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Ethno-medicinal study of spontaneous plants used in Chaiba and El Hadjeb villages (Biskra region), Southern Algeria

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Abstract

Biskra region has long been inhabited by people who have a long tradition of using medicinal plants in the treatment of many ailments. In this context, the aim of this work is to document the ethno-medicinal uses of spontaneous plants in two selected villages (Chaiba and El Hadjeb) of South Algeria. This study was conducted in 2011 using semi-structured questionnaire and distributed to 70 residents selected at random in the studied areas. Data collected were quantitatively analyzed by calculating the factor informant consensus (Fic) and citation frequency (Cf). A total of 44 spontaneous plant species belonging to 24 families and 43 genera were documented which were used for treating more than 14 ailments category. Asteraceae and Lamiaceae were the most abundant families (7 species each). Among the identified species, herbs constituted 72.72%, shrubs 20.45% and tress 6.81%. Leaves were found to be the most frequently utilized plant part (25.71%), and most remedies were prepared as a decoction form (34.33%). The Fic value ranged from 0.56 to 1 and the highest Fic value was found in eye and liver diseases. Cf values ranged from 8.71 to 92.85% and the highly cited species was *Artemisia herba-alba* Asso. These results constitute a source of very precious information for the studied region and for the Algerian flora subsequent researches in phytochemistry and pharmacology in order to search for new bioactive molecules.

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Introduction

Traditional medicine is a combination of knowledge, skill and practice based on the theories, beliefs and experiences indigenous to different cultures used in diagnosing, preventing and eliminating a physical, mental or social disease. It may rely exclusively on past experience and observation handed down from generation to generation verbally or in writing. It is also known as herbalism, the ancient method of curing disease through the use of plants (Babawale *et al.*, 2016).

Ethnobotany is a biological, economic and cultural inter-relationship study between people and plants of an area in which they exist (Parada *et al.*, 2009). Ethnobotanical studies are a way to access to traditional knowledge about plants with therapeutic potential by contributing to plant biodiversity knowledge on one hand and take this knowledge for further social and scientific interventions on the other hand (Ibrar *et al.*, 2007). Preservation of this information can be a valuable policy for good usage of natural sources and investigation in this field (Mohamadi *et al.*, 2015). In these modern days and where the use of medicinal plants is gaining more recognition, ethnobotanical researches are recognized as the most viable method of identifying new medicinal plants or refocusing on those earlier reported bioactive constituents (Ekor, 2014). Currently, 25% of herbal drugs in modern pharmacopeia are plants based and several synthetic drugs are manufactured by using chemical substances isolated from plants (Umair *et al.*, 2017).

The use of plant species as traditional medicines provides a real substitute in healthcare services for rural communities of the developing nations (Hayta *et al.*, 2014). Particularly some international organizations such as the International Union for Conservation of Nature (IUCN) that aim, through the involvement of local communities, to promote biodiversity conservation and sustainable use of natural resources in the world and North Africa (Benderradji *et al.*, 2014). In Africa and according to United Nations Environment Program (UNEP), a significant number of spontaneous species have potential value in terms of medicine. These medicinal plants are valuable resources for the vast majority of rural populations in Africa, where more than 80% of the population use them to provide health care (Diallo, 2005).

Algeria by its climate (Mediterranean, semi-arid and arid climate) and the nature of the soil, has a flora particularly rich in medicinal and aromatic plants, most of which exist in a spontaneous state (Azzi *et al.*, 2012). Even though, it is one of the richest Arab countries with 3164 plant species, a few ethnobotanical studies have been carried out in this country and as a result the Algerian medicinal flora is almost unknown (Vasisht and Kumar, 2004; Boudjelal *et al.*, 2013; Ramdane *et al.*, 2015).

However, in different parts of Algeria, local population has a rich indigenous knowledge which is not always adequately documented and practiced only in a fragmentary and empirical way (Benhammou *et al.*, 2009; Reguieg, 2011; Chermat and Gharzouli, 2015). It should be noted that some medicinal plants are being seriously depleted due to over-exploitation which can lead to the disappearance of the most vulnerable species. So, it will be urgent and essential to adopt a sustainable management strategy to avoid the degradation of biodiversity of the flora (Bouasla and Bouasla, 2017). Therefore, the present study was conducted to assess and document the knowledge of medicinal plants use in Biskra district particularly in Chaiba and El Hadjeb villages.

