© 2020 Journal of Pharmacy & Pharmacognosy Research, 8 (5), 392-409, 2020
ISSN 0719-4250
http://jppres.com/jppres

Original Article | Artículo Original

Ethnobotanical study of plants used in the treatment of respiratory diseases in a population bordering the forest of Izarène

[Estudio etnobotánico de plantas utilizadas en el tratamiento de enfermedades respiratorias en una población que linda con el bosque de Izarène]

Hicham Orch[1]*, Lahcen Zidane[1], Allal Douira[2]

[1]Laboratory of Nutrition, Health and Environment, Department of Biology, UFR: Mycology, Faculty of Sciences, Ibn Tofail University, Kénitra, Morocco.
[2]Laboratory of Botany and Plant Protection, Department of Biology, Faculty of Sciences, Ibn Tofail University, Kénitra, Morocco.
*E-mail: orch3108@gmail.com

Abstract

Context: Ethnobotanical surveys among users of medicinal plants have allowed us to inventory the medicinal species used and to safeguard the maximum of information acquired by the local population in traditional phytotherapy.

Aims: To contribute to a better knowledge of the medicinal plants used in the treatment of respiratory diseases, an ethnobotanical study was carried out among the population bordering the Izarène forest.

Methods: Using 480 questionnaire sheets, ethnobotanical field surveys were conducted during two campaigns (2013 to 2015). The determination of the different survey media was carried out using stratified probability sampling techniques. The ethnobotanical data were analyzed through the calculation of quantitative indices, such as Relative Frequency of Citation (RFC), Family Importance Value index (FIV), Fidelity Level (FL), Informant Consensus Factor (ICF) and Use-Value of the Plant Part (PPV).

Results: Analysis of the results revealed 40 plant species, which fall into 19 botanical families. The *Lamiaceae* family was the most represented (14 species, FIV = 0.076). The highest Relative Citation Frequency (RFC) (0.22) was recorded for *Mentha pulegium*. Concerning the diseases treated, asthma had the highest ICF (0.95). The leaf was considered the most used part of the plant (PPV = 0.34), and most of the remedies were prepared as decoctions.

Conclusions: The results obtained could constitute a basis for further studies for the valorization of medicinal plants used against respiratory diseases through biological and phytochemical studies of the inventoried plants.

Keywords: ethnobotanical surveys; Izarène forest; medicinal plants; respiratory diseases.

Resumen

Contexto: Las encuestas etnobotánicas entre los usuarios de plantas medicinales nos han permitido hacer un inventario de las especies medicinales utilizadas y salvaguardar el máximo de información adquirida por la población local en la fitoterapia tradicional.

Objetivos: Contribuir a un mejor conocimiento de las plantas medicinales utilizadas en el tratamiento de enfermedades respiratorias, se realizó un estudio etnobotánico entre la población que limita con el bosque de Izarène.

Métodos: Utilizando 480 hojas de cuestionarios, se realizaron encuestas de campo etnobotánicas durante dos campañas (2013 a 2015). La determinación de los diferentes medios de encuesta se realizó utilizando técnicas de muestreo de probabilidad estratificadas. Los datos etnobotánicos se analizaron mediante el cálculo de índices cuantitativos, como la frecuencia relativa de citas (RFC), el índice del valor de importancia familiar (FIV), el nivel de fidelidad (FL), el factor de consenso informante (ICF) y el valor de uso de la parte de la planta (PPV).

Resultados: El análisis de los resultados reveló 40 especies de plantas, que se dividieron en 19 familias botánicas. La familia *Lamiaceae* fue la más representada (14 especies, FIV = 0,076). La frecuencia de cita relativa más alta (RFC) (0,22) se registró para *Mentha pulegium*. Con respecto a las enfermedades tratadas, el asma tuvo la ICF más alta (0,95). La hoja se consideró la parte más utilizada de la planta (PPV = 0,34), y la mayoría de los remedios se prepararon como decocciones.

Conclusiones: Los resultados obtenidos podrían constituir una base para futuros estudios para la valorización de plantas medicinales utilizadas contra enfermedades respiratorias a través de estudios biológicos y fitoquímicos de las plantas inventariadas.

Palabras Clave: bosque de Izarène; enfermedades respiratorias; estudios etnobotánicos; plantas medicinales.

ARTICLE INFO
Received: March 1, 2020.
Received in revised form: April 6, 2020.
Accepted: April 14, 2020.
Available Online: April 19, 2020.
Declaration of interests: The authors declare no conflict of interest.
Funding: This research was not funded and did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

INTRODUCTION

Respiratory diseases are heterogeneous disorders that affect the airways and other lung structures (WHO, 2007). They commonly include chronic bronchitis, emphysema, asthma, chronic obstructive pulmonary disease, and unclassified chronic airway obstruction (Wang et al., 2007). Respiratory diseases are a very frequent reason for consultation in Morocco, both in the public and private sectors. They represent about 5.5 million medical consultations per year. In the majority of cases (85%), they are acute respiratory infections, mainly angina, and acute bronchitis. The remaining cases (15%) are chronic respiratory diseases or suspected pulmonary tuberculosis (Ministère de la Santé, 2001).

In response to the spread of these highly treatable diseases, WHO has promoted ethnobotanical studies and pharmaceutical research to improve herbal medicines to promote their optimal use in health care delivery systems (Trabi et al., 2008).

In Morocco, as everywhere in the world, the medicinal plants still find their therapeutic indications in the treatment of several diseases, including diseases of the respiratory system despite the increasing influence of the modern health system.

Morocco occupies a privileged place among the Mediterranean countries, which have a long medical tradition and traditional know-how based on medicinal plants (Scherrer et al., 2005). The richness of its traditional medicine has been demonstrated by all the studies carried out in the field, which is a heritage of the Arab-Berber civilization and benefited in large part from the Muslim and Jewish tradition, which reigned in this country (Jouad et al., 2003). Indeed, some of these plants have been described in the older Moroccan pharmacopeia (Bellakhdar, 1978; Boulos, 1983), and in several recent but partial and fragmentary ethnobotanical studies (Sijelmassi, 1993; Hmamouchi, 1999).

In the field of pharmacology, traditional herbal knowledge has become a recognized tool in the search for new sources of drugs and pharmaceuticals (Sharma and Mujumdar, 2003). Herbal medicines are considered less toxic and milder than pharmaceutical drugs (Dibong et al., 2011).

From this perspective, we have led an ethnobotanical study, whose principal objective is to identify and to count the medicinal plants used in the treatment of the respiratory system by the bordering population of the Izarène forest, which presents a floristic and ecological diversity and offers to the local population a knowledge rather rich in traditional phytotherapy.

