

Floral morphology and foliar anatomy of *Blumea lanceolaria* (Roxburgh) Druce [Asteraceae]

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Abstract

Foliar anatomical study of *Blumea lanceolaria* (Roxburgh) Druce for enhanced taxonomic comprehension of the species in the genus *Blumea* DC. under family Asteraceae was done with the help of light microscope. Epidermal cell shape and size, stomata type, types of trichomes are useful tools for distinguishing the species in the genus. Present paper also highlights on the petiolar anatomy and floral characteristic of the species *Blumea lanceolaria* (Roxb.) Druce. These features can be employed to delimit the species in the genus *Blumea* of the family Asteraceae.

Key words: Anatomy, Foliar morphology, Floral morphology, Petiolar anatomy, *Blumea lanceolaria.*, Asteraceae

INTRODUCTION

Blumea DC. (Asteraceae) is a genus of herbs, shrubs and small trees characterised by disciform capitula with outer filiform female florets and inner tubular bisexual florets, tailed anthers, and presence of one large oxalate crystal in each epidermal cell walls of cypsela (Pronponggrungrueng *et al* 2007). The genus is one largest in the Inuleae-Inulinae, comprising approximately 100 species distributed throughout the Old World tropics, with the highest diversity in tropical Asia and a few species in Australia and Africa (Randeria 1960; Anderberg 1994; Anderberg & Eldena 2007). Many members of *Blumea* DC. are widespread weeds commonly found in disturbed areas. Some species also occur in various undisturbed, open vegetation, but only a few are restricted to evergreen forest. The genus *Blumea* DC. was first described by de Candolle (1836) in order to accommodate some exceptional species of *Conyza* Lessing, with apical stigmatic lines and, in most cases, tailed anthers.

Metcalf & Chalk (1950, 1979) recorded the presence of glandular hairs, secretory elements and cavities and crystals in the stem and petiole, and ranunculaceous or anomocytic stomata in dorsiventral leaf in some of the related members of Asteroideae. Present paper highlights the study of epidermal cell shape and size, stomatal type, types of trichomes, petiolar anatomy and floral characteristic of *Blumea lanceolaria* (Roxburgh) Druce. These useful tools can be employed to delimit the species in the genus *Blumea* DC. of Asteraceae.

This study is aimed to provide valuable and reliable illustrated anatomical descriptions of the leaf and petiole of *Blumea lanceolaria* (Roxburgh) Druce.

MATERIALS AND METHODS

Blumea lanceolaria (Roxburgh) Druce is a medicinally important species of Asteraceae that was collected from different parts of Assam during May 2011- September 2012. Voucher specimens were prepared following the methodology of Jain & Rao (1977). These specimens were identified and confirmed by matching at the herbarium of Guahati University and at ASSAM. The identity of specimens were also determined by consulting different literature including Peng *et al* 1998; Hooker 1884; Hajra *et al* 1995; Kanjilal *et al* 1939; Deb 1981-1983; Haridasan & Rao 1987.

Either fresh leaves or preserved specimens were used for epidermal studies. Anatomical study was done following the methods described by Dilcher (1974), Wilkinson (1983, 1989), Khatijah & Zaharina (1998), Ogundipe & Wujek (2004), Adedeji (2004), Kadiri (2006) with some modifications. For foliar epidermal study both fresh and preserved plant materials were used. For foliar study leaves were cut into five centimetre pieces from the standard median portion of the lamina near the mid-rib. The leaf pieces were later soaked in 2:8 concentrated Nitric acid and water and boiled until chlorophyll contents were degraded. Tissue disintegration was indicated by bubbles and the epidermises were transferred into Petri dishes containing water for cleansing and epidermises were separated with forceps and mounting needle. Tissue debris was cleared off the epidermis with fine-hair brush and rinsed five times in water. Few drops of different grades of Ethanol: 50 %, 70 %, 90% and 100 % were added in turn to harden the cells. Preparations were later stained with Safranin O in 50 % alcohol for about five minutes before mounting in glycerine on glass slides. The epidermis were mounted with the upper surfaces facing up, covered with cover-slips and ringed with nail varnish to prevent dehydration. For node, petiole, midrib and stem, materials were sectioned through free-hand sectioning. Those were stained with safranin & fast green and mounted in DPX. The slides were appropriately labelled and examined under light microscope at different magnification. Microphotographs of different structures were taken for future references. The classification and terminology of stomata have been elaborated following Dilcher (1974).

