



ISSN No: 0975-7384
CODEN(USA): JCPRC5

J. Chem. Pharm. Res., 2011, 3(2):738-746

Anatomical studies of *Indigofera aspalathoides* Vahl (Fabaceae)

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ABSTRACT

The present investigation has been carried out to determine the anatomical features of whole plant of Indigofera aspalathoides, is an important medicinal plant used in the traditional systems of medicine. This plant is used for the treatment of different diseases and ailments of human beings. The plant is popularly known as sivanar vembu in Tamil. In the traditional medicinal system, the leaves, flowers and tender shoot are said to be cooling and demulcent; they are used in the form of decoction for leprosy and Cancerous affections. The leaves are also applied to abscesses. This plant shows midrib it possesses a small circular collateral vascular bundle. The mesophyll is differentiated in to adaxial zone of palisade cells, median level of circular cells and adaxial zone of spongy parenchyma cells. The lamina possesses reticulate venation system with wide, irregularly shaped vein-islets and well defined vein terminations. Calcium Oxalate Crystals are fairly abundant in the leaf mesophyll, cortical cells of the stem and phloem parenchyma of the root.

Keywords: Anatomy, sivanar vembu, *Indigofera aspalathoides*, Leaf, Root, Stem.

INTRODUCTION

In this work, an anatomical study of the complete plant of *Indigofera aspalathoides* was studied in details. The study was aimed to provide valuable and reliable illustrated anatomical descriptions of *Indigofera aspalathoides*. Plant anatomy deals with the structure, contents and development of cells and tissues. It is of primary importance for all aspects of research in plant sciences such as morphogenesis, physiology, ecology, taxonomy, evolution, genetics,

reproduction etc [6]. The systematic anatomy is mainly aimed towards relating structure particularly of vegetative organs to taxonomic classification of the plants in which the characters are exemplified. Application of systematic anatomy can also be extended to detection of adulterants and substitutes [9]. *Indigofera* is a large genus of about 700 species of flowering plants belonging to the family Leguminosae (Fabaceae). It is widely distributed in tropical and subtropical regions. In the most recent treatment 81 species are distributed in China [7], of which three have simple or unifoliate leaves. For Southeast Asia there are totally eight species with simple or unifoliate leaves recorded, namely *I. brunoniana* Grah.ex.Wall, *I. caloneura* Kurz, *I. cordifolia*, *I.linifolia* (L.f.) Retz, *I.maymyoensis*, *I.minbuensis*, *I.nummularifolia* (L.) Livera ex Alston, and *I.squalida* [5]. *Indigofera* species have great promise as forages for ruminants. Their high protein levels and ability to tolerate drought, floods and salinity make them agronomically desirable [14]. *Indigofera* in Greek means indigo dye which is famous for the natural blue colors obtained from the leaflets and branches of this herb. The fruits are oval shaped and elongated, 4-angled or flattened and often curved with many seeds [2]. The species are mostly shrubs, though some are herbaceous and a few can become small trees up to 5-6 feet in height. The dye which is among the most widely used natural dye in the world is obtained mainly from the leaves through a process of fermentation [4]. *Indigofera* species possess wide range of uses ranging from several economical and ecological purposes, feed for livestock, ornamental, medicinal plant recipes as well as dye for commercial purposes [3]. The stem of *Indigofera tinctoria* is chewed to cure cough and decoction of leaves is used to cure chest pains, epilepsy, nervous disorders, asthma, bronchitis, fever and complaints of stomach, liver, kidney and spleen- especially in Cameroon [15].

The present study has been carried out to standardize the anatomical features of leaf, stem and root analysis to serve as a possible tool for proper identification of *Indigofera aspalathoides*. The literature survey revealed that no anatomical studies were carried out on this plant.

EXPERIMENTAL SECTION

The plant was collected from Salem District of Tamil Nadu during the month of September, 2009. The required samples of different organs were cut and removed from the plant and fixed in FAA (Formaline-5ml, acetic acid 5ml and 70%ethyl alcohol 90ml) for 24 hours. After fixation they were washed thoroughly in distilled water, dehydrated, embedded in paraffin wax after infiltration and sectioned using rotary microtome to the thickness of 10 to 12 μ m [13]. Sections were stained with toluidine blue [11]. The sections were stained with safranin and mounted according to the methods described by Johansen 1940. All the photomicrographs were taken using Nikon lab photo 2 microscopic units.

