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Anatomical Characterization of *Barleria prionitis* Linn. : A Well-known Medicinal herb

P.Y. Bhogaonkar* and S.K. Lande*

**Department of Botany,*
Govt. Vidarbha Institute of Science and Humanities, Amravati, (M.S.) India.

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ABSTRACT : *Barleria prionitis* L. (Acanthaceae) is widely distributed throughout the hotter parts of India. In Ayurveda the leaves and inflorescences are supposed to be diuretic and anti-inflammatory; leaves used to treat bleeding gums and toothache. In traditional health practices also root, leaf and bark of the plant is widely used to treat various ailments. Oil extract of the plant is prescribed for arresting graying of hairs. Here an attempt is made to characterize the plant anatomically which will help to identify the crude drug if mixed with adulterants. Detailed morphological and anatomical study was carried out. Primary structure, secondary growth pattern and vessel elements of root and stem, leaf architecture, trichomes and crystals are studied.

Keywords : Acanthaceae, *Barleria prionitis* L., Medicinal plant, Anatomy, Root and Stem structure, Leaf architecture, Trichomes, Crystals.

INTRODUCTION

Barleria prionitis L. commonly called 'Porcupine flower' is widely distributed throughout the hotter parts of India. In Sanskrit it is known as 'Karunta', 'Kurantaka' and 'Pita–Saireyaka'. The plant is anti–inflammatory and used in ulcers, itching of leprosy ulcers and the oil extract of the plant is recommended to arrest the graying of hairs. Leaves and young inflorescences are diuretic. Leaf juice used in stomach disorders, urinary affections, fever and catarrh; leaf juice applied to lacerated soles of feet in rainy season and also for pimples. The plant is especially well known for treating bleeding gums and toothache. Because of its antidontalgic property it is known as 'Vajradanti'. Plant ash mixed with honey is given in bronchial asthma. Bark powder given in cough and bark juice in 'anasarka' Root paste applied on boils and glandular swellings (Chopra *et al.* 1996, Khare 2007). The plant is used in many formulations and preparations like Rasnadi kvatha, Rasnadi churna, Sahachara ghritha, Sahachara taila and Dantaroganashani churna (Sharma *et al.* 2000). Singh et al. (2003) found methanol extract to be anti–inflammatory. Hepatoprotective activity was demonstrated by Singh et al. (2005). Verma et al. (2005) found methanolic extract of the plant to produce anti–spermatogenic effect without affecting the general body metabolism. Anti–inflammatory and anti–nociceptive properties of flowers were demonstrated by Jaiswal *et al*. (2010). Dheer and Bhatnagar (2010) found the leaf extract effective in reducing blood sugar in diabetic animals. Bark extract is effective in controlling candidiasis and other oral fungal infections (Aneja *et al*. 2010). Amoo *et al* (2011) also have studied the fungistatic and fungicial activity. Irridoides present in the plant are effective against respiratory syncytial virus (Chen *et al*. 1998), while Ata *et al*. (2011) have shown them to be anti–oxidant. Phenolic content of the plant also exhibits anti–oxidant properties (Chavan *et al.* 2011).

Adulteration of crude drugs and also the use of substituent plant species in certain cases is a common feature. In South India in place of *B. prionitis* L. roots of *Nilgirianthus heyneanus* (Nees.) Bremek. are used (Shantha et al.; 1988). *B. prionitis* L. though is medicinally important and used in commercial formulations, very little is known about its anatomy. To some extent anatomical characters of root are known (Sharma *et al*. 2000). However, no structural details are available about rest of the plant parts.

