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Ethnobotanic study of medicinal plants in the Guerbes-Sanhadja wetland complex (North East of Algeria)

Abdelouahab BELAIDI [1&2], Yassine BEGHAMI [1&3], Francisco Maria VÁZQUEZ PARDO[4], Nabila SOUILAH [5]

[1]Laboratory for Improvement of Agricultural Productions and Protection of Ecosystems in Dry Areas (LAPAPEZA), Allées 19 mai, Route de Biskra, Batna, Algeria.

[2]Department of SNV, Faculty of Sciences, University of Skikda, P.B. 26 Road of El Hadaiek, Skikda, Algeria.

[3]Department of Agronomic Sciences, Institute of Veterinary Sciences and Agronomic Sciences, Allées 19 mai, Route de Biskra, Batna, Algeria.

[4] Department of Plant Biodiversity and Forest Production, Center for Scientific and Technological Research of Extremadura (CICYTEX), A5 km 372, 06187 Guadajira Badajoz, Spain

[5&1] Laboratory for the optimization of agricultural production in sub-humid zones, Faculty of Sciences, Department of Agronomic Sciences, University of Skikda, Skikda, 21000, Algeria

Corresponding author: abdelouahab.belaidi@univ-batna.dz

Abstract

In order to inventory the medicinal flora and preserve the phytotherapeutic knowledge of the Guerbes-Sanhadja wetland complex, this study was undertaken on the basis of a sample made up of 400 users of medicinal plants, the majority of whom are aged between 40 and 60 years old, married, illiterate and unemployed or farmers. The analysis of the questionnaires allowed the census of 102 species with a clear predominance of *Myrtus communis* L. (158 citations), the results obtained have shown that the most used part of the plant is the leaf (58.25%). In addition, the decoction is the most used preparation method (52.28%). As for the diseases treated, gastrointestinal disorders dominate with the use of 59 species. Finally, the calculation of some ethnobotanical parameters allowed us to observe the wide use of *Pistacia lentiscus* L. (UV = 1.15), the specificity of *Eucalyptus globulus* Labill. to treat respiratory diseases (FL = 100%) and thus the consensus of users with respect to the treatment of gastrointestinal diseases (ICF = 0.91).

Key words: Ethnobotanical, medicinal plants, Wetland, Guerbes-Sanhadja

1. Introduction

The Mediterranean region has an exceptional biological diversity, its richness floristic estimated at 25 000 species of vascular plants, which corresponds to 9.2% of the flora worldwide, in a territory representing only 1.5% of the earth's surface **(Quézel 1997; Médail, 2008)**. This region is the third richest hot pot in the world in plant diversity **(Mittermeier *et al*., 2004).** With more than 3,139 species **(Quézel and Santa, 1962-63)**, the Algerian flora is one of the richest in North Africa **(Miara *et al*., 2018)**. Algeria has 254 wetlands of international importance, located mainly in the east of the country and occupies nearly three million hectares. The Guerbes-Sanhadja wetland complex is one of these Algerian wetlands, it is a site of great importance (classified as a Ramsar site 2001) which constitutes a reservoir of flora biodiversity

(334 species inventoried by Samraoui and **De Belair (1997)** Among this rich flora, several plants are used by the local population for phytotherapeutic purposes.

In Algeria, phytotherapy is an integral part of the local culture; the population has significant indigenous knowledge acquired empirically over generations **(Bouasla and Bouasla 2017)**. According to **Reguieg (2011)**, medicinal and aromatic plants have been used by the Algerian populations to treat several diseases for centuries. Traditional medicines, and more particularly herbal treatments, have been well developed in Algeria, but the use of conventional medicine has led to the abandonment of these ancestral practices which have not been forgotten **(Rebbas *et al*., 2012)**.

Despite the different ethnobotanical studies of medicinal plants published in Algeria **(Kaddem, 1990; Baba Aissa, 1991; Ould El Hadj *et al*., 2003; Hammiche and Maiza, 2015; Rebbas *et al*., 2012; Miara *et al*., 2013; Chermat and Gharzouli, 2015; Ouelbani *et al*., 2016; Bouredja *et al*., 2017; Souilah *et al*., (2018); Bendif *et al*. (2018); Miara *et al*., 2018; Miara *et al*., 2019a and 2019b),** and despite the remarkable floristic richness of the region which is reflected in the various floristic inventories carried out in the region and published **(Samraoui and De Belair, 1997; Belouahem-abed *et al*, 2009; Oumessaad *et al*., 2014)**.

This study represents the first ethnobotanical study initiative carried out in the Guerbes-Sanhadja wetland complex. Such an initiative could however fill this gap and bearing as objectives, the identification of these floristic potentialities, and the knowledge of different phytotherapeutic uses in order to contribute in the preservation of traditional knowledge relating to phytotherapy in the region, which allows by the following the development of these medicinal plants and the establishment of a preservation strategy for this complex, knowing that 60% of medicinal plants are taken from nature (often in an unsustainable way).

2. Materials and method

2.1. Study area

The Guerbès-Senhadja wetland complex (West Numidia), a vast territory that is part of Numidia **(Maire 1926, Quezel and Santa 1962-1963, Marre 1992).**The ecocomplex (36 ° 46'-37 ° 1 'N, 7 ° 8'-7 ° 25' E) is located in the northeast of Algeria and covers the eastern part of the wilaya of Skikda. It covers an area of 42,100 ha and bordered to the north by the Mediterranean Sea, to the east by the Edough forest massif, to the west by the Filfila forest massif and to the south by the forest massif of Boumaïza (Figure 1).

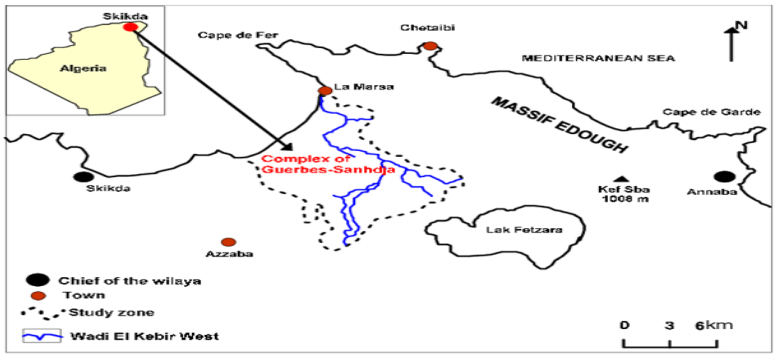

Figure 1. Location of the Guerbes-Sanhadja wetland complex (**Hedjal *et al*., 2014*).***

2.2. Ethnobotanical surveys

The stratified probability sampling technique is the sampling method adopted, this technique allows to have a more representative sample **(Kahouadji, 1986).**And which consists in dividing beforehand the studied population into eight (08) strata or localities, within each stratum (localities) we carried out a simple random sampling composed of 50 users of medicinal plants per stratum, hence a sample total of 400 surveyed (Table 1).