Stomatal Index (SI) was calculated by the following formula (Wilkinson 1979):

$$\text{Stomatal Index (SI)} = \frac{S}{E + S} \times 100$$

Where,

S = Number of stomata per unit area,

E = Number of epidermal cells in the same unit area

Stomatal Frequency (SF) was calculated by the following formula (Abdulrahman & Oladele, 2010):

$$\text{Stomatal frequency (SF)} = \frac{\text{Number of stomata per field}}{\text{Area of the field}}$$

Guard Cell Area (GCA) was calculated by the following formula (Franco 1939):

$$\text{Guard cell area (GCA)} = \text{Length} \times \text{Breadth} \times K$$

$$K = \text{Franco's constant} = 0.78524$$

TAXONOMIC TREATMENT

Blumea lanceolaria (Roxburgh) Druce, Bot. Exch. Club. Soc. Brit. Isles 4: 609. 1917; Kitamura, Coll. Sci. Kyoto. Imp. Univ. Ser. B. Boil. 13: 254, 1937; Li, Fl. Taiwan 4: 812, 1978. Reipubl. Popul. Sin. 75: 17. 1979. *Conyza lanceolaria* Roxburgh, Fl. Ind. Ed. 2. 3: 432.1932. [PLATE I]

Perennial herb or undershrub, erect, 90 – 250 cm tall. Stems woody herbaceous, hollow, 1-2 cm in diam., glabrate or puberulous particularly on younger parts and in inflorescence, usually unbranched except for inflorescence axis. Leaves oblong-ob lanceolate, petiolate, 20-30 cm long and 5-8 cm in width, apex acuminate, base attenuate to auricled, margins minutely serrate-dentate, upper surface often rugose, glabrous and dark green in colour; glabrate-puberulous on lower surface. Leaf venation reticulate, lateral veins 14-16 pairs. Heads pedunculate, peduncles villous, individual head 7-10 mm long, 3-5 mm in width, numerous, terminal, in a pyramidal panicle, involucre globose-campanulate, bracts tri-tetra seriate, outer bracts shorter, ovate-lanceolate to linear, 2-3 mm length and 0.3-0.4 mm in across, villous on outer surface; inner bracts linear, 6-7.5 mm long and 0.3-0.5 mm breadth, margins ciliate. Receptacle flat, avleolate, fimbriate or densely pilose 1.5-3 mm in across. Central florets tubular, yellowish, 6.5-7 mm long, pentamerous, lobes triangular with sessile glands and remotely multicellular hairs. Stamen 5, syngenesious, yellow, 3-4.5 mm long; carpel 2, 6.5-7mm long. Outer florets filiform, 6-7 mm long, 3-5 lobed limbs, glabrous. Androecium absent, carpel 2, 5-5.5 mm long. Achenes 10-ribbed, oblong, brown, pubescent, 0.9-1.2 mm long and 0.3-0.4 mm in across. Pappus pale to yellowish white, 5-5.5 mm long.

Flowers & Fruits: February – April

Execcatus: Karbi –Anglong, Paul, S. 61 dated. 24.02.2012.

Distribution: Southern and South-Eastern Asia and China. India: Assam: Kamrup, Karbianglong, Dhemaji, Lakhimpur, Golaghat, Kokrajhar.

FOLIAR FEATURES

The observations of both qualitative and quantitative characteristic of epidermis of *Blumea lanceolaria* (Roxburgh) Druce were presented in the Table – I.

The epidermis is composed of a single layer of cells on both the upper surface and lower surface.

1. EPIDERMIS:

- i. *Surface:* Leaves of the *Blumea lanceolaria* were hypostomatic.
- ii. *Structure:* The epidermal cells are both pentagonal and hexagonal and isodiametric in upper surface, only polygonal in lower surface. The epidermal cell walls were straight on upper surface and slightly sinus in lower surface (Plate II: A & B).
- iii. *Dimensions:* The lengths of epidermal cells 48.35µm in upper surface and breadths 16.2 µm in upper surface of *Blumea lanceolaria*. Length of epidermal cells 32.47 µm and breadth 10.7 µm in lower surface. L/B ratio of epidermal cell is 3.03 µm was highest in lower surface than upper surface.

2. STOMATA

- i. **Distribution and orientation:** Stomata were distributed uniformly over the entire lamina of lower surfaces in between the veins. They are widely separated from each other by epidermal cells.

