The Phytotherapeutic Arsenal in the Guerbes-Sanhadja Wetlands Complex (North East of Algeria)

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Cover Page Footnote

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THE PHYTOTHERAPEUTIC ARSENAL IN THE GUERBES-SANHADJA WETLANDS COMPLEX (NORTH EAST OF ALGERIA)

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ABSTRACT

This study documents indigenous medicinal flora - utilization, and was carried out in the Guerbes-Sanhadja wetland complex, between January 2018 and December 2020. The detailed information was gathered from users of medicinal plants mainly based on semi-structured interviews. A total of 102 plant species distributed in 48 families were found in practice by the natives for fulfilling their daily life requirements. The most frequently cited plants are: *Myrtus communis* L. (158 citations), *Pistacia lentiscus* L. (122) and *Thymus vulgaris* L. (97). Most of the medicinal species listed were herbs (68.93%). The phanerophytes (33.33%) and hemicriptophytes (27.45%) were the principal species used by the local population of the complex to treat different diseases. And finally, the dependence of the local population on medicinal plants prompted the establishment of a complex management plan in order to promote and protect them through their rational use and domestication.

Keywords: Floristic, medicinal plants, Guerbes-Sanhadja, wetlands.

INTRODUCTION

The Mediterranean basin has been described as one of the richest and most geologically, biologically and culturally complex regions (Blondel et al., 2010). By its high biological diversity and endemism, it constitutes one of the 34 "hot spots" of the planet (Myers et al., 2000).

The northeast of Algeria is considered to be a hotspot, threatened, of plant biodiversity and the Edough-Guerbes-Senhadja-Fetzara area as particularly rich and wild (Vela and Benhouhou, 2009).

Algeria includes 254 wetlands of international importance, including Guerbes-Senhadja. This combines continental wetlands (marshes, wadis,

lakes, garaets, floodplains, permanent and / or temporary ponds and plant hydromorphic zones), coastal wetlands (dunes, estuaries, beaches, sea cliffs), agricultural land - related schools and / or urbanized and wooded areas. The region has significant human and agricultural potential. It is also a biodiversity reservoir sheltering many plant and animal species (Samraoui and De Belair, 1997).

The flora of the complex belongs to the Mauritanian Mediterranean domain, Numidian sector, according to the nomenclature of Quezel and Santa (1962-1963) (Toubal et al., 2014). Samraoui and De Belair (1997) have inventoried 31 wetlands with 334 plant species.

Among this wealth of flora, Medicinal plants constitute a group of plants of great socio-economic importance

because they contain active components used in the treatment of various diseases.

Despite the various floristic and ethnobotanical studies of medicinal plants published in Algeria such as those of Baba Aïssa (1991), Ould El Hadj et al., (2003), Rebbas et al., (2012), Miara et al. (2013), Hammiche and Maïza (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 complex which is reflected in the different floristic inventories carried out in the region by Samraoui and De Belair (1997), Belouahem-Abed et al., (2009), Toubal et al. (2014), the present study represents the first initiative in the field of floristic study of medicinal plants carried out in this complex, such an initiative having as main objective the inventory of medicinal plants used by the local population, could however come and fill this gap, which then allows the promotion of these plants and the implementation of a preservation strategy for this complex, knowing that 58% (Fig. 5) of the medicinal plants used are taken from the wild (often unsustainably).

MATERIALS AND METHODS

Study Area

The Guerbès-Senhadja wetland complex (West Numidia), a vast territory is part of Numidia (Maire 1926, Quezel and Santa 1962-1963, Marre 1992). The eco-complex is located in the north-eastern part of Algeria (36 ° 46'371 N, 7 ° 8'7 25 E) (Fig. 1) and covers an area of 42100 ha. It is a complex of great importance (classified as a Ramsar site 2001) which constitutes a reservoir of flora and fauna of

diverse biogeographical origin (Toubal et al., 2014).

The pre-forest and forest groupings of this complex are:

-cork oak grouping (*Quercus suber* L.), fairly degraded due to the exploitation of cork and fires. *Erica arborea* L., *Ericascoparia* L., *Myrtus communis* L. and *Cistus salvifolius* L., *Pistacia lentiscus* L., *Chamaerops humilis* L. and *Olea oleaster* L.