Ethnobotanical surveys were conducted face to face **(Martin, 1995).** The interview was conducted without pressure to allow the informants to answer questions naturally **(Akerreta *et al*., 2007),** according to the ISE code of ethics (with 2008 additions) (ethnobiology.net/code-of-ethics/). The survey form used includes information on the informant (sex, age, academic level, family situation, monthly income, function and source of information), and information on the plant and its phytotherapeutic uses (vernacular name, part used, method of preparation and diseases treated). The language used is the Arabic language, and at the end of the surveys, the plants were photographed on site, harvested, identified and dried to build the herbarium of the plants used. The botanical identification of the specimens was made using the following floras: **Maire (1959), Quézel and Santa (1962-63), Kaddem (1990), Baba Aissa (1991), Halimi, 1997, Samraoui and De belair, (1997), Toubal *et al*., (2014).** We also used the online data bases:www.tela-botanica.org and www.theplantlist.org for checking the scientific names and synonyms of plants (Table 2).

Table 1. Distribution of surveys by locality

Localities	Number of investigation
Ben azzouz	50
El marssa	50
Djendel	50
Guerbes	50
Ain nechma	50
Ezzaouia	50
El marssa-ZP	50
El hamma	50
Total	400

2.3. Measured parameters

- **Use Value (UV):** The relative importance of each plant species known locally for use as an herbal remedy is called as UV. It was calculated according to the following formula **(Barnert and Messmann, 2008)**: $UV = \Sigma U / n$
  U: number of use-reports cited by each informant for a given plant species, n: total number of informants interviewed for a given plant.

- **Fidelity level (FL):** it is used to determine the most frequent plant species used to treat a particular disease category by informants in the study area. The FL is calculated according to the following formula **(Martin, 1995)**: $FL= (Np/N) X 100$
  Np: number of use-reports cited for a given species for a category of diseases particular, N: total number of use-reports cited for a given species.

- **Informant Consensus Factor (ICF):** is used to see if there is agreement on the use plant in disease categories among plant users in the study area. The ICF was calculated according to the following formula **(Bağı, 2000)**: ICF = (Nur- Nt) / (Nur -1)
  Nur: refers to the number of use-reports for a particular disease category, Nt: refers to the number of taxa for a particular disease category by all Informants.

3. Results and discussions

3.1. Census of medicinal plants used by the local population of the complex

Table 2: list of medicinal plants used by the local population of the complex.

N°	Scientific name	Familly	Common name in French	Common name in English	Vernacular name in Arabic	Diseases treated	N	UV	*FL* (%)
01	*Acanthus mollis* L.	Acanthaceae	Acanthi	Bear's breeches	تفيفرة	Gastro-intestinal disorders	01	**1**	33.33
						Other diseases	01		33.33
02	*Adiantum capillus-veneris* L.	Pteridaceae	Capillaire de Montpellier	Southern maidenhair fern	الزياتة	respiratory diseases	01	**1**	33.33
03	*Ajuga iva* (L.) Schreb.	Lamiaceae	Ivette musquée	Ivette Musky	تشنڤدورة	gastro-intestinal disorders	03	**1**	50
						Genital diseases	01		16,67
						dermatological disorders	01		16,67
						Other diseases	01		16,67
04	*Allium cepa* L.	Amaryllidaceae	Oignon	Onion	البصل	Cardiovascular diseases	04	**1**	66,67
						Urinary diseases	01		11,11
						Fever and headache	01		11,11
						dermatological disorders	03		33,33
05	*Allium sativum* L.	Amaryllidaceae	Ail	Garlic	ثوم	Cardiovascular diseases	10	**1**	66,67
						Aesthetic	02		13,33
						Respiratory diseases	03		20
06	*Allium triquetrum* L.	Liliaceae	Ail à trois angles	Three-cornered leek	بيبراس	Other diseases	01	**1**	50
						Gastro-intestinal disorders	01		50
07	*Aloe succotrina All.*	Aloecaceae	Aloès	Fynbos aloe	الصبار	dermatological disorders	01	1	100
08	*Aloysia citriodora* Palau	Verbenaceae	Verveine odorante	Lemon Verbena	تيزانة, لويزة	respiratory diseases	03	1,17	42,86
						gastro-intestinal disorders	04		57,14
09	*Angelica officinalis* L.	Apiaceae	Angélique officinale	Angelic	ودن الحلوف	dermatological disorders	3**5**	1,1**4**	5**3**,**03**
						gastro-intestinal disorders	3**0**		4**5**,4**5**
						Other diseases	01		1,5**1**
10	*Anthyllis vulneraria* L.	Fabaceae	Vulnéraire trèfle jaune	Common kidneyvetch	عشبة الخياطة	gynecological diseases	01	**1**	12,5
						dermatological disorders	07		87,5
11	*Apium graveolens* L.	Apiaceae	Céleri	Celery		Cardiovascular diseases	01		50

					لكرافس	Gastro-intestinal disorders	01	**1**	50
12	*Arbutus unedo* L.	Ericaceae	Arbousier	Strawberry Tree	**اللنج**	Burns	01	**1**	100
13	*Artemisia absinthium* L.	Asteraceae	Absinthe	Wormwood	**الشيبة حشيشةمريم**	Cardiovascular diseases	04		66,67
						endocrine diseases	02	**1**	33,33
14	*Artemisia herba-alba* Asso.	Asteraceae	Armoise	Wormwood	**الشيح**	Gastro-intestinal disorders	07	1,17	100
15	*Arum italicum* Mill.	Araceae	Arum d'Italie	Italian arum	**قريوة**	Cardiovascular diseases	13		68,42
						fever and headache	05	1	26,32
						Jaundice	01		5,26
16	*Asphodelus microcarpus* L.	Xanthorrhoeaceae	Asphodèle	Asphodel	**البرواڤ**	dermatological disorders	06		85,71
						O.R.L	01	1	14,29
17	*Avena sativa* L.	Asparagaceae	Avoine	Oat	**الخرطال**	Endocrine diseases	01	1	100
18	*Carlina gummifera* (L.) Less.	Asteraceae	Chardon à glu	Lectotype Atractylis	**الدادة**	dermatological disorders	04		57,14
						Burns	01	1	14,29
						Cardiovascular diseases	02		28,57
19	*Borago officinalis* L.	Boraginaceae	Bourrache officinale	Borage	**الحرشة**	Gastro-intestinal disorders	01	1	100
20	*Carpobrotus edulis* (L.) N.E.Br.	Aizoaceae	Doigt de sorcière	Hottentot-fig	**الملاحة**	Dermatological disorders	**01**	**1**	100
21	*Cassia abovata* collad.	Fabaceae	Séné du Sahara	Neutral henna	**الفليت**	Gastro-intestinal disorders	01	1	100
22	*Ceratonia siliqua* L.	Fabaceae	Caroubier	The carob	**الخروب**	Gastro-intestinal disorders	**01**	**1**	100
23	*Chamaemelum nobile* (L.) All.	Asteraceae	Camomille romaine	Roman Chamomile	**البابونج**	gastro-intestinal disorders	10		62.5
						Analgesics and sedatives diseases	02		12.5
						Aesthetic	01		6.25
						Endocrine diseases	01	1,14	6.25
						Urinary diseases	01		6.25
						Genital diseases	01		6.25
24	*Circaea lutetiana* L.	Onagraceae	Circeé de paris	Witches herbs	**العشرق**	Genital diseases	01	1	100
25	*Citrullus colocynthis* (L.) Schard.	Cucurbitaceae	Coloquinte officinale	Bitter Cucumber	**الحنضل/ الحدج**	Eye diseases	01	1	100
26	*Citrus limon (*L.) Osbeck	Rutaceae	Citron	Lemon	**الليمون**	Other diseases	01	1	100
27	*Citrus sirensus* (L.) Osbeck.	Rutaceae	Oranger	Orange	**البرتقال**	Dermatological disorders	01	1	100

