

Taxonomic revision of Thai *Gnetum* (Gnetaceae), including two new species

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ABSTRACT

A comprehensive taxonomic revision of *Gnetum* (Gnetaceae) in Thailand is presented based on morphological characters. Eleven taxa are recognised (ten species and two varieties) including two newly described species, *Gnetum khaoluangense* and *G. megaspermum*, both endemic to Thailand. An update of morphological characters, taxon descriptions (including illustrations of the two new species), diagnostic characters, and an identification key to all Thai taxa, are provided. Lectotypification is provided for six taxa: *G. cuspidatum*, *G. gnemon* var. *tenerum*, *G. leptostachyum*, *G. macrostachyum*, *G. microcarpum* and *G. tenuifolium*.

KEYWORDS: Flora of Thailand, gymnosperms, Gnetales, lectotypes, tropical plants.

Accepted for publication: 2 February 2026. Published online: 24 March 2026

INTRODUCTION

The family Gnetaceae, represented by the single genus *Gnetum* L., exhibits a unique collection of morphological traits that have long complicated their taxonomic placement (Gifford & Foster, 1989). This family possesses several characteristics that differ from most other gymnosperms, such as the presence of vessels in secondary xylem, partially closed megasporangia (or ovules), and broad, net-veined leaves, double fertilization, leading to past hypotheses pointing to a direct ancestral connection with flowering plants (Mathews & Kramer, 2012).

The Gnepine hypothesis is a theory in plant evolution proposing that the Gnetophytes (*Gnetum*, *Ephedra* Tourn. ex L., and *Welwitschia* Hook.f.) are nested within the conifers, specifically as the sister group to the Pinaceae, rather than being a separate major branch of seed plants (Judd *et al.*, 2008). Contemporary phylogenomic investigations have repeatedly disproved the other theory, a historical relationship with flowering plants and firmly established *Gnetum* as a monophyletic group nested

within the gymnosperms (Ran *et al.*, 2018; Stull *et al.*, 2021). The results from analyses based on thousands of single-copy nuclear genes strongly support the Gnepine hypothesis, which places the Gnetophytes as the sister group of the Pinaceae (Stull *et al.*, 2021; Yang *et al.*, 2022). Consequently, the traditional concept of conifers *sensu lato* (*s.l.*) being monophyletic is no longer considered correct and has been revised. In the updated classification of extant gymnosperms, the family Gnetaceae is placed within the largest class, Pinopsida, which also includes the families Ephedraceae and Welwitschiaceae, along with all traditional conifers (Yang *et al.*, 2022).

Gnetum is widely distributed across tropical and subtropical Asia, Africa, and northwestern South America, with the highest diversity in South-East Asia (Won & Renner, 2006; Rydin & Korall, 2009). These evergreen plants are mostly woody climbers, although some species form trees or shrubs, typically with round stems, swollen nodes, and opposite leaves (Markgraf, 1930; Phengklai, 1973). Plants can be either monoecious or dioecious, with exposed seeds

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that turn red, pink, or orange upon ripening (Markgraf, 1930; Kubitzki, 1990; Price, 1996; Hou *et al.*, 2015). This genus comprises 44 species (POWO, 2025).

Reproductive structures of *Gnetum* are notable for their angiosperm-like appearance (Hufford, 1996). The strobili are relatively small and may appear in clusters at branch tips or along the stem (Markgraf, 1951; Phengklai, 1975). They vary in structure from simple to compound and bear bracteoles that form collar-like rings around the reproductive organs (Jørgensen & Rydin, 2015; Phengklai, 1975). The central axis (rachis) supports spirally or whorled sporophylls, which are either staminate or ovulate or occasionally both (bisexual) (Markgraf, 1951; Jørgensen & Rydin, 2015). Staminate sporophylls bear sporangia that produce pollen grains, which act as male gametophytes. Wind disperses the pollen to ovulate strobili, where fertilization occurs within megasporangia, resulting in seed development.

In Thailand, *Gnetum* species are commonly found in humid environments, particularly near waterfalls in evergreen forests. Nine taxa have been reported, *G. cuspidatum* Blume, *G. gnemon* L. var. *gnemon*, *G. gnemon* var. *tenerum* Markgr., *G. latifolium* Blume, *G. leptostachyum* Blume, *G. macrostachyum* Hook.f., *G. microcarpum* Blume, *G. montanum* Markgr., and *G. tenuifolium* Ridl. (Phengklai, 1975).

Despite the considerable diversity of *Gnetum* in Thailand, more than half of the examined specimens were misidentified or unidentified. Therefore, a taxonomic revision of the genus was undertaken to resolve existing ambiguities among the Thai taxa. Two specimens were discovered that did not match any previously reported species, and several names required lectotypification. Furthermore, several reproductive parts were recorded for the first time in this group, providing crucial and complete support for the species descriptions.

MATERIALS AND METHODS

This taxonomic revision used morphological characters of fresh samples and herbarium specimens. The fresh materials were collected from various field sites across Thailand and herbarium specimens were

examined from Thai herbaria (BK, BKF, QBG, and PSU) and online herbarium databases, including B, BM, C, K, L, NY, P, and SING (herbarium acronyms followed Thiers (2025, continuously updated)). Morphological features were described from both fresh and dried specimens.

The measurement parameters and terminology for strobili (simple and branched strobilus) and seeds are shown in Figure 1. Pedunculet is a new term defined here to describe the area between bract and first collar. Seed-bearing strobili are defined here as the structures containing a group of seeds along a central axis, developed from ovulate strobili, and arranged in a simple or branching infructescence-like structure, collectively called a seed-bearing strobilus.

New voucher specimens were prepared and deposited in the Thai herbaria (BKF and QBG).

RESULTS

Based on our taxonomic revision, we confirmed nine *Gnetum* taxa previously reported by Phengklai (1975). In addition, our study recognizes two new species, increasing the total number of Thai *Gnetum* to eleven. These newly described taxa are primarily distinguished from previously known species by differences in strobilus arrangement, scales on the seed surface (presence or absence of silvery scales), and seed size.

Gnetum khaoluangense is distinguished by its branching strobili combined with seeds that entirely lack silvery scales. This unique combination differentiates it from the *G. montanum* complex, which typically possesses distinct silvery scales. On the other hand, *G. megaspermum* is uniquely identified by having the largest seeds among all Thai congeners, with a seed length reaching 3–3.5 cm.

Thai species are categorized based on key morphological characters as follows: Strobili are predominantly fascicled and branching, except in *G. cuspidatum*, *G. macrostachyum*, *G. microcarpum* and *G. tenuifolium*, where they are solitary. Seed morphology is species-dependent and divided into sessile and stalked groups. Sessile seeds are found in *G. cuspidatum*, *G. gnemon*, *G. leptostachyum*, *G. macrostachyum* and *G. microcarpum*. Seed surfaces form two groups: (1) seeds with silvery