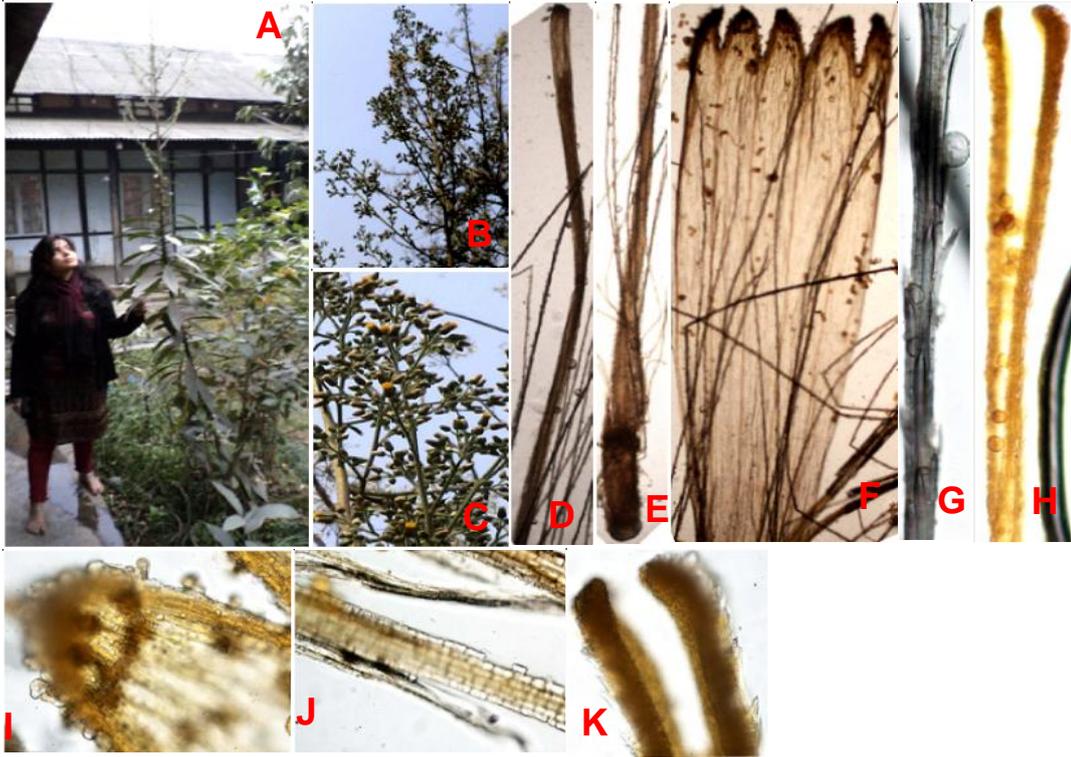


PLATE I: *Blumea lanceolaria* (Roxburgh) Druce: A. Whole plant; B. Upper part of the plant; C. Panicle of capitula; D. Ray floret (upper part); E. Ray floret (lower part); F. Corolla splitted open; G. Pappus; H. Stigmas; I. Anther tip; J. Anther base; K. Tip of stigma

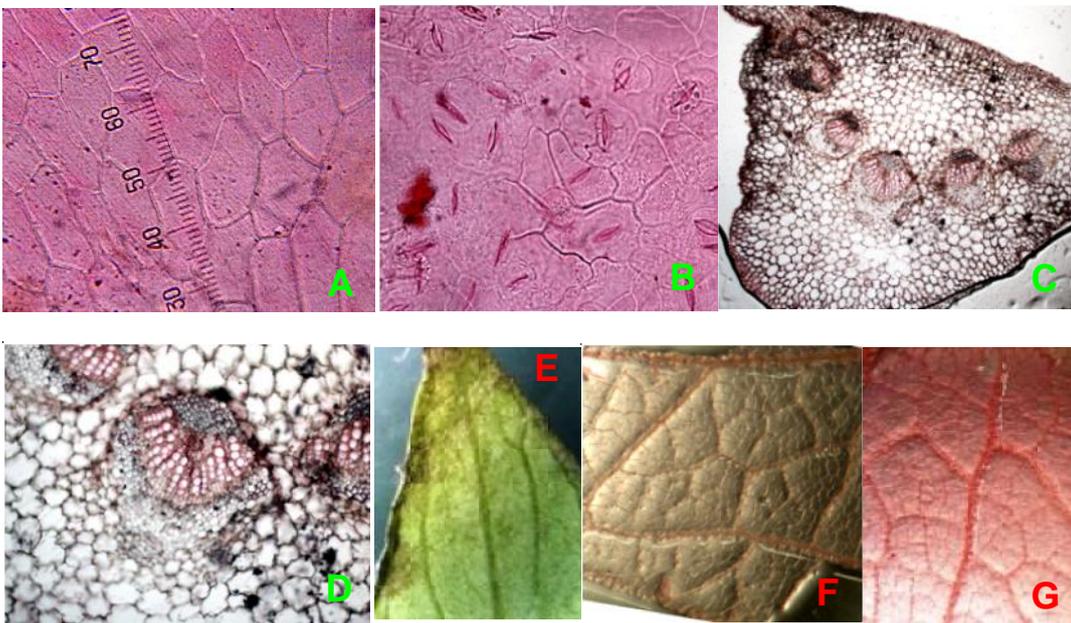


PLATE II: *Blumea lanceolaria* (Roxburgh) Druce: A. Upper epidermis; B. Lower epidermis; C. T.S. of petiole; D. Part of stele in stem; E - G. Architecture in different part of lamina

