

Article

Classification of Some Medicinal Plants (Asteraceae) in Badia Al Muthanna, Iraq

Haider Mahmud Jasim*¹

1. Department of Pharmacognosy and Medicinal Plants, College of Pharmacy, Al-Muthanna University, Samawah, Iraq

* Correspondence: haider.jasim@mu.edu.iq

Citation: Jasim H. M. Classification of Some Medicinal Plants (Asteraceae) in Badia Al Muthanna, Iraq. American Journal Of Botany And Bioengineering 2026, 3(5), 23-31.

Received: 10th Jan 2026

Revised: 11th Jan 2026

Accepted: 24th March 2026

Published: 20th May 2026



Copyright: © 2026 by the authors. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>)

Abstract: The Asteraceae family is one of the largest plant families with high species diversity, including about 23,000 species under 1,620 genera. This study aimed to classify and identify some medicinal plant species under the Asteraceae family in the desert of Al-Muthanna, southern Iraq, by using morphological and taxonomic characteristics. In different locations for the Badia Al-Muthanna, field surveys were carried out, and plant samples were collected using random sampling. The voucher specimens containing vegetative and reproductive plant parts were recorded and identified based on morphological features, including habitat, stem type, leaf morphology and shape, inflorescence type, flower color, and fruit type. Some diagnostic traits, such as aromatic test, hairy surfaces, ray florets, pappus presence, and latex production, were also examined. A total of nine medicinal Asteraceae species were identified and classified, namely *Aaronsohnia factorovskyi*, *Achillea santolina*, *Anthemis deserti*, *Artemisia herba-alba*, *Artemisia scoparia*, *Calendula arvensis*, *Launaea capitata*, *Launaea mucronata*, and *Pulicaria* sp. The morphological analysis revealed major phenotypic diversity between the studied species and explained distinct ecological adaptations to desert conditions. Cluster analysis grouped the species into four principal clusters according to similar morphological and diagnostic traits. *Artemisia* and *Launaea* species exhibit a strong taxonomic relationship. The aromatic and herbal characteristics were recognized among several species, reflecting their medicinal significance. This study provides valuable taxonomic and diversity information regarding medicinal Asteraceae species in the Badia of Al-Muthanna and establishes a scientific foundation for future pharmacological and taxonomic studies in Iraqi desert ecosystems.

Keywords: Asteraceae, Badia Al-Muthanna, Dichotomous Key, Medicinal Plant and Plant Classification

Introduction

The Asteraceae, or daisy family, is a big family within the order Asterales belonging to the dicotyledons, comprising approximately 1,620 genera and more than 23,000 species, according to the Royal Botanic Gardens, Kew [1], [2], [3], [4]. Most species of this family are herbaceous plants. A high number of species also occur as shrubs and trees. The roots may be fleshy or woody, with the majority being fibrous in nature. The stem is generally erect. Leaves are arranged alternately or oppositely and may be simple; however, they are often deeply lobed and serrated. The flowers are characterized by their bright colors and are usually solitary, although they may sometimes occur as small clustered

inflorescences. The fruit typically contains a single seed per fruit. Pollination is primarily carried out by insects, which explains the strong attraction of insects to plants belonging to the Asteraceae family [5], [6], [7]. The classification of medical plants refers to the grouping of similar phenomena, whether natural or human, into smaller groups of patterns, which are then further organized into broader groups based on a selected unifying criterion. Classification aims to organize geographical phenomena into broader and fewer groups in order to facilitate their understanding, description, interrelation, and scientific analysis. As is well known among geographers, there is no single universally agreed system that can be strictly followed in classifying geographical phenomena; rather, each classification system differs from one researcher to another depending on its intended purpose and suitability [8], [9], [10]. Medicinal plants are classified with shared characteristics or similar features that bring together members of the same plant group. This is done to facilitate their study and identification of their various properties, including the environmental conditions suitable for their production, the active chemical constituents contained in their different parts, and the methods of extraction, separation, and purification of these compounds. It also includes methods of collection, harvesting times, cultivation practices, and drying techniques [11], [12].

