Original Article

Taxonomical study of Halothamnus iraqensis Botsch. (Amaranthaceae) in Al-Tar Caves, Karbala, Iraq

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Abstract

Halothamnus iraqensis Botsch. (Amaranthaceae) It is one of the endemic plant species in Iraq, which studied taxonomically from the morphological and anatomical aspect of the plant stem, as well as studying the shapes of stem cells, leaves and the stomata complex, also geographical with habitat and ecological study to give a clearer picture of this plant and to facilitate the diagnosis process for other researchers. The results that showed that this species is a small shrub to 50 cm tall, has stiff woody stem and succulen which branching very copiously from base. Contains Unicellular hairs and Multicellular hairs, The average length of the epidermal cells on surfaces of the leaf was about 55.55 □m and 43.25 □m on adaxial and abaxial surfaces, respectively. Adaxially, width of the epidermal cells was about 38.56□m while abaxially, it was about 31.22 □m.

Keywords: Taxonomic, Halothamnus iraqensis, Al-Tar Caves, Karbala, Iraq.

INTRODUCTION

Halothamnus Jaubert & Spach (1845) is a genus of flowering plants in the family Amaranthaceae and subfamily Salsoloideae [1]. Previously, it belonged to the family Chenopodiaceae [2]. The name is derived from the Greek words ἅλς (neck) of salt and θαμνος (thamnos) of shrub from so it means] " salt bush "; Which may indicate salty places of growth and also the accumulation of salt inside plants [3,4]. (The Amaranthacea have more than 60 genera, that include about 800 species for dicotlyledonous, herbaceous plants, annual and perennial herbs, subshrubs or shrubs, That plants is dioecious , polygamous or monoecious4. Leaves simple , Can be alternate or opposite, estipulate, entire [5,6]. Inflorescence of this family has a dense head, Maybe loose or spike -like thyrse, raceme or panicle, bracteate; bracts transparent , also membranous , white or other colour, subtending one or more flowers [7,8,9]. The Flowers small, Maybe hermaphrodite or unisexual, modified to bristles or sterile , actinomorphic, bracteolate; sepals ovary superior , 2-3-carpellate, 1-locular, The placentation basal , has 1 style and stigma of variable form. Fruits have few-seeded capsules, also nutlets, achenes or berries; the seeds black and shiny) and contains 21 species which distributed in a number of countries in the world [10]. Most species of this genus are used like a fodder and for medicinal purposes. All Previous studies confirmed that the species of the genus Halothamnus have a mechanism of unique C4

photosynthesis, so this gives them more resistance for drought and high salinity when compared with C3 plants [11,12,13].

Halothamnus iraqensis Botsch. (1981) is a perennial branched shrub, up to 50 cm in height. A ccepted species, native forom Syria to Iraq also North Arabian Peninsula, which includes two accepted Infraspecifics: Halothamnus iraqensis var. hispidulus Botsch. (The native range is Iraq) and Halothamnus iraqensis var. iraqensis which also accepted, also native range is Syria to Iraq and North Arabian Peninsula [14]. The seeds for H. iraqensishave a persistent wing that is retained in the mature fruit and the pericarp [15].

Many species of the Halothamnus (as H. iraqensis) that are grazed by camels, goats and sheep characterized by excellent sand-fixation ability, also able to tolerate extreme temperatures, high salinity and high drought. Therefore, H.iraqensiscan be used for rehabilitating the degraded arid also the salt-affected lands [16,17].

The aim of the study is to determine the phenotypic and anatomical characteristics of the species, which makes it easier for researchers to distinguish the species from other species through the results of this study, and also useful in adding new characteristics to the taxonomic keys that facilitate the separation between genera and plant species.

Materials and methods

Sample collection

Fresh plant samples were gently collected from Al-Tar Caves, Karbala, Iraq during the flowering period in April of 2021 from Al-Tar Caves, Karbala, Iraq,It was kept for the purpose of taking measurements for the purpose of studying its morphological study. Parts of it were preserved in alcohol for the purpose of later anatomical study.

Morphological study

The taxonomic identification of the plants was determined by the author, In the Plant and Environment laboratory in Iraq Natural History Research Center and Museum, University of Baghdad. After measuring each plant parts of the studied species and recording the results of the measurements, The diagnosis of species and the specimens were stored in the herbarium o fIraq Natural History Research Center and Museum/ University of Baghdad. The synonyms of HalothamnusiraqensisBotsch. (Amaranthaceae) have been verified according to GBIF Secretariat. Our specimens were classified and identified by using different classification keys such as: [18,19,20].

