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Ethnobotanical investigation on medicinal plants used by local populations in Tlemcen National Park (extreme North West Algeria)

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Abstract. Medicinal plants are currently used by local populations to treat different diseases around the world. In the present study, the local knowledge of medicinal plants used by indigenous populations living in the Park of Tlemcen (North-West Algeria) has been documented. A total of 254 informants with a strong ethnomedicinal knowledge living in the national park of Tlemcen were interviewed by using a questionnaire. Data collected was analyzed using quantitative indices such as the ethnobotanicity index (EI), use value (UV), and Informant Consensus Factor (F_{IC}). 109 species belonging to 54 families were identified and used by indigenous populations to treat different diseases. The most frequent families were lamiaceae (15.5%), asteraceae (11.9%), and rosaceae (5.5%). Roots, rhizomes or tubers were the most used part for medical care (37.6%), followed by leaves (33.6%), other aerial parts (16%), fruits (8%), flowers (1.6%), and seeds (3.2%). Regarding modes of preparation, we noticed that decoction (40.4%) and infusion (28.5%) were the most predominant. Moreover, *Thymus lanceolatus* (UV=0.96), *Origon glandulosum* (UV=0.96) and *Ammoides verticillata* (UV=0.94) were the most frequently used species. FIC values ranged from 0.65 to 0.98. The highest F_{JC} were recorded for reproductive and sexual disorders (0.98), respiratory tract diseases (0.98), cardiovascular system disease and blood disorders (0.94), digestive disorders (0.93), and general health (0.93). A variety of species are used to treat several ailments. Recorded species with high UV should be prioritized for conservation and subjected to further phytochemical and pharmacological studies.

Keywords: Algeria; Ethnobotanical; Tlemcen; Plants; Phytotherapy.

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1. Introduction

For centuries, man used medicinal plants to treat several health problems, and still uses this ancestral knowledge despite the enormous progress made by modern medicine. According to the World Health Organization (WHO), more than 80% of the world's population uses medicinal plants as a source for primary health care (Agisho *et al*., 2014). In recent years, an important increase has been observed regarding the use of medicinal plants owing to their abundance, cultural importance and low prices (Thomford *et al*., 2015). It has been found that about 28% of higher plant species are used for a therapeutic purpose while 74% of pharmacological principles are derived from plants, as a result of ethnomedicinal studies (Ncube *et al*., 2008). Even though the clinical use of a drug based on active principles derived from plants involves several disciplines such as botany, chemistry and pharmacology, so-called traditional medicine relating

to the use of plants according to ancestral tradition and the ethnobotanical investigations among ethnic groups facilitate the search for these active principles (Rates, 2001; Radford *et al*., 2011). Owing to its diversified climate allowing an important development of medicinal plants, in coastal, mountainous and also Saharan regions, Algeria is considered one of the richest countries in flora. In fact, the Algerian flora consists of 4000 taxa with 131 families and 917 genera. The national endemic flora counts 464 Taxa (387 species, 53 subspecies and 24 varieties) (Radford *et al*., 2011). In spite of several ethnobotanical studies carried out to document the popular knowledge related to the use of medicinal plants in Algeria (Benarba *et al*., 2015a; Benarba *et al*., 2015b; Benarba, 2016; Benarba *et al*., Boudjelal *et al*., 2013, Ramdane *et al*., 2015, Azzi *et al*., 2012), The present study is the first comprehensive ethnobotanical investigation among indigenous populations living in the Park of Tlemcen (North-West Algeria).

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2. Materials and methods

2.1. Study area

The Tlemcen National Park is located in northwestern Algeria, with an area of 8225.04 hectares (Figure 1). The climate is characterized by a summer drought as early as June (only 7.2 mm in summer, with an annual rainfall of 483 mm). The mean maximum temperature for the hottest month is 32.35 ° C, the coldest month is 3.2 ° C. Emberger's precipitation index is 51.1. The altitude varies from 800 to 1418 m with a diversified relief.
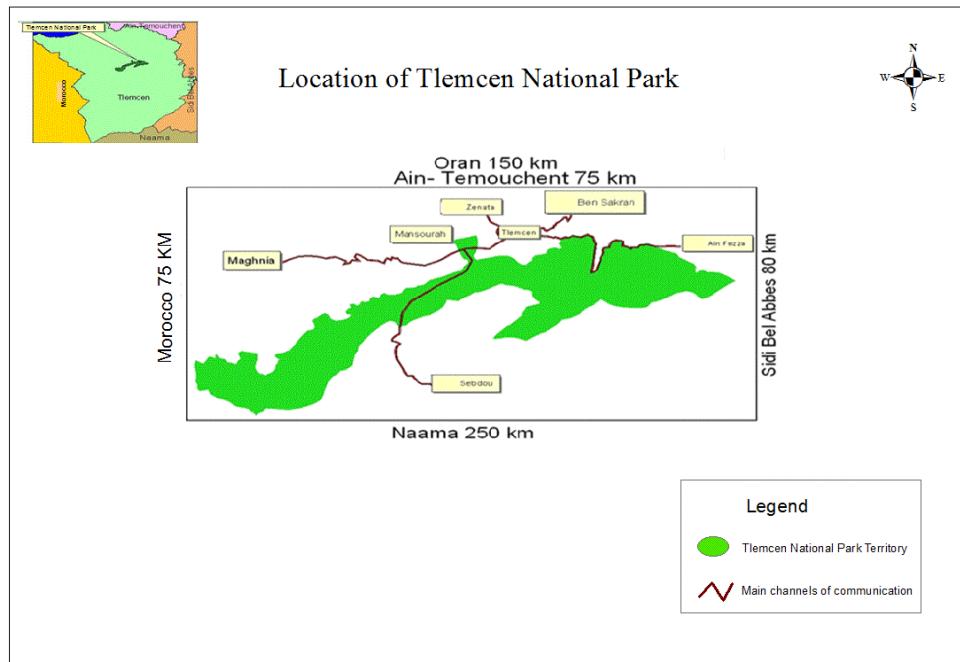

Figure 1. Location of the Tlemcen National Park (Extreme North-West Algeria).