MATERIAL AND METHODS

Plant material was collected from Amravati Dist. Maharashtra. Anatomy of root, stem and leaf was studied. Freshly handcut sections were observed under microscope and camera lucida sketches were made. Dried pieces of old root and stem were selected for maceration and observation of vessel elements. Thin slices of roots and stems were treated with macerating fluid (5% solution of HNO_3 + 5% solution of $K_2Cr_2O_7$) for 12 to 24 hours. The macerate was then thoroughly washed with water and vessel elements were stained with 1% aqueous safranin and mounted in glycerin. Measurements were made by occular scale lens and camera lucida sketches drawn. Classification of Radford et al. (1974) is followed for categorizing the vessel elements. Leaf constants such as stomatal frequency, stomatal index, palisade to spongy ratio (as seen in t.s.), PR value were determined (Kokate *et al.* 1998).

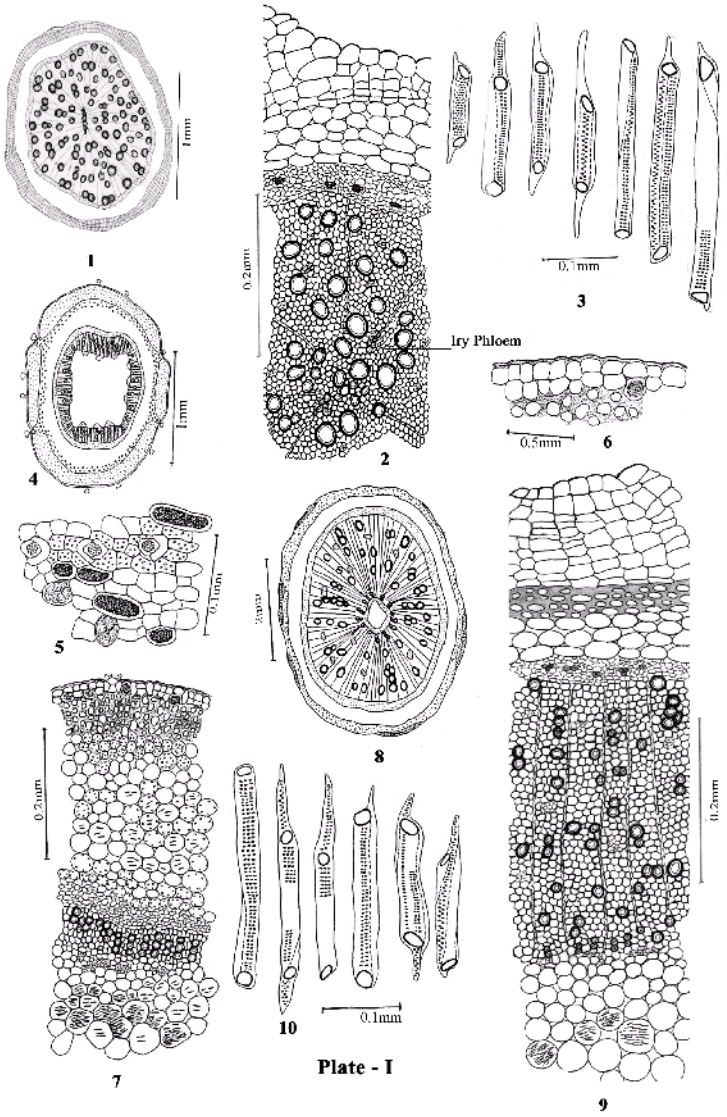
RESULTS AND DISCUSSION

Shurb, 2 – 5 feet high, much branched, usually prickly. Stem and branches cylindrical, glabrous, whitish. Leaves 6–15cm × 3–6. 5cm long, oblong, acuminate, entire, margin finely ciliate, lamina glabrous above, more or less pubescent beneath, base tapering into stalk; stalk 1–2cm long, widely

spreading spines present in axils. Flowers sessile, often solitary, axillary or in short terminal spike; bract 1.2–1.5cm long, oblong–lanceolate, acute, glabrous; bracteole 0.7–1cm long linear. Calyx 4, sepals hairy free upto base, broader at base; outer pair unequal acuminate, larger 1.5–2 cm, smaller 1–1.2 cm; inner pair unequal, linear–lanceolate. Corolla 5–5.5 cm long, yellow, slightly pubescent outside, glabrous inside, some what 2–lipped; lobes oblong–obovate, obtuse at apex, entire, tube 2–2.5cm long. Stamens 2, perfect; staminodes 2; filaments of stamens exerted beyond the corolla tube. Style long, filiform, slightly pubescent at base. Capsule 2–2.5cm long, ovoid, apex acute. Seed rounded, 0.5 cm in dia. with compact silky hairs present on surface as well as on margins.

