



Medicinal plants traditionally used in the Algerian Sahara: an ethnobotanical study

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Abstract

The use of medicinal plants in the Algerian Sahara goes back a long way and has become one of the main sources of healing in the region. However, this traditional knowledge will disappear if no measures are taken to preserve it. Present is the first study to bring together the ethnobotanical knowledge of traditional practitioners and inhabitants of the Adrar region (Southwestern Algeria). It aims to record different medicinal species used in this area. The ethnobotanical survey was conducted among 206 subjects and 20 traditional practitioners over a period of 8 months using questionnaire designed for the purpose. The study enabled us to identify 126 species belonging to 47 families. Lamiaceae (21.9%), Apiaceae (16.8%) and Asteraceae (14.8%) were found to be dominant. Five species viz. *Artemisia herba-alba* Asso. (60 citations), *Origanum vulgare* L. (51 citations), *Foeniculum vulgare* (L.) (42 citations), *Mentha spicata* (L.) (39 citations) and *Trigonella foenum graecum* L. (31 citations) were cited more than 30 times. Leaves were reported to be the most used parts (30.8%), while majority of the formulations were prepared as infusions and decoctions (53.3% and 31.3%). Most of the plants were used against diseases of the digestive system (32%) followed by respiratory system (18.8%) and metabolic disorders (15.5%). The results obtained constitute a source of information concerning the medicinal flora of the region, which could be a database for further research aiming at inventorying the medicinal plants of all regions of Algeria and exploring their composition.

Keywords Algeria · Adrar · Ethnobotanical survey · Traditional medicine

Abbreviations

°C	Degree Celsius
Fc	The frequency of citation (Fc)
FL	The fidelity level (FL)
ICF	Informant consensus factor (ICF)
m	Meters
mm	Millimeters
Nt	Number of species reported in each category

Nur	Number of citations used in each category
RFC	The relative frequency of citation (RFC)

Introduction

Algeria is one of the Mediterranean countries with a long medical tradition and traditional knowledge of medicinal plants (Boughrara 2016). Its Islamisation has played a key role in the cultural development of plants as medicinal agents (Bouzabata 2013). Its geographical location and history have led to a cultural crossbreeding and fusion between Islamic medicine and Mediterranean pharmacopeias (Eddouks et al. 2007). However, this traditional knowledge is inherited and transmitted orally from one generation to the next, which makes it vulnerable to loss; especially since the new generation is not interested in archiving and preserving the know-how of the older generation (Bouasla and Bouasla 2017).

This traditional medicine is provided by traditional practitioners, who according to the World Health Organization (WHO) "are recognized by the community in which they live as competent to provide healthcare through the

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use of herbal, animal or mineral substances and other methods based both on the socio-cultural and religious foundation and on knowledge, behavior and beliefs related to physical, mental and social well-being, as well as to the etiology of diseases prevalent in the community" (Sissoko 2006). These traditional practitioners may practice different therapies such as herbal medicines, naturopathy, acupuncture and manual therapies such as chiropractic, osteopathy as well as other related techniques including qigong, tai chi, yoga, thermal medicine, and other physical, mental, spiritual and mind–body therapies ("WHO traditional medicine strategy 2022). Herbalists and healers are the ones who use plants the most; the former know their uses and sell them while the latter treat with non-conventional methods. They can diagnose ailments and prescribe the appropriate medicinal plants.

The Algerian Sahara, one of the largest deserts in the world and representing 90% of the national territory, is characterized by a diverse climate that offers great biodiversity that has unfortunately been rarely studied (Ozenda 2004). The presence of several ethnic groups with different nutritional and therapeutic habits makes this region very interesting for studies on the relationship between humans and the flora of their environment.

Given the absence of local pharmacopeias, several studies aimed to explore the ethnobotanical knowledge of the region, and to list the medicinal plants used by the local population (Merzaia 2015; Benarba 2015, 2016; Bouafia et al. 2021; Hadjadj et al. 2015; Hammiche and Maiza 2006; Miara et al. 2019b; Ould El Hadj et al. 2003; Telli et al. 2016; Yasser et al. 2018).

Adrar is located in southwestern Algeria and covers an area of 4,27,971 Km² (19.9% of the country's surface area). It is a real oasis archipelago made up of 4 regions (Gourara, Touat, Tidikelt and Tanezrouft). Its population is made up of several strata: the chorfas (noble descendants of the family of the prophet), the merabtime (descendants of a saint), the Ahrar (free people representing the Arab) and Zenet tribes and the haratins (descendants of former slaves) (Yousfi 2017), which makes its culturally diverse which is reflected in the food and therapeutic habits. This is the population that often resorts to herbal medicine to treat health problems, mainly because of the small number of pharmacies in the region (1 pharmacy per 1000 inhabitants), which does not provide them access to the conventional treatments.

This study is in addition to the above-mentioned ones, in order to enrich the data already collected in the Saharan region. Its main objective is to explore the diversity of the medicinal flora of the Adrar region and to archive the knowledge of herbal medicine of its population in order to preserve this know-how, which could be transmitted to the future generations. Our survey is the first to target both traditional practitioners and the inhabitants of this region.

Material and methods

Study area

Adrar is located in the Algerian Sahara in the southwest of the country, 1543 km from the capital-Algiers. It is bordered to the north by the wilaya (administrative division of Algeria) of El-Bayadh, to the north-west by the wilaya of Bechar, to the west by the wilaya of Tindouf, to the south by Mali, to the south–west by Mauritania, to the south–east by the wilaya of Tamanrasset, and to the north–east by the wilaya of Ghardaia (Fig. 1). Its geographical coordinates are: Latitude: 26°03′ to 28°03′ North, Longitude: 0°30′ East to 0°30′ West with mean altitude of 222 m (see Fig. 2).

It is composed of 11 dairas (subdivisions of the wilaya), 28 communes (smallest administrative division headed by a mayor) and 294 ksours (fortified villages of Berber architecture), all divided into four regions: the Gourara (4 dairas) constituting the northern part of the wilaya and the Touat (5 dairas) the central part. The Tidikelt in the south-eastern region, and the Tanezrouft in the south-western part. The latter is difficult to access due to the lack of transport and was not included in the study (Fig. 1).

The population of Adrar is estimated to be 5,13,966 according to the general census of population and housing of 2018 (ONS 2018).

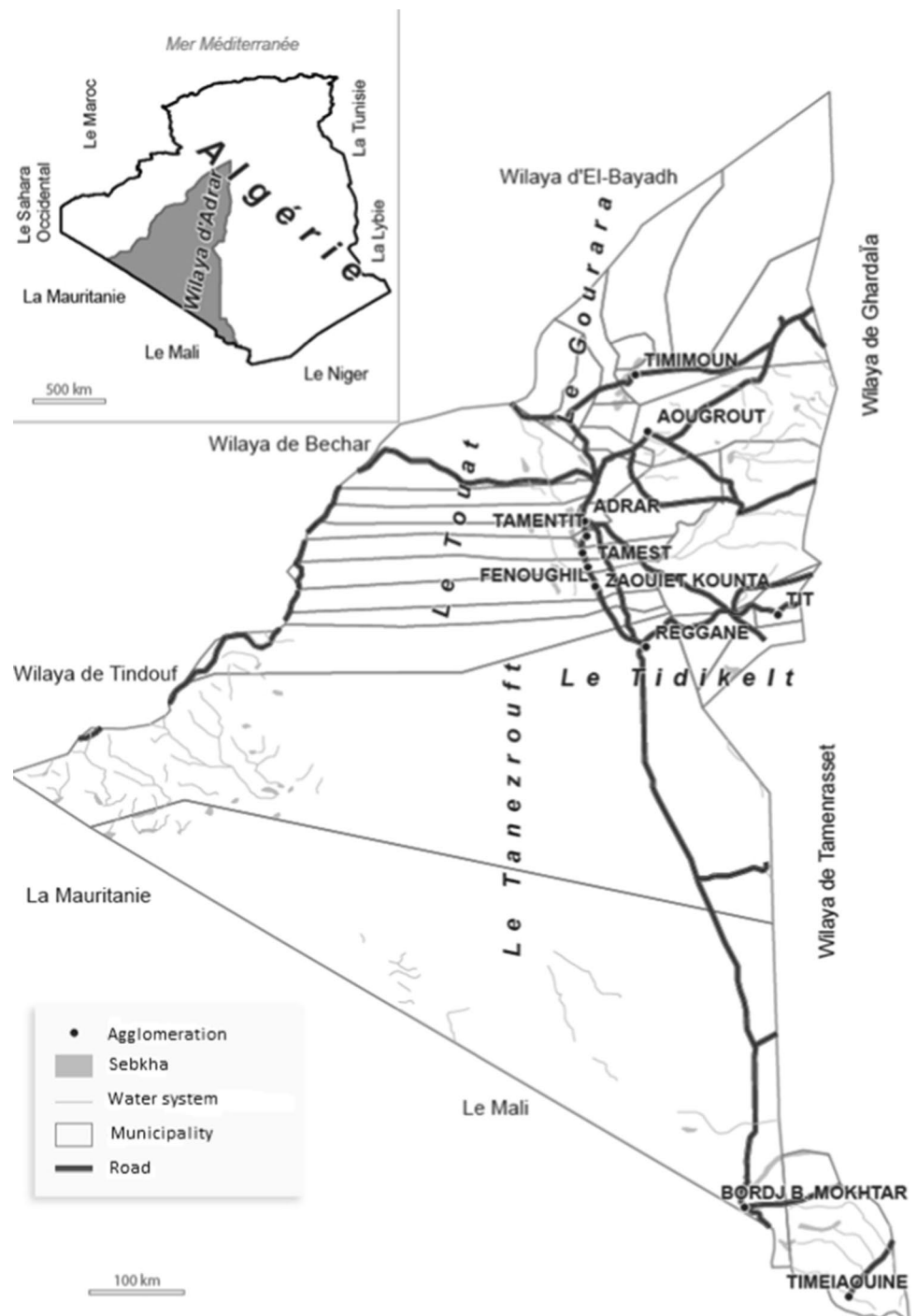
Two climates predominate in the region viz. the pre-Saharan (semi-desert) from Timimoun to the west of Bechar and the Saharan (desert) at Timiaouine in the south. The ambient temperature can exceed 45 °C in summer and is often low in winter, reaching 0 °C in December and January (INSID 2021). Rainfall is irregular and frequently less than 20 mm per month.

The Adrar region is characterized by a desertic relief, subdivided into Reg (horizontal surface covered with gravelly debris) (Boutadara and Ali 2009); the Tadmait plateau with an average altitude of 500 m (Bellal et al. 2016); Erg (accumulation of sand brought by the wind in different aspects) (Moulay 2014); sabkhas (depressions with salty soils and no vegetation).

Ethnobotanical survey

The survey was conducted with 20 traditional practitioners (13 herbalists and 7 healers), as well as 206 subjects from the local population, over a period of 8 months (October 2019–May 2020). Two questionnaires were prepared (Supplementary File 1), one for traditional healers and another for the inhabitants of the region. They were in two languages (Arabic and French) so that it can be understood by

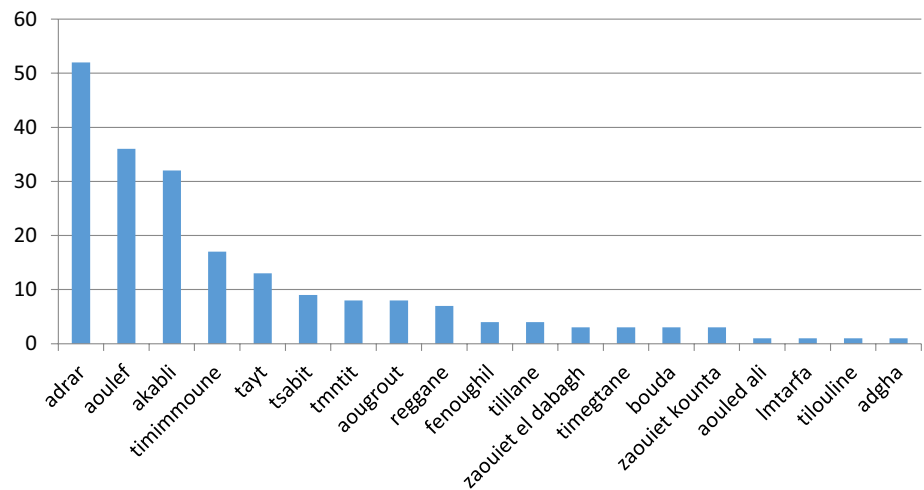
Fig. 1 Geographical location of the wilaya of Adrar. Source: ONS (2018)



all participants. The questions were combined from different similar surveys in order to gather as much information as possible about the interviewee and the plants concerned (Bouasla and Bouasla 2017; Tahraoui 2007). The interviews with traditional healers were oral, direct and face-to-face in which respondents were asked questions about the basic survey information (age, level of education, etc.) and used plants (used part, method of preparation, etc.).

The survey of the population was carried out using questionnaire forms in Arabic and French which contained questions about the informant (age, sex, academic level, family situation and therapeutic practice) and the ethnobotanical knowledge (preparation methods, the uses of medicinal plants.). Respondents were approached at home, markets, herbal shops, pharmacies and health facilities in the area, who were available for the survey. Explanation of the context

Fig. 2 Distribution of the surveyed population by place of residence



and purpose of the study were provided at the beginning of the survey. They were interviewed orally with the dialect of the region, in cases wherein people were unable to answer the questionnaire by themselves.

Informant consent was obtained verbally before starting the questionnaire, and the ethical guidelines prescribed by the International Society of Ethnobiology were respected (Society of Ethnobiology Code of Ethics 2022).

The species were identified using different references on the Saharan flora (Quézel and Santa 1963, Ibn-Tattou 2008; Belakhdar, 1998; Trabut 1935; Merad 1973).

The scientific names of the species were checked on www.theplantlist.org. Voucher specimens were kept in the pharmacognosy laboratory of the Pharmacy Department at the Faculty of medicine- Dr. Benaouda Benzerdjeb.

Data analysis

The data was analyzed using IBM-SPSS Statistic 23, while graphical representations were made using Microsoft Office Excel®. Quantitative data analysis was conducted by using following:

- The Relative Frequency of Citation (RFC) is an index used to demonstrate the local importance of each plant species. It was calculated based on the frequency of citation (F_c) is the number of informants, who mentioned the use of a plant species) divided by the total number of informants (N) who participated in the study (Tardio and Pardo-de-Santayana 2008).

$$RFC = F_c/N$$

- The fidelity level (FL) was calculated to quantify the importance of a species for a given disease. It is the ratio of the number of informants citing the species for a given disease (N_p) to the total number of informants citing the plant for any disease (N) (Phillips and Gentry 1993):

$$FL = N_p/N \times 100.$$

- Informant consensus factor (ICF) measures the homogeneity of information among informants on the medicinal uses of plants. ICF values are low (close to 0) if plants are randomly selected or if there is little exchange of information between the population. They approach 1 when informants agree on the use of the plants concerned (Trotter and Logan 1986). It was calculated according to the formula:

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

where, Nur is the number of citations used in each category and Nt is the number of species reported in each category.

