Pak. J. Bot., 55(6): 2369-2380, 2023. DOI: http://dx.doi.org/10.30848/PJB2023-6(36)

TAXONOMICAL KNOWLEDGE, BIOLOGICAL SPECTRA AND ETHNOMEDICINAL PLANT INVENTORY OF ASTERACEAE FAMILY IN VARIOUS AREAS OF GAZA STRIP, PALESTINE

MOHAMAD ABOU AUDA

Department of Biology, Faculty of Science, Al-Aqsa University, Gaza, Palestine
Corresponding email: mohamadabouauda2021@gmail.com; mohamadmahmoudabouauda@gmail.com

Abstract

The current study was designed to provide comprehensive information on the biodiversity, classification, biological spectra, and ethnomedicinal plant inventory of species and genera of the Asteraceae (Compositae) family. A total of 32 plant species belonging to 25 genera of the family Asteraceae were collected from different regions of the study area of the Gaza Strip, Palestine, during 2019-2022. The current study included a dichotomous key for the identification of different genera and species of the Asteraceae based on various characteristics. The result showed that about 29 plant species out of the total studied species had medicinal properties with different biological activities and used for treating various diseases. Most of them were used as antimicrobial (19 spp), antioxidant (18 spp), anti-inflammatory (14 spp), and anticancer (11 spp). The genus Centaurea was represented by 3 species (9.4%), followed by Leontodon, Crepis, Carduus, Erigeron and Anthemis genera. Three life forms were recognized and Therophyte life form was the most dominant with 25 plant species (78%), followed by Hemicryptophyte with 4 species (12.5%), and finally, Chamaephyte with 3 species (9.5%). According to the ethnomedicinal survey, whole plant was most widely (10 spp) used followed by an aerial part (9 spp), and leaves (7 spp) for treating different ailments. Asteraceae family is rich in terms of medicinal plant species which are important for their used in traditional medicines for the treatment of different diseases, and the most used species were *Verbesina encelioides*, *Calendula arvensis*, *Erigeron canadensis*, and *Silybum marianum*.

Key words: Asteraceae, Biological spectrum, Gaza strip, Medicinal plants, Species diversity, Taxonomy.

Introduction

The surrounding environment influences the development of human existence and civilization, as it has direct and indirect links to them. Human existence, including the diet system, is completely dependent on plants. Plants are an essential low-cost, non-toxic, more effective, conveniently accessible source of traditional remedies used to cure various ailments (Iqbal *et al.,* 2014).

Plant biodiversity systematics includes studying species diversity, conservation, extinction and evolution, risks to biodiversity and biogeographic regions, exploration, and other ecological functions (Scotland & Wortley, 2003). The taxonomy is severely degraded across the board in the field of biodiversity (Smith *et al.,* 2008; Pysek & Richardson, 2010). Natural ecological deterioration remains persistent and it jeopardizes the long-term existence of numerous species throughout the planet (Alam & Ali, 2010; Pimm *et al.,* 2014).

The total number of species found in a specific geographic location, whether alien or native, is diverse and serves as the identity and source of vegetation and plant natural resources (Khan *et al.,* 2019). Plant resources have the greatest impact on agriculture, deforestation, overgrazing, over-browsing, natural catastrophes, and human interaction (Badshah *et al.,* 2013). Many preservation measures have been evolved in reaction to this deterioration, with the formation of protected areas, being one of the most effective conservation endeavours (Jenkins & Joppa, 2009).

The number of infectious diseases linked with the development of bacterial and fungal resistance has been recently increased, necessitating a comprehensive search for innovative drugs to treat these infections. Species in the Asteraceae family have high biological potential and are utilized in traditional medicine to treat several diseases (Sobrinho *et al.,* 2017).

The Asteraceae family is one of the largest and most diverse eudicot angiosperm plant families, with 13 subfamilies and 45 tribes (Sobrinho *et al.,* 2017; Marzouk *et al.,* 2021). The family has around 1600–1700 genera and 25,000–33,000 species (Mandel *et al.,* 2017). Susanna *et al.,* (2020) have accepted 16 subfamilies and 50 tribes.

According to APG IV, the family was classified into Eudicots, Superasterids, Asterids, Campanulids and Asterales (Chase *et al.,* 2016). Biological study on its extracts, oils and components for manufacturing phytochemicals has seen an increase in multidisciplinary interest in the scientific community (Garcia-Sanchez *et al.,* 2011; Yang *et al.,* 2004).

On the other hand, the Asteraceae family emerged as the most diversified and prevalent group in Palestine's ecosystem, particularly in wildlife. Asteraceae has agricultural and economic relevance in Palestine and also have therapeutic and nutritional value, which highlights the importance of biodiversity in Palestine (Sawalha *et al.,* 2020). Unfortunately, after Boulos (1959) no floristic studies were conducted adequately in the Gaza Strip.

The vegetation in Gaza Strip varies, and many vegetational types are documented. Gaza Strip is floristically important, and it has various vegetational zones. Previous research was conducted to study the flora and plant life forms in Wadi Gaza, and compared to other areas in the Mediterranean region; the researchers concluded that the area has a high diversity of plant species and habitat diversity, with 219 plant species are reported (Abou Auda *et al.,* 2009).

A study by (Abou Auda, 2012) revealed that 52 plant species are medicinal; they belonged to 48 genera and 33 families with medicinal benefits. In the other study during the spring months of 2004, 70 plant species from 32 families and 24 orders were discovered in Wadi Gaza (Abd Rabou *et al.,* 2008). One hundred vascular plant species belonging to 85 genera and 34 families were reported by Awaja (2015). Whereas along Al-salqa valley region, 145 plant species from 112 genera and 40 families were identified (Abu Batnain, 2014).

As previously stated, certain plant families' have been studied from various locations in Palestine. Yet, some other families have not yet been scrutinized, and the inquiry into these families has not yet been documented. As a result, plant species investigation and recording are urgently required to preserve the ethnomedicinal data of the examined location before the information is lost.

Because wild plant species are dispersed randomly, efforts should be taken to conserve them. The main goal of this study was to catalogue the taxonomic knowledge of plant species from the chosen family. The Asteraceae species were collected, identified, and mounted on standard herbarium sheets as a reference for future scholars. Furthermore, the current study intends to conserve knowledge connected to medicinal plant uses in specific areas of the Gaza Strip for future studies. It looks to be the first step toward discovering the possibility of its enhancement and investigation for the benefit of the residents.

Material and Methods

Study area: The research was conducted in the Gaza strip, Palestine, an area of 365 km^2. It borders the occupied lands to the east and north and Egypt to the south. It is approximately 41 Km long and between 6 and 12 km wide. Several field surveys were carried out to document, and collect plant species belonging to the Asteraceae family in different growing seasons during 2019-2022 at various sites in the Gaza Strip, Palestine.

Field work and data collection: The plant specimens were collected by cutting them using the plant cutter properly. Specimens were carefully observed during the fieldwork, and some species were identified on the basis of their habit and habitat during the field trips. Specimens, including flowers, leaves, stems and fruits, were collected for their correct identification. Specimens were dried, pressed, and mounted on standard herbarium sheets. Species were identified, using taxonomic literature, particularly the Flora of Palestine (Täckholm, 1974; Zohary, 1978; Dothan, 1978 a and b; Boulos, 1999, 2000 and 2002; Danin, 2000 and 2004). For the correct scientific name of the taxa "the plant list" (http://www.theplantlist.org) was followed. The identified specimens were deposited at the Al-aqsa University herbarium in Gaza, Palestine. Life forms were classified according to Raunkiarian (1934). The vernacular names of the species were obtained from the local community of the study area. Dichotomous keys of all species and genera were constructed. Finally, the ethnomedicinal uses of the selected species of Asteraceae obtained from the local population were also verified from the available literature.