Badia Al-Muthanna, located in a part of southern Iraq, was characterized by an arid to semi-arid climate, with hot summers, mild winters, and limited annual rainfall. The Badia region's vegetation is dominated by drought-resistant shrubs, herbs, and small trees, with prominent families such as Asteraceae, Brassicaceae, Lamiaceae, and Zygophyllaceae. Among these, medicinal plants such as *Artemisia herba-alba*, *Ziziphus spina-christi*, and *Peganum harmala* have been extensively used by local communities for centuries to treat a wide range of diseases, such as digestive disorders, respiratory inflammation, and skin diseases [7], [13], [14]. The Al-Muthanna Desert (Badia of Al-Muthanna) is one of the extensive geographical regions in southwestern Iraq. Administratively, it falls within the state of al-Muthanna, especially in al-Salman district, al-Najmi district, and parts of al-Basiyah [15], [16]. This desert borders the Kingdom of Saudi Arabia, and paperwork is part of the larger western desert of Iraq, which is characterized by arid and semi-arid environmental conditions. Summer temperatures are over forty-five degrees Celsius, and can be lower. Annual precipitation can be very low, between 100–50 mm, depending on the year. This also affects depleted groundwater sources and a lack of sustained water flow [17]. Relative humidity also generally decreases at some level during most 12 months, typically no more than 30% during the dry months. The soil in this area is mainly sandy or calcareous clay soil, with an organic matter content that leads to negative fertility and limited plant growth capacity. In some areas, gypsum-rich soils and salt sabakha formations are endowed, which furthermore alter the general plant environment [18], [19]. Despite these harsh conditions, the Al-Muthanna desert supports many plant species in line with drought and heat stress, as well as various medicinal plants and perennial shrubs with *Alhagi*, *Haloxyton*, *Caligonum*, and *Artemisia*. Lack of water, extreme heat, common air, sparse coffee, and coffee. However, this extravagant environment favors the survival of plant species with exceptional physiological diversity, including water storage capacity and smaller leaf basal area to reduce transpiration [20]. This ecosystem represents a clear example of plant adaptation to environmental stress, highlighting its ecological and scientific importance for studying plant diversity [9], [17]. This study aims to highlight the plant diversity of the Al-Muthanna desert, focusing on medicinal Asteraceae plants.

Materials and Methods

Study area

Al Muthanna Desert is a semi-desert region located in southern Iraq. This area was characterized by an arid or semi-arid climate, with hot summers, mild winters, and low annual rainfall. The Badia has not been extensively addressed in Iraqi geography literature, primarily because the term "Western Plateau" is more commonly used to refer to the Badia region located in the northwestern and southwestern parts of Iraq. According to Abbas Al-Saadi, the plateau region (Badia) has been described in detail in his geographical studies of Iraq. The region encompassing the western desert of Iraq is known as the plateau or Badia, comprising both the Northern and Southern Badia, which are separated

by Wadi Al-Khir, north of Al-Najaf Al-Ashraf Governorate. This location represents an important and promising part of the surface work in Iraq, attracting more scholarly attention than the alluvial plain, although it is not uncommon to assume that unprotected land areas show an unvaried uniform pattern that covers most of the elements. Astronomically, it lies between 29°10'–32°23'N and 43°50'–46°25'E and spans about 47,563 km.

