

A revision of Boraginaceae subfamily Ehretioideae in Thailand

KANOKORN RUENGSAWANG & PRANOM CHANTARANOETHAI*

Applied Taxonomic Research Center, Department of Biology, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand

ABSTRACT. Boraginaceae subfamily Ehretioideae in Thailand are revised. Four genera are recognized. There are five species in *Ehretia*, one each in *Carmona*, *Coldenia* and *Rotula*. Synonymy and keys to genera and species, with information and specimens examined are provided.

KEYWORDS: taxonomy, Ehretioideae, *Carmona*, *Coldenia*, *Ehretia*, *Rotula*, Thailand

INTRODUCTION

Recent authors have recognized a more broadly defined Boraginales, with four traditional subfamilies, Cordioideae, Ehretioideae, Heliotropioideae and Boraginoideae treated at the family level, Cordiaceae, Ehretiaceae, Heliotropiaceae and Boraginaceae plus Hydrophyllaceae and Lennoaceae (Miller, 2007). Delimitation of the family as a whole is still controversial. While some authors think that the family can be subdivided into four or five subfamilies, others treat some of these subfamilies as separate families (Riedl, 1997). In this work, several separate subfamilies or families are treated as Boraginaceae as in the traditional classification (Ruengsawang & Chantaranonthai, 2009).

Subfamily Ehretioideae in Thailand comprises four genera viz. *Carmona*, *Coldenia*, *Ehretia* and *Rotula*. Molecular analyses show that *Carmona* and *Rotula* are transferred to *Ehretia* (Gottschling & Hilger, 2001). *Carmona* has a single species originally described as a species of *Cordia* or *Ehretia* but differs in habit, leaves, pollen and fruit structure, which is undivided endocarp. *Rotula* is segregated from *Ehretia* due to its undivided stigma (Johnston, 1951). The pollen of *Carmona*, *Ehretia* and *Rotula* are totally different (Ruengsawang & Chantaranonthai, in prep.). Therefore, these genera are accepted here as separate taxa.

MATERIALS AND METHODS

This revision is based on field observations and examination of herbarium collections in BK, BKF, BM, E, K, KKU and QBG (herbarium codes follow Thiers, 2010), the Department of Biology Herbarium,

*Corresponding author: pranom@kku.ac.th

Received: 16 September 2010

Accepted: 29 November 2010

Chiang Mai University and the literatures. Photographs of living specimens were also taken in the field.

TAXONOMIC TREATMENT

EHRETIOIDEAE

Riedl, Fl. Males. 13: 59. 1997; Heywood, Brummitt, Culham & Seberg, Fl. Pl. Fam. World: 67. 2007.

Trees, shrubs rarely prostrate herbs. *Leaves* alternate. *Flowers* bisexual, solitary, 2-6 in fascicles or cymose to paniculate, axillary or terminal, usually 5-merous,

ebracteate. *Calyx* 5-lobed, rarely 4-lobed, persistent. *Corolla* campanulate; tube shorter than lobes. *Stamens* usually 4, 5 in *Rotula*, inserted near base or at middle or above the middle of corolla tube, exserted. *Ovary* superior, ± entire; style terminal, simple or bifid producing 4 ovules in 2 or 4 locules. *Fruits* dry, thinly fleshy and breaking up into four 1-seeded or two 2-seeded nutlets or pyrenes.

Four genera and seven species indigenous to Thailand; one species introduced.

KEY TO THE GENERA

1. Prostrate herbs **2. Coldenia**
 1. Trees or shrubs **2**
 2. Style simple, weekly bifid; stamens 5 **4. Rotula**
 2. Style bifid; stamens 4 **3**
 3. Flowers a few in fascicles, cultivated **1. Carmona**
 3. Flowers in a loose, scorpioid inflorescences, native **3. Ehretia**

1. CARMONA

Cav., Icones 5: 22, t. 438. 1799; I.M. Johnston, J. Arnold Arbor. 32: 16. 1951; Backer & Bakh.f., Fl. Java 2: 459. 1965; Ng in Tree Fl. Mal. 4: 59. 1989; Nowicke & Miller in Dassan. & Fosberg, Fl. Ceyl. 7: 5. 1991; Zhu, Riedl & Kamelin, Fl. China 16: 337. 1995; Riedl, Fl. Malesiana 13: 65. 1997. Type species: *C. heterophylla* Cav. [= *C. retusa* (Vahl) Masam.].

Shrubs or small trees. *Leaves* alternate, small, fascicled on dwarf shoots; lamina obovate to spatulate. *Inflorescences* axillary.

Flowers 2–6-fascicled, ebracteate. *Calyx* green, deeply 5-lobed, persistent. *Corolla* white, campanulate, 5-lobed, tube shorter than lobes. *Stamens* 4, separate, exserted; filaments inserted near base of corolla tube; anthers oblong, introrse, laterally dehiscent, glabrous. *Ovary* glabrous; styles bifid terminal, slender and elongate, clefted below the middle of ovary; stigmas capitate. *Fruits* a drupe, red or yellow, 4-seeded.

A monotypic genus which is widely distributed in India, China, SE Asia, New Guinea to the Solomon Islands.

1. *Carmona retusa* (Vahl) Masam., Trans. Nat. Hist. Soc. Formosa 30: 61. 1940; Backer & Bakh.f., Fl. Java 2: 459. 1965; Ng in Tree Fl. Mal. 4: 59. 1989; Nowicke & Miller in Dassan. & Fosberg, Fl. Ceyl. 7: 5. 1991; Riedl, Fl. Malesiana 13: 65, f. 2. 1997.

Cordia retusa Vahl, Symb. Bot. 2: 42. 1791. Type: Plukenet, Phytographia, t. 31, f. 1, Haitat in India Orientali.

