The Biosystematic Study of Endiandra R.Br. (Lauraceae) in New Guinea

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ABSTRACT
Endiandra R.Br. is a genus consisted of more than 100 tree and shrub species that are distributed in Asia and Australia with several species found in Pacific Islands (Rohwer 1993). New Guinea and Australia are the most-rich areas of Endiandra with approximately 50 species and 38 species respectively. Unlike Australian Endiandra which have been treated thoroughly, the New Guinean species are less known and difficult to recognize. No recent research was done for Endiandra from New Guinea since over four decades ago where materials for a revision of Lauraceae was prepared by Kostermans in 1969. Moreover, based on observation on the specimens, New Guinea is thought to be the main distribution area of Endiandra, therefore it is important to undertake a taxonomic treatment of New Guinean Endiandra. During observation of herbarium specimens of Endiandra, it is noted that the flowers of Endiandra are composed by different floral parts. Staminal glands located nearby the stamens can be present or absent in different species. It is noted that all species of Endiandra from Borneo bear no staminal glands at the base of the stamens, however 31 out of 38 species of Australian Endiandra do bear glands. It is important to know the variation of New Guinean species in terms of the presence of glands because the character might be useful for further categorization within Endiandra. Based on the facts above, the study of the genus Endiandra was carried in three related topics. The first topic entitled Species enumeration of Endiandra R.Br. (Lauraceae) in New Guinea. This study was carried out at the Herbarium Bogoriense (BO) using Endiandra specimens available at BO and recently collected specimens from Waigeo Island. Loan specimens from Singapore Botanic Gardens (SING) were also studied, including images of type specimens from The Natural History Museum, London (BM); National Botanic Garden of Belgium (BR); Harvard University Herbaria, Massachusetts (HUH); Royal Botanic Gardens, Kew (K); Nationaal Herbarium Nederland, Leiden (L); Muséum National d'Histoire Naturelle, Paris (P); and Smithsonian Institution, Washington, D.C. (US). Forty six species of Endiandra are recognized from New Guinea, with discovery of six new species, i.e., Endiandra areolata, E. crassitepala, E. cupulata, E. kassamensis, E. lanata and E. rifaiana. It is noted that 36 species are endemic to New Guinea, distributed in both West Papua and Papua New Guinea. Ten species are distributed further to the West up to Celebes, Moluccas and to the Southeast in Australia. Most New Guinean species of Endiandra bear staminal glands in their flowers, only eight species lack of glands. To understand the importance of staminal glands for creating grouping within Endiandra, the second and third topics were carried out in this study. The second topic entitled The phylogenetic relationships of New Guinean species of Endiandra and Beilschmiedia (Lauraceae) based on morphological characters. The study was aimed to understand the relationships among Endiandra species in New Guinea, the distribution of species with and without staminal glands in the cladogram and to understand the relationships of Endiandra and Beilschmiedia. Selected morphological characters from the study of Topic 1 were analyzed to understand the relationships of Endiandra species. Fifty taxa, consisted of 41 species of Endiandra, 6 species of Beilschmiedia (as in-

groups) and 3 species of Cryptocarya (as outgroups) with 47 characters were analyzed using Maximum Parsimony method and resulted in 86 most parsimonious trees. Even though the species with staminal glands are grouped together in clades I, II, III, IV and VI, the species with and without staminal glands are grouped together in clade V. Therefore, in this study, the grouping within Endiandra based on the presence and absence of staminal glands was not well supported. Moreover, Endiandra and Beilschmiedia are forming their own clades, suggesting the two genera are monophyletic based on morphological characters. Stamen number and position in the floral whorls determined the generic delimitation between the two genera. Endiandra has 3 or 6 stamens in the 3rd whorl or 2nd and 3rd whorls (respectively), whereas Beilschmiedia has 9 or 6 stamens in the 1st, 2nd and 3rd whorls or 1st and 2nd whorls (respectively). However, characters selection is subjective, which different characters used for the phylogenetic analysis will result in different grouping. Therefore, finding new characters that are reliable for grouping is needed, and phylogenetic analysis using those characters are suggested to be carried out to improve the knowledge on the species relationships of Endiandra. The third topic entitled Phylogenetic relationships of Endiandra R.Br. (Lauraceae) inferred from ITS regions of nrDNA sequences was aimed to understand the relationships among Endiandra species and between Endiandra and Beilschmiedia. Molecular data of ITS region of nrDNA sequences was explored for the first time to understand the phylogenetic relationships of Endiandra. Thirty one species of Endiandra and Beilschmiedia were analysed, including 7 species of Cryptocarya used as outgroups. The parsimony analysis of the ITS sequences of nrDNA has resulted in 108 equally parsimonious trees. One of most parsimonious trees suggested that Beilschmiedia cannot be separated from Endiandra which explained the difficulty of distinguishing the two based on morphology. The staminal glands distributed in the lower clades of the tree, left the terminal clade with a group of glandless species with an exception of E. monothyra B. Hyland. Staminal gland is a good character for practical purpose but the grouping based on the present and absence of stamina gland is not well supported by the ITS sequences of nrDNA. Improving the resolutions of the cladogram for more reliable interpretations of the species relationships within Endiandra is suggested by adding more samples and introducing more suitable markers.</i>