Valorization of local ethnobotanical knowledge in Ouled Ben Abdelkader region, Northwest of Algeria

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Research

Abstract

Background: This study aims to explore the ethnobotanical practices and to emphasize the local ethnobotanical knowledge of the indigenous population in the region of Ouled Ben Abdelkader, located in the Northwest of Algeria.

Methods: The present ethnobotanical investigation was conducted during the period from November 2021 to April 2022, based on a sample of 269 participants. The collection of information on plants usage was based on semi-structured interviews. The collected data were subsequently analyzed through the calculation of several parameters, including the use value, the relative frequency of citation and the informant consensus factor for each plant.

Results: Through this ethnobotanical survey, 100 species belonging to 44 botanical families were widely reported by the local population. Lamiaceae, Asteraceae and Apiaceae were the most dominant families with 14%, 10% and 8% respectively. Leaves and aerial parts were the most commonly used parts, with infusion and decoction being the most common techniques. *Eucalyptus globulus* and *Origanum vulgare* were the most frequently cited plants, while *Pistacia lentiscus* had the highest use value. The analysis of the data showed 13 distinct ailment categories, the respiratory system disorders and gastrointestinal system diseases exhibited the highest values with 0.94 and 0.92 respectively, suggesting that the respondents were in agreement regarding the potential therapeutic applications of medicinal plants against these specific ailments.

Conclusions: As part of this study, the main objective was to enhance the ethnobotanical heritage of the population in this study area by envisaging promising opportunities in the field of pharmacology.

Keywords: Ethnobotany, traditional medicine, valorization, quantitative indices, local population, Algeria.

Background

Ethnobotany explores the direct relationship between plants and humans; it mainly concerns the traditional use of medicinal plants by indigenous peoples and local communities (Balik *et al*. 1996, Prance 2000). The importance of this discipline lies in the fact that herbal medicine still occupies a significant role in health care practices (Bouzabata 2017). The ancestral interest in medicinal plants, which has existed worldwide for thousands of years, is explained by their potential to improve and preserve the human health, their minimal side effects and their affordable cost (Hassani *et al*. 2016, Ramadan *et al*. 2013).

Algeria, a country located in North Africa, is characterized by a rich floristic diversity totaling approximately 4000 species according to Quezel and Santa (1962, 1963), which represents a highly valuable natural heritage. Among these botanical taxa many wild and cultivated species have traditionally been used by the local populations in traditional medicine (Baba Aïssa 2011, Miara *et al*. 2018, Yahi & Benhouhou 2011). According to the geographical distribution of this flora, every region of Algeria has its own traditional medicine based on locally available plants, thus, the traditional use of medicinal plants by the indigenous populations in various regions of the country were the subject of several publications (Bendif *et al*. 2020, Chermat & Gharzouli 2015, Dahmane *et al*. 2023, Hadj Ali *et al*. 2023, Lakhdari *et al*. 2016, Mechaala *et al*. 2022, Merouane *et al*. 2022, Miara *et al*. 2018, Ouadeh *et al*. 2021, Ouelbani *et al*. 2016). However, Ouled Ben Abdelkader, a region known by its high floristic diversity and rich traditional knowledge, remains unexplored up-to-date, and has not been the subject of any ethnobotanical research. Unfortunately, in the absence of such scientific researches, this unrecorded traditional knowledge is at risk of being lost (Stolton & Dudley 2010), due to the fact that the practitioners of traditional medicine are becoming older, while the younger generation is not interested in this practice.

In this context, the main objective of this ethnobotanical study was to transcribe, preserve and perpetuate the rich traditional knowledge of the indigenous populations of Ouled Ben Abdelkader in connection with the use of medicinal plants, by thoroughly recording the knowledge, therapeutic practices and skills accumulated by the local population throughout history and often passed verbally from the older to the younger generation.

Materials and Methods

Ethnogeography of the study area

The region of Ouled Ben Abdelkader is located in the Southeast of Chlef, a city located in Northwest Algeria, at approximately 200 kilometers west of the capital, Algiers (Fig. 1). The study area covers an area of approximately 180,47 km^2 (Ilrna 2019), with altitudes ranging from 200 to 1200 meters and a semi-arid climate at the lower elevations and a subhumid climate at the higher elevations. Rainfall varies from 300 mm per year recorded in the plain, and 600 mm in the high mountains of Ouarsenis (Duac 2019).

Sampling method

In total, we interviewed 269 individuals using a non-probabilistic sampling method, involving questioning individuals available at the time of the survey (Albuquerque *et al*. 2014). Unfortunately, not all approached individuals were able or willing to participate in the interview; some declined, citing a lack of knowledge on the subject. Therefore, we prioritized interviews with those asserting knowledge of plants and their medicinal uses.

The study was conducted in four (4) of the most densely populated villages within the municipality of Ouled Ben Abdelkader (Table 1).

Table 1. Distributions of investigations in the villages of Ouled Ben Abdelkader.

Municipality	Village	Population	Number of investigation
Ouled Ben Abdelkader	Ouled Ben Abdelkader center	13725	114
	Zemmoura	3184	24
	Ziadnia	2419	28
	Dhar Elouz	4963	103

