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Botanical studies of the leaf of *Acalypha wilkesiana* var. *macrophylla* family: Euphorbiaceae, cultivated in Egypt

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Abstract

Acalypha wilkesiana Muell Arg (Euphorbiaceae). Its common names include copper leaf, Joseph's coat, fire dragon, beef steak plant and match-me-if you can. It is a native to Fiji and nearby Islands in the southern pacific and it is a popular outdoor plants that provides colour throughout the year, although it is also grown indoor as a container plant. *Acalypha wilkesiana* are succulent with sappy stalks which tends to loose sappiness with age, it is round upright in habit, dense and coarse in texture, has a fast growth rate. The present study deals with macro and micro morphological investigation of *A. wilkesiana* var. *macrophylla* leaves, which will be greatly helpful in identification and authentication of this plant species. The leaf is microscopically characterized by the presence of paracytic stomata, non-glandular hairs and clusters of calcium oxalate.

Keywords: *Acalypha wilkesiana*, Euphorbiaceae, Leaves, hairs, botanical studies, Clusters of Ca Ox

1. Introduction

The family Euphorbiaceae found by A.L. de Jussieu in 1789, or known as the Spurge family is a large family of flowering plants with 300 genera and around 7500 species which includes trees, shrubs and herbs. Several characteristics in identifying species in this family include 3-locular capsules, stipules and spikes of tiny flowers. Several members of the family Euphorbiaceae Juss. are used as traditional remedies.^[1]

Acalypha wilkesiana (Copper leaf) belongs to the family Euphorbiaceae. The genus *Acalypha* comprises about 570 species, a large proportion of which are weeds while the others are ornamental plants. There are a quite reasonable number of cultivars worldwide, the *macrophylla*, *hofammani*, *godseffiana*, *macefeena*, *hispida*, *marginata* and *racemosa* are peculiar cultivars within Nigeria. This plant grows as an annual bedding plant. It is a fast growing evergreen shrubs which provides a splash of colour in the landscape with bronze red to muted red, the leaves appear as heart shaped with combination of colour like green, purple, yellow, orange, pink or white depending on cultivation^[2].

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

2. Taxonomy

Acalypha wilkesiana belongs to: Kingdom *Plantae*, Plants, Sub-kingdom *Viridaeplantae*, greenplants Superdivision *Streptophyta*, Land plants Division *Magnoliophyta* Class *Magnoliopsida* Subclass *Rosidae* Order *Malpighiales* Family *Euphorbiaceae*, Spurge family Subfamily *Acalyphoideae* Genus *Acalypha* L., Copperleaf Species *Acalypha wilkesiana*. (Müll, Arg.)^[3,4].

3. Materials and Methods

3.1. Plant Material

The plant material consisted of *A. wilkesiana* var.*macrophylla* leaves (Fig 1) that were collected from plants cultivated in the campus of Minia University in may 2015. The plant was kindly identified by Prof. Mahmoud Abdelhady Hassan, Professor of Horticulture, Faculty of Agriculture, Minia University. A voucher sample (Mn-ph-Cog-024) 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).

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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. Microscopic 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).



Fig 1: Photos of *Acalypha wilkesiana var. macrophylla*.

4. Results and Discussion

4.1. Macroscopical characters of the leaves

The leaves (Fig. 2) are compound, Alternate, cordate or heart shape and petiolated. The lamina has acuminate apex, a symmetric base with dentate margin and reticulate venation.

The midrib is more prominent on the lower surface. The leaf has fine hairy texture with purple, crimson or pink in colour. It measures 8-12 cm in length and 4-7 cm in width with a mucilaginous taste and faint odour.



