Available online at http://bjas.bajas.edu.iq
https://doi.org/10.37077/25200860.2024.38.1.4
College of Agriculture, University of Basrah

Basrah Journal of Agricultural Sciences

ISSN 1814 – 5868 Basrah J. Agric. Sci., 38(1), 48-58, 2025 E-ISSN: 2520-0860

Comparative study of upper and lower leaf epidermis and trichomes in some species belong to Malvaceae family

Sadeq S.K. Al-Taie[1,*] & Sahar A.A.M. Al-Saadi[2]

[1]Department of Biology, College of Science, University of Misan, Iraq.

[2] Department of Biology, College of Science, University of Basrah, Iraq.

[*]**Corresponding author email**: **S.S.K.A.**: sas_altti@uomisan.edu.iq; **S.A.M.A.**: saharmalik2010@gmail.com

Received 13th October 2024; Accepted 1st June 2025; Available online 30th June 2025

Abstract : Leaf characteristics of four genera represented by nine species belonging to the family Malvaceae were examined: *Althaea ludwigii* L., *Gossypium herbaceum* L., *Hibiscus cannabinum* L., *H. sabdariffa* L., *H. rosa-sinensis* L., *H. tiliaceus* L., *Malva sylvestris* L., *M. nicaeensis* All., and *M. parviflora* L. The results reveal differences in the shape of anticlinal wall cells, stomatal frequency, stomatal index, and trichome types among the species. Additionally, the shape of the anticlinal wall cells is straight in *A. ludwigii, G. herbaceum, H. sabdariffa* and *H. tiliaceu* species; sinuate in *H. cannabinum* and *H. rosa-sinensis* and undulate or strongly undulate in *Malva* species. On average epidermal cells in the upper epidermis of *M. sylvestris* were 91.25 µm long, while on average, they were 27.18 µm long in *H. tiliaceus*. The current results identified five different stomatal patterns: anomocytic (rununculaceous); hemiparacytic; paracytic; anisocytic (cruciferous) and diacytic. Trichomes on the leaves are recognized as unicellular non-glandular in *M. parviflora*, *M. nicaeensis*, and *M. sylvestris*, glandular in *H. rosa-sinensis*, *G. herbaceum*, and *H. sabdariffa*, and stellate hairs in *M. nicaeensis, M. parviflora*, *M. sylvestris* and *A. ludwigii*. The stomatal index varies between species and on the upper and lower epidermis. The highest stomatal index was 50.98 in *H. sabdariffa* on the lower surface and the lowest 7.11 on the upper surface.

Keyword: Epidermal cells, Leaf, Malvaceae, Stomata, Trichome.

Introduction

People use the Malvaceae family of plants for food, fiber, ornamentation and medical purposes (Chachad & Vaidya, 2016). The Malvaceae family, which has 244 genera and about 4225 species, is widespread in tropical and subtropical areas. The Malvaceae family includes herbs, shrubs, and small trees (Christenhusz & Byng, 2016; Silva *et al*., 2023; Nbeaa *et al*., 2023). There are 29 species belonging to 8 genera represent the Malvaceae in Iraq (Townsend & Guest, 1980).

According to Chung (2002), the glandular trichomes of 32 species are crucial for identifying each species within the Malvaceae family. Numerous anatomical investigations on Malvaceae were carried out from different angles. Certain Malvaceae species' leaves have been described in terms of their epidermal anatomy (Celka *et al*., 2006). Many important leaf microcharacters, such as trichomes types,

stomatal types, and density, are present in the surface of leaves and epidermis and can serve as clues in taxonomic identification. These characters can identify certain taxa, while the stomatal frequency and index can be attributed to habitat variations and ecological conditions (Akcin & Ozbucak 2006; Al-Mousawi *et al*., 2019; Obead & Jerry, 2019; Hashim *et al*, 2019; Al-Garory & Al-Kaabi, 2020).

Uzunhisarcikli & Vural (2012) studied a variety of characteristics in the examined *Alcea* and *Althaea* species that are thought to be taxonomically significant. Essiett and Iwok (2014) investigated the anatomy of the leaf epidermis and petiole of *Hibiscus* species and showed differences between them. Naskar (2016) investigated the Malvaceae family's anatomical characteristics and created an identifying key for the delimitation of genera. The systematic relevance of 17 species of the Saudi Arabian Malvaceae was demonstrated by Karakish *et al.* (2020). Arabameri *et al.* (2020) studied trichomes in 26 species of *Alcea*. *Hibiscus rosa-sinensis* stomata type has been studied by (Rakhimov *et al*., 2021). Taia & Mahdy (2021) found that the leaf macro- and micro-characters are useful in separating the species and clarifying the evolutionary line within the studied species. Hemiparacytic and anomocytic stomata were the predominant types in *Hibiscus syriacus* (Rakhimov *et al*. 2021; Zhang *et al*., 2024). Some studies have connected the stomatal density and epidermal growth in *Alcea* (Malvaceae) to the number of veins and adaptability to terrestrial conditions (Abbas, 2021; Ibrahim *et al*., 2023; El Kholy *et al*., 2023).

The goal of this study is to examine the anatomical traits of nine species of the Malvaceae family that belong to four genera, using leaf epidermal characteristics such as epidermal cells, stomata, and trichomes to distinguish some species in the Malvaceae genera.