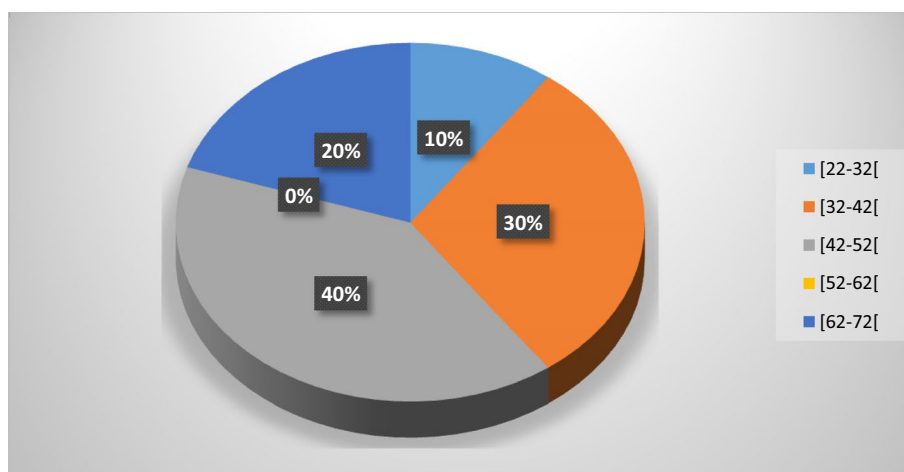
Results and discussion

Profile of the study population

Traditional practitioners

Majority of the traditional practitioners (65%) were men, as against 35% in women category. It is probably due to the culture and traditions of the region, where women are not encouraged to work outside the family environment (Boudjelal et al. 2013), nor to converse with strangers (Miara et al. 2019b). Most of the traditional practitioners were aged between 32 and 52 years (Fig. 3) and the same age range was

Fig. 3 Distribution of traditional healers by age group



observed in other regions of the country (Boudjelal et al. 2013). This could be due to the time required to gain the necessary experience to be able to practice this profession. Sixty percent of the respondents acquired their knowledge through experience, 35% received trainings and 5% through family initiation.

The number of herbalists (65%) was greater than that of healers (35%). This is because many herbalists come from other regions to settle in Adrar. Their number is growing. There were 150 herbalists in 2017, which increased to 161 in 2020 (Ministère Algérien du commerce 2020). It is also due to the carefully guarded secret of the healer's profession. To become a healer, the person concerned must be trained by another recognized healer, which is called "techyakh" in the region. The practice of herbal medicine in the country does not require any diploma or license and a trade register is considered enough. The herbalists interviewed fell into two categories: first category with 3 Herbalists who sold spices, dried plants and mixtures prepared with the powders and honey called "agda" (أغدة) to treat certain diseases such as anemia and weight loss. Second category included 4 Herbalists specializing in the sale of packaged herbal products such as herbal teas.

Population of the region

Of the 206 patients interviewed, 84% reported using plants, 68.4% of them were women and most (30.46%) were aged between 28 and 38 years. About 55.4% lived in rural areas and 35.63% were illiterate (Table 1). Significant rates of herbal medicine use have also been reported in other regions of the country such as Annaba, El Taref, Tiaret, Mascara and Ouargla (Benarba 2015; Bouzabata et al. 2020; Miara et al. 2013; Telli et al. 2016). The small number of pharmacies in the region, high cost of medicines and lack of infrastructure/modern medical personnel may explain this (Fundiko 2017). We also noticed that the

Table 1 The socio-demographic characteristics of respondents

		C characteristics	n (%)
Herbalists and healers	Age	22–32	4 (20.00)
		32–42	7 (35.00)
		42–52	7 (35.00)
		> 62	2 (10.00)
	Sex	Female	7 (35.00)
		Male	13 (65.00)
Population interviewed	Age	18–28	49 (23.78)
		28–38	72 (34.95)
		38–48	39 (18.93)
		48–58	21 (10.19)
		58–68	16 (7.76)
		> 68	9 (4.36)
	Sex	Female	129 (62.60)
		Male	77 (37.40)
	Educational level	Illiterate	67 (32.50)
		Primary school	23 (11.20)
		Middle school	23 (11.20)
High school		33 (16.00)	
	University	60 (29.10)	

population trusts everything that is natural and has easy access to medicinal plants. Patients are often dissatisfied with their doctors and also want to avoid the side effects of medicines.

A relationship between use of traditional medicine and gender was observed. Women used plants more frequently than the men. This result is similar to that was reported earlier (Boughrara 2016). This is because of their

responsibilities as mothers, they administer first aid especially to their children and participate in group discussions.

Of the respondents, 55.4% of plant users lived in urban areas. The living area did not influence the use of herbal medicine ($p=0.27 > 0.05$). This is in line with other studies conducted in the USA, Uganda and Tlemcen (Loman 2003; Nuwaha and Musinguzi 2013; Saïdi and Ali Belhadj 2016). This again proves that the idea we have that people in rural areas use plants more commonly is wrong. Also age and education level have no relation with the use of herbal medicines ($p=0.06 > 0.05$; $p=0.22 > 0.05$). The lifestyle and culture of the inhabitants of Adrar meant that the use of herbal medicine affected all age groups regardless of their level of education. A similar result was observed in the region of Tlemcen (Achouri and Cherki 2018). However, this was contradictory to Telli et al. (2016), where plants were used by people with a lower level of education or (Saïdi and Ali Belhadj 2016) where elderly people were the ones who used plants the most.

Phytotherapy in the region of Adrar

Diversity of plants used

Our study identified 126 species belonging to 47 families cited by traditional healers and inhabitants of the Adrar region. Table 3 summarizes the results obtained, in which the species are listed in alphabetical order. This number is higher than that reported (46 to 84 species) in other studies in the region (Benarba 2016; Yasser et al. 2018; Amrouche et al. 2019). The diversity of plant species obtained is related to the degree of knowledge and uses of the plants by the population of Adrar as well as the fact that we targeted traditional practitioners along with plant users. Most of these plants (77.3%) grew spontaneously (42.3%) or were

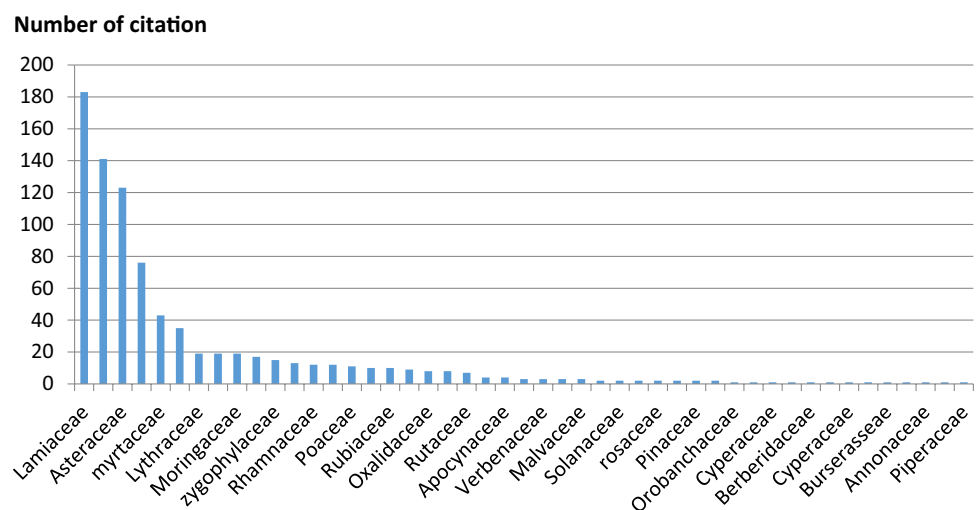
cultivated (57.7%) in the region and 22.7% were introduced either from other wilayas or from other countries.

The most dominantly represented family was Lamiaceae with 21.9% contribution (Fig. 4), in contrast to the Touat region wherein members of Asteraceae were the most commonly used (Yasser et al. 2018). This was followed by Apiaceae family with 16.8% and Asteraceae family with 14.8%. The Lamiaceae family was in the majority in other studies conducted locally in Msila, Bordj Bouarriridj and Ouergla (Madani et al. 2012; Miara et al. 2019a; Telli et al. 2016); as well as in the Mediterranean region (Benítez 2010). This can be explained by the fact that this family is among the ones with the most medicinal species (Benítez 2010) as well as the richness of the region's flora with species belonging to the Lamiaceae (Telli et al. 2016).

Plants parts used and preparation methods

The most commonly used parts for preparation were leaves (30.8%), followed by fruits (22.73%), aerial parts (15.19%) and stems (13.6%) (Fig. 5). Several authors in different regions (Constantine, Mila, Sétif, Mascara and Skikda) of Algeria (Benarba 2016; Chermat and Gharzouli 2015; Ouelbani et al. 2016) and in other Mediterranean countries (Benítez 2010; Eddouks et al. 2017) have noted the predominant use of leaves. Their ease and speed of harvesting compared to other plant parts and being the site of photosynthesis and storage of secondary metabolites have led to their increased use (Francis Xavier et al. 2015). Two species had more than one part used for medicinal purposes: *Zea mays* whose styles called (*lekbel*) and seeds (*tafsout*) could be used for the treatment of urinary system problems. Also, *Myrtus communis*, whose leaves (*rayhan*) were used to relieve gastrointestinal problems, and the aerial parts (*edrou*) against cardiovascular diseases.

Fig. 4 Distribution of families by number of citations



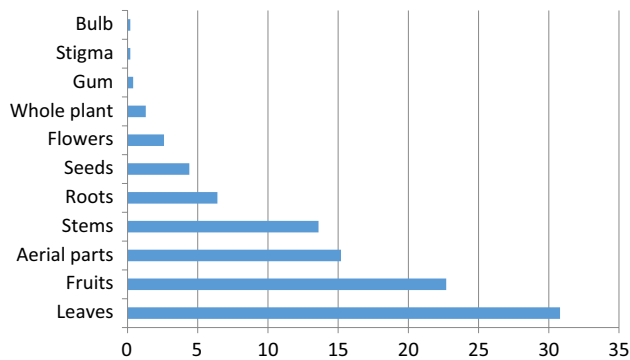


Fig. 5 Distribution of plant parts used

The drugs were mainly used orally (74.6%), followed by external route (22.4%) and fumigation (3.2%). The duration of use did not exceed 15 days. The oral route was the main one used in other regions of the country (Benarba 2016; Chermat and Gharzouli 2015; Saïdi and Ali 2016) as well as in other African countries such as Ghana and Cameroon (Asase and Kadera 2014; Etame-Loe et al. 2018).

Most of the formulations were prepared by infusion (53.3%), which was also in accordance with other reports (Miara et al. 2019b; Ouelbani et al. 2016). This may be related to the nature of active components contained in the used parts, ease of preparation, ease of administration and maintenance of effectiveness of the components without degrading them at high temperature.

Most of the species mentioned (70%) were used in mixtures with other plants or non-vegetable ingredients. The use of mixtures of different species can result in a synergistic effect as well as the mitigation of toxicity or adverse effects of some of the plants in the mixture (Bruschi 2011). The addition of ingredients such as honey, milk, olive oil or sugar aims to improve the acceptability of some plants with an unbearable bitter taste. Honey and milk remained the most commonly used adjuvants. Similar results have been reported in Mascara, Algeria and even in other countries such as India and Argentina (Benarba 2015; Bhatia et al. 2015; Zamudio et al. 2010).

Most cited species

Based on the information obtained from the population of the study area, the different health problems were classified into seven categories (Table 2). Of the 126 species, 86 plants were cited only once or twice and 16 plants had more than 16 citations. The most cited species were: *Artemisia herba-alba* Asso. (60 citations), *Origanum vulgare* L. (51 citations), *Foeniculum vulgare* L. (42 citations), *Mentha spicata* L. (39 citations), *Trigonella*

Table 2 Categories of different ailments (Benarba 2016)

Category	Ailments
Cardiovascular system diseases	Hypercholesterolemia, high blood pressure, heart troubles
Gastro-intestinal system diseases	Bloating, constipation, indigestion
Metabolic disorders	Diabetes, goiter
Respiratory tract diseases	Bronchitis, asthma, cold, flu
Skeleto-muscular diseases	arthritis, rheumatism
Skin diseases	Burns, fungal infections
Urogenital diseases	Kidney Stones, infections

foenum graecum L. (31 citations) (Table 3). Many surveys revealed that *Artemisia herba-alba* Asso. was the most used species in the country (Benarba 2016; Boudjelal et al. 2013; Bouzabata et al. 2020; Telli et al. 2016). *Origanum vulgare* L. was the most used plant by the population of Mila (Ouelbani et al. 2016).

Artemisia herba-alba is mainly used in urogenital and respiratory diseases. In Algeria, this plant has been reported by numerous studies for its use against ulcers, indigestion, diarrhea, stomach problems, inflammation, diabetes, hypertension, colds and bronchitis (Chehma and Djebbar 2008; Ouelbani et al. 2016; Hassaine et al. 2019; Tahraoui 2007).

A. herba-alba use in respiratory and urogenital diseases may be due to its richness in terpene compounds: 1,8-cineole, β -thujone, α -thujone and camphor; which gives it an antiseptic power by excellence. High antidiabetic and anticholesterolemic activities were recorded from leaf extracts in different studies (Gacem et al. 2020).

In our survey, *Origanum vulgare* was used in skin diseases (pimples), respiratory tract diseases, metabolic disorders and gastrointestinal system disorders. The same plant has been reported for its benefits in respiratory problems, hypertension, diuretic, antiseptic, eczema, rheumatic pain, tumor, digestive problems antispasmodic, carminative and emmenagogue properties (Boudjelal et al. 2013; Miara et al. 2019a; Ouelbani et al. 2016). This plant has been the subject of several studies, demonstrating its cytotoxic, antiproliferative and anticancer activity. This effect was attributed to the high concentration of rosmarinic acid (Koldaş et al. 2015). Cytotoxicity of the essential oil has been demonstrated on human colon adenocarcinoma cells (Beghini et al. 2014). Its activity on lipoxigenase has been demonstrated, hence its anti-inflammatory activity (Koukoulitsa et al. 2006). The essential oil of *O. vulgare* is rich in carvacrol and/or thymol, linalool, *p*-cymene and polyphenols (flavonoids and phenolic acids), which have antiseptic properties and thus this plant was very commonly used in the respiratory affections (Gacem et al. 2020).

