



E-ISSN: 2278-4136  
P-ISSN: 2349-8234  
JPP 2019; 8(1): 576-578  
Received: 25-01-2019  
Accepted: 28-02-2019

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## A Contribution on the Anatomical Characters of *Moringa oleifera* Lamk. and their significance

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### Abstract

The anatomical structure of various organs of *Moringa oleifera* Lamk. has been investigated. Root is tetrarch. In old root large number of vessel elements embedded in xylem parenchyma cells are observed. In young stem 16 - 18 collateral vascular bundles are present in ring. Vascular cambium produces small amount of secondary phloem and large amount of secondary xylem. Eglanular trichomes are present on various parts of leaf. Stomata are anomocytic. A large semi - triangular collateral vascular bundle is the characteristic of midrib. Petiole is made up of central vascular cylinder and collenchyma containing oxalate crystals. Rachis has 10 - 12 collateral strands and tanniferous contents in cortical cells. Distinguishing characters have significance in pharmacognosy.

**Keywords:** *Moringa oleifera*, medicinal plant, anatomy, pharmacognosy

### Introduction

*Moringa oleifera* Lamk. is a medicinal plant as well as used as vegetable in several countries. It is widely distributed in many countries of tropics and subtropics (Nadkarni, 2005; Mehta *et al.*, 2011; Ramachandran *et al.*, 1980) <sup>[1, 2, 3]</sup>. It grows widely in South Gujarat region of India and used for dysentery (Sharma and Singh, 2000; Tandon, 2008) <sup>[4, 5]</sup>, Jaundice (Kumar and Goel, 1999) <sup>[6]</sup> and is also used by tribal people in burns, sores, erysipelas, retention of urine, cholera and urinary gravel (Jain and Tarafder, 1970) <sup>[7]</sup>. The fruit is recommended in diseases of liver, spleen and in paralysis (Stayavati *et al.*, 1987) <sup>[8]</sup>. Certain anatomical characters can be utilized for the identification of plants (Metcalf, 1979) <sup>[9]</sup>. This study is aimed to investigate internal features of *Moringa oleifera* Lamk. and their significance.

### Materials and Methods

Different organs of *Moringa oleifera* Lamk. were collected from the field of South Gujarat region of India. Their small pieces were fixed in FAA (Formaldehyde - Alcohol - Acetic acid) and processed for microtomy. 8 - 10 micron thin transections were taken and stained with safranin O and FCF fast - green. For the study of stomata and trichomes, the peels were stained in Delafield's haematoxyline and mounted in glycerine (Berlyn and Miksche, 1976) <sup>[10]</sup>.

### Results

#### Stem

In young stem 16 - 18 collateral vascular bundles are present in a ring. Pith is large and parenchymatous. Pericycle is composed of alternate groups of fibers and parenchyma cells (Fig. 1A) in young stem but it turns into a complete circular band of fibers in old stem (Fig. 1B).

In old stem vascular cambium produces small amount of secondary phloem and large amount of secondary xylem, which is composed of uniseriate xylem rays, lignified thick walled xylem fibers and roundish vessel elements (Fig. 1B).

#### Root

Young root has tetrarch xylem (Fig. 1C).

In old root vascular cambium is 6 - 8 layered which produces many roundish vessel elements embedded in large number of xylem parenchyma cells (Fig. 1E). Starch grains and tannin are observed in xylem parenchyma (Fig. 1D). Phellogen is 3 - 4 layered, which forms phellum of rectangular or squarish cells. Phelloderm is large and consisted of thin walled parenchymatous cells. Many of them contain tannin. Scattered groups of fibers are embedded in this region (Fig. 2A). Wall of phellum cells is suberized.

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## Leaf

### Lamina

Epidermal cells of adaxial surface are larger than cells of abaxial epidermis. Palisade cells are elongated, present in a single row and have dense tanniferous content. Stellate crystals of oxalate are observed in cells of lamina, midrib and petiole (Fig. 2B).

Cell wall of epidermal cells is sinuous on abaxial side and non sinuous on adaxial side. Leaf is hypostomatic with anomocytic stomata (Fig. 2C). Contiguous stomata at right angle to each other are also observed (Fig. 2D).

### Midrib

The main parts of midrib has hypodermis, cortex and a large semi - triangular collateral vascular bundle. Hypodermis is made of collenchyma and present only on abaxial side. Parenchymatous cells are observed below abaxial epidermis. Cortex is parenchymatous (Fig. 2B).

