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# Morphoanatomy Studies of the Leaf of *Citharexylum quadrangulare* Jacq. Cultivated in Egypt

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## Abstract

*Citharexylum quadrangulare* Jacq., family Verbenaceae. It is a large tree, native of the West Indies. It is used in traditional medicine as diuretic, antipyretic, antiarthritic and liver disorders. The present study investigates various standardized parameters such as macroscopic and microscopic characters which could be helpful in authentication of the leaf of *Citharexylum quadrangulare* Jacq.

**Keywords:** *Citharexylum quadrangulare*, Verbenaceae, leaf, petiole, Morphoanatomy study.

## 1. Introduction

*Citharexylum quadrangulare* Jacq., family Verbenaceae is known as fiddlewood, Fiddlewood's Latin name, is derived from the Greek kithara (lyre or fiddle) and xylon (wood)<sup>[1]</sup>. Fiddlewood's common name comes from the use of its wood to make stringed instruments by the people of the Caribbean<sup>[2]</sup>. It has a synonym: *Citharexylum spinosum* L.<sup>[3]</sup>. It is a large tree, native of the West Indies, with permanently 4-angled branches and opposite, entire leaves. The small white odorous flowers occur in racemes, the fruit is a fleshy drupe. This tree might prove to be a good ornamental for the northern part of the United States<sup>[4, 5]</sup> and cultivated in El-Zohria, Orman and the Zoo gardens, Giza, Egypt. It is used in traditional medicine as diuretic, antipyretic, antiarthritic and liver disorders<sup>[6]</sup>. Several members of the Verbenaceae are known to contain flavonoids and essential oils<sup>[7, 8]</sup>. They also contain iridoids, anthocyanins, quinones and caffeic acid derivatives, while alkaloids appear to be rare<sup>[9-11]</sup>.



Fig 1: Photo of *C. quadrangulare* Jacq.



Fig 2: Photo of the leaf (X 0.5)

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## 2. Taxonomy

*Citharexylum quadrangulare* Jacq.<sup>[4, 12]</sup>, Kingdom: Plantae, Subkingdom: Tracheobionta, Division: Magnoliophyta or Angiospermae, Class: Magnoliopsida, Subclass: Asteridae,

Order: Lamiales, Family: Verbenaceae, Subfamily: Verbenoideae, Genus: *Citharexylum* and Species: *quadrangulare* Jacq.

### 3. Materials and Methods:

**A. Plant material:** The leaves of *Citharexylum quadrangulare* Jacq. were collected in June 2007. It was identified by Eng. Teres Labib director of Orman garden. The materials used for botanical study were taken from the samples preserved in 70% methanol containing 5% glycerin. A voucher specimen has been deposited at the department of pharmacognosy, faculty of pharmacy, Minia University, Minia, Egypt under registration number Mn-Ph-Cog-005.

**B. Microscopic studies:** Surface preparation, transverse section as well as powder of the leaf were used for observation of various microscopic features.

### 4. Results and Discussion

#### A. Macroscopical characters of the leaf

The leaves are green, simple and opposite. The individual leaf is petiolated, elliptical with entire margin, acuminate apex and symmetric base. Both surfaces are slightly hairy. The venation is pinnate reticulate. The midrib is more distinct in the lower part than the upper part. It measures from 11.0 to 16.0 cm in length and 2.0 to 5.0 cm in width near the middle part of the stem. The

