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RESEARCH ARTICLE

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Taxonomic revision of the genus *Microcos* (*Malvaceae-Grewioideae*) in Peninsular Malaysia and Singapore

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Key words

Malvaceae-Grewioideae
Microcos
Peninsular Malaysia
Singapore
taxonomic revision

Abstract A revision of the genus *Microcos* in Peninsular Malaysia and Singapore was conducted resulting in the recognition of twelve species. Six taxa (*M. antidesmifolia* var. *antidesmifolia*, *M. fibrocarpa*, *M. lanceolata*, *M. latifolia*, *M. laurifolia* and *M. tomentosa*) are common and occur more or less throughout Peninsular Malaysia. Four species (*M. globulifera*, *M. hirsuta*, *M. latifolia* and *M. tomentosa*) are recorded for Singapore. One species (*M. riparia*) is newly recorded for Peninsular Malaysia, and two species (*M. erythrocarpa* and *M. malayana*) are endemic to Peninsular Malaysia. A complete list of exsiccatae, key, nomenclatural typification and synonymy, descriptions and illustrations are provided for all twelve species.

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INTRODUCTION

The genus *Microcos* L. was founded by Linnaeus (1753) based on a Sri Lankan species, *M. paniculata* L. In 1767, however, Linnaeus reduced *Microcos* to the synonymy of *Grewia* L. In the past few decades, this reduction has generated a widespread controversy with regard to the delimitation and taxonomic status of *Microcos* and *Grewia*. Recently, Bayer et al. (1999), Chung (2002, 2003, 2006), Bayer & Kubitzki (2003), Chung et al. (2003, 2005a, b), Cheek (2007) and Mabberley (2008) concluded that based on morphological, wood anatomical, leaf epidermal, pollen morphological characters and combined analyses of plastid *atp*B and *rbc*L DNA sequences, *Microcos* and *Grewia* should be treated as two distinct genera.

Microcos species are found mainly in the Malesian region, with their centre of distribution probably in Borneo. Burret (1926), using morphological characters of the flower (such as the pedicel length, stamen number, ovary shape, ovule number per locule and style length), recognised two subgenera: subg. *Microcos* Burret (species from Africa, Asia and West Malesia) and subg. *Eumeriandra* Burret (species from the Moluccas and New Guinea).

Up to 2010, a total of 97 binomials for *Microcos* had been published, representing taxa from tropical Africa to Indo-Malesia (Bayer & Kubitzki 2003, International Plant Names Index 2010). About 50 binomials have been published for plants from South-East Asia, of which 11 were attributed to Peninsular Malaysia and Singapore (Burret 1926, Turner 1993, 1997, Turner et al. 1997). In this paper, we recognise 12 species in Peninsular Malaysia and Singapore.

MATERIAL AND METHODS

This work was carried out without any attempt to revise or to monograph the genus *Microcos* on a world scale. However, in order to establish the correct taxonomic status of the recognised species occurring in Peninsular Malaysia and Singapore, other specimens including that of the type species of the genus were examined. For this purpose herbarium specimens referable to the genus were examined from various herbaria. All specimens cited have been seen by the authors. The dimensions given in the descriptions are for dried material except for the gynoecium and androecium characters which are of rehydrated flowers or from spirit collections.

The descriptions were based on herbarium specimens and thus all colours given are for dried material. Terminology and definitions used mainly follow Lawrence (1951), Benson (1957) and Radford et al. (1974). Specimen citations and herbarium acronyms follow Holmgren et al. (1990). Nomenclature follows the rules as accepted by the International Code of Botanical Nomenclature of Vienna (McNeill et al. 2006).

Two basic inflorescence structures are found in *Microcos* (Chung 2003, Chung et al. 2005b): 'Type A panicle' of triflorous cyme-like units where only first-order branches are conspicuous and the cyme-like units being borne terminally on these first-order branches, and 'Type B panicle' of triflorous cyme-like units where at least two orders of branching are conspicuous and the cyme-like units are terminally borne on the second-order branching (Fig. 1a–d).

Degrees of lobing (Benson 1957) in stipules, bracts and involucral bracts are defined as follows: lobed, with the indentations extending to 1/4 the distance to the base; cleft, with the indentations reaching between 1/4 and nearly 1/2 the distance to the base; parted, with the indentations running between 1/2 and 3/4 the distance to the base; and divided, with the indentations running practically more than 3/4 the distance to the base (Fig. 1e–h).

Pseudostalk of fruit is defined as basal extension of fruit derived from androgynophore.

MICROCOS

Microcos L. (1753) 514; (1754) 230; Burret (1926) 756; Backer & Bakh.f. (1964) 393; Whitmore & Tantra (1986) 241; Phengklai (1986) 15; (1993) 33; I.M.Turner (1997) 487. — *Grewia* L. subg. *Microcos* (L.) J.R.Drumm. (1915) 114. — *Grewia* L. sect. *Microcos* (L.) Wight & Arn. (1834) 81; King (1891) 109. — Type species: *Microcos paniculata* L.

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Arsis Lour. (1790) 335. — Type species: *Arsis rugosa* Lour. [= *Microcos paniculata* L.].

Fallopia Lour. (1790) 335. — Type species: *Fallopia nervosa* Lour. [= *Microcos nervosa* (Lour.) S.Y.Hu].

Omphacarpus Korth. (1842a) t. 42; (1842b) 192. — *Grewia* L. sect. *Omphacarpus* (Korth.) Miq. (1859) 204; King (1891) 109. — Type species: *Omphacarpus opacus* Korth. [= *Microcos opaca* (Korth.) Burret].

Inodaphnis Miq. (1861) 357. — Type species: *Inodaphnis lanceolata* Miq. [= *Microcos lanceolata* (Miq.) Burret].

Grewia L. p.p.: King (1891) 108, p.p.; Ridl. (1922) 299, p.p.; Corner (1939) 262, p.p.; Kochummen (1973) 396, p.p.; Corner (1988) 732, p.p.

Evergreen or deciduous shrubs or small to medium-sized trees to 30 m tall; bole usually straight to 60(–70) cm diam, sometimes fluted at base, sometimes with small buttresses. *Outer bark* smooth to scaly, sometimes lenticellate, green, grey-green or green-brown; inner bark fibrous, red-brown to orange-yellow or even paler and then streaked red; no exudate. *Twigs* terete. *Stipules* lobed or unlobed, more or less caducous. *Leaves* alternate (distichous), petiolate; blade simple, usually entire or sometimes distantly serrate to serrulate, dentate or undulate, 3(–5)-veined at base (Peninsular Malaysia and Borneo: 3-veined); indumentum of simple, tufted or stellate hairs. *Inflorescences* terminal and/or axillary, panicles of triflorous cyme-like units (Type A and/or Type B); bracts caducous, rarely persistent; bracts of cyme-like units involucrate, with those of the outer whorl 2–3(–4)-lobed and that of the inner whorl narrow and entire. *Flowers* bisexual, actinomorphic, pedicellate; sepals 5, distinct, free, valvate, margin incurved, apex convex-cucullate, covered with tufted or stellate hairs on both sides; petals 5 or fewer due to abortion or absent, caducous, up to half as long as the sepals, clawed-appendage absent, glandular at the base inside, the glands barbellate marginally; androgynophore present, apex expanded into a platform-like structure or not, upper part absent; stamens numerous, rarely 5–15 (for Moluccas and New Guinea taxa), inserted at the platform-like structure or surrounding the ovary at the apex of androgynophore, filaments distinct, sometimes minutely pilose beneath, anthers dorsifixed, 2-lobed, kidney-shaped, longitudinally dehiscent; ovary superior, sessile, usually (1–)3(–5)-locular, each locule with (2–)4–8 ovules; style narrowed towards the apex (subulate), stigma with 3 plano-convex stigmatic arms or inconspicuously lobulate. *Fruits* drupaceous, usually unlobed or sometimes slightly, shallowly, vertically 3(–4)-lobed near the apex, globose, obovoid or pyriform; mesocarp fibrous; endocarp coriaceous or woody. *Pyrenes* 1–3(–4), partly connate or free; fertile pyrene 1–(2–3) per fruit, each pyrene containing 0–1(–2) seeds; sterile pyrenes 1–2(–3), conspicuous or inconspicuous. *Seeds* wingless, with endosperm; cotyledons foliaceous.

Distribution — The genus comprises about 80 species occurring in tropical Africa (not in Madagascar), India, Sri Lanka, Myanmar, Indochina (Thailand, Laos, Cambodia and Vietnam), southern China (incl. Hainan Island), and throughout Malesia (except the Lesser Sunda Islands). In Malesia, about 52 species are known with two centres of species diversity: 36 species in West Malesia and 16 species in the Moluccas and New Guinea. In Peninsular Malaysia there are 12 species with 2 endemics and Singapore has four species (none endemic).

Habitat & Ecology — In open and shaded places, often along rivers or streams, in primary and secondary lowland to lower montane forests on alluvial to sandy soils; overlying sandstone or acidic rock, but not on limestone, at altitude to 1400 m. Flowering: mainly in March–July; fruiting: May–November.

Uses — The wood of several *Microcos* species is used locally for general construction under cover (e.g., rafters), and also for making small utensils where strength and elasticity are required, like tool handles, agricultural implements, sporting goods, billiard cues and vehicle bodies. The fibrous bark is utilised for manufacturing ropes and the fruits of most species are reported as edible. The pulped bark is used in Papua New Guinea to stupefy fish (Boer & Sosef 1998).

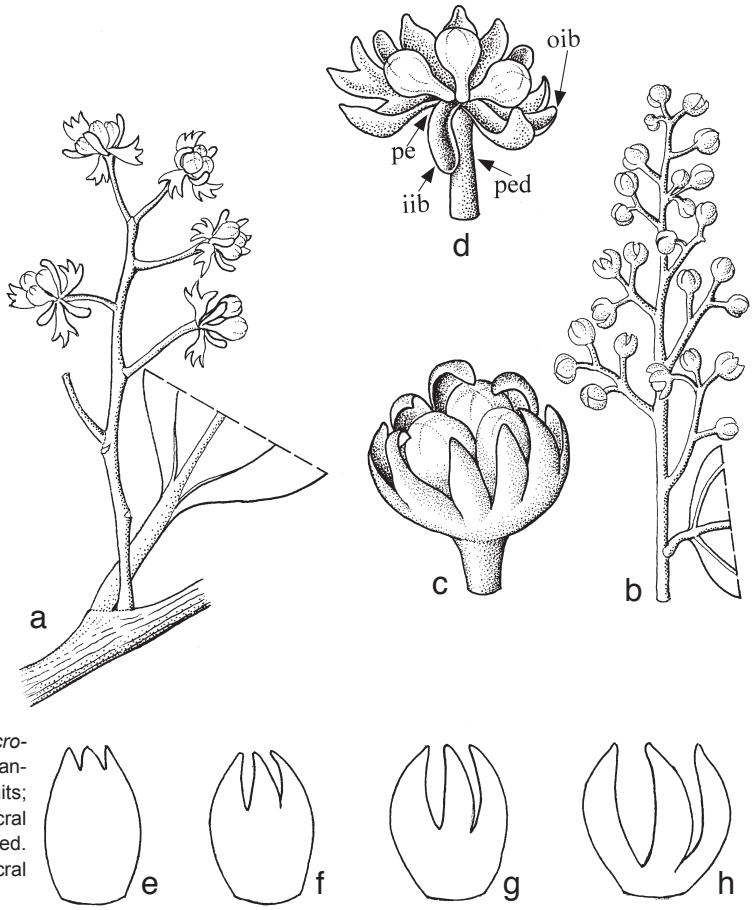


Fig. 1 Type of inflorescences (a–d) and degrees of lobing (e–h) of *Microcos* species. a. Type A panicle with triflorous cyme-like units; b. Type B panicle with triflorous cyme-like units; c. almost open triflorous cyme-like units; d. open triflorous cyme-like units showing the outer and inner involucral bracts as well as buds and pedicels; e. lobed; f. cleft; g. parted; h. divided. Abbreviations used: pe = pedicel; ped = peduncle; iib = inner involucral bract; oib = outer involucral bract. — Drawn by J. Pao, SAR.

KEY TO THE SPECIES

1. Leaf margin serrate to dentate towards apex, jaggedly toothed far apart or undulate and entire on the lower half. Fruits subglobose to obovoid, drying curved striate, 0.5–1.2 by 0.4–0.9 cm . . . . . 12. *M. tomentosa*
1. Leaf margin almost entire or rarely minutely or obscurely serrulate. Fruits pyriform, obovoid or ellipsoid, drying smooth or with shallow vertical lobes, 1.5–3 by 0.7–2.5 cm 2
2. Fruits pyriform, with 4–10 mm long pseudostalk 3
2. Fruits obovoid or ellipsoid, without pseudostalk 6
3. Stipules persistent, obovate, more than 4 mm wide. Leaves coriaceous; midrib distinctly raised and sharp beneath; petioles glabrous. Bracts obovate, more than 4 mm wide . . . . . 8. *M. latistipulata*
3. Stipules caducous or persistent, lanceolate, less than 2 mm wide. Leaves chartaceous to subcoriaceous; midrib raised but not sharp beneath; petioles hairy to glabrescent. Bracts narrowly oblong, less than 1 mm wide 4
4. Leaves chartaceous; midrib flattened above; petioles apically not swollen . . . . . 1. *M. antidesmifolia*
4. Leaves subcoriaceous; midrib raised or impressed and rarely flattened above; petioles apically swollen for 5–10 mm . 5
5. Leaf acumen blunt; midrib raised above; secondary veins 5–7 pairs. Flower buds oblong, 2.5–3.5 mm wide; sepals lanceolate; androgynophore concave in outline; style sparsely covered with stellate hairs at base to between 0.25 and 0.5 of its length and glabrous towards apex. Infructescence glabrous. Fruits smooth; mesocarp 5–6 mm thick. Pyrene 1; fertile pyrene 1, sterile pyrene inconspicuous . . . . . 11. *M. riparia*
5. Leaf acumen pointed; midrib impressed and rarely flattened above; secondary veins 3–4 pairs. Flower buds obovoid, 1.5–2 mm wide; sepals narrowly oblong to oblanceolate; androgynophore obovate in outline; style glabrous. Infructescence densely minutely covered with stellate hairs. Fruits with 2–3 shallow vertical furrows; mesocarp 1–1.5 mm thick. Pyrenes 3; fertile pyrenes 1–2, sterile pyrenes conspicuous . . . . . 9. *M. laurifolia*
6. Endocarp woody. Pyrenes 2–3; 1–2 sterile pyrenes conspicuous 7
6. Endocarp coriaceous. Pyrene 1; sterile pyrene inconspicuous 8
7. Leaves chartaceous or subcoriaceous; midrib raised and glabrous above. Androgynophore cylindrical in outline, 0.2–0.3 mm long; ovary transversely elliptic with 3 shallow ridges in cross section. Pyrenes 2; sterile pyrene 1 6. *M. lanceolata*
7. Leaves coriaceous; midrib impressed and hairy above. Androgynophore concave in outline, 1–1.3(–2) mm long; ovary oblate in cross section. Pyrenes 3; sterile pyrenes 2 . . . . . 7. *M. latifolia*
8. Leaf margin minutely or obscurely, distantly serrulate, undulate; midrib and secondary veins impressed above . . . . . 3. *M. fibrocarpa*
8. Leaf margin entire; midrib flattened above; secondary veins flattened to inconspicuous above 9
9. Leaf base subcordate and rarely obtuse; basal pair of secondary veins reaching almost or slightly more than 0.25 of blade length. Flower-bud globose to narrowly oblong or obovoid; sepals oblanceolate; androgynophore striate to grooved 10
9. Leaf base obtuse to rounded; basal pair of secondary veins reaching between 0.25 and 0.5 of blade length. Flower-bud oblong; sepals linear to oblong; androgynophore smooth 11
10. Stipules caducous. Inflorescences (2–)5–8(–10) cm long. Flower buds globose to narrowly oblong; petals oblong, 1.4–1.7 mm wide, glands circular; ovary globose, circular in cross section. Fruits obovoid. Known from lower montane forest . . . . . 2. *M. erythrocarpa*
10. Stipules persistent. Inflorescences 13–15 cm long. Flower buds obovoid; petals lanceolate, 0.4–0.8 mm wide, glands ellipsoid to broadly ellipsoid; ovary ellipsoid, elliptic in cross section. Fruits ellipsoid. Known from lowland forest . . . . . 10. *M. malayana*
11. Leaves minutely scabrous or sparsely covered with simple and tufted hairs above; blade elliptic to broadly elliptic or sometimes slightly obovate, acumen blunt; petioles densely covered with tufted hairs. Inflorescences 4–8(–12) cm long; involucral bracts of outer whorl rugose. Ovary ovoid, elliptic in cross section . . . . . 4. *M. globulifera*
11. Leaves glabrous above; blade narrowly elliptic to narrowly oblong, acumen pointed; petioles densely covered with stellate hairs. Inflorescences (1–)1.5–3(–6) cm long; involucral bracts of outer whorl smooth. Ovary ellipsoid, circular in cross section . . . . . 5. *M. hirsuta*

1. *Microcos antidesmifolia* (King) Burret

Microcos antidesmifolia (King) Burret (1926) 780; I.M.Turner (1997) 487; R.C.K.Chung et al. (2005b) 105. — *Grewia antidesmifolia* King (1891) 113 (as '*antidesmaefolia*'); Ridl. (1922) 302; Kochummen (1973) 397, p.p.; (1997) 428; Corner (1988) 733. — Lectotype (Chung et al. 2005b): *King's Collector 4029* (holo K), Peninsular Malaysia, Perak, Larut.