-grouping of oak-kermes (*Quercus coccifera* L.), combined with *Halimium halimifolium* (L.) Willk. grouping of *Pistacia lentiscus* L. and *Olea oleaster* L. (Toubal and coll., 2014).

Figure 1: Location of the Guerbès-Senhadja wetland complex (Toubal et al., 2014), modified by (Hedjal et al., 2018).

Study Method

The stratified probability sampling technique was adopted; this technique provided a more representative sample (Kahouadji, 1986). which consists in probably dividing the population studied in advance into eight (08) strata or localities, within each stratum (localities) we carried out a simple random sampling composed of 50 users informants of medicinal plants by stratum from where a global sample of 400 respondents (Tab. 1).

Table 1: Distribution of investigations according to localities.

Localities	Geographic coordinates	Bioclimatic stage	Number of investigation
Ben azzouz	36°52' N, 7°17' E	Mild sub-humid	50
El marssa	37°01' N, 7°15' E	Mild sub humid	50
Djendel	36°47' N, 7°13' E	Mild sub humid	50
Guerbes	36°52' N, 7°11' E	Mild sub humid	50
Ain nechma	36°50' N, 7°16' E	Mild sub humid	50
Ezzaouia	36°52' N, 7°21' E	Mild sub humid	50
Remila-Lezrag	37°00' N, 7°16' E	Mild sub humid	50
El hamma	36°47' N, 7°17' E	Mild sub humid	50
Total			400

The survey form used provided information on the informant (gender, age, family situation, study level and function) and on the plant used (scientific name, vernacular name, Origin, morphological type, biological type). The botanical identification of the specimens was made using the following floras: Maire (1959), Quezel 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, www.theplantlist.org, and African Plant Database for checking the scientific names and synonyms of plants.

The Fidelity level (FL) is used to determine the most frequent plant species used to treat a particular disease category by informants in the study area. It is calculated according to the following formula (Martin, 1995):

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

FL: fidelity Level.

N_p: 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.

RESULTS AND DISCUSSION

Analysis of the socio-demographic profile of informants

The ethnobotanical analyzes carried out showed that the majority of surveyed are men (79, 25%) aged between 40 and 60 (44,06%), married (85,4%), illiterate (30, 69%) or having a middle level (28,22%) and working as a farmer (36,88%) or unemployed (31, 19) (Tab. 2).

Table 2: Classification of informants according to several factors.

Factor	Category	%
Gender	Male	79,25
	Female	20,75
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
	Illetrate	30,69
Study level	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

Census of Medicinal Plants used by the Local Population of the Complex.

Table 3: List of medicinal plants traditionally used by the local population of the complex.

N°	Scientific name	Family	Common name in English	Diseases treated	Np	FL (%)
01	<i>Acanthus mollis</i> L.	Acanthaceae	Bear's breeches	Gastro-intestinal disorders	01	50
				Other diseases	01	50
02	<i>Adiantum capillus-veneris</i> L.	Pteridaceae	Southern maidenhair fern	respiratory diseases	01	100
03	<i>Ajuga iva</i> (L.) Schreb.	Lamiaceae	Ivette Musky	gastro-intestinal disorders	03	50
				Genital diseases	01	16,67
				dermatological disorders	01	16,67
				Other diseases	01	16,67
04	<i>Allium cepa</i> L.	Amaryllidaceae	Onion	Cardiovascular diseases	04	44,45
				Urinary diseases	01	11,11
				Fever and headache	01	11,11
				dermatological disorders	03	33,33
05	<i>Allium sativum</i> L.	<u>Amaryllidaceae</u>	Garlic	Cardiovascular diseases	10	66,67
				Aesthetic	02	13,33
				Respiratory diseases	03	20
06	<i>Allium triquetrum</i> L.	Liliaceae	Three-cornered leek	Other diseases	01	50
07	<i>Aloe succotrina</i> All.	Aloecaceae	Fynbos aloe	Gastro-intestinal disorders	01	50
08	<i>Aloysia citriodora</i> Palau	Verbenaceae	Lemon Verbena	dermatological disorders	01	100
				respiratory diseases	03	42,86
09	<i>Angelica officinalis</i> L.	Apiaceae	Angelic	gastro-intestinal disorders	04	57,14
				dermatological disorders	35	53,03
				gastro-intestinal disorders	30	45,45
10	<i>Anthyllis vulneraria</i> L.	Fabaceae	Common kidneyvetch	Other diseases	01	1,52
				gynecological diseases	01	12,5
11	<i>Apium graveolens</i> L.	Apiaceae	Celery	dermatological disorders	07	87,5
				Cardiovascular diseases	01	50
12	<i>Arbutus unedo</i> L.	Ericaceae	Strawberry Tree	Gastro-intestinal disorders	01	50
				Burns	01	100