Anatomy

Root. Stele diarch. Pith absent. Endodermis and pericycle not distinct; cortex narrow. Secondary growth anomalous. Cambium abnormal; produced in pericyclic region outside the stele. As a result patches of primary phloem alternating the primary xylem get retained. Activity of cambium anomalous. It produces secondary xylem and interxylary patches of secondary phloem to the inner side and phloem to the outerside. Distinct growth rings seen. Each growth ring marked by vessels arranged in circular fashion. Vessels scattered, solitary. Rays uniseriate. Phloem with scattered patches of stone cells. Cortical cells horizontally stretched. Cork thick, 5–6 layered. Cork cambium superficial. (Fig. 1 & 2) Vessel elements extremely small (Class A 168 – 175 × 27 – 30 µm), very short (Class B207– 249 × 27 – 30 µm) and moderately short (Class C 258–315 × 21–27 µm); cylindrical–angular, tailed; tails long or short, present on one end or both ends; few without tails. Perforation plates horizontal to slightly oblique (Fig. 3).



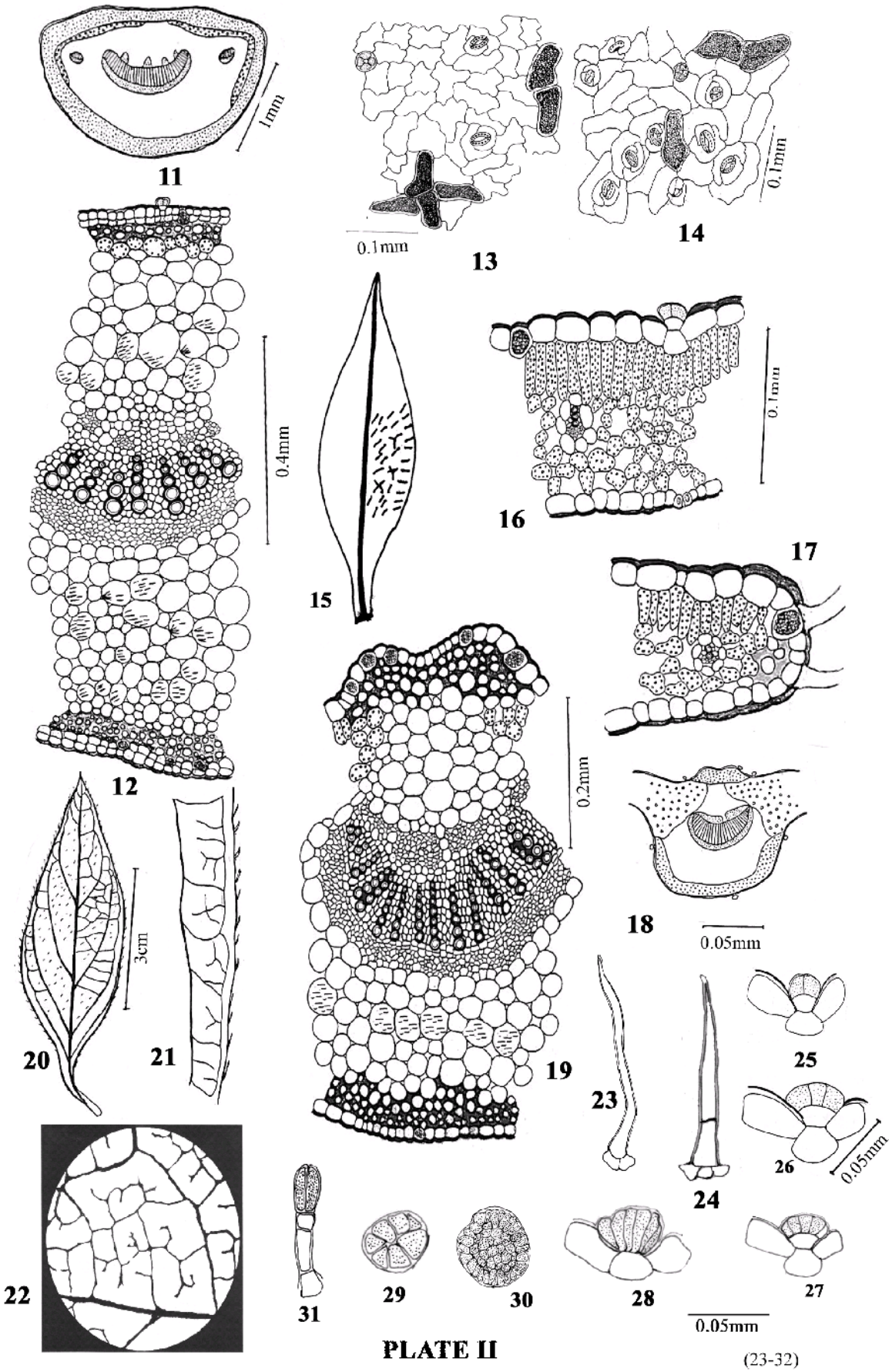


PLATE II

(23-32)

Stem. Young stem roughly quadrangular, flat laterally and convex dorsiventrally (Fig. 4). Epidermis cutinised and cuticularised, showing bands of chlorophyllose and non–chlorophyllose cells; stomata diacytic monocyclic as well as hemibicyclic present in chlorenchymatous region (Fig. 5). Epidermis not uniformly single layered; sometimes two layered and then cystoliths present in inner epidermal layer (Fig. 6). Cystoliths paired as well as solitary. Epidermis followed by 4–6 layered collenchymatous hypodermis. Cortex parenchymatous, 2–3 layers of outer cortex with dense chloroplasts, cells