Fig 2: Photos of *Acalypha wilkesiana var. macrophylla*. leaf

4.2. Microscopical characters of the leaf

4.2.1. The leaf blade

A transverse section in the leaf blade is planocovex in the outline with prominent midrib on the lower surface, (Fig. 3). Both the upper and lower epidermises carry non-glandular trichomes that are more distributed on the midrib. The transverse section also reveals a dorsiventral mesophyll interrupted by the cortical and vascular tissues at the midrib region. In addition, a mass of sub-epidermal collenchyma is found under both the upper and lower epidermises of the midrib region. The vascular system of the midrib showing 3-4 inverted vascular bundles, in addition to the presence of numerous calcium oxalate clusters scattered in the midrib region.

4.2.1.1. The epidermis

4.2.1.1.1. The upper epidermis

It formed of one row of square to sub rectangular elongated cells with thin cuticle as seen in the transverse section (Fig. 3 and 4). In surface view, the cells appear isodiametric polygonal, with slightly wavy anticlinal walls covered with a thin, faintly striated cuticle and showing paracytic stomata (Fig. 5 and 6)

4.2.1.1.2. The lower epidermis

It is formed of one row of square to subrectangular cells as seen in the transverse section (Fig. 4 and 5). In surface view, the cells appear polygonal, with more sinuous anticlinal walls, covered with thin striated cuticle and showing paracytic stomata (Fig. 6).

4.2.1.2. The mesophyll

The mesophyll is a dorsiventral, showing one row of the upper columnar cylindrical thin walled palisade cells containing chloroplasts and is interrupted by a mass of sub-epidermal collenchyma cells in the mid rib region (Fig. 4). The palisade layer represents about one third of the distance between the two epidermises (Fig. 4). The spongy tissue is formed of 4-5 rows of thin walled less rounded parenchyma cells with wide intercellular spaces (Fig. 4). In addition, clusters of calcium oxalate are scattered throughout the lamina region.

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 consists of 4-5 rows whereas the lower one is formed of 2-3 rows of small rounded cells with thick cellulosic walls and no intercellular spaces followed by several rows of polygonal, large parenchymatous cells with thin cellulosic walls and small intercellular spaces. The endodermis is parenchymatous and indistinguishable.

4.2.1.4. The vascular tissue

4.2.1.4.1. The pericycle

The pericycle is parenchymatous cells (Fig. 5).

4.2.1.4.2. The phloem

It consists of thin-walled cellulosic elements; sieve tubes, companion cells and phloem parenchyma (Fig. 5).

4.2.1.4.3. The cambium

The cambium is represented by 1-2 rows of tangentially elongated thin-walled meristematic cells (Fig. 5).

4.2.1.4.4. The xylem

The xylem is formed of lignified vessels, fibres and wood parenchyma (Fig. 5). The vessels are mostly with spiral, annular and scleriform thickenings (Fig. 13). The fibres are two types as normal and dentate forms, the first type has acute apices, narrow lumen and thick lignified walls but the second type has blunt apices, narrow lumen and thick lignified

dentate walls (Fig. 8). The wood parenchyma consists of radially elongated cells with pitted lignified walls. The medullary rays are uni- to biserrate forming radiating lines of elongated thin-walled cellulosic cells traversing the xylem (Fig. 5).

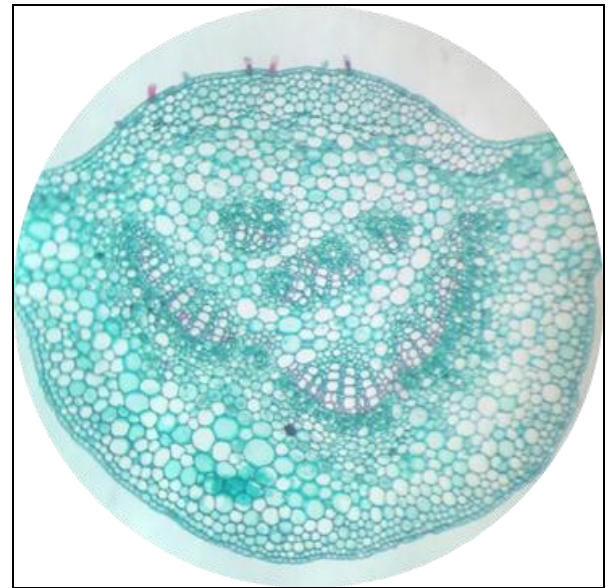


Fig 3: A diagrammatic T.S. in the leaf. (x 40)

