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Comparative Study for Some Anatomical Quality Characteristics of Some Species of the Malvaceae Family in Erbil, Iraq

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Abstract

A detailed study was conducted on various specimens of *Alcea* and *Althaea*, including *Althaea hirsuta, Althaea ludwigii, Althaea officinalis*, and *Alcea kurdica, Alcea rosa* cultivars (white, pink, violet, and red hollyhocks, depending on the flower color. Each specimen exhibited distinct morphological characteristics in petiole structure, midrib anatomy, leaf border features, and epidermal cell patterns. Trichome Diversity and Leaf Anatomy. The specimens displayed a variety of trichomes, including non-glandular (unicellular and multicellular), glandular (capitate and short-stalked), and peltate types. Additionally, druse crystals were observed in the petiole and midrib of all specimens, suggesting a possible role in structural support or defense mechanisms. Epidermal Cell and Stomatal Characteristics. The anticlinal walls of the epidermal cells varied from straight to undulate, with polygonal cell morphologies dominating across all samples. Stomatal analysis revealed the presence of paracytic and anisocytic types on both abaxial and adaxial leaf surfaces, with some instances of conjugate stomata, indicating adaptations to different environmental conditions. Variations among Cultivars and Wild Species. The *Alcea rosa* cultivars exhibited subtle differences in trichome density and leaf margin structure compared to wild species like *Alcea kurdica* and *Althaea* spp., which had more pronounced midrib shapes and petiole cross-sections. These morphological distinctions could be useful for taxonomic identification and understanding ecological adaptations. This study highlights the structural diversity within *Alcea* and *Althaea*, providing insights into their classification and potential functional adaptations.

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1. Introduction

Family Malvaceae have a largely global distribution, as they are found in mild temperate and seasonally dry tropical regions. They comprise 80-244 genera and over 4225 species [1-5]. *Alcea* (hollyhook). Depending on the cultivar, hollyhooks can reach heights of 2 to 9 feet and are regarded as long blooming biennial herbs [6]. The name is either from *Alce* (remedy), a reference to its medicinal significance, or from *Alke* (strong), in recognition of the plant's rapid growth. Prior to being recently referred classified as clearly different genera, both *Alcea* and *Althaea* were closely related taxa that were previously combined [7].

One of the therapeutic herbs known as common mallow in Europe, Iran, Pakistan, and India is *Khubazi* (*Malva sylvestris* Linn.), the biennial-perennial herbaceous plant *M. sylvestris* is widely distributed in North Africa, Europe, and Southwest Asia. It has long been used to treat digestive and respiratory disorders in the Ayurvedic, Unani, and Siddha systems of medicine. With eighty per cent of the world's population relying on complementary and alternative medicine for their medical requirements, there is a growing interest in assessing the therapeutic effects of plants. The drug *Khubazi* consists of dried fruits of *Malva*

sylvestris. Use of the drug *Khubazi* in the Unani system of medicine dates back thousands of years. Hollyhock was used to facilitate birth and boost nursing mothers' milk production [6, 8, 9]. Also, Malva plants are most famous for their anti-inflammatory effect, which is attributed to bioactive compounds such as phenolics, which are also potent antioxidants in different organs (leaves, stem, flower, fruits)[10]

Alcea rosea is a plant that is used in traditional medicine to cure an assortment of illnesses, implicate the common cold and cough. The leaves and flowers are the main parts used in demulcent because of their properties, making them valuable as a poultice for bruises, inflammation, insect bite, or taken internally for treatment of respiratory system diseases or inflammation of the digestive or urinary system. All parts of these plants are antiphlogistic, astringent, demulcent, diuretic, emollient, expectorant, laxative, and salve [11]. *Malvaneglecta* Wallrae member of the Malvaceae family, is commonly found as a weed on roadsides. The plant is native to practically the entire continent of Europe, including northern, central, and southern Europe. Western Asia, Northwestern Asia, the Arabian Peninsula, as well as China and the Indian subcontinent, are all home to this species. The majority of *Malva* species are nitrophilous plants that require nitrogen-rich soils to thrive [12].

The development of the microscope predates the development of systematic anatomy. The presence of taxonomists highlights the anatomical similarities between related plant groups. The tree Systematists have always regarded anatomy and morphology as the foundation of plant taxonomy and have highlighted how qualities such as diversity, phylogeny, and evolution have developed over time as a result. Anatomical knowledge is employed to enhance categorization systems and is frequently used in research. Plant anatomy is the branch of botany dealing with the anatomical and histological structure of various parts of plant organs. Nowadays, along with other branches, anatomy is also essential to validate and understand many aspects of plant biology, including the ecological and molecular ends of the spectrum. This field of biology finds application in several fields, viz., systematics, forensics, and pharmacognosy. The structural variations in anatomical characteristics have enormous implications in these fields [13, 14].

From a biosystematic perspective, the leaf epidermis is the most important classification property, and Malvaceae is one of the families whose classification studies are focused on the leaf epidermis [7]. This study's objective is to compare anatomy between *Althaea hirsuta, Althaea ludwigii, Althaea officinalis*, *Alcea kurdica, Alcea rosa* cultivars (white, pink, violet, and red hollyhocks).

