ETHNOBOTANICAL STUDY OF MEDICINAL PLANTS IN "EL-MERGUEB" NATURE RESERVE, M'SILA PROVINCE, NORTHERN ALGERIA

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(Received 1st Sep 2023; accepted 16th Nov 2023)

Abstract. Medicinal plants are considered as a rich sources of bioactive compounds. The present study aimed to document the local knowledge of medicinal plants' use in El Mergueb natural reserve of the wilaya of M'sila, northern Algeria. The valorization of this natural heritage requires an ethnobotanical study which allows to describe the different uses of medicinal plants by the local population and to establish the catalogue of medicinal plants and their therapeutic uses. Ethnobotanical data were collected from 182 local informants through semi-structured questionnaires and open interviews. In the present study a total of 46 plant species belonging to 23 botanical families were recorded for the treatment of different ailments. Asteraceae was the most represented family with 9 species followed by Poaceae, Lamiaceae and Fabaceae. *Artemisia herba-alba* Asso (UV = 0.58), *Stipa tenacissima* L. (UV = 0.42), *Artemisia campestris* L. (UV = 0.3), *Zyziphus lotus* L. (UV = 0.16) and *Marrubium vulgare* L. (UV = 0.14) were the most frequently used by local informants, with the highest UV. Leaves (39.6%) were the most widely used plant parts. Most herbal remedies were consumed as decoction and infusion. The results obtained are very valuable source of information on the region studied and on the Algerian medicinal flora. They could serve as a database for further phytochemical and pharmacological investigations and for research into new natural sources of biomolecules beneficial to people.
Keywords: *survey, phytotherapy, diseases, semi-arid region, Algeria*

Introduction

Algeria is the largest country in the Mediterranean basin and Africa with a total area of 237 639 100 ha, distinct bioclimatic, ecological zones, and significant species diversity (Souilah et al., 2018). Medicinal plants have long been a part of healthcare in many parts of the world, particularly in developing nations. Traditional medicine has used medicinal plants as a cure for a variety of diseases for many years (Ekor, 2014).

Therapeutic plants with pharmacological qualities have been identified as rich sources of components with significant potential for disease prevention (Karbab et al., 2020). Like other countries in the world, plants have long been used in Algeria to cure a variety of diseases. The knowledge of the plants used can shed light on their qualities, which will allow future research (Hamza et al., 2019).

Ethnobotany is the study of human-plant relationships; several active chemicals utilized in modern medicine are derived from ethnobotanical data, which is mostly based on popular and traditional medical knowledge. This knowledge, which primarily belongs to traditional practitioners is still passed down orally putting this herbal traditional practice at risk of extinction if it is not preserved (Ouelbani et al., 2016).

In Algeria, many ethnobotanical and ethnopharmacological studies have recently been undertaken in different regions such as the central Sahara (Hammiche and Maiza, 2006), the North (Bouasla and Bouasla, 2017) and Northwest Algeria (Benarba et al., 2015) in

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2201_459472

order to preserve indigenous knowledge and to develop a strategy for the protection of biodiversity and particularly rare plant species, threatened or extinct in the wild from excessive human use (Bakiri et al., 2016). The inventory of plants is now estimated at 4449 taxa, including 3951 native taxa of which 464 are endemic (Habib et al., 2020). In this context, we conducted an ethnobotanical study in El Mergueb natural reserve. To our knowledge, this region has never been explored ethnopharmacologically. Therefore, this study was conducted to obtain the ethnomedicinal knowledge of the El Mergueb natural reserve and to determine the cultural importance of plant taxa, families, local names, usage parts and methods of preparation.

Material and methods

Ethnobotanical survey

Survey area

M’ sila (known also as Hodna) region is situated in the central part of Northern Algeria at 351 42′ N latitude and 41 32′ E longitude. It covers a total area of 18718 km^2 (47 municipalities) (*Fig. 1*). The territory is mostly hilly with an average altitude of 500 m, semi- arid and characterized by the predominance of steppe (63% total area) (Boudjelal et al., 2013). El Mergueb reserve is a natural steppe space located at the western edge of the Hodna pan (*Fig. 1*). It covers an area of 16.481 ha, straddling the communes of Sidi Hadjeres, Ain El Hadjel and Sidi Ammer (Boudjadja et al., 2010). It extends between the coordinates of Lambert relative to the topographic map of Aïn El-Hadjel to (1/50.000, following: X (608.5 and 626.7) km and Y (243.6−263.8) km. The three experimental stations lie between latitudes (35°36’12.6”N and 35°35’05.7”N) and longitudes (03°56’23.8”E and 03°58’08.7”E) with an altitude of 575 and 634 m located in the municipality of Ain EL-Hadjel (Adjabi et al., 2019).