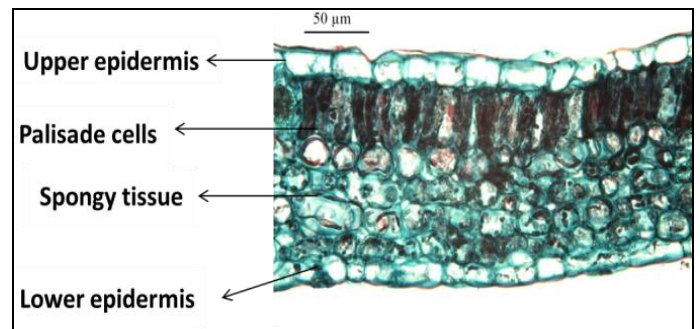


Fig 4: A detailed T.S. in the lamina of the leaf (× 200)

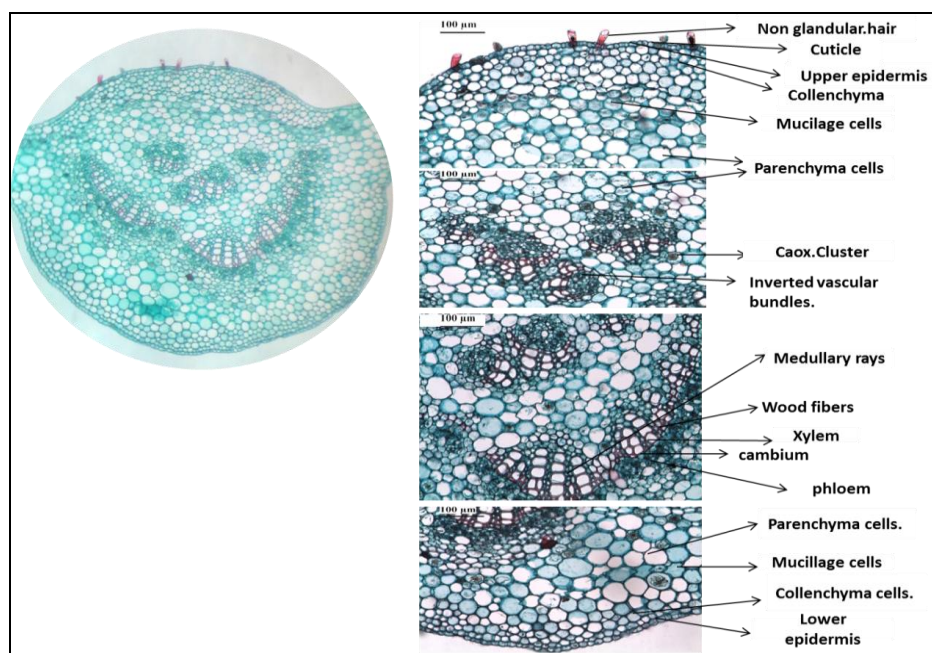


Fig 5: A detailed T.S. in the midrib region of the leaf.

