Consensus Level and Knowledge of Spontaneous Medicinal Plants Used in Algerian Central Steppe Region (Djelfa)

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Summary

Ethnobotanical studies gather pure information that can be used to support scientific research. Traditional remedies are considered as an alternative tool to chemical treatments in health care. This study aims to investigate the knowledge of spontaneous medicinal plant used by healers and elderly people. Moreover, it focuses on consensus level estimation of used medicinal plants. An exhaustive survey was carried out in the region of Djelfa in Algeria. The information was gathered from 43 informants who responded to structured questionnaire. Survey data were quantitatively characterized by five indices, namely; relative frequency citation, medicinal use-value, family use-value, informant consensus factor and fidelity level. In the current study, 51 species belonging to 28 botanical families were recorded and 185 uses and 58 diseases were described as well. Most recipes used a single species; however, some preparations were used as a species mixture. This specific preparation is called "Djor yebrir" and it was used as a curative treatment. The most represented families were the *Asteraceae, Lamiaceae, Cupressaceae* and *Poaceae*. The most cited species were *Artemisia campestris* L., *Juniperus phoeniceae* L., *Teucrium polium* L., *Marrubium deserti* (Noë) Coss., A*rtemisia herba alba* Asso., *Ruta montana* (L.) L. and *Saccocalyx satureioides* Coss. et Durieu. These species were mentioned to treat mainly digestive system diseases and signs and ill-defined morbid states which showed the highest consensus level. This study reveals that traditional remedies are still used in this region. This information showed the abundance of medicinal plants and the ethnobotanical knowledge in the studied region which need to be preserved, so phytochemical and biological screenings are more than needed.

Key words

consensus level, medicinal plants, survey, Djor yebrir, diseases

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Introduction

Herbal medicine is the treatment of diseases by fresh or dried plants as well as by their natural extracts (Delaveau et al., 1985). Herbal medicine presents one of the aspects of man's behavior towards plants and the knowledge of this behavior is, in general, ethnobotany. According to Vergiat (1970), this term is reserved for the knowledge of the various jobs that men created of this or that species in the exercise of their daily life. The ethnobotanical prospecting of medicinal plants allows identifying empirical knowledge in the field of phytotherapy which can help science by facilitating the task of researchers in the field of medicine (time saving). Girre (1980) reported that the discovery of the antimitotic action of ellipticine had taken several years of chemical screening studies. It is noted that the first ellipticine was isolated from Ochrosia; the natives of the Maluku Islands traditionally used *Ochrosia oppostifolia* (Lam.) K. Schum. (Apocynaceae) latex to assuage both "tumescence" of the nose and the face. It seems very useful to benefit from this empirical knowledge, reported by ethnobotanical studies, instead of wasting time and money to discover a therapeutic substance (chemical screening) that can be found naturally in plants with minor side effects (Dar et al., 2017). Thus, traditional herbal medicine still has an important place in the modern-day drug industries (Dar et al., 2017).

The exploitation of medicinal plants shows the value which was attributed to this or that plant only by their curative use. This term includes the answer to several questions that deal with the disease treated by a particular plant, the plant part used in the preparation of the plant drug which is responsible for a therapeutic action. Empirical information constitutes the results of very long experiences dealing with plants uses. However, this information differs from region to another and between people. This is due to the knowledge transfer manner between informants who are traditional healers, herbalists and patients. Therefore, the therapeutic use efficiency could be verified by the repetition of the treatments by several informants (Cheikhyoussef et al., 2011). Quantitative data analysis is a valuable approach to recognize the most likely pharmacological plants (Andrade-Cetto and Heinrich, 2011). The quantitative useful tools were factor of informant consensus, fidelity level, use-value and relative importance (Andrade-Cetto and Heinrich, 2011). Several studies were carried out in Algeria describing therapeutic uses and medicinal plants used in different regions (Aicha et al., 2017; Bouasla and Bouasla, 2017; Boudjelal et al., 2013; Boughrara and Belgacem, 2016; Bouredja et al., 2017; Chermat, 2016; Hamza et al., 2019; Miara et al., 2018; Sarri et al., 2014; Yabrir et al., 2018). The use of medicinal plants for the treatment of common diseases in the region of Djelfa has been known for a long time and it is still being practiced in the daily life of the local population. Nomadism and transhumance were the lifestyle of the local population, forcing people sometimes to find themselves far from health centers, and therefore being obliged to use the properties of the existing flora. The people of this region have become accustomed to feed livestock from the rangelands, which have aroused an important interest due to plants nutritional, energetic or curative value. This region is characterized by bioclimatic variability (aridity gradient) and a specific vegetation cover characterized by the presence of some plants with medicinal properties. These plants can be beneficial to the local population, especially in the case of pain relief or healing of diseases. The exploration of plant therapeutic uses is more than necessary. The study of Yabrir et al., (2018) was carried out in an extreme environment (dune cordon) in Djelfa region, which constitute a small part of this vast territory that needs to be more investigated. Therefore, the current study aimed to explore and evaluate the importance and consensus level of medicinal plants and to register the most cited medicinal plants, diseases and diseases category in this region.

Material and Methods

Studied area

The studied area is located in Djelfa province of Algeria. It is situated between 2° and 5° east longitude and between 33° and 35° north latitude (Fig. 1). It covers a total area of 32,280.41 km² representing 1.36% of the total area of Algeria. The altitude varies from 1613 m in the east to 150 m in the extreme south. The climate of the region is the Mediterranean type, characterized by a dry and hot summer season, alternating with a rainy or cold winter season. The rainfall regime is marked by low rainfall with high intra-annual and inter-annual variability and a spatial variation in annual rainfall. The thermal regime is characterized by low temperatures and frequent frost in winter, heat and dry winds in summer.