The climate of M’Sila is characterized by semi-arid and dry conditions typical of a desert region. It is continental, subject in part to the Saharan influences. According to the data from the meteorological station of M’sila (2010-2015), the variation in average monthly precipitation is irregular in a general manner. The rainyest month is September with an average of 25.6 mm, while July has the least rainy month with a value of 3.75 mm (*Fig. 2*). January is the coldest month, with a minimum of 8.41°C, while the warmest month is July, with an average maximum of 31.11°C for average monthly temperatures (*Fig. 2*). The average maximum temperature curve (M) shows that the highest maximum temperature is recorded in July with 44°C and the lowest average maximum temperatures observed in January 18.3°C. Thus, M’sila has a dry period that extends over twelve months, from January to December and it is located in the semi-arid bioclimate with a cold winter according to the Emberger rainfall ratio (Q2 = 15.62) (Merniz et al., 2018).

Data collection

In order to identify and establish a list of plants used in traditional medicine due to their pharmacological properties, an ethnobotanical survey was carried out using a questionnaire distributed to villagers and people with knowledge on the use of medicinal plants through face-to-face interviews, with the aim of collecting accurate information on therapeutic practices by the population. Our study was conducted from June 2020 to January 2021 spread over 182 questionnaire cards using probability sampling method (Ocvirk et al., 2019) and all the respondents were villagers from El Mergueb. The

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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information is divided into two sections (*Fig. 3*); the first concerns the informant as the sole owner of the information, while the second gathers information concerning the medicinal plant such as local name, plant parts used, spontaneous or cultivated, toxicity, medicinal use and preparation. The identity of each plant species mentioned by the informants was verified and confirmed by a bibliography (Quézel and Santa, 1962a) and Ozenda (1977). A medicinal use was accepted as valid only if it was mentioned by at least three independent interviewees (Al-Qura'n, 2009).

