



Medicinal plants and their traditional uses in the highland region of Bordj Bou Arreridj (Northeast Algeria)

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ABSTRACT

In the highlands of Bordj Bou Arreridj in Northeast Algeria, traditional knowledge about medicinal plants is still put to use, but has been poorly explored by researchers. In view of its natural and cultural richness and the socio-economic context, this area is an ideal location for the study of aromatic and medicinal plants and their traditional uses. The aim of this ethnobotanical study was to shed light on how medicinal plants are used in traditional phytotherapy in the region of Bordj Bou Arreridj. Over a two-year period (2014–2016), herbalists practicing phytotherapy in the region were surveyed, and asked to provide information about themselves and the plants they used (vernacular name, mode of preparation, parts used and toxicity). The data was analyzed in terms of the Use-Value of species (UV), Medicinal Informant Agreement Ratios (Med. IARs), Fidelity Level (FL) and the Informant Consensus Factor (ICF). Among the 51 herbalists interviewed, men dominated the practice of traditional phytotherapy. The majority of these herbalists, whose ages varied between 46 and 65, were illiterate. During the survey, 83 species of medicinal plants were identified. They belonged to 66 genera and 37 botanical families, among which Lamiaceae were the most used. The herbalists most commonly used plant leaves, and for the most part, preferred to prepare the remedy in the form of infusions. *Origanum vulgare* subsp. *glandulosum* (Desf.) Ietsw., *Rosmarinus eriocalyx* Jord. & Fourr. and *Allium cepa* L. were the plants with the most important UV. Thirty-eight species had maximum values for the Med IARs index and digestive diseases were those with the highest ICF value. Interviewees indicated 10 taxa possessing toxicity but did not indicate the toxicity limits of each plant. Taxonomic analysis allowed the authors to recognize several taxa having changed systematic positions and/or nomenclature. The chorological analysis led the authors to distinguish 6 endemic taxa and 13 taxa that were not native to the country. The importance of this study lies in the originality of the information obtained, which must be preserved and used by researchers in pharmacology and other fields. Particular interest should be devoted to the taxonomic and chorological aspects of medicinal plants in order to avoid common serious errors in this kind of research.

1. Introduction

The great majority of the world's developing countries (80%) uses medicinal plants for health purposes and for the treatment of pain (Cunningham, 1993; Agisho et al., 2014). In the African region,

knowledge and practices regarding traditional medicine have been passed from one generation to the next as oral tradition. In recent years, several African countries have strengthened training programs for traditional health practitioners to increase their knowledge (WHO, 2013).

Traditional medicine and especially herbal treatments are well

Abbreviations: ANDI, Agence Nationale de Développement de l'Investissement (National Agency for Investment Development); APG, Angiosperm Phylogeny Group; DPSB, Direction de la programmation et suivie budgétaire (Directorate of Programming and Budget Monitoring); FL, fidelity level; ICF, informant consensus factor, med; IARs, medicinal informant agreement ratios; UV, use-value; WHO, World Health Organization

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developed in Algeria, but the use of conventional medicine has led to the neglect of these ancestral practices, which risk being forgotten (Rebbas et al., 2012).

In Algeria, several authors have published books on traditional phytotherapy and ethnobotany (Baba Aissa, 1991; Beloued, 1998; Aït Youssef, 2006) and ethnobotanical research (Rebbas et al., 2012; Boudjelal et al., 2013; Miara et al., 2013; Meddour and Meddour-Sahar, 2015; Benarba et al., 2015; Chermat and Gharzouli, 2015; Lakhdari et al., 2016; Ouelbani et al., 2016). However, this country remains poorly explored, even though it encompasses considerable natural resources distributed in different ecosystems and has considerable floristic diversity. In this area, old knowledge and therapeutic practices are still jealously preserved. This is the case of the Bordj Bou Arreridj region, where to date no investigation on medicinal plants or their traditional therapeutic uses had been conducted, hence the importance and necessity of this first exploratory study.

This area of the Algerian highlands constitutes an ideal location for the study of plant species and their traditional uses in view of its natural and cultural richness and other considerations related to the geographical situation and the socio-economic context of this region. This area is characterized by a population of farmers and peasants who have retained many old practices transmitted through the generations. Factors such as poverty and the lack of socio-economic development programs, particularly in the field of health, have prompted the local population to use traditional medicine as a cheap alternative to products from the pharmaceutical industry. For example, Bordj Bou Arreridj has only 5 hospitals with a capacity of 747 beds for a total population of approximately 690,000 inhabitants (DPSB (Direction de la programmation et suivie budgétaire), 2015). The bibliographical search for studies on plants and ethnopharmacological knowledge in this region indicated that no research has been carried out or published for this region, which remains rather ecologically and socio-economically different from other areas already explored. Thus it was hoped that original therapeutic uses of plants might be found in this region, because it is very common for the population to turn to herbalist practitioners of traditional medicine and because little is known in the academic world about their accumulated wisdom.

In this context, this work reports the results of this first regional study to answer the following questions:

- What are the plant species used in local phytotherapy and what are their characteristics and properties (names, uses, chorologies and taxonomy)?
- What are the characteristics of herbalists of the region practicing traditional medicine and what are the social factors (sex, age, family situation, level of study, ...) influencing the uses of the plants?
- What are the original local uses of plants in this region that are unknown elsewhere?

Thus, the aim of this study was to identify the medicinal plants and to analyze the old knowledge used in phytotherapy in the Bordj Bou Arreridj region. The investigations focused on plant identification, uses, and method of administration, while data analyses centered on floristic, therapeutic, taxonomic and chorologic aspects.

2. Materials and methods

2.1. Study area

The region of Bordj Bou Arreridj, located in the eastern highlands of the country, extends on the Algiers-Constantine axis at the geographical point 36° North latitude and 4°30' East longitude (Fig. 1). It is delimited to the North by the city of Bejaia, to the East by Setif, to the West by Bouira and to the South by Msila. It covers an area of around 3921 km², with altitudes ranging from 302 to 1885 m. The highlands can be divided into 3 main zones: the high plains zone, the mountainous zone

and the steppe zone. The climate is of semi-arid continental type with harsh winters and dry and hot summers, but there are rainfall contrasts related to the altitude between the different main zones (Seltzer, 1946; Le Houerou, 1995).

The population of the Bordj Bou Arreridj region reached 693,906 inhabitants in 2015 (DPSB (Direction de la programmation et suivie budgétaire), 2015), and its economy is based on agriculture. The high plains are farmed for high-yield cereals, while in the north, the mountainous area of the Bibans is dominated by arboriculture, predominantly olives and figs, and features many traditional oil mills. The south-west is a steppe area, and is used for livestock grazing (ANDI (Agence Nationale de Développement de l'Investissement), 2013).

2.2. Ethnobotanical surveys

The surveys were carried out over a period of two years (2014–2016).

A non-probabilistic sampling method called "non-random sampling by snowball" (Cochran, 1977) was used which consisted of identifying an informant, in our case an herbalist, and then asking this person in turn to indicate another informant from the same community. This process continues until all the possible informants have been identified and interviewed (Houéhanou et al., 2016). According to Espinosa et al. (2014), this sampling technique can be used in exploratory studies in quantitative ethnobotany.

The data was collected through interviews, and subsequently codified and categorized for proper statistical analysis (Albuquerque et al., 2014). The authors used a structured interview with a two-part questionnaire (supplementary on-line data). The first part concerned the profile of the interviewed herbalist (sex, age, family situation, level of study), while the second part concerned plants and their uses (vernacular name, use and diseases treated, mode of use, part used, toxicity). At the end of each interview, researchers bought plant specimens from the interviewees in order to identify them and add them to a herbarium. The botanical identification of the specimens was made using the following floras: Battandier and Trabut (1895); Maire (1959) and Quezel and Santa (1962–63). The updating of the old nomenclature of these references was carried out through the index of the database of North Africa (Dobignard and Chatelain, 2010) and the The Plant List database (www.theplantlist.org). Voucher specimens were confirmed and deposited in the herbarium of the Laboratory of Botany of the University of Tiaret, Algeria.

2.3. Data analysis

Data were analyzed according to four indices frequently used in similar studies (Abu-Irmaileh and Afifi, 2003; Thomas et al., 2009; Nzuki Bakwaye et al., 2013; Zashim Uddin and Abul Hassan, 2014; Benarba et al., 2015; Eddouks et al., 2016; Houéhanou et al., 2016; Ouelbani et al., 2016).

The use-value of species (UV) (Phillips and Gentry, 1993 modified by Rossato et al., 1999) is a quantitative method that demonstrates the relative importance of species in a community (Houéhanou et al., 2016). It is calculated according to the following formula:

$$UV = \sum U/N$$

Where: U is the number of citations per species and N the number of informants.

Medicinal Informant Agreement Ratio (Med. IARs) has been proposed by Trotter and Logan (1986) as follows:

$$0 < IARs = Nr-Na/Nr-1 < 1$$

Whereby Nr is the total number of medicinal responses registered for species s and Na is the number of ailments or health conditions that are treated with this species.

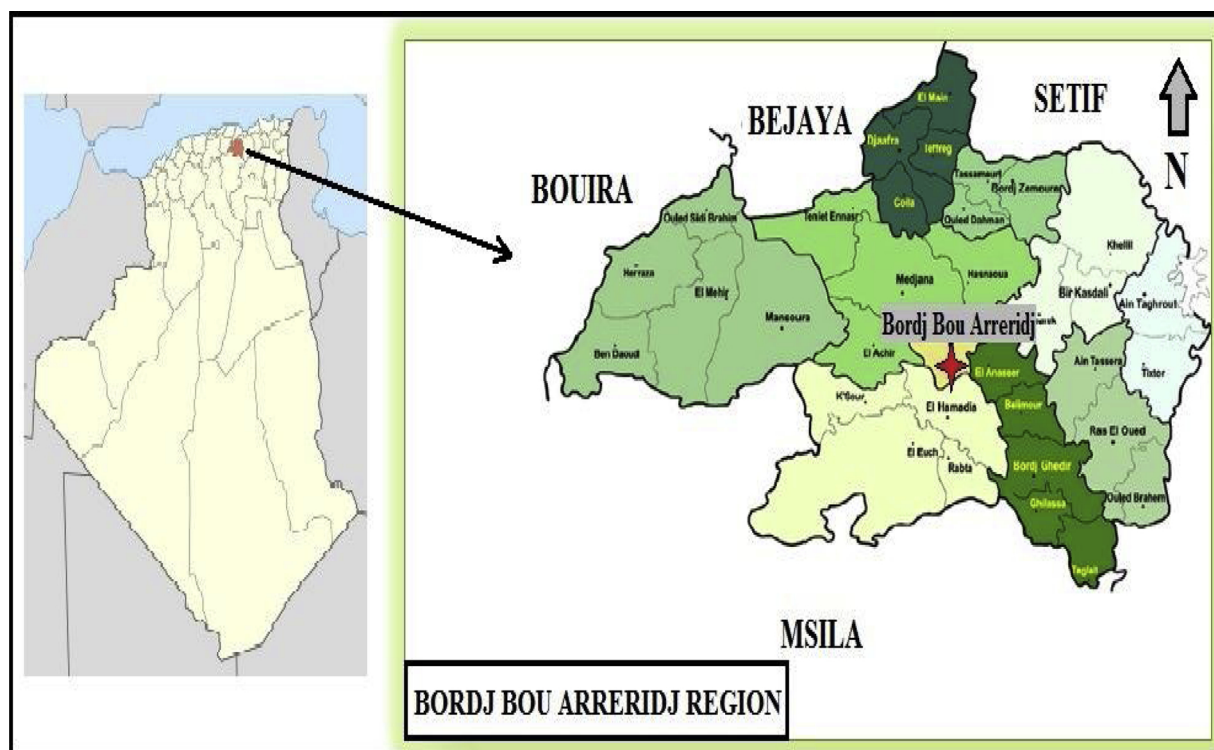


Fig. 1. Location of the study area Bordj Bou Arreridj, Northeast Algeria (ANDI (Agence Nationale de Développement de l'Investissement), 2013).