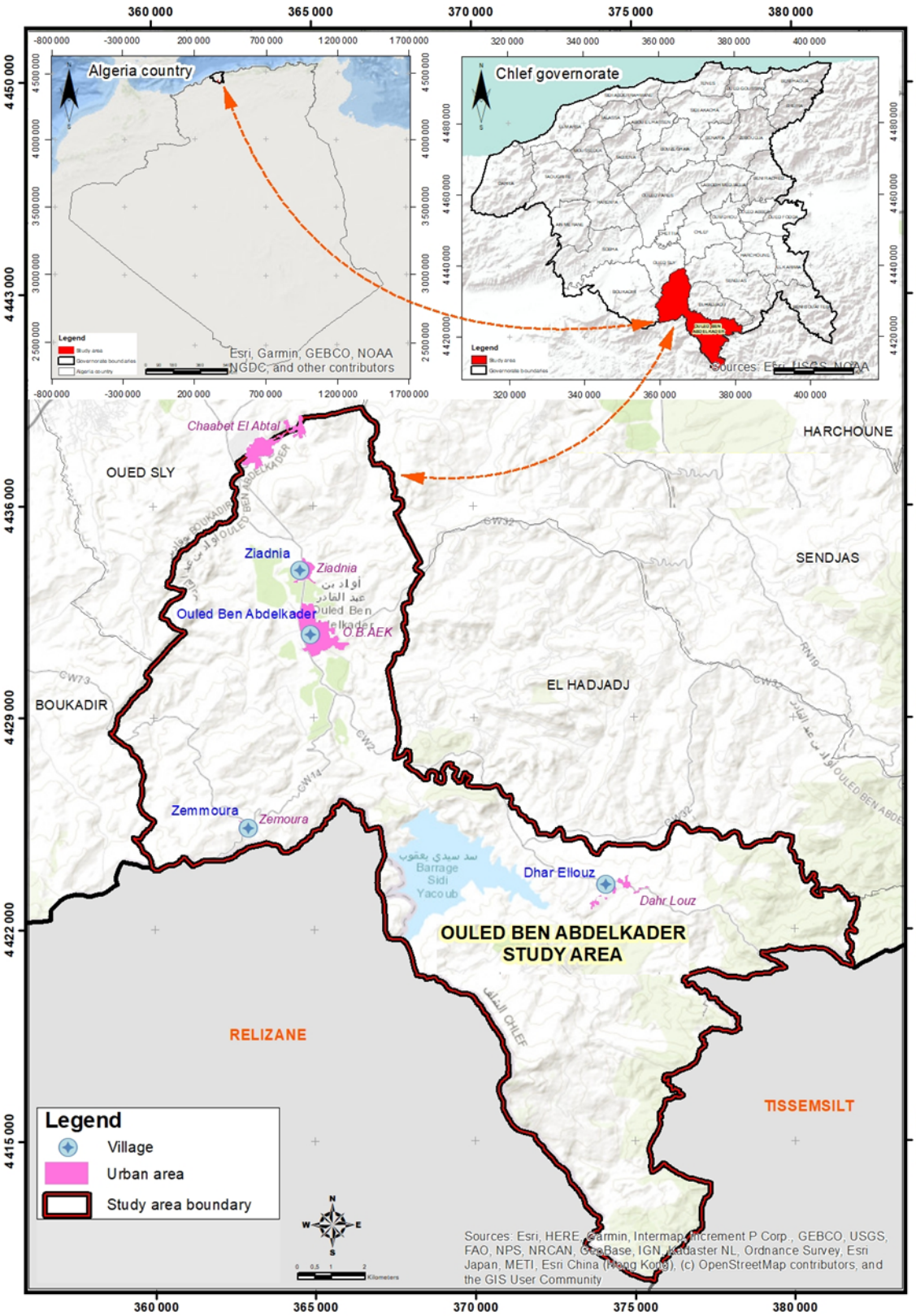

Figure 1. Location of the study area: municipality of Ouled Ben Abdelkader

Ethnobotanical study

Data collection

Through this research, data regarding the application of medicinal herbs by the local populace in the region of Ouled Ben AEK were gathered over a period of 6 months, from November 2021 to April 2022.

We conducted interviews with 269 people aged between 20 and 83 to gather information. A first questionnaire was used to quantify the number of individuals who use medicinal plants. A second questionnaire was carried out with individuals who had used plants. It was designed to obtain data on the age and sex of the user on the one hand and, on the other hand, information on the disease treated, the plant used, the method of preparation of the different medicinal plants, and the part of the plant used.

In order to collect data, we conducted a quantitative and qualitative inventory of traditional applications of medicinal plants applied by the local community. We followed a conventional procedure for ethnobotanical data collection (Albuquerque *et al*. 2014, Meddour *et al*. 2022).

Quantitative analysis

After the botanical identification of medicinal plants by botanists using the guide of Algerian flora by Quezel and Santa (1962-1963), the following ethnobotanical indices were calculated to evaluate our data statistically:

Relative frequency of citation (RFC)

This index indicates the importance of each plant species recognized as a medicinal plant on a local scale. The RFC for each species was calculated. For this measure, we used the following formula according to Tardío and Pardo de Santayana (2008):

$$RFC=FC/N$$

Where FC represents how often informants mention the species' use, and N represents the total number of survey participants.

Use value (UV)

This ethnobotanical index is widely used and would be more objective to evaluate the importance of a plant in a community. The formula recommended by (Phillips *et al*. 1994) is utilized to compute this index:

$$UV=U/N$$

Ui: the number of uses cited by the participant i and n: the number of total participants questioned.

Informant Consensus Factor (ICF)

The following index is frequently utilized for the medicinal uses of plants, as indicated by (Trotter & Logan 1986):

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

Nur: the number of times a particular category p of condition was mentioned,
Nt: The specified number of plants to be utilized in the treatment of this specific condition is p.

Results and Discussion

The sociodemographic characteristics of the informants

We conducted our survey with 269 informants (Table 2), both men and women, who were considered to be holders of traditional medicinal knowledge. Women (50.6%) and men (49.4%) have shared medicinal knowledge. According to (Mattalia *et al*. 2020, Meddour *et al.* 2020, Merouane *et al*. 2022), the majority of individuals learn about traditional remedies from their parents, who transmit this information within the family.

The majority (44.3%) fall into the age category of over 50 years, indicating that older individuals possess more excellent knowledge and experience compared to their younger counterparts. These results are consistent with other research (Benkhaira *et al*. 2021, El-Assri *et al*. 2021, Senouci *et al*. 2019, Sousa *et al*. 2012, Susanti & Zuhud 2019).
The study also highlighted an imminent threat: the gradual disappearance of this ancestral traditional knowledge due to the upheavals caused by modernization.

The majority of informants are illiterate or at the primary level (Table 2). The low level of education is not a constraint on the knowledge of plants and their uses or the transmission of ethnobotanical information from one generation to the next by oral means.

Table 2, Demographic information of the individuals interviewed.