Table 3 List of the most frequently used medicinal plants in the region of Adrar

Family	Plant name/Number of voucher	Local name	Used part	Ailment category: (n) of use reports	Method of preparation	Use citations	RFC	Recorded literature uses	References
Amaranthaceae	<i>Haloxylon salicornicum</i> Pomet. SHT-037	Ramt	Infusion	Urogenital diseases (2)	Leaves	2	0.008	Insect stings (externally), antiseptic, anti-inflammatory, intestinal ulcers, diuretic, kidney diseases	Arshad et al. (2002), Ashraf et al. (2013, 2015), Taïbi et al. (2021)
	<i>Chenopodium ambrosioides</i> L. SHT-069	Mkhinza	Decoction	Urogenital diseases (2)/Respiratory tract diseases(1)/Gastro-intestinal system disorders (1)	Leaves	2	0.008	Anthelmintic, tonic, astringent, antispasmodic, emmenagogue, euppeptic and digestive, fever	Brigunche et al. (2015), Teixidor-Toneu et al. (2016)
Amaryllidaceae	<i>Allium cepa</i> L. SHT-038	Bssal	Raw	Cardio-vascular system diseases (4)	Bulb	4	0.017	Kidney, skin and respiratory ailments,	Eddouks et al. (2017)
	<i>Allium sativum</i> L. SHT-002	Thoum	Raw	Cardio-vascular system diseases (4)	Bulb	4	0.017	Hypertension, Respiratory and eye diseases, kidney disorders, intestinal parasites, hemorrhoids	Miara et al. (2013), Hassaine et al. (2019)
Annonaceae	<i>Xylopia aethiopica</i> (Dunal) A.Rich. SHT-039	Oud kermi	Powder	Cardio-vascular system diseases (1)	Fruits	1	0.004	Cancer, anti-inflammatory, diabetes, cardio-vascular diseases, anti-emetic, asthma	Fetse et al. (2016), Soladoye et al. (2010)
Arecaceae	<i>Phoenix dactylifera</i> L. SHT-040	Tamr	Raw	Urogenital diseases (1)	Fruits	1	0.004	Fever, diuretic, anxiety, intestinal troubles, urogenital diseases, vertigo, diabetes, hypertension	Sadeghi and Kulestani, (2014), Selmani et al. (2017)
Aristolochiaceae	<i>Aristolochia longa</i> L. SHT-041	Berrostom	decoction	Cancer (1)	Roots	2	0.008	Tumor, wound, healings	Boudjelal et al. (2013), Chevallie (1996)
Apiaceae	<i>Ammi visnaga</i> (L.) Lam. SHT-042	Khella	Infusion	Gastro-intestinal system disorders (1)	Seeds	1	0.004	Asthma, Renal lithiasis, joints pains, Stomachache, Heart attack	Bouasla and Bouasla (2017)
	<i>Ammaducius leucorichius</i> Coss. SHT-047	Oum dhriga	Fumigation	Gastro-intestinal system disorders (25)	Seeds	25	0.11	digestive disorders, vomiting, allergies, palpitations, fever	Chehema and Djebar (2008), Hammiche and Maiza (2006)
	<i>Ammoides pusilla</i> (Brot.) SHT-003	noukha	Infusion	Cardio-vascular system troubles(2)/Respiratory tract diseases(2)	Leaves	2	0.008	Hypertension, flu, vertigo, tonic	Benarba (2016)
	<i>Apium graveolens</i> L. SHT-004	Krafes	Infusion	Metabolic disorders (1)	Leaves	1	0.004	Hypertension, Flatulence, Anxiety, Skin care,vertigo, kidney infections, lithiasis	Bouasla and Bouasla (2017), Boughrara (2016), Hassaine et al. (2019), Taïbi et al. (2021)
	<i>Bunium bulbocastanum</i> L. SHT-046	Terghouda	Decoction	Metabolic disorders (2)	Roots	2	0.008	Intestinal gaz and stomach colic	(Miara et al. (2019a)
	<i>Carum carvi</i> L. SHT-008	Kerwia	Infusion	Gastro-intestinal system disorders (4)	Fruits	4	0.0017	Hypertension, appetite, lactation, rheumatism, anxiety, antispasmodic, carminative	(Merzouki et al. (2000), Ouelbani et al. (2016), S. Hassaine et al. (2019)

Table 3 (continued)

Family	Plant name/Number of voucher	Local name	Used part	Ailment category: (n) of use reports	Method of preparation	Use citations	RFC	Recorded literature uses	References
	<i>Cortandrum sativum</i> L. SHT-013	Kosbor	Infusion	Gastro-intestinal system disorders (17)	Fruits	17	0.07	hypertension	Hassaine et al. (2019)
	<i>Cuminum cyminum</i> L. SHT-044	Kemmoun	Infusion	Metabolic disorders(20)/Gastro-intestinal system disorders (20)	Fruits	20	0.08	Digestive problems, lactation, anti-spasmodic, carminative inflammation of the urinary tract	Eddouks et al. (2017), Miara et al. (2019a)
	<i>Daucus carota</i> L. SHT-045	Djazar	Decoction	Urogenital diseases (4)	Seeds	4	0.017	Contraception, aphrodisiac, carminative, diuretic, emmenagogue, nerve tonic and stimulant. To treat dropsy, chronic dysentery, kidney ailments, uterine pain and worms. Obstructions of the viscera, dropsy, jaundice, and scurvy	Jansen and Wohlmuth (2014), Kumarasamy et al. (2005)
	<i>Ferula foetida</i> St.-Lag. SHT-048	Lahnatit	powder	Skeleto-muscular diseases (2)	Gum	2	0.008	Diuretic, antispasmodic, anthelmintic, colics, emmenagogue	Amiri and Joharchi (2016), Mohammadhosseini et al. (2019)
	<i>Foeniculum vulgare</i> L. SHT-043	Besbas	Infusion	Gastro-intestinal system disorders (42)	Seeds	42	0.18	Antispasmodic, diabetes, rheumatism, muscular problems, intestinal gaz, diarrhea	Eddouks et al. (2017), Miara et al. (2019a)
	<i>Peucedanum ostruthium</i> L. SHT-049	Eljawi	Powder	Gastro-intestinal system disorders (1)	Gum	1	0.004	Joint pains, painful limbs, diuretic, fever, chronic indigestion, externally for ulcers and cancer	Adams et al. (2009), Sarkhaal (2014)
	<i>Petroselinum sativum</i> Hoffm. SHT-029	Maâdhous	Infusion	Cardio-vascular diseases (1)	Leaves et seeds	1	0.004	Acne, diuretic, hypertension, heart attack	Benarba (2015)
	<i>Pimpinella anisum</i> L. SHT-030	Habbet hlawa	Infusion	Respiratory tract diseases (21)	Fruits	21	0.09	Stomachache, flu, anxiety, insomnia, lactation, pain, digestive, diuretic, spasmolytic, expectorant, carminative	Bouasla and Bouasla (2017), Ouelbani et al. (2016)
Apocynaceae	<i>Solenostemma argel</i> (Delile) Hayne. SHT-050	Ghlachem- Adkhir	Decoction	Metabolic disorders (4)	Stems	4	0.017	Diabetes, respiratory diseases, Rheumatism, fever, abdominal pain	Madani et al. (2014), Ramdane et al. (2015)
Asphodelaceae	<i>Asphodelus tenuifolius</i> Cav SHT-051	Eitaziya	Decoction	Gastro-intestinal system disorders (1)	Whole plant	1	0.004	hemorrhoids	Qurashi (2008)

Table 3 (continued)

Family	Plant name/Number of voucher	Local name	Used part	Ailment category: (n) of use reports	Method of preparation	Use citations	RFC	Recorded literature uses	References
Asteraceae	<i>Anvillea radiata</i> Cross. et Durieu. SHT-059	Nkedd	Infusion	Gastro-intestinal system disorders (2)/Metabolic disorders(2)	Leaves	2	0.008	diabetes	Snoussi et al. (2016)
	<i>Artemisia absinthium</i> L. SHT-057	Setret meriem	Powder	Urogenital diseases (4)	Whole plant	4	0.017	Diabetes, hypertension, vermifuge, cholagogue stomachic, anti-inflammatory , diuretic	Boudjelal et al. (2013)
	<i>Artemisia campestris</i> L. SHT-058	Goffet	Infusion	Cardio-vascular system diseases (2)	Leaves	2	0.008	Diabetes, hypertension	Boudjelal et al. (2013)
	<i>Artemisia herba-alba</i> Asso. SHT-005	Echih	Infusion	Against parasites (1)/Urogenital diseases (1)/Respiratory tract diseases (59)/eye diseases (1)	Aerial parts	60	0.26	Indigestions, rhumes, stomach pain , ulcer, anti-inflammatory, diabetes, bronchitis, hypertension, diarrhea	Chehma and Djebar (2008), Ouelbani et al. (2016), Hassaine et al. (2019), Tahraoui (2007)
	<i>Conula cinerea</i> Delile. SHT-052	Elgartoufa	Decoction	Urogenital diseases (15)/Respiratory tract diseases(1)/Gastro-intestinal system disorders (1)	Aerial parts	15	0.06	Pharyngitis, migraine, stomachache, bronchopulmonary problems, coughing, nausea and vomiting, sunstroke, rheumatism.	Benarba (2016), Benhouhou (2005)
	<i>Lepidium sativum</i> L. SHT-053	Habb erchad	Decoction	Skeleto-muscular diseases (12)/Respiratory tract diseases(13)/Metabolic disorders(13)	Seeds	13	0.05	Purification, Stomachache, insomnia, Rheumatism. Skin care.	Bouasla and Bouasla (2017)
	<i>Matricaria chamomilla</i> L. SHT-054	Babounj	infusion	Gastro-intestinal system disorders (12)	Flowers	12	0.05	Cardio-vascular diseases, respiratory diseases, boils, anxiety, anti-inflammatory	Boudjelal et al. (2013), Miara et al. (2019a), Ouelbani et al. (2016)
	<i>Matricaria pube-scens</i> (Desf.) Lipsch. SHT-060	wazwaza	decoction	Respiratory tract diseases (1)	Whole plant	1	0.004	Troubles neurologiques, gastrointestinal disorders, calculus, otitis	Benhouhou (2005), Yasser et al. (2018)
	<i>Saussurea costus</i> (Falc.) Lipsch. SHT-056	Kist Hindi	decoction	Metabolic disorders(6)/Gastro-intestinal system disorders (6)	Roots	6	0.026	Anti-inflammatory, diuretic, anti-septic, expectorant, hypertension	Ansari (2021)
	<i>Taraxacum officinale</i> L. SHT-061	Hendbaa barriya	Decoction	Gastro-intestinal system disorders (1)	Stems, Flowers, Roots.	1	0.004	Colon ailments, stomachache, constipation	Senouci et al. (2019)
Berberidaceae	<i>Berberis vulgaris</i> L. SHT-007	Oud ghriss	Decoction	Metabolic disorders (1)	Roots	1	0.004	Cancer, cholesterol, stomachache, diabetes, cough, skin infection, hypertension	Benarba (2016), Benarba (2015)

Table 3 (continued)

Family	Plant name/Number of voucher	Local name	Used part	Ailment category: (n) of use reports	Method of preparation	Use citations	RFC	Recorded literature uses	References
Brassicaceae	<i>Brassica rapa</i> subsp. <i>Rapa</i> L. SHT-062	Left	Decoction	Skeleto-muscular diseases (1)/Respiratory tract diseases (1)/Metabolic disorders (1)	Leaves/Roots	1	0.004	Kidney stones	Abbasi et al. (2019)
	<i>Erica Sativa</i> Mill. SHT-063	Jarjir	Infusion	Gastro-intestinal system disorders (1)	Leaves	1	0.004	Diuretic, appetitive, digestive, stomachic, urinary infection, fracture	Bouasia and Bouasia (2017), Miara et al. (2019a), Kizwana et al. (2016)
		Elharra	Decoction	Cardio-vascular system diseases(7)/Respiratory tract diseases(7)/Metabolic disorders(7)/Gastro-intestinal system disorders (7)	Seeds	7	0.03		
Burseraceae	<i>Pistacia lentiscus</i> L. SHT-064	Oum ennas	Powder	Gastro-intestinal system disorders (1)	Gum	1	0.004	Uro-genital diseases, skin problems, edema, tooth care, labor pains, asthma	Miara et al. (2013), Ouelbani et al. (2016)
Cactaceae	<i>Opuntia ficus-indica</i> L. SHT-065	Sebbar	Infusion	Respiratory tract diseases (1)	Leaves	1	0.004	Hemorrhoids, diarrhea, respiratory system diseases, bladder inflammation, prostate enlargement	Meddour and Meddour-Sahar (2015), Ouelbani et al. (2016), Taïbi et al. (2021)
Capparaceae	<i>Capparis spinosa</i> L. SHT-066	Kabbar	Infusion	Cardio-vascular system diseases(2)/Metabolic disorders(2)/Gastro-intestinal system disorders (2)	Leaves	2	0.008	Skin problems, chologogue, diabetes, emmenagogue, antiseptic, inflamed wounds, cardio-vascular and respiratory system	Güzel et al. (2015), Merzouki et al. (2000), Ouelbani et al. (2016)
	<i>Cleome amhyocarpa</i> Baratte et Murb. SHT-067	Niel	Powder	Skeleto-muscular diseases (1)	Leaves	1	0.004	Bacterial infections, rheumatic pain, diuretic, kidney problems	Burkill (1985), Mossa (1987)
Caryophyllaceae	<i>Arenaria serpyllifolia</i> L. SHT-068	Herraset lahджер	Infusion	Urogenital diseases (1)	Whole plant	1	0.004	bladder diseases, calculus troubles, chronic cystitis, along with minerals medicinal stones, used to promote kidney functions	Ballabh et al. (2008), Chandra and Rawat (2015)
	<i>Corrigiola telephifolia</i> Pourr. SHT-103	Boughellab	Decoction	Metabolic disorders (1)	Seeds	1	0.004	flu, dermatological diseases, inflammation, ulcer, coughs, jaundice, anaesthetic, diuretic	Chandra and Rawat (2015)
	<i>Spergularia rubra</i> (L.) J.Presl & C.Presl. SHT-070	Bssat lemlouk	Infusion	Urogenital diseases (1)	Flowers	1	0.004	Diuretic and kidney pain, anti-septic,	Bouasia and Bouasia (2017), Chandra and Rawat (2015), Ouelbani et al. (2016)
Chenopodiaceae	<i>Atriplex halimus</i> L. SHT-071	Ktef	Infusion	Urogenital diseases (17)	Leaves	17	0.07	Cancers, goitre, skin oedemas, dermatological problems, eczema, diabetes, heart diseases, stomach, emmenagogue, cystis, lithiasis, pyelonephritis	Ahmed and Réda (2021), Bellifa et al. (2020), Benarba (2015), Boudjelal et al. (2013), Taïbi et al. (2021)

Table 3 (continued)

Family	Plant name/Number of voucher	Local name	Used part	Ailment category: (n) of use reports	Method of preparation	Use citations	RFC	Recorded literature uses	References
Cucurbitaceae	<i>Citrullus colocynthis</i> (L.) Schrad. SHT-072	Hadja	Powder	Urogenital diseases (6)/Skin diseases (6)/Metabolic disorders (6)	Fruits	6	0.026	Hemorrhoids, hypertension, cancer, rheumatism, diabetes, urogenital diseases, dermatological problems, gynecological diseases	Benarba (2016), Boudjelal et al. (2013), Hussain et al. (2014), Ouelbani et al. (2016)
	<i>Cucurbita maxima</i> Duchesne. SHT-073	Zerriaat el kabouya	Decoction	Gastro-intestinal system disorders (1)	Seeds	1	0.004	Nervous system disorders, migraine	(Adnan et al. (2017), Benarba (2015, 2016), Ouelbani et al. (2016)
	<i>Cucurbita pepo</i> L. SHT-069							Duoretic, tonic, fever, bronchitis, stomach ulcer, hemorrhoids, asthma, scabies, respiratory and urinary system problems	Benarba (2015, 2016), Ouelbani et al. (2016)
	<i>Echballium elaterium</i> L.A.Rich. SHT-074	Fekkous lehmir	Decoction	Cardio-vascular system diseases (1)	Fruits	1	0.004	Hepatic diseases, hemorrhoids, migraine, poison, emetic, anorexia, mental nervous system, cardio-vascular diseases	Boudjelal et al. (2013), Meddour and Meddour-Sahar (2015), Merzouki et al. (2000), Ouelbani et al. (2016)
Cupressaceae	<i>Juniperus phoenicea</i> L. SHT-075	Araâr	Decoction	Respiratory tract diseases (19)	Aerial parts	19	0.084	Stomach pain, gases, antiseptic, thyroid, hypertension, anti-inflammatory	Benarba (2016), Ouelbani et al. (2016)
Cyperaceae	<i>Cyperus esculentus</i> L. SHT-076	Hab laâziz	Decoction	Gastro-intestinal system disorders (1)	Seeds	1	0.004	Infertility	(Agbodjento et al. (2020)
	<i>Cyperus rotundus</i> L. SHT-077	Tara	Decoction	Respiratory tract diseases (1)	Roots	1	0.004	Sedative, vermifuge, carminative, fever, cough, stomach disorders, vomiting, anthelmintic, scorpion stings	EL-Kamali (2009), Joshi (2005)
Euphorbiaceae	<i>Ricinus communis</i> L. SHT-078	Kherwaâ	Infusion	Gastro-intestinal system disorders (1)	Leaves	1	0.004	Sterility, breast pain, urine alkalisation, lactation, to treat cow jaundice, fever, dermatological problems, skeletal-muscular system problems, constipation, respiratory infections, skin care	Bouasia and Bouasia (2017), Merzouki et al. (2000), Ouelbani et al. (2016)

