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Botanical Studies of the Stem of *Citharexylum quadrangulare* Jacq. Cultivated in Egypt

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Abstract

Family Verbenaceae is also known as Verbain or Verbena. It includes about 100 genera and more than 3000 species. One of these genera is *Citharexylum* which contains 115 species. *Citharexylum quadrangulare* Jacq. is a large tree, native of the West Indies. The study investigates macroscopic and microscopic characters which could be helpful in authentication of the stem of *C. quadrangulare* Jacq. Moreover, it could be used also for further scientific investigation of the plant.

Keywords: *Citharexylum quadrangulare*, *Citharexylum spinosum*, Verbenaceae, Stem, Botanical studies.

1. Introduction

Family Verbenaceae is also known as Verbain or Verbena [1]. It includes about 100 genera and more than 3000 species [2,3]. One of these genera is *Citharexylum* which contains 115 species [4]. *Citharexylum quadrangulare* Jacq. is a large tree, native of the West Indies, with permanently 4-angled branches and opposite, entire leaves [5,6]. It has a synonym: *Citharexylum spinosum* L. [7]. It is used as an antihypertensive herbal drug and in gastrointestinal tract disorders [8]. Moreover, it has hepatoprotective, immunomodulatory in addition to anti *Schistosoma mansoni* cercariae activities [8-10]. While, it used in folk medicine as diuretic, antipyretic, antiarthritic and liver disorders [11].

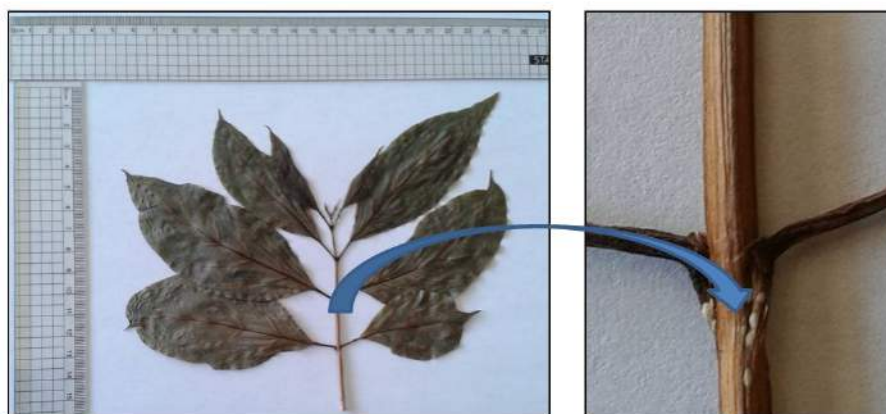


Fig 1: Photo of the stem of *Citharexylum quadrangulare* Jacq.

2. Taxonomy

Citharexylum quadrangulare Jacq. belongs to [5,12]:

Kingdom: Plantae Subkingdom: Tracheobionta, Division: Magnoliophyta or Angiospermae, Class: Magnoliopsida, Subclass: Asteridae, Order: Lamiales, Family: Verbenaceae, Subfamily: Verbenoideae, Genus: *Citharexylum*, Species: *C. quadrangulare* Jacq.

3. Material and methods

3.1 Plant material

The stems of *C. quadrangulare* Jacq. were collected in June 2007. It was identified by Eng.

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Teres Labib (Director of El-Orman garden, Giza, Egypt). It was dried at room temperature and then reduced to fine powder. 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 Pharmacognostical Museum, Pharmacognosy Department, Faculty of Pharmacy, Minia University, Minia, Egypt, under registration number Mn-Ph-Cog-005.

3.2 Dyes

Safranin and light green were used for staining the plant sections.

3.3 Microscopic studies

Surface preparation, transverse section as well as powder of the stem were used for observation of various microscopic features. All sections and powder pictures were done by using Microscope with camera, Leica® (Germany).