13	<i>Artemisia absinthium</i> L.	Asteraceae	Wormwood	Cardiovascular diseases	04	66,67
				endocrine diseases	02	33,33
14	<i>Artemisia herba-alba</i> Asso.	Asteraceae	Wormwood	Gastro-intestinal disorders	07	100
15	<i>Arum italicum</i> Mill.	Araceae	Italian arum	Cardiovascular diseases	13	68,42
				fever and headache	05	26,32
				Jaundice	01	5,26
16	<i>Asphodelus microcarpus</i> L.	Xanthorrhoeaceae	Asphodel	dermatological disorders	06	85,71
				O.R.L	01	14,29
17	<i>Avena sativa</i> L.	Asparagaceae	Oat	Endocrine diseases	01	100
				dermatological disorders	04	57,14
18	<i>Carlina gummifera</i> (L.) Less.	Asteraceae	Lectotype Atractylis	Burns	01	14,29
				Cardiovascular diseases	02	28,57
				Gastro-intestinal disorders	01	100
19	<i>Borago officinalis</i> L.	Boraginaceae	Borage	Dermatological disorders	01	100
20	<i>Carpobrotus edulis</i> (L.) N.E.Br.	Aizoaceae	Hottentot-fig	Gastro-intestinal disorders	01	100
21	<i>Cassia abovata</i> collad.	Fabaceae	Neutral henna	Gastro-intestinal disorders	01	100
22	<i>Ceratonia siliqua</i> L.	Fabaceae	The carob	Gastro-intestinal disorders	01	100
				gastro-intestinal disorders	10	62,5
				Analgesics and sedatives diseases	02	12,5
				Aesthetic	01	6,25
				Endocrine diseases	01	6,25
				Urinary diseases	01	6,25
				Genital diseases	01	6,25
24	<i>Circaea lutetiana</i> L.	Onagraceae	Witches herbs	Genital diseases	01	100
25	<i>Citrullus colocynthis</i> (L.) Schard.	Cucurbitaceae	Bitter Cucumber	Eye diseases	01	100
26	<i>Citrus limon</i> (L.) Osbeck	Rutaceae	Lemon	Other diseases	01	100
27	<i>Citrus sirensus</i> (L.) Osbeck.	Rutaceae	Orange	Dermatological disorders	01	100
28	<i>Crataegus monogyna</i> Jacq.	Rosaceae	Common hawthorn	Cardiovascular diseases	01	33,33
				Gastro-intestinal disorders	02	66,67
29	<i>Cucumis melon</i> L.	Cucurbitaceae	Yellow melon	Gastro-intestinal disorders	01	100
30	<i>Cuminum cyminum</i> L.	Apiaceae	Cumin	Gastro-intestinal disorders	03	100
31	<i>Cupressus sempervirens</i> L.	Cupressaceae	Mediterranean cypress	Dental diseases	06	85,71
				Hemorrhoids	01	14,29
32	<i>Cynara scolymus</i> L.	Asteraceae	Artichoke	Gastro-intestinal disorders	01	100
33	<i>Cytisus triflorus</i> Lam.	Fabaceae	Elongated laburnum	gastro-intestinal disorders	38	63,33