Materials & Methods

Nine species of the Malvaceae family: *Malva sylvestris* L., *M. nicaeensis* All., *M. parviflora* L., *Althaea ludwigii* L., *H. cannabinum* L., *H. sabdariffa* L., *H. rosa-sinensis* L., *H. tiliaceus* L, and *Gossypium herbaceum* L. have been investigated. The fresh leaves of these species were collected from various regions of Iraq between October 2023 and January 2024; preservation was followed in a formalin acetic acid alcohol solution (F.A.A.) for 48 hours and kept them in 70% alcohol. The leaves were macerated in Jeffrey's solution to prepare the epidermis (chromium trioxide 10 gm and 90 ml nitric acid) and then put in glycerin jelly (5 ml of glycerin and 1 ml of Safranin stained). On the leaf's upper and lower surfaces, the trichome type and stomatal frequency in mm^2 were observed. Used a digital camera to take photos of the leaves under Olympus light microscope. The anatomical terminologies used are taken from (Esau, 1965; Ramírez-Díaz, 2024). The following formula was used to determine the stomatal index in accordance with (Metcalfe & Chalk, 1979):

SI= S/ E+S X 100

where: S.I = Stomatal index; S = Stomata number per unit area, E = epidermal cells number.

Statistical analysis

Analyses of variance (ANOVA) were performed on the data, and all results were produced using the statistical program SPSS v17. Means have been compared at 0. 05 probability.

Results & Discussion

Epidermal cells

The characteristics and dimensions of epidermal cells are compiled in Table (1) and Figures (1-2). In the species under study, the upper and lower surfaces of the leaf typically differ in cell shape and size. The study showed that the shape of the anticlinal wall cells differed in the upper and lower epidermis among examined species. The wall of the upper epidermal cells was distinguished as straight in *A. ludwigii, G. herbaceum, H. sabdariffa* and *H. tiliaceu* species, sinuate in *H. cannabinum* and *H. rosasinensis*, and undulate or strongly undulate in *Malva* species. There was straight lower epidermis in *G. herbaceum, H. sabdariffa*, and *H. rosa-sinensis*, undulating lower epidermis in *A. ludwigii*, *H. cannabinum*, and *H. tiliaceus*, and strong undulating lower epidermis in *Malva* species (Table 1; Figure 2). Chachad & Vaidya (2016) showed that the upper epidermis of *H. rosa-sinensis* has polygonal epidermal cells and the lower epidermal cells have a wavy border and are irregular. *M. sylvestris* recorded an average length of epidermal cells in the upper epidermis of 91.25 µm, while *H. tiliaceus* showed a lower average length of 27.18 µm. *H. sabdariffa* had the highest width in the upper epidermis at 61.87 µm, while *G. herbaceum* had the lowest width at 24.06 µm. In the lower epidermis, *H. sabdariffa* had the highest width at 81.66 µm, and *H. tiliaceus* had the lowest width at 18.12 µm (Table 1). Each species has a different number of cells on its adaxial and abaxial epidermis: the highest mean was 114x137 cells in *M. parviflora* and the lowest mean was 38 cells in *H. sabdariffa.* The upper epidermis in *A. ludwigii* was 33 cells (Table 1).

Stomatal pattern

The study identified five different stomatal complex types: anomocytic (rununculaceous); hemiparacytic; paracytic; anisocytic (cruciferous) and diacytic (Figure 1 and 2). The results agree with the findings of Mitra *et al*., (2015) who reported that all Malvaceae species had an anomocytic type. As well as Chachad & Vaidya (2016) observed that the stomata of *Hibiscus* species on the upper epidermis have anomocytic and anisocytic types with kidney-shaped guard cells. Taia *et al*., (2023) demonstrated that the common type of stomata in Malvaceae is anomocytic, whereas in the *Alcea* and *Althaea*, it is paracytic, which aligns with our findings.

The measurement of the stomata showed a clear difference in the upper and lower epidermis (Table 2). The highest rate of stoma length on the upper surface was 35.33µm in *A. ludwigii*, and the lowest rate was 20.75 µm in *H. cannabinum*. The highest rate of stomata width on the upper surface recorded in *H. rosa-sinensis* was 29.07 µm and the lowest width was 11.75 µm in *H. cannabinum*. On the lower surface, the highest average stoma length was 60.62 µm in *H. tiliaceus* and the lowest average was20.41 µm in *G. herbaceum*, the highest average stoma width was 24.58 µm in *H. rosa-sinensis*. The lowest rate was in *H. cannabinum* 12.16 µm. The largest number of stomata in the upper epidermis and lower epidermis recorded in *H. cannabinum* was 54 stomata/mm^2 and99 stomata/mm^2 respectively. The lower epidermis of *H. rosa-sinensis* recorded 9 stomata/mm^2, while *A. ludwigii* recorded 15 stomata/mm^2 in the upper epidermis (Table 2). The stomatal index varies between species and on the upper and lower epidermis. It was noted that the stomatal index in the lower epidermis was higher than the upper epidermis in all species. The *H.*

sabdariffa plant had the highest stomatal index 50.98 on the lower surface and the lowest 37.70 on the upper surface (Table 2 and Figure 3). The *M. sylvestris* had the lowest stomatal index 18.18 on the lower surface and the lowest 7.01 on the upper surface. Our findings concurred with those of Kumari & Kandir (2021), who examined the stomatal index of *Hibiscus rosa-sinensis* and discovered that it was on the upper surface 32.81. The variation in the epidermal characters besides stomatal density, trichome density, leaf ages, position, and characteristics of environmental conditions (Al-Taie *et al*., 2018). The variations in stomatal complex characteristics demonstrated ecological environment divergence and adaptation. Characteristic similarities were observed in the majority of other Malvaceae species (Al-Saadi *et al*., 2019; Al-Saadi *et al*., 2023).