2.2. Data collection

The ethnobotanical investigation was carried out using a stratified sampling plan to establish an overview of traditional local uses and floristic diversity of the pharmacopoeia of this area. On the other hand, 254 informants with a strong ethnomedicinal knowledge living in the national park of Tlemcen were interviewed by using a questionnaire. Demographic characteristics of the informants are shown in table 1. The ethnobotanical survey was realized in two phases. The first phase consisted of open interviews with the local population, trying to reach all categories with ethnomedicinal knowledge (old, men, women, and young people). During the second phase, more specific information was requested from the traditional therapists through semi-structured interviews by using a questionnaire, to obtain more specific information on medicinal plants (the vernacular name including the nominations in Arabic and/or Amazigh of the plant, diseases treated, parts used, mode of preparation, etc.). Besides, a herbarium was established for all the plants harvested in the park. The plants were identified by the Botanical laboratory (University of Tlemcen, Algeria) and the Botanical Department of the National Higher School of Agronomy (ENSA, El-Harrach, Algeria). Plants collection and ethnobotanical investigations were carried out between 2017 and 2018.

Table 1. Demographic characteristics of informants (%)

Demographical characteristics	(%)
Gender	
Male	33
Female	67
Age (years)	
15−30	12
31−45	17
46−60	27
≥61	44
Education level	
Illiterate	59
Primary school	17
Secondary school	17
University	7
Profession	
Unemployed	60
Employed	11
Retired	16
Student	6
Farmer	7

2.3. Ailment categories

The ailments treated by the medicinal plants were grouped into 13 categories according to the use-reports reported by the informants (Table 2). Each citation of a particular part of a particular species was recorded as one use report. When a species was mentioned to be used to treat or manage different ailments in the same category, it was considered as a single use-report (Benarba *et al*., 2015).

Table 2. Studied ailment categories. In brackets category abbreviations; %, percentage of total reports.

Category	Ailments/disorders	%
Kidneys diseases (KD)	Stone, infections	1.6
Gastro-intestinal diseases (GISD)	Stomach ulcer, stomachache, dysentery, colic, gases, constipation, colitis, parasites, hydatid cyst, liver problems, hepatitis, biliary problems, diarrhea, and toothache.	18.3
Skin diseases (SD)	Skin diseases, fungal infections, burns.	2.9
Endocrine system diseases (ESD)	Diabetes, goiter, weight loss.	2.5
Nervous system (NS)	Depression, anxiety, vertigo, migraine, dementia.	0.9
Skeletal-muscular system disorder (SMSD)	Rheumatism, arthritis, inflammation, body pain.	1.0
Cancer (Can)	Tumors, cancers, metastases.	0.6
Cardiovascular system disease and blood disorders (CSD)	Cholesterol, high blood pressure, heart problems, anemia, hemorrhoids, blood purification.	2.2
Haircare (HC)	Hair loss, hair growth.	0.3
Respiratory tract diseases (RTD)	Cold, cough, asthma, bronchitis, flu, allergy.	30.8
General health (GH)	Body pain, tonic, psychopathic disorders, systemic healing, and systemic problems.	19.1
Sexual-reproductive problems (SRP)	Menstrual cramps, infertility, sexual impotence, gynecological problems.	18.4

2.4. Data analysis

Data analysis was carried out by calculating different indices as follows:

Use-value (UV): The UV of each species was calculated by using the following formula: UV= $\Sigma U/n$, where U is the number of uses reported by each informant for a given species and n is the total number of informants (Prance *et al*., 1987; Rossato *et al*., 1999).

Informant consensus factor (F_{IC}): The F_{IC} was calculated according to the formula: $F_{IC} = (Nur-Nt)/(Nur-1)$ where *Nur* is the number of use citations in each category and *Nt* is the number of species reported in each category (Tardío & Pardo de Santayana, 2008).

Ethnobotanicity index (EI): The EI expressed as a percentage, was calculated as follows: EI= n/N where *n* is the number of useful medicinal species and *N* is the number of all the species of the total flora in the area according to Porterès (1970). The EI reflects the importance of medicinal plants in an area (Sreekeesoon & Mahomoodally, 2014).

