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PHYSICAL CHARACTERISATION OF *PERISTROPHE PANICULATA* (FORSSK.) BRUMMIT. A WELL-KNOWN TROPICAL MEDICINAL HERB

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ABSTRACT:

A vast majority of people from less developed countries depend on medicinal plants for the treatment of various diseases, due to the high cost of synthetic drugs. Medicinal plants have been used for centuries by man in treatment of diseases. *Peristrophe paniculata* (Forssk.) Brum. (syn. *P. bicalyculata* (Retz.) Nees.) of Acanthaceae is a well-known medicinal plant. The whole plant and all the parts of the plant have medicinal value. Though an important medicinal plant, no anatomical data is available for drug characterization. Drug characterization is important to understand purity of the drug. Here an attempt is made to study the macro and micromorphology of all plant organs in details i.e. primary structure, secondary structure, vessel elements of root and stem, leaf architecture, and trichomes are studied.

KEY WORD: *Peristrophe paniculata*(Forssk.) Brummit., Medicinal plant, Micromorphology, Root, Stem, Leaf, Trichomes.

INTRODUCTION:

In the recent past, there has been growing interest in exploiting the biological activities of various medicinal herbs, owing to their natural origin, cost effectiveness and lesser side effects (Naik et al. 2003). *Peristrophe paniculata* (syn. *P. bicalyculata*) (Retz.) Nees.) of Acanthaceae is distributed warm tropical regions like India, Africa, Mauritiana, Niger and Nigeria, Burma and Thailand (Burkill 1985). It is a well-known drug plant of Ayurveda, known by various names like Nadikaanta, Praachibala, Sulomashaa, Kaaktikta, Kaakjangha etc. It is used as febrifuge, dried root is recommended in insomnia and fear psychosis in children. Essential oil extracted inhibits growth of various strains of *Mycobacterium tuberculosis* (Khare 2007). It is also widely used by different ethnic communities throughout India. Whole plant used in fracture and sprains by 'Tharu' tribe of U.P. (Maheshwari et. al 1980). Leaves are used in eye diseases by 'Irulas' of Tamil Nadu (Ramchandran and Nair 1981) and fruits by 'Kol' tribe of U.P. (Maheshwari and Singh 1987). Roots are used in gout and rheumatism by tribals of Mirzapur District, U. P. (Maheshwari et. al 1986). It is used for fever, also considered as antiseptic and are applied on wound (Uniyal, (1999). The leaves of the plant were used traditionally as analgesic, antipyretic, anti-inflammatory, sedative, stomachic, anticancer, fertility, diuretics and diarrhoea. It is also considered as antiseptic and are applied on wound (Uniyal, (1999). In Indore district of M. P. local name is "Chotiharjori" (Dwivedi, and Gupta, 2002). The whole plant is used by the traditional healers for curing many skin-related problems, also used as an antidote for snake poison when macerated in an infusion of rice, and as an insect repellent. It is also used for horse feed and ploughed into the soil as green manure (Dwivedi, 2008). In Northern Nigeria, it is called "Tubanin Dawaki" by Hausas meaning floor of the horse. The leaves of the plant were used traditionally as analgesic, antipyretic, anti-inflammatory, sedative, stomachic, anticancer, fertility, diuretics and diarrhoea.

Recently it was discovered to have hypolipidemic effects and such effects are known to protect against cardiovascular diseases, including hypertension (Abdulazeez et al. 2009). Various activities of plant extracts have been proved. Abdulazeez et al. (2010) have demonstrated blood pressure lowering effect of the plant extract. The decrease in liver enzymes after treating hypertensive rats also shows the hepato-protective effect of aqueous extract, especially at higher dose of 250mg./kg. body weight being most effective. Giwa et al. (2010) found the leaves to be antimicrobial even at low concentration; while, Jankiraman et al. (2012) found it to be anti-bacterial. Tanavade et al. (2012) proved *in vitro* anticancer activity of ethanolic extract. In 2013 Abdulazeez et al. studied effect anti-trypanosomal effect of whole plant extracts. Cold water extract was found to be most effective producing 90% inhibition. Iwara et al. (2014) demonstrated that the combined leaf extracts of *P.*

bicalyculata and *Moringa oleifera* were beneficial in management of hypoglycemia and hyperlipidemia.

Jankiraman et al. (2012) isolated bioactive compounds from the species. They found the presence of an alkene ((6Z)-nonen-1-ol) that is antimicrobial, an alkaloid((2H) pyrrole-2-carbonitrile, 5-amino-3,4-dihydro) which is antimicrobial and anti-inflammatory, aromatic alcohol (Cyclooctyl alcohol) found to be antimicrobial as well as antioxidant, and a cynocompound (Ethaneperoxoic acid,1-cyno-1(2-(2-phenyl-1,3-dioxolan-2-yl)ethyl) pentyl ester) showing antimicrobial and insecticidal properties.