Table (1): Measurements of cells in the epidermis of Malvaceae species.

species	Shape of anticlinal cells		Epidermal cells (micrometer)				Number of cells (mm^2)	
			Upper		Lower			
	Upper epidermis	Lower epidermis	Length	Width	Length	width	Upper epidermis	Lower epidermis
A. ludwigii	Striaght	Sinute	(25-32.5) * 28.75	(30-62.5) 50.11	(50-57.5) 53.75	(32.5-37.5) 35.01	(40-45) 44	(30-40) 33
G. herbaceum	Striaght	Striaght	(35-50) 42.50	(22.5-25) 24.06	(35-37.5) 35.93	(18.75-20) 19.37	(100-112) 102	(99-110) 105
H. cannabinum	Sinute	Sinute	(50-62.5) 55.11	(25-28.7) 27.08	(32.5-35) 33.75	(30-37.5) 33.75	(80-95) 88	(97-100) 98
H. sabdariffa	Striaght	Striaght	(52.5-57.5) 55.11	(62.5-65) 64.87	(75-87.5) 81.66	(75.1-87 81.25	(36-50) 38	(59-61) 60
H. tiliaceus	Striaght	Sinute	(25-30) 27.18	(25-35) 30.62	(16.25-20) 18.12	(15-16.25) 15.77	(80-100) 93	(92-100) 97
H. rosa-sinensis	Sinute	Striaght	(25-37.5) 32.51	(45 -57.5) 51.87	(62.5-75) 70.62	(22.5-26.2) 24.68	(85-90) 88	(50-54) 53
M. nicaeensis	Strongly undulate	Strongly undulate	(50-57.5) 53.75	(41.25-37.5) 39.06	(55-62.5) 57.50	(35-36.25) 36.07	(110-120) 117	(80-90) 88
M. parviflora	Strongly undulate	Strongly undulate	(50-57.5) 53.75	(17.5-35) 27.75	(50-55) 51.87	(25-30) 27.18	(130-140) 137	(100-110) 114
M. sylvestris	Strongly undulate	Strongly undulate	(80-100) 91.25	(45-50) 48.12	(67.5-72.5) 70.62	(45-62.5) 51.25	(100-110) 106	(95-101) 99
L.S.D.			2.43	1.71	4.70	2.11	4.82	3.65

*The values between arches represent the meaning, and the values out of the arches represent the minimum and maximum values of eight replicate.

Table (2): The measurements of the leaves' stomata of the Malvaceae species.

species	Stomata dimension (micrometer)				Stomata frequency		Stomata index rate	
	Upper		Lower		Stomata /mm²			
	Length	width	Length	width	Upper epidermis	Lower epidermis	Upper epidermis	Lower epidermis
A. ludwigii	(34.75-36) * 35.33	(21.25-22.5) 21.66	(30-33.75) 32.66	(21.25-22.5) 21.85	(8-10) 9	(14-16) 15	16.98	31.25
G. herbaceum	(23.75-25) 24.58	(16.25-17.5) 17.08	(20-20.5) 20.41	(16.25-18.75) 17.80	(20-22) 21	(42-45) 44	17.07	29.53
H. cannabinum	(20-21.25) 20.75	(11.25-12.5) 11.75	(22.25-23.7) 22.83	(12.5-13.75) 12.16	(52-55) 54	(90-101) 99	37.58	50.25
H. sabdariffa	(23.75-25) 24.11	(20-20.75) 20.04	(23.7-25) 24.68	(21.25-22.5) 21.66	(19-25) 23	(50-54) 52	37.70	50.98
H. tiliaceus	(22.5-23.75) 22.91	(17.5-18.75) 17.90	(20-21.25) 20.62	(16.25-17.5) 16.87	(8-10) 9	(80-95) 84	8.82	46.40
H. rosa-sinensis	(27.5-30) 29.16	(26.25-30) 29.07	(32.5-35.2) 34.06	(23.75-25.1) 24.58	(3-5) 4	(17-19) 18	34.34	25.35
M. nicaeensis	(22.5-25) 24.06	(17.25-18.75) 17.70	(21.25-22.5) 22.08	(15.75-17.5) 16.45	(50-55) 53	(58-62) 63	31.17	41.72
M. parviflora	(18.04-23.75) 22.81	(16.25-17.5) 15.31	(22.5-23) 22.58	(16.25-17.5) 16.99	(45-55) 47	(54-56) 55	31.75	32.54
M. sylvestris	(21.2-22.5) 21.66	(12.5-13.7) 12.81	(23.7-28.7) 25.82	(18.7-20) 19.68	(7-9) 8	(22-24) 22	7.01	18.18
L.S.D.	1.92	3.66	2.45	1.38	2.77	3.92	1.32	3.11

*The values between arches represent the meaning, and the values out of the arches represent the minimum and maximum values of eight replicate.