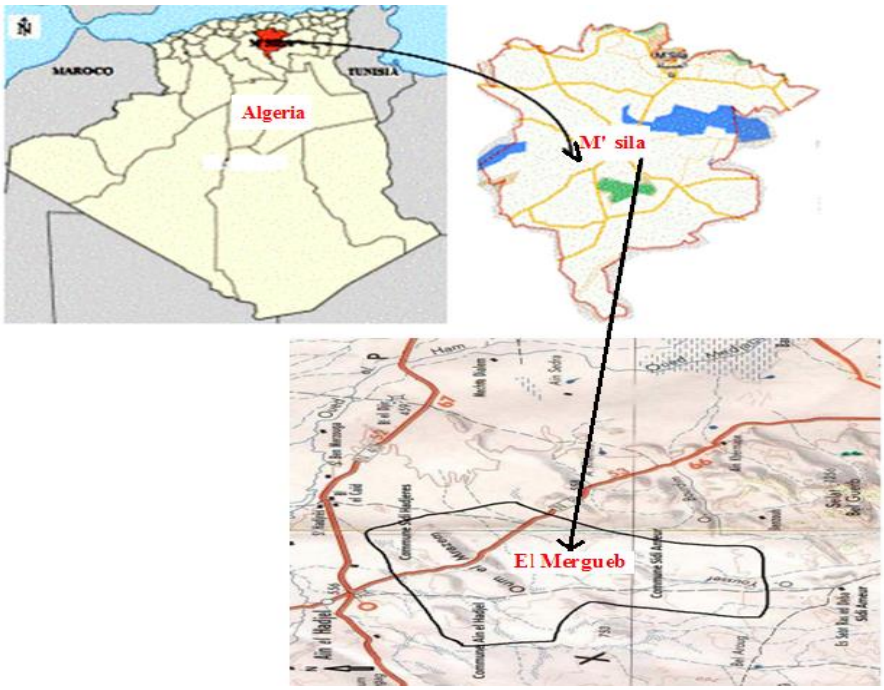

Figure 1. *Geographical location of El Mergueb nature reserve (Algeria)*

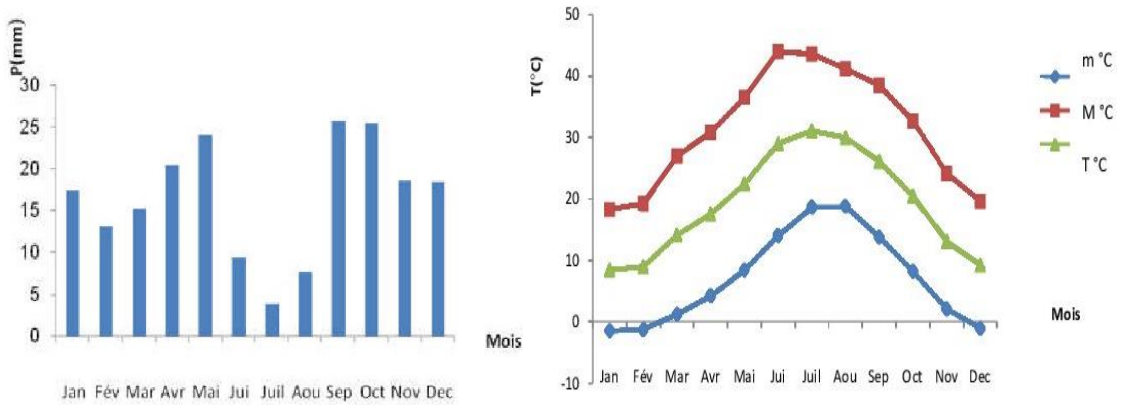

Figure 2. *Average rainfall and temperature in M'Sila, Algeria (Merniz et al., 2018)*

Data analysis

Data obtained were spread on an Excel spreadsheet and statistically analyzed (age, gender, education level, Origin of ethnobotanical knowledge, various proportions like plant families, plant parts used, methods of use). The particular use of use value (UV) is

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to determine the relative significance of the local species. UV was calculated using *Equation 1*.

$$UV = \Sigma Ui/N \quad \text{(Eq.1)}$$

where Ui: number of uses reports per species, and N: total number of informants (Trotter and Logan, 1986). It demonstrates the relative importance of plants known locally (Ouelbani et al., 2016).

Section A: *Questions about the informant: sex, age, level of education, origin of ethnobotanical knowledge.*

Variables	**Categories**
Gender	Female Male
Age	[20years-35years] [36years-50years] [51years-60years] >60years
Educational level	Illiterate Primary College Secondary University
Origin of ethnobotanical knowledge	Family knowledge Herbalist Scientific research

Section B: *Questions concerning the medicinal plant: uses of the medicinal plant, the part of the plant used, the pathology treated.*

Plant name		Part used	Mode of use	Therapeutic property	Spontaneous/ cultivated/ Toxicity
Scientific name	Vernacular name				

Figure 3. *Questionnaire card of survey*

Results and discussion

Demographic features of the informants

For all interviewers, gender, age, profession, and background information were recorded. According to *Table 1*, the local informants (n = 182) comprised 69% women and 31% men were interviewed. This result is in agreement with the studies of Ramdane et al. (2015), Miara et al. (2018) and Bouafia et al. (2021) who found that the majority of informants were women with the percentage of 63%, 56% and 57.14%, respectively when the authors compared medicinal plant knowledge held by males and females. This could be due to women's greater knowledge of medicinal plants and the ease with which they can share this knowledge.

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The age group that formed the majority of informants was the 51 years-60 years age group contributing 37%, followed by the 36 years-50 years and informants over 60 years (*Table 1*). The percentage of medicinal plant users older than 60 years old is similar to that found by Alalwan et al. (2019) where the most respondents were adults between the ages of 40 years –60 years (62.5%) followed by (27.5%) in the age group of above 60 years. The highest age respondents provide more reliable information because they hold much of the ancestral knowledge that is part of the oral tradition. The least participative age group was the 20 years-35 years which had 9% (*Table 1*). The reason for lack of interest on medicinal plants within this age group could be explained by the mistrust of certain young people, who tend not to believe this herbal medicine due to the influence of modernization and exotic culture influence.