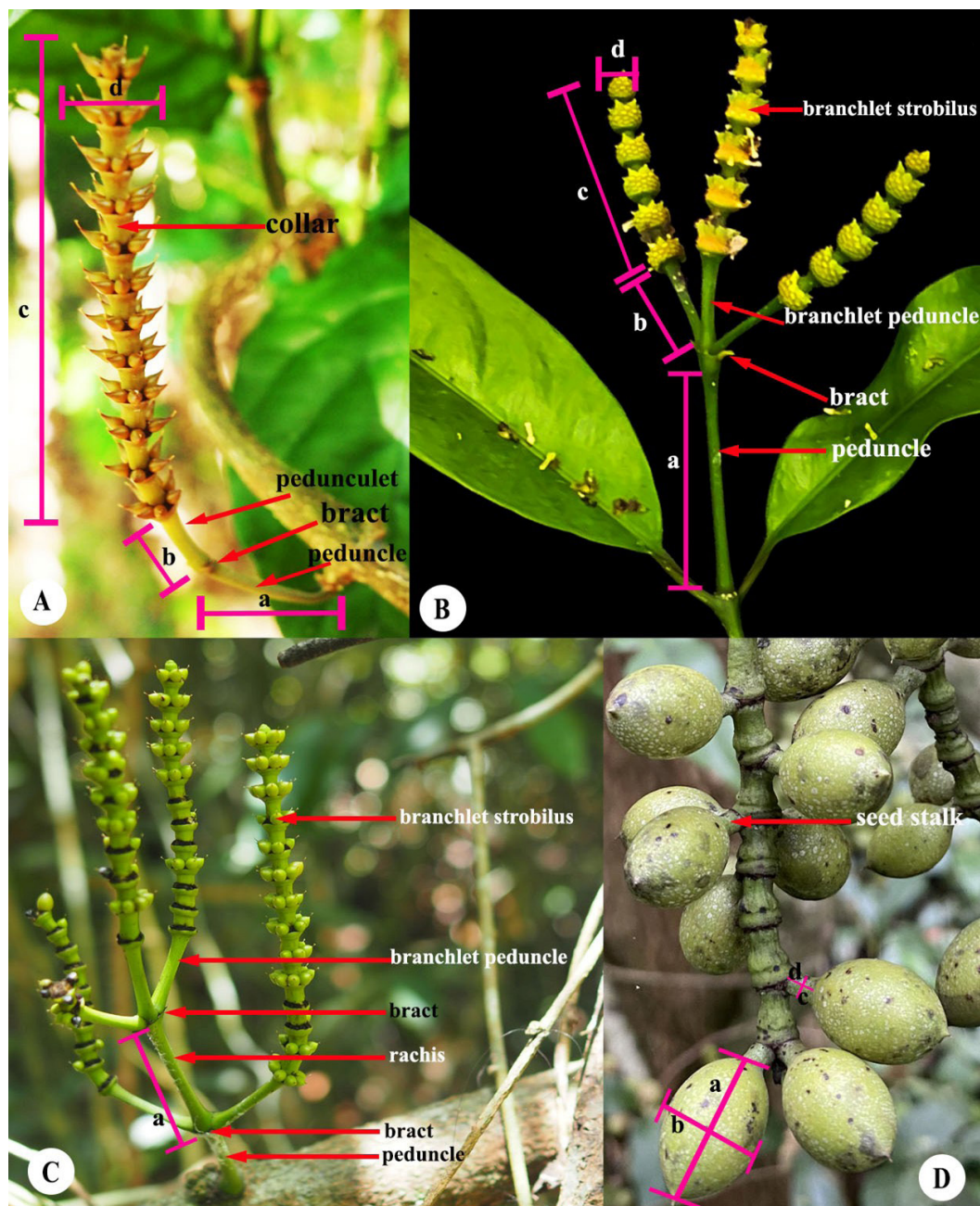


Figure 1. The measurement of strobili and seeds; A. simple strobilus, a: peduncle length, b: pedunculet length, c: strobilus length, d: strobilus width; B. once-branched strobilus, a: peduncle length, b: pedunculet length, c: strobilus length, d: strobilus width; C. many-branched strobili, a rachis length and others measure as once-branched; D. seeds, a: seed length, b: seed width, c: seed stalk length, d: stalk width (photos by K. Kuaphu).

scales, including *G. latifolium*, *G. megaspermum* and *G. montanum*; and (2) seeds lacking silvery scales, such as *G. tenuifolium* and *G. khaoluangense*.

TAXONOMIC TREATMENT

GNETUM

L., Mant. Pl. 1: 18. 1767. Lectotype: *Gnetum gnemon* L. "*Gnemon Domestica*" [icon] in Rumphius, Herb. Amboin., 1: 181, t. 71. 1741, designated by Stevenson in Stevenson & Zanoni (1991).

Large or slender woody climbers, scandent-shrubs or trees; dioecious, rarely monoecious; nodes swollen, glabrous; branches flattened or rather slender, green to brownish-green or yellowish-green; bark rough, thin, finely fissured, yellowish-grey, brownish-grey, dark greyish-green, or dark grey. *Leaves* simple, opposite or decussate, glabrous; lamina shape, base and apex variable, coriaceous to chartaceous, green or yellowish-green when fresh and black, dark greyish-brown, or green-yellow when dry, margin entire; venation pinnate, secondary nerves curved, bent, or straight and distinctly joined in loops near the margin. *Strobilus* cauline, axillary, or terminal, solitary or fascicled, simple or once-branched or once- to many-branched, erect or pendulous, hairy or glabrous; peduncle present; bracts connate at base and forming 2-triangular lobes, apex acute or acuminate; pedunculet, branchlet peduncle, and rachis present or absent; collars present, tubular or dish-like, each collar sitting below the row of megasporangia (ovules) or microsporangiophores

(stamen-like) or both, microsporangiophores and megasporangia arranged in whorls. *Staminate strobilus* cylindric, microsporangiophores sitting in 1-6 rows, consisting of a microsporangial stalk and two microsporangia. *Ovulate strobilus* broadly ovoid, megasporangium sitting in a row. *Seed-bearing strobilus* erect or pendulous. *Seed* ellipsoid, obovoid, or oblate-ellipsoid; sessile or with a slender or stout stalk; surface waxy and shining, hairy; base rounded, obtuse, or cuneate; apex mucronate, apiculate, or obtuse; fresh seed green, maturing to pink or dark orange; occasionally covered with silvery scales (Fig. 2).

1. *Gnetum cuspidatum* Blume, Rumphia 4: 5. 1849. Type: Indonesia, Sumatra, *C.L. Blume s.n.* (lectotype: **L** [L0277278] designated here, photo seen; isolectotypes: **L** [L0277274, L0277277] photos seen, **P** [P00731172, P00731173] photos seen).

Large woody climber, dioecious; branches flattened, green or brownish-green; bark yellowish-grey. *Leaves*: petioles 1–1.7 cm long; lamina elliptic, elliptic-oblong, or elliptic-lanceolate, 11–20 × 3.5–8 cm, base obtuse or cuneate, apex cuspidate or acuminate; secondary nerves bent; coriaceous, green when fresh and brown or blackish when dry. *Strobilus* cauline, solitary or fascicled, simple, pendulous; peduncle 0.5–0.7 cm long, bract 0.5–0.7 cm long; pedunculet 0.3–0.6 cm long; collar tubular, 5–11 rows. *Staminate strobilus* 5–6 cm × 5–6 mm; 80–100 microsporangiophores per collar. *Ovulate strobilus* 4–5 × 0.4–0.6 cm, 5–7 megasporangia per

KEY TO SPECIES OF *GNETUM* IN THAILAND

- | | |
|---|-----------------------------------|
| 1. Trees or scandent shrubs | 2. <i>G. gnemon</i> |
| 1. Woody climbers | |
| 2. Strobilus simple | |
| 3. Collars with conspicuous hairs | 6. <i>G. macrostachyum</i> |
| 3. Collars with inconspicuous hairs | |
| 4. Seeds stalked | 10. <i>G. tenuifolium</i> |
| 4. Seeds sessile | |
| 5. Staminate strobilus erect; sporangiophores 20–30 per collar; seed strobilus 4.5–8.5 cm long | 8. <i>G. microcarpum</i> |
| 5. Staminate strobilus pendulous; sporangiophores 80–100 per collar; seed strobilus 14.5–20 cm long | 1. <i>G. cuspidatum</i> |
| 2. Strobilus branching | |
| 6. Seeds sessile | 5. <i>G. leptostachyum</i> |
| 6. Seeds stalked | |
| 7. Seed without silvery scales | 3. <i>G. khaoluangense</i> |
| 7. Seed with silvery scales | |
| 8. Rachis up to 10 cm long; seed stalk stout, 0.3–0.4 cm long | 9. <i>G. montanum</i> |
| 8. Rachis up to 3 cm long; seed stalk slender, 0.4–1.3 cm long | |
| 9. Seeds 1.4–2.6 × 0.8–1.2 cm; sporangiophores 30–50 per collar | 4. <i>G. latifolium</i> |
| 9. Seeds 3–3.5 × 1.7–2 cm; sporangiophores 70–90 per collar | 7. <i>G. megaspermum</i> |

