UNIVERSITI PUTRA MALAYSIA

# A SYSTEMATIC STUDY ON CALLICARPA L. (VERBENACEAE) IN BORNEO

GLORIA ABRAHAM-OANES

# A SYSTEMATIC STUDY ON *CALLICARPA* L. (VERBENACEAE) IN BORNEO

By

GLORIA ABRAHAM-OANES

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Doctor of Philosophy

November 2002

To *PHILIP*, My husband

And to my Kids:

*Yen-yen*

*Phee-em*

*Phi-ar*

*Phee-jay*

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy.

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**Chairman: Assoc. Prof. Faridah Hanum Ibrahim, Ph.D.**

**Faculty: Forestry**

A systematic study on the Bornean *Callicarpa* (Verbenaceae) was undertaken utilising more than 1, 200 collections from fourteen herbaria. A total of 37 taxa were recognised and twenty-two taxa are undoubtedly endemic to the island. Two new species namely, *C. hanumi*ae and *C. argentii* were described and illustrated while two new records, i.e., *C. ramiflora* and *C. arborea* for Borneo were made. Five formerly recognised varieties such as *C. havilandii* var. *hispida*, *C. japonica* var. *rhombifolia, C. kinabaluensis* var. *endertii, C. kinabaluensis* var. *gibotii* and *G. hexandra* var. *macrophylla* while three forms viz. *C. longifolia* f. *floccosa, C. longifolia* f. *subglabrata* and *C. pentandra* var. *typica* f. *hexandra* were raised to species and variety levels, respectively. The other two forms, *C. pentandra* var. *typica* f. *farinosa* and *C. pentandra* var. *paloensis* f. *apoensis* were likewise raised to distinct varieties. All Bornean *Geunsia* reduced to *Callicarpa* by Lam and Bakhuizen van den Brink (1921) is basically supported by the present study. Several approaches such as morphology, anatomy, palynology, ecology and phytogeography were employed to

species delimitation. Many characters obtained from these lines of evidences were proven to have taxonomic value. The leaf shape, margin, size of the lamina, degree of hairiness of leaf surfaces and petioles and leaf base, were among the diagnostic vegetative morphological characters. Taxonomically valuable reproductive characters include the point of insertion of the inflorescence, type of the inflorescence's indumentum, length of the peduncle, the colour of the corolla, the hairiness of the outside lobe of the calyx and calyx margin. The patterns of the vascular bundles in the petiole, the minor leaf venation patterns and the cuticular ornamentation were acknowledged as new diagnostic anatomical characters in species identification and delimitation in addition to other useful characters such as stomata and trichomes. The stomata are anomocytic in most species and mostly hypostomatic in its orientation. The orientation of the guard cells relative to epidermis provides a valuable taxonomic character. Trichomes display a substantial variation among species and are taxonomically significant in species identification. The presence of domatia in *C. saccata* is unique which makes this species very distinct from the rest. The pollen grains are medium-sized, solitary, isopolar and elliptic in equatorial view and amb rounded in polar view. They are prolate spheroidal shaped in most of the species and 3-colpate with microreticulate exine structure. However, the pollen morphology is less significant in the taxonomy at the species level, but taxonomically valuable at the generic level. The majority of the species occur at lower elevations ( up to 1200 m. a.s.l), and are found in both primary and secondary forests, usually in mixed dipterocarp forest. *C. longifolia* is the most widespread species. Generally, *Callicarpa* has a disjunct distribution within its geographical range. In Borneo, the centre of distribution and species preponderance is in Sabah comprising a total of 27 taxa, 9 of which are endemic. The numerical analysis does not support the

division of the genus into two sections by Briquet (1895) and Moldenke (1971). Instead, it grouped the species into 10 clusters. A systematic treatment was presented comprising the morphological description of the genus and species, keys to individual taxa, ecology and distribution, illustration for new species, maps indicating the species distribution in Borneo, vernacular names, phenology and some uses. The specimens examined and seen were cited in every species description including the locality and date of collection, name of the collector and the name of the herbaria where the specimens were seen and studied.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagi memenuhi keperluan untuk ijizah Doktor Falsafah