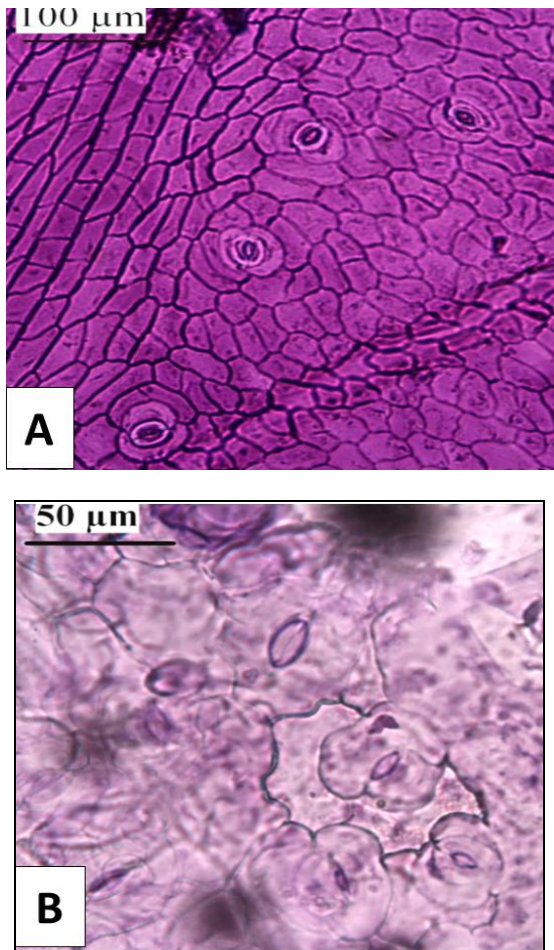


Fig 6: Surface preparation of leaf: (A) Upper epidermis, (B) Lower epidermis showing paracytic stomata. A (x 400), B (x 200).

4.2.2. The leaf petiole

A transverse section in the petiole (Fig. 7) appear nearly

circular with upper depressed surface outline, The cortical parenchyma is formed of 6-8 rows of thin walled rounded cells, containing clusters of calcium oxalate The vascular system is continuous appear as U- shaped vascular bundle, each bundle consists of parenchymatous pericycle, xylem, Cambium, phloem and wide parenchymatous pith which contains calcium oxalate clusters.

4.2.2.1. The epidermis

The epidermis is formed of small rounded to rectangular cells similar in structure to the upper and lower epidermises of the leaf, except for the presence of non-glandular unicellular hairs covered with smooth cuticle (Fig. 7 and 8).

4.2.2.2. The cortical tissue

The cortex consists of 4-5 rows of small rounded collenchyma cells with no intercellular spaces followed by 6-8 rows of rounded to polygonal large parenchyma cells with small intercellular spaces. Clusters of calcium oxalate are scattered within the cortical tissue (Fig 7).

4.2.2.3. The vascular system

The vascular system of the petiole is formed of 8-10 isolated collateral vascular bundles (Fig. 7). The pericycle is parenchymatous. The phloem is represented by thin-walled cellulosic elements. Clusters of Ca oxalate are scattered in the cortical regions. The xylem is formed of wood parenchyma, wood fibers, and lignified xylem vessels. The wood parenchyma are polygonal with thick lignified walls. The wood fibers have thick lignified walls, narrow lumen and tapering end as shown in the powder (Fig. 11). The medullary rays are uni- or biseriate of elongated, lignified, thick-walled cells. The pith is formed of large thin-walled parenchyma cells containing numerous clusters of calcium oxalate

