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Stem botanical studies of *Parmentiera cereifera* Seem., family Bignoniaceae, cultivated in Egypt

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Abstract

Many families are rich in secondary metabolites and have high economic and therapeutic values such as Family Bignoniaceae. One of the important plants of this family is *Parmentiera cereifera* Seem. A thorough survey search indicated that *P. cereifera* was not studied the stem pharmacognostically. The current study investigates both macroscopical and microscopical features, which could be helpful in authentication of the plant stem. It is also supportive in the identification of powdered drug prior using in any herbal preparations.

Keywords: Bignoniaceae, Botanical, *Parmentiera cereifera*, stem

1. Introduction

Many families are rich in active principles and have high economic and medicinal values as Family Bignoniaceae [1]. Its plants are particularly abundant in northern South America, a few genera occur in tropical Africa, Madagascar and Asia [2]. It comprises 104 genera and 860 species, according to the last taxonomic revision [3]. One of these species is *Parmentiera cereifera* Seem. was named after the French botanist Antione Augustin Armentieres [4], while *cereifera* means wax bearing [5]. It has no synonyms [6]. Reviewing the available botanical literature, one showed that described both upper and lower epidermises of *P. cereifera* leaf [7] and another one describing the wood characters of genus *Parmentiera* [8]. Moreover, the recent chemical investigation revealed the isolation of two new phenolic acid glycosides from the leaves and stems of *P. cereifera* [9]. A thorough survey search indicated that *P. cereifera* was not studied the stem pharmacognostically. The current study investigates both macroscopical and microscopical features, which could be helpful in authentication of the plant stem. It is also supportive in the identification of entire and powdered drug prior using in any herbal preparations.

2. Material, dyes and methods

2.1 Plant material

The plant material (stems) of *P. cereifera* was cultivated in El-Zohria botanical garden, Giza, Egypt. It was collected in February 2009. Dr. Mamdouh Shokry (Director of El-Zohria Garden) identified the plant. A voucher sample was kept in the Herbarium of Pharmacognosy Department., Faculty of Pharmacy, Minia University, Minia, Egypt. The number of the voucher specimen is (Mn-Ph-Cog-003). The fresh plant samples and the preserved ones in alcohol (70%)-glycerine-water (1:1:1) are used in the botanical study. They were air-dried and grinded for microscopical examination. They stored in closely tight containers.

2.2 Taxonomy

P. cereifera Seem. Belongs to [10]:

Kingdom: Plantae, **Subkingdom:** Viridaplantae (green plants), **Infrakingdom:** Streptophyta (land plants), **Superdivision:** Embryophyta, **Division:** Tracheophyta (vascular plants), **Subdivision:** Spermatophytina (seed plants), **Infradivision:** Angiospermae (flowering plants), **Class:** Magnoliopsida, **Superorder:** Asteranae, **Order:** Lamiales, **Family:** Bignoniaceae (bignonias), **Genus:** *Parmentiera* DC. and **Species:** *P. cereifera* Seem. (Candle tree).

2.3 Dyes

The plant sections, surface preparations and powder are stained with safranin and light green dyes.

2.4 Microscopic studies

Surface preparations, transverse sections as well as the 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) and digital, 10 megapixels camera, Samsung (Korea).

3. Results and Discussion

3.1 Macroscopical characters of the stem

It is a small, evergreen, erect and spineless tree up to 7 m in height, the trunks reach 20 cm in diameter, with strongly ascending main branches from near the ground. The leafy stems measure 1.2-6.0 mm in diameter, terete, usually with hard shelf-like tissue below the leaf base ^[11, 12] (Figure 1).

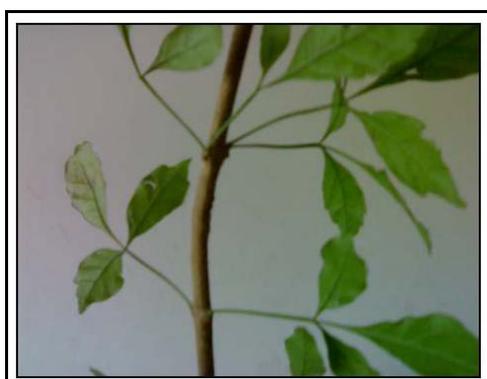


Fig 1: Photo Stem of *Parmentiera cereifera* (x 0.4).