Materials and methods

Study area

This research was conducted to document the traditional knowledge on medicinal plants of Biskra district (Known also as Ziban region), exactly in two localities Chaiba and El Hadjeb. This region is located in the Algeria Sahara, the world's largest non-polar desert that covers 84% of the total Algerian area (2.381.741 km²) (Ozenda, 1991) and it is approximately 500 kilometers away from the Algeria capital (Fig. 1).

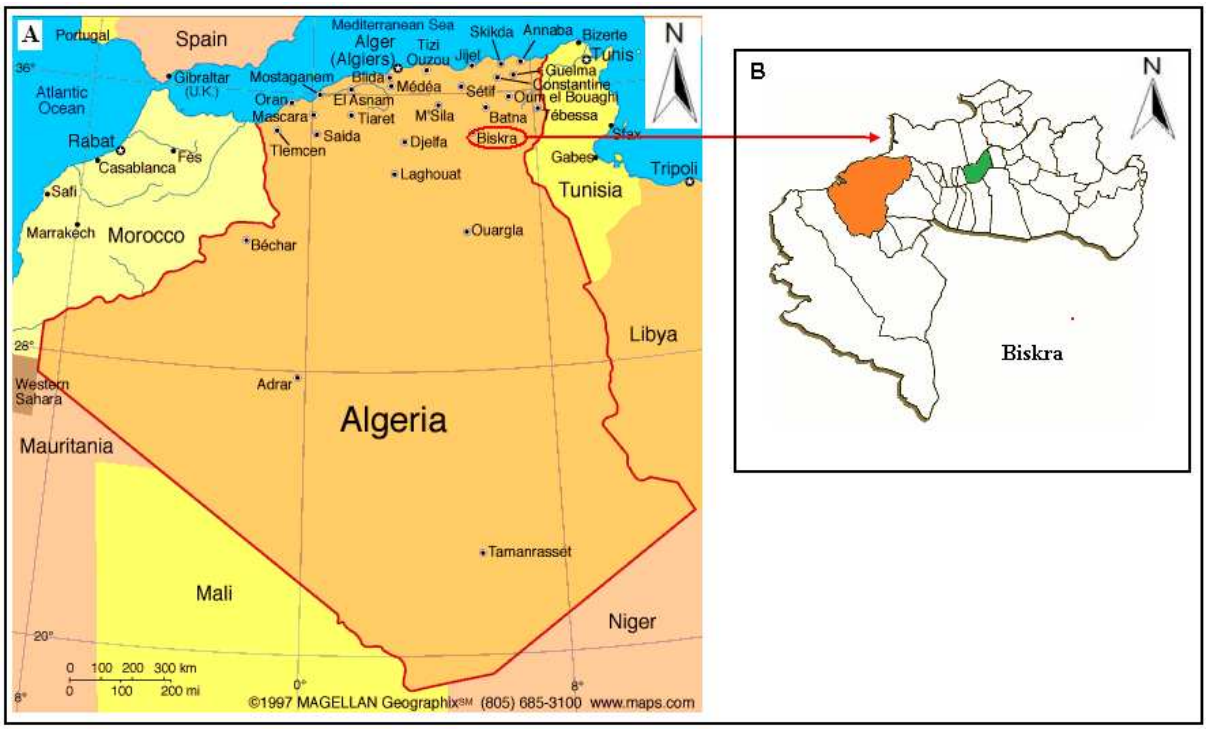

Fig. 1. Map of Biskra province (Algeria) (A), the studied areas are represented in Orange: Chaiba and Green: El Hadjeb (B).

The study area occupies a privileged position in the south-east of Algeria between 34°52' N, 5°45' E covering an area of 2 167.20 km². It is delimited in North by Batna, in the East by Khenchela, in the North West by M'sila, in the West by Djelfa, in South East by El Oued and in the South by Ouargla. Major activities of the local people of these two villages depend on essentially agriculture and grazing among other activities. The climate of the investigated area is subject to a dry Saharan type, the summer is hot and dry while the winter is cold with low and irregular rain with 120 to 150 mm rainfall per year and with an average annual temperature of 24.4°C (ANDI, 2013). According to the data of National Agency for Territorial Development (ANAT, 2003), Biskra contains calcium-magnesium soils with a well-developed structure. Most of the territory landscape consists of natural steppe formations and oases.

