Leaf Morphoanatomy Studies of *Parmentiera cereifera* Seem., Family Bignoniaceae, Cultivated in Egypt

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Abstract

*Parmentiera cereifera* Seem. is one of the edible and medicinal plants. It is known as Candle tree, Candlestick tree and Panama Candle tree. Reviewing the available literature, only two studies could be traced concerning the microscopical features of *P. cereifera*. The current leaf morphoanatomy studies showed various standardized parameters such as macroscopic and microscopic characters. These various diagnostic features could be helpful in authentication and identification of *P. cereifera* Seem. leaf.

Keywords: *Parmentiera cereifera* Seem., Bignoniaceae, leaf, leaflet, rachis, morphoanatomy

1. Introduction

Family Bignoniaceae is rich in secondary metabolites and includes many genera of high economic and medicinal values [1]. It is known as the Bignonia family [2]. It is widely distributed in tropical and subtropical regions, with a few species in temperate climates [3]. It comprises 104 genera and 860 species, according to the last taxonomic revision [3]. One of these species is *Parmentiera cereifera* Seem. It is one of the edible and medicinal plants [4]. A study in the available botanical literature described the upper and lower epidermises of the leaf of *P. cereifera* [5]. Another study illustrated the macro- and microscopic characters of the stem [6]. Moreover, the features of the wood of genus Parmentiera were reported previously [7]. A thorough literature search showed that *P. cereifera* was not studied the botany of the leaf. The present study investigates leaf botanical characters not only morphologically but also anatomically, which could be helpful in authentication of the leaf of *P. cereifera* Seem. It is also give a tool for herbal quality control of the plant.

2. Taxonomy

*P. cereifera* Seem. belongs to [8];

**Kingdom:** Plantae, **Subkingdom:** Viridiplantae, **Infrakingdom:** Streptophyta, **Superdivision:** Embryophyta, **Division:** Tracheophyta, **Subdivision:** Spermatophytina, **Infradivision:** Angiospermae, **Class:** Magnoliopsida, **Superorder:** Asteranae, **Order:** Lamiales, **Family:** Bignoniaceae, **Genus:** Parmentiera DC. and **Species:** *P. cereifera* Seem. (Candle tree).
3. Experimental
3.1 Plant material
The plant material (leaves) of *P. cereifera* cultivated in El-Zohria botanical garden, Giza, Egypt, (Figures 1 and 2). The plant material was collected in February 2009. The plant was kindly identified by Dr./ Mamdouh Shokry, director of El-Zohria botanical garden. A voucher specimen (Mn-Ph-Cog-003) was kept in the Herbarium of Pharmacognosy Dept., Faculty of Pharmacy, Minia University, Minia, Egypt. The plant material used for botanical study was taken from the fresh samples, as well as the samples preserved in alcohol (70%)-glycerine-water (1:1:1). The leaves were air-dried, reduced to fine powder suitable for microscopical examination and stored in well-closed containers.

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

3.3 Microscopic studies
Surface preparations, transverse sections (T.S.), longitudinal sections (L.S.) as well as the powder of the leaf were used for observation of various microscopic features. All microscopical investigations were done by using Microscope with camera, Leica® (Germany) and 10 megapixels digital camera, Samsung (Korea).

4. Results and Discussion
4.1 Macroscopical characters of the leaves
The leaves are palmate compound with opposite to subopposite phyllotaxis, rarely in whorls of 3 or 4. The leaves are formed of three leaflets on winged, narrow and greenish petioles. They measure 1.5-5.0 cm in length and 0.3 cm in width. The leaflets are elliptic to elliptic-rhomboidal in shape and the terminal leaflets are larger in size than the laterals. The leaflets measure 1.5-7.0 cm in length and 0.8-3.5 cm in width in the middle part. The margin of both lateral and terminal leaflets is entire when the tree matures, but when juvenile the margin is coarsely serrate. The apex is acute to acuminate and the base is decurrent on the petiole [4, 9]. The leaflet shows reticulate pinnate venation. The surface of the leaflet is hairy. Both the upper and lower surfaces are dark green in color (Figure 2).

4.2 Microscopical characters of the leaf

4.2.1 Microscopical characters of the leaflet
A transverse section in the leaflet blade shows that the midrib is prominent on the lower surface and showing a small raised rounded ridge on the upper surface (Figure 4B). The lamina has a dorsiventral structure and the palisade layer is continuous in the midrib region (Figure 4A and 4B). The transverse section also reveals a mass of subepidermal collenchyma under the upper and lower epidermises in the midrib region. The vascular system of the midrib is formed of a collateral vascular bundle with central pith surrounded by a quite or
almost continuous ring of xylem and phloem. The pericycle consists of groups of lignified pericyclic fibers lining the vascular bundle, interrupted by few parenchyma cells (Figures 4B and 4C).

