Quantitative ethnobotanical investigation of medicinal plants used by the local population in the rural municipalities of Haizer and El Asnam, province of Bouira, Northern Algeria

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Abstract. This study aims to assess ethnobotanical knowledge in Bouira province, focusing on the traditional uses of medicinal plants. The purpose was to quantify the traditional knowledge of medicinal plants commonly used by local populations for treating a wide range of ailments, to preserve the medicinal knowledge and the biodiversity of this area.

Ethnobotanical data were gathered using a questionnaire during the spring of 2018. Semi-structured interviews were conducted with 69 key informants at six villages of Bouira province. Quantitative analysis through diffrent indices, including the informant consensus factor (FIC), use value (UV), relative frequencies of citation (RFC), and fidelity level (FL), was performed for the recorded medicinal plants.

Overall, 136 plants species were recorded. Their uses in 10 disease categories were documented. They belong to 54 families; the most represented are the *Asteraceae* (18 species) and *Lamiaceae* (16 species). With 98 use reports, diabetes is the most treated ailment. The highest RFC values are recorded for *Carthamus caeruleus* (0.57) and *Asplenium ceterach* (0.52), indicating that these plants are the most preferred species used in study areas to treat skin burns and kidney stones, respectively. The plant with the highest use value is *Lavandula stoechas* (1.21), used to treat different digestive disorders (bloating, colon pain, and stomach ulcer). We found 13 medicinal plants having the highest FL value (100%), e.g., *Rhamnus alaternus* (jaundice), *Lonicera implexa* (weak eyesight), and *Ulmus minor* for treating skeletomuscular ailments. These latter are the most interesting species used in treating a specific ailment category. The maximum FIC value (0.86) indicated high agreement in the use of plants (e.g., *Aristolochia fontanesii* and *Ophrys speculum*) in the genitourinary and reproductive ailment category among the informants.

We highlighted the homogeneity of informant knowledge in medicinal plants appropriate for different ailment categories and the most preferred plant species used to treat each ailment category in the study area. By overstepping the limits of orally transmitted pharmacopeia, we aim to valorize the huge ethnopharmacology legacy of the region for promising pharmacological perspectives.

Keywords: Ethnobotany, traditional medicine, quantitative indices, rural population, Berber people, North-eastern Algeria.

Introduction

Considering its geographical position, Algeria has a great diversity of habitats and plants (4449 species and subspecies) (Dobignard & Chatelain, 2010–2013). It has a great wealth of medicinal plants, with more than 600 species (Mokkadem, 1999). Algeria is recognized by its ancestral tradition about medicinal plant uses throughout the country, and the local traditional medicine continues to be an important source of remedies for primary healthcare. Therefore, it has huge scientific value and must be preserved and studied thoroughly.

The Great Kabylia, a phytogeographical subdivision distinguished by Quézel & Santa (1962–1963), forms a part of the mountainous system of the Tellian Atlas in Northeastern Algeria. It constitutes a homogeneous natural region by its physical features, climate, rich flora, dense population, language (Berber), and economy (Dahmani & Dahmani, 2004). The Kabylia, a Berber or *Amazigh*-speaking region of Algeria, is endowed with a rich ethnobotanical knowledge system on traditional medicine resulting from a prosperous wide history of interaction with the flora of this rural region. This area of Northern Algeria, which keeps its cultural identity (Hammiche, 2014), represents a unique social and

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environmental context for ethnobotanical studies, owing to the existence of a large mountainous area (Djurdjura chain) that is recognized as a hotspot for biodiversity and ethnocultural diversity (UICN, 2015).

Despite this fact, only a few studies have explored the use of plants in Kabylian traditional medicine, for example, Aumassip (1984), Brette (1985), Ait Youcef (2006), and Hammiche (2014). An increasing interest in medicinal plants in Algeria has led to many local ethnobotanical studies in various regions of Kabylia, especially in Tizi Ouzou province by our team: Meddour *et al*. (2010), Meddour-Sahar *et al*. (2010), Derridj *et al*. (2010), and Meddour & Meddour-Sahar (2015). However, most of this information is scattered and challenging for the international scientific community to access.

On the other hand, local knowledge has begun to be studied by ethnobotanists using quantitative analyses to assess the relationship between biological and cultural diversity and the relative importance of natural resources for the local population in a given culture (Phillips, 1996; Bletter, 2007; Medeiros *et al*., 2011). Nowadays, quantitative techniques are common in ethnobotanical literature (Albuquerque *et al*., 2006). Over the last ten years, in Algeria, these quantitative tools were used in some ethnobotanical studies to analyze the use of plant species in different ethnographic populations. In this context, we can mention: Boudjelal *et al*. (2013), Benarba *et al*. (2015), Ouelbani *et al*. (2016), Sarri *et al*. (2017), Bouasla & Bouasla (2017), Hamel *et al*. (2018), Yabrir *et al*. (2018), Senouci *et al*. (2019), Miara *et al*. (2019), Lazli *et al*. (2019) and Kefifa *et al*. (2019). The most used ethnobotanical indices in these studies are informant consensus factor (FIC), use value (UV), fidelity level (FL), and relative frequency of citation (RFC) of plant species.

Following up on our work at the Tizi Ouzou province, this study aims to describe and evaluate current available data on the medicinal plants traditionally used by the local population in Bouira province (Kabylia) for human health. For this purpose, we analyze ethnobotanical data through several quantitative indices frequently used in similar studies (FIC, FL, UV, and RFC) in Algeria to evaluate the importance of the recorded plant species and understand the importance of their utilization in the studied region. The investigation of ethnobotanical knowledge on medicinal plants used by indigenous communities is a part of an important strategy linked to the conservation of cultural traditions and biodiversity and the discovery of new medicines (Almeida *et al*., 2006).

Materials and methods

Ethnogeography of the study area

The province of Bouira (Tuvirets, in Berber) is located in Kabylia, in the north-central region of Algeria, about 120 km southeast of Algiers, and extends over an area of 4439 km². The province of Bouira is characterized by several large physiographic areas, notably the southern slope of the Djurdjura massif north of the province, where the two study municipalities are located (Figure 1). The municipality of Haizer (36°23′49″N, 3°59′57″E) covers an area of 89 km². The resident population is 18838 inhabitants, an average density of 211 inhabitants/km² (Anon., 2013), spread over 21 villages. The municipality of El Asnam (36°19′16″N, 4°00′50″E) covers an area of 114 km². The resident population is 13976 inhabitants, or an average density of 122 inhabitants/km², spread over 11 villages.

The inhabitants of this area are Berbers and are part of the great Kabyle tribe of Ath Yaala. This tribe, who inhabit the villages located on the southern slope of Djurdjura, form an ethnolinguistic homogeneous people. The study region (Haizer, El Asnam) is characterized by a hot and dry Mediterranean climate in summer, cold and rainy in winter. The average rainfall is 450 to 660 mm/year. Average monthly temperatures vary between 20 and 40°C from May to September in the hot season and from 2 to 12°C from January to March in the cold season (Anon., 2013). It is characterized by a semi-arid to subhumid temperate bioclimate.

Our survey was carried out in six of the most densely populated villages in the two municipalities (1000 to 2000 inhabitants), located at an altitude of 460–610 m asl (Table 1). Cereals and rustic arboriculture occupy the plains and foothills, while the mountain ranges are covered with forest vegetation, especially Aleppo pine (Anon., 2009).

Table 1. Geographic coordinates of the study villages. Datum WGS84.

