

凹唇姜属 (*Boesenbergia* O. Kuntze) 和山柰属 (*Kaempferia* L.) (姜科) 叶的解剖学

Khatijah H. HUSSIN¹, Halijah IBRAHIM², D. Aminah H. A. ALI¹,
廖景平³, 刘念³

- (1. School of Environmental and Resource Sciences, Universiti Kebangsaan Malaysia, 43600 Bangi, Malaysia;
2. Biodiversity and Conservation Section, Institute of Biological Sciences, Universiti Malaya, Kuala Lumpur, Malaysia;
3. 中国科学院华南植物研究所, 广东 广州 510650)

摘要: 通过凹唇姜属 (*Boesenbergia curtisii*, *B. prainiana*, *B. rotunda* 和 *B. plicata*) 和山柰属 (*Kaempferia pulchra*, *K. galanga*, *K. gilbertii*, *K. rotunda*, *K. parviflora* 和 *K. angustifolia*) 种间叶解剖学变化的研究, 寻找能用于鉴别种的解剖学特征。结果显示变化表现在气孔的类型、中脉的结构、叶缘和叶柄横切面轮廓、叶片的远轴面或近轴面下皮层和毛状体的出现或缺如。研究表明这些特征的联合对已研究的种的鉴别是有用的。

关键词: 气孔; 叶柄; 中脉; 叶片; 叶缘

中图分类号: Q94.56 **文献标识码:** A **文章编号:** 1005-3395(2001)01-0049-06

ANATOMICAL VARIATIONS IN LEAVES OF *BOESENBURGIA* O. KUNTZE AND *KAEMPFERIA* L. SPECIES (ZINGIBERACEAE)

Khatijah H. HUSSIN¹, Halijah IBRAHIM², D. Aminah H. A. ALI¹, LIAO Jing-ping³, LIU Nian³

- (1. School of Environmental and Resource Sciences, Universiti Kebangsaan Malaysia, 43600 Bangi, Malaysia;
2. Biodiversity and Conservation Section, Institute of Biological Sciences, Universiti Malaya, Kuala Lumpur, Malaysia;
3. South China Institute of Botany, the Chinese Academy of Sciences, Guangzhou 510650, China)

Abstract: Leaf anatomical variations between species of *Boesenbergia* (*B. curtisii*, *B. prainiana*, *B. rotunda* and *B. plicata*) and *Kaempferia* (*K. pulchra*, *K. galanga*, *K. gilbertii*, *K. rotunda*, *K. parviflora* and *K. angustifolia*) were studied in order to investigate anatomical variations which could be used to distinguish species. Results show that there are variations in the type of stomata, the structure of the midrib, the outlines of the leaf margin and petiole in transverse section, and the presence or absence of abaxial or adaxial hypodermis and trichomes in the lamina. The results suggest that a combination of these characters is useful in distinguishing the species studied.

Key words: Stomata; Petioles; Midribs; Laminae; Margins

1 Introduction

The tribe Hedychieae in the family Zingiberaceae consists of 20 genera distributed worldwide^[1,2]. In Malaysia it is represented by eight genera which includes *Boesenbergia*,

B. plicata. It has been found useful in differentiating between certain species of *Zingiber*^[7] and *Alpinia*^[8]. The outline of the margin in TS is characteristic for each species and provides an extra character for comparative studies. This study shows that this character is valuable as diagnostic characters for *K. pulchra* (which curves downwards like a hawk's beak), *K. gilbertii* (with beak having a short end consisting of only two cells) and *B. prainiana* (with a straight and blunt tip; no beak present). The character that can be used to distinguish *Boesenbergia* from *Kaempferia* is the presence of arc II bundles in the petioles of the former and the absence of those in the latter. Arc II bundles are also present in *Scaphochlamys kuntsteri*^[9], and a few *Alpinia* species^[8]. Petioles of both genera do not have any arc IV bundles as reported for many *Alpinia* species^[8].

The type of stomata with six or more subsidiary cells that was observed in *B. prainiana* and *B. plicata* has not been reported for the family which was said to be characterised by the tetracytic type^[10]. Tomlinson^[11] had mentioned the rare presence of modified epidermal cells adjacent to the stomata in *Boesenbergia* species but no description was given.