Ehretia microphylla Lam., Tabl. Encycl. 1: 425. 1792; C.B. Rob., Philipp. J. Sc. Bot. 4: 692. 1909; Alston in Trimen, Handb. Fl. Ceyl. 6: 200. 1931. Type: India, *Sonnerat*.

Ehretia buxifolia Roxb., Pl. Corom. 1: 42. 1796 & Fl. Ind., ed. Carey & Wall., 2: 343. 1824; C.B. Clarke in Hook.f., Fl. Brit. Ind. 4: 144. 1883; Ridl., Fl. Mal. Pen. 2: 442. 1923. Type: India.

Carmona heterophylla Cav., Icones 5: 23, t. 238. 1799. Type: "Habitat prope Manbulac in insulae Luzon, et in Huanmantae altera ex Marianis. *Nees*"

Carmona microphylla (Lam.) G. Don, Gen. Syst. 4: 391. 1837; I.M. Johnston, J. Arnold Arbor. 32: 17. 1951; Zhu, Riedl & Kamelin, Fl. China 16: 337. 1995.

Ehretia buxifolia Roxb. var. *microphylla* (Lam.) DC., Prodr. 9: 509. 1845.

Ehretia dentata Cour. in Lecomte, Fl. Indo-Chine 4(2): 206, f. 24 (6-10). 1914 & in Lecomte, Not. Syst. 3: 35. 1914. Syntypes: Laos, *Massis* s.n.; Luang Prabang, *Dupuy* 284; Attopeu, *Harmand* s.n.; Lakhon, *Thorel* s.n.; Vietnam, Cochinchina, Trian, *Pierre* s.n. (K!); Phuoc-than, *Thorel* 1191.

Ehretia buxifolia Roxb. var. *heterophylla* (Spreng.) Gagnep. in Lecomte, Fl. Indo-Chine 4(2): 207. 1914.

Ehretia monopyrena Gottschling & Hilger, Bot. Jahrb. Syst. 123(2): 263. 2001.

Shrubs or small trees 1–2 (–4) m high, branchlets terete, bark brown, hispid, brownish-tomentose, short shoots producing cluster of leaves and inflorescence. *Leaves* with petiole 2–8 mm long; lamina coriaceous, obovate to spatulate, 0.9–4.6 by 1.1–2.4 cm; apex toothed or crenate; base cuneate; margin recurved; upper surface dark green, lustrous, scabrous; lower surface light green, subglabrous; midrib impressed on upper surface; lateral veins in 3–4 pairs, impressed on upper surface, conspicuous on lower surface. *Inflorescences* 1.5–3 cm long, axillary, cymose, with 2–6 flowers. *Peduncle* 1.5–2 cm long, tomentose. *Flowers* with pedicels 1–6 mm long, dark green, tomentose. *Calyx* 4.2–5.5 mm long, tube ca. 1 mm long, lobes linear or linear-spathulate, 3.5–4.2 by 1–1.3 mm, sparsely hispid outside, densely hairy inside, persistent in fruit. *Corolla* 5–6.5 mm long, tube 1.7–2 mm long, lobes spreading, oblong, 2.1–3.5 by 2.5–3 mm, glabrous. *Stamens* 4.7–5 mm long; filaments 3–4 mm long, glabrous, inserted near base of corolla tube; anthers oblong, 1–1.2 mm long. *Ovary* 4-locular, each locule with 1 ovule, ovoid, 0.8–1 mm long; styles 4.5–5 mm long, bifid, branches 4–4.3 mm long, glabrous; stigmas 2, capitate. *Fruits* globose, 3–4 mm long, red or yellow at maturity. Fig. 1.

Thailand.— All provinces.

Distribution.— India, Sri Lanka, Myanmar, Laos, Cambodia, Vietnam, China (Hainan, Kwangtung), Taiwan, Japan (Ryuku Island), Malesia.

Ecology.— Cultivated as ornamentals.

Vernacular.— Khoi chin (ข่อยจีน), Cha yuan (ชาญวน) (Bangkok); Cha (ชา) (Chiang Mai); Cha yipun (ชาญี่ปุ่น), Cha hokkian (ชาฮกเกี้ยน) (Central).

Specimens examined.— *A.F.G. Kerr* 6917 (BK, BM, E, K).

Notes.— The distinguishing characters of *C. retusa* are a few in fascicles and its obovate to spatulate leaves. The species is widely cultivated as ornamental plant.

2. COLDENIA

L., Sp. Pl.: 125. 1753 & Gen. Pl. ed. 5: 61. 1754; C.B. Clarke in Hook.f., Fl. Brit. Ind. 4: 144. 1883; Trimen, Handb. Fl. Ceyl. 3: 196. 1895; Ridl., Fl. Mal. Pen. 2: 442. 1923; I.M. Johnston, J. Arnold Arbor. 32: 12. 1951; Backer & Bakh.f., Fl. Java 2: 460. 1965; Nowicke & Miller in Dassan. & Fosberg, Fl. Ceyl. 7: 22. 1991; Verdcourt, Fl. Trop. E. Afri.: 44. 1991; Zhu, Riedl & Kamelin, Fl. China 16: 337. 1995; Riedl, Fl. Malesiana 13: 67. 1997. Type species: *C. procumbens* L.

Lobophyllum F. Muell. in Hook., J. Bot. Kew Gard. Misc. 9: 21. 1857.

Annual herbs. *Leaves* alternate, small; lamina crenate-dentate to lobulate, oblong or obovate, margin lobed, lateral veins ending in sinuses. *Flowers* solitary, axillary. *Calyx* green, deeply 4-lobed, persistent. *Corolla* white, campanulate, 5-lobed, tube shorter than lobes. *Stamens* 4, separate; filaments attached at middle of corolla tube; anthers rounded, introrse or laterally dehiscent, glabrous. *Ovary* glabrous; styles short; stigmas capitate. *Fruits* fleshy or dry, nutlets, 4-seeded.