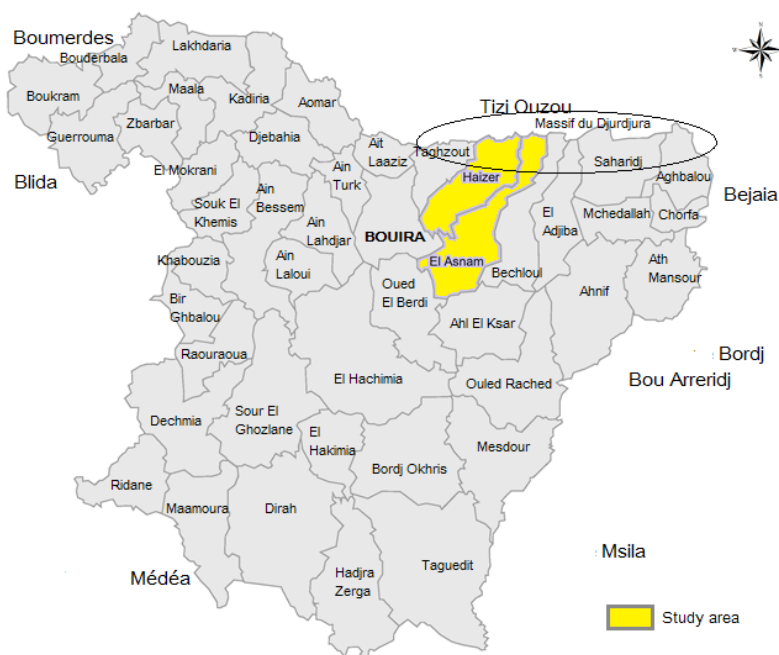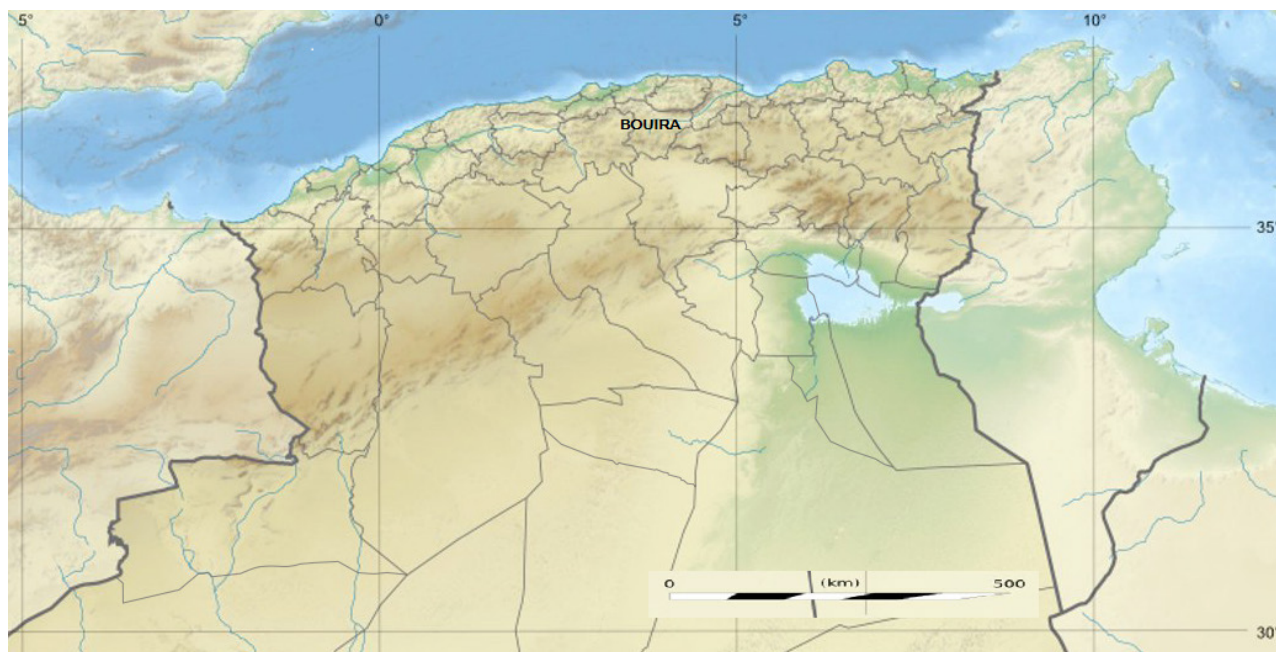| Municipalities	Villages	Altitude (m asl)	Latitude	Longitude
Haizer	Tikbouchet	610	36°22'42.71''N	3°58'24.69''E
	Aguarcif	605	36°24'39.57''N	3°59'15.07''E
	Guentour	592	36°24'05.19''N	4°02'40.32''E
El Asnam	Guemgouma	571	36°17'29.22''N	3°59'25.16''E
	Ath Ahgoune	460	36°18'22.08''N	4°00'52.03''E
	Loglib	485	36°18'15.16''N	4°00'55.25''E

Figure 1. Location of the study area: municipalities of Haizer and El Asnam, Bouira province (Anon., 2013).

Ethnobotanical study

Data collection

We carried out a qualitative and quantitative inventory of current traditional uses of medicinal plants as daily primary health care for humans for data collection. We followed standard ethnobotanical data collection protocols (Cotton, 1996; Alexiades & Sheldon, 1996; Cunningham, 2001; Martin, 2004; Bellakhdar, 2008; Albuquerque *et al*., 2014).

The choice of the sample was focused on the research of informants considered the most knowledgeable (local experts), with traditional knowledge and expertise

regarding local medicinal plants. They are native people, elderly for most, to which the community recognizes a certain competence and gives complete confidence (Hammiche, 2014).

At each of the villages concerned by the survey, we applied the snowball technique (Cotton, 1996; Cunningham, 2001; Martin 2004) to select 11 to 12 informants by village, without considering their gender or age ratios. The field survey was performed in the study area from March to April during the spring of 2018. Direct face-to-face interviews were conducted in Kabyle or *Taqbaylit* (local Berber language), with our key informants, with a semi-structured questionnaire pre-established. The code of ethics of the International

Society of Ethnobiology (ISE, 2006) was strictly followed. Prior informed consent (PIC) was verbally obtained from all informants before beginning any of the interviews. The anonymity of participating in the survey and freely sharing their therapeutic knowledge was assured (Gonzalez-Tejero *et al.*, 2008). Interviews were mainly focused on knowledge about the current uses, mode of preparation, parts of the plants used, way of administration, and types of diseases treated. We have thus interviewed 69 informants in the six villages. Direct interviews were combined with guided tours, a technique that allows validating vernacular names of inventoried plant species by identifying them directly (Albuquerque *et al.*, 2014). In the field, the informant directly tells us about the plant and its uses (Rivière *et al.*, 2005). Plant names were given in *Taqbaylit* and their identification was performed using the determination keys of the "New Flora of Algeria" (Quézel & Santa, 1962–1963). The scientific nomenclature of plant species and their families was updated according to the synonymic index of North African Flora of Dobignard & Chatelain (2010–2013) and the African plant database (APD, 2021). Finally, voucher specimens of the collected plants were deposited in the Herbarium of the Faculty of Biological and Agronomic Sciences, Mouloud Mammeri University of Tizi Ouzou, Algeria.

Data processing

Gathered ethnobotanical data were entered into a table of raw data. As usually done in ethnobotanical surveys, we structured data into detailed use reports (UR), where each informant mentioned a specific use (e.g., digestive disorder) of a given plant part (e.g., leaves) for a specific preparation (e.g., decoction) (Mattalia *et al.*, 2020). These data were then processed with Sphinx Plus² software, version 5, a survey processing and data analysis software (https://www.lesphinx-developpement.fr/ logiciels /enquete-analyse-sphinx-iq/).

The data processed are relating to the following aspects: questions concerning the demographic data of the informant, including gender, age, level of education, profession, source of ethnobotanical knowledge; local medicinal uses and other traditional uses attributed to each plant; plant parts used, pharmaceutical preparation methods, forms of administration; diseases and symptoms treated and the potential toxicity of the plant used.

The reported diseases and symptoms have been grouped into major disease categories according to Collins *et al.* (2006) and the classification adopted in the Mediterranean region by Gonzalez-Tejero *et al.* (2008). These categories can be considered to reflect the healthcare concept of the local population of Bouira (Kabylia). At this level, in a population where knowledge has been transmitted only orally, great attention should be paid to the description of the ailments that can affect individuals and comments on the use of plants for therapeutic purposes (Friedberg, 1991). It implies a thorough knowledge of the local culture, particularly the case of the author (NA), a native of Haizer.

Quantitative analysis

To analyze our data statistically, we have used the following quantitative ethnobotanical indices:

The relative frequency of citation (RFC) shows the local importance of each plant species known locally as medicinal plants. It is calculated by the formula (Tardío & Pardo-de-Santayana, 2008): RFC = FC/N, where the Frequency of Citation (FC) is the number of informants who mention the use of the species, and N is the total number of informants participating in the survey, without considering the variable use categories (Tardío & Pardo-de-Santayana, 2008). This index theoretically varies from 0, when no informant refers to the plant as useful, to 1 in the case that all the informants mention the use of the species (Medeiros *et al.*, 2011).

The use value (UV) gives the relative importance of plant species known locally in traditional medicine. It is calculated using the following formula (Phillips & Gentry, 1993a,b, modified by Rossato *et al.*, 1999): UV = $\sum U_i/N$, where U_i is the number of use reports for a given plant species mentioned by each informant, and N is the total number of informants interviewed (Rossato *et al.*, 1999). UV are high when there are many use reports for a plant and low when there are few reports related to its use (Phillips & Gentry, 1993a,b).

The Fidelity level (FL) indicates the percentage of informants claiming the use of a certain plant species for the same major purpose. It is calculated by the following formula (Friedman *et al.*, 1986): FL(%) = Np/Nx100, where Np is the number of informants that claimed a use of a plant species to treat a particular disease category and N is the number of informants that used plants as a medicine to treat any given disease category (Friedman *et al.*, 1986). A high FL value indicates a high frequency of use of the plant species for treating a particular ailment category by the informants of the studied area (Musa *et al.*, 2011).

The factor of informant consensus (FIC) estimates the consensus in using plants in a group about treating various diseases (Trotter & Logan, 1986). It is calculated using the following formula (Heinrich *et al.*, 1998): FIC = (Nur − Nt)/(Nur − 1), where Nur is the number of use reports of a particular ailment category and Nt is the number of plants used to treat the particular ailment category. FIC values range from 0 to 1. High FIC values are obtained when only one or a few plant species are reported to be used by a high proportion of informants to treat a particular ailment category, whereas low FIC values indicate that informants disagree over which plant to use in the treatment within an ailment category (Heinrich *et al.*, 1998; Andrade-Cetto & Heinrich, 2011).