28	*Crataegus monogyna* Jacq.	Rosaceae	Aubépine	Common hawthorn	الزعرور البري	Cardiovascular diseases	01		33,33
						Gastro-intestinal disorders	02	1	66,67
29	*Cucumis melon* L.	Cucurbitaceae	Melon jaune	Yellow melon	البطيخ	Gastro-intestinal disorders	01	1	100
30	*Cuminum cyminum* L.	Apiaceae	Cumin	Cumin	الكمون	Gastro-intestinal disorders	03	1	100
31	*Cupressus sempervirens* L.	Cupressaceae	Cypress	Mediterranean cypress	السرو	Dental diseases	06		85,71
						Hemorrhoids	**01**	1,17	14,29
32	*Cynara scolymus* L.	Asteraceae	Artichaut	Artichoke	الخرشف	Gastro-intestinal disorders	01	1	100
33	*Cytisus triflorus* Lam.	Fabaceae	Cytise allonge	Elongated laburnum	لقة	gastro-intestinal disorders	**3**8		6**3**,33
						Burns	12	1,05	20
						dermatological disorders	**10**		16,67
34	*Daphne gnidium* L.	Thymelaeaceae	Daphné garou	Daphne Were	الشرواخ اللزاز	Cardiovascular diseases	01		10
						Jaundice	0**7**	1,11	70
						fever and headache	01		10
						Dental diseases	01		10
35	*Dittrichia viscosa* (L.) Greuter	Asteraceae	Inule visqueuse	Viscous Inule	المقرمان	dermatological disorders	06	1	66,67
						Gastro-intestinal disorders	03		33.33
36	*Ecballium elateruim* L.	Cucurbitaceae	Concombre d'âne	Squirting cucumber	فقوس الحمير	Gastro-intestinal disorders	0**1**	1	50
						Jaundice	01		50
37	*Echinops ritro* L.	Asteraceae	Azurite	Outhern globethistle	الشوكة الزرقاء	Gastro-intestinal disorders	**01**	1	100
38	*Eucalyptus globulus* Labill.	Myrtaceae	Eucalyptus/ Gommier bleu	Australian Fever Tree	الكاليتوس	Respiratory diseases	73	1,01	100
39	*Euphorbia helioscopia* L.	Euphorbiacaea	Euphorbe réveil matin	sun spurge	حليب الدابة	Burns	01	1	100
40	*Ferula assa-foetida* L.	Apiaceae	Ase fédite	Heeng/ Asafoetida	الحنتيتة	Gastro-intestinal disorders	01	1	50
						fever and headache	01		50
41	*Ficus carica* L.	Moraceae	Figuier	Fig	الكرموز	dermatological disorders	01	1	100
42	*Foeniculum vulgare* Mill.	Apiaceae	Fenouil doux	Sweet Fennel	البسباس	Gastro-intestinal disorders	11	1	100
43	*Fraxinus angustifolia* Vahl	Oleaceae	Frêne	Narrow-leafed ash	الضرضار	Gastro-intestinal disorders	**01**	**1**	100
44	*Genista tricuspidata* Desf.	Fabaceae	Génêt à 3 points	Broom	القندول	Gastro-intestinal disorders	01	1	50
						Eye diseases	01		50
45	*Globularia alypum* L.	Plantaginaceae	Globulaire buissonnante	Globe Daisy	تسلغة	Gastro-intestinal disorders	**09**	1	100

46	*Glycyrrhiza glabra* L.	Fabaceae	Réglisse	Licorice	عرقالسوس	Gastro-intestinal disorders	01	1	100
47	*Heliotropium bacciferum* Forssk.	Boraginaceae	Héliotrope	Turn-sole	الرمرام	Gastro-intestinal disorders	07		87,5
						Dermatological disorders	01	1	12,5
48	*Hordeum vulgare* L.	Poaceae	Orge commun L.	Barley	الشعير	Gynecological diseases	1	1	25
						Urinary diseases	03		75
49	*Hyoscyamus albus* L.	Solanaceae	Jusquiame blanche	White henbane	صالح الدار / قنفيط	Other diseases	01	1	50
						Dermatological disorders	01		50
50	*Juniperus oxycedrus* L.	Cupressaceae	Genévrier oxycèdre	Oxycedre Juniper	العرعار	Gastro-intestinal disorders	01	1	100
51	*Laurus nobilis* L.	Lauraceae	Laurier sauce	Bay Laurel	الرند	Cardiovascular diseases	10		55,55
						Gastro-intestinal disorders	06	1	33,33
						Dermatological disorders	01		5,56
						Endocrine diseases	01		5,56
52	*Lavandula stoechas* L.	Lamiaceae	Lavande papillon	Lavender	الحلحالة / الخزامة / عرقالصفيرة	gastro-intestinal disorders	20	1.10	95,24
						Endocrine diseases	01		4,76
53	*Lawsonia inermis* L.	Lythraceae	Henné	Henna	الحناء	fever and headache	01	1	100
54	*Lens culinaris* Medik.	Fabaceae	lentille cultivée	Lentil	لعدس	Hematologic diseases	01	1	100
55	*Lepidium sativum* L.	Brassicaceae	Cresson alénois	Cress	حب الرشاد	Dermatological disorders	01	1	100
56	*Linum usitatissimum* L.	Linaceae	Lin cultivé	Flax	زريعةالكتان	Gastro-intestinal disorders	01	1	100
57	*Malva sylvestris* L.	Malvaceae	Grand mauve	Common Mallow	الخبايزة	Gynecological diseases	01		25
						Cardiovascular diseases	01		25
						Hematologic diseases	01	1	25
						Dermatological disorders	01		25
58	*Marrubium vulgare* L.	Lamiaceae	Marrube commun	White Horehound	تمريوت	Endocrine diseases	**07**		50
						Gastro-intestinal disorders	**04**		28,57
						Other diseases	0**2**	1	14,29
						Urinary diseases	01		7,14
59	*Mentha viridis* L.	Lamiaceae	Menthe verte	Green Mint	النعناع	Gastro-intestinal disorders	24	1,04	100
60	*Mentha pulegium* L.	Lamiaceae	Menthe pouliot	Mint	لفلايو	gastro-intestinal disorders	23		74,19
						Analgesics and sedatives diseases	05		16,13
						Respiratory diseases	01	1,11	3,23