2. Materials and Methods

2.1 Plant collection

Alcea rosa cultivars (white hollyhocks, pink hollyhocks, violete hollyhocks, and red hollyhocks) were collected from the plantation Presidency of Erbil Municipality in Erbil city-Iraq in May 2018 (flowering stage) and fixed in fixative (FAA) (formalin, acetic acid, alcohol). Plant materials of *Althaea* species (*Alcea kurdica*, *Althaea hirsuta*, *Althaea ludwigii*, and *Althaea officinalis*) were taken from the Sciences College Herbarium in Erbil, Iraq, in the Biology department, College of Sciences, Salahaddin University, Erbil, Iraq, in 2018. Three replicates were taken for each sample.

2.2 Prepare the sections (Paraffin method)

Sample pieces were stored in FAA (Formalin acetic acid alcohol) and dehydrated using a range of alcohol concentrations, following which the samples were cleaned using xylene (3-4 hrs). After being submerged in a mixture of xylene and paraffin for 30 minutes, the material was put into pure paraffin wax and kept at 60 °C for 24 hrs. Then, using a rotary microtome, pieces with a thickness of 8–10 µm were created and embedded in paraffin wax. Safranin and quick green were then used to stain the pieces. Finally, the slides were mounted by DPX (Distyrene Plasticizer Xylene) [15].

2.3 Stomata

Mechanical scraping was used to prepare the leaf epidermis. Using Analysis Image Analysis Software (ScopeImage9.0) and a light microscope (Olympus) with a camera (inside the Microscope), the samples were examined [16].

3. Results

In *Alcea rosea* cv. (white hollyhocks and pink hollyhocks), the petiole outline is sub-circular. In *Alcea rosea* cv. violate hollyhocks, pink hollyhocks, *Alcea kurdica*, and *Althaea officinalis*, it is triangular. In *Althaea hirsuta* and *Althaea ludwigii*, it is irregular. The epidermis is a single layer. **V:** is the vascular strand that is interrupted. **C:** The collenchyma is angular type. In *Alcea rosea* cv. white hollyhocks, the trichomes were peltate, while unicellular glandular as in *Alcea rosea* cv. violate hollyhocks. Although the trichomes in *Althaea officinalis* are peltate and stellate, those in *Alcea kurdica* are unicellular, glandular and peltate. All species and cultivars have the secretory cells **(S)**, druses crystals **(D)**, and fibers **(f)** close to the phloem. *Althaea hirsuta*, *Althaea officinalis*, *Althaea ludwigii*, and *Alcea rosa* var. (white hollyhocks, pink hollyhocks, violate hollyhocks, and red hollyhocks) have interrupted vascular bundle arrangements, whereas Alcea kurdica has closed arrangements (Figures 1, 2).

In *Alcea rosea* cv. white hollyhocks, the midrib outline is adaxially humped, and the abaxial surface is cup-shaped. In *Alcea rosea* cv. pink hollyhocks, the adaxial surface is hamped, and the abaxial surface is circular. In *Alcea rosea* cv. violate hollyhocks, the adaxial surface is huge, humped, and the abaxial surface is circular. In *Alcea rosea* cv. red hollyhocks, the adaxial surface is straight. In *Alcea kurdica*, the adaxial surface is narrowly humped and the abaxial surface is slightly broad; in contrast, the adaxial surface of *Althaea hirsuta* is slightly convex and the abaxial surface is broad. Whereas the adaxial surface of *Althaea*

ludwigii is concave and the abaxial surface is V-shaped, *Althaea officinalis* has a slightly concave adaxial surface and a U-shaped abaxial surface. All samples had crescent-shaped vascular bundle arrangements **(V)**. All specimens have rosette crystals **(D)** and secretory canals **(S)** surrounding the vascular bundles. The type of collenchyma tissue is angular **(C)**. In *Alcea rosa* cultivars (white hollyhocks, pink hollyhocks), *Althaea hirsuta,* and *Alcea rosea* cv. red hollyhocks, the trichomes are unicellular glandular, while the head is multicellular glandular with a unicellular stalk. In *Althaea officinalis*, the hairs are peltate and the head is multicellular and glandular with a unicellular stalk (Figure 3, 4).

In cultivars of *Alcea rosa* (white hollyhocks, red hollyhocks), *Althaea hirsuta*, and *Althaea officinalis*, the margin shape is straight and rounded; in cultivars of *Althaea ludwigii* and *Althaea ludwigii*, however, the margin is pointed downward with existing unicellular non-glandular trichomes (Figure 5).

The epidermis anticlinal wall is straight to undulate, with stomata present in both adaxial and abaxial surfaces; anisocytic and paracytic type. In *Alcea rosa* cv. white hollyhocks, and *Alcea rosa* cv. pink hollyhocks in adaxial surface present conjugated stomata, the stomata apparatus consists of two guard cells, but sometimes is consists of one cell as in *Alcea rosa* cv. pink hollyhocks in the adaxial surface present the stomata consist of one guard cell (6, 7, 8). Table 1 shows the size of stomata, the thickness of the stomatal opening and wide of the stomata pore.

Table 1: Stomata characters (µm).

