

A STUDY ON THE ANATOMICAL CHARACTERISTICS OF *ACANTHUS ILLICIFOLIUS* LINN.P. Santhiavalli¹ and G. Jayanthi^{2*}¹Research and Development Centre, Bharathiar University, Coimbatore.²PG and Research Department of Botany, Vellalar College for Women (Autonomous), Erode - 638012, Tamilnadu.**Corresponding Author: Dr. G. Jayanthi**

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ABSTRACT

Acanthus illicifolius is a mangrove medicinal plant. In this study, the aim was to investigate the anatomical characteristics of this medicinally important plant species. As a result of the study, it was discovered that the vascular stem of the midrib is multistranded. The unique type of glandular trichome. The stomata are diacytic and the venation is densely reticulate. The stem consists of intact epidermis, wide cortex, thin hallow vascular cylinder and wide pith.

KEY WORDS: Anatomy, medicinal plant, *Acanthus illicifolius*, Acanthaceae, mangroves.**INTRODUCTION**

Acanthus illicifolius Linn. (Acanthaceae) is a spiny herb of the mangrove that is widely distributed in the coastal areas and it occupy only 5% of the total forest. The common name of the plant is holy leaved *Acanthus illicifolius*. In tamil it is called as Attumulli and Kaludaimulli. These are the most hostile environment with fluctuating tial and saline regime and limited plant species can survive under such condition. These plants are most valuable resources and provide economical and ecological benefits to the coasted people.

It has typical spinose margins on its evergreen leaves and stipular spines at stem nodes. It is a gregarious, sparingly branched evergreen shrub, 0.6 – 1.5 meter in height. The chemical constituents (salts, organic acids, carbohydrates, hydrocarbons, triterpens, alkaloids, flavonoids and tannins)^[1-3].

The plant is used against rheumatism, paralysis, asthma, skin diseases, boils and wounds^[4,5&6,7]. The present study describe the anatomical characteristics of *Acanthus illicifolius*.

MATERIALS AND METHODS

The aerial parts of *A. illicifolius* were collected from the coastal areas of Thirumalairayan Pattinam Panchayathu, Karaikal District, Puducherry State. The plant material was identified and authenticated taxonomically with the help of the local floras^[8,9] and Botanical survey of India, Southern Regional Centre, Coimbatore, Tamil Nadu. The herbarium specimen number in BSI is No.BSI/SRC/5/23/2016/Tech/.632.

Pharmacognostical studies

Fresh aerial parts of the study plant were taken for morphological and histological studies. For the microscopical studies, leaf and stem were prepared and stained as per standard procedures^[10,11].

Morphological assessment done by physical observation and measurement of physiognomic features of their fresh leaf, stem and flower specimens. For the anatomical studies, the fresh samples were fixed and cross sections were obtained using a microtome^[12]. The sections were independently stained with heamatoxyline and safranin. A light microscope was used to view the slides and adjusted to finest resolution (40X). Microphotographs were obtained using a Nikkon digital camera focused through the microscope eyepiece.

RESULTS**Botanical Description**

It is an erect herb whose stems are upto 1.5m which grow in clumps, little divided and are glabrous (Plate-1). Leaves are shortly petioled and are oblong or elliptical whose base is usually spinous, toothed and commonly solitary. The plant produces a cluster of flowers. Flowering and fruiting occurs almost throughout the year, bract and bracteoles present which has 4 sepals, outer 2 are elliptic rounded, inner 2 are broadly lanceolate and subacute. The petals are 5 in number, blue coloured, united, 2 lipped Corolla tube short and pubescent from within which contains 4 stamens, didynamous, filaments stout, anthers 1 – lobed, carpels 2, ovary 2 chambered having 2- ovules in chamber. The

flowers that develop into pods when the pods ripe, they explode to propel the seeds up to 2m away.

Microscopic studies

Anatomical studies made on *Acanthus ilicifolius* showed dissimilar characteristics of other species of the Acanthaceae to which this species belongs Metcalfe and Chalk 1957.