A monotypic genus ranging from tropical Africa and Asia to Australia.

1. *Coldenia procumbens* L., Sp. Pl.: 125. 1753; C.B. Clarke in Hook.f., Fl. Brit. Ind. 4: 144. 1883; Trimen, Handb. Fl. Ceyl. 3: 197. 1895; C.B. Rob., Philipp. J. Sc. Bot. 4: 693. 1909; Gagnep. & Cour. in Lecomte, Fl. Indo-Chine 4(2): 213, f. 25 (5-10). 1914 & in Lecomte, Not. Syst. 3: 213. 1914; Ridl., Fl. Mal. Pen. 2: 442. 1923; I.M. Johnston, J. Arnold Arbor. 32: 13. 1951; Backer & Bakh.f., Fl. Java 2: 460. 1965; A. Richardson, Rhodora, 79: 476, f. 2-4. 1977; Nowicke & Miller in Dassan. & Fosberg, Fl. Ceyl. 7: 23. 1991; Verdcourt, Fl. Trop. E. Afri.: 44, f. 11. 1991; Zhu, Riedl & Kamelin, Fl. China 16: 338. 1995; Riedl, Fl. Malesiana 13: 67, f. 3. 1997. Type: Ceylon, Hermann Herbarium (lectotype BM-HERM, chosen by Verdcourt, 1991).

Lobophyllum tetrandrum F. Muell., Hooker's J. Bot. Kew Gard. Misc. 9: 21. 1857. Type: Australia (K!).

Annual prostrate herbs, stems branched from base, greyish hairy. *Leaves* with petiole 0.2–1.5 cm long; lamina slightly thickened, crenate-dentate or lobulate, somewhat oblong or obovate, markedly asymmetric, 1–2 by 0.3–0.6 cm; apex rounded; base obliquely cuneate; upper surface dark green, coarsely strigose between veins, hairs often with bulbous base, spreading on lower surface; midrib impressed on upper surface; lateral veins in 4–6 pairs, impressed on upper surface, conspicuous on lower surface. *Flowers* minute, subsessile, axillary. *Calyx* 2–2.5 mm long, tube ca. 0.5 mm long, lobes lanceolate or ovate-lanceolate; 1.5–2 by 3–5

mm, strigose outside, glabrous inside, persistent in fruit. *Corolla* 1.5–2 mm long, tube *ca.* 1 mm long, lobes suborbicular or ovate, 2.5–5 mm long, glabrous. *Stamens* 5–7 mm long; filaments *ca.* 5 mm long, glabrous, inserted at middle of corolla tube; anthers rounded, 0.1–0.2 mm long. *Ovary* 4-locular, each locule with 1 ovule, pyramidal, 0.5–0.7 mm long; styles *ca.* 1 mm long, bifid nearly to the base, branches 0.3 mm long, glabrous; stigmas 2, capitate. *Fruits* pyramidal, 2–3 mm long, 4-lobed, nutlets breaking, mesocarp corky, glandular-pubescent. Fig. 2.

Thailand.— NORTHERN: Chiang Mai (Bang Nong Jet Noi), Uttaradit, Tak (Ban Na); NORTH-EASTERN: Loei (Phu Kradung), Sakon Nakhon (Phu Pa Yol), Khon Kaen; EASTERN: Surin, Si Sa Ket (Kantarak); CENTRAL: Nakhon Nayok (Khao Yai); SOUTH-EASTERN: Chon Buri (Siracha), Trat (Ko Chang); PENINSULAR: Satun (Tarutao).

Distribution.— Africa, India, Sri Lanka, Myanmar, Laos, Cambodia, Vietnam, China (Hainan), Taiwan, Malesia, Australia.

Ecology.— Scattered along the edge of rice field or sandy places, beaches, mixed evergreen forest, alt. 0–1,100 m.

Vernacular.— Ya tin tukkae (หญ้าตีนตุ๊กแก); Ya tin tukto (หญ้าตีนตุ๊กโต), Ya tupto (หญ้าตุบโต) (Chiang Mai).

Specimens examined.— *D.J. Collins* 2074 (BK, K); *H. Jawaii* 1443 (Biology Herb., Chiang Mai University); *A.F.G. Kerr* 1885 (BM, K), 13943 (BK, K), s.n. (BK); *J.F. Maxwell* 87-369 (BKF), 93-251 (Biology Herb., Chiang Mai University), 04-260 (Biology Herb., Chiang Mai University); *Y. Paisooksantivatana & S. Sutheesorn* y920-82

(BK); *P. Sangkhachand* 197 (BK); *S. Sasirat* 102 (QBG); *T. Smitinand* 4437 (BKF, K), 12405 (BKF); *M.N. Tamura* T-60449 (BKF); *S.N.* 21 (BK); *S.N.* 314 (BK).

Notes — *C. procumbens* is distinctive on account of its procumbent habit and having greyish hairs on stem, leaves and inflorescence. This species is a common weed in dry rice field.

3. EHRETIA

P. Br., *Civ. Nat. Hist. Jam.*: 168. 1756; *L.*, *Syst.*, ed. 10: 936. 1759; *DC.*, *Prodr.* 9: 502. 1845; *Miq.*, *Fl. Ind. Bat.* 2: 919. 1856; *C.B. Clarke* in *Hook.f.*, *Fl. Brit. Ind.* 4: 141. 1883; *Trimen*, *Handb. Fl. Ceyl.* 3: 195. 1895; *Gagnep. & Cour.* in *Lecomte*, *Fl. Indo-Chine* 4(2): 205. 1914; *Ridl.*, *Fl. Mal. Pen.* 2: 441. 1923; *Backer & Bakh.f.*, *Fl. Java* 2: 459. 1965; *Nowicke & Miller* in *Dassan. & Fosberg*, *Fl. Ceyl.* 7: 20. 1991; *Zhu, Riedl & Kamelin*, *Fl. China* 16: 333. 1995; *Riedl*, *Fl. Malesiana* 13: 91. 1997; *Mill* in *Grierson & Long*, *Fl. Bhutan* 2(2): 872. 1999.