Anatomical study

Preparing of epidermis

Epidermis of the stem and leaf were peeled for fresh specimen, The peels obtained from stem and both adaxial and abaxial surfaces for leaves by using the razor blade. After preparing, slides were observed under light microscope. The studied traits were: the shape, length and width for epidermal cells, presence and absence the stomata in each epidermis, type of stomata, length and width for the guard cells [21].

Preparing of transverse sections

The fresh mature leaves and stem for ten plant replicates of Halothamnus iraqensis Botsch. were washed with tap water, followed by distilled water. Then, the samples were cut to small pieces and fixed in FAA solution for 24 hrs (Johansen, 1940). Then, the samples were washed many times with 70% Ethyl Alcohol solution and maintained in it for using them later. Several cross sections were made from the middle part of leaves and stem, many anatomical characteristics were assessed like the outline shape of stem and pith cross sections, also the type of sclerenchymatous cells above the phloem, the number of vascular bundles and collenchymatous layers in stem, the shape of midrib, lamina and the type of mesophyll. After preparing, slides were observed by the compound light microscope. Also microphotographs were taken using digital camera fitted on the light microscope. These microphotographs were useful for the identification and differentiation of cells of vegetative organs on the base of microscopic features among different plant species [22].

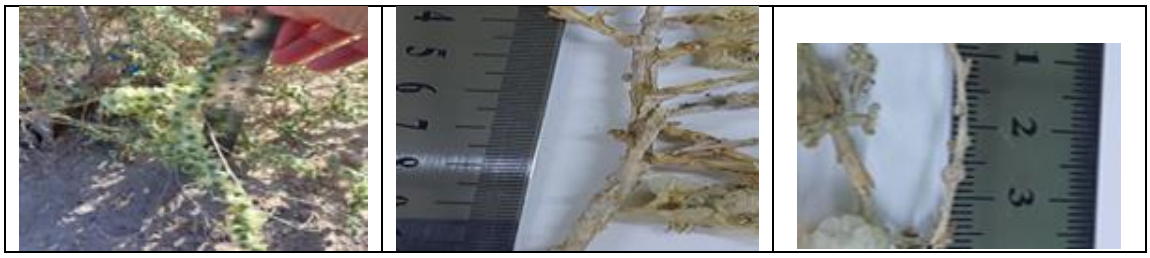
Geographical study withHabitat/ecology

The geographical distribution was also studied for the spread of this species in all regions of Iraq by referring to the dried plant samples found in the Iraqi herbaria affiliated to the University of Baghdad or to the rest of the universities or the National Herbarium of the Ministry of Agriculture in the Abu Ghraib area.

Results

Morphological study

Small shrub to 50 cm tall, has stiff woody stem and succulen which branching very copiously from base, In addition to distinguishing it by the presence of striate crusts in epicuticular wax. Branches 8-24 cm tall, leaves linear 12-20x 0.5-1.2 mm, caducous. Bracts triangular-ovate, 3-4.5x 2-3 mm, mucronate. Bracteoles clasping perianth, ovate, 2-4.5x 1.5-3.5 mm, weakly keeled. Perianth 4-6 mm long, the tepals white or pale yellow. Anther 3-4 mm. This species has developed many morphological traits to adapt and thrive in harsh drought and salinity conditions(Figure 1)These results are agree with [18].



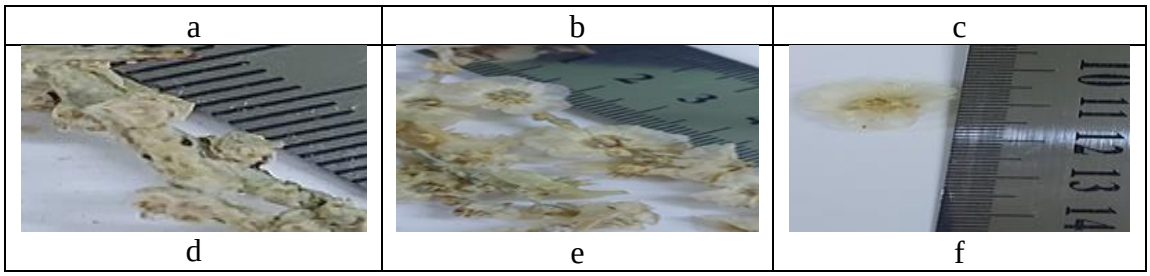


Figure 1. HalothamnusiraqensisBotsch. a: whole plant, b: the stem, c: side branches, d: leaves, e,f: the fruit

