

Morphological and anatomical characteristics of Leaf and Stem anatomy in *Garcinia mangostana* L.

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ABSTRACT

Garcinia mangostana has been widely used to treat abdominal pain, diarrhoea, dysentery, infected wound, suppuration, and chronic ulcer. The observation on cellular level morpho-anatomy is a major aid for the authentication of the species. Because of this, the present study was carried out for the morphological and anatomical exploration of the leaf and stem of *Garcinia mangostana* L. (Family: Clusiaceae), popularly known as Queen of fruits. In morphological evaluation, it was observed that the leaves are opposite, shortly petiolate, thickly coriaceous, ovate-oblong, simple with entire margin, base acute to obtuse, apex acuminate, glabrous, pinnately nerved with a prominent midrib, evenly spaced lateral nerves and green in colour. Stem is cylindrical in shape and brownish-green in appearance. Microscopic evaluation revealed the presence of thick cuticle, uniseriate epidermis, and rubiaceous stomata. The leaf tissues include druses and calcium oxalate crystals. It is concluded that these characteristics are important for the identification of the studied species used in drugs.

Key words : *Garcinia mangostana*, Morphology, Anatomy, Leaf, Petiole and Stem

INTRODUCTION

Morphology and anatomy are the classical source of data used in plant taxonomy and are useful in solving problems of relationships. The internal characters are as valuable as the external characters because of the frequent persistence of the vascular supply of lost organs after all external evidence of the organs has disappeared (Eames 1961).

Plant systematics deals with the description, naming, classification, identification, and determination of relationships among plants by using data from many disciplines such as morphology, anatomy, molecular biology, ecology, etc. The majority of the plants have evidence according to morphological features; however, for accurate classification, information from diverse sources must be utilized. Anatomical features have played a very important role in determining phylogenetic relationships. *Garcinia mangostana* L., (Mangosteen) which is popularly known as "Queen of fruits" belongs to the family Clusiaceae. It has been widely used to treat abdominal pain, diarrhoea,

dysentery, infected wound, suppuration, and chronic ulcer. The genus *Garcinia* was named to honour the Dutch army doctor and naturalist Laurentius Garcin, who studied these plant specimens of mangosteen (Garcin and Zollmah 1733). The family occupies 6 genera and up to 26 species in Kerala (Sasidharan, 2006). Many species are cultivated for edible fruits and medicinal purposes.

Thus, this study aimed to perform the morphological and anatomical characteristics in the leaf and stem of Mangosteen for the authentication of the species.

MATERIALS AND METHODS

G. mangostana leaf and stem samples were collected from Aymanam (9° 36'32.5" N 76° 29' 40.9"E) of the Kottayam district of Kerala. The herbarium specimen of Mangosteen was deposited at the Department of Botany, C M S College Kottayam, Kerala (Voucher no: CMS 3119). The healthy plants were selected and the mature leaves from the fifth and sixth nodes were taken for the anatomical studies (Plate 1-A.). The leaf sections were made at a position approximately halfway between the base and apex, from one side of the

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lamina and the stem was studied by collecting the tertiary branches. The transverse section (TS), transverse longitudinal (TLS), and radial longitudinal section (RLS) were stained with Safranin. The slides were analyzed by a trinocular compound microscope (model no. 10093409) and photographs were made by using the camera Nikon Coolpix 4500.

RESULTS AND DISCUSSION

Morphological characteristics

The leaf and stem morphological characteristics were observed. The leaflet is dark green coloured, having an opposite decussate arrangement, round base, acuminate apex and margin are entire. The leaf shape varies greatly from oblong to elliptic. The leaves are petiolate with a swollen base and with a brownish-green cylindrical stem.

Anatomical characteristics

a) Anatomy of leaf

Leaf anatomical characteristics of Mangosteen were observed and illustrated in Plates 1 (A-D). The cuticle is thick on the adaxial surface of the species. The epidermal cells are uniseriate (Priya and Hari, 2018). The ground tissue showed the presence of numerous druses, starch grains, and secretory cavities. The secretory cavities are lined with epithelial cells similar to features that were reported in leaves of dicotyledonous plants (Amanda *et al.*, 2013; Dickson, 2000). The vascular elements are arranged as patches and are plate-like in appearance. The phloem cells are arc-shaped and overarch the xylem bands. The entire vascular elements were covered with sclerenchymatous cells. The xylem elements are compactly packed and are with narrow medullary rays.

The thickness of the cuticle and the uniseriate epidermis are the important characteristics of Clusiaceae (Metcalfe and Chalk, 1950). The massive palisade cells were present in Mangosteen. Then round spongy parenchyma cells appeared as networks with airspace and are highly chlorophyllated.

The vascular zone with a cowry-like appearance (Plates 1-B). In the leaf lamella, transfusion tracheids were seen and the vascular structure is interrupted with a unilacunar leaf trace and is on the opposite sides.

The leaf contains highly pigmented polygonal-irregular shaped epidermal cells. The stomatal unit showed the elongated stomatal pore, which contains

two subsidiary cells and is parallel to the guard cells (Pate.1-B, C & D).

The outer surface showing ridges and furrows stomata were rubiaceous and with an average length of 15.2 μm and width of 3.2 μm . The most common stomatal type in *Garcinia* is parasitic (Pathirana and Herat, 2004).

b) Anatomy of Petiole

The trichomes were absent in the epidermis. The epidermal cells were somewhat elevated and dome-shaped (Plate 1-E & F). The cross-section of the petiole shows a semi-circular stele. The anatomical characteristics showed a thick cuticle with a uniseriate epidermis (Vigi and Hari, 2020). The ground tissue was prominently dispersed with numerous starch grains and druses.