Results and Discussion

Taxonomic information, biological spectra, and ethnobotanical studies are extremely important in protecting and managing natural resources, particularly studies of areas with a wide systematic variety. All species of the Asteraceae family are well-represented in the research region. In all 32 species in 25 genera of the family Asteraceae were recognized (Table 1), occuring in several study locations in the Gaza Strip, Palestine. Among these 29 species with various biological activities found to be used in the treatment of different diseases. In addition, keys to the genera and species were generated for all the family Asteraceae species. Table 1 contained data on plant species, including the botanical scientific name, vernacular name, part used in traditional medicine for the treatment of different ailments alongwith the main references of the previous studies. Because the floristic makeup of the family varies greatly across the research area, the current study is thought to be the first time of the family Asteraceae therefore the present work has been for extensive analysis in the chosen study area.

Ethnobotanically, practically all plant species are used by local people described in many sources, and they are significant medicinally. Figure 4 and Table 1 show the treatment of different ailments such as antimicrobial (19 spp, 66%), antioxidant (18 spp, 62%), anti-inflammatory (14 spp, 48%), anticancer (11 spp, 38%), antifungal (8 spp, 28%), cytotoxic (8 spp, 28%), renal diseases (8 spp, 28%), liver diseases (8 spp, 28%), digestive disorders (7 spp, 24%). diuretic (7spp, 24%), antidiabetic (7 spp, 24%), rheumatism (5 spp, 17%), stomachache (5 spp, 17%), fever (4 spp, 14%), dermatologic diseases (4 spp, 14%), antiviral, respiratory diseases, sedative and diarrhea (3 spp, 10%).

In addition, the results revealed that the most commonly used species of the Asteraceae family in the traditional medicines for treating some diseases also have different activities (Fig. 5) such as *Verbesina encelioides* (26), *Calendula arvensis* (23), *Erigeron canadensis* (22), *Silybum marianum* (20), *Erigeron bonariensis* (18), *Matricaria aurea* (15), *Carthamus tenuis* (13), *Anthemis pseudocotula* (12), *Carduus australis* (10), *Dittrichia graveolens* (10), *Artemisia monosperma* (9), *Lactuca serriola* (8), *Onopordum carduiforme* (8), *Senecio glaucus* (7), *Xanthium spinosum* (6), *Echinops philistaeus* (6), *Centaurea pallescens* (6), *Anthemis palestina* (6), *Scolymus hispanicu*s (5), *Urospermum picroides* (5) and *Notobasis syriac*a (5). It was found that the genus Centaurea was the most prevalent, with 3 species (9.4%), followed by Leontodon, Crepis, Carduus, Conyza, and Anthemis, each with 2 species (6.3%), and the remaining genera were each with 1 species (1,3%) (Fig. 3; Fig. 6a-f and Fig. 7a-f). Three distinct life forms were observed in the present investigation (Fig. 1, Table 1). Raunkiarian was used to determine the biological spectra (1934). Biological spectra are critical physiognomic properties extensively exploited in vegetation research (Hussain *et al.,* 2021).

Table 1. Showing the checklist of wild plant species of Asteraceae family and their uses in the folk medicine in Gaza Strip, Palestine.

Name of taxa	Vernacular name	Life form	Part used	Traditional and medicinal uses/ailments treated	Reference
Scolymus hispanicus L.	Sinaria mouamira	Hemicryptophyte	Whole plant	Traditionally used as a "bitter" tonic to enhance appetite and digestion, anticancer herbal remedies have the potential to be a source of dietary fibre and can be included in the daily diet as an alternative vegetable and used for treating diuretics and ulcers. It may be a functional food because of its natural antioxidant potential.	Altiner & Sahan (2016), Ugurlu & Secmen (2008).
Cichorium endivia L.	Seraes, Aleek	Therophyte	Leaves and Seeds	Strong antibacterial action, used to treat bacterial infections and rheumatism.	Said *et al*., (2002), Amer, (2018)
Hedypnois rhagadioloides (L.) F.W. Schmidt	Rouiesa japal	Therophyte	-	The species has not medicinal uses	-
Urospermum picroides (L.) Scop. ex F.W, Schmidt	Koudied	Therophyte	Flower	Plants are a valuable source for generating efficient anticancer medicines since they have anti-inflammatory, antibacterial, and antioxidant activities and considerable cytotoxic potential against many cancer cell lines, has an important bioactive compound with anticancer potential.	El-Amier *et al*., (2016), Alper & Guney (2019)
Leontodon laciniatus (Bertol.) Widder	Reepan Sahrawi, cheshain	Therophyte	-	The species has not medicinal uses	-
Leontodon tuberosus L.	Reepan darani	Hemicryptophyte	Leaves	Alim: boiling leaves used in vegetable pies and "frittata," stuffing for "gatafin," or as a side dish, blood purifying.	Cornara *et al*., (2009), Pieroni, (2000)
Lactuca serriola L.	Kass el zieet	Therophyte	Whole plant	Important as an anticancer**,** antibacterial, antifungal, spasmolytic, bronchodilator, and vasorelaxant. The herb is a cooling, sedative, diaphoretic, and diuretic and is useful in treating coughs in bronchitis, asthma, and whooping cough. Tea is used as stomachic.	Qureshi *et al*., (2008), Abdul-Jalil (2020)
Crepis aspera L.	Chofie Jaleesa, choufie	Therophyte	Aerial parts	Antifungal activities	Qasem & Abu-Blan (1996)
Crepis reuteriana Boiss.	Souriera Router	Hemicryptophyte	Leaves	As a salad to reduce joint pain and as an appetizer.	Khatib *et al*., (2021)
Xanthium spinosum L.	Shoupiet shawki	Therophyte	Whole plant	Infusions are used to treat a variety of neoplasias. It plays a vital part in angiogenesis inhibition, which is promising for tumor therapy and hydrophobia, rabies, intermittent fever, diarrhoea and cancer treatment, also has antiviral capabilities.	Güez *et al*., (2012), Romero *et al*., (2015)
Echinops philistaeus Feinbrun & Zohary	Chouchier falastini	Chamaephyte	Whole plant	The genus Echinops has been documented to contain a variety of secondary metabolites that have traditionally been used to cure pain, inflammation, respiratory disorders, and diseases caused by various microbes, as an aphrodisiac, to hasten placental ejection, and to remove kidney stones.	Bitew & Hymete (2019)
Carthamus tenuis (Boiss & Blanche) Bornm.	Kouies	Therophyte	Aerial parts	Used traditionally to treat skin diseases, haemorrhoids, abortion, infertility, an immunosuppressive role as well as antifungal, antibacterial, anti-inflammatory activity, and anticancer activity. It has cytotoxicity against different human cancer cells and antiproliferation activity. The plants are boiled, then squeezed and fried in oil as a nutrient.	Shawagfeh (2020), Khatib *et al*., (2021)
Onopordum carduiforme Boiss.	Kourfiesh	Hemicryptophyte	Aerial parts	The genus Onopordum have been widely employed in treating inflammatory illnesses and renal difficulties due to its antihypertensive, antioxidant, and antibacterial properties. The plants show significant protective activity against lipid peroxidation and could prevent oxidative damage; which has rich in phytochemical compounds, especially phenols and flavonoids.	Aljaja *et al*., (2021)
Carduus australis L	Lessan el kalb	Therophyte	Whole plant	Carduus plants are used to cure a variety of human ailments, such as the common cold, stomach aches, and rheumatism. The genus Carduus was discovered to have a wide range of biological actions, including anti-inflammatory, antispasmodic, anticancer, antiviral, antibacterial, antioxidant activity and also used as liver tonic.	Hassan *et al*., (2015)

Table 1. (Cont'd.).