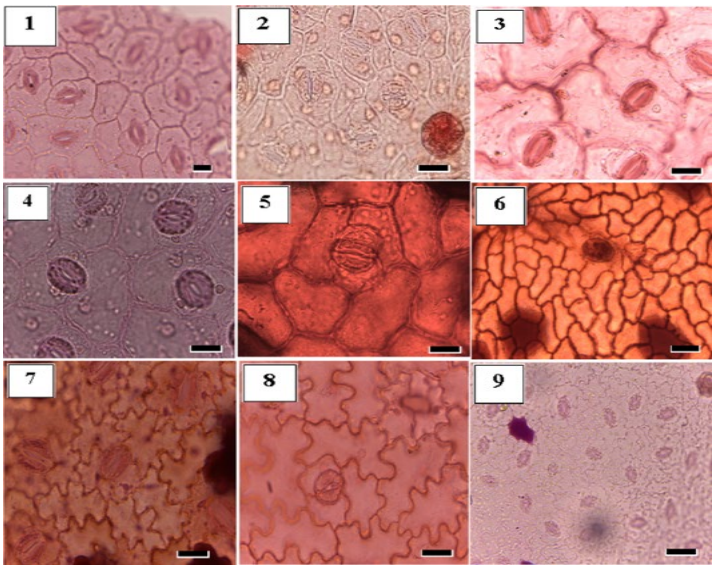

Fig. (1): Surface view of leaf epidermis in light microscope on upper surface (scale 25 um) 1: *Althaea ludwigii* 2: *Gossypium herbaceum*3: *H. cannabinum* 4: *H. sabdariffa* 5: *H. tiliaceus* 6: *H. rosa-sinensis*7: *M. nicaeensis* 8: *M. sylvestris* 9: *M. Parviflora*

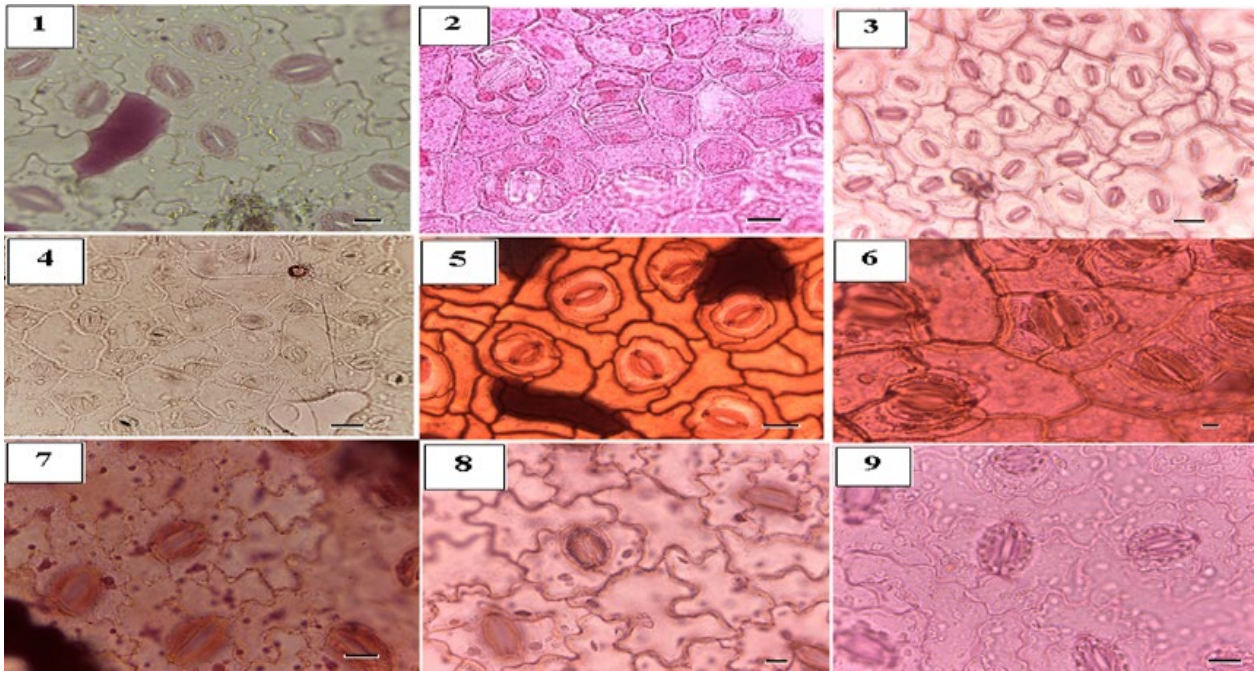

Fig. (2): Lower surface of the leaf epidermis under a light microscope (scale: 25 um).

1**:** *Althaea ludwigii* 2*: Gossypium herbaceum* 3*: H. cannabinum* 4*: H. sabdariffa* 5*: H. tiliaceus* 6*: H. rosa-sinensis* 7*: M. nicaeensis* 8: *M. sylvestris* 9*: M. parviflora*.