				Burns	12	20
				dermatological disorders	10	16,67
				Cardiovascular diseases	01	10
34	<i>Daphne gnidium</i> L.	Thymelaeaceae	Daphne Were	Jaundice	07	70
				fever and headache	01	10
				Dental diseases	01	10
35	<i>Dittrichia viscosa</i> (L.) Greuter	Asteraceae	Viscous Inule	dermatological disorders	06	66,67
				Gastro-intestinal disorders	03	33,33
36	<i>Ecballium elateruim</i> L.	Cucurbitaceae	Squirting cucumber	Gastro-intestinal disorders	01	50
				Jaundice	01	50
37	<i>Echinops ritro</i> L.	Asteraceae	Outhern globethistle	Gastro-intestinal disorders	01	100
38	<i>Eucalyptus globulus</i> Labill.	Myrtaceae	Australian Fever	Respiratory diseases	73	100
39	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	sun spurge	Burns	01	100
40	<i>Ferula assa-foetida</i> L.	Apiaceae	Heeng/ Asafoetida	Gastro-intestinal disorders	01	50
				fever and headache	01	50
41	<i>Ficus carica</i> L.	Moraceae	Fig	dermatological disorders	01	100
42	<i>Foeniculum vulgare</i> Mill.	Apiaceae	Sweet Fennel	Gastro-intestinal disorders	11	100
43	<i>Fraxinus angustifolia</i> Vahl	Oleaceae	Narrow-leafed ash	Gastro-intestinal disorders	01	100
44	<i>Genista tricuspidata</i> Desf.	Fabaceae	Broom	Gastro-intestinal disorders	01	50
				Eye diseases	01	50
45	<i>Globularia alypum</i> L.	Plantaginaceae	Globe Daisy	Gastro-intestinal disorders	09	100
46	<i>Glycyrrhiza glabra</i> L.	Fabaceae	Licorice	Gastro-intestinal disorders	01	100
47	<i>Heliotropium bacciferum</i> Forssk.	Boraginaceae	Turn-sole	Gastro-intestinal disorders	07	87,5
				Dermatological disorders	01	12,5
48	<i>Hordeum vulgare</i> L.	Poaceae	Barley	Gynecological diseases	1	25
				Urinary diseases	03	75
49	<i>Hyoscyamus albus</i> L.	Solanaceae	White henbane	Other diseases	01	50
				Dermatological disorders	01	50
50	<i>Juniperus oxycedrus</i> L.	Cupressaceae	Oxycedre Juniper	Gastro-intestinal disorders	01	100
				Cardiovascular diseases	10	55,55
51	<i>Laurus nobilis</i> L.	Lauraceae	Bay Laurel	Gastro-intestinal disorders	06	33,33
				Dermatological disorders	01	5,56
				Endocrine diseases	01	5,56
52	<i>Lavandula stoechas</i> L.	Lamiaceae	Lavender	gastro-intestinal disorders	20	95,24
				Endocrine diseases	01	4,76

53	<i>Lawsonia inermis</i> L.	Lythraceae	Henna	fever and headache	01	100
54	<i>Lens culinaris</i> Medik.	Fabaceae	Lentil	Hematologic diseases	01	100
55	<i>Lepidium sativum</i> L.	Brassicaceae	Cress	Dermatological disorders	01	100
56	<i>Linum usitatissimum</i> L.	Linaceae	Flax	Gastro-intestinal disorders	01	100
57	<i>Malva sylvestris</i> L.	Malvaceae	Common Mallow	Gynecological diseases	01	25
				Cardiovascular diseases	01	25
				Hematologic diseases	01	25
				Dermatological disorders	01	25
58	<i>Marrubium vulgare</i> L.	Lamiaceae	White Horehound	Endocrine diseases	07	50
				Gastro-intestinal disorders	04	28,57
				Other diseases	02	14,29
				Urinary diseases	01	7,14
59	<i>Mentha viridis</i> L.	Lamiaceae	Green Mint	Gastro-intestinal disorders	24	100
60	<i>Mentha pulegium</i> L.	Lamiaceae	Mint	gastro-intestinal disorders	23	74,19
				Analgesics and sedatives diseases	05	16,12
				Respiratory diseases	01	3,23
				dermatological disorders	01	3,23
				Cardiovascular diseases	01	3,23
61	<i>Mespilus germanica</i> L.	Rosaceae	Medlar	Gastro-intestinal disorders	03	100
62	<i>Myrtus communis</i> L.	Myrtaceae	Myrtle	gastro-intestinal disorders	140	88,61
				Analgesics and sedatives diseases	11	6,96
				Cardiovascular diseases	06	3,80
				Respiratory diseases	01	0,63
63	<i>Nerium oleander</i> L.	Apocynaceae	Oleander	dermatological disorders	02	66,67
64	<i>Nicotiana tabacum</i> L.	Amaranthaceae	Cultivated tobacco	Gastro-intestinal disorders	01	33,33
65	<i>Ocimum basilicum</i> L.	Lamiaceae	Basil	dermatological disorders	01	100
				Cardiovascular diseases	01	25
				Analgesics and sedatives	01	25
				Gastro-intestinal disorders	02	50
66	<i>Olea europaea</i> L.	Oleaceae	Olive Tree	Gastro-intestinal disorders	05	35,71
				Oral diseases	04	28,57
				Cardiovascular diseases	02	14,29
				Respiratory diseases	01	7,14