Results

Socio-demographic profile of the informants

Table 2 provides socio-demographic information recorded from the 69 informants who participated in the survey. Men have a slight numerical advantage over women

(52.17% versus 47.83%). Nevertheless, women have further medicinal knowledge since they provide a greater number of use reports comparing to men (59.63% versus 40.37%). Women report an average of 24.75 use reports of plants, while men report much lesser, 15.36 use reports. The major part of the knowledgeable informants is that of age groups over 40 years old, i.e., 95.65%, including 17.39% for the eldest (over 80 years). This latter age group is the most knowledgeable, with an average of 27.83 use reports by an informant. Those under 40 years old (only one age group) are merely represented by 4.35%. On the other hand, the majority of the informants are illiterate, with 53.62%. The informants are largely housewives (39.13%) or retirees (26.08%).

On the other hand, most people interviewed (69.55%) are unwaged (housewives, retirees, unemployed) in this isolated region; they have no source of income. According to the informants of our survey, ethnobotanical information can be acquired from various sources. However, the primary source of informants' ethnobotanical information is family knowledge held by the parents and grandparents (97.1%), while a weak percentage represents other sources.

We found a sizable wealth of ethnobotanical information concerning the traditional medicinal uses of plants among our informants (especially some elderly and illiterate people). They provided us 1370 use reports for all species, with a noteworthy average of 19.9 per informant.

Table 2. Socio-demographic characteristics of the informants

Characteristics	Categories	Number of informants (n = 69)	Percentage of informants (%)
Gender	Women	33	47, 83
	Men	36	52, 17
Age group	Less than 40	3	4, 35
	40–49	11	15, 94
	50–59	13	18, 84
	60–69	15	21, 74
	70–79	15	21, 74
	More than 80	12	17, 39
Education level	Illiterate	37	53, 62
	Primary	9	13, 04
	Secondary	11	15, 94
	High school	5	7, 25
	University	7	10,14
Profession	Housewives	27	39, 13
	Retirees	18	26, 08
	Workers	11	15, 94
	Farmers, pastors	7	10,14
	Unemployed	3	4, 35
	Traditional healers	3	4, 35
Source of knowledge	Family knowledge	67	97.1
	Herbalists	4	5.8
	Traditional healers	3	4.3
	Books	3	4.3
	Media, Internet	1	1.4

Diversity of medicinal plants

The ethnomedicinal plants identified and recorded based on all the use reports are presented in Appendix 1, in alphabetical order of taxa (species and subspecies). For each taxa, we mention the scientific name, family, local vernacular names (in *taqvaylit*). Information such as therapeutic uses or treated diseases, plant parts used, mode of preparation, administration route, frequency citation (FC), relative frequency citation (RFC), and use value (UV), are also provided for each plant species.

During the present ethnobotanical investigation, we inventoried 136 plant species (including 2 subspecies) traditionally used for medicinal purposes, belonging to 123 genera and 54 families, comprising 131 Angiosperms, 4 Gymnosperms, and one species of *Pteridophyta*.

Families with the most reported plant species were *Asteraceae* with 18 species (13.3% of the total number of plants recorded), closely followed by the *Lamiaceae* with 16 species (11.9%) and the *Apiaceae* with 12 plants (8.9%) (Figure 2). These three families represent 1/3 of the total number of species and are the most used and the best known for their therapeutic virtues.
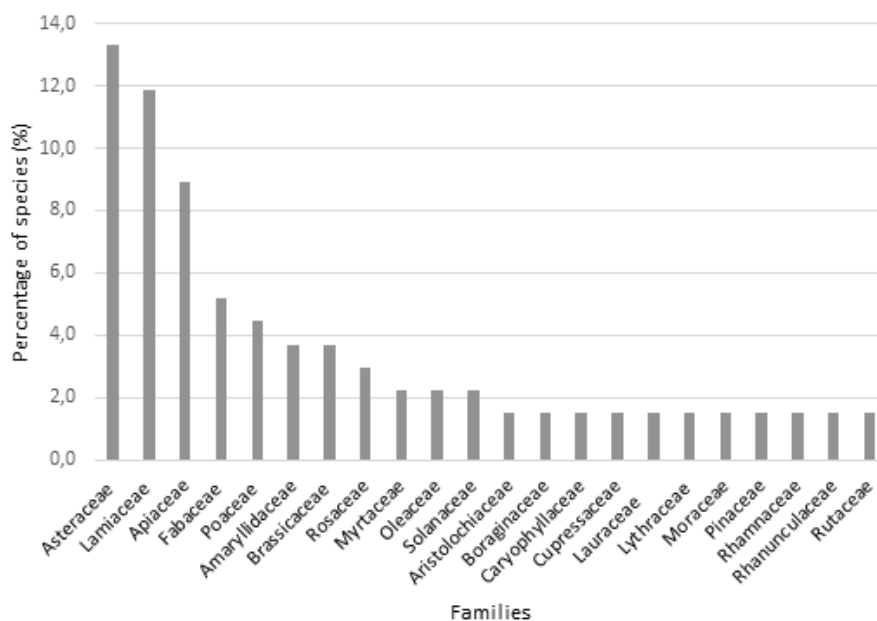
Figure 2. Number of medicinal plant species by families (32 families with one species each are not represented).

Toxic plants

Eight out of 136 plants (5.9%) were indicated as being toxic or potentially deadly for humans or livestock by the informants: *Arum italicum* Mill., *Asphodelus ramosus* L., *Carlina gummifera* (L.) Less., *Conium maculatum* L., *Euphorbia helioscopia* L., *Hyoscyamus albus* L., *Nerium oleander* L., and *Thapsia garganica* L. The local population is aware of their toxicity and sometimes lethality, since it recognized it in 50 use reports (3.6% of the total), and species of known toxicity are prescribed with caution and only for limited use in Kabylia.

Plant parts used, mode of preparation and administration

The local population uses the plants mainly in the fresh form (64.6% of all use reports) and has little recourse to drying plants (18.9%). In addition, 18.6% of plants are used as well, fresh or dry. Leaves are the most frequently used part, with 52% of all use reports. Stems and fruits come second and third, with 17% and 8% respectively. Underground vegetative organs (rhizomes, bulbs, tubers) are less used (6.5% in total). (Figure 3). Decoction is the most common preparation, accounting for 41% of all use reports, followed by crushed preparations (15%) and powder (13%). Otherwise, it is often enough for the local population to consume a cooked preparation (12%) based on wild plants to cure the disease of which they suffer (Figure 4). Oral ingestion is the predominant administration route, accounting for 52% of all use reports. By way of compresses, the local application comes second, with 17% of use reports, followed by other methods used topically, with 18.5% overall (Figure 5).
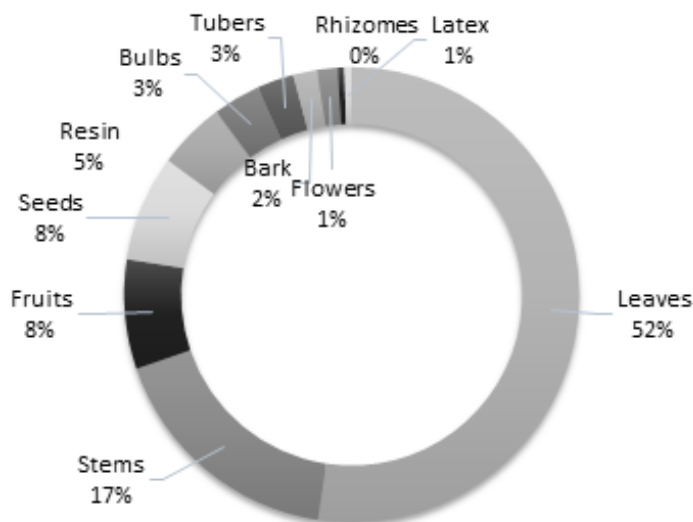