Table 3 (continued)

Family	Plant name/Number of voucher	Local name	Used part	Ailment category: (n) of use reports	Method of preparation	Use citations	RFC	Recorded literature uses	References
Fabaceae	<i>Acacia gummifera</i> Willd. SHT-079	Neguir	Infusion	Respiratory tract diseases (2)	Leaves	2	0.008	Cough, bronchitis, hypertension	Benarba (2015), Ouarghidi et al. (2013)
	<i>Acacia arabica</i> (Lam.) Willd. SHT-080	Samgh el arabi	Powder	Urogenital diseases (3)	Gum	3	0.013	Kidney stones, Respiratory problems	Jaradat et al. (2017), Yasser et al. (2018)
	<i>Cassia angustifolia</i> Vahl. SHT-081	Hagagar-Flagit	Decoction	Gastro-intestinal system disorders (21)	Leaves	21	0.092	Digestive problems, carminative	Miara et al. (2019a)
	<i>Glycyrrhiza glabra</i> L. SHT-082	Ark essous	Decoction/powder/fumigation	Respiratory tract diseases(9)/Gastro-intestinal system disorders (9)	Roots	9	0.039	Emuresis, cardiovascular diseases, nervous system diseases, diuretic, anti-inflammatory, cough, digestive system problems, respiratory system problems, allergy	Jamila and Mostafa (2014), Jaradat et al. (2017), Merzouki et al. (2000), Ouelbani et al. (2016)
	<i>Lupinus luteus</i> L. SHT-083	Termes	Decoction	Skeleto-muscular diseases(1)/Metabolic disorders(1)	Seeds	1	0.004	Diabetes, Nervous weakness, digestive disorders, hypertension	Belhaj et al. (2021), Benarba (2015, 2016)
	<i>Lupinus albus</i> L.								
	<i>Medicago sativa</i> L. SHT-084	Fessa	Decoction	Metabolic disorders (1)	Seeds	1	0.004	Diabetes	(Belhaj et al. (2021)
	<i>Phaseolus vulgaris</i> L. SHT-085	Fassouliya sawda	Decoction	Urogenital diseases (1)	Seeds	1	0.004	Diabetes, renal failure	(Belhaj et al. (2021), Jaradat et al. (2017)
	<i>Quercus infectoria</i> L. SHT-086	Debgba	Decoction	Skin diseases(5)/Gastro-intestinal system disorders (5)	Fruits	5	0.022	Ulcer, hemorrhoids, colon, prostatic enlargement, wounds, hair strength	Benarba (2016), Jaradat et al. (2017)
	<i>Retama raetam</i> (Forssk.) Webb. SHT-087	Rtem	Infusion	Against parasites (1)/Respiratory tract diseases (1)/Metabolic disorders (1)	Leaves	1	0.004	Fever, diarrhea, furuncles, vermifuge, anti-inflammatory, scorpion stings, eczema	Boudjelal et al. (2013), Ould El Hadji et al. (2003)
	<i>Trigonella foenum graecum</i> L. SHT-088	Helba	Decoction	Skin diseases(31)/Metabolic disorders(31)/Gastro-intestinal system disorders (31)	Seeds	31	0.13	Galactogen, hypoglycemic, appetitive, bronchitis, stomach pains, anemia, digestive problems, respiratory diseases, diuretic, anti-inflammatory	Eldouks et al. (2017), Miara et al. (2019a), Ouelbani et al. (2016)
	Iridaceae	<i>Vigna unguiculata</i> (L.) Walp. SHT-089	Tedlagh	Decoction	Metabolic disorders(2)/Respiratory tract diseases(2)	Seeds	2	0.008	strengthen the stomach
<i>Crocus sativus</i> L. SHT-090		Zâafran	Infusion	Metabolic disorders (2)	Stigma	2	0.008	Emuresis, immune system, tonic, urinary or genital infections, insomnia	Bouasla and Bouasla (2017), Jaradat et al. (2017), Ouelbani et al. (2016)
Lamiaceae	<i>Ajuga reptans</i> (L.) Schreb. SHT-091	Chendgoura	Infusion	Urogenital diseases (4) (menstrual disorders, reduce lactation)	Leaves	4	0.017	Diabetes, allergy, cancer, hypertension, digestive problems, leishmaniose, diarrhea, fever, sterility, thyroid	Benarba (2015), Bouasla and Bouasla (2017), Bouyahya et al. (2020)

Table 3 (continued)

Family	Plant name/Number of voucher	Local name	Used part	Ailment category: (n) of use reports	Method of preparation	Use citations	RFC	Recorded literature uses	References
	<i>Lavandula angustifolia</i> Mill. SHT-020	Khzama	Infusion	Urogenital diseases (10)	Aerial parts	10	0.044	Urogenital diseases, teeth, digestive disorders, asthma, nervous system, suckle	Boughrara (2016), Ouelbani et al. (2016)
	<i>Marrubium deserti</i> (Noë.) Coss. SHT-092	Jaâda	Decoction	Gastro-intestinal system disorders (1)	Stems	1	0.004	Digestive disorders, diabetes, leishmaniose, eye treatment, stomach pain	(Boudjelal et al. (2013), Chermat and Gharzouli (2015)
	<i>Marrubium vulgare</i> L. SHT-093	Merrioua	Decoction	Against parasites (4)/Gastro-intestinal system disorders (4)	Leaves	4	0.017	Diabetes, digestive problems, vomiting, anti-emetic, wound, cardio-vascular diseases, respiratory problems	(Boudjelal et al. (2013), Meddour and Meddour-Sahar (2015), Miara et al. (2019a), Ouelbani et al. (2016)
	<i>Mentha pulegium</i> L. SHT-094	Fliou	Infusion	Urogenital diseases (2)/Respiratory tract disorders (2)/Metabolic disorders (2)/Gastro-intestinal system disorders (2)	Leaves	2	0.008	Hypertension ,antispasmodic, anxiety, constipation, diabetes, wounds, respiratory diseases	(Boudjelal et al. (2013), Meddour and Meddour-Sahar (2015), Ouelbani et al. (2016)
	<i>Mentha spicata</i> L. SHT-024	Naâmaâ	Infusion	Gastro-intestinal system disorders (39)	Leaves	39	0.17	Digestive problems, antispasmodic, antiseptic, anxiety,	Meddour and Meddour-Sahar (2015), Miara et al. (2019a)
	<i>Ocimum basilicum</i> L. SHT-095	Hbaq	Decoction	Urogenital diseases (21)/Respiratory tract diseases (21)/Gastro-intestinal system disorders (21)	Aerial parts	21	0.09	Kidney stones, flu, cough, laryngitis, stomachache, goitre, hypertension, heart diseases, anxiety, antispasmodic, antiseptic, diuretic, lactation, skin problems, conjunctivis	Benarba (2015), El-Hilaly et al. (2003), Jaradat et al. (2017), Meddour and Meddour-Sahar (2015), Ouelbani et al. (2016)
	<i>Ocimum tenuiflorum</i> L. SHT-096	Lahbika	Infusion	Urogenital diseases	Leaves	1	0.004	Urogenital diseases, expectorant, stimulant, stomachic, scorpion sting	Mossa (1987), Yasser et al. (2018)
	<i>Origanum majorana</i> L. SHT-097	Berdkouch	Decoction	Metabolic disorders (14)/Gastro-intestinal system disorders (14)	Leaves	14	0.06	Rheumatism, thyroid, gastric pains, headache, insomnia, allergy, obesity, cough, flu, wounds	Benarba (2016), Merzouki et al. (2000), Ouelbani et al. (2016)
	<i>Origanum vulgare</i> L. SHT-028	Zaâtar	Infusion/fumigation	Skin diseases (1) (pimples)/Respiratory tract diseases (2)/Metabolic disorders (1)/Gastro-intestinal system disorders (50)	Aerial parts	51	0.22	Respiratory problems, hypertension, diuretic, antiseptic,eczema, rheumatic pain, tumor, digestive problems antispasmodic, carminative, emmenagogue	(Boudjelal et al. (2013), Miara et al. (2019a), Ouelbani et al. (2016)
	<i>Phlomis bovei</i> Noë L. SHT-098	Kheyata	Decoction	Skin diseases (1)	Stems	1	0.004	Lesions, burns, skin infections, allerges	(Liolios et al. (2007)

Table 3 (continued)

Family	Plant name/Number of voucher	Local name	Used part	Aliment category: (n) of use reports	Method of preparation	Use citations	RFC	Recorded literature uses	References
	<i>Rosmarinus officinalis</i> L. SHT-033	Azir	Decoction	Metabolic disorders (15)	Aerial parts	15	0.06	Painful menstruations, hypertension, cancer, hepatic diseases, eczema, antispasmodic, cold, flu, stomachache, cholesterol, hair loss	Bellifa et al. (2020), Bouasla and Bouasla (2017), Boudjelal et al. (2013), Meddour and Meddour-Sahar (2015)
	<i>Sabia officinalis</i> L. SHT-099	Miramya	Infusion	Urogenital diseases (16)	Leaves	16	0.07	Diabetes, hypertension, weight loss, eczema, nervous system diseases, muscle pain, headache, memory, analgesic, gynecological diseases, cholesterol	Boudjelal et al. (2013), Ouelbani et al. (2016)
Lauraceae	<i>Cinnamomum cassia</i> (L.) J. Presl. SHT-009	Karfa	Decoction	Respiratory tract diseases(11)/Gastrointestinal disorders(11)	Bark	11	0.04	Cough, respiratory affections, diabetes, hypertension	Belhaj et al. (2021), Benarba (2016), Hassaine et al. (2019)
	<i>Laurus nobilis</i> L. SHT-019	Rand	Infusion	Gastrointestinal system disorders	Leaves	1	0.004	Skin diseases, allergy, respiratory problems, digestive problems, cardio-vascular diseases	Meddour and Meddour-Sahar (2015), Ouelbani et al. (2016)
Linaceae	<i>Linum usitatissimum</i> L. SHT-018	Zerriat el kettan	Decoction	Skin diseases (10)	Seeds	10	0.04	Diabetes, cholesterol, cancer prevention, weight loss, headache, anti-inflammatory, Laxative, diuretic, vermifuge, Digestive system problems, respiratory system problems, allergy, menstrual pains	Bouasla and Bouasla(2017), Ouelbani et al. (2016)
Lythraceae	<i>Punica granatum</i> L. SHT-100	Rommane	Powder	Skin diseases(8)/Gastro-intestinal system disorders (8)	Pericarp of fruits	8	0.03	Hypertension, digestive problems, aphthas, anemia, kidney disorders, ulcer, eczema, anti-septic	Eddouks et al. (2017) Meddour and Meddour-Sahar (2015), Ouelbani et al. (2016)
	<i>Lawsonia inermis</i> L. SHT-101	Henna	Powder	Skin diseases(11)/Gastro-intestinal system disorders (11)	Leaves	11	0.048	Kidney diseases, digestive disorders, antifungal, skin diseases, hair care, breast cancer, pharyngitis, diabetes	Benarba (2015), Eddouks et al. (2017), Lahsissene (2010)
Malvaceae	<i>Hibiscus sabdariffa</i> L. SHT-016	Karkade	Decoction	Cardio-vascular system diseases (8)	Seeds	8	0.03	Cardiovascular diseases	Benarba (2015), Miara et al. (2019a)
	<i>Malva sylvestris</i> L. SHT-102	Khebbiz	Bandage	Cardio-vascular system diseases (1) Skin diseases (3)	Flowers	1	0.004	Urinary tract infection, cardiovascular diseases	Benarba (2015), Jaradat et al. (2017)
	<i>Moringa oleifera</i> Lam. SHT-104	Moringa	Infusion	Metabolic disorders (19)	Leaves	19	0.08	Emollient, urinary and digestive problems, uterus pains, cold, stomachache	Chehema and Djebar (2008), Meddour and Meddour-Sahar (2015), Ouelbani et al. (2016)
								Constipation, eye irritation, heartburn	(Roshetko et al. (2017)

Table 3 (continued)

Family	Plant name/Number of voucher	Local name	Used part	Aliment category: (n) of use reports	Method of preparation	Use citations	RFC	Recorded literature uses	References
Musaceae	<i>Musa acuminata</i> L. SHT-105	Banane	Raw	Gastro-intestinal system disorders (1)	Fruits	1	0.004	Hypertension, anemia, diabetes	Chintanumee and Mahomoodally (2012), GJ et al. (2013)
Myrtaceae	<i>Eucalyptus globulus</i> Labill. SHT-106	Calitous	Infusion/inhalation	Respiratory tract diseases (8)	Leaves	8	0.03	Flu, cough, Ieshmaniose, burns, rheumatic pains	(Boudjelal et al. (2013), Ouelbani et al. (2016)
	<i>Eugenia caryophyllata</i> Thunb. SHT-107	Kronfel-ennour	Powder	Skeleto-muscular diseases (28)	Flower bud	28	0.12	Diabetes, menstrual pain, stomach troubles	Belhaj et al. (2021), Briguiche et al. (2015)
	<i>Myrtus communis</i> L. SHT-012	Rayhan	Infusion	Gastro-intestinal system disorders (6)	Leaves	6	0.02	Antiseptic, cancer, diabetes, hypertension, cardiac diseases, digestive disorders, allergy, skin diseases, rheumatism, diarrhea, anxiety, urinary system disorders	Bellifa et al. (2020), Benarba (2015), Bouasla and Bouasla (2017), Boudjelal et al. (2013), El-Hilaly et al. (2003), Jamila and Mostafa (2014), Ouelbani et al. (2016)
	<i>Edrou</i>	Edrou	Decoction	Cardio-vascular system diseases (1)/Gastro-intestinal system disorders (1)	Aerial parts	1	0.004		
Oleaceae	<i>Olea europaea</i> L. SHT-026	Zeytoun	Infusion	Skeleto-muscular diseases (2)/Respiratory tract diseases(3)/Metabolic disorders(3)	Leaves	3	0.01	Hypertension; hemorrhoids, toothache, muscular pain, diuretic, eczema, flu, gingivitis	Eddouks et al. (2017), Meddour and Meddour-Sahar (2015), Miara et al. (2019a), Ouelbani et al. (2016)
Orobanchaceae	<i>Cistanche phelypaea</i> (L.) Coult. SHT-108	Demnoun	Infusion	Cancer (1)/Urogenital diseases (1)/Gastro-intestinal system disorders (1)	Whole plant	1	0.004	Digestive problems	(Yasser et al. (2018)
Pedaliaceae	<i>Sexamum indicum</i> L. SHT-109	Semsem	Decoction	Gastro-intestinal system disorders (1)	Seeds	1	0.004	Memory problems, appetite, diabetes, anxiety, breast cancer	Benarba (2015), Tahraoui (2007)
Pinaceae	<i>Pinus maritima</i> Mill. SHT-110	Tayda	Powder	Respiratory tract diseases (2)	Gum	2	0.008	Flu, bronchitis	Benarba (2015, 2016)
Piperaceae	<i>Piper nigrum</i> L. SHT-111	Felfel khal	Powder	Gastro-intestinal system disorders (1)	Fruits	1	0.004	Bronchitis, pancreas cancer, carcinative, febrifuge, rubifacient, stimulant	Benarba (2015), Chaveerach et al. (2006), Chebat et al. (2014)

Table 3 (continued)