				dermatological disorders	02	14,29
67	<i>Olea europaea</i> (L). Var sylvestris (Mill.) Lehr	Oleaceae	Oleaster	Cardiovascular diseases	08	40
				endocrine diseases	08	40
				dermatological disorders	02	10
				Gastro-intestinal disorders	01	5
				respiratory diseases	01	5
68	<i>Opuntia ficus-indica</i> (L.) Mill.	Cactaceae	Prickly Pear	respiratory diseases	08	57,14
				urinary diseases	02	14,29
				dermatological disorders	04	28,57
69	<i>Petroselinum crispum</i> (Mill.) Fuss.	Apiaceae	Parsley	urinary diseases	10	71,43
				Hemorrhoids	01	7,14
				Gastro-intestinal disorders	03	21,43
70	<i>Phillyrea media</i> L.	Oleaceae	Mock privet	Antiseptic	01	100
71	<i>Pinus pinaster</i> Aiton	Pinaceae	the maritime pine	respiratory diseases	01	33,33
				Gastro-intestinal disorders	02	66,67
72	<i>Pistacia lentiscus</i> L.	Anacardiaceae	Mastic	Gastro-intestinal disorders	47	38,52
				respiratory diseases	34	27,87
				dermatological disorders	24	19,67
				burns	12	9,84
				eye diseases	03	2,46
				Analgesics and sedatives	01	0,82
				hemorroïdes	01	0,82
73	<i>Populus alba</i> L.	Salicaceae	White Poplar	Cardiovascular diseases	01	33,33
74	<i>Punica granatum</i> L.	Lythraceae	Pomegranate	dental diseases	02	66,67
75	<i>Pimpinella anisum</i> L.	Apiaceae	Anise	Gastro-intestinal disorders	13	100
76	<i>Piper nigrum</i> L.	Piperaceae	Black Pepper	Gastro-intestinal disorders	01	100
77	<i>Quercus suber</i> L.	Fagaceae	Cork Oak	respiratory diseases	01	100
				gastro-intestinal disorders	24	92,32

				endocrine diseases	01	3,84
				hematologic diseases	01	3,84
78	<i>Rhamnus alaternus</i> L.	Rhamnaceae	Mediterranean Buckthorn	Jaundice	07	87,5
				endocrine diseases	01	12,5
79	<i>Rosa canina</i> L.	Rosaceae	Dog-Rose	Gastro-intestinal disorders	01	100
80	<i>Rosmarinus officinalis</i> L.	Lamiaceae	Rosemary	gastro-intestinal disorders	48	90,57
				respiratory diseases	02	3,76
				urinary diseases	01	1,89
				O.R.L	01	1,89
				endocrine diseases	01	1,89
81	<i>Rubus ulmifolius</i> J.Presl & C.Presl	Rosaceae	Bramble	burns	18	94,74
				oral diseases	01	5,26
82	<i>Ruta chalepensis</i> L.	Rutaceae	Commun Rue	respiratory diseases	04	26,67
				burns	04	26,67
				Gastro-intestinal disorders	03	20
				Cardiovascular diseases	02	13,32
				endocrine diseases	01	6,67
				Other diseases	01	6,67
83	<i>Salvia officinalis</i> L.	Lamiaceae	Sage	gastro-intestinal disorders	01	25
				oral diseases	01	25
				Gynecological diseases	02	50
84	<i>Scilla maritima</i> L.	Liliaceae	Squill	fever and headache	01	33,33
				burns	01	33,33
				dermatological disorders	01	33,33
85	<i>Silybum marianum</i> (L.) Gaerth.	Asteraceae	cardus marianus	Gastro-intestinal disorders	02	50
				urinary diseases	01	25
				endocrine diseases	01	25
86	<i>Spergularia rubra</i> (L.) J.Presl. & C.Presl	Caryophyllaceae	Red Sandspurry	Urinary diseases	17	100