RESULTS AND DISCUSSION

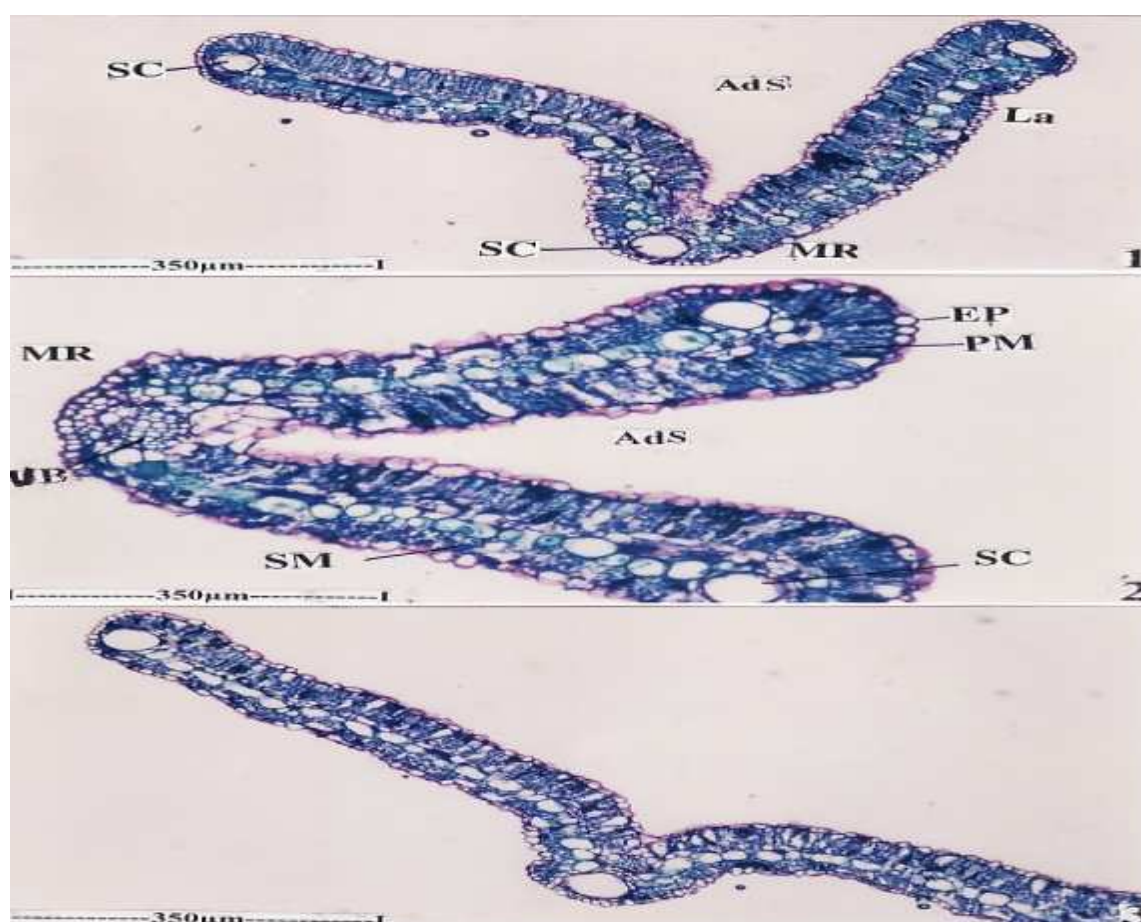
Habit

The plant *Indigofera aspalathoides* is a sub shrub growing up to the height of 75 cm. The leaves and tender shoots are silvery pubescent. The leaves are digitately 3 or 5 foliolate. The leaflets are linear, 4×0.5 mm, membranous, petiole absent, flowers are axillary and solitary. The corolla is red. The fruits are cylindrical, straight, 1.5 cm long.

