphate dehydrogenase deficiency (Kok *et al*., 2004). A daily dose of 3, 30 or 300 mg extract of the plant produces 40-60% of abortion in rats; the resulting infertility is permanent (Munshi *et al*., 1977).

Precautions for use
It is recommended that the liver function should be monitored during treatment

Adverse effects
Mild increase in liver transaminases

Contraindications
Liver disease

Dosage and dosage forms
Infusion: 30 g dried leaves in 600 ml of water; 3-4 teacups daily
Tincture: 1:5 in 45% alcohol; 5 ml three times daily

Storage
Store in a cool dry place

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Lippia multiflora

Botanical name
Lippia multiflora Mold

Family
Verbenaceae

Synonyms
Lippia adoensis Hochst.; *Lippia grandifolia* Hochst. ex Walp.

Common names
Bush tea; Gambian tea bush; Healer herb; Ti-tree English), Thé de Gambie (French).

Vernacular names
Burkina Faso: Mooré – Kwilg-wisaoré, Dioula – Kangaliba, Fulfuldé – Légal café
Cote d'Ivoire: Anyi – Amaniena, Kalango – Akankoino, Maninka – Sonugba Suba
Gambia: Fular–Usumbolomo, Mandika– Killiba (Sisilinghyamo), Wolof – Mbormbor
Ghana: Akan – Sre-Nunum, Ga – Naasuruu, Ewe – Afudoti (Afu)
Guinea: Fula Pulaar – Bahe, Susu – Diohuli
Mali: Fula Pulaar – Bahe-Bahe, Manding Bambara – Gane Ba
Nigeria: Fula Fulfulde – Dirisi, Yoruba – Efinrin-Gogara Fefe
Senegal: Balanta – Brege, Serer – Mbalat, Diola – Busag
Sierra Leone: Temne – A-Kimbo
Togo: Tem – Fasau Klouto – Avudati, Ewe – Nyone

Description of the plant
A stout woody, aromatic perennial shrub; stems ridged, shortly pubescent, simple leaves, oblong lanceolate, thick texture, dentate margin, lateral veins 7-8 pairs, bluish-green; flower whitish, sweet-scented; branched inflorescence.

Herbarium specimen number
Ghana: GC 47812
Togo: TOGO09207

Habitat and geographical distribution
Guinea and coastal savannah; also in tropical West Africa

Plant material of interest
Leaf

Other parts used
Root; whole plant.

Definition of plant material of interest
Healer herb consists of the fresh or dried leaf of *Lippia multiflora* Mold (Verbenaceae).

Ethnomedical uses
Lippia is a popular plant with a long history of use as an aromatic tea in African traditional medicine and other parts of the world. The leaves are used as a hot beverage and a tea-like infusion for fevers, gastrointestinal disturbances, enteritis, coughs and colds. Rural communities in some parts of W. Africa take Lippia tea after a hard day's work to relax and enhance sleep, while in urban areas the tea is drunk in the morning to relieve stress. In Ghana and Nigeria, an infusion of the leaves is used for the treatment of malarial and microbial infections (Kerharo and Adam, 1974; Kunle *et al.,* 2003; Ajaiyeoba *et al.,* 2004). The tea is also used traditionally as an antihypertensive, and a laxative. A drink made from the bolied leaves and palm nut is used to expel placenta after delivery (Burkill, 1997; Irvine, 1961). In Mali the powdered leaf is used in the production of a remedy for treating malaria (Diallo *et al.,* 2004).

Biological and pharmacological activities
Leaf extracts of the plant have considerable hypotensive effects (Pham *et al*., 1988). *L. multiflora* has demonstrable tranquilizing and analgesic properties comparable to diazepam (Abena *et al.,* 1998). The oil has also shown muscle relaxant effect; it depresses cardiac contractility (Mwangi *et al.,* 1992; Mwangi, 1990). The hexane and dichloromethane extracts showed antimicrobial activity with the hexane fraction possessing the higher activity, attributable to carvacrol an antimicrobial agent,

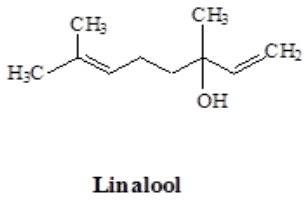
isolated from it (Kunle *et al.,* 2003). The essential oil had antibiotic activity against the mosquito larvae and it was more active than DEET as insect-repellant when tested on the maize weevil (*Sitophilus zeamais*) (Mwangi *et al.,* 1991). Lippia oil exhibited marked antifungal activity against *Colletotrichum coffeanum*, the causative agent of coffee berry disease (Mwangi *et al.,*1991; Addae-Mensah, 1992). The essential oil also showed significant and dose-dependent analgesic effect on acetic acid-induced writhing in mice; only a dose of 8 ml/kg of essential oil antagonized brewer's yeast-induced hyperexia and no effect on granuloma formation was observed.

Clinical data

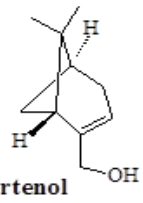
No information available

Chemical constituents

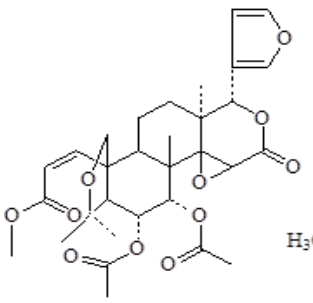
Volatile oil: (linalool, camphor, terpineol, thymol and other monoterpenes); flavonoid; saponin (glycoside) (Pelissier, 1994; GHP, 1992).



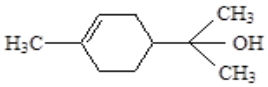
Linalool



Myrtenol



Limonoid



Terpineol

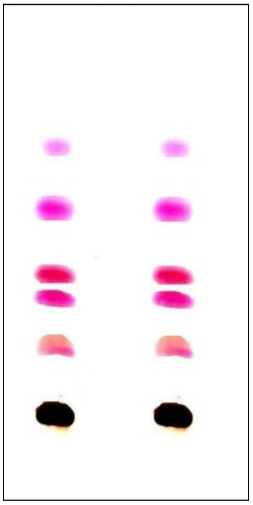
Tests for identity and purity

Moisture content: not more than 7.90%
Total ash: 17.80%
Acid-insoluble ash: 27.90%
Water-soluble extractive: not less than 1.58%
Alcohol-soluble (70%) extractive: not less than 5.02%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of five characteristic spots with R_fs 0.66 (violet), 0.51 (violet), 0.42 (pink), 0.38 (pink) and 0.29 (pink).



Chromatogram

Macroscopy

Leaves broadly oblong-lanceolate, 5-12 cm long 2-4 cm wide, margin serrated, acuminate apex, base asymmetric, venation reticulate, texture rough; colour olive green; odour aromatic; taste sharp.

Microscopy

Both surfaces covered with numerous clothing and glandular trichomes, more abundant on lower surface, clothing trichomes unicellular uniseriate, thin and warty; stomata on both surfaces paracytic; epidermis striated; transverse section shows straight anticlinal epidermal cell walls; mesophyll abounds in collenchyma tissue in midrib region; vascular bundle bicollateral, xylem lignified.

Powdered plant material

Colour green; aromatic odour; numerous clothing trichomes, warty; paracytic stomata; lignified vascular elements in veins and veinlets.

Therapeutic actions

Adjuvant for cosmetics (oil); antihypertensive; antimalarial; antimicrobial; diuretic; laxative; mouth disinfectant (locally); muscle relaxant; sudorific (Pelissier, 1994; GHP, 1992).

Therapeutic indications

Arterial hypertension, conjunctivitis; cosmetic adjuvant; dysmenorrhoea, fever; gastroenteritis; insomnia; lactation failure; malaria; nausea; venereal diseases; placenta retention;

xerostomia (Mshana *et al.,* 2000; GHP, 1992; Addae-Mensah, 1992).

Safety data
The LD_{50} of the aqueous extract (*p.o*) was found to be >3000 mg/kg in rats. Significant decrease in target organs-liver, kidney and heart at doses >100 mg/kg and lungs >1000 mg/kg. Increase in MCV, MCH, LYM, but decrease in MCHC and neutrophils. At a dose of 3000 mg/kg, there is increased ALP, GGT, direct bilirubin, urea and creatinine suggesting an adverse effect on the kidney and liver at high doses in rats.

Precautions for use
Caution should be taken in the administration of the aqueous extract in patients with compromised liver and renal function especially at high doses.

Adverse effects
Sedating; purging, possible increase in liver transaminases, creatinine and urea at high doses.

Contraindications
Hypotension, elderly, pregnancy and lactation and antihypertensive medications.

Dosage and dosage forms
Infusion; tincture; spray
Infusion: 30 g dried leaves in 600 ml of water; 3-4 teacups daily
Tincture: 1:5 in 45% alcohol; 5 ml three times daily

Storage
Store in a cool dry place in covered containers

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Mitragyna inermis

Botanical name
Mitragyna inermis (Willd.) O. Kuntze

Family
Rubiaceae

Synonyms
Uncaria inermis Willd*; Mitragyna africana* (Willd.) Korth; *Nauclea africana* Willd.

Common name
False abura (English)

Vernacular names
Burkina Faso:Mooré – Yiilga, Dioula – Djum, Fulfildé – kwali;koli;kadiolé
Ghana: Dagare – Ila, Akan – Kukyamfie
Nigeria: Igbo – Akpatenyi
Senegal: Arabic – Agbal
Togo: Ewe – Lenkati, Mina – Elikpati, Moba – Yelowum

Description of the plant
A tree up to 16 m high high, often densely branching from the base, then composed of numerous 4-5 m high, erect stem, with rounded, open crown. Bark Smooth to rough, grey to pale brown, with pale brown, fibrous slash. Stems Pubescent, pale brown. Stipules caducous, foliaceous, lanceolate-oblong, 1.5-2cm long, reddish. Leaves Opposite, glabrous or more or less pubescent beneath on nerves (adult leaves) or finely pubescent (young leaves), elliptic or obovate, 6-9 (-14) cm long and 3.5-5(-8) cm across, pointed or shortly acuminate at apex, cuneate, rounded or subcordate at base. The young leaves are often red-tinged. Petiole 0.6-1 cm long. Nerves Pinnate, with about 3 nerves 1-2 mm from the blade base, and 6-9 pairs of barely prominent lateral nerves edging the blade. Tertiary venation more or less visible. Inflorescence A solitary, compact, globose head, with a 3-9 cm long glabrous peduncle, terminal or at the base of a leaf, composed of a great number of fragrant flowers, 2-2.5 cm in diameter. Flowers Sessile, white or cream, with glabrous tubular calyx, 5-lobed, glabrous, tubular corolla, and a bottle-brush shaped style, sticking out by 3-5 mm. Infructescence Spherical, brown turning blackish, 1.2-1.8cm in diameter, persisting for a long time on the tree. Fruit, a small, oblong capsule, about 5 mm long, topped by a horny crown shape, dehiscing into two halves to reveal a great number of seeds.

Herbarium specimen number
Ghana: VBS482
Togo: TOGO07354

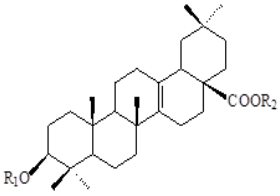
Ethnomedical uses
Liver disease, stomach and intestinal disorders; malaria; hypertension (Adjanohoun *et al.,* 1985; Phillipson and Wright, 1991), abortifacient, vermifuge; antiemetic, debility, analgesic and pain-killer.

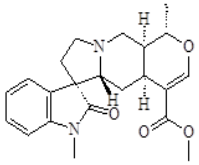
Biological and pharmacological activities
The total alkaloids extracted from the leaves of *Guiera senegalensis* and those of *M. inermis* showed a synergistic antimalarial effect. The plant's antimalarial activity and the lack of genotoxicity have been demonstrated *in vitro* and *in vivo* (Monjanel-Mouterde *et al.,* 2006). Extracts of the plant inhibited the growth of *Plasmodium falciparum* (Mustafa *et al*., 2000). The aqueous extracts produced a concentration-dependent *ex vivo* increase in cardiac contractile response and coronary flow but did not modify heart rate in the rat. This showed that the extract possesses positive inotropic effect resulting in an increase in coronary flow without inducing tachycardia in isolated heart (Ouédraogo *et al*., 2004). Sy *et al.,* (2004) have reported the myorelaxant and antispasmodic activities of the extracts of *M. inermis* whose alkaloids have been reported to increase biliary flow and also decrease hepatic enzymes and total cholesterol in the rat (Touré *et al.,* 1996).

Clinical data
No information available

Chemical constituents

Indole alkaloids (rhynchophylline, rotundifoline, speciophylline and uncarine); tripterpenoid saponins (inermiside I and inermiside II) [Cheng *et al.,* 2002; Shellard and Sarpong, 1969, 1970; Shellard *et a*l., 1971].

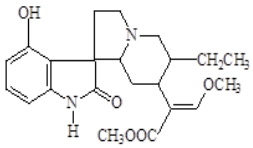




Inermiside I, R_1 = glc'' (1→6)glc' R_2 = 6-deoxy-D-glc'''

Inermiside II R_1 = 6-deoxy-D-glc, R_2 = H

Uncarine



Rotundifoline

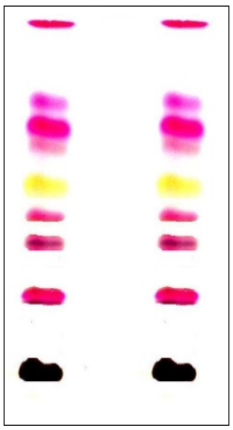
Tests for identity and purity

Moisture content: not more than 8.90%
Total ash: 12.02%
Water-soluble extractive: not less than 7.35%
Alcohol-soluble (70%) extractive: not less than 10.30%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10ml glacial acetic acid, 85 ml methanol and 5ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of six characteristic spots with R_fs 0.98 (pink), 0.76 (pink), 0.69 (pink), 0.53 (yellow), 0.46 (pink) and 0.22 (pink)



Chromatogram

Macroscopy

Bark is grayish with a fairly smooth surface. Inner bark is pale to dark brown and is fibrous. It has a characteristic taste and odour.

Microscopy

Leaves have straight walled epidermal cells with numerous anisocytic cells. Numerous unicellular and multicellular clothing trichomes. Bark has numerous pitted vessels and cortical fibres

Powdered plant material

Numerous starch grains occur, non-lignified pitted vessels, bundles of sclereids, scanty prismatic calcium oxalate vessels, cork cells, non-lignified fibres and covering trichomes unicellular

Therapeutic actions

Antimalarial, antispasmodic, cardiotonic, anticholesteremic activities

Therapeutic indications

Malaria, diarrhoea, dysmennorrhea, cardiac disease

Safety data

The LD_{50} of the aqueous extract (*p.o*) was found to be > 3000 mg/kg in rats. In subacute studies (300-3000 mg/kg) for 14 days, no significant changes in body weight, but a decrease in liver weight at doses ≥ 1000 mg/kg was seen. WBC counts increased with the treatment, but no adverse effect on liver function was observed. There was a significant rise in serum creatinine and at doses ≥1000 mg/kg of the aqueous extract.

Precautions for use

Caution should be taken in the administration of the aqueous extract in patients with compromised renal function and in heart disease especially at high doses

Adverse effects

Possible increase in serum creatinine at high doses.

Contraindications

Renal disease

Dosage and dosage forms

Decoction; tincture
Decoction: 30 g leaf per litre of water, boil for 10-15 minutes, take a cupful three times daily.

Tincture: 1-5 in 45% alcohol; 5 ml three times daily

Storage
Store in a cool dry place away from light

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Botanical name
Momordica charantia L.

Family
Cucurbitaceae

Synonyms
Momordica thollonii Cogn.

Common names
Balsam pear, African cucumber, Cundeamor, Bitter apple, Bitter melon, Carilla plant, Wild cucumber, Bitter cucumber (English); Poire de balsame, Concombre Africain, Margose, liane/pomme de merveilles (French).

Vernacular names
Benin: Fon / Goun – Nyèsinkèn, Yorouba – Edjini, Dendi – Atakluma
Burkina Faso: Fulfildé – Njalam fetuhi
Côte d'Ivoire: Adioukrou – Sing Biep, Guéré-N'guéné Boué
Ghana: Akan – Nyanya, Ewe – Kakle, Hausa – Daddagu
Nigeria: Yoruba – Ejinrin
Togo: Ewe – Agnagnran, Adja – Adounka, Mina – Guêssikan

Description of the plant
Climbing herbaceous, tendril-bearing vine, grows to 5 metres; leaf digital and lobed, alternate, petiolate, long-stalked and provided with co-petiolar tendrils fine and simple blade, generally pentagonal, divided into five main lobes, 2 to 6 cm long, 10 to 25 mm wide, a rounded top: 2-5 secondary veins per lobe; leaf-base deeply cordate and 3-veined; hair soft and smooth on both sides, thin top, longer and denser on the veins beneath; golden yellow flowers 3 cm wide, 5 lobes obtuse at the top corner, with three longitudinal ridges, male flowers on top of an axillary peduncle, 4 to 7 cm long, leafy bracts cordate slightly above the base, female flowers at the top of the ovary, peduncle 3 to 4 cm and covered with dense spines; fruit berry, distinct warty exterior and oblong shape, hollow in cross-section, with a thin layer of flesh surrounding a central seed cavity filled with large flat seeds and pith; seeds and pith appear white in unripe fruits; bright orange at maturity, 3 to 6 cm long, 2-3 cm wide, soft spines; as the fruit ripens, the flesh becomes tougher, more bitter and too distasteful.

Herbarium specimen number
Ghana: GC 47907
Togo:TOGO02802

Habitat and geographical distribution
Pantropical species,widely grown in Asia, Africa, and the Caribbean for its edible fruit; native to India, but widespread throughout the tropics; occurring mainly in areas with more or less humid climate; occurs as a weed along roadsides and outskirts of towns,, among hedges, bushes or shrubs and abandoned crops; sometimes cultivated in homes (GHP, 1992).

Plant material of interest
Leaf and fruit

Other parts used
Whole plant, root

Definition of plant material of interest
African cucumber consists of the fresh or dried leaf or fruit of *Momordica charantia* L. (Curcurbitaceae).

Ethnomedical uses
M. charantia is a popular medicinal plant widely used in traditional medicine in all humid and sub-humid tropical countries, where they grow spontaneously. Among the Yorubas of Nigeria, the decoction is used to treat malaria and in Senegal, the leaves are indicated for fever, whilst the fruits and leaves are used against itchy skin conditions such as scabies (Paulino de Albuquerque *et al*., 2007). The decoction or poultice of the leaves is used to treat mouth sores, gangrenous wounds and gastric ulcers (Agyare *et al*., 2009), while the whole plant is used to treat malaria, stomach ache, stomach acidity, fever, diarrhoea, intestinal parasites and kidney complaints (Luziatelli *et al*., 2010). Fruit, tender shoots and tender roots are used for

diabetes, blood purification and snake bite. Others also use the leaves to treat rabies, chest and rheumatic pains (Pradhan and Badola, 2008).

Biological and pharmacological activities

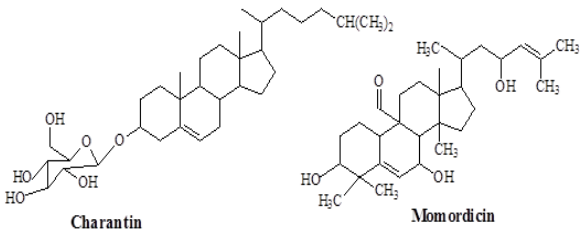
Oral intake of different doses of the fruit, juice, or powder by subjects with maturity onset diabetes mellitus significantly reduced blood glucose levels and/or improved glucose-tolerance (Welihinda *et al*., 1986). The fruit decoction showed hypoglycaemic activity in normal rabbits. Charantin is thought to be partly responsible for the hypoglycaemic effect. *p*-Insulin isolated from the seeds and fruit of the plant has also shown hypoglycaemic activity (Ng *et al*., 1986; Welihinda *et al*., 1986; Best *et al*., 1924). Alcoholic extract of the pulp has antidiabetic activity (Sarkar *et al*., 1996). A group of ribosome-inactivating proteins (α- and β-momorcharin, momordin, and cucurbitacin B) have been reported to possess cytotoxic activity (GHP, 1992). The aqueous crude extract demonstrated the ability to inhibit the enzyme guanylate cyclase, which is thought to be linked to the pathogenesis and replication of psoriasis, leukaemia and cancer. This crude extract killed human leukaemia cells in a dose-dependent manner while normal human lymphocytes subjected to the same doses were not affected (GHP, 1992). The compound momordin demonstrated cytotoxic activity against Hodgkin's lymphoma *in vivo*, while several other *in vivo* studies have shown the cytostatic and antitumor activity of the entire plant. Aqueous extracts inhibited the growth of rat prostate carcinoma and the development of mammary tumours in mice (GHP, 1992).The proteins α- and β-momorcharin have been reported to inhibit HIV virus *in vitro*. Momordica Anti-human Immunovirus Protein (MAP30) has been reported to activate natural killer cells and thus interfere with replication of HIV viruses. It also increased the body's production of interferon-gamma, a natural substance that fights all types of viruses. Extracts of the plant also have antiviral activity against *Herpes simplex* virus type 1 and antihelminthic and antiinflammatory effects (Lans *et al*., 2007; Beloin *et al*., 2005). Methanol extract has antiulcer activity (Alam *et al*., 2009). Leaves of *M. charantia* have been found to possess antibacterial effects against *E. coli* and *Staphylococcus aureus* (Georges and Pandelai, 1949), while the methanolic extract of the whole plant has anti-parasitic effects *in vitro* (Mesia *et al*., 2008). The alcoholic extract of the fruit has spermicidal activity (an ethanol extract caused a decrease in testicular weights and sperm production in gerbils and dogs), while the root has abortifacient effects in females (Jamwall and Anand, 1964). The seeds demonstrated the ability to induce abortion in rats and mice, and the fruit and leaf exhibited *in vivo* antifertility effect in female animals. Several components of the fruit such as charantin and sitosterol showed stimulating effects on the uterus (Yeung, 1996).

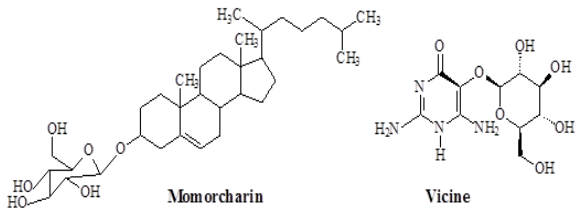
Clinical data

A four-week, randomized, double-blind trial found that the plant had a modest hypoglycaemic effect and significantly reduced blood sugar levels among patients with Type 2 diabetes, who took 2000 mg daily. It was, however, noted to be less effective than the antidiabetic drug, metformin (Fuangchan *et al*., 2011).

Chemical constituents

Charantin, vicine, polypeptide-p, momordicine 1, 2 and 3, momorcrines A and B, momordine, arginine, asparagine, aspartic acid, leucine, leusine, tyrosine, fixed oil; acid resins; vitamin C; carotene; γ-aminobutyric acid; mineral salts (e.g. salts of silicon, calcium, phosphorus, strontium, copper, lead, zinc, sodium and iron); pectic acid, pectin; saponins, 5-hydroxytryptamine; albumin, globulin and glutelin rich in essential amino acids and vitamin B, carotene and alpha-amino butyric acids; alkaloids, saponins (Olaniyi and Marquis, 1975).





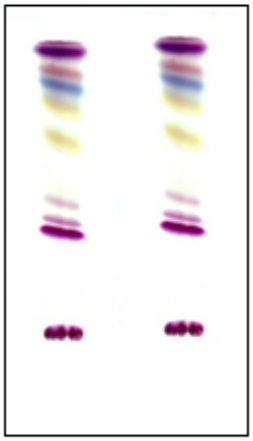
Test for identity and purity

Moisture content: not more than 7.70%
Total ash: 16.73%
Water-soluble extractive: not less than 22.60%
Alcohol-soluble (70%) extractive: not less than 20.70%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8] , detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of seven characteristic spots with R_f 0.90 (violet), 0.82 (brown), 0.79 (blue), 0.72 (yellow), 0.63 (yellow), 0.36 (purple) and 0.33 (purple).



Chromatogram

Macroscopy

A climbing herb with tendrils spirally twisted at nodes, leaves simple, petiolate, alternate or whorled, deeply lobed with wavy margins; stem grooved; flowers male and female (hermaphrodite); leafy bract; fruit ellipsoid, 5-7 cm long, warty, ridged, green turning bright orange when ripe, splits to reveal several deep red flattened seeds.

Microscopy

Both surfaces of the leaf show numerous trichomes, also on the veins and veinlets, both multicellular uniseriate clothing trichomes and glandular types; epidermal cell walls wavy; stomata anomocytic with 4-5 subsidiary cells; transverse section of the leaf shows dorsiventral structure; giant clothing trichomes with collapsed cells occur on the upper surface while a few of the same occur on the veins on the lower surface; palisade cells abut on to collenchyma cells in the midrib region, spongy mesophyll comprises of large parenchymatous cells and contain rosette-type calcium oxalate crystals; vascular xylem elements are lignified; stem is pubescent; transverse section shows an outer epidermal layer; parenchymatous layer forms the cortex; a sclerenchymatous lignified tissue encircles the vascular tissues with a central pith with parenchymatous cells some of which have rosette calcium oxalate crystals.

Powdered plant material

Greenish-brown colour; odour characteristic; taste bitter; glandular trichomes with multicellular heads, abundant collapsed uniseriate clothing trichomes; lignified xylem vessels also vascular elements in mid rib and stem fragments; lamina fragments show epidermal cell types and anomocytic stomata; starch grains present.

Therapeutic actions

Antimicrobial; antidiabetic; antidiarrhoeal; antifertility; antihelminthic; antiinflammatory; antineoplastic; antioxidant, antitumor, antiulcer; antiviral; astringent; febrifuge; vulnerary.

Therapeutic indication

Diabetes, wounds, ulcers, herpes, parasitic infections, arterial hypertension; abdominal pains; burns; cancer; contraception; dermatitis; fever; HIV/AIDS; infectious diseases (e.g. dysentery; gonorrhoea, chickenpox); malaria; measles; otitis; scalds; senile debility; skin rashes (e.g. yaws); whitlow; (Mshana *et al*., 2000; GHP, 1992; Dennis, 2002).

Safety data

In a 24-hour acute study, the LD_{50} of the aqueous leaf extracts (*p.o*) in mice was >3000 mg/kg. Sub-acute studies did not show any clinical signs of toxicity after treatment of male and female mice (500 to 1000 mg/kg; *p.o*) for 14 days apart from hypoglycaemia. In sub-chronic toxicity studies, repeated administration of 100, 200 and 1000 mg/kg of aqueous leaf extract for 14 days caused hypoglycaemia. The red arils of the seeds are dangerous to children. Two cases of poisoning secondary to ingestion of fresh leaf infusion have been reported. They resulted in a *status epilepticus* and required hospitalization. The toxicity of two fruit extracts (ethanol and unripe fruit juice) was evaluated in normal and diabetic rats. Both extracts decreased blood glucose levels in two rat models. In normal rats the two extracts had no significant effect on blood levels of urea, creatinine, ALT, AST and AP, while in diabetic rats the two extracts caused a significant decrease in levels of serum urea, creatinine, ALT, AST, AP, cholesterol and triglycerides. These extracts have shown anti-diabetic activity, hepatic and hypolipidemic properties (El Sattar El Batran *et al*., 2006).

Precautions for use

Control of the blood sugar required in case of administration of aqueous leaf and bark extracts;

avoid co-administration with other antidiabetic medicines except under medical supervision.

Adverse effects
Antifertility effects and abortion were observed in female animals, decrease in male fertility rate but there was no effect on sperm production, hypoglycaemic coma and convulsions;

Contraindications
Persons with a genetic erythrocytic deficiency of glucose 6-phosphate dehydrogenase; pregnancy

Dosage and dosage forms
Decoction; infusion; tincture; tablets; capsules
Decoction: 30 g dried aerial parts in 900 ml water; simmer until reduced to 600 ml; 1 teacup three times daily
Infusion: 30 g dried aerial parts in 600 ml of water; 1 teacup three times daily
Tincture: 1:5 in 45% alcohol; 5 ml three times daily
Capsules: 1-2 g of powdered leaf, 1 capsule two times daily

Storage
Store in a cool dry place

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Morinda lucida

Botanical name
Morinda lucida .Benth.

Family
Rubiaceae

Synonyms
Morinda citrifolia L.

Common names
Brimstone tree (English)
Arbre à soufre, oruwo (French)

Vernacular names
Burkina Faso: Dioula – Mangana
Ghana: Akan – Bronyadua Konkroma
Nigeria: Igbo – Nuke, Yoruba – Oruwo
Sierra Leone: Mende – Hojologbo
Togo: Ewé – Dzadzaklan, Ouatchi – Dadaklan, Adja – Tsikémachou

Description of the plant
M. lucida is an evergreen shrub or small to medium-sized tree up to 18-25 metres tall, with bole and branches often crooked or gnarled; bark smooth to roughly scaly, grey to brown, often with some distinct purple layers. Leaves opposite, simple and entire; stipules ovate or triangular, 1-7 mm long, petiole up to 1.5 cm long; blade elliptical, 6-18 cm × 2-9 cm, base rounded to cuneate, apex acute to acuminate, shiny above, sometimes finely pubescent when young. Inflorescence a stalked head 4-7 mm in diameter, 1-3 at the nodes opposite a single leaf; peduncle up to 8 cm long bearing at base a stalked cup-shaped gland. Flowers bisexual, regular, 5-merous, heterostylous, fragrant; calyx cup-shaped, about 2 mm long, persistent; corolla salver-shaped, about 1.5 cm long, white or greenish yellow, lobes ovate-lanceolate, up to 5 mm × 2.5 mm; ovary inferior, 2-celled, style 8-11 mm long with 2 stigma lobes 4-7 mm long; stamens 5. Fruit a drupe, several, together arranged into an almost globose succulent syncarp 1-2.5 cm in diameter, soft and black when mature; pyrene compressed ovoid, up to 6.5 mm × 4 mm, dark red-brown, very hard, 1-seeded. Seed ellipsoid, about 3.5 mm × 2 mm × 0.5 mm, yellowish, soft.

Herbariun specimen number
Ghana: GC1189
Togo: TOGO07498

Habitat and geographical distribution
Morinda lucida occurs from Senegal to Sudan and southward to Angola and Zambia. It is sometimes planted around villages and grows in

grassland, exposed hillsides, thickest forests, often on termite mounds, sometimes in areas which are regularly flooded, from sea-level up to 1300 m altitude.

Plant material of interest
Leaf, root and stem bark

Definition of plant material of interest
Brimstone tree consists of the leaf, root or the stem bark of *Morinda lucida* Benth. (Rubiaceae).

Ethnomedical uses
In West Africa, *M. lucida* is an important plant in traditional medicine. Decoctions and infusions or poultices of roots, bark and leaves are recognized remedies for the treatment of different types of fever (including yellow fever), malaria, trypanosomiasis and bouts of fever during labour. The plant is also used in cases of diabetes, hypertension, stroke, dysentery, stomach pain, ulcers, leprosy and gonorrhoea. In Nigeria, *M. lucida* is one of the four most commonly used traditional remedies against fever. In Cote d'Ivoire, a bark decoction is used against jaundice, and in DR Congo it is combined with the powdered root bark as a poultice to treat the itch and ringworm The fruits are used in the treatment of asthma (Chin, 2002) and in Nigeria, the leaves are used to treat diabetes (Gbolade, 2009; www.prota.org). The leaves, stem bark and roots are used in the treatment of malaria (Asase and Oppong-Mensah, 2009; Adebayo and Kretti, 2011), while the infusion or decoction of the leaves and bark of the trunk, are used in the treatment of oral cancer (Ashida *et al*., 2010). The decoction of the bark of the trunk is also used in the treatment of haemorrhoids and gastric ulcer (Agyare *et al*., 2009).

Biological and pharmacological activities

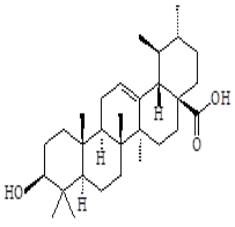
The purgative effect of a methanol extract of the leaves of the plant has been reported. Oral treatment (12.5-100 mg/kg) caused a pronounced increase in the number of wet faeces in rats and potentiated castor oil-induced diarrhoea in mice (Olajide *et al*., 1999). The dried methanol extract of the leaves promoted gastric emptying in rats and intestinal motility in mice. The extract did not induce gastric ulceration nor did it afford protection against acetylsalicylic acid-induced ulcer in rats. (Olajide *et al*.,1998). The extract of the root bark exhibited a mutagenic activity with a low cytotoxicity (Sowemimo *et al*., 2007). Extracts of the leaves had significant dose-dependent *in vitro* inhibitory effect on the growth of *Plasmodium falciparum* (Do Ceu de Madureira, 2002; Tona *et al*., 1999). The crude extracts of the leaves and stem bark also had antiplasmodial effect with an IC_{50} value of 3.90 and 5,70 µg/ml respectively, whilst the compound urosilic acid, isolated from the plant, exhibited an antiplasmodial activity with IC_{50} value of 3.10 µg/ml (Adebayo and Kretti, 2011). Leaf and stem bark extracts showed significant but non-selective cytotoxic properties (Ashidi *et al*., 2010). The anthraquinones and triterpenoid acids of the plant exhibited *in vitro* antileishmanial and antimalarial activites (Sittie *et al*., 1999).

Clinical data

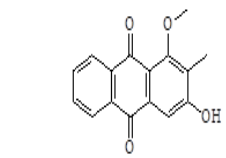
No information available

Chemical constituents

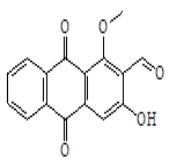
Anthraquinones (Durodola, 1974, Koumaglo *et al*., 1992; Sittie *et al*., 1999); urosilic acid and other triterpenoid acids (Cimanga *et al*., 2006; Adebayo and Kretti, 2011).



Ursolic



3-hydroxy-1- methoxy-2-methylanthraquinone
(Rubiadin-1-methyl ether)



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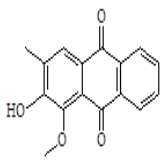


2-hydroxy-1-methoxy-3-methylanthraquinone
(Digitolutein)

Test for identity and purity

Moisture content: 6.35% (leaves), 6.13% (stem bark)

Total ash: Leaves: 8.39% (leaves), 5.54% (stem bark)

Sulphated ash: 12.33% (leaves), 6.64% (stem bark)

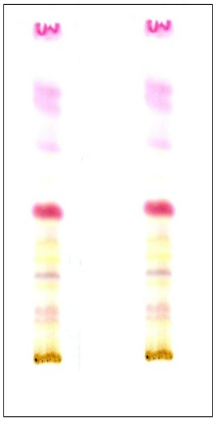
Water-soluble extractive: not less than 17.65% (leaves), 20.89% (stem bark)

Alcohol-soluble (70%) extractive: not less than 15.78% (stem bark)

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of three characteristic pink spots with R_f s 0.79, 0.71 and 0.61.



Chromatogram

Macroscopy

Outer bark is smooth to roughly scaly, grey to brown. The inner bark is light brown to yellowish. Has an aromatic smell with a bitter taste.

Microscopy

Thick walled collechyma cells below the upper epidermis and above lower epidermis. Acicular crystals in cortical parenchyma cells. Vascular bundle is arc shaped. Straight walled epidermal cells with numerous isocytic stomata. Unicellular covering trichomes.

Powdered plant material

Acicular calcium oxalate crystals as well as raphides with few prismatic crystals. Abundance of stone cell with pits. Numerous cork cells and pitted vessels.

Therapeutic actions
Antimalarial, antipyretic, antidiabetes and pesticidal (antitrypanosome and antihelminthic) (Okpekon *et al*., 2004).

Therapeutic indications
Malaria, fever, jaundice, diabetes, and trypanosomiasis, helminthiases (Okpekon *et al*., 2004).

Safety data
The LD_{50} of the aqueous extract (*p.o*) was found to be >3000 mg/kg in rats. Subacute studies (300-3000 mg/kg) of repeated administration for 14 days, did not show any significant effect on body weight. Decreased relative weights of liver, lungs and spleen were observed in treated rats, with decreased levels of haemoglobin, MCHC but increased MCV and platelets; increased ALP and GGT levels with decreased serum albumin. Increased serum creatinine was observed at a dose of 3000 mg/kg.

Precautions for use
Caution should be taken in the administration of the aqueous extract in patients with compromised renal and liver functions.

Adverse effects
Possible increase in serum creatinine when given at high doses.

Contraindications
Renal and liver disease

Dosage and dosage forms
Decoction, Infusion
Decoction: 30 g plant material in 900 ml water; simmer until reduced to 600 ml; 1 teacup three times daily.

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Botanical name
Moringa oleifera Lam.

Family
Moringaceae

Synonyms
Moringa pterygosperma Gaern. (I), *Moringa aptera*

Common names
Horse radish Tree; Drumstick Tree; Ben Oil Tree; Miracle Tree; Clarifier Tree; Kelor Tree; Mother's Best Friend, French; Mourongue; Moringa

Vernacular names
Burkina Faso: Moore – Arzan Tiiga, Dioula – ArdjinaYiri, Fulfuldé – Gilgandja
Ghana: Dagari – Zangala, Ewe – Babatsi, Hausa – Zingaridende
Mali: Bambara – Nevrede, Mandigue – Nebedayo
Nigeria: Yuroba – Ewe Igbale, Hausa – Danga
Senegal: Wolof – Nebeday
Togo: Ewe – Yovovigbe, Ouatchi – Kpotsi, Lamba – Spe

Description of the plant
Small to medium sized perennial tropical tree, up to 12 m high at maturity, with drooping branches; stem brittle with a corky bark; commonly grown in some African countries as living fence; tendency to have deep tuberous roots, wide-open, typically umbrella-shaped crown and usually a single stem; soft wood, light bark; tree developing caudexed base with age; leaves leathery, dark green on upper side, pale green, almost ashy on lower side; compound, tri-pinnate (or sub-pinnate, imparipinnate), each leaf with up to nine leaflets (or pinnae) with wide variation in sizes, 0.7-5.3 cm long and 0.3-3.6 cm wide, leaflets petiolate (0.1-0.4 cm long), have entire margins, obtuse, rounded or emarginated apices with reticulate venation, oppositely arranged on primary, secondary and tertiary axes, shapes of leaflets range from elliptic, ovate to obovate, terminal leaflets, obovate and larger than elliptically or ovately shaped lateral ones, leaflets quite pale when young, bases of leaflets symmetrical, acute, rounded or obtuse, Dry leaflets feathery and papery in texture and brownish to yellowish green in colour; inflorescences axillary, shorter than leaves; flowers cream coloured or white, 2.5 cm in diameter; stamens yellow, appear in panicles during periods of stress; fruits or pods pendulous, green and succulent when young and

brown when mature; triangular, tapering at both ends, 30-120 cm long, 1.8 cm wide, splitting lengthwise into 3 parts when dry; each pod contains about 20 seeds, dark brown with 3 papery wings.