Table 1. *Demographic profile of informants interviewed (N = 182)*

Variables	Categories	Total	Percentage (%)
Gender	Women	126	69%
	Men	56	31%
Age	[20 years-35 years]	17	9%
	[36 years-50 years]	51	28%
	[51 years-60 years]	67	37%
	>60years	47	26%
Educational level	Illiterate	15	30%
	Primary	24	13%
	College	31	17%
	Secondary	38	19%
	University	74	21%
Origin of ethnobotanical knowledge	Family knowledge	118	65%
	Herbalist	37	20%
	Scientific research.	27	15%

Users of medicinal herbs with no educational background accounted for 30% of the total (*Table 1*), while those with a university education accounted for 21%. Those with only a primary, middle, or secondary education account for 13%, 17%, and 19% of the population, respectively. Traditional knowledge of the use of plants for medical purposes, or the interchange of information and development of herbal medicine production, might explain these findings. Boughrara and Belgacem (2016) found that the illiteracy rate was 33% among users of medicinal plants and the percentage of people who have a university level of study is 21.33%. These results are quite similar to ours. The majority of ethnobotanical knowledge came from family, with 65 percent being passed down through generations. The rest were herbalists (20%) and scientific research (15%). Our findings are consistent with those previously reported by Eddouks et al. (2017) and Chaachouay et al. (2019) who found that heritage is the primary source of knowledge acquisition for residents, accounting for approximately 45 percent of all knowledge acquisition in Morocco.

Diversity of medicinal plants

The research area's floristic diversity, as well as a renewed interest in phytotherapy encouraged us to identify the therapeutic plants of El Mergueb Natural Reserve. An

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
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ethnobotanical survey and analysis of the flora of the research region were conducted in this area. A total of 46 taxa belonging to 23 different families were recorded (*Table 2*). All of the species mentioned are spontaneous, according to the flora of Algeria (Quézel and Santa, 1962b), with the exception of the following species *Pinus halepensis* Mill., *Pistacia atlantica* Desf., *Pistacia lentiscus* L., *Nerium oleander* L., *Juniperus phoenicea* L., *Eucalyptus globulus* Labill., *Avena sativa* L., *Hordeum vulgare* L., *Triticum vulgare* L. and *Populus nigra* L. which are cultivated. As illustrated in *Figure 4*, the most represented families were Asteraceae with 9 medicinal plant species, followed by Poaceae (6 species) and Lamiaceae (4 species). Our findings are similar with those of Hammiche and Maiza (2006) who found that among 33 families listed, Asteraceae, with 12 species (15%), are the most common. This high proportion could be explained by the high representation of these families in El Mergueb Natural Reserve flora because of the ecological factors that favour the development and adaptation of the majority of their species. According to Habib et al. (2020), Asteraceae, Poaceae and Brassicaceae characterize the arid and semi-arid areas in the Mediterranean regions. In Algeria, some studies highlighted the dominance of Asteraceae, Poaceae and Fabaceae in the steppe regions (Kazi Tani et al., 2010). This was also reported in Morocco by Fennane (2008).

As seen in *Figure 5* species with high used values (UV) were *Artemisia herba-alba* Asso (0.58), *Stipa tenacissima* L. (0.42), *Artemisia campestris* L. (0.3), *Zyziphus lotus* (UV = 0.16), *Marrubium vulgare* L. *(*UV = 0.14). This means that these species are the most important medicinal plants used in folk medicine by the population of El Mergueb to treat ailments, which might be due to their vast distribution in the area study. *Artemisia herba-alba* was named the first specie in others studies (Katiri et al., 2017; Nawash et al., 2013). In Algerian traditional medicine, *Artimisia herba-alba* is one of the most commonly utilized herbs. This plant is used to cure gastrointestinal problems including diarrhea and abdominal discomfort, as well as to heal exterior wounds (Khennouf et al., 2010; Boudjelal et al., 2013; Miara et al., 2018), diabetes (Bouasla and Bouasla, 2017), cancer, and respiratory system diseases (Ouelbani et al., 2016). The second most plant cited is *Stipa tenacissima* which is recommended as a hypoglycemic and in the treatment of persistent scalp ulcers, cleaning the ashes. *Artemisia campestris* is used for digestive disorders, stomach discomfort, nausea, and menstrual cramps. vulnerary, anti-hemorrhagic poultice whereas, *Zyziphus lotus* is used to treat anti-inflammatory diseases (Benderradji et al., 2014). *Marrubium vulgare* is utilized for diabetes therapy, digestive problems, stomach pain, fever, migraine, wound, cardiovascular diseases, respiratory and liver diseases, allergies, leishmaniose, febrifuge, vermifuge, anti-emetic, tonic, analgesic, antispasmodic (Miara et al., 2019).