Anatomy of the leaf

Midrib: The midrib in cross sectional view appear flat on the adaxial side and unequally two lobed and thick on the abaxial side (Plate 2-a). It is 1mm thick and 1.2 mm wide. The lobes are 300 – 500 μm thick. The vascular system of the midrib is multistranded. There are three, independent circular vascular bundles of unequal size (Plate 2-b) of the three bundles two smaller bundles are adaxial and lateral in position, the third larger bundle is abaxial and median (Plate 2-b). All three bundles differ in their vascular architecture.

The adaxial lateral smaller bundle consists of a bowl shaped cluster of narrow angular thick walled xylem elements. On the upper part of the bundle occurs a thick mass of sclerenchyma cells which extends to the lower side forming an arc. Phloem is located in small thin layer of sieve elements on the lower end of the xylem strand (Plate 2-c).

The adaxial lateral larger bundle is elliptical in outline. It includes two small groups of circular thick walled vessels. The vessels are located lateral to each other. Phloem strands occur on the lower end of each vascular bundle. A thick sclerenchyma sheath encloses the entire vascular bundle (Plate 2-d). The third bundle which is abaxial and median in position is the largest bundle; it is circular in outline (Plate 2-e).

It includes a circle of vessels with wide gaps in between the vessels. The vessels are highly thick walled, circular and fairly wide. Phloem occurs on the outer part of each xylem strand. (Plate 2-e) Sclerenchymatous bundle sheath occurs encircling the vascular bundle.

Lamina: The lamina is dorsiventral with smooth abaxial side and adaxial side. On the adaxial side of the lamina, there are deep, narrow grooves inside which occurs a simple, unique type of glandular trichome (Plate 2-f and g). The lamina is 370 μm thick. The adaxial epidermal cells of the lamina are thin, tabular in shape and have thin cuticle. The abaxial epidermis is further thin with small squarish cells. The mesophyll tissues are differentiated into adaxial band of two layer of columnar palisade cells and abaxial zone of small spherical spongy parenchyma cells which form reticulate partitions for air – chambers (Plate 2-f).

Leaf-Margin (Plate 2-g): The marginal part of the lamina is thick, semicircular and measures 350 μm in thickness. These are a thick circular bundle of fibres with

small, less prominent vascular elements in the centre. The cells inner of the epidermis are angular, thick walled and compact “Fig. 3.2”.

Glandular Trichome (Plate 3-a and b): On the adaxial epidermis of the lamina, these are deep, vertical grooves inside which occurs a short gland. There is large epidermal cell at the bottom of the groove, on which is seated the gland (Plate 3-b).

The gland is rectangular, short with thick walls and dense cytoplasm. The body of the gland is 30 μm thick and 30 μm in height. One or two circles of epidermal cells occur around the groove. The gland appears to consist of four cells forming a circular outline (Plate 3-c and d).

Epidermal cells and Stomatal type

In paradermal sections of the lamina the epidermis appear in surface view. The epidermal cells are polygonal, thick walled with straight anticlinal walls. Stomata are densely distributed (Plate 3-e and f). They are random in orientation. The stomata are diacytic type. These are two subsidiary cells of unequal or equal size located on the polar ends of the guard cells; the common walls of the two subsidiary cells lies at right angles to the guard cells (Plate 3-g). The guard cells are broadly elliptical measuring 15 x 20 μm in size.

Venation Pattern of the lamina (Plate 4-a & b)

The venation of the lamina is densely reticulate. The major veins are thick and straight. The lateral veins become gradually thin ultimately forming wide vein-islets. The vein islets are mostly elongated and have thick vein-boundaries. The vein-terminations are profusely branched forming dendroid outline. The vein-terminations are thick and straight (Plate 4-b).

Stem

The stem is circular with smooth-even outline as seen in cross-sectional view (Plate 4-c). The stem consists of intact epidermis, wide cortex, thin hollow vascular cylinder and wide pith. Epidermal layer consists of small, squarish, thick walled cells with darkly stained inclusions. The cortex is 500 μm thick. It consists, angular, thin walled, compact parenchyma cells; many of the cells have dark cell inclusions (Plate 4-d). The vascular cylinder includes outer layer of phloem and inner xylem. The cylinder is 450 μm thick (Plate 4-d).