						dermatological disorders	01		3,23
						Cardiovascular diseases	01		3,23
61	*Mespilus germanica* L.	Rosaceae	Néflier commun	Medlar	**الموز /الزعرور**	Gastro-intestinal disorders	03	1	100
62	*Myrtus communis* L.	Myrtaceae	Myrte commun	Myrtle	**الريحان**	gastro-intestinal disorders	140	1,04	88,61
						Analgesics and sedatives diseases	11		6,96
						Cardiovascular diseases	06		3,80
						Respiratory diseases	01		0,63
63	*Nerium oleander* L.	Apocynaceae	Laurier rose	Oleander	**الدفلة**	dermatological disorders	02	1	66,67
						Gastro-intestinal disorders	01		33,33
64	*Nicotiana tabacum* L.	Amaranthaceae	Tabac cultivé	Cultivated tobacco	**الدخان**	dermatological disorders	01	1	100
65	*Ocimum basilicum* L.	Lamiaceae	Basilic	Basil	**لحبق**	Cardiovascular diseases	01	1,33	25
						Analgesics and sedatives diseases	01		25
						Gastro-intestinal disorders	02		50
66	*Olea europaea* L.	Oleaceae	Olivier	Olive Tree	**الزيتون**	Gastro-intestinal disorders	05	1,40	35,71
						Oral diseases	04		28,57
						Cardiovascular diseases	02		14,29
						Respiratory diseases	01		7,14
						dermatological disorders	02		14,29
67	*Olea europaea* (L). Var sylvestris *(Mill.) Lehr*	Oleaceae	Oléastre	Oleaster	**الزبوش**	Cardiovascular diseases	08	1,05	40
						endocrine diseases	08		40
						dermatological disorders	02		10
						Gastro-intestinal disorders	01		5
						respiratory diseases	01		5
68	*Opuntia ficus-indica* (L.) Mill.	Cactaceae	Figuier de Barbarie	Prickly Pear	**الهندي**	respiratory diseases	08	1,4	57,14
						urinary diseases	02		14,29
						dermatological disorders	04		28,57
69	*Petroselinum crispum* (Mill.) Fuss.	Apiaceae	Persil cultivé	Parsley	**المعدنوس**	urinary diseases	10	1,17	71,43
						Hemorrhoids	**01**		7,14
						Gastro-intestinal disorders	03		21,43
70	*Phillyrea media L.*	Oleaceae	Filaire	Mock privet	**الفيلار /الكتم**	Antiseptic	01	01	100
	Pinus pinaster Aiton	Pinaceae	Pin maritime		**الصنوبر البحري**	respiratory diseases	01		33,33

71				the maritime pine		Gastro-intestinal disorders	02	01	66,67
72	*Pistacia lentiscus* L.	Anacardiaceae	Pistachier lentisque	Mastic	الضرو القضوم	Gastro-intestinal disorders	47	1,15	38,52
						respiratory diseases	34		27,87
						dermatological disorders	24		19,67
						burns	12		9,84
						eye diseases	03		2,46
						Analgesics and sedatives diseases	01		0,82
						hemorroïdes	01		0,82
73	*Populus alba* L.	Salicaceae	Peuplier blanc	White Poplar	الصفصاف	Cardiovascular diseases	01	1	33,33
						dental diseases	02		66,67
74	*Punica granatum* L.	Lythraceae	Grenadier commun	Pomegranate	الرمان	Gastro-intestinal disorders	13	1	100
75	*Pimpinella anisum L.*	Apiaceae	Anis cultivé	Anise	حبةحلاوة	Gastro-intestinal disorders	01	1	100
76	*Piper nigrum* L.	Piperaceae	Poivre noir	Black Pepper	الفلفل لكحل	respiratory diseases	01	1	100
77	*Quercus suber* L.	Fagaceae	Chêne liège	Cork Oak	البلوط/ الفرنان	gastro-intestinal disorders	24	1	92,32
						endocrine diseases	01		3,84
						hematologic diseases	01		3,84
78	*Rhamnus alaternus* L.	Rhamnaceae	Nerprun alaterne	Mediterranean Buckthorn	عودالخير	Jaundice	07	1	87,5
						endocrine diseases	01		12,5
79	*Rosa canina* L.	Rosaceae	Rosier des chiens	Dog-Rose	نابالكلب	Gastro-intestinal disorders	01	1	100
80	*Rosmarinus officinalis* L.	Lamiaceae	Romarin	Rosemary	لكليل	gastro-intestinal disorders	48	1	90,57
						respiratory diseases	02		3,76
						urinary diseases	01		1,89
						O.R.L	01		1,89
						endocrine diseases	01		1,89
81	*Rubus ulmifolius* J.Presl & C.Presl	Rosaceae	Roncier	Bramble	العليڤ /الحلس	burns	18	1,12	94,74
						oral diseases	01		5,26
82	*Ruta chalepensis* L.	Rutaceae	Rue	Commun Rue	الفيجل	respiratory diseases	04	1,07	26,67
						burns	04		26,67
						Gastro-intestinal disorders	03		20
						Cardiovascular diseases	02		13,33
						endocrine diseases	01		6,67
						Other diseases	01		6,67

83	*Salvia officinalis* L.	Lamiaceae	Sauge officinale	Sage	سواكالنبي	gastro-intestinal disorders oral diseases Gynecological diseases	01 01 02	1	25 25 50
84	*Scilla maritima* L.	Liliaceae	Scille maritime	Squill	العنصل	fever and headache burns dermatological disorders	01 01 01	1	33.33 33.33 33.33
85	*Silybum marianum* (L.) Gaerth.	Asteraceae	Chardon Marie	cardus marianus	الخرشف البري	Gastro-intestinal disorders urinary diseases endocrine diseases	02 01 01	1,33	50 25 25
86	*Spergularia rubra* (L.) J.Presl. & C.Presl	Caryophyllaceae	Sabline	Red Sandspurry	كسارةلحجر	Urinary diseases	17	1,06	100
87	*Spinacia oleracea* L.	Amaranthaceae	Epinard	Spinach	السلق	Hematologic diseases	01	1	100
88	*Syzygium aromaticum* (L.) Merr. & L. M. Perry	Myrtaceae	Giroflier	Cloves	الطيب	Dermatological disorders	01	01	100
89	*Tamarix aphylla* (L.) H.Karst.	Tamaricaceae	Tamarix	Tamarix	الطحطاح/ عرعار الواد	Dermatological disorders	01	1	100
90	*Thymus algeriensis* Boiss. et Reut.	Lamiaceae	Thym	Wild Thyme	زعترالجبل	gastro-intestinal disorders	15	1	100
91	*Thymus serphyllum* L	Lamiaceae	Serpolet	Breckland thyme	الزعتر البري	Gastro-intestinal disorders	01	1	100
92	*Thymus vulgaris* L.	Lamiaceae	Thym cultivé	Garden Thyme	الزعتر	gastro-intestinal disorders Respiratory diseases Analgesics and sedatives diseases	94 02 01	1,02	96,91 2,06 1,03
93	*Teucrium polium* L.	Lamiaceae	Germandrée tomenteuse	Felty germander	حشيشة الريح	Gastro-intestinal disorders	01	01	100
94	*Traganum nudatum* Delile	Amaranthaceae	Domrane	Domrane	الضمران	Gastro-intestinal disorders Dermatological disorders Hemorrhoids Other diseases Genital diseases Cardiovascular diseases Analgesics and sedatives diseases	33 05 05 03 02 01 01	1,04	 10 10 6 4 2 2