4.2.1.1 The epidermis

4.2.1.1.1 The upper epidermis

It is formed of one row of subrectangular to square cells as seen in the transverse section (Figures 4A, 4C and 5C). In surface view, the cells appear polygonal, with slightly sinuous anticlinal walls covered with thin, slightly striated cuticle and stomata are absent (Figure 5A, 5B and 16F). The cells of the upper epidermis contain cluster, acicular crystals and prisms of calcium oxalate in addition to starch granules, which are oval to round in shape with central point-like hilum (Figures 5 and 16F). The granules are medium in size and the aggregation is mainly simple. The striations are indistinct.

The upper epidermis shows many types of hairs of both glandular and non-glandular types. It has two types of glandular hairs. The first one shows a multicellular head with indefinite number of cells and a unicellular stalk, which is called patelliform hair (Figure 6A, 6B and 16E). The second type of glandular hair shows unicellular stalk and multicellular head of 16-22 radiating cells, which is called peltate hair (Figure 6C, 6D and 16D). The non-glandular hairs present in 4 different types. Abundant unicellular conical, non-glandular hair covered with smooth cuticle (Figures 7A and 16C). Bicellular (Figures 7B and 16A) and multicellular uniseriate hairs of 4-8 cells with acute apices are present, but they are less abundant (Figures 7D and 16B). Another type of multicellular hair is presently having 3-4 uniseriate cells with blunt apex and the cells are nearly equal in size (Figure 7C). The neural epidermis is slightly elongated carrying glandular and non-glandular hairs (Figure 8).

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Fig 4: Detailed T.S. of the leaflet; A-Lamina and B-Midrib.
Fig 5: Upper epidermis showing; A-Prisms of calcium oxalate in surface preparation (x 200), B-Clusters of calcium oxalate and starch granules in surface preparation (x 400) and C-Clusters of calcium oxalate in T.S. in the lamina (x 400).

Fig 6: Upper epidermis showing glandular hairs; A-Top view of patelliform (x 400), B-Side view of patelliform (x 200), C-Top view of peltate (x 400) and D-Side view of peltate (x 200).

Fig 7: Upper epidermis showing side views of non-glandular hairs; A-Unicellular (x 400), B-Unicellular and bicellular hairs (x 400), C-Multicellular hairs with blunt apex (x 400) and D-Multicellular with acute apex (x 100).
4.2.1.2 The lower epidermis
It is formed of one row of subrectangular to square cells as seen in the transverse section (Figures 4C and 9C). In surface view, the cells appear polygonal, with slightly more sinuous anticlinal walls than the upper epidermis, covered with thin smooth cuticle. The stomata are found only on the lower epidermis. Its type is anomocytic (Figures 9A, 9B and 16G). They are surrounded by 4-6 subsidiary cells. The cells of the lower epidermis also contain cluster, acicular crystals and prisms of calcium oxalate in addition to starch granules as the upper epidermis (Figure 9).

4.2.1.3 The cortex
It shows both upper and lower subepidermal collenchyma layers. The upper layer consists of 3-4 rows and the lower layer is formed of 1-2 rows (Figure 4C). The collenchyma cells have thick cellulosic walls with no intercellular spaces. The rest of the cortical tissue consists of rounded to oval parenchyma cells having thin cellulosic walls surrounding the main vascular bundle of the midrib. It is wider below the bundle, consisting of 5-6 rows of parenchyma cells, while above the bundle, the parenchyma is formed of 1-2 rows of cells (Figure 4C). The cortex parenchyma contains acicular, prism and cluster crystals of calcium oxalate (Figure 10). The endodermis is parenchymatous and slightly distinguishable (Figure 4C).
4.2.1.4 The vascular tissue
4.2.1.4.1 The pericycle
It is formed of islets of strongly lignified pericyclic fibers separated by parenchyma cells (Figure 4C). The pericyclic fibers are fusiform in shape, septate with thick lignified dentate walls (Figures 11 and 16L).

4.2.1.4.2 The phloem
It is formed of a narrow ring. It consists of thin walled, soft cellulosic elements; sieve tubes, companion cells and phloem parenchyma. The phloem region is free from any lignified elements (Figure 4C).

4.2.1.4.3 The cambium
It is formed of 2-3 rows of thin walled, cellulosic, meristematic and rectangular cells (Figure 4C).

