International Journal of Biology Research
ISSN: 2455-6548
Impact Factor: RJIF 5.22
www.biologyjournal.in
Volume 3; Issue 2; April 2018; Page No. 60-63

Physical characterisation of *Dipteracanthus prostatus* (Poir.) Nees a medicinal herb

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Abstract
The plants are valuable source of new medicinal agents. Medicinal plants have various effects on living system and the contents of medicinal plants are used for the development of new drug compound that are used in various diseases. *Dipteracanthus prostatus* (Poir.) Nees (Synonym *Ruellia prostrata*) is a indigenous medicinal plant of family Acanthaceae. The whole pant and parts of plant are medicinally important. To some extent information about its phytochemical is available; very few data is available about its antomy which is very important from pharmacognostic point of view. This paper deals with the micromorphological study of root, stem and leaf of *Dipteracanthus prostatus* for standardization of drug.

Keywords: *Dipteracanthus prostatus* (Poir.) Nees, medicinal plant, acanthaceae, macromorphology, micromorphology

Introduction
Plant-derived substances have recently become of great interest owing to their versatile applications. Medicinal plants are the richest bio-resource of drugs of traditional systems of medicine, modern medicines, nutraceuticals, food supplements, folk medicines, pharmaceutical intermediates and chemical entities for synthetic drugs (Tiwari *et al*. 2011) [20]. The use of medicinal plants as a source for relief from illness can be traced back over five millennia to written documents of the early civilization in China, India and the Near east, but it is doubtless an art as old as mankind (Mahesh and Satish, 2008) [10]. Herbal medicine has been practiced worldwide and is now recognized by WHO as an essential building block for primary healthcare (Chopra *et al*., 1956) [6].

Dipteracanthus prostratus (Poir.) Nees. (Synonym *Rullia prostrata*) is an indigenous medicinal plant, which present in moist shady places throughout India. It is widely distributed in Arica, Srilanka, Pakistan and throughout India (Akthar *et al*. 1992) [25]. The plant is commonly known as bell weed (Anonymous, 1959) [4] and black weed (Palanisamy *et al*. 2012) [14]. The whole plant and parts of plant is medicinally useful. This plant gains significance due to its medicinally important properties like anticancer, hypoglycemic, anti-inflammatory, diuretic, and antimicrobial activities (Agrawal and Singh (1999) [1], Onayade *et al*. (1990) [13], Yoganandam *et al*. (2014) [22]. Historically this plant is used to cure gonorrhea, hypoglycemia, eye disease and ear diseases (Chopra *et al*. (1956) [6], Rastogi, and Mehrotra (1989) [18], Asolkar *et al*. (1992) [5]. The important bioactive compounds isolated from this plant are glycosides, phenolic compounds, saponins, tannins, flavonoids, gums, alkaloids and mucilage. The whole plant juice is used as antidote for snakebite by the tribal of the western ghats of south India (Maruthupandian *et al*. 2011) [11]. It is used as a remedy for ear disease and believed to be anti-cancer against the nasopharynx region, slightly hypoglycemic, anti-inflammatory and anti-microbial (Jeyachandran *et al*. 2010) [7]. It is used in gonorrhoea and is slightly hypoglycaemic ((Chopra *et al*. 1956) [6], also used as cardiotonic, antiulcer, antioxidant, paranychia, venereal diseases, rheumatic complaints, eye diseases, insect bite and healing of wounds (Yadav and Yadav (2009) [21], Singh and Khan (1990)) [19]. The roots of plant are edible and used in preparation of local drinks (Palanisamy *et al*. 2012) [14]. The leaves are used as vegetable (Anonymous, 1959 and Jeyachandran *et al*. 2010) [4, 7].

Material and Methods
Plant material was collected from Amravati Dist. Maharashtra. Anatomy of root, stem and leaf was studied. For the anatomical studies freshly hand cut sections were observed under microscope and camera lucida sketches were made. Dried pieces of old root and stem were selected for maceration to observe vessel elements. Thin slices of roots and stems were treated with macerating fluid prepared by mixing 5% solution of HNO3 and 5% solution of K2Cr2O7 for 12 to 24 in cavity blocks. 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 were drawn. Classification of Radford *et al*. (1974) [17] is followed for categorizing the vessel elements. Stomatal types described following Paliwal (1966a &b) [15, 16]. Leaf constants such as stomatal frequency, stomatal index, palisade to spongy ratio (as seen in t.s.), PR value were determined (Kokate *et al*. 1996) [9].

