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Enas R AbdEl-Aleem
Department of Pharmacognosy,
Faculty of Pharmacy, Minia
University, 61519 Minia,
Egypt

Fatma El-Zahraa F Sedik
Department of Pharmacognosy,
Faculty of Pharmacy, Minia
University, 61519 Minia,
Egypt

Mamdouh N Samy
Department of Pharmacognosy,
Faculty of Pharmacy, Minia
University, 61519 Minia,
Egypt

Samar Y Desoukey
Department of Pharmacognosy,
Faculty of Pharmacy, Minia
University, 61519 Minia,
Egypt.

Botanical studies of the leaf of *Cordia myxa* L.

Enas R AbdEl-Aleem, Fatma El-Zahraa F Sedik, Mamdouh N Samy and Samar Y Desoukey

Abstract

Cordia myxa L. (family: Boraginaceae). Is a medium sized deciduous tree. It is distributed in tropical and sub-tropical regions. The present study deals with macro- and micro-morphological investigation of *C. myxa* leaves, which will be greatly helpful in identification and authentication of this plant. The leaf is microscopically characterized by the presence of anomocytic stomata, non-glandular hairs and cystolith cell containing calcium carbonate.

Keywords: *Cordia myxa*, Boraginaceae, Leaves, botanical studies, Cystolith cell.

1. Introduction

Boraginaceae (Borage) family comprises about 2740 species distributed in 148 genera. The genus *Cordia* is one of the most representatives of this family. *Cordia* is a genus of trees or shrubs, sometimes subscendent in the borage family. About 300 species have been identified worldwide [1]. The generic name honours a 16th century botanist, Valerius Cordus [2]. The plant parts like fruits, leaves, stem bark, seeds and roots of most species of this genus have been used in traditional medicine [1].

Cordia myxa (Syn. *Cordia obliqua*, *Cordia crenata*) [3] is a medium sized deciduous tree about 10.5 m. It has several Common names: Clammy cherry, Sebesten plum, Lasura, Bhirala, Bhokar, Chhotalaslasa, Chhotalasora, Gondi, Guslasah and Rasalla. The flowering starts during the last week of April and continues till the end of May. The fruiting season lasts from the beginning of July to the end of August [4].

Hence, the current botanical study was undertaken to examine the macroscopic and microscopic characters of *Cordia myxa* L. leaves, which could be a useful tool for authentication of this plant.

2. Taxonomy

Cordia myxa L. belongs to Kingdom: Plantae; Sub-kingdom: Tracheobionta; Super division: Spermatophyta; Division: Magnoliophyta; Class: Magnoliopsida; Subclass: Asteridae; Order: Lamiales; Family: Boraginaceae, Borage family; Subfamily: Cordioideae; Genus: *Cordia*; Species: *Cordia myxa* L. [4, 5]

3. Materials and Methods

3.1. Plant material

The plant material consisted of *C. myxa* L. leaves (Fig. 1), were collected from El Orman garden in may 2015. The plant material was kindly identified by Prof. Mahmoud Abdel-Hady Hassan, Professor of Horticulture, Faculty of Agriculture, Minia University. A voucher sample (Mn-ph-Cog-023) was kept in the Herbarium of Pharmacognosy Department, Faculty of pharmacy, Minia University, Minia, Egypt. The plant material used for the botanical study was taken from the fresh samples, as well as the samples preserved in alcohol (70%)-glycerin-water (1:1:1). Leaves was also left for air drying in the shade, reduced to a fine powder for microscopical examination and stored in well-closed containers.

3.2. Preparation of samples for microscopical examination

Safranin, light green, phloroglucinol, concentrated hydrochloric acid and iodine were used for preparation the plant sections and the powder.

3.3. Microscopical studies

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

Correspondence
Enas R AbdEl-Aleem
Department of Pharmacognosy,
Faculty of Pharmacy, Minia
University, 61519 Minia,
Egypt



Fig 1: Photo of *Cordia myxa* L. (x 0.026)

4. Results and discussion

4.1. Macroscopical characters of the leaves

The leaves (Fig. 2) are simple, Alternate, lanceolate to broad ovate in shape and petiolated. The lamina has rounded or acuminate apex, symmetric base, entire to slightly dentate margin and reticulate venation. The midrib is more prominent on the lower surface. The leaf has acoriaceous texture. The upper surface is darker than the lower one. The leaves are variable in size measuring 8-17 cm in length and 5-8 cm in width. The petiole is cylindrical green in colour and measures 2-5 cm in length and 0.2-0.4 cm in diameter with faint odour and taste.