3. Results and Discussion

3.1. Botanical data

The total flora of the national park of Tlemcen consists of 917 inventoried species, representing 31.6% of the national flora, with 22 protected species (9.7% of the total national protected species) (Radford *et al*., 2011). The flora is also rich and diverse with 31 endemic species, 38 rare species and 27 very rare species. Our results (Table 3) showed that 109 species belonging to 54 families are used by local populations to treat different health problems. Moreover, the most frequent families were lamiaceae with 18 species (15.5%), asteraceae with 13 species (11.9%), and rosaceae with 6 species (5.5%) (Figure 2). Our findings are consistent with most of the previous ethnobotanical investigations carried out in Algeria and neighboring countries. Indeed, in a previous study realized in North-West Algeria (Mascara), we found that traditional healers used 141 medicinal plant species belonging to 54 families and 125 genera, with dominance of lamiaceae, asteracea and apiaceae (Benarba *et al*., 2015b). In line with our results, lamiaceae and asteraceae were found to be the most predominant botanical families in different Mediterranean countries such as Algeria (Bendif *et al*., 2018; Benarba et al., 2015c; Sarri *et al*., 2015), Morocco (Bachar *et al*., 2016; Hamsas EL Youbi *et al*., 2016), and Spain (Parada *et al*., 2009). The same predominant families lamiaceae and asteraceae were reported in other regions of the world such as Bolivia (Cussy-Poma *et al*., 2017), Iran (Mosaddegh *et al*., 2012), or South America (Molares & Ladio, 2009). In most of the ethnobotanical studies around the world, lamiaceae, asteraceae, and rosaceae are the most predominant families (Quave *et al*., 2012). This predominance could be explained by the important occurrence of species belonging to these families which may result in large use and enhanced ethnomedicinal knowledge by local populations (Benarba *et al*., 2015b).
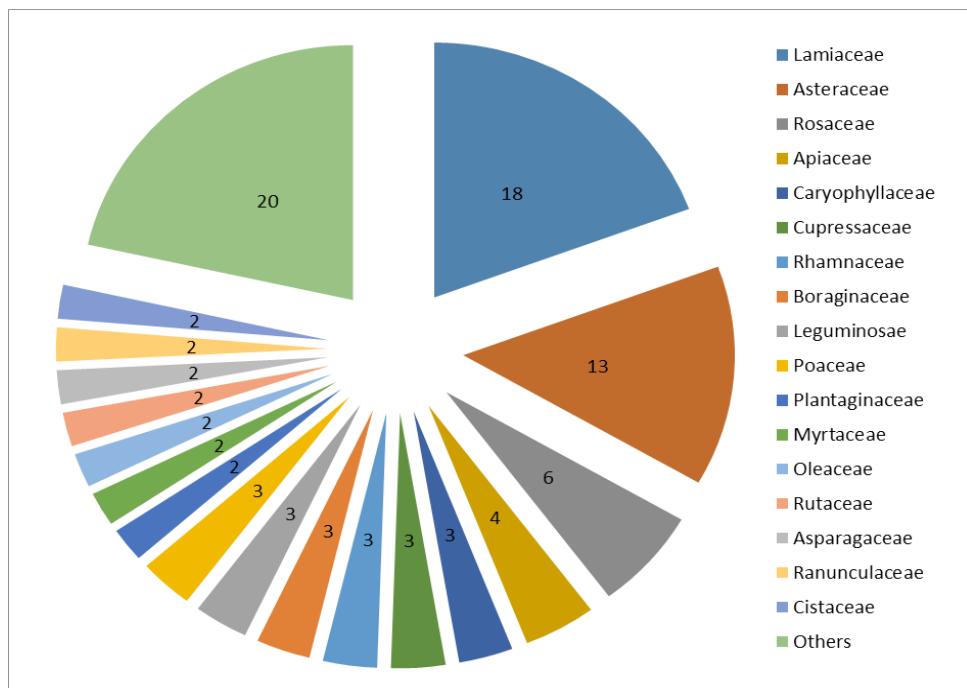
Figure 2. Distribution of reported species by botanical families.

3.2. Parts used

According to our results, roots, rhizomes or tubers represented the most used part for medical care (37.6%). Leaves occupied the second position (33.6%), followed by other aerial parts such as stem and bourgeons (16%), fruits (8%), flowers (1.6%), and seeds (3.2%). Although a majority of recent ethnobotanical studies reported that aerial parts (leaves) are the most used part of the medicinal species (Tugume *et al*., 2016; Benarba *et al*., 2015a,b; Salhi *et al*., 2010), our findings are in consistence with those reporting that roots, rhizomes and tubers are the most commonly used plant part (Jin *et al*., 2018; Bisht & Adhikari, 2018; Kumar & Pandey, 2015). The frequent use of underground parts of the plants that are responsible for their multiplication and regeneration would be responsible for their disappearance. Indeed, during our collection of medicinal plants in Tlemcen Park, we found that these species are becoming increasingly rare.

3.3. Modes of preparation

The most common methods of preparation were: decoction (40.4%), infusion (28.5%), raw (17.4%), poultice (6.3%), dry (2.3%), juice (3.1%), maceration (0.7%), and fumigation (0.7%). Our findings corroborate those previously reported in Algeria (Madani *et al*., 2017; Benarba *et al*., 2016; Chahma and Djebar, 2008), Morocco (Abouri *et al*., 2012), Africa (Buwa-Komoren *et al*., 2019) or in South American countries (Tuler *et al*., 2014; Marcia *et al*., 2005). It is suggested that the use of decoction or infusion as frequent modes of preparation of herbal remedies would be explained by the fact that heating allows better extraction of the active principles, a reduction of the toxicity as well as disinfection of the plant (Benarba *et al*., 2015; Lahsissene *et al*., 2009).

According to our results, oral administration (82.7%) was the most frequent route prescribed by local populations in the national park of Tlemcen. Moreover, 14.5% of plant species are used via topical application. Our findings are in perfect consistency with those we previously reported in North-West (Benarba *et al*., 2015b) and South-West Algeria (Benarba *et al*., 2016). Similar findings were reported in most of the ethnobotanical investigations carried out in Algeria and its neighboring countries (Skalli *et al*., 2019; Boudjelal *et al*., 2013; Teixidor-Toneu *et al*., 2016; Telli *et al*., 2016). A high incidence of internal disorders, as well as cultural factors, may explain the predominance of the oral route as preferred administration mode as revealed in the present study (Benarba *et al*., 2016).

Moreover, our results showed that 46% of the cited species are administered with other plants. Out of them, 8 species are mixed with one plant, 12 species with two or three plants and 20 species are administered with more than three plants. The use of herbal mixtures in popular therapy may be explained by the search of a synergistic effect or the reduction of toxic effects of certain species (Bruschi *et al*., 2011). On the other hand, our results revealed that 64 species (59% of total cited plants) are mixed with honey, milk, olive oil or sugar. Bees honey was found to be the most added adjuvant (Figure 3).