Taxon / characters	adaxial stomata size	abaxial stomata size	adaxial thickness of the stomatal opening	abaxial thickness of the stomatal opening	adaxial width of the stomata pore	abaxial width of the stomata pore
Alcea rosa cv. white hollyhocks	23.746	29.534	30.371	32.383	3.000	3.200
Alcea rosa cv. pink hollyhocks	15.176	19.402	20.191	22.402	4.327	5.657
Alcea rosa cv. violate hollyhocks	18.758	19.618	20.498	25.225	4.983	4.561
Alcea rosa cv. red hollyhocks	33.501	19.866	24.400	24.145	5.000	4.389
Alcea kurdica	28.564	25.640	23.549	30.308	4.268	4.726
Althaea hirsuta	27.316	28.747	32.597	31.620	6.106	5.832
Althaea ludwigii	24.306	21.031	32.410	26.659	6.354	4.824
Althaea officinalis	34.312	39.330	28.588	45.965	4.487	6.462

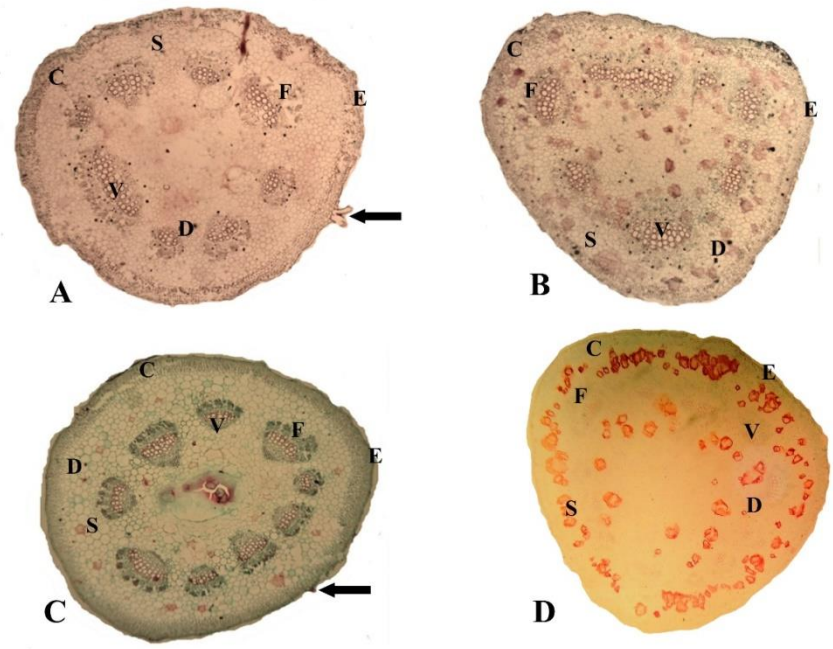

Figure 1. T.S of petiole sections: A. *Alcea rosa* cv. white hollyhocks, B. *Alcea rosa* cv. pink hollyhocks, C. *Alcea rosa* cv. violate hollyhocks, D. *Alcea rosa* cv. red hollyhocks. C: collenchyma, E: epidermis, S: secretory canal, D: druses, V: vascular bundle, F: fiber, trichomes (black arrow). A, B, C, D =4X.

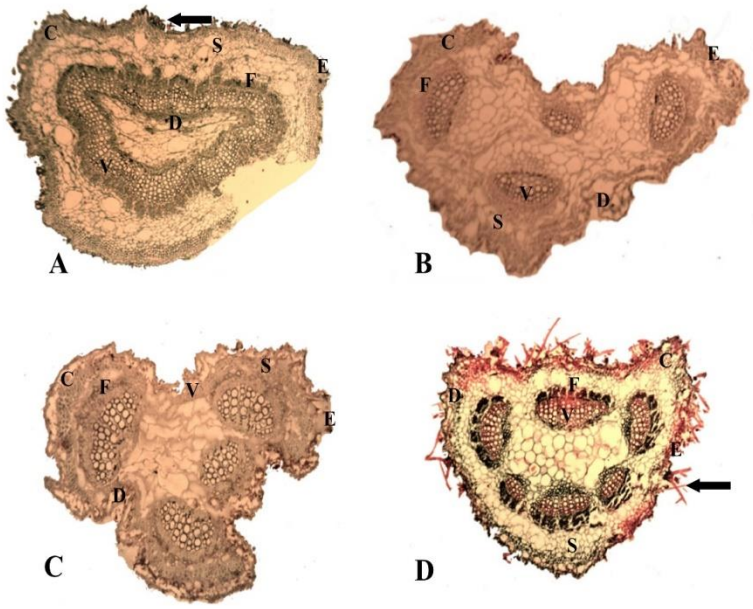

Figure 2. T.S of petiole sections: A. *Alcea kurdica*, B. *Althaea hirsuta*, C. *Althaea ludwigii*, D. *Althaea officinalis*. C: collenchyma, E: epidermis, S: secretory canal, D: druses, V: vascular bundle, F: fiber, trichomes (small black arrow). A, B, C, D =4X.