Name of taxa	Vernacular name	Life form	Part used	Traditional and medicinal uses/ailments treated	Reference
Carduus getulus Pomel	Houshrouf, Lesan el kalb	Therophyte	Aerial parts	Among reported biological effects include antimicrobial screening that can be used to cure infectious diseases and liver function. The plant extracts significantly improved the biochemical and antioxidant parameter levels with antihepatotoxic activity.	Taha *et al*., (2019)
Silybum marianum (L.) Gaertn.	Shouk el gazal, kourshief el jmal	Therophyte	Seeds and fruits	It has been widely utilized as a medication and food to treat various ailments, including antibacterial, anticancer, hepatoprotective, cardiovascular-protective, neuroprotective, skin-protective, and antidiabetic. Significantly, it has reduced the toxicity of antibiotics, metals, and pesticides. The plant species is considered a safe phytogenic supplement in animal feeding, with a particular benefit to horse health and energy metabolism. A decoction of the seeds is used to treat Crohn's disease, ulcerative colitis, and gastrointestinal inflammation, as well as an immune system booster, to prevent cancer, and to treat liver diseases and infections, cleanse the liver from accumulated toxins, contribute to the production of breastfeeding milk, treat a lack of appetite and indigestion, dyspepsia, aphrodisiac for women and men, and diabetics, varicose veins, for the treatment of uterine congestion and uterine infections.	Wang *et al*., (2020), Dockalova *et al*., (2021), Khatib *et al*., (2021)
Notobasis syriaca (L.) Cass.	Kourshief adi	Therophyte	Aerial parts and seeds	There is evidence that people utilize this plant, mostly as food, to cure diabetes, as an antioxidant, anti-inflammatory, and antifungal agent, and for making cheese from milk, and crushed seeds are used to treat liver ailments.	Azab (2018)
Centaurea hyalolepis Boiss.	Marar shafafi	Therophyte	Aerial parts	Antioxidant, cytotoxic, and anti-inflammatory properties are found in plant species.	Erel *et al*., (2014)
Centaurea procurrens Sieber ex Spreng.	Marar	Chamaephyte	-	The species has not medicinal uses	-
Centaurea pallescens Delile	Yamour	Therophyte	Roots and seeds, Aerial parts	Used as digestive tonics or stomachics due to their bitter flavour, as diuretic, and has antimalarial effects, hepatoprotective activity and antitumor activities.	Arif *et al*., (2004), Ali *et al*., (1987), Abdallah *et al*., (2013)
Ifloga spicata (Frossk.) Sch.Bip.	Zaneema, Kreesha eljeedi	Therophyte	Whole plant	Antioxidants, cytotoxic chemicals, and antileishmanial action. Various solvent fractions showed substantial antibacterial ability against various bacterial and fungus strains, while different organic solvent fractions demonstrated antioxidant defence system balancing effects in human lymphocytes.	Shah *et al*., (2019), Khan *et al*., (2021)
Erigeron bonariensis (L.) Cronquist	Shieek el rabee	Therophyte	Leaves	The plant has been used as a pungent tonic, an astringent to control bleeding, a diuretic, a hemostatic, and probably an anthelminthic, and it may be effective in diarrhoea and diabetes, hemorrhages of the bowels, uterus, used for the treatment of headache, cutaneous leishmaniasis, and its antibacterial and cytotoxic activity. It is commonly used in folk medicine to treat rheumatism, gout, cystitis, nephritis, dysmenorrhea, and tooth pain; it is also said to have antiulcerogenic and anticoagulant properties.	Araujoa *et al*., (2013), Riyadh *et al*., (2014)
Erigeron canadensis (L.) Cronquist	Shieek el rabee	Therophyte	Whole plant	The herb is homeostatic, stimulant, astringent, and diuretic. It is used to treat dysentery, diarrhoea, uterine haemorrhage, dropsy, gravel, cystitis, calculus, bronchial catarrh, and hemoptysis, as well as acute pain, inflammation, fever, and especially microbial infections such as urinary infections, respiratory infections, diarrhoea, dysentery, and the treatment of ringworm and eczema.	Shakirullah *et al*., (2011), Qureshi *et al*., (2008)
Matricaria aurea (Loefl.) Sch.Bip	Papounaj dahapi	Therophyte	Flower	Decoction or infusion of flowers is used orally to cure fever, coughing, heart illness, chest discomfort, headache, and kidney stone. It is also used to treat skin infections, burns, wounds, and dermatitis. Dried capitulas are used to make infusions or tea to cure diseases such as colic pains, abdominal cramps, and stomach aches. They have antibacterial, antioxidant, and antifungal properties.	Rizwana *et al*., (2016), Khatib *et al*., (2021)

Table 1. (Cont'd.).

Name of taxa	Vernacular name	Life form	Part used	Traditional and medicinal uses/ailments treated	Reference
Artemisia monosperma Delile	Ather, Lealeal	Chamaephyte	Whole plants	In folk medicine, the herb is used to alleviate gastrointestinal disorders, diabetes, rheumatic pain, and fever and to induce abortion in addition of shows high antioxidant, and antimicrobial activity, as well as insecticidal and antimalarial potentiation.	Abu-Niaaj & Katampe (2018)
Calendula arvensis M. Bieb.	Akhawan el hakel	Therophyte	Leaves, flowers	It is traditionally used as a food colour, spice, and tea, as well as a tincture, ointment, or cosmetic cream, as well as a cure for skin issues and is administered topically to bites and stings, sprains, wounds, painful eyes, and varicose veins. Activities include anticandidal, antibacterial, cytotoxic, antioxidant properties, anti-inflammatory, anticancer, antipyretic agent, antimutagenic, and hemolytic activities. The leaves are considered sudorific, emmenagogue, diaphoretic, and sedative. It has wound-healing effects, and crushed leaves are administered topically to wounds. Decoction of capitula is also used to cure burns.	Abudunia *et al*., (2016), Khatib *et al*., (2021), Arora *et al*., (2013)
Anthemis palestina Boiss.	Akhawan phalastini	Therophyte	Flowers	The plant has a significantly high potential for essential oil as a bioactive oil for nutraceutical and medical applications, with antioxidant properties that can be used as an alternative medicine to prevent or treat oxidative stress, antimicrobial, antifungal, cytotoxicity, and antiproliferative activities.	Bardawee *et al*., (2014)
Anthemis pseudocotula Boiss.	Akhawan, pasoom, arpial	Therophyte	Whole plants	Plants in the genus Anthemis have been shown to have anti-inflammatory, hepatoprotective, and antioxidant properties for their high concentrations of key physiological and biological components. They are involved in energy transfer, photosensitization, and morphogenesis, as well as being antimicrobial, antispasmodic, and used to treat inflammatory illnesses. In folk medicine, they are widely used to treat gastrointestinal ailments, haemorrhoids, dysmenorrhea, and stomach discomfort.	Boukhary *et al*., (2019)
Verbesina encelioides (Cav.) Benth. & Hook.f. ex A.Gray	Verbisina enkouloidis	Therophyte	Roots, Leaves	The herb has long been used to cure stomach problems particularly haemorrhoids. Roots are utilized for water retention, bladder irritation, and as a blood purifier and the leaves are applied as a poultice to hurting legs in treating rheumatism, and the juice is used as a laxative. The herb is generally used as an anti-inflammatory for orifice redness and swelling. The paste is immediately applied to labial inflammations, and painful gums, used for the treatment of spider bite symptoms. The plant contains antibacterial, antiviral, anti-tumour, hypoglycemic, and anti-implantation properties and treats cancer, snake bite, digestive issues, skin diseases among other things. Diabetes has been treated ethnomedicinally using an active glargine. It also possesses antifungal, antiviral, antiimplantation, hypoglycemic, antibacterial, anticancer, antidiabetic, antioxidant, anticancer and anti-obesity properties.	Sindhu *et al*., (2010), Ramakrishnan *et al*., (2017), Verma *et al*., (2019)
Pulicaria arabica (L.) Cass.	Raera ayoup	Therophyte	Aerial parts	Aerial parts of this species can be used in analgesic, antipyretic, anti-inflammatory, hepatoprotective, and nephritic effects and have antioxidant, antibacterial and antifungal activities.	Yusufoglu (2014), Djermane *et al*., (2016)
Senecio glaucus L.	Karaiee, Soufiera	Therophyte	Leaves and stems	Because of its diverse pharmacological qualities, it is widely utilized in traditional medicine. It is an excellent potential source of natural antioxidants and has cytotoxic activity against colon cancer cells. Senecio species have long been used in folk medicine for various diseases, including cough therapy, wound healing speed, and asthma and eczema treatment.	Oladipupo & Adebola (2009), Alqahtani *et al*., (2020)
Dittrichia graveolens (L.) Greuter	Tayoun ragoue	Therophyte	Aerial parts	Aerial parts are traditionally used to treat urinary tract infections, haemorrhoids, wounds, and leishmaniasis as an anti-infective, anti-inflammatory, anti-pathogenic, and sedative drug. Antioxidant, and antibacterial properties have also been reported.	Mazandarani *et al*., (2014)