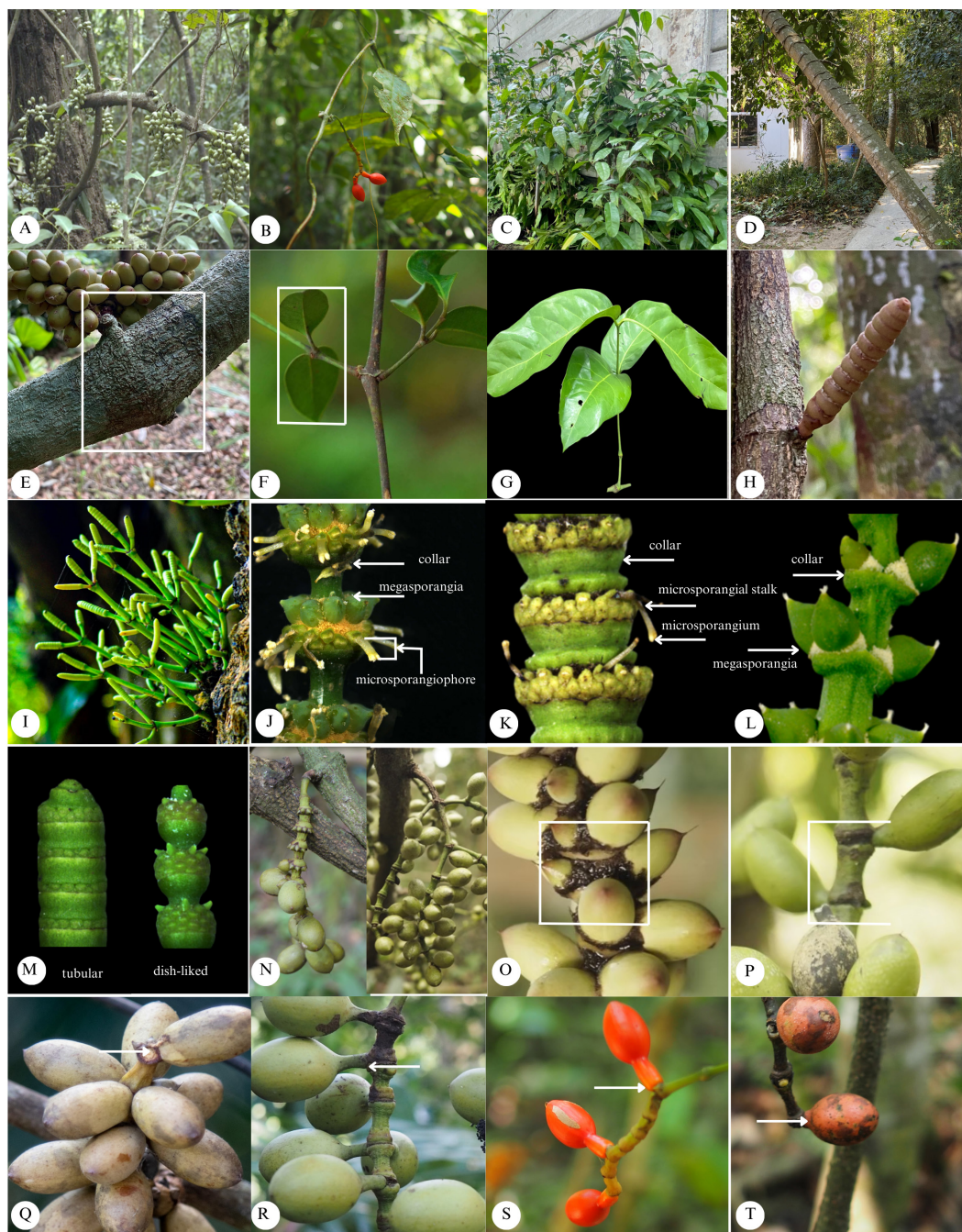


Figure 2. Morphological characters of *Gnetum* in Thailand: A. large woody climber; B. slender woody climber; C. scandent-shrub; D. tree; E. swollen nodes; F. opposite leaves; G. decussate leaves and pinnate venation; H. simple strobilus; I. fascicled and branching strobili; J. monoecious strobilus; K. staminate strobilus; L. ovulate strobilus; M. collar; N. simple and branching seed-bearing strobilus; O. collar with villose hairs; P. collar glabrous; Q. seed sessile; R. seed with linear stalk; S. seed with stout stalk; T. seed with short stalk (photos by K. Kuaphu)

collar, megasporangium 4–5×4–5 mm. *Seed-bearing strobilus* pendulous, 14.5–20×0.4–0.6 cm. *Seed* ellipsoid, 2.3–3.2 × 1.5–1.7 cm, base rounded, apex mucronate or apiculate; surface green and shining when young, not seen ripe, sessile.

Thailand.— SOUTH-WESTERN: Phetchaburi [Kaeng Krajan, 30 Jan. 2005, *Williams et al.* 1212 (BKF!); Prachuap Khiri Khan [Huai Yang, 8 Oct. 1980, *Put* 3245 (BK!); SOUTH-EASTERN: Chanthaburi [Pong Namron, 14 Feb. 2014, *Maknoi* 6669 (QBG!); PENINSULAR: Chumphon [Kao Long, 1 Jan. 1927, *Kerr* 11513 (BK!); Ranong [Kaper, Klong Naka, 19 Nov. 1973, *Santisuk* 627 (BKF!); Kaper, 25 Jan. 1979, *Kerr* 16863 (BKF!); Khao Pho Ta Chong Dong, 18 Jan. 2020, *Kuaphu* 4 (BKF!, QBG!); Surat Thani [Ban Ta Khun, 28 Nov. 1986, *Niyomdham et al.* 1297 (BKF!); Phang Nga [Nai Chong, 11 May 1973, *Phengklai* 5348 (BKF!); Kho Yao, 30 Apr. 2007, *Suddee et al.* 3138 (BKF!); Khuraburi, 19 Jan. 2016, *Kertsawang* 3894 (QBG!); Nakhon Si Thammarat [Kiriwong Village, 27 Oct. 1951, *Smitinand* 978 (BKF!); 27 Oct. 1994, *Smitinand* 749 (BKF!); Karom Waterfall, 15 Feb. 2020, *Kuaphu* 7 (BKF!); Phatthalung [Tamot, 23 May 1997, *Maxwall* 87-465 (BKF!, PSU!); Trang [Thung Khai Botanical Garden, 1 Apr. 2021, *Kuaphu* 69 (BKF!, QBG!); Songkhla [Saba Yoi, 16 Feb. 2004, *Middleton et al.* 3125 (BKF!); Yala [Nikom Kuelong, 12 Dec. 1972, *Santisuk* 407 (BKF!); Batong, 23 Feb. 2000, *Niyomdham et al.* 6064 (BKF!); Narathiwat [Sirindhorn Waterfall, 11 Feb. 1997, *Puudjae* 351 (BKF!); Phikulthong Botanical Garden, 9 May 2000, *Niyomdham et al.* 6154 (BKF!).

Distribution.— Cambodia, Vietnam, Malaysia, Indonesia

Ecology.— On stream banks and near waterfalls, usually in moist, shaded locations in evergreen forests and tropical rainforests, sometimes extending to adjacent disturbed areas; at alt. 100–700 m. *Strobili*: July–August; seeds: August–October.

Vernacular.— Mueai dam (เมือยดำ) (Chumphon).

Notes.— Blume (1849) described *Gnetum cuspidatum* based on his specimens from Sumatra but did not mention the type. We found *Blume s.n.* in **L** (L0277274, L0277277, L0277278) and *Blume s.n.* in **P** (P00731172, P00731173), and select *Blume s.n.* at **L** (L0277278) as the lectotype because this specimen has a strobilus, and Blume worked in

Leiden. The other specimens in **L** (L0277274, L0277277) and **P** (P00731172, P00731173) are isolectotypes. *Gnetum cuspidatum* is distinguished from the other species by its flattened stem, and the cuspidate or acuminate leaf apex. The strobili are simple, solitary, and pendulous, produced on a long stem. The basal bract is sparsely hairy. The seeds are sessile and waxy.

2. *Gnetum gnemon* L., Mant. Pl. 1: 125. 1767. Type: “*Gnemon Domestica*” [icon] in Rumphius, Herb. Amboin., 1: 181, t. 71. 1741, designated by Stevenson in Stevenson & Zanoni (1991).

Scandent-shrub or tree, monoecious or dioecious; crown narrow or cylindrical; branches green or yellowish-green; bark thin, finely fissured. *Leaves*: petioles 0.6–1.5 cm long; lamina elliptic, elliptic-lanceolate, lanceolate or oblong, 9–18 × 4–8.3 cm, base attenuate or cuneate, apex acuminate or caudate; secondary nerves curved; coriaceous or chartaceous; green or dark green when fresh and yellowish-green when dry. *Strobilus* axillary, solitary, simple or once-branched, erect; peduncle 0.3–2.3 cm long; bract 0.3–0.7 cm long; rachis absent; branchlet peduncle 1–2.7 cm long, collar dish-like, 4–9 rows. *Staminate strobilus* 2.6–4.8 × 0.5–0.6 cm, 80–100 microsporangio-phores per collar, *Ovulate strobilus* 1.9–4.7 × 0.2–0.5 cm; 5–8 megasporangia per collar, megasporangium 2–4×2–4 mm. *Seed-bearing strobilus* erect, 4–11.6 × 0.3–0.4 cm. *Seed* ellipsoid, 2–3 × 1–1.5 cm, base cuneate or obtuse, apex mucronate, apiculate or obtuse; yellow, orange-yellow, or red when ripe, sessile.

KEY TO VARIETIES OF *GNETUM GNEMON*

- a. Tree, up to 10 m tall; lamina 13–18 × 4.8–8.3 cm, coriaceous; ripe seeds orange-red or red **a. var. *gnemon***
- b. Scandent-shrub, up to 3 m tall; lamina 9–14 × 4–6 cm, chartaceous; ripe seeds yellow, orange-yellow or red when ripe **b. var. *tenerum***

a. *Gnetum gnemon* var. *gnemon*

Tree, up to 10 m tall, dioecious. *Leaves*: petioles 0.6–1.5 cm long; lamina elliptic-lanceolate or oblong, 13–18 × 4.8–8.3 cm, coriaceous, base cuneate, apex acuminate or acute; dark green when fresh. *Strobilus*: peduncle 0.7–2.3 cm long; bract 0.5–0.7 cm long; branchlet peduncle 1–2.7 cm long; collars 4–9 rows. *Staminate strobilus* 2.6–3.6 × 0.4–0.5 cm.

80–100 microsporangiophores per collar. *Ovulate strobilus* $2.3\text{--}4.7 \times 0.4\text{--}0.5$ cm; 4–5 megasporangia per collar, megasporangium $3\text{--}4 \times 3\text{--}4$ mm. *Seed-bearing strobilus* $4\text{--}11.6 \times 0.3\text{--}0.4$ cm. *Seed* $2\text{--}3 \times 1\text{--}1.5$ cm, apex mucronate, apiculate or obtuse, orange-red, or red when ripe

Thailand.—NORTHERN: Chiang Mai [Queen Sirikit Botanic Garden, 22 Apr. 1997, *Nanakorn et al.* 8987 (**QBG!**)]; Phayao [Phu Sang Waterfall, 27 July 2014, *La-ongsri et al.* 3546 (**QBG!**)]. SOUTH-EASTERN: Chachoengsao (cultivated) [Khao Hin Son Botanical Garden, 8 Dec. 2018, *Kuaphu* 2 (**BKF!**, **QBG!**)]; Khao Hin Son Botanical Garden, 27 Dec. 2019, *Kuaphu* 61 (**BKF!**, **QBG!**)]. PENINSULAR: Chumphon [Pa To, 2 May 1974, *Tipawa* 197 (**BK!**)]; Pa To Watershed, 12 Apr. 2008, *Wessumritt* 159 (**QBG!**)]; Ranong [Kra Buri, 27 Feb. 1968, *Vachanapong* 160 (**BK!**)]; Kaper, Khlong Nakha Wildlife Sanctuary, 21 Aug. 2001, *Pirun* 14 (**BKF!**)]; Surat Thani [Khao Sok, 14 Nov. 1999, *Watthana* 719 (**QBG!**)]; Phang Nga [Kho Sam, 7 Apr. 2010, *Phengkklai et al.* 16140 (**BKF!**)]; Khuraburi, Ban Bangsoi Khura, 3 Mar. 2015, *Phaosrichai* 175 (**QBG!**)]; Nakhon Si Thammarat [Lansaka, Khaokaew, 31 Apr. 2002, *Pirun* 330 (**BKF!**)]; Trang [Khao Chong, 13 Mar. 1969, *Sangkhachand* 1781 (**BK!**)]; Khao Chong, 12 Apr. 1993, *Winai & Parinya WP-189* (**BK!**)]; Pattani [Bukit, 24 Jan. 1981, *Put* 3620 (**BK!**)]; Narathiwat [Sukhirin, 21 Dec. 2019, *Kuaphu* 59 (**BKF!**, **QBG!**)]; Su-ngai Padi, 20 May 2002, *Ubon* 252 (**QBG!**)].