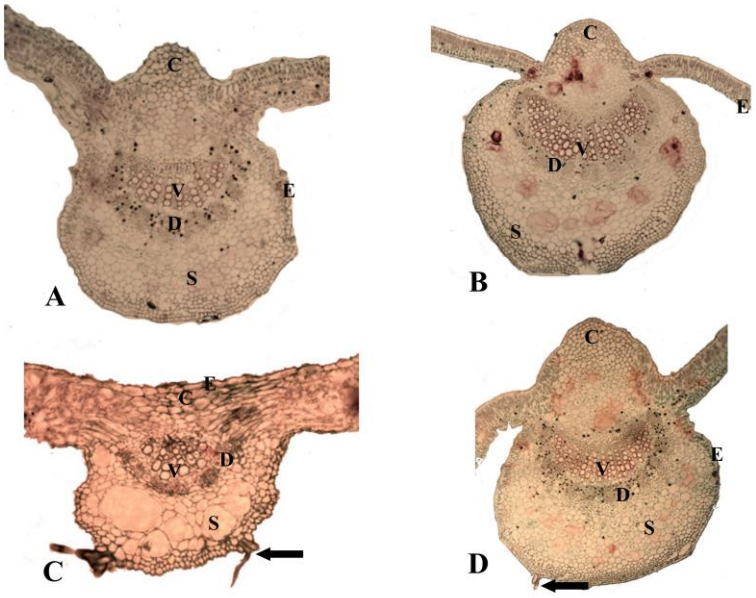

Figure 3. T.S of midrib sections: A. *Alcea rosa* cv. white hollyhocks, B. *Alcea rosa* cv. pink hollyhocks, C. *Alcea rosa* cv. violate hollyhocks, D. *Alcea rosa* cv. red hollyhocks. C: collenchyma, E: epidermis, S: secretory canal, D: druses, V: vascular bundle, trichomes (small black arrow). A, B, C, D =4X.

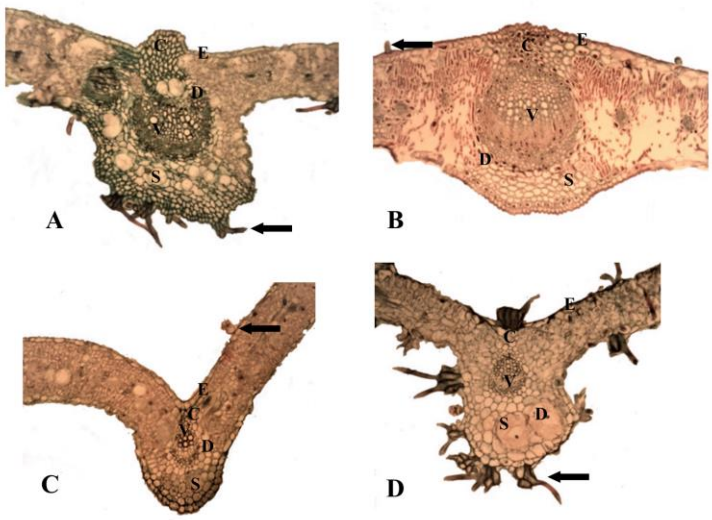

Figure 4. T.S of midrib sections: A. *Alcea kurdica*, B. *Althaea hirsuta*, C. *Althaea ludwigii*, D. *Althaea officinalis*. C: collenchyma, E: epidermis, S: secretory canal, D: druses, V: vascular bundle, trichomes (small black arrow). A, B, C, D =4X.