Medium-sized tree to 24 m tall, dbh to 50 cm; buttresses occasionally present, short plank-like. *Outer bark* smooth to minutely dippled, greenish grey to greyish brown; inner bark pinkish brown to orange-brown, fibrous; sapwood pale yellow to whitish. *Twigs* striate, greyish brown or pale brown to brown, densely or sparsely covered with stellate hairs when young, glabrescent when older. *Stipules* unlobed, early caducous or persistent. *Leaves* greenish brown or pale green to olive-green on both sides, chartaceous, glabrous or sparsely covered with stellate hairs on midrib and secondary veins above, glabrous or sparsely covered with stellate hairs beneath; petioles (5–)6–20(–25) mm long, 1–1.5(–2) mm thick, olive-green or brown to dark brown when dried, apically not swollen, densely or sparsely covered with stellate hairs to glabrescent; blade narrowly elliptic or oblong, equilateral or inequilateral, (7.5–)9–22(–27) by (3–)4–8(–9) cm, base cuneate or obtuse to rounded, margin entire, not ciliate, apex acute or acuminate, acumen 0.5–1.5 cm long with a blunt tip; midrib and secondary veins flattened above, raised beneath, secondary veins 5–7(–8) pairs, basal pair reaching between 0.5 and 0.75 of blade length, forming an angle to 45° with the midrib; domatia absent or pocket-type and hairy inside, or sometimes covered with stellate hairs without pocket, in axils of basal vein pair and other veins beneath; tertiary veins reticulate, inconspicuous above, conspicuous or obscure beneath. *Inflorescences* Type A and/or Type B panicles, terminal or axillary, (1.5–)2–7.5(–10) cm long, densely covered with stellate hairs; bracts unlobed, narrowly oblong, 3–4 by 0.8–1 mm, densely covered with stellate hairs on both sides, caducous; involucral bracts of outer whorl 2.5–4.5 mm long, (2–)3-lobed or (2–)3-cleft, lobes lanceolate to ovate, 0.5–1.5 mm long, apex acute, smooth outside, densely covered with stellate hairs on both sides, that of inner whorl oblanceolate, narrowly oblong or rarely linear, 1.5–4 by (0.2–)1–1.5 mm, apex acute, obtuse or obliquely truncate, densely covered with stellate hairs on both sides. *Flower buds* oblong or occasionally ellipsoid, 2–4(–5.5) by 1–2.2(–2.5) mm, densely covered with stellate hairs; pedicels 0.5–1.5(–2) mm long, 0.4–0.9 mm thick, densely covered with stellate hairs; sepals narrowly

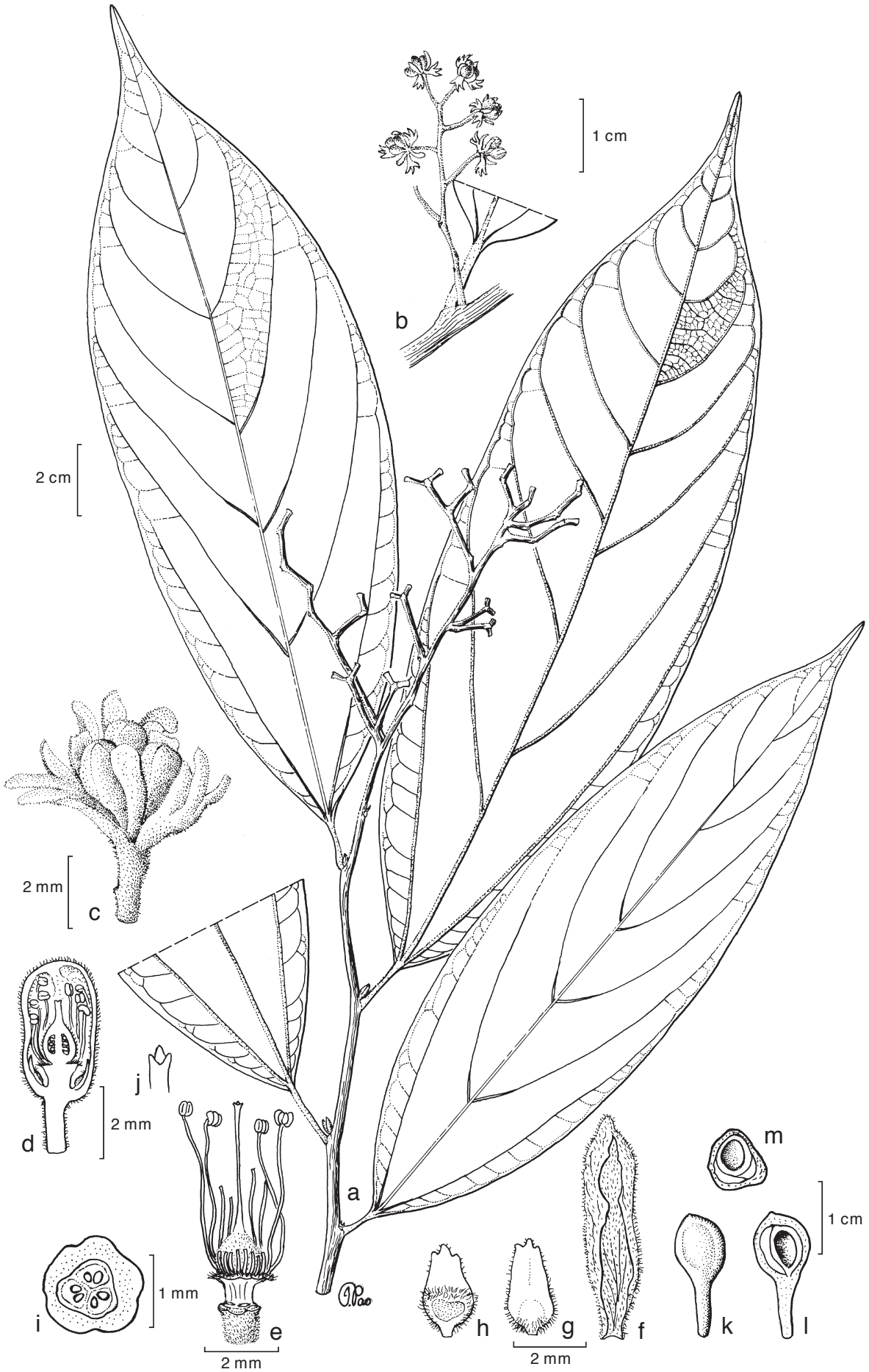


Fig. 2 *Microcos antidesmifolia* (King) Burret var. *antidesmifolia*. a. Fruiting leafy twig; b. flowering leafy twig; c. flower buds surrounded by involucral bracts; d. longitudinal section of mature flower bud; e. flower with sepals and petals removed; f. adaxial surface of sepal; g. abaxial surface of petal; h. adaxial surface of petal; i. cross section of ovary; j. stigma; k. fruit; l. longitudinal section of fruit; m. cross section of fruit (a, k–m: *Stevens et al. 90*; c: *Cockburn FRI 7816*; b, d–j: *King's Coll. 4029*). — Drawn by J. Pao, SAR

oblong, oblong or oblanceolate, 3–6(–6.5) by 0.7–1.5(–2) mm, densely covered with stellate hairs outside, sparsely covered with stellate hairs inside; petals absent or 5, elliptic, oblong or obovate, 1.2–2.5 by 0.7–1 mm, apex obtuse, rounded or truncate (1–2-lobed), outside sparsely covered with glandular trichomes or sparsely covered with stellate hairs near base and sparsely covered with glandular trichomes towards the apex, inside densely covered with stellate hairs around the glands reaching between 0.5 and 0.75 of its length and sparsely covered with glandular trichomes towards the apex; glands globose, broadly ovoid or broadly depressed ovoid; androgynophore concave in outline, 0.5–1.5 mm long, 0.5–1 mm diam, very shallowly longitudinally grooved, glabrous, apical part expanded into a platform-like structure of c. 0.3 mm wide with undulate rim covered with stellate hairs; stamens with filaments 2.5–4.2 mm long, glabrous or sparsely covered with stellate hairs at base to c. 0.25 of its length and glabrous towards the apex, anthers c. 0.2 mm diam; ovary 3(–4)-locular, ovoid or subglobose to globose, 0.7–1.5 mm diam, oblate, depressed ovate or depressed obovate in cross section, densely covered with stellate hairs (in buds), glabrescent or sparsely covered with glandular trichomes (in flowers); style 1.5–3.2 mm long, glabrous. *Infructescences* sparsely covered with stellate hairs. *Fruits* ripening orange to red, pyriform, with 3–4 shallow vertical lobes, 1.5–2.5 by 0.7–1.5 cm, drying dark brown to black, glabrous; apex obtuse to rounded or with tiny beaked; pseudostalk narrowed, 4–10 mm long; exocarp membranous; mesocarp 1–2 mm thick; endocarp 0.5–1 mm thick, woody. *Pyrenes* 3–4, partly connate or free; fertile pyrenes 1–2(–3), 1-seeded, 7–10 mm long; sterile pyrenes 1–2(–3), conspicuous; pyrenes arranged triangularly, with the fertile one larger than the sterile pyrenes.

Distribution — Peninsular Malaysia and Borneo.

Note — Two varieties are recognised and can be distinguished by the characters shown in the key below.

KEY TO VARIETIES

1. Older twigs glabrous. Leaves glabrous beneath, equilateral; domatia present. Filaments glabrous; ovary oblate in cross section . . . . . a. var. *antidesmifolia*
1. Older twigs densely or sparsely covered with stellate hairs. Leaves sparsely covered with stellate hairs beneath, inequilateral; domatia absent. Filaments sparsely covered with stellate hairs at base to c. 0.25 of its length and glabrous towards the apex; ovary depressed ovate or depressed obovate in cross section . . . . . b. var. *hirsuta*

a. var. ***antidesmifolia*** — Fig. 2; Map 1

Twigs sparsely covered with stellate hairs when young, glabrous when older. *Stipules* early caducous. *Leaves*: petioles (8–)9–20(–25) mm long; blade glabrous on both sides, equilateral; domatia pocket-type and hairy inside, or sometimes covered with stellate hairs without pocket. *Inflorescences* Type B panicles; involucral bracts of inner whorl oblanceolate or rarely linear, 3–4 by (0.5–)1–1.5 mm, apex obtuse or obliquely truncate. *Flower buds* 2.5–4(–5.5) by 1.8–2.2(–2.5) mm; sepals narrowly oblong or oblanceolate, 5–6(–6.5) by 1–1.5(–2) mm; petals 5, oblong or obovate, 2–2.5 by 0.7–1 mm, apex obtuse or truncate (with 1–2-lobed), outside covered with stellate hairs around the base, inside densely covered with stellate hairs around the glands to c. 0.5 of its length; androgynophore 0.8–1.5 mm long; stamen filaments glabrous; ovary 3-locular, 0.7–1(–1.2) mm diam, oblate in cross section, densely covered with stellate hairs (in buds) and glabrescent (in flowers). *Fruits* with 3 shallow vertical lobes. *Pyrenes* 3, 1 fertile, 2 sterile.

Distribution — Endemic to Peninsular Malaysia and widely distributed (Kedah, Perak, Kelantan, Terengganu, Pahang, Selangor and Johor).

Habitat & Ecology — In alluvial freshwater swamp forest, dipterocarp and secondary forests; near river banks, to 650 m altitude. Flowering: January–May, October; fruiting: February–July, November.

Vernacular names — Chenderai, damak-damak (Malay).

Uses — Fruits subedible (*Stone & Chin 13853*).

b. var. ***hirsuta*** (King) Burret — Fig. 3, Map 1

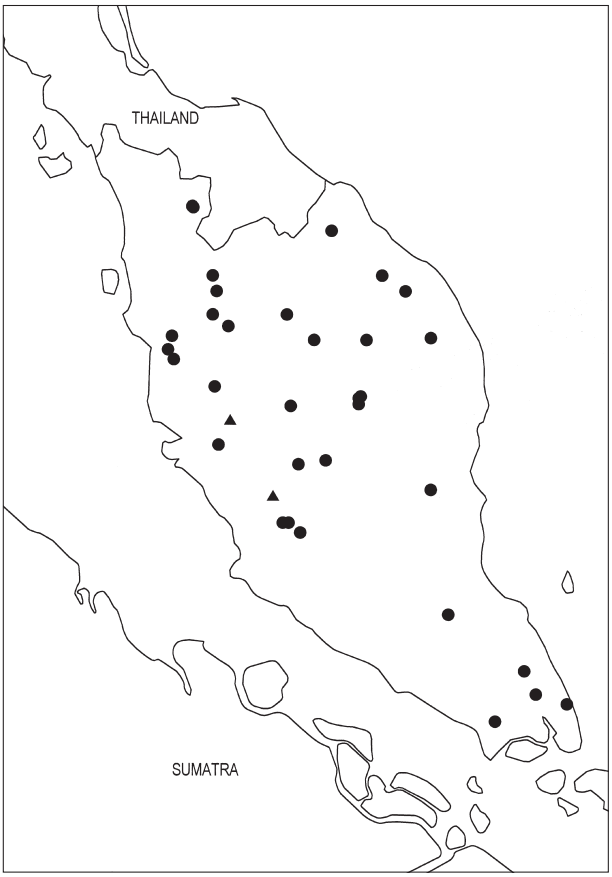
Microcos antidesmifolia var. *hirsuta* (King) Burret (1926) 780; R.C.K.Chung et al. (2005b) 106. — *Grewia antidesmifolia* King var. *hirsuta* King (1891) 113; Ridl. (1933) 489. — Lectotype (Chung et al. 2005b): *King's Collector 10185* (holo K), Peninsular Malaysia, Perak.

Microcos elmeri Merr. (1929) 186; Masam. (1942) 450; Coode et al. (1996) 323, p.p. — *Grewia elmeri* (Merr.) P.S.Ashton (1988) 443. — Type: *Elmer 20911* (A, BO, GH, K, L, NY, SING, UC), Borneo, Sabah, Tawau.

Microcos creaghii Ridl. (1933) 490; Masam. (1942) 449. — Type: *Creagh s.n.* (K), Borneo, Sabah, Sandakan.

Grewia antidesmifolia auct. non King (1891): Kochummen (1973) 397, p.p. (excl. *G. antidesmifolia* var. *hirsuta*).

Twigs densely or sparsely covered with stellate hairs. *Stipules* lanceolate, 4–10 by 1–2 mm, apex acute or obtuse, sparsely covered with stellate hairs on both sides, caducous to persistent. *Leaves*: petioles (5–)6–10(–15) mm long; blade glabrous or sparsely covered with stellate hairs on midrib and secondary veins above, sparsely covered with stellate hairs beneath, inequilateral; domatia absent. *Inflorescences* Type A and Type B panicles; involucral bracts of inner whorl narrowly oblong, 1.5–2 by 0.2–0.4 mm, apex acute. *Flower buds* 2–3.5 by 1–1.8 mm; sepals oblong, 3–4.5 by 0.7–2 mm; petals absent or 5, elliptic or oblong, 1.2–1.5 by 0.8–1 mm, apex rounded, outside sparsely covered with glandular trichomes all over, inside



Map 1 Distribution of *M. antidesmifolia* (King) Burret: var. *antidesmifolia* (●) and var. *hirsuta* (King) Burret (▲) in Peninsular Malaysia.

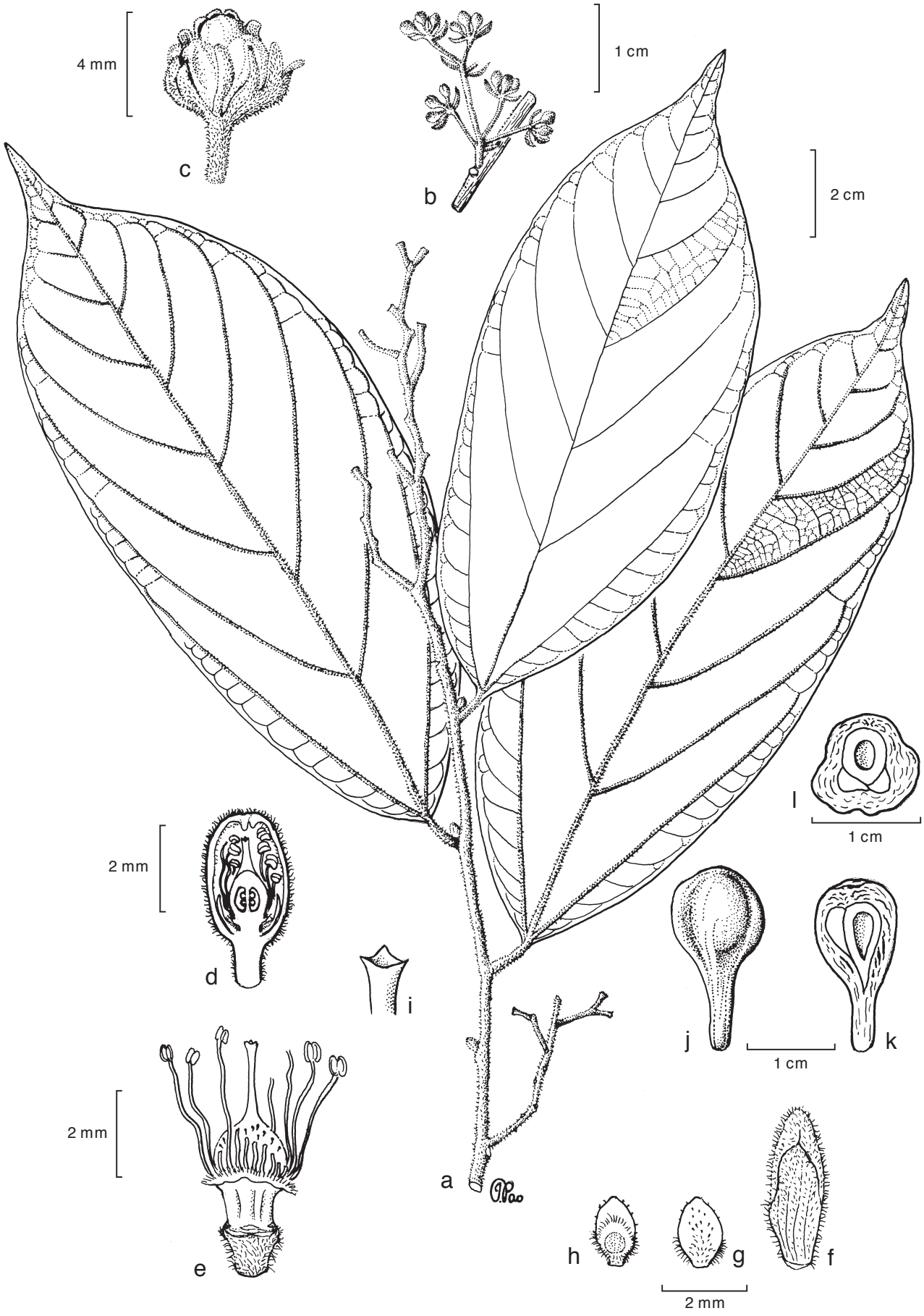


Fig. 3 *Microcos antidesmifolia* (King) Burret var. *hirsuta* (King) Burret. a. Fruiting leafy twig; b. flowering leafy twig; c. flower buds surrounded by involucral bracts; d. longitudinal section of flower bud; e. flower with sepals and petals removed; f. adaxial surface of sepal; g. abaxial surface of petal; h. adaxial surface of petal; i. stigma; j. fruit; k. longitudinal section of fruit; l. cross section of fruit (a: *Kadir SAN A 2893*; b: *Enggoh FMS 48988*; c–i: *Elmer 20911*; j–l: *Castro SAN A 819*). — Drawn by J. Pao, SAR.