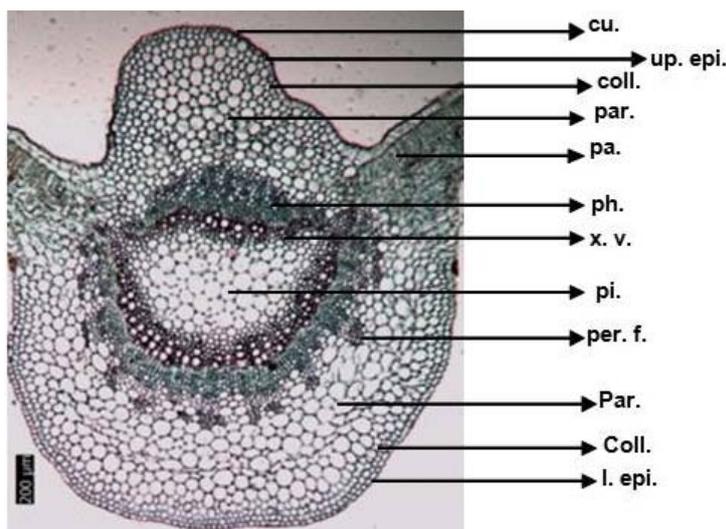


Fig. 3: Photo of the diagrammatic T.S. of the leaf (X 40).

cu.: cuticle, up. epi.: upper epidermis, coll.: collenchyma, par.: parenchyma, pa.: palisade, ph.: phloem, x.v.: xylem vessels, pi.: pith, per. f.: pericycle fiber, l. epi.: lower epidermis.

#### ii. The lower epidermis

It is formed of one row of sub rectangular to square cells as noticed in transverse section (Fig 3 & 4 D), while in surface view the cells appear strongly wavy usually isodiametric to slightly elongate with thin anticlinal walls covered with thick cuticle (Fig 5A). They are measured 20-35-60  $\mu\text{m}$  in width, 42-65-85  $\mu\text{m}$  length and 10-13-15  $\mu\text{m}$  in height. The stomata of anomocytic type which are surrounded by 4-5 cells are often found. Moreover, Multicellular head, short stalked and disk-shaped glandular hairs are also found (Fig. 4E, 5B & 6C).

#### iii. The palisade cells

The palisade on the upper epidermis consists of one row of columnar, thin walled cells containing chloroplasts and measuring 50-60-66  $\mu\text{m}$  in height and 6-10-13  $\mu\text{m}$  in width (Fig. 3 & 4E). The palisade tissues are interrupted by a collenchyma at the

upper surface is darker than the lower one. It has a faint characteristic odor and a slight bitter taste. The leaf rachis is cylindrical in shape and hairy. It usually reaches about 10.0 to 20.0 mm in length and 0.1 to 1.5 mm in diameter with pale brownish green color (Fig. 2).

#### B. Microscopical characters of the leaf

A transverse section through the midrib region shows a prominent midrib on the lower surface. In the midrib region, collenchyma is abutting on the upper and lower epidermises. The vascular system of the midrib is formed of continuous ring of xylem surrounded by phloem with central pith and surrounded by groups of pericyclic fibers. The lower epidermis carries glandular and non-glandular hairs while the upper is free of hairs. The lamina shows a dorsiventral structure with palisade layer under the upper epidermis.

#### I. The lamina

##### i. The upper epidermis

It is formed of one row of sub rectangular to square cells as illustrated in the transverse section (Fig. 3 & 4A), while in surface view the cells appear strongly wavy usually isodiametric to slightly elongate covered with thin and smooth cuticle. They are measured 25-30-50  $\mu\text{m}$  in width, 35-70-93  $\mu\text{m}$  in length and 10-15-20  $\mu\text{m}$  in height. It shows no stomata (Fig. 5C).

midrib region.

##### iv. The mesophyll

It consists of 3-5 rows of thin-walled, rounded or slightly irregular chlorenchymatous cells with fairly wide intercellular spaces and measuring 7-14-21  $\mu\text{m}$  in diameter (Fig. 4E).

#### II. The cortical tissue

It consists of ordinary parenchyma surrounding the main vascular bundle of the midrib. It forms a wide region above and below the vascular bundle and consists of (7-9, 6-11 rows), respectively. The diameters of parenchymatous cells were determined as 50-60-66  $\mu\text{m}$  in diameter. The subepidermal masses of collenchyma cells consist of 2-3 rows on both sides and measure 8-15-27 in diameter (Fig. 3, 4A, 4B & 4D).