Characteristics	Category	Number	Percentage (%)
Gender	Female	136	50,6
	Male	133	49,4
Age group	Less than 30	46	17,1
	31-40	47	17,5
	41-50	57	21,2
	51-60	46	17,1
	61-70	37	13,8
	More than 71	36	13,4
Marital status	Single	43	16.0
	Married	201	75.8
	divorced	11	4.1
	Veuve	11	4.1
Education level	Illiterate	87	32,3
	Primary	48	17,8
	Secondary	95	35,3
	University	39	14,5

Plant diversity

According to the results of our survey, the people of the Ouled Ben Abdelkader region use one hundred (100) plant species in traditional medicine. These taxa belonged to 44 different botanical families (Table. 2), mainly dominated by the Lamiaceae (14%), the Asteraceae (10%), the Apiaceae (8%), the Fabaceae (6%) and the Rosaceae (5%). The other families present less than 5% of the total (Fig. 2).

The number of 100 plant species is remarkable when compared with data from previous ethnobotanical studies conducted out in Algeria and elsewhere. In Algeria, previous work has reported 27 species in Naama (Bouafia *et al*. 2021), 80 species in Djurdjura Park (Meddour *et al*. 2020), 83 species in Bordj Bou Arreridj (Miara *et al*. 2019), and 70 species in the Bissa region, Chlef (Senouci *et al*. 2019). In Tunisia, a study has identified 70 species in Ouled Dabbeb (Karous *et al*. 2021), and Morocco; the numbers range from 45 species in the province of Moulay Yaâcoub (Mahraz *et al*. 2023) to 57 species in the Fez-Meknes (Tlemcani *et al.* 2023). Pradhan *et al*. (2023) counted only 40 plants in India, specifically in West Bengal.

In contrast, the number of species is similar to that found by (Ouelbani *et al.* 2016), who reported 102 plants utilized in Constantine (Algeria); (Meddour & Meddour-Sahar 2015) also described 98 species used in Kabylie (Algeria). Similar numbers were discovered in Morocco; (Teixidor-Toneu *et al.* 2016) recorded 94 species in the province of Al Haouz, while (Daoudi *et al*. 2015) counted 103 species in the province of Khénifra. In Pakistan, a recent study listed nearly 104 species in the Punjab region (Mustafa *et al*. 2023).

Toxicity of plants of Ouled Ben Abdelkader

Of the 100 plant species listed, nine, representing 9%, have been identified as toxic to humans or livestock on the basis of various studies. The species concerned are *Artemisia Absinthium* L., *Daphne gnidium* L., *Ecballium elaterium* L., *Peganum harmala* L., *Ruta chalepensis* L., *Urtica urens* L., *Nerium oleander* L., and *Citrullus colocynthis* L. According to earlier work by Hammiche *et al.* (2013) and Meddour *et al*. (2020) the species *Artemisia Absinthium* L., *Daphne gnidium* L., and *Ecballium elaterium* L. have already been identified as toxic in the Djurdjura national park in Algeria, Other species, namely *Ruta chalepensis* L., *Urtica urens* L., *Peganum harmala* L., *Nerium oleander* L., and *Citrullus colocynthis* L., have been classified as toxic according to Bendif and Miara (Bendif *et al*. 2020, Miara *et al*. 2019). Testimonials also reported that high doses of these plants could be dangerous.

Part used and method of preparation

The parts generally used by individuals in Ouled Ben AEK seem to be leaves (28%) and elevated parts (21%) (Fig.3). Several authors have noted this information in diverse Algerian regions (Bendif *et al*. 2018, Chermat & Gharzouli 2015, Meddour *et al*. 2020, Miara *et al*. 2019) and even in other nations, (Eddouks *et al*. 2016) in Morocco, (Parada *et al*. 2009) in Spain, and (Tuttolomondo *et al.* 2014) in Italy.

Several methods are employed in our study area, including infusion, decoction, maceration, and powder (Fig. 4). (Bendif *et al*. 2020) suggest that consumers generally prefer the simplest technique for preparing herbal medications, with infusion and decoction being the most popular. This preference for preparatory methods was similarly noted in Constantine by Ouelbani *et al*. (2016). However, (Benarba *et al.* 2015) found that decoction was the more prevalent method of preparation.