The outer zone is the secondary phloem and inner zone is the secondary xylem. The secondary xylem is wavy cylinder of unequal thickness. It consists of solitary and radial multiples two or three vessels which are oblong elliptical, angular or circular in outline. They have very thick and lignified secondary walls. The xylem fibers are in regular compact radial files; they have very thick lignified walls and narrow lumen xylem rays are fairly distinct. They are one - cell thick and straight. The ray

cells are radially oblong and thick walled (Plate 4-d and e).

Secondary phloem is composed of several sieve-elements which diffuse in distribution; the cells are

angular thick walled and compact. Each sieve-tube member is associated with a prominent companion cell. Isolated brachysclereids are seen sparsely distributed in the phloem (Plate 4-f).

Legend for the figures

Plate 1-a: Morphology of *Acanthus ilicifolius*.

b: An enlarged Inflorescence.

c: Fruiting twig of *Acanthus ilicifolius*.

Plate 2-a : T.S. of leaf through midrib showing multistranded vascular bundles.

b. Vascular bundles of the midrib-enlarged.

(Ads – Adaxialside; La-Lamina; Lo – Lobe; M.R. – Midrib; Ph – Phloem; VB- Vascular Bundles; X – xylem)

c. Adaxial lateral, small bundle

d. Adaxial lateral larger vascular bundle.

e. Abaxial medium largest vascular bundle

(Ph – phloem; Sc – sclerenchyma; X-xylem)

f. Ts of Lamina.

g. Ts of marginal part of the lamina.

(AbE- Abaxial Epidermis; AdE – Adaxial Epidermis; Gr- Groove ; GTr – Glandular Trichome; LM – Leaf Margin; LV – Lateral Vein; MB – Marginal Bundle; MT-Mesophyl Tissue; PM – Palisade Mesophyll; SM – Spongy mesophyll)

Plate 3-a. Ts of lamina showing epidermal groove and glandular trichome.

b. Glandular trichome – enlarge.

(BC – Body cell; Ep – Epidermis; Gr – Groove; Est – Epidermal stalk cell; GTr – Glandular Trichome; PM-

Palisade Mesophyll)

c. Paradermal section of the adaxial epidermis.

d. Glandular head as in surface view

(AW – Anticlinal wall; EC – Epidermal Cell; GTr – Glandular Trichome; RC – Rosette cells).

e. Paradermal section of the abaxial epidermis.

f. Stomata on the abaxial epidermis.

g. A diacytic stomata – enlarged.

(EC: Epidermal Cells; GC – Guard Cells; GTr- Glandular Trichome; SC – Subsidiary Cells; SP – Stomatal Pore; St – Stomata)

Plate 4-a. Venation system of the lamina

b.. Vein – islet and vein terminations

(VI – Vein Islets; VT. Vein – Terminations)

c. Ts of stem – A portion

d. Ts of stem showing epidermis, cortex and vascular cylinder.

(Co – Cortex; Ep-Epidermis; Pi – Pith; Ph – Phloem; SX – Secondary xylem, VC – Vascular cylinder)

e. Secondary phloem and secondary xylem elements

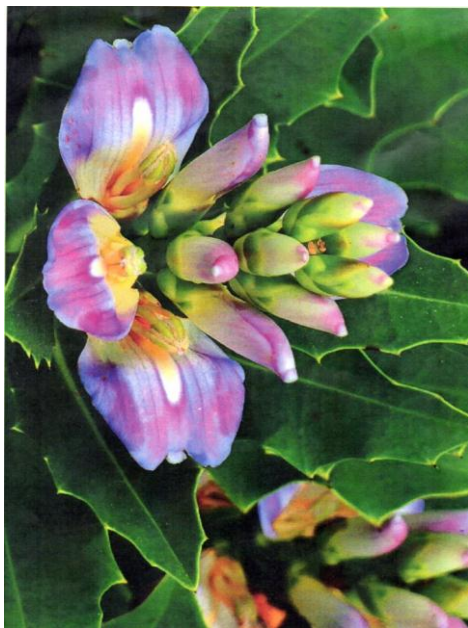
f. Secondary xylem elements.