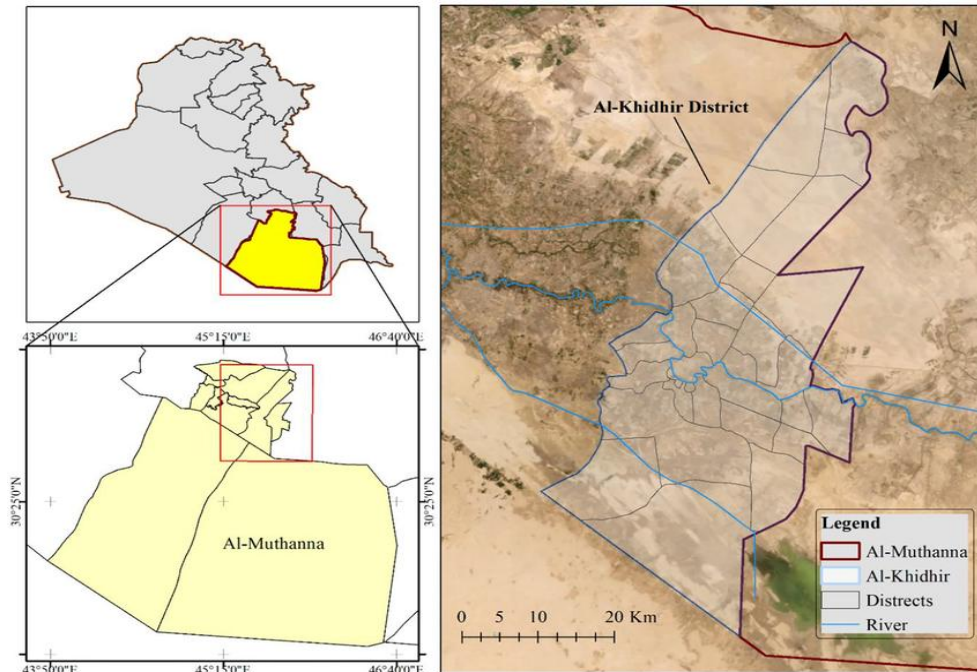


Figure 1. Shown is the study area of Al Muthanna Desert.

Plant Collection and Identification

The medicinal plant belong Asteraceae family were collected from different locations in desert of Al-Muthanna using random field sampling. Plant samples were photographed in habitats, and voucher specimens containing vegetative and reproductive organs were collected for taxonomic study. The specimens were identified based on morphological characters for leaves, stems, and flower morphology using key classification for the Asteraceae family, Iraqi flora, and herbarium specimens. Diagnostic features such as leaf shape, inflorescence type, flower morphology, achene characters, and pappus structure were examined for species identification.

Dichotomous Key for Asteraceae family

- 1a. Plant species produce latex 2
- 1b. Plant species without latex 3
- 2a. Annual herb, capitula in dense clusters, basal leaves lobed *Launaea capitata*
- 2b. Perennial shrublet, rigid, branched stems, narrow, mucronate leaves *Launaea mucronata*
- 3a. Plant species aromatic 4
- 3b. Plant species non-aromatic..... 7
- 4a. Ray florets absent 5
- 4b. Ray florets present 6
- 5a. Perennial shrub, silvery, divided leaves, clustered capitula *Artemisia herba-alba*
- 5b. Annual/biennial herb, filiform leaves, loose panicle capitula *Artemisia scoparia*
- 6a. Dense corymb capitula, flowers white to cream *Achillea santolina*

- 6b. Small radiate capitula; yellow flowers; pappus present *Pulicaria sp*
 7a. Pappus present *Aaronsohnia factorovskyi*
 7b. Pappus absent 8
 8a. Daisy-like capitula; white ray florets with yellow disc *Anthemis deserti*
 8b. Solitary large capitula; bright yellow/orange flowers *Calendula arvensis*

Results and Discussion

The Topography of the study area

Despite its variety, the region is predominantly characterized by the desert (Hijara) area, which represents more than half of the total area. It occupies the central, western, and northwestern parts of the study area. Following this comes the semi-desert (Dibdiba) region, which extends over the eastern, northeastern, and southeastern parts of the area. The elevated regions are mainly located in the western and southwestern parts of the study area, representing the most wind-eroded areas, known for their rocky and gravelly terrain (Hammad).

In addition to this, there are other landforms such as the sandy strip and sand dunes, which extend from northwest to southeast (northwest-southeast) of the study area. There are also discontinuous edges, collapsed depressions in the central region, and valleys like Wadi al-Sabiyat and the western plains of eastern Najaf. Furthermore, there are saline depressions in the western part near the western hills, as well as unique geographical features in the region. Hijara Region: A flat rocky plain interrupted by some shallow valleys, the most important of which are Sha'ib al-Aqra', al-Ghanami, and al-Salman depression. This region is named "Hijara" due to the abundance of rocks and sharp-edged stones scattered throughout. Some of these rocks are made of limestone and dolomite. The presence of these rocks is due to the action of wind and running water, which carry away finer materials and leave behind rocks and gravel visible to the naked eye. This rocky terrain dominates the central, western, and northwestern parts of the study area, located between the discontinuous edges, the sandy dunes from the north, bordered by the Hammad region to the south, the Dibdiba region to the east, and the administrative borders of Najaf to the west.