Trees or shrubs, *Leaves* alternate, petiolate; lamina elliptic, ovate, obovate, narrowly obovate, broadly lanceolate, oblong-lanceolate, ovate-elliptic, suborbicular or spatulate, margin entire or serrate. *Inflorescences* terminal or axillary, cymose to paniculate. *Flowers* sessile or subsessile, ebracteate. *Calyx* green, deeply 5-lobed, imbricate, persistent. *Corolla* white, orange-white or pale blue, campanulate or funnel-shaped, tubular with 5 spreading to reflexed, exerted or included; filaments attached above middle of corolla tube; anther oblong, introrse, laterally dehiscent, glabrous. *Ovary*

4-locular, each locule with 1 ovule; style 1, terminal, bifid; stigmas 2, capitate. *Fruits* drupe, 4-seeded.

A genus of about 75 species widely distributed in the tropics and subtropics; five species are indigenous to Thailand.

KEY TO THE SPECIES

1. Scandent shrubs, leaves at most 5 cm long **5. *E. winitii***
1. Trees or shrubs, leaves at least 7 cm long 2
2. Leaves serrate to irregularly dentate **1. *E. acuminata***
2. Leaves entire 3
3. Corolla tube twice as long as corolla lobes **2. *E. javanica***
3. Corolla tube shorter than or as long as corolla lobes 4
4. Leaves ovate to lanceolate **3. *E. laevis***
4. Leaves oblanceolate **4. *E. timorensis***

1. *Ehretia acuminata* R. Br., Prodr. 1: 497. 1810; C.B. Rob., Philipp. J. Sc. Bot. 4: 690. 1909; C.B. Clarke in Hook.f., Fl. Brit. Ind. 4: 141. 1883; Gagnep. & Cour. in Lecomte, Fl. Indo-Chine 4(2): 209. 1914; Zhu, Riedl & Kamelin, Fl. China 16: 334. 1995; Riedl, Fl. Malesiana 13: 92. 1997. Type: Australia, Port Jackson, *R. Brown* 2916 (holotype K!, isotype K!).

Ehretia serrata Roxb., [Hort. Beng.: 17. 1810, *nom. nud.*] Fl. Ind., ed. Carey & Wall. 2: 340. 1824; Miq., Fl. Ind. Bat. 2: 920. 1856; Koord., Exk. Fl. Java 3: 127. 1912; Mill in Grierson & Long, Fl. Bhutan 2(2): 875. 1999. Type: Cultivated in Calcutta Bot. Garden.

Ehretia polyantha DC., Prodr. 9: 503. 1845; Miq., Fl. Ind. Bat. 2: 920. 1856. Type: Philippines, Luzon, Manila, *Perrottet* s.n. (GE).

Trees *ca.* 8 m high; bark grey-brown, branchlets terete, greyish, with elliptic lenticels, glabrous. *Leaves* with petiole 1.8–2.7 (–3) cm long, strigose; lamina

subcoriaceous, elliptic to obovate or narrowly obovate, 7–15 by 4–8 cm; apex acute or acuminate; base acute or oblique; margin serrate to irregularly dentate; upper surface dark green, strigose; lower surface light green, strigose; midrib, lateral veins and nervations impressed on upper surface, conspicuous on lower surface; lateral veins in 4–6 pairs. *Inflorescences* 7–10 (–15) cm long, terminal, paniculate, with 30–60 flowers, pubescent. *Peduncle* 1–2 cm long, pubescent. *Flowers* subsessile. *Calyx* campanulate, 3.2–3.6 mm long; tube *ca.* 0.5 mm long; lobes ovate or suborbicular, 2–2.5 by 2–3 mm, pubescent outside, glabrous inside, persistent at fruiting. *Corolla* white, 2–3.8 mm long, short tubular with spreading lobes; tube 1.5–2 mm long; lobes oblong 2–2.5 by 0.8–1 mm. *Stamens* 5, separate, 4.5–5.5 mm long; filaments 3.5–4.5 mm long, glabrous, inserted near base of corolla tube, exserted; anther oblong, 1–1.3 mm long. *Ovary* ovoid, *ca.* 1 mm long; style 3–4

mm long, bifid, branches *ca.* 0.5 mm long, glabrous. *Fruits* subglobose, 3–4 mm long, yellow or orange at maturity.

Thailand.— NORTHERN: Chiang Mai (Doi Suthep-Pui), Chiang Rai (Mae Chan, Doi Luang); SOUTH-WESTERN: Phetchaburi (Pa La U, Kaeng Krachan).

Distribution.— India, China, Vietnam, Malesia, Australia.

Ecology.— In mixed evergreen forest, alt. 300–1,400 m.

Vernacular.— Kai kom (กล้วยคอม).

Specimens examined.— *A.F.G. Kerr* 5142 (BK, BM); *J.F. Maxwell* s.n. (Biology Herb., Chiang Mai University); *M.F. Newman*, *T. Boonthavikoon*, *C. Hemrat* & *D.J. Middleton* 1109 (BKF, E); *N. Morci* 1410 (Biology Herb., Chiang Mai University).

Notes.— *E. acuminata* is easily recognised by its serrate to irregularly dentate leaves.

2. *Ehretia javanica* Blume, Bijdr.: 842. 1826; Backer & Bakh.f., Fl. Java 2: 460. 1965; Riedl, Fl. Malesiana 13: 95. 1997. Type: Indonesia, Java, *Blume* s.n. (holotype L!).