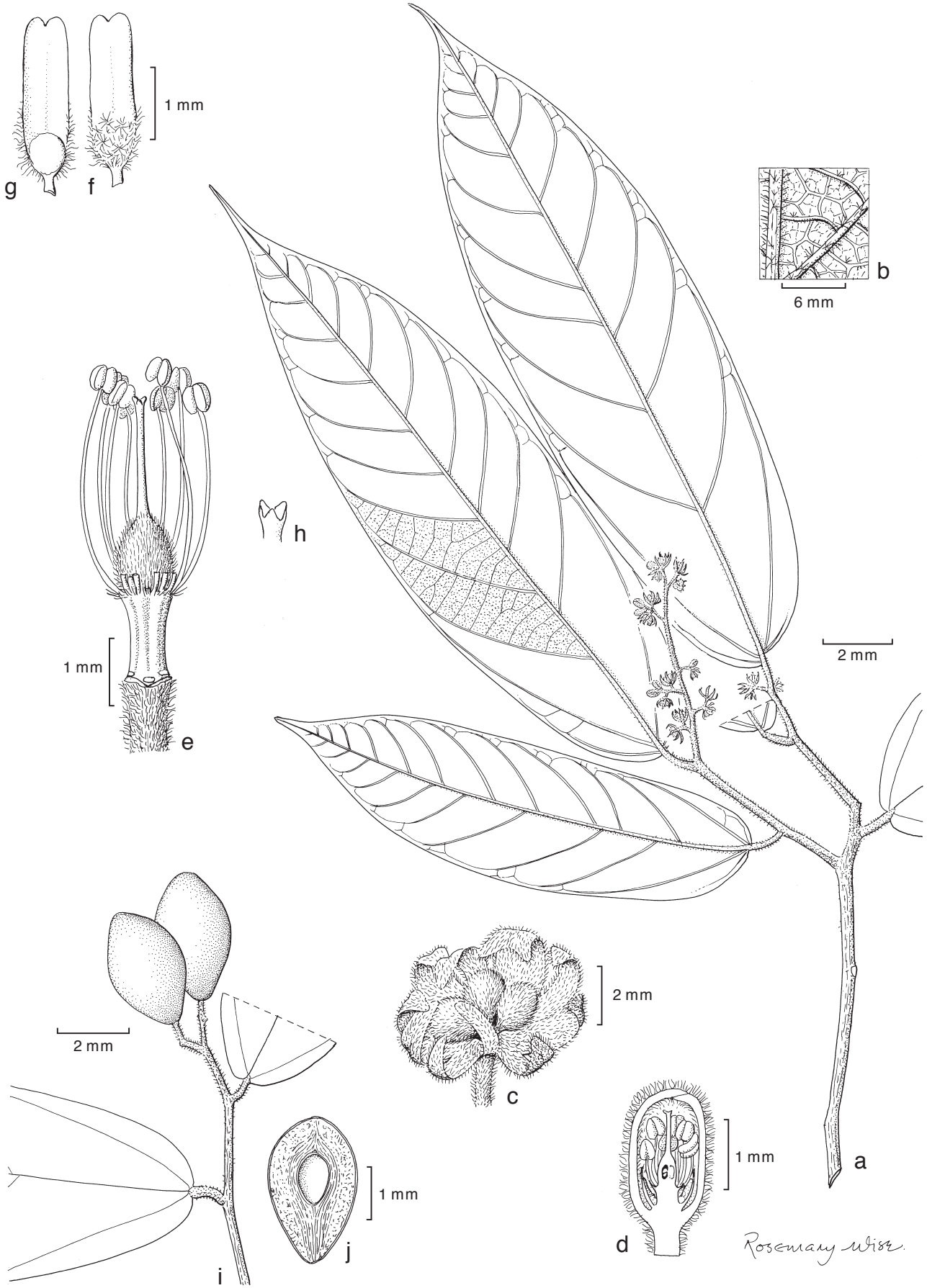


Fig. 4 *Microcos erythrocarpa* (Ridl.) Airy Shaw. a. Flowering leafy twig; b. detail of abaxial leaf surface near midrib; c. flower buds surrounded by involucral bracts; d. longitudinal section of flower bud; e. flower with sepals and petals removed; f. abaxial surface of petal; g. adaxial surface of petal with gland at base; h. stigma; i. fruiting leafy twig; j. longitudinal section of fruit (a, b, e–h: *Kochummen FRI 2980*; c, d: *Kochummen FRI 16417*; i, j: *Kochummen FRI 29363*). — Drawn by R. Wise, FHO.

densely covered with stellate hairs around the glands to c. 0.75 of its length; androgynophore 0.5–0.8 mm long; stamens with filaments sparsely covered with stellate hairs at base to c. 0.25 of its length and glabrous towards the apex; ovary 3(–4)-locular, 0.8–1.5 mm diam, depressed ovate or depressed obovate in cross section, covered with stellate hairs or sparsely covered with glandular trichomes. *Fruits* with 3–4 shallow vertical lobes. *Pyrenes* 3–4, 1–2(–3) fertile, 1–2(–3) sterile.

Distribution — Peninsular Malaysia (confined to Perak and Selangor) and Borneo.

Habitat & Ecology — In alluvial freshwater swamp forest and mixed dipterocarp forest on yellow clay or brown to black soil; on hillsides, ridges or along riversides, at 150–900 m altitude. Flowering and fruiting almost all year round.

Uses — Ripe fruits edible.

2. *Microcos erythrocarpa* (Ridl.) Airy Shaw — Fig. 4; Map 2

Microcos erythrocarpa (Ridl.) Airy Shaw (1949) 160; I.M.Turner (1997) 487. — *Grewia erythrocarpa* Ridl. (1920) 174, p.p. (quoad specim. *Ridley 15908*); Ridl. (1922) 301, p.p.; Burret (1926) 731 (as an excluded species); Kochummen (1973) 397. — Lectotype (designated here): *Ridley 15908* (holo K; iso SING), Peninsular Malaysia, Selangor, Sempang Mines.

Small tree to 8 m tall, dbh to 4 cm; buttresses absent. *Twigs* smooth, dark brown, densely covered with tufted hairs when young, glabrescent or glabrous when older. *Stipules* unlobed, lanceolate, 9–12 by 2–2.5 mm, apex acuminate, densely covered with tufted hairs on both sides, caducous. *Leaves* yellowish green or olive-green on both sides, chartaceous, glabrous or densely covered with simple and tufted hairs on midrib and glabrescent on secondary veins above, glabrous or sparsely covered with simple and tufted hairs on midrib and secondary veins beneath; petioles (7–)8–11(–13) mm long, (1–)1.3–2(–2.5) mm thick, yellowish brown to dark brown, apically not swollen, densely covered with tufted hairs; blade narrowly lanceolate to lanceolate or sometimes elliptic, inequilateral, (10–)13–27(–31) by (3–)4.5–7(–8) cm, base subcordate or rarely obtuse, margin entire, not ciliate, apex acuminate, acumen 1–2 cm long with a pointed tip; midrib flattened above, raised beneath; secondary veins (5–)8–10(–13) pairs, slightly conspicuous or inconspicuous above, prominent beneath, basal pair reaching almost or slightly more than 0.25 of blade length, forming an angle of 45° with the midrib; domatia absent; tertiary veins reticulate, inconspicuous above, conspicuous beneath. *Inflorescences* Type A and Type B panicles, terminal and rarely axillary, (2–)5–8(–10) cm long, densely covered with tufted hairs; bracts unlobed, lanceolate, (6–)8–10(–12) by 2–2.5(–3) mm, densely covered with tufted hairs on both sides, often persistent; involucral bracts of outer whorl 4–6.5 mm long, 2–3-divided, lobes oblong, 3–5 mm long, apex acute, smooth outside, densely covered with tufted hairs on both sides, that of inner whorl oblanceolate, 5–7 by 1–1.8 mm, apex acute, densely or sparsely covered with tufted hairs on both sides. *Flower buds* globose or narrowly oblong, 2–3 by 1.5–2 mm, densely covered with tufted hairs; pedicels 0.5–1.5 mm long, 0.5–0.9 mm thick, densely covered with tufted hairs; sepals oblanceolate, 5.5–7 by 0.8–1.5 mm, densely covered with tufted hairs outside, sparsely covered with tufted hairs inside; petals 5, oblong, 2–2.3 by 1.4–1.7 mm, apex emarginate or shallowly 2-lobed, outside sparsely covered with tufted hairs at base to c. 0.25 of its length and glabrous towards the apex, inside densely covered with tufted hairs around the glands and glabrous towards the apex, glands globose; androgynophore concave in outline, 1–1.3 mm long, c. 0.5 mm diam, shallowly longitudinally grooved with 5 ridges, glabrous, apical part not expanded outwards, with entire rim covered with tufted hairs or glabrescent; stamens with filaments 2.8–3.5 mm long, glabrous, anthers c. 0.5 mm diam; ovary 3-locular, globose, 1–1.2 mm diam, circular in cross section, densely covered with tufted hairs; style 2.5–3 mm long, glabrous. *Infructescences* densely covered with tufted hairs. *Fruits* ripening bright red, obovoid, smooth, 2.5–3 by 1.5–2.5 cm, drying brown-black or black, glabrous; apex rounded, without pseudostalk; exocarp membranous and soft; mesocarp 4–5 mm thick; endocarp thin-coriaceous. Fertile *pyrene* 1, 1-seeded, 6–8 mm long; sterile pyrene inconspicuous.

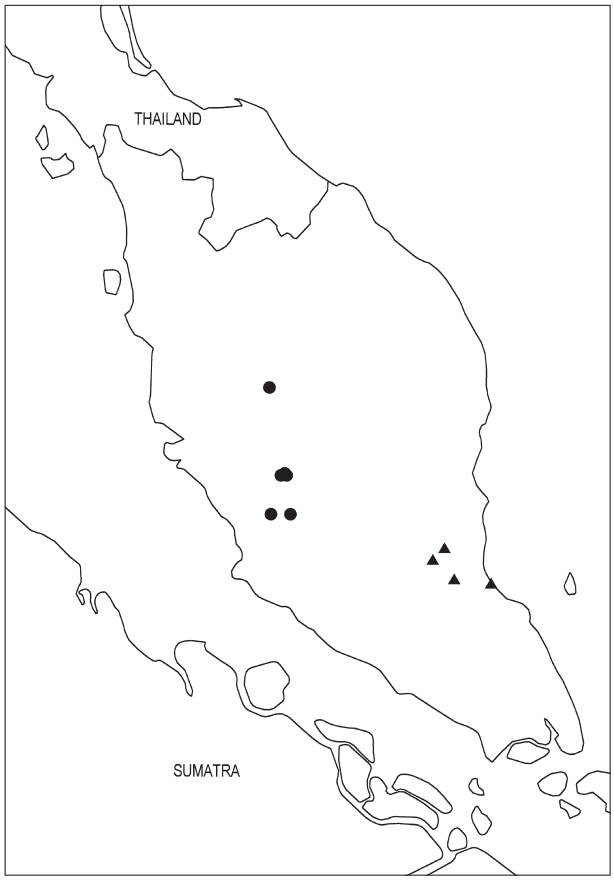
Distribution — Endemic to Peninsular Malaysia. Found in Perak, Pahang (Fraser's Hills, Cameron Highlands and Genting Highlands only) and Selangor.

Habitat & Ecology — In mixed dipterocarp and lower montane forests; on ridges and hill slopes, at 900–1400 m altitude. Flowering: March–May, July–September; fruiting: April, July–September, December.

Vernacular name — Damak (Malay).

Notes — Ridley (1920) cited *Wray 599* as one of the syntypes of *G. erythrocarpa.* This collection, however, differs from *M. erythrocarpa* in the vegetative and reproductive characters, and should be included in *M. fibrocarpa*.

Similar to *M. malayana* (a lowland forest species) but can be easily distinguished by its caducous stipules, smaller leaves with shorter acumen, as well as by floral and fruit characters.



Map 2 Distribution of *Microcos erythrocarpa* (Ridl.) Airy Shaw (●) and *M. riparia* (Boerl. & Koord.) Burret (▲) in Peninsular Malaysia.

3. *Microcos fibrocarpa* (Mast.) Burret — Fig. 5; Map 3

Microcos fibrocarpa (Mast.) Burret (1926) 782; Phengklai (1986) 54, f. 24; (1993) 38, f. 24; I.M.Turner (1997) 487; R.C.K.Chung et al. (2005b) 108. — *Grewia fibrocarpa* Mast. (1874) 391; King (1891) 111; Ridl. (1922) 301; Kochummen (1973) 397; Corner (1988) 733. — Lectotype (Chung et al. 2005b): *Maingay 1080* (holo K [with flower buds and fruits]; iso K, 2 sheets), Peninsular Malaysia, Malacca.

Grewia erythrocarpa Ridl. (1920) 174, p.p. (quoad specim. *Wray 599*); Ridl. (1922) 301, p.p.

Small tree to 15 m tall, dbh to 20 cm; buttresses to 60 cm high. *Outer bark* smooth or dippled, greyish brown to brown; inner bark orange-red to brown; sapwood white; heartwood light red. *Twigs* smooth, greyish brown to brown, densely covered with tufted hairs when young, glabrescent when older. *Stipules* 4–7 mm long, 4–6-parted, lobes linear, 3–6 mm long, densely covered with tufted hairs on both sides, caducous to persistent. *Leaves* yellowish green to olive-green on both sides, chartaceous, minutely scabrous or densely covered with simple and tufted hairs on midrib and secondary veins above, densely covered with soft simple and tufted hairs beneath; petioles (5–)7–15 mm long, 1.5–2.5(–3) mm thick, yellowish brown, apically not swollen, densely covered with tufted hairs; blade elliptic, oblong, or sometimes broadly elliptic, obovate or rarely ovate, equilateral or sometimes inequilateral, (11–)13–24(–29) by 4–10(–12) cm, base obtuse or rounded, margin distantly and obscurely serrulate, undulate, ciliate, apex shortly and abruptly acuminate, acumen (0.5–)1–2.5(–3) cm long with a pointed tip; midrib and secondary veins impressed above, raised beneath; secondary veins 7–10 pairs, basal pair reaching between 0.25 and 0.5 of blade length, forming an angle of 45° with the midrib; domatia absent; tertiary veins (sub-)scalariform, slightly impressed and obscure above, thin but prominent beneath. *Inflorescences* Type A and Type B panicles, terminal or axillary, (1–)2–5(–6) cm long, densely covered with tufted hairs; bracts 4–6-parted, lobes linear or lanceolate, 2–6 mm long, densely covered with tufted hairs on both sides, persistent or caducous; involucral bracts of outer whorl 5–6 mm long, 2-parted, lobes narrowly elliptic or oblanceolate, 3–4 mm long, apex acute, smooth outside, densely covered with tufted hairs on both sides, that of inner whorl lanceolate, 3.5–6 by 1–1.5 mm, apex acute, densely covered with tufted hairs on both sides. *Flower buds* obovoid, 4–8 by 3.5–5 mm, densely covered with tufted hairs; pedicels 0.9–1.2 mm long, c. 1 mm thick, densely covered with tufted hairs; sepals linear or elliptic, 8–11 by 2–2.5 mm, densely covered with tufted hairs outside, sparsely covered with tufted hairs inside; petals 5, oblong, 2–3.3 by 0.5–1 mm, apex truncate, outside sparsely covered with tufted hairs at base to c. 0.25 of its length and glabrous towards the apex, inside densely covered with tufted hairs around the glands to c. 0.5 of its length and glabrous towards the apex; glands obovoid; androgynophore concave in outline, 1–1.5 mm long, 0.5–0.8 mm diam, striate, glabrous, apical part slightly expanded outwards, with undulate rim covered with tufted hairs; stamens with filaments 4.5–5.5 mm long, glabrous, anthers c. 0.5 mm diam; ovary 3-locular, broadly ovoid or globose, 1.5–2 mm diam, broadly ovate in cross section, densely covered with tufted hairs; style 4–5 mm long, glabrous. *Infructescences* densely covered with tufted hairs. *Fruits* ripening orange to red, obovoid, smooth, 2–3 by 1–2 cm, drying yellowish brown, densely covered with tufted hairs; apex rounded, without pseudostalk; exocarp membranous; mesocarp 4–6 mm thick; endocarp thin-coriaceous. Fertile *pyrene* 1, 1-seeded, 7–10 mm long; sterile pyrene inconspicuous.

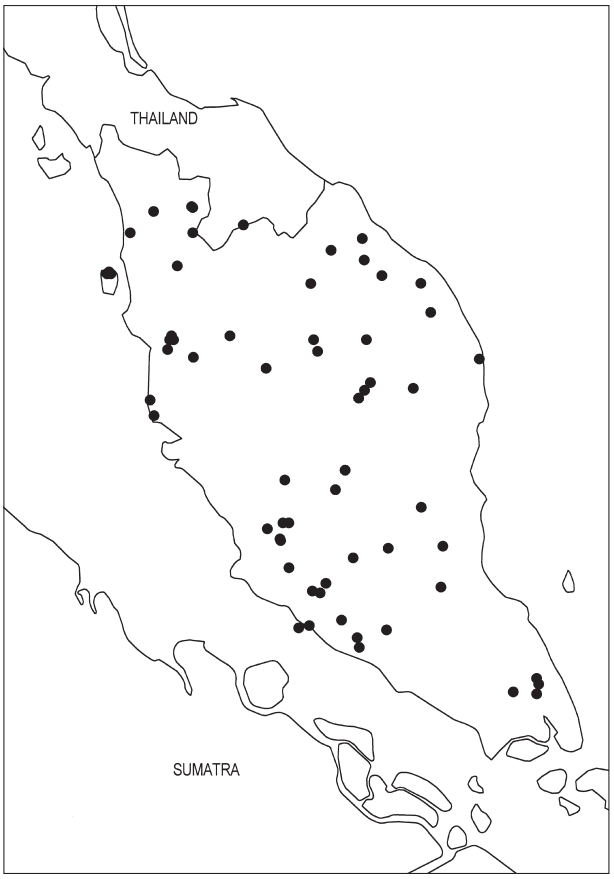
Distribution — Peninsular Thailand, Peninsular Malaysia and Borneo.

Habitat & Ecology — In mixed dipterocarp forest on sandstone or acidic rock; on gently sloping hillsides, ridge tops or sometimes along river banks, at 90–600 m altitude. Flowering and fruiting all year round.

Vernacular names — Asam damat, chenderai asam, chenderai hutan, chenderai paya, chenderai rimba, damak-damak asam, damak-damak bulu (Malay).

Uses — Ripe fruits edible (*Mohd. Shah & Ahmad MS 3241*, *Van Balgooy 2195* and *Whitmore FRI 12845*).

Note — This species is morphologically similar to *M. globulifera* (see note under *M. globulifera*).



Map 3 Distribution of *Microcos fibrocarpa* (Mast.) Burret in Peninsular Malaysia.

4. *Microcos globulifera* (Mast.) Burret — Fig. 6; Map 4

Microcos globulifera (Mast.) Burret (1926) 779; I.M.Turner (1997) 487; I.M.Turner et al. (1997) 3. — *Grewia globulifera* Mast. (1874) 391; King (1891) 112; Ridl. (1922) 302; Kochummen (1973) 397. — Lectotype (designated here): *Maingay 1576* (holo K; iso K), Peninsular Malaysia, Malacca.
Microcos blattaefolia (Corner) R.S.Rao (1949) 299, p.p. (quoad specim. *Maingay 245* et *Maingay 1576A*).