4. Results and discussion

4.1 Macroscopical characters

The main trunk of the stem (Figure 1) is rough, quadrangular in shape, solid, woody and monopodially branched. It measures from 6.0 to 7.0 m in height and 29-45 cm in diameter. Internodes vary from 1.3 to 2.7 cm in length. The stem is covered with numerous lenticels and whitish grey patches. Both the terminal and the lateral branches are glabrous, quadrangular in shape and striated. They have greenish brown in color, faint characteristic odor and bitter taste.

4.2 Microscopical characters of the stem

A transverse section in the stem (Figure 2) is quadrangular in shape with four and small wings. The transverse section shows an epidermis followed by layers of periderm. The remains of primary cortex as well as the endodermis are indistinguishable. The pericycle consists of groups of fibers alternating with parenchymatous cells. The pericyclic layer surrounds a continuous ring of vascular tissue with wide parenchymatous pith in the center. The phloem zone is separated from xylem by layers of thin, cellulosic walls and meristematic cells of the cambium.

4.2.1 The epidermis

The epidermis (if present in young stem) is formed of one row of square, sometimes subrectangular cells covered with thick and smooth cuticle as seen in transverse section (Figure 3), while in surface view (Figure 6) the cells appear polygonal, usually axially elongated sometimes isodiametric with straight anticlinal walls and smooth cuticle, measuring 21-28-42 μm in width 35-64-78 μm in length and 10-14-17 μm height. Stomata of anomocytic type (Figure 6A) and surrounded by 4-8 subsidiary cells. The glandular hairs are present (Figure 3, 6B & 7B) and formed of unicellular, short stalk, disk shape and multicellular head usually consists of 6-8 cells. The outer outline of the transverse section has four wings. The winged parts are found in each corner. Each one is arranged in 4 to 6

rows of collenchyma cells. They are oval to round in shape and measuring 16-22-28 μm in diameter.

4.2.2 The periderm

The periderm consists of the cork or phellem, phellogen and phelloderm. The cork is formed of sub rectangular cells, 3-6 rows (Figure 3 & 4) and measuring 45-54-81 μm in width and 14-25-28 μm in height (Figure 7A). It is covered with lenticels (Figure 4). The phellogen is formed of 2-3 rows followed by phelloderm which is formed of parenchymatous cells contain starch granules (Figure 7F) and arranged in 4-6 rows. The parenchyma cells are oval to round in shape and measuring 21-36-50 μm in diameter. The starch granules are small, oval, simple starch granules with indistinct striations and hilum. They measure measuring 28-42-57 μm in diameter.

4.2.3 The vascular tissue

4.2.3.1 The pericycle

The pericycle consists of groups of fibers (7 to 70 fibers) alternating with parenchymatous cells (Figure 2, 3, 4). The fibers are elongated, with acute apex, narrow lumen, thick, lignified, straight walls, measuring up to 450 μm in length and 13 μm in width (Figure 7C).

4.2.3.2 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 (Figure 2 & 3).

4.2.3.3 The cambium

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

4.2.3.4 The xylem (wood)

The xylem is formed of lignified and radiating elements viz. vessels, fibers and xylem parenchyma (Figure 2, 3, 5). Moreover, it is traversed by uni- to biseriate medullary rays (Figure 5). They measure 45-60-70 μm in length and 25-35-45 μm in width. The xylem vessels are mainly spiral and measuring 20-23-30 μm in diameter (Figure 7D). The xylem fibers are elongated, with acute apex, narrow lumen, thick, lignified, straight walls. They measure from 400-683-750 μm in length and 10-13-16 μm in width (Figure 7E). The xylem parenchyma are rectangular in shape with simple pits and lignified walls. They measure from 55-60-75 μm in length and 18-25-30 μm in width (Figure 7G).

4.2.4 The pith

The pith is formed of a wide parenchymatous zone (Figure 2 & 3) consisting of large and oval to round with moderate thin walls. They have needle crystals of calcium oxalate (8-15-20 μm in length) and starch granules, measuring 28-42-57 μm in diameter. The pith represents approximately 3/4 of the whole transverse section of the stem.

