



Research Paper

**ANATOMICAL CHARACTERIZATION OF *Lepidagathis cristata* WILLD. –
A ETHNOMEDICINAL HERB**

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Abstract

Medicinal plants are widely used by traditional medicinal practitioners for treating various diseases in their day to day practice. *Lepidagathis cristata* Willd. (Acanthaceae) is a common herb of arid waste lands. The leaves, roots, flowers, seeds and whole plant are medicinally useful. To some extent information about its photochemical profile is available; however, no data is available regarding anatomy, which is very important from pharmacognostic point of view. For physical standardization of the drug, detailed anatomical study has been carried out. Primary structure, secondary growth pattern, vessel elements of root and stem; leaf architecture, trichomes and crystals are studied.

Key words: Acanthaceae, *Lepidagathis cristata* Willd., medicinal plant, anatomy.

INTRODUCTION

Plants are one of the most important source of medicine and are said to be biosynthetic laboratory for most of the active principles like Alkaloids, Glycosides, Resins, Tanins, Flavonoids, Volatile oils, Gums, Oleo-resins etc. which exhibit different dose dependant pharmacological and therapeutic effects (Krishnaveni 2011). Today a large number of drugs prepared from plants are regularly used. The advantage of green drug therapy is safety, economy and easy availability (Prakash and Gupta 2005). Because of these advantages medicinal plants are widely used by the traditional practitioners.

Lepidagathis cristata Willd.(Acanthaceae) is a perennial herb with almost no stem. Whole plant and all parts (leaves, roots, flowers, and seeds) of the plant are medicinally useful. In Maharashtra it is known as Bhuigend, Bhuterda and in Korku language (Melghat, M.S.) as Kumbhi. The herb is used as tonic in fever and applied on itchy affections of skin. Ash of dry plant is used as application to sores (Chopra et al. 1996, Khare 2007). Whole plant antiallergic, haemostatic; used on scabies, sores, boils, wounds; leaves febrifuge (Jain 1991). It is used in combination with other plants also. Root paste mixed with seed powder of *Abrus precatorius* and Karanj oil applied on leucoderma, ash of inflorescence mixed with oil used on wounds (Varghese 1996). For burns, wounds and the tumor, ash mixed with coconut oil is used as lotion by Yanadi tribe of Andhra Pradesh (Reddy and Rao 2013). In Chattisgarh, it is used in treatment of fever, particularly of Malarial fever. The decoction of leaves is used internally for this purpose. Its utility in treatment of fever has given it the name Bukhar Jadi; it is also the used in treatment of itchy affections of skin. In many parts of Chhattisgarh, the cattle

owners use the decoction of the herb to wash the cattles in rainy season in order to keep them free from flies (Madhava2005). Its roots are considered stomachic, used in dyspepsia; leaves are used for fever and flower ash used for burns (Singh 1983 and Madhava 2005).

Some of the activities are experimentally proved. Kumar et al. (2012) found that petrolium extract of whole plant shows significant antipyretic activity. Leaf extracts have shown 50% analgesic activity, while standard drug produced only 31.25% activity (Reddy and Rao 2013a). Methanolic root extract was also found to exhibit 50% analgesic activity (Reddy and Rao 2013b).

MATERIAL AND METHODS

Plant material was collected from Amravati Dist. Maharashtra. Anatomy of root, stem and leaf was studied. Hand cut sections of fresh material were observed under microscope and camera lucida sketches were made. For vessel studies, thin slices of mature roots and stems were treated with macerating fluid (5% solution of HNO_3 + 5% solution of $\text{K}_2\text{Cr}_2\text{O}_7$) 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 ocular scale lens. 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 (Salisbury 1927 and Kokate et al. 1998).