### III. The vascular tissue

#### i. Pericycle

It is formed of islets of pericyclic fibers separated by thin walled parenchyma cells. Each group consists of 6-20 fibers (Fig. 3, 4B & 4C). The fibers are elongated, with acute apex, narrow lumen, thick, lignified, straight walls. They measure up to 730  $\mu\text{m}$  in length and 15  $\mu\text{m}$  in width (Fig. 6D). The groups of pericyclic fibers towards the upper surface are smaller than those of the lower surface and consist of 4-12 fibers in each group.

#### ii. The phloem

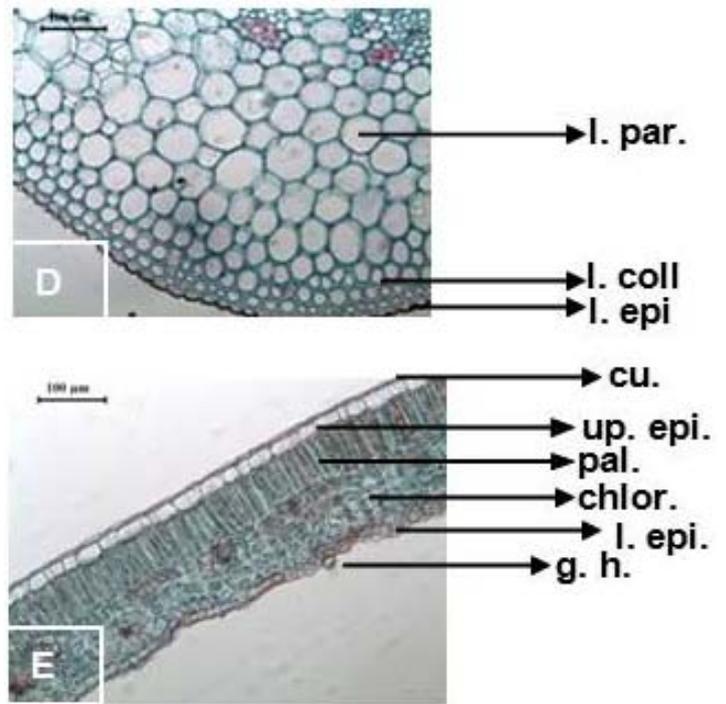
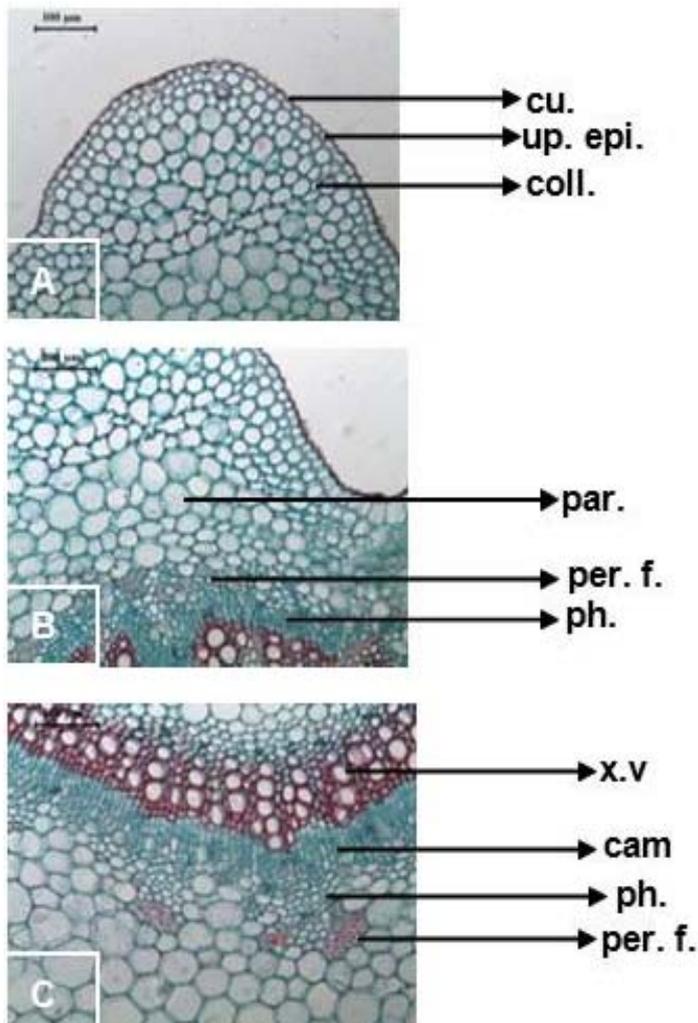
It is formed of a narrow ring consisting of thin walled, soft, cellulosic elements: sieve tubes, companion cells and phloem parenchyma (Fig. 4C).