### Petiole

Cells of epidermal and sub epidermal layers of petiole are radially elongated. Some of them have tanniferous content. The rest of the part of petiole is made up of central vascular cylinder and collenchyma cells containing large number of oxalate crystals (Fig. 3A).

### Rachis

Epidermis has thin and smooth cuticle. Tanniniferous contents are observed in cortical cells. Pericycle is composed of fibers and parenchyma groups present external to the ring of 10 - 12 collateral vascular bundles (Fig. 3B, C).

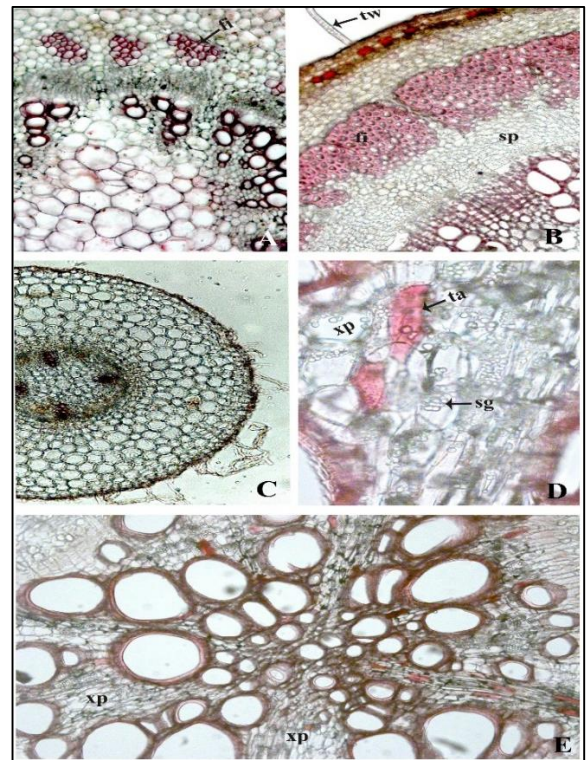
Eglandular unicellular filiform trichomes are present on the epidermis of stem, lamina, midrib, petiole and rachis. They have warted cell wall (Fig. 1B, 3B, C).

## Discussion

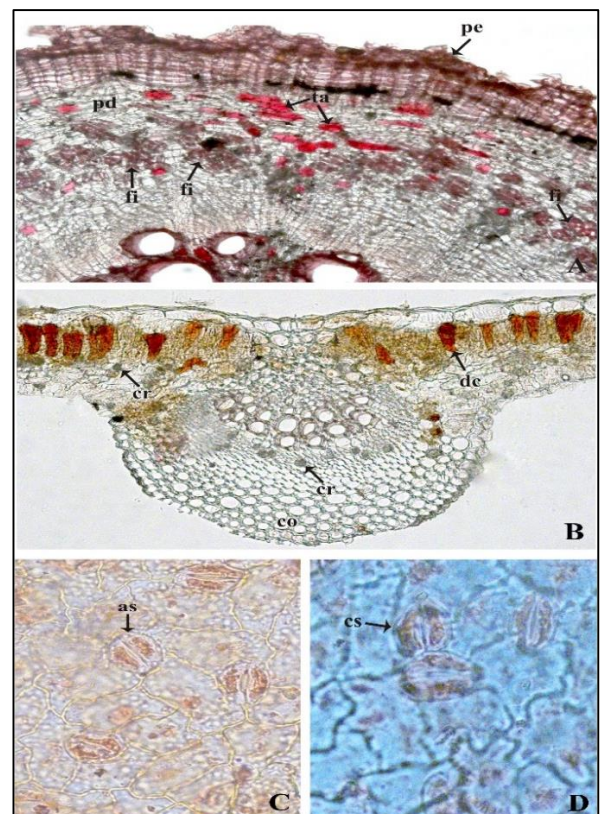
The anatomical characters of leaflet of various species of *Moringa* were studied by few workers (Abubakar *et al.*, 2011; Torres - Castilio *et al.*, 2013; Abdel - Hameed, 2015) [11- 13]. Santhan (2013) [14] reported a single layer of palisade cells in seven species of *Moringa*. The species investigated here also has a single layer of palisade cells which are elongated and some of them exhibit tanniferous dense content.