OBSERVATIONS

Macromorphology

Plants shrubby, perennating by root stalk. Branches numerous, spreading on all sides close to the ground, sometimes rooting at nodes, stem quadrangular. Leaves sessile, opposite, elliptic-narrow, 1.5 - 2.5cm x 0.5 - 1.5, acute, rounded at base; veins prominent beneath, hairy, margin entire, ciliate. Flowers in sub-radical, globose head on the lower part of leafy branches; bracts ovate, acuminate, 0.8 - 1cm long, spinous pointed, hairy; bracteoles 0.8 - 1cm, margin membranous, ciliate. Calyx 0.5 - 0.7cm long, sepals 4, partite up to base, unequal, densely softly hairy on both the surfaces, 2 sepals broader; one of them short, bilobed; lateral two narrower, elliptic, acute, all ciliate and spinous pointed, lower segment 2-fid. Corolla 1.6 - 2cm, white, dotted with brown spots, hairy outside, 2-lipped; tube narrow, constricted and expanded upwards; upper lip 0.4 cm, oblong, obtuse, notched at apex; lower lip 0.5 cm 3 lobed, middle one obovate, obtuse. Stamens 4; filaments glabrous; anthers 2 celled, cells unequal, larger cell slightly pubescent on upper side, smaller glabrous. Style minutely pubescent on one side. Capsule 0.6 - 0.8 cm long, ovoid, sub-acute, glabrous, grooved on two sides, 2 seeded; seeds 0.5 cm in dia., ovoid, rounded, densely clothed with mucilaginous hairs.

Micromorphology

Root: Root perennial. Stele diarch. Pith absent (**Fig.1**). Secondary growth anomalous; producing bands of included phloem that give an impression of growth rings. Wood with small and short vessels representing Class A (Extremely small: 141 - 171 x 24 - 36 μm , 150 - 160 x 12 - 15 μm), Class B (Very short: 177 - 210 x 21 - 27 μm) and Class C (Moderately short 273 - 306 x 24 - 39 μm) of Radford et al. (1974) (**Fig. 2**). Vessels scattered, solitary, paired or in series of 3-4. Small patches of thick walled paratracheal parenchyma produced. Rays uniseriate or biseriata; uniseriate being more frequent. Endodermis distinct. Cortex narrow, parenchymatous; cells getting stretched with growing girth. (**Fig. 3**)

Stem: Young stem roughly quadrangular, with 4 narrow wings. Wings forming pairs on dorsiventral side (**Fig.4**). Epidermis single layered, showing chlorophyllose bands with stomata and non-chlorophyllose bands. Stomata diacytic, hemi-bicyclic and bi-cyclic. Cystoliths solitary (**Fig.5**). Hypodermis collenchymatous. Wings filled with collenchyma up to half followed by chlorenchyma. Cortex narrow, 2 - 3 layered, parenchymatous; cells enclosing small intercellular spaces. Endodermis distinct; cells squarish. Pericycle not distinct. Internal phloem in the form of continuous band encircling the pith. Phloem cells against protoxylem with stored food. Pith small; cells containing raphides and styloids (**Fig. 6**).

Secondary growth anomalous (**Fig. 7**). Cambium producing continuous phloem cylinder of thick-walled cells to the outer side and secondary xylem with patches of included phloem and thick-walled paratracheal parenchyma to the inner side. Vessels scattered, solitary or paired, cylindrical or quadrangular, tailed; tails short or long, present on one end or both ends, broader vessels without tails. Perforation plates horizontal to slightly oblique. Vessels extremely small, (Class A) 108 - 175 x 18 - 24 μm and medium sized (Class D), 369 - 396 x 12 - 21 μm , 400 - 450 x 15 - 18 μm (**Fig. 8**). Rays uni and biseriate. To keep pace with growing girth, few cells of inner phloem ring divide to add secondary parenchyma; as a result a parenchymatous ring with scattered patches of inner phloem is produced. Some pith cells become lignified; variously shaped crystals of calcium oxalate (raphides and styloids rectangular) present. Cork cambium deep seated, originating inner to endodermis; producing secondary parenchymatous cortex to the outer side while to the inner side almost no cells are produced. Some of the cortical cells also divide tangentially producing secondary cortical parenchyma to keep pace with growing girth of wood. (**Fig. 9**)

Node: Unilacunar single trace.

Leaf base: Leaf base grooved with two lateral wings. Epidermis cutinised and cuticularised, cystoliths solitary. Hypodermis collenchymatous, 1 - 2 layered on upper and lower side. Ground tissue parenchymatous; cells thin-walled, enclosing small intercellular spaces. Vasculature in the form of central crescent. Vessels arranged in series. Both abaxial and adaxial phloem present in the form of continuous band. (**Fig. 10, 11**)

Lamina: Amphistomatous; epidermis single layered; cells shallowly sinuous, cutinised and cuticularised. Stomata diacytic; bi-cyclic and hemi-bicyclic. Large lithocysts present in epidermis containing cystoliths of various sizes (**Fig. 12a, 12b**). Along the margin and veins cystoliths form continuous chains parallel to midrib and veins; while in intercostals areas either they are horizontally scattered or in horizontal chains (**Fig. 13**).