Medium-sized tree to 18(–21) m tall, dbh to 25(–40) cm; buttresses absent, with slightly fluted bole at the base. *Outer bark* smooth and sparsely lenticellate, brownish grey to reddish brown; inner bark light brown to brown, outer part granular, inner part fibrous; sapwood pale yellow to white; heartwood pale brown. *Twigs* smooth, greyish brown to dark brown, densely covered with tufted hairs when young, glabrescent or glabrous when older. *Stipules* early caducous. *Leaves* yellowish green to olive-green on both sides, subcoriaceous, minutely scabrous or sparsely covered with simple and tufted hairs on midrib and secondary veins above, sparsely covered with simple and tufted hairs beneath; petioles (10–)11–18(–23) mm long, (1.5–)2–2.5(–3) mm thick, yellowish brown to brown, apically not swollen, densely covered with tufted hairs; blade elliptic to broadly elliptic or sometimes slightly obovate, inequilateral, (10–)12–23(–25) by (7–)8–12(–14) cm, base rounded or sometimes obtuse, margin entire, not ciliate, apex acute or sometimes shortly and abruptly acuminate, acumen 0.5–1(–1.5) cm long with a blunt tip; midrib and secondary veins flattened above, raised beneath; secondary veins 7–9 pairs, basal pair reaching between 0.25 and 0.5 of blade length, forming an angle of more than 45° with the midrib; domatia absent; tertiary veins scalariform, obscure above, rather thin but conspicuous beneath. *Inflorescences* Type B panicles, 4–8(–12) cm long, terminal and axillary, densely covered with tufted hairs; bracts

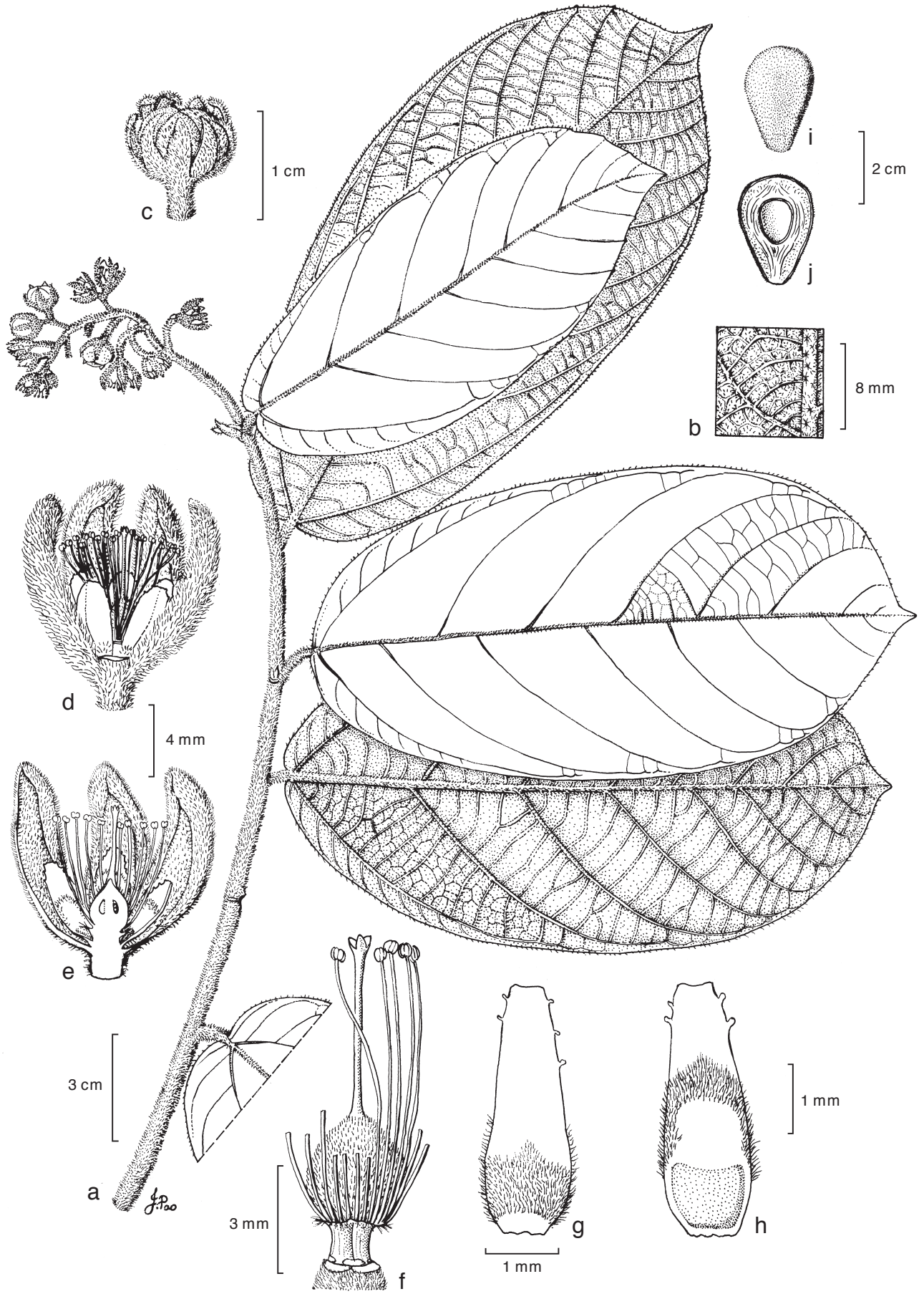


Fig. 5 *Microcos fibrocarpa* (Mast.) Burret. a. Flowering leafy twig; b. detail of abaxial leaf surface near midrib; c. flower buds surrounded by involucral bracts; d. flower; e. longitudinal section of flower; f. flower with sepals and petals removed; g. abaxial surface of petal; h. adaxial surface of petal with gland at base; i. fruit; j. longitudinal section of fruit (a–d, f–h: *Maingay 1082*; e: *Chan FRI 6730*; i, j: *Kiah SFN 32009*). — Drawn by J. Pao, SAR.

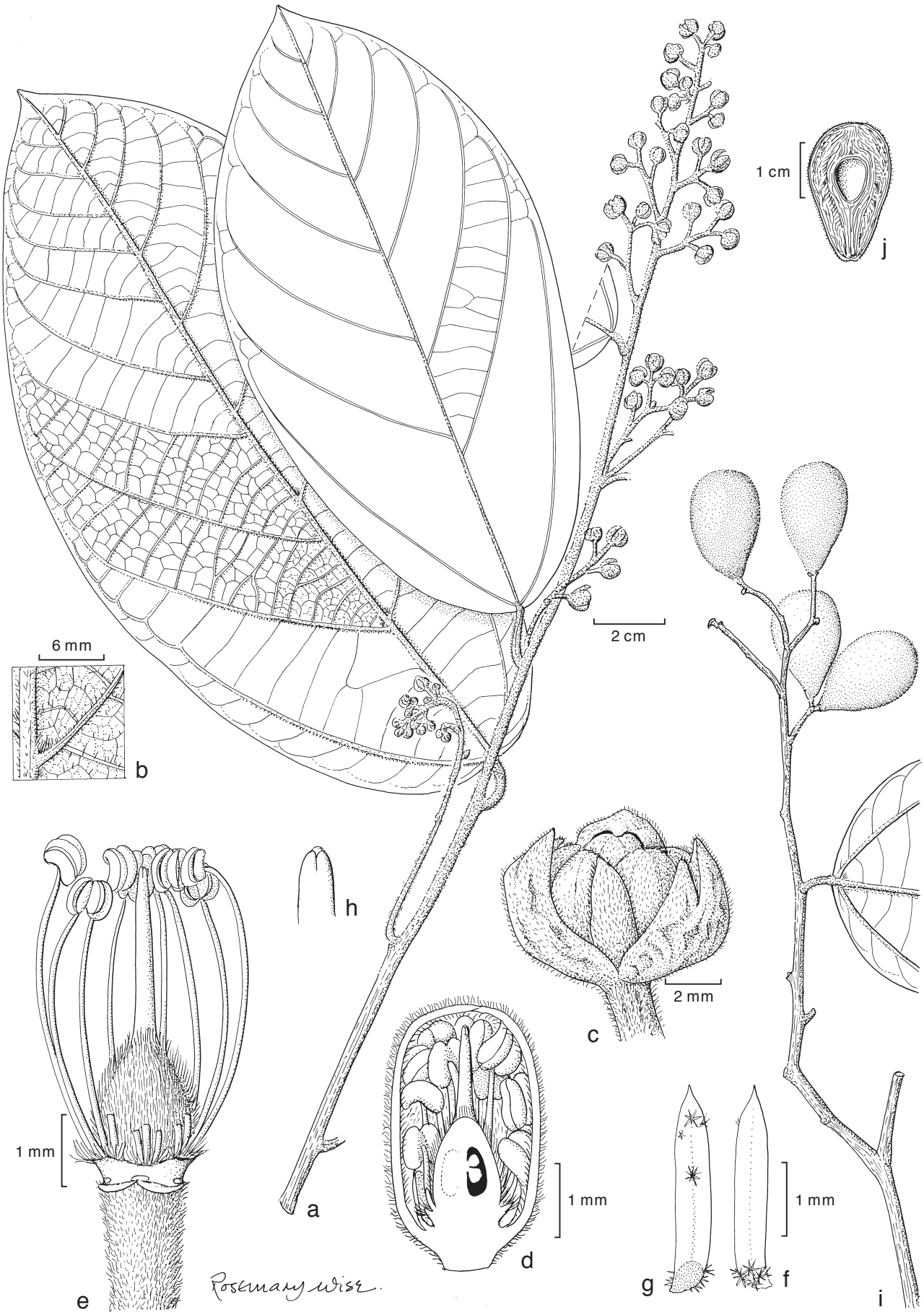
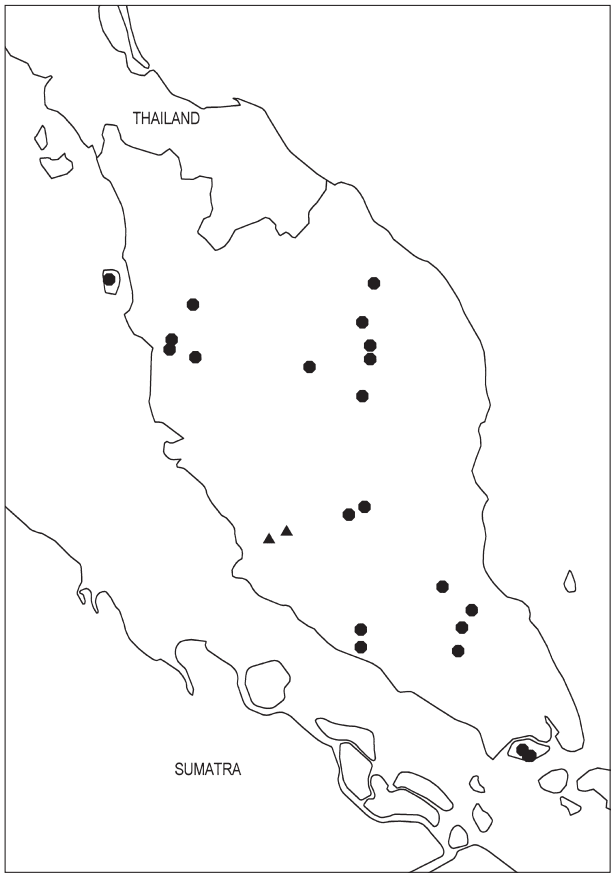


Fig. 6 *Microcos globulifera* (Mast.) Burret. a. Flowering leafy twig; b. detail of abaxial leaf surface near midrib; c. flower buds surrounded by involucral bracts; d. longitudinal section of flower bud; e. flower with sepals and petals removed; f. abaxial surface of petal; g. adaxial surface of petal with gland at base; h. stigma; i. fruiting leafy twig; j. longitudinal section of fruit (a, b: *Razali R 203*; c, d: *Ogata KEP 105036*; e–h: *Maingay 1576*; i: *Ng FRI 1405*; j: *Cockburn FRI 7054*). — Drawn by R. Wise, FHO.

early caducous; involucral bracts of outer whorl unlobed, elliptic, 6–7 by 4–4.5 mm long, apex broadly acute, or sometimes 2-lobed, lobes ovate, 1–2 mm long, apex acute, rugose outside, densely covered with tufted hairs on both sides, that of inner whorl lanceolate or narrowly elliptic, 4.5–5.5 by 1.5–2.5 mm, apex acute, densely covered with tufted hairs on both sides. *Flower buds* oblong, 3–4 by 2–3 mm, densely covered with tufted hairs; pedicels 0.4–0.5 mm long, c. 0.5 mm thick, densely covered with tufted hairs; sepals oblong, 5.5–8 by 1.2–2.2 mm, densely covered with tufted hairs on both sides; petals 5, linear or lanceolate, 3–3.5 by 0.5–1.5 mm, apex shortly acuminate or acute, outside sparsely covered with tufted hairs at base and glabrous towards the apex, inside sparsely covered with tufted hairs around the glands to c. 0.5 of its length and glabrescent towards the apex; glands globose or sometimes absent; androgynophore shallowly cup-shaped in outline, 0.7–1 mm long, c. 0.8 mm diam, smooth, glabrous, apical part slightly expanded outwards, with undulate, pubescent rim; stamens with filaments 2–5.5 mm long, glabrous, anthers c. 0.5 mm diam; ovary 3-locular, ovoid, 1.2–1.5 mm diam, transversely elliptic in cross section, densely covered with tufted hairs; style 3–3.5 mm long, glabrous. *Infructescences* densely covered with tufted hairs. *Fruits* ripening orange, obovoid, smooth, 2.5–3 by 1.5–2.5 cm, drying yellowish brown to brown, densely covered with tufted hairs; apex rounded, without pseudostalk; exocarp membranous; mesocarp 5–8 mm thick; endocarp thin-coriaceous. Fertile *pyrene* 1, 1-seeded, 6–8 mm long; sterile pyrene inconspicuous.

Distribution — Peninsular Malaysia and Singapore.

Habitat & Ecology — In mixed dipterocarp forest on sandy soil; on hillsides or ridge tops, near streams, to 300 m altitude. Flowering: February–June, August; fruiting: March–April, June, August–September.



Map 4 Distribution of *Microcos globulifera* (Mast.) Burret (●) and *M. latistipulata* (Ridl.) Burret var. *latistipulata* (▲) in Peninsular Malaysia and Singapore.

Vernacular names — Chenderai rimba, damak-damak, damak-damak bulu, damak-damak merah, dedamak, menamak, salut sabul (Malay).

Uses — Ripe fruits edible (*Wray 3779*).

Notes — *Microcos globulifera* is sometimes confused with the very variable *M. latifolia* because of its leaf shape. The present species differs from *M. latifolia* (especially the Peninsular Malaysian specimens) by its minutely scabrous leaves above (vs glabrous), midrib flattened above (vs impressed), involucral bracts of outer whorl rugose outside (vs smooth), oblong flower buds (vs broadly obovoid), shallowly cup-shaped in outline and smooth androgynophore (vs concave in outline and shallowly longitudinally grooved), 5–8 mm thick mesocarp (vs 1.5–3 mm thick), coriaceous endocarp (vs woody), one pyrene (vs three), and inconspicuous sterile pyrene (vs conspicuous).

Morphologically, *M. globulifera* is also similar to *M. fibrocarpa*, but can be distinguished by its subcoriaceous leaves which are sparsely covered with simple and tufted hairs beneath (vs chartaceous, densely covered with soft simple and tufted hairs), entire non-ciliate margin (vs distantly and obscurely serrulate, ciliate margin), blunt acumen tip (vs pointed), and flattened midrib and secondary veins above (vs impressed), as well as by its floral characters.

5. *Microcos hirsuta* (Korth.) Burret — Fig. 7; Map 5

Microcos hirsuta (Korth.) Burret (1926) 782; Whitmore & Tantra (1986) 241; I.M.Turner (1993) 221; (1997) 487; Cheek & I.M.Turner (1995) 129; R.C.K.Chung et al. (2005b) 110. — *Omphacarpus hirsutus* Korth. (1842a) t. 42; (1842b) 193. — *Grewia omphacarpa* Miq. (1859) 204; Ridl. (1922) 301. — *Grewia hirsuta* (Korth.) Kochummen (1973) 39, nom. illegit. & nom. *superfl.*, non *G. hirsuta* Vahl (1790) 34; Whitmore & Tantra (1986) 240; Keng (1990) 88. — Lectotype (Chung et al. 2005b): *Korthals s.n.* (holo L, acc. no. 908.253-200; iso L, acc. nos. 944.56-122–124, 908.253-353, 908.253-341–342), Borneo, Kalimantan, Doesoen River.

Grewia palembanica Miq. (1861) 405. — Type: *Teijsmann HB 3658* (BO, L, acc. no. 908.253-799, U n.v.), Sumatra, Palembang, Muara Enim.