MATERIAL AND METHODS

Description of the study area

According to the territorial division of 2015, the forest massif of Izarène is part of the Tangier-Tetouan-Al Hoceïma area. It is located in the North-Western part of the Kingdom 12 km North-East of the town of Ouezzane and covers an approximate forest surface of 14600 ha between the parallels 34°45' and 34°58'N and the meridian lines 5°25' and 5°32'W. Limited to the southern part by marls of the pre-Rifaine Cretaceous nappe, this forest massif is characterized by a rugged relief where altitudes vary approximately between 350 and 680 m (HCEFLCD, 2005).

The study area, the Circle of Mokrisset, is a part of the province of Ouezzane and includes 3 Caïdats (Zoumi, Mokrisset and Brikcha), and 3 rural communes (Zoumi, Ain Baïda and Brikcha) (Fig. 1); it contains a population estimated at 25 000 inhabitants (SPEF, 2004). The geological formation of the forest massif is characterized by a tormented relief due to the presence of several hills forming the beginning of the Rifaine Mountains on the southern side. These hills are characterized by a deep clayey-schist or clayey-marly soil that can reach in some places more than 3 meters of depth. The climate of the area is subhumid with temperate winters, with an average annual rainfall of about 1000 mm. This rainfall is spread over about 70 days throughout the year (November to April). One winter soft practically without cold and very rainy succeeds a dry season and hot of

duration from 3 to 4 months (Askarn, 1982). The vegetable cover is characterized by a rich and diversified forest formation consisting mainly of vegetation, which testifies to a degradation of the climatic formation of the cork oak (Borgniet et al., 2009). Forest fires constitute one of the main factors of degradation and destruction in the region.

The forest of Izarène has a vital economic, ecological, and social importance for the bordering population. It assures the needs of the population for the firewood and work and constitutes the principal source of fodder for the cattle (SPEF, 2004). Beyond its paramount functions, it also plays a role in traditional medicine thanks to the use of the medicinal plants that are part of the means of subsistence of the bordering population.

Methodology

Data collection

During a period from 2013 to 2015, ethnobotanical surveys were carried out in different localities, villages, and *douars*, bordering the Izarene forest, in order to collect as much information as possible about the use of medicinal plants used for treating respiratory tract infections.

The determination of the various mediums of inquiries was achieved thanks to the techniques of probabilistic stratified sampling (Godron, 1971; Godron and Daget 1982). In this study, the sample is divided into four homogeneous strata (S1, S2, S3, and S4), of which three correspond to the numbers of the rural communes of the Circle of Mokrisset (Table 1).

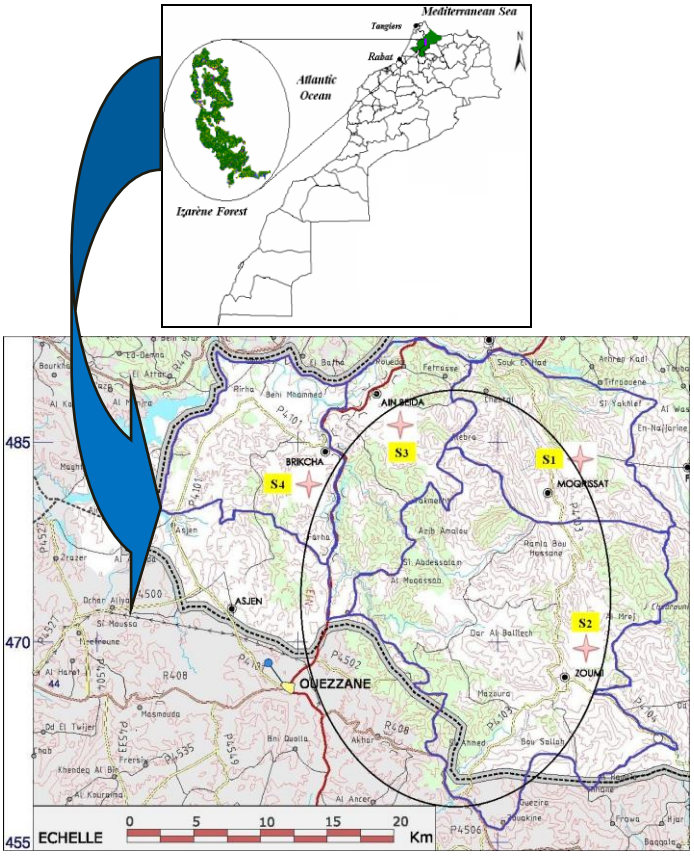

Figure 1. Location map of the study area.

Table 1. Distribution of the surveys by strata.

Strata	Names of strata	Number of investigations
Strata 1	Mokrisset	120
Strata 2	Zoumi	120
Strata 3	Ain Baïda	120
Strata 4	Brikcha	120
Total		**480**

The survey was conducted among 480 people living in villages and *douars* in the study area. Using a stratified random sampling method, samples of 120 people were then formed for each of the 4 strata and put together to form the overall sample (480 people). The field studies required us to deal with two groups: those who knew and used plants for medicinal purposes and those who used plants and plant products for commercial purposes (plant collectors, herbalists, traditional practitioner). The interviews with the informants were conducted in the Arabic dialect of the region. A questionnaire was prepared from the preliminary surveys in the study area and validated by a team from the botanical laboratory of the Faculty of Sciences of Kenitra. The questionnaire used consists of two parts: the first part deals with the demographic characteristics of the informants, and the second one focuses on the plants used in the treatment of diseases (Appendix 1). The time devoted to each interview was approximately two hours, and the oral and written consent of the informants was collected for each interview. All persons who shared their traditional knowledge were informed about the principle of the study, its interest, and the procedure used while respecting the anonymity of the information collected.

Taxonomic identification and conservation of plant species

The plants indicated by the informants were systematically photographed, and botanical samples were collected and placed in the herbarium or a plastic bag with a label indicating its vernacular name. The taxonomic validation of the species was carried out in the laboratory using herbaria and completed with the following documents: Les plantes médicinales du Maroc by Sijelmassi (1993); Flore pratique du Maroc by Fennane et al. (1999) and Catalogues des plantes vasculaires du Nord du Maroc, incluant des clés d'identification, by Valdés et al. (2002), volumes I and II.

Data analysis

The data recorded on the survey sheets were then transcribed into a database and processed by SPSS (System Professional for Social Sciences) version 21 and the Excel spreadsheet (version 2010). Descriptive statistical methods were used to analyze the socio-demographic data of informants.

