Murraya macrophylla (Rutaceae): A New Rank Combination and Supplementary Description of Biological Characteristics (Post-print)

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Date: 2019-01-30T00:00:00+00:00

Abstract

To clarify the systematic relationship and taxonomic status between Murraya kwangsiensis (C. C. Huang) C. C. Huang var. macrophylla C. C. Huang and its original variety M. kwangsiensis (C. C. Huang) C. C. Huang var. kwangsiensis within the genus Murraya (Rutaceae), comprehensive taxonomic studies were conducted on several species of Murraya using multiple research methods including literature review, specimen identification, field investigation, cultivation observation, and micro-anatomical analysis. The results demonstrate that M. kwangsiensis var. macrophylla exhibits extremely significant differences from M. kwangsiensis var. kwangsiensis in morphological characteristics including leaves, flowers, and fruits; therefore, it should be treated as an independent species, and a new combination, Murraya macrophylla (C. C. Huang) F. J. Mou, is proposed. A detailed description of the morphological characteristics and distribution of M. macrophylla is provided for the first time. The pinnate compound leaves and leaflets of this species are the largest within the genus Murraya, showing closer affinity to M. glabra (Guillaumin) Swingle, which is distributed only in Vietnam; however, its characteristics such as larger leaflets, sunken leaf veins, and wrinkled leaf surfaces make it distinctly different from other species within the genus Murraya. Murraya macrophylla is an independent species rather than a variety of M. kwangsiensis; this new perspective on the taxonomic status of M. macrophylla contributes to the reconstruction of phylogenetic relationships and the exploration of interspecific systematic relationships within the entire genus Murraya.

Full Text

Murraya macrophylla, a New Rank and New Combination in Rutaceae with Supplementary Biological Characterization

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Abstract: To clarify the systematic relationship and taxonomic status of *Murraya kwangsiensis* (C. C. Huang) C. C. Huang var. *macrophylla* C. C. Huang relative to its type variety *M. kwangsiensis* var. *kwangsiensis* (Rutaceae), we conducted a comprehensive taxonomic study of several *Murraya* species using literature review, specimen examination, field surveys, cultivation observations, and microanatomical experiments. Our results demonstrate that *M. kwangsiensis* var. *macrophylla* differs substantially from *M. kwangsiensis* var. *kwangsiensis* in numerous morphological characters, including leaves, flowers, and fruits. This taxon should be recognized as an independent species, for which we propose the new combination and rank *Murraya macrophylla* (C. C. Huang) F. J. Mou. We provide the first comprehensive description of the morphological characters and distribution of *M. macrophylla*. This species possesses the largest pinnate leaves and leaflets in the genus *Murraya* and shows closer affinity to *M. glabra* (Guillaumin) Swingle, which is endemic to Vietnam. However, its notably large leaflets, sunken adaxial veins, and wrinkled leaflet surfaces clearly distinguish it from other *Murraya* species. *Murraya macrophylla* represents an independent species rather than a variety of *M. kwangsiensis*. This revised systematic status will facilitate reconstruction of phylogenetic relationships within *Murraya* and exploration of interspecific systematic relationships.

Keywords: *Murraya kwangsiensis*; *Murraya macrophylla*; biological characters; new rank; new combination; Rutaceae

Funding: Supported by the National Natural Science Foundation of China "The taxonomic revision and systematics of *Murraya* s. l." (31400181)

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The genus *Murraya* L. (originally published as *Murraea*) was first established