The Dibbiba Region: The development of the landforms in this region is a result of the erosion of the carbonate rocks, which causes the water to drain away in the direction of the furthest parts of the region. It is located to the north of the study area, specifically in Wadi al-Batl [21], [22], which runs from the east to the west. The study area extends from the eastern part, and its most important landforms are the alluvial deposits and the high plateaus in the area. The study area also has large depressions and valleys, and in the part near the study area's western side, the terrain consists mostly of rocky and gravelly surfaces. These regions are known for being eroded by wind and water, leaving behind many hills and lowland forms. The Hammad Region: The surface of this region, which is composed of vast flatlands and undulating terrains, includes some areas with steep rises. This region has an elevation of approximately 915 meters above sea level [23], which represents the highest point in the area. It is located near the Saudi Arabian border and extends to the most distant parts of the west and southwest of the study area. The highest peaks in the region, which can reach heights of 570 meters above sea level, are part of the mountain range stretching from the eastern borders of the study area, near the Saudi Arabian border [24], [25]. This area has an extremely rocky surface, which is composed of basalt and limestone, and includes many layers of sedimentary rock. The region's rocky surface and elevations make it an important location in geological studies. The Rasawi Plain: Located in the northernmost part of the study area, this plain is characterized by its high level of drainage. The flat terrain is formed by the river valleys that drain the area from the north. Its elevation is over 500 meters above sea level, and the flat terrain in this region provides a unique landscape feature that is highly significant for studies [26], [27], [28].

Morphological Characters

A total of nine medicinal plant species belonging to the family Asteraceae were identified and classified from the Badia of Al-Muthanna, Iraq, based on morphological characters including life form, stem, leaf morphology, inflorescence type, flower color, fruit characters, and habitat preference. Cluster analysis using the Jaccard similarity coefficient revealed the formation of four major taxonomic groups, indicating morphological similarities among the studied taxa

The comparative analysis of diagnostic characters among the nine studied Asteraceae species revealed clear taxonomic variation and ecological adaptation. Aromatic properties were observed in five species (*Achillea santolina*, *Anthemis deserti*, *Artemisia herba-alba*, *Artemisia scoparia*, and *Pulicaria* sp.), indicating the prevalence of volatile secondary metabolites, which are common in medicinal Asteraceae and may contribute to adaptation under arid environments [29].

Hairy surfaces (trichomes) were recorded in six species, including *Aaronsohnia factorovskyi*, *Achillea santolina*, *Anthemis deserti*, *Artemisia herba-alba*, *Calendula arvensis*, and *Pulicaria* sp. Trichomes may play an important role in reducing water loss and protecting plants under desert conditions [30].



Figure 2. Shown the nine plant species of Asteraceae family in Al Muthanna Desert (A) *Aaronsohnia factorovskyi*, (B) *Achillea santolina*, (C) *Anthemis deserti*, (D) *Artemisia herba-alba*, (E) *Artemisia scoparia*, (F) *Calendula arvensis*, (G) *Launaea capitata*, (H) *Launaea mucronata* and (I) *Pulicaria* sp.

Radius flowers were obtained in 5 species, while carp male or female *Aaronsohnia factorovskyi*, *Launaea* main flower, *Launaea mucronata*, *Pulicaria* sp. Latex formation was observed only in *Launaea capitata* and *Launaea mucronata*, which aids their close taxonomic relationship and distinction from different taxa. A comprehensive diagnosis of several medicinal plant species of the family Asteraceae

(Compositae) was classified from special locations under Badia, Al-Muthanna, Iraq The collected species showed great diversity in morphological characteristics mainly leaf shape, stem shape, flower arrangement, seedling arrangement, and botanical reproduction the pattern of Asteraceae in desert road environments in western and southern Iraq [31], [32] Some species have shown wonderful medicinal value, historically in human medicine for inflammation, digestive issues, pores, skin diseases and microbial infections used [10] taxonomic species, emphasizing the different species floral richness in the Badiya environment, and supported previous observations of vegetation diversity in Iraqi deserts [33].