To determine the socio-demographic parameters influencing the orientation of the riverside population towards traditional medication, an analytical study using logistic regression was conducted.

Analysis of ethnobotanical data was carried out using the Relative Frequency of Citation (RFC), the Family Importance Value (FIV), the Plant Part Value (PPV), Fidelity Level (FL), Informant Consensus Factor (ICF) and Use-Value of the Plant Part (PPV).

Relative frequency of citation (RFC)

RFC was calculated to appreciate the local importance of each species. The RFC was the result of the Citation Frequency (Fc), that is the number of informants who mentioned the use of the species, divided by the total number (N) of respondents [1] (Tardío and Pardo-de- Santayana, 2008), with ($0 < RFC < 1$).

$$RFC = Fc/N \quad [1]$$

Family Importance Value (FIV)

The Family Importance Value (FIV) identified the importance of medicinal plant families. It was calculated using the method [2] proposed by Cadena-González et al. (2013).

$$FIV = FCfamily/Ns \quad [2]$$

where FCfamily: RFC is the number of informants mentioning the family and Ns: total number of species in each family. Family use-value is a culturally significant index that can be applied to ethnobotany to calculate the biological value of the plant taxon (Gakuubi and Wanzala, 2012).

Fidelity Level (FL)

The Fidelity Index was calculated to identify the species most commonly used in the treatment of a particular disease. It was calculated according to the method [3] proposed by Friedman et al, (1986).

$$FL = (Fc/ Ft) \times 100 \quad [3]$$

where Fc is the frequency of citation of the species in the treatment of a particular disease and Ft is the total number of citations of the species.

Informant Consensus Factor (ICF)

It was calculated for each category in order to assess the agreement between informants on the use of plants for specific use categories. It is obtained using the following formula [4] (Heinrich et al. 1998).

$$ICF = (Nur - Nt) / (Nur - 1) \quad [4]$$

Where Nur is the number of use citations for a disease category and Nt is the number of species used by informants in a given use category. The value calculated from this consensus ranges from 0 to 1 and is close to 1 when the plant is used by a large number of the respondents for a particular disease and/or if information is exchanged between informants on the use of the species for a particular disease, and close to 0 (low) when the plant is randomly selected or if there is no exchange of information about use among informants (Yaseen et al., 2015).

Plant Part Value (PPV)

The PPV was calculated to assess the importance of each part of the plant used by the respondents, it was obtained by the following formula [5].

$$PPV = RUplant\ part/ RU \quad [5]$$

where RUplant part is the sum of reported uses per part of the plant and RU is the number of reported uses of all parts of the plant

RESULTS AND DISCUSSION

Socio-demographic profile of respondents

The ethnobotanical surveys were carried out on a sample of 480 people, and the results obtained show that men and women are concerned with traditional medicine. However, women have slightly more knowledge about medicinal species compared to men, with a frequency of 75% compared to 25% for men (Table 2), which corresponds to a sex ratio of 3.

The predominance of women can be justified by the fact that women are always on the lookout for natural remedies based on medicinal plants, to improve their knowledge of these plants and to maintain their health and that of their families since they are closer to the plants either in their children's medication or in their use in cooking. These results confirm the results of other ethnobotanical work carried out at the national level (El Hilah et al., 2016; Ben Akka et al., 2019).

The use of medicinal plants concerns all age groups at the scale of the riparian population of the forest massif of Izarène. The results obtained show a predominance of the elderly, so those with an age of over 60 represent 36.5%. The age groups of [50-59], [40-49], [30-39], [18-29] have a percentage of 16.7%, 17.9%, 15% and 14%, respectively. Indeed, older persons are expected to provide more reliable information on the traditional use of medicinal plants, because they hold much of the

ancestral knowledge that is transmitted orally. The transmission of this knowledge is currently in danger because it is not always ensured (Anyinam, 1995). The relative transmission of traditional practices from one generation to the next may explain the mistrust of some people, particularly young people, who tend not to believe too much in this traditional medicine (Orch et al., 2017).

Concerning the level of education of the respondents in the study area, the results obtained show that the majority of users had been illiterate with a percentage of 48.8%. This relatively high percentage is in direct correlation with the level of education of the local population. Nevertheless, those with primary and secondary education had a significant percentage (27% and 17%, respectively), while those with university education had a percentage of 8%. Other studies have shown that the knowledge of the population on the use of medicinal plants is held by illiterate people (Lahsissene et al., 2009; Omer et al., 2012).

The majority of the residents surveyed in this region are married, with a percentage of 85% married *versus* 15% single.

Concerning the socio-economic level, 45.2% of the people surveyed had a low socio-economic level, 42.5% were unemployed, and 12.3% had a medium level.

According to the logistic regression model, it appears that the variables: gender, age, and least expensive use are predictors influencing the orientation of the riverside population towards traditional medication, pointing out that the least expensive use factor represents an influence of 12 times more than the other factors (Table 3). The high cost of modern medical treatments, their side effects, and the unfavorable socio-economic conditions of the local population are the essential factors that push the local population to make extensive use of herbal medicine. These results confirm the results achieved by El Hassani in Middle Moulouya (El Hassani et al., 2013).

Table 2. Socio-demographic characteristics of the participants in the study area.

Variable	Distribution	Number of informants	Percentage (%)
Gender	Male	120	25.0
	Female	360	75.0
Age group	[18-29]	67	14.0
	[30-39]	72	15.0
	[40-49]	86	17.9
	[50-59]	96	20.0
	≥ 60	159	33.1
Educational level	Illiterate	234	48.8
	Primary	128	26.7
	Secondary	81	16.9
	University	37	7.7
Family situation	Married	407	84.8
	Single	73	15.2
Monthly income	No income	204	42.5
	Low income	217	45.2
	Average income	59	12.3

Table 3. Statistical analyses of the influence of socio-demographic parameters on confidence in plant use.

Variable	Odds-ratio	IC for 95%		
		Lower	Upper	p-value
Gender	0.189	0.08	0.445	0.000
Age groups	0.294	0.208	0.415	0.000
Educational level	1.147	0.893	1.474	0.282
Family situation	1.203	0.340	4. 254	0.774
Monthly income	1.018	0.572	1.709	1.812
Least expensive use	12.403	5.915	26.009	0.000

Floristic analysis

Botanical families most represented in the study area

The study of medicinal plants led to the identification and listing of 40 species belonging to 19 families and divided into 35 genera. These plants are presented in alphabetical order. For each plant listed, the scientific name, family, local name, the part used, and the method of preparation adopted by the local population are given, as well as the data of FL, FC, RFC and FIV are shown in Table 4.