Leaflets

The leaflet folded adaxially with the lamina being vertical and the other being laterally deflexed (Plate-I,1). In some of the leaflets the two lateral lamina will be folded vertically with the lamina standing vertically parallel to each other (Plate-I,2), in other cases, the two lamina –wings will be flat without folding (Plate-I,3). Another unique feature of the leaflet is the presence of wide, circular, canals in the presence of midrib and leaf margins. The distribution of the canals is also variable. They may be located both in the midrib and at marginal portions of both lamina (Plate-I, 1), or the canals may be present only at the leaf margins and not in the midrib (Plate-I, 2). The canals are empty in the sections. Epithelial cells are also lacking. The canals are 50 µm in diameter.

PLATE I- *Indigofera aspalthoides*



**Anatomy of the Leaf: 1.TS of adaxially folded Leaflet,
2.Leaflet folded in V-shape,
3.TS of leaflet with flattened lamina**

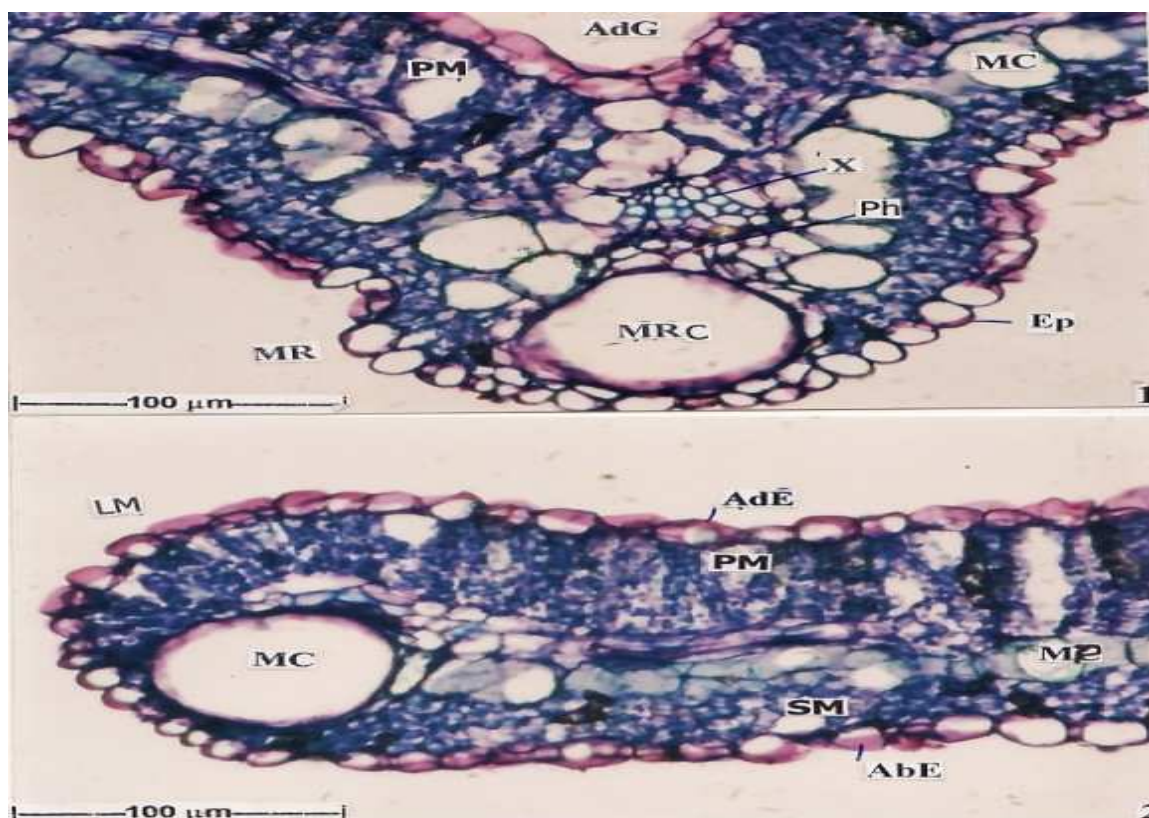
Lamina

The lamina is distinctly bifacial. It consists of square or rectangular, wide, thin walled epidermal cells which 15-20 µm wide. The mesophyll is differentiated in to adaxial zone of palisade cells, median level of circular cells and adaxial zone of spongy parenchyma cells

(Plate-I).The palisade cells are in two rows; they are narrow and cylindrical and compactly arranged. The median circular cells in one two rows. The spongy parenchyma cells are three layered; they are lobed and loosely arranged. The lamina is 250 μm thick.