Family	Plant name/Number of voucher	Local name	Used part	Aliment category: (n) of use reports	Method of preparation	Use citations	RFC	Recorded literature uses	References
Poaceae	<i>Cenchrus ciliaris</i> L. SHT-112	Sabt	Decoction	Gastro-intestinal system disorders (1)	Stems	1	0.004	Digestive problems	(Yasser et al. (2018))
	<i>Cynodon dactylon</i> (L.) Pers. SHT-113	Ennejm	Decoction	Urogenital diseases (1)	Aerial parts	1	0.004	Rheumatism, lack of bone marrow, urogenital diseases	Meddour and Meddour-Sahar (2015), Yasser et al. (2018)
	<i>Elymus repens</i> (L.) Gould. SHT-114	Sebboulet el far	Decoction	Urogenital diseases (1)	Roots	1	0.004	Digestive disorders, diuretic, kidney stones, urogenital diseases	(Ouelbani et al. (2016), Yasser et al. (2018))
	<i>Hordeum vulgare</i> L. SHT-017	Chiir	Decoction	Urogenital diseases (2)/Metabolic disorders(2)	Seeds	2	0.008	Anemia, urinary diseases, diabetes, colon pains, respiratory problems	(Miara et al. (2019a), Ouelbani et al. (2016))
	<i>Panicum miliaceum</i> L. SHT-115	Bechna	Decoction	Skeleto-muscular diseases (5)	Seeds	5	0.02	Diabetes, skin diseases (measles), speeding convalescence	(Belhaj et al. (2021), Haddad et al. (2003), Phondani et al. (2010))
	<i>Zea mays</i> L. SHT-116	Lekbel	Decoction	Urogenital diseases (2)	Style	2	0.008	Prostatic enlargement, urinary tract infections	(Jaradat et al. (2017))
		Tafsout	Decoction	Urogenital diseases (1)	Seeds	1	0.004	Rheumatism, erectile dysfunction, diuretic, kidney stones, urinary tract infections, high blood pressure, fluid retention, jaundice, stomach complain, emollient for ulcer	Kumar and Narayan (2013), Lans (2006)
Ranunculaceae	<i>Nigella arava</i> L. SHT-025	Habba sawda	Decoction	Allergy(13)/Cancer(13)/Urogenital diseases(13)/Respiratory tract diseases(13)/Metabolic disorders(13)	Seeds	13	0.057	Anemia, respiratory infection, flatulence, anxiety, skin care, allergy, pharyngitis, hemorrhoids	Bouasla and Bouasla (2017), Meddour and Meddour-Sahar (2015)
Resedaceae	<i>Randonia africana</i> Coss. SHT-117	Laghim	Decoction	Allergy (1)	Stems	1	0.004	Allergy	(Yasser et al. (2018))
Rhamnaceae	<i>Rhamnus alaternus</i> L. SHT-118	Meliles	Infusion	Cardio-vascular system diseases (4)	Leaves	4	0.017	Hepatic jaundice, cancer, headache, diabetes, cholesterol, nervous system disorders, purgative	(Boudjelal et al. (2013), Ouelbani et al. (2016))
	<i>Ziziphus lotus</i> (L.) Lam. SHT-119	Sedra	Infusion	Skin diseases (12)	Leaves	12	0.053	Hypertension, pulmonary diseases, stomach acidity, lung diseases	Cherhat and Gharzouli (2015), Miara et al. (2019a, 2013)
Rosaceae	<i>Crataegus oxyacantha</i> L. SHT-014	za'arour	Infusion	Cardio-vascular system diseases (1)	Leaves	1	0.004	Hypertension, antispasmodic, anxiety	(Miara et al. (2019a), Ouelbani et al. (2016))
	<i>Rosa canina</i> L. SHT-120	Ward	Infusion	Respiratory tract diseases (1)	Flowers	1	0.004	Cough, menstrual problems, hypertension, memory, fever, stomachache; tranquilizer, open pores, eye wash, digestive	Benarba (2016), Ouelbani et al. (2016), Tutolo-mondo et al. (2014)

Table 3 (continued)

Family	Plant name/Number of voucher	Local name	Used part	Aliment category: (n) of use reports	Method of preparation	Use citations	RFC	Recorded literature uses	References
Rubiaceae	<i>Ephedra alenda</i> (Stapf) Andr. SHT-121	Alenda	Decoction	Cancer(8)/Respiratory tract diseases(8)/Metabolic disorders(8)	Stems	8	0.03	Breast cancer, cold, influenza, respiratory problems, hypertension, body weakness, cough, goiter	(Bouafia et al. (2021), Lakhdari et al. (2016), Miara et al. (2019b), Ould El Hadj et al. (2003))
Rutaceae	<i>Rubia tinctorum</i> L. SHT-122	Foua	Infusion	Gastro-intestinal system disorders (2)	Leaves	2	0.008	Kidney and bladder stones, digestive problems	(Bloméke et al. (1992), Yasser et al. (2018))
Rutaceae	<i>Citrus sinensis</i> (L.) Osbeck. SHT-011	Bortoukal	Infusion	Cardio-vascular system diseases (1)	Leaves	1	0.004	Malaria cold	(Camejo-Rodrigues et al. (2003), Lalfakzuala et al. (2007))
Rutaceae	<i>Ruta chalepensis</i> L. SHT-123	Figel	Decoction	Respiratory tract diseases(1)/Metabolic disorders(1)/Gastro-intestinal system disorders (5)	Leaves	6	0.02	Diabetes, renal calculi, vertigo, hypertension, antispasmodic, eczema, diuretic, digestive disorders, abortifacients, ear pain	Benarba (2015), Boudjelal et al. (2013), Chermat and Gharzouli (2015), El-Hilaly et al. (2003)
Solanaceae	<i>Hyoscyamus muticus</i> L. SHT-124	Lebtina	Decoction	Respiratory tract diseases (1)	Whole plant	1	0.004	Respiratory diseases, the roots are fortifying, asthma, toothache, sea sickness	Mossa (1987), Ould El Hadj et al. (2003), Yasser et al. (2018)
Solanaceae	<i>Solanum nigrum</i> L. SHT-125	Inab eddib	Decoction	Gastro-intestinal system disorders (1)	Whole plant	1	0.004	Digestive disorders, diuretic, chronic enlargement of liver, dysentery, piles, skin diseases, expectorant, anxiety	(Lakhdari et al. (2016), Mossa (1987), Yasser et al. (2018))
Tamariaceae	<i>Tamarix aphylla</i> (L.) H. Karst. SHT-126	Ferssig	Decoction	Skin diseases (1)	Stems	1	0.004	Skin diseases, rheumatic pain	(Madani et al. (2014), Yasser et al. (2018))
Theaceae	<i>Camellia thea</i> Link. SHT- 127	Ataye	Infusion	Metabolic disorders (2)	Leaves	2	0.008	Lithiasis, diabetes, stomach troubles, diuretic, constipation, vasodilator, tonic	(Belhaj et al. (2021), Bouasla and Bouasla (2017), Briguiche et al. (2015))
Verbenaceae	<i>Verbena citriodora</i> (Palau) Cav. SHT- 035	Louisa	Infusion	Respiratory tract diseases(3)	Leaves	3	0.01	Colitis, respiratory problems, hypertension, diabetes	(Belhaj et al. (2021), Benarba (2016), Hassaine et al. (2019), Yasser et al. (2018))
Viscaceae	<i>Viscum album</i> L. SHT- 128	Leijbar	Decoction	Skeleto-muscular diseases (2)	Seeds	2	0.008	Flu, breast milk secretion, fractures, weight gain, hypertension, anxiety, cough, asthma, diabetes	Benarba(2015), Bourabata (2013), Elyebdri et al. (2017)
Zingiberaceae	<i>Alpinia officinarum</i> Hance. SHT-129	Khouljan	Decoction	Respiratory tract diseases (1)	Roots	1	0.004	Female sterility, rheumatism, digestive problems, respiratory diseases, colds, gain weight	Benarba(2015), Jamila and Mostafa (2014), Ouarghidi et al. (2013)
Zingiberaceae	<i>Curcuma longa</i> L. SHT-015	Kourkom	Powder	Cardio-vascular system diseases (5)	Roots	5	0.022	Enuresis, gastro-intestinal system diseases, aches and pains, anxiety, skin care, liver diseases, hypertension	Benarba (2015, 2016, 2017), Jaradat et al. (2017), S. Hassaine et al. (2019)
Zingiberaceae	<i>Zingiber officinale</i> Roscoe. SHT-036	Zanjabil	Infusion	Respiratory tract diseases(29)/Gastro-intestinal system disorders (29)	Roots	29	0.12	Aphrodisiac, allergy, digestive disorders, female sterility, diabetes, kidney diseases, anti-inflammatory	Benarba (2015), Ouelbani et al. (2016)

Table 3 (continued)

Family	Plant name/Number of voucher	Local name	Used part	Ailment category: (n) of use reports	Method of preparation	Use citations	RFC	Recorded literature uses	References
Zygophyllaceae	<i>Balanites aegyptiaca</i> (L.) Delile. SHT-130	Touga	Powder	Gastro-intestinal system disorders (1)	Seeds	1	0.004	Abdominal pain, constipation, diabetes, anthelmintic, bilharzia	Abdelaziz et al. (2020), Madani et al. (2014)
	<i>Peganum harmala</i> L. SHT-131	Harmel	Decoction	Urogenital diseases(6)/Metabolic disorders(6)	Leaves	6	0.02	Leishmaniasis, rheumatism, arthritis, depression, anxiety, vermifuge, menstrual pains, hemorrhoids, antispasmodic, respiratory system diseases, diabetes, hypertension, fever	Bouasla and Bouasla (2017), Boudjelal et al. (2013), Chermat and Gharzoul (2015), Ham-miche and Maiza (2006), Ouelbani et al. (2016)
	<i>Zygophyllum album</i> L. f. SHT - 132	Agaya	Powder/fumigation	Skin diseases(8)/ Gastro-intestinal system disorders (8)	Aerial parts	8	0.03	Digestive disorders, diabetes, anal-gesic, disinfectant, dermatosis,	(Ould El Hadji et al. (2003), Yasser et al. (2018)

Fig. 6 Different categories of diseases mentioned in the survey

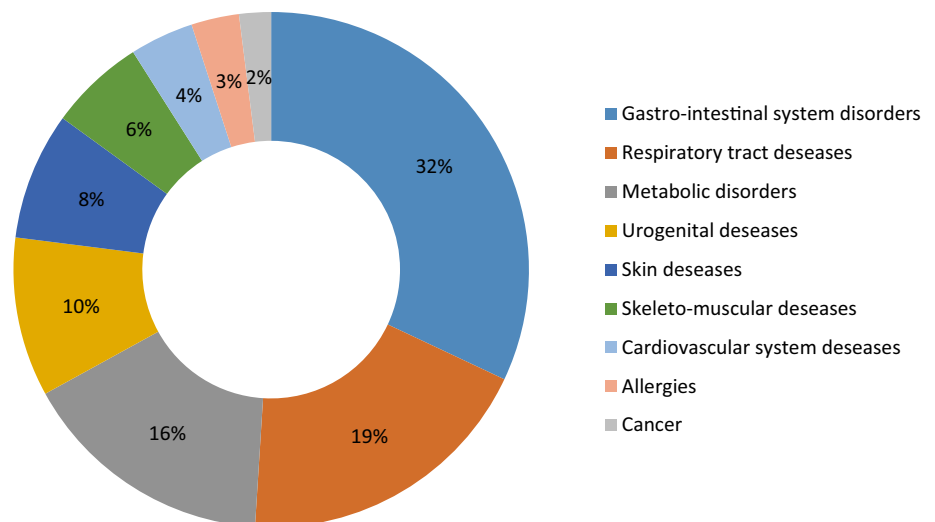


Table 4 Informative consensus factor for medicinal plants used in the region of Adrar

Ailments	Nur	Nt	ICF
Gastro-intestinal system diseases	388	32	0.9199
Respiratory tract diseases	222	20	0.914
Metabolic disorders	179	25	0.865
Urogenital diseases	121	17	0.867
Skin diseases	93	10	0.902
Skeleto-muscular diseases	51	7	0.88
Cardiovascular system diseases	34	9	0.758
Cancer	22	3	0.905
Allergies	14	2	0.923
Against parasites	3	3	0

Most cited ailments

The results obtained show that the species listed were mainly used in the treatment of digestive (Nur = 388), respiratory (Nur = 222) and metabolic diseases (Nur = 179) (Fig. 6) (Table 4). The same result was obtained in Mascara in Algeria, Morocco, Lebanon (Baydoun et al. 2015; Benarba 2015; Jamila and Mostafa, 2014) and also in Touat in the same region (Yasser et al. 2018). But it is different from that reported by (Benarba, 2016), wherein the predominant use by herbalists in the wilaya of Adrar and Bechar was against kidney diseases and cancer (locally called "el mard ecchin" *ين*). The predominance of digestive diseases is probably related to an unhealthy lifestyle. Indeed, the population of the Adrar region is known for a diet very rich in spices and fats.

The highest ICF values were recorded for allergies, digestive and respiratory problems (ICF = 0.923, ICF = 0.919, ICF = 0.914). These three diseases categories were treated

with 2, 32 and 20 species respectively. The most cited were *Nigella sativa* L. for allergies, *O. vulgare*. and *Foeniculum vulgare* L. for digestive diseases and *A. herba-alba* for respiratory disorders. The ICF value for cancer and dermatological diseases was 0.905 and 0.902. Three and 10 species were cited for each disease, respectively. The most repeated were *Nigella sativa* L. against tumors and *T. foenum graecum* against dermatological diseases. This shows that there is a kind of consensus on the indications of the plants used, as majority of the users used them for the same reasons. Digestive disorders had the highest ICF in most of the studies in Algeria (in Souk Ahras, Constantine, Mila, Mascara, and Bordj Bou Arreridj) and in other countries like Morocco, Tunisia, Italy and Spain (Benarba 2015; Benítez 2010; Bouasla and Bouasla 2017; El-Hilaly et al. 2003; Leporatti and Ghedira 2009; Miara et al. 2019a; Ouelbani et al. 2016a). This could be explained by the fact that digestive disorders have quite common and easy to identify signs.

Fidelity level

The FL was calculated for the 10 most cited plants, and we considered values above 50 as significant. Table 5 indicate that seven species viz. *Mentha spicata* L. (98.8%); *Foeniculum vulgare* L. (97.9%); *Ocimum basilicum* L. (96.6%); *Cassia angustifolia* Vahl. (96.0%); *Origanum vulgare* L. (93.9%) and *Trigonella foenum graecum* L. (93.0%) had the highest values to treat digestive problems-. *Artemisia herba-alba* Asso. (96.66%) was used for respiratory diseases and *Syzygium aromaticum* (L.) Merr & L.M. Perry (96%) for skeleto-muscular diseases. No plant had a 100% FL unlike other studies in the country with one species each (Bouafia et al. 2021; Miara et al. 2019b) and seven species (Benarba 2015).