Table 4. List of medicinal plants used for the treatment of respiratory diseases in the study area.

Family and scientific name	Local name	Part used	Preparation mode	Medicinal use	FL %	FC	RFC	FIV
Amaryllidaceae								0.02
Allium cepa L.	Lbesla	Bulb	Raw	AT	100	15	0.031	
Allium sativum L.	Toum	Bulb	Raw	AT	100	4	0.008	
Apiaceae								0.002
Ammoides pusilla (Brot.) Breistr.	Noukha	Leaves	Decoction	BC	100	1	0.002	
***Asteraceae* (*Compositae*)**								0.006
Dittrichia viscosa (L.) Greuter	Terrahlâ	Leaves	Decoction	BC	100	3	0.006	
Boraginaceae								0.010
Echium plantagineum L.	Lsanthour	Flowers	Infusion	BC, LC	80	5	0.010	
***Brassicaceae* (*Cruciferae*)**								0.053
Brassica oleracea L.	Krumb	Leaves	Infusion	TA	100	24	0.05	
Lepidiumsativum L.	Habbrchad	Seeds	Decoction	CL, CG, BC	77.1	35	0.073	
Raphanus sativus L.	Lefjel	Roots	Powder	CL, CG, BC	61.1	18	0.037	
Burseraceae								0.019
Boswellia carterii Birdw.	Salabân	Resin	Powder	CG	100	9	0.019	
Capparaceae								0.008
Capparis spinosa L.	Al'Kabbar	Fruit	Powder	CL, AT	75	4	0.008	
Cistaceae								0.012
Cistus monspeliensis L.	Chtâppa	Leaves	Decoction	AT, CG	66.6	6	0.012	

Table 4. List of medicinal plants used for the treatment of respiratory diseases in the study area (continued…).

Family and scientific name	Local name	Part used	Preparation mode	Medicinal use	FL %	FC	RFC	FIV
Fabaceae								0.032
Glycyrrhiza glabra L.	Arqsûss	Roots	Decoction	CG, TA, AT, BC	68	25	0.052	
Trigonella foenum-graecum L.	Al'Houlba	Seeds	Powder	BC, AT, CG	66.6	6	0.012	
Gentianaceae								0.035
Centaurium Erythraea Rafn	Gossat Al'Hayya	Aerial parts	Decoction, infusion	AT	100	17	0.035	
Geraniaceae								0.023
Geranium rotundifolium L.	Mersetadialouad	Leaves	Decoction	CL	100	11	0.023	
Lamiaceae								0.076
Ajuga iva (L.) Schreb.	Chendgûra	Leaves	Other	TB	100	1	0.002	
Calamintha officinalis Moench	Manta	Aerial parts	Infusion	CL, CG	70.8	48	0.1	
Lavandula dentata L.	Lakhzama	Flowers	Decoction	FL, CL, AT	71.8	64	0.133	
Lavandula stoechas L.	Al'Halhal	Leaves	Decoction	CL, CG, FL	62	50	0 .104	
Marrubium vulgare L.	Merriwta	Leaves	Infusion	AT, BC	78.2	55	0.114	
Mentha pulegium L.	Fliyou	Aerial parts	Infusion, poultice, and inhalation	CL, CG, AT, TA	52.4	105	0.22	
Mentha suaveolens Ehrh.	Mchichtrô	Leaves	Infusion	TB	100	8	0.017	
Mentha viridis L.	Naanaâ	Aerial parts	Infusion	TA	100	25	0.052	
Ocimum basilicum L.	Lahbak	Leaves	Decoction, infusion	TA	100	5	0.010	
Origanum compactum Bentham.	Zaâtar	Leaves	Infusion	CL, FL, TA	58.1	62	0.13	
Origanum majorana L.	Merdedouch	Leaves	Infusion	CG	100	23	0.048	
*Rosmarinus officinalis*L.	Aazir	Leaves	Decoction	AT	100	12	0.025	
*Salvia Officinalis*L.	Assalmiya	Leaves	Decoction	CL	100	17	0.035	
Thymus ssp (vulgaris)	Zaîtra	Aerial parts	Decoction	CL, FL, CG, TA	77.1	35	0.073	
Myrtaceae								0.045
Eucalyptus globulus Labill	Al' Kalitûs	Leaves	Decoction	AT, CG, FL	61.9	63	0.131	
Eugenia caryophyllata Thunb	Qronfel	Flowers	Decoction, powder, and maceration	LC	100	2	0.004	
Myrtus communis L.	Arraihan	Leaves	Decoction, infusion	TB	100	1	0.002	
Oleaceae								0.135
Olea europaea L.	Zitoun, Zabbouj	Seeds	Other	TA, CG	76.9	65	0.135	
Poaceae								0.008
Avena sativa L.	El khortale	Seeds	Decoction	TA	100	4	0.008	
Ranunculaceae								0.125
Nigella sativa L.	Assânûj	Seeds	Decoction, powder	FL, BC, AT	65	60	0.125	
Rosaceae								0.010
Crataegus oxyacantha L.	Admame	Leaves, flowers	Decoction	AT, CG, BC	60	5	0.010	

Table 4. List of medicinal plants used for the treatment of respiratory diseases in the study area (continued…).

Family and scientific name	Local name	Part used	Preparation mode	Medicinal use	FL %	FC	RFC	FIV
Rutaceae								0.067
Citrus limon(L.) Brum.	Lhâmmed	Fruit	Other	CL, CG, BC	75	32	0.067	
Zingiberaceae								0.067
Alpinia officinarum Han.	Khdenjâl	Rhizome	Powder	CL, FL, BC	62.9	27	0.056	
Elettaria cardamomum Roxb. Maton.	Kaâ kola	Fruit	Decoction	CL	100	3	0.006	
Zingiber officinal Rosc.	Sekinjbîr	Rhizome	Decoction, powder, and maceration	CL, FL, TA, CG	52.2	67	0.14	

AT: Asthma, CL: Cold, FL: Flu, TA: Throat affection, CG: Cough, BC: Bronchitis, TB: Tuberculosis, LC: Lung Cancer. FIV=Family importance valueindex; FC= Number of informants; RFC=Relative frequency of citation, FL = Fidelity level.