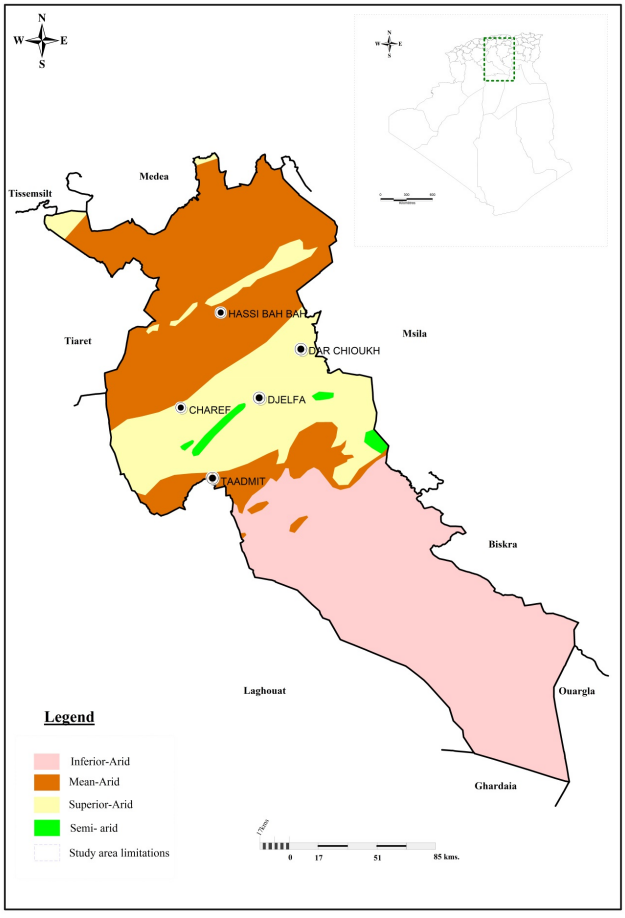

Figure 1. Localization of studied region: Colors in legend indicate the bioclimatic stages; pink: Inferior-Arid, brown: Mean-Arid, yellow: Superior-Arid and green: Semi-Arid

The relief of the studied region varies from mountain, highland and dune cord. The mountainous massifs were predominantly covered with tree and /or shrub formations of Aleppo pine (*Pinus halepensis* Mill.) and Phoenician juniper (*Juniperus phoenicea* L.), the essential vegetal landscape of the territory consists of steppe formations (Kaabache, 1990).

Survey and Data Collection

The survey was conducted from January to June 2019 among elderly people and herbalists through direct contact. The healers and the elderly in this region have more knowledge and experience than others. They suffered from difficult living conditions during colonialism in which there were no medications and hospitals at all or not enough. Therefore, the collected information from these people is very precious and more credible because they represent the results of several repetitions over time. Altogether, 43 participants were interviewed in the five localities (Djelfa, Hassi Bahbah, Taadmit, Dar chioukh and Charef) with various numbers (13, 10, 5, 6 and 9 participants respectively). Most informants were indigenous people (IP) who used or had used a medicinal plant as a treatment for various diseases (88.33%), while herbalists (HR) and traditional healers (TH) represented only 11.67%. Furthermore, the traditional healer showed an experience of more than 15 years in the field (Fig. 2). Surveyed men were more dominant (76.74%) than women (23.26%). The educational background is mainly characterized by illiterate informants (81.40%), the others showed different educational level (from elementary to university) (Fig. 2). The survey was conducted within aged people; only 16 % of informants were between 35 to 50 years old, the rest were more than 50 years old (84%). The survey focused on issues related to the medicinal plant, treated disease, the used part of the plant, the method of preparation and the dose and duration of treatment. Our exhaustive survey was conducted in the central part of the region characterized by three bioclimatic zones: semi-arid, arid and hyper-arid. Consequently, five localities were chosen belonging to these three different bioclimatic zones: Djelfa (semi-arid), Hassi Bahbah, Taadmit, (mean-arid), Dar chioukh, Charef (Superior-arid) (Fig. 1). The participants in the survey responded to a structured questionnaire related to the medicinal plant using the free listing method (Vitasović Kosić et al., 2017). The survey form was presented as a table written in French and translated into Arabic to facilitate our investigation task.

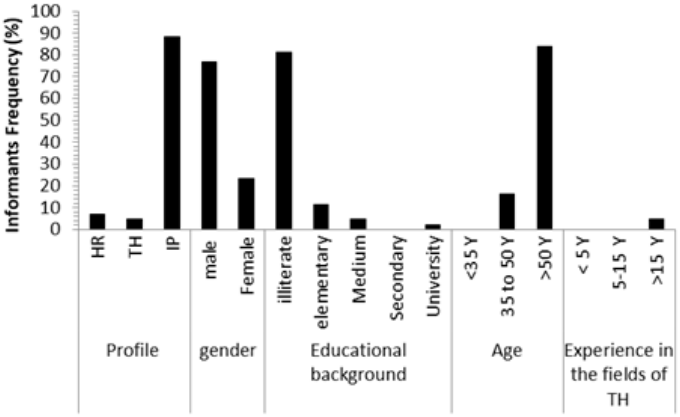

Figure 2. Informants' demographic information

During the survey, all plants that do not grow spontaneously in the area (spices, food plants, introduced plants, etc.) were excluded. The gathered information during the data collection phase allowed us to identify plants with vernacular names, which required species collection and identification. The specimen collection was conducted within the study area, with the help of the rural people knowing the vernacular names. After the specimen collection, the species identification was carried out by consulting botanists and the use of the following botanical literature and identification keys: Beniston (1984); Boukef (1986); Ozenda (1977) and Quezel and Santa (1962). The identification was verified and taxonomy follows the Plant List (TPL, 2013). Voucher specimens were deposited in the herbarium of the Agricultural Department of Ziane Achour University, Djelfa, Algeria.

Data Analysis

Collected data from the survey were quantitatively characterized by five indices, which are Relative Frequency Citation (RFC), Medicinal Use-Value (MUV), Family Use-Value (FUV), Informant Consensus Factor (ICF) and Fidelity Level (FL).

Relative Frequency Citation (RFC)

The Relative Frequency Citation varies from 0 (when nobody refers to the plant as useful) to 1 (in the unlikely case that all the informants would mention the use of the species) and does not consider the use-category (Tardío and Pardo-De-Santayana, 2008). It measures the plants that were the most frequently mentioned as useful (Medeiros et al., 2011). Therefore, it could estimate the importance of each species in the local pharmacopeia.