Anatomical study

The epidermal cells of the adaxial surfaces of Halothamnus iraqensis Botsch. as well asthe abaxial, Characterized by a quadrangular or polygonal shape. The average length of the epidermal cells on surfaces of the leaf was about 55.55 □m and 43.25 □m on adaxial and abaxial surfaces, respectively. Adaxially, width of the epidermal cells was about 38.56□m while abaxially, it was about 31.22 □m. When studying the stomatal complex, it was observed anisocytic and tetracytic types on adaxial surface, while, tetracytic and polycytic were viewed on the abaxial surface, also the anomocyticstomatal complex observed on the stem epidermis of this species [23,24]. The anatomical features of the stem of the this species are summarized in Table, stem has circular to sub-circular form, The cuticle was a thick layer; epidermis of both species was single layered. The epidermal cells were rectangula and semi- rectangula Sometimes irregular in shape Mean thickness of the epidermis layer was 28.38□m. Cortex comprised of 10-14 rows of parenchyma tissue, the outer 8-12 rows were chlorenchyma type. The collateral vascular bundles were about 20-25 bundles. Wood has ovate shape also has mean thickness 140.33□m [21].

Indumentum (Trichomes)

Keeping in view the importance of epidermal trichomes, Features of the eglandular trichomes of this species were summarized in Table (9). It is characterized by a diversity of hairs, despite their small number in this plant, perhaps because it is spread in dry areas. These eglandulartrichomes can be classified according to the cells number to:

1- Unicellular hairs (Simple hairs): This type of trichomes have a single cell graduated in length with acute apex.

2- Branched hairs: The trichome is unicellular but branched in Y (foorked) shape.

3- Multicellular hairs: This type consisted of more than two cells unequal in length, that's agree with [25,26].

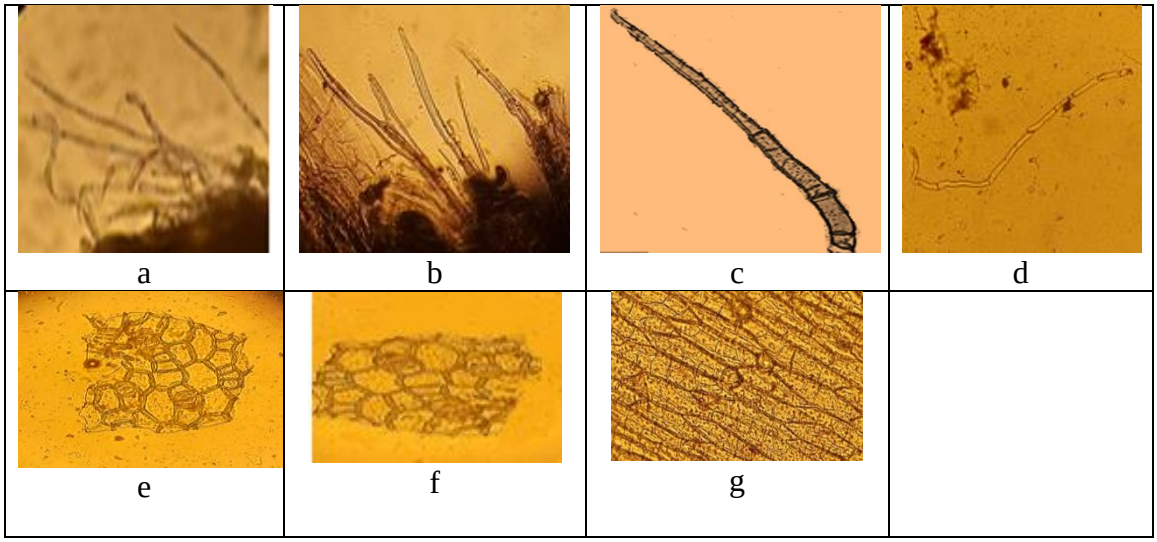


Figure 2. Indumentum (Trichomes) and epidermis form of the species Halothamnus iraqensis Botsch.a: -d Trichomes, e-g: epidermis of leaf , f: epidermis of stem

Geographical study with Habitat/ecology

Halothamnus iraqensis Botsch. According to the plant samples that were collected and the samples preserved in the plant herbaria, it was found that this plant is spread in most parts of Iraq, but it was found much less in the northern regions, As the results showed that it was present in Sulaymaniyah.It also spread in dry areas in central and southern Iraq, but no presence was

recorded in the capital, Baghdad Governorate. The endemic species grows in a dry desert environment in semi-deserts and deserts that are characterized by high temperature and little water, as it bears difficult environmental conditions. This plant thrives in colonies spread densely in the loamy, stony or sandy soil, also this species tolerate surfaces of salt or gypsumalso(Figure 3). Alt. 0-180 m, flowering Aug.-Nov., fruiting Oct.-Dec [18].