Distribution.—India, Myanmar, China, Malaysia, Vietnam, Indonesia, Philippines.

Ecology.—Along streams or near streams, in shaded areas of secondary vegetation within evergreen forests, occasionally in partially disturbed habitats; at alt. 50–200 m. *Strobili*: January–February; *seeds*: February–March.

Vernacular.—Miang (ม้าง)(Malay-Narathiwat).

b. *Gnetum gnemon* var. *tenerum* Markgr., Bull. Jard. Bot. Buitenzorg ser. 3, 10(4): 444 (t. 1, figs. 3–4). 1930 (lectotype: [Icon]: Markgr., Bull. Jard. Bot. Buitenzorg ser. 3, 10(4): 444 t. 1, f. 3–4. 1930], designated here).

Scandent shrub, up to 3 m tall, monoecious. *Leaves*: petioles 0.7–1.5 cm long; lamina lanceolate, elliptic or oblong, $9\text{--}14 \times 4\text{--}6$ cm, chartaceous, base

attenuate or cuneate, apex acuminate, attenuate or caudate; green when fresh. *Strobilus* $2\text{--}8 \times 0.3\text{--}0.6$ cm, collar 5–9 rows; microsporangiophores 80–100 per collar, arranged in 5–9 rows sitting between collar and megasporangia row; 5–8 megasporangia per collar and sitting on upper row, megasporangium $2\text{--}3 \times 2\text{--}4$ mm, peduncle 0.3–1 cm long; bract 0.3–1.5 cm long, branchlet peduncle 1–2.7 cm long. *Seed-bearing strobilus* $4\text{--}8.9 \times 0.3\text{--}0.4$ cm. *Seed* $2\text{--}2.5 \times 1\text{--}1.5$ cm, apex mucronate or apiculate, yellow, orange-yellow or red when ripe.

Thailand.—NORTHERN: Chiang Mai [Mae Rim, Queen Sirikit Botanic Garden, 29 Nov. 2010, *Pongamornkul* 2847 (**QBG!**)]; 17 Feb. 2014, *Muangyen* 81 (**QBG!**)]; Tak [Kao Ra Chanl, 20 Apr. 1931, *Lakshnakara* 721 (**BK!**)]; SOUTH-WESTERN: Kanchanaburi [Sai Yok, 8 Mar. 1999, *Paisooksunti YP.99-4* (**BK!**)]; Tao Daun, 1 Mar. 2000, *Urai UC-579* (**BK!**)]; Phetchaburi [Tuangnam, 23 Mar. 1975, *Maxwell* 75-285 (**BK!**)]; Kaeng Krachan National Park, 1 Dec. 2002, *Middleton et al.* 1555 (**BKF!**)]; SOUTH-EASTERN: Chachoengsao [Khao Hin Son Botanical Garden, 8 Dec. 2018, *Kuaphu* 2 (**BKF!**, **QBG!**)]; 27 Dec. 2019, *Kuaphu* 61 (**BKF!**, **QBG!**)]; PENINSULAR: Chumphon [Lang Suan, 18 Mar. 1980, *Paisooksunti* 280-80 (**BK!**)]; 27 Jan. 2020, *Kuaphu* 6 (**BKF!**, **QBG!**)]; Ranong [Ban Kerng, 2 Feb. 1927, *Kerr* 11771 (**BK!**)]; Kra Buri, 27 Jan. 2020, *Kuaphu* 5 (**BKF!**, **QBG!**)]; Surat Thani [Ban Hai, 18 Feb. 1930, *Kerr* 18107 (**BK!**)]; Phanom, 18 Feb. 1930, *Kerr* 18310 (**BK!**)]; Phang Nga [Kho Sam, 7 Apr. 2010, *Phengkklai et al.* 16140 (**BKF!**)]; Khuraburi, 3 Mar. 2015, *Phaosrichai* 175 (**QBG!**)]; Krabi [Mueng, 27 Aug. 1985, *Vacharee* 679 (**BK!**)]; Khaoper-Bang Krem, 16 Feb. 1991, *Niyomdhum et al.* 2114 (**BKF!**)]; Nakhon Si Thammarat [Chawang, 20 Feb. 1957, *Sanan* 925 (**BKF!**)]; Khao Luang National Park, 16 Mar. 1985, *Newman* 56 (**BKF!**)]; Trang [Khao Chong, 13 Mar. 1969, *Sangkhachand* 1781 (**BK!**)]; Khao Chong, 12 Apr. 1993, *Winai & Parinya WP-189* (**BK!**)]; Pattani [Bukit, 24 Jan. 1981, *Put* 3620 (**BK!**)]; Narathiwat [Chawarin Waterfall, 22 Dec. 1993, *Fukuoka & Koyama T-61980* (**BKF!**)]; Sukhirin, 21 Dec. 2019, *Kuaphu* 59 (**BKF!**, **QBG!**)].

Distribution.—Indonesia, Malaysia.

Ecology.—Along streams and on mountain summits in evergreen forests at alt. 50–200 m. *Strobili*: January–February; *seeds*: February–March.

Vernacular.— Phak kariang (ผักกะเหรียง) (Chumphon), phak miang (ผักเหมียง) (Phangnga), phak liang (ผักเหลียง) (Chumphon).

Notes.— Markgraf (1930) described *Gnetum gnemon* var. *tenerum* but did not mention the type. However, he prepared the illustration simultaneously and we select it here as the lectotype. *Gnetum gnemon* var. *tenerum* is the only monoecious Thai *Gnetum*. The strobilus structure shows special features. The megasporangia and microsporangiophores are arranged in whorls. The microsporangiophores are arranged in 5–9 rows and sit on a collar. The megasporangia are arranged in a row and sit above a microsporangiophore row (Fig. 2J).

3. *Gnetum khaoluangense* Kuaphu & Suwanph., sp. nov.

Gnetum khaoluangense resembles *G. montanum* but differs in its leaves with curved secondary veins, drying dark brown (vs secondary veins straight, drying dark greyish brown in *G. montanum*), once-branched strobilus (vs many-branched in *G. montanum*), longer peduncles 2.2–2.5 cm long (vs 0.6–1.2 cm long in *G. montanum*), 7–9 megasporangia per collar (vs 5–8 in *G. montanum*), larger oblate-elliptic seeds, $2.1\text{--}2.4 \times 1.4\text{--}1.6$ cm (vs ellipsoid, $1.2\text{--}3 \times 0.8\text{--}2$ cm in *G. montanum*), and lacking silvery scales (vs seed coat covered with silvery scales in *G. montanum*). Type: Thailand, Nakhon Si Thammarat, Khao Luang National Park, 4 Apr. 2021, K. Kuaphu 75 (seed) (holotype: **BKF!**; isotypes: **BKF!**, **QBG!**). Figs. 3, 4.

Large woody climber, dioecious; branches green or brownish-green; bark dark greyish-green. *Leaves*: petioles 0.7–1.5 cm long; lamina lanceolate, oblong or elliptic-oblong, $11\text{--}18 \times 7.6\text{--}11.3$ cm, coriaceous, base rounded or cuneate, apex acute or attenuate; secondary nerves curved; green when fresh and dark brown when dry. *Strobilus* cauline, fascicled, many-branched, erect; peduncle 1.2–2 cm long; bract 0.2–0.5 cm long, rachis 2–3 cm long, branchlet peduncle 1.8–3.5 cm long; collar tubular, 7–10 rows. *Staminate strobilus* not seen. *Ovulate strobilus* not seen. *Seed-bearing strobilus* pendulous, $9.5\text{--}18 \times 0.4\text{--}0.5$ cm. *Seed* oblate-elliptic, $2.1\text{--}2.4 \times 1.4\text{--}1.6$ cm, base rounded, apex mucronate-apiculate; seed without silvery scales, seed coat thinly and minutely velvety, ripe seed not seen; stalk slender, $0.5\text{--}0.6 \times 0.2\text{--}0.3$ cm.

Distribution.— Endemic to Thailand (Nakhon Si Thammarat).

Ecology.— Restricted to mountainous areas of the peninsular region in Nakhon Si Thammarat, in the shaded understory of evergreen forest; at alt. 1,000–1,200 m, Strobili; month(s) not seen; seeds: April – June.

Vernacular name.— Mueai khaoluang (เมื่อยเขาหลวง) (Proposed here).

Etymology.— The specific epithet refers to Khao Luang National Park (Nakhon Si Thammarat Province, Thailand), where the type specimens were collected.

Conservation status.— Following the IUCN Standard and Petitions Committee (2024) criteria using GeoCAT (Bachman & Moat 2012), we propose its conservation status of Critically Endangered (CR): B1a, B2a, with an extent of occurrence (EOO) of 0.100 km² and an area of occupancy (AOO) of 4.00 km². The species is known from a single population located in Khao Luang National Park. Although the area is protected, it is situated near a community settlement and is a tourist destination. This close proximity to human activity puts the species at a high risk of being impacted by encroachment and environmental degradation.