Mesophyll homogeneous, consisting of palisade tissue only. Upper 2 - 3 layers of elongated cells compactly placed and densely filled with chloroplasts. Lower palisade layers of short cells with fewer chloroplasts. Vein-bundles embedded in mesophyll; bundle sheath parenchymatous. Around the bundle sheath, palisade cells concentrically arranged. (**Fig. 14a**)

Margin: Mesophyll continuous in the margin; however, lowermost layer of cells devoid of chloroplasts. 1 - 2 vein bundles present in the margin. (**Fig. 14b**)

Midrib: Ridged on upper side. Epidermis cutinised and cuticularised, cystoliths solitary. Hypodermis collenchymatous, completely filling the ridge, 1 - 2 layered on lower side. Ground tissue parenchymatous; cells enclosing small intercellular spaces. Mesophyll continuous, in midrib reaching up to vascular bundle on both the lateral sides. Vasculature in the form of central crescent; vessels arranged in series separated by thin-walled cells. Internal phloem in the form of continuous band. (**Fig. 15**)

Venation: - Eucamptodromous (**Fig. 16**). **Primary** vein massive, straight, unbranched. Secondary veins acute, moderate, curved uniformly, unbranched, in 5- 7 pairs, diverging at 40° - 65° to midrib. Upper secondary more obtuse than lower; inter-secondary veins composite. Tertiary veins random, reticulate; veins of higher order distinct. Quaternary veins at 4° angle, normal, random, highest vein order showing excurrent branching at 3° , marginal ultimate venation looped; some free veins and clusters of free veins beyond loops; Veinlets simple, linear as well as branching once. Areoles imperfect, quadrangular to irregular, random, large (**Fig. 17**).

Leaf constants:
A. Epidermis

| | Upper Epidermis | Lower Epidermis |
|----------------------|---|---|
| Epidermal cells size | 86.8 ± 2.146 x 46 ± 0.814 x 30 ± 1.643 µm | 70.8 ± 3.739 x 32.8 ± 1.174 x 27 ± 1.643 µm |
| Stomata size | 28.5 ± 0.308 x 15 ± 0.331 µm | 34.5 ± 0.322 x 21.2 ± 0.338 µm |
| Stomatal frequency | 42.2/mm ² | 70.2/mm ² |
| Stomatal index | 24.57 % | 30.43 % |
| Cystolith size | 183.3 ± 14.185 x 51 ± 1.123 µm | 112.9 ± 8.377 x 36.8 ± 0.784 µm |

B. Palisade : Spongy ratio (P:S ratio)- 1 : 0.65

C. Pallisade : Epidermis ratio (PR ratio) - 1:9.8

D. Leaf dimensions (in v.s. / t.s.) -

Thickness of lamina- 180 ± 1.643 µm. Height of palisade tissue - 69 ± 2.121 µm. Height of spongy tissue - 54 ± 2.5099 µm

E. Trichomes - Simple as well as glandular present on stem and leaf.

Simple trichomes:- 1 - 3 celled; 0.11 µm to 0.28 µm, smooth. Some unicellular trichomes quite broad. **(Fig. 18 - 21)**