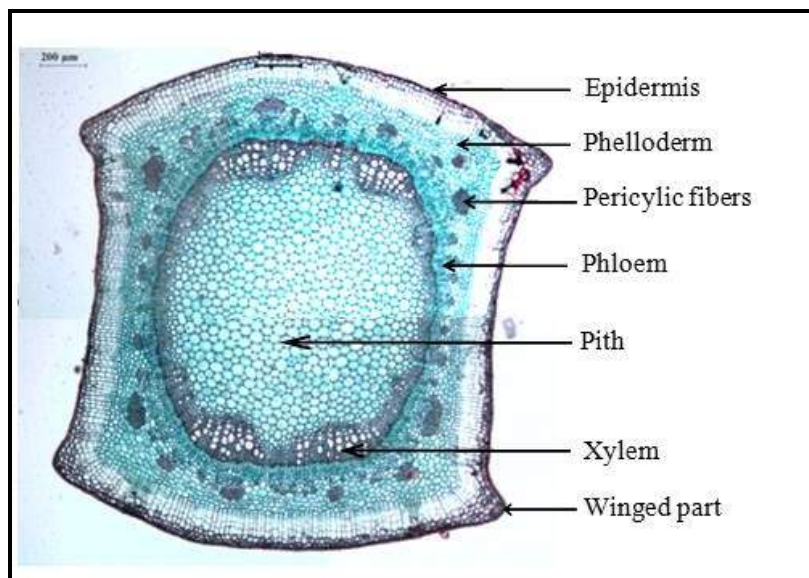


Fig 2: Photo of the diagrammatic T.S. of the stem

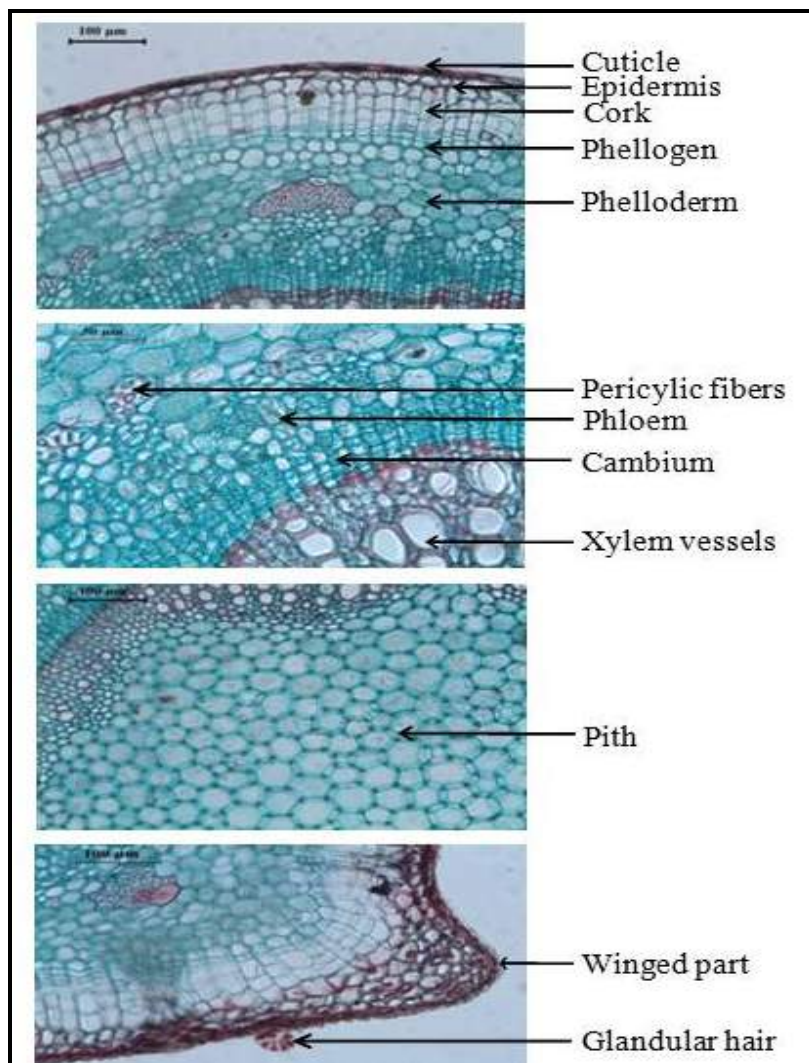


Fig 3: Photos of detailed T.S. of the stem with winged part

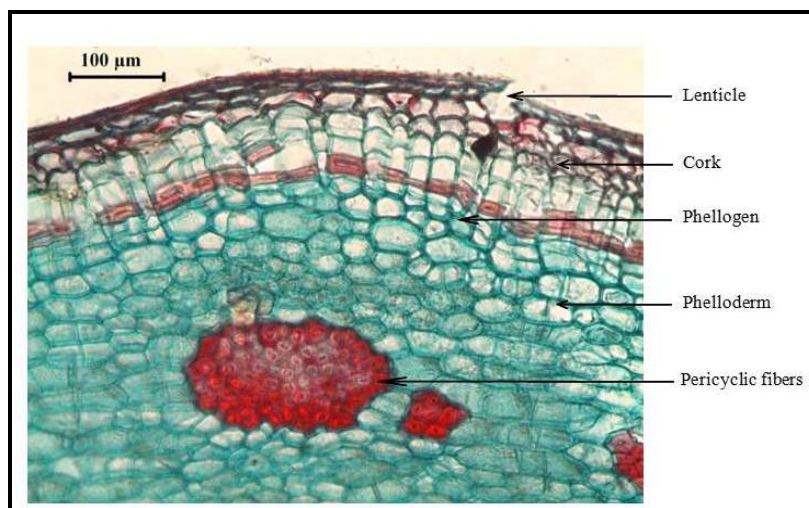


Fig 4: Photo of detailed T.S. of the stem (periderm and pericycle).