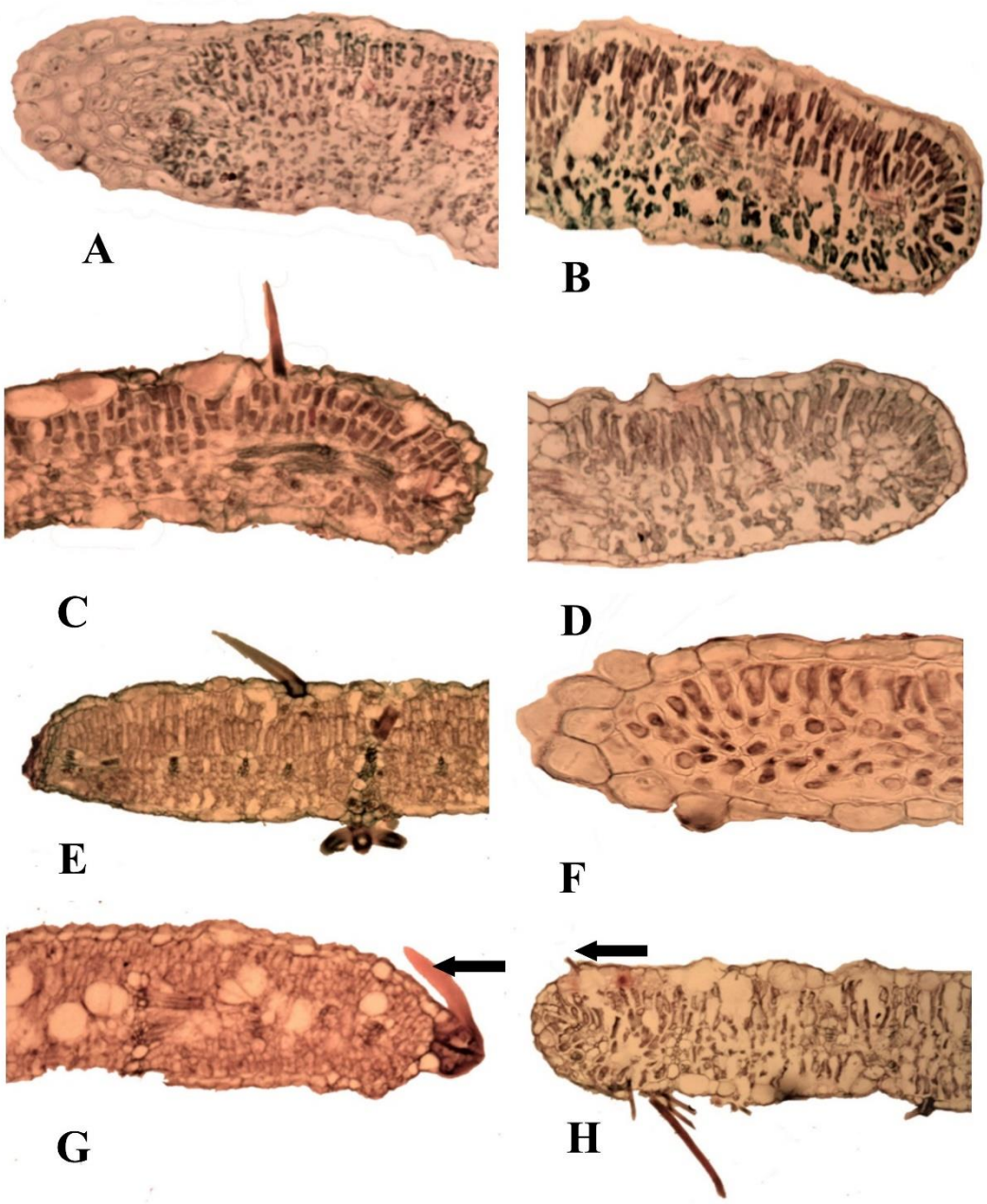

Figure 5. T.S of margin sections: A. *Alcea rosa* cv. white hollyhocks, B. *Alcea rosa* cv. pink hollyhocks, C. *Alcea rosa* cv. violate hollyhocks, D. *Alcea rosa* cv. red hollyhocks, E. *Alcea kurdica*, F. *Althaea hirsuta*, G. *Althaea ludwigii*, H. *Althaea officinalis*. trichomes (small black arrow). A, B, C, D =4X.