Herbarium specimen number
Ghana: GC9898
Togo: TOGO05250

Habitat and geographical distribution
M. oleifera is believed to be native to the sub-Himalayan tracts of Northern India. However, it grows in many parts of the savanna tropics, probably spreading through intensive cultivation for various purposes. According to Muluvi *et al.,* (1999) the Moringa tree was introduced to Africa from India at the turn of the twentieth century. In the West African sub-region, *M. oleifera* appears to be more important in relatively more arid regions. It is found in Ghana, mostly in the northern regions, in Mali, in the more arid northern parts of Nigeria and in many other places where it is known to be edible. Moringa is naturalized in Malawi, Niger, Senegal and Tanzania. In India, the young pods or drumsticks are canned and exported all over the world. Moringa is adapted to arid sandy conditions and although drought-resistant, it is intolerant of water logging. It can grow well in the humid tropics' blistering heat, desiccating dryness or destitute soils. However, Moringa grows best on dry sandy soil and yields much less foliage when it is continuously under water stress. It can be grown as annual or greenhouse plant in temperate zones. The plant is reported to tolerate annual rainfall of 4.8 – 40.3 dm, temperature range of 26 to 40°C and pH of 4.5-

8.5. It grows well from sea level to an elevation of 1000 m. In tropical and sub-tropical climates, it fruits freely and continuously. Moringa is reported to tolerate bacterial, mycobacterial and fungal attacks, although it has its own specific pathogens. Heavy pruning encourages lateral shoots and increase leaf production, keeping the plant at a height convenient for easy harvesting and providing a means of obtaining very high yields of leaf matter.

Plant material of interest
Leaf

Other parts used
Flower, fruit, root, seed

Definition of plant material of interest
Moringa consists of the fresh or dried leaf of *Moringa oleifera* Lam. (Moringaceae).

Ethnomedical uses
The plant is cultivated for its leaves, fruits, roots and seeds for a variety of uses, both food and drug. Almost every part of the plant is valuable as food. However, the leaves and pods are more used as food sources or supplements. The young leaves of *M. oleifera* are edible and are part of the traditional diets in many countries where the tree grows and are eaten cooked or added to food as dried leaf powder. The seeds are eaten as peanuts and the oil from it is edible. Thickened roots are used as substitute for horseradish. One most notable use of Moringa leaf powder is for the treatment and prevention of malnutrition, especially in children. The record of medicinal uses of *M. oleifera* in folklore is abundant. Plant parts other than the leaves are responsible for most of the medicinal uses of the plant, especially the roots and seeds. However, the leaves also have medicinal uses in folklore. Flowers, leaves and roots of the plant are used for tumours. The leaves as poultice, is applied to sores or rubbed on the temples as a treatment for headaches. The poultice of leaves is also used in reducing glandular swellings. The leaves are used as a purgative, to promote digestion and in traditional medicine as a hypocholesterolemic agent in obese individuals. The juice extracted from the leaves is applied directly on to the eye for the treatment of conjunctivitis. It is also warmed and applied to affected areas to relieve the pain associated with sprain. The leaves are used in a preparation which is cooked and taken for the treatment of high blood pressure. In India, the plant is used as an abortifacient (Nath *et al.*, 1992).

Biological and pharmacological activities
The plant's isothiocyanate glycoside, and the thiocarbamates niaziminin A and niaziminin B were shown to have hypotensive activity but not the nitrile glycosides niazirin and niazirinin (Faizi *et al.*, 1994). *M. oleifera* is one of the few plants known to contain all the three types of compounds, nitriles, thiocarbamates and isothiocyanates (Faizi *et al.*, 1994), which can be transformed to thiocyanates in mammalian metabolism. Pterygospermin isolated from the flowers and seeds is bacteriocidal and fungicidal and the alkaloids moringinine, acts as a cardiac stimulant and produces a rise in blood pressure. The compound 4-[(4'-O-acetyl-α-L-rhamnosyloxy)benzyl] isothiocyanate, a glucosinolate has been shown to have antibiotic activity, whilst the thiocarbamate and isothiocyanate compounds inhibit tumour-promoter teleocidin B-4-induced Epstein-Barr virus (EBV) activation in Raji cells (Murakami *et al.*, 1998). The juice from the leaves and stem bark inhibited *Staphylococcus aureus* but not *Escherichia coli*. A 50% ethanolic extract of the aerial part of *M. oleifera* showed anti-cancer activity against human epidermoid carcinoma of nasopharynx in tissue culture and P388 lymphocytic leukemia in mice. Crude extract of *M. oleifera* has been shown to have cholesterol lowering effect. Ghasi *et al.,* (2000) showed that administration of a crude leaf extract along with a high-fat diet decreased the high-fat diet-induced increases in the levels of cholesterol in the serum, liver and kidney in rats. An ethanolic extract of *M. oleifera* has been shown to contain a plant growth promoting hormone of the cytokinin type. *M. oleifera* leaf extract may be used to regulate hyperthyroidism since it has been shown to inhibit the peripheral conversion of thyroxine (T4) to tri-iodotyronin (T3) in female rats (Tahiliani and Kar, 2000). However, the effect was absent in male rats.The leaf extract has also been shown to be abortifacient. In a study to evaluate the anti-reproductive potential of the plant, leaf extract of *M. oleifera* was shown to be 100% abortifacient at a dose equivalent to 175 mg/Kg of starting dry material (Nath *et al.*, 1992). Various studies have demonstrated the nutritional value of Moringa leaves. In a survey of some wild plants of importance used during drought, Lockett *et al.,* (2000) found Moringa to be a good source of protein and fat and an excellent source of calcium, iron, copper and

zinc. The leaves contain high amounts of pro-vitamin A in the form of carotenoids, especially β-carotene, and high amounts of Vitamin C when raw. The amino acid composition of the proteins compares favourably with the World Health Organization standards for essential amino acids (Freiberger *et al.*, 1998). All the essential amino acids are at a higher than adequate concentrations when compared with the recommended FAO/WHO/UNO reference standars for 2 to 5 year old children. The leaves are a good source of the sulphur-containing amino acids methionine and cysteine, which are often low in plant proteins. In a study of mineral composition of non-conventional leafy vegetables including *M. oleifera*, all the vegetables studied contained high levels of calcium compared to common vegetables. Micro-nutrients varied among the vegetables but *M. oleifera* had the highest content of zinc, although the mean daily intake of the various micro-nutrients were lower than the recommended daily allowances (RDAs), except for magnesium (Barminas *et al*, 1998). The leaves of the plant also contain significant amounts of selenium and phosphorus (Freiberger *et al.*, 1998). However, the mineral content of the leaves may vary depending on the geographical location of the plant. The iron content is good enough for the leaves to be prescribed for anaemia in the Philippines. Vitamin A, in the form of β-carotene, is the most abundant vitamin in *M. oleifera* with values as high as 22,000 IU per 100 g of leaf (Echo's Knowledge Bank) compared to the average reported value of approximately 11,000. Bio-availability trials indicate that β-carotene from *M. oleifera* can overcome Vitamin A deficiency. Using a rat model, Nambiar and Seshadri (2001) found that with respect to growth parameters, fresh leaves of *M. oleifera*, as well as the leaf powder, were better than synthetic vitamin A, although serum levels of the vitamin were higher with the group of animals on synthetic vitamin A. According to one report, the B Vitamins are not particularly high in *M. oleifera*. However, the physiological availability of thiamine, riboflavin and niacin, calculated from individual dose-response curves, is high (Girija *et al.*,, 1982). Vitamin E is present in *M. oleifera* but not in large quantities (Ching and Mohamed, 2001). Some anti-nutritional factors are present in *M. oleifera* and they include the sugars raffinose and stachyose, nitrate, oxalate, saponins and phytate. The oxalates and nitrates would decrease bio-availability of minerals. As indicated by Pankaja and Prakash (1994), the presence of oxalates inhibited the intestinal absorption of calcium from *M. oleifera*. Saponins are present, but unlike their counterparts in other plants, the saponins in *M. oleifera* do not show haemolytic properties. Intravenous administration (1-10 mg/kg) of any of the compounds (niazinine A, B niazinine, niazimicine and niaziminine A + B) produced hypotensive and bradycardic effects in anaesthetised Wistar rats. Pretreatment of animals with atropine (1 mg/kg) completely abolished the hypotensive and bradycardic effects of acetylcholine (ACh), while the cardiovascular responses of isolated compounds were unchanged, eliminating the possible involvement of muscarinic receptor activation. All compounds (50-150 pg / mL) produced negative inotropic and chronotropic effects on isolated guinea pig atria. Spontaneous contractions of rat uterus were also inhibited by all compounds (Gilani *et al*, 1992; 1994). The antispasmodic activity could be attributed to the presence of 4-[α-(L-rhamnosyloxy) benzyl]-o-methyl thiocarbamate in the ethanolic leaf extracts of the plant (Gilani *et al.*, 1992). Methanolic leaf extracts showed antiulcerogenic and hepatoprotective effects in rats; the aqueous leaf extracts also showed anti-ulcer effects. A study by Jaiswal *et al.,* (2009) showed that aqueous leaf extracts possessed antidiabetic and hypoglycaemic properties. A significant reduction in glycosuria and proteinuria was also observed. A Japanese study of 2007 shows that consumption of Moringa improves diabetes *in vivo* (Hurtel, 2008) and a similar study in Thailand in the same year showed that Moringa contains antioxidants that cause a decrease in blood cholesterol levels accompanied by a significant decrease in the formation of atherosclerotic plaques (Hurtel, 2008).

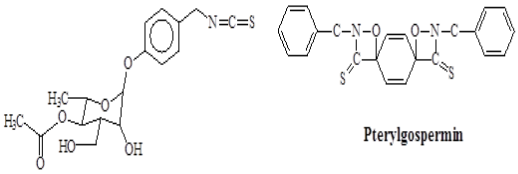
Clinal data

In a pediatric unit of a hospital in Senegal, the reported cases of infant malnutrition recorded fell from nearly 600 in 1997 to less than 50 in the year 2000.

Chemical constituents

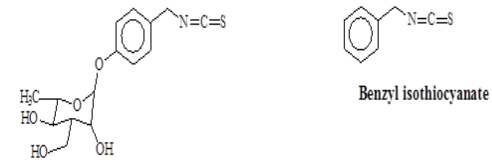
Estrogenic substances (including β-sitosterol); pectinesterase; pterygospermin; alkaloids (moringine and moringinine); acetylated glycosides (e.g. niaziminin A, niaziminin B niazirin, niazirinin), (Faizi *et al.*, 1995; Murakami *et al.*, 1998); glycosides containing isothiocyanates (Faizi *et al.*, 1994); (4-[(4'-O-acetyl-α-L-rhamnosyloxy)benzyl] isothiocyanate)

(Evans, 1996); β-carotene, reducing sugars; tannins, flavonoids and cardiac glycosides.



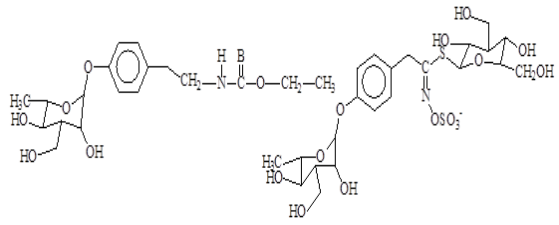
Pterylgospermin

4-(4'-O-acetyl-a-L-rhamnopyranosyloxy) benzyl isothiocyanate



Benzyl isothiocyanate

4-(a-L-rahmnopyranosyloxy) benzyl isothiocyanate



Niazimicin

4-(a-L-rhamnopyranosyloxy) benzyl glucosinolate

Tests for identity and purity

Moisture content: Not more than 10.00%
Total ash: Not more than 10.00%
Acid-insoluble ash: Not more than 1.50%
Water-soluble extractive: Not less than 7.00%
Alcohol-soluble (70%) extractive: Not less than 3.00%
Palisade ratio: 6.20 – 7.50
Vein Islet number: 12.00 - 14.00.
Veinlet termination number: 14.00 – 17.00
Stomatal number: 5.20 – 9.80 Lower surface
Stomatal index: 6.60 – 12.00 Lower surface

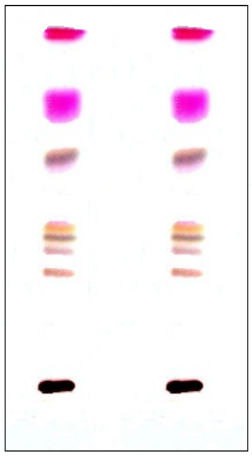
Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spots with R_fs 0.98 (pink), 0.81 (pink), 0.59 (grey) and 0.35 (dark grey).

Macroscopy

The leaves of *M. oleifera* are compound, tripinnate and imparipinnate, measuring between 30-60 cm long and 10-20 cm wide; leaves are oppositely arranged on the primary, secondary



Chromatogram

and the tertiary axes, each leaf consists of up to nine (9) leaflets, terminal leaflets are obovate and larger than the elliptically or ovately shaped lateral ones, bases of the leaflets are symmetrical, acute, rounded or obtuse, petiolate (0.1- 0.4 cm long), have entire margins, obtuse, rounded or emarginated apices and reticulate venation, fresh leaflets are leathery in texture, dark green on the upper surface and light green on the lower surface, dried leaves are papery in texture and brownish to yellowish green in colour.

Microscopy

The upper epidermis is composed of cell with waxy walls but those on the veins appear to be straight-walled; cuticle is thin and smooth; stomata are rare; the underlying palisade cells are tightly packed; cells of the lower epidermis are also wavy-walled; numerous stomata are present, both anomocytic and anisocytic, especially on the lower side of the leaflets; both surfaces bear thin-walled characteristically long, slender and uniseriate trichomes; transverse section of *M. oleifera* leaflet reveals a dorsi-ventral arrangement, with a double-layered palisade that merges into the collenchyma of the midrib region, tissue arrangement in the midrib region shows an upper epidermis abutting a narrow region of collenchyma beneath which is a region of parenchyma; cells of the parenchyma tissue are smaller in size and tightly packed. The central part of the midrib is occupied by an ox-bow shaped, slightly lignified vascular tissue, surrounded by a region of tightly packed parenchyma bearing starch grains abutting collenchyma and contiguous with the lower epidermis; within the parenchyma region, both above and below the vascular tissue region are

irregularly distributed idioblasts containing calcium oxalate crystals of the cluster type; both the upper and lower epidermis of the midrib bear slender but long and curved unicellular trichomes; transverse section through the petiole shows a similar arrangement of tissue as found in the midrib, except that there is no palisade tissue.

Powdered plant material
The free flowing powder of *M. oleifera* leaflets reveals abundant, whole and broken pieces of unicellular uniseriate trichomes, some of which are curved near the base, anomocytic type of stomata is present. Lamina fragments in sectional view show epidermal cells with a single layer of palisade cells. Broken fragments of veins with reticulate and pitted xylem vessels are present. There are abundant prismatic and cluster crystals of calcium oxalate scattered in the powder and also starch grains.

Therapeutic actions
Antiparasitic, antimicrobial, antiviral, adjuvant, anticholesteremic.

Therapeutic indications
Hypertension, diabetes, malaria, high cholesterol levels

Safety data
The LD_{50} of the aqueous extract (*p.o*) was found to be >3000 mg/kg in rats. No significant changes in body weight, but reduced relative liver weight at a dose of 3000 mg/kg was observed; the haematological profile was not significantly affected. ALP and GGT increased significantly at all doses greater than 100 mg/kg of the aqueous extract and serum creatinine was elevated at 3000 mg/kg.

Precautions for use
Caution should be taken in the administration of the aqueous extract in patients with compromised renal and liver functions.

Adverse effects
Possible increase in serum creatinine at high doses with elevated ALP and GGT.

Contraindications
Renal and liver diseases

Dosage and dosage forms
Powder, decoction, tincture
The leaf is eaten as a leafy vegetable either raw or boiled. For decoction boil 30 g of the dried leaves in 900 ml water; simmer until reduced to 600 ml; 1 teacup three times daily.

Storage
Store in a cool dry place

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Botanical name
Ocimum basilicum L.

Family
Lamiaceae

Synonyms
Ocimum lanceolatum Schum & Tonn, *Ocimum dicotomum* Hochst ex Benth., *Ocimum americanum* L., *Ocimum. menthaefolium* A. Chev., *Ocimum album, Ocimum anisatum, Ocimum barrelieri, Ocimum medium, Plectranthus barrelieri*

Common names
English: Sweet Basil
French: Basilic, Basilic aux sauces, Basilic commun, Basilic romain, Framboisin (Antilles), Herbe Royale, Oranger Savetiers, Des Pistou.

Vernacular names
Burkina Faso: Mooré – Yulin-gnuuga, Dioula – chou kolan, Fulfuldé – Ngunguné;gugumã
Cote d'Ivoire: Baule – Emia
Ghana: Akan – Nunum, Ga – Sulu, Ewe – Dzevetu
Mali: Bambara – Chou Kolan
Nigeria: Yoruba – efinrin wewe
Sierra Leone: Kono – Peinga
Togo: Akasalem – Kunyonyo

Description of the plant
Small, annual aromatic herb, sub-shrub, or shrub; stems quadrangular, branched and forming compact balls of light green color generally; serrated leaves, clearly stalked, thin, elliptical, ovate or oblong cuneate at the base, acuminate at apex, 2 to 4 cm long; whorled inflorescence up to 20 cm, pedicels very short, curved, loose terminal racemes of white flowers, white petals measuring 4-5 mm, calyx lobes orbicular to higher than 6 mm in diameter, calyx ovoid to campanulate, limb 2-lipped; upper lip 3-toothed, middle tooth circular to obovate, margin winged, decurrent, lateral teeth shorter; lower lip 2 toothed , teeth narrower, apex acuminate to spinescent, sometimes approximate, corolla tube slightly shorter than calyx or rarely exserted, dilated, obliquely campanulate at throat; limb 2-lipped, upper lip subequally (3- or 4 -lobed); lower lip somewhat elongated or not, declined, margin entire, flat or slightly concave, stamens 4, exserted, declined on lower corolla lip, anterior 2 longer; filaments free or anterior 2 connate at base; anthers ovoid-reniform, 1-locellate, style longer than stamens, 2-cleft at apex; lobes sub -

equal, subulate or flat; nutlets ovoid.

Herbarium specimen number
Ghana: GC52343

Habitat and geographical distribution
The plant thrives well in light (sandy) and medium (loamy) well-drained soils; prefers acidic, neutral and basic (alkaline) soils. It cannot grow in the shade; requiring moist soil, preferably on cultivated beds.

Plant material of interest
Leaf

Other parts used
Flower

Definition of plant material of interest
Sweet basil consists of the fresh or dried leaf of *Ocimum basilicum* L. (Lamiaceae)

Ethnomedical uses
Sweet basil has been used for thousands of years as a culinary and medicinal herb. It acts principally on the digestive and nervous systems, easing flatulence, stomach cramps, colic and indigestion. The leaves and flowering tops are antispasmodic, aromatic, carminative, digestive, galactogogue, stomachic and tonic (Singh *et al*., 2011). It is taken internally in the treatment of feverish illnesses (especially colds and influenza), poor digestion, nausea, and abdominal cramps, gastro-enteritis, migraine, insomnia, depression and exhaustion. It is externally used to treat acne, loss of smell, insect stings, snake bites and skin infections. The leaves can be harvested throughout the growing

season and are used fresh or dried (Njorege, 2006**).** The mucilaginous seed is taken as an infusion in the treatment of gonorrhoea, dysentery and chronic diarrhoea, and it is claimed to remove film and opacity from the eyes. The root is used in the treatment of bowel complaints in children. Extracts from the plant are bactericidal and anti-parasitic. In India, sweet basil is used for dental ailments due to its proposed antimicrobial effects (Patel and venkatakrishna, 1988). The essential oil is used in aromatherapy.

Biological and pharmacological activities

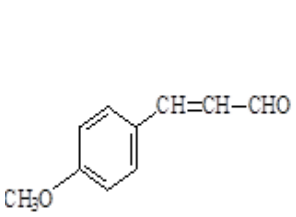
In a laboratory study, *O. basilicum* showed promising antibacterial activity against *Salmonella* spp., *Escherichai coli*, *Campylobacter jejunii*, and *Clostridium perferingens* (Wannissorn *et al*., 2005). The essential oil obtained from the aerial parts was also effective against multidrug resistant clinical isolates from the genera *Staphylococcus*, *Enterococcus*, and *Pseudomonas* (Opalchenova *et al*., 2003). A study by Niture *et al*., (2006) showed that *O. basilicum* has anti-cancer potential. Extracts from the plant caused an increase in O-6-methylguanine-DNA-methyltransferase (MGMT) levels as well as an increase in glutathione S-transferase-pi expression, albeit to a lesser extent than MGMT. Sweet basil oil has been reported to be 12.7 times less potent than the anticancer agent fluorouracil in cancer (P388) cell lines (Manasroi *et al*., 2006). *O. basilicum* showed significant inhibitory effects against HIV-1 induced cytopathogenicity in MT-4 cells (Yamasaki *et al*., 1998). The active components in the extract samples were found to be the water-soluble polar substances. In addition, these aqueous extracts inhibited giant cell formation in co-culture of Molt-4 cells with and without HIV-1 infection and showed inhibitory activity against HIV-1 reverse transcriptase. In a second laboratory study, Chiang *et al*., (2005) found that crude aqueous and ethanolic extracts of *O. basilicum* and components such as apigenin, linalool, and ursolic acid exhibit a broad spectrum antiviral activity *in vitro*. However, no activity was noted for carvone, cineole, ß-caryophyllene, farnesol, fenchone, geraniol, ß-myrcene, or α-thujone. Rosmarinic acid present in the plant inhibited complement – dependent inflammatory processes (Renzuli *et al*., 2004) and was also able to reduce radical oxygen species production, protein and DNA synthesis inhibition, and apoptosis *in vitro*. The mosquito-repellent effect of the plant has also been reported (Erler *et al*., 2006). Based on a study of human spermatozoa *in vitro*, sweet basil is thought to possess potent spermicidal action (Buch *et al*., 1988).

Clinical data

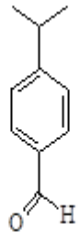
In a study of patients with chronic bronchitis, exposure to essential oils of basil caused lowering of plasma levels of dienic conjugates and ketones and activation of catalase in red cells characteristic of antioxidant effects (Siurin, 1997). *O. basilicum* has been studied in humans for acne vulgaris, although a mechanism of action is unclear (Balambal *et al*., 2005)

Chemical constituents

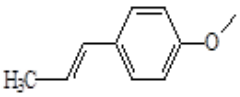
Essential oils (contains linalool, *epi*-α-cadinol, α-bergamotene, γ-cadinene, eugenol, chavicol, linalool, anethole, estragole, limonene, cuminaldehyde, α-terpineol and cinamic acid derivatives (Abdulah *et al*., 2008; Politeo, 2007).



4-methoxycinnamaldehyde

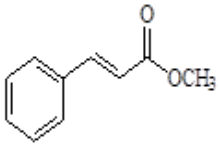


Cuminaldehyde

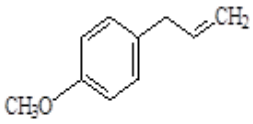


Anethole

Limonene



Methyl cinnamate



Estragole

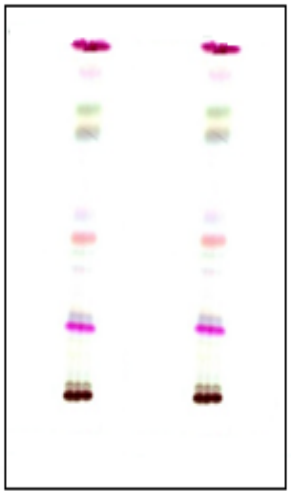
Tests for identity and purity

Moisture content: not more than 9.90%
Total ash: 11.14%
Water-soluble extractive: not less than 14.50%
Alcohol-soluble (70%) extractive: not less than 8.94%.

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100 - 110°C for 5-10 min. Presence of five characteristic spots with R_fs 0.91 (pink), 0.80 (grey), 0.73 (grey), 0.45 (pink) and 0.20 (pink).



Chromatogram

Macroscopy

Greenish with aromatic odour and bitter taste; leaf simple, shortly petiolate; lamina 3-5cm long, 1.5-2 cm broad; ovate to obovate in shape; margin is shallowly serrate; apex is acuminate, leaf base cuneate and venation reticulate, leaf. surface is glabrous, texture papery with a depressed midrib

Microscopy

Epidermal strips revealed a surface topography that shows wavy anticlinal walls, trichomes, non-glandular, unicellular and multicellular; numerous oil globules, stomata, mainly paracytic, sclereids abundant on the adaxial surface; transverse section of mid-rib showed a slight depression on the dorsal side and a slight protuberance on the ventral side with cells, ovoid-globose in shape; vascular bundles showing a slight concave shape with 2-3 celled xylem.

Powdered plant material

Wavy parenchymatous cells of the epidermis, non-glandular, covering trichomes, unicellular and multicellular; paracytic stomata, abundant sclereids, xylem vessels

Therapeutic actions

Antiasthmatic, anticonvulsant, antibacterial, insect repellant, antiflatulence

Therapeutic indications

Chronic catarrh, asthma, convulsion, colic, indigestion

Safety data

Animal studies in male rats showed that the LD_{50} of the aqueous extract (*p.o*) was >3000 mg/kg. No signs of toxicity were seen in the acute treatment of the animals following a single dose (300-3000 mg/kg) followed by monitoring over a 24-hour period. Changes in body weight were comparable to vehicle-treated animals. Haematological profile was normal. An elevation of AST was observed but not ALT. ALP also showed a mild increase at doses >1000 mg/kg suggesting that the aqueous extract has an adverse effect on the hepatobiliary system. There was no evidence of perturbation of renal function.

Precautions for use

Caution should be taken in patients with hypoglycaemia and liver disease. Basil oil contains estragole a potentially carcinogenic and mutagenic agent. It should not be taken during pregnancy or given to small infants/children

Adverse effects

Possible hypoglycaemia and hepatic dysfunction.

Contraindications

Pregnancy and liver disease

Dosage and dosage forms

Decoction, instillation, paste.

Decoction: 30 g plant material in 900 ml water; simmer until reduced to 600 ml; 1 tablespoonful two times daily.

Storage

Store in a cool dry place

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Ocimum gratissimum

Botanical name
Ocimum gratissimum L.

Family
Lamiaceae

Synonyms
Ocimum viride Willd, *Ocimum guineense* Schum. and Thonn.

Common names
Tea Bush, mosquito plant, fever leaf, fever plant of Sierra Leone, French: Basilic de ceylan

Vernacular names
Cote d'Ivoire: Anyi – Samane, Baule – Aloamagneree, Fulfulde – Cunfere
Ghana: Adangme – Gbekona, Akan – Onunum , Ga – Sru Sulu Suru
Guinea Bissau: Crioulo – Doreda
Guinea: Manding Maninka – Su-Guen-Fira
Nigeria: Edo – Aramogho, Hausa – Dai Dooyaata Gidaa, Igbo – Ncho-Anwu Nchuagwunta, Yoruba-efinrin nla
Senegal: Crioulo – Doreda, Fula – Kunfere, Maninka – Sukuru Baba, 'Susu' Barikiri
Togo: Ewe – Dzogbeti, Akaselem – Ditsunonon

Description of the plant
The plant is an erect shrub that grows up to a height of 1.8 m; the stems are nearly glabrous with leaves, which have rather long petiole, lanceolate to oblong-lanceolate or ovate or obovate, cuneate or asymmetric base, apex acute or acuminate, margin toothed or distantly serrated, up to 12 cm long, 4 cm broad; flowers are cream-white or yellowish, pedicel puberulous, calyx two-lipped, upper lip ovate, lower lip oblong, two-teethed; occurring in paniculate racemes usually 15 cm long with green colour at the bud stage but turns brown when dry (Trease and Evans, 1972).

Herbarium specimen number
Ghana: GC52056
Nigeria: FHI 107436
Togo: TOGO04218

Habitat and geographical distribution
It is widely distributed in the tropics including Africa and can be found mainly in gardens, compounds, old farms near villages, often cultivated in various parts of West Africa. It is found across many parts of Nigeria, both north and south.

Plant material of interest
Leaf

Other parts used
Flower

Definition of plant material of interest
Tea bush consists of the fresh or dried leaf of *Ocimum gratissimum* L. (Lamiaceae).

Ethnomedical uses
O. gratissimum is renowned in African traditional medicine for its use in the treatment of upper respiratory tract (e.g. coughs, pneumonia, etc.) and digestive disorders (e.g. diarrhoea, dysentery), skin diseases, fever, headaches and conjunctivitis (Onajobi, 1986; Oliver-Bever, 1960). It is used as an anticonvulsant and antibacterial agent in the treatment of malaria and small pox (Irvine, 1961). The leaves are used to treat nose bleeding and dizziness, and it is chewed with salt or boiled with it and used as febrifuge and diaphoretic. Fluid obtained by rubbing the leaf with a little water is used as an eye drop for ophthalmic conditions such as conjunctivitis. The leaf infusion is mixed with pepper to treat dysentery (Dalziel, 1936). Oil from the leaves is used to prevent mosquito bites and repel other insects. The leaves are also used to treat constipation, menorrhagia and abdominal colic. The whole plant is used for rheumatism and the root for snakebite (Adjanohoun *et al.*, 1991).

Biological and pharmacological activities
Nakamura *et al.*, (1999) have shown that the plant's essential oil and purified extracts have antibacterial activity *in vitro*; the antimicrobial

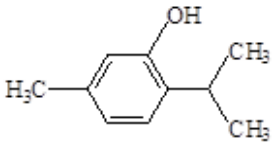
effect has been ascribed to the monoterpenoids eugenol and thymol contained in the volatile oils (Oliver-Bever, 1960; Sainsbury and Sofowora, 1971). The essential oil exhibited significant antimicrobial activity aginst *Staphylococcus aureus*, *Shigella flexineri, Salmonella enteritidis, Escherichia coli, Klebsiella spp* and *Proteus mirabilis* in a dose-dependent manner (Nakamura *et al*., 1999). The compound responsible for the antimicrobial activity was identified as eugenol (Nakamura *et al*., 1999). In a related study, Ndounga and Ouamba (1997) found that the volatile oil of *O. gratissimum* had higher activity than the volatile oil of *Ocimum bacilicum* and was more potent than the reference antimicrobial agents (tetracycline, oxacillin, clotrimazole, cefotaxime, mecillinam, clinamycine, clotrimazole, ketoconazole and Nystatin) against *Staph. aureus, Strept. faecalis, E. coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus vulgaris, Aspergillus fumigatus, Trichophyton mentagrophytes and Candida albicans*. The oil inhibited 80% of the dermatophite strains tested (Lima *et al*., 1993) and also showed activity against *Trichophyton rubrum* and *Trichophyton mentagrophytes*. Remarkable antibacterial effects, higher than those of commercial antiseptic products used as positive control were demonstrated at 2%. Leaf extracts have demonstrated promising anti-viral (anti-HIV-1) effects (Ayisi and Nyadedzor, 2003). *O. gratissimum* extracts have also shown promising antihelminthic effects by the ability to inhibit glutathione S-transferases from parasitic nematodes (Fakae *et al.,* 2000). The essential oil reversibly and concentration-dependently showed relaxant effects on intestinal smooth muscle (Madeira *et al.,* 2002). The methanolic leaf extracts demonstrated significant hypoglycaemic effect *in vivo* (Aguiy *et al.,* 2000) while the aqueous and methanolic leaf extracts promoted blood coagulation (Edemeka and Ogwu, 2000). Ocimum oil was more effective in hydrophilic bases than in lipophilic bases in some ointments (Orafidiya *et al*., 2001). An aqueous and butanol fractions of the crude extract of the leaf produced blood anticoagulation at 10-12mg/ml (Elujoba *et al*., 2001). Investigation of the decoction of the leaf against multi drug-resistant *Shigella* species, isolated from patients with bacillary dysentery, inhibited isolates at 3000 mg/ml (Iwalokun *et al*., 2001; Ilori *et al*., 1996).

Clinical data

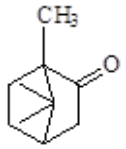
No information available

Chemical constituents

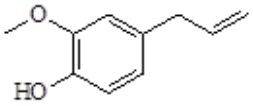
Volatile oil (e.g. thymol, eugenol, alpha and βpinene, camphene, terpinene, limonene and methyl eugenol; camphor, caryophylline); triterpenes; reducing sugars (GHP, 1992; Onajobi, 1986; Sainsbury and Sofowora, 1971; Sofowora, 1970; El Said *et al*., 1969).



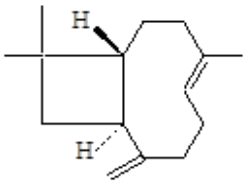
Thymol



Camphor



Eugenol



Caryophyllene

Tests for identity and purity

Moisture content: powder, when dried at 105°C loses not more than 50.00%; 45.00% when air-dried

Total ash: 15.50%

Acid – insoluble Ash: 3.40 %

Water- soluble Ash: 4.00 %

Water-soluble extractive: Not less than 15.00 %

Alcohol-soluble (70%) extractive: Not less than 10.00%

Palisade ratio: 4.25-5.89-7.5

Stomatal index:12.5-28.7 (upper surface); 18.2-28.5 (lower surface)

Stomatal number: 100 -184- 300 (upper surface); 300 -317- 400 (lower surface)

Veinislet number: 3.5 - 4.0

Veinlet-termination number: 10.0 - 14.5

(Elujoba and Olawode, 2004)

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with Anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of characteristic four spots with R_fs 0.76 (pink), 0.65 (purple) and 021 (purple).

Chromatogram

Macroscopy
The leaves are simple, decussately arranged; long petiolate, lanceolate to oblong-lanceolate or ovate to obovate; apex acute or acuminate or acute at both ends; base cuneate or asymmetric; midrib prominent on dorsal surface; venation reticulate; fairly glabrous, with toothed or distantly serrated margin; can be up to 12 cm long and 6cm wide, markedly punctuate-glandular below; racemes spike-like, strict and solitary to several in a panicle of up to 15 cm long; odour thyme-like, aromatic, pungent but characteristic; taste is pungent, aromatic, spicy or minty, colour green (Ekejiuba, 1984).

Microscopy
Transverse section dorsiventral, single palisade layer; mesophyll filled with starch, abuts on collenchyma in midrib region, the mid-rib and the transverse section bifacial structure, characteristic sub-epidermal masses of collenchyma on both surfaces, spongy mesophyll contains oil droplets; vascular bundle, bicollateral, surrounded by lignified pericyclic fibres; stomata, diacytic on both surfaces, more common on the lower epidermis, surface gland is dotted (punctate); trichomes/hairs, numerous in young leaves, abundant on the midrib and veins, multicellular, clothing, conical, multicellular uniseriate located on veins and veinlets on lower surface, 3 to 8 cells long, slightly curved with thin, warty walls; about 243-521 µ in length; similar hairs are found on the stem (Ekejiuba, 1984).

Powdered plant material
Diagnostic features include wavy epidermal cell walls; lignified elements of veins and veinlets; starch grains; oil globules; multicellular uniseriate clothing trichomes, warty, uniserriate and fairly curved, some with collapsed cells, small groups of fragmented epidermal parenchymatous cells and collenchyma tissue; diacytic stomata; fragmented xylem vessel members and oil droplets are present; colour green; aromatic, spicy taste.

Therapeutic actions
Antibacterial; antiseptic; antispasmodic (essential oil); antitussive; diaphoretic; febrifuge; laxative; ophthalmic; stomachic

Therapeutic indications
Diarrhoea, colic, bacterial infections, catarrh, conjunctivitis, dysentery, fever, headache, rheumatism, sinusitis, skin diseases, upper respiratory tract disorders (e.g. cough, pneumonia) and vomiting (GHP, 1992; Onajobi, 1986).

Safety data
Animal studies in male rats showed that the LD_{50} of the aqueous extract (*p.o*) is >3000 mg/kg. No signs of toxicity were seen in the acute treatment of the animals following a single dose (300-3000 mg/kg) followed by monitoring over a 24-hour period. Changes in body weight were comparable to vehicle-treated animals. Haematological profile was normal. An elevation of AST was observed but not ALT. ALP also showed a mild increase at doses >1000 mg/kg suggesting that the aqueous extract has an adverse effect on the hepatobiliary system. There was no evidence of perturbation of renal function.

Precautions for use
Caution should be taken in patients with hypoglycaemia and liver disease. May not be used in chronic constipation; its use in bleeding situations must be medically supervised; overdose or prolonged use may lead to acute constipation and colonic inertial. May irritate mucous membranes when used externally in high doses; pregnancy and lactation.

Adverse effects
Possible hepatic dysfunction and hypoglycaemia.

Contraindications
Liver disease

Dosage and dosage forms
Infusion; decoction; tincture; essential oil.

Decoction: 30 g dried leaves in 900 ml water; simmer until reduced to 600 ml; 1 teacup three times daily
Infusion: 30g dried herb in 600 ml of water; 1 teacupful three times a day
Tincture: 1:5 in 50% alcohol, 5 ml three times daily
Essential oil: 2-3 drops three times daily.

Storage
It should be stored in airtight containers in a cool, dry, dark place, protected from light and moisture.

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Phyllanthus niruri

Botanical name
Phyllanthus niruri var genuinus Mull Arg

Family
Euphorbiaceae

Synonyms
Phyllanthus carolinianus Blanco*; P. asperulatus* Hutch*; Phyllanthus filiformis* Parmex Baillon*; Nymphanthus niruri* Lour*; Diasperus niruri* (L) Kuntze. *Phyllanthus fraternus subspecies* togoensis Brunel & Roux

Common names
Stone breaker, carry-me-seed, Creole senna, cane peas senna, quinine weed, hurricane weed, gale-wind weed, French: Herbe au chagrin

Vernacular names
Burkina Faso: Mooré – Tinguin garga, Fulfuldé – Lébèl
Cote d'Ivoire: Baules – Ugniassi, Kru Guere – Tienwe, Kulango – Lumbodiataka.
Ghana: Twi – Bowomma guwakyi, Ga Dangme – Mbatoatshi, Nzema – Nwamenle
Guinea Bissau: Fula Pulaar – Bubunguel
Guinea: Kissi – Fundelo Un'do, Koranko – Kode, Toma – Sakade
Nigeria: Edo – Orosorsor, Igbo – Ososo, Igbo (Ibuzo) – Awueli
Sierra Leone: Mende – Eroboe

Description of the plant
A glabrous annual herb 30-50 cm high with grooved stem; slightly winged; leaves simple, alternate and distichous, oblong-elliptical rounded at both ends; 6-14 mm long, 25-5.5 mm broad; pale green; unisexual flowers, solitary with six sepals, males in the lower axils and the females in the upper axils with deep dentate discs and very short styles; fruit capsule, about 2 mm in diameter.