Data collection

To improve our knowledge on the usage of medicinal plants, an ethnobotanical study was conducted during the year of 2011. The method used is based on surveys through semi-structured questionnaires prepared and distributed to the residents selected at random of the study area. The questionnaires were distributed to both sexes (males and females) whose ages varied between 20 and over 90 years old. The questionnaires were composed of questions related to socio-demographic characteristics of participants (gender, age, education, etc.) and also the medicinal plants used, their common names, their medicinal characteristics, the used parts, their method of preparation (decoction, infusion,...etc.), the usage period and their side effects. The informants were interviewed in their local Arabic language.

Herbarium specimen preparation and identification

Plant species were collected from Chaiba (34° 50′ 27″ N and 4° 55′ 20″ E) and El Hadjeb (34° 47′ 25″ N and 5° 35′ 49″ E) villages. These plants were dried and voucher specimens for each species have been processed using standard herbarium techniques.

These specimens were identified by consulting the floras of Quezel and Santa (1963) and Ozenda (1991), verified, characterized and confirmed by the scientific and technical research center on the arid region and preserved for identification. Plant specimens are deposited at biology department of Biskra University.

Table 1. List of spontaneous medicinal plants species and their traditional use data in Chaiba and El Hadjeb ([a, b] represent the usage of medicinal plants in each village respectively).