Use Value

Use Value was evaluated by two indices, the Medicinal Use-Value (MUV) and the Family Use-Value (FUV) which characterizes the importance of each species and each family respectively. It was calculated using the following formula:

$$UV = \sum U / n$$

where U = number of citations per species; n = number of informants (Trotter and Logan, 1986).

Informant Consensus Factor (ICF)

It is one of the three categories in the quantitative approaches for analyzing informants' knowledge (Phillips and Gentry, 1993). In the informant consensus method, the relative importance of each use is calculated directly from the degree of consensus in informants' responses (Phillips, 1996). According to Medeiros et al., (2011), this factor indicates how homogenous the ethnobotanical information is. ICF was developed by Trotter and Logan, (1986) and subsequently readapted by (Heinrich et al., 1998) to recognize medicinal plants that might be useful. It provides a range of 0 to 1, where a high value suggests that a large proportion of the healers use relatively few taxa (usually species), whereas a low value indicates that the informants disagree with the taxa to be used in a category of disease care (Heinrich, 2000).

The ICF was calculated by the following formula:

$$ICF = (Nur - Nt) / (Nur - 1)$$

where:

Nur = number of citations for each category,

Nt = number of species for that category (Trotter and Logan, 1986).

ICF values range from 0 to 1.

The diseases were classified using several categories that were cited by the ethnobotanical database PHARMEL on African medicinal plants (Adjnohbun et al., 1989): (DNSSO) Diseases of the Nervous System and Sense Organs (migraine, otitis and otalgia, ear flow; (MD) Mental Disorders (anguish, anxiety); (DD) Dermatological Diseases (skin diseases and eczema); (DDS) Diseases of the Digestive System (stomach pain, abdominal pain, toothache, diarrhea, dyspepsia, swelling of the gall bladder, aerocoly, colic, constipation, swelling of the abdomen, hydatid cyst, stomach ulcer, small intestine); (TLP) Traumatic Lesions and Poisoning (lead poisoning, injuries, burns, stings of snakes and venomous insects); (SIMS) Signs and Ill-defined Morbid States (nausea, fever, headache, cough, icterus (jaundice), anorexia, insomnia, back pain, children's diseases (Rekia)); (UGOD) Urogenital Organs Disease (female sterility, dysuria, renal lithiasis, urinary system diseases, biliary lithiasis, lithiasis of the bladder, kidney diseases, enuresis and urethritis); (DRS) Diseases of the Respiratory System (cold, angina, pulmonary diseases, asthma and pharyngitis); (DCS) Diseases of the Circulatory System (hypertension, hypotension, obstruction of the veins and purification of blood); (ENMID) Endocrine, Nutritional, Metabolic and Immune Disorders (Diabetes); (IPD) Infectious and Parasitic Diseases (ascariasis, intestinal parasites, wart, measles, gales, mycosis of face, mycosis, boils (furuncle), influenza of children (Melkika)); (DOMCT) Diseases of the Osteo-articular System, Muscles and Connective Tissues (rheumatism, joint pain and fatigue).

Fidelity Level (FL)

Fidelity level is used to quantify the percentage of informants claiming the use of a certain plant for the same major purpose (Medeiros et al., 2011). It is generally used to determine the relative healing potential of each medicinal plant against a particular ailment (Kankara et al., 2015).and was calculated using the following formula:

$$FL = Ip/Iu$$

where:

Ip refers to the number of citation of the species for each category,

Iu refers to the number of citation of the species for all categories (Ugulu, 2012).

Results

Therapeutic Uses of Medicinal Plants

The survey inventories 51 species belonging to 28 botanical families (Table 1). Furthermore, 185 traditional uses and 58 diseases were recorded. The number of uses varies among species and between families. The family *Rutaceae* counts a single species with 9 uses that treats 7 diseases (Figure 3 (A and C)). However, within the *Lamiaceae* family, 7 species were identified to treat 15 diseases according to 37 uses (Figure 3 (A and C)). Moreover, the *Asparagaceae* family counts one species that treats a single disease with one traditional use (Figure 3 (A and C)).

Most of the traditional uses have an internal application which can be explained by the specificity of certain botanical families to treat internal diseases without any danger. However, external application is less known than internal application probably due to the limited number of external diseases (wounds, burns, ... etc.). A few families were cited to treat internal and external diseases; it concerns only two botanical families: *Rhamnaceae* and *Lamiaceae* (Fig. 3C).

Regarding the species number per family, the *Asteraceae* family is the most represented, followed by *Lamiaceae* and *Poaceae, Apiaceae, Cucurbitaceae*, (Table 1 and Fig. 3B). All parts of the plant are mentioned, as the aerial part, roots, young twigs, resins, leaves, flowers, inflorescences, fruits and seeds (Table1). Some families treat a large number of diseases probably due to the capacity of these plants to have several active ingredients. However, other families present an action on a well-defined category of disease; it can probably be due to the presence of an appropriate active principle (Figure 3D).

Medicinal Tea

Most of traditional uses utilized a single species; however, some preparations were used as a species mixture. It is called precisely in our region "DJOR YEBRIR" or "ADJOUAR" as decoction of a mixture of medicinal plants harvested in the spring. This mixture includes only beneficial and non-toxic plants. It is used as a preventive or curative treatment. It is recommended against several diseases such as: diarrhea, flu, colds, abdominal pain, stomach pains as well as an antiseptic after postpartum. The mixture includes species without bitter taste, namely: *Juniperus phoenicea* L., *Artemisia herba alba* Asso., *Artemisia campestris* L., *Ajuga iva* (L.) Schreb., *Ruta montana* (L.) L., *Thymus algeriensis* Boiss. & Reut., *Rosmarinus tournfortii* (Noë ex Jord. & Fourr.) Jahand. & Maire, *Pinus halepensis* Mill., *Ziziphora hispanica* L. and *Pistacia lentiscus* L., etc. The number of species is not limited; it depends on their availability. Furthermore, there exist other medicinal plant mixtures that treat certain diseases. Each mixture is composed of a main plant mixed with other secondary plants. The latter are probably used to improve the taste and sometimes the smell of the preparation.