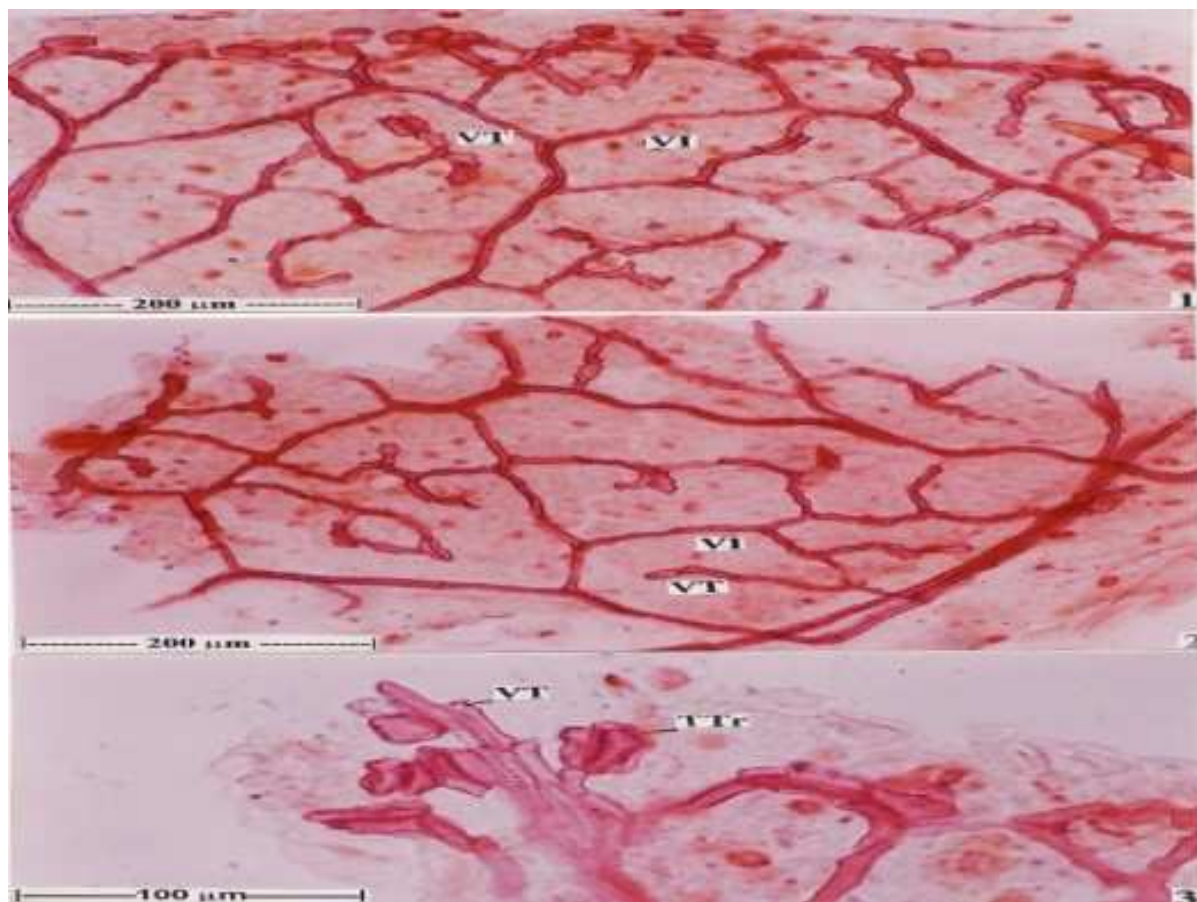
Midrib

The midrib possesses a small circular collateral vascular bundle. In a midrib there is no canal, the vascular bundle is situated in median part. The vascular bundle consists of three or four shoot, parallel lines of xylem elements and small group of phloem elements. The abaxial epidermis consists of prominent papillae cells (Plate-II).



Midrib:1.TS of leaflets through the midrib with canal,
2.TS of marginal part of the leaflet with marginal canal.