Herbarium specimen number
Togo: TOGO03567

Habitat and geographical distribution
Occurs commonly in gardens, waste places and roadsides

Plant material of interest
Leaf

Other parts used
Aeriael parts

Definition of plant material of interest
Phyllanthus consists of the leaves of *Phyllanthus niruri var* genuinus Mull Arg (Euphorbiaceae).

Ethnomedical uses
Its Spanish name *chanca piedra*, which means "stone breaker" or "shatter stone", describes its folkloric use among Amazonians for eliminating gallstones and kidney stones. It is also used for hepatitis, colds, flu, fever, tuberculosis, malaria, diabetes, hypertension and liver diseases among others. In the Asian, Mediterranean regions and most parts of east Africa, the plant is boiled and taken as tea. Hot water extract of dried aerial parts administered orally is used as a diuretic, antipyretic and antimalarial (Weninger *et al.,* 1986; Kitisin, 1952). The hot water extract of fresh entire plant is also administered orally for gonorrhoea and other genitourinary disorders (Sahu, 1984; Khan *et al.,* 1978). A decoction of the dried plant is used for coughs in infants and the fresh root is a remedy for jaundice. Water extract of the leaves and roots is taken orally for diabetes, and as a diuretic. Infusion of young shoots is given in dysentery, whilst the leaves are commonly used to treat fever. It can also be used to increase appetite, relieve inflammations and as a remedy for anorexia (Asprey and Thornton, 1955). In India, the fruit is used externally for tubercular ulcers, scabies and ringworm. Hot water extract of the dried plant is administered orally for diabetes and asthma in Ayurvedic medicine (Sircar, 1984; Chauhan *et al.,* 1977; Jain and Sharma, 1967). In the Fiji Islands, the dried powdered whole plant mixed with buttermilk is administered orally for jaundice. Fresh leaf juice is used externally for cuts and bruises, but for eye diseases, the juice is mixed

with castor oil and applied to the eye. Infusion of the green root is taken orally to treat heavy menstrual periods (Singh, 1986).

Biological and pharmacological activities

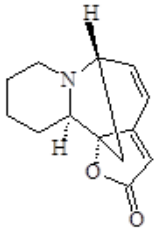
Phyllanthus niruri has undergone extensive phytochemical research spanning over four decades. Human and animal studies using a simple tea infusion showed the plant's ability to promote kidney stone elimination (Santos, 1990). An extract exhibited potent inhibitory effect on calcium oxalate formation *in vitro* (Campos *et al.,* 1999); it also inhibited the growth of the matrix calculus in bladders of rats seeded with calcium and reduced stone satellites compared to controls (Freitas *et al.,* 2002). The plant has also been reported to stimulate bile acid secretion and to help lower blood cholesterol levels (Khanna, *et al.,* 2002). Hydroalcoholic extract of the plant exhibited analgesic effects in mice (Santos, *et al.,* 1995) and in other newly-tested neurogenic pain models (Santos *et al.,* 2000). Geraniin contained in the plant is seven times more potent as an analgesic than aspirin or acetaminophen (Miguel *et al.,* 1996); it has demonstrated antiulcerogenic and gastroprotective effects (Hung *et al.,* 1995). Alkamide-containing fractions of *P. fraternus* extract exhibited moderate antiplasmodial activity *in vitro* (Sittie *et al.,* 1998) while the methanol fraction was found to have hepatoprotective properties (Ahmed *et al.,* 2002). Two other *in vivo* studies have also reported the hypoglycaemic activity of the plant (Hukeri *et al.,* 1986; Ramakishnan *et al.,* 1982). Aqueous extract of *P. niruri* increased the lifespan of mice with liver cancer (Rajeshkumar *et al.,* 2000) and exhibited HIV-1 reverse transcriptase inhibition activity (Ogata *et al.,* 1992).

Clinical data

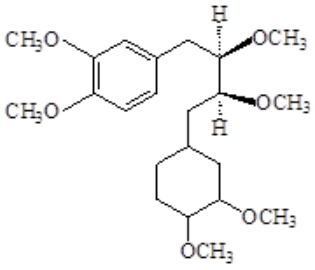
Administration of *P. niruri* extracts to children with acute hepatitis restored liver function within five days (Thabrew *et al.,* 1996) and ingestion of powdered herb by adults with chronic hepatitis showed antihepatotoxic effects (Wang *et al.,* 1994). Capsules of the leaf powder significantly caused reduction in systolic blood presure, increase in urine volume, and in urine and serum sodium excretion as well as a reduction in blood glucose levels (Srividya *et al.,* 1995) in a human trial.

Chemical constituents

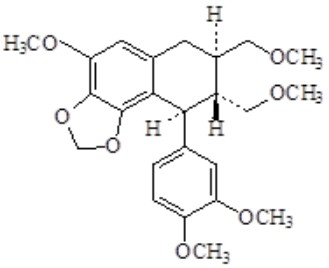
Alkaloids (securinine and related alkaloids); lignans (e.g. phyllanthin and hypophyllanthin); tannins; flavonoids (e.g. quercetin, rutin); methyl salicylate; carboxylic acid; saponins.



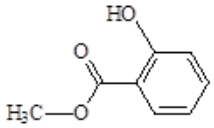
Securinine



Phyllanthin



Hypophyllanthin



Methyl salicylate

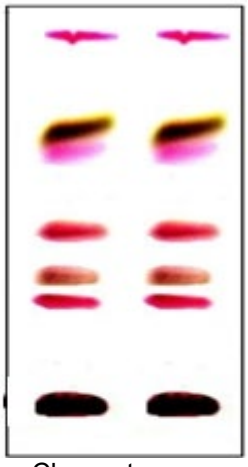
Tests for identity and purity

Moisture content: not more than 7.30%
Total ash: 12.30%
Water-soluble extractive: not less than 19.00%
Alcohol-soluble (70%) extractive: not less than 15.40%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10min. Presence of five characteristic spots with R_fs 0.75 (dark brown), 0.70 (pink), 0.50 (pink), 0.40 (pink) and 0.35 (pink).



Chromatogram

Macroscopy
A herb with cylindrical stem; simple leaves stipulated; alternate; purple or red flush at base of branch; leaves oblong or oblanceolate; apex round or acute; base round or obtuse; up to 14 mm long, colour green; odour characteristic; taste bitter, astringent.

Microscopy
The surface view shows wavy, anticlinal epidermal cell walls, papillose, warty; anisocytic (upper surface), paracytic and anisocytic (lower surface) stomata; a row of rosette crystals on either side of midrib; hooked trichomes on leaf margins; transverse section shows a dorsiventral arrangement; epidermis papillose especially lower one; pallisade one-cell thick, over one-half thickness of lamina, discontinuous in midrib region; midrib region occupied by cuboid-parenchyma with rosette crystals in lower cells; vascular bundle collateral, xylem vessels lignified; starch grains in mesophyll.

Powdered plant material
Green colour; odour characteristic; taste bitter, astringent; lamina fragments with rosette crystals, fibres and vessels; ovoid pollen grains with smooth exine; starch grains.

Therapeutic actions
Antilithic, antiviral, antiprotozoal, hypoglycaemic, analgesic, anti-inflammatory, antimutagenic, antispasmodic, antibacterial, carminative, choleretic, diuretic, febrifuge, hypotensive, laxative, stomachic, tonic, vermifuge, digestive, antihepatotoxic (Ahmed *et al*., 2002; Sittie *et al.,* 1998; GHP, 1992).

Therapeutic indications
Diabetes; alcohol-induced liver damage; jaundice, malaria; kidney stones; gallstones; hypertension; liver cancer; hepatitis; anaemia, raised cholesterol levels; ulcer, dysentery, colic, vaginitis, tumours, flu, cystitis, prostatitis, venereal disease, urinary tract infections; stroke; abdominal pain; diarrhoea; dystocia; prenatal care; hyperglycaemia; septicaemia; snakebite; viral infection (Mshana *et al.,* 2000; GHP, 1992).

Safety data
Animal studies showed that LD_{50} of the aqueous leaf extract (*p.o*) in female rats was >3000 mg/kg. The acute studies (300-3000 mg/kg, 24-hourly and repeated dose administration for 14 days) did not show any clinical signs of toxicity. Body weight changes and relative organ weights of treated animals were not significantly different from vehicle-treated controls. There were no adverse effects on blood and blood cells, the liver or the kidneys.

Precautions for use
Sugar levels and blood pressure to be monitored on long-term treatment.

Adverse effects
Hypotension, if affected withdraw the drug immediately. Abortifacient in high doses, reversible antifertility effects *in vivo* (Rao and Alice, 2001).

Contraindications
May potentiate insulin and antidiabetic drugs probably due to geraniin (Ueno *et al.,* 1988). Heart disorders and/or heart medications, hypoglycaemia, hypotension

Dosage and dosage forms
Decoction; infusion; tincture; liquid extract
Decoction: 30 g dried leafy tops in 900 ml water; simmer until reduced to 600 ml; 1-3 cups daily
Infusion: 30 g dried leaves in 600 ml of water; 1-3 cups daily
Tincture- 1:5 in 50% alcohol, 5 ml three times daily
Fluid extracts/water-glycerine extracts: 1:1 in 50% alcohol; 2-6 ml, 2-3 times daily

Storage
Store in a cool dry place

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Botanical name
Phytolacca dodecandra L'Hér.

Family
Phytolaccaceae

Synonyms
Phytolacca abyssinica Hoffin*; Pircunia abyssinica* Moq.

Common names
Endod, soap berry, African soap berry (English). Phytolaque, endod. Fitolaca (French)

Vernacular names
Ghana: Akan – Ahoro
Nigeria: Igbo – Ogwashi Okomofo Uburuku Aweli, Yoruba – Ososo

Description of the plant
Climbing or scrambling dioecious, semi-succulent shrub, sometimes a liana with stems up to 10-20 m long, with a taproot; trunk sometimes up to 35 cm in diameter; stems usually glabrous; leaves alternate, simple and entire; stipules absent; petiole 1–4 cm long; blade ovate to broadly elliptical, 3–14 cm × 1.5–9.5 cm, base rounded to slightly decurrent into the petiole, apex acute to rounded, mucronate, glabrous to shortly hairy;.inflorescence an axillary or terminal raceme 5–30 cm long, many-flowered, axis hairy; bracts up to 2.5 mm long, shortly hairy, flowers functionally unisexual, 5-merous, sweet-scented; pedicel 2–8 mm long; male flowers with narrowly oblong, about 2.5 mm long, reflexed, whitish to yellowish green sepals, petals absent, stamens 10-20 in 2 whorls, free, filaments 3-7 mm long, ovary usually rudimentary; female flowers with oblong to ovate, about 2.5 mm long, reflexed sepals, accrescent in fruit, turning yellow to red, petals absent, stamens 8-12, rudimentary, ovary superior, consisting of 4-5 free, ovoid carpels, styles 1-2 mm long, curved, stigmas linear; fruit consisting of 4-5 1-seeded berries fused at base, up to 15 mm in diameter, fleshy, remains of style pointing outwards at apex, ripening orange or purplish red. Seeds kidney-shaped, laterally flattened, 2-4 mm long, shiny black.

Herbarium specimen number
Ghana: GC 52816
Nigeria: FHI 109009

Habitat and geographical distribution
P. dodecandra is native to Sub-Saharan Africa and Madagascar and has been introduced in Asia and tropical America. It occurs in forest, forest margins, riparian forest, thickets, wetter bushland, in fences along cultivated land and around houses, on mountain slopes and in open fields, at 1500–3000 m altitude. It grows best under direct sunlight in humid, weakly acidic soils that contain high levels of organic matter, in areas with an annual rainfall of about 1400 mm and a distinct dry period. In areas with high evapotranspiration, especially at lower elevations (below 1500 m) partial shade should be available so that the plants do not burn and wilt. Full shade substantially lowers both fruit yield and saponin concentration.

Plant material of interest
Fruit

Other parts used
The root, leaf, seed

Definition of plant material of interest
Endod consists of the fruit of *Phytolacca dodecandra* L'Hér (Phytolaccaceae).

Ethnomedical uses
Phytolacca dodecandra (Endod) is indigenous to Ethopia, Central and East Africa. In Ethiopia, where it is known as traditional soap, the toxic plant berries are commonly used for washing and ridding clothes of lice and to control or poison fresh water snails (Pankhurst, 1965). It is also used for purging intestinal parasites, for abortion, and against dandruff, gonorrhoea, leeches, intestinal worms, anthrax, rabies,

ringworm, skin itching and other skin diseases (Watt and Breyer-Brandwijk, 1962, Esser *et al.,* 2003). In Central and East Africa and Madagascar, an extract of the roots, leaves, fruits and seeds is taken as a purgative, laxative, diuretic or emetic. These plant parts are used to treat a wide range of diseases including worm infestations, oedema, diarrhoea, abdominal pain, wounds, scabies, eczema, psoriasis, leprosy, boils and vitiligo. An infusion of the fruit or the root decoction is widely taken to treat venereal diseases, bilharzia, rabies, malaria, sore throat and other respiratory problems, rheumatic pain and jaundice. In Ethiopia and Zimbabwe unripe fruits rich in molluscicidal saponins, are widely applied to control bilharzia-transmitting snails. The leaf sap is cicatrizing and haemostatic and causes a burning sensation on the skin. An infusion of the fruit or roots is taken orally and the young leaves and shoots are chewed to induce abortion. In East Africa ground leaves are applied to tumours; the root decoction is also drunk to cause vomiting as treatment of enlarged glands. In Tanzania macerated leaves or root bark are used to treat epilepsy while in Madagascar, a decoction of the aerial parts is applied to treat haemorrhoids. In eastern and southern Africa the whole plant is considered poisonous, and it is said to have caused accidental death of people eating the leaves as a vegetable. The plant is usually not used as firewood, as the smoke is believed to reduce male sexual ability.

Biological and pharmacological activities

Kloos and McCullough (1984) reported that over 1000 plants have been screened for molluscicidal activities and immature berries of *P. dodecandra* have been found to be the most potent molluscicide. Control of *Schistosoma mansoni* by the soapberry endod in Ethiopia indicated that the reduction achieved in the prevalence and intensity of schistosomiasis after an intervention period of four years was limited. Endod has been used in the control of *Biomphalaria pfeifferi* population and schistosomiasis transmission in Ethiopia (Abebe *et al.,* 2005). The antifungal potential of the plant against 33 medically important strains of yeast and dermatophytes were investigated by Woldeamanuel *et al.,* (2005).The MIC of the aqueous extract ranged from 19.5-312.5 mg/L. No activity was observed against yeasts, but larvicidal activity on stream flora and fauna was noted in a comparative toxicity study involving endod and other compounds. Mosquito larvae are particularly susceptible to the lethal effect of endod with confirmed susceptibility of larvae of the black fly (*Simulium* spp.), which causes onchocerciasis, and larvae of the domestic house fly, *Musca domestica*. It is thought that snail and malaria-transmitting mosquitoes may breed in the same type of environment, hence control of snails with endod may have the added benefit of reducing mosquito populations. *Schistosome cercariae* and other trematode larvae are highly susceptible to endod (Spielman and Lemma, 1973; Flemings, 1975). Karunamoorthi *et al*., (2008) have also demonstrated the toxic potential of crude extract of *P. dodecandra* berries against aquatic macro invertebrates *Baetidae* (Mayflies) and *Hydropsychidae* (Caddisflies). Endod has been shown in laboratory studies to cause strong uterine contractions (Stolzenberg *et al.,* 1976), consistent with its use as an abortifacient in traditional societies in Ethiopia and other parts of East Africa. Intrauterine injection of small quantities of endod extract in pregnant mice caused sterile and apparently harmless abortion. In addition to preventing pregnancy, it may be useful as a "day after" pill (Stolzenberg and Parkhurst, 1974).

Clinical data

The butanol extract of endod has been shown to be an extremely effective biological agent against human sperm, which explains its use as a locally produced, vaginal foam birth control agent (Parkhurst and Stolzenberg, 1975).

Chemical constituents

Saponins (triterpenoid glycosides; the aglycones of the glycosides are mainly composed of oleanolic acid, bayogenin , hederogenin and 2-hydroxyoleanolic acid); phytosterols; lipids (palmitic acid, oleic acid, stearic acid); sugars, starches, pectins and gums (Parkhurst *et al.,* 1973; Lemma *et al.,* 1972).

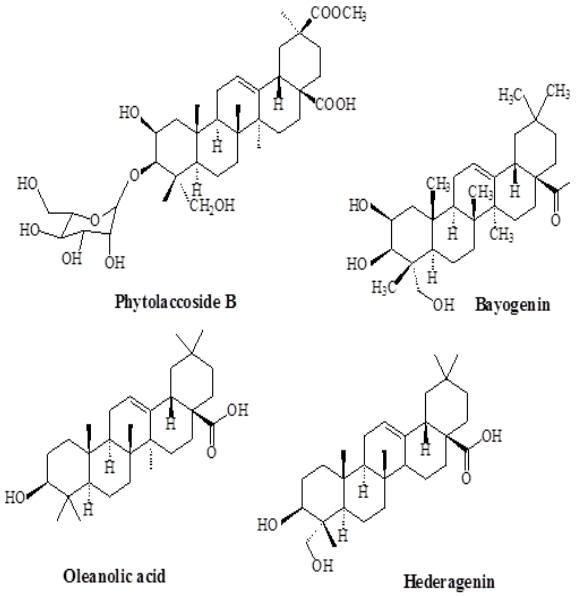
Tests for identity and purity

Moisture content: not more than 12.30%
Total ash: 16.40%
Water-soluble extractive: not less than 18.90%
Alcohol-soluble (70%) extractive: not less than 16.20%.

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with



anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spots with R_fs 0.74 (purple), 0.72 (green), 0.54 (purple) and 0.23 (pink).

Chromatogram

Macroscopy

Greenish with characteristic odour; leaf simple, shortly petiolate; lamina 3-6 cm long, 1.5-2 cm broad; ovate to obovate in shape; margin is shallowly serrate; apex is acuminate, leaf base cuneate and venation reticulate, leaf surface is glabrous, texture papery with a depressed midrib.

Microscopy

Epidermal cells with wavy walls, trichomes, clothing, unicellular and multicellular, stomata, mainly anisocytic, sclereids abundant on the adaxial surface; transverse section of mid-rib showed a slight depression on the dorsal side and a slight protuberance on the ventral side with cells, ovoid-globose in shape; vascular bundles showing a slight concave shape with 2-3 celled xylem.

Powdered plant material

Wavy parenchymatous cells of the epidermis, non-glandular, covering trichomes, unicellular and multicellular; anisocytic stomata, abundant sclereids, xylem vessels

Therapeutic indications

Itching, ringworm, gonorrhoea, intestinal worms, anthrax and rabies, oedema, abdominal pain, eczema, psoriasis, leprosy, boils.

Therapeutic actions

Laxative, anthelmintic, emetic, sudorific, diuretic, antiinfective, analgesic, molluscicidal, haemostatic.

Safety data

As with other molluscicides (Lemma and Yau, 1975), small fish and tadpoles are affected by *P. dodecandra* at molluscicidal concentrations. Birds known to feed on berries of wild plants seem unaffected, as do waterbugs in treated streams. Preliminary studies on the toxicity of *P. dodecandra* to a variety of animal and plant species and tests for carcinogenic properties have been undertaken (Lemma, 1970; Lemma and Ames, 1975). Sheep force-fed with the water extract at a dose of 1 g/kg body weight died within 96 hours, whereas a dose of 200 mg/kg body weight had no apparent effect on kidney and liver function tests done over a period of 4 days. Oral administration to dogs at a dose of about 100 to 200 mg/kg body weight caused vomiting within minutes. Intravenous injection at the dose of about 50 mg/kg body weight was lethal in less than 24 hours, but 8 mg/ml of blood did not show any significant changes. The acute toxicity of two molluscicides extracted from *P. dodecandra* and Niclosamide, was determined. Endod-S showed a 24-h LC_{50} of 2.57 and 5.37 mg/L for *Biomphalaria glabrata* (albino) and *Biomphalaria pfeifferi* respectively. Niclosamide produced a 24-h LC_{50} of 0.063 mg/L and 0.049 mg/L for *Biomphalaria glabrata* (albino) and *Biomphalaria pfeifferi,* respectively. The 4-h LC_{50} for *Schistosoma mansoni* cercaria was 2.92 mg/L for Endod-S and 0.0008 mg/L for Niclosamide. The 24-h LC_{50} for *Tilapia nilotica* was 1.82 mg/L for Endod-S and 0.21 mg/L for Niclosamide. The acute toxicity to rats and mice

was assessed by giving 0, 1000 and 2500 mg/kg of body weight of endod in distilled water at 50 mg/ml and 250 mg/ml concentrations by gavage, after which the animals were monitored for 3 days. The LD_{50} values were determined in rats and mice of both sexes. In rats the LD_{50} were 1000 mg/kg for males and 920 mg/kg for females, whereas in mice the LD_{50} was 1600 mg/kg for males and 3280 mg/kg for females.

Precautions for use
The plant may be toxic and should be used with care

Adverse effects
May cause diarhoea and drowsiness

Contraindications
Pregnancy and lactation

Dosage and dosage forms
Decoction
Decoction: 30 g dried plant material in 900 ml water; simmer until reduced to 600 ml; 1-3 tablspoonfuls daily

Storage
Store in a cool dry place

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Botanical name
Pterocarpus erinaceus Poir.

Family
Papilionaceae

Synonyms
Pterocarpus echinatus DC.

Common names
English: African rosewood, Senegal rosewood, African barwood, African teak, African kino tree.
French: Santal rouge d'Afrique, Vène, ven, palissandre du Sénégal, santal rouge d'Afrique,
Portuguese: Pau sangue.

Vernacular names
Burkina Faso: Mooré – Noèèga ou Nohinga, Dioula – Gôni;gweni;mbeny, Fulfuldé – Bani ;banu ;bané ;bari
Guinea: Maninka- Gbene – Gbin, Pular – Barybani Banigue, Kissi – Koilo Kouelo
Mali: Bambara – Mguèni
Nigeria: Hausa – Dorowan Kurmi, Igbo – Aze Egu, Yuroba – Apepe
Senegal: Sérère – Ban, Wolof – Vèn, Malinké – N'gbéhun

Description of the plant
Small tree, open rounded crown reaching from 15 to 20 m high; bole straight, cylindrical and devoid of branches to a height up to 10 m with light ribbed buttresses; bark brown, greyish to blackish, fissured and scaly; leaves alternate, odd-pinnate compound, with 5-11 leaflets; inflorescence axillary or terminal, paniculate, densely covered with brown hairs, bisexual flowers, with hairy pedicel, fruit pod circular, flattened and indehiscent.

Herbarium specimen number
Ghana: A 4689
Togo: TOGO06455

Habitat and geographical distribution
The plant is found in the Sudano-Guinean and Guinean on all types of soil including laterite.

Plant material of interest
Leaf and stem bark

Other parts used
Root

Definition of plant material of interest
African rosewood consists of the leaf or etem-bark of *Pterocarpus erinaceus* Poir (Papilionaceae).

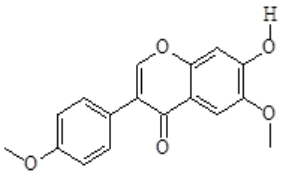
Ethnomedical uses
The plant is used in the treatment of fevers and sores. The infused leaf is used to treat diarrhoea, dysentery, and intestinal worms (Karou *et al*., 2003). The decoction or infusion of the stem bark and roots is effective against bronchial infections, toothache, dysentery, painful menstruation, anaemia, gonorrhoea, postpartum haemorrhage, tapeworm, leprosy, tumours and ulcers (Karou *et al*., 2003). The leaf decoction has aphrodisiac properties. It used as an insect repellent and to treat syphilis (Karou *et al*., 2003). The plant is also used against insomnia and skin fungal infections (Olowokudejo *et al*., 2008).

Biological and pharmacological activities
Aqueous and methanolic bark extracts showed *in vitro* antibacterial and antifungal properties against several pathogenic species of *Staphylococcus*, *Streptococcus*, *Mycobacterium smegmatis* and *Mycobacterium tuberculosis* (Nuhu *et al*., 2000). The leaf extracts showed *in vitro* antiplasmodial activity against *Plasmodium falciparum* (Karou *et al*., 2003). The antioxidant activity of extracts of the plant has been demonstrated (Karou *et al*., 2005). Bizimana *et al*., (2006), have reported the trypanocidal activity of the plant against different species of trypanosomes, whilst Duvall (2008) demonstrated the plant's antigonadotropic activity in female rats.

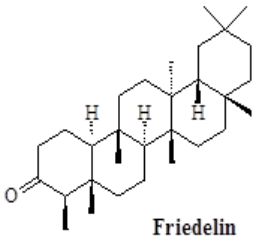
Clinical data
No information available

Chemical constituents
Homopterocarpine, pterocarpin, angolensine, acetyloleanolic acid, afromosin

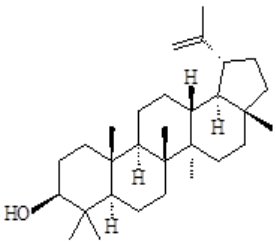
pseudobaptigenine, alkaloids, tannins, saponins and flavonoids (Nuhu *et al*., 2000; Bevan *et al*., 1966; Akisanya *et al*., 1959).



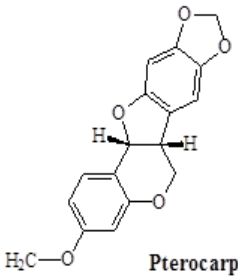
Afromosin



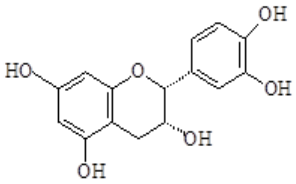
Friedelin



Lupeol



Pterocarpin

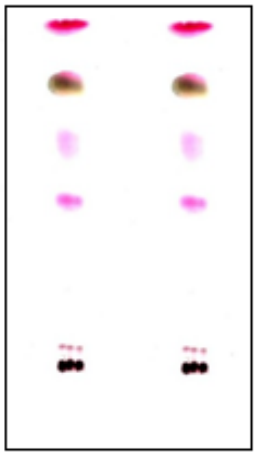


Epicatechin

Tests for identity and purity
Moisture content: not more than 9.21%
Total ash: 13.70%
Water-soluble extractives: not less than 14.30%
Alcohol-soluble (70%) extractive: not less than 15.70%

Chromatographic fingerprints
Chloroform extract
Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spots with R_fs 0.89 (pink), 0.62 and 0.48 (purple)

Macroscopy
Leaf, fresh and green in colour, compound, long petiole; lamina 6-11 cm long, 4-6 cm broad; oblong to elliptic in shape; margin, entire; apex, acuminate, leaf base, round and pubescent, venation is reticulate, texture is fleshy with a prominent midrib.



Chromatogram

Microscopy
Epidermal cells have straight to undulating anticlinal walls on the adaxial surface and straight on the abaxial; stomata on the abaxial surface consist of anomocytic and paracytic types; transverse section of leaf is isobilateral, epidermis is single layered on both surfaces with thick cuticle, mesophyll is undifferentiated and has many air spaces; multicellular trichomes with glandular heads are present on the two surfaces; they are more on the ventral surface; transverse section passing through the mid rib region shows protuberances on both ventral and dorsal sides forming an ovoid shape; vascular bundle fan-shaped; xylem (5-7 celled) located above phloem, centrally placed in the laminal region are some stone cells.

Powdered plant material
Parenchymatous cells of the epidermis, straight anticlinal walls, stomata of anomocytic and paracytic, multicellular, glandular trichomes and xylem vessels.

Therapeutic actions
Antimalaria (Karou *et al*., 2003), antibacterial and antifungal (Nuhu *et al*., 2000), antioxidant (Karou *et al*., 2005), typanocidal (Bizimana *et al*., 2006), antigonadotropic (Duvall, 2008).

Therapeutic indications
Malaria, dysentery, diarrhoea, fever, insomnia.

Safety data
Animal studies showed that LD_{50} of the aqueous leaf extract (*p.o*) in male rats is >3000 mg/kg. There was no evidence of clinical signs of toxicity over the period of treatment (300-3000 mg/kg). Body weight changes and relative organ weights

of treated animals were comparable to vehicle-treated animals. Blood and blood cells, the liver or the kidneys were not affected by the treatment. There was no indication of concern for safety based on the results in this study.

Precautions for use
Do no excced the recommended dosage

Adverse effects
Excessive dosage may cause gastrointestinal disturbances

Contraindications
Pregnancy and lactation

Dosage and dosage forms
Decoction
300 g of plant material boil with 900 ml of water until reduced to 600 ml. Take two tableesponfuls twice daily.

Storage
Store in a cool dry place

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Rauwolfia vomitoria

Botanical name
Rauwolfia vomitoria Azfel.

Family
Apocynaceae

Synonyms
Rauvolfia senegambiae A DC; *Hylacium owariense* P. Beauv

Common names
Swizzlestick, African Rauwolfia (English), Rauwolfia émétique (French).

Vernacular names
Burkina Faso: Dioula – Kolidjohkhi, Fulfuldé – Moyatjalal;Ligéré
Ghana: Akan – Kakapenpen; Ewe – Dodemak Powoe; Hausa – Wada
Mali: Bambara – Kolijoi
Nigeria: Yoruba – Asofeiyeje
Togo: Ewe – Ou Adja, Dodemakpowoe; Akposso – Ilonotchi, Oklubètè;
Senegal: Diola – Gi Upa

Description of the plant
A shrub or small tree up to 15 m high, with dichotomous branching; leaves whorled in groups of 4 or 5, variable, shape ovate, elliptic or oblong, apex acuminate, base cuneate, glabrous, lateral veins 10-16 pairs; terminal inflorescence; flowered corymbs; small white flowers, 3-4 at node, numerous; fruit green, red when ripe (GHP, 2007).

Herbarium specimen number
Ghana: A2492
Mali: 898 DMT
Togo: TOGO02112

Habitat and geographical distribution
The plant occurs naturally in gallery forests but mostly in forest regrowth where fallow periods are prolonged. *R. vomitoria* is native to Cameroon, Democratic Republic of Congo, Ghana, Liberia, Nigeria, Senegal, Sudan and Uganda, but now cultivated in many tropical and subtropical countries.

Plant material of interest
Root

Other parts used
Stem bark

Defintion of plant material of interest
African Rauwolfia consists of the fresh or dried roots of *Rauvolfia vomitoria* Azfel. (Apocyanaceae).

Ethnomedical uses
In traditional African medicine, the decoction of the leaves or roots is administered orally to treat mental illness (Iwu, 1993; Costa-Campos *et al*., 2004). The macerated leaf is used for the treatment of hypertension and fever, and the decoction is used against gonorrhoea, rheumatism, stunted growth, liver diseases, chronic skin diseases and skin parasites (Mesia *et al*., 2008). A root decoction is used to treat haemorrhoids (Agyare *et al*., 2009).

Biological and pharmacological activities
The total alkaloids of *R. vomitoria* as well as the single alkaloids have a sympatholytic action and are therefore used in treating hypertension (Oliver-Bever, 1960). Reserpine and rescinnamine are thought to be the main compounds responsible for the plant's hypotensive, CNS depressant, sedative, vasodilatorý and antihepatotoxic actions. Reserpine has a sedative and tranqullising effect, but it is not hypnotic and it is thought to act through the central nervous system. La Barre (1973) has suggested that reserpine may probably be an antimetabolite of serotonin and catecholamines as it causes serotonin depletion at nerve endings. It is used as a hypotensive agent like rescinnamine and reserpiline in arterial hypertension and as a tranquilliser for the management of anxiety and psychoses (Oliver-Bever, 1986; La Barre, 1973), while ajmaline has coronary and peripheral vasodilatory action and

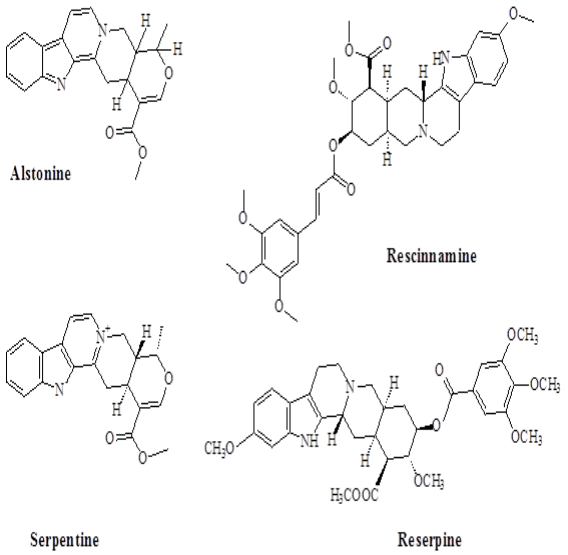
is therefore used in treating angina and Raynaud's disease (Fattorusso and Riter, 1967). Low doses of aqueous root bark extract caused tachypnoea, whilst high doses resulted in increasing bradypnoea and death from respiratory and cardiac arrest. A reserpine-free alkaloid preparation of the root bark had strong hypotensive effect in cats and rats (Oliver-Bever, 1960). Ethanolic root bark extract exhibited significant antiplasmodial activity with an IC_{50} of 2.5 ± 1.0 µg/ml on stem cell chloroquine-resistant *Plasmodium falciparum in vitro* (Zihiri *et al*., 2005). *R. vomitoria* significantly reduced lipid accumulation in experimental diabetic rats by up to 30%, (Campbell *et al*., 2006); aqueous and ethanolic root extracts are effective against several sensitive and resistant strains of bacteria with percentage inhibition ranging from 16 to 100 (Pesewu *et al*., 2008).

Clinical data

No information available

Chemical constituents

Alkaloids (reserpine, rescinnamine, serpentine, reserpoxidine, seredine, ajmaline, alstonine, iso-ajmaline, isoreserpiline, serpagine, raumatorine, rauvomitine, reserpiline, vomalidine, yohimbine, tetraphylline) and flavonoids (African pharmacopoeia 1985; Iwu and 1982; Paris, 1943; Amer and Court, 1980; Iwu and Court, 1982).



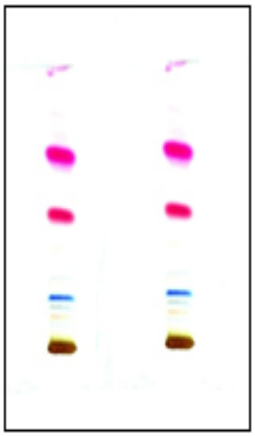
Tests of identity and purity

Moisture content: not more than 12.00%
Total ash: 11.89%
Water-soluble extractives: not less than 21.90%
Alcohol-soluble (70%) extractives: not less than 19.70%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8] , detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of three characteristic spots with R_fs 0.69 (pink), 0.50 (pink) and 0.22 (blue).



Chromatogram

Macroscopy

Roots subcylindrical, slightly tapered and sometimes branched, up to 30 cm in length and 15 cm girth, rarely up to 9 cm in diameter, outer surface greyish brown, deeply longitudinally cracked or smooth by friction with some oblique sections of rootlets; suber, if present, fracture splintery in the wood finely porous radiant, buff or yellow.

Microscopy

Stratified areas of flattened suberized cells, each of 3 or 4 seats in the radial direction, alternating with areas of lignified cells, each from 1 to 120 seats in 55 µ. About 5 to 16 layers of parenchyma, sclereids of about 12 to 18 µ in width or length, singly or in small groups, sometimes containing small prisms of calcium oxalate; phloem with scattered secretory cells with granular contents and isolated groups of sclereids, more bands are staple sclereids in the phloem alternating with external tissue, riddled collapsed, while the inner zone was riddled with clearly defined elements, with many xylem vessels of about 36 to 180 µ in diameter, singly or in pairs, subcylindrical with small bordered pits, vessel elements are approximately 75 to 1200 µ long, many fibres of about 200 to 1500 µ

in length and up to 32 µ wide, with slit-shaped pits oblique broad medullary rays, three cells, heterogeneous groups of isolated sclereids; starch grains in all parenchymal tissues, round, 1-10 to 20µ in diameter, also a few grains grouped by 2 or 4; transverse section shows a thin bark of stratified cork cells, compressed, suberized, alternate with larger lignified cells; thin layer of cork cambium present; secondary cortex consists of parenchyma cells (20-40 µm x 20-28 µm) with numerous starch grains; parenchyma interrupted by lignified sclereids singly or in groups, isodiametric 20-25 µm diameter with narrow lumen; phloem with sieve elements and also parenchyma with prismatic crystals; phloem interspersed with medullary ray cells, 1-3 cells wide, contains starch grains; xylem lignified, made up of vessels (about 20-80 µm diameter), tracheids and parenchyma.

Powdered plant material

Parenchymatous cells; lignified sclereids, many xylem vessels, pitted, many lignified xylem fibres, cells of medullary rays, starch grains inside the parenchymatous cells, cork cells, small prisms of calcium oxalate crystals, scattered secretory cells

Therapeutic actions

Antiplasmodial, antidiabetic; antibacterial; hypotensive, sedative, antibacterial (Pesewu *et al*., 2008; Campbell *et al*., 2006 ; Zihiri *et al*., 2005).

Therapeutic indications

Psychiatric conditions (psychoses); hypertension; bradycardia, insomnia; arrhythmia; angina; schizophrenia; parasitic skin diseases (e.g. head lice); constipation; lumbago; infectious diseases; yaws; malaria; snakebite; diabetes, wounds (Mshana *et al*., 2000; GHP, 2007; Oliver-Bever, 1960).

Safety data

The LD_{50} of the aqueous extract of the stem bark (*p.o*) was found to be > 3000 mg/kg in rats.In acute studies (300-3000 mg/kg), defaecation, salivation and urination which are clear signs of cholinergic stimulation were observed in the 24-hour acute studies. Significant increase in body weight and consequent decrease in organ/body weight of liver, kidney and heart occurred only at the highest dose of 3000 mg/kg in the 14-day study. Serum creatinine levels increased at 3000 mg/kg. No adverse effects on the blood and its cellular elements or the liver was observed.

Precautions for use

The recommended dose should not be exceeded as this may provoke cholinergic symptoms and renal damage.

Adverse effects

Hypotension, hypoglycaemia, bradycardia, diarrhoea, nasal congestion, intestinal upsets.