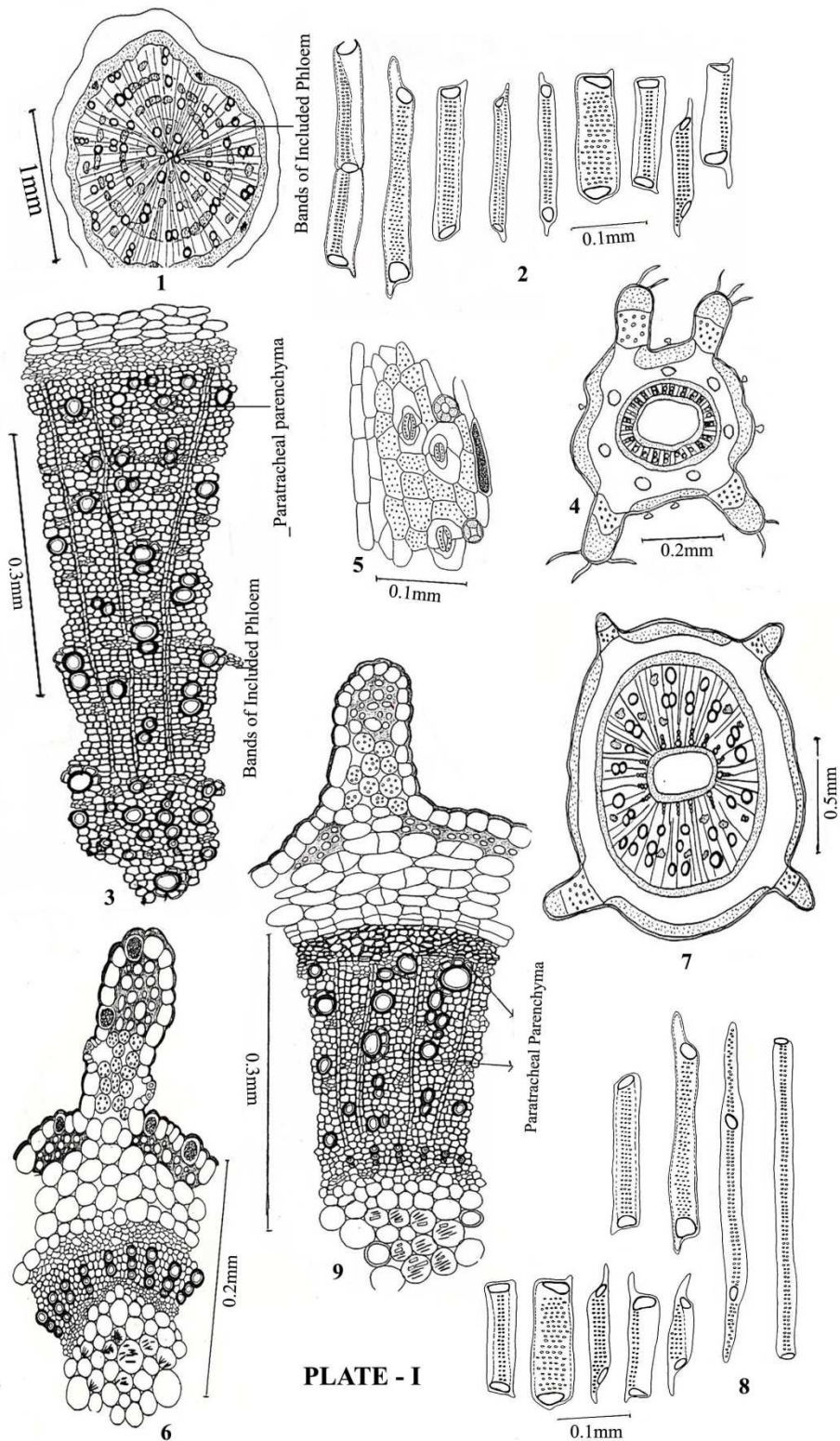
Glandular trichomes: - Sessile as well as stalked; sessile with 4-celled head. Stalked glands with 1 or 2 celled stalks; stalk 0.05 - 0.07 µm. **(Fig. 22 - 25)**

DISCUSSION

Anatomy of *Lepidagathis cristata* is in agreement with the general anatomical features of Acanthaceae like, occurrence of cystoliths both in stem and leaf, presence of inerxylary phloem, anomalous secondary growth producing intraxylary phloem patches, vessels with simple perforation plates, diacytic stomata and calcium oxalate crystals of various shapes. (Metcalf and Chalk 1950).

However, there are many features by which the species is characterized-

- Presence of A, B and C type of vessels in root and those of A & D type in stem.
- Formation of distinct concentric zones resembling growth rings due to the production of bands of included phloem.
- Formation of paratracheal parenchyma producing a sort of narrow sheath around the vessels. This is previously reported for few members like *Sanchezia williamsii* Leonard (Metcalf and Chalk 1950).
- Mesophyll homogeneous, can be described isobilateral. Isobilateral structure reported in some Acanthaceae (Metcalf and Chalk 1950). Concentric arrangement of mesophyll cells around the bundle sheath reminds the Kranz anatomy (Fahn, 1997). However, sheath cells are devoid of chloroplasts which is unlike Kranz anatomy. Leaf margin also provides a characteristic feature that the hypodermal mesophyll layer on the lower surface is devoid of chloroplasts.
- Stomata diacytic; hemi-bicyclic and bi-cyclic.
- Cystoliths in chains parallel to the midrib and secondary veins; intercostals horizontal to midrib.