Results and Discussion
Macromorphology
Annual herb; stem cylindrical, much branched, 24 - 45 cm, more or less pubescent, straggling when growing among

bushes, internode long, nodes swollen. Leaves membranous, simple, opposite, ovate-narrow, 1.5 - 7 x 1 - 4 cm, entire, roughly-finely ciliate, subacute, narrowed at base, pubescent above, hairs present on midrib; petiole 0.5 - 2.5 cm, pubescent. Flowers nearly sessile, axillary, solitary. Bract o; bracteole foliaceous, ovate, 2 x 0.5 cm long with stock, pubescent, obtuse; calyx 5, partite upto ¾, 0.8 - 1.2 cm long, linear, pubescent, acute. Corolla pale violet, 2.5 - 3.5 cm, pubescent outside, tube narrowly cylindric below, infundibuliform above, lobes 1.5 - 1.7 cm across, obovate-oblong, rounded at apex. Stamens 4, didynamous; anthers 2 celled, connate, glabrous. Ovary and style pubescent; filiform. Capsule ovate-oblong, pointed; stalk long, slightly pubescent, compressed laterally. Seeds many, 3 mm in dia., rounded, greenish with white mucilaginous hairs present on margin, only.

Micromorphology

Root

Root pentarch to polyarch (Fig. 1). Pith present, large; cells thick-walled. Cortex large, parenchymatous, cells thin-walled, stretched tangentially and arranged in radial files. Secondary growth normal. Vessels elements Cylindrical, scattered, solitary or in series, accompanied by uniseriate rays. Biseriate rays present against protoxylem poles. Perforation plates mostly horizontal, few slightly oblique; tails sort as well as long, on one side or both sides. Extremely small (Class A): 175 x 15 - 27 µm, very short (Class B): 204 - 228 x 21 - 27 µm, Moderately short (Class C): 246 - 330 x 12 - 30 µm (Fig. 3). Phloem with patches of scattered stone cells. Endodermis distinct; cells dividing tangentially. Cortical cells also divide tangentially. Few cortical cells become stone cells. Fan shaped crystals and cystoliths present. Cork cambium superficial. Very basal portion of root near the hypocotyle shows cystoliths in pith also. (Fig.2 &4)

Stem

Young stem quadrangular, compressed, laterally concave, grooved dorsiventrally (Fig. 5). Epidermis single layered showing chlorophyllose bands with stomata; stomata diacytic, monocyclic and non chlorophyllose bands; cells cutinised and cuticularised. Cystoliths solitary (Fig. 6). Hypodermis collenchymatous interrupted by chlorenchyma at places. Hypodermis followed by 2 - 3 layered chlorenchyma. Cortex parenchymatous; cells thin-walled, with small intercellular spaces. Endodermis distinct; a layer next to endodermis gets differentiated as single layered pericycle distinct from phloem. Vasculature in the form of six strands, four at angles and two laterally placed. Cambium continuous, from the beginning; conjunctive tissue present between vascular patches. Pith large, parenchymatous; cells thin-walled, enclosing small intercellular spaces. (Fig. 7)

Secondary growth normal. Vessels few, scattered, solitary. Cylindrical as well as angular. Perforation plates horizontal, slightly oblique in tailed vessels. Tails short or long, on both sides or on one side only. Extremely small (Class A) : 168 - 171 x 33 -3 6 µm, very short (Class B): 237 - 249 x 18 - 21 µm, moderately short (Class C):255 - 315 x 18 - 30 µm, medium sized (Class D): 462 - 525 x 27 - 45 µm (Fig. 10). Rays uniseriate frequent and few biseriate. Phloem with scattered stone cells. Cortex parenchymatous, cells dividing tangentially to keep pace with growing girth, some cortical cells get transformed into stone cells. Cork cambium superficial; epidermal in origin. Cork few layered. Styloids and fan shaped crystals present in cortex as well as in pith. (Fig. 8 & 9)