95	*Trigonella foenum-graecum* L.	Fabaceae	Fenugrec	Fenugreek	لحلبة	Gastro-intestinal disorders	10	1	91,67
						Analgesics and sedatives diseases	01		8,33
						Hematologic diseases	01		8,33
96	*Triticum durum* Desf.	Poaceae	Blé dur	Durum wheat	لقمح	Urinary diseases	01	1	100
97	*Triticum repens* L.	Poaceae	Chiendent rampant	Couch grass	نجم الأرض	Gastro-intestinal disorders	**01**	1	100
98	*Urtica dioica* L.	Urticaceae	Ortie commune	Common nettle	لحرايقة	Cardiovascular diseases	03	1	75
						Dermatological disorders	01		25
99	*Vitis vinifera* L.	Vitaceae	Vigne cultivée	Grape- Vine	لعنب	fever and headache	05	1	100
100	*Zea mays* L.	Poaceae	Mais	Maize	لمستورة	Urinary diseases	01	1	50
						Dermatological disorders	01		50
101	*Zingiber officinale* Roscoe	Zingiberaceae	Gingembre	Ginger	الزنجبيل	Other diseases	01	1	50
						Gastro-intestinal disorders	01		50
102	*Ziziphus lotus* (L.) Lam.	Rhamnaceae	Sedra	Sedra	السدرة	Respiratory diseases	02	1	50
						Rheumatic diseases	01		25
						Gastro-intestinal disorders	01		25

N: nombre total d'utilisation-rapports citées pour une espèce donnée, VU: valeur d’utilisation, FIC: Factor Informant Consensus.

3.2. Analysis of the socio-demographic profile of informants

Knowledge of the properties and use of medicinal plants are usually acquired through a scientific and experimental knowledge accumulated and passed from one generation to another **(Bouredja *et al*., 2017).**

The results obtained show that all users of different age groups use medicinal plants with different proportions, people aged between 40 and 60 years old dominate with a use rate of 44.06%, followed by the two age groups. [20-40 [and ≥ 60 with utilization rates of 29.95 and 25.49% respectively. While, young people under the age of 20 are not interested in herbal medicine with a fairly low rate of use of around 0.5%. This may endanger herbal medicine, and makes us fear for its future in the next generations, as young people today are not very dependent on this method of treatment and prefer modern medicine. Results similar to those of **Miara *et al*., (2018) and Souilah *et al*., (2018)** in Algeria **and Chaachouay *et al*., (2019)**, in the Rif region in Morocco**. Anyinam *et al*., (1995),** mention that knowledge of the properties and uses of medicinal plants are generally acquired with age and with long experience passed from one generation to the next. The transmission of this knowledge is in danger today because it is not always assured.

In the study region, the majority of herbal users are married with a percentage of (85.4%), compared to (13.36%) for single people, and (1.24%) for divorcees. This predominance is confirmed in Algeria by **Bouredja *et al*. (2017)** and in Morocco by **Chaachouay *et al*. (2019)**, this can be explained by the growing responsibilities of married couples towards their children and thus in order to minimize medical costs. Regarding the level of study of users, we notice the existence of a decreasing relationship between the academic level and the rate of use of medicinal plants, illiterates use plants more than others with a rate of 30.69%, followed by those with a fundamental level (28.22%). However academics have not shown much interest in medicinal plants with a rate of only 10.64%. Same observation by **Sadallah and Laidi, (2018)** in Bouira in Algeria and **Daoudi *et al*., (2015)** in the province of Khénifra in Morocco where illiterates use plants at 75.7% against 0.8% for academics.

The unemployed and farmers represent two thirds of all users with rates of 36.88% and 31.19% respectively, since farmers are in constant contact with plants and know them better than others, in addition to the herbal medicine allows the unemployed to minimize the various burdens generated by modern medicine.

The obtained results allow us to observe the existence of a decreasing relation between the monthly income in DA and the rate of use of medicinal plants, most of the users of these plants having an income of less than 25,000, including the unemployed., with a rate of (30.44%), however the lowest utilization rate is recorded by people with an income greater than 50,000 DA with a rate of around 0.5%. these results obtained are consistent with those of **Kerdous, (2002)** and **Amrouni, (2009), Souilah, (2018)** in eastern Algeria.

Finally, as regards the origin of the information, the majority of users have acquired phytotherapeutic information from the family or other people with a rate of 98.26%, while the other sources of information (reading, internet , and personal experiences) are less cited with a cumulative percentage of only 1.74%, this reflects the image of the transmission of therapeutic

practices from one generation to another and indicates the dependence of users on their families with regard to the phytotherapy. Observation similar to that of **Souilah *et al*. (2018)** in El Kala National Park in Algeria.

Table 3. Classification of informants according to several factors

Factor	Categories	%
Age	< 20	0,5
	[20-40[	29,95
	[**40-60**[	44,06
	≥ 60	25,49
Family situation	Single	13,36
	Married	85,4
	divorced / widowed	1,24
Study level	Illetrate	30,69
	Primary level	17,33
	Middle level	28,22
	Secondary level	13,12
	University level	10,64
Function	Unemployed	31,19
	officials / private	21,04
	Farmers	36,88
	Retirees	10,89
Income per month (AD)	<25 000	80,69
	[25000 - 35000[	10,64
	[35 000-50000[	8,16
	≥ 50 000	0,51
Origin of the information	family or others	98,26
	Reading	1,24
	personal experience	0,5