The IARs of a medicinal species varies between 0 (when the number of health conditions treated equals the number of medicinal responses) and 1 (whereby all participants agree upon the exclusive use of the species for a particular health condition (Thomas et al., 2009). Unlike the use value (UV), which does not reflect the informants' consensus very much, this technique takes into account this parameter (Nzuki Bakwaye et al., 2013).

The Fidelity level, (FL) (Friedman et al., 1986) is used to determine the plant species most frequently used by the informants for treating a particular ailment category. It is calculated using the following formula:

$$FL (\%) = (N_p/N \times 100)$$

Where: N_p refers to the number of informants citing the use of the plant for a particular ailment category and N is the total number of informants citing the plant for any ailment category.

The Informant's Consensus Factor, ICF (Trotter and Logan, 1986) is employed to indicate the extent to which the information is homogeneous. It is calculated according to the formula:

$$ICF = (N_{ur} - N_t) / (N_{ur} - 1)$$

Where: N_{ur} is the number of used citations in each category and N_t is the number of species reported in each category.

3. Results

Table 1 reports the results obtained from the surveys (plant family, scientific name, specimen code, local name, used part, preparation, local use, use value, Med IARs value, recorded literature uses and reference).

3.1. Characteristics of informants

During the survey, 51 herbalists living in the region of Bordj Bou Arreridj, Algeria, were interviewed. The information obtained in regard to the characteristics of these herbalists is summarized in Table 2. The majority of the practitioners interviewed were men (44 people, 86%),

while only 14% (7 people) were women, in line with the traditions of this conservative population, according to which women are generally not allowed to be involved in commercial activities, which for the most part are reserved for men.

Among the herbalists questioned, those aged 46–65 years were the most prevalent, at 51% (26 people), followed by the over 65 year-olds, at 27% (14 people). The herbalists aged 25–45 years were a moderate 20% of the group (10 people), while there was only 1 person under 25 (2%).

More than half of the herbalists were illiterate, with no level of study (51%, 26 people). Those with a primary or secondary level of education accounted for 35% (18 people), while college graduates were only 14% of the group (7 people).

3.2. Botanical diversity

The surveys carried out with these herbalists allowed the identification of 83 species of medicinal plants used as traditional remedies by the local population. These plants belonged to 66 genera and 37 botanical families. The Lamiaceae dominated the list of traditional remedies with 11 species (13%), followed by Asteraceae, 10 species (12%), Apiaceae, 6 species (7%), Fabaceae, 5 species (6%) and Poaceae, 4 species (4%) (Fig. 2).

3.3. Part used and mode of preparation

Leaves were the most frequently used part, named in 42% of the citations, followed by the aerial parts, at 28%. The other parts were little used in local phytotherapy (Fig. 3). The plants indicated by herbalists were mainly used as infusions (40%) and decoction (28%). Other methods of use (powder, raw material, maceration, cooked, fumigation) were less frequent (Fig. 4).

3.4. The use-value (UV)

The use-values (UV) calculated for the plant species used by

Table 1
List of plant species used as medical treatments in Bordj Bou Arreridj region, Northeast Algeria.

Species [Voucher specimen No.]	Family	Vernacular name	Part used	Preparation	Disease/problem/property	UV IARs	Recorded literature uses	Reference
<i>Ajuga reptans</i> L. Schreb. [BH-52]	Lamiaceae	Chendgoura	Aerial parts	Infusion, decoction, powder	Digestive problems/ Antiseptic, antirheumatic, antidiabetic, hypotensive, antidiarrhetic	0.37 0.83	Digestive problems, stomachache, eczema, headache, leishmaniose, animal bites (rabies)/ antidiabetic, antihypertensive, tonic, diarrhea, fever	Boudjelal et al., 2013; Allali et al., 2008; El Hilaly et al., 2003; Moussouli et al., 2014; Miara et al., 2013; Meddour and Meddour- Sahar, 2015; Hendel et al., 2012; Merzouki et al., 2000 Eddouks et al., 2016
<i>Allium cepa</i> L. [BH-16]	Amaryllidaceae	El basla	Bulbs	Decoction, raw, cooked	Wounds, bronchitis, constipation, hair loss, respiratory problems, infections, inflammation, rheumatism/ diuretic	1.37 0.94	Skin, respiratory and kidney ailments	
<i>Allium sativum</i> L. [BH-17]	Amaryllidaceae	El thome	Bulbs	Decoction, maceration, raw	Anti-inflammatory, antiseptic, antispasmodic, hypotensive, anticoagulant	0.12 1	Respiratory and eye diseases, influenza, hemorrhoids, diabetes, cough, hypertension, ear diseases, kidney disorders, intestinal parasites, hair loss and dandruff	Miara et al., 2013
<i>Ampelodesmos mauritanicus</i> (Poir.) T. Durand & Schinz. [BH-75]	Poaceae	Diss	Aerial parts	Decoction	Anti-diabetic, anti- hypertensive	0.14 0.83	Antidiabetic, antihypertensive	Boudjelal et al., 2013; Rossi et al., 1988
<i>Anacamptis papilionacea</i> L. R.M. Bateman, Pridgeon & M.W. Chase. [BH-70]	Orchidaceae	Ghar fartetou	Bulbs	Powder, raw	Aphrodisiac	0.08 1	Male sexual dysfunction	Miara et al., 2013
<i>Artemisia absinthium</i> L. [BH-28]	Asteraceae	Chedjret Meriem	Leaves, stems	Infusion	Digestive problems	0.16 1	Antidiabetic, antihypertensive, analgesic, digestive, diuretic, stomachic, anti- inflammatory, antiseptic, aperitive, aromatic, cholagogue, tonic, vermifuge	Boudjelal et al., 2013; Mahmoudi et al., 2009; Rebbas et al., 2012; Meddour and Meddour-Sahar, 2015; Chermat and Gharzouli, 2015; Bouchikh et al., 2016
<i>Artemisia herba-alba</i> Asso [BH-29]	Asteraceae	Chih	Leaves, stems	Infusion, decoction, powder, maceration	Digestive problems, abdominal pains, liver disorders	0.24 0.91	Nervous disorders, gastrointestinal disorders, rheumatism, constipation, heart diseases, menstrual pains, cough, liver diseases, skin diseases, kidney diseases, cancer, hair loss, anemia/ stomachache, antispasmodic, emmenagogue	Ouelbani et al., 2016
<i>Asphodelus ramosus</i> L. = <i>Asphodelus microcarpus</i> Rchb. [BH-18]	Amaryllidaceae	Berouag, Ançal, Belouaz	Bulbs	Decoction	Ear diseases/ detergent	0.06 1	Ear infections, rheumatism and dental pain	
<i>Atriplex halimus</i> L. [BH-13]	Amaranthaceae	Gtof	Aerial parts	Decoction	Eczema, scarring and bites	0.14 1	Antidiabetic, cysts, dental pain, skin diseases, tumor	Bouchikh et al., 2016
<i>Beta vulgaris</i> L. [BH-14]	Amaranthaceae	Chamandar	Bulbs	Row, cooked	Asthenia and liver disorders/ anti-anemic, aperitive, digestive	0.12 0.8	Digestive problems	González-Tejero et al., 2008
<i>Bunium elatum</i> (Batt.) Batt. [BH-21]	Apiaceae	Talgouda	Aerial parts	Infusion	Intestinal gas and stomach colic	0.08 1		
<i>Carlina gunnifera</i> (L.) Less. = <i>Arctostaphylos gunnifera</i> L. [BH-30]	Asteraceae	Ladad	Roots	Decoction	Rheumatism and abdominal pains	0.22 0.9	Sedative	Beloued, 1998
<i>Cassia senna</i> L. var. <i>senna</i> = <i>Cassia angustifolia</i> Vahl. [BH-45]	Fabaceae	Sana makia	Aerial parts	Infusion	Digestive problems/ carminative	0.18 1		
<i>Centaurea microcarpa</i> Batt. [BH-31]	Asteraceae	Bou Neggat	Aerial parts	Decoction	Hypertension	0.06 1		

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Table 1 (continued)