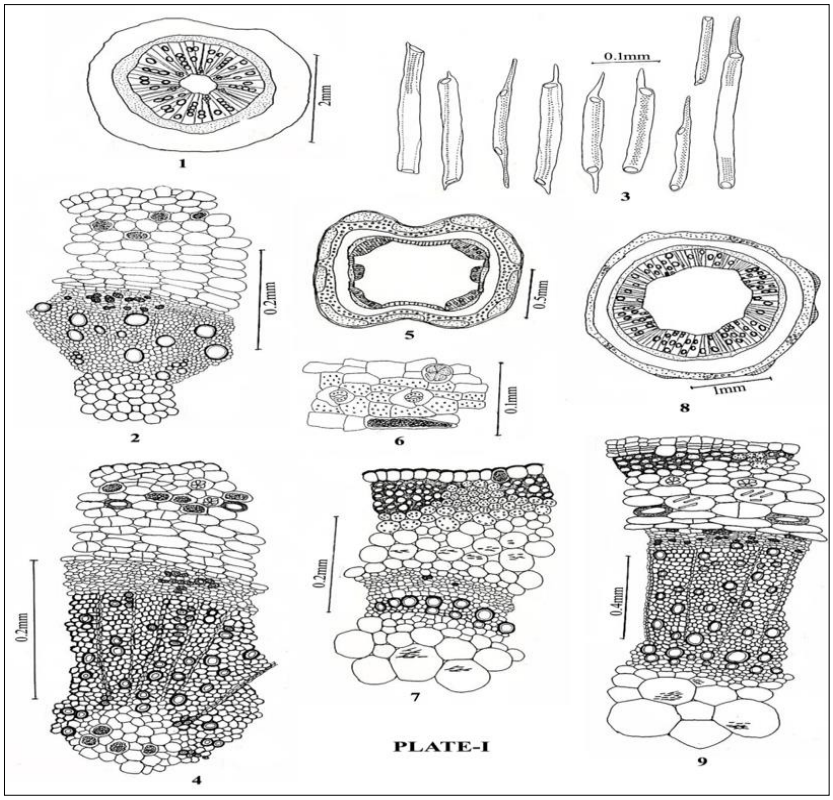

PLATE-I

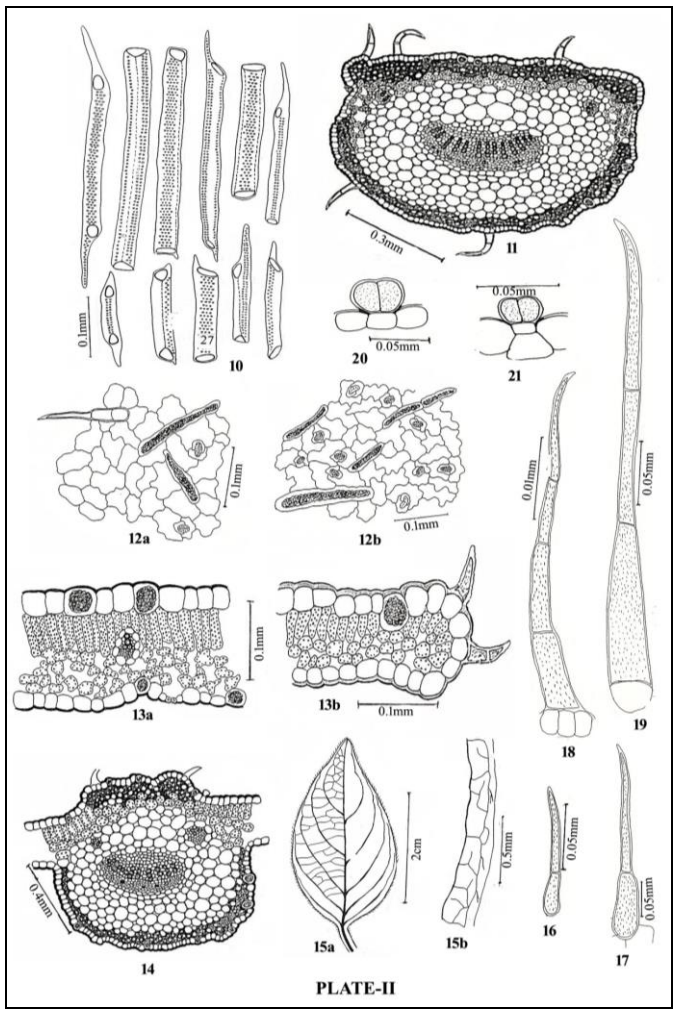

PLATE-II

Node

Unilacunar 3 trace. Central trace large, lateral two traces smaller.

Petiole

Epidermis single layered, cutinised and cuticularised; cystoliths present. Hypodermis 3 - 5 layered, collenchymatous, interrupted by 1 - 2 layered chlorenchyma on upper lateral sides; cells loosely placed forming large intercellular spaces. Ground tissue parenchymatous; cells thin-walled with small intercellular spaces. Vasculature 'C' shaped crescent with two lateral bundles much away from central arc. Vessels arranged in series, separated by thin-walled polygonal cells. Phloem many layered with scattered stone cells. (Fig. 11)

Lamina

Amphistomatous. Epidermis cutinised and cuticularised; cells sinuate, cells of upper epidermis larger than lower. Stomata diacytic; hemibicyclic and bicyclic; some abnormal with single guard cell. Cystoliths soliarty as well as paired and of various sizes, straight or somewhat curved, blunt/obtuse, tapering towards both ends. Orientation of cystoliths horizontal from midrib to margin. (Fig. 12a & b).