Locals are aware of the dangers of poisonous plants and use extreme caution while utilizing plants such as *Thapsia garganica* L. (Mohamed Ibrahim et al., 2018), *Nerium oleander* L. (Aslani et al., 2004), *Colocynthis vulgaris* L. (Adam Sakine et al., 2011), *Retama retam* Webb. (Algandaby, 2015), *Asparagus stipularis* L., *Thymelaea hirsute* L., *Peganum harmala* L. (Nenaah, 2011). Toxicity of therapeutic plants can be attributed to their active chemical combinations, interactions with other herbs and medicines, or intrinsic toxicity. Plants contain complex combinations of terpenes, alkaloids, saponins, and other compounds, which increases the potential of unpleasant responses to any of them or the cumulative or synergistic effects of chemical interactions (Saad et al., 2006).

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Table 2. *Medicinal flora of El Mergueb natural reserve*

Family/scientific name	Vernacular name	Part used	Mode of use	Therapeutic property	UV
Abietaceae *Pinus halepensis* Mill.	Essanaoubar alhalabi	Seeds	Cataplasm	Respiratory diseases, rheumatic diseases, hemorrhoids	0.04
Anacardiaceae *Pistacia atlantica* Desf.	Elbatma	Leaves, fruits,roots	Infusion, decoction	Digestive diseases, respiratory diseases, eye diseases, antitussive, antipyretic	0.13
Pistacia lentiscus L.	Edharou	Leaves, fruits, roots	Infusion, decoction	Antiseptic, expectorant, diuretic	0.05
Piaceae *Bunium mauritanicum* L.	Talghouda	Fruits	Powder, decoction	Intestinal gas, thrombosis, worms	0.02
Thapsia garganica L.	Bounafaa	Aerial parts, roots	Cataplasm, decoction	Rheumatic pain, bronchitis, sprains	0.03
Pituranthos chloranthus L.	Elkezzih	Leaves, flowers	Infusion	Indigestion, abdominal pain	0.02
Apocynaceae *Nerium oleander* L.	Eddafla	Aerial parts	Fumigation, powder	Respiratory disease, heart disease, bone pain, eczema	0.10
Asteraceae *Anthemis arvensis* L.	Elbabounedj	Flowers	Decoction	Abdominal pain, Menstruation pain, urinary tract infections	0.03
Anvillea radiata L.	Ennakd	Aerial parts	Infusion	Abdominal pain, female genital infections	0.02
Artemisia absinthium L.	Chadjeret Meriem	Leaves, flowers	Decoction	Digestive disorders gastric ulcer, deworming	0.03
Artemisia campestris L.	Ettgouft	Leaves	Infusion, powder, cataplasm	Digestive disorders, menstruation pain, antihemorrhagic, snake bites	0.3
Artemisia herba- alba Asso.	Echih	Aerial parts, roots	Infusion, decoction, powder, cataplasm	Gastric ulcer, anti-diarrheic, anti-spasmodic, indigestions, deworming	0.58
Inula viscose L.	Amegraman	Leaves	Powder and Cataplasm	Rheumatic pain, anti-septic healing fractures, deworming	0.04
Scolymus hispanicus L.	Garnina	Leaves	Decoction	Liver and bowel diseases	0.04
Scorzonera laciniata L.	Talma	Leaves, roots	Infusion	Abdominal pain, intestinal gas	0.02
Scorzoneraun dulate L	Uizg	Aerial parts, roots	Infusion	Against snakebites	0.02
Cactaceae *Opuntia ficus-indica* L	Elhendi	Petals, stem, fruits	Cataplasm	Antiteigne, against dermatosis	0.03
Chenopodiaceae *Atriplex halimus* L.	Elgtaf	Leaves, fruits	Decoction	Dry wounds, diuretic	0.03
Anabasis articulata (Forssk.) Moq	Eladjrem	Aerial parts	Plaster Infusion	Antidiabetic	0.04
Arthrophytum scoparium L.	Erramth	Aerial parts	Decoction, cataplasm	Indigestion, stings of scorpion, dermatoses	0.03
Cucurbitaceae *Colocynthis vulgaris* L.	ElHadj	Fruits	Decoction, pomade	Rheumatic pain, against hepatitis	0.06
Cupressaceae *Juniperus phoenicea* L.	Elaraar	Aerial parts	Infusion	Antiparasitic, antiseptic, eczema, abdominal pain	0.03
Fabaceae *Retama raetam* Webb.	Ertem	Aerial parts	Infusion	Healing, against eye irritation, anti-diarrhea, abdominal pain, antirheumatic	0.04
Medicago minima L.	Elhaska	Fruits, leaves	Powder, decoction	Mouth and bladder diseases	0.02
Globulariaceae *Globularia alypum* L.	Tassalgha	Aerial parts	Infusion, powder	Anti-gastralgic, against wounds, menstruation pain	0.02
Lamiaceae *Ajuga iva* L.	Chandgoura	Aerial parts	Infusion	Antiseptic, antirheumatic, regulation of the menstrual cycle	0.03