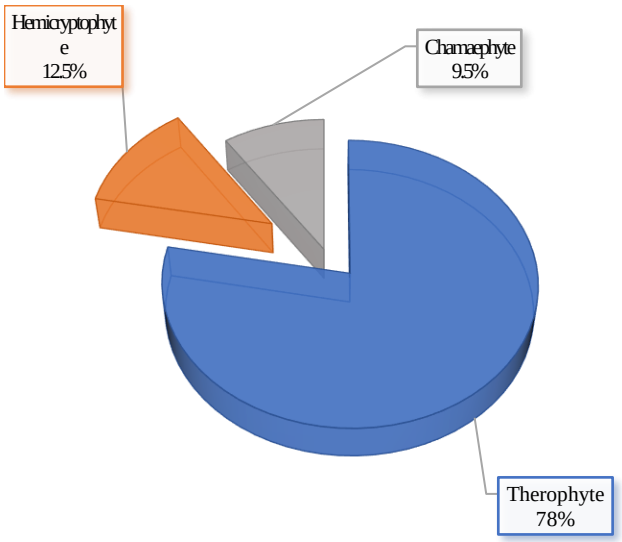

Fig. 1. Life-form spectrum of the plant species in the Asteraceae family at the Gaza Strip, Palestine.

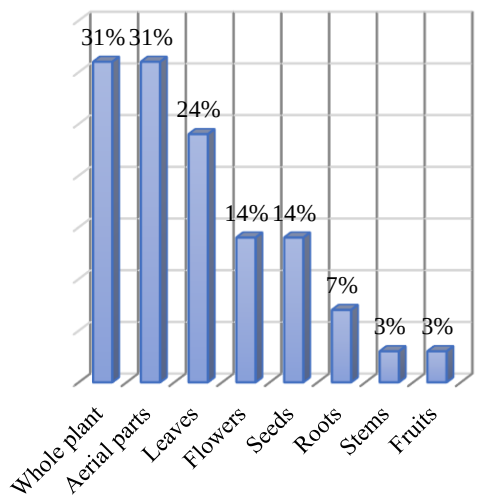

Fig. 2. Percentage of different parts of the medicinal plants used for ethnomedicinal purposes.

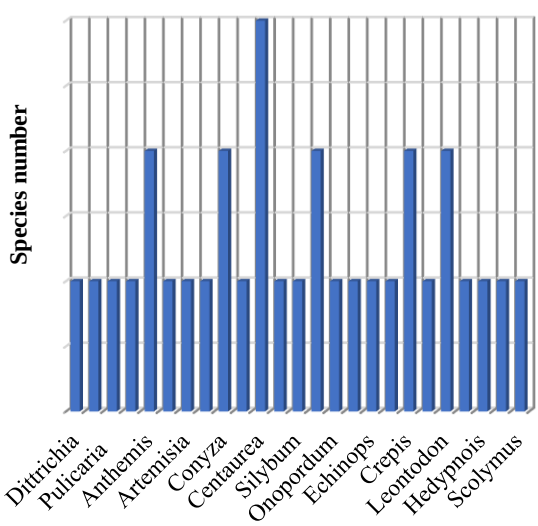

Fig. 3. Total number of plant species and genera distribution of the family Asteraceae occurring in the study sites of the Gaza Strip.

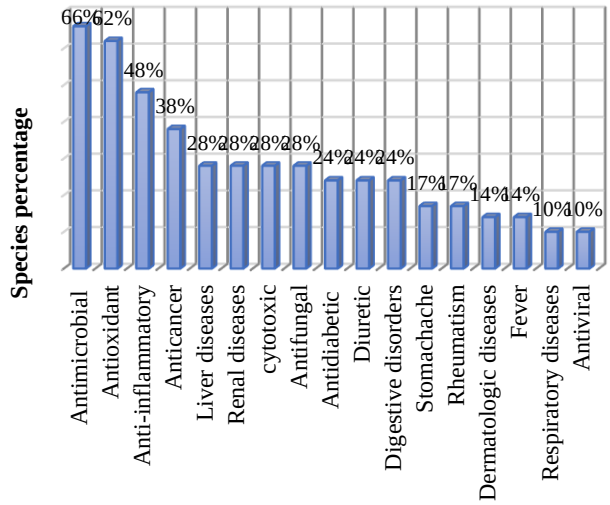

Fig. 4. Major effects and diseases treated using the Ethnomedicinal species of the Asteraceae family.

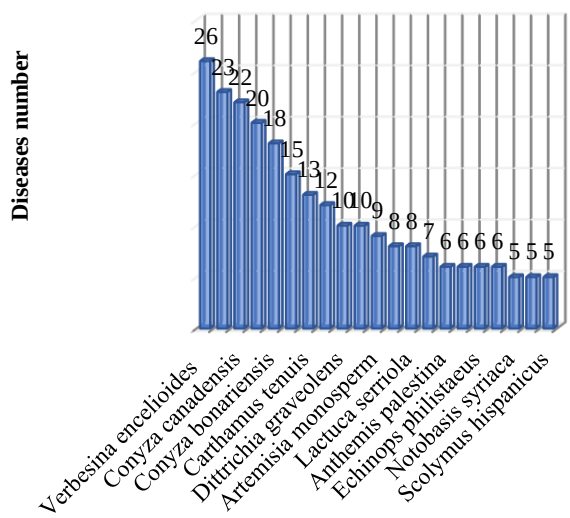

Fig. 5. The most commonly used traditional plant species of the Asteraceae family treat some diseases and have different activities.

Therophyte is the most abundant lifeform, with 25 plant species (78%), followed by Hemicryptophyte with 4 species (12.5%), and Chamaephyte with 3 species (9.5%) (Fig. 1). The life form expresses the adaptability of a species to its climate and is an important reflector of micro and macro climates (Asmus, 1990; Rahman *et al.*, 2018). Therophytes are often common in arid, semi-arid, and disturbed environments (Kovacs-Lang *et al.*, 2000). Therophytes' dominance is frequently tied to the area's dry climatic conditions, as it is an excellent survival strategy (Asri *et al.*, 2003; Mamariani *et al.*, 2009). According to the findings of this study, the majority of the plant species evaluated were herbs (Table 1, Fig. 5), therefore the majority of the plants is used as whole plants or aerial parts (9 spp) and leaves (7 spp) for treatment of different ailments (Fig. 2). The flowers and seeds are used to a lesser extent (4 spp) (Fig. 2). The underground parts such as roots, stems of two and fruits of one species were less commonly used (Fig. 2).

It should be mentioned that the different parts of the plant are occasionally mixed. The vegetative parts are the sites of vital photosynthetic mechanisms and occasionally accumulate secondary metabolites of the plant's important biological properties (Bigendako–Polyganis *et al.*, 1990; Salhi *et al.*, 2010). All the important information related to the ethnomedicinal uses of the different parts of various plant species were recorded in a comprehensive table.