Table 5 Fidelity level values for the 10 most cited species

Ailments	Plant	FL (%)
Gastro-intestinal system diseases	<i>Origanum vulgare</i> L	93.96
	<i>Foeniculum vulgare</i> L	97.90
	<i>Mentha spicata</i> L	98.80
	<i>Trigonella foenum graecum</i> L	93.00
	<i>Zingiber officinale</i> Roscoe	89.00
	<i>Ammodaucus leucotrichus</i> Coss	87.40
	<i>Ocimum basilicum</i> L	96.63
	<i>Cassia angustifolia</i> Vahl	96.00
Respiratory tract diseases	<i>Artemisia herba-alba</i> Asso	96.66
	<i>Origanum vulgare</i> L	4.08
	<i>Zingiber officinale</i> Roscoe	9.89
	<i>Syzygium aromaticum</i> (L.) Merr & L.M. Perry	4.00
	<i>Ammodaucus leucotrichus</i> Coss	1.67
Metabolic disorders	<i>Cassia angustifolia</i> Vahl	4.00
	<i>Foeniculum vulgare</i> L	2.10
	<i>Mentha spicata</i> L	1.20
	<i>Trigonella foenum graecum</i> L	5.00
	<i>Ammodaucus leucotrichus</i> Coss	10.00
Urogenital diseases	<i>Artemisia herba-alba</i> Asso	1.67
	<i>Ocimum basilicum</i> L	1.70
Cardiovascular system diseases	<i>Ammodaucus leucotrichus</i> Coss	0.60
	<i>Trigonella foenum graecum</i> L	2.00
Skeleto-muscular diseases	<i>Syzygium aromaticum</i> (L.) Merr & L.M. Perry	96.00
Skin diseases	<i>Ocimum basilicum</i> L	1.96
Allergies	<i>Zingiber officinale</i> Roscoe	1.11
Against parasites	<i>Artemisia herba-alba</i> Asso	1.67
	<i>Ammodaucus leucotrichus</i> Coss	2.00

The best known traditional use of *Mentha spicata* L. is for diarrhea (Mahendran et al. 2021). It is also used for stomachache, digestive and anthelmintic (Buso et al. 2020). In traditional Nepalese medicine, the whole plant is used for dysentery, indigestion, stomachache and urinary retention (Adhikari et al. 2019), which corresponds to our study wherein it was the mostly used against digestive problems. It was also used for cold, cough (Asowata-Ayodele et al. 2016), and jaundice (Sharma et al. 2012). The anti-diabetic activity of the aqueous extract of the plant has been demonstrated on streptozotocin diabetic rats (Farid et al. 2018). The antiproliferative activity of the essential oil has been proven on different cancer cell lines including human ductal breast epithelial tumor T47D cell line, human colon cancer HCT-116 and human breast adenocarcinoma MCF-7 cell line (Torres-Martínez et al. 2019). The hepatoprotective effect of the aqueous extract of the plant was demonstrated on nicotine-induced oxidative damage in the liver and erythrocytes of a rat model at doses of 100 mg/kg (Ben Saad et al. 2018).

Syzygium aromaticum was the most used against keleton-musclar diseases. The anti-inflammatory effect of clove, specifically eugenol, has been demonstrated in numerous

studies including in human dermal fibroblasts (Han and Parker, 2017) and against skin inflammation (Maurya et al. 2020). The anti-inflammatory effect is also present for the polyphenolic extract of cloves (carvacrol) (Issac et al. 2015). Clove is also used for its analgesic properties due to its agonism with capsaicin (Ohkubo and Shibata 1997) and activation of chloride/calcium channels in ganglionar cells (Li et al. 2008). In addition, eugenol showed greater efficacy against inflammatory-type pain compared to diclofenac (Lugo-Lugo et al. 2019).

New reports for medicinal plants and uses

The comparison of the results obtained with those of other studies in Algeria and in the neighboring countries (Chaibou et al. 2020; Mahamane et al. 2020; Nassiri et al. 2016), helped us to identify 13 species, which are cited for the first time in the country (in bold in Table 3): *Corrigiola telephiiifolia* Pourr., *Xylopiya aethiopyca* (Dunal) A.Rich., *Asphodelus tenuifolius* Cav, *Brassica rapa subsp. rapa* L., *Cleome amblyocarpa* Baratte et Murb, *Chenopodium ambrosioides* L., *Solenostemma argel* (Delile)

Table 6 New uses of the plants in comparison with the studies made in Algeria and the neighboring countries

Species	Previously undocumented uses	References
<i>Ajuga iva</i> (L.) Schreb	Urogenital diseases/menstrual cycle disorders/reduce lactation during weaning	Benarba (2015), Bouasla and Bouasla (2017), Bouyahya et al. (2020)
<i>Apium graveolens</i> L	Metabolic disorders	Bouasla and Bouasla (2017), Boughrara (2016) Hassaïne et al. (2019), Taïbi et al. (2021)
<i>Artemisia herba alba</i> Asso	Against parasites and eye diseases	(Chehma and Djebar, 2008; Hassaïne et al. (2019), Ouelbani et al. (2016), Tahraoui (2007)
<i>Chenopodium ambrosioides</i> L	Respiratory tract diseases	Briguiche et al. (2015), Teixidor-Toneu et al. (2016)
<i>Brassica rapa subsp. Rapa</i> L	Skeleto-muscular diseases/Respiratory tract diseases/Metabolic disorders	Abbasi et al. (2019)
<i>Bunium bulbocastanum</i> L	Metabolic disorders	Miara et al. (2019a)
<i>Cistanche phelypaea</i> (L.) Cout	Cancer/Urogenital diseases	Yasser et al. (2018)
<i>Corrigiola telephifolia</i> Pourr	Metabolic disorders	Chandra and Rawat (2015)
<i>Cotula cinerea</i> Delile	Urogenital diseases	Benarba (2016), IUCN (2005)
<i>Matricaria pubescens</i> (Desf.)	Respiratory tract diseases	IUCN (2005), Yasser et al. (2018)
<i>Origanum vulgare</i> L	Skin diseases (pimples)	Boudjelal et al. (2013), Miara et al. (2019a), Ouelbani et al. (2016)
<i>Ziziphus lotus</i> (L.) Lam	Skin diseases	Chermat and Gharzouli (2015), Miara et al. (2019a, 2013)

Hayne., *Musa acuminata* L. and *Panicum miliaceum* L. Sometimes, it is the part used that is cited for the first time in an Algerian region for example seeds of *Zea mays* L., *Cyperus esculentus* L., *Vigna unguiculata* (L.) Walp. and *Daucus carota* L.

New uses were recorded for 13 species (Table 6). The most cited species, *A. herba alba* Asso. (60 citations) is used in the Adrar region against parasites and eye diseases, indications that we found for the first time. *Origanum vulgare* L. (51 citations) is known in the Mediterranean region for various medicinal properties (against enterobiasis and stomach ache, cough, sores, throat and respiratory tract disorders Alarcón et al. 2015; Eddouks et al. 2017), heartburn and asthma, and as an aperitif, carminative, depurative, digestive and sedative (Vitalini, 2015), antidiabetic, and in the treatment of cold, flu and urinary inflammation (Cakilcioglu et al. 2011; Özdemir and Alpınar 2015), against diabetes (Ali-Shtayeh et al. 2012) but the cutaneous indication against pimples was mentioned in our study for the first time.

New uses were recorded for *Ajuga iva* (L.) Schreb. It has been cited in the treatment of urogenital diseases and menstrual cycle disorders. These indications are different from those found in other regions of Algeria (diabetes, hypertension, digestive disorders, sterility and thyroid problems) (Bouasla and Bouasla 2017; Bouzabata et al. 2020). Nevertheless, this has been recorded in other Mediterranean countries, Morocco and Italy (Eddouks et al. 2020; Guarino et al. 2008). It has even been used to reduce lactation during weaning. Indication cited for the first time in our study.

Conclusion

This study enabled us to prepare an inventory of the medicinal species used in the Adrar region, which constitutes a large part of the Algerian Sahara. It has shown that despite the evolution of medicine, use of traditional treatments is still relevant and has been passed down from generation to generation. More and more young people are turning to plants and becoming herbalists. New recipes are emerging as new species become available in the market. A total of 126 plants belonging to 47 families were identified in this study, of which 13 were cited for the first time in Algeria as medicinal plants. The majority of them come from the region, which reflects the importance that the population attaches to phytotherapy. The species recorded were mainly used against digestive problems, given the diet of the inhabitants of the region, which was rich in spices and fats. The information collected is a valuable source for enriching the national database and contributing to the establishment of an Algerian Pharmacopoeia in order to preserve this heritage.

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Author contributions Sara Hassaïne: Conceptualization, Methodology, Writing the paper, Supervision. Souad Benmalek: Ressources, Formal analyses, Investigation.

Declarations

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- Abbasi N, Rafieian-Kopaei M, Karami N, Abbaszadeh S, Bahmani M (2019) Medicinal Plants for Treatment Kidney Stones, An ethnobotany Study in Shahrekord. Egypt J Vet Sci 50:145–149. <https://doi.org/10.21608/ejvs.2019.14057.1090>
- Abdelaziz SM, Lemine FMM, Tfeil HO, Filali-Maltouf A, Boukhary AOMS (2020) Phytochemicals, antioxidant activity and ethnobotanical uses of *Balanites aegyptiaca* (L.) Del. fruits from the arid zone of Mauritania Northwest Africa. Plants 9:401. <https://doi.org/10.3390/plants9030401>
- Achouri D, Cherki A (2018) Phytothérapie et grossesse. Mémoire pour l'obtention de doctorat en pharmacie. Abou Bakr Belkaid. Tlemcen, p 106
- Adams M, Berset C, Kessler M, Hamburger M (2009) Medicinal herbs for the treatment of rheumatic disorders—a survey of European herbals from the 16th and 17th century. J Ethnopharmacol 121:343–359. <https://doi.org/10.1016/j.jep.2008.11.010>
- Adhikari M, Thapa R, Kunwar RM, Devkota HP, Poudel P (2019) Ethnomedicinal uses of plant resources in the Machhapuchchhre Rural Municipality of Kaski District. Nepal Med 6:69. <https://doi.org/10.3390/medicines6020069>
- Adnan et al (2017) A review on the ethnobotany, phytochemistry, pharmacology and nutritional composition of *Cucurbita pepo* L. J Phytopharmacol 6:133–139
- Agbodjento E, Klotoé JR, Sacramento TI, Dougnon V, Tchabi FL, Déguénon E, Atègbo J-M (2020) Ethnobotanical knowledge of medicinal plants used in the treatment of male infertility in southern Benin. Adv Tradit Med. <https://doi.org/10.1007/s13596-020-00473-3>
- Ahmed M, Réda K (2021) Ethnobotanical characterization of halophytes with medicinal virtues, Case of the Macta wetland flora: North-West Algeria. Genet Biodivers J GABJ. <https://doi.org/10.46325/gabj.v0i0.933>
- Alarcón R, Pardo-de-Santayana M, Priestley C, Morales R, Heinrich M (2015) Medicinal and local food plants in the south of Alava (Basque Country, Spain). J Ethnopharmacol 176:207–224. <https://doi.org/10.1016/j.jep.2015.10.022>
- Ali-Shtayeh MS, Jamous RM, Jamous RM (2012) Complementary and alternative medicine use amongst Palestinian diabetic patients. Complement Ther Clin Pract 18:16–21. <https://doi.org/10.1016/j.ctcp.2011.09.001>
- Amiri MS, Joharchi MR (2016) Ethnobotanical knowledge of Apiaceae family in iran: a review. Avicenna J Phytomed 6:621–635
- Amrouche A, Bessenouci C, Gherib M, Fellah K, Malainine H, Benmehdi H (2019) Approche ethnobotanique descriptive de la flore médicinale en milieu désertique « Cas des oasis du Gourara, de Tidikelt et de Touat » région d'Adrar, Algérie. Phytothérapie 17:334–345. <https://doi.org/10.3166/phyto-2019-0166>
- Ansari S (2021) Ethnobotany and pharmacognosy of Qust/Kut (*Saussurea lappa*, C. B. Clarke) with special reference of unani medicine. Pharmacogn Rev 13:71–76. <https://doi.org/10.5530/phrev.2019.2.7>
- Arshad M, Akbar G, Rashid S (2002) Wealth of medicinal plants of Cholistan desert. Pakistan. Hamdard Med Pak 45(4):25–34
- Asase A, Kadera ML (2014) Herbal medicines for child healthcare from Ghana. J Herb Med 4:24–36. <https://doi.org/10.1016/j.hermed.2013.05.002>
- Ashraf MA, Mahmood K, Wajid A, Qureshi AK, Gharibreza M (2013) Chemical constituents of *Haloxylon salicornicum* plant from Cholistan desert, Bahawalpur. Pakistan. J Food Agric Environ 11(3–4):1176–1182
- Asowata-Ayodele AM, Afolayan AJ, Otunola GA (2016) Ethnobotanical survey of culinary herbs and spices used in the traditional medicinal system of Nkonkobe Municipality, Eastern Cape, South Africa. S Afr J Bot 104:69–75. <https://doi.org/10.1016/j.sajb.2016.01.001>
- Azhar MF, Aziz A, Haider MS, Farrakh M, Zulfiqar MA (2015) Exploring the ethnobotany of *Haloxylon recurvum* (KHAR) and *Haloxylon salicornicum* (LANA) in Cholistan desert, Pakistan. Pak J Agri Sci 54:1085–1090
- Aziagba BOB, Okeke CCU, Ezeabara CCA, Ilodibia CVC, Ufele A, Egboka PT (2017) Determination of the flavonoid composition of seven varieties of *Vigna unguiculata* (L.) Walp as food and therapeutic values. Univ J Appl Sci 5(1):1–4. <https://doi.org/10.13189/ujas.2017.050101>
- Ballabh B, Chaurasia OP, Ahmed Z, Singh SB (2008) Traditional medicinal plants of cold desert Ladakh—Used against kidney and urinary disorders. J Ethnopharmacol 118:331–339. <https://doi.org/10.1016/j.jep.2008.04.022>
- Baydoun S, Chalal L, Dalleh H, Arnold N (2015) Ethnopharmacological survey of medicinal plants used in traditional medicine by the communities of Mount Hermon, Lebanon. J Ethnopharmacol 173:139–156. <https://doi.org/10.1016/j.jep.2015.06.052>
- Begnini KR, Nedel F, Lund RG, de Carvalho, PHA, Rodrigues MRA, Beira FTA, Del-Pino FAB (2014) Composition and antiproliferative effect of essential oil of *Origanum vulgare* against tumor cell lines. J Med Food 17:1129–1133. <https://doi.org/10.1089/jmf.2013.0063>
- Bellakhdar D (1998) La pharmacopée marocaine traditionnelle – Médecine arabe ancienne et savoirs populaires. Ibis Press, Paris, 12 pl. coul. h.t. 2ème édition
- Belhaj S, Chaachouay N, Zidane L, Garrido G (2021) Ethnobotanical and toxicology study of medicinal plants used for the treatment of diabetes in the High Atlas Central of Morocco. J Pharm Pharmacogn Res 9:619–662
- Bellal S-A, Hadeid M, Ghodbani T, Dari O (2016) Accès à l'eau souterraine et transformations de l'espace oasien : le cas d'Adrar (Sahara du Sud-ouest algérien). Cah Géographie Qué 60:29–56. <https://doi.org/10.7202/1038664ar>
- Bellifa N, Houari T, Ismail B (2020) Ethnobotanical Survey of Some Plants Used in Tessala Region, Algeria. Curr Perspect Med Aromat Plants CUPMAP 3:25–30. <https://doi.org/10.38093/cupmap.652708>
- Ben Saad A, Rjeibi I, Alimi H, Ncib S, Bouhamda T, Zouari N (2018) Protective effects of *Mentha spicata* against nicotine-induced toxicity in liver and erythrocytes of Wistar rats. Appl Physiol Nutr Metab 43:77–83. <https://doi.org/10.1139/apnm-2017-0144>
- Benarba B (2015) Ethnobotanical study of medicinal plants used by traditional healers in Mascara (North West of Algeria). J Ethnopharmacol 175:626–637
- Benarba B (2016) Medicinal plants used by traditional healers from South-West Algeria: an ethnobotanical study. J Intercult Ethnopharmacol 5:320–330. <https://doi.org/10.5455/jice.20160814115725>
- Benítez G (2010) Pharmaceutical ethnobotany in the western part of Granada province (southern Spain): Ethnopharmacological synthesis. J Ethnopharmacol 129:87–105
- Bhatia H, Pal Sharma Y, Manhas RK, Kumar K (2015) Traditional phytoremedies for the treatment of menstrual disorders in district