Contraindications

Hypotension, heart failure, diarrhoea

Dosage and dosage forms

Decoction; tincture

Decoction: 30 g dried sliced and chopped roots and rhizome in 900 ml water; simmer until reduced to 600 ml; 1-3 cups daily (GHP, 2007)

Tincture- 1:5 in 50% alcohol, 5 ml three times daily

Storage

Store in a cool dry place away from light

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Sarcocephalus latifolius

Botanical name
*Sarcocephalus latifolius (*J.E Sm.) E.A Bruce

Family
Rubiaceae

Synonyms
Sarcocephalus esculentus Afzel. ex Sabine; *Sarcocephalus sambucinus* K. Schum.; *Nauclea latifolia* Sm, *Nauclea esculenta* (Afzel. ex Sabine) Merrile; *Sarcocephalus sassandrae A.* Chev.; *Sarcocephalus russeggeri* Kotschy ex Schweinf

Common names
African peach; Guinea peach; Country fig; Negro peach

Vernacular names
Burkina Faso: Dagaari – Anguma, Fulfulde – Bakulehi, Grusi – Dianlo
Cote d'Ivoire: Adyukru – Edik, Akye – Esubo Monleuh Sibo, Anyi – Balimbe Sibo Tere
Gambia: Fula – Dundake, Mandinka – Bakaba, Ba-Tio, Wolof – Koba Nandok
Ghana: Adangme – Akabi, Akan – Awintin, Dagbani – Galungun
Guinea Bissau: Balanta – Cunhe Tetugole, Bioyogo – Canhame, Crioulo – Diunk
Mali: Dogon – Ayugu, Manding Bambara – Bari
Nigeria: Edo – Aragbaihi, Hausa – Igiyaa Tafaashiyaa, Igbo – Mbiliinu, Yoruba – Egbesi
Senegal: Vulgar – Dundake, Balanta – Batio Feas, Diola Flup – Bundufe
Sierra Leone: Bulom – Gbilgbil-Le, Fula – Dunduke, Gola – Yumbuyamba
Togo: Bassari – Degangande, Ewe – Alo Kubasa Kaio, Konkomba – Bunangim

Description of the plant
A strangling shrub or a small evergreen tree that grows in the savanna woodland up to 9 m high; crooked bole up to 30 cm in diameter; bark rough; leaves elliptic or rounded-ovate, cuneate, rounded or subcordate base,10-20 cm long, 6-12 cm broad, glabrous, obovate, apex shortly and abruptly acuminate, upper surface darker, petiole red, stipules short, broad, ovate, and more persistent; flowers, pedicel 1-2 cm long; flower-heads white, up to 5 cm in diameter , fragrantly sweet scented, sought by bees, becoming large and fleshy, not drying hard, with reddish fruit, fleshy, comparatively shallow-pitted fruits up to 9 cm in diameter; fruiting season (May-June, Sept.-Oct.), edible, sweetly acid pulp with numerous seeds embedded.

Herbarium specimen number
Ghana:GC43845
Togo:TOGO07535

Habitat and geographical distribution
Common in the guinea savanna; also occurs in grassland savanna.

Plant material of interest
Root

Other parts used
Fruit, leaf and stem bark

Definition of plant material of interest
Sarcocephalus is the dried transversely sliced and chopped root of *Sarcocephalus latifolius (*J.E Sm.) E.A Bruce (Rubiaceae).

Ethnomedical uses
Extracts of the bark, root and leaves are used by natives of West, Central and East Africa for various ailments including sores, gonorrhoea, stomach disorder, cough and fever. The plant is used in Nigerian folk medicine in the treatment of piles and dysentery. An infusion of the bark has been widely used as a tonic and febrifuge, hence the description "African quinine" (Oliver-Bever, 1986). The pulverized root and bark have been used to treat sores and gonorrhoea in Sudan, Ghana, Ivory Coast and Nigeria (Irvine, 1961). Similarly, a decoction of the root bark is commonly employed in the treatment of stomach disorders, cough and malaria fever (Irvine, 1961). The herb has also been reported to be used as a component of arrow poison in Northern Nigeria and Cote d'Ivoire.

Biological and pharmacological activities

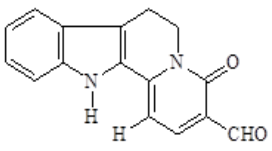
The hot aqueous extracts of the root and stem bark, demonstrated antiplasmodial activity against *Plasmodium falciparum in vitro* (Gbeasor, *et al.,* 1989), while the methanolic and ethanolic extracts of the dried fruit, stem and root bark have been reported to possess antibacterial and spasmolytic properties (Ogunlana, 1975). Root bark extract dose-dependently caused a significant decrease in spontaneous motor activity and exploratory behaviour in test animals. The extract also prolonged pentobarbital sleeping time and attenuated the intensity of apomorphine-induced stereotypy, but had no effect on motor coordination (Amos *et al.,* 2005). The root extract showed broad-spectrum antibacterial and antifungal activities (Iwu, 1993; Deeni and Hussain, 1991) and the aqueous stem bark extract demonstrated anti-parasitic (mixed nematode species) activity in sheep. Administration of the extract to worm-infested sheep resulted in improved haemoglobin and leucocytosis values (Onyeyili *et al.,* 2001). Extracts of the leaves demonstrated hepatoprotective and hypoglycaemic activities in rats (Akpanabiatu *et al*., 2005, Gidado *et al*., 2005) while the root extract showed antihepatotoxic effect and inhibited the multiplication of *Trypanosoma brucei* infection (Madubunyi, 1995).

Clinical data

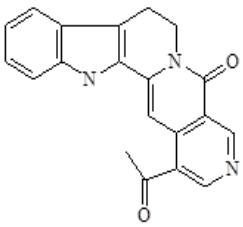
No information available

Chemical constituents

Tannins, phenols, saponins, terpenes, steroids, reducing sugars; glycoalkaloids and indoloquinolizidine alkaloids (e.g. naucletine, nauclefidine); carbohydrates, resins; bitter principles (GHP, 1992; Oliver-Bever, 1960), nauclefoline, and nauclechine (Hotellier *et al.,* 1981).



Nauclefidine



Naucletine

Tests for identity and purity

Moisture Content: 8.30%

Total Ash: 12.90%

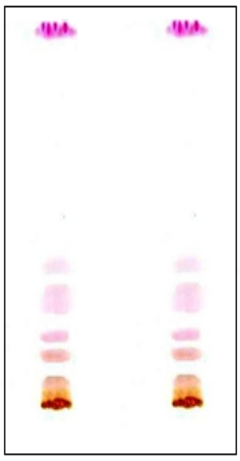
Water-soluble extractive: not less than 11.00%

Alcohol-soluble (70%) extractive: not less than 6.88%.

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spots with R_fs 0.47 (pink), 0.37 (pink), 0.19 (pink) and 0.14 (light brown).



Chromatogram

Macroscopy

Root cylindrical or broken; light to medium material; bark lenticellate, greyish-brown outer surface; wood yellow (pinkish when cut fresh); odour pleasant; taste bitter.

Microscopy

The root bark consists of several layers of oblong occasionally exfoliated, slightly lignified, roughly stratified, thin walled polygonal cork cells; cortical region made up of numerous layers of and occasionally spherical parenchymatous cells; abundant oil globules, secretory cells, scattered throughout the cortex, numerous lignified sclerenchymatous cells, occurring singly but usually in aggregates; sclereids possess a constricted lumen and are more distributed towards the phloem tissue, forming a somewhat disjointed ring around it; phloem tissue consists of a fine network of radial arrangement of medullary rays separating the bundles of lignified phloem fibres, isodiametric parenchyma with starch grains which abound throughout the bark tissue except in the cork cells; rosette crystals occur in the phloem parenchyma; xylem tissue

made up of large vessels scattered throughout the wood; some impregnated with yellow material; the wood is lignified and consists of large vessel members, tracheids, wood fibres, and parenchyma cells with abundant starch grains.

Powdered plant material
Yellowish-brown; odour pleasant; taste bitter; lignified thin-walled cork cells, cortical parenchymatous and sclerenchymatous cells, singly and in small groups, medullary rays, phloem and xylem vessels, sclereids (some with large lumen); fibres (some lignified), parenchyma; starch grains; rosette crystals of calcium oxalate sparsely distributed; secretory cells with oil globules are present in the powdered drug.

Therapeutic actions
Antibacterial; antimalarial; antipyretic; cytotoxic; diuretic; febrifuge; stomachic; tonic

Therapeutic indications
Abdominal pain; haemorrhoids; dysentery; arthritis; dental caries; diarrhoea; fever; infective hepatitis; malaria, oligouria; septic mouth; toothache (Mshana *et al.,* 2000; GHP, 1992; Oliver-Bever, 1960).

Safety data
The water extract had an LD_{50} >2000 mg/kg *p.o.* in rats and mice; no significant toxic activity was observed in the organs or system in the 28 day study. The LD_{50} of the aqueous extract of the stem bark (*p.o*) was found to be >3000 mg/kg in rats; there was no evidence of toxicity to the animals in the 14-day subacute study (300-3000 mg/kg), and no abnormality in the liver and liver enzymes AST, ALP and ALT in rats. There was no effect on both conjugated and total bilirubin which often results from jaundice or liver disease; no effect on creatinine or urea which are sensitive indicators of kidney function and no effect on triglycerides, cholesterol and glucose. Overall, the plant extract did not affect the haemopoetic system adversely. The extract exhibited some psychoactive properties in rodents prolonging (50-200mg/kg p.o.) the duration and shortening the onset of pentobarbital-induced sleep in rats dose-dependently. It (50-200 mg/kg p.o.) also significantly ($p<0.05$) reduced SMA in mice. The reduction was dose and time dependent.

Precautions for use
Do not exceed the recommended doses

Adverse effects
May delay labour in childbirth

Contraindications
Constipation, uterine inertia, urinary retention, pregnancy

Dosage and dosage forms
Infusion, decoction and tincture
250 g macerated in about 600 ml “gin” (local alcoholic beverage) or hot water; 100 ml taken orally two or three times a day depending on the severity of the feverish condition
Tincture: 1:5 in 50% alcohol, 5 ml three times daily.

Storage
Store in a cool dry place

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Sclerocarya birrea

Botanical name
Sclerocarya birrea (A. Rich) Hochst.

Family
Anacardiaceae

Synonyms
Sclerocarya caffra, *Poupartia caffra* (Sond.), *Poupartia birrea* (A.Rich.), *Spondias birrea*

Common names
Marula, Cider tree (English); Prunier d'Afrique, Sclérocarya à bière, prunier jaune, Poupartia (French).

Vernacular names
Burkina Faso: Mooré – Nobɛ́ga;Noabga, Dioula– N'gouna;kunan;kuntan, Fulfuldé – Hedi
Cote d'Ivoire: Malinké – N'guma
Ghana: Dagbani – M umuga, Mole – Noagba
Mali: Bambara – N'gunan Kutan 'Dao, Dogon – Bi, Peulh: He 'Di, Kedɛ, 'Eri, Hɛ́dɛ́hi
Niger: Haussa–Dania, Zarma–Diney, Béribéri–Koma
Senegal: Wolof **–** Bir Ber, Basari – Ngudy

Description of the plant
S. birrea is a medium sized, single stemmed, terrestrial, erect, perennial deciduous tree of about 10-15 m in height. The stem-bark is flaky, with a grey mottled appearance due to contrasting grey and pale-brown pattern. The leaves are composite, deciduous, imparipinnate, 7 to 10 pairs of ovate, elliptical and glabrous leaflets, leaflets green above, lighter below; usually only serrated when young, otherwise entire; flowers are small, dioecious, greenish, in spikes shorter than 2 cm long borne on small oblong clusters at the end of branches and usually appear before the leaves; the fruit is a green drupe on tree, falling off in autumn and turning light yellow on the ground; three seeds contained in the hard kernel, the fleshy pulp highly nutritious; female *S. birrea* trees bear plum-like stony fruits of about 30 mm in diameter (Ojewole, 2003).

Herbarium specimen number
Ghana: GC 35847
Mali: 0071DMT

Habitat and geographical distribution
Native to tropical Africa, *Sclerocarya birrea* is widespread in Sudan-Sahel zone from Ethiopia in the North to Kwazulu-Natal (South Africa) in the south, from Gambia in the west across to

Nigeria and Cameroon in Central Africa, and to Kenya and Sudan in the East (Belemtougri *et al*.,2007).The plant grows naturally in various types of woodland, on sandy soil or occasionally sandy loam.

Plant material of interest
Leaf, stem bark

Other parts used
Root and fruit

Definition of plant material of interest
Sclerocarya consists of fresh or dried leaf or stem bark of *Sclerocarya birrea* (A. Rich) Hochst. (Anacardiaceae).

Ethnomedical uses
Sclerocarya birrea leaves are used to treat jaundice and the bark is combined with the leaves of *Cymbopogon gigentus* to treat ascites. The plant is effective in the treatment of measles. A drink made from leaves is used for the treatment of gonorrhoea and roots and bark are used as laxatives. Maceration of the stem bark is used in the treatment of abdominal pain, nausea, vomiting, syphilis, dysentery, rheumatism and has a prophylactic effect against malaria. The stem bark in combination with *Momordica balsamina* is indicated for snake bite or scorpion stings. The bark is an effective remedy for treating haemorrhoids. Pellets made from the bark are used for neuralgia in dental caries (Adjanohoun *et al*., 1980). In Ghana, the leaves are used to treat snakebite, and pruritus (filarial); the stem bark, the root and the fruits are used to treat pharyngitis, splenomegaly and goitre,

respectively (Mshana *et al*., 2000). Externally, the paste of the bark is added to shear butter and applied to the forehead to treat migraine and blepharitis. The fruit juice is effective in the treatment of ear infections, constipation, hypertension, anorexia, and scurvy. The seeds are recommended by some therapists for asthenia (Kerharo and Adams, 1974).

Biological and pharmacological activities

The plant has antidiabetic, anti-inflammatory, analgesic, antidiarrhoeal, antimicrobial, antiplasmodial, antihypertensive, anticonvulsant, gastroprotective and antioxidant properties (Ojewole *et al*. 2010; Makom *et al*., 2010; Fotio *et al*. 2010; Keita, 2005; Ojewole, 2002; Van de Venter *et al*., 2008; Gondwe *et al*., 2008; Dimo *et al*., 2007; Coulibaly, 1988; Haidara, 1999; Laurens, 1976; Gueye *et al*., 1973). According to Gueye, (1973), oral and intraperitoneal administarion of the aqueous extract of the leaves has an effect on blood glucose levels and a peripheral action on glucose uptake in rats. The ethanolic stem bark extract reduces blood pressure and has a protective effect on the kidneys and the heart in diabetes mellitus (Gondwe *et al*., 2008). The methanol and aqueous extracts of the stem bark administered orally at a dose of 500 mg/kg showed promising antiinflammatory action on rat paw oedema (Ojewole, 2002) and a dose of 300 mg/kg methanolic stem bark extract showed maximum inhibition in both acute and chronic inflammation in rats (Fotio *et al*., 2009). The aqueous stem bark extract has hypotensive and vasorelaxant properties (Ojewole, 2006). Aqueous, ethanolic and chloroformic extracts have significant antagonistic effect on caffeine-induced calcium release from sarcoplasmic reticulum (Belemtougri *et al*. 2001). The antidiarrhoeal activity of the tannins and procyanidins of the lyophilized stem bark decoction has been demonstrated (Galvez *et al*., 1991). The acetone extract of the stem bark and leaves demonstrated antibacterial properties against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli* and *Enterococcus faecalis* and *Mycobacterium tuberculosis* (Green *et al*., 2010; Eloff, 2001). Acetone and aqueous extracts from the stem bark showed strong antibacterial activity against strains of metronidazole and clarithromycin-resistant *Helicobacter pylori* (Njume *et al*., 2011b; Njume *et al*., 2011a).

Clinical data

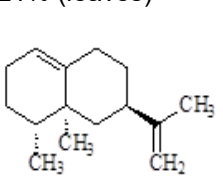
The antidiabetic properties of macerated and decocted leaves have been confirmed by clinical studies (Gueye, 1973). Clinical trials have shown the efficacy of the decoction in patients with type II diabetes (Sanogo, 2007). The nutritional value of the nuts of *Sclerocarya birrea* has also been demonstrated in children (Glew *et al*., 2004).

Chemical constituents

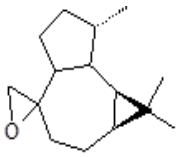
Tannins (epicatechin-3-galloyl ester), alkaloids, saponins, flavonoids, terpenes, coumarins, triterpenoids, phytosterols, carbohydrates, oils, proteins, fibre, ascorbic acid and minerals (Ojewole *et al*., 2010; Glew *et al*., 2004; Bracca *et al*., 2003; Haidara, 1999; Smith *et al*., 1996; Galvez *et al*., 1992; Eromosele *et al*., 1991; Dao, 1988; Laurens, 1976; Kerharo and Adams, 1974).

Tests for identity and purity

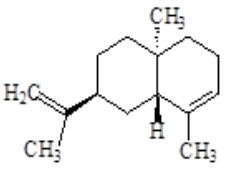
Moisture content: 7.80% (leaves) 7.80% (stem bark)
Total ash: 9.30% (leaves) 6.41% (stem bark)
Sulphated ash: 16.11% (leaves) 9.54% (stem bark)
Water-soluble extractive: not less than 31.30% (leaves) 27.30% (stem bark)
Alcohol-soluble (70%) extractive: not less than 21% (leaves)



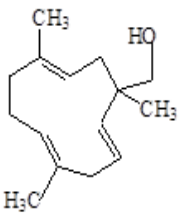
Valencene



Alloaromadendrene epoxide



Epi-alpha-selinene



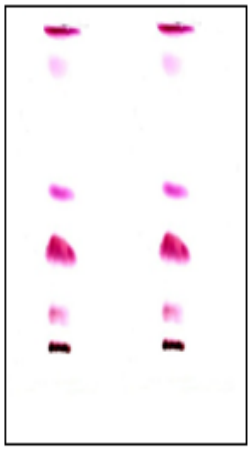
14-Hydroxy-alpha-humulene

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml

concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spot with R_fs 0.88 (pink), 0.48 (pink), 0.32 (pink) and 0.10 (pink).



Chromatogram

Macroscopy
The leaves are odd-pinnate, opposite, with slightly elliptical leaflets, rounded or pointed at the edge; veins alternate on either side of the petiole and the edge of curved blade which is asymmetric with a very short petiole.

Microscopy
Transverse section dorsiventral, single palisade layer; mesophyll filled with starch, abuts on collenchyma in midrib region, characteristic sub-epidermal masses of collenchyma on both surfaces, vascular bundle, bicollateral, surrounded by lignified pericyclic fibres; stomata, isocytic on both surfaces, trichomes/hairs, numerous in young leaves, abundant on the midrib and veins, multicellular.

Powdered plant material
Calcium oxalate crystals, abundant, fragments of epidermis, many starch grains, several tissue fragments, stomata on epidermal cell fragment, few fragments of xylem tissue, many fragments of sclerenchymatous fibres.

Therapeutic actions
Antidiabetic (Gueye, 1973, Laurens, 1976, Coulibaly, 1988; Haidara, 1999; Ojewole, 2003); vasorelaxant and hypotensive (Ojewole, 2006; Belemtougri *et al*., 2001); antidiarrheal and antibacterial (Eloff, 2001); analgesics, antiinflammatory, antimicrobial, antiplasmodial, anticonvulsant and antioxidant (Ojewole, 2003, Van de Venter *et al*., 2008, Dimo *et al*., 2007; Ojewole, 2002; Ojewole *et al*., 2010; Fotio *et al*., 2010); anti-mycobacterium tuberculosis (Green *et al*., 2010) anti-Helicobacter pylori (Njume *et al*., 2011b, Njuma *et al*., 2011a).

Therapeutic indications
Diabetes mellitus or type II diabetes

Safety data
24-hour acute study showed that, the LD_{50} of the aqueous stem bark extracts (*p.o*) in mice>2000 mg/kg. Sub-acute studies did not show any clinical signs of toxicity after treatment of male and female mice (500 to 2000 mg/kg; *p.o*) for 14 days. In Sub-chronic toxicity studies, repeated administration of aqueous leaf extract for 45 days did not affect biochemical parameters of blood, liver and kidney function. The relative weights of liver, spleen and kidney were not affected; histological features were normal. Repeated administration of aqueous bark extract for 45 and 90 days did not cause significant changes in body weight, relative weight of target organs (liver, spleen and kidneys). The aqueous extract did not cause anaemia, but caused hypoglycemia. Transaminases were affected especially at the high dose 1000 mg/kg; histological features were normal. Creatinine remained normal, with a slight increase in uric acid levels compared with the control group.

Precautions for use
Aqueous extract of the plant can cause hypoglyacemia and increase hepatic and renal parameters. Monitor blood glucose biochemical parameters of the liver and kidney regularly on prolonged use. Do not combine with other hypoglycaemic drugs except under specialist supervision.

Adverse effects
Renal and liver diseases

Contraindications
Hypoglycaemia

Dosage and dosage forms
Powder, decoction, tincture
Preparation: 60g of dried leaves in a pint of water and boil for 15 minutes and filter.
Method of administration in the form of decoction orally
Dosage according to blood sugar:
Up to 2 g / l: 60 g in 3 doses
Beyond 2 g / l: 100g in 3 doses and the treatment lasts 7 days

Maintenance therapy is done with a dose of 40 g in 2 doses.
Decoction: 30 g of ground seeds in 900 ml of water and simmer until reduced to 600 ml, and drink a glass of water three times a day.
Tincture: 1:5 in 50% alcohol 5 ml three times daily

Storage
Store in airtight containers in a cool, dry place, away from light

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Scoparia dulcis

Botanical name
Scoparia dulcis L.

Family
Scrophulariaceae

Synonyms
Scoparia ternata Forssk; *Capraria dulcis* (L) Kuntze; *Gratiola micrantha* Franch & Sav.

Common names
English: Sweet broom; bitter broom; broom weed; licorice weed

Vernacular names
Burkina Faso: Mooré – koostiiga, Dioula – N'timintiminin
Ghana: Twi – Onyame ko metiri; Fante – Oguan nkyene, Ga – Shuoblo
Mali: Bamabara – Ntimitimini, Bruturut
Senegal: Balanta – Brutulut
Sierra Leone: Bulom – Tjunkae

Description of the plant
An erect shrubby plant, 20-70 cm high; stems glabrous; leaves opposite or whorled, narrowly lanceolate, crenulate in upper half, narrowed, entire in lower half, glabrous; flowers in slender racemes in upper leaf-axils; petals four, white or bluish, bearded inside; fruit globose, capsule.

Herbarium specimen number
Mali: DMT 941
Nigeria: FHI 65355
Togo: TOGO08437

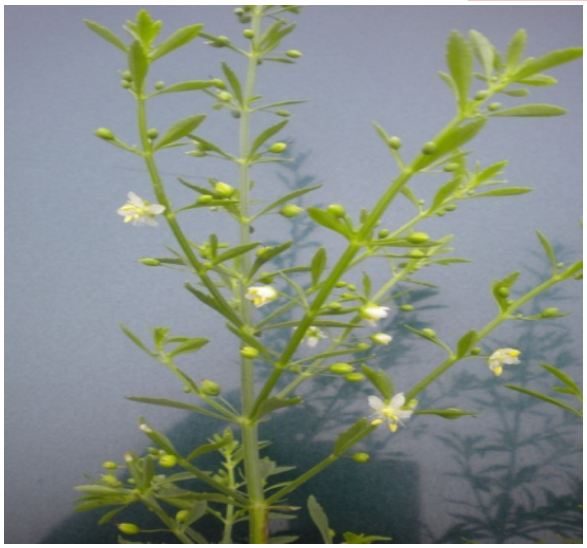
Habitat and geographical distribution
A common weed of waste places in villages and on road and path sides; also in marshy places. It is widely distributed in many tropical countries.

Plant material of interest
Leaf

Other parts used
Twig, bark, root

Definition of plant material of interest
Sweet broom consists of the fresh or dried leaf of *Scoparia dulcis* L. (Scrophulariaceae)

Ethnomedical uses
Scroparia dulcis is used to treat diabetes, hypertension, abdominal disorders, pain, fever, inflammation, bronchitis, haemorrhoids and hepatosis (Hayashi, 2000; Satyanarayana 1969;



Freire *et al.,* 1993; Hayashi *et al.,* 1993; Chow *et al.,* 1974). The plant is used against burns, herpes, pimples, dysentery and hair loss (Luziatelli *et al*., 2010). Leaves of *S. dulcis* are used for dermatological (Rodrigues, 2006) and prostate disorders (Lans, 2007b). The whole plant is used in magico-religious rituals (Paulino de Albuquerque *et al*., 2007).

Biological and pharmacological activities
S. dulcis has antiviral, diuretic, anti-tumour, antiulcerogenic, anti-inflammatory, antidiabetic, antimicrobial and antioxidant properties. *In vitro* and *in vivo* studies have shown that scopadulcic acid B and C have the ability to inhibit cell proliferation, replication of *Herpes simplex* 1, gastric acid secretion and PTH-stimulated bone resorption. Several studies involving isolated compounds obtained from the plant exhibited anti-tumour potential (Ahsan *et al.,* 2003; Fulda *et al*., 2000; Nishino *et al.,* 1993). A methanol extract of the leaves showed anti-cancer effects (Nishino *et al.,* 1993). Whilst scopadulcic acid B promotes antitumour activities, scopadulcic C potentiates antiviral effects and scoparic acid A inhibits α-glucuronidase (Hayashi, 2000; Hayashi *et al.,* 1992; Hayashi *et al*., 1988). Scoparinol demonstrated analgesic, antiinflammatory, diuretic and barbiturate potentiation activities *in vivo* (Ahmed *et al.,* 2001). Freire *et al.,* (1991; 1993; 1996) reported the analgesic, anti-inflammatory and sympathomimetic properties of the plant. Scopaducilic acid B, scopadulciol and diacetyl scopadol (Hayashi *et al.,* 1987) exhibited a gastroprotective effect by reversibly inhibiting the activity of H^+/K^+-ATPase (Asano *et al.,* 1990; Hayashi *et al.,* 1990b; Hayashi *et al.,* 1991a; Mesía-Vela *et al.,* 2007). Aqueous extracts of the

plant showed antidiabetic effects in rats (Pari *et al*., 2005; Latha *et al.,* 2004; Pari and Venkateswaran, 2002) and antioxidant activity *in vitro* (Ratnasooriya *et al.,* 2005). Other studies have also shown the *in vitro* antioxidant and antimicrobial (fungi and bacteria) properties of the plant (Pari *et al.,* 2004; Garcia *et al*., 2010). The chloroform/methanol fractions of the plant exhibited antimicrobial activity against several human pathogenic bacteria and fungi strains (e.g. *Salmonella typhii*, *Staphylococcus aureus*, *Escherichia coli*, *Candida albicans*, *Aspergillus niger*) [Latha *et al*., 2006; Lans, 2007a]. Leaves have antiplasmodial activity (Ruiz *et al*., 2011). The freeze-dried aqueous extract from the aerial parts of the plant inhibited the histamine- or bethanechol-stimulated gastric secretion in mice with similar potency and the bioactivity-guided purification of the extract yielded a flavonoid-rich fraction with a specific activity 4–8 times higher than the aqueous extract (Meséıa-Vela *et al*., 2007; Igoli *et al*., 2005).

Clinical data

Oral administration of a daily dose of 15-20 mg to diabetic patients, produced a reduction of glucosuria and hyperglycaemia, promoted wound healing and influenced the increase of haematopoeitic activity (Nath *et al.*, 1945 in: Dokosi, 1998).

Chemical constituents

Diterpenoids (scopadulcic acid A, B and C; scoparic acid A and scopadulin); triterpenoids (friedelin, glutinol, α-amyrin, betulinic acid, ifflaionic acid and dulcioic acid); scopadiol, scopadulciol; amellin; coumarins, saponins, tannins, amino acids, flavonoids (8-hydroxytricetin-7-glucoronide, apigenin); alkaloids (6-methoxy benzoxazolinone), oleoresins; reducing sugars (Akendengue *et al.,* 2005; Hayashi 2000; Mahato *et al.,*1981; Freire, 1993; Nath, 1945).

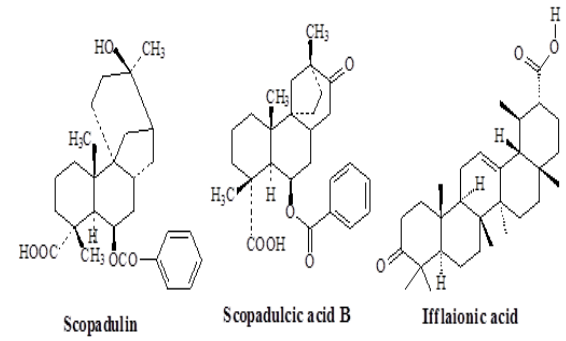
Tests for identity and purity

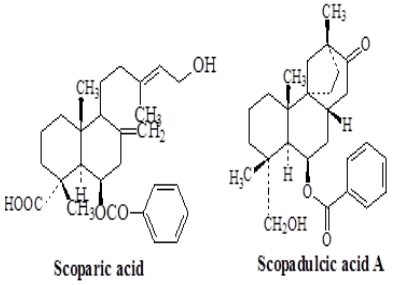
Moisture content: not more than 9.50%
Total ash: 11.22%
Water-soluble extractive: not less than 15.06%
Alcohol-soluble (70%) extractive: not less than 18.29%

Chromatographic fingerprints

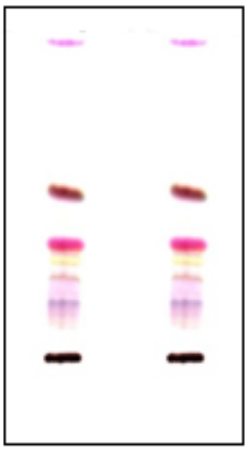
Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 oC)/chloroform [2:8], detection in daylight, after spraying with





anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of three characteristic spots with R_fs 0.85 (pink), 0.59 (brown) and 0.42 (pink).



Chromatogram

Macroscopy

Simple leaf, petiolate; arrangement opposite and whorled; shape elliptic or narrowly lanceolate; margin serrate; 2.5-5.0 cm long, 1.5 cm broad; apex acute; base symmetrical; venation pinnate; texture papery; colour green; odour characteristic; taste slightly bitter.

Microscopy

Both upper and lower surfaces show striated cuticles; upper epidermal cell walls wavy, lower ones more wavy; anisocytic stomata on both

surfaces, more abundant on lower surface; glandular trichomes on lower surface; transverse section shows undulating epidermis, papillose; bifacial leaf, palisade one layer, interrupted in midrib region by collenchymatous cells; midrib prominent on lower surface; vascular bundle collateral, xylem vessels spiral, lignified; refractory bodies (oleo-resin) present in all cells; prismatic calcium oxalate crystals present in many tissues.

Powdered plant material
Green; characteristic odour; taste slightly bitter; parechymatous epidermal cells, fragments of lamina show anisocytic stomata; glandular trichomes, veins with lignified vascular bundle elements, spiral; calcium oxalate prisms; oil present; starch grains present.

Therapeutic actions
Antiasthmatic, anticancer, antioxidant, febrifuge, antidiabetic, antispasmodic, antihypertensive analgesic, antimicrobial (Mshana *et al*., 2000; GHP 1992).

Therapeutic indications
Diabetes; mild hypertension; menstrual disorders (pain, cramps, premenstrual syndrome); upper respiratory tract bacterial and viral infections (sore throat and mouth ulcers); pain (arthritis, migraine, headaches, stomach aches, muscle pain); venereal diseases and urinary tract infections; varicose veins; intestinal helminthiasis; cough; asthma (Mshana *et al*., 2000; GHP, 1992).

Safety data
Animal studies (100-3000 mg/kg) in rats showed that the LD_{50} of the aqueous extract of the leaves of *Scoporia dulcis* (p.o) was beyond 3000 mg/kg and there was no manifestation of clinical signs of toxicity over the period of the acute toxicity study. There was no change in organ/body-weight ratios or haematological parameters at the dosage range tested during the 14-day sub-acute study. Administration of the aqueous extract to rats (doses >100 mg/kg) resulted in increased levels of liver transaminases (ALT, AST, GGT, ALP) and indirect bilirubin. Markers for renal function did not change. These findings suggest possible damage to the hepatobiliary system.

Precautions for use
Caution should be taken in the administration of the aqueous extract in liver disease.

Adverse effects
No adverse effects known if used in therapeutic doses although in one study an ethanol extract inhibited radioligand binding to dopamine and serotonin and an aqueous extract given intragastrically to rats potentiated the effects of barbiturates

Contraindications
Known hepatic disease, elderly patients and children; pregnancy; antidepressants or barbiturates; hypoglycaemia

Dosage and dosage forms
Decoction, infusion, capsules.
Infusion/decoction: 30 g in 600 ml of water; 1 teacup twice daily
Tincture: 1:5 in 60% alcohol, 5 ml three times daily
Capsules: 2-3 g twice daily

Storage
Store in a cool dry place away from light

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Securidaca longepedunculata

Botanical name
Securidaca longepedunculata Fres.

Family
Polygalaceae

Synonyms
Securidaca spinosa Sim. *Lophostylis pollida* klotzsch

Common names
Violet tree (English), Arbuste à Serpent (French)

Vernacular names
Burkina Faso: Mooré – Palgu ;Pélga, Bissa – Hensasi, Dioula – Djoro;Djoto, Fulfuldé – Alali
Cote d'Ivoire: Lobi – Samuele, Gagou: Dioro, Malinké – Diulo, Ndjuru
Gambia: Malinké – Juto Djuto, Wolof – Fuf, Fula –Alali
Ghana: Akan – Ofodo Kyrito
Guinea Conakry: Malinké – Diodo, Fula – Diantu
Mali: Bambara – Djoro Dioro, Peulh – Iguili, Dogon – Toroe
Niger: Hausa – Warnagunguna, Fula – Adali, Djerma – Hasukore
Nigeria: Hausa – Sanya, Fula: Adali, Adehi, Yoruba – Ipeta
Senegal: Diola – Fu Daray, Serer – Kuf Kuf, Wolof – Fuf
Togo: Ouatchi – Etritou, Mina – Metritu, Ewé – Kpeta
Sierra Leone: Malinké – Juto, Jodoo

Description of the plant
S. longipedunculata is a semi-deciduous shrub or small tree that grows to 12 m high, with an often flattened or slightly fluted bole; much branched, with an open, rather straggly looking crown; young branches drooping and pubescent; bark smooth, thick and light yellow, covers a yellow wood fibre; very thick roots; have a characteristic odour of methyl salicylate; leaves alternate, entire, simple, oblong-elliptic, 5 to 6 cm long and 13-20 mm wide with very fine hairs when young but losing these by maturity; apex rounded; base narrowly tapering; petiole slender; purple papilionaceous flowers, about 10 mm long, very fragrant, on long slender stalks in terminal axillary racemes; fruit is a samara of 4 to 5 cm long, more or less a round nut, somewhat heavily veined, occasionally smooth, bearing a single, oblong, rather curved, membranous wing up to 4 cm long.

Herbarium specimen number
Ghana: GC 2799
Mali: 0058 DMT
Togo: TOGO06917

Habitat and geographic distribution
S. longipedunculata occurs in a broad range of vegetation, from semi-arid scrub to dense forest, including many woodland and bush habitats and gallery forests. It is widely distributed in the Sudano-Sahelian, Sudanian and Sudano-Guinean regions of Africa including Angola, Benin, Botswana, Burundi, Cameroon, Chad, Cote d'Ivoire, Democratic Republic of Congo, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Kenya, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Uganda, Zambia, Zimbabwe.

Plant material of interest
Leaf and root bark

Other parts used
Stem bark

Definition of plant material of interest
Violet tree consists of the root bark or leaf of *S. longepedunculata* Fres. (Polygalaceae).

Ethnomedical uses
The fresh root is reduced to a pulp and rubbed vigorously on a snake bite. Decoction of the root pulp or leaves in combination with other plants is used to induce emesis and purgation after poisoning (Kerharo and Adam, 1974). The decoction of the crushed leaves is applied to sores and boils to drain pus. The foam obtained

from the root is mixed with water to treat gonorrhoea, while fresh root decoction is used to treat bronchitis, stomach pain and leprosy. Root and stem bark infusions are recommended as an antidote for poisoning; a powder made from the root is used as a snuff for headaches. In Ethiopia, smoke from the root is inhaled as a medicinal incense to treat flatulence. The powdered bark is used to treat wounds and a paste of pounded bark with copper sulfate is applied to blisters caused by Guinea worm to promote expulsion and for rheumatoid arthritis, chronic rheumatism, bruises or swelling, a paste of powdered root bark is used. In West Africa, the plant is used for the treatment of infantile convulsions and combined with *Boophane disticha* for psychoactive purposes. The plant is known in many African countries as an abortifacient (Oliver-Bever, 1986).

Biological and pharmacological activities

The plant's antivenom and anti-inflammatory properties have been demonstrated in several scientific investigations (Koné, 1989; Coulibaly Nee Diop, 1986; Metou, *et al*., 1989). The chloroform extract of the root showed antibacterial activity against both Gram positive and Gram negative bacteria and clinical isolates of *Klebsiella pneumoniae* (Pallant and Steenkamp, 2008), while the aqueous extract was found completely inactive (Almagboul *et al*., 1985). Acetone and hexane extracts showed an anti-mycobacterium tuberculosis activity with MIC of greater than 100 µ/ml (Green *et al*., 2010), while the hexane extract showed significant activity against *Mycobacterium bovis* BCG and *Mycobacterium tuberculosis H37Ra* with minimum MIC of 15.6 to 62.5 µg/mL (Luo *et al*., 2011). The dichloromethane extract of the roots at a dose of 150 mg/kg significantly reduced parasitemia in mice experimentally infected with *Trypanosoma brucei brucei* (Aderbauer *et al*., 2008). The trypanocidal and cytotoxic activities of the plant have also been demonstrated by Nibret *et al*., (2009); the dichloromethane extract showed a trypanocidal activity with an IC_{50} less than 20 µg/ml. Akinmoladun *et al*. (2010) have also demonstrated the plant's antioxidant activity. Oral administration of a root decoction produced a sedative, anxiolytic and anticonvulsant effects in a dose-dependent manner (Adeyemi *et al*., 2010; Oliver-Bever, 1986). The compound securinine showed *in vitro* antimalarial activity on *Plasmodium falciparum* (Weenen *et al*. 1990) and the acid derivatives of quinine isolated from the roots exhibited anti-HIV activity *in vitro* (Mahmood *et al*., 1993). The plant also has activity against the polio virus at a concentration between 10 and 50 mg/ml (Beuscher *et al*., 1994). Extracts of the roots have proteolytic, analgesic, antiinflammatory, antioxidant and hypoglycaemic properties (Muanda, *et al*., 2010; Ojewole, 2008; Bah, 2006).

Clinical data

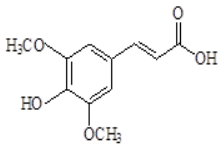
No information available

Chemical contituents

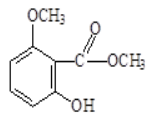
Saponins, tannins, anthraquinones; alkaloids; terpenes; methyl salicylate; sterols, sugars, caffeic acid, sinapic acid; (Odebiyi, 1978; Kamwendo *et al*., 1985; Kerharo and Adam, 1974; Declaude, 1971; Lenz, 1913; Mahmood *et al*., 1993; Costa *et al*., 1992, Scandola *et al*., 1994; Mitaine-Offer *et al*., 2010; Muanda, *et al.,* 2010).