3.2 Micromorphology of the stem

3.2.1 The upper part of the stem

A transverse section (T.S.) in the upper part of the stem is oval

to rhomboidal in outline (Figure 2). The section reveals an epidermis followed by a narrow cortex formed of subepidermal masses of collenchyma cells and parenchymatous layer towards the vascular tissue. In addition, the section shows the pericycle, which is mainly parenchymatous with few pericyclic fibers surrounding a continuous ring of vascular tissue with wide parenchymatous pith in the center.

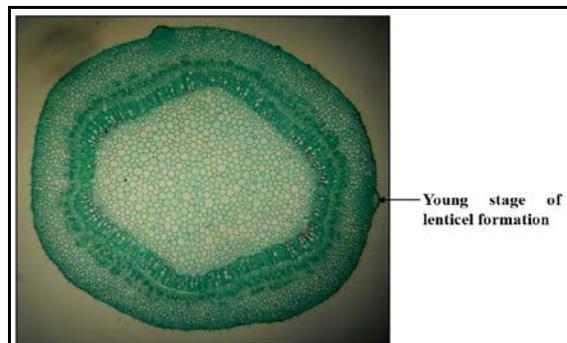


Fig 2: Diagrammatic T.S. of the upper part of the stem (x 47).

3.2.1.1 The epidermis

It is formed of one row of subrectangular to square cells as seen in the transverse section (Figure 3B). In surface view, the epidermal cells appear polygonal, axially elongated with straight anticlinal walls covered with smooth cuticle (Figure 4A). Hairs of both glandular and non-glandular types are present. Non glandular unicellular conical hairs covered with slightly thick, smooth cuticle are numerous (Figures 3 and 4B). Bicellular non glandular hairs are less abundant (Figure 4B). Glandular hairs with unicellular stalk and multicellular head of 16-22 radiating cells (peltate hairs) are present (Figure 4C).

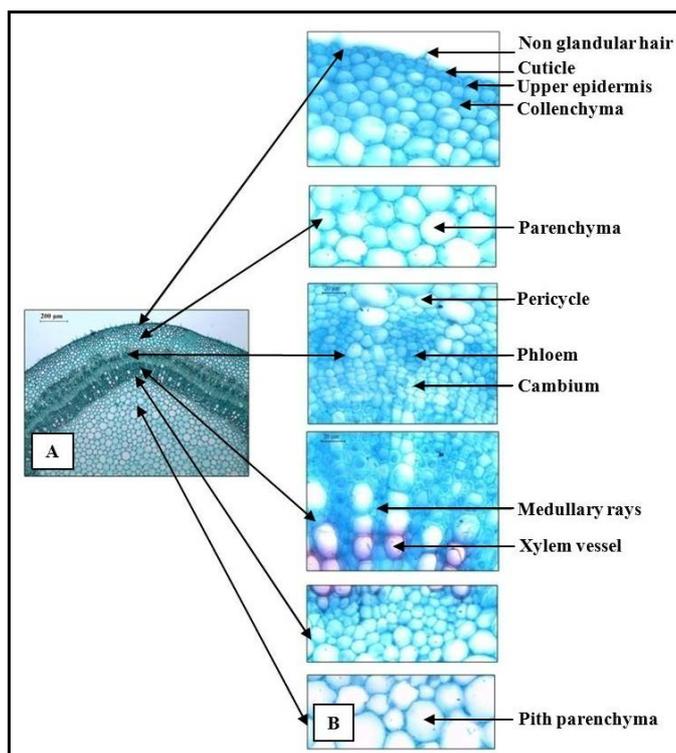


Fig 3: T.S. of the upper part of the stem; A-Diagrammatic (x40) and B-Detailed (x200).