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 ocular scale lens and camera lucida sketches were drawn. Classification of Radford et al. (1974) is followed for categorizing the vessel elements. Stomatal types described following Paliwal (1966a &b). 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).

RESULTS AND DISCUSSION:

Macromorphology

Erect, annual, much branched herb, 4 - 6 feet tall; stem angular, swollen at node, much branched, clothed with white hairs. Leaves simple, opposite, narrow-ovate, 1.8 - 8cm x 1.3 - 3.6 cm, rounded at base, entire, acute, hairy on both surfaces; petiole 0.5 - 1cm, veins prominent beneath. Flowers in lax, trichotomous cyme; bracts 2, unequal, 7 - 13mm, linear- lanceolate, pointed, pubescent, margin scarious and ciliate; bracteoles 4, linear 5 - 7 mm, pointed, pubescent, scarious with ciliate margin. Calyx 5, partite up to base, 5 - 7 mm; sepals linear, acute, pubescent, scarious with ciliate margin. Corolla pink, 2- lipped, 1.5 - 2cm, pubescent outside. Stamens 2, excluded, reddish; filaments 4mm long, pubescent. Ovary and style glabrous; stigma bifid. Capsule oblong, 10 - 12mm, pubescent, mucronate, seeds 4, orbicular 0.3 - 0.5 in dia., glandular pubescent, wrinkled, white.

Micromorphology

Root

Stele diarch. Pith absent (**Fig. 1**). Endodermis and pericycle indistinct. Cortex narrow. Secondary growth normal. Vessels scattered, solitary, paired or in uniseriate tiers. Vessel elements extremely small (Class A 84 - 165 x 12 - 18 μm), very short (Class B 175 - 177 x 21 - 24 μm), cylindrical, some tailed; tails short or long, present on one end or both ends, frequently tails absent. Perforation plates horizontal to slightly oblique (**Fig. 2**). Paratracheal parenchyma present. Rays uni and biseriate. Bundles of acicular fibres develop within phloem cells and bundles of tiny stone cells also develop within single phloem cell. Outer peripheral conjunctive tissue thick. Distinct growth zones seen. Each growth zone marked by ring of vessels. Amount of conjunctive tissue comparatively more. (**Fig. 3**)

Stem

Young stem 6 angled (with 6 ridges and furrows) (**Fig.4**). Epidermis single layered showing chlorophyllose bands with stomata and non-chlorophyllose bands, cells cutinised and cuticularised; cuticle warty. Stomata diacytic, bicyclic and tricyclic. Cystoliths solitary (**Fig.5**). Ridges completely filled with collenchyma. Entire cortex consists of palisade tissue. In later stage inner 1 - 2 layers of cortical cells become somewhat isodiametric. In furrows the palisade tissue almost abutting the endodermis. Endodermis distinct. Below the endodermis single layer of stone cells present against vascular patch. Vasculature present at angles in the form of 6 discrete bundles alternating with conjunctive tissue. In later stage of development, the layer below the endodermis in inter fascicular region and outer layer of phloem in fascicular region becomes meristematic, this cambium produces thick-walled conjunctive tissue to the inner side and scanty phloem to the outer side. Pith large, parenchymatous, enclosing small intercellular spaces. (**Fig.6**)

Secondary growth normal (**Fig. 7**). Secondary vasculature added to the fascicular region. Vessels solitary, paired or in uniseriate tiers. Vessel elements extremely small (Class A 138 - 175 x 42 μm), very short (Class B 252 - 348 x 27 - 36 μm), moderately short (Class C 366 - 540 x 21 - 36 μm), cylindrical or quadrangular, tailed. Tails short or long, present on one end or both ends. Perforation plates horizontal to slightly oblique (**Fig. 8**). Rays uniseriate. In interfascicular region large amount of conjunctive tissue produced. In later stage of growth few vessels are produced in conjunctive tissue. Phloem with patches of tiny stone cells. Endodermis distinct. Cells of cortex dividing tangentially to keeps pace with growing girth. (**Fig. 9**)

In swollen part of node amount of parenchyma (cortical as well as medullary) increases.

Node

Unilacunar single trace; trace in the form of shallow arc.

Petiole

Epidermis cutinised and cuticularised; cystoliths solitary. Hypodermis collenchymatous, 3-4 layered; on upper side interrupted by chlorenchyma at 1 - 2 places, laterally only chlorenchyma present; cells elongated to isodiametric. Stomata present in chlorenchymatous region. Ground tissue parenchymatous, enclosing small intercellular spaces. Vasculature in the form of central shallow crescent. Vascular trace single at very base and then divides to give 2 small lateral bundles. Vessels in series, separated by thin-walled polygonal cells. **(Fig. 10)**

Lamina

Amphistomatous; epidermal cells sinuous. Stomata diacytic, bicyclic or hemibicyclic. Cystoliths large, solitary, straight or geniculate **(Fig. 11a, 11b)**. Cystoliths horizontal throughout lamina from midrib to margin. **(Fig. 12)**