(CC – Companion cells; Scl- Sclereides; Sph – Secondary phloem; St – stomata; Sx – Secondary xylem; Ve – Vessels; XF – Xylem Fibres; XR – Xylem Ray; Pi – Pith)

PLATE – 1



a. Morphology of *Acanthus ilicifolius*

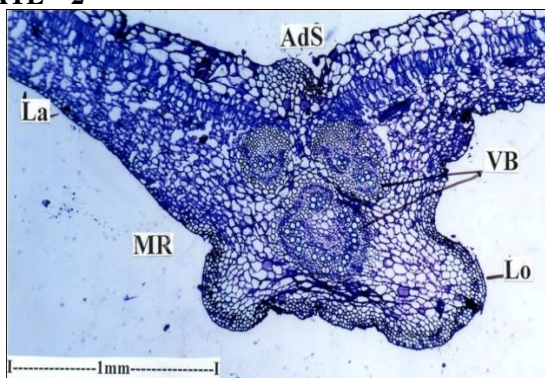


b. An Enlarged Inflorescence

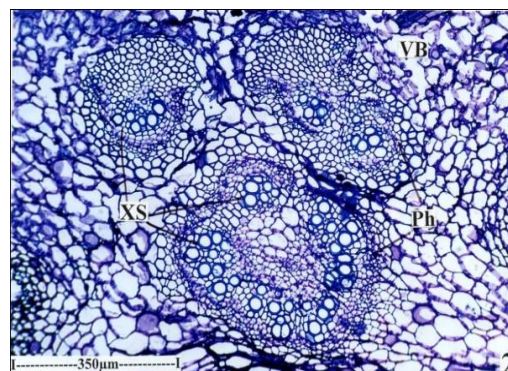


c. Fruiting twig

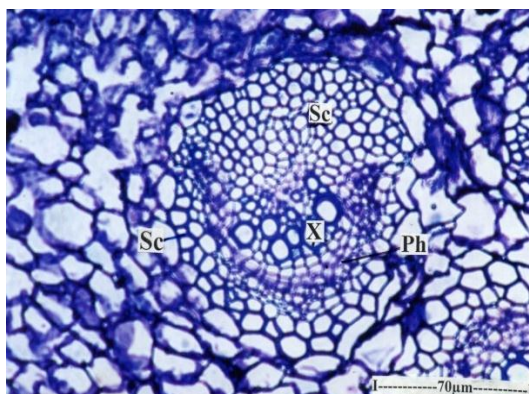
PLATE – 2



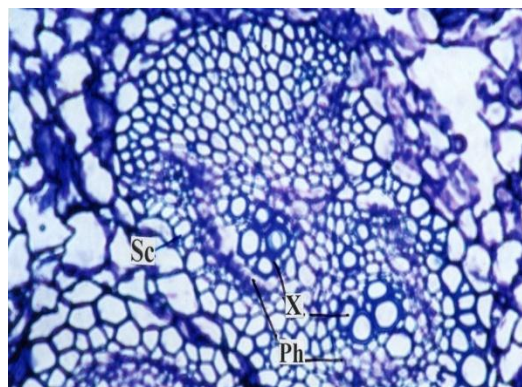
a. T.S.of leaf through midrib showing multistranded vascular bundles



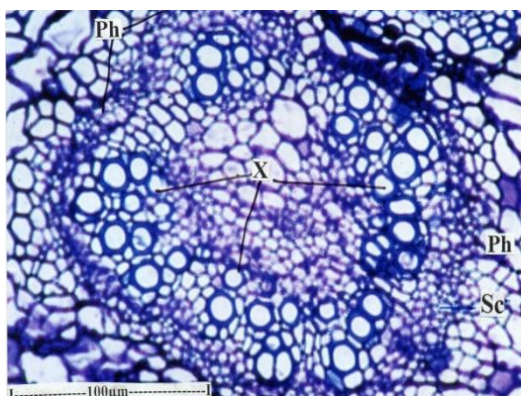
b. Vascular bundles of the midrib-enlarged