Species [Voucher specimen No.]	Family	Vernacular name	Part used	Preparation	Disease/ problem/property	UV IARs	Recorded literature uses	Reference
<i>Ceratonia siliqua</i> L. [BH-46]	Fabaceae	Kharoub	Leaves	Decoction, raw	Skin tasks	0.1 1	Rheumatism, blood purification, antihypertensive, cough, salivary secretions, stomachic and intestinal worms, hemorrhoids, diarrhea/ appetite	Ouelbani et al., 2016; Merzouki et al., 2000; Benitez et al., 2010
<i>Chamaemelum nobile</i> (L.) All. <i>Anthemis nobilis</i> L. [BH-32]	Asteraceae	Baboundj	Inflorescences	Infusion, decoction, maceration	Sores, fever, boils, abscesses and skin inflammations	0.14 0.83	Eczema, cardiovascular diseases, respiratory diseases, immune system diseases/ anti-inflammatory, sedative	Boudjelal et al., 2013; Ouelbani et al., 2016
<i>Clematis cirrhosa</i> L. [BH-79]	Ranunculaceae	Zenzou	Leaves	Decoction	Rheumatic pains	0.06 1		
<i>Crataegus azarolus</i> L. [BH-82]	Rosaceae	Zaaroura	Leaves, roots	Infusion, raw	Intestinal gas, lung affections/ Antidiarrhetic, vermifuge	0.22 0.9	Nervous system diseases, digestive disorders, muscle relaxing, fever, cough, cardiovascular diseases, sexual dysfunctions, cancer and diabetes, hypertension/ diuretic	Ouelbani et al., 2016; Said et al., 2002; Chermat and Gharzouli, 2015
<i>Crataegus monogyna</i> Jacq. = <i>Crataegus oxyacantha</i> L. [BH-83]	Rosaceae	Zaarour el barri	Leaves	Infusion, decoction	Cardiovascular diseases	0.08 1	Cardiovascular diseases, hypertension/ antispasmodic, sedative	Ouelbani et al., 2016; Meddour and Meddour-Sahar, 2015; Rebhas et al., 2012
<i>Cuminum cyminum</i> L. [BH-22]	Apiaceae	Krafesse	Aerial parts	Infusion, decoction	Digestive problems, inflammation of the urinary tract	0.39 0.95	Cough, rheumatism, lactation, gastric pains/ carminative and sudorific, sedative, analgesic, antispasmodic	Eddouks et al., 2016; Merzouki et al., 2000; Tuttolomondo et al., 2014; Guzel et al., 2015
<i>Gynura cardunculus</i> L. [BH-33]	Asteraceae	Khorchaf	Stem	Infusion, raw	Anemia/ appetite, stomachic	0.31 0.93	Diabetes, stomach pains	Meddour and Meddour-Sahar, 2015
<i>Dittrichia viscosa</i> (L.) Greuter = <i>Inula viscosa</i> (L.) Alton [BH-34]	Asteraceae	Magramâne	Leaves	Infusion, decoction	Wound / antidiarrhetic and vermifuge	0.25 0.92	Analgesic, antiseptic, diuretic, hemostatic and vermifuge	Rebhas et al., 2012
<i>Erica vesicaria</i> (L.) Cav. [BH-38]	Brassicaceae	Djardjir	Aerial parts	Infusion	Diuretic, appetite, digestive and stomachic	0.29 0.93		
<i>Eucalyptus globulus</i> Labill. [BH-68]	Myrtaceae	Kalitouss, Kaffour	Leaves	Fumigation	Rheumatic pains, burns	0.06 1	Colds and flu, leishmaniose, respiratory diseases/ antitussive	Boudjelal et al., 2013; Asgarpanah and Roohi, 2012; Benarba et al., 2015; Ouelbani et al., 2016; Rebhas et al., 2012
<i>Ficus carica</i> L. [BH-66]	Moraceae	Karna	Fruits	Raw, maceration	Antidiarrhetic	0.18 1	Constipation, warts, asthma, antispasmodic, depurative, diuretic, emollient, laxative, nutritive, tonic, vermifuge	Chermat and Gharzouli, 2015; Meddour and Meddour-Sahar, 2015; Rebhas et al., 2012
<i>Foeniculum vulgare</i> Mill. [BH-23]	Apiaceae	Besbas	Bulbs	Infusion, raw	Diarrhea, intestinal gas, colon pains	0.22 1	Rheumatism and muscular problems, lactation, weight loss, digestive, diabetes, cardiovascular diseases/ analgesic, antispasmodic	Eddouks et al., 2016; Fakchich and Elachouri, 2014
<i>Globularia alypum</i> L. [BH-72]	Plantaginaceae	Tessleghe	Inflorescences	Infusion, decoction	Depurative, diuretic, laxative (depending on the dose, it may become purgative), stomachic and diaphoretic	0.25 0.92	Leishmaniasis, digestive disorders, eczema, nervousness, jaundice, anemia, colon, gynecological diseases, wound, respiratory diseases, constipation, fever, mycosis, stomachache, headache/ astringent, cholagogue, depurative, diuretic, laxative (depending on dose, it may become purgative), diaphoretic, Antidiabetic, antiparasitic, antiseptic, excitant, antifungal, hypotensive, antipyretic	Boudjelal et al., 2013; Skim et al., 1999; Chermat and Gharzouli, 2015; Miara et al., 2013; Ouelbani et al., 2016; Benarba et al., 2015; Meddour and Meddour-Sahar, 2015; Rebhas et al., 2012
<i>Hedysarum naudinianum</i> Coss. & Durieu. [BH-47]	Fabaceae	Sella	Aerial parts	Decoction	Intestinal disorders, diarrhea	0.18 1		
<i>Hibiscus sabdariffa</i> L. [BH-65]	Malvaceae	El karkadya	Flowers	Decoction	Anemia, blood pressure	0.14 0.83	Cardiovascular diseases	Benarba et al., 2015

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Table 1 (continued)

Species [Voucher specimen No.]	Family	Vernacular name	Part used	Preparation	Disease/problem/property	UV IARs	Recorded literature uses	Reference
<i>Hordeum vulgare</i> L. [BH-76]	Poaceae	El chaire	Seeds	Infusion, powder	Diabetes, anemia, tuberculosis, stomachache, colon pains, rheumatism, kidney diseases, urinary tract inflammation, diarrhea	0.12 0.88	Anemia, tuberculosis, stomachache, colon pain, rheumatism, kidney and urinary diseases, jaundice and diarrhea, fractures, allergy, fever, digestive and respiratory problems/ tonic, sedative, nutrient,	Rebbas et al., 2012; Ouelbani et al., 2016; Fakchich and Elachouri, 2014; González-Tejero et al., 2008;
<i>Juglans regia</i> L. [BH-51]	Juglandaceae	Eldjouz	Leaves, cores	Infusion, powder	Skin diseases/ antidiabetic, stomachic, depurative, antiseptic, vermifuge	0.25 0.83	Dental pain, mouth ulcer/ astringent, antidiabetic, stomachic, depurative, antiseptic, vermifuge	Rebbas et al., 2012; Meddour and Meddour-Sahar, 2015
<i>Juniperus oxycedrus</i> L. [BH-43]	Cupressaceae	Tagga	Leaves	Infusion, powder	Skin diseases (eczema)/ stomachic, diuretic	0.39 0.89	Migraine, rheumatism, articular system diseases, dermatological diseases, urinary system diseases, digestive disorders, respiratory system diseases, eye infections, eczema, pulmonary, psoriasis, leishmaniose/ stimulant, diuretic, stomachic, tonic, depurative, anti-inflammatory, antiparasitic, hypoglycemic, anti-inflammatory, antiparasitic, antiseptic and astringent	Boudjelal et al., 2013; Chermat and Gharzoui, 2015; Miara et al., 2013; Ouelbani et al., 2016; Rebbas et al., 2012
<i>Juniperus phoenicea</i> L. [BH-44]	Cupressaceae	Aârâr	Aerial parts	Infusion, decoction	Antiparasitic, antiseptic, detergent (treatment of wounds)	0.16 0.86	Digestive disorders, eczema, thyroid/ antihypertensive, anti-inflammatory	Boudjelal et al., 2013; Chermat and Gharzoui, 2015
<i>Laurus nobilis</i> L. [BH-63]	Lauraceae	Rand	Leaves	Powder	Skin, allergy	0.14 1	Respiratory problems, nervous system diseases, dialysis, cough, hypertension, musculoskeletal and digestive problems, cardiovascular diseases/ hypoglycemic, tonic, carminative	Meddour and Meddour-Sahar, 2015; Ouelbani et al., 2016; Fakchich and Elachouri, 2014; Tuttolomondo et al., 2014; Benitez et al., 2010; Rebbas et al., 2012
<i>Lavandula stoechas</i> L. [BH-53]	Lamiaceae	Mezir	Aerial parts	Infusion, maceration	Hepatic disorders/ antiseptic, antispasmodic, carminative	0.18 0.88	Heart diseases, circulatory problems, digestive problems, rheumatism, stomachache/ sedative, antispasmodic, cancer, astringent, stomachic, diuretic	Hendel et al., 2012; Meddour and Meddour-Sahar, 2015; Merzouki et al., 2000; Miara et al., 2013
<i>Lepidium sativum</i> L. [BH-39]	Brassicaceae	Haberr-achad	Leaves, seeds	Infusion	Hypoglycemia and rheumatism	0.16 0.86	Hair loss and dandruff, rheumatism and musculoskeletal problems, goiter, tumor, immune system diseases, anemia, hair loss / depurative, hypoglycemic and tonic, diuretic, antibiotic, appetite	Rebbas et al., 2012; Eddouks et al., 2016; Ouelbani et al., 2016
<i>Lycopus europaeus</i> L. [BH-54]	Lamiaceae	El zekza	Leaves, stems	Infusion	Infections	0.06 1		
<i>Macrochloa tenacissima</i> L. Kunth = <i>Stipa tenacissima</i> L. [BH-77]	Poaceae	Halfa	Leaves	Infusion	Chronic ulcers, hair, kidney, insomnia/ antidiabetic	0.31 0.8	Diabetes, weight loss, depression, neuralgia, hypercholesterolemia, hypertension, chronic ulcers, hypoglycemic	Boudjelal et al., 2013; Chermat and Gharzoui, 2015; Miara et al., 2013; Rebbas et al., 2012
<i>Malva sylvestris</i> L. [BH-64]	Malvaceae	Khoubéize, M'djir	Aerial parts	Infusion, decoction	Tumors, eye irritations, inflammations, urinary and digestive problems	0.12 0.40	Weight loss, gastrointestinal disorders, urinary system diseases, uterus pain, colds, stomachache, skin/ anti-inflammatory, emollient	Boudjelal et al., 2013; Asgarpanah and Roohi, 2012; Chermat and Gharzoui, 2015; Ouelbani et al., 2016; Meddour and Meddour-Sahar, 2015; González-Tejero et al., 2008
<i>Marrubium vulgare</i> L. [BH-55]	Lamiaceae	Merriouat	Leaves	Infusion, decoction, maceration	Liver diseases, respiratory disorders, fever (in young children)/ antidiabetic, stomachic	0.35 0.82	Diabetes, diarrhea, digestive problems, stomach pain, fever, migraine, wound, cardiovascular diseases, respiratory and liver diseases, allergies, leishmaniose/ febrifuge, vermifuge, anti-emetic, tonic, analgesic, antispasmodic	Hendel et al., 2012; Eddouks et al., 2016; Meddour and Meddour-Sahar, 2015; Ouelbani et al., 2016; Miara et al., 2013; Chermat and Gharzoui, 2015; Boudjelal et al., 2013

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Table 1 (continued)

