

## Ethnobotanical study of medicinal plant in Djerba island, Tunisia

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### Abstract

**Objective :** The aim of this study was to document the diversity and use of natural plants in the island of Djerba (Tunisia) in traditional pharmacopoeia and other uses in order to develop an ethnobotanical catalogue that could subsequently be the subject of scientific research.

**Materials and Methods:** The technique of semi-structured interviews was used with people originating and residing or not in Djerba. Occasional conversations and direct observations were exploited for one year.

**Results:** We have identified 86 plants out of 122 mentioned belonging to 80 genera and 43 families. Asteraceae were the most important family represented by 13 species followed by Lamiaceae and Poaceae (7 species each). The results showed that 45 species have medicinal uses (52.32%). Leaves were the most used parts (59% of species for medicinal use). Decoction was the most common method for preparing remedies.

**Conclusion:** This study provides an important source of information for flora valorization in the studied region. The results could form a database for the search of new natural substances with added value.

**Keywords:** Ethnobotanic, Djerba island, uses categories, knowledge

### 1. Introduction

Ethnobotany is a science that determines the relationship between plants and human culture. It played an important role in understanding the dynamic relationship between biological diversity and social and cultural systems (Husain et al., 2008). Plants have been used since the emergence of human civilization for food and healing. The term ethnobotanical was used for the first time by John Harshberger since 1896 (Campbell et al., 2008). It represents the most appropriate method for study of natural resources and their management by indigenous residents. It consists in working with local people to explore their knowledge based on their experiences across generations. However, there are neither dispositions nor laws that protect the knowledge rights of the indigenous population. Research on the cultural values of plant species

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played an important role in modern medicine and pharmaceutical industry. Ethnobotanical approaches allowed highlighting the most important local plant species as sources of new raw remedies. Documentation from of indigenous knowledge, particularly valuable plant species, was the source of modern medicines wide variety (Cox, 2000). 80% of the population in developed countries use traditional medicine as a basic treatment (Malik et al., 2010).

Djerba is an island located in the Gulf of Gabes in southern Tunisia. Its climate is characterized by summer aridity that is little alleviated by the proximity to the sea. Volume and distribution of rainfall were extremely variable. This great variability of precipitation affected the distribution of vegetation. Indeed, we noted abundance of therophytes which constituted the most abundant biological group. 56% of local plant species are annuals. A large number of arable weed species appeared in non-irrigated fields and were influenced by substrate quality (Berghen, 1977a, b). Ethnobotanical information about plants with curative properties and their uses by the indigenous people was a great value and importance for the protection of culture, biodiversity, health and for the discovery of new drugs (Farnsworth, 1993). No ethnobotanical studies have been carried out within Djerba. Although there is a previous study on island vegetation performed by Vanden Bergghen (1977) in four notes highlighting its richness in species despite its arid climate. The present study showed ethnobotanically important resources for the Djerba inhabitants in order to analyze and conserve traditional knowledge on most plants used by the local community.

## 2. Material and methods

### 2.1. Study area

Djerba is a continental island located at 33 ° 45 '(37G50) latitude N and 10 ° 50' (9G50 ') longitude E. A 2.5km strait separates it from southern Tunisia. The island occupies an area of 514 km<sup>2</sup> with a perimeter about 125 km. It extends 30 km from the west to the east and about 30 km south to the north. It is characterized by a heterogeneous terrestrial ecosystem with a mosaic aspect of its environments and its various biotopes. It is characterized by a semi-arid climate and subarid at its south side. The average maximum temperature in August is 33 ° C and the minimum temperature for the month of January is above 8 ° C. Regarding precipitation, the average rainfall is 216 mm (maximum rainfall: 850 mm, minimum rainfall : 39 mm). Dry season dominating most of the year alternates with a wet season with relatively low precipitation. As a result, vegetation belongs to pre-desert septic domains in the center of the island with halophilic Crassulaceous steppes on the coast (Baouendi, 1999; Henia Omrane et al., 2008).



○ Study area : Djerba-Tunisia

**Figure 1:** Geographical location of the study area (Google map)

## 2.2 Methodology

Ethnobotanical information was obtained through interviews with residents and originated from Djerba during the period of 2015 to 2016. We have adopted participatory tools to estimate knowledge and solicit responses (Martin, 1995). Their flexible and informal characteristics enabled the active and relaxed participation of the various interviewees. The themes dealt mainly with the diversity of resources, their use, preparation, administration, name in Arabic and their meaning or etymology. The collected information concerned informant profiles (age, gender, level of education, marital status and habitat).