Our findings are in line with those previously reported in Algeria. Benarba *et al*., 2016 reported that more than 50% of the cited medicinal plants used by traditional healers in South-West Algeria were administered with other plant species or non-plant-adjuvant. They found that honey was the adjuvant most added (53%) to medicinal plants used to treat several diseases. Similar findings were reported in different regions in Algeria (Bouasla & Bouasla, 2017; Ouelbani *et al*., 2016), and other parts of the world (Appiah *et al*., 2019; Bhatia *et al*., 2015), probably to soften the unpleasant taste of plants (Benarba *et al*., 2015b).
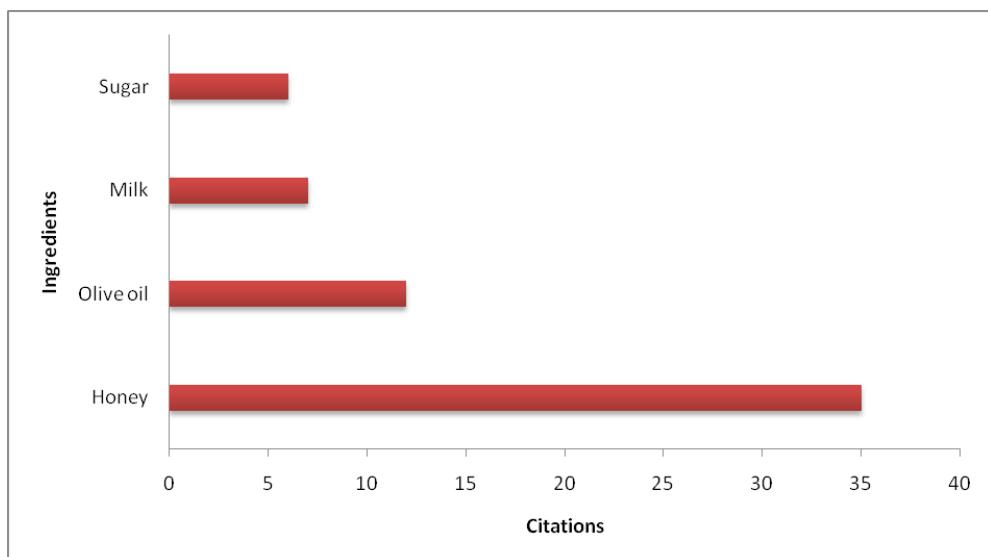
Figure 3. Ingredient added to plants used.

3.4. Ethnobotanicity index (E.I.)

Among the 917 plant species of the total flora, we identified 102 species used for medicinal purpose. Therefore, the calculated ethnobotanicity index was found to be 11.8%. This means that around 12.0% of the plant species are known to be useful as medicinal plants by local populations of the national park of Tlemcen. This finding is similar to those previously reported in the Mediterranean basin such as in Italy (Tuttolomondo *et al*., 2014), Spain (Menendez-Baceta *et al*., 2014), and Portugal (Novais *et al*., 2004). Nonetheless, when compared to EI estimated for Mediterranean regions with the same total flora (approximately 1000 species), the EI of the national park of Tlemcen is significantly lower than the reported in Spain (Martínez-Lirola *et al*., 1996) or Portugal (Camejo-Rodrigues *et al*., 2003).

3.4. Use value

Ranging from 0.01 to 0.96, the UV values allowed ranking the plant species according to the importance of their use by the local population of the Tlemcen national park. Our results (Table 3) showed that *Thymus lanceolatus*, *Origon glandulosum* and *Ammoides verticillata* were the most frequently used species with the highest UV values of 0.96, 0.96, and 0.94, respectively. Besides, these species were followed by *Echinops spinosus* (UV=0.88), *Mentha pulegium* (UV=0.84), *Anacyclus pyrethrum* (UV=0.84), *Daucus critinus* (UV=0.82), *Arenaria aggregata* (UV=0.81), and *Junipenus oxycedrus* (UV=0.66) (Table 3).

Species belonging to the genus *Thymus* were found to be the most frequently used medicinal plants in several ethnobotanical investigations in both Algeria (Bouredja *et al*., 2017; Benarba *et al*., 2016; Benarba *et al*., 2015b) and other countries (Axiotis *et al*., 2018; Rajaei & Mohamadin, 2012). In the present study, *T. lanceolatus* is used to treat respiratory diseases (flu, allergy, …) and several gastrointestinal problems (food poisonings, stomachache). The use of Thymus species to treat the respiratory diseases in the Mediterranean basin is well documented (Benarba *et al*., 2015b; Benarba *et al*., 2016; Leto *et al*., 2013; Teixidor-Toneu *et al*., 2016). Similarly, different Thymus species were reported to be used to treat several gastrointestinal disorders (Pant & Samant, 2010; Singh, 2012).

Recently, Nouasri *et al*. (2018) demonstrated that *T. lanceolatus* native of North-West Algeria was rich in phenolic acids, and had important antioxidant activity besides its antimicrobial effects against *Staphylococcus aureus* and *Umpelopsis ramaniana*. Furthermore, rosmarinic acid was the major compound of the fourteen identified. The ethanolic extract of *T. lanceolatus* exhibited a protective effect of human cells against oxidative damage (Caprioli *et al*., 2018). The use of *Thymus* species in the treatment of respiratory diseases could be attributed to their anti-inflammatory potential by targeting the NF-κB p65 and NF-κB p52 pathways resulting in a significant reduction pro-inflammatory cytokines (IL-1 beta and IL-8), and Muc5ac secretion (Oliviero *et al*., 2016).

In line with our results, *Origanum sipyleum* L. and *Thymus sipyleus* Boiss. were found to be the most frequently used species in Greek islands in North Aegean Region. These two species were mainly used to treat respiratory and gastrointestinal disorders (Axiotis *et al*., 2018).