Species [Voucher specimen No.]	Family	Vernacular name	Part used	Preparation	Disease/problem/property	UV IARs	Recorded literature uses	Reference
<i>Mentha pulegium</i> L. [BH-56]	Lamiaceae	Filou	Aerial parts	Infusion	Anti-hypertensive, antispasmodic	0.22 0.9	Diabetes, colds and coughs, stomach pains, respiratory diseases, digestive disorders, mouth and gum disorders, sedative, hematomas, wounds and swelling, antihypertensive, antispasmodic, laxative, cooling	Boudjelal et al., 2013; Allali et al., 2008; Miara et al., 2013; Ouelbani et al., 2016; Meddour and Meddour-Sahar, 2015; Tuttolomondo et al., 2014; Hendel et al., 2012
<i>Mentha spicata</i> L. [BH-57]	Lamiaceae	Naanaa	Aerial parts	Infusion, powder	Digestive problems/ antiseptic, antispasmodic	0.14 1	Hypotension/ sedative, disinfectant, astringent, carminative, stomachic, sedative, cooling	Hendel et al., 2012; Meddour and Meddour-Sahar, 2015
<i>Morus alba</i> L. [BH-67]	Moraceae	Toute	Fruits	Raw	Diabetes	0.06 1		
<i>Nerium oleander</i> L. [BH-27]	Apocynaceae	Defla	Leaves	Decoction	Skin diseases, respiratory and heart problems	0.37 0.89	Diabetes, dermatological disorders, hypotension, bone fracture, heart diseases/ anti-viral antifungal, cardiotonic, diuretic, hypoglycemic, analgesic	Ould El Hadj et al., 2003; Meddour and Meddour-Sahar, 2015; Ouelbani et al., 2016; Miara et al., 2013; Chermat and Gharzouli, 2015; Lakhdari et al., 2016
<i>Ocimum basilicum</i> L. [BH-58]	Lamiaceae	Abbak	Leaves, stems	Infusion, powder	Digestive problems, abdominal and stomach pains, cardiovascular diseases	0.31 0.93	Hemorrhoids, heart diseases, hypertension, weight loss, digestive disorders, migraine, fever, lactation, dermatological problems, sensory, mental nervous, flu, laryngitis, conjunctivitis, cough, toothache, goiter/ analgesic, anxiolytic, antispasmodic, antiseptic, antifungal, diuretic	El Hilaly et al., 2003; Doukkali et al., 2015; Jouad et al., 2001; Ouelbani et al., 2016; Miara et al., 2013; Benarba et al., 2015; Meddour and Meddour-Sahar, 2015; Hendel et al., 2012
<i>Olea europaea</i> L. subsp. <i>europaea</i> [BH-69]	Oleaceae	Zitoune	Leaves, fruits, bark	Infusion, raw, cooked	Inflammations, ophthalmia/ hypoglycemic, anti-hemorrhoid, hypotensive	0.22 0.9	Toothache, cholesterol regulation, muscular pain, sensory, digestive pains, gingivitis, high blood pressure, flu, eczema, cardiovascular problems, skin care/ diuretic, antidiabetic, antihypertensive	Eddouks et al., 2016; Meddour and Meddour-Sahar, 2015; Ouelbani et al., 2016; González-Tejero et al., 2008; Miara et al., 2013; Boudjelal et al., 2013; Heamalatha et al., 2011
<i>Opuntia ficus-indica</i> L. Mill. [BH-41]	Cactaceae	Hindi	Leaves	Decoction	Hair	0.06 1	Respiratory system diseases, hemorrhoids, diarrhea	Ouelbani et al., 2016; Meddour and Meddour-Sahar, 2015
<i>Origanum vulgare</i> subsp. <i>glandulosum</i> (Desf.) Ietsw. = <i>Origanum glandulosum</i> Desf. [BH-59]	Lamiaceae	Zaater	Leaves	Infusion, decoction, fumigation	Rheumatic pains, liver tumor, eczema, digestive problems, influenza, respiratory problems/ antihypertensive	1.55 0.91	Respiratory and digestive problems, immune system diseases/antibiotic, analgesic, diuretic, antihypertensive, antiseptic, antispasmodic, carminative, emmenagogue, expectorant, sedative, antitussive, appetitive, astringent	Rebbas et al., 2012; Meddour and Meddour-Sahar, 2015; Ouelbani et al., 2016; González-Tejero et al., 2008; Boudjelal et al., 2013
<i>Papaver rhoeas</i> L. [BH-71]	Papaveraceae	Benaâmane, gboubch	Flowers	Infusion	Digestive problems/ antispasmodic	0.12 0.8	Cough and pulmonary diseases/ antibacterial, sedative, analgesic, antispasmodic, softening, emollient, hypnotic	Ouelbani et al., 2016; Merzouki et al., 2000; Meddour and Meddour-Sahar, 2015; Rebbas et al., 2012
<i>Paronychia argentea</i> Lam. [BH-42]	Caryophyllaceae	Kassarar El Hadjer	Leaves	Infusion	Inflammation of urinary tract/ diuretic, appetitive	0.12 0.8	Urinary problems/ antilithiasis	Meddour and Meddour-Sahar, 2015; Miara et al., 2013; Boudjelal et al., 2013
<i>Peganum harmala</i> L. [BH-95]	Zygophyllaceae	Harnel	Leaves	Decoction	Aphrodisiac and euphoric	0.1 1	Skin diseases, urinary tract, fever, worms, arthritis, nervous system, blood purification, memory, respiratory system diseases, eczema, rheumatism/ antidiabetic, antihypertensive, strength and tonic, sudorific, antispasmodic	Boudjelal et al., 2013; Chevallier, 1996; Lakhdari et al., 2016; Chermat and Gharzouli, 2015; Miara et al., 2013; Benarba et al., 2015; Eddouks et al., 2016; Ould El Hadj et al., 2003
<i>Petroselinum crispum</i> (Mill.) Fuss. [BH-24]	Apiaceae	Maâdnousse	Aerial parts	Infusion	Digestive problems, abdominal pain/ galactogen	0.14 1		
<i>Pinus halepensis</i> Mill. [BH-73]	Pinaceae	Snowber	Leaves, resin	Infusion, decoction	Respiratory ailments (bronchitis, pneumonia and colds), urinary problems, parasitosis, wounds	0.55 0.81	Disinfectant of respiratory tract, antifungal	Chermat and Gharzouli, 2015
<i>Pistacia atlantica</i> Desf. [BH-20]	Anacardiaceae	Btom	Leaves	Decoction	Stomachache	0.24 1	Leishmaniasis, dental pain, gingivitis, thrush	Chermat and Gharzouli, 2015

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Table 1 (continued)

Species [Voucher specimen No.]	Family	Vernacular name	Part used	Preparation	Disease/problem/property	UV IARs	Recorded literature uses	Reference
<i>Pistacia lentiscus</i> L. [BH-19]	Anacardiaceae	Dharw	Leaves, fruits	Infusion, decoction	Respiratory and digestive problems	0.31 0.93	Edema, urinary system diseases, genital disorders, dermatological problems	Merzouki et al., 2000
<i>Populus nigra</i> L. [BH-87]	Salicaceae	Safsaf	Leaves	Infusion	Digestive problems	0.06 1	Digestive disorders, hemorrhoids, hair care	Miara et al., 2013
<i>Punica granatum</i> L. [BH-74]	Punicaceae	Romane	Peel of fruit	Infusion, powder	Aphthae, diarrhea, digestive problems	0.14 1	Kidney disorders, cholesterol, stomach, ulcer, anemia, gum and teeth, intestinal, peptic ulcer, eczema, gastro-intestinal diseases antiseptic/ antiseptic and hemostatic	Eddouks et al., 2016; Meddour and Meddour-Sahar, 2015; Ouelbani et al., 2016; Merzouki et al., 2000; Benarba et al., 2015
<i>Quercus ilex</i> subsp. <i>ballota</i> (Desf.) Samp. [BH-50]	Fagaceae	Kerouch - Ballout	Leaves, fruits	Raw, cooked	Antidiarrhetic, antiseptic, nutrient and tonic	0.2 1	Urinary disorders of children (nocturnal enuresis), anuria, stomach upset, hyperacidity/ antidiarrhetic, antiseptic, astringent, febrifuge, hemostatic	Miara et al., 2013; Meddour and Meddour-Sahar, 2015; Rebbas et al., 2012
<i>Retama raetam</i> (Forsk.) Webb. [BH-48]	Fabaceae	Rtem	Aerial parts	Infusion, decoction	Skin affections (furuncles), eye irritations, diarrhea, fever and worms	0.2 0.89	Rheumatism, scorpion sting, eczema, wound, intestinal worms, scabies, fever, abortion/ analgesic, antiseptic and anti-inflammatory, vermifuge	Ould El Hadj et al., 2003; Lakhdari et al., 2016; Chermat and Gharzouli, 2015; Boudjelal et al., 2013
<i>Rhamnus alaternus</i> L. [BH-80]	Rhamnaceae	M'iles	Aerial parts	Decoction	Hepatic jaundice and chlorosis	0.1 1	Hepatic jaundice, nervous system disorders, cancer, stomachache, headache, skin/ astringent, laxative, purgative, hypoglycemic and hypocholesterolemic,	Rebbas et al., 2012; Ouelbani et al., 2016; Boudjelal et al., 2013; Benarba et al., 2015
<i>Rosmarinus eriocalyx</i> Jord. & Fourn. [BH-60]	Lamiaceae	Aklil, mzir	Leaves, stems	Infusion, decoction, maceration	Hepatic disorders, dyspepsia, intestinal gas, migraine, rheumatism, skin and hair affections	1.39 0.94		
<i>Rubus ulmifolius</i> Schott. [BH-84]	Rosaceae	El Allaigue	Resin	Raw	Wound, ulcers/ antidiarrhetic, tonic, depurative	0.24 0.82	Colds, diabetes, respiratory diseases/ stomachic	Meddour and Meddour-Sahar, 2015
<i>Ruta chalepensis</i> (L.) [BH-85]	Rutaceae	Fidjel	Leaves	Infusion, decoction	Respiratory problems/ antispasmodic, anti- inflammatory (ophthalmic), diuretic, vermifuge	0.24 0.91	Diabetes, kidneys, migraine, ear pain, digestive problems, intestinal worms eczema/ antihypertensive, antispasmodic, diuretic, tonic, abortifacients	Boudjelal et al., 2013; Chevallier, 1996; Chermat et Gharzouli, 2015; Benarba et al., 2015; El Hilaly et al., 2003
<i>Ruta montana</i> (L.) L. [BH-86]	Rutaceae	Awarni	Aerial parts	Decoction	Rheumatism	0.08 1	Digestive disorder, helminthiasis, ulcer, odonalgia chilblains, rheumatism and difficult childbirth, stomach upset, sterility/ analgesic, abortive, antispasmodic, anti-inflammatory (ophthalmic), emmenagogue, diuretic, sedative, sudorific, vermifuge, antimicrobial, sudorific	Rebbas et al., 2012; Meddour and Meddour-Sahar, 2015; Ouelbani et al., 2016; Benitez et al., 2010; Miara et al., 2013
<i>Santolina pectinata</i> Lag. = <i>Santolina rosmarinifolia</i> L. [BH-35]	Asteraceae	Jaâda	Flowers, stem	Infusion	Digestive problems/ stomachic, diuretic	0.41 0.9	Wound, digestive disorders	Boudjelal et al., 2013
<i>Scorzonera undulata</i> Vahl. [BH-36]	Asteraceae	Talma	Aerial parts	Infusion, raw	Urinary diseases	0.06 1	Depurative, diuretic, emollient, and sudorific	Rebbas et al., 2012
<i>Sinapis arvensis</i> L. [BH-40]	Brassicaceae	Khardel	Leaves	Infusion	Stomachic	0.08 1	Musculoskeletal problems	González-Tejero et al., 2008
<i>Sonchus oleraceus</i> L. [BH-37]	Asteraceae	Tilflaf	Aerial parts	Infusion	Digestive problems	0.16 1	Diabetes, obesity, eczema, diarrhea, stomach pain	Meddour and Meddour-Sahar, 2015; Lakhdari et al., 2016; Ould El Hadj et al., 2003
<i>Spinacia oleracea</i> L. [BH-15]	Amaranthaceae	Selg	Aerial parts	Cooked	Anti-inflammatory, diuretic, galactogen	0.18 1		
<i>Tamarix africana</i> Poir. [BH-89]	Tamaricaceae	Tarfa	Leaves	Infusion	Cardiovascular diseases/ diuretic	0.08 1	Digestive disorders, eye diseases/ antiscarthal, appetitive, astringent, diuretic, hemostatic, sudorific	Boudjelal et al., 2013; Akrouit et al., 2012; Rebbas et al., 2012

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Table 1 (continued)