Small tree to 15 m tall, dbh to 20 cm; buttresses absent. *Outer bark* smooth, greyish brown; inner bark pale orange to pinkish brown, fibrous; sapwood pink to white. *Twigs* smooth, dark brown to black, densely covered with stellate hairs when young, glabrescent when older. *Stipules* 4–6 mm long, 3–4-lobed or 3–4-cleft, lobes oblong or lanceolate, 2–4 mm long, glabrescent on both sides, caducous. *Leaves* olive-green on both sides, subcoriaceous, glabrous or sparsely covered with simple and stellate hairs on midrib and secondary veins above, densely covered with simple and stellate hairs beneath; petioles (5–)6–16(–20) mm long, 1–2 mm thick, yellowish brown, apically swollen for 4–10 mm long, densely covered with stellate hairs; blade narrowly elliptic or narrowly oblong, rarely elliptic or oblong, equilateral or sometimes inequilateral, (9–)10–25(–32) by (3–)4–10(–13) cm, base obtuse to rounded, margin entire, sometimes ciliate, apex acuminate or acute, acumen 1–2.5(–3) cm long with a pointed tip; midrib and secondary veins flattened above, raised beneath; secondary veins 7–9 pairs, basal pair reaching between 0.25 and 0.5 of blade length, forming an angle of less than 45° with the midrib; domatia absent; tertiary veins reticulate, inconspicuous above, thin and prominent beneath. *Inflorescences* Type A and Type B panicles, terminal and axillary, (1–)1.5–3(–6) cm long, densely covered with stellate hairs; bracts 2–3-cleft, lobes lanceolate, 1–2.5 mm long, densely covered with stellate hairs on both sides, persistent or caducous; involucral bracts of outer whorl 6–8.5 mm long, 2–3-cleft, lobes ovate, 2–4 mm long, apex acute, smooth and densely covered with stellate hairs outside, sparsely covered with stellate hairs inside, that of inner whorl oblanceolate, 4–5 by 1.5–2 mm, apex acute, densely covered with stellate hairs on both sides. *Flower buds* oblong, 2.5–4.5

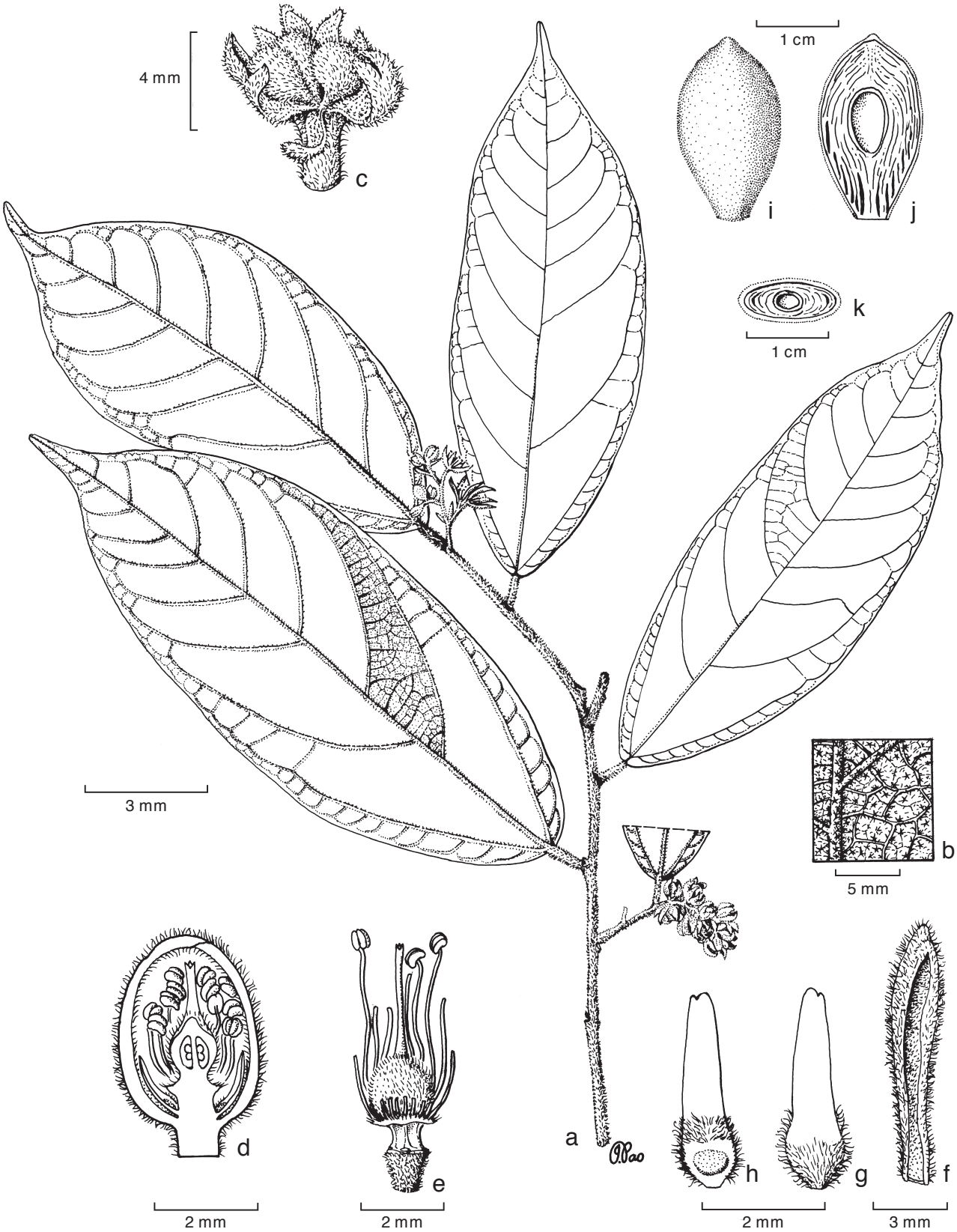
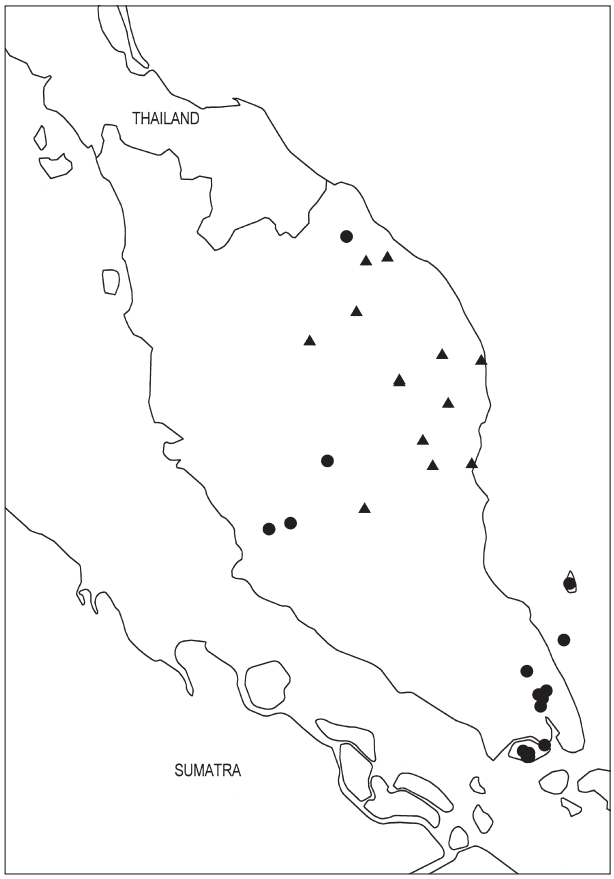


Fig. 7 *Microcos hirsuta* (Korth.) Burret. a. Flowering leafy twig; b. detail of abaxial leaf surface near midrib; c. flower buds surrounded by involucral bracts; d. longitudinal section of flower bud; e. flower with sepals and petals removed; f. adaxial surface of sepal; g. abaxial surface of petal; h. adaxial surface of petal with gland at base; i. fruit; j. longitudinal section of fruit; k. cross section of fruit (a–h: *Korthals s.n.* = L acc. no. 908.253.200; i–k: *Korthals s.n.* = L acc. no. 944.56.122). — Drawn by J. Pao, SAR.

by 1.8–2.5 mm, densely covered with stellate hairs; pedicels 0.5–2 mm long, 0.6–0.9 mm thick, densely covered with stellate hairs; sepals linear or narrowly oblong, 7–10 by 1.2–1.5 mm, densely covered with stellate hairs outside, sparsely covered with stellate hairs inside; petals 5, lanceolate, 2–4 by 0.7–1 mm, apex shallowly 2–3-lobed, outside covered with stellate hairs at base to c. 0.25 of its length and glabrous towards the apex, inside densely covered with stellate hairs around the glands to c. 0.25 of its length and glabrous towards the apex; glands depressed obovoid; androgynophore concave in outline,



Map 5 Distribution of *Microcos hirsuta* (Korth.) Burret (●) and *M. malayana* R.C.K.Chung (▲) in Peninsular Malaysia and Singapore.

0.7–1.2 mm long, c. 0.8 mm diam, smooth, covered with stellate hairs or glabrescent (in buds) then become glabrous (in flowers), apical part expanded into a platform-like structure of c. 0.2 mm wide, with undulate rim covered with stellate hairs; stamens with filaments 3.2–5 mm long, glabrous, anthers c. 0.2 mm diam; ovary 3-locular, ellipsoid, 1.5–2 mm diam, circular in cross section, densely covered with stellate hairs; style 3–3.5 mm long, glabrous. *Infructescences* sparsely covered with stellate hairs. *Fruits* ripening bright orange, obovoid, smooth, 2–2.8 by 1–2 cm, drying yellowish brown to brown, densely covered with stellate hairs; apex rounded, without pseudostalk; exocarp membranous; mesocarp 3–5 mm thick; endocarp thin-coriaceous. Fertile *pyrene* 1, 1-seeded, 7–10 mm long; sterile pyrene inconspicuous.

Distribution — Sumatra, Peninsular Malaysia, Singapore and Borneo.

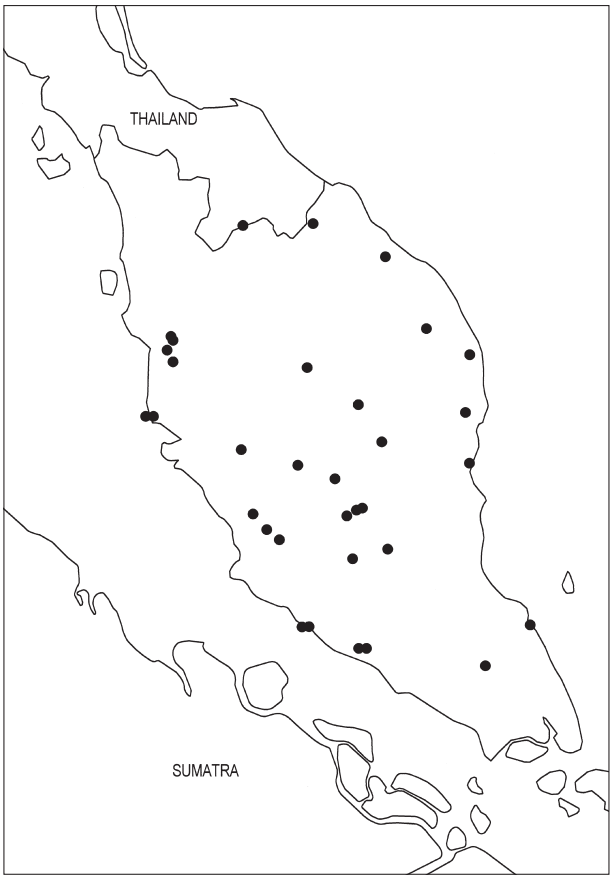
Habitat & Ecology — In alluvial freshwater swamp and mixed dipterocarp forests on yellow sandy soil; on gentle to steep slopes, or ridges, at 25–900 m altitude. Flowering and fruiting all year round.

Uses — Ripe fruits edible (*Mat Asri FRI 38695*).

6. *Microcos lanceolata* (Miq.) Burret — Fig. 8; Map 6

Microcos lanceolata (Miq.) Burret (1926) 778; I.M.Turner (1997) 487. — *Inodaphnis lanceolata* Miq. (1861) 357; (1867) 89. — *Grewia miqueliana* Kurz (1872) 398; King (1891) 115; Ridl. (1922) 302; Kochummen (1973) 397; (1997) 429; Whitmore & Tantra (1986) 240. — Type: *Teijsmann s.n.* (n.v.), W Sumatra, Pajakumbuh.

Small tree to 15 m tall, dbh to 15 cm; buttresses absent. *Outer bark* smooth, lenticellate, dark brown with grey patches; inner bark red; sapwood white or pale with net-like rays. *Twigs* smooth, brown to dark brown, covered with minute stellate hairs when young, glabrous when older. *Stipules* unlobed, lanceolate, 4–6(–9) by 0.9–1.2(–1.5) mm, apex obtuse, sparsely covered with minute stellate hairs on both sides, caducous. *Leaves* brown to dark brown on both sides, chartaceous or subcoriaceous, glabrescent or glabrous on both sides; petioles 4–7(–9) mm long, 1–2 mm thick, brown to dark brown, apically not swollen, sparsely covered with minute stellate hairs or glabrous; blade narrowly elliptic to elliptic, equilateral or sometimes inequilateral towards base, (6.5–)7–18(–20) by (2.5–)3–5.5(–6) cm, base narrowly cuneate to cuneate or sometimes shortly attenuate, margin entire, not ciliate, apex acuminate, acumen 0.5–1(–1.5) cm long, blunt; midrib and secondary veins raised on both sides; secondary veins (6–)7–8 pairs, basal pair reaching almost 0.25 or occasionally between 0.25 and 0.5 of blade length, forming an angle of less than 45° with the midrib; domatia absent; tertiary veins reticulate, obscure above, conspicuous or obscure beneath. *Inflorescences* Type A and sometimes Type B panicles, terminal or axillary, 2–4 cm long, covered with minute stellate hairs; bracts early caducous; involucral bracts of outer whorl 4–5 mm long, 2-cleft, lobes ovate, 1.5–2.3 mm long, apex acute, smooth, blackish, and covered with minute stellate hairs or glabrescent outside, densely covered with stellate hairs inside, that of inner whorl oblanceolate or obovate, 4–5.2 by 1.5–2.2 mm, apex acute or obtuse, covered with minute stellate hairs on both sides. *Flower buds* obovoid, 3.9–4.2 by 1.7–1.9 mm, densely covered with stellate hairs; pedicels 0.5–1.5 mm long, 0.6–0.8 mm thick, densely covered with stellate hairs; sepals oblanceolate, 5–6 by 1–1.5 mm, densely covered with stellate hairs on both sides; petals 5, linear or oblanceolate, 1.5–2 by 0.2–0.5 mm, apex acute, sparsely covered with stellate hairs (outside) or densely covered with stellate hairs (inside) at base to c. 0.25 of its length and glabrous towards the apex on both sides; glands absent; androgynophore cylindrical in outline, 0.2–0.3 mm long, 0.8–1 mm diam, longitudinally grooved, glabrous, apical part slightly expanded outwards, with slightly undulate rim covered with



Map 6 Distribution of *Microcos lanceolata* (Miq.) Burret in Peninsular Malaysia.

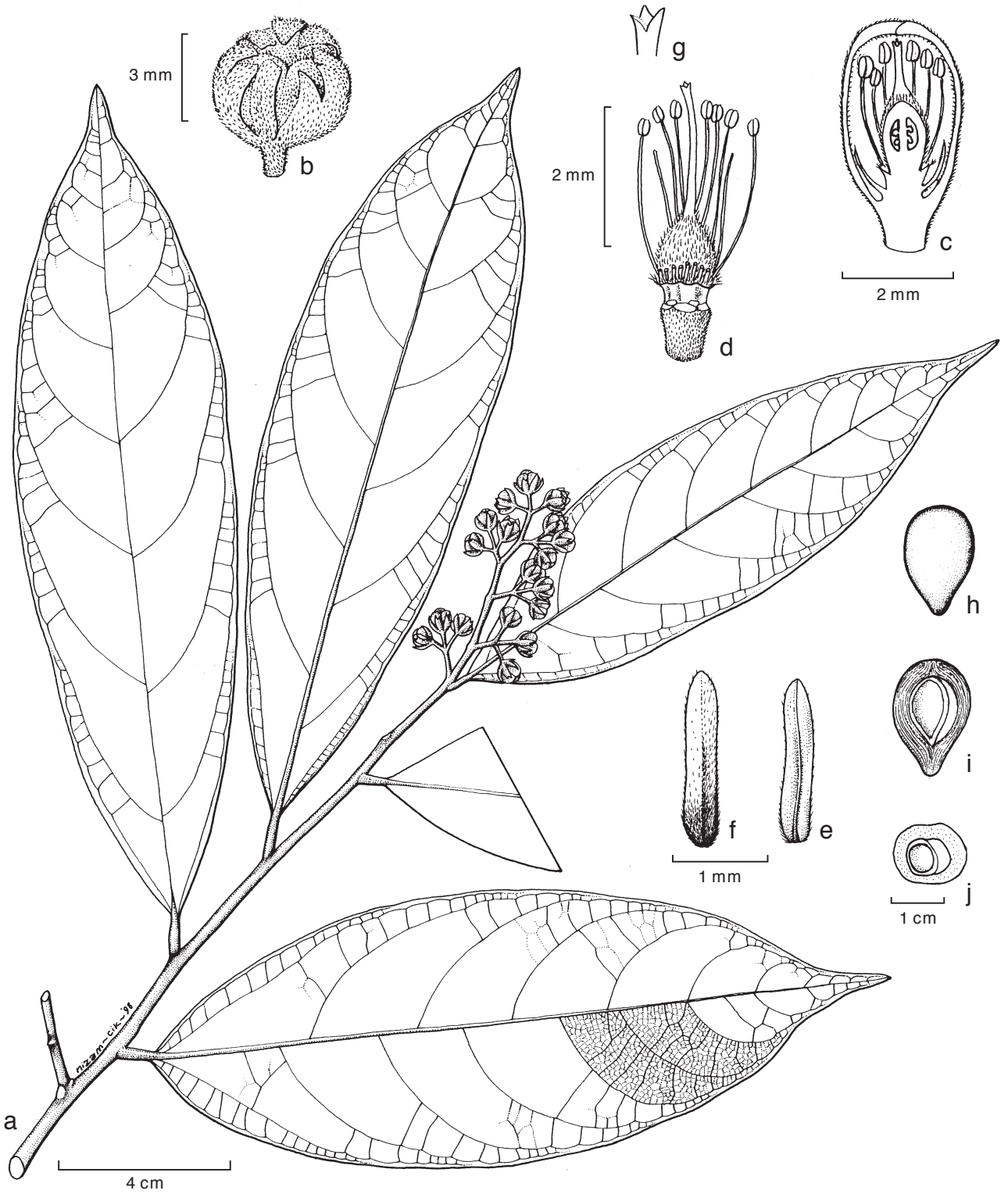


Fig. 8 *Microcos lanceolata* (Miq.) Burret. a. Flowering leafy twig; b. flower buds surrounded by involucral bracts; c. longitudinal section of flower bud; d. flower with sepals and petals removed; e. abaxial surface of petal; f. adaxial surface of petal without gland at base; g. stigma; h. fruit; i. longitudinal section of fruit; j. cross section of fruit (a–c: *Mohzan KEP 99575*; d–g: *Chelliah KEP 104621*; h–j: *Chan FRI 16922*). — Drawn by M. Nizam, UKMB (a, b, e, f) and by J. Pao, SAR (c, d, g–j).

stellate hairs; stamens with filaments 3–4 mm long, glabrous, anthers 0.2–0.3 mm diam; ovary 2-locular, globose or ovoid, 0.8–1 mm diam, transversely elliptic with 3 shallow ridges in cross section, densely covered with stellate hairs; style 3.5–4 mm long, glabrous. *Infructescences* sparsely covered with minute stellate hairs. *Fruits* obovoid, smooth, 1.5–2.5 by 1–1.5 cm, drying chestnut-brown to dull brown, glabrous; apex rounded, without pseudostalk; exocarp brittle; mesocarp 1–3 mm thick; endocarp 0.5–1.5 mm thick, woody. *Pyrenes* 2, partly connate or free; fertile pyrene 1, 1-seeded, 7–9 mm long; sterile pyrene 1, conspicuous; pyrenes arranged horizontally, with the fertile one nearly of the same size as the sterile pyrene.

Distribution — Sumatra and Peninsular Malaysia.

Habitat & Ecology — In mixed dipterocarp forest; frequently found along rivers or on ridge tops, to 600 m altitude. Flowering: March–June, August–October, December; fruiting: February–April, June–November.