based on a single species, *Murraea exotica* L., while *Bergera* L. was published based on *B. koenigii* (Linnaeus, 1771). Subsequent taxonomists unanimously treated *Murraya* and *Bergera* as congeneric, and *Murraya* has been conserved against *Chalcas* L., despite *Chalcas* being published earlier (Linnaeus, 1767). Most *Murraya* species are distributed in southern China and Indo-Malaysia, although some extend to Sri Lanka, New Caledonia, and northeastern Australia (Swingle, 1938; Swingle & Reece, 1967). Tanaka (1929) recognized eight species and two varieties in the genus (under the name *Chalcas*). The species were subsequently divided into two or three groups, with eleven species and four varieties recognized overall (Tanaka 1929; Swingle 1938; Swingle & Reece, 1967; But et al., 1986). Studies on Chinese materials added one new species, *Murraya tetramera* C. C. Huang (Huang, 1959), one new combination *M. kwangsiensis* (C. C. Huang) C. C. Huang, and one new variety *M. kwangsiensis* var. *macrophylla* C. C. Huang (Huang, 1978). Nine species and one variety are endemic to China (Huang, 1997; Zhang et al., 2010). Based on differences in chemical constituents between two sections of *Murraya*, *M. kwangsiensis* var. *macrophylla* was included in Sect. *Bergera* along with *M. kwangsiensis* var. *kwangsiensis* (But et al., 1986). However, based on morphological characteristics of leaf epidermis in nine Chinese *Murraya* species, the former should belong to Sect. *Murraya* as an independent species (Zou et al., 1997; 1999). Currently, extremely limited and controversial findings exist regarding the taxonomic status and systematic position of this taxon.

Since its publication, *M. kwangsiensis* var. *macrophylla* has been described with only a few morphological characteristics, limited to leaflet blade size and fruit color, and consistently treated as a variety of *M. kwangsiensis* (Huang, 1978; 1997; Zhang et al., 2010). Only ten specimens, including the type, are deposited across three herbaria: IBK, GXMI, and GXMG. Due to this limited information, little is known about the taxon. For these reasons, further field research and experimental studies are needed. During our project "The taxonomic revision and systematics of *Murraya* s. l.," several populations of *M. kwangsiensis* var. *macrophylla* were discovered exclusively in Guangxi.

Materials and Methods

We carefully examined all specimens of *Murraya kwangsiensis* var. *macrophylla* and *M. kwangsiensis* var. *kwangsiensis* preserved in IBK, GXMI, GXMG, KUN, IBSC, SYS, PE, and NAS to collect information on numerous morphological characteristics. From 2016 to 2017, we conducted field research in Longzhou County, Daxin County, and Napo County, Guangxi, documenting morphological features, growth status, population status, and ecological conditions. To continuously observe the biological and phenological characters of this species, several plants from Napo and Daxin were transplanted to the greenhouse of Southwest Forestry University in 2016 and 2017, respectively. During 2017–2018, we intensively investigated flowering and fruiting in cultivated environments and studied leaves, flowers, and fruits using microanatomical methods.

Taxonomic Treatment

***Murraya macrophylla* (C. C. Huang) F. J. Mou et D. X. Zhang, comb. et stat. nov. (Plate I)**

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Basionym: *Murraya kwangsiensis* (C. C. Huang) C. C. Huang var. *macrophylla* C. C. Huang, in Acta Phytotax. Sin. 16(2): 85 (1978).

Type: China, Guangxi, Daxin, (Z. J. Li 3198, Holotype: IBK! barcode IBK00191042).

Additional specimens examined: China, Longzhou, X. F. Deng 10571 (IBK), H. Q. Li 40099 (IBK); Daxin, F. J. Mou 618, 619 (SWFC); Jingxi, Y. D. Peng 451025141014005LY (GXMG); Napo, D. Fang et al. 0885 (GXMI), D. Fang et al. 3-15482 (GXMI), D. X. Nong et al. 451026130722029LY (GXMI, GXMG), B. Y. Huang 451026141015067LY (GXMG), X. Y. Huang 451026131127023LY (GXMG), F. J. Mou 543, 550, 552, 624, 625 (SWFC).