Table 3. List of medicinal plants used by local populations in Tlemcen National Park. Abbreviations are: V. name, Vernacular name; V.N., voucher number (INA-19-); Parts, parts used; Admin., administration type; UV, use value. See Table 2 (Ailment categories) for abbreviations on Diseases treated.

Name	V. name	V.N.	Parts	Diseases treated	Preparation	Admin.	UV
Origanum majorana L. (Lamiaceae)	الزعتر الطويل	001	Aerial	RTD: 200 (cold, allergy), GISD: 45 (stomachache, food poisoning).	Infusion	Oral	0,964
Thymus lanceolatus Desf. (Lamiaceae)	الزعتر رحل	002	Aerial	RTD: 200 (cold, allergy), GISD: 43 (stomachache, food poisoning), SRP: 2 (menstrual cramps).	Infusion	Oral	0,964
Ammoides pusilla (Brot.) Breistr. (Apiaceae)	نونخة	003	Aerial	RTD: 212 (cold, cough, flu), GH: 33 (body pain).	Infusion, maceration	Oral, inhalation	0,944
Echinops bovei Boiss. (Asteraceae)	تاسكرة	004	Roots	SRP: 205 (female sterility, menstrual cramp, gynecological disorders), GH: 20 (body pain, systemic problems).	Decoction, powder	Oral	0,880
Anacyclus pyrethrum (L.) Lag. (Asteraceae)	تغنطس	005	Roots	SRP: 212 (gynecological disorders, infertility), NS: 1 (depression), RTD: 7 (bronchitis, cold), SMSD: 17 (rheumatism).	Decoction, powder	Oral, Topical	0,846
Mentha spicata L. (Lamiaceae)	فليو	006	Aerial	SRP: 25 (Menstrual cramps), RTD: 190 (cold).	Infusion	Oral	0,846
Daucus crinitus Desf. (Apiaceae)	بوزفور	007	Roots	RTD: 3 (Bronchitis), SMSD: 50 (arthritis), GH: 137 (body pain), GISD: 20 (appetite).	Decoction, powder	Oral	0,826
Arenaria aggregata subsp. *mauritanica* (Batt.) Maire (Caryophyllaceae)	الوضمي	008	Roots	SRP: 150 (female sterility), GH: 57 (body pain).	Decoction, powder	Oral	0,814
Juniperus oxycedrus L. (Cupressaceae)	الطاقة	009	Roots	SMSD: 120 (arthritis), GH: 50 (body pain).	Decoction	Oral	0,669
Calamintha nepeta (L.) Savi. (Lamiaceae)	النابطة	010	Aerial	RTD: 120 (cold, cough, flu).	Infusion	Oral	0,472
Dittrichia viscosa (L.) Greuter (Asteraceae)	مقرمان	011	Roots, leaves	GH: 46 (body pain), SD: 20 (wound), SRP: 9 (gynecological problems), SMSD: 45 (arthritis).	Decoction, poultice	Oral, topical	0,472
Chamaerops humilis L. (Arecaceae)	الدوم	012	Roots	GISD: 98 (stomach ulcer, colon), GH: 17 (body pain).	Decoction	Oral, topical	0,452
Rhamnus alaternus L. (Rhamnaceae)	املیلس	013	Roots, leaves	GISD: 28 (hepatitis), CSD: 67 (blood purification).	Decoction	Oral	0,374
Crataegus monogyna Jacq. (Rosaceae)	عين بقرة	014	Roots, fruits	SMSD: 37 (inflammation), CSD: 32 (hypertension, hypercholesterolemia), CSD: 9 (blood purification), KD: 4 (renal disorders).	Decoction, powder	Oral	0,322
Anchusa undulata L. (Boraginaceae)	حميمر	015	Roots	CSD: 45 (anemia), GISD: 45 (liver diseases), GH: 25 (body pain).	Decoction, powder	Oral	0,275
Atractylis macrophylla Desf. (Asteraceae)	قرقاع الأرض	016	Roots	SMSD: 22 (arthritis), GISD: 20 (colon, appetite), GH: 13 (body pain), RTD: 13 (cold), Can: 2 (cancers).	Decoction, powder	Oral	0,275
Mentha rotundifolia (L.) Huds. (Lamiaceae)	ظنارم	017	Aerial	GISD: 32 (colon), SRP: 13 (impotence, menstrual cramps, gynecological disorders), RTD: 18 (cold).	Infusion, poultice	Oral, topical	0,248
Ballota hirsuta Benth. (Lamiaceae)	مريوة	018	Leaves	ESD: 25 (hypertension), KD: 15 (fungal infections), SD: 15 (skin diseases).	Poultice	Topical	0,216
Aloysia citriodora Palau. (Verbenaceae)	لويزة	019	Leaves	GISD: 40 (colon, constipation).	Infusion	Oral	0,177
Ziziphus lotus (L.) Lam. (Rhamnaceae)	السدرة	020	Roots, leaves	GISD: 22 (stomachache, colon), GH: 12 (body pain), SMSD: 11 (arthritis).	Decoction	Oral	0,177
Lavandula stoechas L. (Lamiaceae)	الخزامة	021	Aerial	CSD: 5 (hypertension), NS: 2 (sedative).	Infusion	Oral	0,157
Tetraclinis articulata (Vahl.) Mast. (Cupressaceae)	العرعار	022	Leaves, seeds	RTD: 40 (cough, flu).	Decoction	Oral, inhalation	0,157