Vernacular names — Batang libut, chenderai hutan, chenderai paya, malabu (Malay).

Uses — Ripe fruits edible (*Zainuddin FRI 17941*).

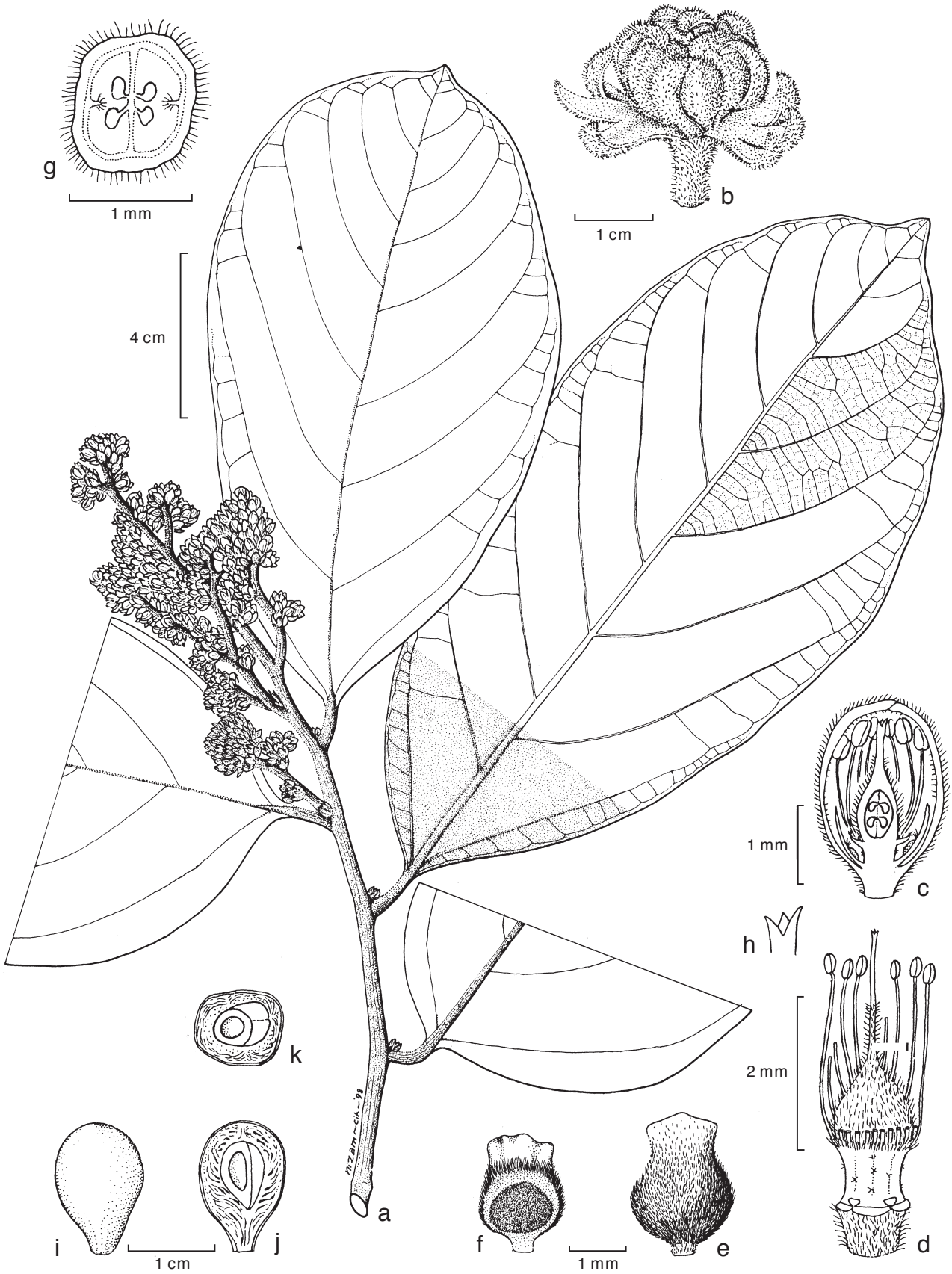
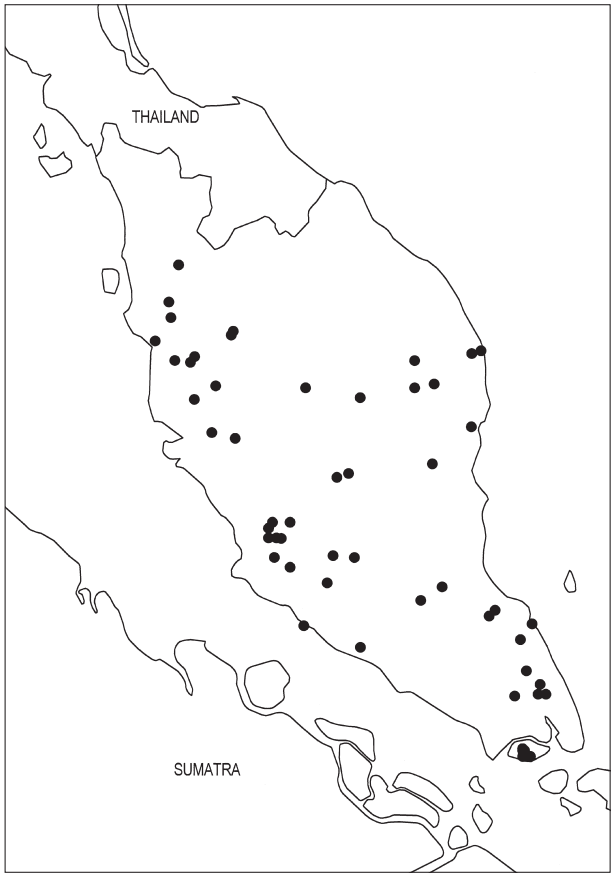


Fig. 9 *Microcos latifolia* Burret. a. Flowering leafy twig; b. flower buds surrounded by involucral bracts; c. longitudinal section of flower bud; d. flower with sepals and petals removed; e. abaxial surface of petal; f. adaxial surface of petal with gland at base; g. cross section of ovary; h. stigma; i. fruit; j. longitudinal section of fruit; k. cross section of fruit (a–c, g: *Yeop FMS 9497*; d–f, h: *Griffith 638/1*; i–k: *Ahmad Zainuddin et al. AZ 3901*). Drawn by M. Nizam, UKMB (a, e, f) and by J. Pao, SAR (b–d, g–k).

7. ***Microcos latifolia*** Burret — Fig. 9; Map 7

Microcos latifolia Burret (1926) 781; R.C.K.Chung et al. (2005b) 111. — *Grewia latifolia* Mast. in Hook.f. (1874) 392, non *G. latifolia* F.Muell. ex Benth. (1863) 271; King (1891) 112; Ridl. (1922) 300. — *Grewia blattaefolia* Corner (1939) 262; Kochummen (1973) 399; (1997) 429; Corner (1988) 733; Keng (1990) 88. — *Microcos blattaefolia* (Corner) R.S.Rao (1949) 300, p.p.; I.M.Turner (1993) 221; (1997) 487. — Lectotype (Chung et al. 2005b): *Maingay 3150* (holo K), Peninsular Malaysia, Malacca.

Small tree to 15 m tall, dbh to 20 cm; buttresses absent. *Outer bark* smooth, lenticellate, brown or reddish brown with greenish patches; inner bark pale brown or brown, fibrous; sapwood white. *Twigs* striate, greyish brown, densely covered with tufted hairs. *Stipules* unlobed, oblong, 3–7 by 2–4 mm, apex obtuse, densely covered with tufted hairs on both sides, caducous or persistent. *Leaves* brown to dark brown on both sides, coriaceous, glabrous or densely covered with simple and tufted hairs on midrib and secondary veins above, densely covered with simple and tufted hairs or glabrescent beneath; petioles (6–)8–16(–19) mm long, 2–2.5(–3) mm thick, brown to dark brown, apically not swollen, densely covered with tufted hairs; blade narrowly or broadly elliptic, equilateral or sometimes inequilateral, (10–)13–27(–30) by (4–)5–10(–12) cm, base cuneate or obtuse to rounded, margin entire and uneven, not ciliate, apex obtuse, acute or acuminate, acumen 1–2 cm long with a pointed tip; midrib and secondary veins impressed or raised above, raised beneath; secondary veins 6–9 pairs, basal pair reaching between 0.25 and 0.5 of blade length, forming an angle of 45° with the midrib; domatia absent; tertiary veins reticulate, inconspicuous above, conspicuous or obscure beneath. *Inflorescences* Type B panicles, terminal or axillary, (2–)3.5–8 cm long, densely covered with tufted hairs; bracts unlobed, narrowly elliptic or obovate, 1.5–4.5(–5.5) by 0.3–1.5(–3.5) mm, densely covered with tufted hairs on both sides, caducous or occasionally persistent; involucral bracts of outer whorl 4–5.5 mm long, 2–3-parted or 2–3-divided, lobes lanceolate, 2.5–4 mm long, apex acute, smooth outside, densely covered with tufted hairs on both sides, that of inner whorl oblanceolate, 3.5–4 by 1–1.8 mm, apex obtuse or obliquely truncate, densely covered with tufted hairs on both sides. *Flower buds* broadly obovoid, 3–5.5 by 2–4 mm, densely covered with tufted hairs; pedicels 0.8–1 mm long, c. 1 mm thick, densely covered with tufted hairs; sepals oblanceolate, 5.5–8 by 1–1.5 mm, densely covered with tufted hairs outside, sparsely covered with tufted hairs inside; petals 5, broadly ovate, 1.5–3 by 1–1.5 mm, apex acute or obtuse, outside densely covered with tufted hairs at base to c. 0.5 of its length and sparsely covered with glandular trichomes towards the apex, inside densely covered with tufted hairs around the glands to c. 0.75 of its length and glabrous towards the apex; glands obloid or broadly obovoid; androgynophore concave in outline, 1–1.3(–2) mm long, 0.8–1(–1.5) mm diam, shallowly longitudinally grooved, glabrous or sparsely covered with tufted hairs only on the ridges, apical part not expanded outwards, with undulate rim covered with tufted hairs; stamens with filaments 2.5–4(–5) mm long, glabrous, anthers c. 0.1 mm diam; ovary (1–)3-locular with internal ridges covered with tufted hairs directly opposite the placenta, subglobose or obloid, 1.2–1.5 mm diam, oblate in cross section, densely covered with tufted hairs; style 2.5–3.5(–4) mm long, occasionally glabrous or covered with tufted hairs at base to reaching between 0.25 and 0.5 of its length and glabrous towards the apex. *Infructescences* sparsely covered with tufted hairs. *Fruits* obovoid, smooth, 1.5–2(–2.5) by 1–1.5(–1.8) cm, drying brown to dark brown, initially sparsely covered with tufted hairs, becoming glabrous; apex rounded, without pseudostalk; exocarp brittle or membranous; mesocarp 1.5–3 mm thick; endocarp 1–2(–2.5) mm thick, woody. *Pyrenes* 3, partly connate; fertile pyrene 1, 1-seeded, 8–10 mm long; sterile pyrene 2, conspicuous; pyrenes arranged horizontally or occasionally triangularly, with the fertile one larger than the sterile pyrenes.



Map 7 Distribution of *Microcos latifolia* Burret in Peninsular Malaysia and Singapore.

Distribution — Peninsular Malaysia, Singapore and Borneo (confined to Sarawak and Brunei).

Habitat & Ecology — In lowland and hill mixed dipterocarp forests, to 600 m altitude. Flowering: January, March–October; fruiting: January, April, July–December.

Vernacular names — Chenderai gajah, damak-damak bulu, tajam damak (Malay).

Uses — Ripe fruits edible.

8. ***Microcos latistipulata*** (Ridl.) Burret

Microcos latistipulata (Ridl.) Burret (1926) 795; Whitmore & Tantra (1986) 241; I.M.Turner (1997) 487; R.C.K.Chung et al. (2005b) 112. — *Grewia latistipulata* Ridl. (1924) 262; (1925) 293. — Type: *Burkill SFN 7826* (holo K; iso SING), Peninsular Malaysia, Selangor, Klang.

Small tree. *Twigs* striate, brown, sparsely covered with minute stellate hairs when young, glabrous when older. *Stipules* unlobed, narrowly obovate to obovate, (2–)9–15(–18) by (1–)4–7(–9) mm, apex rounded, sparsely covered with minute stellate hairs or glabrous on both sides, caducous or persistent. *Leaves* brown to deep brown on both sides, coriaceous, glabrous on both sides; petioles (4–)8–25(–32) mm long, 1.5–4 mm thick, dark brown, apically not swollen, glabrous; blade narrowly elliptic to elliptic, sometimes broader towards apex, equilateral, (11–)17–35(–37.2) by (4.5–)7–14(–16.5) cm, base narrowly cuneate or obtuse to rounded, margin entire, not ciliate, apex acute or obtuse, acumen 0.5–0.9 cm long with a blunt tip; midrib and secondary veins slightly raised above, distinctly raised and sharp beneath; secondary veins (6–)7–11(–12) pairs, basal pair reaching almost 0.5 of blade length, forming an angle of 45° with the midrib; one pair of hairy pocket-type domatia sometimes present beneath in axils of basal vein pair as well as other veins; tertiary veins reticulate, obscure above, conspicuous beneath.

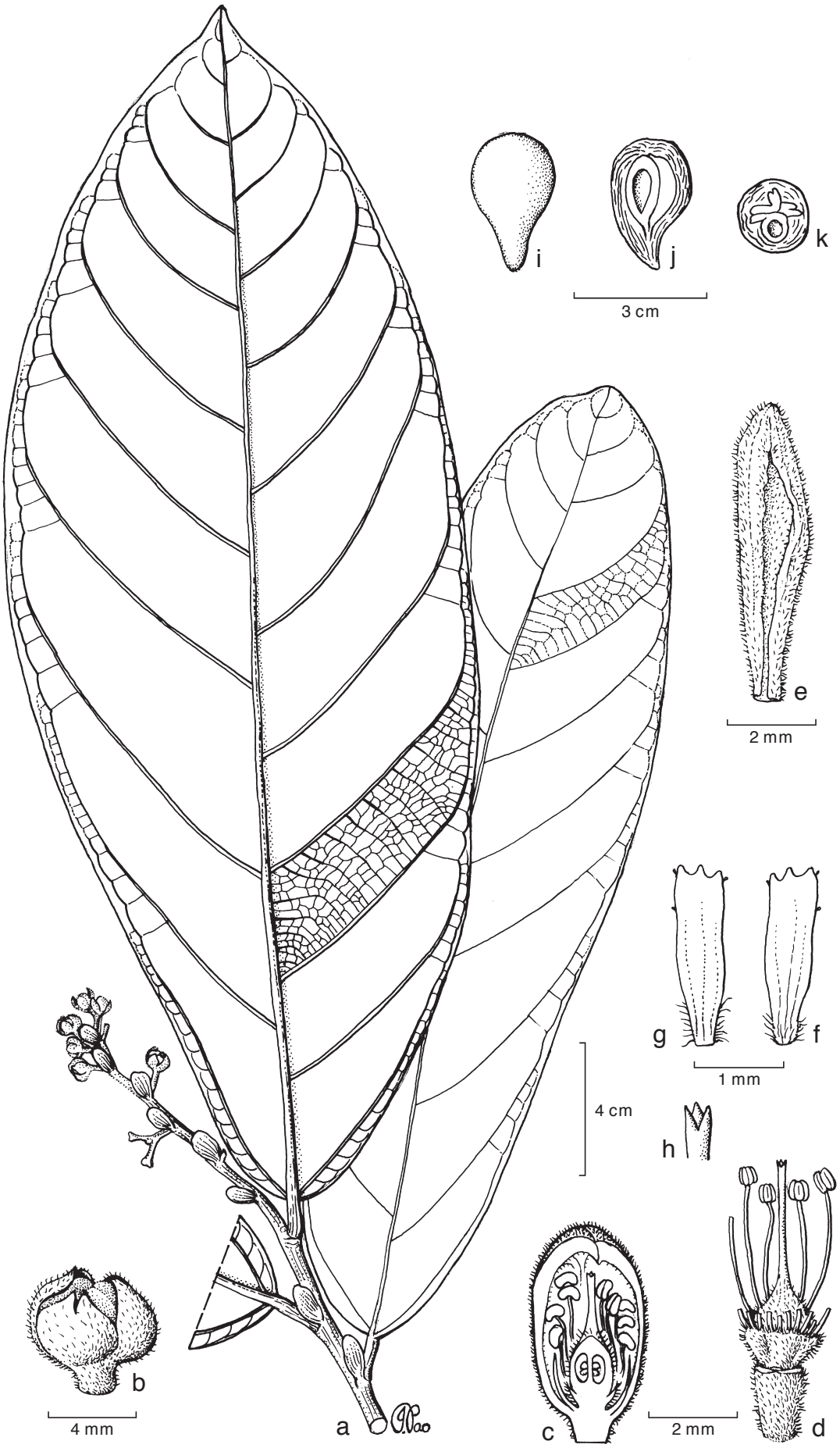


Fig. 10 *Microcos latistipulata* (Ridl.) Burret var. *latistipulata*. a. Flowering leafy twig; b. flower buds surrounded by involucral bracts; c. longitudinal section of flower bud; d. flower with sepals and petals removed; e. adaxial surface of sepal; f. abaxial surface of petal; g. adaxial surface of petal without gland at base; h. stigma; i. fruit; j. longitudinal section of fruit; k. cross section of fruit (a, c–h: *Burkill SFN 7826*; b: *Teo TP 391*; i–k: *Hardial & Sidek 435*). — Drawn by J. Pao, SAR.