Tests for identity and purity

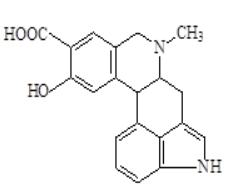
Moisture content: not more than 4.59%
Total ash: 2.33%
Water-soluble extractive: not less than 19.29%
Alcohol-soluble (70%) extractive: 15.40%

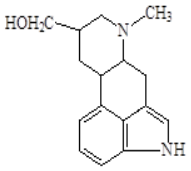


Sinapic acid

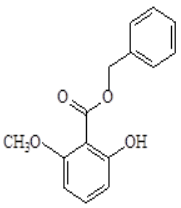


2-hydroxy-6-methoxy benzoic acid methylest





Racine alkaloids



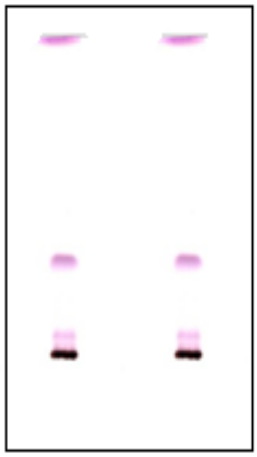
Methyl-2-hydroxy-6-methoxybenzoate

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml

concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of two characteristic purple spots with Rfs 0.92 and 0.35.



Chromatogram

Macroscopy

The root of *S. longepedunculata* is tortuous, rough, light yellow, very thick with a characteristic odour; leaf fresh and green in colour; simple and shortly petiolate; lamina 2-5 cm long and 2-3 cm wide; oblong-lanceolate in shape; margin entire; apex round, leaf base is cuneate and venation is reticulate, leaf surface glabrous but pubescent beneath, texture papery with a depressed midrib.

Microscopy

Leaf is isobilateral; epidermal cells on the adaxial surface possess straight anticlinal walls and wavy to undulating walls on the abaxial surface; stomata and trichomes absent on the adaxial surface but numerous anomocytic and paracytic stomata and glandular trichomes present on the abaxial surface; many sphaerocrystals on this surface; epidermal cells rectangular with a layer of waxy cuticle; cells striated; mesophyll undifferentiated with heavily lignified parenchyma cells; mid-rib region shows convex protuberance with ovoid-globose shaped cells; vascular bundles arranged in a fan shape with 6-8 celled xylem; bundle sheath encloses both phloem and xylem; trichomes are absent.

Powdered plant material

Leaf greenish in colour, odour characteristic, epidermal cells, parenchymatous with straight anticlinal walls, some wavy and undulating, numerous stomata of anomocytic and paracytic types, glandular trichomes, xylem tissues

Therapeutic actions

Anti-inflammatory (Coulibaly Nee Diop, 1986, Metou, *et al*., 1989), antibacterial (Almagboul *et al*., 1985); antimalarial (Weenen *et al*., 1990), antiviral (Beuscher *et al*., 1994; Mahmood *et al*., 1993); analgesic and hypoglycaemic (Ojewole, 2008); antiparasitic (Nibret *et al*., 2010); antioxidant (Akinmoladun *et al*., 2010); anticonvulsant, sedative and anxiolytic (Muanda *et al*., 2010), anti-Mycobacterium tuberculosis (Green *et al*., 2010, Luo *et al*., 2011).

Therapeutic indications

Pains, worm infestation, rheumatism, psoriasis, eczema and immunosuppressive diseases, leprosy, wounds

Safety data

In a 24-hour acute toxicity study, the LD_{50} of the aqueous root extract (*p.o*) in mice was >2000 mg/kg. Subacute studies did not show any clinical signs of toxicity after treatment of male and female mice (500 to 2000 mg/kg; *p.o*) for 14 days. Oral intake of aqueous root extract over 28 days, caused toxicity by decreasing the antioxidant system in the treated animals (Ajiboye *et al*. 2010). The minimum lethal dose in rats in 24 hours of raw ethanol stem bark extract was 50 mg/kg (Sandberg and Cronlund, 1982). Some active saponins from the root are highly toxic: LD_{50} of 500 mg/kg administered when orally and 50 mg/kg parenterally in mice (Tubery, 1969). The LD_{50} of saponin-rich crude fresh root extract was 0.875/kg by oral adminstration. Ingestion of the root by mouth produces irritation of the digestive tract, which can be fatal causing death after 19 hours; humans have a much more sensitive response with oral LD_{50} = 170 mg/Kg (Scandola *et al*., 1994). Leaves are less toxic than the stem and root; LD_{50} of the freeze-dried macerated aqueous extract is 5g/kg oral or 53.76 g/kg (Scandola *et al*., 1994). Securinine has a very high toxicity; doses of 0.1-0.2 mg/kg to 5-30 mg cause death by respiratory arrest (Chang Hui-yun, 1974).

Precautions for use

Do not exceed the recommended doses; the root has demonstrated a very low safety dose margins and self-medication is not encouraged

Adverse effects

Bad smell and taste, root may stimulate nausea and vomiting

Contraindications

Pregnancy, liver and heart diseases

Dosage and dosage forms
Decoction, powders
Seneginate magnesium is used in capsule 130 mg and at 2 to 10 capsules a day

Storage
Store in a cool dry place

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Senna alata

Botanical name
Senna alata (L) Roxb.

Family
Leguminosae-Ceasalpinioideae

Synonyms
Cassia alata L., *Hepetica alata* Ref., *Cassia bracteata* L.; *Cassia herpetica* Jacq.

Common names
Ringworm shrub, Craw-craw plant, King of the forest, Candle stick cassia; ringworm senna; guajava; ringworm bush; seven-golden-candlesticks; Emperor's candlesticks; Empress-candle plant; christmas-candle; candlestick senna; candle bush, fleur St Christophe

Vernacular names
Ghana: Twi – Osempe, Ga Adangbe – Bayisa, Ewe – Agbobladzoe
Nigerian: Yoruba – Asunwon oyinbo, Hausa – Majamfari, Ibo – Ogalu
Niger: Hausa – Sanga Sanga
Togo: Ewe - Zangarati, Ouatchi – Zanguerati, Adja – Zangalati

Description of the plant
It is a soft-wooded shrub, highly decorative with an unusual and interesting appearance, about 3 m or more in height; leaves are compound pinnate consisting of 8-14 pairs of oblong to obovate leaflets (5-16 cm long by 3-8 cm wide) which are rounded at the end; rachis narrowly winged with a ridge connecting the leaflets; petiole and rachis are up to 60 cm in length; plant flowers in February and October to November; flowers in crest terminal cymes, producing golden yellow flowers in stout, dense, erect and large, spike–like racemes with fertile stamen; fruit, with four broad crenate wings along the middle, straight, winged along sides, contains 30-40 seeds per fruit, measures 15–25 cm long and about 1.8 cm broad, green when unripe and black when ripe (Adjanohoun *et al*., 1991).

Herbarium specimen number
Nigeria: FHI 107441
Togo: TOGO00121

Habitat and geographical distribution
Native to America but now found widely distributed throughout the tropics including West Africa from Senegal to Nigeria (Irvine, 1961). It is a common plant in villages, wastelands,

clearings and homes; cultivated or spontaneous. In Nigeria it can be found in the rain forest and the savannah, both in the southern and northern parts of the country (Elujoba and Ogunti, 1993; Adjanohoun *et al*., 1991).

Plant material of interest
Dried leaflets

Other parts used
Flower; root; seed; bark

Definition of plant material of interest
Alata leaf consists of the fresh or dried young leaflets of *Senna alata* L. Roxb. (Leguminosae-Ceasalpinioideae).

Ethnomedical uses
The leaves are used for dermatitis, eczema, ringworm, intestinal helminthiasis, taeniasis, constipation, asthma, gonorrhoea, bronchitis, delayed labour and as an abortifacient (Oliver-Bever, 1986; Hauptman and Lacerda, 1950).

Biological and Pharmacological activities
Several laboratory reports have lent support to some of the herbs' folkloric claims. The anthranoid glycosides cause purgation by stimulating peristalsis in the large bowel and diminishing water absorption. Extracts of various parts of the plant have shown promising antimicrobial and analgesic properties (Palanichamy and Nagarajan, 1991) and laxative activities (Ogunti and Elujoba, 1993; Nickell, 1959). Alcoholic extract of the leaf and flower of *S. alata* showed antimicrobial activity on unspecified Gram-positive bacteria (Benjamin

and Lamikanra, 1981). In a study by Crockett in 1992, extracts were reported to be effective in treating the opportunistic infections of AIDS. Ethanolic extracts exhibited high antimicrobial activity against various species of dermatophytic fungi but low activity against non-dermatophytic fungi; bacterial and yeast species showed resistance to the extract *in vitro* (Ibrahim, 1995). The ethanolic leaf extract showed low MIC values of 12.5-25.0 mg/ml against *Trichophyton rubrum* and *Basidiobolus haptosporus* (Lemli, 1976). The leaf extract also showed maximum analgesic activity *in vivo* compared to kaempferol 3-O-sophoroside with morphine (Palanichamy and Nagarajan, 1990). Oil extracted from the leaf had inhibitory effects on Gram-positive and Gram-negative bacteria including *Pseudomonas* sp., *Staphylococcus aureus* and *Escherichia coli* (Okafor *et al*., 2001).

Clinical data

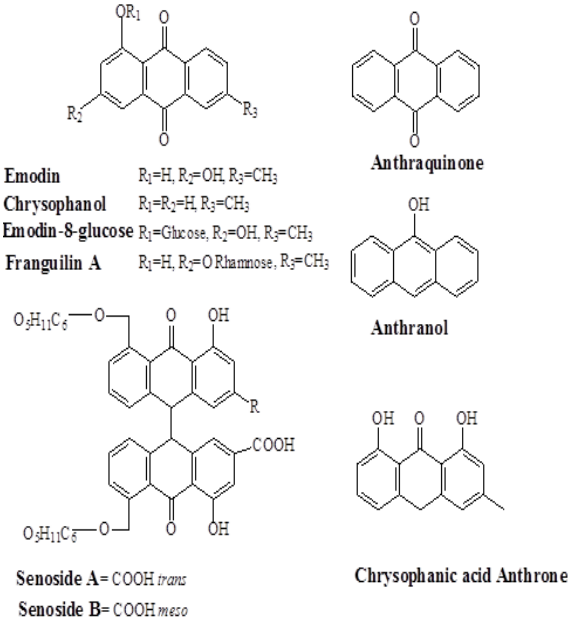
In a multicentre randomized controlled trial, leaf infusions administered at bed-time was found to have stronger purgative action compared to placebo. A small percentage of the participants (16-25%) were reported to have experienced minimal side effects, i.e., nausea, dyspepsia, abdominal pain and diarrhoea (Thamlikitkul *et al.,* 1990). A 10-year human study found the leaf extract to be an effective antifungal agent for the treatment of *Pityriasis versicolor* (Damodaran and Venkataraman, 1994). Oladele *et al.,* (2010, 2012) reported on an observational clinical study with *Senna alata* herbal soaps for the management of superfacial skin infections among the prison inmates. It significantly cleared the lesions on 94% of the patients in 4 weeks, mainly comprising of *Taenia vesicolor* and *T. corporis* as the causative *infections.* In a related study by the same research group, 3% *Senna alata* incorporated into the herbal soap, gave the best result among the other 2 herbal soaps (Oladele *et al.,* 2012).

Chemical constituents

Anthraquinones: aloe-emodin, rhein glycoside and aloe-emodin glycoside, sennosides, rhein, chrysophanic acid; tannins and mucilage (Elujoba *et al*, 1989; Rai and Adbullahi, 1978; Ogunti *et al*, 1991; GHP, 1992; Gupta, 1991).

Tests for identity and purity

Moisture content: Coarse powder loses not more than 12 % when dried at 100°C
Total ash: Not more than 10.00%
Acid-insoluble ash: Not more than 1.60%



Sulphated ash: Not more than 15.00 %
Water-soluble ash: Not less than 5.00%
Water-soluble extractive (Coarse powder): Not less than 20.00%
Alcohol-soluble (70%) extractive (Coarse powder): Not less than 17.00%
Stomatal index: 10 – 14.25 – 18.3 (upper surface),18.5 – 21.85 – 25 (lower surface)
Stomatal number: 275 – 296 –320 (upper surface), 405 – 472 – 515 (lower surface)
Palisade ratio: 8.25 – 9.53 – 10.50
Veinislet number: 13 – 15.8 – 20.0
Veinlet- termination number: 17.5 – 19 – 21.5

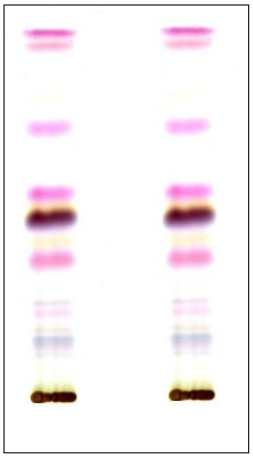
Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of characteristic six spots with R_fs of 0.96 (pink), 0.93 (pink), 0.71(pink), 0.53 (pink), 0.47 (brown) and 0.38 (pink).

Macroscopy

Compound leaves, paripinnate, vary from 30-60 cm in length with 8-14 pairs of leaflets attached to the rachis; leaflets greyish green, thick and papery, oblong-obovate to lanceolate, asymmetrical at the base, 50-150 cm long and 40 to 90 mm wide, apex mucronate, base flat or round, margin entire, petiole short, 1-3 mm long,



Chromatogram

venation pinnate, more distinct on the undersurface with lateral veins leaving the midrib at an angle of about 60°; both surfaces are covered with hairs; texture papery; colour greenish when fresh, lower surface greyish green, petiole yellowish-brown; taste slightly bitter, mucilaginous and the leaf curves slightly when dried with a greyish–green colour (Elujoba and Ogunti, 1993).

Microscopy

Epidermal layer consists of polygonal cells covered by a thin, warty and undulating cuticle; stomata are paracytic; epidermal cells less wavy and stomata fewer on upper surface; covering trichomes with pointed tips, thick and warty walls, conical and sometimes appressed to the epidermis, present on both surfaces, unicellular with the base surrounded by radially elongated epidermal cells; clusters of calcium oxalate distributed throughout the tissue while prisms are found in the epidermal cells; transverse section presents a dorsiventral leaf arrangement, thick cuticle, papillose on lower surface, cuboidal epidermal cells; thick, warty-walled, with a layer of discontinuous monolayer palisade cells, below the upper epidermis with almost straight anticlinal walls; interrupted in midrib region by spongy mesophyll cells; midrib projects on the lower surface and is traversed by a vascular strand formed by an arch of collateral vascular bundles, endodermis in two semi-circles enclosing the collateral vascular bundle, whole strand surrounded by a sclerenchymatous pericycle followed by the cortex, which consists of 3-5 rows of parenchyma cells and 2-3 rows of collenchyma cells; xylem vessels and the endodermis (fibrous) are lignified while the epidermis and mesophyll cells contain mucilage, the latter also contain round yellowish ergastic substances (Elujoba and Ogunti, 1993).

Powdered plant material

Consists of fragments of epidermal cells which are polygonal in shape showing paracytic stomata, fragments showing cicatrix with epidermal cells radiating outwards, xylem tissue: reticulate, (lignified) annular, spiral vessels; few phloem fibres non-lignified; characteristic warty-walled covering trichomes, unicellular and uniseriate, appressed, fragments of pitted vessels and groups of fibers with prisms of calcium oxalate crystals which may also be isolated and also occurring as sheaths on veins; starch grains 26-42 cm; 49-120 cm long, green colour and characteristic bitter taste.

Therapeutic actions

Antidiarhoeal, antibacterial, antifungal, antiviral

Therapeutic indications

Ascites; constipation; craw-craw, dermatitis; dhobey-itch; dystocia; eczema; gonorrhoea; leprosy; mycosis; parturition; ringworm; shingles; stomach ache; tattoo; tinea (Mshana *et al.,* 2000; Assane, 1993; GHP, 1992, NHP, 2008).

Safety data

In animal studies using female rats, the LD_{50} was >3000 mg/kg and treatment (300-3000 mg/kg) did not cause changes in body weight or organ/body-weight ratios. In acute studies (300-3000 mg/kg), diarrhoea was observed in the group that received 3000 mg/kg. There were no significant changes in haematology, liver or renal function. The aqueous extract of the leaf is considered safe.

Precautions for use

High doses may affect the absorption of other drugs due to reduction in intestinal transit time. Use in nursing mothers, children under 10 years and for more than 2 weeks, would require medical supervision. As with all anthranoid glycoside-containing herbs, long-term use may cause pigmentation of the intestinal mucosa, also provoke nausea and vomiting in large doses.

Adverse effects

Diarrhoea

Contraindications

Contraindicated in pregnancy and lactation; rectal bleeding, appendicitis and intestinal

obstruction and stenosis; high doses may cause gripping, colic, abdominal discomfort, diarrhoea, loss of electrolytes and dehydration; inflammatory bowel disorders; idiopathic abdominal pains; haemorrhoids; colitis and ulcer.

Dosage and dosage forms

Tincture; infusion (tea); decoction

Infusion: (hot or cold): the dried pods or leaves should be steeped in warm water for 6-12 hours; 1 teaspoon in about. 150 ml of water; filter after 10 minutes; take one cup in the morning and/or before going to the bed.

Powder: 1-2 g with 150 ml of water (as purgative)

Tincture: 1:5 in 50% alcohol; take 2-4 ml at bedtime.

Laxative: 3 – 4g as hot infusion at bedtime

Skin infections*:* 1-2% powder, incorporated into soap or body cream.

Storage

Store in a cool dry place

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Senna alexandrina

Botanical name
Senna alexandrina Mill

Family
Leguminosae-Ceasalpinioideae

Synonyms
Cassia senna L..; Cassia acutifolia Del; *Cassia angustifolia* Valil.; *Cassia elongata* Lam.; *Cassia lantiva* Brisch; *Cassia lanceolata* Collad

Common names
Alexandrian senna (*Cassia acutifolia* Del.); Tinnevelley senna (*Cassia angustifolia* Valil.)

Vernacular names
Mali: Tamachek – Aghe-Agher, Egerger
Niger: Arabic – Senna Jebeli, Senna Makha
Nigeria: Arabic Shuwa – Senna Jebeli, Hausa – Filáskon Máká

Description of the plant
A small shrub with erect stack 1 to 1.5 m high, compound paripinnate leaves about 10 cm in length, 3-7 pairs of leaflets and about 12-24 cm long, 7-12 mm wide, narrow, pale green to yellowish green in colour; zygomorphic flowers with yellow petals; fruit is elliptical, flattened, dehiscent pod, 4-7 cm long, 2 cm wide containing 6-10 seeds per pod (WHO, 1999; African Pharmacopoeia, 1985; Wallis, 1967).

Habitat and geographical distribution
Upper Nile territories, Alexandria, Sudan and other semi-desert zones of Africa.

Plant material of interest
Leaf

Other parts used
Fruit

Definition of plant material of interest
Alexandrian senna consists of the dried leaflets or fruit of *Senna alexandrina* Mill (Leguminosae-Ceasalpinioideae).

Ethnomedical uses
It is used for bowel evaculation, in constipation, liver disease, jaundice, anaemia, splenomegally and typhoid.

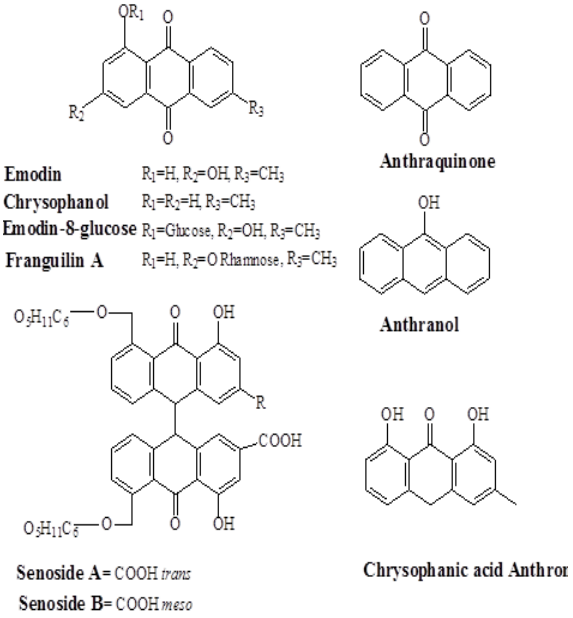
Biological and pharmacological activities
The laxative effects of senna are due to the presence of Sennosides A and B, which

influence colonic motility and enhance colonic propulsive transit. Senna stimulates peristaltic contraction, significantly increasing the rate of defaecation, faecal weight and stool fluidity (Fleming, 2000).

Clinical data
The time of action of senna is usually 8-10 hours, and thus the dose should be taken at night. The action of the sennosides augments, without disrupting, the response to the physiological stimuli of food and physical activity. The sennosides abolish the severe constipation of patients suffering from severe irritable bowel syndrome. In therapeutic doses, the sennosides do not disrupt the usual pattern of defecation times and markedly soften the stool. Sennosides significantly increase the rate of colonic transit and increase colonic peristalsis, which in turn increase both faecal weight and dry bacterial mass. Due to their colonic specificity, the sennosides are poorly absorbed in the upper gastrointestinal tract (WHO, 1999).

Chemical constituents
Hydroxyanthracene glycosides particularly Sennosides A, B, C and D, aloe-emodin, rhein – 8-glucosides, mucilage and flavonoids (African pharmacopoeia, 1985; Wallis, 1967), Sennocides A, B, C (Okafor *et al*., 2001).

Tests for Identity and purity
Moisture content: Not more than 10.00% (leaf); 12.00% (fruit)
Total ash: Not more than 12.00% (leaf); 6.00% (fruit)
Acid-insoluble ash: Not more than 2.00% (leaf); 2.00% (fruit)



Water-soluble extractive: Not less than 3% (leaf), 25.00% (fruit)
Stomatal index: 10-12.5-15
Stomatal number: 11.4 – 12.2 –13
Vein islet number: 20-25-30
Palisade ratio: 4.5 – 9.5 - 18(upper epidermis) 3.5-7.0 – 14.5 (lower epidermis)
Foreign organic matter: Not more than 1.0% (leaf); 1.0% (fruit).

Chromatrographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of six characteristic spots with R_fs 0.94 (pink), 0.89 (brown), 0.76 (green), 0.62 (violet), 0.48 (violet) and 0.32 (yellowish brown).

Chromatography

Macroscopy

Leaflets are lanceolate to ovate-lanceolate of 2.5 cm long, 0.5 to 1.6 cm wide, pale greyish-green or yellowish-green; thin and brittle texture, leaves in commerce thus appear in more or less broken form, asymmetrical and unequal at the base, covered on both surfaces with whitish hairs distinctly visible near the veins, apex is acute and mucronate, petiole about 1mm long; vein more conspicuous on the lower epidermis, radius (if present) is slender, 7 to 10 cm long, 4 to 6 pairs of leaflets, odour slight, taste mucilaginous with characteristic bitterness (WHO, 1999; BPC, 1959). Fruit: pods leguminous, entire, compressed laterally, almost flat and broadly oblong, thin pods, yellowish green to yellowish brown, about 3-6 cm long, up to 2.5 cm wide, round apex with slight projecting point, each containing about 5-7 flat, obovate-cuneate, hard seeds, 5-6 mm long 3-4 mm wide; pericarp is dry and membranenous, the embryo is large and straight, green, flat cotyledons, surrounded by scanty grey endosperm.

Microscopy

Leaf epidermis has polygonal tabular polyhedral, straight walled cells with mucilage contents, paracytic or rubiaceous stomata of equal number on both epidermises, unicellular, thick-walled, conical, warty, trichomes appressed to the epidermis and measuring up to 260 µ long and 12 to 18 to 25 µ wide, a single row of palisade under the epidermis; transverse section through the mid-rib shows a meristele consisting of xylem and phloem with an arc of pericyclic fibres below and a mass of schlerenchyma above; below the veins, groups of pericyclic fibres flanked externally by a sheath containing prisms of calcium oxalate crystals measuring 4–0–20- 25 µ with cluster crystals, 8–15–20–30 µ, occur in the palisade and spongy tissues (Wallis, 1967).

Powdered plant material

Leaf powder is light-green to greenish-yellow; fragments of polygonal epidermal cells, paracytic stomata, unicellular, conical, warty, covering trichomes isolated or attached to fragments of epidermal cells; fragments of vascular bundles with sheath of calcium oxalate prismatic crystals, cluster crystals of calcium oxalate, isolated or inside fragments of parenchyma cells.

Fruit powder contain fragments of epicarp cells containing stomata of anomocytic or paracytic type; unicellular, conical, warty trichomes, found singly or attached to surface cells; fibres from the

endocarp, polygonal, mucilaginous cells of the endosperm.

Therapeutic actions
Antidiarhoeal, antibacterial, antifungal

Therapeutic indications
Constipation, liver disease, jaundice, anaemia, splenomegaly and typhoid.

Safety data
In animal studies using female rats, the LD_{50} was > 3000 mg/kg and treatment (300-3000 mg/kg) did not cause changes in body weight or organ/body-weight ratios. In acute studies (300-3000 mg/kg), diarrhoea was observed in the group that received 3000 mg/kg. There were no significant changes in haematology, liver or renal function. The aqueous extract of the leaves is considered safe. Adefemi *et al.* (1988) reported that high doses may cause excessive gripping, abdominal discomfort, diarrhoea, electrolyte depletion and weight loss; larger doses or chronic use may damage the liver, the kidney and affect spermatogenesis.

Precautions for use
No special precautions but high doses may affect the absorption of other drugs due to reduction in intestinal transit time. Except on medical advice, it should not be used for more than 14 days or for children under the age of 10 years (British Pharmacopoiea, 1988; Godding, 1998).

Adverse effects
Discolouration of the urine during therapy.

Contraindications
Pregnancy, intestinal obstruction/ stenosis, appendicitis, diuretic, corticosteroid or digoxin therapy; hypermotility of the intestines

Dsage and dosage forms
Decoction, Infusion
As laxative: 0.5-2.0 g at bed time as hot tea, and as purgative: 2-4 g at bed time as hot tea

Storage
In well-closed containers, protected from light and moisture

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Senna occidentalis

Botanical name
Senna occidentalis (L.) Link

Family
Leguminosae-Ceasalpinioideae

Synonyms
Cassia occidentalis L.; *Cassia caroliniana* Walter; *Cassia foetida* Persoon; *Ditremexa occidentalis* (L) Britt & Rose

Common names
Coffee senna, Mogdad coffee, stinkweed (English); Herbe puante, Casse fétide (French); Fedegosa (Portuguese)

Vernacular names
Buirkina Faso: Mooré – Kinkéliba, Dioula – M'balan m'balan;mbala fin, Fulfuldé – Tasbati
Cote d'Ivoire: Baoulé – Aloukou Sere Sere, Malinké – Badjaa; Akyé – M'bechilè
Gambia: Mandinka – Kassala, Fulla – Tiga Sowru, Wollof – Hobi
Ghana: Akan – Mmofraborodee, Ga Dangme – Gbekebii Arnadaa, Ewe – Dzongbale
Mali: Bambara – N'Balan Balanfing, Noms – Tasbati, Malinké – Kassé
Niger: Djerma – Sanga Sanga, Hausa – Raydoré
Nigeria: Yoruba – Rere
Senegal: Serer – Ben Fènè; Bénékèné, Wolof – Bantamaré, Diola – Bufata
Sierra Leone: Kisi – Dilankido, Shebro – Sabibosueleh, Temne – E- Bambaforke
Togo: Ewé – Bessissan, Ouatchi – Avakofè; Adja – Laloui

Description of the plant
Glabrous herb or undershrub; annual or up to 3 years duration; leaves compound pinnate, leaflets 4-5 pairs, terminal pair largest, broadly lanceolate or ovate, 3.5-10 cm long, 3-4 cm broad, apex acute, gland near base of leaf rachis; flowers yellow; fruit linear pod, somewhat flattened abruptly beaked.

Herbarium specimen number
Ghana: GC45900
Mali: 1525 (DMT)

Habitat and geographical distribution
Common weed on wasteland in villages and towns and on roadsides; pantropical.

Plant material of interest
Leaf

Other parts used
Seed and root

Definition of plant material of interest
Coffee senna consists of the dried leaf of *Senna occidentalis* (L.) Link (Leguminosae-Ceasalpinioideae).

Ethnomedical uses
S. occidentalis is used in many parts of Africa to treat a range of conditions such as abscesses, bruises, cataracts, constipation, eye infections, headache, jaundice, kidney infections, leprosy, malaria, kidney pain, menstrual disorders, rheumatism, ringworm, scabies, sore throat, stomach ulcers, stomachache, syphilis, tetanus, worms, fevers, tuberculosis, anaemia, liver, disorders; general weakness; asthma; bronchitis; venereal diseases (Chukwujekwu *et al.,* 2005; Tona *et al.,* 2004; Samy and Ignacimuthu, 2000; Kuo *et al.,* 1996; Soukup, 1970; Rutter 1990; Coimbra, 1994; Ayensu, 1981; Altschul, 1983; Ronquillo, 1988; Robineau, 1989; Standley and Steyermark, 1946; Kabiruddin, 1951; Kirthikar *et al* 1969). In Mali, the leaves are used to treat oedema and a decoction is made for malaria, fevers in pregnancy, yellow fever, headache and conjunctivitis. The seeds are brewed into a coffee-like beverage for asthma, hypertension, malaria, fevers and stomach complaints.

Biological and pharmacological activities
The laxative effect of the various parts of the Senna plant was reported as far back as the 1950s (Grote and Woods, 1951). Several scientific investigations have shown that S. *occidentalis* has antibiotic, antiinflammatory, anthelmintic, abortifacient, cholagogic,

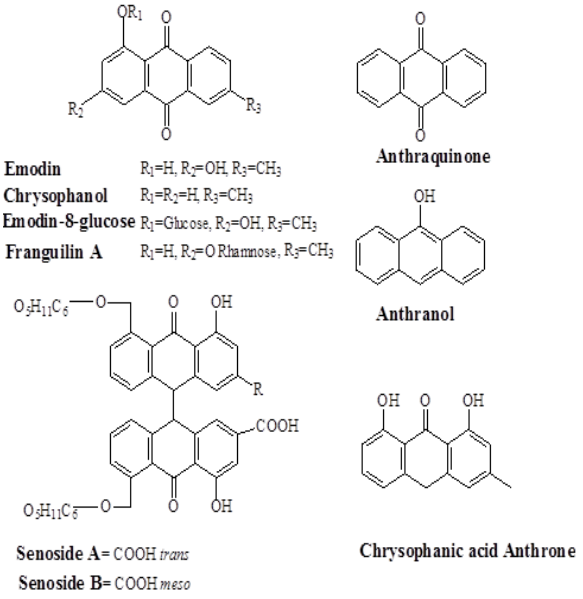
cicatrizant, diuretic, laxative and tonic properties (Ake, 1983; Morton, 1981; Robineau 1989; Chukwujekwu *et al* 2006). The aerial parts of the plant (leaves, fruits and leaves) have purgative properties (Watt and Breyer-Brandwijk, 1962). Extracts of the leaf exhibited broad spectrum antibacterial activity against *B. subtilis* and *S. aureus* (Samy and Ignacimuthu, 2000) and the benzene and ether extracts of the leaves, root and seeds were also active against Gram-positive and Gram-negative bacteria (Ikram *et al* 1978). It showed antibacterial activity against *Salmonella typhi* (Perez and Anesini, 1994; Evans *et al*., 2002). A study by Tona *et al* (1999) also showed that the ethanol and dichloromethane leaf extracts possessed anti-parasitic effect *in vitro*, whilst the ethanolic, dichloromethane and lyophilized aqueous extracts of the root bark produced chemosuppressions of parasitaemia in a dose-dependent manner; the ethanolic lipophilised extract was more active (Tona *et al*., 1999; Tona *et al*., 2001; Tona *et al*., 2004). However, Gasquet *et al* (1993), reported mild antimalarial effects. Another study by Caceres *et al.,* (199lc) found that the leaf decoction was active against *E. flocossum, M. gypseum, T. mentagrophytes* and *T. rubrum*. *In vivo* and *in vitro* studies have shown that aqueous extracts of the plant possess anti-mutagenic activity against benzo[α]pyrene and cyclophosphamide-induced mutagenicity (Sharma *et al* 1999; Sharma *et al* 2000a; Sharma, *et al*., 2001). Cyclophosphamide-exposed animals showed enhanced immunity on administration of the plant extracts (Bin-Hafeez *et al* 2001). *In vivo* studies have also shown that the plant's powder has antiinflammatory activity, as well as an ability to stabilize human erythrocyte membrane against hypotonicity-induced lysis (Sadique *et al.,* 1987). The leaf extracts produced significant hepatoprotection (Jafri *et al*., 1999) while its aqueous extract exhibited significant antihyperglycaemic activity in normal and alloxan-induced diabetic rats (Verma *et al*., 2010). Aqueous extract of the whole plant, also had more potential than hydro-alcoholic and alcoholic extracts against human cancer cell lines at 100, 30, and 10 µg/ml. The hydro-alcoholic extract showed potential against *Bacillus subtillis* (Bhagat and Saxena, 2010), whilst ethyl acetate fraction of the leaf methanolic extract exhibited the high antioxidant potential of the plant (El-Hashash *et al*., 2011). Aqueous and hydro-alcoholic extracts of *C. occidentalis* induced complete inhibition of egg hatching at a concentration less than or equal to 1mg/ml. Aqueous extract also induced 96.36% inhibition of larval development, but hydro-alcoholic extracts of the plant (9%) had poor inhibitory effect (Eguale *et al*., 2011).

Clinical data

The efficacy of *S. occidentalis* as a stimulant for skin repigmentation in vitiligo was demonstrated in preclinical and clinical studies (Babitha *et al*., 2011).

Chemical constituents

Anthraquinone (e.g. the sennosides, chrysophanol, physcion, helminthosporin, emodin), fatty oils, flavonoids ((jaceine 7-rhamnoside, mattencinol 7-rhamnoside, matteucinol 7-rhamnoside, jaceidin-7-rhamnoside, cassiaoccidentalins A, B and C), xanthones (cassiollin); gallactomannan, polysaccharides and tannins) (Chukwujekwu *et al.,* 2006; Chauhan *et al.,* 2001; Purwar *et al.,* 2003; Hatano *et al.,* 1999; Ikram *et al.,* 1978; Glasby, 1991; Rai and Shok, 1983; Gupta *et al*., 2005).



Tests for identity and purity

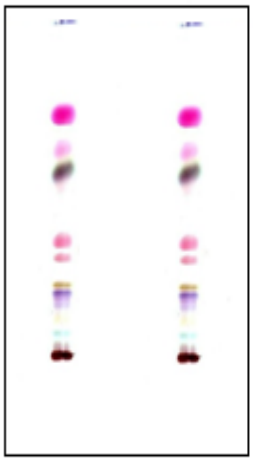
Moisture content: 8.84%
Total ash: 11.54 %
Water-soluble extractive: not less than 21.64%
Alcohol-soluble (70%) extractive: not less than 21.17%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 oC)/chloroform

[2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of eight characteristic spots with R_fs 0.71 (pink), 0.64 (pink), 0.55 (dark grey), 0.35 (pink), 0.29 (pink), 0.21 (brown), 0.19 (violet) and 0.09 (green).



Chromatogram

Macroscopy

The dried seed is flattened, somewhat obovate with one end (raphe) pointed; testa smooth, hard; brown. Leaf green with characteristic odour and slight bitter taste.

Microscopy

The testa comprises of an outer cuticularised layer surrounding a vascularised circumscribed layer; within is a monolayer of radially oriented nearly isodiametric cells; followed by an inner tangentially elongated sclerenchymatous tissue; a hyaline layer separates the testa from the endosperm. The leaves have Straight walled epidermal cells with numerous paracytic stomata on both surfaces. Few scattered unicellular clothing trichomes.

Powdered plant material

Roasted seed, colour dark brown; odour aromatic coffee-like; sclerenchymatous tissue; short unlignified fibres; compact cork-like tissue; sclereids; parenchymatous cells with oil; grains of starch. The leaf powder has straight walled epidermal cell with few unicellular trichomes ans scatterd starch grains.

Therapeutic actions

Antianaemic, antimicrobial, detoxicant, antihypertensive, antihelminthic, antihepatitis, antimalarial

Therapeutic indications

Abdominal pains, anaemia, bacterial and fungal infections, cirrhosis, detoxification, hypertension, intestinal worms, liver disorders (jaundice, hepatitis) injury, malaria, skin parasites (Mshana *et al*., 2000; GHP, 1992).

Safety data

The LD_{50} of the aqueous extract of leaves (*p.o*) in mice over a period of 24 hours was >2000 mg/kg. Sub-acute studies did not show any clinical signs of toxicity after treatment of male and female mice (500 to 2000 mg/kg; *p.o*) for 14 days. In a sub-chronic toxicity study, repeated administration of the aqueous extract can cause hypoglycemia and liver and kidney dysfunction in rats. The toxicity of the fresh or dried beans was demonstrated in several animal studies. The LD_{50} is 1 g/kg for mice and rats. Toxicity is attributed to alkaloids, various anthraquinones and their derivatives, but the specific toxins have not been identified. The clinical spectrum and histopathology of *S. occidentalis* poisoning in children resemble those of animal toxicity, affecting mainly hepatic, skeletal muscle and brain tissues. The case-fatality rate in acute severe poisoning is 75-80% in children (Vashishtha *et al*., 2009). Ingestion of large doses of the leaves may expose people to the risk of hepatotoxicity (Vanderperren *et al*. 2005; Borrelli *et al*., 2005; Nuhu and Aliyu, 2008). Acute toxicity studies carried out in rats revealed that the hydroalcoholic extracts of stem and leaf were well tolerated, the LD_{50} were higher than 5 g/kg. Oral subacute administration during pregnancy in female Wistar rats showed no statistically significant differences between the control and treated groups in terms of offspring/dam relationship; foetuses, placentae and ovarian weight; number of implantation and resorption sites; number of corpora lutea in the ovaries and pre- and post-implantation loss rates (Aragão, *et al*., 2009). Subacute treatment with the hydroalcoholic extracts of stem and leaf failed to change body weight gain, food and water consumption and haematological and biochemical profiles; no changes in macroscopic and microscopic features of organs were observed in the rats (Silva *et al*. 2011).

Precautions for use

The aqueous extract of the plant can cause hypoglycaemia and increased hepatic and renal function. Blood glucose and the biochemical

parameters of liver and kidney need to be regularly monitored on prolonged use

Adverse effects

Long term ingestion of small amounts and single high dose of the seed caused myodegeneration, respiratory failure, disruption of mitochondrial structure and death in rabbits (O'Hara and Pierce, 1974). High doses can interfere with the metabolism of some drugs in the liver.