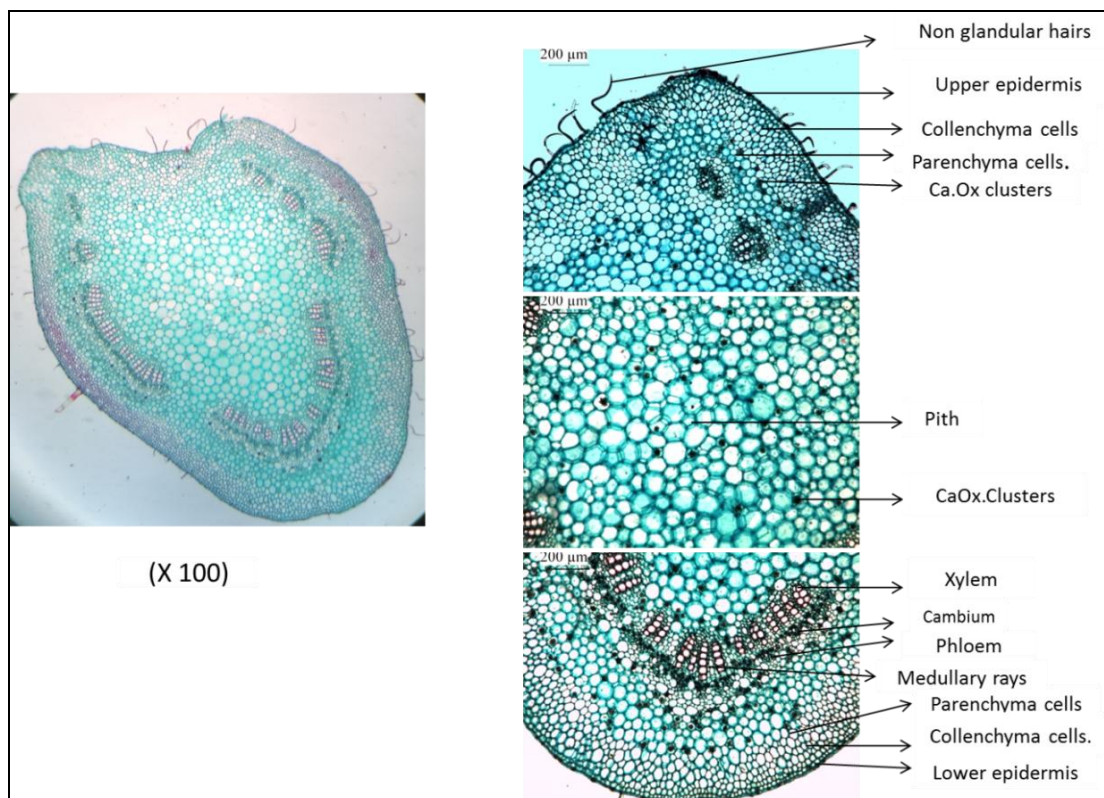


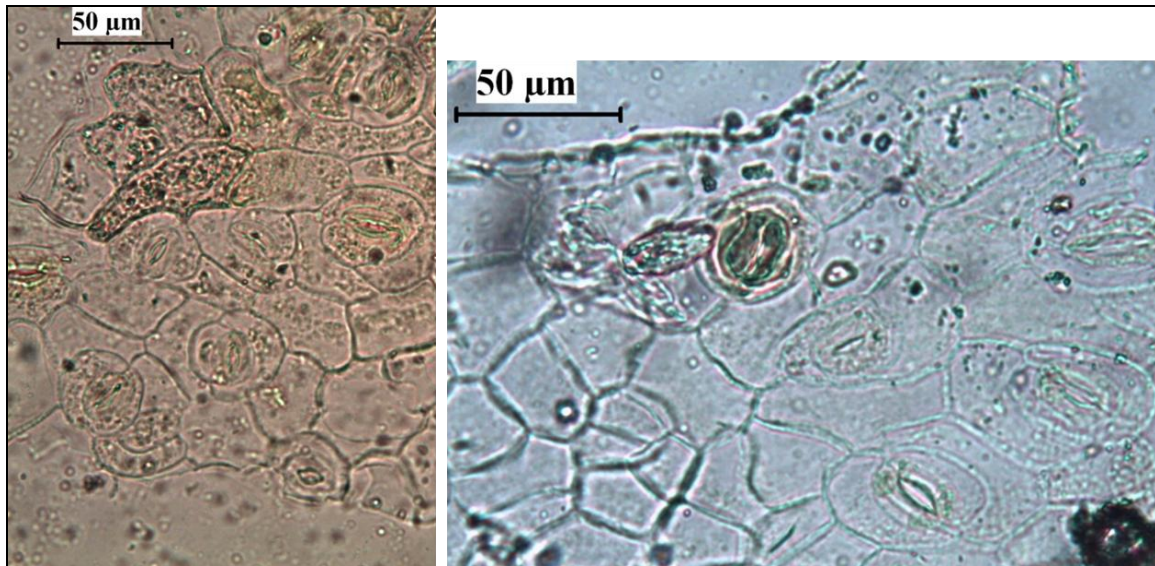
Fig 7: A detailed T.S. of the petiole.