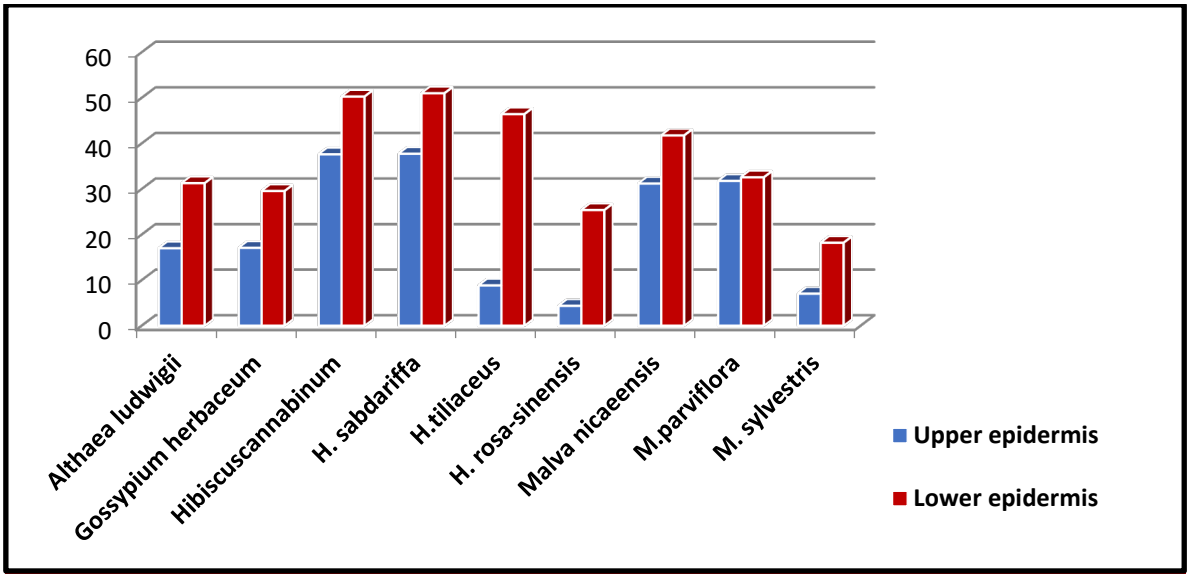

Fig. (3) : Variations in stomatal index in epidermis for Malvaceae species

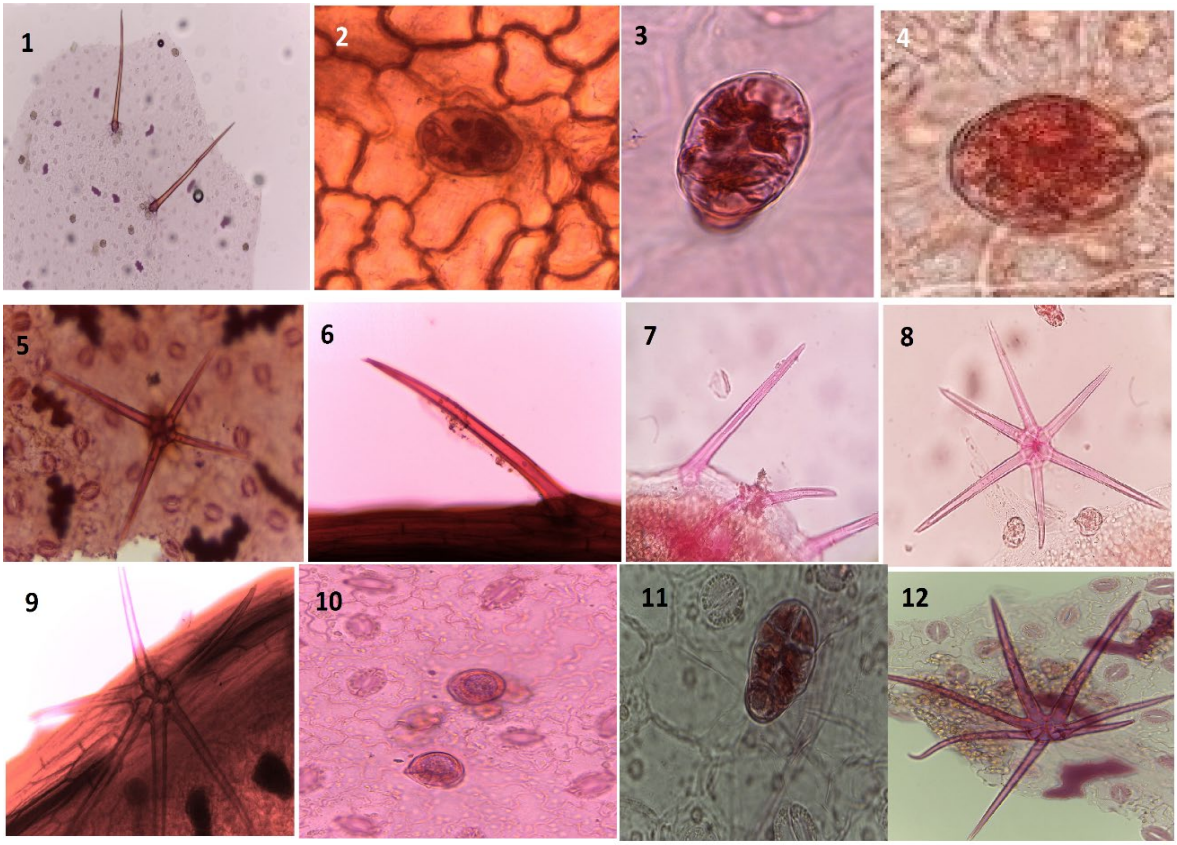

Fig. (4): Trichomes type in light microscope on upper and Lower surface

1-*M. parviflora* 2- *H. rosa-sinensis* 3- *H. sabdariffa* 4- *G. herbaceum*

5-6: *M. nicaeensis* 7-9*: M. sylvestris* 10- *M. parviflora* 11-12: *Althaea ludwigii*

Trichomes

The current study showed that the trichomes on the leaves of *M. nicaeensis, M. parviflora*, and *M. sylvestris* plants are single-celled and not glandular, while they are glandular on *H. rosa-sinensis*, *G. herbaceum*, and *H. sabdariffa* plants and have stellate hairs on *M. parviflora*, *M. nicaeensis*, *A. Ludwig* and *M. sylvestris* (Figure 4). This was agreed with (Munir *et al*., 2011; Essiett & Iwok, 2014; Taia *et al*., 2023). The results aligned with the findings of Taia *et al.* (2023); Silva *et al*. (2023); Al-Hawshabi (2024) and Wannan (2024), identifying one type of trichome on both the abaxial and adaxial surfaces, or two or three types on both leaf surfaces, and identifying stellate hairs and multicellular uniseriate points on the surface of Malvaceae species. Many researchers reported that species of Malvaceae contains not glandular or glandular hairs (Silva *et al.,* 2023). Additionally, stellate trichomes are present in the family (Metcalfe & Chalk, 1979; Rakhimov *et al*., 2021). In some plant species, leaf trichomes have been demonstrated to decrease insect herbivory (Abdullah *et al*.,2025; Silva *et al.,* 2023).