The number of species and the FIV index revealed three families with high values and which are, therefore, predominant in the treatment of respiratory diseases (Fig. 2). These are *Lamiaceae* (14 species with FIV = 0.076), *Zingiberaceae* (3 species with FIV = 0.067), *Brassicaceae* (3 species with FIV = 0.053), and *Myrtaceae* (3 species with FIV = 0.045). The remaining families had only one or two species. This representativeness was also observed, with some differences, during ethnomedical surveys carried out in other regions of the country by El Hilah et al. (2015) and Chaachouay et al. (2019).

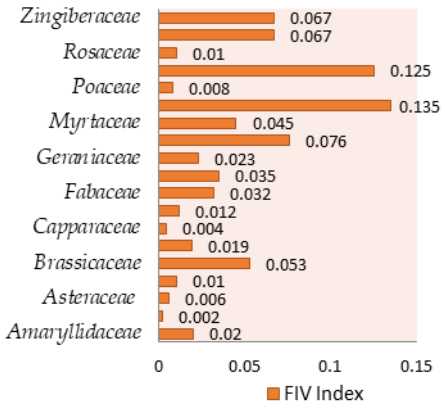

Figure 2. Distribution of medicinal plants according to the family importance value (FIV) in the study area.

Relative Frequency of Citation (RFC) and Fidelity Level (FL)

Some species were more recommended by the local population than others; this is reflected by a high citation frequency (FC). The value of the relative frequency of citation (RFC) as numerical representatives in the quantitative ethnobotanical survey serves to underline the importance of traditional knowledge. Species with a very significant relative citation frequency are those with a high level of use.

Among these plants, seven species belonging to five botanical families were frequently used by the bordering population in the treatment of respiratory diseases. These are: *Mentha pulegium* (RFC=0.22), *Zingiber officinal* (RFC=0.14), *Olea europaea* (RFC=0.135), *Lavandula dentata* (RFC=0.133), *Eucalyptus globulus* (RFC=0.125), *Origanum compactum* (RFC=0.13) and *Nigella sativa* (RFC=0.125).

Some of these plants have been reported in recent ethno-medicinal surveys in the treatment of respiratory diseases (El Hilah et al., 2015; Chaachouay et al., 2019). Among these plants are *Mentha pulegium*, *Zingiber officinal*, *Eucalyptus globulus*, *Origanum compactum* and *Lavandula dentata*.

In addition, some of the listed plants are known to be toxic, such as *Salvia officinalis* (Bruneton, 1996), *Mentha pulegium* (Franchomme and Penoël, 2001), and *Nigella sativa* (Zaoui et al., 2000; Ali and Blunden, 2003). Indeed, the majority of phytotherapists are unaware of the toxicity of the plants used as well as the modalities of their use, in particular the modes of preparation and the recommended doses. The use of medicinal plants must be rationalized, and the benefit/risk determined. Studies on these objectives are therefore necessary.

The fidelity index value (FL) is an important means of determining, which disease a particular species is more effective, a high FL indicates a high use of plant species for a particular disease, while a low FL demonstrates a wide range of medicinal uses but with a low frequency for each disease (Yaseen et al., 2015).In the present study, the majority of plants had a high FL, and the highest 100% FL was recorded for 37 plant species (Table 4). Only 3 species had low fidelity values (FL < 60). Among the species with the highest fidelity for the treatment of a wide range of respiratory diseases are *Mentha pulegium,* which has the highest FL for the treatment of colds (FL = 52.4%) and *Zingiber officinal,* which is used most often for the treatment of throat diseases (FL = 52.2%). Indeed, these results have been confirmed by similar ethnobotanical studies carried out in the Central Plateau (El Hilah et al., 2015) and in the Rif region (Chaachouay et al., 2019).

Frequency of Use of the medicinal plants according to their origin

The ethnobotanical study allowed us to identify 40 medicinal plants used in the treatment of diseases of the respiratory system. Among them, 16 species were imported from other regions of the country, while 9 species were cultivated, and 15 species had collected from the forest of Izarene. This high use of local species can be explained by the high price of imported medicinal plants by the free and proximity of local medicinal plants. It should be noted that among the spontaneous medicinal species collected in the Izarène forest, three medicinal plants: *Origanum compactum*, *Ajuga iva* and *Centaurium erythraea* are scarce in the region (Orch et al., 2013) and risk disappearing from the forest if no protective measures are taken by the services concerned, due to the intensive collection of these species.

Ethnobotanical analysis

Used parts

For the treatment of respiratory diseases, several parts of the listed plants were exploited by the local population (leaves, seeds, flowers, roots). The calculation of the PPV usage index showed that leaves were the most used parts with an index PPV= 0.34, followed by the aerial part with an index PPV= 0.224, then the seeds (PPV= 0.165). The other parts were used to a lesser degree (Fig. 3). Indeed, these results have been confirmed by similar ethnobotanical studies carried out in other regions of Morocco (Sbai-Jouilil et al., 2017; Chaachouay et al., 2019). Leaves are the most widely used because they are at the same time central to photochemical reactions and reservoirs of organic matter derived from them, therefore rich in active principles, and are easy to harvest.

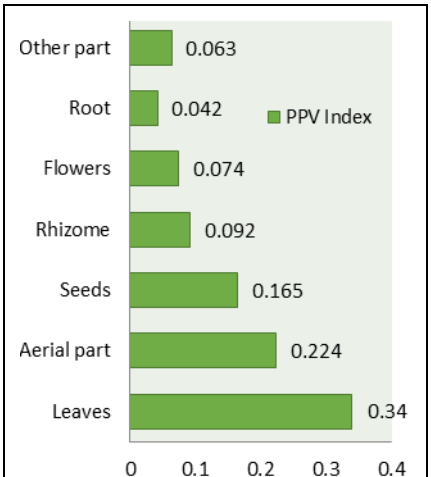

Figure 3. Different parts used for the treatment of respiratory diseases in the zone of study.

Method of preparation and administration used

The population bordering the forest of Izarène uses several methods of preparation for the treatment of respiratory ailments (decoction, infusion, powder) to administer the active ingredients contained in the medicinal plants. The decoction was the most used mode of administration with a percentage of 42.9% (Fig. 4), followed by the Infusion preparation with a percentage of 24.5% and the use of the plant powder with a percentage of 16.3%, the other modes of preparation namely maceration, inhalation, cataplasm and others also had represented 16.3%. The high percentage of decoction preparation shows that the local population believes in this type of preparation and finds it adequate to warm the body and disinfect the plant to cancel the toxic effect of some recipes, but

the decoction can destroy some active ingredients of the species used.