4.2.3. The powdered leaf (Fig. 8)

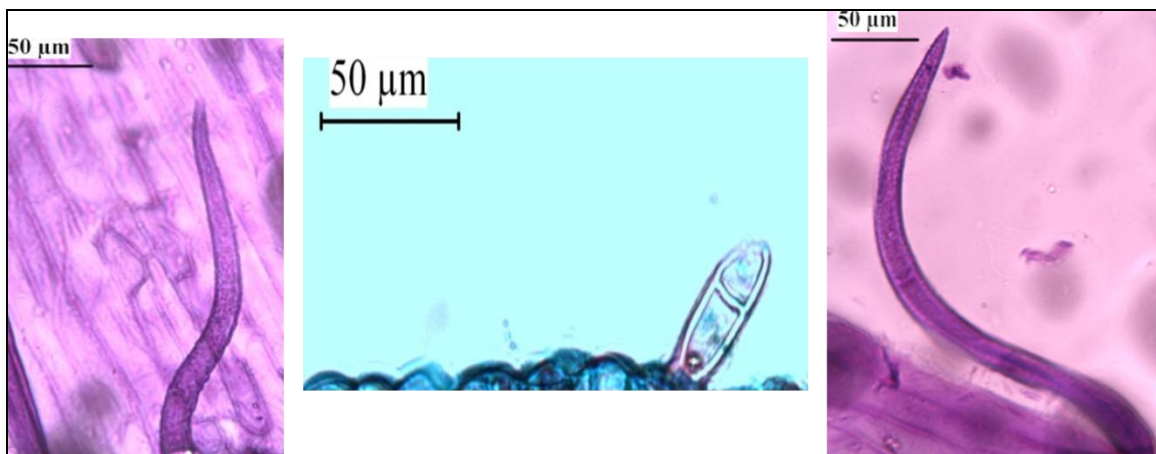
The powder of the leaf is pale pink in colour with faint characteristic odour and a disagreeable taste. Elements of the powdered leaf include:

1. Fragments of the upper and lower epidermises.
2. Non glandular hairs (unicellular & bicellular and multicellular).

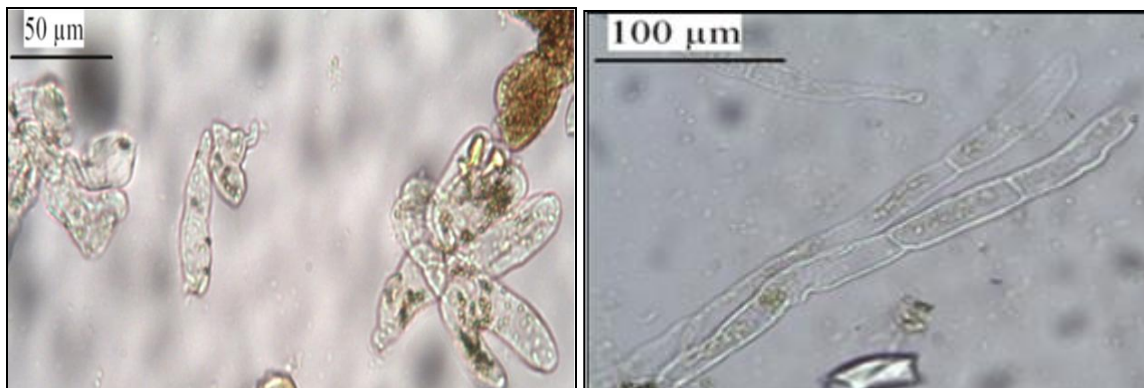
3. Fragments of palisade cells.
4. Fragment of medullary rays.
5. Fragment of wood fibers (normal & dentate) fibers.
6. Cluster of calcium oxalate.
7. Frgment of xylem vessles with spiral, annular and sclariform thickenings.