Conclusion

The present study observed some species recognized taxonomically from another species studied, such as the wall of the upper and lower epidermal cells were undulate - strongly undulate in *Malva* species compared with other species, it was straight or sinuate. Also found different types of trichomes: unicellular non-glandular, glandular, and stellate hairs in the leaf epidermis of nine species belonging to the Malvaceae family. While the study found All species of *Malva* have stellate hair. This study also examined stomatal complexes such as anomocytic (ranunculaceous), hemiparacytic, paracytic, anisocytic (cruciferous), and diacytic, with (Ramírez-Díaz *et al*., 2024; Taia *et al.*, 2023) reporting comparable results. But the study showed that *M. sylvestris* has lower values than the stomata index rate, while *H. sabdariffa* has higher values. So, this work is a significant contribution as an aid in the identification of the species with the help of anatomical studies.

Acknowledgements

The authors acknowledge the central laboratory workers in the Biology Department help photograph the samples and the management of Basrah University.

Contributions of authors

S. S. K. A.: Collection of specimens. Laboratory techniques and identification of the plant.

S.A.M.A.: Suggestion the proposal of the article, Laboratory techniques and identification of the plant. Also, wrote and revised the manuscript.

ORCID

S.S.K. Al-Taie: https://orcid.org/0000-0002-4313-8830.

S. A. M. Al-Saadi: https://orcid.org/0000-0003-2782-3907

Ethical approval

There was no need for ethics approval for the present research.

References

Abbas, R. J. (2021). Effect of supplementing different levels of okra seed (*Abelmoschus esculentus* L.) powder on growth performance, carcass characteristics, blood parameters and gut microbial populations in broiler chickens. *Basrah Journal of Agricultural Sciences*. 34(2), 29-41, https://bjas.bajas.edu.iq/index.php/bjas/article/view/434.

Abdullah, N. A., Alpresem, W. F., & Hzaa, A. Y. L. (2025). Effect of Plant Extracts and Nano-Selenium

on the Anatomical Characteristics of Mango Seedling Leaves (*Mangifera indica* L.) Under Stress Conditions. In IOP Conference Series: Earth and Environmental Science (Vol. 1487, No. 1, p. 012042). IOP Publishing. https://iopscience.iop.org/article/10.1088/1755-1315/1487/1/012042

Akcin, O.E. & Ozbucak, T.B. (2006) Morphological, anatomical and ecological studies on medicinal and edible plants *Malva neglecta* Wallr (Malvaceae). *Pakistan Journal of Biological Sciences*, 9, 2716–2719. https://scialert.net/fulltext/?doi=pjbs.2006.2716.2719.

Al-Garory, N. H., & Al-Kaabi, W. J. (2020). Determination of some Heavy Metals Concentration in some Dairy Products from Three Different Regions of Basrah, Iraq. *Basrah Journal of Agricultural Sciences*, 33(2), 1–13. https://bjas.bajas.edu.iq/index.php/bjas/article/view/206

Al-Hawshabi, O.S. (2024). Anatomical study on Hibiscus L. (Malvoideae) of Malvaceae Sensu lato in Toor Al-Bahadistrict, Lahej Governorate, Yemen. *Electronic Journal of University of Aden for Basic and Applied Sciences*, 5(1), 95–113. https://doi.org/10.47372/ejua-ba.2024.1.332.

Al-Mousawi, N.; Al-Waheeb, A.N. & Al-Saadi, S.A.M. (2019). Anatomical study of some species belonging to the Papaveraceae *family in north of Iraq*. *Bulletin of the Iraq Natural History Museum*. 15 (4): 363-379. https://doi.org/10.26842/binhm.7.2019.15.4.0363.

Al-Saadi, S. A. A.; Al-Taie, S.S. & Al-Waheeb, A.N. (2023). Anatomical study of *Nerium oleander* L. leaves found in places contaminated with H_2S. IOP Conf. Series: *Earth and Environmental Science*:1-7. https://iopscience.iop.org/article/10.1088/1755-1315/1215/1/012052.

Al-Saadi, S. A. A; Qader, K.O & Fetah, H. F. (2019) Anatomical characters used to delimit species of some genera of Brassicaceae in Iraq. *Journal of Zankoy Sulaimani.* (Part-A): 1-21. https://sjpas.univsul.edu.iq/article?id=823.

Al-Taie, S. S., Al-Waheeb, A.N. & Al-Saadi, S.A.A. (2018). Anatomical study of some species of Caryophyllaceae in Iraq. *Biochemical and Cellular Archives*.18(2): 2173-2179. https://www.connectjournals.com/pages/articledetails/toc028896.

Arabameri, M., Khodayari, H. & Zarre, S. (2020). Trichome micromorphology in *Alcea* L. and allied genera (Malvaceae). And its systematic implication. *Nordic journal of Botany:*1-16. https://doi.org/10.1111/njb.02540.