Family	Scientific name	Local name	Part used	Treatment	Mode of preparation	Cf (%)
Asteraceae (7 species) ae	*Anvillea radiata* Coss. & Durieu	Nougd	Aerial parts[a] and leaves[b]	Diabetic[a], liver diseases[b], anti-hypertensive[a] and pain[b]	Decoction[b] and infusion[a]	21.42%
	Artemisia herba-alba Asso	Chih	Aerial parts[b], leaves[a] and stems[a]	Antipyretic[b], diabetes[b,a] and relief from intestinal gas [b,a]	Decoction[b], powder[a], tisane[b] and fumigation[a]	92.85%
	Chrysanthemum fuscatum L.	Babicha	Areial parts[a] and flowers[b]	Pain of menstruation[a], fatigue[b] and hair loss[a]	Infusion[a,b]	11.42%
	Matricaria pubescens (Desf.) Sch. Bip.	Gartoufa	Areial parts[a,b]	Antirheumatic[a,b], analgesic[a,b], pain[a] and delay of menstruation[a]	Decoction[a,b]	35.71%
	Launaea resedifolia (L.) Kuntze	Rogiame	Leaves[b]	Stomach pain[b]	Decoction[b]	17.14%
	Artemisia campestris L.	Dgouft	Areial parts[a,b]	Diabetes[a], scorpions bites[b], anti-poisonous[a,b]	Infusion[a], powder[a] and decoction[b]	50%
	Onopordum arenarium (Desf.) Pomel	Tafsa	Leaves[b]	stomach pain[b]	Decoction[b]	11.42%
Lamiaceae (7 species)	*Teucrium polium* L.	Khaitta	Areial parts[a,b]	Wounds healing[a,b], and hemorrhoids[b]	Infusion[a,b], powder[a], lotion[b] and decoction[b]	45.71%
	Ajuga iva (L.) Schreb.	Chandgoura	Leaves[a,b] and stems[a]	Stomach aches[a] and colic[b]	Tisane[a], and decoction[b]	30%
	Marrubium vulgare L.	Tamariout	Aerial parts[b] and leaves[a]	Otitis [a], fever[b] and flu[b]	Decoction[a,b], lotion[b] and infusion[d]	78.57%
	Thymus algeriensis Boiss. & Reut.	Djertil	Aerial parts[a]	Antiseptic[a] and facility for kidney dialysis[a]	Tisane[a]	25.71%
	Mentha pulegium L.	Fliou	Aerial part[a,b]	Flu[a,b] and fatigue[a,b]	Decoction[a,b], inhalation[a,b] and infusion[a,b]	18.57%
	Rosmarinus officinalis L.	Liklil	Aerial parts[a]	Pain of menstruation[a]	Infusion[a]	40%
	Lavandula antineae Maire	Flaifla, afsse	Aerial parts[a]	Flu[a] and distresses[a]	infusion[a] et inhalation[a]	14.28%
Poaceae (2 species)	*Lygeum spartum* L.	Halfa	Whole plant[b]	Urinary diseases[b] and distresses[b]	Decoction[b]	15.71%
	Cynodon dactylon (L.) Pers.	Al Nedjme	Whole plant[b]	Urinary infections[b]	Decoction[b]	27.14%
Chénopodiaceae (2 species)	*Atriplex halimus* L.	Gtaff	Seeds[b] and fruits[b]	Gynaecological diseases[d]	Infusion[b]	35.71%
	Haloxylon scoparium (Pomel) Iljin	Rameth	Leaves[a,b]	Wounds healing[a], antirheumatic[b], diabetes[b] and fatigue[b]	Cataplasm[a] and inhalation[b]	24.28%
Apiaceae (2 species)	*Ferula vesceritensis* Coss. & Durieu ex Batt.	Klakh	Roots[b]	Antirheumatic[b], anti-inflammatoire[b]	Powder with milk[b] and cataplasm[b]	12.85%
	Foeniculum vulgare Mill.	Besbes	Seeds[a]	Digestive disorders[a]	Infusion[a]	22.85%
Fabaceae (2 species)	*Astragalus armatus* Willd.	Likdad	Roots[a], flowers and stems[b]	Digestive disorders[a,b]	Infusion[b], decoction[a,b] and cataplasm[a,b]	14.28%
	*Retama raetam (*Forssk.) Webb	Rtem	Aerial parts[a,b]	Hair loss[a,b]	Infusion[a,b]	17.14%
Rhamnacea e (2 species)	*Zizyphus lotus* (L.) Lam.	Sedra	Leaves[a,b] and roots[b]	Rheumatism[a,b] and kidney stone[a]	Pulverization[a] and decoction[b]	15.71%
	Rhamnus frangula L.	El Lak	Fruits[a,b]	Digestive disorders[a] and distresses[b]	Eat the fruits fresh[a,b]	44.28%
Capparaceae (2 species)	*Cleome arabica* L.	Mintna	Leaves[b] and seeds[b]	Analgesic[b] and rheumatism[b]	Compress[b]	7.14%
	Capparis spinosa L.	Kabbar	Leaves[b] and roots[b]	Rheumatism[b], hemorrhoids[b], analgesic teeth[b] and skin diseases[b]	Decoction[b], pulverization[b], cataplasm[b], message[b], and gargarisation[b]	32.85%
Zygophyllaceae (2 species)	*Peganum harmala* L.	Harmel	Leaves[a,b]	Rheumatism[a,b] and hemorrhoids[b]	Decoction[b], cataplasm[a,b] and pulverization [a,b]	52.85%
	Zygophyllum album L.	Bouggriba	Leaves[b]	Diabetes[b]	Decoction[b] and pulverization[b]	48.57%
Brassicaceae (2 species)	*Moricandia arvensis* (L.) DC.	Lahmime	Aerial parts[a]	Genital diseases[a]	Decoction[a]	10%
	Eruca vesicaria (L.) Cav.	Ahgane	Leaves[a]	Renal problems[a]	Decoction[a]	12.85%