#### iii. The cambium

It is formed of 3-4 rows of thin, cellulosic walled meristematic cells (Fig. 4C).

#### iv. The xylem

It is formed of a wide region of lignified and radiating elements viz. vessels, fibers and xylem parenchyma (Fig. 3 & 4C). The vessels are spiral and measuring 19-30-38  $\mu\text{m}$  in diameter. The xylem fibers are elongated, with acute apices, narrow lumen, thick, lignified, straight walls. They measure up to 638  $\mu\text{m}$  in length and 26  $\mu\text{m}$  in width (Fig. 6F).

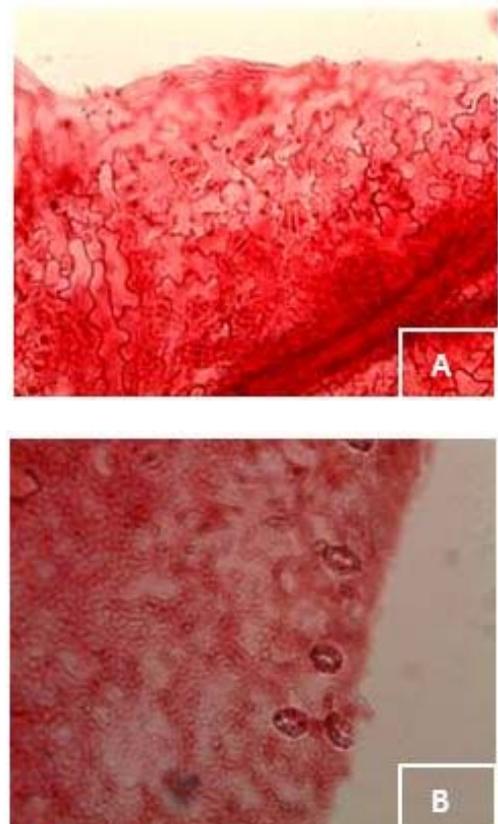


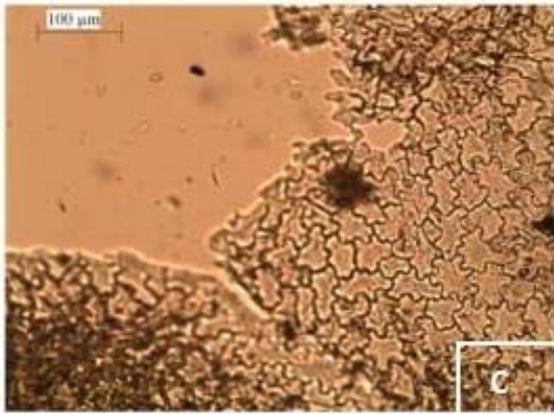
**Fig 4:** Photos of detailed T.S of the leaf (X 100).

cu.: cuticle, up. epi.: upper epidermis, col.: collenchyma, par.: parenchyma, per. f.: pericycle fiber, ph.: phloem, x.v.: xylem vessels, cam.: cambium, l. par.: lower parenchyma, l. coll.: lower collenchyma, l. epi.: lower epidermis, pal.: palisade, chlor.: chlorophyllous, g. h.: glandular hair.

### IV. The Pith

It is formed of parenchymatous zone (Fig. 3), consisting of large and oval to round cells with moderate thin walls. It contained starch granules and measuring 14-29-50  $\mu\text{m}$  in diameter. It represents approximately 1/4 of the whole section.