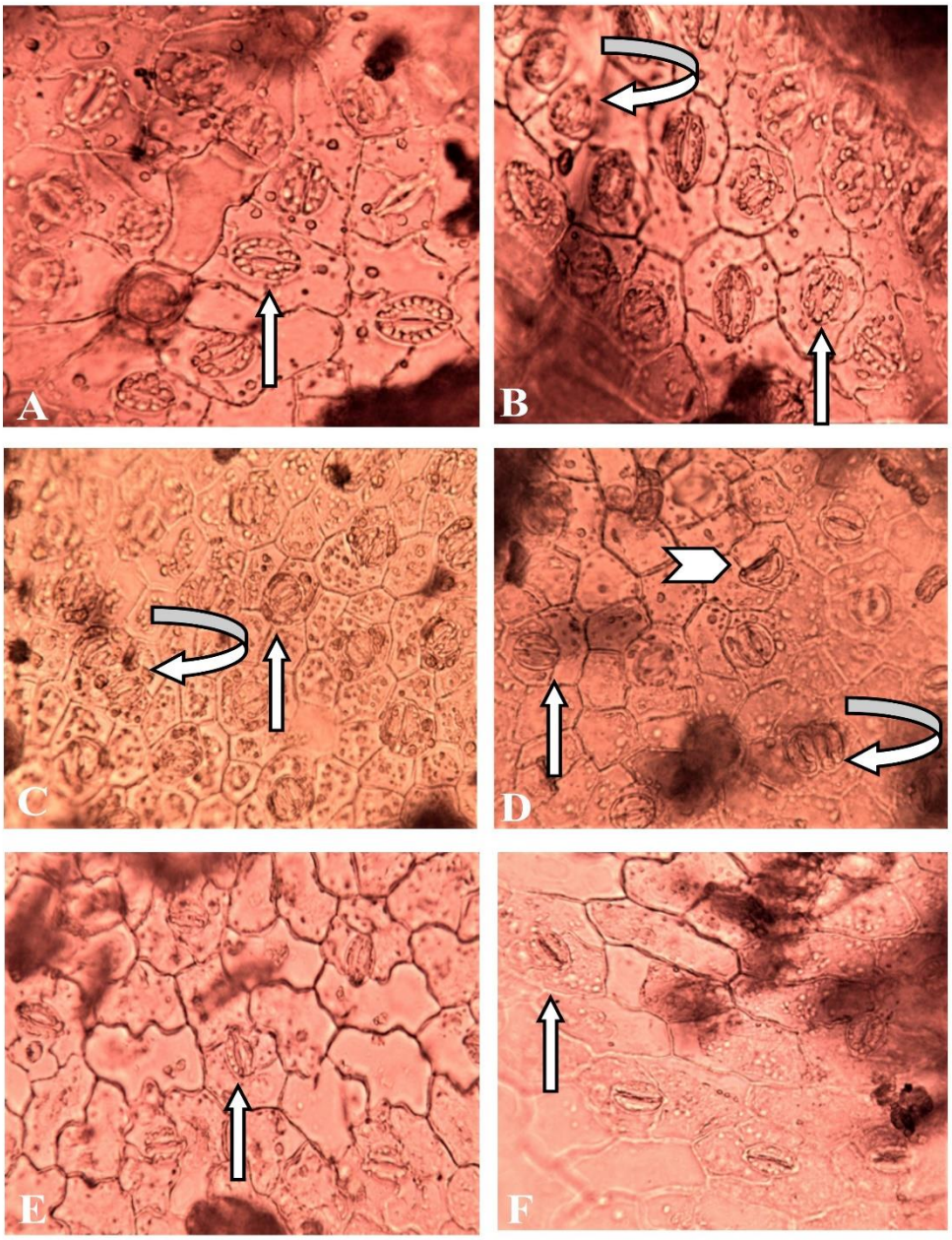

Figure 6. Epidemis: A. adaxial surface of *Alcea rosa* cv. white hollyhocks, B. abaxial surface of *Alcea rosa* cv. white hollyhocks, C. adaxial surface of *Alcea rosa* cv. pink hollyhocks, D. abaxial surface of *Alcea rosa* cv. pink hollyhocks, E. adaxial surface of *Alcea rosa* cv. violate hollyhocks, F. abaxial surface of *Alcea rosa* cv. violate hollyhocks. Stomata (large arrow), conjugated stomata (circular arrow), stomata one cell (chevron arrow). A, B, C, D, E, F=40X.

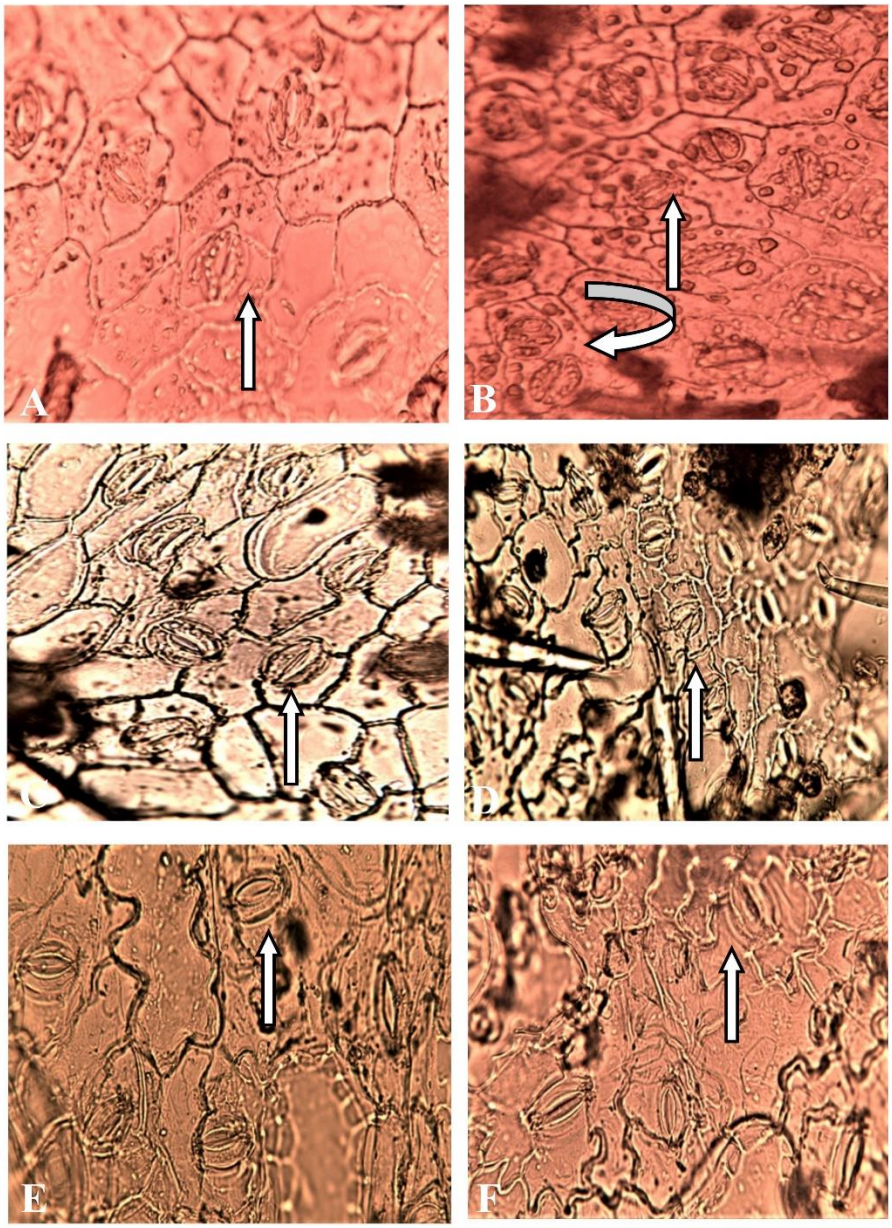

Figure 7. Epidemis: A. adaxial surface of *Alcea rosa* cv. red hollyhocks, B. abaxial surface of *Alcea rosa* cv. red hollyhocks, C. adaxial surface of *Alcea kurdica*, D. abaxial surface of *Alcea kurdica*, E. adaxial surface of *Althaea hirsuta*, F. abaxial surface of *Althaea hir*. Stomata (large black arrow), conjugated stomata (small black arrow). A, B, C, D, E, F=40X.