Trees *ca.* 25 m high; bark grey-brown, branchlets terete, reddish brown or greyish brown, with elliptic lenticels, glabrous. *Leaves* with petiole 2.2–2.5 cm long, pubescent; lamina subcoriaceous, obovate, broadly lanceolate or oblong-lanceolate, 7–9 by 3.5–5.5 cm; apex acuminate or obtuse; base acute, rounded or oblique; margin entire; upper surface dark green, glabrous; lower surface light green, minutely pubescent; midrib, lateral veins and nervations impressed on upper surface,

conspicuous on lower surface; lateral veins in 6–8 pairs. *Inflorescences* 4–7 cm long, terminal or axillary, subcorymbose, with 20–30 flowers, pubescent. *Peduncle* 2–4 cm long, pubescent. *Flowers* with pedicels 3–4 mm long, minutely pubescent. *Calyx* cup-shaped, 1.8–2.2 mm long; tube 0.7–1.2 mm long; lobes lanceolate or ovate, 0.8–1 by 0.4–0.6 mm, slightly strigose outside, glabrous inside, persistent at fruiting. *Corolla* orange-white, funnel-shaped, 8–10 mm long; tube cylindrical 5–7 mm long; lobes oblong 1.9–2.2 by 1–2 mm. *Stamens* 5, separate, 7–8 mm long; filaments 6.5–7 mm long, glabrous, inserted near base of corolla tube, included; anther oblong, 0.6–0.8 mm long. *Ovary* ovoid, 1–1.5 mm long; style 6.5–8 mm long, bifid, branches *ca.* 0.6 mm long, minutely pubescent. *Fruits* not seen.

Thailand.— PENINSULAR: Pattani (Khao Kala Khiri).

Distribution.— Malesia.

Ecology.— In evergreen forest, alt. *ca.* 1,500 m.

Specimens examined.— *A.F.G. Kerr* 15006 (BK, BM, K, E).

Notes.— *E. javanica* is easily distinguished by its subcorymbose inflorescence and corolla tube twice as long as corolla lobe.

3. *Ehretia laevis* Roxb., Pl. Corom. 1: 42, t. 56. 1795; Kurz, Forest Fl. Burma 2: 210. 1877; C.B. Clarke in Hook.f., Fl. Brit. Ind. 4: 141. 1883; Trimen, Handb. Fl. Ceyl. 3: 195. 1895; Gagnep. & Cour. in Lecomte, Fl. Indo-Chine 4(2): 208. 1914; I.M. Johnston, J. Arnold Arbor. 32: 107. 1951; Nowicke & Miller in Dassan. & Fosberg, Fl. Ceyl. 7: 21.

1991; Zhu, Riedl & Kamelin, Fl. China 16: 336. 1995; Riedl, Fl. Malesiana 13: 96. 1997; Mill in Grierson & Long, Fl. Bhutan 2(2): 872. 1999. Type: Plate in Roxburgh, t. 56. "Srigade of the Telingas".

Ehretia laevis var. *platyphylla* Merr., Lingnan Sci. J. 14(1): 55. 1935. Type: China, Hainan, Naam Shan Leng, Ngai District, 27 July 1932, S.K. Lau 323 (isotype K!).

Trees 5–10 m high; bark thick, rough, grey-brown, branchlets terete, greyish, with elliptic lenticels, glabrous. *Leaves* with petiole 1–3.5 (–4) cm long, tomentose; lamina coriaceous, ovate-elliptic, obovate or suborbicular, 6–20 by 3.5–11.4 cm; apex obtuse, acuminate, rounded or emarginate; base acute to cuneate or oblique; margin entire; upper surface dark green, glabrous, lustrous; lower surface light green, glabrous, minutely pubescent when young, with hairs in the axils of lateral veins when mature; midrib, lateral veins and nervations impressed on upper surface, conspicuous on lower surface; lateral veins in 4–5 pairs. *Inflorescences* 6–13 cm long, terminal or axillary, cymose, with 9–13 flowers; branches somewhat scorpioid, pubescent. *Peduncle* 1–10 cm long, pubescent. *Flowers* subsessile or with pedicels up to 1 mm long, light green, pubescent. *Calyx* green, campanulate, 1.5–2 mm long; tube 0.5–1 mm long; lobes lanceolate or ovate, 1–1.8 by 0.8–1 mm, strigose outside, glabrous inside, persistent at fruiting. *Corolla* white, 3–4 mm long, short tubular with spreading lobes; tube 1–1.8 mm long; lobes oblong 2–2.2 by 1–1.2 mm. *Stamens* 5 (–6), free, 2.5–4 mm long; filaments 1.8–2.3 mm long, glabrous, inserted near base of corolla tube, exerted;

anther oblong, versatile or basifixed, 0.5–0.8 mm long. *Ovary* 4-locular, each locule with 1 ovule, ovoid, 0.5–1 mm long; style 1–1.8 mm long, bifid, branches ca. 0.3 mm long, glabrous; stigmas 2, capitate. *Fruits* subglobose, 4–5 mm long, yellow or orange at maturity. Figs. 3–4.

Thailand.—NORTHERN: Chiang Mai, Lamphun (Mae Tha), Lampang, Phrae (Mae Yom, Song), Tak (Khao Padang), Phitsanulok (Thung Salang Luang), Nakhon Sawan (Taklee); NORTH-EASTERN: Loei (Ban Hung Quag); EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi (Khao Sahn Chan, Sai Yok), Phetchaburi (Khao Tam Kan Chon, Cha-am), Prachuap Khiri Khan (Hua Hin, Pran Buri); CENTRAL: Saraburi (Sahm Lahn); SOUTH-EASTERN: Chon Buri (Siracha); PENINSULAR: Surat Thani, Phatthalung, Songkhla (Hat Yai).