Ethnobotanical Indices Analysis

Relative Frequency Citation (RFC)

In our study, this index varied from 0.02 to 0.84 (Table 1). The two most cited species were *Artemisia campestris* (0.84) and *Juniperus phoeniceae* (0.84), followed by *Teucrium polium* L. (0.72), *Marrubium deserti* (Noë) Coss. (0.72), *Artemisia herba alba* (0.67), *Ruta montana* (0.60) and *Saccocalyx satureioides* Coss. et Durieu (0.53). The two first species were mainly used to treat digestive systems diseases.

Table 1. Therapeutic uses of medicinal plants: The mode of preparation and the used part of each recipe are respectively indicated by a number followed by a letter in the subscript of therapeutic use column

Botanical family	Species	Used part	Therapeutic use	Mode of preparation	RFC
Asteraceae	*Artemisia campestris* L.	Aerial part	Fever[1], Diarrhea[1,2], Stings of snakes[2]	Decoction (1), Powder (2)	0,84
	Artemisia herba alba Asso.	Aerial part and inflorescences	Swelling of the gall bladder[1], Intestinal parasites[1], Aerocoly[2], Anxiety[1]	Decoction (1), Maceration (2)	0,67
	Anacyclus cyrtolepidioides Pomel.	Leaves	Stomach pain	Decoction	0,12
	Onopordum arenarium (Desf.) Pomel	Roots	Dental pain	Cataplasme	0,02
	Artemisia absinthium L.	Aerial part (a), Leaves (b)	Female sterility[1a], Lead poisoning[2b]	Decoction (1), Infusion (2) (with care)	0,05
	Anacyclus clavatus (Desf.) Pers.	Flower (a), Aerial part (b)	Anxiety[2a], Urethritis[1a], Renal diseases[1a], Aerocoly[1b]	Decoction (1), Infusion (2)	0,09
	Cotula cinerea Delile	Leaves	Hypertension[1,2], Obstruction of the veins[1]	Decoction (1), Powder (2)	0,07
	Anvillea radiata Coss. & Durieu	Leaves	Abdominal pain[1,2], Diarrhea1, Stings of snakes and venomous insects[1]	Decoction (1), powder (2)	0,07
	Sonchus oleraceus (L.) L.	Leaves	Rheumatism[1,2]	Plant bath (1), Cataplasme(2)	0,05
Lamiaceae	*Saccocalyx satureioides* Coss. et Durieu	Young twigs	Cold, Hypertension	Decoction	0,53
	Marrubium deserti (Noë) Coss.	Aerial part	Fever[1,2], dental pain[3]	Decoction (1), Maceration (2), Cataplasme (3)	0,72
	Ajuga iva (L.) Schreb.	Aerial part (a), Leaves (b)	Fever[1a], Diarrhea[1b], Stomach pain[1b], Abdominal pain[(1,2,3)b]	Decoction (1), Infusion (2), Powder (3)	0,4
	Teucrium polium L.	Aerial part	Injuries[2], Stomach ulcer[1,2], Nausea[2], Diarrhea[2], Abdominal pain[1], Colic[1]	Decoction (1), Powder (2)	0,72
	Rosmarinus tournefortii (Noë ex Jord. & Fourr.) Jahand. & Maire	Aerial part (a), Leaves (b)	Hypertension[1b], Abdominal pain[1a], Diarrhea[2a]	Decoction (1), Powder (2)	0,37
	Thymus algeriensis Boiss. & Reut.	Aerial part (a), Leaves (b)	Hypertension[(1,2)a], Migraine[1a], Abdominal pain[1b], Stomach pain[1a], Nausea[1b]	Decoction (1), Maceration (2)	0,23
	Ziziphora hispanica L.	Aerial part	Stomach pain[1,2,3], Headache[1,3], Abdominal pain[1], Cough[1], Jaundice[1]	Decoction (1), Maceration (2), Powder (3)	0,28
Poaceae	*Cynodon dactylon* (L.) Pers.	Leaves (a), Roots (b)	Dysuria[1b,2a], Renal lithiasis[1b], Colic[1b]	Decoction (1), Maceration (2)	0,16
	Lygeum spartum Loefl. ex L.	Leaves	Face mycosis	Friction	0,02
	Stipa tenacissima L.	Leaves	Stomach pain[1], Diabetes[2], Hyprtension[1]	Decoction (1), Maceration (2)	0,09
Cucurbitaceae	*Colocynthis vulgaris* Schrad.	Fruits (a), Seeds (b)	Diabetes[1a,2b,3a], Constipation[1], Hemorrhoid[2]	Maceration (1), Powder (2) Cataplasme (3), Suppository (4),	0,21
	Ecballium elaterium (L.) A.Rich.	Fruits	Jaundice[1], Skin diseases[2]	Nasal instillation of the juice (1), Compress (2)	0,05
	Bryonia dioica Jacq.	Roots	Otitis, otalgia	Decoction	0,02