Figure 3. Map of Iraq showing species distribution in different governorates

Discussion

In the nature, Each plant has different morphological and anatomical Features. We will see the dependent plants of the same sex, morphological and anatomical differences according to their ages, or in other words, we mean, So Certainly, defining both morphological and anatomical characteristics is an attempt to distinguish the genus or species to which a plant should belong. Morphology is an indication of the surface appearance of plants, As Features of the internal structure of the plant contributed to plant systematic, Also anatomical features contribute to complement the elaboration for the genetic relationship or the

phylogenetics. Our study found that the morphlogical traits remain no matter how other studies supporting it develop, such as chemical or genetic studies and pollen, but morphological studies remain the basis for plant diagnosis and the development of taxonomic keys for genus and species. Small shrub to 50 cm tall, has stiff woody stem and succulent,Because it is one of the plants that are able to adapt and live in environments that lack sufficient or medium quantities of water, and among those environments are dry areas.Also, plants that live in saline areas or in light alkaline soils show the characteristics of desert plants because despite the availability of water in such an environment, the plant cannot benefit from it physiologically,all work to reduce plant water loss.The studying of the stomatal complex, it was observed anisocytic and tetracytic types on adaxial surface, while, tetracytic and polycytic were viewed on the abaxial surface, also the anomocyticstomatal complex observed on the stem epidermis of this species, The results of the current study showed that the shapes of stomatal complexes are of anatomical importance. There is a wide range of species under study that are closely related to the genetic factor in addition to their physiological function inside the plant body [27]. The species was also distinguished by its trichomes, which are theyunicellular hairs,branched hairs and multicellular hairs, It is customary that the surface covering has been used since ancient times to isolate and classify the different classify plants, It agrees with what was mentioned by [28,29]. And considers it an important factor in finding similarities and evolutionary relationships between different species [30].

Conclusions

Under the circumstances of these morphological and anatomical results and the shapes of the epidermis of the stem and leaf, the important characteristics that distinguish this type from other types, which help researchers to distinguish it from others, and diagnose the species based on the characteristics available in this article.

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Conflicts of Interest

The authors declare no conflict of interest.

REFERENCES

1. Helmut, F.; Vagif, A.; Esat, C.; Mustafa, A. The genus HalothamnusJaub. &Spach (Chenopodiaceae) in Turkey. Turkish Journal Of Botany. 2009, 33, 325-334.
2. Arvind, B.; Narayana, R. B.; Valentina. M.; Andrea, S. Eco-physiological studies on desert plants:germination of HalothamnusiraqensisBotsch. Seeds under different conditions. Journal Of Arid Land. 2019, 11, 75-85.
3. Al-Nafie, A.H. Phytogeograph of Saudi Arabi–Saud Journal of Biological Sciences. 2008, 15, 159-176.
4. Freitag, H.; Atamov, V.; Celin, E.; Aslan, M. The genus HalothamnusJaub. &Spach. (Chenopodiaceae) in Turkey. – Turk. J. Bot. 2009, 33, 325-334.
5. Sara, E. L.T.; Cleide, A. S.T.; Rhanany, A. C.P.; Maysa I.S.; Lucas, P.G.; Aniely, O.S.; Valter, P.A.; Jane, M.B.; Roosevelt, I. C.S.; Ariany, C.S.; Vanessa, S. S.; Denise, B.S.; Paulo, R.D.; Arquimedes, G.J. Celosia argentea L. (Amaranthaceae) a vasodilator species from the Brazilian Cerrado – An ethnopharmacological report.Journal of Ethnopharmacology. 2019,229, 115-126.
6. Iamonico, D.; Das, S. Amaranthusbengalense (Amaranthaceae) a new species from India, with taxonomical notes on A. blitum aggregate. Phytotaxa. 2004, 181, 293–300.
7. Freitag, H.Chenopodiaceae. In: Güner A, zhatay N, Ekim T&Başer KHC (eds.) Flora of Turkey and the East Aegean Islands. Edinburgh: Edinburgh University2000, 11, 57-65.
8. Iamonico, D. Amaranthuspowellii S. Watson subsp. cacciatoi comb. & stat. nov. (Amaranthaceae). Nordic Journal of Botany. 2012, 30, 12–16.
9. Vipin, C. P.; Om, V. S.; Bhuwanendra, S.; Arshad, A. Pharmacognostical Studies of AmaranthusSpinosus Linn. Journal of Pharmaceutical and Biosciences. 2013, 1, 32-37.
10. Mosyakin, S.L. Salsola. In: Morin, N. (Ed.) Flora of North America 4. Oxford Univerty Press, Oxford & New York. 2003, 398–403.
11. Tanveer , H.B.; Shazia, B.; Muhammad, T.; Samreen, G. K.; Saira, H.; Muhammad, I. J.; Muhammad, L.; Sobhy, M. I.; Munawar, I.; Arif, N. Estimation of Mineral Composition, Antioxidant, Antimicrobial, Biofilm Activity and HPLC Profile of Halothamnusauriculus. Polish Journal of Environmental Studies . 2021, 30, 1557-1562.
12. 12.Post, G.E.; Dinsmore, J.E. Flora of Syria, Palestine and Sinai ed. Beirut: American Press.1993, 2, 426-455.
13. Sukhorukov, A.P. On some new and critical taxa of the Family Chenopodiaceae in the flora of the Caucasus. NovostiSistematikiVysshikhRastenii (Moscow & Leningrad). 2011, 42, 106–110.
14. The Global Biodiversity Information Facility (Gbif). HalothamnusiraqensisBotsch. 2021, https://www.gbif.org/species/6035784.
15. Katarzyna, W.; Agnieszka, M. AmaranthusCruentus Taxonomy, Botanical Description, and Review of its Seed Chemical Composition. Natural Product Communications. 2019,1-10.
16. Mlakar, S.G.,; Turinek, M.; Jakop, M.; Bavec, M.; Bavec, F. Nutrition value and use of grain amaranth: potential future application in bread making.