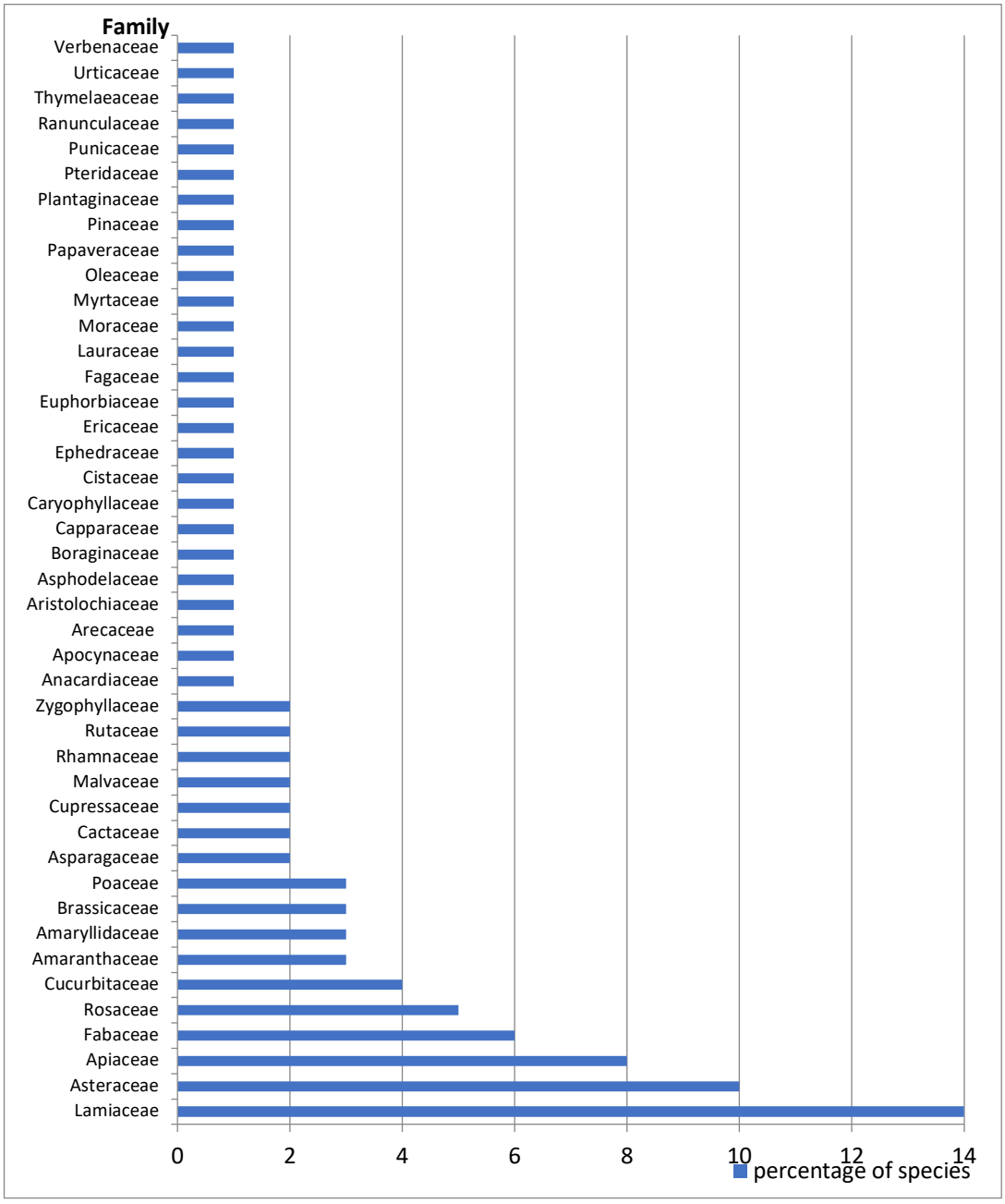

Figure 2. Botanical families used in traditional medicine (percentage of species)

Table 3. Medicinal species used by the population locale of Ouled Ben Abdelkader.

Family	Scientific name and voucher numbers	Local name	Origin	Parts used	Method of preparation	Medicinal uses
Amaranthaceae	*Atriplex halimus* L. AH-0727	Guetaf	Natural	Leaves	Infusion	Ovarian cysts
	Beta vulgaris L. BV-0731	betrave	Cultivated	Bulb	Raw	Emollient, laxative
	Spinacia oleracea L. SO-0007	Selg	Natural	Aerial parts	Cooked	Diabetes, anemia, diarrhea
Amaryllidaceae	*Asphodelus ramosus* L. AR-0492	Berwag	Natural	Bulb	Raw	Cough, antifungal, hemorrhoid
	Allium cepa L. AC- 0563	El bssal	Cultivated	Bulb	Raw	Cold, otitis, angina hair loss
	Allium sativum L. AS-0564	El thome	Cultivated	Bulb	Raw	Dry hair, eczema, influenza
Anacardiaceae	*Pistacia lentiscus* L. PL-1782	Dharw	Forest	Aerial parts	Decoction, Infusion, oil	Scar, ulcers of the mouth, hemorrhoid, cough, diarrhea, stomachache, colon pain, gastric ulcers
Apiaceae	*Ammi visnaga* L. AV-1991	Khella	Natural	Aerial parts	Infusion, Decoction	Influenza, headache, tooth diseases, gum sensitivity
	Ammoides pusilla (Brot.) Breistr. AP-0008	Noukha	Natural	Aerial parts	Infusion, Decoction	Influenza, fever, headache
	Apium graveolens L. AG-1980	kerafess	Cultivated	Aerial parts	Infusion	Kidneys, urinary inflammation, influenza
	Bunium bulbocastanum L. BB-0009	Targouda	Natural	Tuber	Infusion	Allergy, bronchitis, cough
	Coriandrum sativum L. CS-1914	Kosbor	Cultivated	Seeds	Infusion	Cholesterolemia, Anemia
	Foeniculum vulgare Mill. FV-1963	Besbas	Natural	Bulb, seeds, aerial parts	Infusion, Decoction	Analgesic, diarrhea, gastric trouble, colon pain, abdominal pain, colic, spasms, stomachache
	Magydaris panacifolia (Vahl.) Lange. MP-1945	Tafifra	Forest	Stem	Put under the Pillow	fear
	Petroselinum crispum (Mill.) Fuss. PC-1997	Maàdnousse	Cultivated	Leaves	Decoction, Infusion	Colic, visual impairment
Apocynaceae	*Nerium oleander* L. NO-2167	Defla	Natural	Leaves	Poultice	Eczema, diabetic foot

Arecaceae	*Chamaerops humilis* L. CH-0449	Doum	Natural	Fruit, roots aerial parts	Raw, fumigation	Colon pain, stomachache, prostate, tumors
Aristolochiaceae	*Aristolochia baetica* L. AB-0717	Borestom	Natural	Aerial parts	Powder	Cough, cancer, sterility treatment
Asparagaceae	*Asparagus officinalis* L. AO-0541	Sekoum	Natural	Stem	Infusion	Liver diseases
	Urginea maritima (L.) Baker *Seilla maritima* L UM-0517	fereoun	Natural	Bulb	Decoction	Infection
Asphodelaceae	*Aloe vera* (L.) Burm.f. AV-0010	Oulivira	Cultivated	Leaves	Gel	Hair loss
Asteraceae	*Artemisia Absinthium* L. AA-2889	Chedjret Meriem	Natural	Leaves, stem	Infusion, Decoction	Hemorrhoid
	Atractylis gummifera L. = *Carlina gummifera* (L.) Less. CG-2906	Ladad	Natural	Roots	Decoction	Influenza, headache , running delay Hepatitis, constipation, obesity, rheumatism,tranquilizer
	Carthamus caeruleus L. CC-3015	Amargouzgouz	Natural	Roots	Powder	Burns
	Chamaemelum nobile (L.) All. CN-0011	Baboundj	Natural	Flowers	Infusion	Stomachache
	Cynara cardunculus L. CC-2939	Khorchef	Natural	Leaves, flowers	syrup	liver problems
	Dittrichia viscosa (L.) Greuter. DV-0012	Magraman	Natural	Aerial parts	Infusion, Decoction	Antifungal, bronchitis
	Echinops spinosus L. ES-2897	Taskara	Natural	Leaves, fruit	Decoction	Regulating the menstrual cycle, hormone regulation
	Scolymus hispanicus L. SH-3034	Guernina	Natural	Stem	Cooked	Diabetes, galactagogue
	Sonchus oleraceus L. SO-0012	Tilffaf	Natural	Aerial parts	Raw	Galactagogue
	Cichorium intybus L. CI-3040	Hindaba	Natural	Leaves	Infusion	Cholesterolemia
Boraginaceae	*Borago officinalis* L. BO-2228	Lsan elthour	Natural	All parts of the plant	Infusion, Decoction	Constipation, kidneys relaxing, galactagogue