Continued

Botanical family	Species	Used part	Therapeutic use	Mode of preparation	RFC
Apiaceae	*Thapsia garganica* L.	Roots	Anorexia[1], Rheumatism[2]	Decoction (1), Lotion of the decoction (2)	0,12
	Pituranthos scoparius (Coss. & Durieu) Schinz	Leaves	Jaundice	Decoction	0,05
	Bunium incrassatum Amo.	Tubercle	Angina[1,2], cold[2]	Decoction (1), Powder (2)	0,16
Cupressaceae	*Juniperus phoenicea* L.	Young twigs	Stomach pain[1,2,3,4], Diarrhea[4], Headache[5]	Decoction (1), Maceration (2), Infusion (3), Powder (4), Inhalation (5)	0,84
	Juniperus oxycedrus L	Leaves	Enuresis[1], Stomach pain[2], Jaundice[1], Cough[1]	Decoction (1), Powder (2)	0,12
Caryophyllaceae	*Herniaria hirsuta* L.	Aerial part	Renal lithiasis[1], Biliary lithiasis[2], Bladder lithiasis[2]	Decoction (1), Infusion (2)	0,28
	Silene cucubalus Wibel.	Entire plant	Female sterility	Decoction	0,02
Plantaginaceae	*Globularia alypum* L.	Aerial part (a), Leaves (b)	Joint pain[1b], Influenza of children[4b], Diabetes[3b,1a], Gales[2b], Injuries[3b], Constipation[1b], Hyprtension1a	Decoction (1), Maceration (2), Powder (3), Compress (4)	0,28
	Plantago albicans L.	Aerial part with flowers	Back pain[1], Enuresis[1], Stomach pain[1], Diarrhea[1], Ear flow[2]	Decoction (1), Auricular instillation (2)	0,12
Apocynaceae	*Nerium oleander* L.	Leaves	Eczema, Diabetes	Lotion (plant bath)	0,07
Boraginaceae	*Echium trygorrhizum* Pomel.	Entire plant(a), Leaves (b), Roots (c)	Jaundice[1(a,b,c)], Diabetes[1b], Angina[2b]	Decoction (1), Powder (2)	0,42
Cleomaceae	*Cleome arabica* L.	Entire plant	Female sterility	Steam fumigation	0,05
Amaranthaceae	*Arthrophytum scoparium* (Pomel) Iljin	Aerial part (a), Leaves (b)	Stings of snakes and Venomous Insects[(1,2)b], Diabetes[(1,2)b], Stomach ulcer[2a]	Decoction (1), Powder (2)	0,09
Cyperaceae	*Scirpus holoschoenus* L.	Aerial part	Urinary system, Kidney diseases		0,09
Euphorbiaceae	*Euphorbia bupleuroides* Desf.	Aerial part (milky sap)	Eczema[2], Mycoses[2], Warts[2], Dental pain[1]	Cataplasme (1), Friction (2)	0,07
Fabaceae	*Retama raetam* (Forssk.) Webb	Aerial part (a), leaves (b)	Intestinal parasites[2b], Jaundice[1b], Rheumatism[4a], Cold[3a]	Decoction (1), Suppository (2), Inhalation (3), Steam fumigation (4)	0,05
Asparagaceae	*Asparagus stipularis* Forsk.	Aerial part	Injuries	Dusting	0,02
Xanthorrhoeaceae	*Asphodelus microcarpus* Salzm et Viv.	Tubercle	Otitis, Otalgia	Auricular instillation	0,05
Linaceae	*Linum usitatissimum* L.	Seeds	Small intestine	Powder	0,02
Malvaceae	*Malva sylvestris* L.	Leaves	Furuncle[1,3], Angina[2,4], Renal diseases[2]	Decoction (plant bath) (1), Decoction (2), Cataplasme (3), Powder (4)	0,21
papaveraceae	*Papaver rhoeas* L.	Leaves (a), Flower (b), Seeds (c)	Measles[1(a,b,c),2b]	Decoction (1), Infusion (2)	0,16

Continued

Botanical family	Species	Used part	Therapeutic use	Mode of preparation	RFC
Pinaceae	*Pinus halepensis* Mill.	Resin (a), Fruits (b), Leaves (c), Tree bark (d), Immature fruits (d)	Cough^{2a,1b}, Furuncle^{4a}, Pulmonary diseases^{1c,3a}, Asthma^{1d}, Anorexia^{1c}, Stomach ulcer^{1d}	Decoction (1), Powder (2), Inhalation (3), Anointing oily liniment (4)	0,14
Rhamnaceae	*Ziziphus lotus* (L.) Lam.	Leaves (a), Roots (b)	Insomnia$^{(2,3)a}$, Renal diseases^{1a}, Hydatid cyst^{1b}	Decoction (1), Maceration (2), Lotion (3)	0,05
Rutaceae	*Ruta montana* (L.) L.	Aerial part (a), Leaves (b)	Anguish^{1b}, Anorexia^{1b}, Insomnia$^{1(b,a)}$, Abdominal pain^{1b}, Aerocoly^{1b,2a}, Colic^{1a}, Nausea^{3b}	Decoction (1), Infusion (2), Powder (3)	0,6
Salicaceae	*Populus alba* L.	Leaves	Anorexia	Decoction	0,02
Tamaricaceae	*Tamarix gallica* L.	Leaves (a), Inflorescences (b)	Liver diseases$^{(1,2,3)a}$, Abdominal pain$^{4(a,b)}$	Decoction (1), Infusion (2), Powder (3), Gargling (4)	0,19
Nitrariaceae	*Peganum harmala* L.	Aerial part (a), Seeds (b)	Headache^{1a}, Rheumatism$^{(2,3)a,3b}$, Cough^{4b}	Steam fumigation (1), Anointing cataplasme (2), Cataplasme (3), Inhalation (4)	0,28
Anacardiaceae	*Pistacia atlantica* Desf.	Fruits	Renal diseases	Decoction	0,02
Thymelaeaceae	*Thymelaea microphylla* Meisn.	Leaves (a), Roots (b)	Alopecia^{1a}, Gale^{1a}, Mycosis^{1b}, Aerocoly^{2b}, Abdominal pain^{2b}	Decoction (Plant bath) (1), Decoction (2) (with care)	0,05

Medicinal (MUV) and Family Use-Values (FUV)

The highest family use-values were recorded within *Rutaceae* (0.58), *Lamiaceae* (0.50), *Cupressaceae* (0.48) and *Boraginaceae* (0.42) (Table 3). The *Asteraceae* family showed a relatively low family use-value which could be attributed to the low medicinal use-values of its species. Both MUV and FUV were recorded with similar value for botanical family with one cited species (Table 3). The highest MUV was recorded for *Teucrium polium* (0.88) followed by *Juniperus phoenicea* (0.84), *Artemisia campestris* (0.74), *Marrubium deserti* (0.72) and *Artemisia herba alba* (0.67) (Table 3).

Informant Consensus Factor (ICF)

In the present study, ICF varied from 0.33 to 0.86 (Table 2). The highest ICF value was observed for digestive system diseases (0.86) followed by signs and ill-defined morbid stats (0.82). However, the lowest ICF value was recorded for mental disorders (0.33). Digestive system diseases showed a relatively high informants' consensus in many other studies (Boudjelal et al., 2013; Kaval et al., 2014; Miara et al., 2018; Yabrir et al., 2018). Symptoms, signs and ill-defined morbid states appear to be the second most important diseases category. This category was treated essentially by *Marrubium deserti, Echium trygorrhizum* Pomel. and *Ajuga iva*.