Agricultura. 2009,6,43–53.
17. Liu, M. Morphology and anatomy of seed plant. Science Press: Beijing, China. 2006, 121-268.
18. Ghazanfar, S.A. ; Edmondson, J. R. Flora of Iraq. Royal Botanic Gardens, Kew. 2016,7,1.
19. Davis, P.H.; Mill, R.R. ; Kit, Tan. Flora of Turkey and the East Aegean Islands. Edinburgh: Edinburgh University Press. 1992,10,94-95.
20. Kothe, H. G. 28. Halothamnus. In: Rechinger, KH (ed) Flora Iranica. Graz: AkademischeDrucku. Verlagsanstal. 1997, 172, 255-289.
21. Metcalfe CR, Chalk L. Anatomy of the Dicotyledons, Clarendron Press, Oxford.1950,1,
22. Khansaa, R. A.; ,Lubab, G.A.; , Sukeyna, A. A. Morphological, anatomical and numerical taxonomy studies for some species of the fabaceae family. Journal of Biodiversity and Environmental Sciences. 2017, 11, 117- 123.
23. Rudall, P. (2007): Anatomy of flowering plants, an introduction to structure and development. Cambridge University Press: New York.
24. Abbas, A.; Ahmed, M.; Ola, H. A.E. Comparative anatomical studies on some species of the genus Amaranthus (Family: Amaranthaceae) for the development of an identification guide. Annals of Agricultural Science. 2017, 1-9.
25. Werker, E. Trichome diversity and development. – In: Hallahan, D.L., Callow, J.C. (ed.) Advances in Botanical Research, incorporating advances in plant pathology: plant trichomes, Academic Press: London. 2000, 1-36.
26. Carolin, R.C. The trichomes of the Chenopodiaceae and the Amaranthaceae. – Bot. Jb. Syst.1993, 103, 451–466.
27. Feryal, K.K.; Athiya, N.A. Study of Epidermal cells, stomatal complex of stems and indumentum of some taxa of the family AmaranthaceaeJuus. in Iraq. 2017, 9,54-70.
28. Khan, M.; Musharaf, S.;Ibrar, M.;Hussain, F. Pharmacognosticevolution of the Amaranthusviridis L. research in Pharmaceutical Biotechnology. 2011, 3,11-16.
29. Gaafar, T.;Kasem, W.; Marei, H;Elfade, H. Morphology and stem anatomy description of Amaranthus L. species from Jazan. Saudia Arabia. International Journal of Current Research. 2015, 7, 12277-12281.
30. 30. Vrbnicanin, S.; Stefanovic, L.; Bozic, D.;Saric, M.; Radosevic, R.Comparative analysis of the anatomy of two populations of red-root Amaranth (Amaranthusretroflexus L.). pesticphytorned (Belgrad). 2009, 24, 103-112.