Distribution.— India, Myanmar, Vietnam, China (Hainan), Malaysia.

Ecology.— Open, dry deciduous or evergreen forest, alt. 50–1,100 m.

Vernacular.— Kom (กุ่ม).

Specimens examined.— *Bunnak* 560 (BK); *K. Bunchuai* 1568 (E); *D.J. Collins* 670 (K), 707 (K), 827 (BK, E), 963 (BK, K), 2045 (BK, BM, K); *A.F.G. Kerr* 2308 (BM, K, E), 2981 (BM, K, E), 3089 (BM, K, E), 3154 (BM, K, E), 3942 (BM, K), 4812 (BK, BM, K, E), 9857 (BK, BM, K, E), 10134 (BK, BM, K, E), 10580 (BK, BM), 12260 (BK, BM, K, E), 13584 (BK, K, E), 18179 (BK, BM-2 sheets, K), 19933 (BK, BM); *M.C. Lakshnakara* 1403 (BK, BM, K); *A. Marcan* 369 (BM-2 sheets, K), 2675 (BM, K); *J.F. Maxwell* 74-112 (BK), 74-243 (BK),

85-108 (BKF), 93-1473 (Biology Herb., Chiang Mai University), 96-659 (BK, Biology Herb., Chiang Mai University), 05-23 (Biology Herb., Chiang Mai University), 05-227 (Biology Herb., Chiang Mai University); *C. Niyomdham* 4876 (BKF); *S. Phengnaren* 142 (BKF); *Put* 1503 (BK, BM, K), 2152 (BK, BM, K, E), 2444 (BM, K, E), 2819 (BK, BM, K, E); *D.D. Soejarte, T. Smitinand, T. Santisuk & K. Taylor* 5763 (BKF); *S. Sutheesorn* 457 (BK), 2944 (BK); *K. Suvarnasudthi* 109 (BKF); *Vanpruk* 169 (K); 760 (BKF, K); *Winit* 35 (BM), 246 (BM), 247 (BM).

Notes.— *E. laevis* is similar to *E. timorensis* in having cymose inflorescence and corolla tube which is shorter than corolla lobes, but it differs in its ovate to lanceolate leaves and pubescent inflorescence branches.

4. *Ehretia timorensis* Decne., *Nouv. Ann. Mus. Par.* 3: 395. 1834, *Ridl., Fl. Mal. Pen.* 2: 442. 1923, *Ng, Tree Fl. Mal.* 4: 63. 1989; *Dayang Awa in Soepadmo, Wong & Saw, Tree Fl. Sabah & Sarawak* 2: 101. 1996; *Riedl, Fl. Malesiana* 13: 98. 1997. Type: Timor, *Anon.* s.n. (holotype P).

Ehretia laevis var. *timorensis* (Decne.) C.B. Clarke in *Hook.f., Fl. Brit. Ind.* 4: 142. 1883; *King, J. Asiat. Soc. Beng.* 74, extra no.: 493: 1906.

Trees 5–15 m high; bark grey-brown; branchlets terete, greyish, glabrous. *Leaves* with petiole 1.5–1.7 cm long, pubescent; lamina subcoriaceous, elliptic, ovate to obovate, 5–15 by 2.5–6 cm; apex acuminate; base acute, acuminate or oblique; margin entire; upper surface dark green, glabrous; lower surface light green, minutely pubescent;

midrib, lateral veins and nervations impressed, slightly grooved on upper surface, conspicuous on lower surface; lateral veins in 5–7 pairs. *Inflorescences* 3–8 cm long, terminal or axillary, cymose, with 30–60 flowers; branches somewhat scorpioid, glabrous. *Peduncle* 0.7–2 cm long, glabrous. *Flowers* subsessile or with pedicels up to 0.5 mm long, glabrous. *Calyx* campanulate, 1.3–1.5 mm long; tube 0.4–0.5 mm long; lobes lanceolate, 0.4–0.8 by 0.4–0.5 mm, strigose outside, glabrous inside, persistent at fruiting. *Corolla* white, 2–3 mm long, short tubular with spreading lobes; tube 0.7–1.5 mm long; lobes oblong 1.3–1.5 by 1–1.2 mm. *Stamens* 5, separate, 1.5–3 mm long; filaments 1.8–2.3 mm long, glabrous, inserted near base of corolla tube, exerted; anther oblong, 0.5–0.8 mm long. *Ovary* ovoid, ca. 1 mm long; style 2.5–3 mm long, bifid, branches ca. 1 mm long, glabrous. *Fruits* subglobose, 6–10 mm long, yellow or orange at maturity.

Thailand.— NORTHERN: Sukhothai; EASTERN: Nakhon Ratchasima (Tachang); SOUTH-WESTERN: Kanchanaburi (Ban Keng); CENTRAL: Saraburi (Sahm Lahn); SOUTH-EASTERN: Chon Buri (Siracha, Sattahip); PENINSULAR: Chumphon, Surat Thani (Koh Tao), Trang (Khao Chong).

Distribution.— Malesia.

Ecology.— In evergreen forest, open, rocky area in the hardwood forest, along roadsides, alt. 100–400 m.

Vernacular.— Kai kom (กำยคอม).

Specimens examined.— *D.J. Collins* 1709 (BK, K), 1808 (BK, K); *A.F.G. Kerr* 11237 (BK, K, E), 12993 (BM), 17662 (BM), 19833 (BK, BM-2 sheets, K); *A. Marcan*

2560 (BM, K); *J.F. Maxwell* 71-609 (BK), 73-677 (BK); *P. Sangkhachand* 2242 (BK); *S. Suthesorn* 2860 (BK); *Vacharapong* 67 (BK).

Notes.—*E. timorensis* is closely related to *E. laevis* but differs in having elliptic, ovate to obovate leaves with acuminate apex.