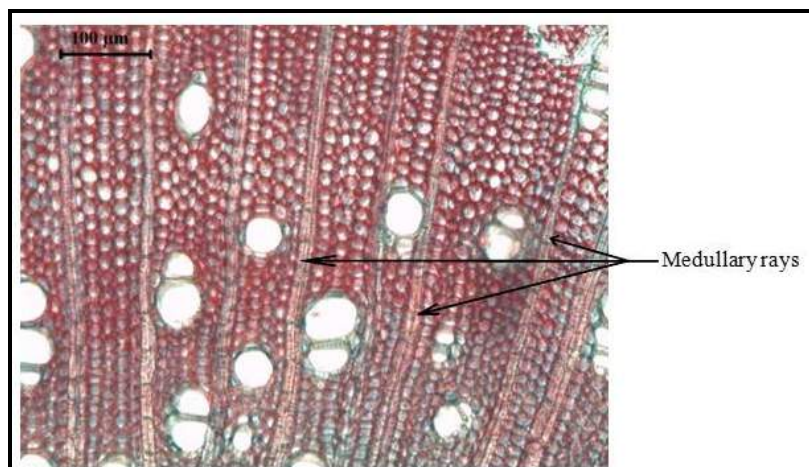


Fig 5: Photo of detailed T.S. of the stem (xylem).

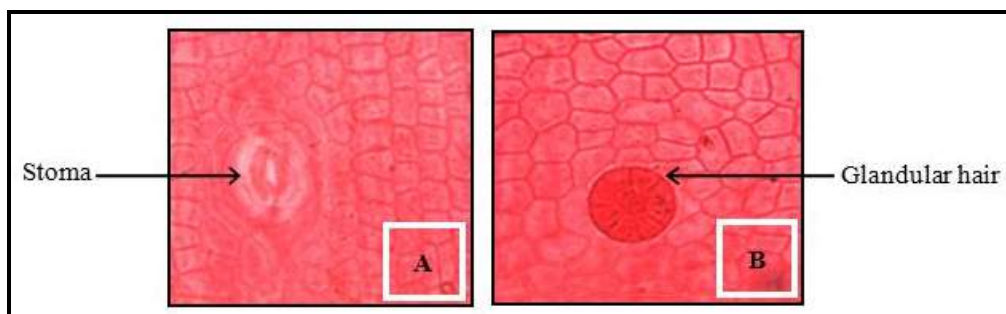


Fig 6: Photos of surface preparation of the stem:
A. Anomocytic stoma, **B.** Top view of glandular hair.