Celka, Z., Szkudlarz, P. & Bierężnoj, U. (2006). Morphological variation of hairs in Malvaceae L. (Malvaceae). *Biodiversity Research and Conservation,* 3-4: 258-261. http://brc.amu.edu.pl/Morphological-variation-of-hairs-in-Malva-alcea-L-Malvaceae-,121604,0,2.html.

Chachad, D. P. & Vaidya, M. (2016). Stomatal studies on some selected plants of Malvaceae. World *Journal of Pharmaceutical Research*. 5 (3), 1060-1068. https://www.wjpr.net/abstract_show/4759.

Christenhusz, M.J.M. & Byng, J. W. (2016). The number of known plant species in the world and its annual increase. *Phytotaxa,* 261(3), 201-217. https://www.biotaxa.org/Phytotaxa/article/view/phytotaxa.261.3.1

Chung, R.C.K. (2002). Leaf epidermal micromorphology of *Grewia* L. and *Microcos* L. (Tiliaceae) in Peninsular Malaysia and Borneo. *The Gardens' Bulletin Singapore*, 54, 263-286. https://www.biodiversitylibrary.org/creator/134137/author?bpg1&ppg=1&psize=250#/sections

El Kholy, D.M., Mohamed, A.H. & Khafagi, A.A.F. (2023) The taxonomic significance of pollen and seed morphology in the Mimosoideae and Caesalpinoideae (Leguminosae). *Egyptian Journal of Botany*, 63(1), 31–43. https://ejbo.journals.ekb.eg/article_257980.html.

Esau, K. (1965). Plant anatomy. 2nd ed. Wiley Eastern Limited, New Delhi, *Calctta, Madras*, 767. https://www.amazon.com/Plant-Anatomy-2nd-Katherine-Esau/dp/0471244562

Essiett, U.A. & Iwok, E. S. (2014). Floral and leaf anatomy of *Hibiscus* species. *American Journal of Medical and Biological Research,* 2 (5), 101-117. https://pubs.sciepub.com/ajmbr/2/5/1/index.html.

Hashim, M. G., Hashim, M. G., & Abdullah, A. M. (2019). Corn cobs Efficiency in Adsorption of Cadmium Ions (Cd+2) from its Aquatic Solutions. *Basrah Journal of Agricultural Sciences*, 32, 135–

139. https://www.bajas.edu.iq/BJAS/index.php/bjas/article/view/76

Ibrahim, Z.M.; Hassan, S.A.; Karakish, E.A. & Ismail, I.M. (2023) Significance of seed storage protein and seed morphological characters in the classification of some species of Malvaceae. *Egyptian Journal of Botany*, 63(2), 431–455. https://ejbo.journals.ekb.eg/article_275143.html.

Karakish, E. A.; Al-Ruzayza, S. & Khalik, K. A. (2020). Comparative anatomical studies of some species of family Malvaceae from Saudi Arabia and its systematic significance. *The Egyptian Society of Experimental Biology. (Bot.)*, 16(2), 203 - 221. https://www.bibliomed.org/?mno=29845.

Kumari, N. & Kandir, K. (2021). Comparative study of stomatal index of some ethnomedicinal plants of some species of family Malvaceae in Ranchi district of Jharkhand. *Biospectra*. 16(1), 81-84. https://mset-biospectra.org/2021/09/comparative-study-of-stomatal-index-of-some-ethnomedicinal-plants-of-some-species-of-family-malvaceae-in-ranchi-district-of-jharkhand/

Metcalfe, C.R. & Chalk, L. (1979) "Anatomy of Dicotyledons", 2nd ed. Vol.1, *Oxford University Press, London,* 276p. https://www.scirp.org/reference/referencespapers?referenceid=1365527.

Mitra, S., Maiti, G.G. & Maity, D. (2015). Structure and distribution of heteromorphic stomata in *Pterygota alata* (Roxb.) R. Br. (Malvaceae, formerly Sterculiaceae). *Adansonia*. 3, 37 (1), 139-147. https://doi.org/10.5252/a2015n1a9.

Munir, M., Khan, M.A.; Ahmad, M.; Abbasi, A.M.; Zafar, M.; Khan, K. Y.; Tariq, T.; Tabassum, S.; Ahmed, S.N.; Habiba, U. & Bano, A. (2011). Taxonomic potential of foliar epidermal anatomy among the wild culinary vegetables of Pakistan. *Journal of Medicinal Plants Research*. 5(13), pp. 2857-2862. https://academicjournals.org/journal/JMPR/article-abstract/9FA9B5418606.

Naskar, S. (2016). Anatomical studies of some common members of Malvaceae S.S. from West Bengal. *Indian Journal of Plant Sciences*., 5(1), 1-7. https://www.cibtech.org/J-Plant-Sciences/PUBLICATIONS/2016/JPS-05-01-Contents.htm

Nbeaa, R. A., Abo-Trabi, B. & Ahmad, E. (2023). Phenotypic correlation and path coefficient and relative Importance studies in okra *Abelmoschus esculentus* (L.) Moench. *Basrah Journal of Agricultural Sciences.* 36(1), 50-59. https://bjas.bajas.edu.iq/index.php/bjas/article/view/906.