Table 1. Shown the major morphological characters in nine species in the Asteraceae family.

| Plant | Life form | Stem | Leaf | Inflorescence | Flower color | Fruit | Habitat |
|---------------------------------|-------------------------|------------------------------|--------------------------------|----------------------------|-------------------------|-------------------------|------------------|
| <i>Aaronsohnia factorovskyi</i> | Annual herb | Branched, soft, hairy stems | Pinnatisect, narrow lobes | Small solitary capitula | Yellow | Small ribbed | Annual |
| <i>Achillea santolina</i> | Perennial herb/subshrub | Woody at base, aromatic | Deeply dissected, grey-green | Dense corymb capitula | White to cream | Compressed | Perennial |
| <i>Anthemis deserti</i> | Annual herb | Erect branched stems | Bipinnate, soft leaves | Daisy-like capitula | White rays, yellow disc | Small angular | Annual |
| <i>Artemisia herba-alba</i> | Perennial shrub | Densely branched woody stems | Silvery, highly divided leaves | Small clustered capitula | Yellowish | Tiny smooth | Shrub |
| <i>Artemisia scoparia</i> | Annual/biennial herb | Slender erect stems | Filiform divided leaves | Loose panicle capitula | Greenish-yellow | Small | Annual |
| <i>Calendula arvensis</i> | Annual herb | Soft hairy stems | Simple oblong leaves | Solitary large capitula | Bright yellow/orange | Curved heteromorphic | Annual |
| <i>Launaea capitata</i> | Annual herb | Milky latex present | Lobed basal leaves | Capitula in dense clusters | Yellow | Beaked with pappus | Annual |
| <i>Launaea mucronata</i> | Perennial shrublet | Rigid much-branched stems | Narrow mucronate leaves | Solitary or a few capitula | Yellow | Ribbed | Perennial |
| <i>Pulicaria sp.</i> | Annual/perennial herb | Sticky or aromatic stems | Simple hairy leaves | Small radiate capitula | Yellow | Cylindrical with pappus | Annual/Perennial |

Table 2. Shows the major medical features of nine species in the Asteraceae family.

| Species | Aromatic | Hairy surface | Ray florets | Pappus | Latex |
|---------------------------------|----------|---------------|-------------|--------|-------|
| <i>Aaronsohnia factorovskyi</i> | - | + | + | + | - |
| <i>Achillea santolina</i> | + | + | + | - | - |
| <i>Anthemis deserti</i> | + | + | + | - | - |

| | | | | | |
|-----------------------------|---|---|---|---|---|
| <i>Artemisia herba-alba</i> | + | + | - | - | - |
| <i>Artemisia scoparia</i> | + | - | - | - | - |
| <i>Calendula arvensis</i> | - | + | + | - | - |
| <i>Launaea capitata</i> | - | - | - | + | + |
| <i>Launaea mucronata</i> | - | - | - | + | + |
| <i>Pulicaria sp.</i> | + | + | + | + | - |

In Figure 3, In Figure 3, the first group (Artemisia group) consisted of *Artemisia herba-alba* and *Artemisia scoparia*, which showed close similarity due to their highly detached leaves, aromatic nature, and grouped capitulum. Group III (annual herbs with radiating heads) was *Anthemis deserti*, *Aronsohnia factorowski*, and *Calendula arvensis*, which were characterized by annual growth habits, benign stems, and radiating heads with yellow and white flowers. Group IV (*Launaea* Institute): *Launaea*'s main head. rib- or pappus-bearing achenes [29], [32], [34]. The dendrogram showed a similarity score (~0.5), indicating a large morphological range in medicinal Asteraceae species within the region.