Key to the genera

1. - Plants with latex, heads containing either hermaphrodite and unisexual florets, or all florets hermaphrodite, all florets ligulate …… 2
   + Plants without latex, at least central florets tubular …… 8
2. - Stems spiny-winged. Leaves and involucral bracts spiny ……..……. Scolymus
   + Stems not spiny-winged. Leaves and involucral bracts not spiny ……..……..……. 3
3. - Corollas blue, purple or pink, achene, all or some, with a well-developed persistent pappus of hairs and bristles, leaves oblong or oblanceolate; achenes 2-3 mm, not beaked ……..…….. Cichorium
   + Corollas yellow …….……..... 4
4. - Pappus of aristate scales and barbellate, plant with distinct stem; leaves not in a rosette, oblong-oblanceolate, sinuate-dentate; achene incurved ……... Hypnosis
   + Pappus of hairs and/or plumose bristles …… 5
5. - Phyllaries c. 8, 1-seriate, connate in their lower part, rather fleshy and similar; achene all alike, compressed, muricate-lamellate ……..……. Urospermum
   + Phyllaries numerous, 2-or more-seriate, imbricate, differing in shape and size, not fleshy …….. 6
6. - Plants stemless, leaves all basal in a rosette, leaves hispidulous, with multicellular hairs, pappus of ray achenes scaly, that of disc achenes plumose ……..…… Leontodon
   + Plants with distinct stems, leaves cauline, not in a rosette ……..…….……..…... 7
7. - Achenes compressed or flattened, capitulum 5-25-flowered, involucre cylindrical after anthesis, achenes beaked, beak sometimes short, annual or biennial herb, stems not spinescent, leaves not decurrent, achenes with distinct beak 1-4 times as long as the achene body ……..… Lactuca
   + Achene not compressed or flattened, plant not stoloniferous, stems not creeping, roots not bearing tubers, pappus of smooth or barbellate bristles, never plumose, indumentum of simple, not glochidiate hairs, or plant glabrous. peduncle ebracteate, outer phyllaries much shorter than the inner, and forming a calyculus, achenes homo-heteromorphic, beakless and truncate, or attenuate to a thick, persistent beak, ribs on achene body not transversely squamosa-muricate, beak …….…….. Crepis
8. - Capitula unisexual, staminate capitula many-flowered, terminal, pistillate capitula 1-2-flowered below the male capitula, with connate phyllaries enclosing the florets, fruiting involucre with hooked prickles, phyllaries of staminate capitula free …….……..…….. Xanthium
   + Florets all bisexual, or bisexual and unisexual in the same capitulum ……...… 9
9. - Capitula compound, numerous 1- flowered. Plant without latex, pappus absent or of short bristles, stems not winged, leaves not decurrent, spiny, pappus of short bristles ..…… Echinops
   + Capitula simple, few- or many-flowered ……..……..….. 10
10. - Leaves and/or bracts spiny, rarely, spinulose, leaves and phyllaries spiny or spinulose, achenes glabrous, hilum lateral, pappus of scales …….…….. Carthamus
    + Leaves and bracts not spiny or spinulose, during or after anthesis ……..……... 15
11. - Phyllaries spine-tipped or prickly ……..…….. 12
    + Phyllaries neither spine-tipped nor prickly ……... 15
12. - Stems with spinose wings ……..…….. 13
    + Stems without spinose wings ……..…..…. 14
13. - Pappus of plumose bristles ……..…… Onopordum
    + Pappus of bristles not plumose ……..….. Carduus
14. - Pappus of all achenes barbellate ……..……..…….. Silybum
    + Pappus, at least of inner achenes, plumose, annual, receptacle not fleshy, corollas purple, pappus of marginal achenes scaberulous, not plumose …….……..… Notobasis
15. - Pappus dimorphic, the inner 1-seriate, of short equal scales, the outer multiseriate, of longer bristles. Florets more than 15, corollas yellow or pink, pappus not purple, hilum not linear ……. Centaurea
    + Phyllaries not fused to form a tubular sheath around the achenes and lacking glands ..……..... 16
16. - Capitula small, leaves simple, sometimes deeply dissected but not lobed, pappus-bristles plumose at the apex, stems not winged, ray florets absent, phyllaries herbaceous or the margin scarious …….…. Ifloga
    + Capitula conspicuous ……..…….. 17
17. - Achenes epappose or with a membranous crown or auricle …… 18
    + Achene with pappus of hairs or bristles, capitula not solitary, outer phyllaries not ovate, pappus scabrous or fine 1-seriate bristles, leaves entire, sparsely dentate, serrate, incised or 3-5-lobed at the apex. Stems hairy or glandular-hairy, achenes 1-1.8 mm, capitula heterogamous, outer florets pistillate, numerous, multiseriate, central florets few …….….... Erigeron

18. - Pappus a membranous crown or auricle, leaves finely dissected, plants glabrous, stems erect, achenes 1-1.5 mm, capitula radiate or disciform, peduncle 1-3 cm, achenes 1 mm, distinctly 5-ribbed, pappus absent or of a membranous corona ……..... Matricaria
    + Pappus not a crown or auricle, corollas yellow, perennial, capitula smaller, in panicles, receptacle glabrous or hairy, phyllaries 2-seriate, florets more than 10, ray florets, if present, pistillate, apical anther-appendages subulate ……..…. Artemisia
19. - Pappus absent or of a membranous crown or auricle, or a few minute bristles …..……..……..……. 20
    + Pappus of hairs, bristles, scales or awns ……...…… 21
20. - Annual, leaves not dissected, plant not covered with appressed short rigid hairs, leaves alternate, capitula conspicuous, solitary, conspicuously and regularly rayed, corollas orange-yellow, achenes polymorphic, incurved, brown ……..……...….. Calendula
    + Annual, leaves dissected, achenes not winged, pappus of a membranous crown, an auricle, or absent, receptacle paleaceous, paleae, deciduous, disc florets with yellow corollas, achenes glabrous, the base of the corolla of disc florets swollen in fruit ……...…..... Anthemis
21. - Pappus of 2 filiform awn-like bristles, ray florets with white or yellow corollas, ray limbs yellow, leaves of different shapes, not narrowly linear ……..…….. Verbesina
    + Pappus of numerous bristles or scales ……...……..……..…… 22
22. - Pappus of an outer cupule of short connate scales and inner much longer barbellate bristles ...…… Pulicaria
    + Pappus of outer and inner series of bristles ……..…..……...…. 23
23. - Phyllaries 1-seriate, with a basal calyculus, anthers not appendiculate at the base, pappus of silky scaberulous hairs, usually deciduous ……..……...……...…….. Senecio
    + Phyllaries multiseriate, anthers with ciliate basal appendages, pappus of bristles ...……...…… Dittrich

Key to the species

Leontodon:

1. - Perennial, with tuberous roots ……..…….. *Leontodon tuberosus*
    + Annual, with taproots, all achenes pappose, plant ± glabrous, leaf-lobes 1-2 mm broad, mostly linear, phyllaries ± glabrous ……..…… *Leontodon laciniatus*

Crepis:

1. - All (or at least the inner) achenes distinctly beaked, beak about as long as achene or longer, ….…… 2
    + Inner achenes not beaked, various parts of plant hairy, heads pedunculate, perennial rhizomatous herbs of shady habitats, flowering stems tall, leafy, branched from below middle, lateral lobes of radical leaves acute, inner involucral bracts glabrous or nearly, achenes straight ……..….. *Crepis reuteriana*
2. - Fruiting heads not reaching 1,5 cm in length, cauline leaves acutely dentate, rarely lobed, all achenes beaked, or marginal achenes beakless and 4-5 mm long with a wing on the ventral side, pappus of inner achenes deciduous, stems usually with sparse long yellow bristles ……...…….. *Crepis aspera*

Carduus:

1. - Intermediate bracts ovate-oblong, nearly obtuse, somewhat rounded at the sides, midvein very short, ending in a short spinule ……..……..……..... *Carduus australis*
    + Intermediate bracts narrowly triangular-lanceolate, long-attenuate, straight at the sides, midvein ending in a rather long spinule ……..…….. *Carduus getulus*

Centaurea:

1. - Heads subtended by several upper leaves, bristles of pappus not scabrous, spinules at base of spine absent, sometimes 1-2 pairs of spinules present ……..….... *Centaurea hyalolepis*
    + Intermediate involucral bracts with a narrow membranous or hyaline margin, margin narrower than the base of the spine, spine with 2-5 pairs of spinules at base …… 2
2. - Capitula cobwebby, spines of phyllaries stout, with spinules restricted to the base of the spine, corolla and anthers yellow, plants of sandy loam of the coastal plain ...…….…… Centaurea procurers
    + Capitula glabrous, spines of intermediate involucral bracts 1-2 mm broad at the base, involucre slightly cobwebbed, plants of steppe and desert of the country ...……...…..…….. Centaurea pallescens

Erigeron:

1. - Leaves glabrous or ciliate, involucral bracts glabrous or nearly so, achenes together with pappus 3-3.5 mm ……..…….. *Erigeron canadensis*
    + Middle cauline leaves narrowly linear, rarely up to 6 mm broad, entire or sometimes dentate, receptacle minutely muricate, not areolate ……...…….. *Erigeron bonariensis*

Anthemis:

1. - Fruiting peduncles distinctly thickened and strongly recurved, outer achenes very thick, nearly tetragonal ……..……..…… *Anthemis pseudocotula*
    + Achenes cuneate, strongly compressed dorsoventrally, 4-angled in cross-section, receptacular bracts often spathulate ……..……..… *Anthemis Palestina*

Fig. 6. Selected photos of plant species recorded in the Asteraceae family at the Gaza Strip, Palestine. A. *Echinops philistaeus*; B. *Xanthium spinosum*; C. *Notobasis syriaca*; D. *Anthemis pseudocotula*; E. *Verbesina encelioides*; F. *Cichorium endivia*.

Fig. 7. Selected photos of plant species recorded in the Asteraceae family at the Gaza Strip, Palestine. A. *Leontodon tuberosus;* B. *Carthamus tenuis;* C. *Silybum marianum;* D. *Centaurea hyalolepis;* E. *Centaurea procurrens;* F. *Erigeron bonariensis.*

Conclusion

The current study helps researchers in the ethnobotanical and ethnomedicinal fields in the Gaza strip, Palestine. The current study demonstrates that the studied region have a high floristic diversity of the family Asteraceae, Therophytes. Plant species diversity increases throughout the spring season. Among thirty-two plant species recorded in the study area, 29 were considered medicinal plants and had different biological activities. The present investigation provides a floristic checklist with up-to-date nomenclature that will help the future investigation and sustainable use of plant resources of this region and conservation of plant biodiversity. However, this research could be a database and information which attract the attention of plant scientists for further important research on different medicinal plants presented in the Gaza Strip, Palestine, area to find significant novel biological substances for phytochemical and pharmacological future studies.

References

Abd Rabou, A.F.N., M.M. Yassin, M.R. Al-Agha, M.I. Madi. M.M. Al-Wadi, A.K.S. Ali and D.M. Hamad. 2008. Notes on some common flora and its use in Wadi Gaza. *Islamic Univ. J*., 16: 31-63.

Abdallah, H.M., M.A. Mohamed, A.M. Allia, M.M. Hamed, A.B. Abdel-Naim and O.M. Ashour. 2013. Protective effect of *Centaurea pallescens* Del. against CCl4-induced injury on a human hepatoma cell line (Huh7), *Med. Chem. Res.* DOI 10.1007/s00044-013-0563-y.

Abdul-Jalil, T.Z. 2020. *Lactuca serriola*: Short Review of its Phytochemical and Pharmacological Profiles. *Int. J. Drug Deliv. Tech.,* 10(3): 501-508.

Abou Auda, M. 2012. Medicinal plant diversity in the flora of Gaza Valley, Gaza Strip, Palestine. *An - Najah Univ. J. Res.,* 26: 61-84.

Abou Auda, M., N. Deeb and K.F. EL Sahhar. 2009. The flora and plant life forms of Wadi Gaza area, Middle Governorate, Palestine. Proceedings of the 4th Conference on Recent Technologies in Agriculture, 3-5 Nov, Cairo University, Faculty of Agriculture, 201-212.

Abu Batnain, M. 2014. Study of floristic diversity and screening of medicinal plants for antimicrobial activity in Al- Salqa valley area, Gaza strip, Palestine. Islamic University – Gaza, Master of Biological Sciences/Botany.

Abudunia, A., I. Marmouzi, M. Faouzi, Y. Ramli, J. Taoufik, N. El Madani, E. Essassi, A. Salama, K. Khedid, M. Ansar and A. Ibrahimi. 2016. Anticandidal, antibacterial, cytotoxic and antioxidant activities of *Calendula arvensis* flowers. *J. De Mycologie Médicale*. http://dx.doi.org/10.1016/ j.mycmed.2016.11.002

Abu-Niaaj, L. and I. Katampe. 2018. Isolation and Characterization of Flavones from *Artemisia monosperma*. *Pharmaco. J*. 10(5): 1018-23.

Alam, J. and S.I. Ali. 2010. Contribution to the red list of the plants of Pakistan. *Pak. J. Bot*., 42(5): 2967-2971.

Ali, Y.E., A.A. Omar, T.M. Sarg and D.J. Slatkin. 1987. Chemical constituents of *Centaurea pallescens*. *Planta Med*., 53(5): 503-504.

Aljaja, M.K., R. Lahdo and A. Kitaz. 2021. Phytochemical study and protective effect investigation against oxidative damage in human erythrocytes of Syrian Asteraceae plants. *Bull. Pharm. Sci., Assiut Uni*., 44(2): 323-338.

Alper, M. and H. Guney. 2019. Determination of anticancer effects of *Urospermum picroides* against human cancer cell lines. *Int. J. Sec. Met*., 6(1): 28-37.

Alqahtani, A., R. Herqash, O. Noman, F. Nasr , N. Alyhya, S. Anazi, M. Farooq and R. Ullah. 2020. *In vitro* antioxidant, cytotoxic activities, and phenolic profile of *Senecio glaucus* from Saudi Arabia. *Evidence-Based Complementary and Alternative Medicine*, Article ID 8875430: (1-9). https://doi.org/10.1155/2020/8875430.

Altiner, D.D. and Y. Sahan. 2016. A Functional Food Additive: *Scolymus hispanicus* L. *Flour. Int. J. Food Engin*., 2(2): 124-127. https://doi.org/10.18178/ijfe.

Amer, A.M. 2018. Antimicrobial effects of egyptian local chicory, *Cichorium endivia* subsp. *Pumilum. Int. J. Micro*. Article ID 6475072, 6 pages.

Araujoa, L., L.M. Moujira, J. Rojasb, L. Rojasb, J. Carmonac and M. Rondónc. 2013. Chemical composition and biological activity of *Conyza bonariensis* essential oil collected in Mérida, Venezuela. *Nat. Prod. Comm.,* 8(8): 1175-8. PMID: 24079198

Arif, R., E. Kupeli and F. Ergun. 2004. The biological activity of *Centaurea* L. species. G.U. *J. Sci.,* 17(4): 149-164.

Arora, D., A. Rani and A. Sharma. 2013. A review on phytochemistry and ethnopharmacological aspects of genus Calendula. *Pharmacog. Rev.,* 7(14): 179-87.

Asmus, U. 1990. Floristic and phytosociological studies in Gropisstadt Berlin, Germany. *Vern. Berl. Bot. Ver*., 8: 97-140.

Asri, Y. 2003. Plant diversity in Touran biosphere reservoir. *Publishing research institute of forests and rangelands, Tehran, Iran*, (305): 306.