Fidelity Level (FL)

FL values ranged from 0.02 to 1.00 (Table 4). The species which treat exclusively one category were represented with high values (1.00). However, the other species were mentioned to treat more than one category. Therefore, for each species, all mentioned categories were represented with variable fidelity level. Species with high level were *Euphorbia bupleuroides* Desf. for dermatological diseases (1.00), *Herniaria hirsuta* L. for urogenital organs diseases (1.00), *Juniperus phoenicea* for digestive system diseases (0.98), *Marrubium deserti* and *Echium trygorrhizum* for signs and ill-defined morbid states (0.97 and 0.88 respectively), *Saccocalyx satureioides* for respiratory system diseases (0.81). *Teucrium polium* was used for treating both digestive system diseases and traumatic lesions and poisoning equally (0.45), *Rosmarinus tournefortii* was found to treat equally both digestive and circulatory system diseases (0.50). However, *Ajuga iva* was used to treat digestive system diseases together with signs and ill-defined morbid states (0.52 and 0.43 respectively).

Table 2. Informant consensus factor (ICF) and usage expression percentage

Categories	Use citation (Nur)	Species number (Nt)	ICF	Usage expression percentage (%)
Digestive System Diseases (DSD)	183,00	27,00	0,86	38,28
Signs and Ill-Defined Morbid States (SIMS)	94,00	18,00	0,82	19,67
Respiratory System Diseases (RSD)	43,00	11,00	0,76	9,00
Circulatory System Diseases (CSD)	26,00	7,00	0,76	5,44
Traumatic Lesions and Poisoning (TLP)	27,00	8,00	0,73	5,65
Infectious and Parasitic Diseases (IPD)	10,00	4,00	0,67	2,09
Urogenital Organs Disease (UGOD)	37,00	14,00	0,64	7,74
Endocrine Diseases, Nutrition, Metabolism and Immune Disorders (ENMID)	17,00	8,00	0,56	3,56
Diseases of the Nervous System and Sense Organs (DNSSO)	10,00	5,00	0,56	2,09
Dermatological Diseases (DD)	16,00	9,00	0,47	3,35
Diseases of the Osteo-Articular System, Muscles and Connective Tissues (DOMCT)	12,00	7,00	0,45	2,51
Mental Disorders (MD)	4,00	3,00	0,33	0,84

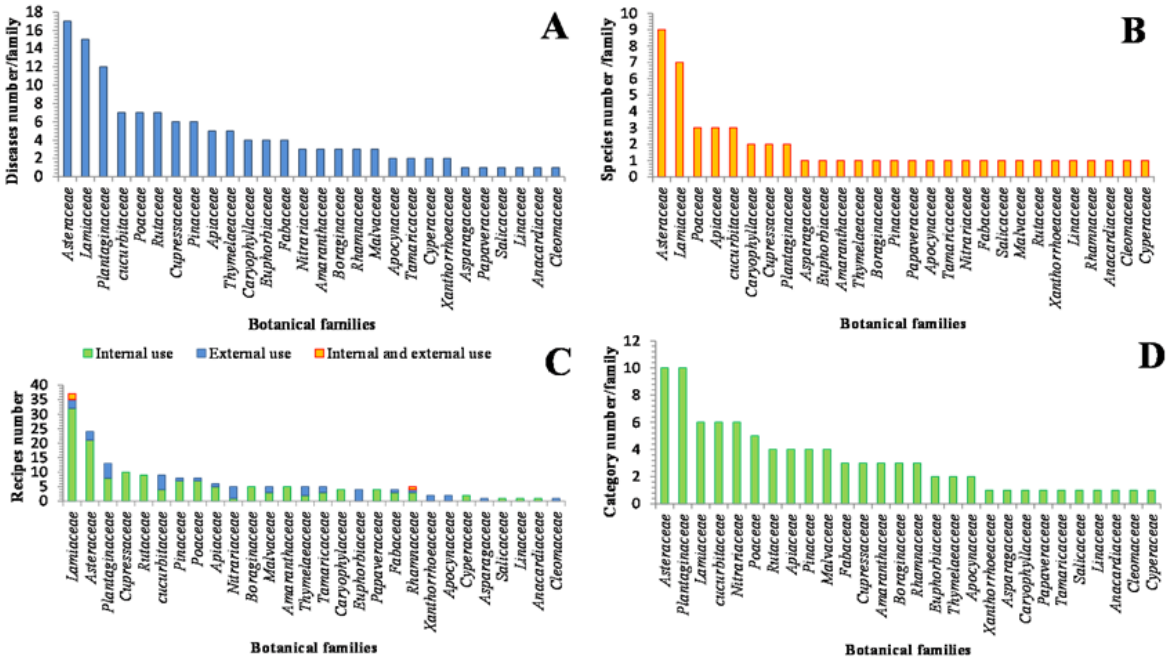

Figure 3. Number of diseases (A), species (B), uses (C) and categories (D) per botanical family