5. *Ehretia winitii* Craib, Bull. Misc. Inform., Kew 1922: 172. 1922. Type: Thailand, Kanchanaburi, 27 December 1916, *Winit* 532 (holotype K!).

Scandent shrubs, climbing up to 4 m; branchlets terete, greyish, with elliptic lenticels, pubescent. *Leaves* with petiole 2–9 mm long, pubescent; lamina chartaceous, obovate or spatulate, 2–5.2 by 1.5–2.5 cm; apex mucronate; base cuneate or attenuate; margin entire; upper surface dark green, glabrous, lustrous; lower surface light green, with hairs in the axils of lateral veins; midrib, lateral veins and nervations impressed on upper surface, conspicuous on lower surface; lateral veins in 3–6 pairs. *Inflorescences* 2.3–4 cm long, terminal or axillary, cymose, with 9–30 flowers. *Peduncle* 0.5–2 cm long, pubescent. *Flowers* with pedicels 1–3 mm long, light green, pubescent. *Calyx* green, campanulate, 8–9 mm long; tube ca. 0.5 mm long; lobes lanceolate or ovate, 2–2.5 by 0.8–1 mm, strigose outside and ciliate on the margin, glabrous inside, persistent at fruiting. *Corolla* white or pale blue, funnel-shaped; tube 3–5.5 mm long; lobes shorter than tube, oblong 2–3.5 by 1.5–2 mm. *Stamens* 5, free, 3.2–4 mm long; filaments 2.5–3.2 mm long, glabrous, inserted near base of corolla tube, exserted; anther oblong, versatile or basifixed, 1–1.4 mm long. *Ovary* 4-locular, each locule

with 1 ovule, ellipsoid, ovoid, 0.8–1 mm long; style 4–4.8 mm long, bifid, branches ca. 1 mm long, glabrous; stigmas 2, capitate. *Fruits* subglobose, 4.5–5 mm long, orange at maturity. Fig. 5.

Thailand.— NORTHERN: Nakhon Sawan (Doi Kun Ming, Taklee); SOUTH-WESTERN: Kanchanaburi, Ratchaburi, Prachuap Khiri Khan (Khao Lommuak); CENTRAL: Pathum Thani (Samkhok); PENINSULAR: Songkhla.

Distribution.— Endemic.

Ecology.— Common by the rice fields, in open jungle.

Vernacular.— Chan nam (จันทน์).

Specimens examined.—*N. Aggimarangsee* 1017 (Biology Herb., Chiang Mai University); *A.F.G. Kerr* 5976 (BK, BM, K), 9046 (BK, BM, K, E), 19756 (BK, BM, K); *A. Marcan* 1003 (BM-2 sheets); *T. Smitinand* 11348 (BKF); *M. van de Bult* 754 (Biology Herb., Chiang Mai University); *Winit* 532 (K); *T. Wongprasert* s.n. (BKF).

Notes.— *E. winitii* is distinguishable from the other species by its obovate or spatulate leaves and mucronate apex.

4. ROTULA

Lour., Fl. Cochinch. 1: 121. 1790; C.B. Rob., Philipp. J. Sc. Bot. 4: 693. 1909; I.M. Johnston, J. Arnold Arbor. 32: 14. 1951; Nowicke & Miller in Dassan. & Fosberg, Fl. Ceyl. 7: 7. 1991; Riedl, Fl. Malesiana 13: 114. 1997. Type species: *Rotula aquatica* Lour.

Rhabdia Mart., Nov. Gen. 2: 136, t. 195. 1827; C.B. Clarke in Hook.f., Fl. Brit. Ind. 4: 144. 1883; Vidal, Rev. Pl. Vasc. Filip.: 194:

1886; Trimen, Handb. Fl. Ceyl. 3: 197. 1895; Gagnep. & Cour. in Lecomte, Fl. Indo-Chine 4(2): 214. 1914; Ridl., Fl. Mal. Pen. 5: 323. 1925. Type species: *Rhabdia lycioides* Mart. [= *Rotula aquatica* Lour.].

Shrubs or trailing vines. *Leaves* alternate, crowded on short branches; lamina oblanceolate to oblong. *Inflorescences* terminal or axillary. *Flowers* subsessile. *Calyx* green, 5-lobed, persistent. *Corolla* pink to purplish, campanulate, 5-lobed, tube shorter than lobes. *Stamens* 5, free, exserted, filaments attached above middle of corolla tube; anthers oblong, dehiscent, glabrous. *Ovary* glabrous; styles terminal; stigmas subcapitate. *Fruits* drupe 4-lobed, breaking up into 4 pieces.

A genus of about three species widely distributed in SE Asia, Africa and Brazil; one species is indigenous to Thailand.

1. *Rotula aquatica* Lour., Fl. Cochinch.: 121. 1790; C.B. Rob., Philipp. J. Sc. Bot. 4: 693. 1909; Alston in Trimen, Handb. Fl. Ceyl. 6: 200. 1931; I.M. Johnston, J. Arnold Arbor. 32: 15. 1951; Nowicke & Miller in Dassan. & Fosberg, Fl. Ceyl. 7: 7. 1991; Zhu, Riedl & Kamelin, Fl. China 16: 337. 1995; Riedl, Fl. Malesiana 13: 115, f. 11. 1997. Type: Vietnam, Cochinchina (BM!).

Rhabdia lycioides Mart., Nov. Gen. 2: 136, t. 195. 1827; C.B. Clarke in Hook.f., Fl. Brit. Ind. 4: 145. 1883; Vidal, Rev. Pl. Vasc. Filip.: 194: 1886; Trimen, Handb. Fl. Ceyl. 3: 197. 1895; Gagnep. & Cour. in Lecomte, Fl. Indo-Chine 4(2): 214, f. 25/12-18. 1914. Type: Brazil, Bahia, *Martius*.