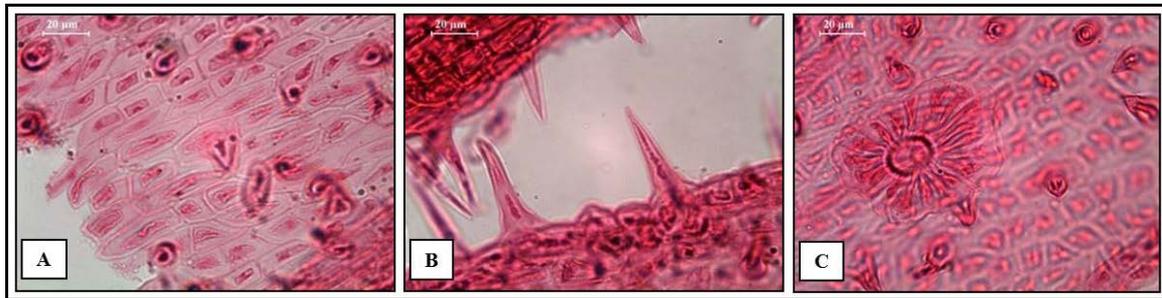


Fig 4: Stem epidermis of the upper part of the stem; **A**-Top view, **B**-Non-glandular hairs (side view) and **C**-Peltate hair (top view) (All x 400).

3.2.1.2 The cortex

It is a narrow zone formed of an outer subepidermal collenchymatous zone followed by an inner parenchymatous zone. The collenchyma layer is formed of 3-4 rows of rounded to oval cells having thick cellulosic walls with no intercellular

spaces, while the parenchymatous zone consists of 4-6 rows of rounded to oval cells having thin cellulosic walls with intercellular spaces. The endodermis is parenchymatous and indistinguishable (Figure 3).

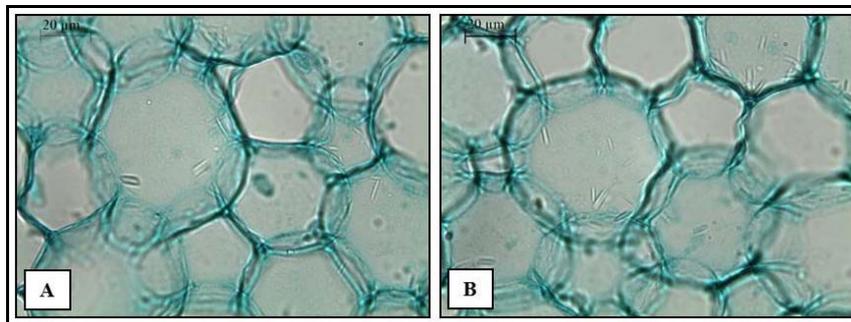


Fig 5: Calcium oxalate in pith parenchyma of the upper part of the stem; **A**-Prisms crystals and **B**-Acicular (x 400).

3.2.1.3 The Vascular tissue

3.2.1.3.1 The pericycle

It is formed mainly of parenchymatous cells with few fibers. They are long with moderately narrow lumina and non-lignified walls. (Figure 3).

3.2.1.3.2 The phloem

It is formed of a narrow ring of thin walled, soft, cellulosic elements; sieve tubes, companion cells and phloem parenchyma. The phloem region is free of any lignified elements (Figure 3).

3.2.1.3.3 The cambium

The phloem is separated from the xylem by a zone of cambium, which is formed of 4-5 rows of thin-walled, cellulosic, meristematic and rectangular cells (Figure 3).

3.2.1.3.4 The xylem

It forms a narrow zone that consists of xylem vessels (which are slightly lignified towards the pith) mainly with spiral thickening in addition to xylem parenchyma. Uniseriate to biseriate medullary rays traverse the xylem zone (Figure 3).

3.2.1.4 The pith

It represents approximately 3/4 of the whole section. It is formed of a wide zone of rounded and thin walled parenchyma cells containing acicular crystals and prisms of calcium oxalate (Figures 3 and 5).