87	<i>Spinacia oleracea</i> L.	Amaranthaceae	Spinach	Hematologic diseases	01	100
88	<i>Syzygium aromaticum</i> (L.) Merr. & L. M. Perry	Myrtaceae	Cloves	Dermatological disorders	01	100
89	<i>Tamarix aphylla</i> (L.) H.Karst.	Tamaricaceae	Tamarix	Dermatological disorders	01	100
90	<i>Thymus algeriensis</i> Boiss. et Reut.	Lamiaceae	Wild Thyme	gastro-intestinal disorders	15	100
91	<i>Thymus serpyllum</i> L.	Lamiaceae	Breckland thyme	Gastro-intestinal disorders	01	100
92	<i>Thymus vulgaris</i> L.	Lamiaceae	Garden Thyme	gastro-intestinal disorders	94	96,91
				Respiratory diseases	02	2,06
				Analgesics and sedatives	01	1,03
93	<i>Teucrium polium</i> L.	Lamiaceae	Felty germander	Gastro-intestinal disorders	01	100
94	<i>Traganum nudatum</i> Delile	Amaranthaceae	Domrane	Gastro-intestinal disorders	33	66
				Dermatological disorders	05	10
				Hemorrhoids	05	10
				Other diseases	03	6
				Genital diseases	02	4
				Cardiovascular diseases	01	2
				Analgesics and sedatives	01	2
				Gastro-intestinal disorders	10	83,34
95	<i>Trigonella foenum-graecum</i> L.	Fabaceae	Fenugreek	Analgesics and sedatives	01	8,33
				Hematologic diseases	01	8,33
96	<i>Triticum durum</i> Desf.	Poaceae	Durum wheat	Urinary diseases	01	100
97	<i>Triticum repens</i> L.	Poaceae	Couch grass	Gastro-intestinal disorders	01	100
98	<i>Urtica dioica</i> L.	Urticaceae	Common nettle	Cardiovascular diseases	03	75
				Dermatological disorders	01	25
99	<i>Vitis vinifera</i> L.	Vitaceae	Grape- Vine	fever and headache	05	100
100	<i>Zea mays</i> L.	Poaceae	Maize	Urinary diseases	01	50
				Dermatological disorders	01	50
101	<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Ginger	Other diseases	01	50
				Gastro-intestinal disorders	01	50
102	<i>Ziziphus lotus</i> (L.) Lam.	Rhamnaceae	Sedra	Respiratory diseases	02	50
				Rheumatic diseases	01	25
				Gastro-intestinal disorders	01	25

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

The surveys carried out with these users allowed the identification of 102 species of medicinal plants used as traditional remedies by the local population (tab. 3), (Fig. 2), this number of species considered very interesting compared to the results of certain studies in different regions of Algeria such as in; Ouargla (37 species) (Ould El Hadj, 2003); M'sila (58 species) (Boudjelal et al., 2013); Bourdj Bou Arreridj (83 species) (Bendif et al., 2018); Sétif (93 species) (Chermat and Gharzouli, 2015); Kabylia (98 species) (Meddour and Meddour, 2015) and finally in Constantine and Mila with the description of 102 species by (Ouelbani et al., 2016). While, other authors have published more important results such as;

(Souilah et al., 2018), who identified 112 species in El kala national park and (Benraba et al., 2015), who mentioned 141 species in the Mascara region.

At regional and international level; the study conducted by (Chaachouay et al., 2019) in the Rif region in Morocco has identified 30 species, the other work by Béné et al. (2016) in the department of Transua at the coast of Ivory brought out 94 species. In Spain and over a large area, Vallès and Agelet (2001) obtained data on 437 plant species used. Finally, in India, Jayakara Bhandary and Chandrashekar (2014) inventoried 342 species.