3.3. Use of medicinal plants according to the organ of the plant used

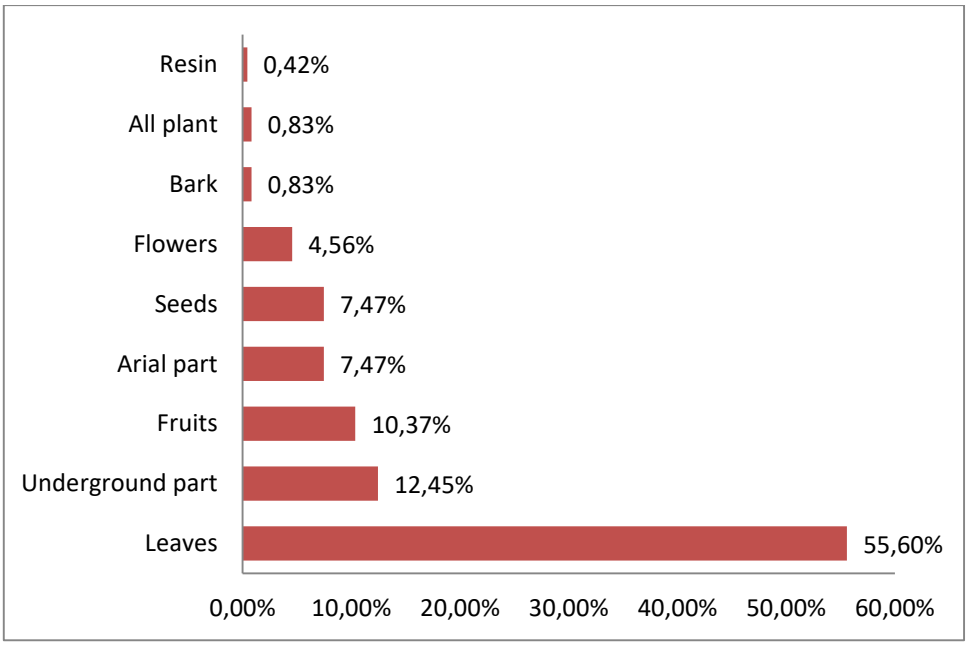

Figure 2. Use of medicinal plants according to their organs.

In general, the parts of plants used in traditional medicine are: the leaves, the underground part (roots, bulbs, tubers), the fruits, the seeds, the aerial part, the resin, and the bark. The results of this survey show that the leaf is the part of medicinal plants the most used (55.6%), a similar observation in the majority of ethnobotanical studies in Algeria such as; **Bouredja *et al.*, (2017)**, **Souilah, (2018)**; and even in Morocco cited by **Daoudi *et al.* (2015)**, followed by the underground part (12.45%) and fruits with 10.37%, against 0.83% for the bark and only 0.83% for the resin. (Figure. 2).

The high frequency of leaf use can be explained by the ease and speed of the harvest **(Bitsindou, 1986)** but also by the fact that they are the seat of photosynthesis and sometimes of the storage of secondary metabolites responsible for the biological properties of the plant **(Bigendako-Polygenis and Lejoly, 1990).** From an ecological point of view, the remarkable frequency of use of the leaves compared to the root parts, flowers and seeds, in reality avoid the excessive pulling out of the plants and therefore ensure their renewal and natural regeneration.

3.4. Use of medicinal plants according to the method of preparation

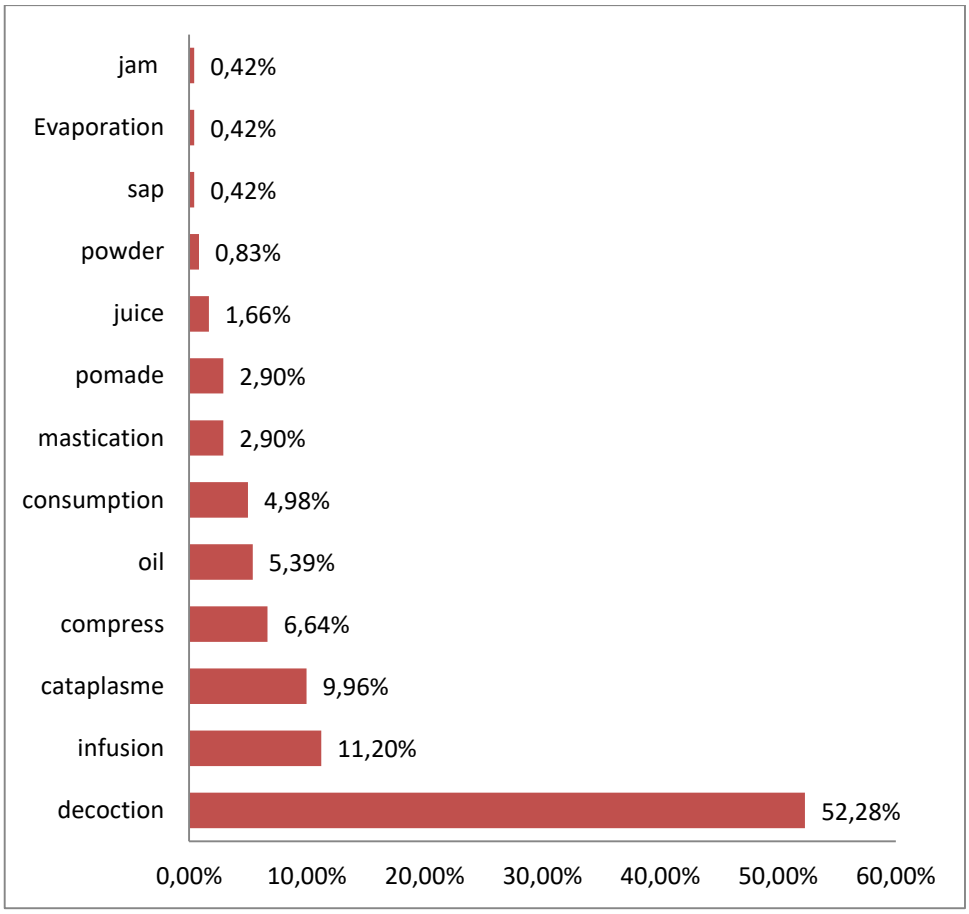

Figure 3. Use of medicinal plants according to the method of preparation.

In order to facilitate the administration of the active ingredients, several preparation methods are Used, in our study, the decoction method is the technique most used by the local population with a high rate of around 52.28%, a result conformed by **Miara *et al.*, (2019)** and **Bouredja *et al.*, (2017)** in Algeria and **Douira *et al.*, (2010)** in Morocco, Due to the conviction of users in the region that the decoction allows the sterization of the plant and the extraction of the active ingredients. The second method used is infusion (11, 20%) followed by poultice (9.96%), while the other methods namely; the compress, the oil, the consumption, the chewing, the ointment, the juice, the powder, the sap, the evaporation and finally the jam are used at rates varying from 6.64 and 0.42%.

