Anatomy of Indoneesiella echioides (L.) Streem: A medicinal Herb

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ABSTRACT

Indoneesiella echioides (L.) Streem (syn. Andrographis echioides (L) Nees is a less known medicinal herb, commonly called ‘False Waterwillow’. To some extent information about its phytochemistry is available; however, no data is available regarding the anatomy which is very important from pharmacognostic point of view. In order to standardize the drug, detailed morphological and anatomical investigations were made. Anatomical diagnostic features of Indoneesiella echioides (L.) Streem are - class A, B, C and D type of vessel elements in root and stem, scattered patches of included phloem in secondary xylem of root, secondary phloem cells dividing to form patches of minute stone cells; rays unig, bi and multiseriate with some pit cells in root; young stem with chlorophyllose cortical tissue on dorsiventral side; single large chloroplast in collenchymatous cells of ridges; stomata diacytic monocyclic and hemicyclic. Cystoliths, raphides and styloides, long stalked glandular trichomes and various types of simple trichomes and glands present. Veneation euacamotromous with marginal veinlets forming loops and some free veinlets beyond loop. These characters can help to identify the drug material.

Key word: Acanthaceae, Anatomy (Root, Stem, Leaf, Leaf architecture), Indoneesiella echioides, Medicinal plant.

INTRODUCTION

India is one of the twelve megadiversity countries of the world having rich vegetation with a wide variety of plants having medicinal value (Kumar et al. 2007). To overcome the health problems the tribes of developing countries primarily rely on herbal medicines which are giving beneficial effect to humans. The herbs are constantly being screened for their biological and pharmacological activities such as anti-diabetic, antioxidant, antimicrobial and anticancer activities. Indoneesiella echioides (L.) Streem (V. Ranchimani) is a less known medicinal plant which is commonly known as ‘false water willow’, found throughout India and Sri Lanka. Bioactive compounds of plants generally like phenol, saponins, alkaloids, amino acids and flavonoids are possessing biological activities including anticancer, antifungal and anti-inflammatory activities (Nadkarni 1954). Plant used in fever and is supposed to be diuretic (Asolkar et al. 1992, Chopra et al. 1996). Diuretic activity of alcoholic extract has been confirmed (Khare 2007). Leaf juice boiled with coconut oil is applied on head to prevent falling and graying of hair (Kumar et al. 2007). Qadrie et al. 2009 found ethanolic extract exhibiting anti-bacterial activity. Premkumar et al. 2010 showed the herb to be showed strong antioxidant. Qadrie et al. (2011) demonstrated significant hepatoprotective effects of I. echioides extracts. The hydroalcoholic extract of whole plant parts of Andrographis echioides is reported to possess several bioactive compounds and the chemical constituents shows anti-inflammatory activities (Shen et al. 2013). Alagesaabooopathi (2014) reported that the whole plant extract is given for the treatment of fever and leaf paste is applied externally in Snake-bite. Locally the plant material was found to be sold in village market as substitute for Andrographis paniculata Nees as hepatoprotective.

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MATERIALS AND METHODS

Plant material was collected from Amravati Dist. Maharashtra. For the anatomical characterization freshly handcut sections of root, stem and leaf were observed. For vessel studies thin slices of old root and stem were macerated, stained with 1% aqueous safranin and measured by ocular scale lens. Camera Lucida sketches were 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.) and PR value were determined (Kokate et al. 1998).

RESULTS AND DISCUSSION

Annual, erect, hairy herb, up to 30 - 35 cm tall, branching from the base. Stem quadrangular, grooved, densely covered with dull white hairs; hairs 3 - 5 mm long. Leaves sessile, lanceolate, 8 - 9 cm x 2.5 - 3 cm long, entire with ciliate margin, obtuse, base rounded; veins prominent beneath. Flowers numerous, placed along the upper side of the slender, hairy rachis, in axillary racemes, shorter than leaves. Bract 0.1 - 0.2 cm long, lanceolate, pubescent; bracteole minute, hairy. Calyx 0.5 - 0.7 cm long, divided up to base; sepals linear, acute, ciliate, enlarged in fruit. Corolla white, densely pubescent outside, 1.2 - 1.5 cm long, 2-lipped; lips 6 - 8 mm long; upper lip obovate, oblong round; lower lip - 2 lobed, with purple spot; lobes oblong, obtuse, the middle lobe slightly larger than lateral ones. Stamens 2; filament 7 mm long, sparsely hairy; anthers brown, beared at base. Style pubescent. Capsule 1.5 - 2 cm long, elliptic-lanceolate, compressed, acute at both ends, 4 seeded, pubescent, half broad as long; seeds 0.3 - 0.5 cm in dia., oblong, compressed, rugose, glabrous.