Apocynaceae (1 species)	*Nerium oleander* L.	Dafla	Leaves[a]	hemorrhoids[a]	Compress[a]	27.14%
Axlepiadaceaee (1 species)	*Pergularia tomentosa* L.	Ghelga	Whole plant[a,b]	Antirheumatic[a] and analgesic teeth[b]	Powder[a,b]	11.42%
Cucurbitaceae (1 species)	*Citrullus colocynthis* (L.) Schrad.	Hajja	Leaves[a,b], seeds[a,b] and fruits[a,b]	Antirheumatic[a,b], hemorrhoids[a] and insects puncture[a,b]	Decoction[a,b] and cataplasm[a,b]	51.42%
Cupressaceae (1 species)	*Juniperus phoenicea* L.	Araar	Leaves[a], fruits[a]	Digestive disorders[a], diarrhea[a] and fever[a],	Decoction[a] and powder[a]	48.57%
Malvaceae (1 species)	*Malva sylvestris* L.	Khobiza	Aerial parts[a] and leaves[b], fruits[b]	Antirheumatic[a,b]	Fresh[a,b], decoction[a,b] and cataplasm[a]	64.28%
Plumbaginaceae (1 species)	*Limoniastrum guyonianum* Boiss.	Zaitta	Leaves[b]	Diabetes[a]	Infusion[a]	8.71%
Rutaceae (1 species)	*Ruta montana* L.	Fidjel	Aerial parts[a,b]	Analgesic[b], anti-epilepsy[b], weights loss[b] and rheumatism[a,b]	Decoction[b], cataplasm[b], pulverization[b] and infusion[a]	28.57%
Tamaricaceae (1 species)	*Tamarix gallica* L.	Tarfa	Leaves[b] and stems[b]	Colic[b] and antidiarrhea [b]	Decoction[b]	47.14%
Thymeleaceae (1 species)	*Thymelea microphylla* Coss. & Durieu ex Meisn.	Mithnane	Leaves[a,b] and stems[a,b]	Digestive disorders[a,b]	Mixed with other plants [a,b]	18.57%
Caryophyllaceae (1 species)	*Hernicaria glabra* L.	Fatat Elhajer	Aerial parts[a]	Anti-inflammatory[a]	Decoction[a]	22.85%
Oliaceae (1 species)	*Olea laperrinei* Batt. & Trab.	Zaboge	Leaves[a] and stems[a]	Hypotensive[a]	Tisane[a]	25.71%
Anacardiaceae (1 species)	*Pistacia atlantica* Desf.	Btom	Seeds[a]	Eye diseases[a]	Decoction[a]	37.14%
Globulariaceae (1 species)	*Globularia alypum L.*	Tasselga	Leaves[b] and flowres[b]	Diabetes and cough[b]	Decoction[b]	32.78%
Polygonaceae (1 species)	*Rumex acetosa* L.	Homayda	Roots[b]	Rheumatism[b]	Cataplasm[b]	35.72%

Data analysis

The collected data was entered into Excel software (Microsoft corporation, 2007) and summarized by statistical methods. In order to study the usage of plant species according to culture applicability, the factor informant consensus (Fic) was measured. The Fic was calculated as the number of use reports in each category (Nur) minus the number of taxa or species used (Nt), divided by the number of use reports in each category minus one (Heinrich *et al.*, 1998);

$$\text{Fic} = \frac{\text{Nur} - \text{Nt}}{\text{Nur} - 1}$$

Fic values range from 0 to 1. High Fic values are obtained when only one or a few plant species are reported to be used by a high proportion of informants to treat a particular category, whereas low Fic values indicate that informants disagree over which plant to use (Andrade-Cetto and Heinrich, 2011).Citation frequency of medicinal plants (Cf) is useful to determine most common spontaneous medicinal plants in the studied areas. Citation frequency values were estimated using the formula:

$$\text{Citation frequency (Cf \%)} = \frac{n}{N} \text{X100}$$

Where, n refers to number of people interviewed citing species, N refers to total number of people interviewed (Hossain and Oliur Rahman, 2018).

Results and discussion

Research survey

The ethnobotanical study in the El Hadjeb and Chaiba villages allowed us to make a list of spontaneous medicinal species as exhaustive as possible and to make a ranking of the most represented families in the studied areas by the number of their species.

Table 2. Categories of ailments and informant consensus factor (Fic) for each category.