Name	V. name	V.N.	Parts	Diseases treated	Preparation	Admin.	UV
Cupressus sympervirens L. (Cupressaceae)	الزنين	023	Leaves, seeds	RTD: 35 (Bronchitis).	Decoction	Oral	0,137
Teucrium polium L. (Lamiaceae)	الجعدة	024	Leaves	GISD: 20 (stomach ulcer, colon), ESD: 15 (diabetes).	Infusion	Oral	0,137
Rhaponticum acaule (L.) DC. (Asteraceae)	التافغة	025	Roots	GISD: 32 (stomach ulcer).	Decoction	Oral	0,125
Salvia verbenaca L. (Lamiaceae)	الخياطة	026	Leaves	SD: 32 (wound).	Powder	Topical	0,125
Aristolochia longa L. (Aristolochiaceae)	برستم	027	Roots	SD: 25 (wound), Can: 5 (cancers).	Powder	Oral, topical	0,118
Bunium fontanesii (Pers.) Maire (Apiaceae)	ترغودة	028	Roots	ESD: 26 (goiter), GH: 3 (body pain), SD: 1 (burns).	Powder	Oral	0,118
Rubia peregrina L. (Rubiaceae)	الفوة	029	Roots	CSD: 25 (anemia), GISD: 25 (kid cough), GH: 5 (body pain).	Decoction, powder	Oral	0,118
Urtica urens L. (Urticaceae)	حريق	030	Leaves, roots	SMSD: 29 (rheumatism).	Poultice, decoction	Topical	0,114
Globularia alypum L. (Plantaginaceae)	عين الارنب	031	Leaves	SRP: 22 (menstrual cramp), ESD: 4 (diabetes).	Infusion	Oral	0,102
Verbascum sinuatum L. (Scrophulariaceae)	مصلح لمضار	032	Roots, leaves	SMSD: 18 (inflammation), GH: 7 (body pain).	Decoction	Oral	0,098
Arbutus unedo L. (Ericaceae)	اللنج	033	Roots	CSD: 11 (blood purification), GH: 11 (body pain), GISD: 5 (liver diseases), KD: 4 (renal disorders).	Decoction	Oral	0,078
Beta vulgaris L. (Amaranthaceae)	السلق	034	Aerial	GISD: 20 (colon).	Powder	Oral	0,078
Eucalyptus camaldulensis Dehnh. (Myrtaceae)	الكاليتوس	035	Leaves	RTD: 20 (flu).	Fumigation	Inhalation	0,078
Hordeum vulgare L. (Poaceae)	الشعير	036	Seeds	KD: 17 (cystitis).	Decoction	Oral	0,066
Anchusa italica Retz. (Boraginaceae)	لسان الفرد	037	Roots	SMSD: 11 (inflammation), GISD: 2 (colon), RTD: 2 (cold), GH: 1 (body pain).	Decoction	Oral	0,062
Ajuga iva (L.) Schreb. (Lamiaceae)	شندقورة	038	Leaves	CSD: 15 (hypertension).	Infusion, decoction	Oral	0,059
Calicotome intermedia C. Presl (Leguminosae)	القندول	039	Roots	GH: 15 (body pain)	Decoction	Oral	0,059
Genista tricuspidata L. (Leguminosae)	الشبرق	040	Roots	GH: 13 (body pain), CSD: 2 (hypercholesterolemia).	Decoction	Oral	0,059
Herniaria hirsuta L. (Caryophyllaceae)	فتاتة الحجر	041	Aerial	KD: 15 (renal calculi).	Infusion, decoction	Oral	0,059
Laurus nobilis L. (Lauraceae)	الرند	042	Leaves	GH: 15 (body pain).	Infusion	Oral	0,059
Malva parviflora L. (Malvaceae)	الخبيز- البقول	043	Aerial	GISD: 15 (colon, constipation), CSD: 15 (heart disorders).	Infusion	Oral	0,059
Myrtus communis L. (Myrtaceae)	الريحان	044	Leaves	GH: 15 (body pain).	Infusion	Oral	0,059
Pistacia lentiscus L. (Anacardiaceae)	الضرو	045	Leaves	GH: 2 (body pain), GISD: 13 (stomachache).	Decoction	Oral	0,059
Quercus ilex subsp. *ballota* (Desf.) Samp. (Fagaceae)	البلوط الاخضر	046	Roots	GISD: 15 (stomachache).	Decoction	Oral	0,059
Rubus ulmifolius Schott (Rosaceae)	العليق	047	Roots	CSD: 15 (blood purification).	Decoction	Oral	0,059
Mentha pulegium L. (Lamiaceae)	النعنان	048	Aerial	NS: 13 (depression).	Infusion	Oral	0,051
Arisarum simorrhinum Durieu (Araceae)	البقوقة	049	Roots	Can: 2 (cancers), ESD: 10 (goiter).	Powder	Oral	0,047
Olea europea L. (Oleaceae)	الزيتون	050	Leaves, fruits	ESD: 10 (diabetes), CSD: 2 (hypertension).	Decoction, powder	Oral	0,047
Ziziphus vulgaris Mill. (Rhamnaceae)	سفيزف	051	Roots, seeds	CSD: 2 (hypercholesterolemia), GISD: 9 (liver disorders).	Decoction	Oral	0,043
Citrus limon (L.) Osbeck (Rutaceae).	الليم	052	Fruits	CSD: 10 (hypertension).	Juice	Oral	0,039