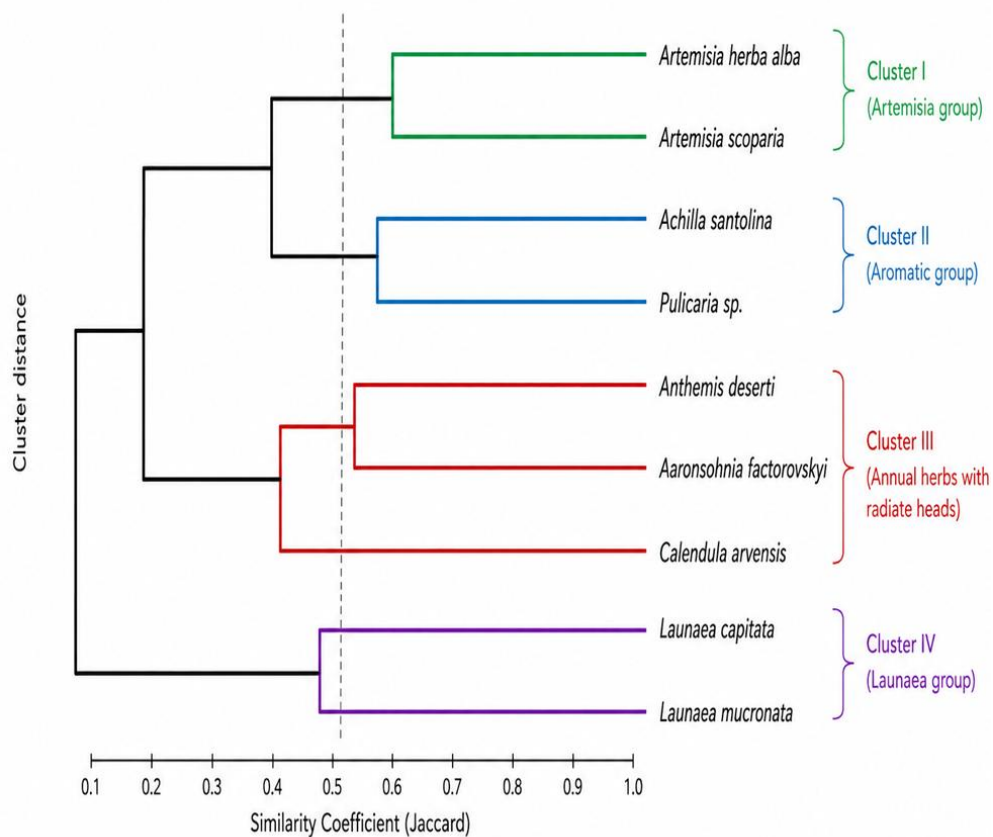


Figure 3. phylogenic tree of nine plant species of Asteraceae family in Al Muthanna Desert.

Conclusion

This study successfully classified some medicinal plant species under the Asteraceae family distributed in the desert of Al-Muthanna, southern Iraq. The morphological and taxonomic characteristics were used to achieve that. The results discovered a high morphological diversity among the studied plants and exhibited clear taxonomic relationships between them, as supported by cluster analysis, which grouped species according to similar morphological traits. Species of *Artemisia* and *Launaea* showed a good relationship within their clusters, reflecting similarities in adaptiveness and characters. The annual herbs formed a distinct pattern based on floral morphology and reproductive

traits. Furthermore, the propagation of aromatic and hairy characters within several species focuses on their ecological adaptation to the arid desert environment of the Al-Muthanna Desert and supports their medicinal significance. This study contributes valuable taxonomic information on medicinal Asteraceae species in southern Iraq and provides useful information for future studies, such as ecological and pharmacological investigations, where the combination of additional anatomical, physiological, and molecular tools may further refine species delimitation and systematic relationships.