Distribution of medicinal plants according to botanical families

Figure 3: Distribution of medicinal species according to botanical family.

Concerning the distribution of plants according to the botanical family, we recorded a remarkable number of families (48) (Fig. 3), with a predominance of Lamiaceae (12 species), followed by Asteraceae and Fabaceae with 8 species. The other remaining families included between 1-4 species. This dominance was confirmed by several previous Algerian

studies such as those of; Boudjelal et al., (2013), Chermat and Gharzouli (2015) and Souilah et al., (2018), and foreign sources by Benkhniqie et al., 2010), El Alami et al (2016), Sbai-Jouilil et al., (2017) and Chaachouay et al., (2019), This could be explained by the richness of these families in phenolic and flavonoid compounds.

Figure 2: Some plant species identified: (a) *Myrtus communis* L., (b) *Pistacia lentiscus* L., (c) *Mentha viridis* L., (d) *Euphorbia helioscopia* L., (e) *Asphodelus microcarpus* L., (f) *Lavandula stoechas* L., (g) *Rubus ulmifolius* J.Presl & C.Presl, (h) *Borago officinalis* L., (i) *Angelica officinalis* L., (j) *Arbutus unedo* L., (k) *Dittrichia viscosa* (L.) Greuter, (l) *Scilla maritima* L.

Origin of Medicinal Plants

Figure 4: Spectrum of different origins of medicinal plants.

Most plants were collected from the wild (59 species, or 58.25%) (Fig. 4), indicating the strong pressures on wild plant resources from the Guerbes-Sanhadja wetland complex, cultivated plants were used with a rate of 28.43%, and finally, the local population of the region used plants imported from other regions or countries with 13.73%.

The dominance of wild collections is also reported in Miara et al. (2018) in the Algerian steppe, with a rate of 60%, and Giday (2001), Tamene (2000) and Hunde (2001) in different countries.

Morphological Types

Figure 5: Spectrum of different morphological.

Our results showed that herbs were the majority (68.93%), followed by shrubs (16.51%), trees (10.68%) and lianas

(3.88%) (Fig. 5), these results indicate the dependence of users of medicinal plants on herbaceous species. Similar observations have been reported by other authors in a few countries with different rates such as; Yineger (2005) in Ethiopia (51.7%), Ghulam et al., (2015) in Pakistan, (73.56%). This demonstrated a heavy dependence of users on herbs because of their abundance and ease of harvesting.

On the other hand, and in other countries, in Bangladesh, Jamil et al., (2014) found the predominance of trees with a rate of 47%, same finding of Addo-Fordjour et al., (2008) in Ghana and Chettri et al., (2019) in the Himalayas.

Raunkiaer Plant Life form

Figure 6: Spectrum of different Biological forms.

The phanerophytes and the hemicryptophytes with respectively 33.33 and 27.45% were the most represented, followed by the therophytes (20.59%), the chamaephytes (10.78%) and finally the geophytes with only (7.84%) (Fig. 6). This clear dominance of phanerophytes informed about a regular use of these plants, because these species are present throughout the year by their roots, branches and leaves, and their harvest were spread over time more than other species (Miara et al., 2018). However, and under different conditions, the studies by Chermat and Gharzouli (2015) in Djebel Zdim (Setif) and Boughani et al., (2013)

in the Saharan Constantine Atlas region had shown the dominance of the Therophytes with the rate respectively of 32.26% and 44%, This richness in therophytes was a characteristic of the Mediterranean and arid zones where dominates a strong hydric stress (Daget, 1980; Madon and Medail, 1996).

CONCLUSION

The present study was the first initiative in terms of the floristic study of medicinal plants in the Guerbes-Sanhadja wetland complex (Ramsar Site), this study, based on surveys of 400 users of medicinal plants in eight (08) localities, has allows to reveal the diversity of the medicinal flora of the study area, with the census of 102 species, divided into 48 botanical families.

The study showed that the area has plenty of spontaneous medicinal species as: *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. and *Quercus suber* L.

The local population of the study area remained very dependent on medicinal plants to treat various diseases despite the development of modern medicine. It can be constituted a database to set up a management plan for this complex aimed at the enhancement and conservation of these plants, especially those threatened with extinction, by raising the awareness of the local population on rational use and even domestication of this wealth.

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