3.5. Diseases treated in traditional medicine

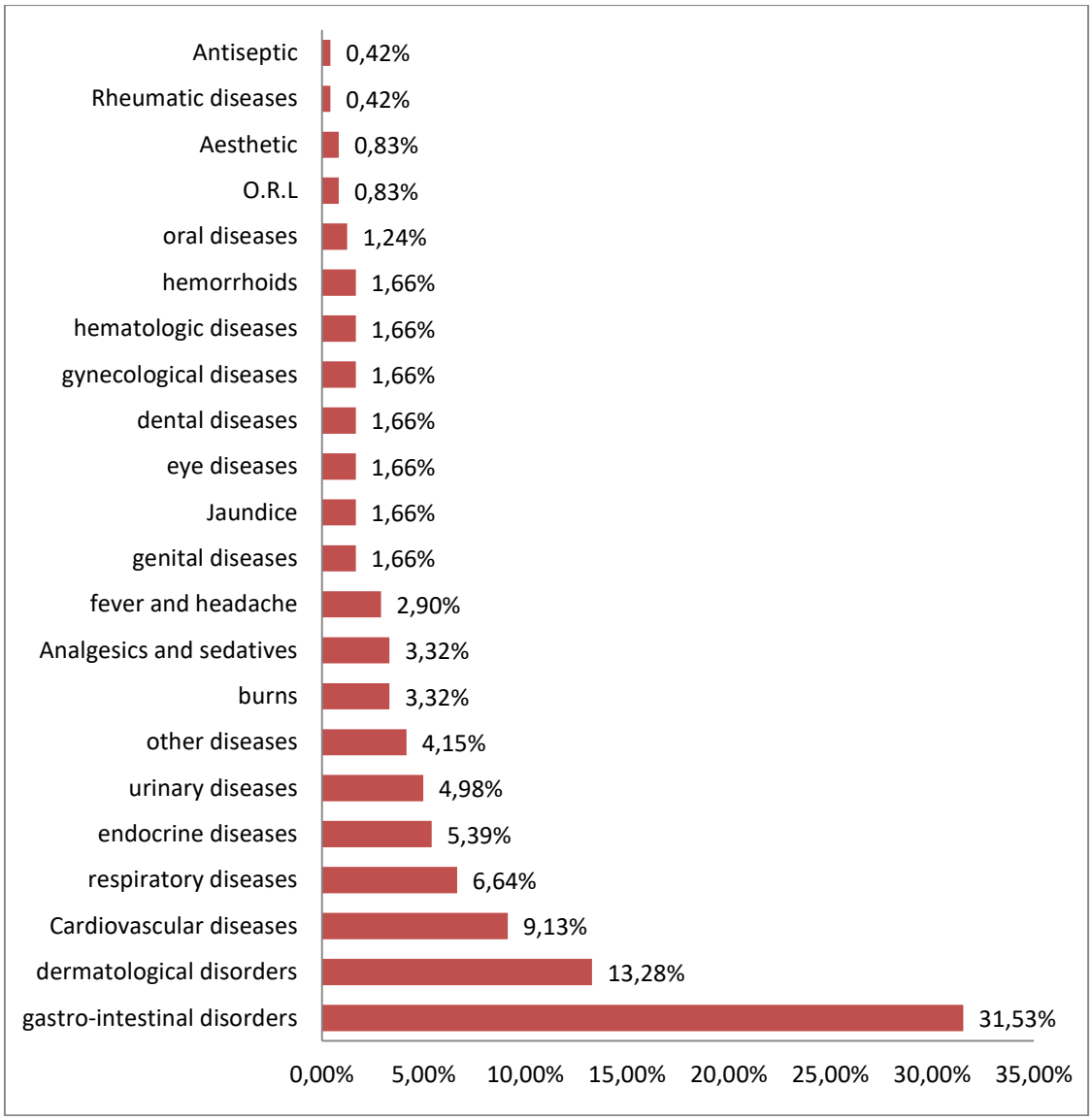

Figure 4. Use of medicinal plants according to treated diseases.

The ethnobotanical analysis revealed 22 categories of diseases treated by the inventoried plants, gastrointestinal disorders represent the most cited disease with a rate of 31.53%, followed by thermatological disorders (13.28%), cardiovascular (9.13%), and respiratory diseases (6.64). The remaining 18 diseases are less cited by the local population with low rates varying from 5.39% to 0.42%. The predominance of gastrointestinal disorders is very frequent in Algerian ethnobotanical studies with different rates such as; **Souilah *et al*., (2018)** (20%); **Ould El Hadj *et al*. (2003)** (26.38%); **Chermat and Gharzouli, (2015)** (34.41%), the same observation is also mentioned in Morocco by **Daoudi *et al*., (2016)** (38.9%) and **Douira *et al*. (2010)** (26.15 %). The results obtained can be explained by the poor eating habits answered in the region characterized by the excessive use of pasta and dried legumes.

3.6. Analysis of calculated paraeters

3.6.1. The most cited medicinal plants

Myrtus communis L. is the species with the highest citation number with a number of 158, followed by *Pistacia lentiscus* L. (121), *Thymus vulgaris* L. (96), this can be explained by the efficiency and the reliability of these plants against various categories of diseases.

Table 4. List of The most cited medicinal plants.

N°	Medicinal plants	Number of citation	%
01	*Myrtus communis L.*	158	12,77
02	*Pistacia lentiscus L.*	121	9,92
03	*Thymus vulgaris L.*	97	7,81
04	*Eucalyptus globulus Labill.*	73	5,78
05	*Angelica officinalis L.*	66	5,37
06	*Cytisus triflorus Lam.*	60	4,80
07	*Rosmarinus officinalis L.*	53	4,31
08	*Traganum nudatum Delile*	50	4,07
09	*Mentha pulegium L.*	31	2,52
10	*Quercus suber L.*	26	2,11

3.6.2. Use-value (UV)

According to the obtained results, the use values of the species are very close and vary from 1.15 to 1, however the highest is observed in *Pistacia lentiscus* L, with a use value of 1.15, which testifies to a wide use of this plant in traditional local medicine to treat seven (07) categories of diseases (Gastro-intestinal disorders, respiratory diseases, dermatological disorders, burns, eye diseases, Analgesics and sedatives diseases and hemorrhoids), this result confirms that of **Souilah *et al*., (2018)** in El kala National Park. The fruits used in Spain to treat dermatophytosis in cows **(Kivçakand Akay, 2005).** Presence of α-Pinene, myrcene, trans-caryophyllene and germacrene D and a-cadinol in the leaves may explain its remedial potential these compounds are known to have antioxidant properties **(Bozogri *et al*., 2013).** High VU indicate that local people are using the plant for many years. Many purposes to treat various categories of diseases **(Barnert and Messmann, 2008)**.

Table 5. use-value of the most cited medicinal plants.

N°	**Medicinal plants**	**N**	**VU**
01	*Pistacia lentiscus L.*	122	1,15
02	*Angelica officinalis L.*	66	1,14
03	*Mentha pulegium L.*	31	1,11
04	*Eucalyptus globulus Labill.*	73	1.01
05	*Cytisus triflorus Lam.*	60	1,05
06	*Traganum nudatum Delile*	50	1,04
07	*Myrtus communis L.*	158	1,04
08	*Thymus vulgaris L.*	97	1,02

09	*Rosmarinus officinalis L.*	53	1
10	*Quercus suber L.*	26	1

UV : Use value
N: total number of use-reports cited for a given species.