REFERENCES

- [1] L. Katinas and V. A. Funk, "An updated classification of the basal grade of Asteraceae (= Compositae): from Cabrera's 1977 tribe Mutisieae to the present," Apr. 02, 2020, *Taylor and Francis Ltd.* doi: 10.1080/0028825X.2020.1718168.
- [2] R. A. Al-Souz H R H Al-Newani Researcher Assist, "TAXONOMICAL IMPLICATIONS OF NATURAL COMPONENTS IN DELIMITATION OF SOME SPECIES OF ASTERACEAE FAMILY IN BAGHDAD." [Online]. Available: <https://powo.science.kew.org/>,
- [3] E. Mohammed Ali Abo Ghazal and B. Ambedkar, "Taxonomic studies on the family asteraceae (Compositae) of Hajjah governorate, West of Yemen," ~ 90 ~ *Journal of Medicinal Plants Studies*, vol. 7, no. 5, pp. 90–100, 2019, [Online]. Available: <http://www.plantsjournal.com>
- [4] T. W. Kyi, N. N. Yee, and T. T. Htun, "Taxonomic Study on Thirteen Species of Family Asteraceae from Sagaing and Shwebo District."
- [5] C. Author *et al.*, "Taxonomic Studies on the Family Asteraceae (Compositae) of the Rajshahi Division," 2008.
- [6] M. Farhana Easmin, L. Al Faria Research Fellow, R. Rani Assistant Professor, and A. Mahbubur Rahman Professor, "ASTERACEAE: A TAXONOMICALLY AND MEDICINALLY IMPORTANT SUNFLOWER FAMILY," *American International Journal of Biology and Life Sciences*, vol. 3, no. 1, p. 2021, 2021, [Online]. Available: <https://www.aceusa.org/journal/index.php/ajibls>
- [7] "SIXTH NATIONAL REPORT OF IRAQ TO THE CONVENTION ON BIOLOGICAL DIVERSITY," 2018.
- [8] Bscbo-, *TAXONOMY OF ANGIOSPERMS AND BIODIVERSITY BSCBO-201 TAXONOMY OF ANGIOSPERMS AND BIODIVERSITY DEPARTMENT OF BOTANY SCHOOL OF SCIENCES UTTARAKHAND OPEN UNIVERSITY.*
- [9] C. Yebouk *et al.*, "Review and cross-cultural analysis of medicinal plants traditionally used in Mauritania," *J. Ethnobiol. Ethnomed.*, Dec. 2025, doi: 10.1186/s13002-025-00842-9.
- [10] M. S. Rao, S. P. Kumar, and K. S. Rao, "Classification of Medical Plants Based on Hybridization of Machine Learning Algorithms," *Indian Journal of Information Sources and Services*, vol. 13, no. 2, pp. 14–21, 2023, doi: 10.51983/ijiss-2023.13.2.3761.
- [11] A. N. Alhasnawi, L. Neamah, A. M. Mandal, and H. M. Jasim, "Using molecular markers to determine the genetic relationships of medicinal plants," 2025.
- [12] M. T. El-Saadony *et al.*, "Medicinal plants: bioactive compounds, biological activities, combating multidrug-resistant microorganisms, and human health benefits - a comprehensive review," 2025, *Frontiers Media SA.* doi: 10.3389/fimmu.2025.1491777.
- [13] S. A. . Ghazanfar and J. R. . Edmondson, *Flora of Iraq. Volume 5. Part 2, Lythraceae to Campanulaceae.* Royal Botanic Gardens, Kew, 2013.
- [14] Y. A. N. Aldabbagh, H. Z. M. Shafri, S. Mansor, and M. H. Ismail, "Desertification prediction with an integrated 3D convolutional neural network and cellular automata in Al-Muthanna, Iraq," *Environ. Monit. Assess.*, vol. 194, no. 10, p. 715, 2022, doi: 10.1007/s10661-022-10379-z.
- [15] Khansaa Rasheed Al-Joboury, "Checklist of the Umbelliferae family in the herbarium of Iraq natural history museum," *GSC Biological and Pharmaceutical Sciences*, vol. 15, no. 3, pp. 177–181, Jun. 2021, doi: 10.30574/gscbps.2021.15.3.0160.
- [16] K. Rasheed Al-Joboury, "SURVEY OF EXOTIC PLANT SPECIES IN IRAQ," 2020.