Among *Boesenbergia* species, *B. prainiana* and *B. plicata* share many similar characters such as the stomata with six or more subsidiary cells, the characteristic of the adaxial epidermal cells in TS being large and as high as wide and the absence of hypodermis in the lamina as well as the outline of the leaf midribs. Morphologically, however, *B. prainiana* and *B. plicata* differ both in their vegetative and floral characters. As for *Kaempferia*, the asiatic species have been classified into three groups. Section *Kaempferia* Benth. includes *K. galanga* and *K. pulchra* group, Section *Protanthium* (Horan.) Benth. includes the *K. rotunda* group, while Section *Stachyanthesis* Benth. is typified by *K. scaposa*, the only species in the section^[12]. However, no similarities or closeness of characters could be seen between *K. pulchra* and *K. galanga*. Identification of some species can be achieved diagnostically, such as the outline of the leaf margin in TS for *K. pulchra*, *K. gilbertii* and *B. prainiana*. For other species, identification is possible by a combination of characters, e.g. *B. curtisii* which has an abaxial hypodermis in the lamina, a grooved midrib with arc II bundles and a margin with a short and straight beak in TS.

Acknowledgements

The authors wish to thank Rosli Mohamed, Farouk Mohd. Yusoff and Noraini Talip for their technical assistance. The co-operation of the South China Institute of Botany, the Chinese Academy of Sciences and Professor Puangpen Sirirugsa from the Prince of Songkla University, Thailand are gratefully acknowledged. This work was funded by IRPA RM7 grant (08-02-03-0229) from the Ministry of Science and Technology, Malaysia, to whom the authors are grateful.

References:

- [1] Mood J, Larsen K. *Cornukaempferia*, a new genus of Zingiberaceae from Thailand [J]. Nat Hist Bull Siam Soc, 1997, 45: 217-221.

were captured by using a 35 mm camera fitted onto a Leitz Diaplan microscope.

Species examined *Kaempferia galanga* L., *K. pulchra* Ridl. and *K. gilbertii* Bull. from Malaysia, and *K. angustifolia* Roscoe, *K. rotunda* Linn., and *K. parviflora* Wall ex Bak. from China and *Boesenbergia curtisii* (Bak.) Schltr., *B. prainiana* (King ex Bak.) Schltr., *B. rotunda* (L.) Mansf. and red-flowered *B. plicata* (Ridl.) Holttum from Thailand.

3 Results

Epidermis The adaxial and abaxial epidermal cells of all species are five to Seven-sided and not stretched; anticlinal walls often straight, seldom slightly curved (Plate I:A–J). Simple unicellular trichomes were observed on the leaf surfaces of *B. curtisii*, *B. rotunda*, *B. plicata*, *K. galanga*, *K. gilbertii* and *K. pulchra*. Stomata are of tetracytic type in *B. curtisii*, *B. rotunda* and all *Kaempferia* species (Plate I:A,C,E–J) but in *B. prainiana* and *B. plicata* there are at least six to ten subsidiary cells (Plate I:B,D). The guard cells lie at the same level as epidermal cells.

Lamina In transverse sections the adaxial epidermal cells are large and as high as wide in *B. prainiana* and *B. plicata* (Plate II:B,D), while in the rest of the species they are about twice as wide as high. In *K. angustifolia* (Plate II:E, Plate III:A), and *K. pulchra* (Plate II:I) the outer walls of the adaxial epidermis are convex. Adaxial and abaxial hypodermis are present in all *Kaempferia* species and *B. rotunda*, while in *B. curtisii* it is present on the abaxial side only (Plate II:A). In *B. prainiana* and *B. plicata* the hypodermis is completely absent (Plate II:B,D). Palisade tissue is in one layer occupying a quarter or half of the leaf thickness. Solitary calcium oxylate crystals are present in the mesophyll cells of all species. Lamina bundles contain one to three metaxylem vessels (Plate III:B–D). In *B. plicata*, *K. angustifolia*, *K. parviflora* and *K. rotunda* the adaxial surfaces of the lamina are raised above the large bundles (Plate II:D,E,H,J). Fibrous caps are present on both adaxial and abaxial sides of large bundles (Plate III:B), while in smaller bundles, fibers are present on the abaxial side only (Plate III:C,D). In the large bundles the fibres extend to the hypodermis or epidermis. No girders from the bundle caps to the epidermis were observed.

Leaf margin The outline of the tip of the margin in TS is straight and blunt in *B. prainiana* (Plate IV:B) while in the other species the tips extend beyond the mesophyll tissue, forming a 'beak', consisting of the adaxial and abaxial epidermal cells as in *B. curtisii*, *B. rotunda* and *K. gilbertii* (Plate IV:A,C,G) or mixed with some colourless parenchyma as in *K. galanga* and *K. pulchra* (Plate IV:F,I). These beaks may be long or short and the shapes vary from straight (Plate IV:A,D,H) or slightly pointing downwards as in *B. rotunda*, *K. angustifolia*, *K. galanga*, *K. gilbertii* and *K. rotunda* (Plate IV:C,E–G,J). In *K. pulchra* it is characteristically curved downwards like a hawk's beak (Plate IV:I), while in *K. gilbertii* the beak protrudes into a short end like a 'teat', consisting of only two cells (Plate IV:G).