Categories of ailments	Number of use reports (Nur)	Number of taxa (Nt)	Fic value
Gastrointestinal diseases	50	12	0.78
Rheumatism	31	9	0.73
Diabetes	20	7	0.68
Respiratory diseases	25	4	0.88
Hemorrhoids	21	4	0.85
Dermatological diseases	11	3	0.80
Scorpion bite and insect puncture	10	2	0.89
Gynecological diseases	12	5	0.64
Kidney problems	10	5	0.56
Hypertension	11	2	0.90
Hair loss	8	2	0.86
Analgesic for teeth	6	2	0.80
Pain and inflammation	15	5	0.71
Eye diseases	8	1	1.00
Liver diseases	5	1	1.00

The obtained results revealed and documented 44 species belonging to 24 families and 43 genera (Fig. 2). The most represented families were Asteraceae (7 species, 6 genera) and Lamiaceae (7 species, 7 genera). Furthermore, 8 families are represented with two species and two genera, and 14 families are represented with one species and one genus each. Our results are in connection with the ethnobotanical study of Benarba *et al.* (2015) in Mascara (Northest of Algeria). Among the reported vegetation, herbs are represented by 72.72% (32 species) followed by shrubs with 20.45% (9 species) and trees with 6.81% (3 species). In the present study, it was observed that local people use herbaceous medicinal plants more than shrubs and trees to treat different aliments, which may be due to their easy availability, collection or abundance in the area (Hassan *et al.*, 2017).

With respect to the sex, the general analysis of the questionnaires showed a significant dependence of the local population on spontaneous medicinal plants to treat various diseases.

Fig. 2. Photos of spontaneous medicinal plant species documented in Chaiba and El Hadjeb villages.

The use of these medicinal plants varies according to the sex where a total of 70 personal interviews with different educational levels revealed that women use the medicinal plants more than men. Indeed, 60% of the questioned women used traditional medicine against 40% of the male population. This can be explained by the fact that women are traditionally the secrets agents of the medicinal plants. The same observations are noted in other regions of Algeria and many regions of Moroco, where people share the same culture (Azzi *et al.*, 2012). This confirmed that the women in our country conserved their traditional knowledge (Jouad *et al.*, 2001; Ennacerie *et al.*, 2017). For each species, family, scientific name, local name, used part, treatment and mode of preparation were recorded (Table 1).