## 2.3 Data analysis

Data were collected and analyzed using quantitative value indices:

- Relative Citation Frequency (RCF): to determine the local importance for each species. It was obtained according to the following formula:

$$RFC = CF / N$$

CF: number of informants who mentioned the use of the species

N: total number of informants

- Citation number: corresponds to the number of informants who mentioned species. It is used to calculate the ethnobotanical parameters used in this study.

- Number of reported use of the species (RU): is the total number of uses in a use category for each species (Houéhanou et al., 2015).

- Cultural importance (CI): to measure the variation of knowledge between the different communities. It is also appropriate for estimating the importance of a plant for a category of use (food use, medicinal use ...) (Tardío and Pardo-De-Santayana, 2008):

$$CI = \frac{\sum_{u=1}^{u=NC} \sum_{i=1}^{i=N} \frac{UR_{ui}}{N}}{N}$$

NC: total number of use categories, N: total number of informants

- Informant Consensus Factor (ICF): was calculated using the following formula

$$ICF = (Nur - Nt) / (Nur - 1)$$

Nur: number of times a particular category of disease has been reported

Nt: number of plant (s) mentioned for the treatment of this particular condition p (Heinrich et al., 1998). It allowed to test the homogeneity of the information: FIC is low (close to 0) when the plants are chosen randomly or the informants do not exchange information on their use. FIC is high (close to 1) when the selection criteria are well defined and / or information is shared among informants (Mükemre et al., 2015)

-Fidelity level (FL): calculated according to the following formula

$$FL = (NP / N) * 100$$

NP: the number of informants who cited an A species to treat a disease

N: the number of informants who cited species A to treat any disease (Friedman et al., 1986).

FL is employed to determine the species most used by informants in the study area in the treatment of a particular condition

## 2.4 Identification of plants

Cited plants by the informants were harvested, photographed and identified based on the floristic literature (Floche and Boulos, 2010), and the Med Check list and African plants database

## 3. Results and discussion

### 3.1. Demographic characteristics of participants

The direct contact with informants allowed us to determine their demographic characteristics (Table 1). 92% of informants hold information from the experiences of others. This showed the importance of the

information transfer from one person to another. 61.33% of the participants used both types of modern and traditional medicine compared with 29% who only use modern medicine. No informant relied only on traditional medicine for medication. This could be due to cultural and socioeconomic changes and developments as well as the accessibility of pharmacies and the proximity of public and private health units.

**Table 1:** Demographic characteristics of informants in the study area

Demographic characteristics (n = 75)		Number	Percentage (%)
<b>Ages</b>	A1 (20-30)	10	13.33
	A2 (31-40)	14	18.66
	A3 (41-50)	20	26.66
	A4 (51-60)	11	14.66
	A5>60	20	26.66
<b>Sex</b>	Male	29	38.66
	Female	46	61.33
<b>Family situation</b>	Single	9	12.00
	Married	59	78.66
	Widower	7	9.33
<b>Academic level</b>	Illiterate	12	16.00
	Primary	32	42.66
	Secondary	18	24.00
	University	13	17.33
<b>Information origin</b>	Reading	6	8.00
	Experiences of others	69	92.00
	Pharmacist	0	0.00
	Other	0	0.00
<b>Recourt</b>	Traditional medicine only	0	0.00
	Only in modern medicine	29	38.66
	Both	46	61.33

### 3.2 Plants identification

We have identified 86 species among the 120 vernacular names cited by the informants. These species belong to 80 genera and 43 families. The inventory details were listed in Table 2. The most cited families were *Asteraceae* (17.29% of total citations, including 13 species). Indeed, it was the most extended family in this area as well as in other areas reported by the literature (Bano et al., 2012 ; Blanco, et al., 1999). This was due to the great distribution of its species. According to the relative citation frequency (RCF), *Malva sylvestris* (FRC = 0.52) and *Allium roseum* (FRC = 0.45) were the most important species among the informants and the core of ethnobotanical culture of the study area. In fact, these two plants were commonly used in the daily live of informants (cooking, medicinal uses...)