Figure 3. Relative importance of different plant parts used for medicinal preparations.
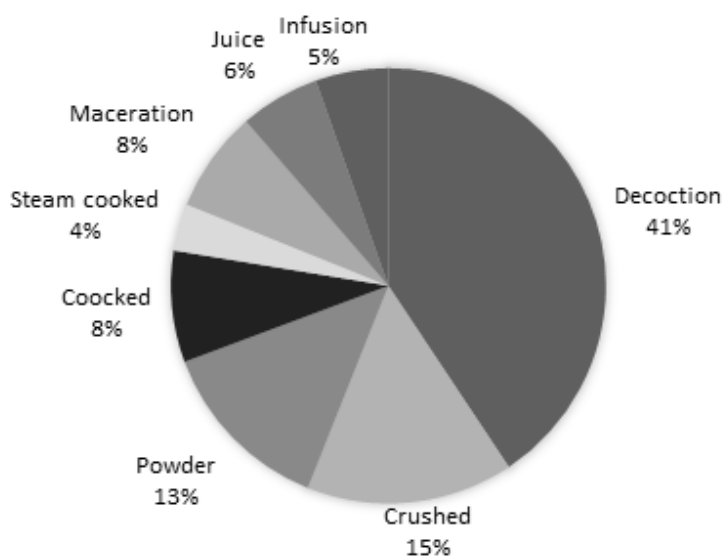
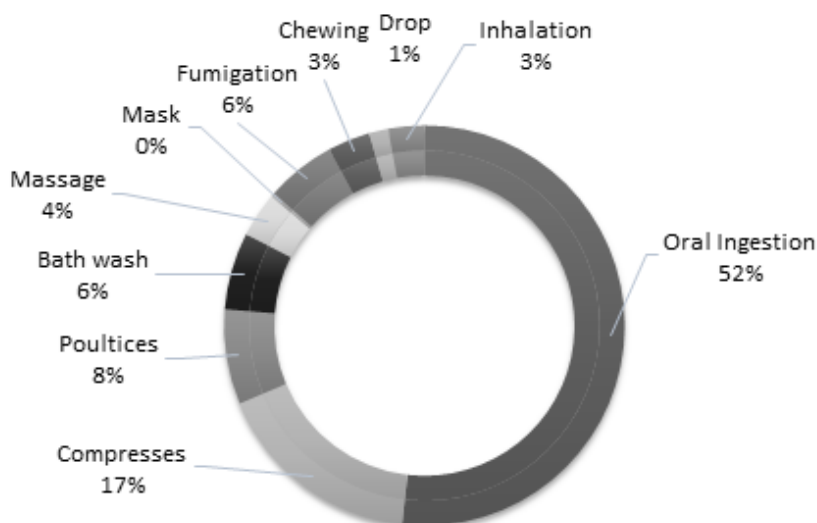Figure 4. Relative importance of different preparation modes.

Figure 5. Relative importance of different administration routes.

Diseases groups, treated diseases and number of use reports

The large number of diseases and symptoms (68) identified during our investigation was grouped into ten major diseases groups (Table 3). Of the 68 diseases and symptoms identified in our survey, 10 are commonly treated. They are mentioned in a great number of use reports, more than 40 UR. Diabetes, with 98 UR, colon pain (80 UR), and influenza (73 UR), are the most treated ailments by the local population. They are followed by kidney stones (56 UR), skin burns (54 UR), stomach ulcer (54 UR), hair loss (53 UR), diarrhea (49 UR), arthritis (46 UR), and bloating (40 UR). All these diseases are treated with a minimum of five plants, the maximum being 23 plants for colon pain. Then, 20 diseases are treated quite ordinarily they are cited in 14 to 40 UR each; e.g., indigestion, jaundice, furuncles, bronchitis, bone fracture, wounds, cough,

angina, anemia, hypertension, etc. These diseases are treated with 10 plants (e.g., anemia) to one plant (e.g., jaundice). Lastly, 38 diseases are the least cured, since they are cited in fewer use reports (less than 14 UR). We noted that the surveyed population did not report cancers explicitly.

Quantitative ethnobotanical analysis

Relative frequency of citation (RFC)

The relative frequency of citation (RFC) of the 136 plant species recorded and cited by the informants ranged from 0.01 to 0.57 (see Appendix 1). The highest value was recorded for *Carthamus caeruleus* (L.) Presl, 'amargouzgouz', (0.57), followed by *Asplenium ceterach* L., 'fetat lahjar', (0.52). Twenty other plant species are mentioned with a high RFC

value between 0.5 and 0.3, such as *Rhamnus alaternus* L., *Cedrus atlantica* (Endl.) Manetti ex Carrière, *Urtica dioica* L., *Marrubium vulgare* L., *Globularia alypum* L., *Ajuga iva* (L.) Schreb., *Artemisia herba-alba* Asso, and *Lavandula stoechas* L. These high RFC values show the medicinal importance attributed to these species by the local population, as they are of very wide therapeutic uses. On the other hand, the informants mention twenty plant species (14.7%) with a weak RFC value (0.01).

Table 3. Major disease categories (Disease C), disease treated (Disease T), their numbers of use reports (N. use rep.) and the number of plant species (N. species) in the study area. Disease C: D: digestive, R: respiratory, M: metabolic and nutritional, C: cardiovascular and circulatory, Sk: skin, Sm: skeletomuscular, G: genitourinary and reproductive, N: mental-nervous, O: oral-dental, Se: sensory.

Disease C	Disease T	Kabyle names of diseases	N. use rep.	N. species
M	Diabetes	Atan nskar	98	14
D	Colon pain	Igeghad amqran, Igred amkran	80	23
R	Influenza	Abehri, Adhou	73	14
G	Kidney stones	Izra tgazal	56	5
Sk	Skin burns	Thimarghiwth	54	5
D	Stomach ulcer	El jarh lestoma	54	15
Sk	Hair loss	Anchaw ocheboub	53	7
D	Diarrhea	Assarah t3abote	49	7
Sm	arthritis	Aqrah ighessane	46	10
D	Bloating	Achofo t3abote	40	10
Sk	Furuncles	Thimisthe, Thimamisthe	36	6
Sm	Bone fracture	Thimarziwth	33	3
D	Indigestion	Lakya, Liqu	32	3
D	Jaundice	Siwrar	32	1
R	Bronchitis	Tussoth iqat3an, Tussouth batas	31	4
R	Cough	Tussouth	28	8
C	Hypertension	Thalin l'atension	27	5
R	Angina	Tiwarmin	25	2
Sk	Wounds	El jarh	24	8
M	Anemia	Lakhessasse idamen	23	10
G	Menstrual pains	Tharda	22	7
Sk	Cracked feet	Thifakhssa	20	1
G	Infertility	Ti3ikarth	20	2
D	Stomach pain	Aqrah lestoma	20	7
O	Gum disease	Akhsoum bouglan	19	2
D	Colic	Akrah ta3bot	17	7
N	Weak eyesight	Ateless, Lakhsas gezri	16	1
N	Dizziness	Doukha	15	3
Sm	Rheumatism	Vosmadh	15	3
D	Constipation	Ahvesse t3abot	14	3
C	Cholesterol	Thassemth idamen	13	4
R	Cold	Abehri n wudem, Thazla banzaren	13	1
Se	Earache	Aqrah umzugh	13	3
D	Lack of appetite	Lakhsas lmakla	13	2
N	Migraine	Chqiqa	13	3
N	Headache	Aqrah oqaro	12	3
R	Asthma	Tiqaf	11	3
Sm	Back pain	Aqrah ozagour	11	3
O	Dental pain	Aqrah tughmas	11	4
Sk	Eczema	Lahmoreyya, Ifiriwen	11	2
G	Miscarriage	Raloy tadhisth	11	1

Disease C	Disease T	Kabyle names of diseases	N. use rep.	N. species
D	Gas trouble	Nafs	10	2
C	Hemorrhoids	Lumbassar, Bassar	10	3
Se	Mumps	Chuff mejjir	10	2
Sk	Mycosis	Thiffiri	9	3
G	Prostate	Prostate	9	1
D	Vomiting	Iriran	9	2
Sk	Wart	Thifidhli	9	2
Sk	Gangrene	Iwet	8	1
Sk	Scabies	Azejidh	8	1
N	Anguish	Lxiq, Taqlaq	7	4
G	Labor pain	Aqrah nafsa	7	1
Sk	Thorn of feet	Asnan odar	7	1
Sk	Toenail	Amsmar odhar	7	2
C	Fever	Tawla	6	2
D	Gastric reflux	Azi	6	2
M	Obesity	Lqabath	6	2
O	Canker sores	Vomlal	5	3
O	Caries	Fula	5	1
D	Hepatitis	Atan ntassa	5	2
D	Nausea	Am3ouqui	4	1
G	Sexual impotence	Tudart levri	4	1
O	Tooth abscess	Achoffo tughmasse	4	3
N	Insomnia	Lqala guidhas	3	3
Sm	Torsion	Alorzim	3	1
Sk	Abscesses	Assebi	1	1
C	Hypotension	Raloy l'atension	1	1
G	Menstruation delay	Ahvas les règles	1	1

Use value (UV) of species

Concerning the use value of reported species, it ranges between 0.014 and 1.21 (see Appendix 1). We found that *Lavandula stoechas* L. was the most frequently used according to local informants, with the highest use value of 1.21, with 25 use reports. Local population uses this plant to treat mostly digestive disorders, such as bloating, colon pain, and stomach ulcer. This lavender is followed by *Carthamus caeruleus* (L.) Presl (UV = 1.13), *Juglans regia* L. (1.08), *Cynara cardunculus* L. (0.95), *Cynoglossum cheirifolium* L. (0.95), *Rhamnus alaternus* L. (0.92), and *Cedrus atlantica* (Endl.) Manetti ex Carrière (0.89), which were reported to have high use values.