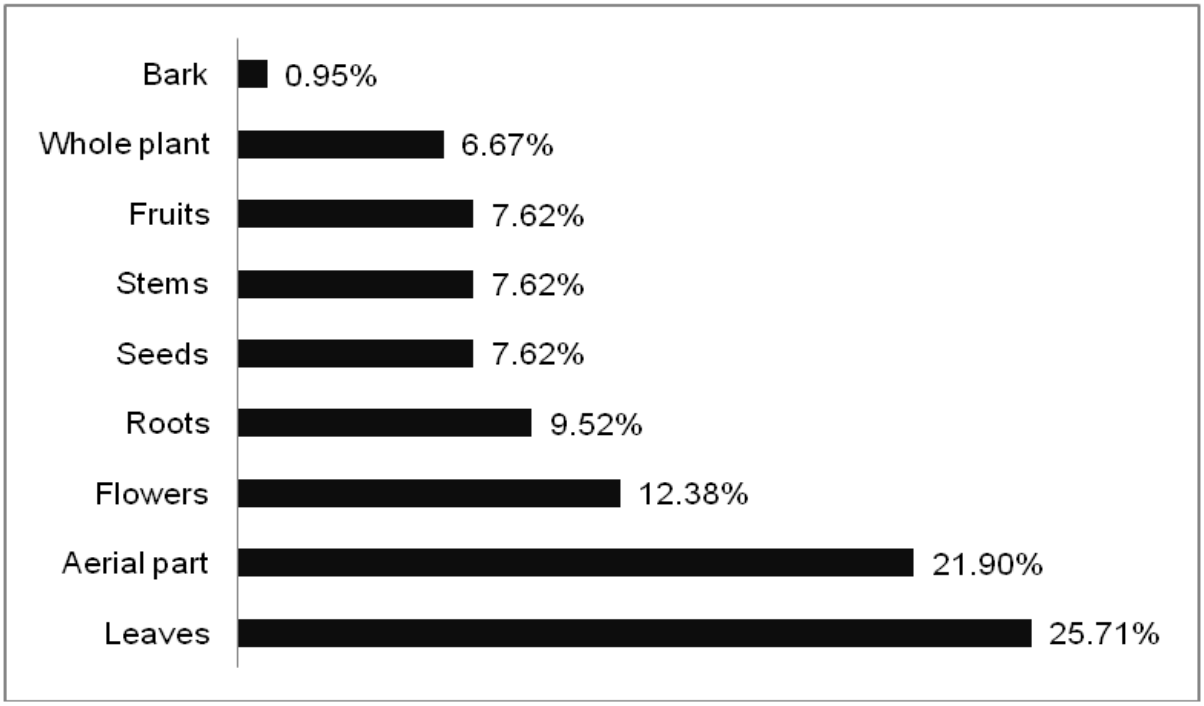

Fig. 3. Percentage of plant parts used in herbal preparations in Chaiba and El Hadjeb villages.

Ailments treated and factor informant consensus (Fic)

The Fic values are presented in the Table 2. These values varied from 0.56 up to 1 with an average value of 0.81. Both eye (8 use reports, 1 species) and liver (5 use reports, 1 species) diseases had the highest Fic values (1) and the species responsible for these high consensuses were *Pistacia atlantica* and *Anvillea radiata* respectively.

Hypertension comes second (0.9) followed by scorpion bites and insect punctures (0.89), respiratory diseases including cough, cold, flu and fever (0.88), hair loss (0.86), hemorroides (0.85), dermatological diseases and analgesic for teeth (0.80 each) and gastrointestinal diseases including stomach pain, colic, digestive disorders and diarrhea (0.78). The results obtained from our study were found consistent with Hassan-Abdallah *et al.* (2013) where they reported high Fic value for eye diseases in a survey in the Region of Randa, Djibouti. The variation in Fic value might be due to availability and diversity of medicinal plants and its associated knowledge in a particular locality, restriction in exchange of ethnobotanical knowledge from one generation to another and one locality to another (Uddin and Abul Hassan, 2014). However, the plant species with high use reports were gastrointestinal diseases (50), rheumatism (31) and respiratory diseases (25) while the lowest use was recorded for liver diseases with 5 use reports.

In the other hand, the highest number of plant species were reported to be used for treatment

of gastrointestinal diseases (12 species, 27.27%) followed by rheumatism (9 species, 20.45%), diabetes (7 species, 15.90%), gynecological diseases, kidney problems, pain and inflammation (5 species, 11.36% each), respiratory diseases and hemorrhoids (4 species, 9.09% each), dermatological diseases (3 species, 6.81%), scorpion bite and insect puncture, hypertension, hair loss and analgesic for teeth (2 species, 4.54% each), liver disease and eye diseases (1 species, 2.27% each).