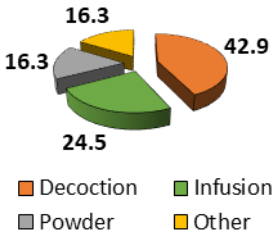

Figure 4. Percentages of different modes of remedies preparation used in the zone of study.

In the area studied, the oral route was the most widely used for most plants. However, most of the respondents were unaware of the weights, the dose, and the precise measurements to be prescribed in the preparation and dosage of the phytomedicines.

The Informant Consensus Factor (ICF)

The Informant Consensus Factor (ICF) reflects the homogeneity of information provided by different informants regarding the medicinal plants used to treat a category of diseases. Table 5 shows that the ICF values range from 0.72 to 0.95 per use category. A total of 40 species were identified to treat respiratory diseases. The categories with the highest ICF values were asthma (0.95), followed by cold (0.94), flu (0.93), throat affection (0.92), and cough (0.91). These high ICF values reflect the reasonable reliability of informants on the use of herbal species (Lin et al., 2002) and indicate that natural remedies are considered to be extremely effective. Therefore, species with a high ICF should be prioritized for further pharmacological and phytochemical studies to discover new active molecules.

The lowest agreement among informants was observed for herbal medicines used to treat bronchitis (0.77), tuberculosis (0.77), and lung cancer (0.72). These values highlight a marked non-homogeneity in the consensus for these categories and may indicate a lack of specific use for a set of species. In agreement with Neves et al. (2009), a low ICF could also be due to the availability of readily available synthetic drugs that represent a better alternative to traditional drugs.

Origin of information on medicinal plants

Regarding the therapeutic use of medicinal plants, the majority of respondents gathered information through the experience of people around them (62.8%), which reflects the image of the relative transmission of traditional practices from one generation to the next. Herbalists are ranked as the second source of information (20.6%) and a small minority (16.6%) through their own experience via television programs (Fig. 5).

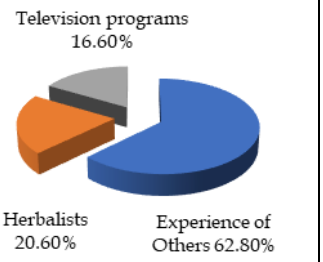

Figure 5. Modes of acquisition of traditional knowledge.

CONCLUSIONS

The ethnobotanical surveys conducted as part of this study have highlighted the medicinal plant potential and the traditional knowledge related to the use of plants among the riparian population of the Izarène forest.

A total of 40 plants of therapeutic value were identified and used in the treatment of respiratory ailments. The qualitative analysis showed a strong association between the orientation of the local population towards traditional medication and specific socio-demographic characteristics. In fact, low cost, gender, and age are the essential factors that push the local population towards this medication. Similarly, the list of species collected contains toxic plants. In the light of this study, we would like to make the local population aware of the risks of the anarchic use of plants for therapeutic purposes.

This work constitutes an information source that contributes to a knowledge of the medicinal flora and the preservation of the popular local know-how. It can also constitute a database for phytochemists and pharmacologists for the valorization of medicinal plants used in respiratory diseases to discover new active ingredients that can be used in pharmacology.

Table 5. Informant Consensus Factor (ICF) values by categories for the treatment of respiratory diseases.

Categories	List of plant species used (number of citations)	Total number of		ICF
		Species	Use citations	
Asthma (AT)	*Allium cepa* L. (15), *Allium sativum* L. (4), *Capparis spinosa* L. (1), *Cistus monspeliensis* L. (2), *Glycyrrhiza glabra* L. (17), *Trigonella foenum-graecum* L. (4), *Centaurium erythraea* Rafn (17), *Lavandula dentata* L. (46), *Marrubium vulgare* L. (43), *Mentha pulegium* L. (44), *Rosmarinus officinalis* L. (12), *Eucalyptus globulus* Labill (sp.) (39), *Nigella sativa* L. (39), *Crataegus oxyacantha* L. (3).	14	286	0.95
Cold (CL)	*Lepidium sativum* L. (27), *Geranium rotundifolium* L. (11), *Calamintha officinalis* Moench (34), *Lavandula dentata* L. (5), *Lavandula stoechas* L. (31), *Mentha pulegium* L. (55), *Origanum compactum* Bentham. (10), *Salvia officinalis* L. (17), *Thymus ssp (vulgaris)* (1), *Citrus limon* (L.) Brum. (24), *Alpinia officinarum* Han. (17), *Elettaria cardamomum* Roxb. Maton. (3), *Zingiber officinal* Rosc. (5).	13	240	0.94
Flu (FL)	*Lavandula dentata* L. (13), *Lavandula stoechas* L. (4), *Origanum compactum* Bentham. (36), *Thymus ssp (vulgaris)* (27), *Eucalyptus globules* Labill (sp.) (5), *Nigella sativa* L. (9), *Alpinia officinarum* Han. (6), *Zingiber officinal* Rosc. (15).	8	115	0.93
Throat affection (TA)	*Brassica oleracea* L. (24), *Glycyrrhiza glabra* L. (2), *Mentha pulegium* L. (1), *Mentha viridis* L. (25), *Ocimum basilicum* L. (5), *Origanum compactum* Bentham. (16), *Thymus ssp (vulgaris)* (1), *Olea europaea* L. (15), *Avena sativa* L. (4), *Zingiber officinal* Rosc. (35).	10	128	0.92
Cough (CG)	*Lepidium sativum* L. (3), *Raphanus sativus* L. (11), *Boswellia carterii* Birdw. (9), *Cistus monspeliensis* L. (4), *Glycyrrhiza glabra* L. (3), *Trigonella foenum-graecum* L. (1), *Calamintha officinalis* Moench (14), *Lavandula stoechas* L. (15), *Mentha pulegium* L. (5), *Origanum majorana* L. (23), *Thymus ssp (vulgaris)*(6), *Eucalyptus globulus* Labill (19), *Olea europaea* L. (50), *Crataegus oxyacantha* L. (1), *Citrus limon* (L.) Brum. (5), *Zingiber officinal* Rosc. (12).	16	181	0.91
Bronchitis (BC)	*Ammoides pusilla* (Brot.) Breistr. (1), *Dittrichia viscosa* (L.) Greuter (3), *Echium plantagineum* L. (4), *Lepidium sativum* L. (5), *Raphanus sativus* L. (1), *Glycyrrhiza glabra* L. (3), *Trigonella foenum-graecum* L. (1), *Marrubium vulgare* L. (12), *Nigella sativa* L. (12), *Crataegus oxyacantha* L. (1), *Citrus limon*(L.) Brum. (3), *Alpinia officinarum* Han. (4).	12	50	0.77
Tuberculosis (TB)	*Ajuga iva* (L.) Schreb. (1), *Mentha suaveolens* Ehrh. (8), *Myrtus communis* L. (1).	3	10	0.77
Lung cancer (LC)	*Echium plantagineum* L. (1), *Raphanus sativus* L. (6), *Capparis spinosa* L. (3), *Eugenia caryophyllata* Thunb (2).	4	12	0.72

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGMENTS

The authors would like to thank all the residents of the Izarène region and all the people who contributed to the realization of this work. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

Ali BH, Blunden G (2003) Pharmacological and toxicological properties of *Nigella sativa*. Phytother Res 17: 299–305.