Inflorescences Type A and Type B panicles, terminal and axillary, (1.5–)3–11(–12) cm long, densely or sparsely covered with minute stellate hairs; bracts unlobed, oblong, elliptic or obovate, 5–15(–17) by 2–8(–9) mm, sparsely covered with stellate hairs or glabrous on both sides, persistent or caducous; involucral bracts of outer whorl 7–8.5 mm long, 2-lobed, lobes ovate, 2–2.5 mm long, apex obtuse, smooth outside, densely covered with stellate hairs or glabrescent on both sides, that of inner whorl elliptic or oblong, 6.5–7.5 by 2.5–4 mm, apex rounded or obliquely truncate, densely covered with stellate hairs on both sides. *Flower buds* obovoid, 4.5–6 by 2.5–4 mm, densely covered with stellate hairs; pedicels 1–1.5 mm long, c. 1 mm thick, densely covered with stellate hairs; sepals oblanceolate, 5–6 by 1–1.5 mm, densely covered with stellate hairs outside, sparsely covered with stellate hairs inside; petals absent or 5, oblong or oblanceolate, 2–3 by 0.4–0.7 mm, apex mucronate or truncate, outside sparsely covered with stellate hairs at base to c. 0.5 of its length and glabrous towards the apex, inside glabrous or sometimes sparsely covered with stellate hairs around the glands to c. 0.5 of its length and glabrous towards the apex; glands globose or absent; androgynophore cup-shaped in outline, 0.5–0.7 mm long, 0.5–1.5 mm diam, surface wavy, covered with stellate hairs or glabrous, apical part not expanded outwards, with undulate rim densely covered with stellate hairs; stamens with filaments 2–4 mm long, glabrous or occasionally sparsely covered with stellate hairs at base to c. 0.25 of its length and glabrous towards the apex, anthers c. 0.2 mm diam; ovary (2–)3-locular, ovoid, 0.8–1.5 mm diam, oblate in cross section, sparsely covered with stellate hairs or glabrous; style 1.5–3 mm long, glabrous. *Infructescences* glabrescent. *Fruits* ripening reddish orange, pyriform, smooth or sometimes with 3 shallow vertical lobes, 1.8–3 by 1.2–2 cm, drying dark brown to black, glabrous; apex rounded or sometimes beaked, pseudostalk narrowed, 4–10 mm long; exocarp thin and hard; mesocarp 2–4 mm thick; endocarp c. 1 mm thick, woody. *Pyrenes* 3, partly connate or free; fertile pyrene 1, 1-seeded, 7–13 mm long; sterile pyrenes 2, thin and conspicuous; pyrenes arranged triangularly, with the fertile one larger than the sterile pyrenes.

Distribution — Sumatra, Peninsular Malaysia and Borneo.

Note — A species with two recognised varieties. In Peninsular Malaysia and Borneo only var. *latistipulata* is known. The other, var. *lanceolata*, occurs in Sumatra.

a. var. ***latistipulata*** — Fig. 10; Map 4

Small tree to 12 m tall, dbh to 30 cm; buttresses to 15 cm high. *Outer bark* smooth, greyish brown; inner bark yellowish brown, fibrous; sapwood pale yellow or white. *Stipules* obovate, (9–)12–15(–18) by (4–)5.5–7(–9) mm. *Leaves*: petioles (8–)10–25(–32) mm long, 2–4 mm thick; blade elliptic, sometimes broader towards the apex, (14–)17–35(–37.2) by (7–)8–14(–16.5) cm; base obtuse to rounded; basal pair of secondary veins reaching between 0.25 and 0.5 of blade length. *Inflorescences* (3–)7.5–11(–12) cm long; bracts obovate, 8–15(–17) by 4–8(–9) mm.

Distribution — Peninsular Malaysia and Borneo (confined to the east coast of Sabah).

Habitat & Ecology — In mixed dipterocarp forest on brownish black, yellowish and red soil; on hillsides or ridges, at 60–150 m altitude. Flowering: January–October; fruiting: January–June, August–September, November–December.

Uses — Ripe fruits edible.

Note — After examining the specimens of var. *lanceolata* (i.e., *Beccari 931* and *Beccari 937*), we concluded that both varieties have coriaceous leaves, raised midrib and secondary veins above and also distinctly raised as well as sharp midrib and secondary veins beneath, pyriform fruits with 3 shallow vertical lobes, 3 pyrenes with 2 conspicuous sterile pyrenes, and pyrenes arranged into a triangular position with the fertile pyrene larger than the sterile pyrenes. However, var. *lanceolata* differs from var. *latistipulata* by its narrowly obovate stipules measuring 2–3 by 1 mm (vs obovate; 9–18 by 4–9 mm), narrowly elliptic (11–20 by 4.5–7 cm) leaves with narrowly cuneate base (vs elliptic; obtuse to rounded), basal pair of secondary veins reaching less than 0.25 of blade length (vs reaching between 0.25 and 0.5 of blade length), 4–8 mm long petioles (vs 8–32 mm long), 1.5–2.5 cm long inflorescences (vs 3–12 cm long), and oblong or elliptic bracts measuring 5–7 by 2–3 mm (vs obovate; 8–15 by 4–9 mm).

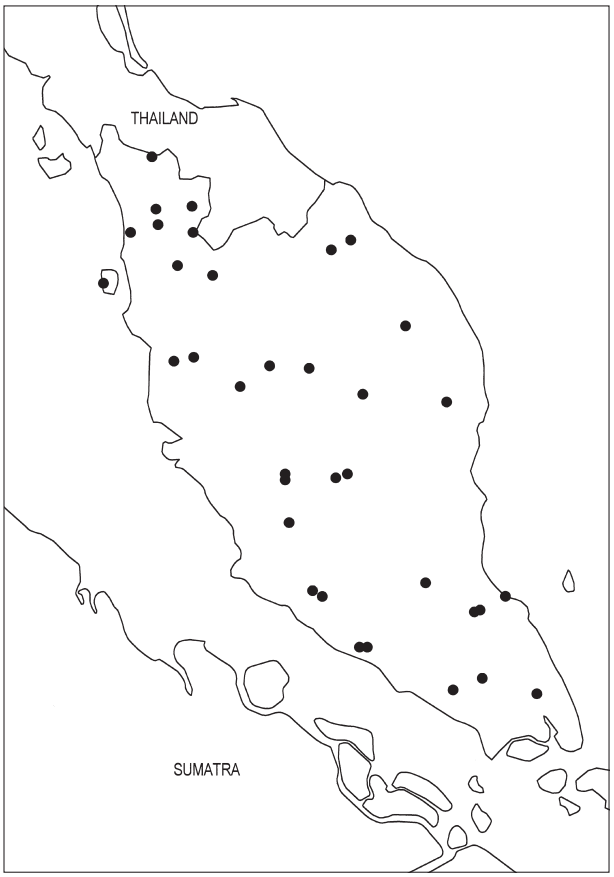
9. *Microcos laurifolia* (Hook.f. ex Mast.) Burret — Fig. 11; Map 8

Microcos laurifolia (Hook.f. ex Mast.) Burret (1926) 771; Phengklai (1986) 56, f. 25; (1993) 39, f. 25; I.M.Turner (1997) 487; R.C.K.Chung et al. (2005b) 113. — *Grewia laurifolia* Hook.f. ex Mast. (1874) 392; King (1891) 114; Baker f. (1924) 13; Kochummen (1973) 399; (1997) 429; Corner (1988) 733. — Lectotype (Chung et al. 2005b): *Maingay 1647* (holo K (with flower buds); iso K (with fruits)), Peninsular Malaysia, Malacca.

Grewia florida auct. non Miq. 1861: Ridl. (1922) 303, p.p. (excl. syn. *G. laurifolia*).

Medium-sized tree to 25(–45) m tall, dbh to 60(–70) cm; buttresses short or absent; bole fluted at base. *Outer bark* smooth or finely fissured, sparsely lenticellate, greyish brown; inner bark brown with purplish streaks, granular; sapwood pale yellow to white. *Twigs* smooth, greyish brown to black, sparsely covered with simple or minute stellate hairs when young, greyish brown to brown, slightly grooved and glabrous when older. *Stipules* early caducous. *Leaves* olive-green to reddish brown or dark brown on both sides, subcoriaceous, glabrous or sparsely covered with simple or minute stellate hairs on midrib and secondary veins on both sides; petioles (10–)14–26(–29) mm long, 1–1.5(–2) mm thick, dark brown to black, apically swollen for 5–10 mm long, densely covered with simple or minute stellate hairs near the distal end above, sparsely covered with simple or minute stellate hairs towards the proximal end beneath; blade elliptic, narrowly oblong or lanceolate, equilateral, (7–)9–17(–18.5) by (3–)3.5–6.5(–7) cm, base shortly attenuate or rounded, margin entire, not ciliate, apex acute or acuminate, acumen 0.5–1.5 cm long with a pointed tip; midrib and secondary veins impressed or rarely flattened above, raised beneath; secondary veins 3–4 pairs, basal pair reaching almost 0.75 of blade length, forming an angle of less than 45° with the midrib; glabrous pocket-type domatia sometimes present beneath in axils of basal vein pair; tertiary veins reticulate, obscure above, conspicuous or obscure beneath. *Inflorescences* Type A and sometimes Type B panicles, terminal or axillary, (3–)4–9 cm long, densely covered with minute stellate hairs; bracts early caducous; involucral bracts of outer whorl 3–3.5 mm long, (2–)3-parted, lobes lanceolate, (1–)1.5–2 mm long, apex acute, smooth outside, densely covered with stellate hairs on both sides, that of inner whorl oblanceolate or rarely narrowly elliptic, 2.5–4 by 0.7–1.3 mm, apex obtuse or obliquely truncate, densely covered with stellate hairs on both sides. *Flower buds* obovoid, (2.5–)3–3.5(–4) by 1.5–2 mm, densely covered with stellate hairs; pedicels (0.4–)0.8–1(–1.2) mm long, 0.5–0.8 mm thick, densely covered with stellate hairs; sepals narrowly oblong or oblanceolate, 4–5.5 by 0.8–1.5 mm, densely covered with stellate hairs outside, sparsely covered with stellate hairs towards the apex inside; petals 5 or fewer by abortion, oblong, 2.2–2.8 by 0.8–1 mm, apex shallowly 2–3-lobed, outside densely covered with stellate hairs at base to c. 0.5 of its length and sparsely covered with glandular trichomes towards the apex, inside densely covered with stellate hairs

Fig. 11 *Microcos laurifolia* (Hook.f. ex Mast.) Burret. a. Flowering leafy twig; b. detail of abaxial leaf surface near midrib; c. flower buds surrounded by involucral bracts; d. longitudinal section of flower bud; e. flower with sepals and petals removed; f. abaxial surface of petal; g. adaxial surface of petal with gland at base; h. stigma; i. fruiting leafy twig; j. longitudinal section of fruit (a–h: *Kochummen FRI 16338*; i, j: *Ando et al. AKK 416*). — Drawn by R. Wise, FHO.



Map 8 Distribution of *Microcos laurifolia* (Hook.f. ex Mast.) Burret in Peninsular Malaysia.

around glands to c. 0.5 of its length and sparsely covered with glandular trichomes towards the apex; glands broadly obovoid; androgynophore obovate in outline, 1–1.2 mm long, 0.5–0.8 mm diam, shallowly longitudinally grooved, glabrous, apical part expanded into a platform-like structure of c. 0.2 mm wide with undulate rim covered with stellate hairs; stamens with filaments 2–2.5 mm long, glabrous, anthers c. 0.2 mm diam; ovary 3-locular, globose or obloid, 0.6–0.7 mm diam, oblate or transversely elliptic in cross section, sparsely covered with glandular trichomes in buds and lesser in flowers; style 2–2.5 mm long, glabrous. *Infructescences* densely covered with minute stellate hairs. *Fruits* ripening yellow, pyriform, with 2–3 shallow vertical furrows, 1.5–2 by 0.8–1.3 cm, drying brown to dark brown, glabrous; apex rounded, pseudostalk narrowed, 5–8 mm long; exocarp membranous; mesocarp 1–1.5 mm thick; endocarp 0.5–1 mm thick, woody. *Pyrenes* 3, free; fertile pyrenes 1–2, 1-seeded, 4–6 mm long; sterile pyrenes 1–2, conspicuous; pyrenes arranged triangularly, with the fertile one larger than the sterile pyrenes.

Distribution — Peninsular Thailand, Sumatra, Peninsular Malaysia and Borneo (Brunei).

Habitat & Ecology — In mixed dipterocarp forest; on hillsides, ridges, or near streams, to 1000 m altitude. Flowering: January, March–June, November–December; fruiting: January, April–June.

Vernacular names — Damak-damak air, jejawai (Malay).

10. *Microcos malayana* R.C.K.Chung — Map 5

Microcos malayana R.C.K.Chung (2003) 333, f. 2. — Type: *Loh FRI 19249* (holo KEP; iso K, L, SING), Peninsular Malaysia, Kelantan, Gua Musang, Batu Papan Forest Reserve.

Small tree to 9 m tall; without buttresses. *Outer bark* smooth, reddish brown; inner bark cream; sapwood reddish brown. *Twigs* striate or sulcate, dark brown, densely covered with tufted hairs when young, glabrescent when older. *Stipules* elliptic or lanceolate, (9–)10–14(–15) by 3.5–4(–4.5) mm, apex acuminate, sparsely covered with tufted hairs on both sides, persistent. *Leaves* olive-green above, dull green or pale brown beneath, subcoriaceous, sometimes bullate, glabrous or sparsely covered with simple and tufted hairs on midrib and secondary veins above, densely covered with simple and tufted hairs beneath; petioles (14–)16–24(–26) mm long, (2.5–)3–4 mm thick, pale brown to brown, grooved when more than 3 mm thick, apically not swollen, densely covered with tufted hairs; blade narrowly oblong or narrowly lanceolate, equilateral, (29–)35–53(–55) by (5–)7–10(–11) cm, base subcordate, rarely obtuse, margin entire, not ciliate, apex acuminate, acumen 3–5 cm long with a pointed tip; midrib flattened above, raised and rounded beneath; secondary veins 8–10(–14) pairs, inconspicuous or sometimes impressed above, prominent beneath, basal pair reaching almost 0.25 of blade length, forming an angle of 45° with the midrib; domatia absent; tertiary veins (sub-)scalariform, inconspicuous above, conspicuous beneath. *Inflorescences* Type B panicles, terminal or rarely axillary, 13–15 cm long, densely covered with tufted hairs; bracts unlobed, narrowly elliptic or lanceolate, (8–)9–15(–18) by 4–5.5(–6) mm, sparsely covered with tufted hairs on both sides, persistent; involucral bracts of outer whorl 7.5–9 mm long, 2-cleft, lobes lanceolate, 1.5–3.5 mm long, apex acute or sometimes obtuse, smooth outside, densely covered with tufted hairs on both sides, that of inner whorl narrowly elliptic or obovate, 5–6 by 0.8–1.5 mm, apex acuminate, densely covered with tufted hairs on both sides. *Flower buds* obovoid, 3–5 by 2–3 mm, densely covered with tufted hairs; pedicels 1.5–3 mm long, 0.6–0.9 mm thick, densely covered with tufted hairs; sepals oblanceolate, 8–9 by 0.8–1.5 mm, densely covered with tufted hairs on both sides; petals 5, lanceolate, 2–3 by 0.4–0.8 mm, apex shallowly 2-lobed, or sometimes acuminate, outside densely covered with tufted hairs almost 0.5 of its length and glabrous towards the apex, inside densely covered with tufted hairs around the glands almost 0.5 of its length and glabrous towards the apex, glands ellipsoid to broadly ellipsoid; androgynophore concave in outline or swollen at the apex, 1.2–1.5 mm long, 0.5–0.7 mm diam, striate, glabrous, apical part not expanded outwards, with undulate rim covered with tufted hairs; stamens with filaments 4–6 mm long, glabrous, anthers 0.3–0.4 mm diam; ovary 3-locular, ellipsoid, 0.8–1.3 mm diam, transversely elliptic in cross section, densely covered with tufted hairs; style 4.5–5 mm long, glabrous. *Infructescences* densely covered with tufted hairs. *Fruits* ripening pinkish red, ellipsoid, smooth, 2–2.8 by 1.5–2.5 cm, drying dark brown to black, glabrous; apex rounded, without pseudostalk; exocarp membranous; mesocarp 3–5 mm thick; endocarp thin-coriaceous. Fertile *pyrene* 1, 1-seeded, 8–10 mm long; sterile pyrene inconspicuous.

Distribution — Endemic to Peninsular Malaysia. Found in Ulu Kelantan, Terengganu and Pahang.

Habitat & Ecology — In lowland and hill mixed dipterocarp forests; on ridges or along rivers, to 600 m altitude. Flowering: February–March, June–August; fruiting: June–July, September–November.

Vernacular names — Chenderai, damak (Malay).

Notes — This species is closely allied to *M. erythrocarpa* and *M. pearsonii*. Apart from the floral and fruit characters, it differs from *M. erythrocarpa* by its persistent stipules, larger leaves with longer acumen, longer inflorescences and it is a lowland forest species.

Microcos pearsonii from Borneo is easily distinguished from *M. malayana* by its leaf base, type of indumentum and floral characters.

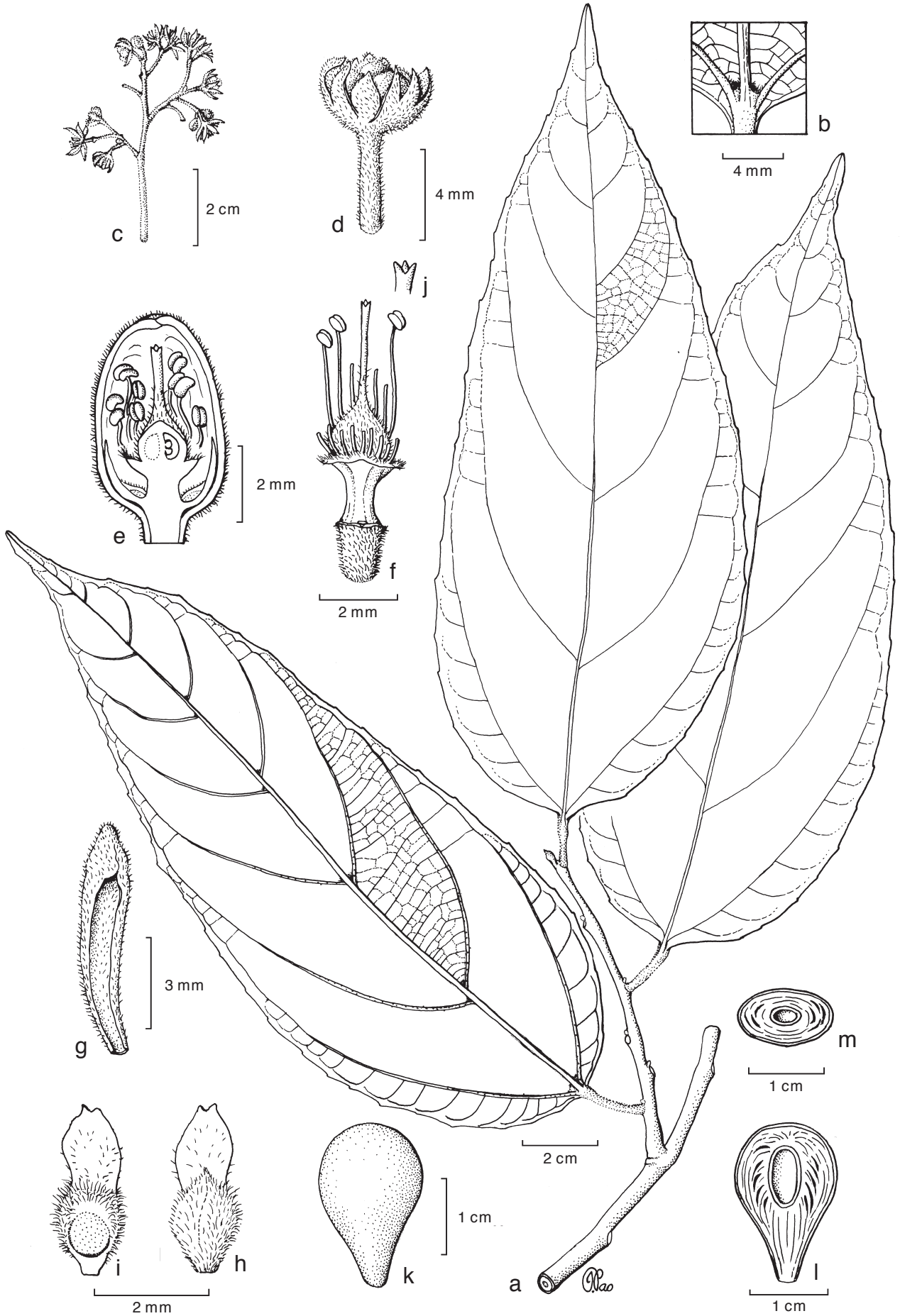


Fig. 12 *Microcos riparia* (Boerl. & Koord.) Burret. a. Leafy twig; b. detail of abaxial leaf surface near base with hairy pocket-type domatia in the axils of basal pair of secondary veins; c. inflorescence; d. flower buds surrounded by involucral bracts; e. longitudinal section of flower bud; f. flower with sepals and petals removed; g. adaxial surface of sepal; h. abaxial surface of petal; i. adaxial surface of petal with gland at base; j. stigma; k. fruit; l. longitudinal section of fruit; m. cross section of fruit (a, b, e–j: *Hallier 2208*; c, d: *Yeob FMS 3190*; k–m: *Mahamud FMS 17156*). — Drawn by J. Pao, SAR.