- Udhampur, J&K. India J Ethnopharmacol 160:202–210. <https://doi.org/10.1016/j.jep.2014.11.041>
- Blömeke B, Poginsky B, Schmutte C, Marquardt H, Westendorf J (1992) Formation of genotoxic metabolites from anthraquinone glycosides, present in *Rubia tinctorum* L. *Mutat Res Mol Mech Mutagen* 265:263–272. [https://doi.org/10.1016/0027-5107\(92\)90055-7](https://doi.org/10.1016/0027-5107(92)90055-7)
- Bouafia M, Amamou F, Gherib M, Benaïssa M, Azzi R, Nemliche S (2021) Ethnobotanical and ethnomedicinal analysis of wild medicinal plants traditionally used in Naâma, southwest Algeria. *Vegetos* 34:654–662. <https://doi.org/10.1007/s42535-021-00229-7>
- Bouasla A, Bouasla I (2017) Ethnobotanical survey of medicinal plants in northeastern of Algeria. *Phytomedicine* 36:68–81. <https://doi.org/10.1016/j.phymed.2017.09.007>
- Boudjelal A, Henchiri C, Sari M, Sarri D, Hendel N, Benkhaled A, Ruberto G (2013) Herbalists and wild medicinal plants in M'Sila (North Algeria): an ethnopharmacology survey. *J Ethnopharmacol* 148:395–402. <https://doi.org/10.1016/j.jep.2013.03.082>
- Bouhrara B (2016) Ethnobotanical study close to the population of the extreme north east of Algeria: the municipalities of El Kala National Park (EKNP). *J Ind Crops Prod* 88:2–7
- Boutadara Y (2009) Etude hydrogéologique des systèmes de captage traditionnels dans les Oasis Sahariennes «cas des Foggaras de la région du Touat (Adrar)»: cadre géomorphologique. Mémoire de Magister en Hydraulique, Université des Sciences et de la Technologies d'Oran
- Bouyahya A, El Omari N, Elmeniy N, Guaougouaou F-E, Balahbib A, El-Shazly M, Chamkhi I (2020) Ethnomedicinal use, phytochemistry, pharmacology, and toxicology of *Ajuga iva* (L.) schreb. *J Ethnopharmacol* 258:112875. <https://doi.org/10.1016/j.jep.2020.112875>
- Bouzabata A (2013) Traditional treatment of high blood pressure and diabetes in Souk Ahras District. *J Pharmacogn Phytother* 5:12–20. <https://doi.org/10.5897/JPP11.065>
- Bouzabata A, Mahomoodally F, Bouzabata A, Mahomoodally MF (2020) A quantitative documentation of traditionally-used medicinal plants from Northeastern Algeria: Interactions of beliefs among healers and diabetic patients. *J Herb Med*. <https://doi.org/10.1016/j.hermed.2019.100318>
- Briguiche H et al (2015) The catalogue of medicinal plants used in the region of El Jadida. *International Journal of Herbal Medicine* 2:46–54
- Bruschi P (2011) Traditional healers and laypeople: a qualitative and quantitative approach to local knowledge on medicinal plants in Muda (Mozambique). *J Ethnopharmacol* 138:543–563
- Burkill HM (1985) The useful plants of west Tropical Africa, 2. Volume 1. University Press of Virginia, Charlottesville
- Buso P, Manfredini S, Reza Ahmadi-Ashtiani H, Sciabica S, Buzzi R, Vertuani S, Baldisserotto A (2020) Iranian Medicinal plants: from ethnomedicine to actual studies. *Medicina (mex)* 56:97. <https://doi.org/10.3390/medicina56030097>
- Cakilcioglu U, Khatun S, Turkoglu I, Hayta S (2011) Ethnopharmacological survey of medicinal plants in Maden (Elazığ-Turkey). *J Ethnopharmacol* 137:469–486. <https://doi.org/10.1016/j.jep.2011.05.046>
- Camejo-Rodriguez J, Ascensão L, Bonet MÀ, Vallès J (2003) An ethnobotanical study of medicinal and aromatic plants in the Natural Park of “Serra de São Mamede” (Portugal). *J Ethnopharmacol* 89:199–209. [https://doi.org/10.1016/S0378-8741\(03\)00270-8](https://doi.org/10.1016/S0378-8741(03)00270-8)
- Chaïbou M, Moussa Bamba AN, Moussa I, Ilagouma AT, Khalid I (2020) Etude Bibliographique et Phytochimique de Quelques Plantes Médicinales Utilisées Pour Le Traitement de Certaines Maladies par les Tradipraticiens de la Zone de l'Azawagh au Niger. *Eur Sci J ESJ*. <https://doi.org/10.19044/esj.2020.v16n6.p126>
- Chandra S, Rawat D (2015) Medicinal plants of the family Caryophyllaceae: A review of ethno-medicinal uses and pharmacological properties. *Integr Med Res*. <https://doi.org/10.1016/j.imr.2015.06.004>
- Chaveerach A, Mokkalum P, Sudmoon R, Taneer T (2006) Ethnobotany of the Genus *Piper* (Piperaceae) in Thailand. *Ethnobot Res Appl* 4:223–231
- Chebat A, Skalli S, Errihani H, Boulaâmame L, Mokrim M, Mahfoud T, Soulaymani R, Kahouadji A (2014) Étude de prévalence des effets indésirables liés à l'utilisation des plantes médicinales par les patients de l'Institut National d'Oncologie, Rabat. *Phytothérapie* 12:25–32. <https://doi.org/10.1007/s10298-013-0828-4>
- Chehma A, Djebar MR (2008) Les espèces médicinales spontanées du Sahara septentrional algérien: distribution spatio-temporelle et étude ethnobotanique. *Synthèse Rev Sci Technol* 17:36–45
- Chermat S, Gharzouli R (2015) Ethnobotanical study of medicinal flora in the North East of Algeria—an empirical knowledge in Djebel Zdimm (Setif). *J. Mater Sci Eng A* 5:50–59. <https://doi.org/10.17265/2161-6213/2015.1-2.007>
- Chevallier A (1996) The encyclopedia of medicinal plants. An excellent guide to over 500 of the more well known medicinal herbs from around the world. DK Edition
- Chintamunnee V, Mahomoodally MF (2012) Herbal medicine commonly used against non-communicable diseases in the tropical island of Mauritius. *J Herb Med* 2:113–125. <https://doi.org/10.1016/j.hermed.2012.06.001>
- Eddouks M, Ouahidi ML, Farid O, Moufid A, Khalidi A, Lemhadri A (2007) L'utilisation des plantes médicinales dans le traitement du diabète au Maroc. *Phytothérapie* 5:194–203. <https://doi.org/10.1007/s10298-007-0252-4>
- Eddouks M, Ajebli M, Hebi M (2017) Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. *J Ethnopharmacol* 198:516–530. <https://doi.org/10.1016/j.jep.2016.12.017>
- Eddouks M, Hebi M, Ajebli M (2020) Medicinal Plants and gynecobstetric disorders among women in the South East of Morocco. *Curr Womens Health Rev* 16:2–17. <https://doi.org/10.2174/1573404815666191206112518>
- El-Hilaly J, Hmammouchi M, Lyoussi B (2003) Ethnobotanical studies and economic evaluation of medicinal plants in Taounate province (Northern Morocco). *J Ethnopharmacol* 86:149–158. [https://doi.org/10.1016/S0378-8741\(03\)00012-6](https://doi.org/10.1016/S0378-8741(03)00012-6)
- El-Kamali HH (2009) Ethnopharmacology of medicinal plants used in North Kordofan (Western Sudan). *Ethnobot Leaflet* 2009(1):24
- Elyebdri N, Boumediou A, Addoun S (2017) Ethnobotanical study on the usage of toxic plants in traditional medicine in the City Center of Tlemcen, Algeria [WWW Document]. <https://doi.org/10.5281/zenodo.1132779>
- Etame-Loe G, Ngoule CC, Mbome B, Pouka K, Ngene JP, Yinyang J, Okalla C, Ngaba GP, Dibong SD (2018) Contribution à l'étude des plantes médicinales et leurs utilisations traditionnelles dans le département du Lom et Djerem (Est, Cameroun). *J Anim Plant*. 35:5560–5578
- Farid O, El Haidani A, Eddouks M (2018) Antidiabetic effect of spearmint in streptozotocin-induced diabetic rats. *Endocr Metab Immune Disord Drug TargetsFormerly Curr Drug Targets Immune Endocr Metab Disord* 18:581–589. <https://doi.org/10.2174/1871530318666180517101708>
- Fetse JP, Kofie W, Adosraku RK (2016) Ethnopharmacological Importance of *Xylopi aethiopica* (DUNAL) A. RICH (Annonaceae)—a review. *J Pharm Res Int*. <https://doi.org/10.9734/BJPR/2016/24746>
- Francis Xavier T, Kannan M, Auxilia A (2015) Observation on the traditional phytotherapy among the Malayali tribes in Eastern Ghats of Tamil Nadu, South India. *J Ethnopharmacol* 165:198–214. <https://doi.org/10.1016/j.jep.2015.02.045>

- Fundiko M-CC (2017) Ethnobotany of plants used in the treatment of diseases of the digestive system in Kinshasa and neighborhood, Democratic Republic of the Congo. *Int J Innov Sci Res* 31:194–203
- Gacem MA, Ould El Hadj-Khelil A, Boudjemaa B, Gacem H (2020) Phytochemistry, toxicity and pharmacology of *Pistacia lentiscus*, *Artemisia herba-alba* and *Citrullus colocynthis*. In: Lichtfouse E (ed) Sustainable agriculture reviews 39, sustainable agriculture reviews. Springer International Publishing, Cham, pp 57–93. https://doi.org/10.1007/978-3-030-38881-2_3
- GJ OJE, Afaha IP, Umoh NS (2013) Haematopoietic properties of ethanolic fruit extract of *Musa acuminata* on Albino rats. *Bull Environ Pharmacol Life Sci* 2:22–26
- Guarino C, De Simone L, Santoro S (2008) Ethnobotanical Study of the Sannio Area, Campania, Southern Italy.
- Güzel Y, Güzelşemme M, Miski M (2015) Ethnobotany of medicinal plants used in Antakya: a multicultural district in Hatay Province of Turkey. *J Ethnopharmacol* 174:118–152. <https://doi.org/10.1016/j.jep.2015.07.042>
- Haddad PS, Depot M, Settaf A, Chabli A, Cherrah Y (2003) Comparative study on the medicinal plants most recommended by traditional practitioners in Morocco and Canada. *J Herbs Spices Med Plants* 10:25–45. https://doi.org/10.1300/J044v10n03_04
- Hadjadj S et al (2015) Journal of Medicinal Plants Research - ethnobotanical study and phytochemical screening of six medicinal plants used in traditional medicine in the northeastern sahara of algeria (area of ouargla). *J Med Plants Res* 9:1049–1059
- Hammiche V, Maiza K (2006) Traditional medicine in Central Sahara: Pharmacopoeia of Tassili N'ajjer. *J Ethnopharmacol* 105:358–367. <https://doi.org/10.1016/j.jep.2005.11.028>
- Han X, Parker TL (2017) Anti-inflammatory activity of clove (*Eugenia caryophyllata*) essential oil in human dermal fibroblasts. *Pharm Biol* 55:1619–1622. <https://doi.org/10.1080/13880209.2017.1314513>
- Hassaine S et al (2019) Plants used in the treatment of high blood pressure in Tlemce,n Algeria. *J Pharma Pharmacognosy Res* 7–1:1–11
- Hussain AI, Rathore HA, Sattar MZA, Chatha SAS, Sarker SD, Gilani AH (2014) *Citrullus colocynthis* (L.) Schrad (bitter apple fruit): A review of its phytochemistry, pharmacology, traditional uses and nutritional potential. *J Ethnopharmacol* 155:54–66. <https://doi.org/10.1016/j.jep.2014.06.011>
- Ibn-Tattou M, Fennane M (2008) Flore vasculaire du Maroc: inventaire et chorologie. Edition Print book
- INSID (2021) Institut National Des Sols De L'irrigation et du Drainage - Essai de représentation d'une technique d'irrigation traditionnelle dans la wilaya d'Adrar : la « foggara ».
- Issac A, Gopakumar G, Kuttan R, Maliakel B, Krishnakumar IM (2015) Safety and anti-ulcerogenic activity of a novel polyphenol-rich extract of clove buds (*Syzygium aromaticum* L.). *Food Funct* 6:842–852. <https://doi.org/10.1039/C4FO00711E>
- IUCN the world conservation union (2005) A guide to medicinal plants in North Africa. Centre for Mediterranean Cooperation, Spain
- Jamila F, Mostafa E (2014) Ethnobotanical survey of medicinal plants used by people in Oriental Morocco to manage various ailments. *J Ethnopharmacol* 154:76–87. <https://doi.org/10.1016/j.jep.2014.03.016>
- Jansen GC, Wohlmuth H (2014) Carrot seed for contraception: a review. *Aust J Herb Med* 26(1):10–17
- Jaradat NA, Zaid AN, Al-Ramahi R, Alqub MA, Hussein F, Hamdan Z, Mustafa M, Qneibi M, Ali I (2017) Ethnopharmacological survey of medicinal plants practiced by traditional healers and herbalists for treatment of some urological diseases in the West Bank/Palestine. *BMC Complement Altern Med* 17:255. <https://doi.org/10.1186/s12906-017-1758-4>
- Joshi K (2005) Ethnobotanical information on *Cyperus rotundus* L. Nepal. *Bionotes* 7(3):86
- Koldaş S, Demirtas I, Ozen T, Demirci MA, Behçet L (2015) Phytochemical screening, anticancer and antioxidant activities of *Origanum vulgare* L. ssp. *viride* (Boiss.) Hayek, a plant of traditional usage. *J Sci Food Agric* 95:786–798. <https://doi.org/10.1002/jsfa.6903>
- Koukoulitsa C, Zika C, Hadjipavlou-Litina D, Demopoulos VJ, Skaltsa H (2006) Inhibitory effect of polar oregano extracts on aldose reductase and soybean lipoxygenase in vitro. *Phytother Res* 20:605–606. <https://doi.org/10.1002/ptr.1901>
- Kumar D, Narayan A (2013) Mini review paper nutritional, medicinal and economical importance of corn: a mini review. <https://doi.org/10.13140/RG.2.2.30058.62408>
- Kumarasamy Y, Nahar L, Byres M, Delazar A, Sarker SD (2005) The Assessment of biological activities associated with the major constituents of the methanol extract of 'Wild Carrot' (*Daucus carota* L.) Seeds. *J Herb Pharmacother* 5:61–72. https://doi.org/10.1080/J157v05n01_07
- Lahsissene K (2010) Analyse ethnobotanique des plantes médicinales et aromatiques de la flore marocaine: cas de la région de Zaër. *Phytothérapie* 8:202–209. <https://doi.org/10.1007/s10298-010-0569-2>
- Lakhdari W, Dehliz A, Acheuk F, Mlik R, Hammi H, Doumandji-Mitiche B, Gheriani S, Berrekbia M, Guermit K, Chergui S (2016) Ethnobotanical study of some plants used in traditional medicine in the region of Oued Righ (Algerian Sahara). *J Med Plants Stud* 4(2):204–211
- Lalfakzuala R, Lalramnghinglova H, Kayang H (2007) Ethnobotanical usages of plants in western Mizoram, vol 63. IJTK
- Lans CA (2006) Ethnomedicines used in Trinidad and Tobago for urinary problems and diabetes mellitus. *J Ethnobiol Ethnomedicine* 2:45. <https://doi.org/10.1186/1746-4269-2-45>
- Leporatti ML, Ghedira K (2009) Comparative analysis of medicinal plants used in traditional medicine in Italy and Tunisia. *J Ethnobiol Ethnomed* 5:31. <https://doi.org/10.1186/1746-4269-5-31>
- Li HY, Lee BK, Kim JS, Jung SJ, Oh SB (2008) Eugenol inhibits ATP-induced P2X currents in trigeminal ganglion neurons. *Korean J Physiol Pharmacol* 12(6):315–321
- Liolios C, Laouer H, Boulaacheb N, Gortzi O, Chinou I (2007) Chemical Composition and Antimicrobial Activity of the Essential Oil of algerian *Phlomis bovei* De Noé subsp. *Bovei*. *Molecules* 12:772–781. <https://doi.org/10.3390/12040772>
- Loman DG (2003) The use of complementary and alternative health care practices among children. *J Pediatr Health Care* 17:58–63. <https://doi.org/10.1067/mp.2003.29>
- Lugo-Lugo DE, Pozos-Guillén AJ, de Zapata-Morales JR, Rodríguez-Chong A, de Rangel-López, AJ, Saavedra-Leos MZ, Vértiz-Hernández AA (2019) Antinociceptive local activity of 4-allyl-1-hydroxy-2-methoxybenzene (*eugenol*) by the formalin test: an anti-inflammatory effect. *Braz J Pharm Sci*. <https://doi.org/10.1590/s2175-97902019000118022>
- Madani S, Djamel S, Noui H, Amel B (2012) Ethnobotanical study of therapeutic plants used to treat arterial hypertension in the Hodna region of Algeria. *Glo J Res Med Plants Indig Med* 1:7
- Madani I, Tahir Y, Nour S (2014) (6) Ethnomedicinal plants used by Kababeesh tribe, northern Sudan. *Nyame Akuma* 82:91–99
- Mahamane H, Ardine AC, Ben Adam MA, Mamadou G, Mahamadou T, Rokia S (2020) Enquête Ethnobotanique Des Plantes Utilisées Pour La Protection Cutanée Des Personnes Atteintes D'albinisme Dans Le District De Bamako (Mali) Et Analyse Qualitative De *Bixa orellana* L. (Bixaceae). *Eur Sci J ESJ*. <https://doi.org/10.19044/esj.2020.v16n12p370>
- Mahendran G et al (2021) The traditional uses, phytochemistry and pharmacology of spearmint (*Mentha spicata* L.): a review. *J*