Anyinam C (1995) Ecology and ethnomedicine. Exploring links between current environmental crisis and indigenous medical practices. Soc Sci Med 40(3): 321-329.

Askarn O (1982) Comportement des Résineux dans l'Arboretum d'Izarène. Mémoire de Troisième Cycle Agronomie, Institut Agronomique et Vétérinaire Hassan II, Rabat, Maroc, 122 pp.

Bellakhdar J (1978) Médecine traditionnelle et toxicologie ouest-sahariennes. Contribution à l'étude de la pharmacopée Marocaine. Rabat, Maroc: Editions techniques Nord-Africaines, pp. 365.

Ben Akka F, Salhi S, Benkhnigue O, Dahmani J, Douira A, Zidane L (2019) Ethnobotanical study of medicinal plants used in the region of middle Oumrbia (Morocco). Plant Arch 19(2): 2005–2017.

Borgniet L, Long M, Capel AC, Bouillon C, Morge D, Ganteaume A, Lampin C, Jappiot M, Curt T, Machrouh A, Sesbou A, Mantzavelas A, Apostolopoulou I, Partozis T, Gitas I, Marell A, Cassagne N, Pimont F, Rigolot E, Morsdorf F, Koetz B and Allgower B (2009) Development of an easy to use tool to recognize and map fuel models. Deliverable D5.1-6 of the Integrated Project "Fire Paradox", Project no. FP6-018505. European Commission. 112 pp.

Boulos L (1983) Medicinal Plants of North Africa. Algonac: Reference Publications Incorporated.

Bruneton J (1996) Pharmacognosie – Phytochimie Plantes Médicinales. 2ème éd. Lavoisier, 1120 pp.

Cadena-González AL, Sørensen M, Theilade I (2013) Use and valuation of native and introduced medicinal plant species in Campo Hermoso and Zetaquira, Boyacá, Colombia. J Ethnobiol Ethnomed 9: 1–34.

Chaachouay N, Benkhnigue O, Fadli M, El Ayadi R, Zidane L (2019) Ethnopharmacological studies of medicinal and aromatic plants used in the treatment of respiratory system disorders in the Rif, Morocco. Ethnobot Res Appl 18: 22.

Dibong S D, Mpondo ME, Nigoye A, Kwin MF, Betti JL (2011) Ethnobotany and phytomedicine of medicinal plants sold in Douala markets [French]. J Appl Biosci 37: 2496–2507.

El Hassani M, Douiri EM, Bammi J, Zidane L, Badoc A, Douira A (2013) Plantes médicinales de la Moyenne Moulouya (Nord-Est du Maroc). Ethnopharmacologia 50: 39–53.

El Hilah F, Ben Akka F, Dahmani J, Belahbib N, Zidane L (2015) Étude ethnobotanique des plantes médicinales utilisées dans le traitement des infections du système respiratoire dans le plateau central marocain. J Anim Plant Sci 25(2): 3886–3897.

El Hilah F, Ben Akka F, Bengueddour R, Rochdi A, Zidane L (2016) Étude ethnobotanique des plantes médicinales utilisées dans le traitement des affections dermatologiques dans le Plateau Central Marocain. J Appl Biosc 98: 9252–9260.

Fennane M, Ibn Tattou M, Mathez J, Ouyahya A, El Oualidi J (1999) Flore pratique du Maroc, Vol. I. Trav. Inst. Sci. Rabat, série botanique 36. 558 pp. Rabat.

Franchomme P, Penoël D (2001) L'aromathérapie exactement. Paris: Ed. Roger Jollois, 480 pp.

Friedman J, Yaniv Z, Dafni A, Palewitch D (1986) A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Isr. J Ethnopharmacol 16(2–3): 275–287.

Gakuubi MM, Wanzala W (2012) A survey of plants and plant products traditionally used in livestock health management in Buuri district, Meru County, Kenya. J Ethnobiol Ethnomed 8: 1–19.

Godron M (1971) Essai sur une approche probabiliste de l'écologie des végétations. Thèse Doct. D'Etat, U.S.T.L. Montpellier, pp. 247.

Godron M, Daget Ph (1982) Analyse de l'écologie des espèces dans les communautés. Collection d'écologie 18, Paris: Masson, pp. 163.

HCEFLCD (2005) Haut Commissariat des Eaux et Forêts et de la lutte contre la désertification: Incendie de forêt au Maroc, situation actuelle et persp d'avenir, pp. 10.

Heinrich M, Ankli A, Frei B, Weimann C, Sticher O (1998) Medicinal plants in Mexico: Healers consensus and cultural importance. Soc Sci Med 47(11): 1859–1871.

Hmamouchi M (1999) Les plantes médicinales et aromatiques marocaines. Editions Fedala, Mohammedia, 450 pp.

Jouad H, Maghrani M, El Hassani RA, Eddouks M (2003) Hypoglycemic activity of aqueous extract of *Eucalyptus globulus* in normal and streptozotocin-induced diabetic rats. J Herbs Spic Med Plants 10: 19–28.

Lahsissene H, Kahouadji A, Tijane M, Hseini S (2009) Catalogue des plantes médicinales utilisées dans la région de Zaër (Maroc occidental). Lejeunia 186: 1–26.

Lin J, Puckree T, Mvelase TP (2002) Anti-diarrhoeal evaluation of some medicinal plants used by Zulu traditional healers. J Ethnopharmacol 79(1): 53–56.

Ministère de la Santé (2001) Guide pratique pour la prise en charge des maladies respiratoires dans les services de sante publiques spécialisés du Maroc, p 58. Direction de l'Epidémiologie et de Lutte Contre les Maladies.

Neves JM, Matos C, Moutinho C, Queiroz G, Gomes LR (2009) Ethnopharmacol notes about ancient uses of medicinal plants in Tras-os-Montes (Northern of Portugal). J Ethnopharmacol 124: 270–283.