Species [Voucher specimen No.]	Family	Vernacular name	Part used	Preparation	Disease/problem/property	UV IARs	Recorded literature uses	Reference
<i>Teucrium polium</i> L. [BH-61]	Lamiaceae	Khayata	Inflorescences	Infusion, powder	Diabetes, migraine	0.2 0.89	Wound, hemorrhoids, weakness, chills, fever, pinworms/ anti-inflammatory, astringent, detergent, febrifuge (paludisme), hypoglycemic, disinfectant, stomachic, hypotensive, coagulant, vermifuge, antidiabetic, antihypertensive, astringent	Rebbas et al., 2012; Hendel et al., 2012; Meddour and Meddour-Sahar, 2015; Ouelbani et al., 2016; Cherrat and Gharzouli, 2015; Hammiche and Maiza, 2006; Miara et al., 2013; Boudjelal et al., 2013; Asgarpanah and Roohi, 2012
<i>Thapsia garganica</i> L. [BH-25]	Apiaceae	Bounafâa, Derias	Roots	Decoction, powder	Rheumatic pains, bronchitis	0.18 0.88	Rheumatic and thorax pains, bronchitis, weakness, weight loss, articular system diseases, traumatic injuries, eczema/ antipyretic, anti-inflammatory	Rebbas et al., 2012; Meddour and Meddour-Sahar, 2015; Ouelbani et al., 2016; Boudjelal et al., 2013
<i>Thymelaea hirsuta</i> (L.) Endl. [BH-90]	Thymelaeaceae	Methmane	Leaves	Infusion, decoction	Dandruff	0.18 1	Dandruff, cough and constipation, female sterility, leishmaniasis, eczema, diabetes/ expectorant, anthelmintic and hydragogue, vermifuge	Rebbas et al., 2012; Miara et al., 2013; Benarba et al., 2015; Boudjelal et al., 2013; El Amrani et al., 2010
<i>Thymus munbyanus</i> subsp. <i>coloratus</i> (Boiss. & Reut.) Greuter & Burdet. [BH-62]	Lamiaceae	Zâaitra	Leaves, stems	Infusion	Hypertension, diabetes/ vermifuge, stomachic	0.98 0.96		
<i>Trigonella foenum-graecum</i> L. [BH-49]	Fabaceae	Elhalba	Seeds	Infusion, decoction, powder	Stomach pains, bronchitis/ diuretic, galactagogue, hypoglycemic, slimming, appetite	0.49 0.88	Diabetes, immune system disease, lactation, anemia, wounds, digestive problems, respiratory diseases/ appetite, fortifying, emollient, depurative, antiinflammatory, diuretic	Miara et al., 2013; Ouelbani et al., 2016; Fakchich and Elachour, 2014; Eddouks et al., 2016
<i>Triticum durum</i> Desf. [BH-78]	Poaceae	El gamh	Seeds	Infusion, powder, raw, cooked	Anemia, galactogen	0.12 1	Colon disease	Benarba et al., 2015
<i>Urtica dioica</i> L. [BH-91]	Urticaceae	Azekdouf	Leaves	Infusion	Diuretic, antihemorrhagic	0.04 1	Anemia, rheumatism and hair loss, thyroid problems, suprarenal gland, diuretic, obesity, circulatory problems, liver disease, cold, hyperglycemia, circulatory problems, prostate, hypercholesterolemia, allergic rashes, hair care/ antidiabetic, anti-inflammatory, coagulant, antirheumatic	Boudjelal et al., 2013; Cakicioglu and Turkoglu, 2010; Miara et al., 2013; Benarba et al., 2015; Benitez et al., 2010; Meddour and Meddour-Sahar, 2015
<i>Urtica urens</i> L. [BH-92]	Urticaceae	Horeig	Aerial parts	Decoction	Skin and hair diseases	0.25 0.92		
<i>Verbascum thapsus</i> L. [BH-88]	Scrophulariaceae	Toufelat	Aerial parts	Infusion	Pulmonary affections (bronchitis)	0.12 1		
<i>Visnaga daucoides</i> Gaertn. = <i>Ammi visnaga</i> Lamk. [BH-26]	Apiaceae	El Kababa	Aerial parts	Infusion	Headache	0.12 0.8		
<i>Vitis vinifera</i> L. [BH-93]	Vitaceae	El dalya	Leaves	Decoction	Sunburn, eye inflammation	0.24 1	Cancer, anaemia, digestive disorders, memory, diabetes, hypertension, heart diseases, varicose veins, wounds and burns, prostate disorders	Tahraoui et al., 2007; Eddouks et al., 2016; Ouelbani et al., 2016; González-Tejero et al., 2008
<i>Zingiber officinale</i> Roscoe [BH-94]	Zingiberaceae	Zandjabil	Bulbs	Infusion, powder	Diuretic, stomachic, aphrodisiac	0.18 0.75	Cough, allergies, blood circulation, appetite, digestive disorders, liver and kidney diseases, hypertension, hypercholesterolemia, female sterility, aphrodisiac, immunity, rheumatism, diabetes/ anti-inflammatory	Ouelbani et al., 2016; Benarba et al., 2015; El Amrani et al., 2010
<i>Ziziphus lotus</i> (L.) Lam. [BH-81]	Rhamnaceae	Sedra	Roots	Powder, raw	Pulmonary affections and jaundice	0.18 1	Stomach acidity, hypertension, lung diseases	Cherrat and Gharzouli, 2015; Miara et al., 2013

Table 2
Characteristics of informants by sex, age and level of education.

Distribution of informants	Categories	Number of informants	Percentage of informants %
By sex	Men	44	86.27
	Women	7	13.72
By age range	Less than 25 Years	1	1.96
	25-45 years	10	19.61
	46-65 years	26	50.98
	More than 65 years	14	27.45
By education level	Illiterate	26	50.98
	Primary and Secondary education	18	35.29
	University education	7	13.72

herbalists showed that *O. vulgare* subsp. *glandulosum*, *R. eriocalyx* and *A. cepa* were those with the highest importance (1.55, 1.39 and 1.37, respectively). These were followed by *H. vulgare* (1.12), *T. munbyanus* subsp. *coloratus* (0.98) and *P. halepensis* (0.55). Other species scoring interesting values were *T. foenum-graecum* (0.49), *S. pectinata* (0.41), *C. cyminum* (0.39), *A. iva* and *N. oleander* (0.37 each) (Table 1).

3.5. Medicinal informant agreement ratio (Med. IARs)

The values of med IARs obtained revealed 38 species with IARs equal to 1, namely: *A. sativum*, *A. papilionacea*, *A. absinthium*, *A. ramosus*, *A. halimus*, *B. elatum*, *C. senna* var. *senna*, *C. microcarpa*, *C. siliqua*, *C. cirrhosa*, *C. monogyna*, *E. globulus*, *F. carica*, *F. vulgare*, *H. naudinianum*, *L. nobilis*, *L. europaeus*, *M. spicata*, *M. alba*, *O. ficus-indica*, *P. harmala*, *P. crispum*, *P. atlantica*, *P. nigra*, *P. granatum*, *Q. ilex* subsp. *ballota*, *R. alaternus*, *R. montana*, *S. undulata*, *S. arvensis*, *S. oleraceus*, *S. oleracea*, *T. gallica*, *T. hirsuta*, *T. durum*, *V. thapsus*, *V. vinifera* and *Z. lotus*.

The rest of the species had values varying between 0.75 and 0.96. The only species with a value less than 0.5 was *M. sylvestris* (0.40) (Table 1).

3.6. The fidelity level (FL)

The Fidelity level (FL) results for the ten most cited species showed that the most important value was attributed to *C. cyminum* (75%) and *S. pectinata* (57%) for the treatment of digestive problems (see Table 3), followed by *R. eriocalyx*, *A. cepa* and *J. oxycedrus* (40% each) for these ailments. Wild thyme (*T. munbyanus* subsp. *coloratus*) with an FL value of 54% was used for cardiovascular problems, while Fenugreek (*T. foenum-graecum*) with an FL value of 32%, was used for diabetes. *Pinus halepensis* presented an FL value of 28% for the treatment of respiratory diseases. Oregano (*O. vulgare* subsp. *glandulosum*) had an FL value of 22% for the treatment of influenza and rheum, while for kidney problems the herbalists used common barley, with an FL value of 21%.

3.7. Informant consensus factor (ICF)

The calculated ICF values for diseases treated by local herbalists in the region (Table 4) showed that digestive disorders were those with the highest values (0.88). This category of disease was treated with more than half of all the species identified in the surveys (44 species), the most cited of which were *A. cepa*, *C. cyminum* and *R. eriocalyx*.

Respiratory disorders (ICF = 0.87) were treated with 13 species, and among these, *O. vulgare* subsp. *glandulosum* was the most frequently mentioned. Cardiovascular diseases (ICF = 0.86) were treated with 14 species, with *T. munbyanus* subsp. *coloratus* as the most cited. Kidney problems, with an ICF value of 0.86, were treated with 16 species, of

which the most cited was *H. vulgare*. An ICF value of 0.85 was assigned to wounds, anemia and rheumatism diseases, which are treated with 21, 28, 56 species, respectively. The ICF value for hair diseases was 0.84, and they were treated with 34 species. Influenza and rheum, skin diseases, liver diseases, diabetes and nervous problems scored an ICF value of 0.83. Diseases with low ICF values were urinary tract disorders, sexual problems and tumors, with values of 0.82, 0.81 and 0.8 respectively.

3.8. Toxic plants

The herbalists interviewed reported 10 plants that were toxic when used at high doses. They were *A. absinthium* L., *P. harmala* L., *E. globulus* Labill., *F. vulgare* Mill., *L. sativum* L., *M. pulegium* L., *N. oleander* L., *Q. ilex* subsp. *ballota* (Desf.) Samp., *R. eriocalyx* and *R. montana*.

In regard to dosage, the herbalists reported that the dose differed from one plant to another, and must be adjusted by taking into consideration several parameters, such as the patient's age, general state of health, previous diseases or presence of any current chronic diseases. Unfortunately, there was no general agreement on precise dose limits for these plants.

3.9. Taxonomy, nomenclature and chorology

Many species mentioned in the survey have been re-assigned to different botanical families following recent taxonomic reviews (APG, 2009). They include species of the Chenopodiaceae, which now appear in the Amaranthaceae; some species of the Alliaceae family, which are now included in the Amaryllidaceae; the Illecebraceae, now converted into Caryophyllaceae; and some species of the Caesalpiniaceae and Plantaginaceae, which are now included in the Fabaceae and Globulariaceae, respectively.

Advanced verifications of the nomenclature of the taxa allowed the authors to highlight several taxonomic and chorological changes. The taxa subjected to changes of the scientific name are: *S. tenacissima* which now is reported as *M. tenacissima*, *C. oxyacantha* (now recognized as *C. monogyna*), *C. angustifolia* (*C. senna* var. *senna*), *A. gummifera* (*C. gummifera*), *A. nobilis* (*C. nobile*), *I. viscosa* (*D. viscosa*), *S. rosmarinifolia* (*Santolina pectinata*), *A. visnaga* (*V. daucoides*) and *A. microcarpa* (*A. ramosus*).

In regard to chorology, it was found that 13 taxa (15%) were native to other countries. These plants are cultivated, introduced or naturalized. These included *S. oleracea*, *A. sativum*, *C. cyminum*, *P. crispum* (, *L. sativum*, *O. ficus-indica*, *T. foenum-graecum*, *J. regia*, *M. spicata*, *O. basilicum*, *M. alba*, *E. globulus*, *V. thapsus* and *Z. officinale*.