3.2.2 The lower part of the stem

A transverse section in the lower part of the stem is more or less circular in outline showing a layer of cork cells followed by secondary cortex. The pericycle appears as scattered patches of lignified pericyclic fibers surrounding a continuous ring of vascular tissue. The pith is comparatively narrower than the upper part of the stem (Figure 6).



Fig 6: Diagrammatic T.S. of the lower part of the stem (x 27).

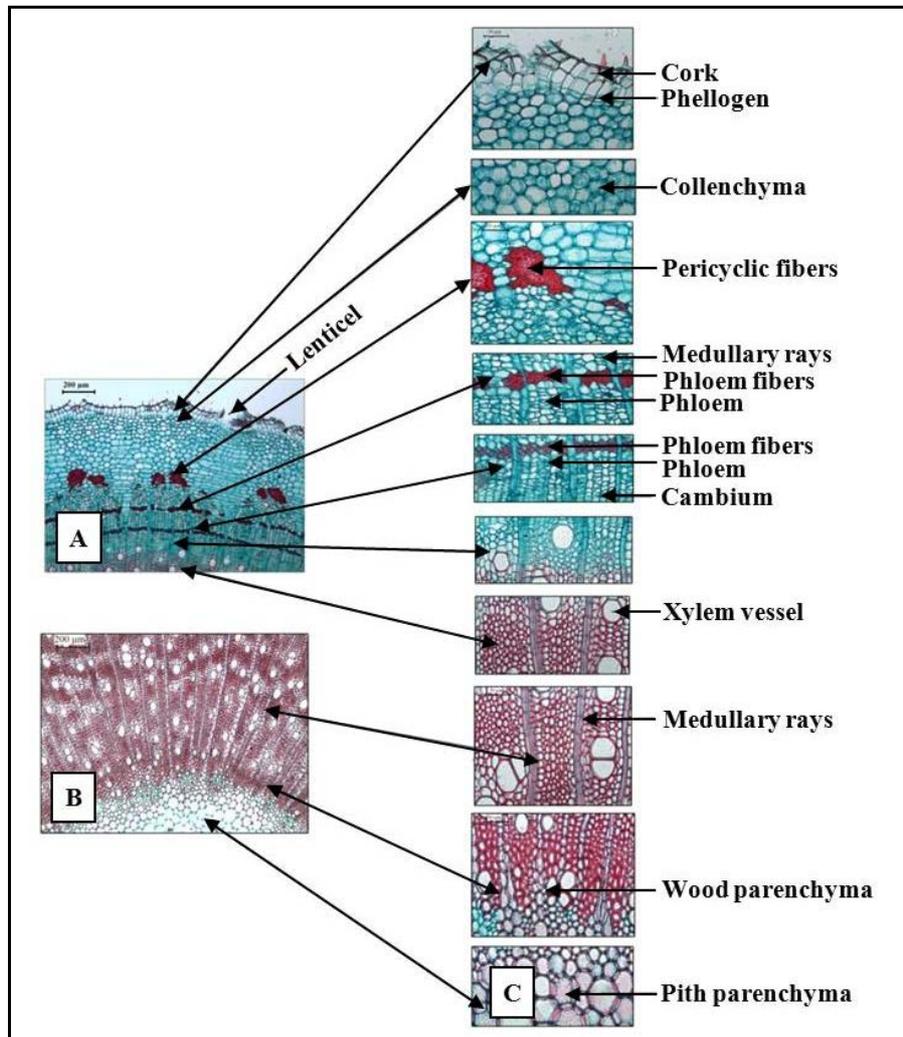


Fig 7: T.S. of the lower part of the stem; **A** and **B**-Digrammatic (x40) and **C**-Detailed (x 200).

3.2.2.1 Cork

It is formed of 2-3 layers of thin walled and rectangular cells as seen in the transverse section (Figure 7). The cork cells are not well-differentiated (Figures 7 and 13A). The remainings of epidermal cells may be seen above the cork layer (Figure 8). Transverse sections taken just above and below the nodes show an abnormal continuous ring of lignified square to subrectangular sclereids surrounding the cork layer just beneath the remainings of epidermal cells (Figure 8).