3.6.3. Fdelity level (FL)

Concerning the level of fidelity (LF), the calculations carried out clearly show that *Eucalyptus globulus* Labill. Possesses the highest fidelity level with a percentage of 100%, this indicates that this species is used by the local population specifically to treat a single category of disease (respiratory diseases). *Thymus vulgaris* L. comes in second position with a percentage by 96.88%, which is often used to treat gastrointestinal disorders. The low level of fidelity is recorded in *Pistacia lentiscus* L. because this species is used to treat seven (07) categories of diseases (Gastrointestinal disorders, respiratory diseases, dermatological disorders, burns, eye diseases, Analgesic and sedative diseases and hemorrhoids).

Table 6. Fidelity Level of the most cited medicinal plants.

N°	Medicinal plants	N	Np	FL (%)	Most frequent therapeutic use
01	*Eucalyptus globulus Labill.*	73	73	100	Respiratory diseases
02	*Thymus vulgaris L.*	97	94	96,91	Gastro-intestinal disorders
03	*Quercus suber L.*	26	24	92,32	Gastro-intestinal disorders
04	*Rosmarinus officinalis L.*	50	48	90,57	Gastro-intestinal disorders
05	*Myrtus communis L.*	158	140	88,60	Gastro-intestinal disorders
06	*Mentha pulegium L.*	31	23	74,19	Gastro-intestinal disorders
07	*Traganum nudatum Delile*	50	33	66	Gastro-intestinal disorders
08	*Cytisus triflorus Lam.*	60	39	65	Gastro-intestinal disorders
09	*Angelica officinalis L.*	6**6**	34	**51**,**5**1	Dermatological disorders
10	*Pistacia lentiscus L.*	12**1**	47	38,**84**	Gastro-intestinal disorders

NF: fidelity Level
Np: number of use-reports cited for a given species for a particular disease category.
N: total number of use-reports cited for a given species.

3.6.4. Informant consensus factor (ICF):

The higher value of the ICF indicates that the local population is in agreement with the use of the species in the treatment of a category of disease. This value, resulting in a well-defined selection criterion in the area studied or in information, is transmitted between the local populations. The lower FCI value indicates that the plants are chosen at random or that the local population does not exchange information about their use (**Kaya, 2006).** The highest value of the ICF recorded for gastrointestinal disorders (0.91) indicates that users of herbal remedies are agreed on the treatment of this disease, and the most frequently used species is *Myrtus communis* L. dermatology comes in second place with a value of 0.76, and Angelica officinalis L. represents the most used species for this category of diseases. And finally the users do not totally agree on the treatment of five types of diseases (Rheumatic diseases, antiseptic, gynecological diseases hematologic diseases and ENT). Because their ICF tends to zero.

Table 7. Informant consensus factor (ICF) for different disease categories.

N°	Medicinal plants	Nt	Nur	ICF	The most used species
01	gastro-intestinal disorders	59	670	0,91	*Myrtus communis L.*
02	dermatological disorders	30	124	0,76	*Angelica officinalis L.*
03	Cardiovascular diseases	19	72	0,75	*Arum italicum Mill.*
04	respiratory diseases	16	138	0,89	*Eucalyptus globulus Labill.*
05	endocrine diseases	12	25	0,54	*Olea europaea L. Var sylvsetris (Mill) Lehr*
06	urinary diseases	12	40	0,71	*Spergularia rubra (L.) J. Presl. & C. Presl.*
07	other diseases	10	13	0,25	*Traganum nudatum Delile.*
08	Burns	08	49	0,85	*Rubus ulmifolius J. Presl & C. Presl*
09	Analgesics and sedatives diseases	08	24	0,70	*Myrtus communis L.*
10	fever and headache	07	15	0,57	*Arum italicum Mill.*
11	genital diseases	04	05	0,25	*Traganum nudatum Delile.*
12	Jaundice	04	16	0,80	*Daphne gnidium L. Rhamnus alaternus L.*
13	eye diseases	03	05	0,50	*Pistacia lentiscus L.*
14	dental diseases	03	09	0,75	*Cupressus sempervirens L.*
15	gynecological diseases	05	05	0.00	*Salvia officinalis L.*
16	hematologic diseases	05	05	0.00	*Trigonella foenum-graecum L.*
17	Hemorrhoids	03	0**8**	0,71	*Traganum nudatum Delile.*
18	oral diseases	04	05	0,25	*Olea europaea L.*
19	O.R.L	02	02	0,00	*Asphodelus microcarpus L. Rosmarinus officinalis L.*
20	Aesthetic	02	03	0,50	*Chamaemelum nobile (L.) All.*
21	Rheumatic diseases	01	01	0,00	*Zizyfus lotus (L.) Lam*
22	Antiseptic	01	01	0,00	*Phillyrea media L.*

ICF: Informant Consensus Factor.
Nur: refers to the number of use-reports for a particular disease category
Nt: refers to the number of taxa for a particular disease category by all Informants.

4. Conclusion

Considered the first initiative for the ethnobotanical study of medicinal plants in the Guerbes-Sanhadja wetland complex (Ramsar site), this study, based on survey of 400 users of medicinal plants distributed in eight (08) localities, has reveals the diversity of the medicinal flora of the study area, with the census of 102 species, divided into 59 botanical families.

The ethnobotanical analyzes carried out show that the majority of surveyed are people; aged between 40 and 60 (44.06%), married (85.4%), illiterate or having a secondary level with a cumulative rate of 58.91% and finally farmers (36.88%) or unemployed (31, 19) whose monthly income is less than 15,000 DA

In addition, the leaf represents the most used part of medicinal plants with a remarkable rate of 58.25%, and the decoction the most common method of preparation with a percentage of 52.28%. As for the pathologies treated, gastrointestinal ones take precedence with the use of 59 species.

The main spontaneous medicinal species with very high frequency of use in the study area are in decreasing order; *Myrtus communis* L., *Pistacia lentiscus* L., *Thymus vulgaris* L., *Eucalyptus globulus* Labill., *Angelica officinalis* L. *Cytisus triflorus* Lam., *Rosmarinus officinalis* L., *Traganum nudatum* Delile, *Mentha pulegium* L., *Quercus suber* L.

The calculation of parameters UV, NF and ICF, led us to note that *Pistacia lentiscus* L. has the widest use, because it is cited to treat 07 categories of disease, with a utility value (VU) of the order of 1.15. the local people were very loyal to the species of *Eucalyptus globulus* Labill. to treat respiratory diseases with a precision level of 100%. In addition this population was agreed on the treatment of gastrointestinal disorders, with a value of the consensus informing factor (ICF) of the order of 0.91. And finally, this study, conducted in the Guerbes-Sanhadja wetland complex, allowed us to conclude that the local population of the study area remains very dependent on medicinal plants to treat various diseases despite the development of modern medicine. It can be set up a database for the valuation and conservation of medicinal plants in order to discover new active ingredients that can be used in pharmacology and to protect this wealth.

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