Mesophyll differentiated into palisade and spongy parenchyma. Palisade single layered, cells compactly placed and densely filled with chloroplasts. Spongy parenchyma 3 - 4 layered, irregular, cells loosely placed. Vein-bundle embedded in mesophyll, surrounded by non-chlorophyllose parenchymatous sheath. (Fig.13a)

Margin

Ciliate. Palisade cells shorter towards margin. Spongy parenchyma 2 layered, cells isodiametric, loosely placed. (Fig.134b)

Midrib

Epidermis single layered, cutinised and cuticularised; cystoliths solitary. Hypodermis collenchymatous, 2 - 3 layered on upper side and 1 - 2 layered on lower side. Mesophyll continuous; cells isodiametric, filled with chloroplasts. Ground tissue parenchymatous, enclosing small intercellular spaces. Vasculature in the form of central 'C' shaped crescent with two lateral bundles. Vessels in series. Phloem many layered with scattered stone cells. (Fig. 14)

Venation

Eucamptodromous (Fig. 15a). Primary vein massive, straight, unbranched. Secondary veins:-5-6 secondary veins along one side of midrib, angle of divergence $45^0 – 60^0$, acute moderate (Upper secondary veins diverges toward margin, lower nearly uniform), upper secondary more acute than lower, moderate, curved uniformly, unbranched, Intersecondary veins composite. Intramarginal vein absent. Tertiary veins - Angle of origin – RR and RO, random reticulate. Higher vein order distinct. Quaternary veins normal, random, highest vein order of leaf - 4^0 showing excurrent branching - 3^0. Marginal ultimate venation looped, with few marginal free vein ends. Veinlets simple linear as well as branched once (Simple linear more frequent than branched once). Areoles Imperfect, quadrangular to polygonal, random, medium (Fig. 15b).

Leaf Constants

Table 1

Epidermis	Upper epidermis	Lower epidermis
Epidermal cell dimensions	96.0 ±1.212 x 43.9 ± 0.607 x 27 ± 1.643 µm	74.5 ± 3.706 x 31.2 ± 0.665 x 24 ± 1.634 µm
Stomata dimensions	30.8 ± 0.351 x 18.5 ± 0.249 µm	28.5 ± 0.286 x 15.4 ± 0.322 µm
Stomatal frequency	56.4/mm^2	69.5/mm^2
Stomatal index	20.90 %	23.52 %
Cystolith dimensions	178.1±3.032 x 29.3±0.611 µm	162.2 ± 1.814 x 33.5 ± 0.817 µm

Leaf dimensions (in v.s. / t.s.):
Thickness of lamina – 129 ± 1.643 µm
Height of Palisade tissue – 36 ± 1.643 µm
Height of spongy parenchyma – 42 ± 2.121 µm Palisade: Spongy - 1: 1.16
PR - 9.3

Trichomes

Simple as well as glandular; on both stem and leaf.Simple trichomes - Bicellular to 4 – celled, 0.11 µm to 0.46 µm. basal cells broad. Walls warty. (Fig. 16 – 19) Glandular trichomes -

Glands sessile and with short 1- celled stalk. (Fig. 20 - 21)

Discussion

In most of the respect anatomy of *Dipteracanthus prostatus* is in confirmation with general anatomical feature of Acanthaceae (Metcalf and Chalk, 1950) [12]. However, many feature together characterised to the herb. These are- 1. Root pentarch to polyarch. Class A, B and C type of vessel elements present. Cells of endodermis dividing tangentially, 2. Stem quadrangular, grooved dorsiventrally, vasculature is in the form of six strands; four at angles and two laterally placed, cambium continuous from the beginning. Class A, B, C and D types of vessel elements present, 3. Phloem with patches of stone cells present in root and stem, 4. Vasculature is in the form of central 'C' shaped present in petiole and midri, 5. Stomata diacytic, hemibicyclic and bicyclic some abnormal stomata with single guard cell present, 6. Venation eucamptodromous, 7. Styloid and fan shaped crystal present in cortex and pith of stem. All these microscopic characters reported in this paper could be used as diagnostic tool for the identification and standardisation of crude drug material.

Acknowledgement

Authors are very much thankful to Director and Head of the department Govt. Vidharba Institute of Science and Humanities for providing laboratory facility.

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