Contraindications

Pregnancy, hypotension, antihypertensives

Dosage and dosage forms

Decoction; tincture

Decoction: 10 g of dried powdered leaves in 500 ml water; 1 teacup two times daily.

Tincture: 1:5 in 50% ethanol; 5 ml three times daily

Storage

Store in airtight containers, in a cool dry place, protected from light.

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Senna podocarpa

Botanical name
Senna podocarpa (Guill. & Perr.) Lock

Family
Leguminosae-Caesalpinoideae

Synonyms
Cassia podocarpa Guill. and Perr

Common name
Podocarpa leaf

Vernacular names
Cote d'Ivoire: Baule – Niaaka Niabaka, Kru Guere – Siogelebe, Sioguele Belebel Kweni
Gambia: Manding Mandinka – Kanayiro
Ghana: Akan – Sreso Simpe, Ga – Nyonbele, Wasa – Nsuduru
Guinea: Basari – Mbokwe, Fula Pulaar – Yeleuk, Konyagi – Mpman
Guinea Bissau: Manding Mandink – Adjam, Djam-Cafae, Pepel - Beuroque
Liberia: Mano - Ba La Bli
Nigeria: Igbo – Gaalu, Igbo (Agulu) – Ogaala, Yoruba – asunwon anago**,** peiebe.
Senegal: Balanta – Banban, Diola – Bunan Bunangabo, Fula - Bendiagkafara
Sierra-Leone: Kono – Wawa, Loko – Balaga, Temne – E-Ai-Ani

Description of the plant
Glabrous shrub, up to 5 m high, leaves pinnately compound, sometimes imparipinnate; petiole and rachis up to 30 cm long; 4-5 pairs of leaflets, elliptic with narrowed ends, 6-12 cm long, 3-6 cm broad; flowers, occurring between October and December, are light yellow; inflorescence with dense, erect, spike-like terminal raceme; fruits are pods, not winged, straight, flat, centrally attached, brownish-black when ripe, shiny, flat-beaked and slightly curved with transverse ridges; 10-12 cm long and about 1.5 cm wide, fruit pods indehiscent, fruiting between November and January; seeds, between 14-16 per pod, and dark-brown to black in colour; smooth, hard and oblong, with a pointed edge (Irvine, 1961).

Herbarium specimen number
Nigeria: FHI 107435

Habitat and geographical distribution
Occurs in Guinea savannah and in secondary clearings; sometimes cultivated in homes; also found in wastelands. The plant is distributed from Senegal to Nigeria but however restricted to the

rain forest zones of Nigeria namely: Benin, Ile-Ife, Olokemeji, Ibadan, Lagos and Nsukka. Not generally found in the Northern and Upper Eastern parts of Nigeria (Dalziel, 1936).

Plant material of interest
Fresh and dried leaflets

Other parts used
Root

Definition of plant material of interest
Podocarpa leaf consists of the leaflets of Senna podocarpa (Guill. & Perr.) Lock (Leguminosae)

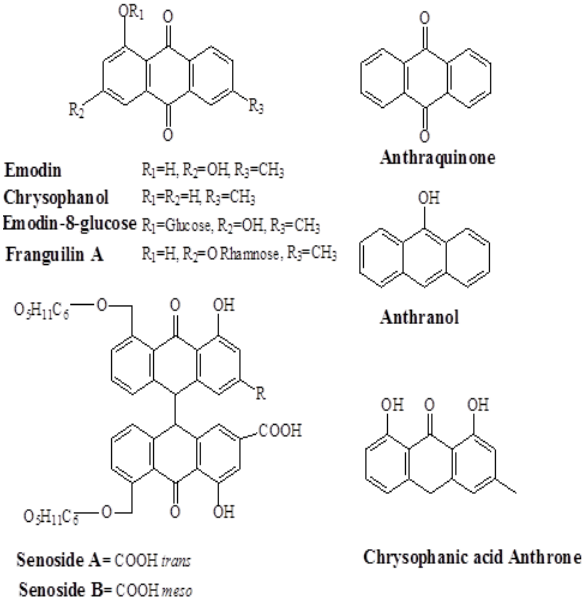
Ethnomedical uses
It is used in folklore as a purgative, labour inducer, anti-gonorrhoeal, guinea worm expellant, emmenagogue and ecbolic (Anton and Haag-Berriere, 1980).

Biological and Pharmacological activities
Podocarpa leaf contains 0.65% free and 1% combined anthraquinones (Rai and Abdullahi, 1978). It produced a significant laxative activity at 500 mg/kg in rats with a biological Senna-equivalent of 0.8 or percentage Senna-activity of 80%; it is devoid of geographical or seasonal variation in the laxative effect, but young leaves produced higher laxative activity than old leaves (Elujoba *et al*, 1989). Both aqueous infusion and methanolic extract of S*. podocarpa* showed *in vitro* antidiarrhoeal effect (Akomolafe *et al.,* 2004). A suspension of the powdered leaf produced wet faeces in mice (Larbi and Lewis, 1976). *S. podocarpa* leaves have been formulated into tablets and used as a substitute

for official Senna in Ghana and Nigeria (Sofowora, 2002).

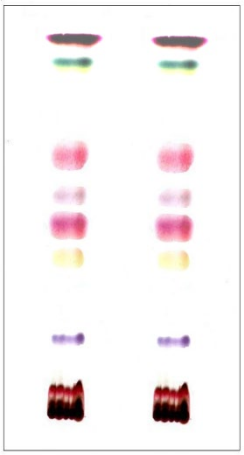
Clinical data
No information available

Chemical constituents
Anthracene glycosides; O-and-C-anthraquinone glycosides; free anthraquinones (emodin).



Tests for identity and purity
Moisture Content: Not more than 12% when coarse powder is dried at 100°C for 4hr.
Total ash: Not more than 10.00%
Acid-insoluble ash: Not more than 15.00%
Sulphated ash: Not more than 16.00%
Water-soluble ash: Not less than 3.50%
Water-soluble extractive: Not less than 17.00%
Alcohol-soluble (70%) extractive: Not less than 15.00%
Stomata index: 2.6 – 4.5 – 9.1 (upper surface); 12.5 – 20 – 28.5 (lower surface)
Stomatal number: 24 – 46 – 72 (upper surface); 306 – 480 – 708 (lower surface)
Palisade ratio: 4 – 5 – 6.5
Vein-islet number: 18 – 20 – 25.5
Veinlet termination number: 17-19.5-24.5

Chromatographic fingerprints
Chloroform extract
Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of seven characteristic spots with R_fs 0.92 (reddish brown), 0.88 (yellowish green), 0.76 (pink), 0.63 (pink), 0.52 (pink), 0.46 (yellow) and 0.22 (violet).



Chromatogram

Macroscopy
Compound leaves are paripinnate, about 25 cm in length, 9 cm wide, size increases gradually from base to apex of rachis, short stout petiole; apex acute or emarginate; with 4 to 5 pairs of leaflets, measuring 4cm to 14.5 cm in length and 2.5 cm to 9.5 cm broad, the maximum width being at the centre. The leaflets are pale yellowish-green, elliptic to ovate-lanceolate, asymmetrical at the base; margin is entire and both surfaces are covered with hairs; pinnate veination, prominent on lower surface; with lateral veins leaving the midrib at an angle of about 45^0 and anastomosing to form a ridge near the margin; texture papery; odour slight, characteristic taste, mucilaginous, astringent, slightly bitter (Elujoba and Ogunti, 1993).

Microscopy
Surface view shows warty-walled clothing trachomes on epidermal cells with wavy walls on both surfaces, those on lower surface being wavier and smaller; leaf epidermis consists of polygonal cells with slightly wavy anticlinal walls covered with a thin cuticle showing parasitic stomata on both surfaces, but more abundant on lower surface, cicatrices present; the epidermal cell measures 35 – 85 µ long and 50-60 u wide for the upper surface, while 60-90 µ long and 40-70 µ wide for the lower surface; unicellular, covering trichomes are conical in shape, with warty walls and often appressed to the epidermal surface, measuring 320 µ in length and 87 µ in width towards the middle; cluster crystals of calcium oxalate are enclosed in parenchyma cells (Elujoba and Ogunti, 1993); transverse

section which shows a bifacial structure containing two discontinuous palisade layers, interrupted by spongy mesophyll cells in the midrib region below the collenchymatous tissue in the lamina differentiates the leaf of *S. podocarpa* from *Senna alata* (a related species) with only one layer of discontinuous palisade in the lamina region below the upper epidermis, mesophyll is differentiated into palisade and spongy tissue, a thin cuticle borders both surfaces; midrib projects on the abaxial surface and is transversed by a vascular strand formed by an arch of collateral vascular bundles; whole strand is surrounded by sclerenchymatous pericycle, followed outwards by the cortex, consisting of 4 to 6 rows of parenchyma cells and then by 3-5 rows of collenchyma cells; xylem tissue is lignified; spongy mesophyll contains starch, calcium oxalate, prismatic crystals and mucilaginous epidermis.

Powdered plant material

Consists of unicellular, covering trichomes; epidermal cells in whole and fragments; paracytic stomata, cluster crystals of calcium oxalate and palisade cells are characteristic features with fragments of lamina; vascular elements are identifiable with the lignified vascular elements in veins and veinlets; dark green to pale yellowish to deep-brown in colour; odour characteristic; taste astringent and slightly bitter.

Therapeutic actions

Purgative, labour inducer, anti-gonorrhoeal, guinea worm expellant, emmenagogue

Therapeutic indications

Laxative, wound and sore dressing, malaria, oliguria and skin ulcer (Mshana *et al.,* 2000; GHP, 1992).

Safety data

In animal studies using female rats, the LD_{50} was > 3000 mg/kg and treatment (300-3000 mg/kg) did not cause changes in body weight or organ/body-weight ratios. In acute studies (300-3000 mg/kg), diarrhoea was observed in the group that received 3000 mg/kg. There were no significant changes in haematology, liver or renal function. The aqueous extract of the leaves is considered safe. Adefemi *et al.,* (1988) reported that high doses may cause excessive gripping, abdominal discomfort, diarrhoea, electrolyte depletion and weight loss; larger doses or chronic use may damage the liver, the kidney and affect spermatogenesis.

Precautions for use

Prolonged use may cause diarrhoea, abdominal colic, dehydration, muscular weakness, weight loss and damage to the myenteric plexus. Use beyond 2 weeks or in children under the age of 10 years requires medical supervision and as for *Senna alexandrina.*

Adverse effects

High doses may cause diarrhoea and lead to fluid and electrolyte loss and for *Senna alexandrina.*

Contraindications

Contraindicated in pregnancy, nursing mothers and intestinal obstruction/stenosis, appendicitis and as for *Senna alexandrina.*

Dosage and dosage forms

Decoction, infusion, tincture

Decoction: 30 g dried leaflets in 900 ml water; simmer until reduced to 600 ml; 1-3 cups daily

Infusion: 30 g dried leaves in 600 ml of water; 1-3 cups daily

Tincture- 1:5 in 50% alcohol, 5 ml three times daily

Storage

In well-closed bottles in cool, dry place protected from light and moisture.

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Solanum torvum

Botanical name
Solanum torvum Sw.

Family
Solanaceae

Synonyms
Solanum mayanum Lundell; *Solanum ferrugineum* Jacq.; *Solanum mannii* Wright

Common names
Solanum (English), Fausse aubergine; aubergine sauvage (French).

Vernacular names
Ghana: Akan- Kwao Nsuswaa
Cote d'Ivoire: Kyama- Guiguisuron
Nigeria: Edo- Omgbabelara, Yoruba- asimonwu
Sierra Leone: Kono- Kōlau

Description of the plant
An erect shrub, up to 3.55 m tall; stem pale green, stellate-tormentose, armed with flat scattered spines; leaves alternate, ovate to oblong-ovate, pinnately lobed, 7-19 cm long, 5-18 cm broad, stellate hairs on both surfaces; petiole 1-4 cm long, also armed with 1-3 cm spines; inflorescence lateral, usually extra axillary racemose, often dichotomous; flowers, many, white or lilac, about 1 cm long, corolla tube short, limb 5-lobed, stamens 4, filaments short, anthers united into a cone, ovary 2-celled; fruit round, 1-15 mm diameter, green, pale orange when ripe.

Herbarium specimen number
Ghana: GC 37723

Habitat and geographical distribution
S. torvum originates from Central and South America, where it is found from Mexico to Brazil and Peru, and is widespread in the Caribbean. It is now a pantropical weed; in West and Central Africa it is a kitchen garden crop, and probably occurs in other regions of Africa as well. *S. torvum* establishes itself on open land in disturbed soil, on roadsides, brushy pastures, recently abandoned farmland, river banks and wastelands, where it often turns into a weed that becomes hard to control. In Cameroon it is a characteristic pioneer species on fallow land. It is listed as a noxious weed in the south-eastern United States. It is normally found either near wetlands or in high rainfall areas, mainly in lowland regions, yet it is tolerant of dry periods (www.prota.org). It grows well in full sunlight,

light shade or shade, but does poorly under a closed forest canopy.

Plant material of interest
Fruit

Other parts used
Leaf, stem and root

Definition of the plant material of interest
Solanum consists of the fresh fruit of *Solanum torvum* SW. (Solanaceae).

Ethnomedical uses
Solanum fruits, flowers and stems possess carminative, anthelmintic and bitter properties. The root is expectorant and used in the treatment of chest pain due to cough, asthma and bronchitis. The leaves are applied externally as a pain relieving agent. Different parts of the plant are used worldwide as an antidote for poison and for the treatment of fever, wounds, tooth ache, gastric ulceration, skin diseases, reproductive disorders, fever and arterial hypertension (Noumi *et al*., 1999; Noumi and Dibakto, 2000; Noumi, 2004; Ndebia *et al*., 2007; Muthu *et al*., 2006; Kala, 2005). In the treatment of female infertility, 3 or 4 g of fruit are macerated in palm wine and administered orally (Telefo *et al*., 2011). The fruits are boiled with leaves and a cupful of the decoction drunk to treat malaria (Asase *et al*., 2010). The leaves are used in Central America, India, and Gabon to treat cuts and wounds and diabetes. In Sierra Leone, the fruit decoction is given to children suffering from cough, whereas in Senegal the plant is used to treat sore throat and stomachache. In the Philippines, roots of *S. torvum* are used for

stomach ache, while the decoction is drunk for indigestion, gastric pain at the navel, rheumatism, numbness, contusion, lumbar muscular pains, and amenorrhoea. Decoction is used in some areas to lessen postpartum haemorrhage.

Biological and pharmacological activities

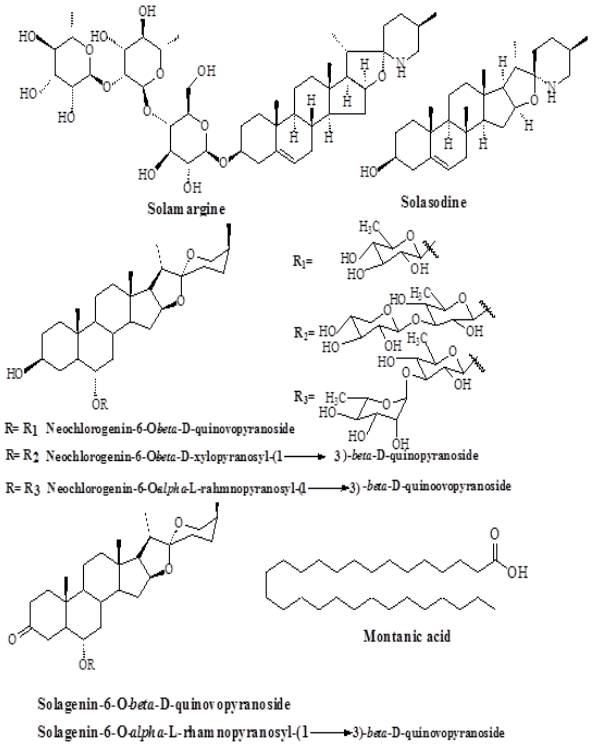
Isoflavonoid torvanol A and the steroidal glycoside torvoside H isolated from the fruits showed antiviral activity against *Herpes simplex* virus type 1 (www.prota.org). The glycoalkaloid solasodine present in the leaves and fruits is used in India for the production of steroidal sex hormones for oral contraceptives (www.prota.org). Methanolic extract of the fruits showed a wide spectrum of antimicrobial activities. Studies on the effect of dried leaf powder in India showed no significant changes with respect to glucose, lipid profile, total amino acids and uronic acid levels in non-insulin dependent diabetes mellitus patients (www.prota.org). The ethanol extract exhibited potent platelet aggregating effects, and the aqueous leaf extract showed both analagesic and antiinflammatory properties. Methanolic extract reduced blood pressure, vascular reactivity changes to catecholamines and reversed metabolic alterations induced by fructose. *S. torvum* had catalytic inhibiting and antioxidant activity (Kusirisin *et al*., 2009). In an *in vitro* study against human pathogenic strains, the water and ethanol extract was found effective against all bacterial strains with an inhibition comparable to that of commercial antibiotics. Methanolic extracts of the roots exhibited promising antibacterial and antifungal effects on all test organisms. The methanol extract at the dose of 750 mg/kg produced significant inhibition of HCl/ethanol-, indomethacin-, pylorus ligation- and stress-induced gastric ulcerations. All the fractions of the methanol extract significantly inhibited ulcer formation. Fruit extracts exhibited hypertensive effects *in vitro* and *in vivo* (Nguelefack *et al*. 2009).

Clinical data

No information available

Chemical constituents

Isoflavonoid (torvanol A), steroidal glycoside (torvoside H); neochlorogenin 6-O-β-D-quinovopyranoside, neochlorogenin-6-O-β-D-xylopyranosyl-(1→3)-β-D-quinovopyranoside, neochlorogenin-6-O-α-L-rhamnopyranosyl-(1→3)-β-D-quinovopyranoside, solagenin-6-O-β-D-quinovopyranoside, solagenin-6-O-α-L-rhamnopyranosyl-(1→3)-β-D-quinovopyranoside, isoquercetin, rutin, kaempferol; quercetin; alkaloids (solasodine, soagenin); tannins (Kusirisin *et al*., 2009; Yuan-Yuan *et al*., 2011; Pérez-Amador *et al*., 2007; Arthan *et al*., 2006).



Tests for identity and purity

Moisture content: not less than 16.80%
Total ash: 13.24%
Water-soluble extractive: not less than 24.60%
Alcohol-soluble (70%) extractive: not less than 13.90%

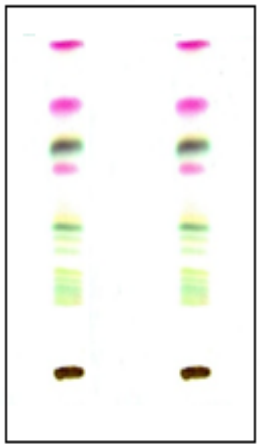
Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of five characteristic spots with R_fs 0.96 (pink), 0.80 (pink), 0.67 (grey), 0.60 (pink) and 0.44 (green).

Macroscopy

The fruit is a berry with persistent calyx; shape globoid, diameter 1.0-1.5 cm; pericarp fleshy but tough, smooth; colour pale green when mature, turns yellowish when ripe; odour characteristic; taste sweetish, slightly bitter after-taste.



Chromatogram

Microscopy
The transverse section of the fruit shows an outer faintly striated cuticular layer bearing glandular trichomes; pericarp is differentiated into epicarp, mesocarp and endocarp; epicarp consists of 2-3 layers of round cells, mesocarp consists of bigger closely packed round or oval cells, both epicarp and mesocarp cells contain prismatic crystals, endocarp consists of large parenchymatous cells with microcrystals (idioblasts) or minute prismatic crystals; numerous small seeds fill the two locules.

Powdered plant material
Numerous oil globules; small spiral vessels and minute prisms of calcium oxalate; spherical starch grains, 2-11 μm diameter; numerous groups of lignified sclereids with characteristic sinuous walls, some with slightly thickened cell walls and large lumen, and others with no thickening.

Therapeutic actions
Antipyretic, antirheumatic, antiphlogistic, anti-infective, anti-contusion, antiinflammatory and analgesic, carminative, anthelmintic, bitter, expectorant

Therapeutic indications
Chesty cough, asthma, bronchitis, sore throat, poisoning, fever, cuts and wounds, tooth ache, gastric ulcer, skin diseases, reproductive disorders, arterial hypertension, malaria, diabetes, stomachache, indigestion, gastric pain at the navel, rheumatism, numbness, amenorrhoea, postpartum hemorrhage.

Safety data
The LD_{50} of the aqueous leaf extract (*p.o*) was found to be > 3000 mg/kg in rats. There was no evidence of toxicity below 3000 mg/ kg in rats. At 3000 mg/kg, significant weight loss, decreased relative weight of liver, kidney, lungs and heart were observed. Increased platelet and WBC count and decreased RBC and HB were seen at 3000 mg/kg. Liver and kidney functions were also affected at 3000 mg/kg as evidenced by increased ALP, the bilirubins and serum creatinine respectively.

Precautions for use
None recommended on the basis of the acute study in rats. However, the unripe fruits are reported to be poisonous.

Adverse effects
High doses may affect liver and kidney function

Contraindications
No information available

Dosage and dosage forms
Decoction, bitters, powders, juice
Decoction of 15 to 30 gm dried roots, or processed into syrup or alcoholic suspension.

Storage
Store in a cool dry place

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Sorghum bicolor

Botanical name
Sorghum bicolor (L.) moench

Family
Poaceae

Synonyms
Sorghum aethiopicum (Hack.) Rupr. Ex, *Sorghum arundinaceum* (Desv.) Stapf Stapf., *Sorghum lanceolatum* Stapf, *Sorghum verticilliflorum* (Steud.) Stapf., *Sorghum virgatum* (Hack.) Stapf

Common names
Great millet, Guinea corn, sweet sorghum (English), Sorgho (French).

Vernacular names
Burkina Faso: Mooré – Baninga ou kazieega, Dioula – Gnô wilé, Fulfuldé – Bayéri;ghaouri
Ghana: Dagare – Kazu Kpulekpule, Dagbani – Chi, Akan – Atoko
Mali: Bambara – Kenegue, Dogon – Eme, Senoufos – Kale Gue
Nigeria: Hausa – Chi Nduka, Kanuri – Mbio, Yoruba – Oka baba
Togo: Ewe – Adako, Mina – Ada, Ouatchi – Adadzen

Description of the plant
It is a cane-like grass, up to 6 m tall with large branched clusters of grains; individual grains are small, about 3-4 mm in diameter; varying in colour from pale yellow through reddish brown to dark brown depending on the cultivar, most cultivars are annuals, few are perennials; cultivated, most weedy sorghum are non-rhizomatous, culms nodes are either glabrous or shortly tomentose; inflorescence contracted, branches of the inflorescence alternate.

Herbarium specimen number
Ghana: EAC 123
Togo: TOGO11487

Habitat and geographical distribution
S. bicolor is an African crop, which is widely distributed throughout the world. Different cultivars are found in different regions depending on the climate. It is adapted to a wider range of ecological conditions and is mostly a plant of hot, dry regions; still survives in cool weather as well as waterlogged habitats.

Plant material of interest
Leaf

Other parts used
Stem and seed

Definition of the plant material of interest
Guinea corn consists of the dry leaf of *Sorghum bicolor* (L.) Moench (Poaceae).

Ethnomedical uses
Reported to be antiabortive, cyanogenetic, demulcent, diuretic, emollient, intoxicant, and poison, sorghum is a folk remedy for cancer, epilepsy and stomachache (Duke and Wain, 1981). While the root is used for malaria in Zimbabwe, the seed is indicated for breast disorders and diarrheoa and the stem for tubercular swellings. In India, the plant is considered anthelminthic and insecticidal, and in South Africa, in combination with *Erigeron canadense* L., it is used for eczema. In China, where the seeds are used to make alcohol, the seed husk is braised in brown sugar with a little water and applied to the chest of measles patients. The seeds are considered beneficial in fluxes (Perry, 1980). The leaf decoction is used to treat measles (Morton (1981), while a powdered mixture of the seeds and the calabash tree (*Cresentia*) is a treatment for lung ailments. In Venezuela, the seeds are toasted and pulverized for diarrhoea and in Brazil the seed decoction is used for bronchitis, cough and other chest ailments. Hot oil packs of the seeds are applied to the back of patients with pulmonary congestion. Grieve (1984), recommends that a decoction of about 50 g seed be boiled in a liter of water to about 1/2 liter for the treatment of kidney and urinary disorders.

Biological and pharmacological activities

Aqueous stem bark extracts of *S. bicolor* at doses of 200, 400 and 800 mg/kg body weight showed anti-anaemic properties in iron deficient weaning rats (Oladiji *et al*., 2007). Antioxidant activity of the methanolic extracts has been demonstrated *in vitro* (Hegde and Chandra 2005). A peptide isolated from the plant strongly inhibited the replication of *Herpes simplex* virus type 1 (HSV-1) in a dose-dependent manner. The peptide also had an *in vitro* prophylactic effect against HSV-1 infection (Filho *et al*., 2008). The decoction of the plant exhibited membrane stabilizing activity *in vitro* and could therefore help to stabilize red blood cells from stress injury (Falade *et al.,* 2005). Cho *et al.,* (2000) observed that feeding rats with whole sorghum, proso millet or buckwheat caused increased faecal bile acid excretion and HDL cholesterol levels without a change in total cholesterol. However it was found that both high-tannin and non-tannin sorghums as well as wheat bran increased blood serum total cholesterol in rats. Lee and Pan (2003) have also shown that dietary tannin-sorghum distillery residues had antioxidant activity by their ability to inhibit haemoglobin-catalyzed oxidation of linoleic acid and significantly improve blood-thinning and erythrocyte membrane integrity of the fish blood cells during winter. There have been several reports on reduced weight gain of animals fed high tannin sorghum (Cousins *et al.,* 1981; Lizardo *et al*., 1995; Al-Mamary *et al*., 2001; Muriu *et al*., 2002). *In vitro* studies have also revealed anti-carcinogenic properties of sorghum. Grimmer *et al*., (1992) demonstrated anti-mutagenicity of sorghum polyphenol extracts.

Clinical data

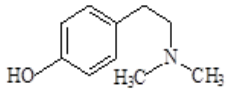
No information available

Chemical constituents

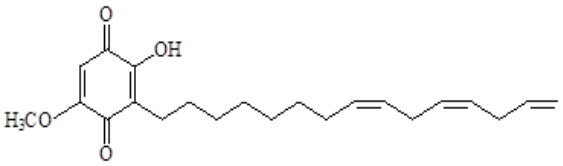
Alkaloids (hordenine), saponins, phytates, phenols, tannins, hydrocyanic acid, quinone, sorgoleone, dihydrosorgoleone, fibre; proteins; carbohydrates; saturated and unsaturated fatty acids (Mehmood *et al.,* 2008; Oladiji *et al.,* 2007; Hegde and Chandra, 2005; Morton, 1981; Barbosa *et al*., 2001).

Tests for identity and purity

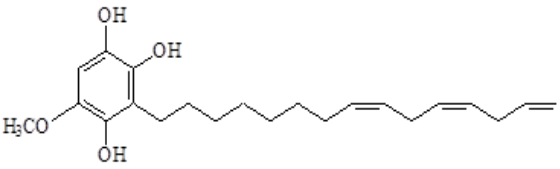
Moisture content: not more than 7.20%
Total ash: 9.33%
Wate-soluble extractive: not less than 11.33%
Alcohol-soluble (70%) extractive: not less than 9.21%



Hordenine



Sorgoleone

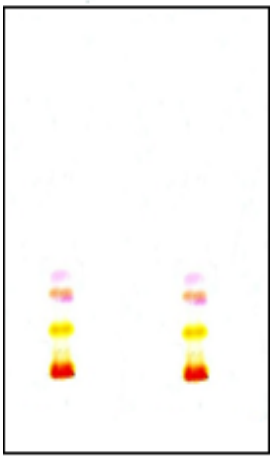


Dihydrosorgoleone

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of two characteristic spots with R_fs 0.28 (orange) and 0.18 (yellow).


Chromatogram

Macroscopy

leaves are broad and coarse, similar in shape to those of corn but shorter and wider; blades glabrous and waxy and have overlapping margins.just above the lower epidermis.

Microscopy
Typical graminaceous wavy epidermal cells interspersed with numerous isocytic stomata on both surfaces. Presence of few long unicellular covering trichomes. The midrib showed the presence of thick walled collenchyma cells below the upper epidermis with numerous vascular bundles lined on them.

Powdered plant material
Acicular calcium oxalate crystals with wavy epidermal cells interspersed with numerous stomata. There are few isolated unicellular trichomes and stone cells. Lignified cells are present.

Therapeutic actions
Anti-oxidant, antianaemic, anticholesterolemic, anticarcinogenic, antiobesity, anticoagulant and aniviral

Therapeutic indications
Anaemia, viral infections, bronchitis, cough, kidney and urinary disorders

Safety data
The LD_{50} of the aqueous extract of the aerial parts (*p.o*) was found to be > 3000 mg/kg in rats; there was no evidence of increase in organ weight but decrease in relative organ weights were observed at the highest dose tested (3000 mg/kg). Liver and kidney functions were not affected by the treatment but high levels of bilirubin were seen in the 14-day subacute study.

Precautions for use
Caution should be taken in infant patients

Adverse effects
Overdosage may lead to respiratory disorders

Contraindications
Patients with respiratory difficulties

Dosage and dosage forms
Infusions; fluid extracts, tincture
Infusion: about 25 g per day
Fluid extract: about 25 ml daily
Tincture: 1:5, 90% alcohol 0.3-1.2 ml, max 25 ml per week

Storage
Store in a cool dry place

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Spathodea campanulata

Botanical name
Spathodea campanulata P. Beauv.

Family
Bignoniaceae

Synonyms
Spathodea tulipifera (Thom.) G. Don., *S. danckelmaniana* Büttn, *S. nilotica* Seeman, *Bignonia tulipifera* Thom.

Common names
English: African tulip tree, Flame tree, Fountain tree, Uganda flame, Nile flame, Nandi flame
French: Tulipier d'Africain, Arbre flamme, Bâton de sorcier

Vernacular names
Burkina Faso: Fulfuldé – Djapelede;kafavano
Ghana: Akan – Akuakuoninsuo
Nigeria: Bokyi – Kenshie
Senegal: Balanta – Blalo
Togo: Ewe – Adatsigo, Fon – Dudu, Ouatchi – Adassigolo

Description of the plant
Dioecious tree reaching about 35 m tall; often in the form of bush savanna, shallow-rooted; fluted, measuring about 60 cm in diameter, bark grey, pale brown and smooth, becoming dark grey with age, rough and scaly at the base of the barrel; leaves opposite or in whorls of 3, odd-pinnate, stipules absent; inflorescence in terminal raceme, bisexual flowers; fruit narrowly ellipsoid, measuring from 15 to 27 cm long, dehiscent by 2 valves.

Herbarium specimen number
Ghana: GC 1012
Togo: TOGO02454

Habitat and geographical distribution
Spathodea campanulata is a medium-sized, spontaneous plant that grows commonly in several African countries such as Ghana, Nigeria, Gabon, Cameroon, Guinea, Angola, Congo, Sudan, Uganda and Senegal. It occurs in deciduous forests, woodlands and savanna forest edges and commonly grown as a street tree (Ofori-Kwakye *et al*., 2009).

Plant material of interest
Stem bark

Other parts used
Leaf

Definition of plant material of interest
African tulip consists of the fresh or dried stem bark of *Spathodea campanulata* P. Beauv. (Bignoniaceae).

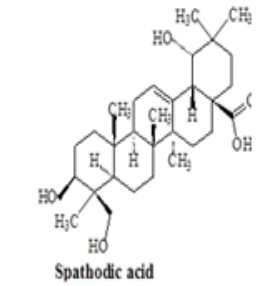
Ethnomedical uses
Various parts of *S. campanulata* are used in African traditional medicine for the treatment of a variety of diseases, including dysentery, gastritis, ulcers, pelvic pain in women, headache, oedema, dermatitis, guinea worm. The stem bark is applied as a paste to treat wounds (Mensah *et al*., 2003). The macerated leaf is used against urethritis and as an antidote for poison. The bark decoction is used for kidney problems, swelling and skin complaints (Irvin, 1961) and the stem bark is used as an enema in diabetes (Niyonzima, 1997). The macerated bark of the trunk is a remedy for infectious diseases including sexually transmitted infections (Magassouba *et al*., 2007). In Ghana, the plant is used for the treatment of dyspepsia, peptic ulcer, arthritis, fracture, toothache, stomach ache and stomach ulcer (Agbovie *et al*., 2002).

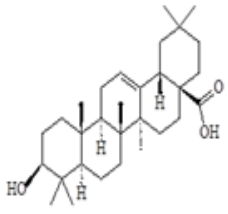
Biological and Pharmacological activities
A bioactivity-guided fractionation led to the isolation of mainly polysaccharides that have shown strong and reproducible hypoglycaemic activity (Niyonzima *et al*., 1999; Niyonzima, 1997). The methanol extract of the stem bark showed antimicrobial, antifungal (*Trichophyton sp*), antioxidant effects *in vitro* (Mensah *et al*., 2003; 2006) and wound healing properties *in vivo* (Sy *et al*., 2005). The cerebrosides significantly inhibited the growth of many Gram-positive and Gram-negative bacteria (Mboso *et al*., 2008). The plant is known to be active *against Pseudomonas solanecearum* (Amusan

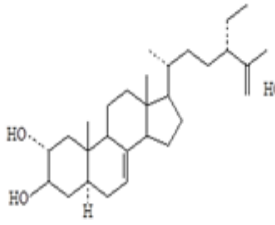
et al., 1994). The antimalarial activity of stem bark extract on mice infected *with Plasmodium berghei berghei* has been reported (Makinde *et al*., 1988). The leaf extract has been shown to possess analgesic effects. Ofori-Kwakye *et al*, (2009) reported the antimicrobial activity of the stem bark extracts against four strains of bacteria and a yeast, *Candida albicans*. *S. campanulata*, and *Hoslundia opposita* and *Pycnanthus angolensis*, which are commonly used by traditional medicine practitioners in Ghana for wound healing in case of stomach ulcers, demonstrated strong antiadhesive activity against *Helicobacter pylori* (Agyare *et al*., 2009).

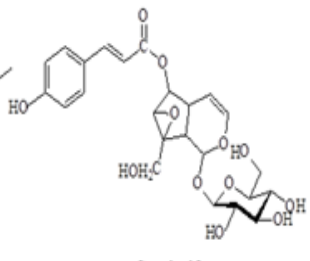
Clinical data
No information available

Chemical constituents
Ferulic acid, vanillic acid; verminoside (6-O-caffeoyl-catalpol: iridoid glycoside), atranorin, stachyose(O-α-D-galactopyranosyl-(1-6)-O-α-D-galactopyranosyl-(1-6)-O-α-D-glucopyranosyl-(1-2)-β-D-fructofuranoside; spathoside, (new cerebroside), spathodea acid; triterpenes: 3β,19α,24-trihydroxyolean -12-ene-28-oic acid), oleanolic acid, 3β-acetoxy-oleanolic acid, β-sitosterol-3-O-β-d-glucopyranoside; quercetin, caffeic acid; siaresinolique acid, 3β-acetoxy-oleanolic acid, β-sitosterol-3-O-β-d-glucopyranoside, β-sitosterol, spathodol (sterol hydroxylated); cyanidin-3-O-rutinoside, pelargonidin-3-O-rutinoside; pomolic acid, p-hydroxybenzoic acid esters and phenylethanol; octacosanol and triacontanol (Gorman *et al*., 2004; Niyonzima, 1997; Mbosso *et al*., 2008; Silvere *et al*., 1990).


Spathodic acid

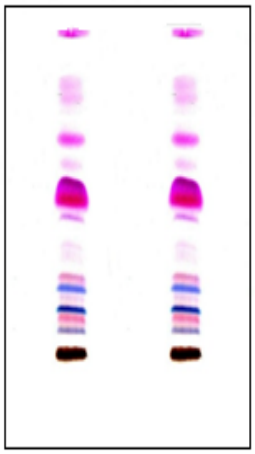

Oleanolic acid


Spathodol


Specioside

Tests for identity and quality
Moisture content: not more than 9.09%
Total ash: 6.95%
Water-soluble extractive: not less than 24.63%.
Alcohol-soluble (70%) extractive: not less than 17.89%

Chromatographic fingerprints
Chloroform extract
Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of six characteristic spots with R_fs 0.66 (pink), 0.52 (pink), 0.47 (pink), 0.32 (blue), 0.25 (blue) and 0.13 (blue).


Chromatogram

Macroscopy
Leaf is compound with a long petiole; lamina 10-15 cm long, 6-8 cm broad; elliptic to oblong in shape; margin entire; apex acuminate, leaf base slightly cuneate and venation reticulate, leaf surface is glabrous, texture is papery with a prominent midrib.

Microscopy
Epidermal strips on both surfaces possess wavy to undulating anticlinal walls and many oil globules; different types of trichomes present on both surfaces; numerous unicellular non-glandular, multicellular non-glandular as well as multicellular glandular trichomes on the adaxial surface; short multicellular non-glandular trichomes on the abaxial; anisocytic stomata on both surfaces (i.e. leaf is amphistomatic), but numerous on the abaxial surface; transverse

section of the leaf is isobilateral, single-layered epidermis on both sides with thick cuticle, epidermal cells are cuboid-rectangular in shape, mesophyll undifferentiated; spongy cells disjointed, mid-rib region has prominent convex protrusion on the dorsal surface; internally bearing bundles of lignified spiral xylem vessels, multicellular trichomes with swollen basal cells present at the protuberances of the mid-rib, 7 vascular bundles collaterally arranged with phloem, alternately arranged at the base of 3-5 celled xylem; central pith bears large collenchymatous cells.

Powdered plant material
Parenchymatous cells with many oil globules; different types of trichomes, numerous unicellular non-glandular, multicellular non-glandular as well as multicellular glandular trichomes, short multicellular non-glandular trichomes; anisocytic stomata, epidermal cells, lignified spiral xylem vessels.

Therapeutic actions
Anti-inflammatory, anti-HIV (Niyonzima *et al*., 1999), antidiabetes (Niyonzima, 1997), anti-malarial (Makinde *et al*., 1988), vulnerary, antioxidant and antimicrobial (Ofori-Kwakye *et al*, 2009; Mensah *et al*., 2003; 2006).

Therapeutic indications
Inflammation, HIV, diabetes, malaria, bacterial infections, wounds.

Safety data
The LD_{50} of the aqueous extract of the stem bark (*p.o*) was found to be > 3000 mg/kg in rats. In subacute studies (300-3000 mg/kg), no significant changes in body weight or relative organ weight were seen. Total WBC number increased but neutrophil numbers reduced at the highest dose tested (3000 mg/kg). At 3000 mg/kg, there were increases in total protein, globulin, GGT and creatinine.