Obead, F. I.., & Jerry, A. N. (2019). Effect of Irrigation Water Quality and Spraying with Tocopherol on Na, K, K+/Na+ and Cl- and Chemical Components of Okra (*Abelmoschus esculentus* L. Moench). *Basrah Journal of Agricultural Sciences*, 32, 291–301. https://bjas.bajas.edu.iq/index.php/bjas/article/view/99

Rakhimov, A., Yoziev, L. & Duschanova, G. (2021). Structural features of the vegetative bodies of *Hibiscus syriacus* L. (Sev. Malvaceae Juss.) growing under the conditions in Uzbekistan. *BIO Web of Conferences*., 30, 04006 https://doi.org/10.1051/bioconf/20213004006.

Ramírez-Díaz, M., Gutiérrez, J., & Terrazas, T. (2024). Arquitectura y anatomía foliar de ocho especies de Tilia (Malvaceae). *Acta Botanica Mexicana, (131).* https://doi.org/10.21829/abm131.2024.2332

Silva, P. C.; Gallão, M. I. & De Arruda, E.C. (2023). Comparative anatomical study of two Malvaceae species from a seasonally dry forest. *Flora*. 303, 152290. https://www.sciencedirect.com/science/article/abs/pii/S0367253023000804.

Taia, W. K., Hassan, A. & El-Badan, G.E. (2023). Leaf variations within representative genera of tribe Malveae and their significance in the taxa phylogeny. *Egyptian Journal Botany* 63(3), 727-742. https://ejbo.journals.ekb.eg/article_290885.html.

Taia, W.K. & Mahdy, R.A. (2021) Significance of stomata and hair variations within some *Bauhinia* L. species. *International Journal of Botany*, 6(6), 322–327. https://www.botanyjournals.com/archives/2021/vol6/issue6/6-6-17

Townsend, C.C. & Guest, E. (1980). Flora of Iraq. Cornaceae to Rubiaceae. *Ministry of Agriculture and Agrarian Reform*. *Volume four –Part one*. p: 219 - 274. https://www.amazon.com/Flora-Iraq-Cornaceae-Rubiaceae-Part/dp/1842463314

Uzunhisarcikli, M.E. & Vural, M. (2012). The taxonomic revision of *Alcea* and *Althaea* (Malvaceae) in Turkey. *Turkish Journal of Botany*, 36(6), 603-636. https://doi.org/10.3906/bot-1108-11.

Wannan, B. S. (2024). *Hibiscus cummingii* Wannan (Malvaceae), a new species from north-east Queensland. *Austrobaileya* 14, 27–35. https://www.qld.gov.au/environment/plants-animals/plants/herbarium/austrobaileya.

Zhang, J., Cheng, C., Xiao, F., Zhang, X., Zhang, C., Zhao, Y., Xu, J., Zhang, S. & Wang, X. (2024). Effects of ploidy level on leaf morphology, stomata, and anatomical structure of *Hibiscus syriacus* L. *BMC Plant Biology* 24 (1), 34-45. https://bmcplantbiol.biomedcentral.com/articles/10.1186/s12870-024-05778-y

دراسة مقارنة بين البشرتين العليا والسفلى للأوراق والشعيرات في بعض الأنواع التي تنتمي إلى العائلة الخبازية Malvaceae

صادق صبيح كريم[1] سحر عبد العباس مالك السعدي[2]

[1]قسم علوم الحياة، كلية العلوم، جامعة ميسان، العراق

[2]قسم علوم الحياة، كلية العلوم، جامعة البصرة، العراق

المستخلص: تم فحص صفات أوراق أربعة أجناس تعود الى تسعة أنواع من العائلة الخبازية: *Althaea ludwigii* L. و *Gossypium herbaceum* L. و Hibiscus *cannabinum* L. و *H. sabdariffa* L. و *H. rosa-sinensis* L. و *H. tiliaceus* L. و *Malva sylvestris* L. و All *M. nicaeensis* و L. *M. parviflora* أظهرت النتائج عن وجود اختلافات بين الأنواع تمثلت في شكل الخلايا الاعتيادية للبشرة وتكرار الثغور ودليل الثغور وأنواع الشعيرات. فقد بدا شكل خلايا الاعتيادية للبشرة مستقيمًا في الأنواع *A. ludwigii* و*G. herbaceum* و*H. sabdariffa* و*H. tiliaceu*؛ ومتموجًا في النوعين *H. cannabinum* و*H. rosa-sinensis*، ومتموجًا أو شديد التموج في أنواع الجنس *Malva*. بلغ معدل طول خلايا البشرة العليا 91.25 مايكروميتر في النوع *M. sylvestris*، بينما بلغ 27.18 مايكروميتر في النوع *H. tiliaceus*. وقد حددت النتائج خمسة أنماط مختلفة للثغور وهي anisocytic (cruciferous) و paracytic و anomocytic (rununculaceous) و hemiparacytic و diacytic. أما الشعيرات فقد تميزت على أنها وحيدة الخلية غير غدية unicellular non-glandular في الأنواع *M. parviflora* و *M. nicaeensis* و*M. sylvestris* وغدية glandular في الأنواع *H. rosa-sinensis* و *G. herbaceum* و*H. Sabdariffa* وشعيرات نجمية stellate في الأنواع *M. nicaeensis* و*M. parviflora* و*M. sylvestris* و*A. ludwigii*. أختلف الدليل الثغري بين الأنواع في البشرتين العليا والسفلى اذ بلغ أعلى دليل للثغور 50.98 في النوع *H. sabdariffa* على السطح السفلي، وأدنى دليل للثغور 7.11 على السطح العلوي.

الكلمات المفتاحية: الاوراق، الثغور، خلايا البشرة، الشعيرات، العائلة الخبازية.