Note.— *Gnetum khaoluangense* is endemic to Thailand but closely resembles *G. montanum* and shares many characteristics with that species. It is clearly distinguished from *G. montanum*, however, in the seed strobilus being many-branched, and the seed indumentum which is thin, minute and velvety.

4. *Gnetum latifolium* Blume, Tijdschr. Natuurl. Gesch. Physiol. 1: 162. 1834. Type: Indonesia. Java, C.L. Blume s.n. (lectotype: L [L0050746] designated by Khuraijam *et al.*, 2020).

Large woody climber, dioecious; branches green or brownish-green, with noticeable swollen nodes; bark brownish-grey. *Leaves*: petioles 0.5–1.5 cm long; lamina ovate to oblong-lanceolate, $7\text{--}12 \times 4.8\text{--}8.8$ cm, thin-coriaceous, base attenuate, rounded, cuneate, or obtuse, apex acuminate, attenuate, acute, or obtuse; secondary nerves curved; green when fresh and dark brown to black when dry. *Strobilus* cauline to terminal, fascicled, many-branched, erect;



Figure 3. Line drawing of *Gnetum khaoluangense* Kuaphu & Suwanph. A. branch with leaves and seed-bearing strobilus. Drawn by T. Khananthong.



Figure 4. *Gnetum khaoluangense* Kuaphu & Suwanph. A. stem; B. leaves; C. leaves and seed-bearing strobilus; D. mature seeds. (photos A-C by K. Kuaphu and photo D by Y. Banchong).

peduncle 0.6–2.3 cm long; bract 0.6–0.9 cm long, rachis 2–3 cm long; branchlet peduncle 1.8–3.5 cm long; collar tubular, 4–20 rows. *Staminate strobilus* 3–5 × 0.4–0.5 cm; 30–50 microsporangiophores per collar. *Ovulate strobilus* 4–5 × 0.4–0.6 cm; 7–9 megasporangia per collar, megasporangium 3–4 × 3–4 mm. *Seed-bearing strobilus* pendulous, 1.5–3 × 0.4–0.5 cm. *Seed* ellipsoid to obovoid, 1.4–2.6 × 0.8–1.2 cm, base rounded, obtuse or cuneate, apex mucronate, apiculate, or obtuse; seed coat covered with silvery scales, pink or dark orange when ripe; stalk slender, 0.4–1 × 0.2–0.4 cm.

Thailand.— NORTHERN: Chiang Mai [Pha Dok Siao Waterfall, 24 July 2020, *Kuaphu* 37 (**BKF!**, **QBG!**)]; Nan [Doi Phu Kha, 3 Mar. 1921, *Kerr* 5001 (**BK!**); Doi Phu Kha, 27 May 2000, *Srisanga* 1443 (**QBG!**); Nakhon Sawan [Mae Wong, 11 Feb. 2005, *van de Bult* 814 (**BKF!**)]; EASTERN: Ubon Ratchathani [Khong Chiam, 28 Apr. 1988, *Wongpranert s.n.* (**BKF!**); Dong Fa Huan Botanical Garden, 25 May 2022, *Kuaphu* 99 (**BKF!**, **QBG!**), *Kuaphu* 100 (**BKF!**, **QBG!**), *Kuaphu* 102 (**BKF!**, **QBG!**), *Kuaphu* 105 (**BKF!**, **QBG!**)]; SOUTH-WESTERN: Prachuap Khiri Khan [Huay Yang

waterfall, 26 Jan. 2004, *Middleton et al.* 2540 (BKF!); CENTRAL: Nakhon Nayok [Nang Rong, 16 Jan. 1985, *Fumihito et al.*, T-49099 (BKF!); SOUTH-EASTERN: Trat [Kho Kut, 7 Apr. 2002, *Phengklai et al.* 13438 (BKF!); Kho Chang, 8 Apr. 2003, *Phengklai et al.* 14611 (BKF!); PENINSULAR: Chumphon [Lang Suan, Khao Kiale, 16 Apr. 1967, *Sakol* 2235 (BK!); Ranong [Kao Chong, 8 Jan. 1929, *Kerr* 16570 (BK!); Phuket [Thalang, 15 Oct. 2004, *Gardner & Sidisunthron* ST1024 (QBG!); Nakhon Si Thammarat [Ban Ta San, 24 Mar. 1928, *Kerr* 15369 (BK!); Walailak University, 25 Mar. 2020, *Kuaphu* 21 (BKF!, QBG!); Trang [Kao Chong, 8 Jan. 1929, *Kerr* 16570 (BK!); 6 Dec. 1965, *Bunnab* 121 (BKF!); Songkhla [Klaung Ou, 21 Jan. 1928, *Kerr* 15876 (BK!); Narathiwat [Sungai Padee, 6 Aug. 1983, *Niyomdham* 657 (BKF!).

Distribution.— India, Indonesia, Malaysia.

Ecology.— Along streams and waterfalls, in evergreen and mixed deciduous forests, frequently in shaded understory near streams; at alt. 300 m, Strobili: May–July; seeds: July–December.

Vernacular.— Ma nuai (มะนวย)(Narathiwat).

5. *Gnetum leptostachyum* Blume, Rumphia 4: 5. 1849. Type: Indonesia. Borneo, *C.L. Blume s.n.* (lectotype: L [L0581739] designated here, photo seen).

Large woody climber, dioecious; branches green or brownish-green; bark yellowish-grey. *Leaves*: petioles 0.6–1.2 cm long; lamina elliptic-oblong, 12–30 × 2.8–8.5 cm, coriaceous, base rounded, acuminate, acute, or obtuse, apex acuminate; secondary nerves bent; green when fresh, brown when dry. *Strobilus* cauline, solitary or fascicled, many-branched, erect; peduncle 0.7–3.2 cm long; bract 0.5–1.3 cm long, rachis 1.7–4.2 cm long, branchlet peduncle 0.4–0.6 cm long; collar cup-like, 6–15 rows, hairy. *Staminate strobilus* 3–6 × 0.4–0.5 cm; 30–40 microsporangiophores per collar. *Ovulate strobilus* 8–10 × 0.4–0.6 cm; 8–10 megasporangia per collar, megasporangium 4–5 × 3–5 mm. *Seed-bearing strobilus* pendulous, 3–20 × 0.4–0.5. *Seed* ellipsoid, 2–2.5 × 0.8–1.2 cm, base rounded or obtuse, apex obtuse or acute; dark orange when ripe, sessile.

Thailand.— NORTHERN: Chiang Mai [Doi Suthep-Pui National Park, 29 Feb. 1988, *Maxwell*

88-299 (BKF!); Doi Inthanon National Park, 26 July 1988, *Phengkhlai* 6899 (BKF!); Lamphun [Khun Tan National Park, 27 Sept. 1993, *Maxwell* 93-963 (BKF!); PENINSULAR: Nakhon Si Thammarat [Walailak University, 15 Mar. 2021, *Kuaphu* 67 (BKF!, QBG!); Tumpang Archaeological Site, 3 Apr. 2021, *Kuaphu* 73 (BKF!, QBG!); Trang [Thung Khai Botanical Garden, 1 Apr. 2021, *Kuaphu* 69 (BKF!, QBG!); Songkhla [Klaung Ou, 21 June 1928, *Kerr* 15876 (BK!); Narathiwat [Hala-Bala, 20 Dec. 2020, *Kuaphu* 56 (BKF!, QBG!).

Distribution.— Indonesia, Laos, Malaysia, Vietnam.

Ecology.— In dry evergreen forest and on limestone substrates; at alt. 1,500 m. Strobili: April–June; seeds: June–December.

Vernacular.— Muai lueai (เผือกน้อย)(Northern).

Notes.— Blume (1849) described *Gnetum leptostachyum* based on a specimen from Borneo, but did not mention the type. We found only *Blume s.n.* at L [L0581739] and select this collection as the lectotype. This species is distinguished by its many-branched and erect strobilus, and the ovulate strobilus is two or three times longer than the staminate strobilus.

6. *Gnetum macrostachyum* Hook.f., Fl. Brit. India 5: 642. 1888. Type: Singapore, Mar. 1885, *R.W. Hullett* 55 (lectotype: SING [SING 0051297] designated here, photo seen; isolectotype: B [B100001491] photo seen).

Large woody climber, dioecious; branches green or brownish-grey; bark yellowish-grey. *Leaves*: petioles 0.6–1.2 cm long; lamina elliptic-oblong, 12–30 × 2.8–8.5 cm, coriaceous, base rounded, acuminate, acute, or obtuse, apex acuminate; secondary nerves bent; green when fresh and brown when dry. *Strobilus* cauline, solitary or fascicled, simple, erect; peduncle 0.2–1.5 cm long; bract 0.9–1.3 cm long; pedunculet 0.2–0.6 cm long; collar tubular, 10–15 rows, hairy, surrounded by a dense layer of long brown hairs. *Staminate strobilus* 2.5–5 × 0.4–0.5 cm; 80–90 microsporangiophores per collar. *Ovulate strobilus* 4–5 × 0.4–0.5 cm; 7–10 megasporangia per collar, megasporangium 3–4 × 4–5 mm. *Seed-bearing strobilus* erect, 9–12 × 0.4–0.5 cm. *Seed* ellipsoid, 1–2 × 0.6–1 cm, red when ripe, sessile, base obtuse, apex mucronate-apiculate.