Fidelity level (FL)

The fidelity level (FL) was calculated for 32 medicinal plants, which have been cited by 16 or more informants for being used against a given ailment. The FL values of the reported species ranged from 35% to 100%. As shown in Table 4, we found 13 medicinal plants having the highest FL value, i.e. 100%. Five of

them were used to treat skin diseases: *Carthamus caeruleus* (L.) Presl (skin burns), *Spartium junceum* L. (hair loss), *Cynoglossum cheirifolium* L. (furuncles, skin burns), *Reseda alba* L. (foot cracks, mycosis), *Nerium oleander* L. (boils, eczema, scabies). Three others treat digestive diseases: *Rhamnus alaternus* L. (jaundice), *Papaver rhoeas* L. (bloating, colon pain), *Artemisia herba-alba* Asso (bloating, colic, indigestion, vomiting). Two species are used to cure sensory diseases: *Asphodelus ramosus* L. (earache and mumps), *Lonicera implexa* Aiton (weak eyesight). *Eucalyptus globulus* Labill. is used for respiratory diseases (colds and influenza), *Asplenium ceterach* L. for genitourinary diseases (kidney stones), and *Ulmus minor* Mill. for skeletomuscular diseases (fracture and torsion). For metabolic and nutritional disorders, two medicinal plants with high FL values are used to treat diabetes according to the informants of the studied area: *Ajuga iva* (L.) Schreb. (92%) and *Cynara cardunculus* L. (86.36%).

Three out of 10 disease categories consists of plants having FL value less than 80%, it is cardiovascular and circulatory disorders, mental-nervous disorders, and oral-dental diseases.

Table 4. Fidelity level (FL) values of the most cited plant species (number of informants (Np) ≥ 16)

Disease categories	Principal disease	Medicinal plant species	Np	Total Np	FL (%)
Digestive	Jaundice	Rhamnus alaternus L.	32	32	100
	Bloating	Artemisia herba-alba Asso	25	25	100
	Colon pain	Papaver rhoeas L.	17	17	100
	Indigestion	Marrubium vulgare L.	24	30	80
	Colon pain	Lavandula stoechas L.	18	25	72
	Lack of appetite	Trigonella foenum-graecum L.	12	20	60
Skin	Burns	Carthamus caeruleus (L.) Presl	39	39	100
	Hair loss	Spartium junceum L.	25	25	100
	Burns	Cynoglossum cheirifolium L.	22	22	100
	Foot cracks	Reseda alba L.	25	25	100
	Furuncles	Nerium oleander L.	17	17	100
	Furuncles	Juniperus oxycedrus L.	13	16	81.25
	Hair loss	Urtica dioica L.	12	31	38.71
Respiratory	Rum	Eucalyptus globulus Labill.	23	23	100
	Flu	Pinus halepensis Mill.	24	25	96
	Flu	Origanum vulgare subsp. glandulosum (Desf.) Ietswaart	16	21	76.19
	Angina	Cedrus atlantica (Endl.) Manetti ex Carrière	23	31	74.19
	Flu	Mentha spicata L.	12	22	54.55
	Bronchitis	Pistacia lentiscus L.	7	20	35
Skeletomuscular diseases	Fracture	Ulmus minor Mill.	16	16	100
	Arthritis	Dittrichia viscosa (L.) Greuter	14	16	87.5
	Arthritis	Drimia maritima (L.) Stearn	12	24	50
	Arthritis	Olea europaea L. subsp. europaea	12	16	75
Genitourinary and reproductive	Kidney stones	Asplenium ceterach L.	36	36	100
	Infertility	Thapsia garganica L.	16	23	69.57
Sensory	Earaches	Asphodelus ramosus L.	17	17	100
	Weak eyesight	Lonicera implexa Aiton	16	16	100
Metabolic and nutritional disorders	Diabetes	Ajuga iva (L.) Schreb.	23	25	92
	Diabetes	Cynara cardunculus L.	20	22	90.91
	Diabetes	Globularia alypum L.	20	27	74.07
Cardiovascular and circulatory disorders	Hypertension	Allium sativum L.	12	18	66.67
Nervous-mental disorders	Migraine	Lepidium sativum L.	10	19	52.63

Factor of informant consensus (FIC)

The FIC values for the different diseases treated ranged from 0.72 to 0.86, with an average value of 0.76 for all disease categories (Table 5). We found that genitourinary and reproductive system disorders (including kidney stones, menstrual pains, infertility, prostate, miscarriage, etc.), with 130 use reports, have the highest FIC value (0.86). This category of diseases was treated with 19 plant species (13.97%, n = 136), of which the most cited within are *Asplenium ceterach* L., *Aristolochia fontanesii* Boiss. & Reut., *Juncus effusus* L., *Ophrys speculum* Link, and *Thapsia garganica* L. Skin system disorders (FIC = 0.84) were treated with 41 plant species (30.15%) and includes a large number of use reports

(247). Among these, *Spartium junceum* L., *Reseda alba* L., *Juniperus oxycedrus* L., and *Salvia verbenaca* (L.) Briq. are the most frequently mentioned. A FIC value of 0.83 was assigned to respiratory diseases (with 181 UR); they were treated with 32 species (23.53%), as the most cited *Cedrus atlantica* (Endl.) Manetti ex Carrière, *Eucalyptus globulus* Labill., *Origanum vulgare* subsp. *glandulosum* (Desf.) Ietswaart, *Pinus halepensis* Mill. The lowest FIC value (0.72) in our study is scored for oral-dental diseases (13 plant species). However, this FIC value is quite high and the agreement among the informants of Bouira in using certain plants (e.g., *Juglans regia* L., *Ziziphus lotus* (L.) Lam., *Cupressus sempervirens* L.) to treat this ailment category is relatively high.

Table 6. Categories of diseases, number of use reports (Nur), percentage of use reports (%Nur), number of species (Ns), percentage of species (%Ns), and their factor of informant consensus (FIC) values.

Disease categories	Nur	%Nur (n=1370)	Ns	%Ns (n=136)	FIC
Genitourinary and reproductive diseases	130	9.5	19	13.97	0.86
Skin	247	18	41	30.15	0.84
Respiratory	181	13.2	32	23.53	0.83
Sensory	23	1.7	5	3.68	0.82
Skeletomuscular	108	7.9	20	14.71	0.82
Metabolic and nutritional disorders	127	9.3	26	19.12	0.80
Digestive	386	28.2	88	64.71	0.77
Cardiovascular and circulatory	57	4.1	15	11.03	0.75
Mental-nervous disorders	66	4.8	17	12.5	0.75
Oral-dental	44	3.2	13	9.56	0.72

Discussion

The findings of our survey in the Bouira province show that plant species play an important role in these rural populations' primary health care system. Women are the legatees of the ethnomedicinal information, orally transmitted within the family. According to Hamel *et al.* (2018), most people acquire their knowledge of traditional remedies from their parents. We confirm thus the vertical transmission of traditional medicinal knowledge and therapeutic practices from one generation to the next through family members (Mattalia *et al.*, 2020), especially from mothers to daughters. On the other hand, the knowledge of medicinal plants persists mainly among the elderly with little education. We also notice a younger generations' lack of knowledge of medicinal plants and their uses. These results agree with other studies (Camejo-Rodrigues *et al.*, 2003; Sousa *et al.*, 2012; Susanti & Zuhud 2019).

We recorded 136 plant species traditionally used for medicinal purposes, belonging to 54 families, predominately *Asteraceae, Lamiaceae,* and *Apiaceae.* This finding is not unexpected because these families are well represented in the Algerian flora: the *Asteraceae* family is the most important, and *Lamiaceae* and *Apiaceae* are among the seven top-ranked families (Dobignard & Chatelain, 2010–2013). Otherwise, the prevalence of families, such as *Asteraceae* and *Lamiaceae* in medicinal ethnoflora is a well-established fact throughout the Mediterranean Region (Gonzalez-Tejero *et al.*, 2008), for example, in Morocco (Fakchich & Elachouri, 2014), in Lebanon (Arnold *et al.*, 2015), and in Spain (Bonet & Vallès, 2003; Akerreta *et al.*, 2007; Belda *et al.* 2013). Novais *et al.* (2004) argued that the more common a plant is in an area, the greater the probability of its widespread use. However, preference for their use may be related as much to their availability as to the factors associated with their biological activity (Gazzaneo *et al.*, 2005).

Quantitative analysis of ethnobotanical data through different statistical indices allowed us to assess the relative importance of medicinal plants used by the local population. The high RFC values of some plants (*Carthamus caeruleus* (L.) Presl, *Asplenium ceterach* L. *Rhamnus alaternus* L., etc.) can be explained by the therapeutic properties of these aromatic and medicinal plants, and may be due to their efficacy, reputation in the local pharmacopoeia or simply their availability (Ouelbani *et al.*, 2016; Bouasla & Bouasla, 2017; Kefifa *et al.*, 2019). This does not mean that a species mentioned by only one informant is without value but may simply reflect the loss of particular knowledge (Akerreta *et al.*, 2007).

Otherwise, some plants were reported to have high UV values, such as *Lavandula stoechas* L., *Cynara cardunculus* L., *Cynoglossum cheirifolium* L., etc. This demonstrates their relative importance and their extensive usage in the ethnomedicinal practices in the study area (Islam *et al.*, 2014). These plants are well known by local people and are used to treat one or different diseases and symptoms. Amongst them, *Juglans regia* L. is widely recognized to cure a particular ailment (mouth ulcers), while *Cedrus atlantica* (Endl.) Manetti ex Carrière, has broad therapeutic uses (bronchitis, angina, eczema, and mycosis).