Root - Two types of roots present - a. tap root b. adventitious roots

a. Root diarch. Pith absent (Fig. 1). Endodermis and pericycle not distinct. Cortex narrow. Secondary growth normal (Fig. 2). Vessels scattered, solitary or paired; Vessel elements extremely small (Class A 66 - 96 x 30 - 42 μm), very short (Class B 213 - 243 x 24 - 33 μm), moderately short (Class C 276 - 315 x 15 - 27 μm) and medium sized (Class D 369 - 483 x 15 - 18 μm); cylindrical, quadrangular and angled; tailed on one end or both ends; short and broad vessels without tails. Perforation plates simple, horizontal as well as slightly oblique (Fig. 3). Rays uni to biseriate, biseriate rays frequent. Patches of stone cells scattered in phloem. Zone of secondary phloem much broad. Cork cambium superficial. b. Roots polyarch (Fig. 4). Pith large; cells thick-walled. Cambium in the form of continuous ring producing patches of exarch and mesarch xylem. Secondary growth scanty. Cortex parenchymatous; cells thin-walled. (Fig. 5)

Stem - Young stem quadrangular; angles prominent, narrowly winged (Fig. 6). Epidermis showing non-chlorophyllose bands and chlorophyllose bands with stomata; stomata diacytic, monocyclic. (Fig. 7). Hypodermis collenchymatous, completely filling the wings, 2 - 3 layered elsewhere, each cell containing single large chloroplast. Cortex chlorenchymatous dorsiventrally; endodermis distinct; pericycle not distinct (Fig. 8). Vasculature in discrete patches; larger opposite the angles (Fig. 9). Cambium originating in pericystic region at an early stage. Secondary vascular elements added in fasicular region only; in interfasicular region secondary phloem added to the outer side and thick walled conjunctive tissue to the inner side. Later, secondary tissue is added only to the inner side. Rays 1 - 4 seriated. Vessels scattered, solitary, paired or uniseriate Vessel elements as in root. To keep pace with growing girth; epidermal cells as well as divide. Pith large parenchymatous; cells with raphides and styloids. (Fig. 10 & 11).

Single trace enters the leaf base (Fig. 12). Leaf Amphistomatous. Cells of upper epidermis bluntly angular, while those of lower epidermis shallowly sinuous and smaller. Stomata diacytic, hemibicyclic and bicyclic; subsidiary cells unequal, single epidermal cell encircling the small subsidiary cell in hemicyclic stomata (Fig. 13 & 14). Cystoliths numerous, solitary, both ends tapering or one blunt other tapering, straight or ‘S’ shaped and of various sizes. Orientation of cystoliths horizontal to vertical from midrib to margin. (Fig. 15) Mesophyll differentiated into palisade and spongy parenchyma. Palisade single layered. Spongy parenchyma 3 - 4 layered, cells irregular, loosely placed. Vein-bundle embedded in spongy tissue; bundle sheath non-chlorophyllose. (Fig. 16). Midrib ridged; ridge with deep furrow, completely filled with collenchymas; 1 - 2 layered collenchyma present on lower side. Vasculature in the form of central crescent. (Fig. 17)
PLATE-II
Venation eucamptodromous (Fig. 18a). Primary vein stout, straight, unbranched. Secondary veins moderate, recurved, unbranched, in 5-6 pairs, diverging at 35°-40° to midrib; angle of divergence more acute in upper secondary veins than lower; Intersecondary veins composite. Tertiary veins percurrent, recurved, approximately at right angles to midvein, predominantly opposite. Marginal veins looped; sometimes free veinlets beyond loops present. (Fig. 18b) Veinlets simple, linear as well as branched. Areoles large, irregular, imperfect, random.

Leaf constants:-
a. Upper epidermis - Epidermal cells - 57 ± 1.207 x 42.8 ± 2.661 x 21 ± 1.643 µm, Stomata size – 25.9 ± 0.370 x 13.5 ± 0.154 µm, Stomatal frequency – 98/mm², Stomatal index – 27.27 %, Cystoliths – 135. 3 ± 7.667 x 36 ± 1.584 µm
b. Lower epidermis –Epidermal cells – 56.6 ± 1.268 x 111.4 ± 0.596 x 15 ± 1.643 µm, Stomata size – 36.2 ± 0.623 x 18 ± 0.213 µm, Stomatal frequency – 105/mm², Stomatal index – 28.57 %, Cystoliths – 123.9 ± 4.917 x 33 ± 1.545 µm.
c. Leaf dimensions (in v.s. / t.s.): Palisade : Spongy- 1 : 1.4, PR - 12

Trichomes - Simple as well as glandular present on stem and leaf. Simple trichomes: – unicellular to multicellular, uniseriate, walls smooth as well as warty. Warty trichomes more conicaland shorter than smooth walled trichomes, 0.14 µm to 0.83 µm. (Fig. 19 - 22), Glandular trichomes stalked- a. stalk long, 5 - 6 celled, 0.36 µm to 1.42 µm, head 4 – 6 celled, b. stalk unicellular, head 4 celled (Fig. 23 - 26). In most of the respects anatomy of Indoneesiella echioides (L.) Streem is in confirmation with general anatomical features of Acanthaceae. However, many features characterize the herb. These are – 1. Presence of class A, B, C and D type of vessel elements in root and stem, 2. secondary phloem cells dividing to form patches of minute stone cells, 3. Rays uni., bi., and multiseriate , 4. Young stem with chlorophyllose cortical tissue present on dorsiventral side, 5. Single large chloroplast in collenchymatous cells of ridges, 6. Stomata diacytic monocyclic and hemibicyclic and bicyclic, 7. Cystoliths, raphides and styloides present, 8. Long stalked glandular trichomes and various types of simple trichomes and glands present, 10. Venation eucamptodromous with marginal veinlets forming loops and some free veinlets beyond loop. Hemibicyclic and bicyclic stomata are reported for the first time in Indoneesiella echioides. These characters can help in identity of the drug material.

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