Thailand.— EASTERN: Nakhon Ratchasima [Pak Thong Chai, Sakaerat, along Huai Krae Stream, 30 Oct. 1996, *van Beusekom 1920* (**BKF!**); Khao Yai, Mo Sing To, 10 Apr. 2002, *Boonkongchart 112* (**BKF!**); Surin [Surin, 2 Dec. 1976, *Phengklai 3541* (**BKF!**); Ubon Ratchathani [Nong Khon, 11 Oct. 1994, *Murata et al. T-62002* (**BKF!**); SOUTH-EASTERN: Chon Buri [Ban Bueng, 10 Feb. 1966, *Phengnaren 200* (**BKF!**); Khao Kieo Siracha, 4 Apr. 1975, *Maxwell 95-190* (**BK!**); Chanthaburi [Pliew Fall, 14 Apr. 1973, *Maxwell 73-53* (**BK!**); Trat [Trat, Khlong Sai Daeng, Koh Chang, 18 Feb. 1955, *Smitinand 2204* (**BKF!**); Koh Kut, 20 Oct. 2000, *Phengklai 13091* (**BKF!**); PENINSULAR: Ranong [Ranong, 5 Jan. 1929, *Kerr 16536* (**BK!**); Chumphon [Phato, 2 May 2020, *K. Larsen & S.S. Larsen 33554* (**BKF!**); Surat Thani [Samui, 2 Jan. 1930, *Kerr 17921* (**BK!**); Ko Samui, 15 Feb. 2005, *Chayamarit N61* (**BKF!**); Phangnga [Khura Khuraburi, 14 Jan. 2016, *Kertsawang 3692* (**QBG!**); Nakhon Si Thammarat [Kao Chum Tawng, 30 Jan. 1928, *Kerr 14347* (**BK!**); Walailak University, 30 May 1995, *Nanakorn et al. 3523* (**QBG!**); Trang [Sikao, 23 Apr. 1991, *Jarp 24* (**BK!**); Songkhla [Songkhla, 26 Apr. 1928, *Kerr 14805* (**BK!**); Kho Hong Hill, 9 May 1985, *Maxwell 85-446* (**PSU!**); Yala [Yala, 30 Jan. 1981, *Put 3661* (**BK!**); Narathiwat [Bala-Hala, 20 Sept. 1997, *Niyomdham 51* (**BKF!**).

Distribution.— Myanmar, Indonesia, Malaysia, Laos, Cambodia, Vietnam.

Ecology.— Along streams in evergreen forests; at alt. 200–900 m. Strobili: January–February; seeds: February–March.

Vernacular.— Mueai duk (เมือยดูก)(Pattani).

Notes.— Hooker (1888) described *Gnetum macrostachyum* based on syntypes from Singapore (Hullett), Penang (Curtis), and Malacca (Mt. Ophir). We found Hullett specimens at **SING** (SING 0051297) and **B** [B100001491], and a Curtis specimen at **K** (K001057626). The Curtis specimen was identified as *G. microcarpum* Blume by Markgraf (1930) and is therefore excluded from the remaining syntypes. We select the Hullett specimen at **SING** as the lectotype, because it is the most complete voucher specimen, and the Hullett specimen at **B** as an isoelectotype.

This species is distinguished by its leaves, which are coriaceous and noticeably thicker than

those of related species. The strobilus is simple or fascicled, solitary, and erect. The collars are densely covered with long brown hairs, completely enclosing the base of the seed.

7. *Gnetum megaspermum* Kuaphu & Suwanph., sp. nov.

Gnetum megaspermum resembles *G. latifolium* but differs by its larger seeds, $3\text{--}3.5 \times 1.7\text{--}2$ cm (vs $1.4\text{--}2.6 \times 0.8\text{--}1.2$ cm in *G. latifolium*), staminate strobili smaller, $2.5\text{--}3 \times 0.4\text{--}0.5$ cm (vs $3\text{--}5 \times 0.4\text{--}0.5$ cm in *G. latifolium*), microsporangiophores per collar more than 70–90 (vs 30–50 in *G. latifolium*). Type: Thailand, Chiang Rai Province, Wiang Pa Pao, 28 May 2022, *K. Kuaphu 108* (seed) (holotype: **BKF!**; isotypes: **BKF!**, **QBG!**). Figs. 5, 6.

Large woody climber, dioecious; branches green or brownish-grey; bark dark greyish-green. *Leaves*: petioles 0.5–1.3 cm long; lamina ovate, lanceolate, or elliptic-oblong, $11\text{--}18 \times 4.8\text{--}6.1$ cm, coriaceous, base obtuse or cuneate, apex acute or attenuate; secondary nerves curved; green when fresh and dark brown when dry. *Strobilus* cauline, fascicled, many-branched, erect; peduncle 0.2–3.5 cm long; bract 0.2–0.5 cm long; rachis 1.5–3 cm long; branchlet peduncle 0.7–1.5 cm long; collar tubular, 5–15 rows, hairy. *Staminate strobilus* $2.5\text{--}3 \times 0.4\text{--}0.5$ cm, 70–90 microsporangiophores per collar, *Ovulate strobilus* $4\text{--}5 \times 0.4\text{--}0.6$ cm; 7–9 megasporangia per collar, megasporangium $3\text{--}4 \times 4\text{--}5$ mm. *Seed-bearing strobilus* pendulous, $7.2\text{--}13 \times 0.4\text{--}0.5$ cm. *Seed* ellipsoid, $3\text{--}3.5 \times 1.7\text{--}2$ cm, base rounded or obtuse, apex obtuse; coat covered with silvery scales, orange when ripe; stalk slender, $0.8\text{--}1.3 \times 0.2\text{--}0.5$ cm.

Thailand.— NORTHERN: Chiang Rai, [Wiang Pa Pao, 28 May 2022, *Kuaphu 108* (types **BKF!**, **QBG!**), *Kuaphu 109* (**BKF!**, **QBG!**); Nan [Na Noi, 5 Dec. 2021, *Kuaphu 95* (**BKF!**, **QBG!**)].

Distribution.— Endemic to Thailand (Chiang Rai and Nan Provinces).

Ecology.— Found in shaded areas of mountainous regions in tropical forests; at alt. 1,500–1,800 m. Strobili: March–April; seeds: May–July.

Vernacular.— Mueai Yai (เมือยใหญ่)(Proposed here).

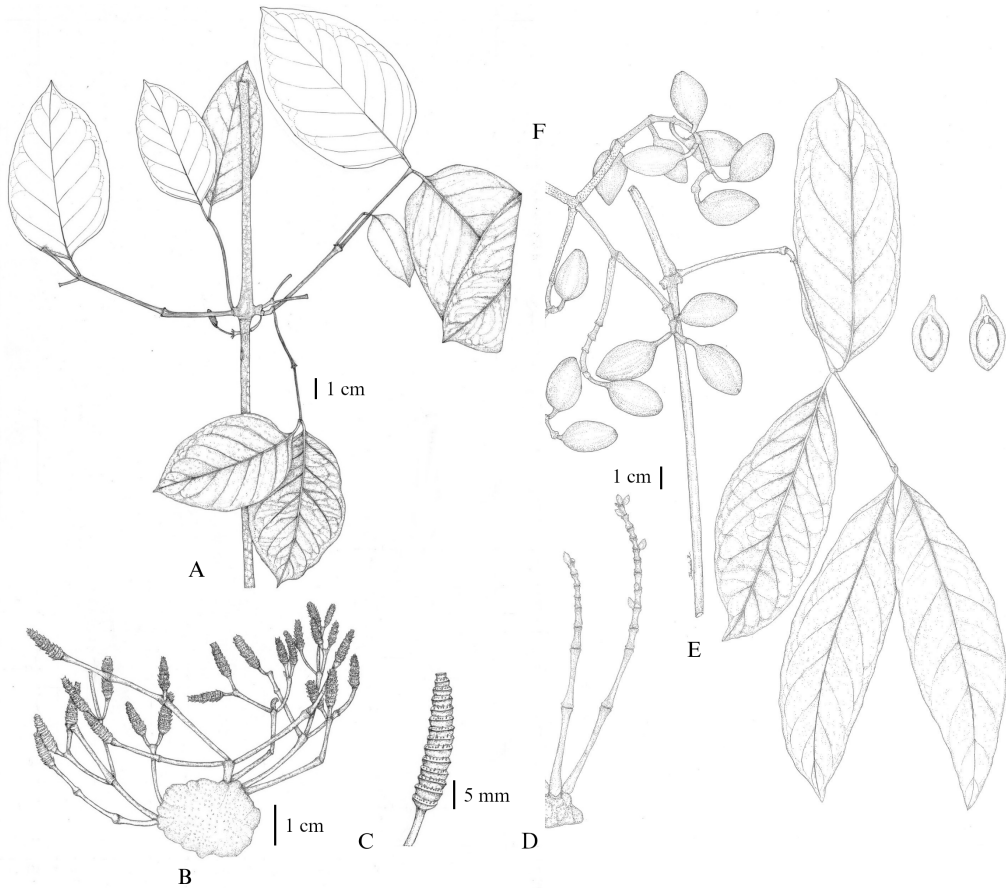


Figure 5. Line drawing of *Gnetum megaspermum* Kuaphu & Suwanph. A. branch with leaves and staminate strobili; B. fascicled and branching staminate strobili; C. staminate strobilus; D. fascicled ovulate strobili; E. branch with leaves; F. seed-bearing strobilus (drawn by T. Khananthong).