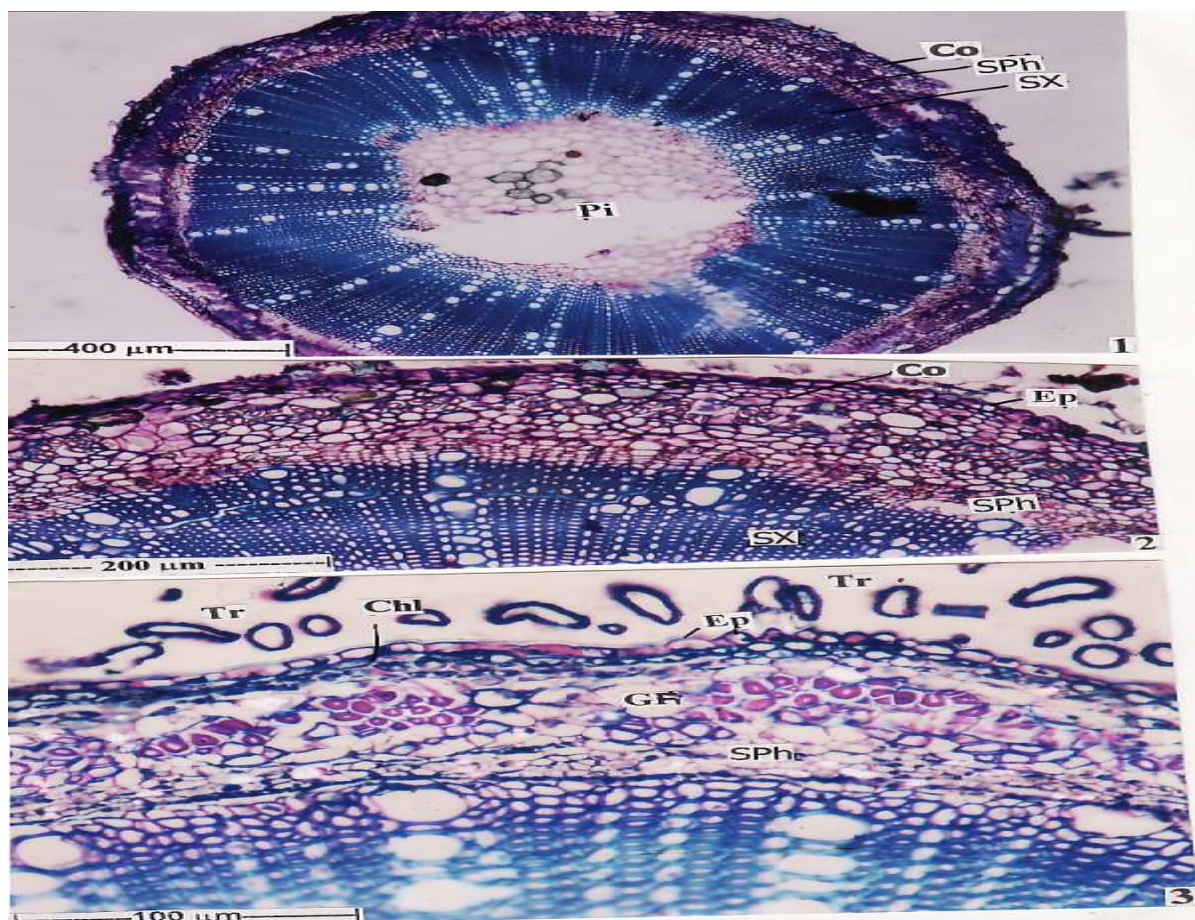
Venation: The lamina possesses reticulate venation system with wide, irregularly shaped vein-islets and well defined vein terminations. The terminations are either simple or forked terminally. The vein terminations possess cylindrical cluster of tracheids. These tracheids are short and cylindrical with pitted thickenings on their walls (Plate-III, 3). The tracheids are 30 μm long and 10 μm wide.