The siphonous incurved vascular strand with a wide distinct gap. The gap consisted of interfascicular round parenchyma cells (Plate 1-E & F). (Rutuja *et al.*, 2017) reported a similar nature of vascular strand in species of *Garcinia*.

The stele consisted of unlayered endodermis. The xylem and phloem were somewhat equal and the species showed the radially arranged vessels. The xylem rays are short and very narrow.

c) Anatomy of stem

The stem was circular in cross sectional view. The epidermis was covered with a thick cuticle. Cortex was thick, multi-layered and parenchymatous. A large number of tannin cells occurred in both cortex and pith. Sclerids and Calcium oxalate crystals were also present in the cortex and pith (Plate 1-G, H & I). Xylem and phloem were in the form of continuous rings.

The radial longitudinal section (RLS) showed the vessels and tracheids; vessels with spiral and annular thickenings; consists of fiber tracheids, axial and ray-parenchyma cells (Plate.1-J). The transverse longitudinal section (TLS) of wood showed alternate intra vascular pitting, the sieve tube with compound sieve plate, companion cells, sclereids, phloem parenchyma, septate and nonseptate phloem fibres. The depositions were found in the sieve elements. Medullary ray was uniseriate. Perforation plates were simple and derived from fusiform initials (Plate.1-K).

CONCLUSION

It is concluded from the present study that morphological and anatomical characteristics play

an important role in the authentication of the species and also the identification of drugs. Anatomical evaluation is one of the cost-effective methods for the correct identification of the source of the material.

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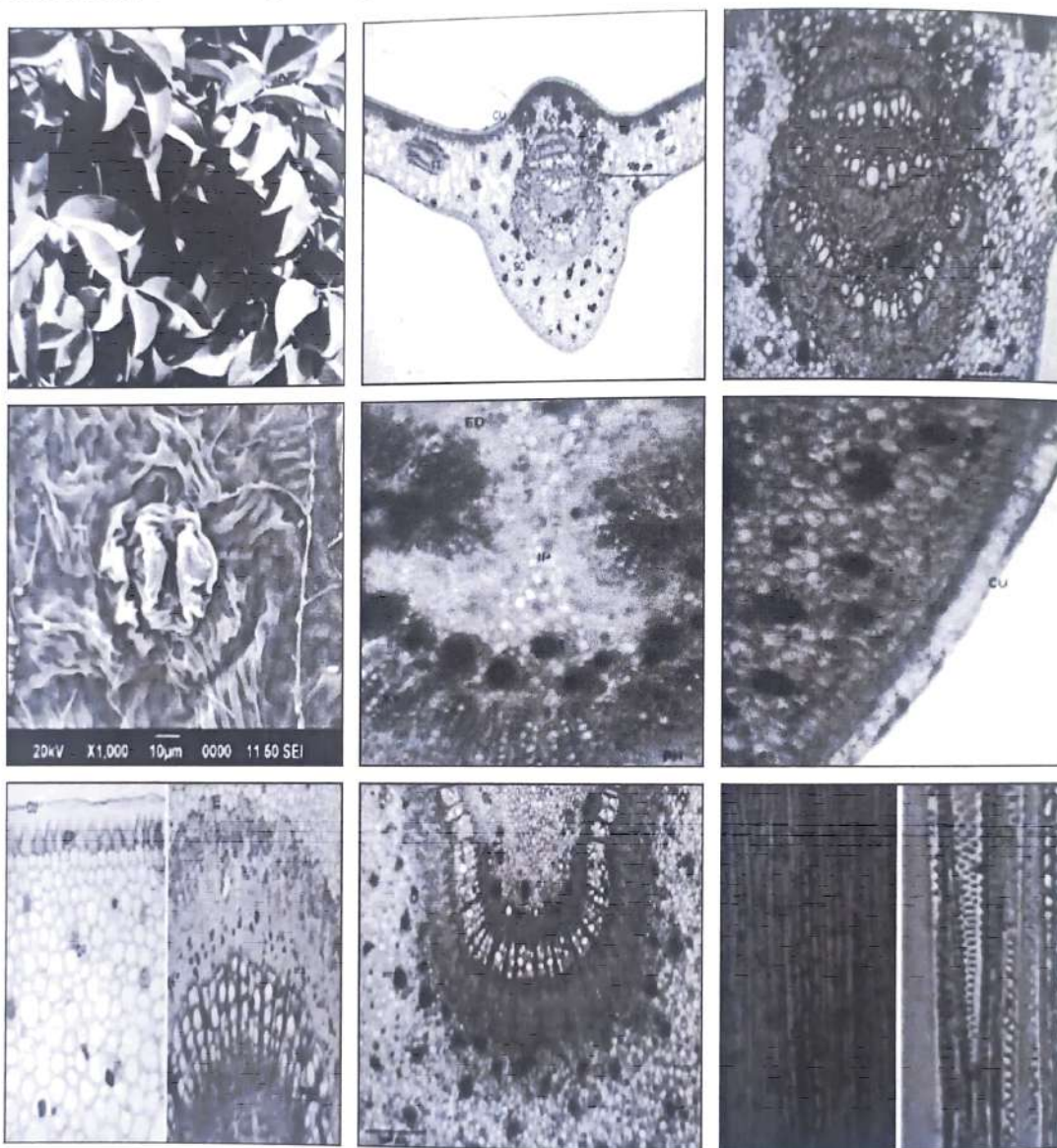


Plate.1- Anatomical characteristics of Leaf (B,C & D) , Petiole (E & F) and Stem (G,H,I, J & K).

EP-epidermal cell, CU-cuticle, SC-secretory cavities, XY-xylem, PH-phloem, DR-druses, SG-starch grains, TE-tracheary elements, IP- Interfascicular parenchyma and ED- Endodermis.

Conflicts of interest

The authors declare no conflicts of interest.

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