Etymology.—The species epithet refers to the large size of the seeds, which is a distinctive character.

Conservation status.—Following the IUCN Standard and Petitions Committee (2024) criteria using GeoCAT (Bachman & Moat 2012), we propose its conservation status of Critically Endangered (CR): B1b(iii), B2b(iii), with an extent of occurrence (EOO) of 18,868 km² and an area of occupancy (AOO) of 8.00 km². The species is found in Thailand's Nan and Chiang Rai provinces. It is susceptible to habitat disturbance due to its limited range and small, isolated populations. The plants are in the proximity to human activities.

Notes.—Compared to other Thai *Gnetum*, *G. megaspermum* possesses the largest seeds and longest stalks, and occurs only in northern Thailand.

8. *Gnetum microcarpum* Blume, Rumphia 4: 7. 1849. Type: Indonesia, Sumatra, *C.L. Blume s.n.* (lectotype [Icon]: Tab. 175 fig. 1 in Rumphia 4: 7. 1849] designated here, photo seen).

Large woody climber, dioecious; branches relatively slender, green or brownish-grey; bark rough, dark grey. *Leaves*: petioles 0.5–1.7 cm long; lamina oblanceolate, lanceolate, long-ovate or elliptic, 6–16 × 3–8 cm, coriaceous, base cuneate or rounded, apex acuminate, attenuate, or cuspidate; secondary nerves straight; green when fresh and dark greyish brown when dry. *Strobilus* cauline to terminal, solitary or fascicled, simple, erect; peduncle 0.8–3.8 cm long; bract 0.4–0.7 cm long; pedunculet 0.3–1 cm long; collar cylindric; 6–11 rows, hairy. *Staminate strobilus* 5–7 × 0.4–0.5 cm; 20–30 microsporangioophores per collar. *Ovulate*

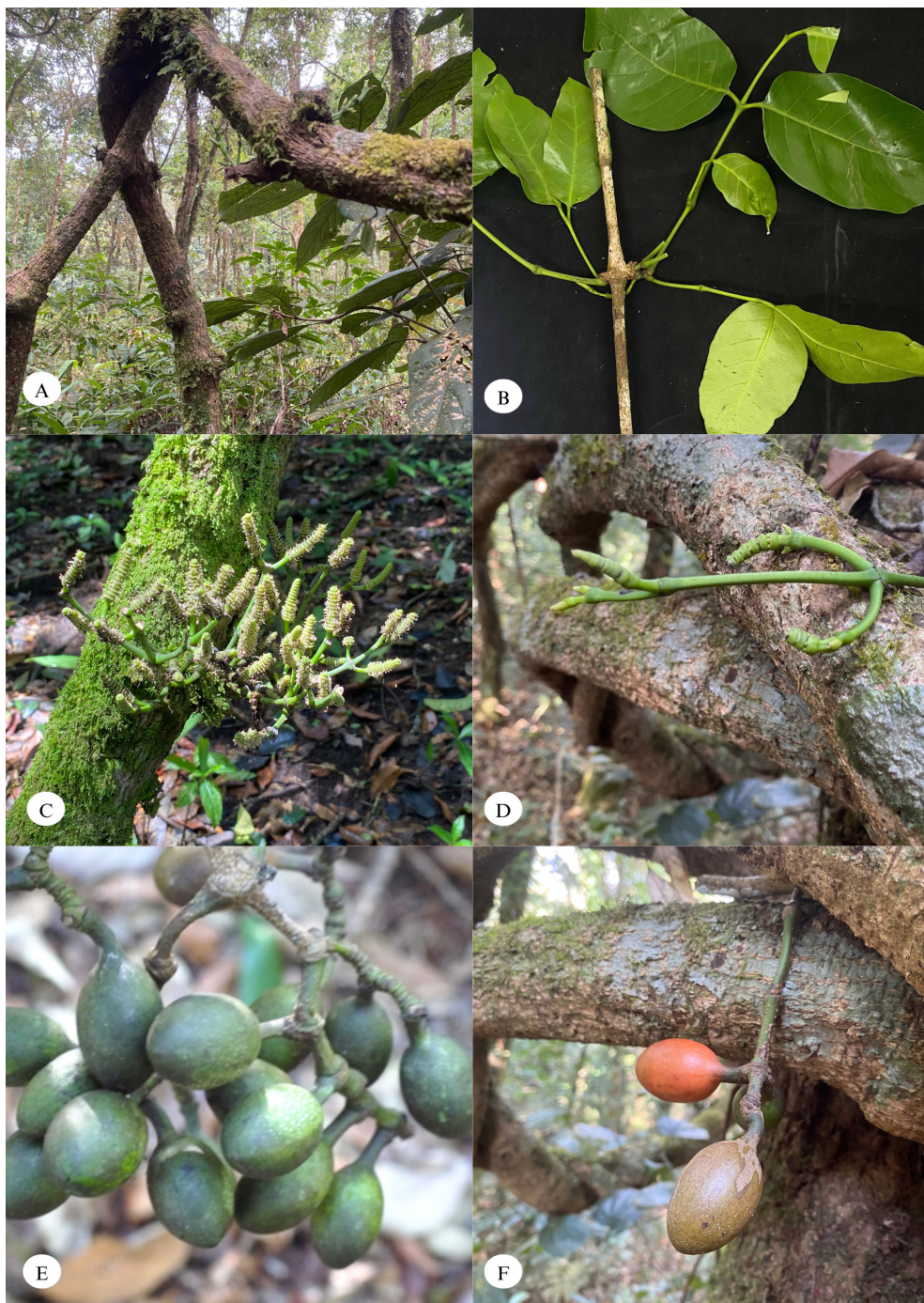


Figure 6. *Gnetum megaspermum* Kuaphu & Suwanph., A. stem; B. leaves; C. staminate strobili; D. ovulate strobili; E. seed-bearing strobili; F. ripening seeds (Photos A, B, D-F by K. Kuaphu and C by C. Suwanphakdee).

strobilus 5–10 × 0.4–0.6 cm; 6–9 megasporangia per collar, megasporangium 3–5 × 4–5 mm. *Seed-bearing strobilus* erect, 4.5–8.5 × 0.4–0.5 cm. *Seed* ellipsoid, 1.6–2.3 × 0.7–1.2 cm, sessile, base obtuse, apex mucronate-apiculate; coat orange or red when ripe.

Thailand.— SOUTH-EASTERN: Trat [Kho Chang, 29 Mar. 2000, *Wongprasert s.n.* (BKF!)]; PENINSULAR: Phang Nga [Ban Yamee, Kho Yao Yai, 30 Apr. 2007, *Wongprasert s.n.* (BKF!)]; Nakhon Si Thammarat [Khao Luang, 14 Oct. 2023, *Kuaphu 114* (BKF!, QBG!); Songkhla [Kho Hong Hill, 21 Aug. 1996, *Nanakorn et al. 7197* (QBG!), 25 Feb. 1986, *Maxwell 86-63* (BKF!, PSU!), 25 May 1985, *Maxwell 85-530* (PSU!), *Maxwell 86-259* (PSU!); Yala [Ungkut Mountain, 20 Dec. 2021, *Kuaphu 96* (BKF!, QBG!); Narathiwat [Chong Khao Khat, Hala-Bala, 20 Dec. 2020, *Kuaphu 55* (BKF!, QBG!)].

Distribution.— Myanmar, Indonesia, Malaysia.

Ecology.— Near waterfalls, often in moist, shady areas in tropical and subtropical rainforests, sometimes in grasslands or open areas; at alt. 50–200 m. *Strobili*: January–February; *seeds*: February–March.

Vernacular.— Mueai nok (เผือกนก) (Songkhla).

Notes.— Blume (1849) described *Gnetum microcarpum* based on an illustration from Sumatra. He did not mention a specific type specimen, so we select the illustration as the lectotype.

This species is distinguished by its leaves smaller than other species in Thailand. The staminate strobilus has very few stamens, similar to those found around the collar. The ripe seeds are orange and not shiny.

9. *Gnetum montanum* Markgr., Bull. Jard. Bot. Buitenz., sér. 3, 10: 466. 1930. Type: Thailand, Chiang Mai: Doi Sutep, 21 Apr. 1909, *A.F.G. Kerr 602* (lectotype: **K** [K000454548] designated by Hou *et al.* (2016: 1362); isoelectotype: **P** [P00722156]).

Large woody climber, dioecious; branches green or brownish-green; bark rough, dark grey. *Leaves*: petioles 1–1.5 cm long; lamina ovate to oblong, 12–25 × 4–11 cm, coriaceous or sub-coriaceous, base rounded or broadly cuneate, apex obtuse or acute; secondary nerves straight; green when fresh

and dark greyish brown when dry. *Strobilus* cauline or terminal, simple or fascicled, many-branched, erect; peduncle 0.6–1.2 cm long; bract 0.4–0.8 cm long; rachis 2.1–10.3 cm long; branchlet peduncle 1.8–3.5 cm long; collar cylindric, 6–11 rows, hairy. *Staminate strobilus* 5–10 × 0.4–0.5 cm; 30–50 microsporangiophores per collar. *Ovulate strobilus* 6–17 × 0.4–0.6 cm; 5–8 megasporangia per collar, megasporangium 3–4 × 4–5 mm. *Seed-bearing strobilus* pendulous, 10.6–23 × 0.4–0.5 cm. *Seed* ellipsoid, 1.2–3 × 0.8–2 cm, base rounded, apex mucronate, apiculate or obtuse; coat covered with silvery scales, orange or red when ripe; stalk stout 0.3–0.4 × 0.3–0.4 cm.