Mesophyll differentiated into palisade and spongy parenchyma; palisade single layered, cells compactly placed and densely filled with chloroplasts. Spongy parenchyma 3 - 4 layered; cells isodiametric to irregular, loosely placed, filled with chloroplasts. Vein-bundle embedded in spongy parenchyma, bundle sheath chlorenchymatous. **(Fig. 13a)**

Margin

Palisade continuous up to margin; cells shorter towards margin. Spongy parenchyma 3 - 4 layered, loosely placed. **(Fig. 13b)**

Midrib

Midrib ridged on upper side and grooved on lower side. Epidermis cutinised and cuticularised. Cystoliths solitary, solitary as well as geniculate. Hypodermis collenchymatous. Collenchyma completely filling the ridge and 1 - 2 layered on lower side. Mesophyll continuous in midrib in the form of 2 layered palisade. Ground tissue parenchymatous, cells thin walled enclosing small intercellular spaces. Vasculature in the form of central crescent. Vessels in series separated by thin-walled polygonal cells. **(Fig. 14a & b)**

Venation

Eucamptodromous **(Fig. 15a)**. Primary vein stout, straight, unbranched. Secondary veins moderate, curved, uniform, unbranched, 5 – 6 secondary veins along each side of midrib, angle of divergence 50° – 65° , acute moderate (angle of divergence of upper secondary decrease towards margin and lower secondary veins nearly uniform). Inter-secondary veins composite. Tertiary veins percurrent, simple, approximately at right angle to midvein, predominantly opposite. Vein order distinct, quaternary veins normal, random, highest vein order of leaf 4° , showing excurrent branching 3° , marginal ultimate venation looped; clusters of free veinlets present beyond loops. Veinlets simple

linear as well as branched once, simple linear more frequent. Areoles imperfect, quadrangular to irregular, random, medium as well as large (**Fig. 15b**).

Leaf constants:

A. Epidermis	Upper epidermis	Lower epidermis
Epidermal cell dimensions	$79.6 \pm 1.149 \times 36.6 \pm 0.537 \times 19 \pm 1.643 \mu\text{m}$	$69.7 \pm 1.324 \times 26.2 \pm 2.012 \times 16 \pm 1.643 \mu\text{m}$
Stomata dimensions	$31.2 \pm 0.412 \times 14.8 \pm 0.181 \mu\text{m}$	$38.5 \pm 0.394 \times 15.4 \pm 0.177 \mu\text{m}$
Stomatal frequency	$28.4/\text{mm}^2$	$68.6/\text{mm}^2$
Stomatal index	21.73 %	45.45 %
Cystolith dimensions	$20.61 \pm 5.441 \times 3.41 \pm 0.462 \mu\text{m}$	$25.86 \pm 6.023 \times 4.06 \pm 1.335 \mu\text{m}$

B. Leaf dimensions (in v.s. / t.s.)

Thickness of lamina – $117 \pm 1.643 \mu\text{m}$

Height of palisade tissue – $37 \pm 2.5099 \mu\text{m}$

Height of spongy tissue – $45 \pm 3.082 \mu\text{m}$

C. Palisade : Spongy – 1 : 1.3

D. PR - 9.6 (Average of palisade cells beneath each epidermal cell)

Trichomes

Simple as well as glandular on stem and leaf. Simple trichomes unicellular to 7celled, $0.13 \mu\text{m}$ to $0.74 \mu\text{m}$, walls rough, warty. Some of the unicellular trichomes are broad almost conical. (**Fig.16-20**)

Glandular trichomes: - Glands sessile as well as with short unicellular stalk and 4 – celled head. (**Fig.21&22**)

DISCUSSION:

In most of the respects anatomy of *Peristrophe paniculata* (Forssk.) Brummit. is in confirmation with general anatomical features of Acanthaceae (Metcalf and Chalk 1950). However, many features together characterize to the herb. These are – 1. Root diarch with uni as well as biseriate rays, paratracheal parenchyma and bundles of acicular fibres in phloem (such type of bundles are earlier reported in few species like *Adhatoda ventricosa* by Solereder 1908). 2. Stem cystoliths in epidermis, some epidermal cells with parallel cuticular ridges; stem ridges with chlorenchyma, outer layers being palisade like; rays uniseriate; vessels A, B and C type; conjunctive tissue large with vessels scattered singly, in patches or in series. 3. Stomata diacytic- mono, bi and hemibicyclic; cystoliths

solitary, straight or geniculate, distributed horizontally from midrib to margin. 4. Palisade single layered in lamina, 2-3 layered in midrib. 5. Venation eucamptodromous with marginal veinlets forming loops, cluster of free veinlets forming beyond loop. 5. Both simple and glandular trichomes present. 6. All details of leaf constants are always unique for any species, hence most important; since, mainly leaves are used as drug part of the plant. All these characters together help to identify the crude drug material.

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