smaller, compactly placed; chlorenchyma reaching epidermis interrupting collenchymatous hypodermis below the angles. Inner cortex 6–7 layered, cells comparatively smaller, complactly placed, with few chloroplasts. Endodermis and pericycle not distinct. Vasculature continuous, small patches of internal phloem lie scattered lining the pith. Pith large, parenchymatous; cells containing bundles of raphides. (Fig. 7).

Cambium continuous from the beginning. Secondary growth anamolous. Vessels narrow, solitary, paired as well as in series. Rays uniseriate. Patches of included phloem scattered in secondary xylem produced. Cork cambium superficial. Cork not produced uniformly, it forms patches at places. Cells of Collenchymatous hypodermis get radially stretched with growth. (Fig. 8 & 9).

Vessel elements very short (Class B 213–222 × 30 – 33 µm), moderately short (Class C 258–330 × 24 – 30 µm) and medium sized (Class D 381 – 800 × 18 – 30 µm); cylindrical–angular, tailed; tails long or short, present on one end or both ends, few without tails. Perforation plates horizontal to slightly oblique. (Fig. 10).

Node. unilacunar single trace. Trace in the form of considerably shallow arc. At leaf base it divides to produce 3 traces.

Leaf. Stalk semicircular in outline. Epidermis not uniformly two layered at places single layered, cutinised and cuticularised. Cystoliths present in lower epidermal layer. Hypodermis collenchymatous. Ground tissue parenchymatous, cells thin–walled with numerous needle shaped calcium oxalate crystals. Vasculature in the form of shallow arc with two small lateral bundles. Vessels in uniseriate tires. Internal phloem in the form of scattered patches. (Fig. 11 & 12).