However, by observing the lists of species of other studies in Algeria, it can be evidenced that the most important species vary from region to region. For example, the plant species with the highest UV values are *Origanum vulgare* subsp. *glandulosum* (Desf.) Ietswaart at Constantine and Mila (Ouelbani *et al.*, 2016), and Bordj Bou Arreridj (Miara *et al.*, 2019), *Thymus vulgaris* L. in the Northeastern Algeria (Bouasla & Bouasla, 2017), and *Artemisa herba-alba* Asso at El Bayadh (Kefifa *et al.*, 2019).

The medicinal plants with the highest FL value (100%) are widely used by the local people of the study area, as *Carthamus caeruleus* (L.) Presl (skin burns), *Spartium junceum* L. (hair loss), *Rhamnus alaternus* L. (jaundice), *Asplenium ceterach* L. (kidney stones), etc. This highest FL value indicates a great frequency of use of these plant species for treating a particular ailment category and shows the most interesting species used in treating a specific ailment category (Musa *et al.*, 2011).

On the contrary, the low value of FL shows the use of plant species for different medicinal purposes (Rehman *et al.*, 2017).

Our research shows a high level of consensus for each disease category within the Kabylian community of Bouira area, particularly genitourinary and reproductive system disorders, skin system disorders, and respiratory diseases. It may indicate the high incidence of these diseases in the study area (Alalwan *et al.*, 2019). High consensus factor (FIC) values point out an important degree of knowledge sharing among the informants of the Bouira province to treat a specific ailment by a particular plant species (Kefifa *et al.*, 2019). We can mention endemic species, such as *Aristolochia fontanesii* Boiss. & Reut., *Cedrus atlantica* (Endl.) Manetti ex Carrière, and *Origanum vulgare* subsp. *glandulosum* (Desf.) Ietswaart used to treat genitourinary and reproductive system disorders for the first and respiratory diseases for the last two aromatic plants. All these species are accountable for a high consensus among informants in treating these diseases categories. This fact also indicates which plants are particularly interesting in searching for bioactive compounds and require phytochemical and pharmacological analyses (Canales *et al.*, 2005; Cheikyoussef *et al.*, 2011; Alalwan *et al.*, 2019).

To evaluate the degree of originality of the ethnoflora reported in this study, we have compared our list of medicinal ethnoflora with those reported in other regions of Kabylia (Ait Youcef, 2006; Meddour *et al.*, 2010; Meddour-Sahar *et al.*, 2010; Hammiche, 2014; Meddour & Meddour-Sahar, 2015). We have also done this with a corpus of 10 previously published articles on Algerian ethnobotany (i.e., Boudjelal *et al.*, 2013; Benarba *et al.*, 2015; Ouelbani *et al.*, 2016; Sarri *et al.*, 2017; Bouasla & Bouasla, 2017; Yabrir *et al.*, 2018; Miara *et al.*, 2018, 2019; Senouci *et al.*, 2019; Kefifa *et al.*, 2019). From this comparison, it appears that 11 wild plant species did not appear in this recent bibliography of medicinal plant use in Algeria. These plants and their therapeutic uses are to be considered new (or at least not previously reported) for the Algerian pharmacopoeia. Those are *Reseda alba* L. (mycosis, foot nail), *Spartium junceum* L. (hair loss), *Cynoglossum cheirifolium* L. (boils, burns), *Juncus effusus* L. (kidney stones), *Portulaca oleracea* L. (diabetes, hypertension), *Kundmannia sicula* (L.) DC. (headache), *Conium maculatum* L. (influenza), *Phlomis bovei* de Noé (wounds), and *Coleostephus myconis* (L.) Cass. ex Rchb.f., *Cistus ladanifer* L., *Hedysarum flexuosum* L., for treating colon pain. The fact of being reported for the first time, sometimes by only one informant, mean that these plants are needed further study in Algeria.

Conclusions

In this first quantitative ethnobotanical survey of the Kabylia area, the number of medicinal plants reported shows that the province of Bouira has a great diversity of medicinal plants. Moreover, 11 species and their uses have not been formerly listed in Algerian ethnobotanical studies. This survey has helped us to assess ethnobotanical knowledge in Bouira province, focusing on traditional local uses of medicinal plants, thereby preserving this indigenous knowledge and biodiversity. We highlighted the homogeneity of informant knowledge in medicinal plants since there is a great consent between the informants (high values of FIC) regarding the use of herbal medicines and the management of diseases in this region. The study also revealed the most chosen and interesting medicinal plants for treating diseases (high use value or fidelity level value), which should be targeted as a priority for pharmacological research and the discovery of new medicines.

Acknowledgments

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Appendix 1. List of recorded medicinal plants with their ethnobotanical features and indices (see text for explanations).

Scientific name	Family	Vernacular name	Plant part(s) used	Preparation mode	Administration route	Therapeutic uses, treated diseases	FC	RFC	UV	Voucher number
Ajuga iva (L.) Schreb.	Lamiaceae	Chkentourat	leaves	decoction	oral	diabetes, colic	25	0.36	0.6	AN-079
Allium cepa L.	Amaryllidaceae	Labsal	bulbs	juice, coocked	topical	mumps, boils, fever	7	0.10	0.2	AN-086
Allium sativum L.	Amaryllidaceae	Ticcert	bulbs	macération, juice	topical, oral	hair loss, hypertension	18	0.26	0.52	AN-087
Allium triquetrum L.	Amaryllidaceae	Vivras	whole plant, bulbs	raw	topical	colon pain	1	0.01	0.028	AN-090
Aloe vera (L.) Burm. f.	Xanthorrhoeaceae	Sebar	leaves	juice	topical	foot nail	1	0.01	0.014	AN-001
Aloysia citriodora Palau	Verbenaceae	Tizana	leaves	decoction	oral	influenza	7	0.10	0.101	AN-135
Ampelodesmos mauritanicus (Poir.) T. Durand & Schinz	Poaceae	Adless	leaves	decoction	topical	mouth ulcers	1	0.01	0.014	AN-107
Anacyclus clavatus (Desf.) Pers.	Asteraceae	Azjigh amelal	flowers, whole plant	infusion	oral	stomach ulcer	4	0.06	0.115	AN-025
Anethum graveolens L.	Apiaceae	Vasvas hartan	tuberous, fruits	raw	topical	bloating	5	0.07	0.216	AN-007
Aristolochia fontanesii Boiss. & Reut.	Aristolochiaceae	Bareztem	roots	crushed	oral	miscarriage, indigestion	12	0.17	0.346	AN-018
Aristolochia sempervirens L.	Aristolochiaceae	Kif alma	leaves, stems, flowers	infusion	topical	diarrhea	7	0.10	0.202	AN-019
Artemisia absinthium L.	Asteraceae	Chedjret n' meriem	leaves, stems	infusion, decoction	oral	menstrual pain, diabetes	9	0.13	0.13	AN-026
Artemisia herba-alba Asso	Asteraceae	Ccih	leaves, stems	decoction, maceration	oral	indigestion, vomiting, bloating, colic	25	0.36	0.36	AN-027
Arum italicum Mill.	Araceae	Avqouq	leaves	heated	topical	bronchitis	1	0.01	0.014	AN-017
Asphodelus ramosus L.	Amaryllidaceae	Avarwaq	leaves	decoction	topical	mumps, ear diseases	17	0.25	0.49	AN-088
Asplenium ceterach L.	Aspleniaceae	Fetat lahjar	whole plant, leaves, stems	decoction	oral	kidney stones	36	0.52	0.52	AN-113
Avena sativa L.	Poaceae	Akhartal	roots, bulbs	powder	oral	cholesterol, diabetes	5	0.07	0.144	AN-108
Beta vulgaris L.	Amaranthaceae	Ibetrave	seeds	decoction	oral	anemia	1	0.01	0.014	AN-002
Borago officinalis L.	Boraginaceae	Foudelghem	leaves	steam coocked	oral	stomach ulcer, colon pain, stomach ache	8	0.12	0.316	AN-038
Brassica oleracea L.	Brassicaceae	Kromb	leaves	raw	topical	arthritis	1	0.01	0.028	AN-042
Calicotome spinosa (L.) Link	Fabaceae	Azzou	leaves, flowers	infusio	oral	diarrhea	5	0.07	0.072	AN-058
Capparis spinosa L.	Capparaceae	Kabar	roots, leaves	decoction	oral	appetitive, stomach pain, burns	2	0.03	0.028	AN-46
Carlina gummifera (L.) Less.	Asteraceae	Addad	roots	crushed, juice	topical	rheumatism	6	0.09	0.086	AN-034
Carthamus caeruleus (L.) Presl	Asteraceae	Amargouzgouz	roots	juice	topical	burns	39	0.57	1. 13	AN-028
Cedrus atlantica (Endl.) Manetti ex Carrière	Pinaceae	Inguel	resin	coocked, juice	oral, topical	bronchitis, eczema, angina, mycosis	31	0.45	0.89	AN-105
Centaurea calcitrapa L.	Asteraceae	Avouneqar	roots	juice	topical	wounds	3	0.04	0.034	AN-023