Table 3. Medicinal (MUV) and family uses (FUV) values

Species	Vernacular name	Botanical family	MUV	FUV
Teucrium polium L.	Djaida	*Lamiaceae*	0.88	0.50
Marrubium deserti (Noë) Coss.	Timiriouet		0.72	
Saccocalyx satureioïdes Coss et Dur	Zaatar ermel		0.53	
Ajuga iva (L.) Schreb.	Chendgoura		0.40	
Rosmarinus tournefortii (Noë ex Jord. & Fourr.) Jahand. & Maire	Lklil		0.37	
Ziziphora hispanica L.	Fliou		0.30	
Thymus algeriensis Boiss. & Reut.	Djertil		0.28	
Juniperus phoenicea L.	Arrar	*Cupressaceae*	0.84	0.48
Juniperus oxycedrus L.	Taga		0.12	
Artemisia campestris L.	Dgouft essaifi	*Asteraceae*	0.74	0.21
Artemisia herba alba Asso.	Chih		0.67	
Anacyclus cyrtolepidioides Pomel.	Rebienne		0.12	
Anacyclus clavatus (Desf.) Pers.	Beibcha		0.09	
Cotula cinerea Delile	Gartoufa		0.07	
Artemisia absinthium L.	Ochbet Meriem		0.05	
Sonchus oleraceus (L.) L.	Karafchoun		0.05	
Onopordum arenarium (Desf.) Pomel	Feries		0.02	
Anvillea radiata Coss et Dur.	Nougued		0.09	
Ruta montana (L.) L.	Feidjel	*Rutaceae*	0.58	0.58
Echium trygorrhizum Pomel.	Hmimech	*Boraginaceae*	0.42	0.42
Peganum harmala L.	Harmel	*Nitrariaceae*	0.28	0.28
Colocynthis vulgaris Schrad.	Hdedj	*Cucurbitaceae*	0.26	0.12
Ecballium elaterium (L.) A.Rich.	Fegouce lhmir		0.07	
Bryonia dioica Jacq.	Berostem		0.02	
Globularia alypum L.	Tasselga	*Plantaginaceae*	0.21	0.17
Plantago albicans L.	Lelma		0.14	
Malva sylvestris L.	Khobiz	*Malvaceae*	0.21	0.21
Tamarix gallica L.	Tarfa	*Tamaricaceae*	0.19	0.19
Pinus halepensis Mill.	Snaoubar	*Pinaceae*	0.19	0.19
Cynodon dactylon (L.) Pers.	Nedjem	*Poaceae*	0.16	0.16
Stipa tenacissima L.	Halfa		0.09	
Lygeum spartum Loefl. Ex L.	Sounak		0.02	

Continued

Species	Vernacular name	Botanical family	MUV	FUV
Papaver rhoeas L.	Bennaaman	*Papaveraceae*	0.16	0.16
Herniaria hirsuta L.	Fetat elhdjar	*Caryophyllaceae*	0.28	0.15
Silene cucubalus Wibel.	Tiketkichet		0.02	
Bunium incrassatum Amo.	Telghouda	*Apiaceae*	0.16	0.11
Thapsia garganica L.	Bounafâa		0.12	
Pituranthos scoparius (Coss. & Durieu) Schinz	Gouzah		0.05	
Thymelaea microphylla Coss et Dur.	Methenane	*Thymelaeaceae*	0.12	0.12
Arthrophytum scoparium (Pomel) Iljin	Remeth	*Amaranthaceae*	0.12	0.12
Retama raetam (Forssk.) Webb	Rtem	*Fabaceae*	0.09	0.09
Euphorbia bupleuroides Desf.	El lebine	*Euphorbiaceae*	0.09	0.09
Scirpus holoschoenus L.	Smar	*Cyperaceae*	0.09	0.09
Ziziphus lotus (L.) Lam.	Sedra	*Rhamnaceae*	0.07	0.07
Nerium oleander L.	Defla	*Apocynaceae*	0.07	0.07
Asphodelus microcarpus Salzm et Viv.	Belouez	*Xanthorrhoeaceae*	0.05	0.05
Asparagus stipularis Forsk.	El odjrm	*Asparagaceae*	0.02	0.02
Pistacia atlantica Desf.	Betoum	*Anacardiaceae*	0.02	0.02
Populus alba L.	Safsaf	*Salicaceae*	0.02	0.02
Linum usitatissimum L.	Ketane	*Linaceae*	0.02	0.02
Cleome arabica L.	Netine	*Cleomaceae*	0.02	0.02

Table 4. Fidelity level

Species	Categories (Fidelity level FL)
Teucrium polium L.	**DSD (0.45), TLP (0.45)**, DNSSO (0.11)
Juniperus phoenicea L.	**DSD (0.98)**, SIMS (0.02)
Artemisia campestris L.	**DSD (0.50)**, SIMS (0.27), RSD (0.15), TLP (0.08)
Marrubium deserti (Noë) Coss.	**SIMS (0.97)**, DSD (0.03)
Artemisia herba alba Asso.	**DSD (0.69)**, RSD (0.10), ENMID (0.10), MD (0.07), IPD (0.03)
Ruta montana (L.) L.	**DSD (0.68)**, SIMS (0.28), MD (0.04), DNSSO (0.04)
Saccocalyx satureioides Coss et Dur	**RSD (0.81)**, CSD (0.19)
Echium trygorrhizum Pomel.	**SIMS (0.88)**, ENMID (0.06), RSD (0.06)
Ajuga iva (L.) Schreb.	**DSD (0.52)**, SIMS (0.43)
Rosmarinus tournefortii (Noë ex Jord. & Fourr.) Jahand. & Maire	**CSD (0.50), DSD (0.50)**
Ziziphora hispanica L.	**DSD (0.69)**, SIMS (0.31)
Peganum harmala L.	**DOMCT (0.33), SIMS (0.25)**, IPD (0.08), DD (0.08), RSD (0.17), DSD (0.08)
Thymus algeriensis Boiss. & Reut.	**CSD (0.58)**, SIMS (0.17), DSD (0.17), DNSSO (0.08)
Herniaria hirsuta L.	**UGOD (1.00)**
Colocynthis vulgaris Schrad.	**ENMID (0.60),** DSD (0.30), DOMCT (0.10)
Malva sylvestris L.	**DD (0.33), RSD (0.33),** UGOD (0.22), DOMCT (0.11)
Globularia alypum L.	**TLP (0.22), ENMID (0.22)**, DOMCT (0.11), DRSDD (0.11), DSD (0.11), CSD(0.11)
Tamarix gallica L.	**DSD (1.00)**
Pinus halepensis Mill.	**SIMS (0.38), RSD (0.38)**, DD (0.13), DSD (0.13)
Cynodon dactylon (L.) Pers.	**UGOD (0.88)**, DSD (0.13)
Papaver rhoeas L.	**IPD (1.00)**
Bunium incrassatum Amo.	**RSD (1.00)**
Plantago albicans L.	**DSD (0.29), DNSSO (0.29)**, TLP (0.14), SIMS (0.14), UGOD (0.14)
Anacyclus cyrtolepidioides Pomel.	**DSD (1.00)**
Thapsia garganica L.	**SIMS (0.43)**, DOMCT (0.29), IPD (0.14), RSD (0.14)
Thymelaea microphylla Coss et Dur.	**DD (0.6)**, DSD (0.4)
Juniperus oxycedrus L.	**UGOD (0.4), SIMS (0.4),** DSD (0.2)
Arthrophytum scoparium (Pomel) Iljin	**TLP (0.40), ENMID (0.40)**, DSD (0.20)
Retama raetam (Forssk.) Webb	**DSD (0.25), DOMCT (0.25), RSD (0.25), SIMS (0.25)**
Euphorbia bupleuroides Desf.	**DD (0.75),** DSD (0.25)
Scirpus holoschoenus L.	**UGOD (1.00)**
Anacyclus clavatus (Desf.) Pers.	**UGOD (0.50)**, MD (0.25), DSD (0.25)