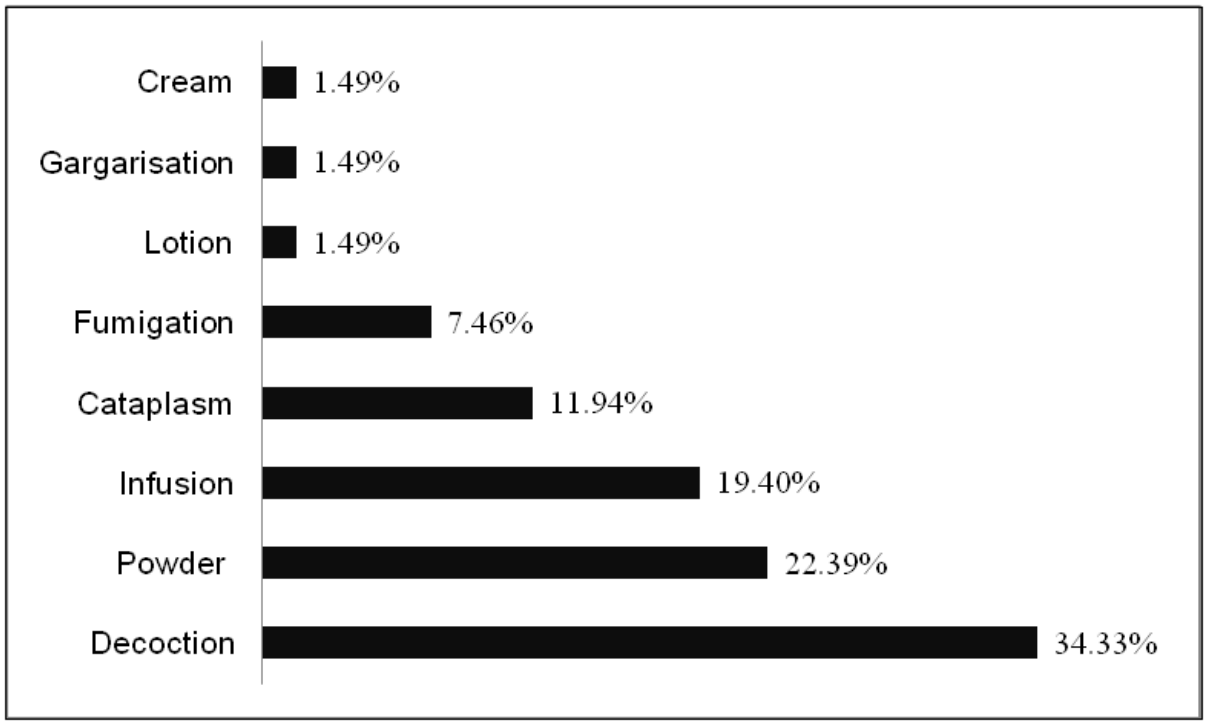

Fig. 4. Mode of remedy preparation in Chaiba and El Hadjeb villages.

Citation frequency (Cf)

The citation frequency in the investigated medicinal plants ranged from 8.71 to 92.85. As the results shown, *Artemisia herba-alba* Asso. had a clear dominance of traditional use in Chaiba and El Hadjeb villages (Cf = 92.85%). Four other species also were found to have over than 50% of Cf value namely; *Marrubium vulgare* L., *Malva sylvestris* L., *Citrullus colocynthis* (L.) Schrad. and *Peganum harmala* L. (Table 1). The high *Cf* value of medicinal plants is a signal of popular and common species in the study areas which can be employed for further analysis to find out new drugs (Bano *et al*., 2014).

Plant parts used for indigenous medicine

In the present study as shown in Fig. 3, leaves are the most used part of the plant with 25.71%, followed by aerial parts (21.90%), flowers (12.38%), roots (9.52%), stems, seeds and fruits with 7.62% each, whole plant (6.67%) and finally bark with 0.85%. Our results were in line with the studies of Boudjelal *et al.* (2013) and Bouredja *et al.* (2017) who also reported that leaves as commonly utilized plant part in herbal medicine.

This may be explained by its easy and speed harvesting as well as the location of secondary metabolites responsible for the biological properties of the plant. Furthermore, it has been reported that the use of leaves is better for the survival of medicinal plants collected by herbalists compared to the collection of whole plant, roots and stem, which may cause severe threat to local flora (Zheng and Xing, 2009). However, the collection manner of these plants in the studied areas is not controlled and the local populations are unconscious. This practice can have a negative consequence on the preservation of the studied areas and some species can totally disappear. Hence, the need to improve the habits of the users towards these medicinal plants is important

and necessary to respect the natural heritage.

Mode of preparation in indigenous medicine

Various modes of preparation are employed by the local population for preparing their treatments of various ailments (Fig. 4). Decoction is the most common method of recipes preparation (34.33%), followed by powder (22.39%), infusion (19.40%), cataplasm (11.94%), fumigation (7.46%), lotion, gargarisation and cream (1.49% each). According to Sarri *et al.* (2017), decoction and infusion are highly valued and often preferred by local healers in Africa.

It is often reported that the decoction collects the most active substances and mitigates or cancels the toxic effect of certain ailments (Sarri *et al.*, 2012). Also, it is easy to make decoction by mixing with tea, water or soup…etc. (Rokaya *et al.*, 2010).

Conclusion

The results of this survey have documented 44 species distributed to 24 families and 43 genera. The highest number of plant species was reported to be used for treatment of digestive disorders, colic, stomach pain and diarrhea.

Most of the reported plants are potentially good source of active ingredients and support the traditional medicinal application of them for medicinal properties. So, our findings could provide preliminary data to launch a search of new drugs with low side effects. With this regard, further scientific investigation on these medicinal plants for toxicological, phytochemical and biological studies is greatly needed.

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