**Anatomy of venation pattern:1, 2.Lamina cleared to show the venation pattern,
3.Vein Terminals with tracheids**

Stem

The thickness of the stem is 900 µm and consists of intact epidermis wide heterogeneous cortex, secondary phloem, secondary xylem and wide pith. Epidermis consists of small spindle shaped thick walled cells. The inner epidermis consist of one or two layers of chlorenchyma cells followed by a few layers of parenchyma cells (Plate-IV, 2) next to the parenchyma zone occurs a discontinuous cylinder of gelatinous fibers of 3 or 4 cells wide. The vascular bundle comprises outer narrow, Continuous zone of secondary phloem unshathing thick secondary xylem cylinder. Secondary phloem elements are arranged in short thin compact rows, secondary xylem includes major portion of thick walled liquefied xylem fibers. Vessels occur in thin uniseriate radial rows with wide gaps in between the rows. The vessels are narrow, thin walled, circular in outline epidermal trichomes are abundant on the surface (Plate-IV, 2 and 3).

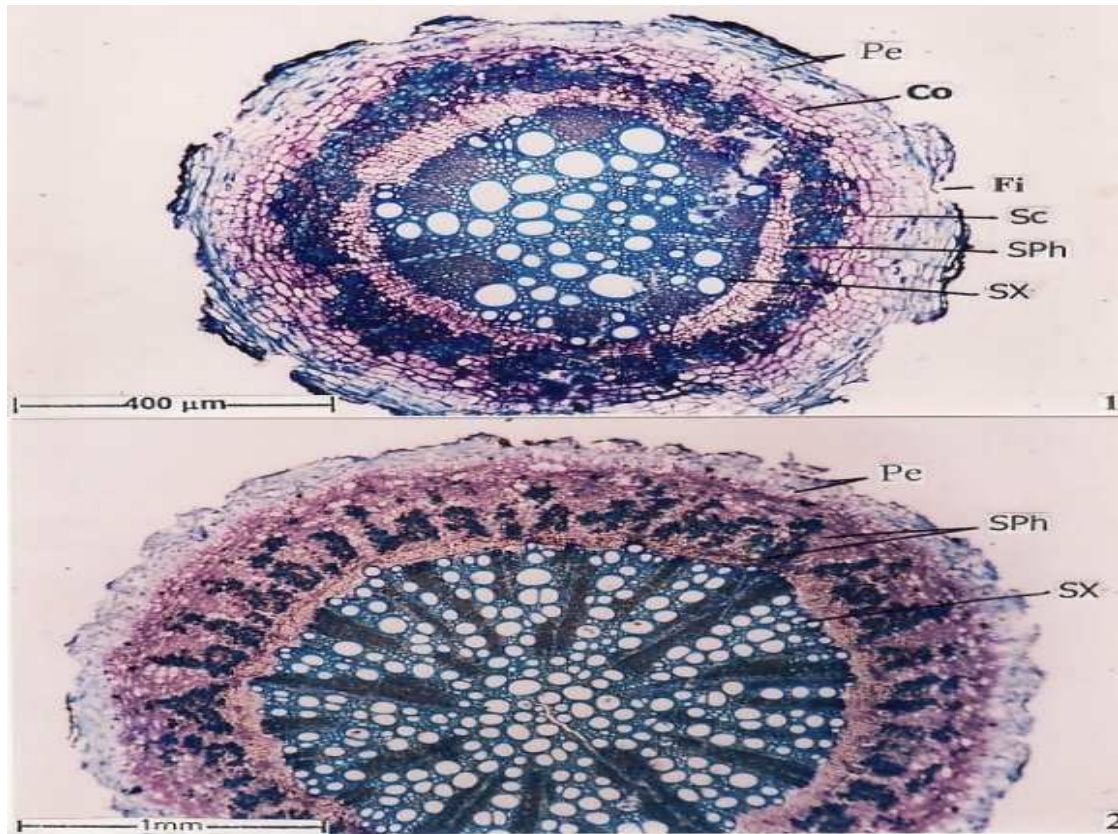


Anatomy of Stem:1. TS of stem-Entire view,
2, 3.Cortex,Secondary phloem and secondary xylem