Fig 2: Photos of *Cordia myxa* L. leaves

4.2. Microscopical characters of the leaf

4.2.1. The Leaf blade

A transverse section in the leaf of the blade is biconvex in outline, showing that the midrib is more prominent on the lower surface than the upper surface (Fig. 3). It also shows a dorsiventral mesophyll interrupted in the midrib region by the cortical and vascular tissue and subepidermal layer of collenchyma cells under both upper and lower epidermis in the midrib region. The vascular bundles are 10-11 isolated collateral, ovoid in shape, with islets of lignified pericyclic fibers and circularly arranged forming pith, vertically intersected by parenchymatous cells of the vascular bundle sheath with an additional vascular bundle in the center in which xylem vessels are towards the upper epidermis.



Fig 3: A diagrammatic T.S. in the leaf. (x 40)

4.2.1.1. The epidermis

4.2.1.1.1. The upper epidermis

The upper epidermis is formed of a row of rectangular cells and covered with a thin cuticle, while in surface view the cells appear polygonal, isodiametric to slightly elongated cells with slightly wavy anticlinal walls covered with a thin cuticle. In lamina region, some epidermal cells are radially arranged surrounding cystolith cells which are distributed through the upper epidermis^[6]. Cystolith cells originate from epidermis

and penetrate through the palisade layer (Fig. 4 and 5). The upper epidermis shows anomocytic stomata. Stomata are oval in shape, consist of a wide osteole and two kidney shaped guard cells surrounded by 3-5 subsidiary cells (Fig. 6). The Upper epidermis rarely shows any hairs. The present hairs are either; short conical unicellular with swollen bases and covered with warty cuticles or long unicellular ones covered with smooth cuticles.

4.2.1.1.2. The lower epidermis

The lower epidermis is formed of a row of rectangular cells covered with a thin cuticle (Fig. 4 and 5), while in surface view the cells appear polygonal, isodiametric with wavy anticlinal walls, covered with a thin cuticle and showing anomocytic stomata (Fig. 6) and non-glandular hairs. The hairs are similar to those in the upper epidermis but more abundant. Hairs are commonly found at the junction between lamina and midrib where cystolith cells are absent in the lower epidermis (Fig. 4 and 5).

4.2.1.2. The mesophyll

The mesophyll is dorsiventral, showing a row of upper palisade cells which are cylindrical, columnar, containing chloroplasts and interrupted by cystolith cells [6] and are also discontinuous in the midrib region. The spongy tissue is formed of 6-9 rows of thin walled, rounded and slightly irregular chlorenchymatous cells with wide intercellular spaces (Fig. 4).

4.2.1.3. The cortical tissue

The cortical tissue of the midrib region (Fig. 5) shows upper and lower sub-epidermal collenchymatous layers. The upper layer is formed of 5-6 rows while the lower one is formed of 3-4 rows of small rounded cells having thick cellulosic walls with no intercellular spaces. Both epidermises are followed by 1-2 rows of parenchymatous vascular bundle sheath which is

formed of large rounded or oval cells with intercellular spaces containing starch granules. Starch granules are medium in size with a rounded shape, pointed or cleft hilum, invisible or absent striations and simple aggregation.

4.2.1.4. The vascular tissue

4.2.1.4.1. The pericycle

The pericycle is represented as islets of lignified pericyclic fibers which are circularly arranged and separated by parenchymatous cells resembling those of the vascular bundle sheath. It is also present above the central vascular bundle. Each group is formed of 9-20 fibers which are fusiform with thick lignified walls and narrow lumens with acute apices (Fig. 5).

4.2.1.4.2. The phloem

The phloem consists of thin walled, soft cellulosic tissue differentiated into sieve tubes, companion cells and phloem parenchyma (Fig. 5).

4.2.1.4.3. The cambium

The cambium is represented by 2-3 rows of tangentially elongated, thin walled, cellulosic, meristematic cells (Fig. 5).

4.2.1.4.4. The xylem

The xylem is formed of lignified xylem vessels and thin walled wood parenchyma (Fig. 5). The vessels show spiral thickening (Fig. 8). The medullary rays are bi, tri or multiseriate of elongated thin walled cellulosic parenchyma cells. The wood parenchyma consists of radially elongated thin walled cells.