Zombiana africana Baill., Hist. Des Pl. 4: 421. 1888; Rolfe in Thiselton-Dyer, Fl.

Trop. Afr. 5: 263. 1900. Type: Upper Guinea, Niger Territory, *Barter* 1143 (K!).

Ehretia aquatica (Lour.) Gottschling & Hilger, Bot. Jahrb. Syst. 123(2): 263. 2001.

Shrubs with many elongate, mostly glabrous, grey or black-grey; branchlets terete, brownish, strigose, short shoots producing cluster of leaves. *Leaves* with petiole 0.1–0.4 cm long; lamina subcoriaceous, oblanceolate to oblong, 0.3–0.8 by 1–2.2 cm; apex obtuse or acute; base cuneate or obtuse; margin entire; upper surface dark green, strigose; lower surface light green, strigose or villose; midrib impressed on upper surface, conspicuous on lower surface; lateral veins in 3–5 pairs. *Inflorescences* terminal or axillary, cymes, with 2–3 flowers. *Peduncle* subsessile, tomentose. *Flowers* with pedicels 2–3 mm long, light green, tomentose. *Calyx* 2.8–3.2 mm long; tube ca. 1 mm long; lobes lanceolate or ovate, 3.5–4 by 1–1.5 mm long, villous outside, glabrous inside, persistent at fruiting. *Corolla* 3.3–4 mm long; tube ca. 1 mm long; lobes rounded, 2.3–3 by 1.8–2 mm long, glabrous. *Stamens* 4.5–5 mm long; filaments 3–4 mm long, glabrous, attached above middle of corolla tube; anthers oblong, 1–1.2 mm long. *Ovary* 4-locular, each locule with 1 ovule, ovoid or ellipsoid, 0.5–0.8 mm long; styles 3–3.5 mm long, undivided, glabrous; stigma 1, capitate. *Fruits* subglobose, 3–4 mm long, red or orange at maturity. Fig. 6.

Thailand.— NORTHERN: Lampang (Ban Wang Hin, Thoen), Tak; SOUTH-WESTERN: Kanchanaburi (Kwae Noi River, Sangkhla Buri, Sisawat, Takanun);

CENTRAL: Nakhon Nayok, Krung Thep Maha Nakhon; PENINSULAR: Chumphon (Ban Kraye, Lang Suan, Leao Lom Falls), Ranong (Khlung Naka, Kapoe), Surat Thani.

Distribution.— India, Sri Lanka, Myanmar, Laos, Vietnam, China, Malesia.

Ecology.— In evergreen forest along sandstone river, alt. 50–400 m.

Vernacular.— Khrai hang nak (ไคร้หางนาค).

Specimens examined.— *Bunnak* 567 (BK); *C. Chermisrivathana* 695 (BK); *Domrongsak* 152 (BKF); *R. Geesink & T. Santisuk* 4910 (BKF, K); *R. Geesink, P. Hiepko & C. Phengkklai* 7580 (BKF, K); *A.F.G. Kerr* 11975 (BK), 16272 (BK, BM); *A. Kostermans* 531 (BK, K); *J.F. Maxwell* 73-57 (BK), 94-18 (Biology Herb., Chiang Mai University); *W. Nanakorn et al.* 8895 (QBG); *B. Nimanong* 64 (BKF); *R. Pooma, V. Chaemchumroon, N. Koonkhunthod & P. Chantaboon* 3728 (BKF); *Prayad* 782 (BK); *B. Sangkhachand* 1157 (BKF); *T. Santisuk* 589 (BKF); *Th. Sørensen, K. Larsen & B. Hansen* 2092 (BKF); *T. Smitinand* 4163 (BKF); *S. Sutheesorn* 2484 (BK); *K. Suvatabandhu* 500 (BK); *A. Ubolchalaket* s.n. (K); *C.F. van Beusekom* 3458 (K); *C.G.G.J. van Steenis* 19578 (K); *Winit* 1625 (BK).

Notes.— *R. aquatica* is characterized by its short shoots producing cluster of leaves and inflorescence with 2–3 flowers.

ACKNOWLEDGEMENTS

We thanks the Directors, Curators and the staff of BCU, BK, BKF, BM, E, K, KKU and QBG herbaria and Department of Biology Herbarium, Chiang Mai University for their facilities. We also thank the TRF/BIOTEC Special Programme for Biodiversity Research and Training grant (BTRR_151001) for supporting excursions to the fields.

REFERENCES

- Gottschling, M. & Hilger, H.H. 2001. Phylogenetic analysis and character evolution of *Ehretia* and *Bourreria* (Ehretiaceae, Boraginales) and their allies based on ITS1 sequences. **Botanische Jahrbücher für Systematik Pflanzengeschichte und Pflanzengeographie** 123(2): 249-268.
- Johnston, I.M. 1951. Studies in the Boraginaceae, XX Representatives of three subfamilies in Eastern Asia. **Journal of Arnold Arboretum** 32(2): 99-122.
- Miller, J.S. 2007. New Boraginales from Tropical America 5: new names and typification for neotropical species of *Cordia* and *Varronia*. **Novon** 17(3): 372-375.
- Riedl, H. 1997. Boraginaceae. **Flora Malesiana, Series I**, 13: 43-144.
- Ruengsawang, K. & Chantaranothai, P. 2009. A revision of Boraginaceae subfamily Boraginoideae in Thailand. **Thai Journal of Botany** 1(2): 89-101.
- Thiers, B. 2010. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available Source: <http://sweetgum.nybg.org/ih/>. October 27, 2010.



FIGURES 1–6 1. *Carmona retusa*, 2. *Coldenia procumbens*, 3. – 4. *Ehretia laevis*, 5. *E. winitii*, 6. *Rotula aquatica*.