Scientific name	Family	Vernacular name	Plant part(s) used	Preparation mode	Administration route	Therapeutic uses, treated diseases	FC	RFC	UV	Voucher number
Centaurium erythraea Rafn	Gentianaceae	Qlilu	leaves	maceration	oral	colic	3	0.04	0.034	AN-064
Ceratonia siliqua L.	Fabaceae	Akharob	fruits	powder	oral	arthritis, colon pain, anemia	11	0.16	0.361	AN-061
Chamaemelum nobile (L.) All.	Asteraceae	Babounej	leaves, flowers, stems	decoction	oral	colon pain	1	0.01	0.014	AN-029
Cicer arietinum L.	Fabaceae	Hamez	seeds	powder	oral	arthritis	1	0.01	0.014	AN-060
Cichorium intybus L.	Asteraceae	Timarzuga	roots, leaves	infusion, decoction	oral	colic, hepatitis	4	0.06	0.057	AN-037
Cinnamonum verum J. Presl	Lauraceae	Karfa	bark	decoction	oral	menstrual delay, anguish, influenza, cholesterol	6	0.09	0.086	
Cistus ladanifer L.	Cistaceae	Thuzalt lakhla	leaves	decoction	oral	colon pain	3	0.04	0.034	AN-050
Citrus limon (L.) Burm. f.	Rutaceae	Elim	fruits	decoction, juice	oral	influenza, cholesterol	2	0.03	0.084	AN-126
Coleostephus myconis (L.) Cass. ex Rchb.f.	Asteraceae	Warzdouz	leaves, stems	steam coocked	oral	colon pain	6	0.09	0.172	AN-036
Conium maculatum L.	Apiaceae	Harmel	leaves, stems	decoction	topical	influenza	1	0.01	0.014	AN-015
Crataegus monogyna Jacq.	Rosaceae	Idmim	leaves, roots	infusion, decoction	oral	nausea, hypertension, kidney stones, insomnia	13	0.19	0.303	AN-121
Cuminum cyminum L.	Apiaceae	El-kemoun	seeds	powder, decoction	topical, oral	intestinal gas, headache	14	0.20	0.405	AN-004
Cupressus sempervirens L.	Cupressaceae	Bestane	fruits	decoction	topical	tooth decay, tooth abscess	6	0.09	0.172	AN-052
Cydonia oblonga Mill.	Rosaceae	Thakthounia	fruits	decoction	oral	anemia	1	0.01	0.028	AN-124
Cynara cardunculus L.	Asteraceae	Thaga	leaves, stems	coocked	oral	diabetes, stomach ulcer	22	0.32	0.95	AN-031
Cynara scolymus L.	Asteraceae	Tifeghwa	leaves	coocked	oral	cholesterol	7	0.10	0.303	AN-033
Cynoglossum cheirifolium L.	Boraginaceae	Mssassa	leaves	crushed	oral	boils, burns	22	0.32	0.95	AN-039
Daucus carota L.	Apiaceae	Thazdhelt	leaves	steam coocked	oral	colon pain	1	0.01	0.028	AN-013
Dittrichia viscosa (L.) Greuter	Asteraceae	Amagramman	leaves	crushed, juice	topical	rheumatism, wounds, arthritis, back pain	16	0.23	0.46	AN-032
Drimia maritima (L.) Stearn	Amaryllidaceae	Tikhfeld	bulbs	decoction	oral, topical	arthritis, cough, delivery pain, back pain	24	0.35	0.52	AN-089
Ecballium elaterium (L.) Rich.	Cucurbitaceae	Fagus lahmir	fruits	crushed, juice	oral, topical	hemorrhoid, anemia	3	0.04	0.034	AN-053
Erica arborea L.	Ericaceae	Akhlenj	leaves	decoction	oral	influenza	3	0.04	0.034	AN-054
Eriobotrya japonica (Thunb.) Lindl.	Rosaceae	Mechimcha	leaves	decoction	oral	diarrhea	10	0.14	0.331	AN-123
Eryngium tricuspidatum L.	Apiaceae	Aquejir ou yazidh	leaves, stems	decoction	oral	diabetes	4	0.06	0.057	AN-005
Eucalyptus globulus Labill.	Myrtaceae	Kalitous	leaves	decoction	oral, topical	flu, influenza	23	0.33	0.66	AN-096
Euphorbia helioscopia L.	Euphorbiaceae	Thihninithine	leaves, latex	raw	topical	warts	6	0.09	0.086	AN-055
Ferula assa-foetida L.	Apiaceae	Hantite	seeds	powder	oral, topical	anguish, headache	2	0.03	0.028	

Scientific name	Family	Vernacular name	Plant part(s) used	Preparation mode	Administration route	Therapeutic uses, treated diseases	FC	RFC	UV	Voucher number
Ferula communis L.	Apiaceae	Oufal	stems	crushed, powder	oral	fracture	14	0.20	0.405	AN-008
Ficus carica L.	Moraceae	Tanequalts	leaves, fruits, latex	maceration	oral, topical	colon pain, constipation, warts	10	0.14	0.288	AN-095
Foeniculum vulgare (Mill.) Gaertn.	Apiaceae	Avesvas	seeds	decoction	oral	obesity, intestinal gas, colon pain	8	0.12	0.143	AN-006
Fraxinus angustifolia Vahl	Oleaceae	Aslen	leaves	steam coocked	topical	rheumatism	1	0.01	0.028	AN-101
Galium aparine L.	Rubiaceae	Imentedh	leaves, stems	raw	oral	bloating	1	0.01	0.014	AN-125
Globularia alypum L.	Plantaginaceae	Thasselgha	leaves	infusion, decoction	topical, oral	diabetes, dizziness, colic	27	0.39	0.39	AN-065
Hedysarum flexuosum L.	Fabaceae	Tassula	stems	raw	oral	colon pain	1	0.01	0.014	AN-059
Helminthotheca echioides (L.) Holub	Asteraceae	El-halafa	leaves	crushed	topical	wounds	4	0.06	0.173	AN-021
Hordeum vulgare L.	Poaceae	Chaïr	seeds	powder	oral	stomach ulcer	1	0.01	0.028	AN-111
Hyoscyamus albus L.	Solanaceae	Bourendjouf	leaves, seeds	crushed, decoction	oral, topical	gangrene, back pain, mycosis	14	0.20	0.202	AN-132
Hyoseris radiata L.	Asteraceae	Thughmas n'tamghart	leaves	raw	oral	stomach ulcer	1	0.01	0.042	AN-024
Juglans regia L.	Juglandaceae	Aghoussim	roots, leaves	chewing	oral	mouth ulcers	15	0.22	1.086	AN-066
Juncus effusus L.	Juncaceae	Azma	stems	decoction	oral	kidney stones, fever	13	0.19	0.376	AN-067
Juniperus oxycedrus L.	Cupressaceae	Thaqa	leaves	powder, decoction	topical, oral	boils, insomnia, stomach ulcer	16	0.23	0.4	AN-051
Kundmannia sicula (L.) DC.	Apiaceae	Amarghanis	leaves	crushed	topical	headache	2	0.03	0.056	AN-009
Laurus nobilis L.	Lauraceae	Rend	leaves	decoction	oral	colon pain	2	0.03	0.056	AN-084
Lavandula stoechas L.	Lamiaceae	Amzir lakhla	leaves, flowers	infusion, decoction	oral	bloating	25	0.36	1.21	AN-076
Lawsonia inermis L.	Lythraceae	Henni	leaves	powder	oral	hair loss	3	0.04	0.068	AN-092
Lens culinaris Medik.	Fabaceae	La3dess	seeds	powder	oral	anemia	5	0.07	0.144	AN-062
Lepidium sativum L.	Brassicaceae	Hab rchad	seeds	powder	oral, topical	headache, arthritis	19	0.28	0.27	AN-044
Linum usitatissimum L.	Linaceae	Zariat lkaten	seeds	powder	oral	obesity	5	0.07	0.072	AN-091
Lonicera implexa Aiton	Caprifoliaceae	Adhrass	leaves	crushed	oral	weak eyesight	16	0.23	0.46	AN-047
Macrochloa tenacissima (L.) Kunth	Poaceae	Halfa	leaves, stems	decoction	oral	diabetes, hypertension	2	0.03	0.028	AN-109
Malva sylvestris L.	Malvaceae	Mejir	leaves	crushed, coocked	oral	ear diseases, stomach ulcer, bloating, boils, abscess	9	0.13	0.39	AN-093
Marrubium vulgare L.	Lamiaceae	Marouyeth	leaves	crushed	oral, topical	indigestion, dizzines	30	0.43	0.43	AN-070
Melissa officinalis L.	Lamiaceae	Ifer zizwith	leaves	maceration, decoction	oral, topical	colon pain, hair loss, anemia	15	0.22	0.37	AN-071
Mentha pulegium L.	Lamiaceae	Fegou	leaves	infusion, decoction	oral	influenza, cough	11	0.16	0.318	AN-068
Mentha spicata L.	Lamiaceae	Na3na3	leaves	infusion, decoction	oral, topical	menstrual pain, influenza, boils	22	0.32	0.63	AN-073
Mentha suaveolens Ehrh.	Lamiaceae	Thimeja	leaves	infusion, crushed	oral, topical	arthritis, stomach ulcer, wounds	11	0.16	0.418	AN-072