Continued

Species	Categories (Fidelity level FL)
Stipa tenacissima L.	**DSD (0.50)**, ENMID (0.25), CSD (0.25)
Anvillea radiata Coss et Dur.	**DSD (0.75)**, TLP (0.25)
Ziziphus lotus (L.) Lam.	**SIMS (0.33), UGOD (0.33), DSD (0.33)**
Cotula cinerea Delile	**CSD (1.00)**
Ecballium elaterium (L.) A.Rich.	**SIMS (0.67)**, DD (0.33)
Nerium oleander L.	**DD (0.67)**, ENMID (0.33)
Artemisia absinthium L.	**UGOD (0.50), TLP (0.50)**
Sonchus oleraceus (L.) L.	**DOMCT (1.00)**
Pituranthos scoparius (Coss. & Durieu) Schinz	**SIMS (1.00)**
Asphodelus microcarpus Salzm et Viv.	**DNSSO (1.00)**
Onopordum arenarium (Desf.) Pomel	**DSD (1.00)**
Lygeum spartum Loefl. Ex L.	**DD (1.00)**
Pistacia atlantica Desf.	**UGOD (1.00)**
Bryonia dioica Jacq.	**UGOD (1.00)**
Silene cucubalus Wibel.	**UGOD (1.00)**
Asparagus stipularis Forsk.	**TLP (1.00)**
Populus alba L.	**SIMS (1.00)**
Linum usitatissimum L.	**DSD (1.00)**
Cleome arabica L.	**UGOD (1.00)**

Discussion

The Relative Frequency Citation (RFC)

The most frequently cited species were *Artemisia campestris* and *Juniperus phoeniceae*. *Artemisia campestris* was reported to treat digestive disorders and was recognized as antidiabetic and as hypertensive in M'sila region of Algeria (Boudjelal et al., 2013; Chermat, 2016; Sarri et al., 2014). Moreover, *Juniperus phoeniceae* was used in the same region to treat digestive disorders and as antihypertensive (Boudjelal et al., 2013; Chermat, 2016). According to Vitalini et al., (2013), the species with high RFC are required to verify scientifically their folk uses and could be the subject of different biological activities studies. But this does not exclude the other species for further analyses. Many biological activities of *Artemisia campestris* (Dib and El Alaoui-Faris, 2019) and *Juniperus phoeniceae* (Nasri et al., 2011) were recorded and validated pharmacologically.

Medicinal (MUV) and Family Uses-Values (FUV)

Rutaceae and *Lamiaceae* were recorded with the highest family use-values. The *Asteraceae* family showed a relatively low FUV. However, this family was identified in other studies as a predominant family (Bonet et al., 1999; Yabrir et al., 2018). The difference between the FUV was attributed to the variation in vegetation and geo-climate of the area (Bibi et al., 2014). Furthermore, the families *Fagaceae, Corylaceae* and *Juglandaceae*, which are not found in our studied region, were classified in other studies as the best use families according the different therapeutic categories (Moerman, 1991). The knowledge of use value is very important in determining the reliability of use and the pharmacological characteristics of a given species (Cakilcioglu and Turkoglu, 2010). The species *Teucrium polium, Juniperus phoenicea, Artemisia campestris* and *Artemisia herba alba* were recognized to treat some digestives system diseases. However, *Marrubium deserti* was highly recommended to treat fever. The

current use of medicinal plants as a conventional medicine showed that it is actively used (Kaval et al., 2014). According to Johns et al., (1990), the use of a plant (family or species) by local populations for phytotherapy is all the more important as its presence in the environment is frequent.

Informant Consensus Factor (ICF)

It is calculated to assess the variability of the use of medicinal plants and to determine if plants from certain groups are of particular interest in the search for bioactive compounds (Heinrich et al., 1998). Digestive system diseases and signs and ill-defined morbid states showed the highest value; however, the lowest value was attributed to mental disorders diseases. The high agreement between informants about these disease categories is due probably to the recipes' efficiency and to the simplicity of diagnoses of these diseases. (Chaachouay et al., 2020) stated that ICF (called elsewhere IAR: Informant Agreement Ratio) depended upon the availability of plants within the study area to treat diseases and found an ICF that ranged from 0.64 to 0.98 per uses categories with diabetes disorders having the highest value in the Moroccan Rif. On the other hand, the relatively low value of ICF for dermatological diseases indicates that the diagnosis of dermatological conditions has poor consensus, which agrees with (Heinrich, 2000) finding in marginal regions of Mexican Indian communities in the southern parts of Mexico.

Fidelity Level (FL)

Increasing values of FL for a species confirm its uniqueness to treat a particular disease (Shil et al., 2014). However, plants with low FL values must be taken into account, otherwise the ancestral know-how may disappear. These low FL are obtained for plants that are used for many different diseases (Srithi et al., 2009) and indicate the low frequency of use or lesser effectiveness of the species in treating the specific ailment (Appiah et al., 2017). For example, (Chaachouay et al., 2020) attribute the low level of *Lavandula officinalis* Chaix (45.5%) to the ignorance of dosage and methods of remedy preparation by informants.

Conclusion

The present study gathered pure ethnomedical practices and knowledge from the region. It should be noted that the listed species remain used only locally. This information is the result of years of experience which has been tested over several generations. However, some uses are not widely known since they constitute a professional or personal secret. The results showed that all the plant parts were used to prepare recipes in this region. Furthermore, many species are used to treat a single or several diseases. Besides, most of recipes can be prepared from one species. However, a mixture of species can be used as curative recipe and is called "DJOR YEBRIR" or "ADJOUAR".

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