- Ethnopharmacol 278:114266. <https://doi.org/10.1016/j.jep.2021.114266>
- Maurya AK, Agarwal K, Gupta AC, Saxena A, Nooreen Z, Tandon S, Ahmad A, Bawankule DU (2020) Synthesis of eugenol derivatives and its anti-inflammatory activity against skin inflammation. *Nat Prod Res* 34:251–260. <https://doi.org/10.1080/14786419.2018.1528585>
- Meddour R, Meddour-Sahar O (2015) Medicinal plants and their traditional uses in Kabylia (Tizi Ouzou, Algeria). *Arab J Med Aromat Plants* 1:137–151. <https://doi.org/10.48347/IMIST.PRSM/ajmap-v1i2.4331>
- Merad Chiali R (1973) Contribution à la connaissance de la pharmacopée traditionnelle algérienne. Thèse pour l'obtention de doctorat en Pharmacie.
- Merzaia AB (2015) The desert spontaneous plants used in saharan phytotherapy: case of Tidikelt region. *J Chem Chem Eng.* <https://doi.org/10.17265/1934-7375/2015.02.006>
- Merzouki A, Ed-derfoufi F, Molero Mesa J (2000) Contribution to the knowledge of Rifian traditional medicine II: Folk medicine in Ksar Lakbir district (NW Morocco). *Fitoterapia* 71:278–307. [https://doi.org/10.1016/S0367-326X\(00\)00139-8](https://doi.org/10.1016/S0367-326X(00)00139-8)
- Miara MD, Hammou MA, Aoul SH (2013) Phytothérapie et taxonomie des plantes médicinales spontanées dans la région de Tiaret (Algérie). *Phytothérapie* 11:206–218. <https://doi.org/10.1007/s10298-013-0789-3>
- Miara MD, Bendif H, Rebbas K, Rabah B, Hammou MA, Maggi F (2019a) Medicinal plants and their traditional uses in the highland region of Bordj Bou Arreridj (Northeast Algeria). *J Herb Med* 16:100262. <https://doi.org/10.1016/j.hermed.2019.100262>
- Miara MD, Teixidor-Toneu I, Sahnoun T, Bendif H, Ait Hammou M (2019b) Herbal remedies and traditional knowledge of the Tuareg community in the region of Illizi (Algerian Sahara). *J Arid Environ* 167:65–73. <https://doi.org/10.1016/j.jaridenv.2019.04.020>
- Ministère Algérien du commerce (2020) Statistiques. Registre de commerce et des sociétés.
- Mohammadhosseini M, Venditti A, Sarker SD, Nahar L, Akbarzadeh A (2019) The genus *Ferula*: Ethnobotany, phytochemistry and bioactivities—a review. *Ind Crops Prod* 129:350–394. <https://doi.org/10.1016/j.indcrop.2018.12.012>
- Mossa JS (1944) Al-Yahya, M.A., 1945-, Al-Meshal, I.A., 1946-, 1987. Medicinal plants of Saudi Arabia. King Saud University Libraries.
- Moulay M (2014) Caractérisation écologique de peuplement de *Balanites aegyptiaca* (L)Del à oued Matriouane dans la région d'Aoulef Adrar. Thèse Master. Univ Tlemcen. p 12, ".
- Nassiri L, Zarkani S, Daoudi A, Bammou M, Bouiamrine EH, Ibi-jbjen J (2016) Contribution à l'élaboration d'un catalogue ethnobotanique de la commune rurale d'Aguelmos (Province de Khénifra, Maroc)/[Contribution to the establishment of ethno botanical catalog of Aguelmos (Khenifra, Morocco)]. *Int J Innov Appl Stud* 17:373–387
- Nuwaha F, Musinguzi G (2013) Use of alternative medicine for hypertension in Buikwe and Mukono districts of Uganda: a cross sectional study. *BMC Complement Altern Med* 13:301. <https://doi.org/10.1186/1472-6882-13-301>
- Ohkubo T, Shibata M (1997) The Selective Capsaicin antagonist capsaizepine abolishes the antinociceptive action of eugenol and guaiacol. *J Dent Res* 76:848–851. <https://doi.org/10.1177/00220345970760040501>
- ONS (National Statistical Office-Algeria) (2018) General population and housing census. ONS archives 2018
- Ouarghidi A, Martin GJ, Powell B, Esser G, Abbad A (2013) Botanical identification of medicinal roots collected and traded in Morocco and comparison to the existing literature. *J Ethnobiol Ethnomed* 9:59. <https://doi.org/10.1186/1746-4269-9-59>
- Ouelbani R, Bensari S, Mouas TN, Khelifi D (2016) Ethnobotanical investigations on plants used in folk medicine in the regions of Constantine and Mila (North-East of Algeria). *J Ethnopharmacol* 194:196–218. <https://doi.org/10.1016/j.jep.2016.08.016>
- Ould El Hadj MD, Hadj-Mahammed M, Zabeirou H (2003) Place des plantes spontanées dans la médecine traditionnelle de la région de Ouargla (Sahara septentrional est). *Courrier Du Savoir* 3:47–51
- Özdemir E, Alpınar K (2015) An ethnobotanical survey of medicinal plants in western part of central Taurus Mountains: Aladaglar (Nigde–Turkey). *J Ethnopharmacol* 166:53–65. <https://doi.org/10.1016/j.jep.2015.02.052>
- Ozenda P (2004) Flore et végétation du Sahara, 3rd edn. CNRS, Paris, p 622
- Phillips O, Gentry AH (1993) The useful plants of Tambopata, Peru: II. Additional hypothesis testing in quantitative ethnobotany. *Econ Bot* 47:33–43
- Phondani PC, Maikhuri RK, Rawat LS, Farooquee NA, Kala CP, Vishvakarma SCR, Rao KS, Saxena KG (2010) Ethnobotanical Uses of plants among the bhotiya tribal communities of Niti Valley in Central Himalaya, India. *Ethnobot Res Appl* 8:233–244
- Quezel P, Santa S (1963) Nouvelle flore d'Algérie et des régions désertiques méridionales. Edition du centre national de la recherche scientifique. ed. Paris, France.
- Qurashi R (2008) Ethnobotany of plants used by the Thari people of Nara Desert, Pakistan. *Fitoterapia* 79(6):468–473
- Ramdane F, Mohammed MH, Hadj MDO, Chanai A, Hammoudi R, Hillali N, Mesrouk H, Bouafia I, Bahaz C (2015) Ethnobotanical study of some medicinal plants from Hoggar, Algeria. *J Med Plants Res* 9:820–827. <https://doi.org/10.5897/JMPR2015.5805>
- Rizwana H, Alwhibi MS, Khan F, Soliman DA (2016) Chemical composition and antimicrobial activity of *Eruca sativa* seeds against pathogenic bacteria and fungi. *J Anim Plant Sci* 26(6):1859–1871
- Roshetko JM, Purnomosidhi P, Sebastian G, Dahlia L, Mahrizal M, Mulyoutami E, Perdana A, Megawati M, Riyandoko R, Maulana HT, Anggrayani S, Martini E (2017) Ethnobotanical use and commercial potential of *Moringa oleifera* in Indonesia: an underused and under-recognized species. *Acta Hort.* <https://doi.org/10.17660/ActaHortic.2017.1158.39>
- Sadeghi Z, Kuehstani K (2014) Ethnobotany of date palm (*Phoenix dactylifera*) in Baluch tribe of Saravan region, Baluchistan, Iran. *J Agric Technol* 10(6):1571–1585
- Saïdi A, Ali Belhadj O (2016) Enquête sur les plantes antihypertensives utilisées dans la région de Tlemcen. Mémoire pour l'obtention de doctorat en pharmacie. Abou Bakr Belkaid. Tlemcen.
- Sarkhail P (2014) Traditional uses, phytochemistry and pharmacological properties of the genus *Peucedanum*: a review. *J Ethnopharmacol* 156:235–270. <https://doi.org/10.1016/j.jep.2014.08.034>
- Selmani C, Chabane D, Bouguedoura N (2017) Ethnobotanical survey of *Phoenix dactylifera* L. Pollen used for the treatment of infertility problems in Algerian oases. *Afr J Tradit Complement Altern Med* 14:175–186. <https://doi.org/10.4314/ajtcam.v14i3>
- Senouci F, Ababou A, Chouieb M, Chouieb M (2019) Ethnobotanical Survey of the Medicinal Plants used in the Southern Mediterranean. Case Study: The Region of Bissa (Northeastern Dahra Mountains, Algeria). *Pharmacogn J* 11:647–659. <https://doi.org/10.5530/pj.2019.11.103>
- Sharma J, Gairola S, Gaur RD, Painuli RM (2012) The treatment of jaundice with medicinal plants in indigenous communities of the Sub-Himalayan region of Uttarakhand, India. *J Ethnopharmacol* 143:262–291. <https://doi.org/10.1016/j.jep.2012.06.034>
- Sissoko M (2006) Chapitre 4. Comment guider les tradipraticiens pour qu'ils jouent un rôle dans les changements de comportement, notamment du couple « mère-enfant » ? In: Moulin A-M, Orfila J, Sacko D, Schemann J-F (eds) Lutte contre le trachome en Afrique subsaharienne. IRD Éditions, pp 35–41. <https://doi.org/10.4000/books.irdeditions.5096>

- Snoussi M, Dehmani A, Noumi E, Flamini G, Papetti A (2016) Chemical composition and antibiofilm activity of *Petroselinum crispum* and *Ocimum basilicum* essential oils against *Vibrio* spp. strains. *Microb Pathog* 90:13–21. <https://doi.org/10.1016/j.micpath.2015.11.004>
- Society of Ethnobiology Code of Ethics [WWW Document] (2022) <https://ethnobiology.org/about-society-ethnobiology/ethics>. Accessed 11 Apr 2021
- Soladoye MO, Amusa N, Raji-Esan SO, Chukwuma E, Taiwo AA (2010) Ethnobotanical survey of anti-cancer plants in Ogun State, Nigeria. *Ann Biol Res* 1:261–273
- Tahraoui A (2007) Ethnopharmacological survey of plants used in the traditional treatment of hypertension and diabetes in south-eastern Morocco (Errachidia province). *J Ethnopharmacol* 110:105–117
- Taïbi K, Aït Abderrahim L, Boussaid M, Taïbi F, Achir M, Souana K, Benaïssa T, Farhi KH, Naamani FZ, Nait Said K (2021) Unraveling the ethnopharmacological potential of medicinal plants used in Algerian traditional medicine for urinary diseases. *Eur J Integr Med* 44:101339. <https://doi.org/10.1016/j.eujim.2021.101339>
- Tardío J, Pardo-de-Santayana M (2008) Cultural importance indices: a comparative analysis based on the useful wild plants of southern Cantabria (Northern Spain)¹. *Econ Bot* 62:24–39. <https://doi.org/10.1007/s12231-007-9004-5>
- Teixidor-Toneu I, Martin GJ, Ouhammou A, Puri RK, Hawkins JA (2016) An ethnomedicinal survey of a Tashelhit-speaking community in the High Atlas, Morocco. *J Ethnopharmacol* 188:96–110. <https://doi.org/10.1016/j.jep.2016.05.009>
- Telli A et al (2016) An ethnopharmacological survey of plants used in traditional diabetes treatment in south-eastern Algeria (Ouargla province). *J Arid Environ* 127:82–92. <https://doi.org/10.1016/j.jaridenv.2015.11.005>
- Torres-Martínez Y, Arredondo-Espinoza E, Puente C, González-Santiago O, Pineda-Aguilar N, Balderas-Rentería I, López I, Ramírez-Cabrera MA (2019) Synthesis of silver nanoparticles using a *Mentha spicata* extract and evaluation of its anticancer and cytotoxic activity. *PeerJ* 7:e8142. <https://doi.org/10.7717/peerj.8142>
- Trabut L (1935) Répertoire des noms indigènes des plantes. Collection du centenaire de l'Algérie
- Trotter RT, Logan MH (1986) Informant consensus: a new approach for identifying potentially effective medicinal plants. In: Etkin NL (ed) *Plants in Indigenous Medicine and Diet*. Redgrave Publishing Company, Bedford Hill
- Tuttolomondo T, Licata M, Leto C, Bonsangue G, Letizia Gargano M, Venturella G, La Bella S (2014) Popular uses of wild plant species for medicinal purposes in the Nebrodi Regional Park (North-Eastern Sicily, Italy). *J Ethnopharmacol* 157:21–37. <https://doi.org/10.1016/j.jep.2014.08.039>
- Vitalini S (2015) Plants, people and traditions: ethnobotanical survey in the Lombard Stelvio National Park and neighbouring areas (Central Alps, Italy). *J Ethnopharmacol* 173:435–458
- WHO traditional medicine strategy: 2014–2023 (2022) [WWW Document], n.d. URL <https://www.who.int/publications/i/item/9789241506096>. Accessed 3 June 2022
- Yasser K, Abdallah M, Abdelmadjid B (2018) Étude ethnobotanique de quelques plantes médicinales dans une région hyper aride du Sud-ouest Algérien «Cas du Touat dans la wilaya d'Adrar». *J Anim Plant Sci*. 36:5844–5857
- Yousfi B (2017) Les territoires sahariens en Algérie. Gouvernance, acteurs et recomposition territoriale. L'année. <https://doi.org/10.4000/anneemaghreb.2951>
- Zamudio F, Kujawska M, Hilgert IN (2010) Honey as medicinal and food resource. comparison between polish and multiethnic settlements of the Atlantic Forest, Misiones, Argentina. *Open Complement Med J* 2:58–73

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