Scientific name	Family	Vernacular name	Plant part(s) used	Preparation mode	Administration route	Therapeutic uses, treated diseases	FC	RFC	UV	Voucher number
Morus alba L.	Moraceae	Etout	leaves	decoction	oral	diabetes	7	0.10	0.101	AN-094
Myrtus communis L.	Myrtaceae	Chelmoune	leaves	decoction	oral	colon pain	3	0.04	0.034	AN-097
Nerium oleander L.	Apocynaceae	Ilili	leaves, stems	decoction	oral	eczema, scabies, boils	17	0.25	0.43	AN-016
Nigella damascena L.	Ranunculaceae	Haba sawda	seeds	powder	oral	asthma, diabetes	2	0.03	0.028	AN-116
Nigella sativa L.	Ranunculaceae	Sanougj	seeds	maceration, powder	oral	colon pain, asthma	12	0.17	0.274	AN-117
Ocimum basilicum L.	Lamiaceae	Lehvaq	leaves	infusion, decoction	oral	vomiting, anguish	4	0.06	0.115	AN-074
Olea europaea L. subsp. europaea var. europaea	Oleaceae	Azemour	leaves, fruits	crushed, decoction	oral, topical	constipation, diabetes, cough, arthritis, hair loss, ear disease, hemorrhoids	22	0.32	0.881	AN-099
Olea europaea L. subsp. europaea var. sylvestris (Mill.) Lehr	Oleaceae	Azeboudj	leaves, fruits	crushed, decoction	oral, topical	diabetes, hypertension, arthritis, cough	16	0.23	0.736	AN-100
Ophrys speculum Link	Orchidaceae	Thihagthin	tuberous	powder	oral	infertility, sexual impotence	8	0.12	0.115	AN-102
Opuntia ficus-indica (L.) Mill.	Cactaceae	Akarmous	leaves, stems	juice, raw	oral, topical	foot nail, diarrhea	14	0.20	0.303	AN-045
Origanum vulgare L. subsp. glandulosum (Desf.) Ietswaart	Lamiaceae	Zaathar	leaves, stems	decoction	oral	cough, dizzines, influenza	21	0.30	0.5	AN-075
Papaver rhoeas L.	Papaveraceae	Wahrir	leaves	coocked	oral	colon pain, bloating	17	0.25	0.7	AN-103
Paronychia argentea (Pourr.) Lam. & DC.	Caryophyllaceae	Latay n'wadhrar	leaves	decoction	oral	kidney stones, stomach ulcer	9	0.13	0.26	AN-049
Petroselium crispum (Mill.) Fuss	Apiaceae	Maadnous	leaves, stems	decoction	oral	hypotension	1	0.01	0.014	AN-014
Phlomis bovei de Noé	Lamiaceae	Khyata lejarh	leaves	powder	topical	wounds	1	0.01	0.014	AN-083
Pimpinella anisum L.	Apiaceae	Habat hlawa	seeds	infusion	oral	colon pain	1	0.01	0.028	AN-010
Pinus halepensis Mill.	Pinaceae	Thaghda	bark, resin	maceration, decoction	oral, topical	bronchitis, gastric reflux	25	0.36	0.36	AN-104
Pistacia lentiscus L.	Anacardiaceae	Amadhagh	leaves, fruits	crushed, decoction	oral, topical	gastric reflux, asthma, wounds, ulcer mouth, cough, bronchitis	20	0.29	0.5	AN-003
Populus alba L.	Salicaceae	Asafsaf	bark	powder	topical	fracture	6	0.09	0.172	AN-128
Portulaca oleracea L.	Portulacaceae	Amarmor	leaves	crushed, coocked	oral, topical	burns, diabetes, hypertension	12	0.17	0.491	AN-114
Pulicaria odora (L.) Rchb.	Asteraceae	Amazough guilef	leaves	juice, steam coocked	oral, topical	wounds, stomach ache	4	0.06	0.173	AN-022
Punica granatum L.	Lythraceae	Areman	fruits	decoction	oral, topical	diarrhea, tooth pain	8	0.12	0.201	AN-115
Quercus ilex L.	Fagaceae	Abelout	fruits	powder, coocked	oral	colon pain, bloating	7	0.10	0.303	AN-063
Raphanus sativus L.	Brassicaceae	Left	fruits	maceration	oral	cough	1	0.01	0.028	AN-041
Reseda alba L.	Resedaceae	Taza3koukt n tikhsi	leaves, stems	crushed	topical	mycosis, foot nail	25	0.36	0.72	AN-118
Rhamnus alaternus L.	Rhamnaceae	Mlilis	leaves	maceration, decoction	oral	jaundice	32	0.46	0.92	AN-119
Rorippa nasturtium-aquaticum (L.) Hayek	Brassicaceae	Garninouche	leaves	coocked	oral	anaemia, diabetes	6	0.09	0.172	AN-043

Scientific name	Family	Vernacular name	Plant part(s) used	Preparation mode	Administration route	Therapeutic uses, treated diseases	FC	RFC	UV	Voucher number
Rosmarinus officinalis L.	Lamiaceae	Azir	leaves	decoction	oral	menstrual pain, bloating	5	0.07	0.072	AN-078
Rubus ulmifolius Schott	Rosaceae	Inijel	roots	decoction	oral	tonsillitis	12	0.17	0.173	AN-122
Rumex conglomeratus Murray	Polygonaceae	Tassemmumt	leaves	powder, coocked	oral	diarrhea, stomach ulcer	8	0.12	0.345	AN-112
Ruta angustifolia Pers.	Rutaceae	Awarmi	leaves	decoction	oral	menstrual pain, colic	8	0.12	0.115	AN-127
Salvia officinalis L.	Lamiaceae	Latay tazagzawthe	leaves	decoction	oral	stomach ulcer, menstrual pain	6	0.09	0.172	AN-081
Salvia verbenaca (L.) Briq.	Lamiaceae	Lkhayata	leaves	powder	topical	burns, wounds	11	0.16	0.159	AN-080
Scolymus hispanicus L.	Asteraceae	Thaghediwth	leaves	coocked	oral	colon pain, bloating	10	0.14	0.432	AN-020
Silene vulgaris (Moench) Garcke	Caryophyllaceae	Tighighach	leaves	crushed, powder	oral, topical	colon pain, hemorroids	10	0.14	0.178	AN-048
Silybum marianum (L.) Gaertn.	Asteraceae	Aamriw	leaves	decoction, coocked	oral, topical	hepatitis	3	0.04	0.034	AN-030
Sinapis arvensis L.	Brassicaceae	Achenaf	seeds	maceration	oral	constipation	3	0.04	0.096	AN-040
Solanum nigrum L.	Solanaceae	Wakethoune	leaves	infusion	topical	diarrhea	10	0.14	0.274	AN-130
Solanum tuberosum L.	Solanaceae	Lbatata	tubers	crushed	oral, topical	stomach ulcer, headache	10	0.14	0.288	AN-131
Sonchus oleraceus L.	Asteraceae	Thifaf	leaves, stems	raw, steam coocked	oral	stomach ache, colon pain, stomach ulcer	12	0.17	0.303	AN-035
Spartium junceum L.	Fabaceae	Rathma	leaves	crushed	topical	hair loss	25	0.36	0.72	AN-057
Syzygium aromaticum (L.) Merr. & L.M. Perry	Myrtaceae	Kranfel	fruits	powder, decoction	oral, topical	tooth abscess, menstrual pain	11	0.16	0.332	
Teucrium polium L.	Lamiaceae	Dja3da	leaves	crushed	oral, topical	wounds, colic	2	0.03	0.028	AN-082
Thapsia garganica L.	Apiaceae	Adaryes	roots, leaves	decoction	oral, topical	thorn, infertility	23	0.33	0.33	AN-011
Thymus numidicus Poir.	Lamiaceae	Iz3itra	leaves	decoction	oral	influenza	2	0.03	0.028	AN-069
Thymus vulgaris L.	Lamiaceae	Tiz3etrin	leaves	infusion, decoction	oral	influenza, cough	7	0.10	0.273	AN-077
Trigonella foenum-graecum L.	Fabaceae	Lhalba	seeds	maceration, powder	oral	anemia, anguish, appetitive	20	0.29	0.28	AN-056
Triticum aestivum L.	Poaceae	Timzin	seeds	powder	oral	stomach ulcer	5	0.07	0.144	AN-110
Ulmus minor Mill.	Ulmaceae	Ulmu	roots	crushed, powder	topical	fracture, torsion	16	0.23	0.69	AN-133
Urtica dioica L.	Urticaceae	Azegdouf	leaves	decoction	oral, topical	stomach ache, prostate, hair loss	31	0.45	0.47	AN-134
Verbascum sinuatum L.	Scrophulariaceae	Tisraw	leaves	infusion	oral	kidney stones	4	0.06	0.057	AN-129
Zea mays L.	Poaceae	Akhval	fruits	coocked	oral	anemia	5	0.07	0.144	AN-106
Zingiber officinale Roscoe	Zingiberaceae	Skenjbire	rhizomes	maceration, decoction	oral, topical	influenza, arthritis, tooth abscess	7	0.10	0.101	
Ziziphus lotus (L.) Lam.	Rhamnaceae	Thazegarth	roots	decoction	topical	gum disease	8	0.12	0.115	AN-120