Six endemic species were also recognized: *B. elatum* (Batt.) Batt. (Algeria), *C. microcarpa* Batt. (Algeria and Tunisia), *H. naudinianum*

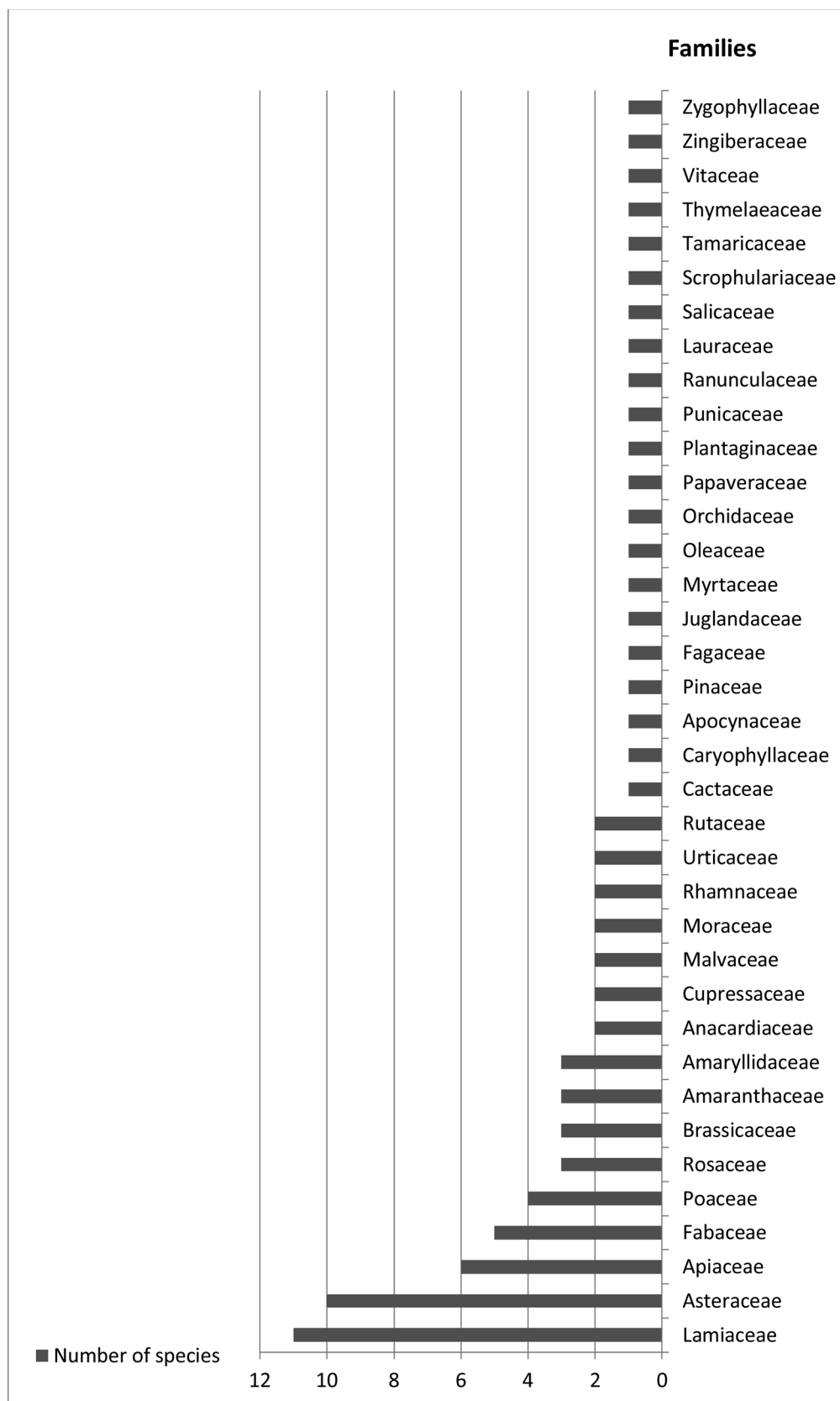


Fig. 2. Contribution of botanical families (number of species).

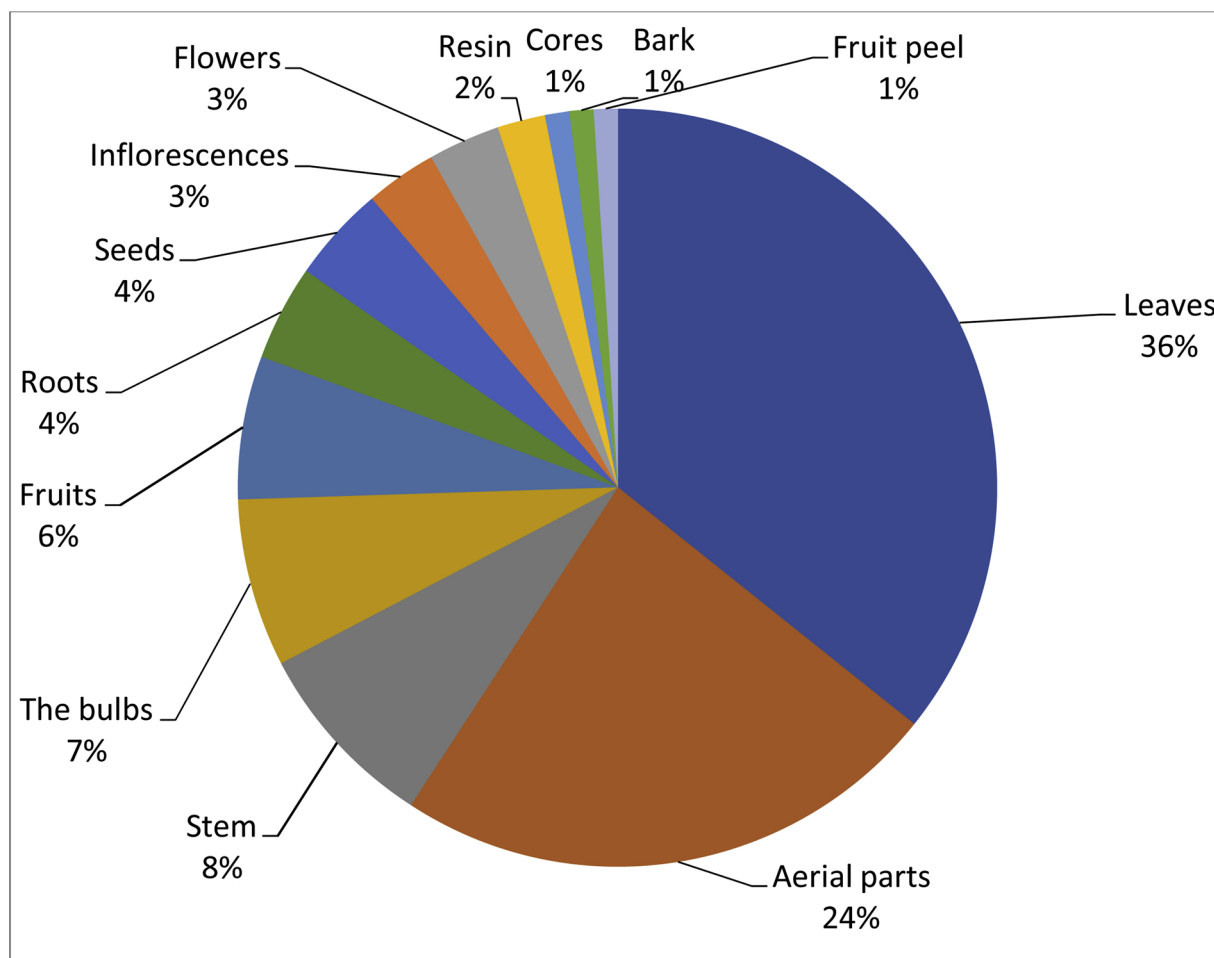


Fig. 3. Proportion of plant parts used by local herbalists.

Coss. & Durieu (endemic to Algeria), *O. vulgare* subsp. *glandulosum* (Algeria and Tunisia), *R. eriocalyx* (Algeria, Morocco and Libya) and *T. munbyanus* subsp. *coloratus* (Algeria and Morocco).

4. Discussion

The number of herbalists interviewed in the present study (51 herbalists) is similar to the numbers reported in previous ethnopharmacological investigations performed in Algeria. For example, Boudjelal et al. (2013) were able to interview 83 herbalists in the Msila region, while in Mascara, Benarba et al. (2015) interviewed 43 traditional healers. Similarly, Ouelbani et al. (2016) questioned 45 herbalists in the Constantine region. Other ethnobotanical studies including interviews of members of the local population have been reported (Miara et al., 2013; Chermat and Gharzouli, 2015; Meddour and Meddour-Sahar, 2015; Lakhdari et al., 2016; Bouasla and Bouasla, 2017).

The predominance of men among the informants was documented by Boudjelal et al. (2013). These authors also reported that this situation is probably due to the cultural traditions of the region, where women are discouraged from working outside the family. The authors believe this is also true for the Bordj Bou Arreridj region. On the other hand, Meddour and Meddour (2015) observed the predominance of women among the informants interviewed in Kabylia, Algeria, and this was also the case for the study of Bouasla and Bouasla (2017) in the Skikda region in the eastern part of the country.

The dominant age category in this study was similar to that observed by Eddouks et al. (2016) in Morocco. In Constantine Algeria however, Boudjelal et al. (2013) in Msila and Ouelbani et al. (2016)

reported the dominance of the group aged 30–40 years. As in this study, the dominant number of illiterate people among the herbalists interviewed was also noted by Boudjelal et al. (2013).

In terms of plant diversity, the number of 83 medicinal species may be considered noteworthy, in comparison with the numbers reported in Algerian ethnobotanical surveys by Ould El Hadj et al. (2003) in Ouergla (37 species), Rebbas et al. (2012) and Boudjelal et al. (2013) in Msila (60 and 85 species, respectively), Miara et al. (2013) in Tiaret (66 species), Lakhdari et al. (2016) in Oued Righ (53 species) and Boughrara and Belgacem (2016) in El Kala (40 species). On the other hand, the number of species was lower than that found by Meddour and Meddour-Sahar (2015), who reported 98 species traditionally used in Kabylia. Bouasla and Bouasla (2017) reported 90 species in Skikda, while Ouelbani et al. (2016) described 102 species used in Constantine, and Benarba et al. (2015) cited 141 species used in Mascara. Other studies focused on larger regions and reported a much higher number of species used; Fakchich and Elachouri (2014); Eddouks et al. (2016) and Teixidor-Toneu et al. (2016) reported 148, 194 and 159 species, respectively, used as natural remedies in Morocco; Parada et al. (2009) and Benitez et al. (2010) described 335 and 224 species, respectively, included in traditional treatments in Spain; Guzel et al. (2015) mentioned 222 plant-borne natural medicines used in Turkey and Ali-Shtayah et al. (2016) reported 198 species used in Palestine.

The most used families in this survey were Lamiaceae and Asteraceae. These two families are considered as two of the most evolved among the Angiosperm Dicotyledones. Moreover, they are also reported as the main source of traditional remedies used in several Mediterranean regions such as Albania, Algeria, Cyprus, Egypt, Italy, Morocco, and Spain (González-Tejero et al., 2008; Boudjelal et al.,