3.2.2.2 Secondary cortex

It is formed of an outer zone of collenchyma and an inner zone of parenchyma. The collenchyma layer consists of 5-6 rows of rounded to oval cells having thick cellulosic walls and no intercellular spaces. The collenchymatous layer is interrupted by oval to subrectangular parenchyma cells. The parenchyma layer is formed of thin walled of rounded to oval parenchyma cells in the region above the pericyclic fibers alternating with oval to rectangular parenchyma cells in the other regions. The parenchyma cells have thin cellulosic walls with intercellular spaces. The endodermis is indistinguishable (Figure 7).

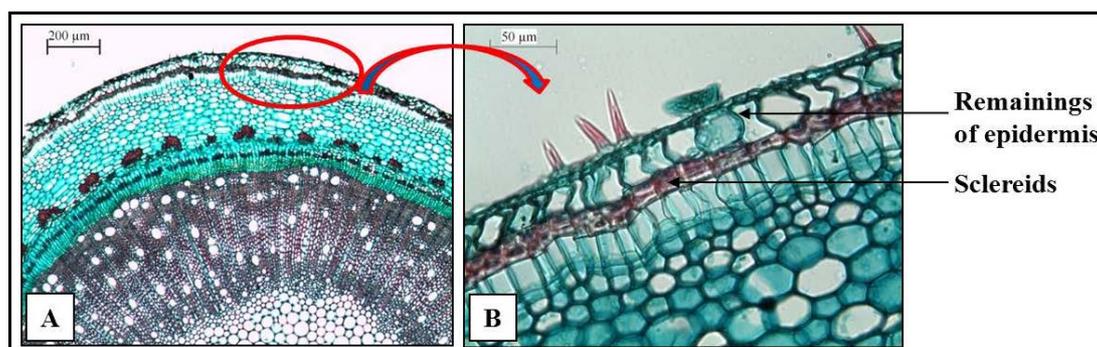


Fig 8: T.S. in the node of the lower part of the stem (**A** x 40 and **B** x 200).

3.2.2.3 The Vascular tissue

3.2.2.3.1 The pericycle

It consists of scattered groups of lignified fibers. Each group is formed of 20-30 fibers. The fibers are long with moderately narrow lumena and heavily lignified thick walls with few projections (dentate like) (Figures 7 and 9A).

3.2.2.3.2 The secondary phloem

It appears as alternating layers of fibrous and soft tissues

traversed by medullary rays (Figure 7) [13]. The phloem fibers are comparatively short, lignified with moderately narrow lumena and tapering ends (Figures 9B and 13D). The soft, thin walled cellulosic parts of the phloem consist of phloem parenchyma and sieve elements (sieve tubes and companion cells). The medullary rays are uniseriate or biseriate consisting of elongated parenchyma cells (Figures 7, 10A and 13H).