**Fig 5:** Photos of surface preparation of the leaf (X 100).

- A - The lower epidermis
- B - The anomocytic stomata of the lower surface
- C - The lower epidermis

## V. The leaf powder

The powder of the leaf is green color with faint characteristic odor and faint bitter taste. The main diagnostic elements are shown in (Fig. 5, 6):

**1-Fragments of the upper epidermis of the lamina in surface view** consisting of polygonal, isodiametric to slightly elongated cells with wavy anticlinal walls covered with striated cuticle.

**2-Fragments showing the lower epidermis of the lamina in surface view** consisting of polygonal, isodiametric to slightly elongated cells with wavy anticlinal walls covered with striated cuticle. The stomata of anomocytic type surrounded by 4-5 cells are often found.

**3-Multicellular head, short stalked and disk-shaped glandular hairs and unicellular, uniseriate non glandular hairs** from lower surfaces of the leaf.

**4-Fragments of elongated pericyclic fibers, with acute apices, narrow lumen, thick, lignified, straight walls.**

**5-Fragments of elongated xylem fibers, with acute apices, narrow lumen, thick, lignified, straight walls.**

**6-Lignified xylem vessels with mainly spiral thickening.**

**7-Small, oval, simple starch granules with indistinct striation and hilum.**

## C. Microscopical characters of the petiole:

A transverse section of the petiole is biconvex in outline showing two short wings (Fig. 7). Collenchyma is abutting on the upper and lower epidermises. The vascular system is formed of continuous ring of xylem surrounded by phloem with central pith and surrounded by groups of pericyclic fibers. In the apex of each wing, there is a small mass of parenchyma around the wing vascular bundle (Fig. 9).

### I-The lamina:

#### i. The upper epidermis

The upper epidermis is formed of one row of sub rectangular to square cells as seen in the transverse section (Fig. 7 & 8) and measuring 7-11-14 μm in height and 7-14-21 μm in width. They covered with thick cuticle.

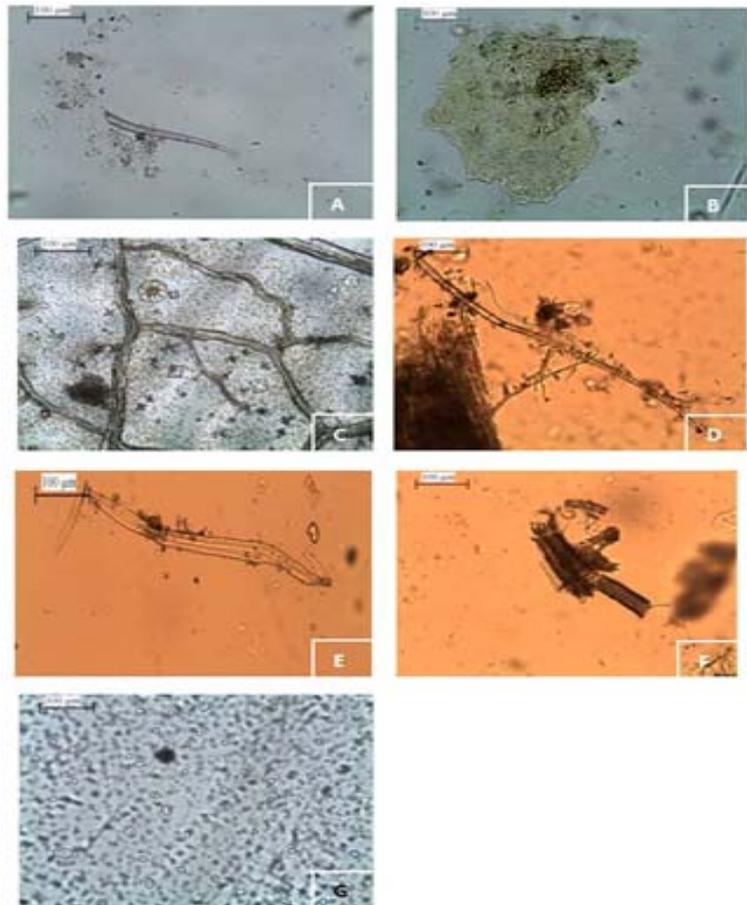
#### ii. The lower epidermis

The lower epidermis is formed of one row of sub rectangular to

square cells as seen in the transverse section (Fig. 7 & 8) and measuring 7-9-14 μm in height and 7-14-21 μm in width. They covered with thick cuticle.