Lamina amphistomatous. Epidermis single layered; cells cutinised and cuticularised, slightly sinuous; cells of upper epidermis more so. Stomata diacytic, some with subsidiary cells more or less parallel to guard cells (paracytic); monocyclic as well as hemibicyclic. Stomata with single guard cell and aborted guard cells present (Fig. 13 & 14). Cystoliths solitary, paired as well as four together arranged in crosslike manner. Orientation oblique to horizontal from midrib to margin. (Fig. 15).

Mesophyll differentiated into palisade and spongy parenchyma; both densely filled with chloroplasts. Palisade single layered; spongy parenchyma 3–4 layered; cells irregular. Vein–bundles embeded in mesophyll; bundle sheath parenchymatous (Fig. 16). Palisade cells shorter towards margin; collenchyma filling the margin (Fig. 17).

Midrib

Epidermis single layered, cells cutinised and cuticularised, cystoliths present. Hypodermis 2 – 3 layered, collenchymatous; ground tissue parenchymatous. Vasculature in the form of central shallow 'C' shaped arc. Vessels in series separated by polygonal cells; patches of internal phloem lie scattered towards protoxylem (Fig. 18 & 19).

Venation: Brochidodromous in upper half and eucamptodromous in lower half (Fig. 20). Primary vein massive, straight, unbranched, Secondary veins moderate, straight, unbranched, in 6–8 pairs, diverging at 50° – 60° to midrib, angle of divergence more acute in upper than lower; intersecondary veins composite. Loop forming branches joining superadjecent at obtuse angle; intramarginal veins present. Tertiary veins random, reticulate. Veins of higher order distinct; quaternary veins at 4° angle, random, highest vein order showing excurrent branching at 3^0; marginal ultimate venation looped; veinlets simple, linear as well as once branched. Areoles large, irregular, imperfect, random (Fig. 21 & 22).

Leaf constants:

A. Epidermis

	Upper Epidermis	**Lower Epidermis**
Epidermal cells size	67.5 ± 1.564 × 29.1 ± 0.496 × 27 ± 1.643 µm	75.1 ± 1.277 × 31.2 ± 0.642 × 18 ± 1.341 µm
Stomata size	38.7 ± 0.388 × 13.0 ± 0.859 µm	34.3 ± 0.315 × 12.5 ± 0.517 µm
Stomatal frequency	7.4/mm^2	140/mm^2
Stomatal index	11.11%	34.61 %
Cystolith size	85.2 ± 3.157 × 22.3 ± 1.042 µm	90.5 ± 2.813 × 28.6 ± 1.602 µm

B. Palisade : Spongy ratio (PS ratio)–1 : 1.1

C. Pallisade : Epidermis ratio (PR ratio) – 1 : 11.8

. . . . . restricted to grooves on stem and at leaf base on upper side, especially when young. Simple as well as glandular trichomes present. Simple trichomes unicellular and bicelled. Glands sunken, stalk short, single celled, head 4 – many celled; cell walls very thin. Few glands with long, 3–4 celled stalk and 4–celled head. **(**Fig. 23–31).

DISCUSSION

In most of the respects anatomy of *Barleria prionitis* L. is in confirmation with general anatomical features of Acanthaceae. However, many features together characterize to the herb. These are – 1. Presence of class A, B, C and D type of vessel elements in root and stem, 2. patches of primary phloem alternating with primary xylem getting retained in old root, 3. formation of patches of interxylary phloem in secondary xylem in root as well as in stem, 4. phloem with patches of stone cells, 5. epidermis not uniformly single layered; sometimes two layered, then cystoliths present in inner epidermal layer, 6. rays uniseriate in root as well as in root and stem, 7. small patches of internal phloem lying scattered lining the stem pith, 8. stomata mostly diacytic, hemibicyclic, sometimes paracytic stomata present, abnormal stomata with one guard cell and aborted guard cells present, 9. cystoliths and raphides present; cystoliths solitary, paired as well as four together in cross like manner, 10. both simple and glandular trichomes present, 11. venetion brochido–eucamptodromous with marginal veinlets forming loops. These characters can help to identity the crude drug material.

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