- [17] N. Adamo, N. Al-Ansari, V. Sissakian, K. J. Fahmi, and S. A. Abed, "Climate Change: Droughts and Increasing Desertification in the Middle East, with Special Reference to Iraq," *Engineering*, vol. 14, no. 07, pp. 235–273, 2022, doi: 10.4236/eng.2022.147021.
- [18] C. Jin, Z. Jia, G. Li, L. Zhao, and Y. Ren, "Effect of Soil Moisture Content on Condensation Water in Typical Loess and Sandy Soil," *Land (Basel)*, vol. 13, no. 7, Jul. 2024, doi: 10.3390/land13070934.
- [19] J. Ma *et al.*, "Soil characteristic changes and quality evaluation of degraded desert steppe in arid windy sandy areas," *PeerJ*, vol. 10, Apr. 2022, doi: 10.7717/peerj.13100.
- [20] B. Han, L. Cui, M. Jin, and H. Dong, "Ecological Adaptation Strategies of Desert Plants in the Farming–Pastoral Zone of Northern Tarim Basin," *Sustainability (Switzerland)*, vol. 17, no. 7, Apr. 2025, doi: 10.3390/su17072899.
- [21] M. H. Ali, F. G. Mohammed, and Y. I. Al-Saady, "Morphometric Analysis of Wadi Hasab Basin in Al-Najaf Governorate, Southwest of Iraq, Using Remote Sensing and GIS Techniques," *Iraqi Journal of Science*, vol. 66, no. 7, pp. 3028–3048, Jul. 2025, doi: 10.24996/ij.s.2025.66.7.29.
- [22] V. K. Sissakian, A. A. Othman, A. K. Obaid, and H. A. Abdulhaq, "SOIL TYPES AND EROSION IN IRAQ: A CRITICAL DISCUSSION," *Iraqi Bulletin of Geology and Mining*, vol. 21, no. 1, pp. 343–364, Jun. 2025, doi: 10.59150/ibgm2101a19.
- [23] I. H. Shekhmamundy and A. M. Surdashy, "Geomorphological Analysis and Distribution of Landform of Erbil Masterplan Layout, 2030," *Iraqi Geological Journal*, vol. 55, no. 2F, pp. 197–211, 2022, doi: 10.46717/igj.55.2F.14ms-2022-12-29.
- [24] A. Majrashi, "Survey of boraginaceae family from taif Saudi Arabia peninsular", [Online]. Available: www.isisn.org
- [25] S. Z. . Jassim and J. C. . Goff, *Geology of Iraq*. Dolin, Prague and Moravian Museum, 2007.
- [26] F. M. Bashar *et al.*, "CLASSIFYING FLUVIAL LANDFORMS USING GEOSPATIAL MODELING IN AL-ASHAALI WATERSHED, IRAQI SOUTHERN DESERT," *Bulletin of the Iraq Natural History Museum*, vol. 18, no. 3, pp. 739–763, 2025, doi: 10.26842/binhm.7.2025.18.3.0739.
- [27] B. F. Maarroof, "Fluvial Landforms Classification Using Geospatial Modeling of Al-Jazeera Eastern Region at Misan Governorate, Iraq," *Iraqi National Journal of Earth Science*, vol. 25, no. 2, pp. 199–218, Apr. 2025, doi: 10.33899/earth.2024.146564.1228.
- [28] Z. D. Hassan, "Morphometric Characteristics and Flooding Risk of Zhrzy Valley in the Rania Plain, Northern Iraq," *Iraqi Geological Journal*, vol. 58, no. 1F, pp. 172–184, Jun. 2025, doi: 10.46717/igj.2025.58.1F.12.
- [29] P. Janačković, M. Gavrilović, D. Ranić, Z. Dajić-Stevanović, A. A. Giweli, and P. D. Marin, "Comparative anatomical investigation of five Artemisia L. (Anthemideae, Asteraceae) species in view of taxonomy," *Brazilian Journal of Botany*, vol. 42, pp. 135–147, 2019, [Online]. Available: <https://api.semanticscholar.org/CorpusID:81978808>
- [30] A. H. Kadhim and I. A. R. M. Al-Dobaissi, "International Journal of Biological Engineering and Agriculture Comparative Leaf Epidermal Anatomy of Selected Asteraceae Species in Baghdad," *International Journal of Biological Engineering and Agriculture*, vol. 2025, no. 4, pp. 326–337, 2025, [Online]. Available: <https://journal.academicjournal.online/index.php/ijbea>
- [31] R. I. Marzouk, S. M. El-Darier, S. A. Kamal, and I. H. Nour, "Comparative Taxonomic Study of Launaea Cass. (Asteraceae, Cichorioideae) in Egypt," *Taxonomy*, vol. 1, no. 3, pp. 192–209, Sep. 2021, doi: 10.3390/taxonomy1030014.
- [32] M. Shahid and N. K. Rao, "First record of the two Asteraceae species from the United Arab Emirates." [Online]. Available: www.researchtrend.net
- [33] T. Nadia *et al.*, "An ethnobotanical study of medicinal plants used for skin diseases by the local people in El Bayadh region, Algeria," *Ethnobotany Research and Applications*, vol. 33, Mar. 2025, doi: 10.32859/era.33.64.1-14.
- [34] H. R. Ghafoor, M. S. Rubar, and A. N. Salih, "Delimitation of Iraqi Scorzonera L. (Cichorieae, Asteraceae) species in Sulaimani District (MSU), Kurdistan Region, based on morphological characterization," *Passer Journal of Basic and Applied Sciences*, vol. 6, no. 1, pp. 115–123, Jun. 2024, doi: 10.24271/PSR.2023.419571.1402.