Brassicaceae	*Brassica rapa* L. BR-1155	Lefte	Cultivated	Tuber	Raw	Cough
	Lepidium sativum L. LS-1080	Hab rchad	Cultivated	Seeds	Infusion, powder	Osteoporosis
	Raphanus sativus L. RS-1119	Radis	Cultivated	Tuber, roots	Juice	Obesity
Cactaceae	*Disocactus speciosus* (Cav.) Barthlott. DS-0013	Sabar	Natural	Aerial parts	Infusion, Decoction, oil	Skin diseases, scar hair loss
	Opuntia ficus-indica (L.) Mill. OF-0014	Karmous nsara, hendi	Natural	Leaves, fruit, Flowers	Decoction, oil	Diarrheas
Capparaceae	*Capparis spinosa* L. CS-1040	Kabar	Natural	Roots	Infusion	Galactagogue
Caryophyllaceae	*Silene vulgaris* (Moench) Garcke SV-0015	Tighighach	Natural	Leaves	Infusion, decoction	Infection, diabetes
Cistaceae	*Cistus monspeliensis* L CM-2056	Touzala	Forest	Aerial parts	Decoction	Diabetes, cataract
Cucurbitaceae	*Citrullus colocynthis* (L.) Schrad. CC-2686	ELhadj, Handhal	Natural	Fruit, leaves	Infusion, Decoction	Diabetes, Diarrhea, sciatica
	Cucurbita moschata Duch. Butternut. CM-0016	Kâbûya Yaqtîn	Cultivated	Fruit	Fumigation	Liver problems, gas trouble
	Cucurbita pepo L. CP-0017	Courgette	Cultivated	Flowers seeds, pulp	Infusion, raw	Emollient, laxative, flatulence and intestinal worms, anti-inflammatory
	Ecballium elaterium L. EE-2682	Fagous el hamir	Natural	Fruit	Poultice	Hemorrhoid
Cupressaceae	*Juniperus oxycedrus* L. JO-0048	Thaga	Forest	Leaves	Infusion, powder	Eczema, stomachache, constipation, cholesterolemia, diabetes, rheumatism, cough
	Juniperus phoenicea L. JP-0050	Aârâr	Forest	Aerial parts, Seeds	Decoction, maceration, infusion	Skin diseases, kidney diseases
Ephedraceae	*Ephedra alata* Decne. EA-0059	Alanda	Forest	Leaves	Infusion	Cancer
Ericaceae	*Arbutus unedo* L. AU-2097	Landj	Forest	Fruit	Raw	Anemia

Euphorbiaceae	*Ricinus communis* L. RC-1733	Al kharwaa	Cultivated	Seeds	Oil	Constipation
Fabaceae	*Calycotome spinosa* L. CS-1368	El guendoul	Natural	Aerial parts	Powder	Vascular activation
	Ceratonia siliqua L. CS-1640	Kharoub	Forest	Fruit	Powder	Diarrhea, anemia, stomachache
	Glycyrrhiza glabra L. GG-1591	Ark sous	Natural	Roots	Infusion, Decoction	Rheumatism, cholesterolemia
	Lens culinaris Medik. LC-1514	La3dess	Cultivated	Seeds	Powder	Anemia
	Trigonella foenum-graecum L. TF-1480	Lhalba	Cultivated	Seeds	Powder, infusion	Slim disease, appetite stimulation
	Vicia faba L. VF-1517	Foul	Cultivated	Seeds	Powder	Anemia
Fagaceae	*Quercus ilex* L. QI-0657	Ballout	Forest	Fruit, leaves	Infusion, Powder, Decoction, Raw	Diarrhea, anorexia, stomachache
Lamiaceae	*Clinopodium nepeta* (L.) Kuntze CN-2386	Elnabta	Natural	Aerial parts	Infusion, Decoction	Cough, Cold
	Lavandula angustifolia Mill. LA-3338	Khozama	Natural	Flowers, Leaves	Infusion, Maceration	Microbial, inflammation
	Lavandula stoechas L. LS-2333	Halhal	Natural	Leaves, flowers	Infusion	Gynecological problem, diarrhea, stomachache
	Marrubium vulgare L. MV-2346	Tamariwat	Natural	Aerial parts	Infusion, Decoction, Maceration	Eczema, wounds
	Melissa officinalis L. MO-2370	Melissa	Cultivated	leaves	Infusion	Heart disease
	Mentha pulegium L. MP-2286	Fliou	Natural	Leaves	Infusion, Powder, Decoction	Stomach problems, bronchitis
	Mentha rotundifolia L. MR- 2283	Timarsad	Natural	Aerial parts	Decoction, Infusion	Infection, rheumatism