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Marrubium vulgare L.	Timriout	Leaves	Infusion, decoction	Expectorant, Diuretic, antiseptic	0.14
Mentha pulegium L.	Elfliou	Aerial parts	Decoction	Against sunburn, allergy of the nose	0.03
Teucrium polium L.	Eljaada	Aerial parts	Infusion	Hypoglycemic, abdominal pain, colic, stomach ulcer	0.05
Lilaceae *Asparagus stipularis* L.	Ain Eddib	Aerial parts	Decoction	Antispasmodic, analgesic, sedative, emollient	0.04
Asphodelus microcarpus L.	Elborouag	Leaves	Decoction Cataplasm	Diuretic, antirheumatic.	0.02
Malvaceae *Malva parviflora* L.	Elkhobiz	Aerial parts, roots	Infusion	Antiseptic, constipation, hemorrhoids, headaches	0.04
Myrtaceae *Eucalyptus globulus* Labill.	Elkalitous	Leaves	Fumigation	Anti-infectious, antiseptic, asthma	0.05
Oleacea *Olea europaea* L.	Azzaitoun	Leaves, fruits, oil	Infusion	Diuretic, hyperglycemia, hypertension	0.07
Papaveraceae *Papaver rhoeas* L.	Ben Naman	Flowers	Infusion	Eczema, migraines, digestive disorders, inflammation of the bladder	0.03
Poaceae *Avena stiva* L.	Khourtal	Seeds	Powder	Diabetes, liver abscesses, diuretic	0.03
Hordeum vulgare L.	Echair	Seeds	Powder	Kidney stones, diabetes, stomach ache, rheumatism	0.02
Stipa tenacissima L.	Elhalfa	Leaves	Infusion	Chronic scalp ulcers, diabetes	0.42
Stipa capensis L.	Essameaa	Leaves	Infusion	Digestive problems antiseptic	0.03
Triticum repens L.	Ennajm	Rhizome	Decoction	Abdominal pain, liver and rat diseases, vomiting	0.02
Triticum vulgare L.	Elkamh	Seeds	Powder	Asthenia	0.03
Triticum aestivum L.	Elkamh	Seeds	Powder	Anemia, convalescence, stomach pain	0.03
Rhamnaceae *Zizyphus lotus* L.	Essidra	Leaves, fruits,roots	Decoction	Sedative, diuretic	0.16
Salicaceae *Populus nigra* L.	Essafsaf	Aerial parts, roots	Decoction, powder	Respiratory pathology, urinary tract pathology	0.02
Tamaricaceae *Tamarix aphylla* L.	Etarfa	Leaves twigs	Decoction	Fungicide, digestive problem	0.04
Thymeliaceae *Thymelaea hirsute* L.	Elmathnan	Leaves	Infusion	Kidney stones, laxative	0.03
Zygophyllaceae *Peganum harmala* L.	Elharmel	Aerial parts	Decoction pomade, fumigation	Digestive problems antirheumatic, fever	0.05