Name	V. name	V.N.	Parts	Diseases treated	Preparation	Admin.	UV
Himantoglossum hircinum (L.) Spreng. (Orchidaceae)	المیتة و الحیة	053	Roots	SRP: 3 (infertility, sexual impotence), GH: 5 (body pain), Can: 1 (cancers), GISD: 1 (weigh loss).	Dry, powder	Oral	0,039
Prunus persica (L.) Batsch (Rosaceae)	الخوخ	054	Leaves	Can: 10 (cancers).	Infusion, powder	Oral	0,039
Punica granatum L. (Lythraceae)	الرمان	055	Fruits	GISD: 10 (stomach ulcer).	Powder	Oral	0,039
Quercus suber L. (Fagaceae)	الفلین	056	Roots	GISD: 10 (stomach ulcer).	Decoction	Oral	0,039
Rosmarinus officinalis L. (Lamiaceae)	الحلال	057	Aerial	RTD: 7 (allergy), GISD: 3 (constipation).	Infusion, decoction	Oral	0,039
Salvia argentea L. (Lamiaceae)	فراشة الندى	058	Leaves	RTD: 10 (bronchitis).	Poultice	Topical	0,039
Silene vulgaris (Moench) Garcke. (Caryophyllaceae)	تغیغت	059	Roots	GISD: 10 (constipation, intestine problems).	Decoction	Oral	0,039
Thymus ciliatus Lam. (Lamiaceae)	الجرتیل	060	Leaves	SD: 3 (skin diseases), GH: 7 (body pain).	Infusion	Oral	0,039
Juglans regia L. (Juglandaceae)	القرقاع-الجوز	061	Leaves, fruits	GISD: 8 (toothache).	Infusion, decoction	Oral	0,031
Onopordum macracanthum Schousb. (Asteraceae)	دادا	062	Fruits	GISD: 8 (stomach ulcer).	Dry	Oral	0,031
Asparagus stipularis Forssk. (Asparagaceae)	السكوم	063	Fruits, roots	KD: 3 (cystitis), GISD: 4 (intestine problems).	Decoction	Oral	0,027
Atractylis caespitosa Desf. (Asteraceae)	كنیدة	064	Leaves	HC: 5 (Hair loss, hair growth), SMSD: 2 (arthritis).	Powder	Topical	0,027
Apium nodiflorum (L.) Lag. (Apiaceae)	الزیاتة	065	Roots, leaves	GH: 6 (body pain).	Decoction, infusion	Oral	0,023
Clematis flammula L. (Ranunculaceae)	الشطبة	066	Roots	GH: 6 (body pain).	Decoction	Oral	0,023
Foeniculum vulgare Mill. (Apiaceae)	البسباس	067	Roots	CSD: 6 (hypercholesterolemia).	Decoction	Oral	0,023
Juncus maritimus Lam. (Juncaceae)	السمار	068	Roots	GH: 3 (body pain), SMSD: 2 (rheumatism).	Decoction	Oral	0,023
Nerium oleander L. (Apocynaceae)	الدفلة	069	Leaves	CSD: 6 (hypertension).	Infusion	Topical	0,023
Plumbago europaea L. (Plumbaginaceae)	تفزوج	070	Roots	SMSD: 5 (arthritis), SD: 1 (skin diseases).	Decoction	Oral	0,023
Prunus cerasus L. (Rosaceae)	حب الملوك	071	Roots	GH: 6 (body pain).	Decoction	Oral	0,023
Ruta angustifolia Pers. (Rutaceae)	الفیجل	072	Aerial	NS: 6 (depression).	Infusion, decoction	Oral, nasal	0,023
Thymbra capitata (L.) Cav. (Lamiaceae)	الزعیترة	073	Aerial	GISD: 6 (colon).	Infusion	Oral	0,023
Artemisia arborescens (Vaill.) L. (Asteraceae)	الشھیبة	074	Leaves	NS: 5 (sedative).	Infusion	Oral	0,019
Ceratonia siliqua L. (Leguminosae)	الخروب	075	Leaves	GISD: 5 (stomach ulcer).	Powder	Oral	0,019
Daphne gnidium L. (Thymelaeaceae)	لزاز	076	Leaves	HC: 5 (Hair loss, hair growth).	Decoction	Topical	0,019
Heliotropium abbreviatum Rusby (Boraginaceae)	باي موث	077	Aerial	GH: 3 (fever).	Infusion	Oral	0,017
Asphodelus ramosus L. (Xanthorrhoeaceae)	البرواق	078	Roots	GH: 4 (body pain).	Decoction	Oral	0,015
Cistus salviifolius L. (Cistaceae)	الغاصة	079	Leaves	SD: 4 (burns).	Powder	Topical	0,015
Cynara cardunculus L. (Asteraceae)	خرشف الخلاء	080	Roots	GH: 4 (body pain).	Decoction	Oral	0,015
Eriobotrya japonica (Thunb.) Lindl. (Rosaceae)	المزاح	081	Leaves	GH: 4 (body pain).	Infusion	Oral	0,015
Ficus carica L. (Moraceae)	الكرموس	082	Leaves, roots	GH 4 (body pain), KD: 1 (renal calculi).	Poultice, decoction	Oral	0,015