## II. The cortical tissue

The cortical tissue (Fig. 7 & 8) consists of ordinary parenchyma surrounding the main vascular bundle. It forms a wide region above and below the vascular bundle and consists of (7-10, 6-8 rows) respectively. The diameter of parenchymatous cells were determined as 23-31-53 μm in diameter and containing crystals of calcium oxalate. Collenchyma arranged in 2-3 rows is abutting on the upper epidermis and measuring 7-14-29 μm in diameter. Another mass of collenchyma is abutting on the lower epidermis and formed of 3-4 rows and measuring 10-17-33 μm in diameter.



**Fig 6:** Photos of the powdered leaf (X 100).

- A-non-glandular hair, B-epidermal cells, C-glandular hair, D-pericyclic fiber, E-xylem fiber, F-xylem vessel, G-starch granules.

## III. The vascular tissue

### i-The pericycle:

The pericycle is formed of islets of pericyclic fibers separated by thin walled parenchyma cells. Each group consists of 5-30 fibers and 45-50 fibers in the apex of each wing (Fig. 7 & 8).

### ii. The phloem

The phloem is formed of a narrow ring. It consists of thin walled, soft and cellulosic elements; sieve tubes, companion cells and phloem parenchyma. While phloem fibers are absent.

### iii. The cambium

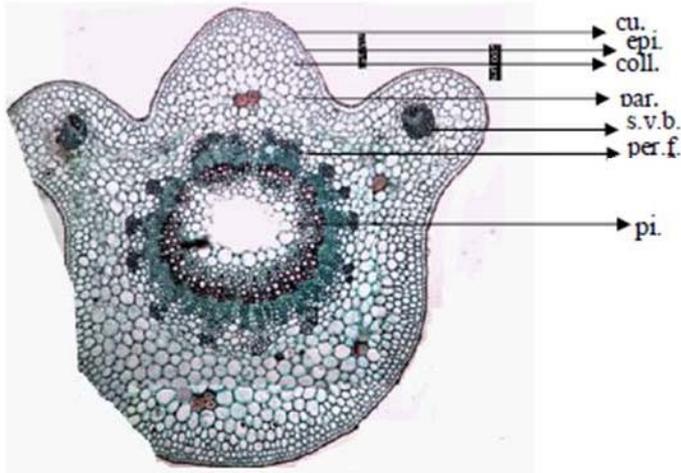
The cambium is formed of 3-4 rows of thin, cellulosic walls and meristematic cells (Fig. 8).

**iv. The xylem**

The xylem is forming a wide region. It is formed of lignified and radiating elements viz. vessels, fibers and xylem parenchyma (Fig. 8).

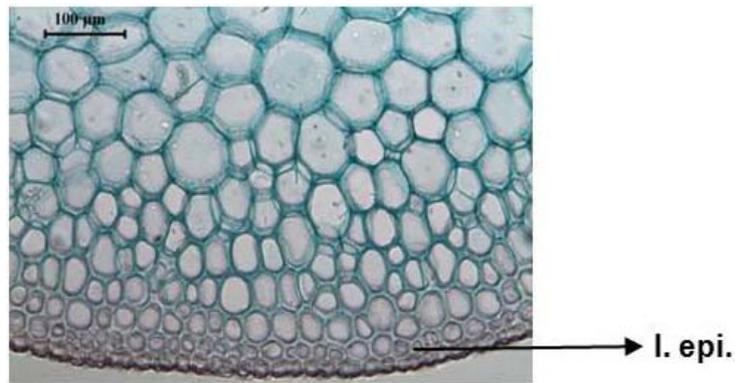
**IV. The pith**

The pith is formed of parenchymatous zone, consisting of large and oval to round with moderate thin walls (Fig. 7 & 8). They have crystals of calcium oxalate and measuring 23-53-69 μm in diameter.