Awaja, S.M. 2015. Taxonomy and ecology of natural vegetation in the industrial area, North Gaza Strip, Palestine. The Islamic University. A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master in Biological Botany& Mycology.

Azab, A. 2018. A facile method for testing antioxidant capacity and total phenolic content of *Notobasis syriaca* and *Scolymus maculatus* extracts and their antifungal activity. *Eur. Chem. Bull*., 7(8): 210-217.

Badshah, L., F. Hussain and Z. Sher. 2013. Floristic inventory, ecological characteristics and biological spectrum of rangeland of District Tank, Pakistan. *Pak. J. Bot*., 45(4): 1159-1168.

Bardawee, S.K., K.A. Tawaha and M.M. Hudaib. 2014. Antioxidant, antimicrobial and antiproliferative activities of *Anthemis palestina* essential oil. *BMC Comp. and Altern. Med.,* 14: 297.

Bigendako-Polyganis, M.J. and J. Lejoly. 1990. La Pharmacopée Traditionnelle au Burundi." Pesticides et médicaments en sante animale. *Pres. Univ. Namur.,* 425-442.

Bitew, H. and A. Hymete. 2019. The Genus Echinops: Phytochemistry and Biological Activities: A Review. *Front. Pharmacol*. Article, 1234, (10): 1-29. doi: 10.3389/fphar.2019.01234.

Boukhary, R., M. Aboul-ElA and A. El-Lakany. 2019. Review on chemical constituents and biological activities of Genus Anthemis. *Pharmacog. J.,* 11(5): 1155-1166.

Boulos, L. 1999, 2000, 2002. *Flora of Egypt*. Vols 1&2&3. Al Hadara Publishing, Cairo, Egypt.

Boulos, L. 1959. A contribution to the flora of Gaza zone. Ministry of Agriculture, Egypt.

Chase, M.W., M.J. Christenhusz, M.F. Fay, J.W. Byng, W.S. Judd, D.E. Soltis, D.J. Mabberley, A.N. Sennikov, P.S. Soltis and P.F. Stevens. 2016. An update of the angiosperm phylogeny group classification for the orders and families of flowering plants: APG IV. *Bot. J. Linn. Soc*., 181: 1-20.

Cornara, L., A. La Rocca, S. Marsili and M.G. Mariotti. 2009. Traditional uses of plants in the Eastern Riviera (Liguria, Italy*). J. Ethno. Pharm.,* 125: 16-30.

Danin, A. 2000. The Nomenclature News of Flora Palaestina, First published in 2000, in: Flora Mediterranean, 10: 109-172.

Danin, A. 2004. Distribution Atlas of plants in the Flora Palaestina Area. The Israel Academy of Sciences and Humanities, Jerusalem.

Djermane, N., N. Gherraf1, R. Arhab, A. Zellagui and K. Rebbas. 2016. Chemical composition, antioxidant and antimicrobial activities of the essential oil of *Pulicaria arabica* (L.). *Cass Der Pharm. Lett.*, 8(7): 1-6.

Dockalova, H., L. Zeman and P. Horky. 2021. Influence of Milk Thistle (*Silybum marianum*) seed cakes on biochemical values of equine plasma subjected to physical exertion. *Animals*, 11(210): 1-16. https://doi.org/10.3390/ani11010210

Dothan, F.N. 1978a. Flora Palaestina, Part three plates Ericaceae to Compositae, The Israel Academy of Sciences and Humanities, Jerusalem.

Dothan, F.N. 1978b. Flora Palaestina, Part three Text Ericaceae to compositae, The Israel Academy of Sciences and Humanities, Jerusalem.

El-Amier, Y.A., O.N. Al-hadithy and T.J. Abdullah. 2016. Antioxidant and antimicrobial activity of different extracts obtained from aerial parts of *Urospermum picroides* (L.) F.W. from Egypt. *J. Adv. Chem. Sci.*, 2(3): 299-301.

Erel, S.B., S. Demir, A. Nalbantsoy, P. Ballar, S. Khan, N.U.K. Yavasoglu and C. Karaalp. 2014. Bioactivity screening of five *Centaurea* species and *In vivo* anti-inflammatory activity of *C. athoa*. *Pharm. Biol*., 52(6): 775-781.

Garcia-Sanchez, E., C.B. Lopez, R.E. Torres and M.M. Pacheco. 2011. A revision de *Eupatorium* (Compositae: Eupatorieae) from Michoacan. *Phyton*, 80:139-146.

Güez, C.M., E.P. Waczuk, K.B. Pereira, M.V. Quero, J.B. Rocha and L.F. Oliveira. 2012. *In vivo* and *In vitro* genotoxicity studies of aqueous extract of *Xanthium spinosum*. *Braz. J. Pharm. Sci*., 48(3): 461-467

Hassan, W.H., H.M. Al-Youssef, L. AL-Shammari and R.H. Abdallah. 2015. New pentacyclic triterpene ester and flavone glycoside from the biologically active extract of *Carduus pycnocephalus* L. *J. Pharmacognosy and phytotherapy*, 7(4): 45-55.

Hussain M., J. Alam, G. Shah, A. Majid, H. Shaheen, T. Habib and S. Khan. 2021. Floristic inventory, biological spectra and phenology of monocots of the Musk Deer National Park, Azad Jammu and Kashmir, Pakistan. *Sylwan*., 165(9): 164-183.

Iqbal, T., H. Rehman, R. Jan, M. Khan, N.A. Nisar, J. Nisar, L. Khattak, A. Iqbal, S. Khurshid, A. Ullah, W. Ahmad and N. Ullah. 2014. Ethnomedicinal study of flora of district Karak, Khyber Pakhtunkhwa, Pakistan. *Int. J. Adv. Res.*, 2(9): 88-93.

Jenkins, C.N. and L. Joppa. 2009. Expansion of the global terrestrial protected area system. *Biol. Conserv*., 142(10): 2166-2174.

Khan, M.N., S. Ali, T. Yaseen, S. Ullah, A. Zaman and M. Iqbal. 2019. Eco-taxonomic study of family Poaceae (Gramineae). *RADS J. Biol. Res. Appl. Sci*., 10(2): 63-75.

Khan, Y., S. Jan, F. Ullah, A. Awan, N. Muhammad and S. Rizvi. 2021. Antimicrobial, antioxidant and cytotoxic evaluation of various extracts of *Ifloga spicata* (Forssk.) Sch.-Bip. *Latin Amer. Appl. Res.*, 51(4): 277-283.

Khatib, C., A, Nattouf and H. Agha. 2021. Ethnobotanical survey of medicinal herbs in the Western region in Syria (Latakia and Tartus). *Res. Squ.*, 1-75. https://doi.org/ 10.21203/rs.3.rs-355008/v1.

Kovacs-Lang, E., G. Kröel-Dulay, M. Kertész, G. Fekete, S. Bartha, J. Mika and I. Hahn. 2000. Changes in the composition of sand grasslands along a climatic gradient in Hungary and implications for climate change. *Phytocoenologia*, 30(3/4): 385-407.

Mamariani, F., M. Joharchi, H. Ejtehadi and K. Emadzade. 2009. Contributions to the flora and vegetation of Binalood mountain range, NE Iran: Floristic and chorological studies in Fereizi region. *J. Cell Mol. Res.*, 1(1): 1-18.

Mandel, J.R., M.S. Barker, R.J. Bayer, R.B. Dikow, T.G. Gao, K.E. Jones, S. Keeley, N. Kilian, H. Ma and C.M. Siniscalchi. 2017. The Compositae tree of life in the age of phylogenomics. *J. Syst. Evol*., 55: 405-410.

Marzouk, R.I., S.M. El-Darier, S.A. Kamal and I.H. Nour. 2021. Comparative taxonomic study of Launaea Cass. (Asteraceae, Cichorioideae) in Egypt. *Taxonomy*, 1: 192-209.