Precautions for use
No special precautions required within the recommended dose of the aqueous extract.

Adverse effects
No adverse effects reported

Contraindications
Pregnancy and lactation

Dosage and dosage forms
Infusions; decoction; tincture
Infusion: about 25 g per day
Tincture: 1:5, 90% alcohol 0.3-1.2 ml, max 25 ml per week

Storage
Store in a cool dry place

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Spermacoce verticillata

Botanical name
Spermacoce verticillata L.

Family
Rubiaceae

Synonyms
Borreria verticillata (L) G.F.W Mey, *Spercacoce globosa* Schum. & Thonn

Common names
Buttonweeds, African borreria (English); Borreria verte, Borrerie verticillée (French)

Vernacular names
Burkina Faso: Fulfuldé – Gurdudal
Mali: Bambara – Missini Koumbere, Peuhl – Samtarde
Nigeria: Yoruba – Irawo-Ile
Senegal: Wolof – Ndatukan, Bu Gôr; Serer – Murah, Faduala, Diola – Karibun, Eribun

Description of the plant
Bushy sub-shrub, perennial, 1 metre high, branched; slightly clayey, hairless stems with stipular sheaths that are smooth or rough; leaves glabrous, oblanceolate up to 4 cm by 7 mm with lateral veins, not very prominent; inflorescence, spherical, compact, terminal and axillary, 10 to 15 mm in diameter, usually with two leafy bracts about 1 cm long, curved downwards; small white flowers; fruit is a drupe, dry, dehiscent.

Herbarium specimen number
Ghana: GC 53415
Mali: 2515 (DMT)

Habitat and geographical distribution
The plant is distributed extensively across the Sudano-Guinean region and part of the Sahel, particularly along the West African coast and along the coast of South America and Madagascar.

Plant material of interest
Leaf, root, aerial parts

Definition of plant material of interest
African borreria consists of fresh or dried aerial parts of *Spermacoce verticillata* L. (Rubiaceae).

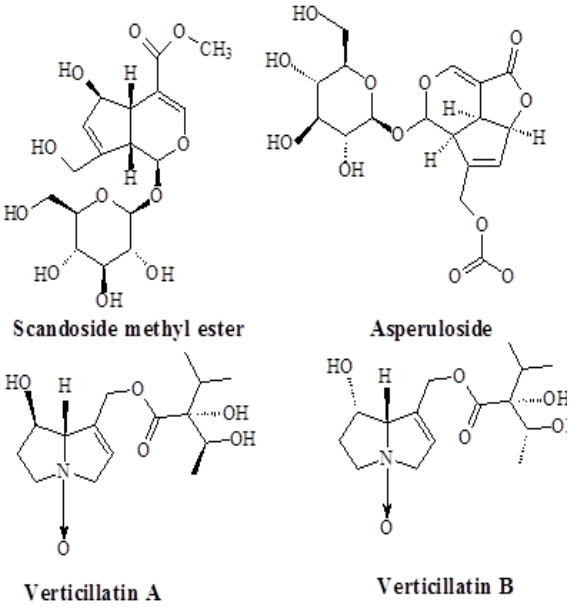
Ethnomedical uses
Borreria verticillata is traditionally used to treat leprosy, boils, syphilis, gonorrhoea, paronychia and schistosomiasis. The root is used as a diuretic and laxative. Leaves and roots are used against vaginal discharge, impotence, and

haemorrhoids (Paulino de Albuquerque *et al*., 2007). The plant is used to treat inflammation (Gazzaneo *et al*., 2005) and as an insecticide (Rohrig *et al*., 2008). The decoction of the bark is administered orally to treat infectious diseases including sexually transmitted infections (Magassouba *et al*., 2007).

Biological and pharmacological activities
Borreverine, an alkaloid extracted from *B. verticillata*, has an antimicrobial activity *in vitro*. The minimum inhibitory concentration was less than 50 µ/ml for Gram-positive cocci (especially *Staphylococcus aureus*) and 6 mg/ml for *Vibrio cholerae* and greater than 200 µ/ml for several Gram-negative strains (Maynart *et al*., 1980). The methanol extract of the root is active against multidrug-resistant *Pseudomonas aeruginosa* strains (De Sa Peixoto Neto *et al*., 2002). Alkaloids isolated from the plant showed antibacterial activities (Pieters and Vlietinck, 2005).

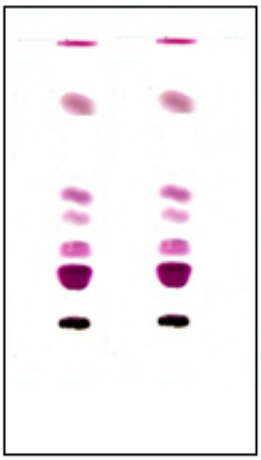
Clinical data
No information available

Chemical constituents
Essential oil (sesquiterpene hydrocarbons, sesquiterpene lactones, phenolic compounds and aromatic polycarboxylic acids); azulene alkaloids (borrérine and borrévérine) iridoids and iridosides (daphylloside 1, 2 asperuloside, feretoside 3, 4 methyl desacetylasperulosidate, aspéruloside, férétoside, daphyloside and asperulosidic acid acid 7) [Sainty *et al*., 1981; African Pharmcopoeia, 1985].



Tests for identity and purity
Moisture content: not more than 7.12%
Total ash: 4.06%
Water-soluble extractive: not more than 10.48%
Alcohol-soluble (70%) extractive: 11.06%

Chromatographic fingerprints
Chloroform extract
Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of six characteristic spots with R_fs 0.89 (pink), 0.79 (purple), 0.45 (pink), 0.38 (pink), 0.27 (pink) and 0.18 (purple).



Chromatogram

Macroscopy
The leaf is oblanceolate in shape with a smooth texture, glabrous surface and green when fresh. The leaf measures 10-50mm in length and 3-10mm in width. Margin is entire, apex acuminate to acute while venation is pinnate- reticulate. The stem is obscurely angled. Odour is characteristic and colour brownish when dried, with a characteristic taste.

Microscopy
The leaf has nearly-straight to straight upper epidermal cells measuring 31.9-116.0 microns by 17.4-52.2 microns; the lower epidermal cells are wavy, measuring 38.2-133.4 microns long by 20.3-63.8 microns wide. Calcium oxalate crystals and trichomes are absent while stomata of rubiaceous type are present on both surfaces with greater abundance on the lower surface. The mesophyll consists of a row of palisade on the upper epidermis only. Special features include oil globules, small, spherical and numerous throughout the mesophyll.

Powdered plant material
Brownish in colour with characteristic odour, containing fragments of wood from the stem and root; also fragments of leaf lamina with rubiaceous stomata, remains of vascular bundles, parenchyma cells; while calcium oxalate crystals and trichomes are absent.

Therapeutic actions
Antibacterial; antibiotic, antieczema, antiseptic, antischistosomiasis, anti-inflammatory and insecticidal (Gazzaneo *et al*., 2005; Rohrig *et al*., 2008; Pieters and Vlietinck, 2005).

Therapeutic indications
Intestinal infections, leprosy, boils, constipation, schistosomiasis, inflammations, wounds, skin infections, eczema.

Safety data
24-hour acute studies in mice (*p.o*) showed that, the LD_{50} of the aqueous extract of the aerial parts of the plant is >2000 mg/kg. In the subacute studies, no clinical signs of toxicity were observed after oral administration of the extract at 500 – 2000 mg/kg; *p.o* to male and female mice for 14 days.

Precautions for use
The plant must be administered orally with caution.

Adverse effects
Overdosage may cause gastrointestinal disorders

Contraindications
Contraindicated on a reactive and allergic skin, skin sensitivity to its alkaloids

Dosage and dosage forms
Internally: tea, essential oil, capsules,
Externally: usually as a topical skin application; lotions, tinctures, ointments, pastes.
Decoction: 30 g plant material in 900 ml water; simmer until reduced to 600 ml; 1 tablespoonful two times daily.

Storage
Store in a cool dry place

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Spondias mombin

Botanical name
Spondias mombin L.

Family
Anacardiaceae

Synonyms
Spondias aurantiaca Schum & Thonn, *Spondias brasiliensis* Mart, *Spondias lucida* Salisd., *Spondias lutea* T, *Spondias myrobalanus* L, *Spondias oghibee* G. Don, *Spondias pseudomyrobalanus* L.Tuss, *Mauria juglandifolia* Benth, *Myrobalanus lutea* Maef

Common names
English: Hog plum (English), Mombin, Prune mombin ou Prune Myrobolan (French)

Vernacular names
Burkina Faso: Dioula – Mingo; Minkon, Fulfuldé – Talé;tali
Cote d'Ivoire: Abe – Ngba
Ghana: Twi – Atoaa
Mali: Barbara – Minko Mingo Ninkom, Peul – Talé tali, Dogon – Enye Vevey
Nigeria: Yoruba – Agliko
Senegal: Wolof – Sob ninkôm, Serer – Yoga, Diola – Bu lila Bu lilu
Togo: Ewe – Akoukonti, Adja – Kukon, Adele – Inyanya

Description of the plant
A tree that grows from 15 to 25 m high with a clear bark, streaked, cracked, rough and thick; bark is usually covered with large spines and exudes resin upon injury; drum thickened at the base, reaching about 0.75 m in diameter; branches are flared and the foliage is full and balanced; leaves are compound, odd-pinnate, measuring 50 cm long with 5-8 pairs of leaflets 7 cm long and 3.5 cm wide, unequal at the base shortly acuminate, short rib at the edge of the lamina uniting the lateral veins; small white flowers, fragrant with large terminal panicles appearing during the dry season defoliation; inflorescences are arranged in terminal panicles, pyramidal, 20 to 40 cm long, covered with short hairs mainly; fruit is a sweet astringent plum; pulpit more or less acidic and pleasant, have ovoid drupes from 2.5 to 4 cm long and 2 to 2.5 cm wide.

Herbarium specimen number
Mali: 0279 DMT
Togo:TOGO01851

Habitat and geographical distribution
The plant is native to the tropical Americas, including the West Indies, but has been naturalized in parts of Africa, India and Indonesia. It is rarely cultivated. It grows well in warm climates and in a wide variety of soils: sandy soil over shallow gravel or in a heavy clayey soil.

Plant material of interest
Stem bark and leaf

Other parts used
Root, flower, fruit

Definition of plant material of interest
Hog plum consists of the stem bark or leaf of *Spondias mombin* L. (Anacardiaceae)

Ethnomedical uses
In Mali, the plant is used to treat tooth decay; it is also used as a diuretic, laxative and purgative and febrifuge (Adjanohoun *et al.*, 1979). The leaf extracts have potent antimicrobial and antifungal properties. The juice obtained by expression of the fresh leaves is commonly used in Senegal for the treatment of eye diseases, while the leaf or root bud decoction is prescribed for diarrhoea and dysentery or macerated for colic pain (Kerharo and Adam, 1974). The decoction of the leaves with added salt has diuretic and laxative properties (Adjanohoun *et al*, 1979). The leaf decoction is also a remedy for caries, dental abscesses, colic, various eye diseases and toothache (Boullard, 2001). The bark infusion is

used as a mouthwash against toothache and as an anthelmintic; the decoction of the bark is used in cough with severe inflammatory symptoms, and vomiting. The dried bark is used as a spray on fresh wounds of circumcision and the stem bark is used as a tea for pregnant women (Boullard, 2001).

Biological and pharmacological activities

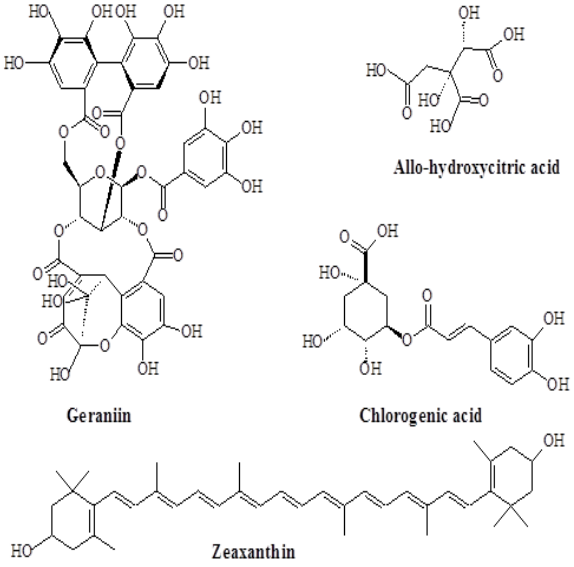
The leaf extract of *S. mombin* exhibited wide spectrum antibacterial effects comparable to those of ampicillin and gentamycin (Abo *et al*., 1999). Cold water, hot water and ethanolic extracts of the plant did not inhibit cariogenic streptococci isolated from dental caries patients (Amadi *et al*., 2007). Caffeoyl esters and ellagitannins present in the plant exhibited pronounced antiviral activity against Coxsackie and *Herpes simplex* viruses (Corthout *et al*., 1991; 1992). A series of 6-alkenylsalicylic acids isolated from the ethanolic extract of leaves and stems of *S. Mombin* were shown to have a pronounced antibacterial effect against *Bacillus cereus*, *Streptococcus pyogenes*, and *Mycobacterium fortuitum* and a molluscicidal effect against the snail *Biophalaria glabrata*, an intermediate host in the schistosome life cycle (Corthout *et al*., 1994). A phytotherapeutic gel comprising of a hydroalcoholic extract of *S. mombin* together with chitosan demonstrated antiviral activity against *Herpes simplex*. Oral administration of a single dose of pectins obtained from the plant caused significant decrease in blood sugar levels in alloxan-induced diabetic rats (El Fiki, 2000). The aqueous, methanol and ethanol extracts possess anxiolytic effect mediated by GABAergic transmission as well as sedative and antidopaminergic effects (Ayoka *et al*., 2005; 2006). Aqueous leaf, stem bark and root bark extracts demonstrated anthelmintic activity (Ademola *et al*., 2005; Gbolade and Adeyemi, 2008). Extracts of the plant showed antiplasmodial activity on standard chloroquine-resistant strains of *Plasmodium falciparum* (Diallo *et al*., 2007).

Clinical data

No information available

Chemical constituents

Tannins, palmitic, linoleic, oleic, stearic, linolenic acids, flavonoids (quercetin, quercetrin, rutin, and their 7-O-glucosides); saponin, sugars; alkaloids, proanthocyanins (condensed tannins) (Moronkola *et al*., 2003; Apori *et al*., 1998; El Fiki, 2000; Edeoga and Eriata, 2001).



Tests for identity and purity

Moisture content: not more than 6.65%
Total ash: 20.00 %
Sulphated ash: 16.88 %
Water-soluble extractive: not less than 11.87%
Alcohol-soluble (70%) extractive: not less than 11.01%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of five characteristicspots with R_fs 0.95 (brown), 0.91 (brown), 0.50 (green), 0.38 (pink) and 0.27 (purple).

Chromatogram

Macroscopy
Colour green with a sweet smell and bitter taste; leaf compound, shortly petiolate; lamina 5-10 cm long, 2-5 cm broad; oblong or oblong-lanceolate in shape; margin shallowly serrate; apex obtuse or broadly acuminate, leaf base oblique,venation reticulate, leaf surface glabrous, texture fleshy with a prominent midrib.

Microscopy
Adaxial epidermal surface, straight anticlinal walls and many heads of trichomes; trichomes simple with conical heads; abaxial surface has slightly undulating walls and long multicellular trichomes which are sometimes branched; anisocytic stomata present; transverse section of leaf dorsiventral, compactly arranged epidermal cells,single layered on both sides covered with thin cuticle; mesophyll differentiated into palisade and spongy parenchyma; upper epidermis followed by 1-2 layers of palisade parenchyma, spongy parenchyma 3-4 cell layers with a group of sclerenchymatous cells at the middle; mid-rib as an ovoid protrusion on both ventral and dorsal sides bearing short simple trichomes; vascular bundle centripetal i.e. xylem (3-5 celled) surrounds the phloem; calcium oxalate crystals scattered over the vascular bundle.

Powdered plant material
Epidermal parechymatous cells have straight anticlinal walls, trichomes, simple with conical heads; multicellular, sometimes branched; anisocytic stomata, a few palisade parenchyma; sclerenchymatous cells, vascular bundle vessel members; calcium oxalate crystals scattered

Therapeutic actions
Broad spectrum antiseptic and antibacterial, abortifacient, anthelmintic, anticarcinogenic, anticonvulsant, antidopaminergic, antifungal, antioxidant, antispasmodic, antiviral, anxiolytic, cytotoxic, smooth muscle relaxant, haemostatic, sedative, uterine stimulant, nervine.

Therapeutic indications
Intestinal worms and parasites, menstrual disorders (pain, cramps and irregularity), vaginal infections and yeast infections.

Safety data
The LD_{50} of the aqueous stem bark extract (*p.o*) in mice was >2000 mg/kg in 24 hours. No clinical signs of toxicity were observed after treatment of male and female mice (500 to 2000 mg/kg; p.o) for 14 days. In a sub-chronic toxicity study, repeated administration of aqueous stem bark extract (*p.o*) at 100, 200 and 1000 mg/kg for 45 days did not cause significant change in body weight or relative weight of target organs (liver, spleen and kidneys). The aqueous extract did not affect haemoglobin levels (no anaemia). The extract, however, caused some hypoglycaemia at the doses tested. Transaminases were affected especially with the high dose of 1000 mg/kg, although this increase did not correspond to histological changes; histological features were normal. Creatinine remained normal, but uric acid levels increased at the dose of 1000 mg/kg compared to the control group. The aqueous, methanol and ethanol extracts of the leaves administered orally were not toxic to mice up to a dose of 5 g/kg. On intraperitoneal injection, the LD_{50} values [mice/rats] were calculated to be (480 – 620 mg/kg) for ethanol extract; (1080-1100 mg/kg) for methanol extract and (1360–1420 mg/kg) for aqueous extract respectively (Ayoka *et al*., 2005). The aqueous ethanolic leaf extract of *S. mombin* is non-toxic and has significant anticonceptive activity (Uchendu and Isek, 2008)

Precautions for use
Should not be used at high doses. Regularl monitor of blood glucose, hepatic and renal biochemical parameters on prolonged use at low doses. Should not be combined with other hypoglycaemic drugs except under medical supervision.

Adverse effects
Fruit is acidic and renders the teeth and tongue sharply sour

Contraindications
Pregnancy and gastric ulceration

Dosage and dosage forms
Infusions; decoction; tincture
Infusion: about 25 g per day
Tincture: 1:5, 90% alcohol 0.3-1.2 ml, max 25 ml per week

Storage
Store in a cool dry place

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Tetrapleura tetraptera

Botanical name
Tetrapleura tetraptera (Schum & Thonn.)

Family
Mimosaceae

Synonyms
Adenanthera tetraptera Schum. & Thonn., Tetrapleura thornningii Benth

Common name
Tetrapleura pod, Tétrapleura à 4 ailes (French).

Vernacular names
Ghana: Akan – Prekese
Nigeria: Yuroba – Aridan, Hausa – Kalangun daji, Igbo – Shosho

Description of the plant
A medium sized perennial, deciduous forest tree about 20 m tall and 3 m girth, with fern-like foliage, dark green leaves, usually devoid of buttresses, slender crown, leaves composite-bipinnate, about 5-10 pairs of alternate leaflets: oblong-elliptic, sub-sessile, pubescent at lower side; bark smooth, greyish, very thin, slash reddish and strong smelling, practically glabrous or minutely hairy twigs and young foliage with common stalk 15–30 cm long, slightly channelled on the upper surface, 6–12 leaflets on each side of pinna-stalk always alternate, leaflets glabrous with slender stalks about 0.25 cm long, lateral veins indistinct, running at a wide angle to the prominent midrib; inflorescence in axiliary spike; flowers are creamy or pink, turning orange, densely crowded in spike-like racemes 5–20 cm long, usually in pairs in the upper leaf axils, individual flowers with slender stalks and about 20 short stamens; fruits, persistent, hanging at the end of branches on stout stalks, 15– 25 cm long, about 5 cm across the winged ribs of the pods which are dark, reddish-brown or dark purple-brown to black in colour when ripe but greenish when unripe, glabrous and glossy, usually curved and about 15 cm long. Two of the wings are hard and woody and the other two filled with a soft pulp; seeds are hard, black, flat oval, about 0.75 cm long, embedded in the body of the pod, which does not split, black-shelled but bright-green inside containing oil (Burkill, 1995; Adjanahoun *et al.,* 1991).

Herbarium specimen number
Ghana: GC 1274
Nigeria: FHI107427
Togo: TOGO04983

Habitat and geographical distribution
T. tetraptera is common on the fringe of the West African rainforest belt, especially secondary forest. The species is found throughout the high forest zone, in the southern savanna-woodland particularly in Benin, Burkina Faso, Cambodia, Cameroon, Chad, Cote d'Ivoire, Gambia, Ghana, Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo and Uganda (Burkill, 1995).

Plant material of interest
Fruit

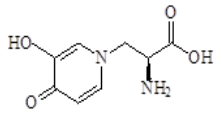
Other parts used
Stem bark

Definition of plant material of interest
Tetrapleura pod consists of the dried fruit of *Tetrapleura tetraptera* (Schum & Thonn) Taub. (Mimosaceae).

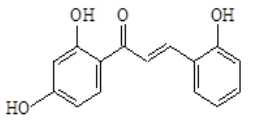
Ethnomedical uses
The plant is claimed to be therapeutically useful in the management of convulsion, leprosy oedema, rheumatic pains, asthma, female sterility and inflammation. Bark decoction is used for cough, bronchitis, menstrual pains and arthritis while the root decoction is used for jaundice. Aqueous extract of the pod is used as anticonvulsant whilst its paste is used to treat rheumatism. The intense odour on roasting is claimed to have insect- and snake-repellent properties (Gill, 1992). In some parts of West Africa, the fruit serves as a a spice or as a source of multivitamins. In eastern parts of Nigeria, fruits are used to prepare soups for mothers from the first day of delivery to prevent postpartum contraction.

Biological and pharmacological activities

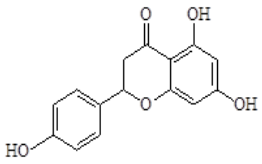
Saponins from *T. tetraptera* are among the most powerful natural molluscicides (Maillard *et al.,* 1989; Adewunmi *et al.,* 1982). Methanolic extracts of the leaf, leaf stalk, stem-bark, root-bark and fruit possess molluscicidal activity (Adewunmi, 1999; Ngazzapa *et al*., 1989) against a variety of freshwater snails including *Bulinus globosus, Lymnaea natalensis, L. columella*, and *Physa waterlotti* (Adewunmi and Marquis, 1981; Adewunmi *et al*., 1982; Adewunmi *et al*., 1989). Aqueous extract of the plant is also effective against *Bulinus globosus* (Adewunmi and Marquis, 1987). Application of the aqueous extract to a snail-infested site reduced field snail population and kept the transmission sites free from schistosome cercariae production for about 28 days (Adewunmi, 1984; Adewunmi and Furu, 1989). Studies have shown that planting of *T. tetraptera* along water courses has potential for the local control of schistosomiasis (Adewunmi, 1991). The triterpenoid saponin aridanin is thought to be responsible for the molluscicidal activity of the fruit (Adesina and Reisch, 1985; Mailard *et al*., 1989). *T. tetraptera* extracts exhibited significant anti-ulcer (Noamesi *et al.,* 1992), anticonvulsant (Akah and Nwambie, 1993) and emulsifying properties. Alcoholic and aqueous extracts inhibited the growth of *Staphylococcus aureus* (Salako *et al*., 1990) and the ethanol extracts and saponins from the stem-bark exhibited an inhibitory effect on luteinizing hormone released by pituitary cells, indicating its potential as a contraceptive agent. The fruit shell, fruit pulp and seed have been shown to contain varying amounts of nutrients such as protein, lipids and minerals (Essien *et al*., 1994).



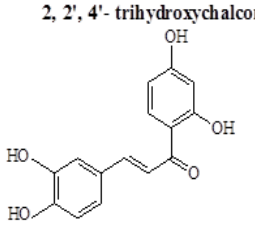
Mimosine



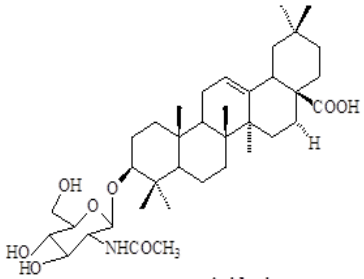
2, 2', 4'- trihydroxychalcone



4', 5, 7- trihydroxyflavanone



2', 3, 4, 4'- tetrahydroxychalcone



Aridanin

Clinical data

No information available

Chemical constituents

Aminopropionic acid derivatives; terpenoids (aridanin), alkaloids (mimosine), saponins, flavonoids, cinnamic acids, caffeic acid, tannins, terpenes, fixed oils, carbohydrates, and triglycoside (Adewunmi, 1999; Adesina and Reisch, 1985; Mailard *et al*., 1989; Ngazzapa *et al*., 1989).

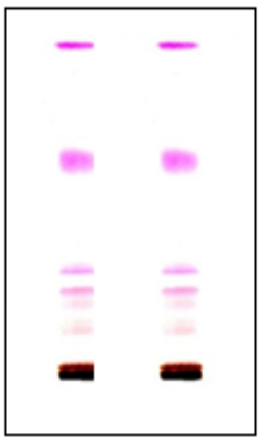
Tests for identity and purity

Moisture content: Not more than 24.10%
Total ash: Not more than 10.90%
Acid-insoluble ash: Not more than 7.51%
Water-soluble ash: Not less than 10.30%
Water-soluble extractive: Not less than 14.60%
Alcohol-soluble (70%) extractive: Not less than 13.60%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic pink spots with R_fs of 0.96, 0.64, 0.31 and 0.25.



Chromatogram

Macroscopy
Dark brown fruit with shiny rough surface; shape tetrahedral, 18–24 cm long, 5–6 cm wide; epicarp coriaceous with fleshy mesocarp and endocarp (Folorunso *et al*, 2005).

Microscopy
Transverse sections shows epicarp with uniseriate epidermal cells that are polygonal, angular and lamella collenchyma; thickened, lignified, sclerenchymatous cells, macrosclereids and osteosclereids, well thickened and lignified; chromoplasts and chloroplasts below the epicarp; mesocarp fibres well elongated; ergastic substances present; endocarp filled with polygonal parenchymatous cells and macrosclereids; longitudinal section shows epidermis; epicarp filled with macrosclereids and osteosclereids, angular and lamella collenchymas; parenchyma, polygonal with sandy crystals, starch grains and cactaceous crystals; collateral vascular bundles and polygonal parenchymatous cells in the endocarp (Folorunso *et al*., 2005).

Powdered plant material
Powder consists of parenchyma cells, elongated with largely oblique end walls; tangential collenchyma cells and elongated fibres are present; osteoscleireids, ergastic substances, trihydric calcium oxalate crystals, tannins and abundant sandy crystals (Folorunso *et al*., 2005).

Therapeutic actions
Molluscicidal, antihypertensive, anticonvulsant antiulcer, antidiabetic and antioxidant.

Therapeutic indications
Convulsion, hypertension, diabetes; ulcer; schistosomiasis

Safety data
The LD_{50} of the aqueous leaf extract (*p.o*) was found to be > 3000 mg/kg in rats.
In subacute studies (300-3000 mg/kg), no significant changes were observed in the body weight of the animals over the treatment period. There was significant reduction in the relative liver and lung weights of the treated animals. WBC and RBC numbers and the HB content also increased. No significant adverse effects were observed on the liver and kidney.

Precautions for use
No special precautions required within the recommended dose of the aqueous extract

Adverse effects
High doses may cause nausea and vomitting

Contraindications
Patients sensitive to its characteristic smell

Dosage and dosage forms
Infusions; decoction; tincture
Infusion: about 25 g per day
Decoction: 300 g of crushed fruit boiled with 900 ml until reduced to 600 ml; take two tablespoonfuls twice daily
Tincture: 1:5, 90% alcohol 0.3-1.2 ml, max 25 ml per week

Storage
In a cool, dry place, protected from moisture and light

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Tinospora bakis

Botanical name
Tinospora bakis (A. Rich) Miers

Family
Menispermaceae

Synonyms
Cocculus bakis A. Rich

Common names
Tinospora (English), Bakis (French)

Vernacular names
Burkina Faso: Mooré – Bésindé, Fulfuldé – Bakañi;bakañé
Ghana: Kusasi – Ba Ila
Nigeria: Igbo – Aga Oyi
Senegal: Wolof–Bakis, Sérère-Péis,Peuhl–Abolo

Description of the plant
Twining herbaceous or shrubby perennial reaching 10-15 m high; stems are vines, climbers, glabrous, topped with very large white lenticels; roots are tuberous; sap is translucent; leaves are simple and alternate, broadly ovate; base is strung; summit shortly acuminate; petiole is 2 to 8 cm long; flowers greenish-yellow, arranged in axillary racemes measuring 3 to 10 cm long; male flowers are small, with 9 cm long and 4 to 5 mm wide, rounded to three sepals borne on pedicels 3 to 5 mm; fruits are small berries greenish; oval, 1 cm long with a slight bulge at the base, apiculate at the summit, pedicels 8 to 10 mm.

Herbarium specimen number
Mali: 1787 DMT
Togo: TOGO04726

Habitat and geographical distribution
The plant is sparsely distributed on the banks of rivers in some parts of sub-Saharan Africa, and is frequently encountered in Senegal, Mali, Mauritania; Niger, Northern Nigeria, in eastern Sudan, Ethiopia and Angola.

Plant material of interest
Root/rhizome

Other parts used
None

Definition of plant material of interest
Tinospora consists of the root/rhizome of *Tinospora bakis* (A. Rich) Miers (Menispermaceae)

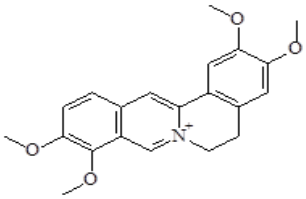
Ethnomedical uses
The plant is used orally for the treatment of jaundice, fever, severe malaria, menstrual disorders, schistosomiasis, dermatitis, and poor vision (Oyen, 2008; Kerharo and Adam, 1974).

Biological and pharmacological activities
Extracts of the root have shown significant choleretic as well as protective activity against acute and subacute carbon tetrachloride toxicity in rats (Fall *et al*., 2010; Thioune *et al*., 2002; Kamssouloum *et al*., 1988). Diallo *et al.,* (1997) demonstrated the hepatoprotective effect of the root extracts *in vitro;* the root extracts increased the secretion of bile at low doses, but caused some toxicity at high doses. The aqueous extracts and the total alkaloids, including palmatine, showed an antipyretic activity *in vivo* (Zafinindra *et al*., 2003) and moderate activity against a chloroquine resistant strain of *Plasmodium falciparum* (Ouattara *et al*., 2006). The root extracts have also shown *in vitro* immunmodulatory activity (Koko *et al*., 2008).

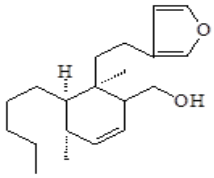
Clinical data
No information available

Chemical constituents
Alkaloids (palmatine, columbine); (Oyen, 2008); steroidal glycosides; saponins, tannins, coumarins; anthocyanins, carotenoids, fatty acids, polysaccharides and reducing sugars.

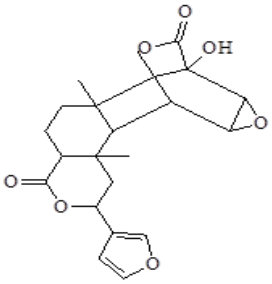
Tests for identity and purity
Moisture content: 9.59%
Total ash: 4.76%
Sulphated ash: 6.66%
Water-soluble extractive: 18.87 - 24.55%



Palmatine



Tinosporafuranol



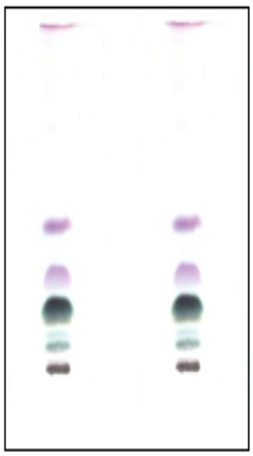
Tinosporide

Alcohol-soluble (70%) extractive: not less than 20.10%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of three characteristic spots with R_fs 0.48 (purple), 0.35 (purple) and 0.24 (blue-black).



Chromatography

Macroscopy

The roots are tuberous. Leaves with characteristic bitter taste and smell.

Microscopy

Presence of numerous starch grains, varying in size more or less rounded. Absence or very scanty microcrystals. Epidermal trichomes present on both surfaces of the leaf.

Powdered plant material

The powder of dried roots very thin, ivory-colored; bitter taste; numerous starch grains. Clothing trichomes embedded in epidermal cell with wavy walls. Parenchyma cell numerous; unlignified pitted vessels present.

Therapeutic actions

Antijaundice, hepatoprotective, antipyretic, antimalaria

Therapeutic indications

Jaundice, malaria, hepatitis, fever

Safety data

The LD_{50} of the aqueous extract of the rhizome (p.o) in mice was >2000 mg/kg in 24 hours. No clinical signs of toxicity were observed after treatment of male and female mice (500 to 2000 mg/kg; *p.o*) for 14 days. Toxicity tests on the total alkaloids showed that a dose of 5 mg/kg administered orally was not toxic to guinea pigs, while a dose of 100 mg/kg caused death in 20 minutes without convulsion (Oyen, 2008).

Precautions for use

Do not exceed recommended doses as high doses caused toxic effects

Adverse effects

The root decoction may induce vomiting and depression

Contraindications

Pregnancy

Dosage and dosage forms

Decoction, Bitters

200 gm of powdered plant material boiled with 1000 ml of water until reduced to 600 ml. Take two tablespoonfuls twice daily.

Storage

Store in a cool dry place away from light

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Vernonia amygdalina

Botanical name
Vernonia amigdalina Del

Family
Asteraceae

Synonyms
Vernonia senegalensis A Chev.

Common names
Bitter leaf

Vernacular names
Benin: Tem – Aloma
Ghana: Adangme – Agba, Akan – Bowin, Guanga Gonja – Saŋka
Guinea: Fula Pulaar – Bantara Burure, Manding Maninka – Kossa Fina.
Nigeria: Hausa – Chusar Doki, Igbo – Olugbu, Yoruba – Ewuro Jije.
Sierra Leone: Krio – Bita-Lif, Mende – Nje Nyani, Temne – A-Bita-Lif
Togo: Ewe – AVenya, Tem – Tusima

Description of the plant
A shrub or small tree, 2-5 m high with striated pubescent branches, becoming glabrous on maturity; leaves alternate, obovate-lanceolate, entire or finely toothed, finely pubescent beneath; florets in heads, 6 mm in diameter, in copious corymbose panicles, pappus white, sweet-scented.

Herbarium specimen number
Ghana: GC 52083
Nigeria: FH108988

Habitat and geographical distribution
It is found in the tropics, in homes and villages as fence posts, medicinal plant, pot-herb. It grows under a range of ecological zones in Africa and is drought tolerant (Bonsi *et al*., 1995).

Plant material of interest
Leaf

Other parts used
Twigs/young stem, root

Definition of the plant material of interest
Bitter leaf is the fresh or dried leaf of *Vernonia amygdalina* Del (Asteraceae)

Ethnomedical uses
The plant is used in several countries for the treatment of schistosomiasis, amoebic

dysentery, stomachache, malarial fever, cough and as a laxative (Huffman *et al.,* 1996; Dalziel, 1937). *V. amygdalina* is commonly called bitter leaf because of its bitter taste.

Biological and pharmacological activities
Leaf and root bark extracts showed antimalarial and antiplasmodial activity against drug-sensitive *Plasmodium berghei* in mice (Tona *et al*., 2004; Abosi and Raseroka, 2003). Some sesquiterpenes and steroidal constituents exhibited antiplasmodial activity *in vitro* (Phillipson *et al.,*1993); the sesquiterpene lactones, vernolide and vernodalol demonstrated significant bactericidal and antifungal activity (Erasto *et al.,* 2006). The leaf extracts containing luteolins showed antioxidant properties *in vitro* (Igile *et al.,* 1994) and ethanolic root extracts provided protection against pentylenetetrazole-induced lethality. The extracts also had antipyretic and analgesic effects (Okokon and Onah, 2004). Various extracts of *V. amygdalina* have been shown to possess antibacterial and anti-leishmanial, antimutagenic, antioxidant and anti-cancer effects (Erasto *et al.,* 2007; Izevbige, 2003; Iwalokun *et al.,* 2003; Akinpelu 1999; Obaseiki-Ebor *et al.,* 1993; Tadesse *et al.,* 1993). The compound elamanolide has insect antifeedant properties (Ganjian, 1983). Leaf extracts of the plant showed inhibitory activity against *Trichomonas vaginalis* (Hakizamungu *et al.,*1992). Vernodaline and vernolide had antitumour properties in leukaemia cells (Jisaka *et al.,* 1993), while the crude extracts inhibited the growth of prostate cancer cells (Izevbigie, 2003). Aqueous leaf extracts containing peptides and edotides inhibited the growth of breast cancer cells (Atanaskova *et al.,* 2002; Mandlekar

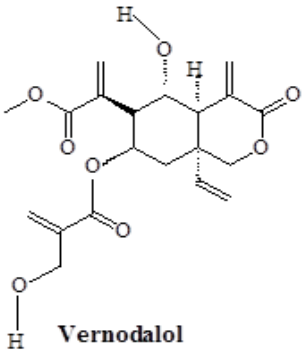
and Kong, 2001). The sesquiterpenone-rich chloroform extract demonstrated cytotoxic activity in human carcinoma nasopharynx cells (Kupchan *et al.,* 1969). Aqueous extract induced an increase in acid output and caused contraction of the guinea pig ileum (Owu *et al.,* 2008). Aqueous leaf extracts of the plant lowered blood sugar levels of normoglycaemic and alloxan diabetic rabbits (Akah and Okafor, 1992) and STZ-induced diabetic mice and rats (NIPRD Technical Report, 2006). A methanol extract of *V. amygdalina* leaves exhibited a carthatic effect in the charcoal meal test in mice (Awe *et al.,* 1999).

Clinical data

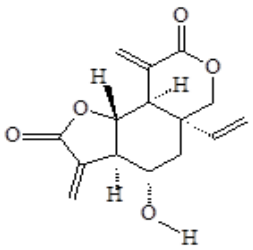
No information available

Chemical constituents

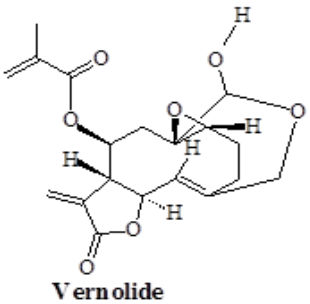
Sesquiterpene lactones (vernolepin, vernolide and vernodalol); tannins; flavonoids (luteolins); saponins (vernoniosides); alkaloids; calcium; amino acids; vitamin C (Masaba, 2000; Sayed *et al.,* 1982).