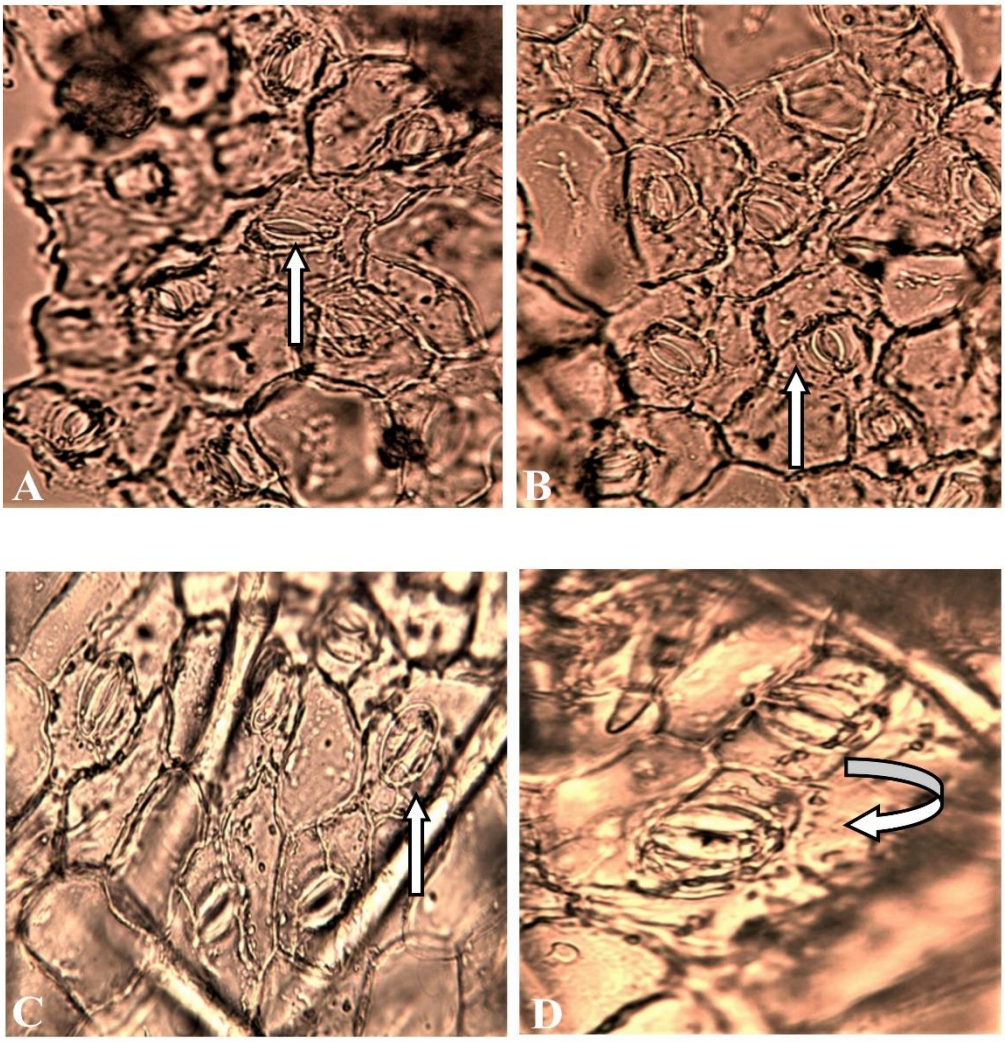

Figure 8. Epidemis: A. adaxial surface of *Althaea ludwigii*, B. abaxial surface of *Althaea ludwigii*, C. adaxial surface of *Althaea officinalis*, D. abaxial surface of *Althaea officinalis*. Stomata (large black arrow), conjugated stomata (small black arrow). A, B, C, D=40X.

4. Discussion

Compared to morphological features, anatomical features are more durable. As a result, anatomical characteristics are useful for taxonomic research. The anatomy of common Malvaceae members has been well examined, including the stem, leaf sections, roots, and seeds; these skeletal characteristics are used to create an identification key [17]. Systematics deals with the description, naming, classification, identification, and determination of relationships among plants by using data from many disciplines such as morphology, anatomy, molecular biology, and ecology. The majority of the plants have evidence according to macro-morphological features, but for accurate classification, information from diverse sources must be utilized.

Anatomical features have played a very important role in determining phylogenetic relationships [14].

This study shows that the petiole structure or anatomy is important for identification. The petiole anatomy of 23 *Microcos* L. (Malvaceae: Grewioideae) species was studied to determine the systematic significance that may be useful in the identification and classification of the species. The petiole anatomical features observed with petiole outlines, patterns of petiole vascular bundles, presence of sclerenchyma cells, phloem sclerenchyma cells, tanniferous idioblast cells, types of crystals, presence of

lignified parenchyma cells, interaxillary and intraxillary phloem, and types of trichomes. The study showed that additional data in the identification and classification of species in the genus Microcos, petiole anatomical characters can be used and that these characters have some taxonomic value [14].