4.2.1.4.4 The xylem
It is formed of lignified vessels, wood fibers, wood parenchyma and medullary rays (Figure 4C). The vessels have mainly spiral and reticulate thickenings (Figures 12 and 16M). Wood fibers are spindle-shaped with thick lignified walls, acute apices and slightly narrow lumina (Figure 12). The wood parenchyma cells are rectangular in shape, with slightly lignified thin walls (Figures 4C and 12). The medullary rays are uni- to biseriate consisting of radially elongated thin-walled, slightly lignified cells (Figure 4C).
4.2.1.5 The pith
It is formed of rounded parenchyma cells with thin cellulosic walls (Figure 4C).

4.2.2 Microscopical characters of the petiole of the leaflet
A transverse section in the petiole shows a similar structure to that of the leaflet except the presence of a small zone of collenchyma at the periphery of the wing (Figure 13).

4.2.3 Microscopical characters of the leaf rachis
It is recognized into two parts; a large winged part and a small non-winged part near its attachment to the stem.

4.2.3.1 Microscopical characters of the leaf rachis (winged part): A transverse section in the winged part of the rachis shows that it is plano-convex in outline with two wings on its upper side. The wings are similar in structure to those of the petiole and the vascular system is identical to that of the leaflet and the petiole (Figure 14).
4.2.3.2 Microscopical characters of the leaf rachis (non-winged part)
A transverse section in the non-winged part of the rachis reveals that it is nearly circular in outline, more or less flattened at the upper surface with two slightly raised in small ridges on the upper side. The structure of the non-winged part of the rachis is similar to that of the winged part, except the two small zones of collenchyma cells under the ridges (Figure 15).
4.2.4 The powder of the leaf

It is dark green in color with a faint aromatic odor and a slightly bitter taste. Its elements are shown in (Figure 16).
Fig 16: The powder of the leaf; A-Non-glandular bicellular hair (x 200), B-Non-glandular multicellular hairs with acute apex (x 200), C-Non-glandular unicellular hair (x 400), D-Glandular peltate hair (x 400), E-Glandular patelliform hair (x 400), F-Fragment of the upper epidermis with clusters of calcium oxalate (x 400), G-Fragment of the lower epidermis with anomocytic stomata (x 400), (H, I, J)-Fragments of parenchyma cells containing prisms and clusters of calcium oxalate (x 400), K-Scattered prisms of calcium oxalate (x 400), L-Fragments of pericyclic fibers (x 200) and M-Fragments of spiral and reticulate xylem vessels (x 400).

Table 1: Microscopical dimensions of the leaflet elements of *P. cereifera* in (µm).

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<thead>
<tr>
<th>Item</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
<th>Diameter</th>
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</thead>
<tbody>
<tr>
<td>1. Non-glandular unicellular hair</td>
<td>40-42-48</td>
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<tr>
<td>2. Non-glandular bicellular hair</td>
<td>50-53-56</td>
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<tr>
<td>3. Non-glandular multicellular hair with blunt apex</td>
<td>43-49-59</td>
<td>-----</td>
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<tr>
<td>4. Non-glandular multicellular hair</td>
<td>90-100-154</td>
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<td>5. Peltate hair</td>
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<td>-----</td>
<td>43-53-60</td>
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<tr>
<td>8. Upper epidermis</td>
<td>26-32-38</td>
<td>15-18-20</td>
<td>9-16-17</td>
<td>-----</td>
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<tr>
<td>9. Lower epidermis</td>
<td>-----</td>
<td>8-10-12</td>
<td>44-58-64</td>
<td>-----</td>
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<tr>
<td>11. Collenchyma</td>
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<td>-----</td>
<td>200-211-395</td>
<td>9-13-14</td>
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<td>12. Parenchyma of cortex</td>
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<td>-----</td>
<td>-----</td>
<td>19-20-22</td>
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<tr>
<td>13. Pericyclic fibers</td>
<td>218-221-230</td>
<td>-----</td>
<td>-----</td>
<td>16-18-34</td>
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<tr>
<td>15. Wood parenchyma</td>
<td>-----</td>
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<td>-----</td>
<td>13-20-27</td>
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<tr>
<td>16. Xylem vessels</td>
<td>6-7-11</td>
<td>2-4-5</td>
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<tr>
<td>17. Parenchyma of pith</td>
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<td>8-10-12</td>
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<td>18. Prisms of calcium oxalate</td>
<td>4-6-12</td>
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<td>19. Clusters of calcium oxalate</td>
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<td>3-4-5</td>
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<tr>
<td>20. Acicular crystals of calcium oxalate</td>
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<td>21. Starch granules</td>
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5. Conclusion
From over present study entitled "Leaf Morphoanatomy Studies of *Parmentiera cereifera* Seem., Family Bignoniaceae, 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.

6. References