11. *Microcos riparia* (Boerl. & Koord.) Burret — Fig. 12; Map 2

Microcos riparia (Boerl. & Koord.) Burret (1926) 795; Whitmore & Tantra (1986) 241; R.C.K.Chung et al. (2005b) 118. — *Grewia riparia* Boerl. & Koord. (1911) 35. — Type: *Koorders 10450* (holo BO), Sumatra.
Microcos ovato-lanceolata Burret (1934) 163. — Type: *Hallier 1314* (BO, 3 sheets), Borneo, Kalimantan, Sungai Keniboeng.

Small tree. *Twigs* smooth or slightly striate, black, covered with minute stellate hairs when young, greyish brown to brown, glabrous when older. *Stipules* early caducous. *Leaves* dull brown above, brown beneath, subcoriaceous, glabrous above, glabrous or sparsely covered with minute stellate hairs beneath; petioles (10–)11–15(–17) mm long, 1–1.5(–2) mm thick, brown to dark brown, apically swollen for 6–10 mm long, densely covered with minute stellate hairs above, basally sparsely covered with minute stellate hairs; blade lanceolate or ovate to broadly ovate, equilateral or sometimes inequilateral, (11–)12–20(–22) by (4–)5–7(–8) cm, base obtuse to rounded or truncate, margin distantly serrulate or undulate and rarely entire, not ciliate, apex acuminate, acumen 1–2 cm long with a blunt tip; midrib raised on both sides; secondary veins 5–7 pairs, flattened above, raised beneath, basal pair reaching almost or more than 0.5 of blade length, forming an angle of 45° with the midrib; hairy pocket-type domatia present beneath in axils of basal vein pair as well as other veins; tertiary veins reticulate, inconspicuous above, conspicuous beneath. *Inflorescences* Type B panicles, terminal or axillary, (3–)6–8 cm long, covered with minute stellate hairs; bracts early caducous; involucral bracts of outer whorl 4–5.5 mm long, 2–3-parted, lobes lanceolate, 3–4 mm long, apex acute, smooth outside, densely covered with stellate hairs on both sides, that of inner whorl narrowly elliptic or narrowly oblong, 4–4.5 by 0.6–0.9 mm, apex acute, densely covered with stellate hairs on both sides. *Flower buds* oblong, 4–6 by 2.5–3.5 mm, densely covered with stellate hairs; pedicels 0.5–1.2 mm long, 0.7–1 mm thick, densely covered with stellate hairs; sepals lanceolate, 6–7.5 by 1–1.3 mm, densely covered with stellate hairs outside, sparsely covered with stellate hairs towards the apex inside; petals 5, narrowly oblong or lanceolate, 2.5–3.5 by 0.7–1 mm, apex shallowly 2-lobed, outside densely covered with stellate hairs at base to c. 0.5 of its length and sparsely covered with glandular trichomes towards the apex, inside densely covered with stellate hairs around the glands to c. 0.5 of its length and sparsely covered with glandular trichomes towards the apex; glands ellipsoid; androgynophore concave in outline, 1.5–2 mm long, 0.5–1.2 mm diam, shallowly longitudinally grooved, glabrous, apical part expanded into a flat disc-like structure of c. 0.3 mm wide, with undulate rim covered with stellate hairs; stamens with filaments 2.5–3.5 mm long, glabrous, anthers c. 0.3 mm diam; ovary 3-locular, globose to subglobose, 0.8–1.2 mm diam, circular in cross section, sparsely covered with stellate hairs; style 3.5–4 mm long, sparsely covered with stellate hairs at base to reaching between 0.25 and 0.5 of its length and glabrous towards the apex. *Infructescences* glabrous. *Fruits* pyriform, smooth, 2.5–2.7 by 1.4–1.8 cm, drying brown-black to dark black, glabrous; apex rounded, pseudostalk narrowed, 5–7 mm long; exocarp membranous; mesocarp 5–6 mm thick; endocarp c. 0.5 mm thick, woody. Fertile *pyrene* 1, 1-seeded, 8–10 mm long; sterile pyrene thin, inconspicuous.

Distribution — Sumatra, Peninsular Malaysia (only recorded from Rompin FR, Pahang) and Borneo (Sarawak and E Kalimantan).

Habitat & Ecology — Alluvial forest near or along rivers, at low elevation. Flowering: April–May, September; fruiting: March, September, December.

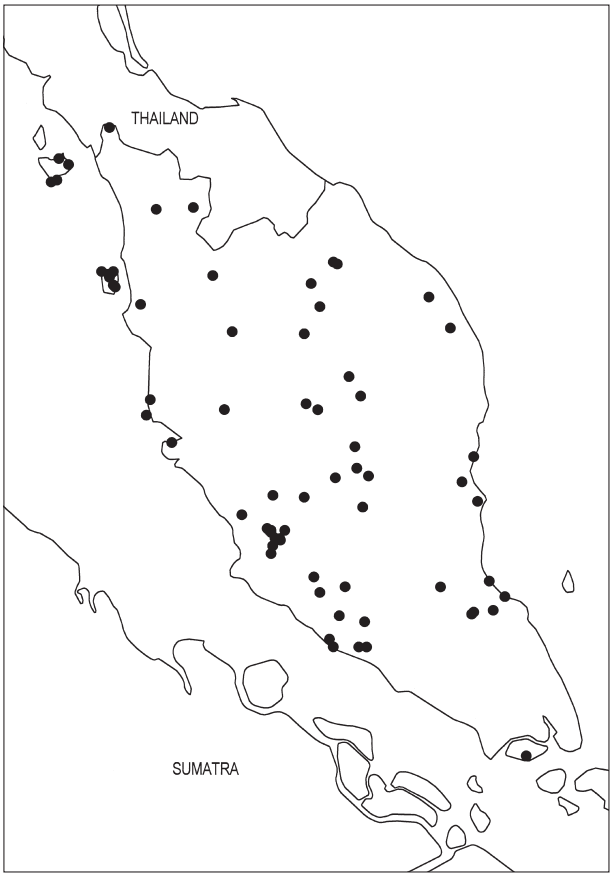
Vernacular names — Damak-damak, damak-damak air, labu-labu (Malay).

Note — A few collections (*Mahamud FMS 17156*, *Soh FMS 15476*, *Yeob FMS 3190* and *FMS 3237*) from Peninsular Malaysia were previously wrongly identified as *M. laurifolia.* These specimens belong to *M. riparia*.

12. *Microcos tomentosa* Sm. — Fig. 13; Map 9

Microcos tomentosa Sm. (1813) 2; Backer & Bakh.f. (1964) 393; Whitmore & Tantra (1986) 241; Phengklai (1986) 52, f. 23; (1993) 37, f. 23; I.M.Turner (1997) 487; R.C.K.Chung et al. (2005b) 120. — *Grewia paniculata* Roxb. ex DC. (1824) 510; King (1891) 110; Ridl. (1922) 300; Kochummen (1973) 397; Whitmore & Tantra (1986) 241; Corner (1988) 734. — Type: *Roxburgh s.n. in Herb. EIC 1097B* (holo K-W, photo; iso BR, barcode BR-S.P. 817069, photocopy), Peninsular Malaysia, Penang.
Grewia blumei Hassk. (1845) 130. — Type: *Teijsmann s.n.* (n.v.), Java.
Grewia cumingiana Turcz. (1858) 231. — Type: *Cuming s.n.* (B†, n.v.), Peninsular Malaysia.
Grewia affinis auct. non Lindl. 1826: Hassk. (1844) 207.

Small tree to 15 m tall, dbh to 20 cm; buttresses absent; bole deeply fluted. *Outer bark* smooth, slightly flaky, dark grey to brown; inner bark reddish brown, gritty; sapwood pale yellow to white. *Twigs* slightly striate, pale brown to dark brown, densely covered with stellate hairs when young, glabrous when older. *Stipules* unlobed, lanceolate, often united in pairs, 4–6 by 0.5–1 mm, apex acuminate, glabrescent on both sides, caducous or persistent. *Leaves* deep brown to pale brown above, olive-green to brown beneath, coriaceous, glabrous or sparsely covered with stellate hairs above, densely covered with stellate hairs beneath; petioles (5–)6–10(–12) mm long, 1–2(–2.5) mm thick, brown, apically not swollen, densely covered with stellate hairs; blade oblong, obovate or sometimes elliptic, equilateral, (7–)10–17(–22) by (4–)5–7(–9) cm, base rounded, margin serrate or dentate towards the apex, distantly, jaggedly toothed or undulate and entire on the lower half, not ciliate, apex truncate, shortly or abruptly acuminate, acumen



Map 9 Distribution of *Microcos tomentosa* Sm. in Peninsular Malaysia and Singapore.

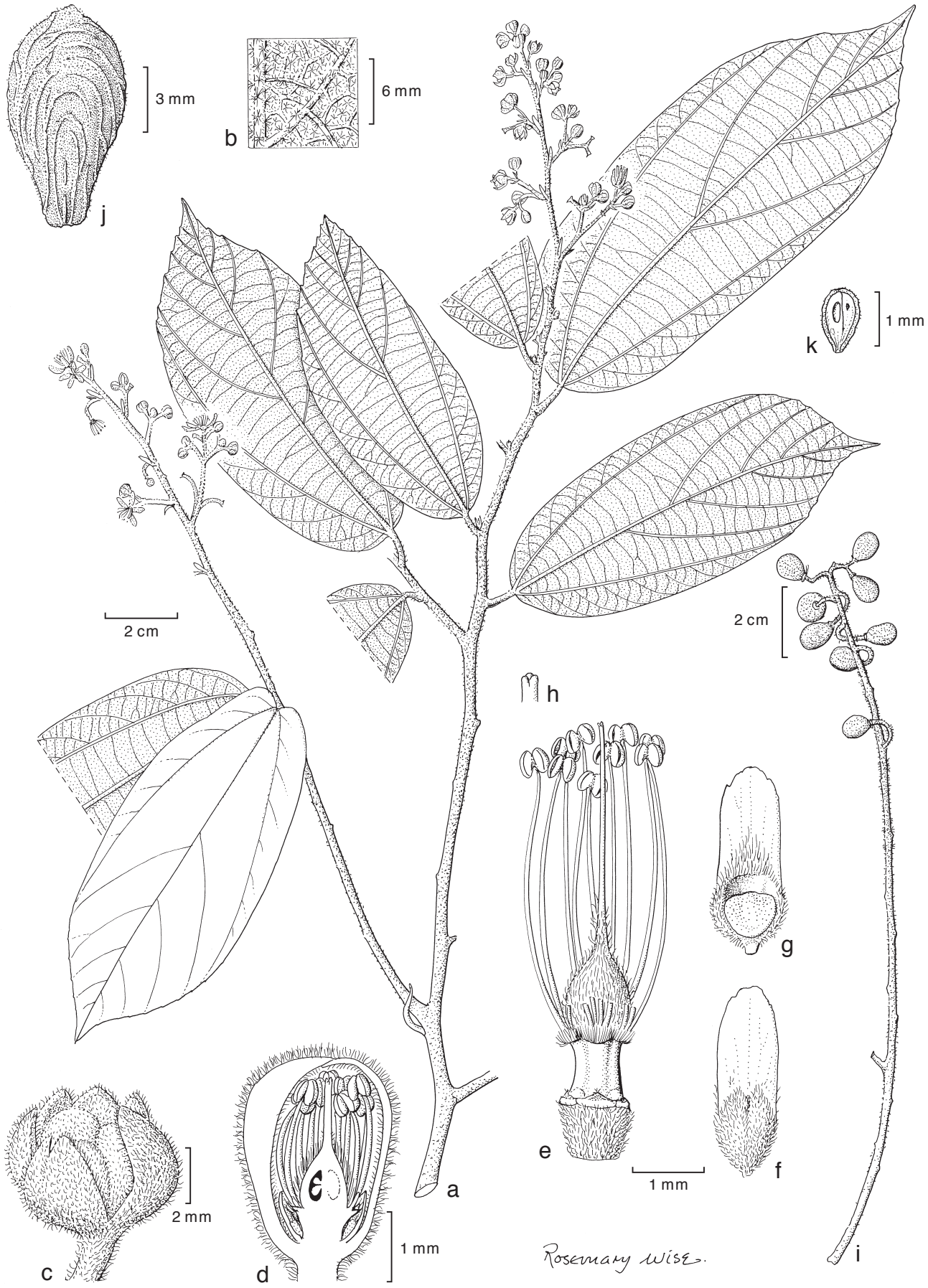


Fig. 13 *Microcos tomentosa* Sm. a. Flowering leafy twig; b. detail of abaxial leaf surface near midrib; c. flower buds surrounded by involucral bracts; d. longitudinal section of flower bud; e. flower with sepals and petals removed; f. abaxial surface of petal; g. adaxial surface of petal with gland at base; h. stigma; i. infructescence; j. fruit; k. longitudinal section of fruit (a–h: *Suppiah FRI 28239*; i–k: *Putz FRI 23607*). — Drawn by R. Wise, FHO.

(0.5–)1–1.5(–2) cm long with a pointed tip; midrib and secondary veins impressed above, distinctly raised beneath; secondary veins 5–7 pairs, basal pair reaching almost 0.75 of blade length, forming an angle of less than 45° with the midrib; domatia absent; tertiary veins scalariform, impressed or obscure above, prominent beneath. *Inflorescences* Type B panicles, terminal or axillary, (3–)5–10(–15) cm long, densely covered with rusty stellate hairs; bracts unlobed, lanceolate, often united in pairs, 3.5–6 by 0.4–1 mm, or 2–4-cleft or 2–4-parted, lobes linear or lanceolate, to 3 mm long, densely covered with stellate hairs on both sides, persistent; involucral bracts of outer whorl 5–6 mm long, 3-parted, lanceolate, 2.5–3.5(–4.2) mm long, apex shortly acuminate, smooth outside, densely covered with stellate hairs on both sides, that of inner whorl oblanceolate, (3–)5–5.8 by (1–)1.5–2.2 mm, apex acute, densely covered with stellate hairs on both sides. *Flower buds* obovoid, 3–3.5 by 2.2–2.5 mm, densely covered with stellate hairs; pedicels 0.5–0.8 mm long, 0.7–0.8 mm thick, densely covered with stellate hairs; sepals obovate, 5–8 by 1.5–2.5 mm, densely covered with stellate hairs on both sides; petals 5, oblong, 2–3 by 0.5–0.9 mm, apex obtuse or slightly 2–3-lobed, outside densely covered with stellate hairs at base to c. 0.5 of its length and glabrous towards the apex, inside densely covered with stellate hairs around the glands to c. 0.5 of its length and glabrous towards the apex; glands broadly globose to obloid; androgynophore concave in outline, 0.5–0.8 mm long, c. 0.5 mm diam, shallowly and narrowly longitudinally grooved, glabrous, apical part expanded into a platform-like structure of c. 0.3 mm wide, with undulate rim covered with stellate hairs; stamens with filaments 2–5 mm long, sparsely covered with stellate hairs at base to c. 0.25 of its length and glabrous towards the apex, anthers 0.2–0.3 mm diam; ovary 3-locular, ellipsoid or ovoid, 0.8–1.3 mm diam, circular in cross section, densely covered with stellate hairs; style 3–3.5 mm long, covered with stellate hairs at base to c. 0.25 of its length and glabrous towards the apex. *Infructescences* densely covered with stellate hairs. *Fruits* subglobose or obovoid, curved striate, 0.5–1.2 by 0.4–0.9 cm, drying brown to deep brown, sparsely covered with stellate hairs; apex obtuse, without pseudostalk; exocarp membranous; mesocarp 1–2 mm thick; endocarp c. 1 mm thick, woody. *Pyrenes* 3, partly connate; fertile pyrene 1–2, 1–2-seeded, 3–9 mm long; sterile pyrenes 1–2, slightly conspicuous to conspicuous; pyrenes occasionally arranged horizontally, with the fertile one nearly of the same size as the sterile pyrenes.

Distribution — Myanmar, S China, Indochina, Thailand, Sumatra, Peninsular Malaysia, Singapore, Java, Borneo and the Philippines. In Peninsular Malaysia, this species is common throughout except in the southern states.

Habitat & Ecology — In mixed dipterocarp forest (generally, very common in secondary forest), to 600 m altitude. Flowering all year round; fruiting: January–March, May, July–December.

Vernacular names — Peninsular Malaysia: ara dani, ara lumut, chenderai, chenerah, chenerai, chenirai, chindarah, jenerai, senderai (Malay).

Uses — Ripe fruits edible (*Mohd. Kassim MK 43*). Timber used for cabinet work (Phengklai 1993).

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IDENTIFICATION LIST

The number after the collector numbers refer to the following *Microcos* taxa. When the number of the collection is not available or unknown then the dates or sheet numbers are mentioned between brackets. The list covers examined specimens that have been collected from Peninsular Malaysia and Singapore only.

1a = *M. antidesmifolia* var. *antidesmifolia*
1b = *M. antidesmifolia* var. *hirsuta*
2 = *M. erythrocarpa*
3 = *M. fibrocarpa*
4 = *M. globulifera*
5 = *M. hirsuta*
6 = *M. lanceolata*
7 = *M. latifolia*
8 = *M. latistipulata* var. *latistipulata*
9 = *M. laurifolia*
10 = *M. malayana*
11 = *M. riparia*
12 = *M. tomentosa*

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