Several of the species studied in the current study have trichomes that are unicellular non-glandular, unicellular glandular, or peltate in the petiole and leaf. According to [17-20], some Malvaceae genera lack the trichomes on the stem and leaves, while others are simple unicellular unbranched or branched, non-glandular stellate or peltate-shaped, multicellular unbranched, multicellular non-glandular, glandular capitate, or globose. All species of the Malvaceae genus contained the mucilagenous cavity. [3, 20] Reported that the some *Althaea armeniaca*, *Althaea officinalis* and *Althaea hirsuta* they have been glandular and non-glandular trichomes occur on stem as epidermal outgrowths, the non-glandular trichomes are paniculate or stellate; single celled hairs are with acute or tapered in the apices with straight cuticles, and the glandular hairs are short with a unicellular stalk and a multicellular head.

This work shows the midrib has been different outline shape, the vascular bundles are quarter or crescent with the rosette crystals. [21-23] mentioned the vascular bundle, which is a crescent-shaped is found in the middle of the midrib. Among the parenchymatic cells could be distinguished a few fibers 1-4 with thinner walls. Phloem, which consists of thin-walled, lignified, radiating, compactly organized tiny cells, makes up the vascular bundle. The phloem's radially oriented rosette crystals. Furthermore, rosette crystals surround the vascular bundle. Large mucilaginous cells and parenchymatous cells make up the midrib's remains. The angular collenchyma cells under the midrib are also visible. The same trichomes are identical to those described by [3] in the stem and leaf.

From a biosystematic perspective, the leaf epidermis is the most important taxonomic characteristic, and many families' taxonomic research are based on it. Malvaceae members have amphistomatic and amphitrichomic leaves. Anisocytic and diacytic stomata were also regularly detected on both leaf surfaces [7]. The epidermal cells of *Pterygota bequaertii* are primarily polygonal with straight anticlinal walls on the abaxial surfaces, while they are a mixture of polygonal and rectangular cells with oblique ends and thin cell walls on the adaxial surface, and they are thick on other surfaces [18]. While [24] refers to that the anticlinal walls of epidermal cells were slightly sinuous contour in *Theobroma grandiflorum* and *Theobroma speciosum*, and were straight in *Theobroma subincanum*, also all the studied species, the epidermis was covered by a smooth cuticle layer with plate-like epicuticular wax deposits on the adaxial surface, but abaxial surface had a dense hairs, especially in *Theobroma subincanum*. Also the anatomy of the leaf epidermis and petiole of *Hibiscus* species show the difference between them [4].

5. Conclusion

The results of this study demonstrated:

1. The importance of stomata types and anticlinal walls of the epidermis.
2. The importance of Petiole, midrib, and border outline shapes in identifying the distinctions between *Alcea* and *Althaea* specimens.
3. Presence of various types of trichome. presence of crystals in the plant part as druses.

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7. Conflicts of interest

The authors declare no conflicts of interest for this work.

8. Financial support affiliation of the study

The authors confirm that this study was conducted without any external financial support.

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دراسات تشريحية وبشرية للنباتات الخطمية في مدينة أربيل، العراق

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المستخلص

أُجريت دراسة مُفصّلة على عينات مُختلفة من نبات الخطمية (*Alcea*) والخطمية(*Althaea*) ، بما في ذلك الخطمية الكرديّة(Alcea kurdica) ، والخطمية الهِرْسُوتا (*Althaea hirsuta*)، والخطمية اللودفيغية(*Althaea ludwigii*) ، والخطمية الطبية(*Althaea officinalis*) ، وأصناف مُختلفة من الخطمية الوردية (الخطمية البيضاء، والوردية، والبنفسجية، والحمراء). أظهرت كل عينة خصائص مورفولوجية مُتميزة في بنية أعناق الأوراق، وتشريح العرق الوسطي ، صفات حافة الاوراق، وأنماط خلايا البشرة. تنوع الشعيرات وتشريح الأوراق. أظهرت العينات مجموعة مُتنوعة من الشعيرات، بما في ذلك الأنواع غير الغدية (وحيدة الخلية ومتعددة الخلايا)، والغدية (رأسية وقصيرة الساق)، ورأسية. بالإضافة إلى ذلك، لوحظت بلورات الوردية في أعناق الأوراق و العرق الوسطي لجميع العينات، مما يُشير إلى دور مُحتمل لها في الدعم الهيكلي أو آليات الدفاع. خصائص الخلايا البشروية والثغور. تباينت جدران الخلايا البشروية المحدبة بين المستقيمة والمتموجة، مع خلاياالبشرة المضلعة في جميع العينات. كشف تحليل الثغور عن وجود أنواع نظيرة للخلايا ومتباينة الخلايا على كل من أسطح الأوراق السفلية والسفلى، مع بعض حالات الثغور المترافقة، مما يشير إلى تكيفات مع ظروف بيئية مختلفة. الاختلافات بين الأصناف والأنواع البرية. أظهرت أصناف *Alcea rosa* اختلافات طفيفة في كثافة الشعيرات وبنية حواف الأوراق مقارنةً بالأنواع البرية مثل *Alcea kurdica* و.spp *Althaea* ، والتي تميزت بأشكال ضلع وسطى ومقاطع عرضية لأعناق الأوراق أكثر وضوحًا. يمكن أن تكون هذه الاختلافات المورفولوجية مفيدة للتعريف التصنيفي وفهم التكيفات البيئية. تسلط هذه الدراسة الضوء على التنوع الهيكلي داخل *Alcea* و*Althaea* ، مما يوفر رؤى حول تصنيفهما والتكيفات الوظيفية المحتملة.