Vernodalol



Vernolepin



Vernolide

Tests for identity and purity

Moisture content: 8.30%

Total ash: 12.50%

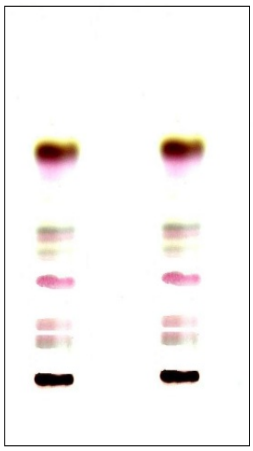
Water-soluble extractive: not less than 20.50%

Alcohol-soluble (70%) extractive: not less than 17.01%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spots with R_fs 0.68 (dark brown), 0.40 (pink), 0.28 (violet) and 0.24 (violet).



Chromatogram

Macroscopy

Simple, petiolate leaf; shape elliptic; apex acuminate; base symmetrical; up to 17 cm long, 8 cm wide; margin irregular serrate; venation reticulate; texture thin, papery (dry); colour green; odour characteristic; taste bitter (GHP, 2007).

Microscopy

Surface views show almost straight-walled epidermal cells on both surfaces; upper surface has few anomocytlc stomata; few multicellular uniseriate, glandular trichomes with oval heads; unicellular, conical clothing trichomes; sessile bicellular glandular trichomes; the lower surface has numerous anomocytic and some anisocytlc stomata with smaller epidermal cells; striated cuticle; numerous multicellular, uniseriate glandular trichomes; multicellular uniseriate clothing trichomes; sessile bicellular glandular trichomes; transverse section shows a dorsiventral arrangement; epidermal cells with straight anticlinal walls line both surfaces and contain mucilage; single-layered palisade cells interrupted in midrib region by collenchymatous cells; spongy mesophyll occupies rest of lamina space except for vascular bundles in veins and

veinlets; rosette crystals, simple starch grains occur in spongy mesophyll cells; collateral vascular bundle with lignified xylem tissue (GHP, 2007).

Powdered plant material
Colour green, odour characteristic and bitter taste; fragments of lamina show anomocytic and anisocytic stomata; palisade parenchymatous cells, striated cuticle; uniseriate, bi-cellular, multicellular, clothing and glandular trichomes, numerous trichome fragments; rosette crystals; starch grains; veinlet fragments with lignified xylem elements.

Therapeutic actions
Analgesic; antibacterial; anticancer; antidiabetic; antifungal; antihelminthic; antiinflammatory; antimalarial; antioxidant; antipyretic; antitumour; diuretic.

Therapeutic indications
Abdominal pain; asthma; bacterial and fungal skin disorders; constipation; diabetes; fever; headaches, helminthiasis; malaria; oliguria; pruritus; psoriasis; ringworm; upper respiratory tract infections (GHP, 2007; Mshana *et al.,* 2000).

Safety data
The LD_{50} of the aqueous leaf extract (*p.o*) was found to be > 3000 mg/kg in rats. Acute toxicity in the form of defaecation, salivation, urination (cholinergic signs) were observed following a single dose administration of the extract. Reduction in relative weight of the liver, kidney, lungs and heart were recorded at doses ≥1000 mg/kg. Increased WBC, RBC, MCV and platelets were observed. At 3000 mg/kg, hepatic and renal functions were affected, evidenced by elevated ALP, GGT, urea and serum creatinine levels. Subacute toxicity studies (daily oral administration of 750,1500, 3000 mg/kg for 28 days) and subchronic toxicity evaluation (daily oral administration of 750,1500, 3000 mg/kg for 90 days) further confirmed the safety of the plant since the organs/tissue (liver, brain, kidney, heart, spleen,intestine, stomach, testes and lungs) were not adversely affected particularly at moderate doses. Histopathological examination of some organs/tissue (brain, lungs, intestine, testes) showed only minor pathology at 1500 and 300 mg/kg. Such changes were also present in some of the control animals. Some observation suggestive of hepatocellular injury as indicated by elevation of ALT and AST enzymatic activity was not conclusive (NIPRD Technical Report, 2006).

Precautions for use
Care should be taken in renal and liver disease.

Adverse effects
Venonine has cardiac activity and is thought to be poisonous to mice and dogs (Abbiw ,1990)

Contraindications
Pregnancy and lactation, gastric ulcer; nephritis, renal and liver dysfunction

Dosage and dosage forms
Decoction; tincture
Decoction: boil 40 g of dried leaves per litre of water for 15 minutes; drink 4 teacupfuls three times a day
Tincture: 1:5 in 30% alcohol; take 5 ml three times a day

Storage
Store in a cool dry place

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Vernonia colorata

Botanical name
Vernonia colorata (Wild) Deake

Family
Asteraceae

Synonyms
Vernonia senegalensis (Pers.) Less., *Epatorium colotatum* Willd

Common names
Bitter leaf (English), Quinine des noirs (French).

Vernacular names
Burkina Faso: Mooré – koa-safandé, Dioula – Khô safouné, Fulfuldé – Ndumburkhat, Mossi – Kosa Safandé, Bambara – Ko Safna
Cote d'Ivoire: Agni – Baoulé Abovi Abowi Aovi, Akyé – Todzo, Malinké – Kosafna
Mali: Bambara – Ko-Safina, Malinké – Ko-Safina
Nigeria: Hausa – Shiwaka, Yoruba – Ewuro, Edo – Owiro
Senegal: Wolof – Ndumburghat Zidor, Diola – Ka Sipa, Serer – Mam Mbumkarkap
Togo: Ewé – Aloma, Ouatchi – Alo, Adja – Alotsi

Description of the plant
Vernonia colorata is a much branched shrub or small tree up to 3-5 m high; leaves pubescent, ovate-elliptic, 8-15 cm long and 5-10 cm broad with distinctly undulate margins, upper surface harshly hairy, undersurface covered in dense woolly hairs; petiole 15-30 mm long, pubescent; inflorescences flattened panicles, composed of small capitulum 5 to 15 cm long; flower white or bluish, tubular 8-10 mm; achenes glabrous, with reddish brown pappus, 3 mm long (Ake Assi and Guinko, 1986).

Herbarium specimen number
Ghana: GC 35269
Mali: 0074 DMT
Togo: TOGO01207

Habitat and geographical distribution
The plant grows as well in savana and rain forests, especially in secondary growth and wet places. It is common in most West African, Central African and South African tropical countries.

Plant material of interest
Leaf

Other parts used
Root

Definition of plant material of interest
Vernonia colorata consists of the fresh or dried leaf of *Vernonia colorata* (Wild) Deake (Asteraceae).

Ethnomedical uses
V. colorata is one of the most widely consumed edible leaf vegetables of all the species of the genus *Vernonia* found in West Africa and Cameroon. The leaves have a sweet and bitter taste; they are sold fresh or dried, and are a common ingredient in soup. *V. colorata* has long been used in traditional medicine for the treatment of cough, fever, hepatitis, gastritis, stomachache, diabetes, colic, rheumatism, dysentery, ulcerative colitis, venereal diseases, diarrhoea, boils and skin eruptions (Hutchings *et al*., 1996). Leaf infusions or decoctions are used as mouth wash for tonsillitis, earache and fever. The fresh leaf extract is applied to wounds (Kerharo and Adam, 1974; Ake Assi and Guinko, 1986; Oliver-Bever, 1996; Adjanohoun *et al*., 1985).

Biological and pharmacological activities
Several studies have demonstrated the antimalarial activities of *V. colorata* extracts (Benoit *et al*., 1996; 2000; Menan *et al*., 2006 and Kaou *et al*., 2008). A study by Kraft *et al*. (2003) showed that the lipophilic extracts from the aerial parts, the plant's sesquiterpene lactones, as well as isolated phenylpropanoids and terpenoids possess potent antiplasmodial activity. The sesquiterpene lactones also possess anthelmintic, amoebicidal, antischistosomal, plasmodicidal, leishmanicidal and muscle relaxant properties *in vitro* and in *vivo* (Campos, *et al*, 2003; Gasquet, *et al*., 1985; Toubiana and Gaudemer, 1967; Kupchan *et al*.,

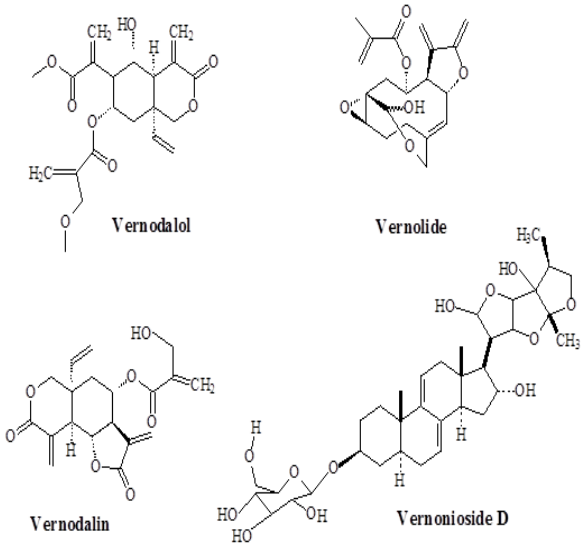
1969; Asaka *et al*., 1977). Dichloromethane, acetone and ethanol extracts exhibited a promising anti-toxoplasma activity. The leaf extracts possess potent antibacterial activity against various bacteria strains (Kelmanson *et al*., 2000). Vernodalin isolated from the leaves has significant antibacterial activity against *Staphylococcus aureus* (Reid *et al*., 2001), while aqueous, methanolic and ethyl acetate extracts were active against *Pseudomonas aeruginosa* (Jonathan *et al*., 2000). Stafford *et al*. (2005) found that aqueous, ethanol and hexane extracts of fresh, 90-day-old and 1-year-old material had antibacterial activity. Different extracts of the leaves also possess both hypoglycaemic and antidiabetic effects in normoglycaemic and alloxan-induced diabetic rats (Sy *et al*., 2004; 2005; 2006).

Clinical data

No information available

Chemical constituents

Amino acids; Vitamin C, carotenoid, iron, essential oil, sesquiterpene lactones (vernolide, hydroxyvernolide,19-hydroxyglaucolide A, vernodalin derivatives) (Ejoh *et al., 2005a,* Ejoh *et al*., 2005b; Senatore *et al*., 2004; Rabe *et al*., 2002; Toubiana and Gaudemer, 1967; Gasquet *et al*., 1985; Toubiana and Gaudemer, 1967; Kupchan *et al*., 1969; Asaka *et al*., 1977).



Tests for identity and purity

Moisture content: not more than 4.81%

Total ash: 7.12%

Water-soluble extractive: not less than 25.12%

Alcohol-soluble (70%) extractive: not less than 22.50%

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spots with R_fs 0.67 (yellowish brown), 0.48 (pink), 0.35 (pink) and 0.12 (brown).

Chromatography

Macroscopy

Simple, petiolate leaf; shape elliptic; apex acuminate; base symmetrical; margin irregular serrate; venation reticulate; texture pubescent, colour green; odour characteristic; taste bitter.

Microscopy

Surface views show almost straight-walled epidermal cells on both surfaces; upper surface has few anomocytic stomata; multicellular, uniseriate, glandular trichomes with oval heads; unicellular, conical clothing trichomes; sessile bicellular glandular trichomes; the lower surface has numerous anomocytic and some anisocytlc stomata with smaller epidermal cells; striated cuticle; numerous multicellular, uniseriate glandular trichomes; multicellular uniseriate clothing trichomes; sessile bicellular glandular trichomes; transverse section shows a dorsiventral arrangement; epidermal cells with straight anticlinal walls line both surfaces and contain mucilage; single-layered palisade cells interrupted in midrib region by collenchymatous cells; spongy mesophyll occupies rest of lamina space except for vascular bundles in veins and veinlets.

Powdered plant material
Green and bitter powder, fragments of lamina show anomocytic and anisocytic stomata, parenchymatous epidermal cells; multicellular, glandular trichomes, oval heads; unicellular, conical covering trichomes; mucilage; palisade cells; vascular bundles and xylem tissues

Therapeutic actions
Antimalarial, antidiabetic, anthelmintic, enteritis, antischistosomiasis, haemostatic, cicatrising, appetizer and digestive tonic.

Therapeutic indications
Malaria, amoebic dysentery, diabetes, bacterial infections.

Safety data
The LD_{50} of the aqueous leaf and bark extracts (*p.o*) in mice was >2000 mg/kg in 24 hours. No clinical signs of toxicity were observed after treatment of male and female mice (500 to 2000 mg/kg; *p.o*) for 14 days.

Precautions for use
Excessive ingestion may induce diarrhoea

Adverse effects
May cause gastrointestinal disorders

Contraindications
Pregnancy and lactation; gactric ulcer, nephritis

Dosage and dosage forms
Decoction, powder
Decoction**:** boil 40 g of dried leaves per litre for 15 minutes; drink 4 teacapfuls three time a day.

Storage
Store in a cool dry place

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Zanthoxylum xanthoxyloides

Botanical name
Zanthoxylum xanthoxyloides (Lam.) Waterm.

Family
Rutaceae

Synonyms
Fagara senegalensis (DC.) A. Chev.; *Zanthoxylum polygamum* Schum.; *Zanthoxylum senegalense* DC. *Fagara xanthoxyloides* Lam

Common names
Candle wood; Zanthoxylum; Fagara (English), Fagarier (French).

Vernacular names
Burkina Faso: Mooré – Rapeoko, Dioula– Woo
Benin: Gbe Gen - Eti, Vhe– Heti, Yoruba Nago – Ata
Gambia: Fula Pulaar – Barkele, Manding Mandinka – Owo, Wolof – Dengidek
Ghana: Adangme – Haatso, Akan – Okanto, Ewe – Ake
Guinea: Fula Pulaar – Barkele, Manding Maninka – Huo
Guinea-Bissau: Balanta – Mantcha, Bidyogo – Aranhe, Crioluo – Bitonco
Cote d'Ivoire: Baul – Akuwe, Kru Bete – Guessi, Klango – Hango
Mali: Manding Bambara – Huo, Khasonke – Wuho, Maninka – Uo
Nigeria: Hausa – Fasa Kuwari, Igbo – Uko, Yoruba –orin ata.
Senegal: Balanta – Macu, Diola – Bu Santi, Manding Bambara – Goro Ngua
Togo: Bassari – Jarejare, Gbe Fon – Che

Description of the plant
Small dioecious trees; mostly under storey, 6 to 12 cm; bole, thorny branches, branchlets, and leaf rachis armed with sharp and recurved panicles; leaves imparipinnate, 3-5 pairs of shining aromatic leaflets, 3-10 cm long by 1.5-3.5 cm broad, thorny medium rib on leaflets; elliptic to elongated, oblong to oblong-lanceolate in shape and elliptic or slightly obovate, rounded or notched, or very shortly acuminate at the apex; broadly cunate; dark green, glossy, glabrous, rather leathery with a prominent midrib and rather faint and irregular lateral nerves, looped near the margin, connected by an open network of indistinct veins; leaflet stalks are stout, 0.2-10.5 cm long; flowers are small, numerous and greenish white; axillaries are narrow, terminal panicles 5-25 cm long with short spike-like branches; glabrous and usually without thorns; individual flowers are about 0.2 cm long; fruit

glabrous, brown, about 0.6 cm across, splitting into two to show shiny blue seeds within and with a spicy taste; spherical capsules, ellipsoidal and one-seeded; with black, ovoid, sub-globular and shinning seeds, all organs containing essential oil, with strong and spicy cinnamon-like taste (NHP, 2006).

Herbarium specimen number
Nigeria: FHI 107452
Togo: TOGO08061

Habitat and geographical distribution
Abundant in coastal grassland, also in closed forest and in guinea savanna. Occurs in most West African countries e.g. Ghana, Gambia, Togo, Nigeria, Senegal and Cote d'Ivoire.

Plant material of interest
Root

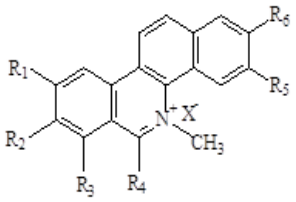
Other parts used
Leaf and stem bark

Definition of plant material of interest
Fagara consists of the root of *Zanthoxylum xanthoxyloides* (Lam.) Waterm. or *Zanthoxylum gillettii* (De Willd.) Waterm. (Rutaceae).

Ethnomedical uses
Fagara is used in many African countries for the treatment of enteritis, dysentery, diarrhoea, guinea worm, uretritis; cough, fever, colds, scaring; toothache, snake bite and sickle cell anaemia. It is used as chewing sticks in most West African countries (GHP, 2007; Dean and Schechter, 1978; Elujoba and sofowora, 1977).

Biological and pharmacological activities

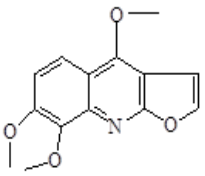
Z. xanthoxyloides has antifungal, antibacterial, antisickling and antileukaemic properties. Aqueous-ethanolic root and stem bark extracts have dose-dependent antifungal effects *in vitro* (Ngane *et al*., 2000); the essential oil also has antibacterial and antifungal activity (Tatsadjieu, 2003; Ngassoum *et al*., 2003). The ether fraction of the aqueous root extract showed antisickling activity (Osoba *et al*., 1989), by normalising sickled HbAS, HbSS and crenated HbAA red blood cells *in vitro* (Sofowora, 2002). Cells treated with the extract changed from sickled cells to round (Headings *et al*., 1979); other studies have found that the extract is non-toxic to whole animals (Isaacs-Sodoye *et al*., 1975). The compound fagaronine is antileukaemic (Messner *et al*., 1972) and the chlorides of nitidine and fagaronine have avian myeloblastosis and reverse transcriptase inhibitory effects (Addae-Mensah *et al*., 1992).



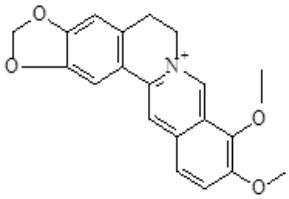
Nitidine chloride $R_1=R_2=OCH_3, R_3=R_4=H, R_5=R_6=OCH_2O$

Fagaronine $R_1=R_4=H, R_2=R_3=OCH_3, R_5=OCH_3, R_6=OH$

Fagaridine $R_1=R_4=H, R_2=OCH_3, R_3=OH, R_5=R_6=OCH_2O$



Skimmianine



Berberine

Clinical data

Aqueous extract at 1.0 gm per ml of the root was used as crude extract on patients whose pain scores were not less than 30 per month or higher. Patients who had a pain score of 25 to 30 per month on a control extract had a zero pain score of zero when swithed over to Fagara extract (Isaacs-Sodeye *et al*., 1975; 1979).

Chemical constituents

Alkaloids (berberine, skimmianine, fagaramide, chelerythrine, canthin-6-one, fagaridine, fagaronine and related alkaloids); benzoic acid derivatives (p-hydroxybenzoic acid, 2-hydroxymethylbenzoic acid and vanillic acid); essential oil, tannin; flavonoid; saponin; essential oil (α-pinene, trans-β-ocimene, citronellol, sabinene, myrcene, limonene and cytronellyl acetate, α-phellandrene) [Tatsadjieu *et al*., 2003].

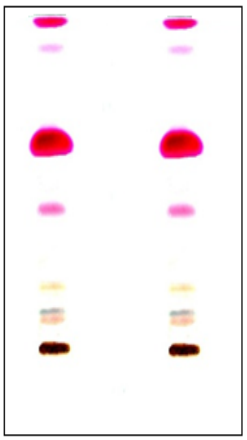
Tests for identity and purity

Moisture content: not more than 7.00%
Total ash: Not more than 5.01%
Acid-insoluble ash: Not more than 3.50%
Water-soluble ash: Not less than 0.25%
Water-soluble extractive: Not less than 10.00 % (moderately coarse powder BP)
Alcohol-soluble(70%) extractive: Not less than 10% (moderately coarse power BP)

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of four characteristic spots with R_fs 0.99 (pink), 0.91 (pink), 0.64 (pink) and 0.46 (pink).



Chromatogram

Macroscopy

Root, cylindrical and tortuous, 0.6 to 1.8 to 2.8 cm long with rootlets attached, measuring about 5 mm in diameter, root is hard, less splintery and less fibrous in fracture; starch present, colour dark chocolate-brown with yellowish circular patches and fine tissues; texture very rough, taste pepperish, aromatic and bitter (Olatunji, 1983).

Microscopy

The root consists of both lignified and unlignified, thin-walled, rectangular to square, cork cells,

forming alternate bands; pericyclic fibres are present; sclereids in the phloem are arranged in 1-3 continuous bands; phloem parenchyma contains starch granules with few phloem fibres, both xylem fibres and vessel elements are present; transverse section shows suberised cork cells (some lignified) with yellow brown content, about 6-7 layers thick, exfoliating in some places; wide cortex of parenchymatous cells containing large numbers of starch grains, oil cells and prismatic crystals of calcium oxalate; an endodermis consisting of parenchymatous cells containing large amounts of starch grains delineates the cortex from the vascular tissue consisting of phloem tissue, which is capped by lignified pericyclic fibres; medullary ray cells 1-2 cells wide and full of starch grains; the wood is composed of lignified vessels, pitted tracheids and xylem parenchyma (African Pharmacopoiea, 1985; Hutchinson and Dalziel, 1958).

Powdered plant material

Colour pale yellow; taste aromatic; cork tissue; numerous starch grains in parenchymatous cells; prismatic calcium oxalate crystals and lignified fibres present; pieces of cork cells in rectangular or square shapes, fragments of pericyclic phloem and xylem fibres with vessel elements present; powder shows calcium oxalate crystals and starch granules giving bluish black reaction to iodine solution.

Therapeutic actions

Analgesic, diurectic, laxative, anticancer, antihypertensive, antipyretic, antirheumatic, antisickling, antispasmodic, broad spectrum antimicrobial, circulatory stimulant, diaphoretic, emmenagogue, sialogogue, urinary antiseptic and astringent (GHP, 2007).

Therapeutic indications

Arterial hypertension; chronic rheumatic conditions; fevers; fibrositis; impotence; lower abdominal pain (post-partum); oedema; peripheral circulatory insufficiency (e.g. intermittent claudication and Raynaud's syndrome); purulent conjunctivitis; sickle cell anaemia; smallpox; syphilis of the throat; toothache; whooping cough and wounds (Mshana *et al*., 2000).

Safety data

The LD_{50} of the aqueous stem bark (*p.o*) was found to be > 3000 mg/kg in rats. In subacute studies, no clinical signs of toxicity were seen on repeated administration of 300-3000 mg/kg for 14 days. No significant changes in body weight or relative organ weights were observed; an increase in WBC, LYM, NEUT and MCV was recorded; increased levels of liver transaminases (AST, ALP, ALT and GGT) were seen at the highest dose (3000 mg/kg) tested, but while albumin levels reduced, serum urea increased at 3000 mg/kg. Other toxicological studies also showed that the extract did not have toxic effects in duck and chick embryo as well as in mice. No teratogenic features were observed in the whole embryos; no deaths were recorded in acute toxicity oral studies at up to 50 g/kg. LD_{50} by intraperitoneal route was 20 g/kg; by intravenous, route was 8 g/kg while the LD_{100} by the later route was 14 g/kg. Chronic toxicity studies showed no pathological changes (Isaacs-Sodeye *et al*., 1975). It was concluded that toxicity to the aqueous extract of the root was virtually non-existent in the animals examined and for the duration of the observation (Isaac-Sodeye, 1979)

Precautions for use

Care should be taken in renal and liver diseases

Adverse effects

High doses may cause gastrintetinal disturbances in some patients.

Contraindications

Renal and liver dysfunctions

Dosage and dosage forms

Decoction; tincture; liquid extract

Decoction: 1-2 teaspoons of bark in 150 ml of water and simmer for 10-15 minutes; 1-3 teacupfuls a day.

Liquid extract: 1:1 in 45% alcohol; 1-3ml three times a day

Tincture: 1:5 in 45% alcohol, 2-5ml three times a day.

Storage

Store in a cool dry place.

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Zingiber officinale

Botanical name
Zingiber officinale Roscoe

Family
Zingiberaceae

Synonyms
Amomum zingiber L. *Zingiber blancoi* Massk., *Zingiber majus* Rumph

Common names
Ginger (English), Gingembre (French).

Vernacular names
Burkina Faso: Mooré – Gnamaku, Dioula – Dougouma niamako, Fulfuldé – Gnamakou Bobo – Dugumo nyamugu
Ghana: Adangbe – Odzahwi, Akan – Akakador Tsintsimir, Dagbani - Sakarra Tschibilli
Guinea: Fula Pulaar – Niamaku, Limba - A-Mbir, Manding Maninka - Niamaku Susu
Guinea-Bissau: Crioulo - Gengipe
Liberia: Mano - Ge Su
Nigeria: Arabic Shuwa – Sakanjabir, Birom – Syataa, Yoruba – Atale.
Senegal: Bedik – Nyamaku, Manding Bambara – Dugukoro Ni Amaku, Wolof – Dinjar.
Sierra Leone: Bulom – Wischa, Bulom – Lone, Yalunka – Nyakhamuna
Togo: Anyi Anufo – Kaka'dolo, Bassari – Afu, Kabere – Wessuguae.

Description of the plant
Ginger is rhizomatous, perennial plant of two kinds: erect stems of 1-1.5 m in height with linear lanceolate, alternate, smooth, sheathing leaves, which die off each year, greenish pale colour (sterile stems) and the other, of about 20 cm or less in height (fertile stems, carrying sheathing bracts) with short, stable, yellowish-green flowers, terminating in a long curve spike; each flower shows a superior tubular calyx, orange-yellow corolla with three lobes and inferior 3-celled ovary with tufted stigma; fruit is a capsule with small argillite seeds; tuberous, branched rhizome, spreads and proliferates underground (WHO, 1999; Gill, 1992).

Herbarium specimen number
Ghana: GC45906
Nigeria: FHI 107440

Habitat and geographical distribution
Tropical plant, especially abundant in Indo-Malaysia; major world producers include Fiji, India, Jamaica, Nigeria, Sierra Leone and China;

commercially cultivated in nearly every tropical and subtropical country of the world.

Plant material of interest
Rhizome

Other parts used
None

Definition of plant material of interest
Ginger consists of the rhizome of *Zingiber officinale* Roscoe (Zingiberaceae).

Ethnomedical uses
Ginger is used in the treatment of a wide range of diseases including rectal prolapse, toothache, voice hoarseness, cough, colds, flu, pregnancy-induced nausea and vomiting, asthma, fever, colic, dysmenorrhoea, diarrhoea, arthritis, hepatitis, dyspepsia (Samy, 2005; Milt and Bone, 2001; Adjanahoun *et al*, 1985; BHP, 1983).

Biological and pharmacological activities
Ginger has diverse phytopharmacological properties. It has circulatory, digestive, central nervous system and gastrointestinal stimulating actions; it increases peristalsis and promotes bile secretion. *In vitro* studies have shown that many constituents of ginger have antiinflammatory properties (Grzanna *et al*, 2005; Srivastava and Mustafa, 1989); ginger extracts possess platelet aggregation and thromboxane synthesis inhibitory effects *in vitro* (Guh *et al*. 1995; Kiuchi *et al*., 1992; Srivastava, 1986). *In vitro* studies have shown that ginger exhibits its antiinflammatory effects by inhibiting arachidonic acid metabolism in both the cyclooxygenase and lipoxygenase pathways (Backon, 1986). single

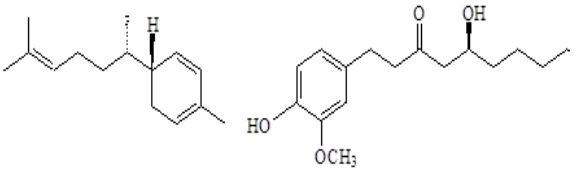
oral dose of 33 mg/kg ginger oil significantly suppressed severe chronic adjuvant arthritis in rats (Sharma *et al*., 1994). The benzene fraction of a petroleum ether extract of dried rhizomes potentiated diazepam-induced motor incoordination *in vitro* (Vishwakarma *et al*., 2000). Extracts of ginger showed significant dose-dependent antiemetic effects against cisplatin-induced emesis in healthy dogs (Sharma *et al*., 1997). Pre-treatment with ginger extract and ginger juice partially reversed inhibition of gastric emptying following cisplatin administration (Sharma and Gupta, 1998). Extracts of ginger have antioxidant (Goyal and Kadnur, 2006; Masuda *et al*., 2004; Kikuzaki *et al*., 1994), radioprotective and neuromodulatory properties (Haksar *et al*., 2006); ethanol extracts demonstrated hepatoprotective activity against acetaminophen-induced acute toxicity (Ajith *et al*., 2007a). The extract alone and in combination with vitamin E partially ameliorated cisplatin-induced nephrotoxicity (Ajith *et al*., 2007b). Ethanolic extract of the plant has also shown antihyperlipidaemic activity *in vitro* (Bhandari *et al*., 1998), while the volatile oil has been found to influence both cell-mediated immune response and nonspecific proliferation of T lymphocyte (Zhou *et al*., 2006). Ginger has also been found to have anticancer properties *in vitro* and *in* vivo (Bode *et al*., 2001; Katiyar *et al*., 1996; Koshimizu *et al*. 1988); the compound [6]-gingerol has been shown to inhibit cell adhesion, invasion and motility in human breast cancer cell lines (Lee *et al*., 1998).

Clinical data

In a small scale study, daily intake of 15 g raw ginger rhizome or 40 g cooked rhizome by 18 healthy volunteers for two weeks did not decrease platelet cyclooxygenase activity (Janssen *et al*.,1996). Administration of a single dose of 2 g of the dried rhizome or placebo to eight healthy volunteers produced no differences in bleeding time, platelet count, and platelet functioning. A randomized, placebo-controlled, crossover study that compared ginger extracts and ibuprofen or placebo in individuals with osteoarthritis of the hip or knee, found no significant improvement in symptoms for both the ginger and ibuprofen groups before crossover with no difference between ginger and placebo at the end of the study (Bliddal *et al*., 2000). In another double-blind randomized, placebo-controlled study, pre-treatment of volunteers with a history of motion sickness with ginger, produced significant protection against nausea (Lien *et al*., 2003). Other double-blind studies have also shown the effectiveness of ginger against motion sickness; a double-blind, placebo-controlled, randomized clinical trial involving 26 women in the first trimester of pregnancy who took one tablespoon of ginger syrup containing 1 g ginger or placebo four times daily found that while daily vomiting ceased in 8 women in the ginger group by the sixth day, only 2 in the placebo group reported cessation of vomiting. Also, while 77% taking the ginger syrup reported a significant decrease in nausea, 20% in the placebo group reported improvement. In another study in which 70 pregnant women received either 250 mg freshly prepared ginger powder or a placebo, a significant reduction in nausea and number of vomiting episodes was observed (Vutyavanich *et al*., 2001). In two double-blind studies performed on women following major gynaecological surgery, nausea was observed in the placebo group throughout the duration of the study, but only 28% experienced nausea in the ginger group and 30% in the metoclopramide group (Bone *et al*., 1990). In a randomized, doubleblind, crossover trial involving 27 women women who had been admitted to hospital for treatment of the most severe form of hyperemesis gravidarum, adminstration of 250 mg of ginger in a capsule four times daily produced a significant reduction in the symptoms of hyperemesis (Murphy, 1998). A significant reduction in nausea and vomiting was observed in the ginger group, compared to placebo and metoclopramide (Phillips *et al*., 1993). In another double-blind trial of chemotherapy-induced nausea in which 41 patients with leukaemia received either ginger or a placebo after administration of compazine (Pace, 1987), a greater symptomatic benefit was observed in the ginger group compared to placebo. Ginger consumption ameliorated the pain and symptoms of rheumatic disorders (Srivastava and Mustafa, 1992). Ginger has been shown to be an effective remedy for reducing postoperative nausea and vomiting (Chaiyakunapruk *et al*., 2006).

Chemical constituents

Volatile oil (oleo-resin): monoterpenes [8-phellandrene, (+)-camphene, cineole, citral, borneol]; sesquiterpenes (zingiberene, bisabolene); gingerols; vitamin B group (niacin, ribloflavin, thiamin); vitamin C; reducing sugars; phosphatidic acids; lecithins; folic acid; mucilage (GHP, 1992; Seukawa *et al*, 1984).



Zingiberine 6-Gingerol

Tests for identity and purity

Moisture content: Not more than 72.80% (fresh), 5.20 % (market dried)

Total ash: Not more than 3.70 % (market dried), 5.30 % (dried at 60°C)

Acid insoluble ash: Not more than 4.30 % (market dried), 2.80 % (dried at 60°C)

Water-soluble ash: Not less than 1.00% (market dried), 2.50% (dried at 60°C)

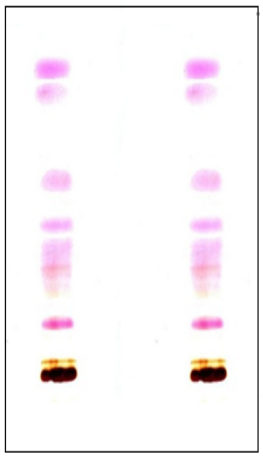
Water-soluble extractive: Not less than 5.00 % (market dried), 2.00% (dried 60°C)

Alcohol-soluble (70%) extractive: Not less than 4.50 % (market dried), 3.00% (dried 60°C)

Chromatographic fingerprints

Chloroform extract

Analytical TLC on silica gel G60 F254, 0.25 mm layer in petroleum ether (40-60 °C)/chloroform [2:8], detection in daylight, after spraying with anisaldehyde (0.5 ml) mixed with 10 ml glacial acetic acid, 85 ml methanol and 5 ml concentrated sulphuric acid and heated to 100-110°C for 5-10 min. Presence of five characteristic spots with R_fs of 0.89 (purple), 0.80 (purple), 0.56 (purple), 0.46 (purple) and 0.14 (purple).



Chromatogram

Macroscopy

Laterally-flattened, branched, unscrapped (or scrapped), rhizomes known as “races” or “hands” with short, obovate, oblique branches called “fingers” arising from the upper surface of the rhizomes, each branch having a depressed scar at the apex; entire rhizome 5–10 cm long, 1.5 to 3 to 4 cm wide and 1.0 to 1.5 cm thick; outer surface of the unscrapped rhizomes shows an outer layer, pale to dark-brown cork with conspicuous, narrow longitudinal and transverse ridges, fracture is shortened and starchy, with projecting fibres; , under a hand-lens,smooth, transverse, cut surface exhibits numerous, scattered, yellow oleo-resin and oil cells, scattered vascular bundles and an endodermis separating the narrow cortex and the wide stele; odour agreeable, aromatic and characteristic; taste strongly and pleasantly pungent and aromatic (WHO, 1999; BP, 1980).

Microscopy

The entire ground tissue consists of thin-walled, cellulosic parenchyma, rounded polygonal cells of about 50 to 100 µ in diameter, containing numerous starch granules, each measuring 50 µ long, 25 µ wide and 7 µ thick, starch granules flattened, ovate to sub-rectangular, transversely striated, running across the grains, perpendicular to the long axis; simple grains, each with a terminal protuberance in which the hilum is located; scattered among the starch-bearing cells are suberised cells containing yellow masses of oleo-resin, numerous in the ground tissue; pigment cells with dark, reddish-brown contents, occurring either in singles in the ground tissue or in axial rows, associated with the vascular bundles, which are closed collateral with non-lignified annular, spiral, reticulate and scalariform thickening; and often also accompanied by thin-walled fibres having wide lumen and lignified middle lamella; calcium oxalate crystals and sclereids are absent but varying amounts of cork cells, composed of thin-walled cells are present in the unscrapped ginger (WHO, 1999; BP, 1980; Wallis, 1967). transverse section of unpeeled rhizome shows zone of cork tissue comprising of outer zone of thin irregularly arranged rectangular cells; inner zone of cells in radial rows with few starch grains abut onto cortical region; cortex comprises polygonal parenchymatous cells containing abundant simple starch grains, oleo-resin cells with yellowish contents; few scattered fibrovascular bundles; a narrow endodermis comprising tangentially elongated cells (about two cells wide) with interspersed radially arranged fibro-vascular bundles separate cortex from much wider stele, ground mass of the stele consists of parenchymatous cells containing

much starch, like the cortical parenchyma; numerous oil cells, fibrovascular bundle comprises xylem elements lightly lignified only, phloem fibres in collateral arrangement; mucilage present in all cells.

Powdered plant material

Numerous thin-walled parenchyma cells of the ground tissue containing abundant starch granules, fibres, vascular bundle elements, non-lignified, scalariform, reticulate and spiral thickening, accompanied by pigment cells, oleo-resin in fragments or droplets, staining with iodine solution; fragments of cork cells, thin-walled and polygonal, from the unscrapped samples; colour is yellowish to dark-brown, taste is pungently aromatic and taste is generally agreeable and aromatic (WHO, 1999; Wallis, 1967).

Therapeutic actions

Absorbent; analgesic; antiemetic; antiinflammatory; antitussive; appetizer; carminative; cholagogue; diaphoretic; febrifuge; flavouring agent; galactogogue; hypotensive; peripheral circulatory stimulant; mild counter-irritant; spasmolytic; sudorific; appetizer (Suekawa *et al*., 1984).

Therapeutic indications

Bloating; boils; chilbains; cough; exhaustion; flatulence; haemorrhoids; indigestion; joint pains; lack of appetite; nausea and vomiting; poor circulation (Dennis, 2002; GHP, 1992).

Safety data

The LD_{50} of the aqueous extract of the rhizome (*p.o*) was found to be > 3000 mg/kg in rats. In subacute studies (300-3000 mg/kg repeated administration for 14 days); no clinical signs of toxicity were observed and no significant changes in body weight was seen but decreased relative weights of the liver, kidney, lungs and heart occurred at 3000 mg/kg dose. Blood and its cellular elements were unaffected by the treatment and there was no evidence of damage to the hepatic or renal systems.

Precautions for use

Excessive doses should not be encouraged to avoid cardiac arrhythmias and CNS depression; to be used with caution in the presence of gallstones and haemorrhagic conditions, may be used in pregnancy but under medical supervision

Adverse effects

Excessive dosage may cause gastrointestinal disorders.

Contraindications

Patients with gastric ulcer and those on anticoagulant therapy

Dosage and dosage forms

Powder; tincture; ginger syrup (Syrupus Zingiberis)
For most purposes a typical dose of ginger is 1-4 g daily, taken in divided doses
Infusion: fresh root, infused for 5 minutes: 1 teaspoon
Decoction: put 1-1.5 teaspoonfuls of the powder in a cup of water.
Tincture: 1:2 in 75% alcohol; 0.25-5 ml three times a day.
Capsules: 1 or 2 x 200 mg
Oil: take 1-2 drops on a sugar lump or in a teaspoon of honey.

Storage

Store in a well closed container in a cool place away from light and moisture.

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ISBN: 978-9988-1-8015-7