4.2.1.5. The vascular tissue

The pith is circular in shape and consists of rounded thin walled parenchymatous cells with intercellular spaces surrounding the large central vascular bundle (Fig. 5).

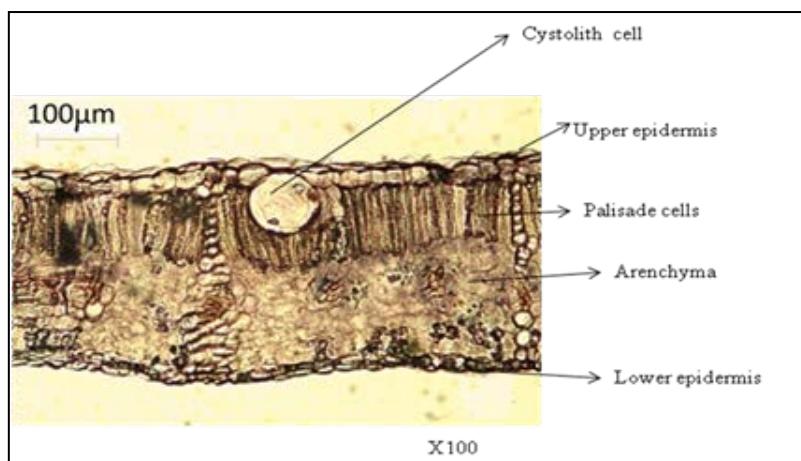


Fig 4: A detailed T.S. in the lamina of the leaf (x 100)

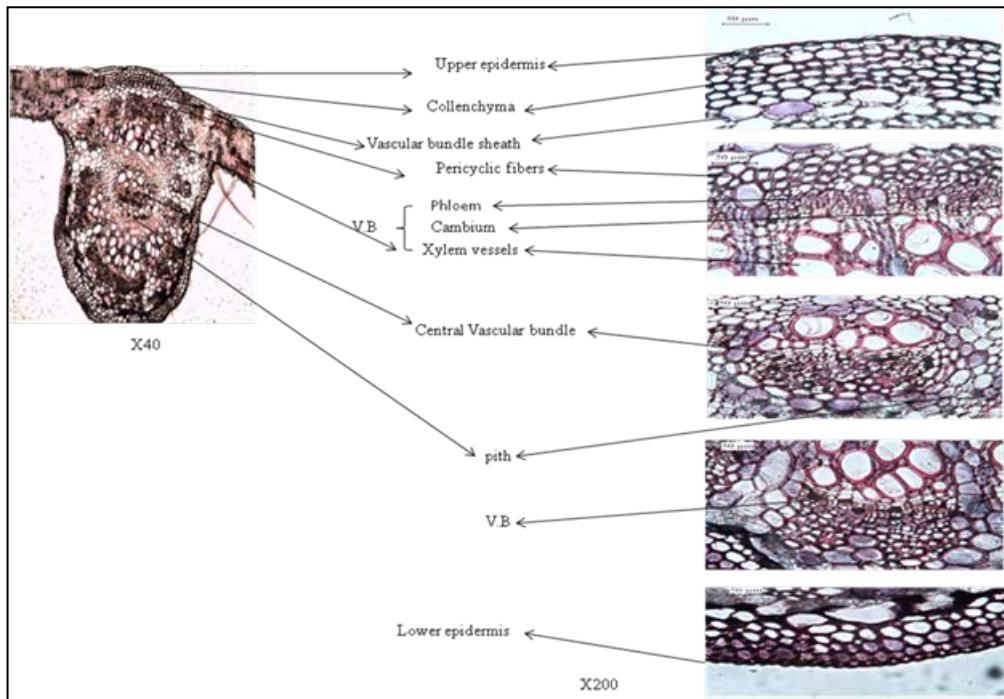


Fig 5: A detailed T.S. in the midrib region of the leaf(x200).