Thailand.— NORTHERN: Mae Hong Son [Ban Huai Tee Sha, Sop Moei, 8 Apr. 2000, *Srisanga 1365* (QBG!); Huai Sai Khao, Huai Pha Mueng, 13 June 2014, *Norsaengsri 11347* (QBG!); Chiang Mai [Doi Pui, 22 Apr. 1966, *Che s.n.* (BK!); San Ku, Doi Suthep, 6 Feb. 2021, *Kuaphu 65* (BKF!, QBG!); Chiang Rai [Doi Luang National Park Phan, 12 July 1958, *Wongprasert 017-02* (BKF!); Nan, Num Cham Mae Sai Q 05911652254688, 31 Mar. 2012, *Norsaengsri 9372* (BKF!); Phayao [Ban Huak Phu Sang, 31 Mar. 2014, *La-onsri et al. s.n.* (QBG!, PSU!); Nan [Tard Marn Waterfall, Chiang Klang 19°17'N 100°48'E, 12 May 2006, *Srisanga et al. 2846* (QBG!); Doi Phu Kha, 1 Mar. 2020, *Kuaphu 10* (BKF!, QBG!); Sukhothai [Route to Tham Tharavasan, 31 Mar. 2014, *Maknoi 7555* (QBG!); Tham Tara Vasan Srisatchanalai National Park, 26 Aug. 2015, *Maknoi 8145* (QBG!); Phitsanulok [Phu Hin Rong Kla National Park, Pharadon Waterfall, 2 June 2021, *Kuaphu 74* (BKF!, QBG!); Man Daeng Waterfall, 3 June 2021, *Kuaphu 77* (BKF!, QBG!); Kamphaeng Phet [Mae Wong NP, Chong Yen, 16 May 1997, *Pooma 3887* (BKF!); NORTH-EASTERN: Loei [Phu Ruea National Park, 2 May 1997, *Phengklai s.n.* (BKF!); Phu Kradueng National Park, 24 June 2021, *Kuaphu 85* (BKF!, QBG!); Eastern: Surin [Surin, 27 Feb. 1927, *Put 651* (BK!); Roi Et [Suwannapoom, 27 Jan. 1984, *Sadakorniy 1426-84* (BK!); Nakhon Ratchasima [Khao Yai National Park, Heo Narok Waterfall, 24 Mar. 2020, *Kuaphu 13* (BKF!, QBG!); Khao Yai National Park, 24 Mar. 2020, *Kuaphu 20* (BKF!, QBG!); Ubon Ratchathani [Dong Fa Huan, 25 May 2022, *Kuaphu 103* (BKF!, QBG!); CENTRAL: Saraburi [Sam Lahn Forest, 3 Apr. 1974, *Maxwell 74-174* (BK!); Nakhon Nayok [Kao Fa Pa, 10 Jan. 1969, *Kan. 599* (BK!); Kho Yai,

11 Aug. 1974, *Maxwell 74-787 (BK!)*; SOUTH-WESTERN: Kanchanaburi [Sangkhlā Buri, 24 Feb. 1960, *Phengkklai s.n. (BK!)*; Kratengieng, Sangklā Buri, 24 Mar. 2017, *Muangyen 1847 (QBG!)*; SOUTH-EASTERN: Chanthaburi [Ao Khung Kraben, Feb. 1991, *Chayarit 58 (BKF!)*; Trat [Khao Klong Plu, Kho Chang, 5 Apr. 2003, *Phengkklai 14437 (BKF!)*; PENINSULAR: Ranong [Ranong, 5 Jan. 1923, *Kerr 16541 (BK!)*; Surat Thani [Kao Laeo Rang, 13 Mar. 1920, *Kerr 14550 (BK!)*; Phuket [Talang, 15 Apr. 1929, *Kerr 17451 (BK!)*; Trang [Khao Chong, 12 Mar. 2020, *Larsen s.n. (BKF!)*; Thung Khai Botanical Garden, 1 Apr. 2021, *Kuaphu 68 (BKF!, QBG!)*] Pattani [Kao Kala, 29 Apr. 1929, *Kerr 14874 (BK!)*; Narathiwat [Bacho, 31 Dec. 1968, *Praryad 1642 (BK!)*; Waeng, 14 June 1970, *Smitinand s.n. (BKF!)*.

Distribution.— India, Nepal, Bhutan, Bangladesh, Myanmar, China, Laos, Cambodia, Vietnam.

Ecology.— Along streams in lowland to montane forests, often in shaded or moist microhabitats; at alt. 50–1,800 m. Strobili: February–April; seeds: March–June.

Vernacular.— Mueai (เผือก)(Trat).

Note.— This species can be distinguished by its less swollen nodes and stout seed stalks with seed covered with silvery scales.

10. *Gnetum tenuifolium* Ridl., J. Straits Branch Roy. Asiat. Soc. 59: 188. 1911. Type: Malaysia, Kedah: Langkawi, Jan. 1897, *H.N. Ridley 8341* (lectotype: **SING [SING 0050779] designated here, photo seen).**

Slender woody climber, dioecious; branches flattened, green or yellowish-green; bark green-grey. *Leaves*: petioles 0.5–1 cm long; lamina obovate-oblong, oblong, or lanceolate, 11–20 × 3.5–8 cm, thin-coriaceous, base narrowly, apex cuspidate or acuminate; secondary nerves bent; green when fresh, and green-yellow when dry. *Strobilus* axillary, simple, solitary, erect; peduncle 0.3–4.8 cm long; bract 0.5–0.7 cm long; pedunculet 0.5–2 cm long; collar tubular, 5–11 rows, hairy. *Staminate strobilus* 5–6 × 0.5–0.6 cm; collars 10–15 rows, 80–100 microsporangiophores per collar. *Ovulate strobilus* 4–5 × 0.4–0.6 cm; 5–7 megasporangia per collar, megasporangium 4–5 × 4–5 mm. *Seed-bearing*

strobilus pendulous, 10–15 × 0.4–0.5 cm. *Seed* ellipsoid or obovoid, 1.3–1.9 × 0.8–1 cm, base obtuse, apex mucronate-apiculate; coat red when ripe; stalk 0.3–1 × 0.2–0.3 cm.

Thailand.— SOUTH-WESTERN: Phetchaburi [Kuiburi National Park, Phraek Ta Khraw Waterfall, 12°22'N 99°31'E, 19 Jan. 2004, *Middleton 2273 (BKF!)*; PENINSULAR: Chumphon [Khao Nom Sao, Phra To, 25 June 2021, *Kuaphu 27 (BKF!, QBG!)*; Ranong [Muang Delay Station, 25 Apr. 2007, *Pooma 5262 (BKF!)*; Surat Thani [Khao Sok National Park, 9 Mar. 1986, *Smitinand s.n. (BKF!)*; Phrasaeng, 17 Aug. 2012, *Katepeteh 1 (PSU!)*; Phangnga [Raman Fall, Takua Thung, 22 Aug. 2009, *Wongprasert s.n. (BKF!)*; Trang [Khao Chong, 12 Oct. 1985, *Maxwell 85-961 (PSU!)*; Khao Chong, 1 Apr. 2022, *Kuaphu 72 (BKF!, QBG!)*; Songkhla [Kho Hong Hill, 25 Aug. 1981, *Sirirugsa PS443 (PSU!)*; Chana, 16 Nov. 2021, *Kuaphu 49 (BKF!, QBG!)*; Yala [Batong, 22 Apr. 2005, *Pooma s.n. (BKF!)*; Than To, along Tomo River in Chulaphon Pathana 7 area, 160 m, 6.0890 N, 101.38 E, 20 May 2005, *Middleton 3521 (BKF!)*; Narathiwat [Khao Chana Katatai, 12 Sept. 1985, *Niyomdham s.n. (BKF!)*.

Distribution.— Indonesia, Malaysia.

Ecology.— This species grows along streams in evergreen and rainforest, typically in moist, shaded areas; at alt. 20–50 m. Strobili: August–September; seeds: September–December.

Vernacular.— Mueai nok (เผือกนก)(Pattani).

Notes.— Ridley (1911) described *Gnetum tenuifolium* in the protologue based on two specimens, *Curtis 8341* from Langkawi and *Curtis 3244* from Kasom, Phangnga. However, he did not indicate which specimen or herbarium he was referring to. We therefore designate the specimen *Curtis 8341* from Langkawi, which is kept at **SING** [SING 0050779], as the lectotype.

This species can be distinguished by its slender woody climbing habit, its thin coriaceous leaves, and seed coats that are bright red and waxy when ripe.

ACKNOWLEDGEMENTS

The authors would like to thank the curators and staff of the herbaria BK, BKF, QBG, and PSU

for permission to study the herbarium specimens and literature. We thank the Department of National Parks, Wildlife and Plant Conservation, Thailand, for permission to collect specimens and for access to their facilities. We sincerely thank Sangtawan Sriboran, Yuthana Banchong, and Maneenuch Tubtamat for the excellent colour illustrations and Thewalee Khananthong for the line drawings. We are also grateful to Pakawat Jarupund, Anuwat Sarapan, Unyamane Phairin, Wilaiwan Kulpholmuang, and Thanyarut Suddeepong for their assistance with collecting field samples. We would like to thank Nopparut Toolmal and Deuanta Kongxaisavath for valuable comments and suggestions. This research is funded by the Faculty of Science, Kasetsart University, through the Graduate Fellowship Program.

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