	Mentha spicata L. MS-2284	Naanaa	Cultivated	Leaves, stem	Infusion, Powder, Decoction	Cold, poor blood, circulation, colon pain
	Ocimum basilicum L. OB-0197	Ahbak	Cultivated	Aerial parts	Infusion	Colon pain, digestive problems, vomiting
	Origanum vulgare L. OV-2420	Zaetar	Forest	Leaves	Infusion, Powder	Cholesterolemia, cold, uterine disease
	Rosmarinus officinalis L. RO-2314	Iklil eldjabel	Natural	Aerial parts	Infusion	Diabetes, stomachache, colon pain, urinary infection, cough, cholesterolemia
	Salvia officinalis L. SO-2317	Marymia	Natural	Leaves	Infusion	Cholesterolemia, Strengthen memory
	Salvia verbenaca L. SV-2320	Khayata	Natural	Leaves	Infusion, Decoction, Maceration	Healing
	Thymus munbyanus Boiss. & Reut. TM-2396	Zaaitra	Natural	Leaves, stem	Infusion, Powder	Nausea, cough, influenza, angina, bronchitis
Lauraceae	*Laurus nobilis* L. LN-1004	Rend	Cultivated	Leaves	Infusion	Microbial inflammation, Influenza, meteorism
Malvaceae	*Grewia tenax* (Forssk.) Fiori. GT-1833	Koudhim	Forest	Fruit	Raw	Stomachache, colon, pain
	Malva sylvestris L. MS-1819	Elkhobiz	Natural	Aerial parts	Infusion, Decoction, Poultice	Breathing problems, stomachache
Moraceae	*Ficus carica* L. FC-0695	Karma	Cultivated	Leaves	Infusion	Angina, obesity, Eczema
Myrtaceae	*Eucalyptus globulus* Labill. EG-1859	calitus	Forest	Leaves	Decoction, Infusion	Chest pain, Influenza
	Myrtus communis L. MG-1856	Rayhane	Cultivated	Leaves	Decoction	Diabetes, cholesterolemia, digestive problems
Oleaceae	*Olea europaea* L. subsp.europaea OE-2157	Zitoune	Natural	Leaves, fruit	Infusion, Decoction, oil	Diabetes, cholesterolemia
Papaveraceae	*Papaver rhoeas* L. PR-1008	Benaâmane	Natural	Flowers	Infusion	Coronary artery, urinary inflammation

Pinaceae	*Pinus halepensis* Mill. PH-0055	Snawber	Forest	Leaves, roots, barks	Infusion, Decoction, Powder	Chest pain
Plantaginaceae	*Globularia alypum* L. GA-2568	Tesslegha	Natural	Aerial parts	Decoction	Diarrhea
Poaceae	*Ampelodesmos mauritanicus* (Poir.) T.Durand & Schinz. AM-0228	Diss	Natural	Aerial parts	Decoction	Diabetes
	Avena sativa L. AS-0246	Choufane, khorthal	Natural	Seeds	Infusion, Powder	Cholesterolemia, slimming, muscular strengthening
	Hordeum vulgare L. HV-0387	Chaiir	Cultivated	Seeds	Decoction, fumigation, maceration	Colon pain, anemia
Pteridaceae	*Adiantum capillus-veneris* L. AC-0030	Ziyata	Natural	Aerial parts	Infusion, Decoction	Stomachache, cold
Punicaceae	*Punica granatum* L. PG-1855	Romane	Cultivated	Fruit, peel of fruit	Infusion, Powder	Cough, influenza diarrhea
Ranunculaceae	*Nigella Arvensis* L. NA-0966	Sanoug	Cultivated	Seeds	Decoction, Powder	Cough, increase immunity, allergy, Bronchitis, angina , fever
Rhamnaceae	*Rhamnus alaternus* L. RA-1796	Meliles	Natural	Leaves	Decoction	Influenza, cold
	Ziziphus lotus (L.) Lam. ZL-1802	Sedra	Natural	Leaves, fruit, roots	Decoction, Maceration, Powder	Stomachache, hair loss
Rosaceae	*Cydonia oblonga* Mill. CO-0001	Sefardjal	Cultivated	Leaves, fruit	Infusion	Cholesterolemia, Diarrhea, Colic
	Eriobotrya japonica (Thunb.) Lindl. EJ-0002	kewirsa	Cultivated	Leaves	Infusion	Diarrhea, stomach pain
	Malus domestica Borkh. MD-0003	Toufah	Cultivated	Fruit	Raw	Heart disease, diabetes, increase immunity
	Persica vulgaris Mill. PV-0004	khoukh	Cultivated	Leaves, fruit	Infusion, raw	Cancer, cholesterolemia, diabetes
	Rubus ulmifolius Schott. RU-1277	Elaolig	Natural	Leaves, fruit	Infusion, raw	Heart disease, cholesterolemia

Rutaceae	*Citrus limon* (L.) Burm.f. CL-0005	Elim	Cultivated	Fruit	Juice, Infusion	Hypotension, Angina, Influenza, Cough
	Ruta chalepensis L. RC-1726	Fidjel	Natural	Leaves	Decoction, Infusion	Respiratory disease, diarrhea, colon pain,
Thymelaeaceae	*Daphne gnidium* L. DG-1837	lezzâz	Natural	Leaves, fruit	Decoction	Lice, back pain, hair loss
Urticaceae	*Urtica urens* L. UU-0701	Horeig	Natural	Aerial parts	Decoction	Heart disease anemia
Verbenaceae	*Aloysia citrodora* Palau. AC-0006	Luiza	Cultivated	Aerial parts	Infusion	Influenza
Zingiberaceae	*Zingiber officinale* Roscoe ZO-0017	Zandjabil	Cultivated	Rhizome	Maceration	Influenza , cold, colon pain, fortifying, stress
Zygophyllaceae	*Peganum harmala* L. PH-1718	Harmel	Natural	Seeds Roots Aerial parts	Decoction, Powder, Poultice	Intertrigo (fingers, toes), Eczema