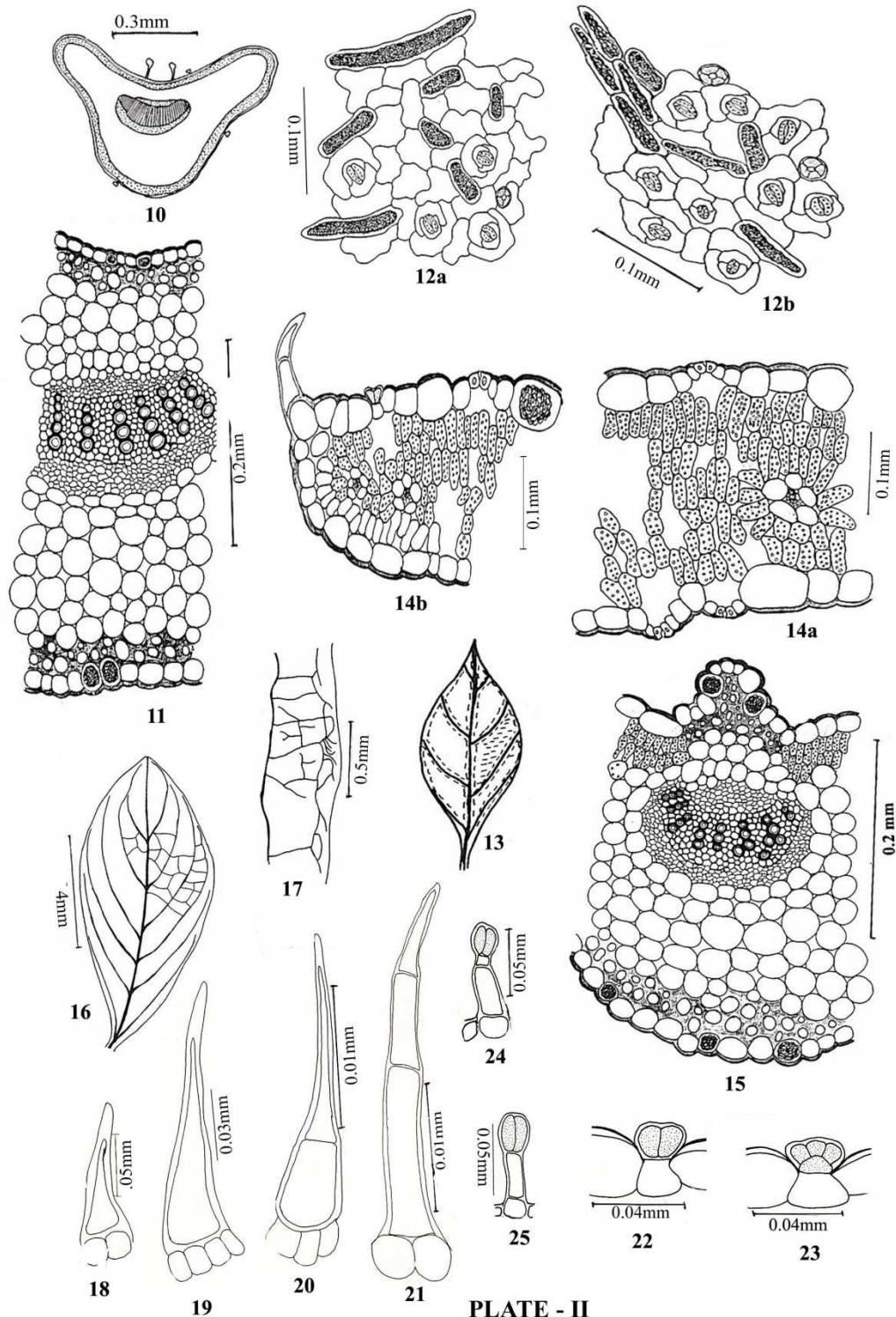


PLATE - II

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