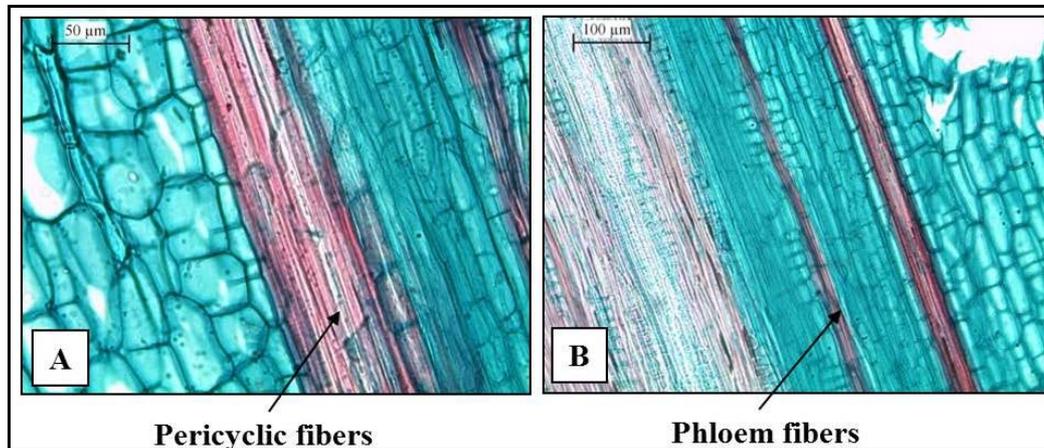


Fig 9: Longitudinal section (L.S.) of the lower part of the stem showing; **A**-Dentate-like pericyclic fibers (x 200) and **B**-Phloem fibers (x 100).

3.2.2.3.3 The secondary cambium

It is formed of 5-6 thin walled, cellulosic, meristematic rectangular cells (Figure 7).

3.2.2.3.4 The xylem

It forms a relatively wide zone formed of xylem vessels, tracheidal vessels, wood fibers and wood parenchyma (Figures 7 and 10). The xylem vessels are lignified, mainly spiral and

rarely reticulate (Figure 13F). The wood fibers are lignified with moderately narrow lumena, thick straight walls and tapering ends (Figures 11 and 13E). The wood parenchyma cells are lignified and pitted (Figures 7, 10A and 13G). The zone of secondary xylem is traversed by lignified, pitted, uniseriate to biseriate medullary rays (Figures 7, 10A and 13H).

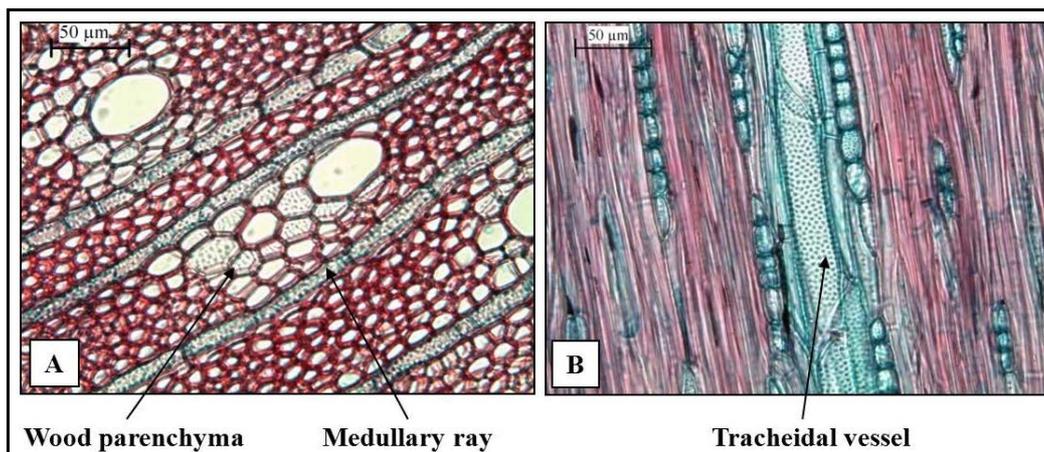


Fig 10: The lower part of the stem showing; **A**-Medullary ray cells and wood parenchyma (T.S.) and **B**-Tracheidal vessels (L.S.) (All x 200).



Fig 11: Wood fiber from the isolated elements of the inner part of the lower part of the stem (x 100).

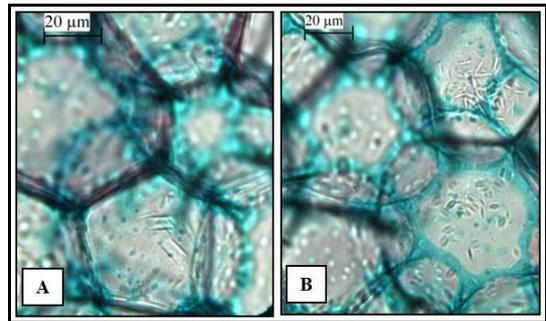


Fig 12: Calcium oxalate in pith parenchyma of the lower part of the stem; **A**-Acicular crystals and **B**-Prisms crystals (All x 400).