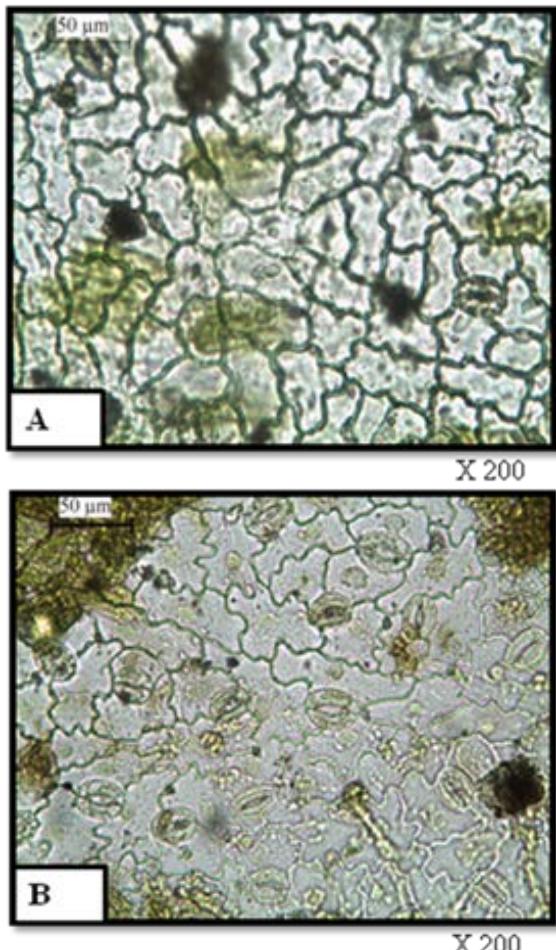


Fig 6: Surface preparation of leaf: (A) Upper epidermis, (B) Lower epidermis showing anomocytic stomata. (x 200).

4.2.2. The leaf petiole

A transverse section in the petiole (Fig. 7) is planoconvex in

outline showing two ridges on its upper side. Its structure is more or less similar to that of the midrib region of the leaf. It consists of upper and lower epidermises covered with a thin cuticle. The cortex is formed of subepidermal collenchymatous cells, followed by a vascular bundle sheath containing starch granules. The pericycle is parenchymatous and indistinguishable. The vascular bundles are about 12 isolated collateral, ovoid ones which are circularly arranged around the pith, with a large central inverted one, and two additional subsidiary vascular bundles are also present, one in each of the two upper ridges. The pith consists of rounded parenchymatous cells with intercellular spaces.

4.2.2.1. The epidermis

The epidermis is formed of small rectangular cells similar in structure to the upper and lower epidermises of the leaf (Fig. 7).

4.2.2.2. The cortical tissue

The cortex consists of upper collenchyma which is formed of 8-10 rows that extend also in the two ridges while the lower one is formed of 5-6 rows of small rounded cells having thick cellulosic walls with no intercellular spaces. The collenchymatous layer is followed by 1-2 rows of parenchymatous vascular bundle sheath which is formed of rounded or oval large cells with intercellular spaces, containing starch granules similar to those in the leaf (Fig 7).

4.2.2.3. The vascular system

The vascular system of the petiole is formed of about 12 isolated vascular bundles (Fig. 7). The pericycle is parenchymatous and indistinguishable and the vascular bundles are collateral, ovoid in shape and circularly arranged forming a pith accompanied by two subsidiary vascular bundles in the two upper ridges and a large central inverted one in the pith. The pith consists of rounded parenchymatous cells with intercellular spaces.