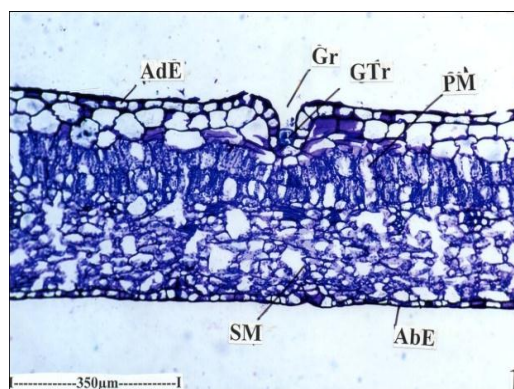
c. Adaxial lateral, small bundle



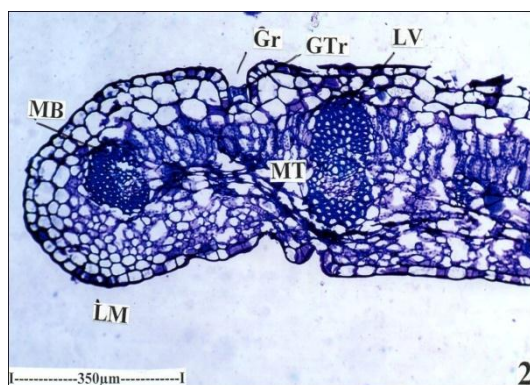
d. Adaxial lateral vascular bundle



e. Adaxial medium large vascular bundle

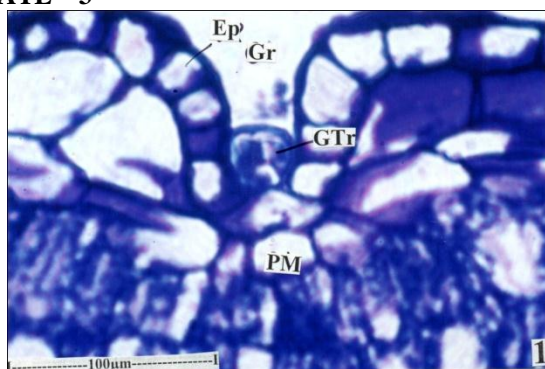


f. Ts of Lamina

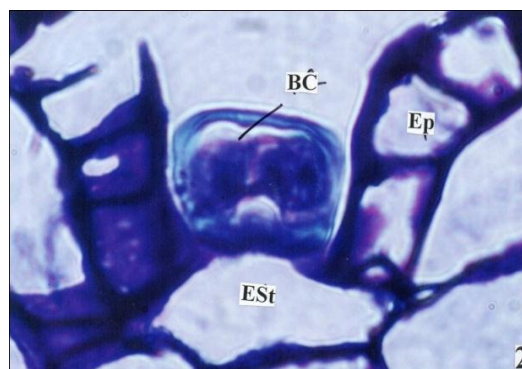


g. Ts of marginal part of the lamina

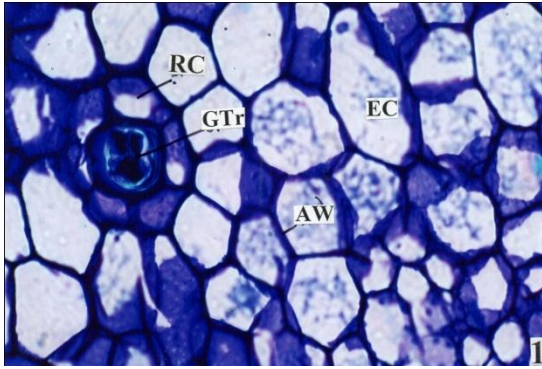
PLATE - 3



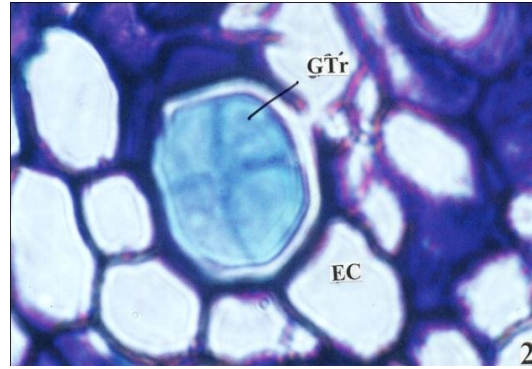
a. Ts of lamina showing epidermal groove and glandular trichome



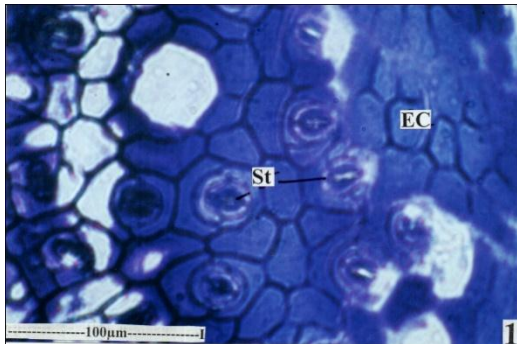
b. Glandular trichome-enlarge



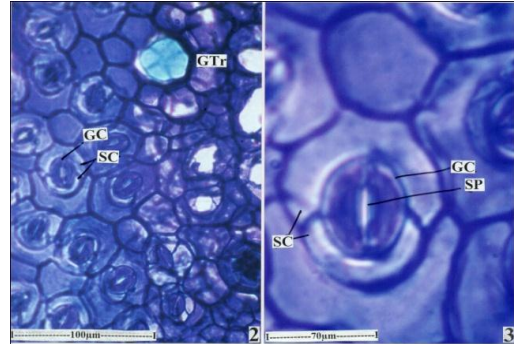
c. Paradermal section of the adaxial epidermis