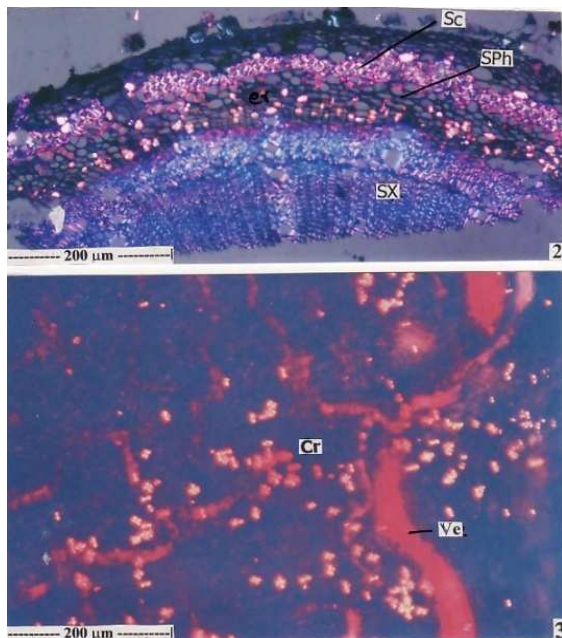
Root

Both young and old roots were studied .Young root is 800 μm thick (Plate-V,1). It consists of fairly wide, superficial, Pheriderm with wide shallow fissures. Periderm is followed by parenchymatous & thick continuous sclerenchyma cells. Secondary phloem is wide and continuous. Secondary xylem is dense and compact, compressing wide, circular thick walled diffuse mass of vessels and sclerenchymous ground tissue. The root measures 2-5 mm thick. It has wider and deeply fissured. Periderm and discontinuous, radial segments of fibers with cortical region.

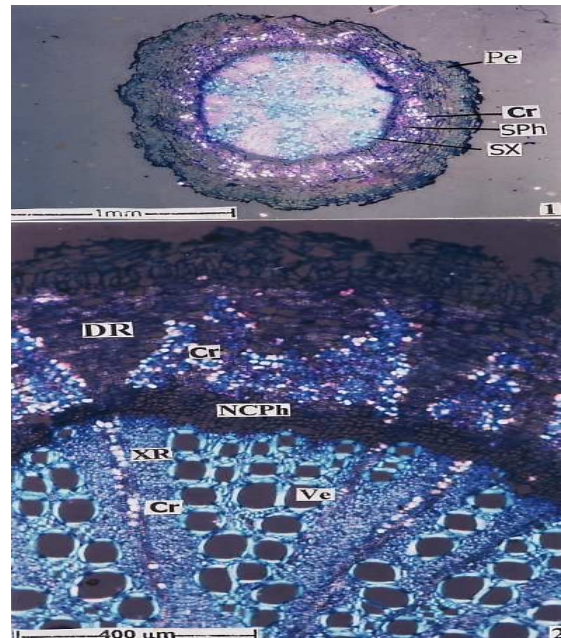
The xylem cylinder is 1.5 mm thick and consists of about nine, fan- shaped radial bands of vessels and fibers and wide dilated rays. The radial levels xylems are further cleaved into smaller units by dilated rays (Plate-V, 2); within each xylem bands occur wide circular thick walled radial chain of vessels. The fibers ensheating the vessels are wider and lignified. Those that are along the lateral part of the xylem bands are small, gelatinous fibers. The vessels are 20-60 μm wide.