3.2.2.4 The pith

It is relatively narrower than that of the upper part of the stem. The pith is formed of rounded, slightly lignified and pitted parenchyma cells containing prisms and acicular crystals of calcium oxalate (Figures 7 and 12).

3.2.2.5 The powder of the stem

It is straw-yellow in color with a faint odor and a slightly bitter taste. Its elements are displayed in (Figure 13).

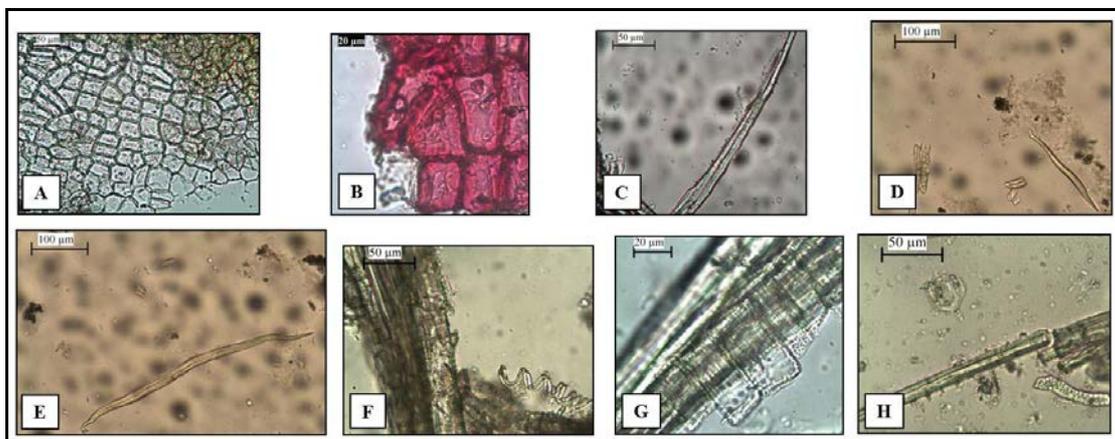


Fig 13: The powder of the stem; **A**-Fragment of cork cells (x 200), **B**-Fragment of sclereids (x 400), **C**-Fragments of pericyclic fibers (x 200), **D**-Fragment of phloem fibers (x100), **E**-Fragment of wood fibers (x100), **F**-Fragment of spiral xylem vessel (x 200), **G**-Fragment of wood parenchyma and **H**-Fragment of medullary ray cells (x 200).

Table 1: Microscopical dimensions of the stem of *P. cereifera* in microns (μ.).

Item	Length	Width	Height	Diameter
The upper part of the stem				
Epidermis	20-28-36	8-11-16	7-8-13	
Non-glandular unicellular hairs	40-42-44			
Peltate hair				43-53-60
Collenchyma				10-15-19
Parenchyma of cortex				20-28-40
Xylem vessels				19-24-29
Parenchyma of pith				30-38-63
Acicular crystals of calcium oxalate	6-7-9			
Prisms of calcium oxalate	7-8-9	1.8-2.5-3.6		
The lower part of the stem				
Cork	20-22-33	8-11-16	13-17-18	
Sclereids	30-31-34	19-22-25		
Collenchyma				30-32-35
Parenchyma of cortex				40-55-58
Pericyclic fibers	210-215-398			15-17-19
Phloem fibers	178-180-214			6-8-10
Wood fibers	450-675-682			18-20-22
Trachiedal vessel	107-145-192			24-25-28
Xylem vessel				16-22-29
Medullary ray	50-63-70	10-13-15		
Wood parenchyma	21-40-50	15-23-29		
Parenchyma of pith				30-60-86
Acicular crystals of calcium oxalate	4-6-8			
Prisms of calcium oxalate	9.2-10-10.8	3-4-4.6		

4. Conclusion

Examination of both macroscopical and microscopical features of the stem of *P. cereifera* Seem. represents a good method in the identification of the plant. In addition, these characters will be helpful in the future investigation of the plant in many pharmacognostical and pharmacological studies.

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