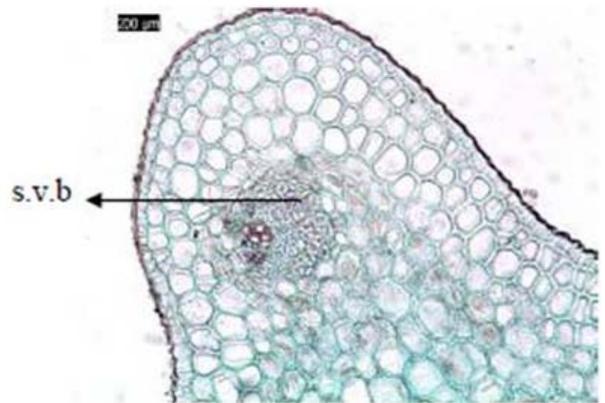
**Fig 7:** Photo of the diagrammatic T.S. of the petiole (X 40).

cu.: cuticle, epi.: epidermis, coll.: collenchyma, par.: parenchyma, s. v. b.: side vascular bundle, per. f.: pericyclic fiber, pi.: pith.



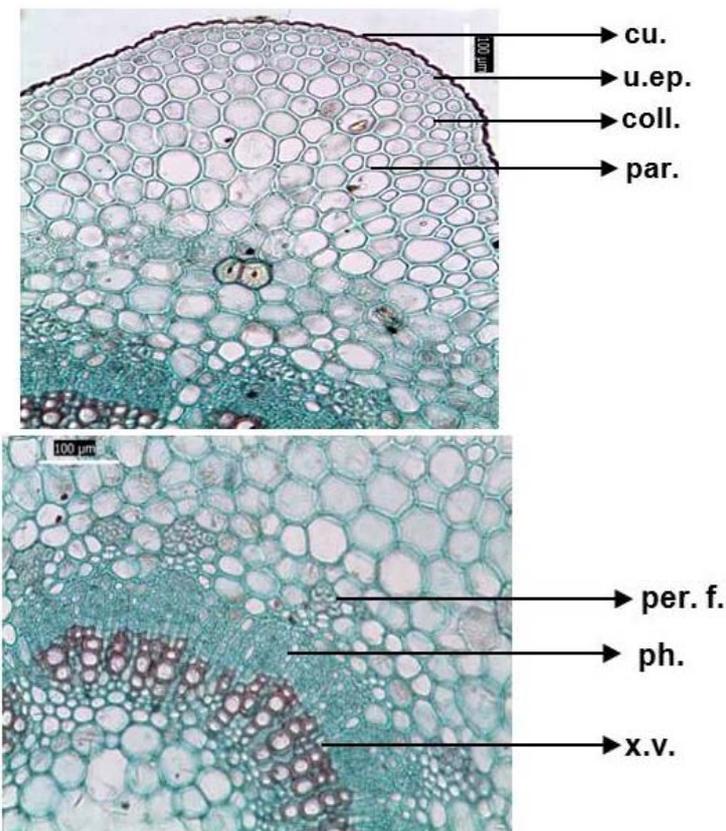
**Fig 8:** Photos of detailed T.S. of the petiole (X 100).

cu.: cuticle, up. epi.: upper epidermis, coll.: collenchyma, par.: parenchyma, per. f.: pericyclic fiber, ph.: phloem, x.v.: xylem vessels, l. epi.: lower epidermis.



**Fig 9:** Photo of detailed T.S. of the winged part of the petiole (X 40).

(s. v. b. - side vascular bundle)



**5. Conclusion**

From over present study entitled “Morphoanatomy Studies of the Leaf of *Citharexylum quadrangulare* Jacq. Cultivated in Egypt”, it could be helpful in authentication of the leaf. Moreover, it is helpful in the identification of powdered drug prior using in any herbal formulations.

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