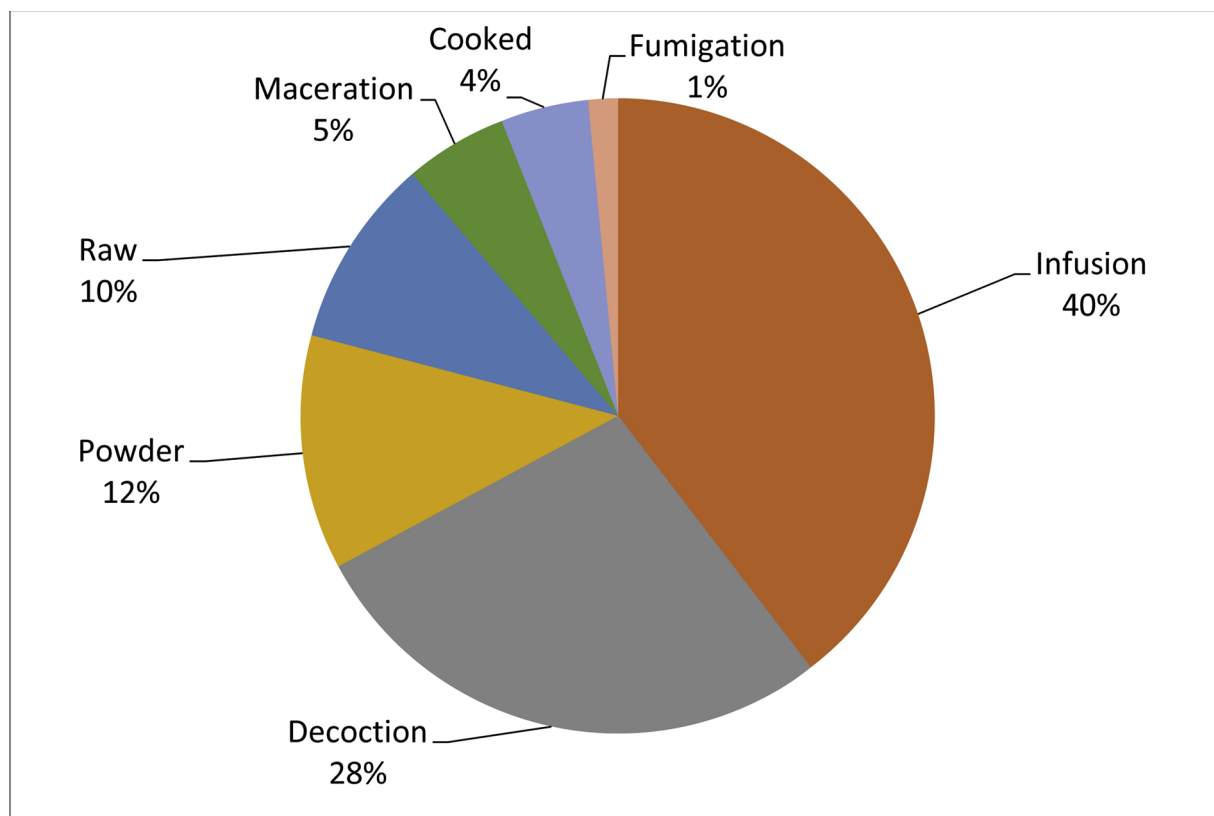


Fig. 4. Methods of herbal preparation used by the herbalists.

Table 3

Fidelity level (FL) values for the most cited plants (10 species).

Ailment category	Species	Np	N	FL (%)
Digestive disorders	<i>Cuminum cyminum</i>	15	20	75.00
	<i>Santolina pectinata</i>	12	21	57.14
	<i>Rosmarinus eriocalyx</i>	29	71	40.85
	<i>Allium cepa</i>	28	70	40.00
	<i>Juniperus oxycedrus</i>	8	20	40.00
Cardiovascular diseases	<i>Thymus munbyanus</i> subsp. <i>coloratus</i>	27	50	54.00
Diabetes	<i>Trigonella foenum-graecum</i>	8	25	32.00
Respiratory disorders	<i>Pinus halepensis</i>	8	28	28.57
Influenza and rheum	<i>Origanum vulgare</i> subsp. <i>glandulosum</i>	18	79	22.78
Kidney disorders	<i>Hordeum vulgare</i>	12	57	21.05

Np: the number of informants citing the use of the plant for a particular ailment category; N: the total number of informants citing the plant for any ailment category.

2013; Benarba et al., 2015; Meddour and Meddour-Sahar, 2015; Teixidor-Toneu et al., 2016). Their therapeutic use could be partly due to the high content of phenolic compounds, which are responsible for the antioxidant activity (Miliauskas et al., 2004; Khled khoudjaa et al., 2014; Maulidiani et al., 2014).

However, some authors reported the dominance of other botanical families in some areas of Algeria. Lakhdari et al. (2016) described the dominance of Chenopodiaceae in southern Algeria (Sahara), whereas Bouchikh et al. (2016) found the main use of Asteraceae in the western Algerian steppe. These particular cases can be explained by the ecological conditions, in particular the nature of the substrate which defines the abundant vegetation type in each of these regions.

The parts most used by herbalists in Bordj Bou Arreridj appeared to be the leaves. This has also been observed by several authors in different regions of Algeria (Cheramat and Gharzouli, 2015; Benarba et al., 2015; Ouelbani et al., 2016; Bouasla and Bouasla, 2017) and in other Mediterranean countries (Parada et al., 2009; Benitez et al., 2010;

Table 4

Informant consensus factor (ICF) values of category of ailments.

Ailment Categories	Nur	Nt	ICF
Digestive disorders	388	44	0.88
Respiratory disorders	95	13	0.87
Cardiovascular diseases	94	14	0.86
Kidney disorders	16	3	0.86
Wounds	21	4	0.85
Anemia	28	5	0.85
Rheumatisms	56	9	0.85
Hair	34	6	0.84
Influenza and rheum	38	7	0.83
Skin diseases	84	15	0.83
Liver diseases	37	7	0.83
Diabetes	69	12	0.83
Central Nervous System	7	2	0.83
Urinary tract disorders	85	16	0.82
Sexual problems	12	3	0.81
Tumors	6	2	0.8

Nur: the number of used citations in each category; Nt: the number of species reported in each category.

Carrió and Vallès, 2012; Tahira et al., 2015; Tuttolomondo et al., 2014; Guzel et al., 2015; Eddouks et al., 2016). This may be related to the nature of active components and ease of preparation and administration of the derived remedies (Bruneton, 1999). Several modes of preparation of plant remedies are practiced in the region of Bordj Bou Arreridj, the most frequent being the infusion. The dominance of this mode of preparation was also observed in Constantine by Ouelbani et al. (2016). However, many authors such as Boudjelal et al. (2013); Benarba et al. (2015) and Eddouks et al. (2016) reported the dominance of other modes of preparation, such as decoction.

During this survey, the highest UV was attributed to *O. vulgare* subsp. *glandulosum*. This endemic taxon (Algeria-Tunisia) is not very well known in terms of medicinal properties or chemical composition.

Table 5

Observed mistakes in identification, chorology and taxonomic confusions in the studies recently published in Algeria.

References	Mistake	Correction
Boudjelal et al. (2013)	<i>Atriplex</i> and <i>Spinacia</i> grouped into Chenopodiaceae <i>Globularia alypum</i> grouped into Globulariaceae <i>Chrysanthemum parthenium</i> <i>Erythraea centaureum</i> (L.) <i>Stipa tenacissima</i> L. <i>Taraxacum officinale</i> F. H. Wigg. in Algeria	Amaranthaceae Plantaginaceae <i>Tanacetum parthenium</i> (L.) Sch. Bip. <i>Centaureum erythraea</i> Rafn <i>Macrochloa tenacissima</i> (L.) Kunth To be confirmed
Sarri et al. (2014)	<i>Lavandula officinalis</i> Chaix. in Algeria <i>Glycyrrhiza glabra</i> L. <i>Cassia aschrek</i> Forssk. <i>Ailanthus glandulosa</i> Desf. <i>Eugenia caryophyllus</i> (Spreng.) Bullock & S. G. Harrison.	Absent in Algeria Uncertain presence <i>Senna italica</i> Mill. <i>Ailanthus altissima</i> (Mill.) Swingle <i>Syzygium aromaticum</i> (L.) Merr. & L. M. Perry.
Benarba et al. (2015)	<i>Allium oscalonicum</i> L. <i>Avena algeriensis</i> Trab.	Uncertain presence. Should be replaced by <i>Allium barthianum</i> Asch. & Schweinf. <i>Avena byzantina</i> K. Koch.
Benarba et al. (2015)	<i>Quercus infectoria</i> G. Olivier in Algeria	Absent in Algeria
Ouelbani et al. (2016)	<i>Crataegus oxyacantha</i> L.	<i>Crataegus monogyna</i> Jacq.

However, *O. vulgare* (sensu lato) is known in the Mediterranean region for its various medicinal properties. This herb has been traditionally used in Spain against enterobiasis and stomach ache, coughs, sore throat and respiratory disorders (González et al., 2010; Alarcón et al., 2015 in Eddouks et al., 2016). In Italy, it is used for heartburn and asthma, and as an appetizer, carminative, depurative, digestive and sedative (Vitalini et al., 2015), while in Turkey it is used as an anti-diabetic, and in the treatment of colds, flu and urinary inflammations (Cakilcioglu et al., 2011; Özdemir and Alpınar, 2015). In Palestine it is also used against diabetes (Ali-Shtayeh et al., 2011).

Rosmarinus eriocalyx (UV = 1.39) is unknown as a medicinal plant, though it is frequently used by the Maghreb populations. It is often confused with *R. officinalis* L. with which it shares similar properties (Bendif et al., 2017; Bendif et al., 2017). In Algerian traditional medicine, *R. eriocalyx* is used in the treatment of infectious diseases and digestive problems (González-Tejero et al., 2008).

Allium cepa (UV = 1.37) is traditionally used in Algeria for the treatment of skin disorders. It is also used in Albania, Cyprus, Italy and Spain to treat skin, respiratory and kidney ailments (González-Tejero et al., 2008). This plant is also used in Palestine against diabetes (Ali-Shtayeh et al., 2011).

Calculated IAR values showed that 38 species have values equal to 1. This indicates that all participants in the survey agree on the exclusive use of the species for a particular disease (Thomas et al., 2009). For example, the species *A. halimus* and *Beta vulgaris* were cited for a single particular disease category each (the former had 7 citations for skin diseases while the latter had 9 citations for urinary problems). The fact that out of the 83 species identified, 38 species had maximum IARs value and 43 species had values varying between 0.75 and 0.96, indicates that there is a strong consensus on the uses of these species by the local sampled herbalists which reinforces the value of our results. A study by Silambarasan and Ayyanar (2015) in India showed that 52 plants among the 118 plants identified had a maximum IARs = 1. These results are very close to this study and mainly concern the most available plants in these areas. The authors results shed light on the importance of the availability of herbal resources and maintenance of local knowledge over their use for medical preparations (Mutheeswaran et al., 2011). Indeed, except *C. microcarpa* and *A. papilionacea*, all plant species with maximum IARs were fairly well known by local herbalists and local population of Bordj Bou Arreridj region, as well as being quite commonly available. These species included: plants available in surrounding forests and preforests in the north of the area such as *Q. ilex* subsp. *ballota* and *P. atlantica*; plants available in the steppe of the southern part of Bordj Bou Arreridj region such as *A. halimus* or *A. absinthium* and cultivated plants available on the market 'souk' or sold by local herbalists as 'Achaba' such as *S. oleracea* and *A. sativum*. In

contrast, the study of Nzuki Bakwaye et al. (2013) conducted in the Democratic Republic of Congo showed a much smaller consensus that may be related to the sampling method, people interviewed and the multitude of uses and knowledge about local plants.

The most important FL value was reported for *C. cyminum* for the treatment of digestive ailments. This was also observed by Benarba et al. (2015) in Mascara (North West of Algeria). For cardiovascular problems, the species *T. munbyanus* subsp. *coloratus* rated a FL of 57%. The authors did not find such use in the literature consulted, it could be said that the use of this species for such problems is unique to the Bordj Bou Arreridj area.

For diabetes, Eddouks et al. (2016) also reported the use of *T. foenum-graecum* with an FL of 41%. For respiratory problems, *P. halepensis* scored an FL value of 28%. Benarba et al. (2015) reported this species for the treatment of digestive problems with an FL of 50%. In the present study, *O. vulgare* subsp. *glandulosum* showed an FL of 22% for use against influenza and rheum. This species was reported by Ouelbani et al. (2016) in Constantine region and by Eddouks et al. (2016) in Morocco for use against digestive disorders, with an FL of 73 and 56%, respectively.

For kidney affections, *Hordeum vulgare* presents an FL value of 21%. This species was reported by Ouelbani et al. (2016) for use against cardiovascular disorders with an FL of 74%.