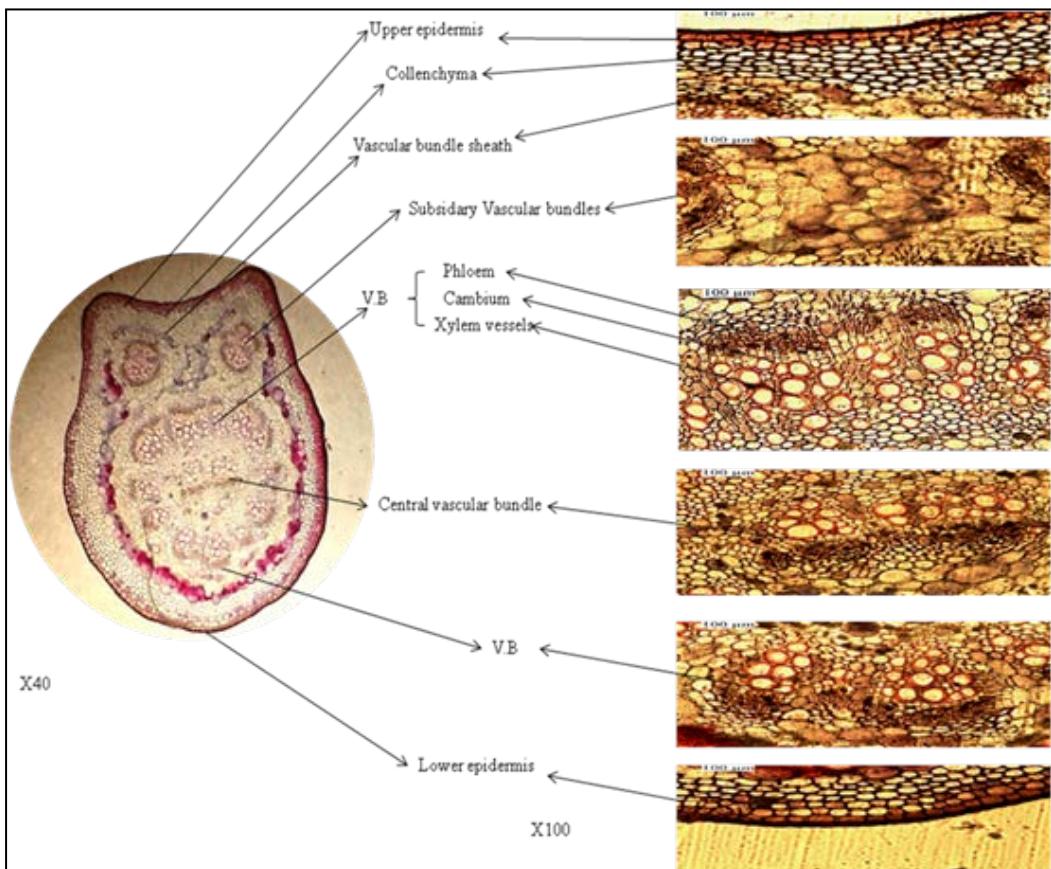


Figure 7: A detailed T.S. of the petiole (x 100).

4.2.3. The powdered leaf (Fig. 8)

The powder of the leaf is dark green in colour with a faint odour and taste. Elements of the powdered leaf include:

1-Fragment of upper epidermis showing polygonal, isodiametric cells with slightly wavy walls covered with a smooth cuticle showing cystolith cells containing calcium carbonate which is confirmed by using Conc. HCl giving effervescence.

2-Fragment of upper epidermis showing polygonal, isodiametric cells with slightly wavy walls covered with a smooth cuticle showing anomocytic stomata.

3-Fragment of lower epidermis showing polygonal, isodiametric cells with wavy walls covered with a smooth cuticle showing a higher number of anomocytic stomata than

the upper epidermis.

4- Short conical non glandular unicellular hairs with swollen bases and covered with warty cuticles.

5- Long non glandular unicellular hairs covered with smooth cuticles.

6- Fragment of pericyclic fibers of the leaf showing fusiform fibers with thick walls, narrow lumens and acute apices.

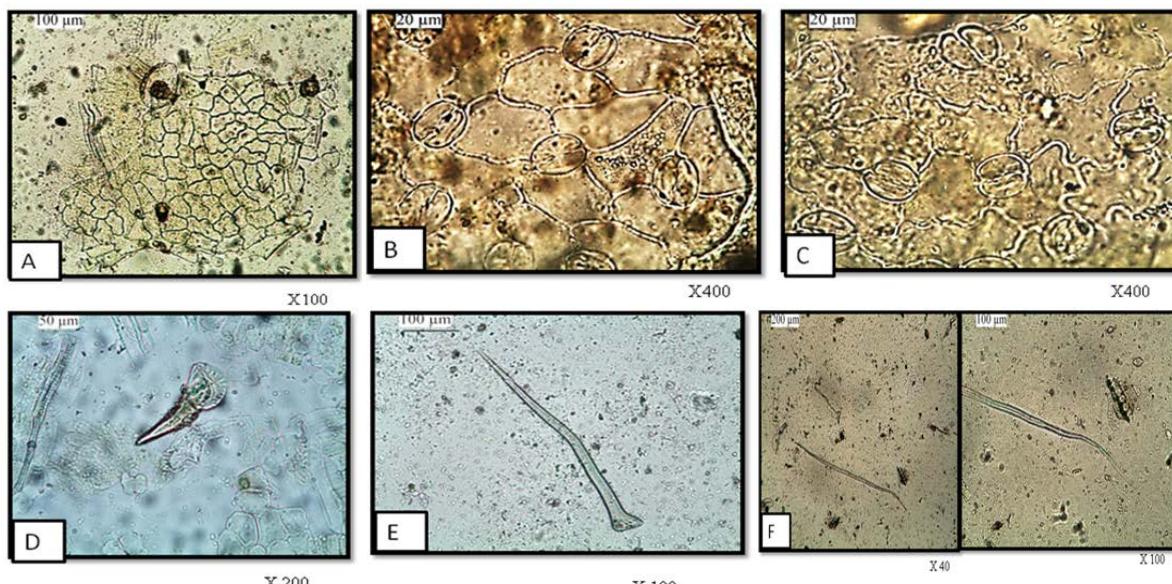
7- Fragment of lignified xylem vessels with spiral thickening.