Mazandarani, M., M. Ghafourian and A. Khormali. 2014. Ethnopharmacology, antibacterial and antioxidant activity of *Dittrichia graveolen*s (L.) W. Greuter. which has been used as remedies antirheumatic, anti-inflammation and antiinfection against leishmaniasis in the traditional medicine of Gorgan, Iran. *Crescent J. Med. Biol. Sci.*, 1(4): 125-129. file:///C:/Users/hp/Downloads/50003620140403.pdf

Oladipupo, L. and O. Adebola. 2009. Chemical composition of the essential oils of the flowers, leaves and stems of two *Senecio polyanthemoides* Sch. Bip. samples from South Africa. *Molecules*, 14(6): 2077-2086.

Pieroni, A. 2000. Medicinal plants and food medicines in the folk traditions of the upper Lucca Province, Italy. *J. Ethnopharm*., 70: 235-273.

Pimm, S.L., C.N. Jenkins, R. Abell, T.M. Brooks, J.L. Gittleman, L.N. Joppa and J.O. Sexton 2014. The biodiversity of species and their rates of extinction, distribution, and protection. *Sci*., 344: 61-87.

Pysek, P. and D.M. Richardson. 2010. Invasive species, environmental change and management, and health. *Ann. Rev. Environ. Resour*., 35: 25-55.

Qasem, J.R. and H.A. Abu-Blan. 1996. Fungicidal activity of some common weed extracts against different plant pathogenic fungi. *J. Phytopath.*, 144: 157-161.

Qureshi1, S.J., M.A. Khan and M. Ahmad. 2008. A survey of useful medicinal plants of Abbottabad in Northern Pakistan. *Trakia J. Sci.*, 6(4): 39-51.

Rahman, I.U., A. Afzal, Z. Iqbal, F. Ijaz, N. Ali, M. Asif and R.W. Bussmann. 2018. First insights into the floristic diversity, biological spectra and phenology of Manoor Valley, Pakistan. *Pak. J. Bot*, 50(3): 1113-1124.

Ramakrishnan, C.K., D. Doss and A. Vijayabharathi. 2017. Biochemical and Antimicrobial Characterization of an Underexploited Medicinal Plant - *Verbesina encelioides*. *Int. J. Curr. Microbiol. App. Sci.*, 6(12): 3407-3416.

Raunkiaer, C. 1934. The life forms of plants and statistical plant geography; being the collected papers of C. Raunkiaer.

Riyadh, A.S.T., C. Xiang-Rong Cheng, N. AL- Hajj, M.R. Rahman and G.W. Le. 2014. Antioxidant and *Conyza bonariensis*: A Review. *Europ. Acad. Res.*, 2(6): 8454-8474.

Rizwana, H., M. Alwhibi and D. Soliman. 2016. Antimicrobial activity and chemical composition of flowers of *Matricaria aurea* a native herb of Saudi Arabia. *Int. J. Pharm.*, 12(6): 576-586.

Romero, M., M. Zanuy, E. Rosell, M. Cascante, J. Piulats, M. Font-Bardia, J. Balzarini, E. De Clerq and M.D. Pujol. 2015. Optimization of xanthatin extraction from *Xanthium spinosum* L. and its cytotoxic, anti-angiogenesis and antiviral properties. *Europ. J. Med. Chem.*, 90: 491-496.

Said, O.K., Khalil, S. Fulder and H. Azaizeh, 2002. Ethnopharmacological survey of medicinal herbs in Israel, the Golan Heights and the West Bank region. *J. Ethno. Pharm.*, 83: 251-265.

Salhi, S., M. Fadli, L. Zidane and A. Douira. 2010. Etudes Floristique et Ethnobotanique des Plantes Médicinales de la Ville de Kénitra (Maroc). *Lazaroa*, 31: 133-146.

Sawalha, K., S. Jarrar, R. Alkowni and A. Omari. 2020. Flora Palestina: Biodiversity Publications Series No. 1 Palestine Academy (in Arabic).

Scotland, R.W. and A.H. Wortley. 2003. How many species of seed plants are there? *Taxon*, 52(1): 101-4.

Shah, S., F. Ullah, M. Ayaz, A. Wahab and Z. Shinwar. 2019. Phytochemical profiling and pharmacological evaluation of Ifloga spicata (Forssk.) Sch. Bip. in leishmaniasis, lungs cancer and oxidative stress. *Pak. J. Bot*., 51(6): 2143-2152.

Shakirullah, M., H. Ahmad, M.R. Shah, I. Ahmad, M. Ishaq, N. Khan, A. Badshah and I. Khan. 2011. Antimicrobial activities of Conyzolide and Conyzoflavone from *Conyza canadensis*. *J. Enzyme Inhib. Med. Chem.*, 26(4): 468-471.

Shawagfeh, M.T. 2020. The Effect of *Carthamus tenuis* Extracts on the Cell Proliferation of Different Tumor Cell Lines. *Pharm. J.*, 12(6): 1332-1339.

Sindhu, R.K., N. Vasudeva and S.K. Sharma. 2010. Pharmacognostical and preliminary phytochemical investigations on *Verbesina encelioides* Benth. Roots. *J. Herbal Med. Toxi*., 4(2): 113-118.

Smith, R.D., G.I. Aradottir, A. Taylor and C. Lyal. 2008. Invasive species management - what taxonomic support is needed? Global Invasive Species Programme, Nairobi Kenya.

Sobrinho, A., S. Morais, E. Souza and R. Fontenelle. 2017. The genus *Eupatorium* L. (Asteraceae): A review of their antimicrobial activity. *J. Med. Plant Res*., 11(3): 43-57.

Susanna, A., B.G. Baldwin, R.J. Bayer, J.M. Bonifacino, N. Garcia-Jacas, S.C. Keeley, J.R. Mandel, S. Ortiz, H. Robinson and T.F. Stuessy. 2020. The classification of the Compositae: A tribute to Vicki Ann Funk (1947-2019). *Taxon*, 69: 807-814.

Täckholm, V. 1974. Students' Flora of Egypt. 2nd Edit. Publ. Cairo university (reprinted by Cooperative Co., Beirut), 888 pp.

Taha, H.E., M.A. Farag, A.M. El Fishawy, S.A. El Toumy, K.F. Amer and A.M. Mansour. 2019. Hepatoprotective Effect of *Carduus getulus* Pomel in relation to its metabolite fingerprint as analyzed via UPLC-MS technique. *BioSci. Res.*, 16(3): 2459-2474.

Ugurlu, E. and O. Secmen. 2008. Medicinal plants popularly used in the villages of Yunt Mountain (Manisa-Turkey). *Fitoterapia* (79): 126-131.

Verma, V., M. Chaudhary and N. Srivastava. 2019. Antioxidative properties of isolated saponins of *Verbesina encelioides* (Cav.) Benth. & Hook. f. ex Gray and SEM studies of synthesized green nanoparticles for acne management. *Plant Sci. Today*, 6: 575-582.

Wang, X., Z. Zhang and S. Wu. 2020. Health Benefits of Silybum marianum: Phytochemistry, Pharmacology, and Applications. *J. Agri. Food Chem.*, 68(42): 11644-11664.

Yang, S.P., J. Huo, Y. Wang, L.G. Lou and J.M. Yue. 2004. Cytotoxic sesquiterpenoids from *Eupatorium chinense*. *J. Nat. Prod*., 67: 638-643.

Yusufoglu, H.S. 2014. Analgesic, antipyretic, anti-inflammatory, hepatoprotective and nephritic effects of the aerial parts of *Pulicaria arabica* (Family: Compositae) on rats. *Asian Pac. J. Trop. Med.*, 7: 583-590.

Zohary, M. 1978. Flora Palaestina. Part Three; Text: Ericaceae to Compositae. The Israel Academy of Science and Humanities, Jerusalem.

(Received for publication 16 March 2022)