Description: This species is a shrub reaching up to 2 m in height. Young branches, rachis, petiole, and petals are scattered with very prominent oil glands. The leaves are compound with a rather thin rachis about 12–30 cm long and 3–9 alternate leaflets. Leaflet blades are thick chartaceous with a few oil glands in the mesophyll, measuring 7–20 × 4–10 cm. They are slightly inequilateral and pointed at the base, abruptly acuminate at the tip, and very slightly denticulate at the margin, with an oil gland at every tooth joint. The upper surface is glabrous, glossy, and deep green, while the lower surface is light yellow-green, turning brown when dried. Lateral veins number 6–9 pairs, sunken on the upper surface and prominent on the lower surface. Petiolules are cylindrical and glabrous, 8–16 mm long, while the petiole is cylindrical, glabrous, and prominently swollen at the base. Inflorescences are terminal cymes with a few small flowers, shorter than the leaves. Pedicels are shorter than the flowers, bearing 2–4 small bracts at the base. Flower buds are broadly ovate or oblong, 4 × 2.5 mm, yellow-white and fragrant. The calyx is 4-connate with very shortly ciliate sepals, each bearing a large oil gland at the base. Petals measure 4 × 1 mm, are glabrous and oblong. Stamens number 10, alternately shorter (3 or 2 mm long), with filaments that gradually constrict in the upper 1/2 and are pubescent above. Anthers are attached dorsally, oval, with a few hairs. The disk is extremely short. The ovary is cylindrical, glabrous, with a few oil glands, distinctly constricted at about 1/3 from the apex. The style is longer than the ovary with very short hairs, and the stigma is distinct. The berry is oval, 4–7 mm in diameter, smooth with dense glands, red when ripe, containing 1–2 seeds (mostly 1-seeded). Flowering occurs June–July; fruiting August–December.

Distribution: China, southwestern Guangxi (Longzhou, Daxin, Jingxi, Napo).

Habitat: Understory of limestone hill forests or valley forests, humid and shaded; altitude 550–1,400 m.

Recognition of *Murraya macrophylla* Status

Murraya macrophylla shares few floral similarities with *M. kwangsiensis*, but the two differ markedly in many morphological characters (Plate I;). However, this taxon is more similar to *M. glabra* from Vietnam in leaf morphological characteristics, though it differs in having fewer oil glands in the mesophyll, smaller cymes, and fewer flowers and fruits. In summary, the taxon should be recognized as a species rather than a variety of *M. kwangsiensis* and placed in Sect. *Bergera* based on morphology.

Plate I. Morphology of *Murraya macrophylla* and *M. kwangsiensis* (Note: A-M. *Murraya macrophylla* [A. Plant and habitat; B-C. Branch and stem; D-E. Leaflet; F. Inflorescence; G-J. Flower; K-L. Fruit; M. Seeds]; N-U. *M. kwangsiensis* [N. Plant and habitat; O. Leaflet; P-Q. Inflorescence; R-S. Flower; T-U. Fruit]).

Conclusion and Discussion

Since its publication, *Murraya macrophylla* has consistently been treated as a variety of *M. kwangsiensis* (Huang, 1978; 1997; Zhang et al., 2010). However, based on specimen studies and field research, we found that the roots, stems, and mature branches of *M. macrophylla* are gray-brown rather than gray-white as in *M. kwangsiensis*. This finding differs from the opinion of Zou et al. (1997, 1999) and indicates that the taxon should be included in Sect. *Bergera* rather than Sect. *Murraya*. The species is more similar to *M. glabra* in leaf morphology and, based on phylogenetic analysis of ITS and six cpDNA sequences from the genus *Murraya* (unpublished data), is more closely related to other Vietnamese species, namely *M. glabra* and *M. stenocarpa*, than to *M. kwangsiensis*. All evidence suggests that *M. macrophylla* should be separated from *M. kwangsiensis* as an independent species, which is consistent with the opinion of Zou et al. (1997; 1999).

Key to related species:

1. Pinnately compound leaves.
    2. Leaflet surface smooth; inflorescences pubescent; calyx 5-connate —*M. kwangsiensis*

    3. Leaflet surface uneven; inflorescences glabrous; calyx 4-connate.
        3. Inflorescences terminal and lateral; petals 4; stamens 8; stigma slightly swollen, yellow —*M. glabra*

        4. Inflorescences terminal; petals 5; stamens 10; stigma indistinct —*M. macrophylla*

2. Unifoliate compound leaves —*M. stenocarpa*

Acknowledgements: The authors thank the following herbaria for their as-

sistance: IBK (Herbarium, Guangxi Institute of Botany), GXMI (Herbarium, Guangxi Institute of Chinese Medicine & Pharmaceutical Science), GXMG (Herbarium, Guangxi Medical Botanical Garden), KUN (Herbarium, Kunming Institute of Botany, Chinese Academy of Sciences), IBSC (Herbarium, South China Botanical Garden, CAS), and SYS (Herbarium of Sun Yat-sen University).

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Note: Figure translations are in progress. See original paper for figures.