4.2.5 The powder of the stem

The powder of the stem is greenish brown in color, faint characteristic odor and faint bitter taste. The main diagnostic elements are:

1. Fragments of the cork cells are formed of sub rectangular cells (Figure 7A).
2. Fragment of the epidermal cells shows top view of the glandular hairs (Figure 7B).
3. Lignified, elongated pericyclic fiber with acute apex, narrow lumen, thick, lignified, straight walls (Figure 7C).
4. Lignified spiral xylem vessel (Figure 7D).
5. Lignified, elongated xylem fiber with acute apex, narrow

- lumen, thick, lignified and straight walls (Figure 7E).
 6. Small, oval, simple starch granules with indistinct striations and hilum (Figure 7F).

7. Fragments of rectangular wood parenchyma with simple pits and lignified walls (Figure 7G).
 8. Fragments of Medullary rays (Figure 7H).

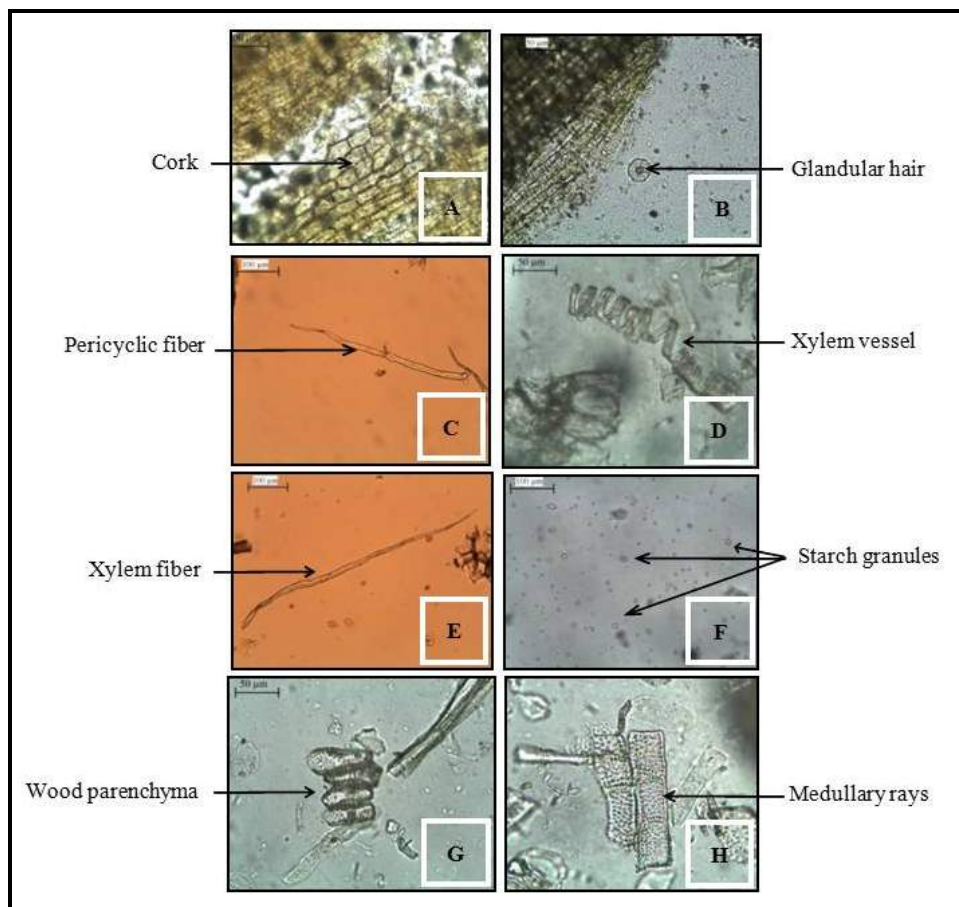


Fig 7: Photos of the powdered stem

5. Conclusion

The study investigates macroscopic and microscopic characters which could be helpful in authentication of the stem of *Citharexylum quadrangulare* Jacq. and for further scientific investigation of the plant.

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