Anatomy of Root: 1.TS of Thin Root, 2. TS of Thick Root



Crystals: 1.T.S. of stem

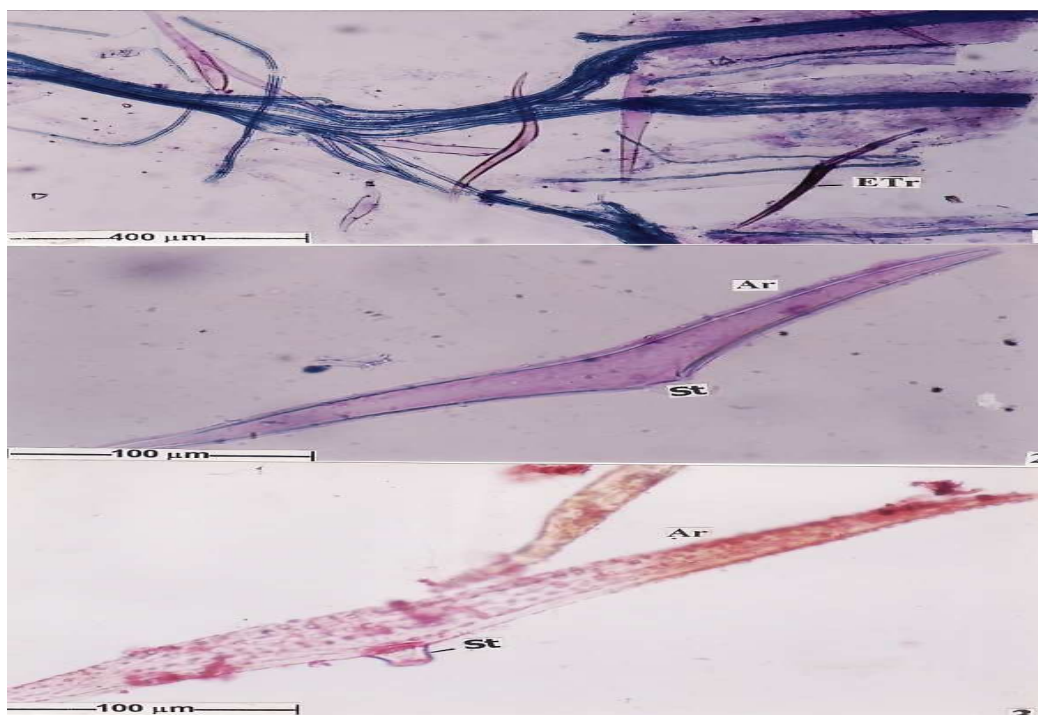


Crystals: Root showing crystals in the outer phloem and cortex

Crystals: Calcium oxalate crystals are fairly abundant in the leaf mesophyll (Plate-VI, 2), cortical cells of the stem (Plate-VI, 1), and phloem parenchyma of the root (Plate-VII, 1 and 2), the crystals are prismatic type. They are diffuse in distribution. In the stem and root, the crystals also occur in the ray parenchyma cells (Plate-VII, 2).

Powder microscopic result

The leaf powder consists of abundance of characteristic epidermal trichomes (Plate-VIII, 1, 2 and 3). The trichomes are 'T' shaped. They have a short, unicellular central stalk with two laterals and opposite arms, spreading parallel to the surface. The walls are thick with minute cuticular spires. The trichome is 350 μm long and 30 μm thick in the middle.



Indian systems of medicine such as Ayurveda and Siddha uses majority of the crude drugs that are of plant origin. It is necessary that standards have to be laid down to control and check the identity of the plant and ascertain its quality before use. A detailed pharmacognostic evaluation therefore is highly essential prerequisite (Ramana.P,2007). According to World Health Organization (WHO) the macroscopic and microscopic description of a medicinal plant is the first step towards establishing its identity and purity and should be carried out before any tests are undertaken [1]. Anatomical features of *Indigofera aspalathoides* were investigated it shows square or rectangular, wide, thin walled epidermal cells which 15-20 μm wide. [10] studied eight *indigofera* species of epidermal cells it shown single layer rectangular and sinuous in *I.pulchra*, *I.senegalensis* and *I.stenophylla*. Pentagonal cells in *I.paniculata*, *I.terminalis*. Hexagonal in *I.tinctotria*. This species studies shows some specific features of interest. The midrib possesses a small circular collateral vascular bundle. The mesophyll is differentiated in to adaxial zone of palisade cells, median level of circular cells and adaxial zone of spongy parenchyma cells. The lamina possesses reticulate venation system with wide, irregularly shaped vein-islets and well defined vein terminations. Calcium Oxalate Crystals are fairly abundant in the leaf mesophyll

(Plate-VI), cortical cells of the stem and phloem parenchyma of the root. The T shaped trichomes are present in leaf powder. *Indigofera aspalathoides* widely used in traditional medicines has tremendous medicinal potential owing to its biological functions. However, there are no detailed pharmacognostic studies on this plant to help in the proper identification. Hence the present study was undertaken with the aim to provide key diagnostic tools of identification.

Acknowledgements

The authors are grateful to thank Bharath University, Chennai, Tamilnadu for their support to carry out this work.

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