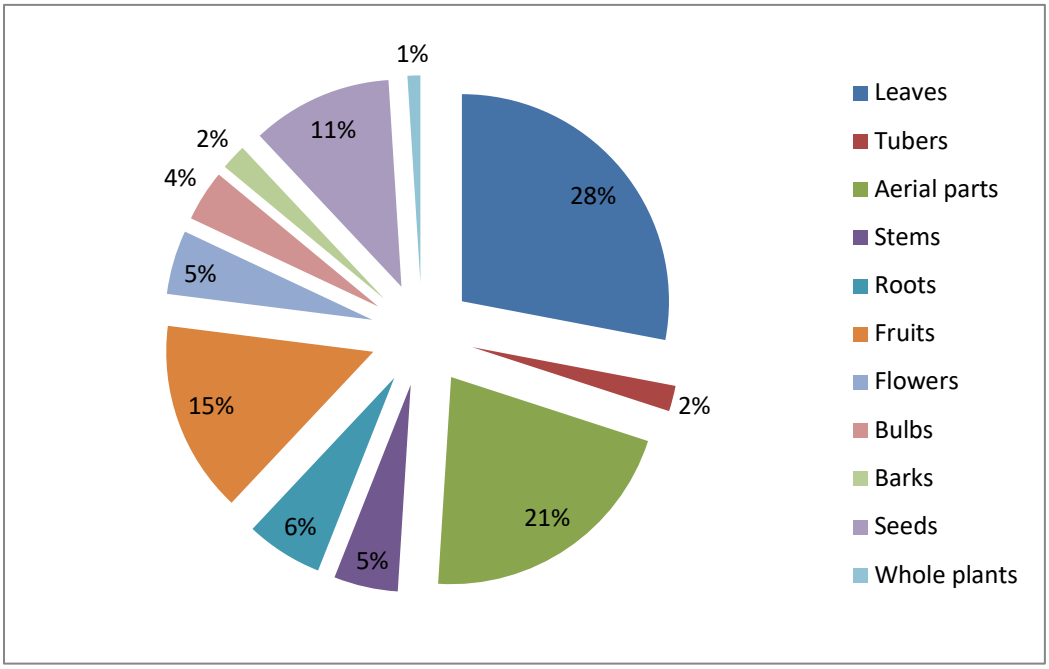

Figure 3.Medicinal plant parts used.

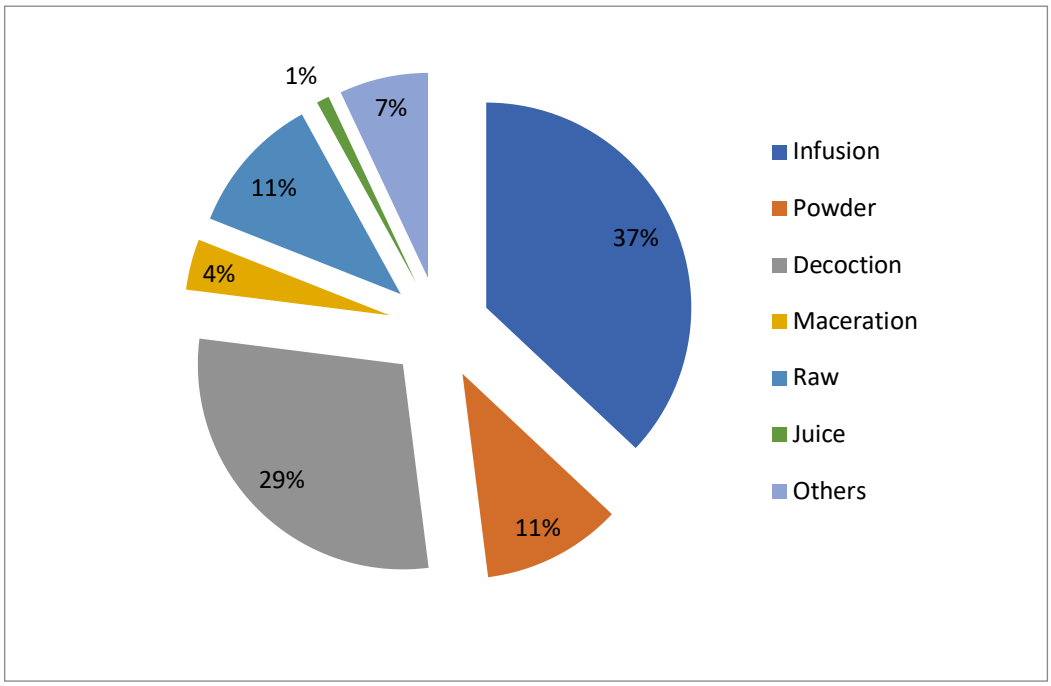

Figure 4. Methods of medicinal plants preparation used.

Quantitative analysis of ethnobotanical data

Relative frequency of citation (RFC)

The relative citation frequency of the 100 species documented by the participants ranged from 0.01 to 0.38. The highest value was recorded for *Eucalyptus globulus* Labill. (0.38) followed by *Origanum vulgare* L. (0.33) and *Pistacia lentiscus* L. (0.30). Sixteen other plant species are mentioned, with an average RFC ranging from 0.10 to 0.30, such as *Bunium bulbocastanum* L., *Ziziphus lotus* L., *Mentha spicata* L., *Mentha pulegium* L., *Rosmarinus officinalis* L., *Marrubium vulgare* L. and *Artemisia Absinthium.* Meddour *et al.* (2022) and Senouci *et al.* (2019) emphasize that the wide therapeutical use of these species remains the good knowledge of the properties and uses of medicinal plants, which is generally acquired following a long experience accumulated and transmitted from one generation to another.

Use value (UV) of species

Species with high used values (UV) were *Pistacia lentiscus* L. (UV=1.22), *Rosmarinus officinalis* L. (UV=0.75), *Origanum vulgare* L. (UV=0.65) and *Mentha spicata* L. (UV=0.63). The fact that the indigenous inhabitants of Ouled Ben AEK employ these specific species to treat a variety of ailments indicates that they possess considerable significance as medicinal plants in the context of traditional medicine.

With a maximum use value of 1.22, *Pistacia lentiscus* L. (Anacardiaceae) was the most frequently utilized plant by local sources of information. The local population uses the pistachio tree to treat mostly gastrointestinal system diseases, such as colon pain, diarrhea, hemorrhoids, stomach aches, and ulcers. This plant is also used for cough treatment. (Senouci *et al*. 2019, Souilah *et al*. 2023) in Algeria, and (Bammou *et al*. 2015) in Morocco have reported that it is widely used in the treatment of gastrointestinal diseases. According to the results of several studies, this plant species has a strong antioxidant capacity. Its leaves are particularly rich in flavonoids, tannins, phenolic compounds, and natural pigments (Dahmoune *et al*. 2014, Longo *et al*. 2007).

When it comes to *Rosmarinus officinalis* L. (Lamiaceae), it was mainly indicated locally in the treatment of gastrointestinal system diseases such as stomachache and colon; it is also used for diabetes, cholesterol, and cough.
Numerous research papers have been written on this particular subject; Rosemary has antioxidant, anti-inflammatory (Wang *et al*. 2012), hypoglycemic (Ramadan *et al*. 2013), antirheumatic effects (Al-Sereiti *et al*. 1999), and hypocholesterolemic effects (Hassani *et al*. 2016). It is also used to reduce pain and stimulate hair growth (Al-Sereiti *et al*. 1999).