d. Glandular head as in surface view

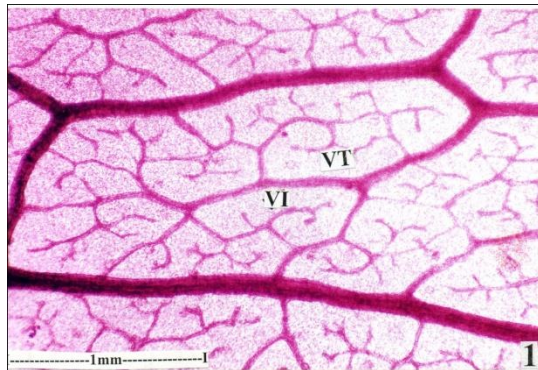


e. Paradermal section of the abaxial epidermis

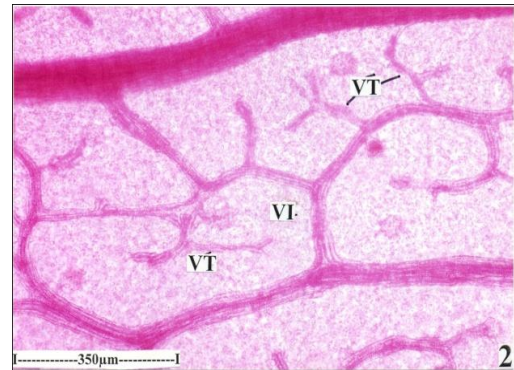


f. Stomata on the abaxial epidermis

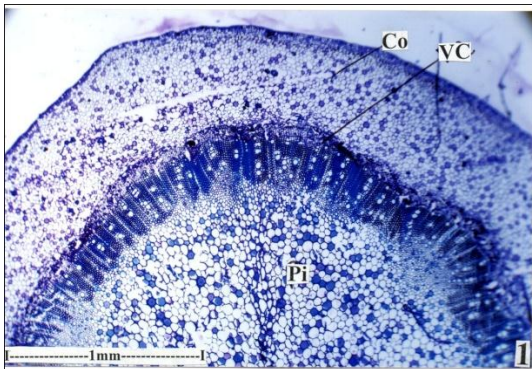
PLATE – 4



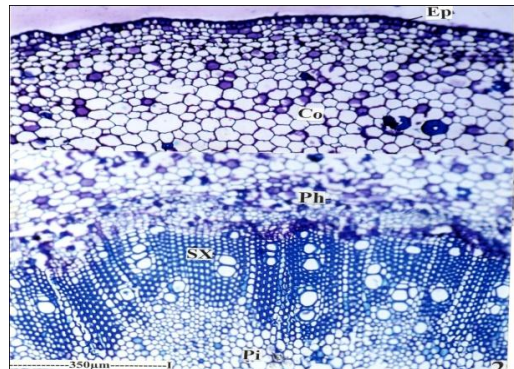
a. Venation system of the lamina



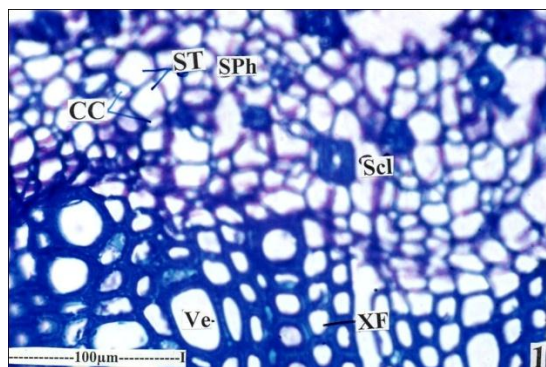
b. Vein – islet and vein terminations



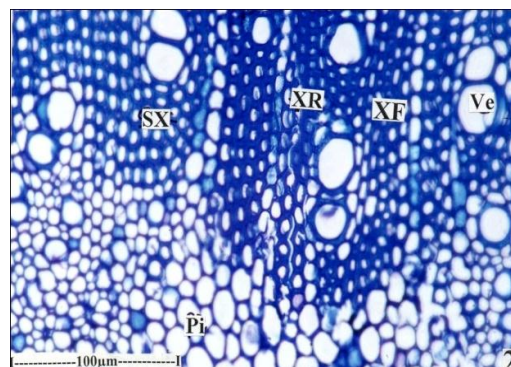
c. Ts of stem- A portion cortex and vascular cylinder



d. Ts of stem showing epidermis,



e. Secondary phloem and secondary xylem elements



f. Secondary xylem elements

DISCUSSION

A. ilicifolius was a good remedy for skin diseases because there was report already documented that this plant have many pharmacological properties. The present anatomical study provides characters which would facilitate quick identification and differentiation of the drug from alike and other material. The midrib is flat on the adaxial side and unequally two lobed and thick on the abaxial side. In lamina portion there are deep narrow grooves inside which occurs a simple unique type of glandular trichome “Fig.3.12”. The presence of columnar palisade cells and reticulate partions for air – chambers “Fig.3.1” and the stomata are diacytic, the venation is densely reticulate. The stem consists of intact epidermis, wide cortex, thin walled vascular cylinder and wide pith, which are the major diagnostic features noted from the present study. These features can be used as reliable aid for detecting adulterations. Similar studies were also carried out in several other plant species^[13-19]. Generally leaf margin, type and distribution of glandular trichomes, epidermal cells and type of stomata are used as diagnostic characters in microscopical studies of herbal drugs^[19-23].

CONCLUSIONS

The current trend of medicinal system of universe is shifting from synthetic to herbal medicine, so we can say ‘come back to Nature’. Medicinal plants known as millenaries and highly esteemed all over the world as a rich source of therapeutic agents for the prevention of diseases and ailments. Anatomical studies on the leaf and stem of *A. ilicifolius* provide diagnostic characters for the identifications of the original drug.

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