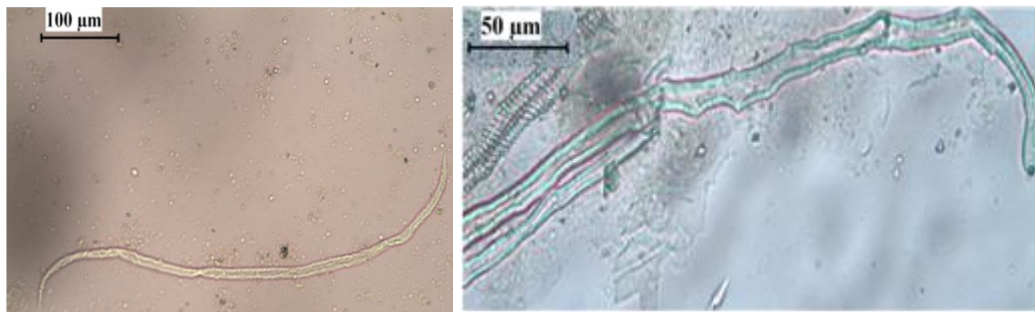
Fragment of Upper & lower epidermis (x200)



Non glandular hairs of the leaf (x200)



Pallisade cells (x200), Medullary rays (x100)



Wood fibers (x100), (x200).



Clusters of ca.ox(x200).

Spiral& annular and scleriform xylem vessles(x200).

Fig 8: Elements of powdered leaf.

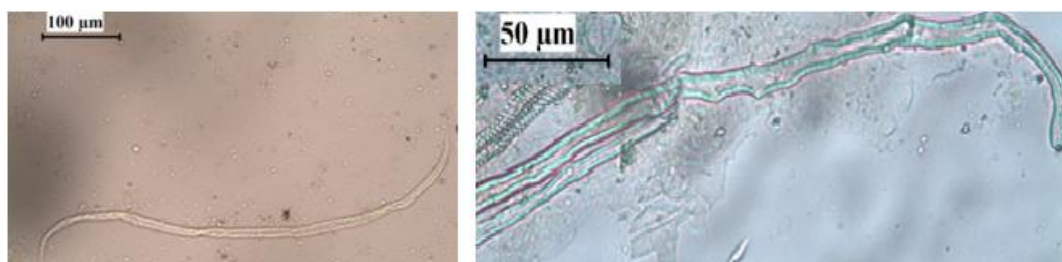


Fig 9: Wood fibers (x100), (x200).

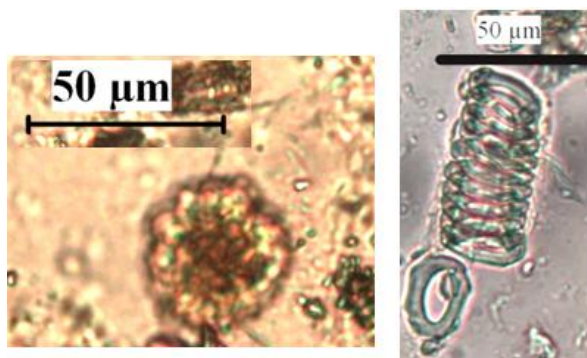


Fig 10: Clusters of ca.ox (x200).



Fig 11: Spiral& annular and scleriform xylem vessles (x200).

5. Conclusion

Examination of both the macroscopical and microscopical features of *A. wilkesiana* var. *macrophylla* leaves provides a good method in the identification of this plant. In addition, the above mentioned botanical characters may also be helpful in future phytopharmacological investigations of this species following appropriate authentication.

6. References

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