Abdel - Hameed (2015) [13] reported only paracytic stomata in *Moringa oleifera*. Contradictory to this anomocytic stomata are found in present work. This observation is similar to the study of Santhan (2014) [15] and Abubakar *et al.* (2013) [16] who also reported only anomocytic stomata in *Moringa*. Contiguous stomata at right angle to each other are observed in present work. There is no report of such stomata in this species by earlier workers. The plant is characterised by unicellular filiform trichomes. These observations are similar to the study of Gill *et al.* (1985) [17], Abubakar *et al.* (2013) [16] and Santhan (2014) [15].

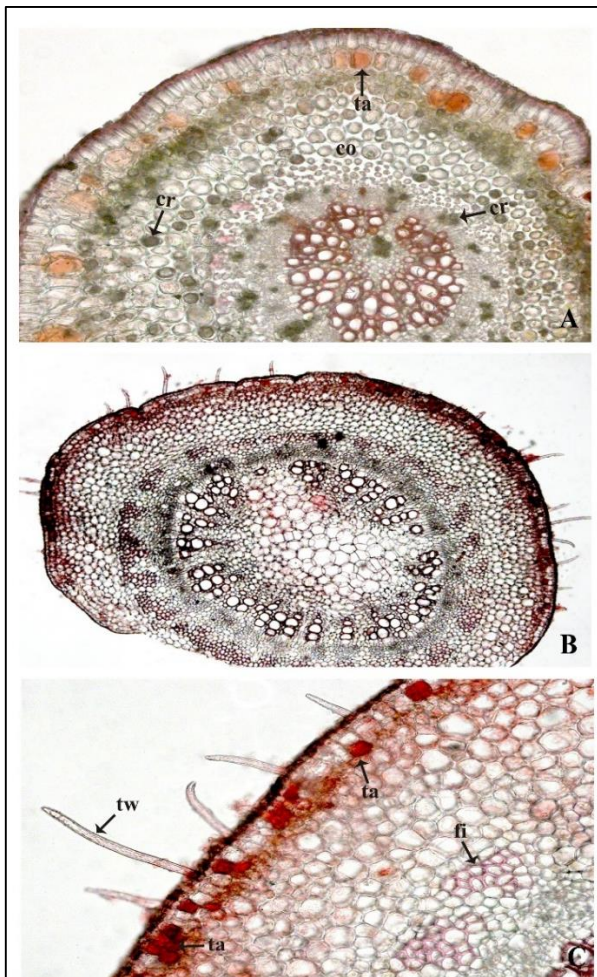
There are few reports of the presence of calcium oxalate crystals in *Moringa oleifera*. They are found in wood cells (Olson and Carlquist, 2001) [18], cork cells of stem (Jayeola, 2013) [19], secondary cortex of stem (Sholapur and Patil, 2013) [20] and leaflet (Santhan, 2014) [15]. In this study they are more common in lamina, midrib and petiole.



**Fig 1:** A-E, transactions. A, B, stem; C-E, root. A, C, X400; B, E, X480; D, X800. (fi-fibers; sg-starch grains; sp-secondary phloem; to-tannin; tw-trichome with warted wall; xp-xylem parenchyma.)



**Fig 2:** A-D, transaction. A, root; B, lamina and midrib. C, D, surface view of abaxial epidermis of lamina. A, B, X480; C, D, X800. (as-anomocytic stomata; co-collenchyma; cr -crystals; cs-contiguous stomata; dc- dense content; fi-fibers; pd-phelloderm; pe-phellum; ta-tannin.)



**Fig 3:** A-C, transactions. A, petiole; B, C, rachis. A, C, X480; B, X80. (co-collenchyma; cr-crystals; fi-fibers; to- tannin; tw- trichome with warded wall).

**Conclusion**

Present study shows that *Moringa oleifera* Lamk. exhibits following distinguishing micro-characters useful in solving taxonomic problems and pharmacognosy.

- Xylem parenchyma cells are produced in large number in root and contain starch grains and tannin.
- Deposition of tannin is observed in certain cortical cells of stem, petiole and rachis.
- Eglanular unicellular trichomes with warded wall are present on various organs.
- Oxalate stellate crystals are present in lamina, midrib and petiole.
- Midrib has a single semi - triangular collateral vascular bundle.
- Petiole has a cylinder of secondary vascular tissue.
- Epidermal and sub epidermal cells are radially elongated in petiole.
- Petiole has ground tissue of collenchyma.

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