The most important therapeutic uses of *Origanum vulgare* L. (Lamiaceae) were those of respiratory tract diseases (cough, cold, and bronchitis) and gastrointestinal system diseases (nausea). Previous studies in many countries have highlighted the use of this species in traditional folk medicine to treat Covid-19 disease (Bary & Amroui 2020, Hamdani & Houari 2020, Helali *et al*. 2020).

The main medicinal applications of *Mentha spicata* L. (Lamiaceae) were for digestive and respiratory disorders. Hadjaidji-Benseghier and Derridj (2017) investigated the northeastern Sahara of Algeria, which revealed the utilization of this species for the treatment of various ailments, including digestive disorders, gastric gas, headaches, hypertension cough, influenza, menstrual soreness, and asthenia. In fact, the Moroccan community has utilized this species to treat quite a few ailments, including skin diseases, diabetes, digestive and respiratory infections, and throat difficulties (Benkhnigue *et al*. 2014, Bouyahya *et al*. 2017, El Menyiy *et al*. 2022).

Informant consensus factor (ICF)

The documented data were categorized into thirteen (13) distinct disease groups in accordance with the reports utilized (Table 4). Respiratory system diseases (ICF=0.94) and gastrointestinal system diseases (ICF=0.92) exhibited the highest ICF values. These results concur with those acquired by Benarba *et al*. (2015) in Algeria, Baydoun *et al*. (2015) in Lebanon, and Mikou *et al*. (2016) in Morocco.

The high values of the consensus factor could be explained by the informants' ability to recognize these conditions easily. Indeed, these pathologies are characterized by recurrent clinical symptoms and can be effectively treated with herbal remedies. (Senouci *et al*. 2019), While also emphasizing the substantial level of information exchange among informants in the region for the treatment of a specific ailment using a particular plant species (Kefifa *et al*. 2019, Meddour *et al*. 2022). In this context, Miara and Ouelbani, in their work (Miara *et al*. 2019, Ouelbani *et al*. 2016), assume that lifestyle is likely the cause of the highest ICF for digestive diseases.

Table 4. Values of the informant consensus factor for category ailments.

Ailment category	Diseases	Nur	Nt	ICF
Respiratory tract diseases	Pulmonary-breathing problem, cold, Sinusitis, nasal-lung, inflammation, cough, pneumonia, bronchitis, asthma, lung filtering/smoker chest and lung diseases, allergy, and chest pain RTD.	679	40	0,94
Gastrointestinal system diseases Irritable	Gastrointestinal diseases, constipation, colitis, ulcers, hemorrhoids, stomachache, diarrhea, intestinal bowel syndrome (IBS), flatulence, heartburn, jaundice/icterus GISD, gallstones, liver diseases.	874	69	0,92

Sexual-reproductive problems	Microbe, breast milk outage, Uterine problems, infections, infertility, prostatitis SRP.	203	18	0,91
Skin diseases	Skin diseases and ulcer, scalp ringworm, wound, festering wounds, and Baldness, Limb swelling, itchy skin, heel fissures, head ulcers, urticaria, lichen tinea capitis, dermatitis or eczema, boils, skin ulcers, leprosy, alopecia areata, chalazion, and hair loss SD, albinism.	264	26	0,90
Cancer	Tumors, cancers	57	7	0,89
Skeletomuscular system disorder	Back pain, Osteoarthritis, fracture, bones pain, gout, acute arthritis, arthritis, osteoporosis, arthrosis, and moving difficulty SMSD	108	13	0,89
Kidney diseases Kidney failure, kidney	Problems, and urolithiasis KD	43	6	0,88
Cardiovascular system diseases	Hypertension, cardiovascular diseases, clogged arteries, and hypercholesterolemia CVSD	253	31	0,88
Nervous system	Migraine, headache, dizziness, head problems, psychosis, insomnia, epilepsy, and sciatica NS	183	22	0,88
General health	Gingivitis, mouth ulcer, Earache and deafness, hoarseness, sore throat, fever, anxiety disorders, halitosis, hypochondria, tonsillitis, and incurable diseases GH	181	23	0,87
Hematological system diseases	Anemia, spleen diseases, blood purification HSD	78	11	0,87
Endocrine system diseases	Diabetes ESD and Goiter	211	28	0,87
Urology system diseases	Urinary tract infection/inflammation, Bladder disease, and cystolithiasis USD	40	10	0,77

Conclusion

Ethnobotany is an interesting and very popular practice used by a large number of traditional practitioners in the region of Ouled Ben Abdelkader in the province of Chlef, especially in terms of traditional medicine, where various disorders are treated using medicinal plants.

The high floristic diversity, in addition, the need to heal and combat illnesses was undoubtly the precursor to the development and the mastery of this practice among ancient local populations. In this respect, it was noted that a large number of medicinal plants (100 species) were used in the treatment of 13 disease categories, particularly respiratory, gastrointestinal and sexual-reproductive disorders, using primarily the leaves and stems, and infusion and decoction as preparation methods.

However, this ancestral knowledge is in danger of disappearing due to the reluctance of young people to traditional practices and the disappearance of older generation, hence the need to make every possible effort to guarantee the preservation and the continuity of this heritage.

Declarations

List of abbreviations: Ouled Ben AEK: Ouled Ben Abdelkader

Ethics approval and Consent to participate: Before beginning the ethnobotanical study, we obtained verbal consent from all participants.

Consent for publication: Not applicable.

Availability of data and materials: The data featured in this manuscript can be obtained from the corresponding author.

Competing interests: It is stated by the author that they do not possess any conflicting interests.

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Authors' contributions: Djahida Hedidi led the ethnobotanical survey, processed the data, and authored the final manuscript. Fatma Zohra Hamdani prepared the questionnaire, Nabila Zemmar, Meriem Belabess, and Fatima Belhacini identified the plant species, and Sofiane Abaidia produced the location map. All authors reviewed and endorsed the final manuscript.

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