Concerning the calculated values of ICF, the results showed the predominance of digestive and respiratory diseases. The same results were obtained by Benarba et al. (2015) in Algeria, Fakchich and Elachouri (2014), Mikou et al. (2016); Eddouks et al. (2016) in Morocco, and Baydoun et al. (2015) in Lebanon. The highest ICF for digestive diseases is probably related to an unhealthy lifestyle (Ouelbani et al., 2016). Indeed, the population of the Bordj Bou Arreridj region is known for a diet very rich in peppers and spices. This may explain the high frequency of digestive diseases in this region.

Finally, indications concerning the toxicity of plants in the region are in agreement with those of Garnier et al. (1961), Paris and Moyse (1976-1981), Sijelmassi (1993), Agra (1996), Bellakhdar (1997) and Hmamouchi (1999). However, the authors could not find data on the toxicity of *R. eriocalyx*.

Many ethnobotanical and phytochemical studies, particularly in Algeria, contain numerous mistakes in identification and taxonomic confusions that must be highlighted (Miara et al., 2013). Indeed, the authors have observed several taxonomic and nomenclatural mistakes in the studies recently published in Algeria (Table 5).

Boudjelal et al. (2013) made a number of nomenclature errors because they did not take into account the recent taxonomic changes. These authors assigned the family of Chenopodiaceae to the genera *Atriplex* and *Spinacia* whereas they are now grouped into the

Table 6Plants used for new therapeutic uses compared with the literature data^a in Algeria and neighboring Mediterranean countries.

Plants	New therapeutic uses
<i>Ajuga iva</i>	Antirheumatic
<i>Allium cepa</i>	Infected wounds, constipation, hair loss, anti-infectious, anti-inflammatory, antirheumatic, diuretic
<i>Allium sativum</i>	Anti-inflammatory, antiseptic, antispasmodic, liquefies the blood
<i>Beta vulgaris</i>	Anti-anemic, aperitif, for asthenia and affections of the liver
<i>Carlina gummifera</i>	Antirheumatic and abdominal pain
<i>Cerantonia siliqua</i>	Treatment of skin spots
<i>Cuminum cyminum</i>	Inflammations of the urinary tract
<i>Cynara cardunculus</i>	Anemia
<i>Eucalyptus globulus</i>	Rheumatic pains and burns
<i>Hibiscus sabdariffa</i>	Anemia
<i>Juglans regia</i>	Skin diseases
<i>Laurus nobilis</i>	Skin allergy
<i>Lavandula stoechas</i>	Hepatic disorders
<i>Macrochloa tenacissima</i>	Hair, kidney stones
<i>Malva sylvestris</i>	Tumors, to clean irritated eyes
<i>Marrubium vulgare</i>	Liver diseases
<i>Olea europaea</i> L. subsp. <i>europaea</i>	Anti-hemorrhoid, for inflammations and ophthalmia
<i>Opuntia ficus-indica</i>	A treatment for the hair
<i>Origanum vulgare</i> subsp. <i>glandulosum</i>	Rheumatic pains, hepatic tumors, eczema, influenza
<i>Papaver rhoeas</i>	Digestive problems
<i>Paronychia argentea</i>	Treats inflammation of the kidneys and the vesicle (dysuria)
<i>Peganum harmala</i>	Aphrodisiac and euphoric
<i>Pinus halepensis</i>	Urinary and parasite problems, wounds
<i>Pistacia atlantica</i>	Stomach and gastric pains
<i>Pistacia lentiscus</i>	Respiratory and digestive problems
<i>Punica granatum</i>	As a mouthwash to treat mouth problems (aphthous), diarrhea
<i>Retama raetam</i>	Healing skin affections, eye irritations, diarrhea
<i>Rubus ulmifolius</i>	Antidiarrheic, tonic, depurative, healing, cleans wounds and ulcers
<i>Ruta chalepensis</i>	Anti-inflammatory, ophthalmic, respiratory disorders
<i>Santolina pectinata</i>	Diuretic
<i>Trigonella foenum-graecum</i>	Slimming
<i>Triticum durum</i>	Anemia, growth, pregnancy and lactation
<i>Zingiber officinale</i>	Diuretic, aphrodisiac
<i>Ziziphus lotus</i>	Pulmonary affections and jaundice

Rossi et al. (1988); Chevallier (1996); Skim et al. (1999); Merzouki et al. (2000); Jouad et al. (2001); Said et al. (2002); El Hilaly et al. (2003); Ould El Hadj et al. (2003); Beloued (1998); Hammiche and Maiza (2006); Tahraoui et al. (2007); Allali et al. (2008); González-Tejero et al. (2008); Mahmoudi et al. (2009); Benitez et al. (2010); Cakilcioglu and Turkoglu (2010); El Amrani et al. (2010); Heamalatha et al. (2011); Akrouit et al. (2012); Asgarpanah and Roohi (2012); Hendel et al. (2012); Rebbas et al. (2012); Boudjelal et al. (2013); Miara et al. (2013); Fakchich and Elachouri (2014); Moussaoui et al. (2014); Tuttolomondo et al. (2014); Benarba et al. (2015); Chermat et Gharzouli (2015); Doukkali et al. (2015); Guzel et al. (2015); Meddour and Meddour-Sahar (2015); Bouchikh et al. (2016); Eddouks et al. (2016); Lakhdari et al. (2016); Ouelbani et al. (2016).

Amaranthaceae family. *Globularia alypum*, which is currently grouped into the Plantaginaceae family, was previously included in the Globulariaceae. Also, some taxa have changed names, for example *T. parthenium* which is no longer recognized as *C. parthenium*. Similarly, *C. erythraea* replaces *E. centaurium*, and *M. tenacissima* is currently used instead of *S. tenacissima*. It should also be noted that the presence of *T. officinale* in Algeria is uncertain and remains to be confirmed.

Sarri et al. (2014) reported the occurrence of *L. officinalis* in the region of Msila, but this species has so far never been reported for Algeria. They cited some species with doubtful occurrence, such as *G. glabra*, and also ignored recent changes in nomenclature, especially for the following species: *C. aschrek* (now recognized as *S. italica*), *A. glandulosa* (*A. altissima*) and *E. caryophyllus* (*S. aromaticum*).

According to other authors (Benarba et al., 2015) *A. ascalonicum* is a confusing name with doubtful occurrence in Algeria and should be replaced by *A. barthianum*. The name *A. algeriensis* has been rejected and now corresponds to *A. byzantina*. *Rubia tinctorum* is used instead of *R. tinctoria*. In the work by Benarba et al. (2015) the description of *Q. infectoria* in Algeria raised doubts about its botanical identification. Finally, Ouelbani et al. (2016) also made some errors, for example using the name *C. oxyacantha* which is a rejected name and should be replaced with *C. monogyna*.

In Table 6, the results of the therapeutic uses of plants against the literature were compared to Algeria and neighboring Mediterranean countries. It was found that in Bordj Bou Arreridj, 34 species have been

used for new therapeutic uses, compared with the information found in regional studies, nationally relevant textbooks and data available from neighboring countries about herbal medicine, pharmacopoeias and prescription books (sources: Rossi et al., 1988; Chevallier, 1996; Skim et al., 1999; Merzouki et al., 2000; Jouad et al., 2001; Said et al., 2002; El Hilaly et al., 2003; Ould El Hadj et al., 2003; Beloued, 1998; Hammiche and Maiza, 2006; Tahraoui et al., 2007; Allali et al., 2008; González-Tejero et al., 2008; Mahmoudi et al., 2009; Benitez et al., 2010; Cakilcioglu and Turkoglu, 2010; El Amrani et al., 2010; Heamalatha et al., 2011; Akrouit et al., 2012; Asgarpanah and Roohi, 2012; Hendel et al., 2012; Rebbas et al., 2012; Boudjelal et al., 2013; Miara et al., 2013; Fakchich and Elachouri, 2014; Moussaoui et al., 2014; Tuttolomondo et al., 2014; Benarba et al., 2015; Chermat et Gharzouli, 2015; Doukkali et al., 2015; Guzel et al., 2015; Meddour and Meddour-Sahar, 2015; Bouchikh et al., 2016; Eddouks et al., 2016; Lakhdari et al., 2016; Ouelbani et al., 2016). These species are: *A. iva* (antirheumatic), *A. cepa* (infected wounds, constipation, hair loss, anti-infectious, anti-inflammatory, antirheumatic, diuretic), *A. sativum* (anti-inflammatory, antiseptic, antispasmodic, anticoagulant), *B. vulgaris* (anti-anemic, aperitive, for asthenia and affections of the liver), *C. gummifera* (antirheumatic and for abdominal pain), *C. siliqua* (treatment of skin spots), *C. cyminum* (inflammation of the urinary tract), *C. cardunculus* (anemia), *E. globulus* (rheumatic pains and burns), *H. sabdariffa* (anemia), *J. regia* (skin diseases), *L. nobilis* (skin allergy), *L. stoechas* (hepatic disorders), *M. tenacissima* (hair, kidney stones), *M. sylvestris*

(tumors, irritated eyes), *M. vulgare* (liver diseases), *O. europaea* subsp. *europaea* (anti-hemorrhoid, inflammation and ophthalmia), *O. ficus-indica* (a treatment for the hair), *O. vulgare* subsp. *glandulosum* (rheumatic pains, liver tumor, eczema, influenza), *P. rhoëas* (digestive problems), *P. argentea* (kidney and vesicle inflammation, dysuria), *P. harmala* (aphrodisiac and euphoric), *P. halepensis* (urinary and parasite problems, wounds), *P. atlantica* (stomach and gastric pains), *P. lentiscus* (respiratory and digestive problems), *P. granatum* (as a mouthwash to treat aphthae, diarrhea), *R. raetam* (skin affections, eye irritations, diarrhea), *R. ulmifolius* (antidiarrheic, tonic, depurative, wounds and ulcers), *R. chalapensis* (anti-inflammatory, ophthalmic, respiratory disorders), *S. pectinata* (diuretic), *T. foenum-graecum* (slimming), *T. durum* (anemia, pregnancy and lactation), *Z. officinale* (diuretic, aphrodisiac) and *Z. lotus* (pulmonary affections and jaundice).

By comparing our data with those of the literature concerning traditional uses of plants in Algeria and neighbouring countries, we identified the first mention of a traditional medical use for the following 13 species: *B. elatum*, *C. senna* var. *senna*, *C. microcarpa*, *C. cirrhosa*, *E. vesicaria*, *H. naudinianum*, *L. europaeus*, *M. alba*, *P. crispum*, *T. munbyanus* subsp. *coloratus*, *U. urens*, *V. thapsus* and *V. daucoides*.

5. Conclusions

This initial ethnobotanical investigation carried out in Bordj Bou Arreridj has documented the floristic richness of the region as well as the traditional knowledge passed on by local people from one generation to another. Herbalists in this region, who are often older men with a fairly low level of education, have provided extensive and valuable information about medicinal plants and their uses for the daily treatment of diseases. It is essential that traditional herbalists and practitioners of phytotherapy continue to hand on their invaluable knowledge to future generations, as a rich part of their cultural heritage. In addition, the natural environment and the rich variety of the local flora must be protected from all too frequent and devastating anthropic action.

Author contributions

The contributions of the respective authors are as follows: M. D. Miara designed the study, contributed to the ethnobotanical survey, plant identification, taxonomic verification and data analysis, and wrote the manuscript; H. Bendif contributed to the ethnobotanical survey and writing of the manuscript; K. Rebbas, B. Rabah and M. A. Hammou contributed to the botanical identification; F. Maggi edited and revised the manuscript. All authors read and approved the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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