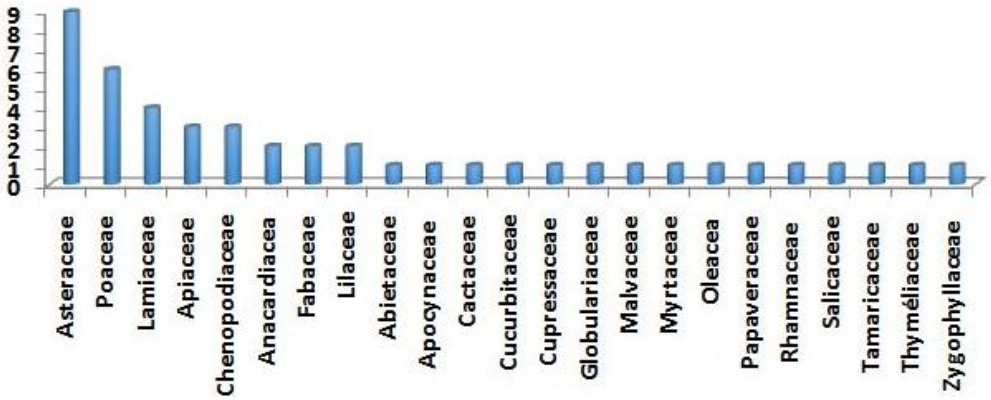

Figure 4. *Number of total species per botanical family*

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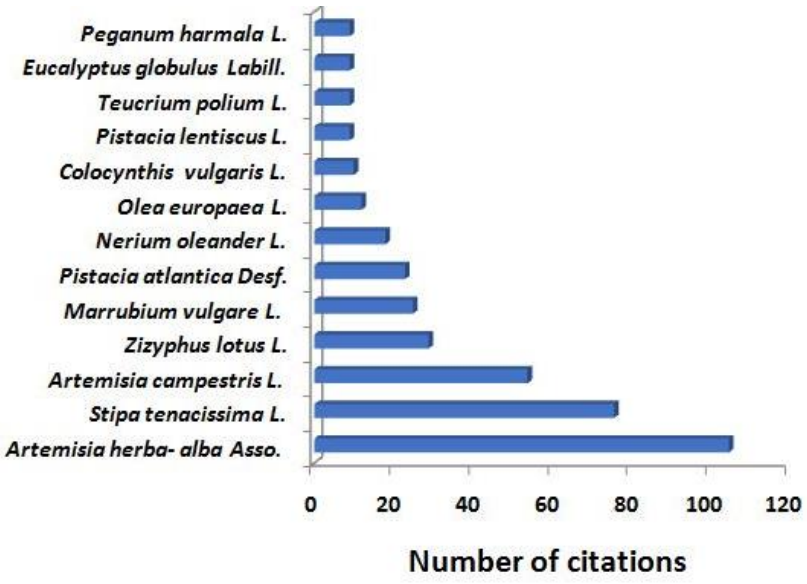

Figure 5. *The most commonly cited medicinal plants of the study area*

Preparation methods

Several medicinal plants preparation methods are used in traditional medicine to fight the different kind of ailments such as decoction, infusion, grinding, maceration, powder and cataplasm. Data analysis showed that infusion is the most common preparation method used by the population studied (42.6%), followed by decoction (27.4%), powder (13%), cataplasm 10%, fumigation (4.4%), pomade (1.6%), and plaster (1%) (*Fig. 6*). This result agrees with findings of previous studies. Demi Rci and Özhatay (2012) reported that the infusion is generally the preparation method of choice, accounting for 41.8% of the recorded species, followed by decoction (23.9%). However, Chaachouay et al. (2019) found that the percentage of infusion was 53.9% followed by decoction (22.1%). It seems to us that decoction and infusion in water are the most widely used methods given the ease of their preparation and administration by users, as it was similarly mentioned in other studies (Hammiche and Maiza, 2006; Benítez et al., 2010; Boudjelal et al., 2013; Fakchich and Elachouri, 2014; Sargin et al., 2015).