**KAJIAN SISTEMATIK TERHADAP *CALLICARPA* L. (VERBENACEAE) DI BORNEO**

**Oleh**

**GLORIA ABRAHAM-OANES**

**November 2002**

**Pengerusi: Prof. Madya Faridah Hanum Ibrahim, Ph.D.**

**Fakulti: Perhutanan**

Suatu kajian sistematik ke atas *Callicarpa* (Verbenaceae) di Borneo telah dijalankan dengan menggunakan lebih daripada 1, 200 koleksi spesimen dari 14 herbarium. Sejumlah 37 takson telah dicamkan dan dua puluh dua daripadanya adalah endemik kepada Borneo. Dua spesies baru, *C. hanumiae* dan *C. argentii* telah dihurai dan diilustrasikan manakala dua rekod baru dicatatkan bagi Borneo iaitu *C. ramiflora* dan *C. arborea.* Lima varieti dan tiga forma dinaikkan taraf ke peringkat spesies iaitu *C. havilandii* var. *hispida*, *C. japonica var. rhombifolia, C. kinabaluensis* var. *endertii, C. kinabaluensis* var. *gibotii, G. hexandra* var. *macrophylla,* manakala *C. longifolia* f. *floccosa, C. longifolia* f. *subglabrata* dan *C. pentandra var. typica* f. *hexandra* telah dinaikkan taraf ke pangkat varieti. Dua lagi forma, *C. pentandra* var. *typica* f. *farinosa* dan *C. pentandra* var. *paloensis* f. *apoensis* telah dinaikkan taraf ke pangkat varieti. Kesemua spesies *Geunsia* yang telah dimasukkan ke genus *Callicarpa* oleh Lam & Bakhuizen van den Brink telah disokong oleh kajian ini. Beberapa pendekatan seperti

dan juga pembatasan spesies dan takson infraspesies. Banyak sifat yang dijanakan melalui pendekatan ini telah didapati bernilai kepada taksonomi. Bentuk daun, tepi daun, saiz lamina, darjah berbulu bagi permukaan daun dan petiol dan bes daun adalah di antara sifat diagnosis vegetatif. Sifat reproduktif yang bernilai taksonomi termasuk peletakan infloresens, jenis indumentum infloresens, panjang pedunkel, warna korola, bulu cuping luar kaliks dan tepi kaliks. Corak berkas vaskular petiol, corak peruratan daun kecil dan perhiasan kutikel juga telah dibuktikan sebagai sifat anatomi diagnosis dalam pengcaman dan pembatasan spesies di samping sifat lain yang berguna seperti stomata dan trikom. Stomata adalah anomositik dalam kebanyakan spesies dan orientasinya hipostomatik. Orientasi sel rakan bila dibandingkan dengan epidermis memberikan suatu sifat taksonomi yang bernilai. Trikom menunjukkan suatu variasi yang baik di kalangan spesies dan berguna untuk pengcaman spesies. Kewujudan domatia pada *C. saccata* adalah unik dan membuat spesies ini berbeza daripada yang lain. Debunga adalah bersaiz sederhana, tunggal, isokutub dan eliptik pada pandangan khatulistiwa dan bulat pada pandangan kutub. Mereka adalah berbetuk subsfera prolat sfera dalam kebanyakan spesies dan semua adalah 3-kolpat dengan struktur eksin mikroreticulat. Walau bagaimanapun, morfologi debunga adalah kurang signifikan dalam taksonomi di tahap spesies, tetapi bernilai pada tahap genus. Kebanyakan spesies wujud di tanah rendah sehingga 1,200 m atas paras laut, di kedua-dua hutan primer dan sekunder, biasanya dalam hutan dipterokarpa campuran. *C. longifolia* adalah yang paling luas taburannya. Amnya, *Callicarpa* mempunyai taburan disjung dalam julat geografinya. Di Borneo, pusat taburan dan kepelbagaian adalah di Sabah yang mempunyai sejumlah 27 takson, 13 adalah endemik. Analisis numerikal tidak menyokong pembahagian genus ini kepada seksi seperti dicadangkan oleh

Briquet (1895) dan Moldenke (1971). Bagaimanapun ia mengumpulkan spesies kepada sepuluh kumpulan. Suatu perlakuan sistematik telah dibentangkan yang mengandungi penghuraian genus dan spesies, kekunci kepada takson, ekologi dan taburan, ilustrasi bagi spesies baru, peta bagi menunjukkan taburan spesies di Borneo, nama tempatan, fenologi dan kegunaan yang diketahui. Spesimen yang diteliti telah diberikan bagi setiap spesies termasuk lokaliti, tarikh pengutipan dan nama pengutip dan juga nama herbarium bagi semua spesimen yang diperhati dan dikaji.

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