- ii. **Type:** Foliar morphological studies of *Blumea lanceolaria* show mostly seven types stomata; these are anomocytic, anisocytic, paracytic, diacytic, tetracytic, haplocytic and polycytic.
- iii. **Dimensions:** The maximum length of stomata 18.67µm and breadth 13.46 µm in lower surface of the species. Maximum L/B ratio of stomata 1.39 µm in lower surface Maximum length of stomatal aperture 13.16 µm and breadth 4.9 µm in lower surface and L/B ratio of stomatal aperture 2.69 µm. Number of stomata per sq mm is 94 in lower surface. The other important quantitative data i.e. length and breadth of stomata, L/B ratio of stomata, length and breadth of stomatal aperture, L/B ratio of stomatal aperture and No. of stomata per square mm. species are presented in Table - 1.
- iv. **Stomatal frequency and Index:** Stomatal Frequency 13.24 mm² and Stomatal Index 33.69 mm on lower surface.

3. Trichome:

The trichomes were absent in both surface of *Blumea lanceolaria*.

FOLIAR ARCHITECTURE

From the tertiary branching or sub-tertiary, the ultimate areoles are formed. So, these areoles are seen with the free vein endings. Sometimes the free vein endings are absent. Free vein endings are mostly unbranched, rarely dichotomous branched (Plate II, Figs. E – G).

PETIOLAR ANATOMY

In the middle portion of the t.s. of petiole (Plate II, C), seven traces were found of which middle large traces cut outside from two laterals and size of traces were gradually decrease from middle large to lateral smaller traces. At the distal end two small traces are developed outside from the middle trace. As a result the distal end of it becomes seven-traced condition with alternate small and large traces.

Table 1. Qualitative data of the foliar epidermal characters of *Blumea lanceolaria* [Ani = Anisocytic; Ano = Anomocytic; D = Cicytic; H = Haplocytic; P = Paracytic; Po = Polycytic; T = Tetracytic]

Surface	Epidermal cell		Trichome	Size of stomata equal/unequal	Type of stoma							
	Shape	Walls			H	P	Ani	Te	D	Po	Ano	
Upper	Pentagonal & hexagonal	Straight	Absent	Absent	-	-	-	-	-	-	-	-
Lower	Polygonal	Sinus	Absent	Unequal	+	+	+	+	+	-	+	+

Table 2. Mean value of the foliar epidermal characters of *Blumea lanceolaria* [B = Breadth; EC = Epidermal Cell; L = Length; SA = Stomatal Aperture; SF = Stomatal Frequency; St = Stomatal]

Surface	No of St/ sq mm	No of EC/ sq mm	SI/ sq mm	SF/ sq mm	St		EC		SA		L / B ratio		
					L	B	L	B	L	B	St	SA	EC
Upper	0	237	0	0	0	0	48.35	16.22	0	0	0	0	2.98
Lower	94	400	33.69	13.24	18.67	13.46	32.47	10.71	13.16	4.9	1.39	2.69	3.03

DISCUSSION

It has been seen that the trichomes were absent in the both surfaces of the plant. Anatomical characters are a useful taxonomic tool for identification of taxa (Davis & Heywood 1963; Radford *et al* 1974; Inamdar & Gangadhara 1977; Wilkinson 1983, 1989; Adedeji 2004). The leaf of *Blumea lanceolaria* (Roxburgh) Druce is dorsiventral. Epidermal cell shape is irregular on two surfaces, epidermal cell walls in lower surface sinuate and straight in upper surface (Plate II, A & B; Table 1). Quantitative characters like epidermal cell size, cell wall thickness, epidermal cell number, stomatal number and stomatal size can be used to distinguish the species from other species of the genus *Blumea* DC. of family Asteraceae (Table – 2). Anomocytic stomata have been reported in the family-Compositae (Metcalf & Chalk 1950, 1979) but in the present study amphianisocytic types (Stace 1989) were also found to accompany anomocytic stomata on the lower surface respectively. (Plate – II, B; Table 1). Solereder (1908) suggested the need to investigate midrib anatomy in resolving taxa identity. In the plant, the midrib is flattened abaxially with convex edges and partially dome-shaped on the adaxial surface (Plate II, B). Vascular bundles are arranged in the form of an arc at the centre. Vascular bundles are collateral and nine in number. These anatomical characters have pointed to the distinct characteristics of the species of the genus *Blumea* DC. in family and the features would have a great deal of taxonomic significance to the plant .

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