8- Fragment of wood parenchyma cells.

9- Fragment of medullary rays cells.

10- Fragment of palisade cells.

11- Starch granules which are medium in size, rounded granules with pointed or cleft hilums, invisible or absent striations and simple aggregation.



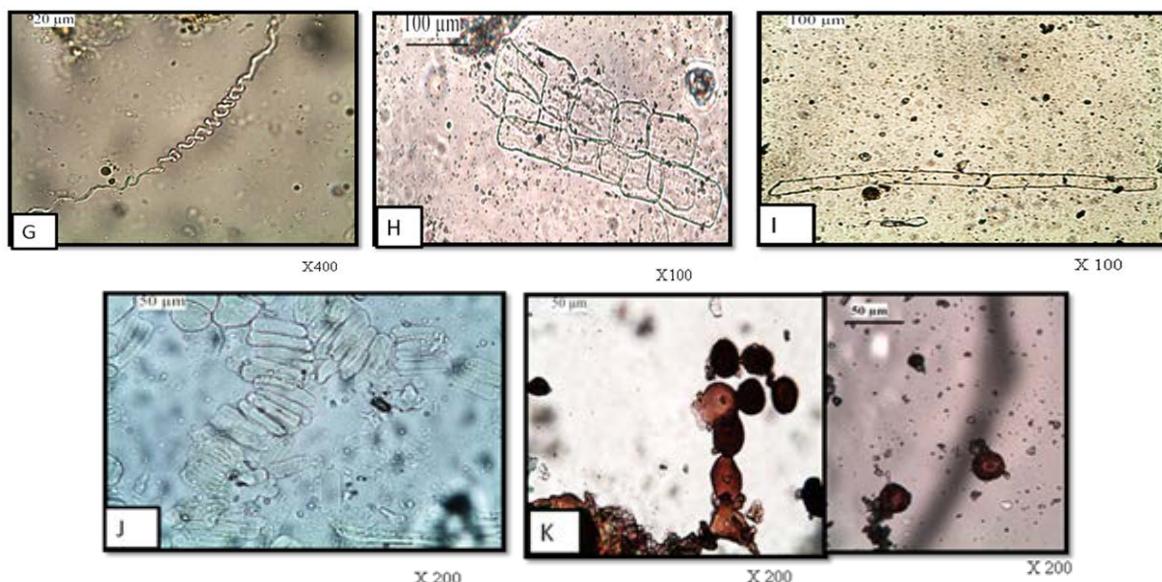


Fig 8: (A) Fragment of upper epidermis showing cystolith cell (x100). (B) Fragment of upper epidermis showing anomocytic stomata (x400). (C) Fragment of lower epidermis showing anomocytic stomata(x400). (D) Short conical non glandular unicellular hair (x200). (E) Long non glandular unicellular hair (x100). (F) Fragment of pericyclic fibers (x40) (x100). (G) Fragment of lignified spiral xylem vessel (x400) (H) Fragment of wood parenchyma cells (x100). (I) Fragment of medullary rays cells (x100). (J) Fragment of palisade cells (x200). (K) Starch granules (x200).

Examination of both the macroscopical and microscopical features of *C. myxa* L. leaves provides a good method in the identification of this plant in both entire and powdered forms. In addition, the above mentioned botanical characters may also be helpful in future phytopharmacological investigations of this species following appropriate authentication.

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