Omer SA, Elobeid MA, Elamin MH, Hassan ZK, Virk P, Daghestani MH, Al-Olayan EM, Al-Eisa NA, Almarhoon ZM (2012) Toxicity of olive leaves (*Olea europaea* L.) in Wistar albino rats. Asian J Anim Vet Adv 7: 1175–1182.

Orch H, Zidane L, Douira A (2013) Contribution à la connaissance de la Flore vasculaire du massif d'Izarène (Nord Ouest Maroc). J Anim Plant Sci 20(2): 3093–3112.

Orch H, Zidane L, Douira A (2017) Ethnobotanical study of the plants used in the treatment of the digestive diseases by the riverine population of the forest of Izarène. Inter J Rec Sci Res 8(1): 15213–15220.

Sbai-Jouilil H, Fadli A, El Hafian M, El Ayad R, Benharbit O, Zidane L (2017) Floristic and ethnobotanical study of medicinal plants used in the treatment of respiratory diseases in Seksaoua region (West H Moroccan Atlas). Ann Res Rev Biol 17(6): 1–10.

Scherrer AM, Motti R, Weckerle CS (2005) Traditional plant use in the areas of Monte Vesole and Ascea, Cilento National Park (Campania, Southern Italy). J Ethnopharmacol 97: 129–143.

Sharma PP, Mujumdar AM (2003) Traditional knowledge on plants from Toranmal plateu of Maharashtra. Indian J Tradit Know 2: 292–296.

Sijelmassi A (1993) Les plantes médicinales du Maroc, 6ème édit. Casablanca: Fennec. 285 pp.

SPEF (2004) Incendie du massif forestier d'Izarene du 23 au 25 août 2004. Service Provincial des Eaux et Forêts de Chefchaouen, 17 pp.

Tardío J, Pardo-de-Santayana M (2008) Cultural importance indices: a comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). Econ Bot 62(1): 24–39.

Trabi FH, Irié GM, N'gaman KCC, Mohou CHB (2008) Études de quelques plantes thérapeutiques utilisées dans le traitement de l'hypertension artérielle et du diabète: deux maladies émergentes en Côte d'Ivoire. Sci Nat 5(1): 39–48.

Valdés B, Rejdali M, Achhal el Kadmiri A, Jury JL (2002) Catalogues des plantes vasculaires du nord du Maroc, incluant des clés d'identification, (2Vol). 1498 pp. Madrid.

Zaoui A, Cherrah Y, Lacaille-Dubois MA, Settaf A, Amarouch H, Hassar M (2000) Diuretic and hypotensive effects of *Nigella sativa* on the spontaneously hypertensive rat. Therapie 55: 379–382.

Yaseen G, Ahmad M, Sultana S, Alharrasi AS, Hussain J, Zafar M, Ur-Rehman S (2015) Ethnobotany of medicinal plants in the Thar Desert (Sindh) of Pakistan. J Ethnopharmacol 163: 43–59.

Wang YC, Lin JM, Lin CY, Li LT, Guo YL, Sung FC (2007) Prevalence and risks of chronic airway obstruction. Chest 131(3): 705–710.

WHO - World Health Organization (2007) Global Surveillance, Prevention and Control of Chronic Respiratory Diseases A Comprehensive Approach, Geneva, 155 pp.

AUTHOR CONTRIBUTION:

Contribution	Orch H	Zidane L	Douira A
Concepts or ideas	x	x	
Design	x	x	x
Definition of intellectual content	x	x	x
Literature search	x	x	
Experimental studies	x	x	
Data acquisition	x	x	
Data analysis	x		
Statistical analysis	x		
Manuscript preparation	x	x	x
Manuscript editing	x	x	
Manuscript review	x	x	x

Citation Format: Orch H, Zidane L, Douira A (2020) Ethnobotanical study of plants used in the treatment of respiratory diseases in a population bordering the forest of Izarène. J Pharm Pharmacogn Res 8(5): 392–409.

Appendix 1. Questionnaire sheets: Medicinal plants and phytotherapy.

Date.....	Commune.....
Caïdat	Survey number.....

Age	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
[18-30[					
[30-40[					
[40-50[					
[50-60[					
> 60					
Job	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Sex	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Male					
Female					
Family situation	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Single					
Married					
Level of study	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Illiterate					
Primary					
Secondary					
University					
Locality	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Village					
Douar					
Income / month (MAD)	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
No income					
Low income					
Average income					
When you feel sick, you address:	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Traditional medicine					
Modern medicine					
Traditional medicine and Modern medicine					
To traditional medicine, why?	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Effective					
Cheapest					
Acquisition					

Appendix 1. Questionnaire sheets: Medicinal plants and phytotherapy (continued…).

Plant Type	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Ineffective medication					
Spontaneous					
Cultivated					
Introduced					
Use of the plant	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Therapeutic					
Cosmetic					
Other					
Harvesting technique	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Manual					
Mechanical					
Harvest Time	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Summer					
Fall					
Winter					
Spring					
Any year					
If desiccated, drying method	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Sun exposure					
In the shade					
Use of the plant	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Fresh					
Desiccated					
After treatment					
Used part	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Fruit					
Stem					
Whole plant					
Seed					
Rhizome					
Other combination					
Root					
Bark					
Leaf					
Flower					
Bulb					

Appendix 1. Questionnaire sheets: Medicinal plants and phytotherapy (continued…).

Form of employment	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Tisane					
Powder					
Essential oil					
Oily oil					
Tincture					
Method of preparation	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Decoction					
Infusion					
Cataplasm					
Raw					
Cooked					
Powder					
Maceration					
Others					
Dose used	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Pinch					
Handle					
Spoonful					
Administration mode	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Oral					
Massage					
Rinse					
Brushing					
Inhalation					
Others					
Dosage for children	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
1time/day					
2time/day					
3time/day					
Other					
Dosage for adults	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
1time/day					
2time/day					
3time/day					
Other					
Dosage for older people	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
1time/day					
2time/day					
3time/day					
Other					

Appendix 1. Questionnaire sheets: Medicinal plants and phytotherapy (continued…).

Length of Use	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
One day					
A week					
One month					
Until healing					
Conservation method	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Sheltered from the light					
Exposed to light					
Other					
Diagnosis By	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Himself					
Doctor					
Herbalist					
Other					
Results	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
Healing					
Improvement					
Ineffective					
Side effects	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
No					
Yes					
Toxicity	**Mokrisset (S1)**	**Zoumi (S2)**	**Ain Baïda (S3)**	**Brikcha (S4)**	**Total**
No					
Yes					