Name	V. name	V.N.	Parts	Diseases treated	Preparation	Admin.	UV
Geranium purpureum Vill. (Geraniaceae)	العطرشة	083	Leaves	GH: 4 (body pain).	Infusion	Oral	0,015
Rosa canina L. (Rosaceae)	بوصوفة	084	Roots	GH: 4 (body pain).	Decoction	Oral	0,015
Salvia officinalis L. (Lamiaceae)	المريمية	085	Leaves	GH: 4 (kids body pain).	Infusion	Oral	0,015
Agave americana L. (Asparagaceae)	الصبار	086	Leaves	HC: 3 (Hair loss).	Decoction	Topical	0,011
Ampelodesmos mauritanicus (Poir.) T. Durand & Schinz (Poaceae)	الديس	087	Roots	GH: 3 (body pain).	Decoction	Oral	0,011
Artemisia herba-alba Asso. (Asteraceae)	الشيح	088	Aerial	ESD: 3 (diabetes).	Infusion	Oral	0,011
Catananche caespitosa Desf. (Asteraceae)	الصليع	089	Roots	GH: 3 (body pain).	Decoction	Oral	0,011
Centaurium erythraea Rafn. (Gentianaceae)	مرارة الحنش	090	Aerial	ESD: 3 (diabetes).	Poultice, infusion	Oral, topical	0,011
Cistus monspeliensis L. (Cistaceae)	توازلة	091	Leaves	SD: 3 (wound).	Poultice	Topical	0,011
Ecballium elaterium (L.) A. Rich. (Cucurbitaceae)	فقوس الحمير	092	Fruits	GISD: 3 (liver diseases).	Juice	Oral	0,011
Euphorbia sp L. (Euphorbiaceae)	رديم	093	Roots	GISD: 3 (weight loss).	Juice	Oral	0,011
Glebionis coronaria (L.) Cass. ex Spach (Asteraceae)	المرارة	094	Flower	SN: 3 (depression).	Infusion	Oral	0,011
Macrochloa tenacissima (L.) Kunth.(Poaceae)	الحلفة	095	Roots	ESD: 3 (diabetes).	Decoction	Oral	0,011
Mentha piperita L. (Lamiaceae)	نعناع الفطور	096	Aerial	GH: 3 (body pain).	Infusion	Oral	0,011
Opuntia ficus-indica (L.) Mill. (Cactaceae)	الهندية	097	Leaves, fruits	KD: 3 (cystitis).	Juice, infusion	Oral	0,011
Oxalis pescaprae L. (Oxalidaceae)	الحميضة	098	Leaves	GISD: 3 (stomachache).	Dry	Oral	0,011
Papaver rhoeas L. (Papaveraceae)	بنعمان	099	Flower	GH: 3 (body pain).	Infusion	Oral	0,011
Peganum harmala L. (Nitrariaceae)	الحرمل	100	Fruits, leaves	Can: 3 (cancers).	Powder, infusion	Oral	0,011
Phillyrea angustifolia L. (Oleaceae)	الكتم	101	Leaves	GH: 3 (body pain).	Decoction	Oral	0,011
Pinus halepensis Mill. (Pinaceae)	التايدة	102	Roots	GISD: 3 (stomach ulcer).	Powder	Oral	0,011
Plantago major L. (Plantaginaceae)	المصاصة	103	Leaves	SD: 3 (skin diseases).	Poultice	Topical	0,011
Quercus faginea Lam (Fagaceae)	التاشة	104	Roots	GH: 3 (body pain).	Decoction	Oral	0,011
Ranunculus arvensis L. (Ranunculaceae)	الموثر	105	Roots	GISD: 3 (weigh loss).	Decoction	Oral	0,011
Rorippa nasturtium-aquaticum (L.) Hayek. (Brassicaceae)	قرنونش	106	Leaves	GISD: 3 (colon).	Dry, poultice	Oral, topical	0,011
Scolymus hispanicus L. (Compositae)	العسلوج	107	Aerial	GISD: 3 (stomach ulcer, colon).	Dry	Oral	0,011
Teucrium pseudochamaepytis L. (Lamiaceae)	شاي الخلاء	108	Aerial	NS: 3 (sedative).	Infusion	Oral	0,011
Ferulago lutea (Poir.) Grande (Apiaceae)	الكليخة	109	Leaves	GISD: 2 (stomachache).	Infusion	Oral	0,007

3.5. Informant consensus factor (F$_{IC}$)

As shown in Table 4, F$_{IC}$ values ranged from 0.65 to 0.98. The highest F$_{IC}$ were recorded for the reproductive and sexual disorders (0.98) with 10 species and 644 use reports, respiratory tract diseases (0.98), cardiovascular system disease and blood disorders (0.94), digestive disorders (0.93), and general health (0.93). Our findings are in agreement with those reported in nomadic populations in Algerian steppe revealing that reproductive and sexual disorders were the ailment category with the highest F$_{IC}$ of 0.92 (Miara *et al.*, 2018). Similar to our results, it has been found that cardiovascular diseases had the 3rd F$_{IC}$ in two ethnobotanical studies carried out in two regions located in North-East Algeria (Miara *et al.*, 2019; Bousala & Bousala, 2017). Likewise, Boughrara & Belgacem (2016) found that these ailments were ranked 3rd in the extreme east of Algeria. Moreover, in most of ethnobotanical investigations in Algeria and neighboring countries, digestive disorders were found to be associated with the highest F$_{IC}$ (Eddouks *et al.*, 2017; Menale *et al.*, 2016; Benarba *et al.*, 2015b; El-Hilaly *et al.*, 2003).

Table 4. Informant consensus factor (F$_{IC}$) for commonly used medicinal plants. See Table 2 for abbreviations on Ailment. Other abbreviations: Nur, number of use- reports; Nt, number of taxa; F$_{IC}$, Informant consensus factor.

Ailment category	Nur	Nt	F$_{IC}$
SRP	644	10	0.98
RTD	1077	18	0.98
CSD	265	15	0.94
GISD	643	40	0.93
GH	579	40	0.93
SD	104	9	0.92
ESD	89	8	0.92
KD	59	7	0.89
HC	13	3	0.83
NS	33	7	0.81
Can	23	6	0.77
SMSD	36	13	0.65

4. Conclusions

The present study reports an important ethnobotanical knowledge possessed by local populations living in the living in the Park of Tlemcen (North-West Algeria). Indeed, 109 species from 54 families are traditionally used to treat different diseases and health problems. Among them, *Thymus lanceolatus*, *Origon glandulosum*, *Ammoides verticillata*, *Echinops spinosus*, *Mentha pulegium*, *Anacyclus pyrethrum*, *Daucus critinus*, *Arenaria aggregata*, and *Junipenus oxycedrus* had the highest UV and therefore should be considered for further phytochemical and preclinical studies to evaluate their biological activities and identify the lead bioactive compounds. Moreover, high consensus has been found

regarding the treatment of reproductive and sexual disorders, respiratory tract diseases, cardiovascular system disease and blood disorders, digestive disorders, and general health.

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