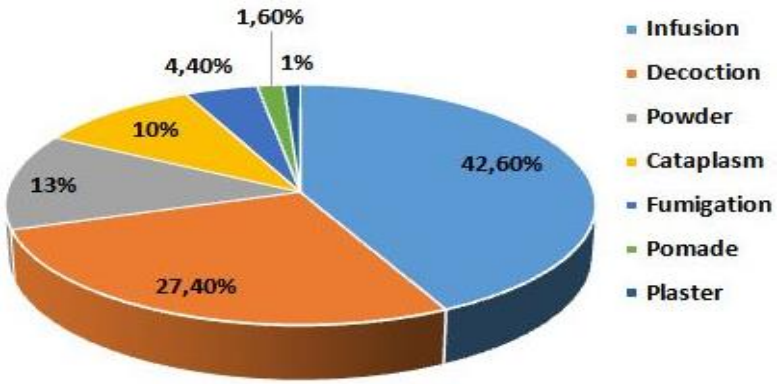

Figure 6. *Modes of preparation*

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Parts of the medicinal plants used

Almost all different parts of plants were reported to be used as a drug by the traditional healers and local people, but leaves were the most common (39.6%) (*Fig. 7*), followed by the aerial part (25.6%), roots (17.4%%), fruits (7.3%), seeds (4%), flowers (2.5%), oil (1.2%), twigs (1%), rhizome (0.5%), petals (0.5%) and 0.2% for stems. This result is consistent with other studies that have shown that leaves are the most preferred part of plant for the preparation of remedies. Miara et al. (2018) indicated that the leaves are the plant part most commonly used as herbal remedies (29%). Unspecified aerial parts are also often used (17%), as well as fruits and seeds (12 and 11% respectively). This result might be explained by the fact that leaves are the most commonly utilized since they are readily available. It was also shown that the respondents had a strong preference for utilizing leaves to identify and differentiate therapeutic plants. As a result, if the leaf is a crucial component in plant identification and has frequent and simple access, it should be employed more than other plant parts. This conclusion is in line with the results of Akerreta et al. (2007). Despite, it has been well established that all parts of the plants are rich in active compounds, the local population most often uses leaves in their preparations, which could be explained by the fact that the totality of the knowledge acquired by the population of the region is traditional and transmitted empirically from one generation to the next. In addition, the leaves are very abundant and their harvest is very easy (Sargin et al., 2015; Yemele et al., 2015). Furthermore, since the leaves are main photosynthetic organ of plants, bioactive phytochemicals are concentrated in the leaves (Benarba et al., 2015).

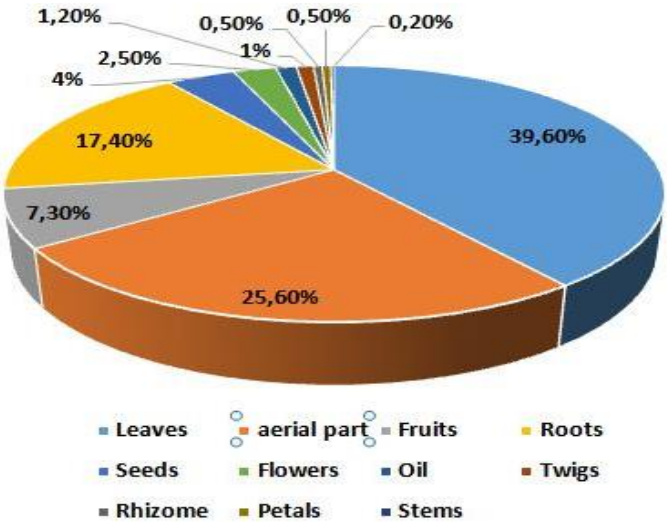

Figure 7. *Distribution of the parts of the plant used*

Conclusion

The ethnobotanical survey revealed that the study area has a great biodiversity with a variety of medicinal plants and still needs more exploration. This floral richness indicates the high potential of traditional knowledge for the development of natural derived products as affordable medicines. In our ethnobotanical study conducted in the El Mergueb reserve in M’sila, we obtained an interesting dataset, including the traditional medicinal use of 46 species belonging to 23 botanical families. Asteraceae and Poaceae were the most widely

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used and important families. Plants with high UV should be studied in order to isolate the bioactive compounds and validate their popular uses. Some of the plants reported in this study were well known phytochemically, pharmacologically, and clinically. Thus, they can be used for the medical or pharmaceutical purposes. Additionally, the traditional and folkloric knowledge for using medicinal plants in this area can help to discover the potential plants for specific health problems.

Acknowledgements. The authors express their gratitude to the Algerian Ministry of Higher Education and Scientific Research (MESRS) and the General Directorate of Scientific Research and Technological Development (DGRSDT) for supporting this research study.

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