**Table 2:** List of plants cited by people of Djerba

Item F.	Family	Item N.S.	Scientific name	French Commun name	CF	RC F
1	<i>Aizoaceae</i> (1 Esp)	1	<i>Mesembryanthemum nodiflorum</i>	Ficoïde à fleurs nodales	18	0.24
2	<i>Amaryllidaceae</i> (2 Esp)	2	<i>Allium porrum</i>	Poireau, Ail poireau	17	0.22
		3	<i>Allium roseum</i>	Ail rose	34	0.45
3		4	<i>Aloe vera</i>	Aloe vera	22	0.29
	<i>Xanthorrhoeaceae</i> (1 Esp)					
4	(1 Esp)	5	<i>Narcissus tazetta</i>	Narcisse à bouquet,	1	0.01
5	<i>Apiaceae</i> (3 Esp)	6	<i>Anethum graveolens</i>	Aneth, Aneth odorant, Fenouil bâtard	2	0.02
		7	<i>Pimpinella anisum</i>	Anis, Boucage anis	9	0.12
		8	<i>Deverra scoparia</i>	Non déterminé	3	0.04
6	<i>Asparagaceae</i> (1 Esp)	9	<i>Asparagus horridus</i>	Asperge horrible	2	0.02
7	<i>Asphodelaceae</i> (1 Esp)	10	<i>Asphodelus tenuifolius</i>	Asphodèle à petites feuilles	23	0.30

8	Asteraceae (13 Esp)	11	<i>Anacyclus clavatus</i>	Anacycle en massue, Anacycle tomenteux	18	0.24
		12	<i>Anthemis arvensis</i>	Anthémis des champs, Camomille sauvage	17	0.22
		13	<i>Artemisia campestris</i>	Armoise des champs. Armoise champêtre. Aurone-des-champs. Armoise rouge	14	0.18
		14	<i>Artemisia saharae</i>	armoise herbe blanche. Armoise blanche	9	0.12
		15	<i>Carduus pycnocephalus</i>	Chardon à tête dense. Chardon à capitules denses	1	0.01
		16	<i>Centaurea bimorpha</i>	Chardon	1	0.01
		17	<i>Centaurea calcitrapa</i>	Centaurée chausse- trape. Centaurée Chausse-trappe	14	0.18
		18	<i>Cyanus segetum</i>	Bleuet. Barbeau	1	0.01
		19	<i>Echinops spinosus</i>	chardon à fleurs globuleuses	1	0.01
		20	<i>Podospermum laciniatum</i>	Scorzonère à .leaves de Chausse-trape	1	0.01
		21	<i>Scorzonera undulata</i>	Scorzonère à .leaves ondulées	10	0.13
		22	<i>Silybum marianum</i>	Chardon marie. Chardon marbré	4	0.05
		23	<i>Sonchus oleraceus</i>	Laiteron maraîcher.	5	0.06

				Laiteron potager.		
				Laiteron lisse		
9	<i>Boraginaceae</i>	24	<i>Borago officinalis</i>	Bourrache.	1	0.01
	(2 Esp)			Bourrache officinale		
		25	<i>Echium arenarium</i>	Vipérine des sables	2	0.02
10	<i>Brassicaceae</i>	26	<i>Anastatica</i>	<u>Rose de Jéricho.</u>	4	0.05
	(4 Esp)		<i>hierochuntica</i>	<u>Anastatique</u>		
		27	<i>Cakile maritima</i>	Cakilier maritime.	1	0.01
				Cakilier. Roquette		
				de mer		
		28	<i>Diplotaxis simplex</i>	diplotaxes	1	0.01
		29	<i>Eruca vesicaria</i>	Roquette.	19	0.25
				Roquette cultivée		
11	<i>Cactaceae</i>	30	<i>Opuntia ficus-indica</i>	Figuier de Barbarie.	13	0.17
	(1 Esp)			Figuier d'Inde		
12	<i>Capparaceae</i>	31	<i>Cleome africana</i>	Cléome	1	0.01
	(1 Esp)					
13	<i>Caryophyllaceae</i>	32	<i>Silene colorata</i>	Silène colorée	3	0.04
	e (1 Esp)					
14	<i>Amaranthaceae</i>	33	<i>Chenopodium</i>	Chénopode fausse	3	0.04
	(1 Esp)		<i>ambrosioides</i>	ambrosie		
15	<i>Cucurbitaceae</i>	34	<i>Citrullus colocynthis</i>	Coloquinte	3	0.04
	(2 Esp)	35	<i>Ecballium elaterium</i>	Concombre d'âne.	2	0.02
				Momordique.		
				Concombre sauvage		
16	<i>Cupressaceae</i>	36	<i>Juniperus phoenicea</i>	Genévrier de Lycie.	4	0.72
	(1 Esp)			Genevrier de		
				phoenicie. Lycien		
17	<i>Cyperaceae</i>	37	<i>Cyperus rotundus</i>	Herbe à oignon.	2	0.02
	(1 Esp)			Souchet rond		
18	<i>Ephedraceae</i>	38	<i>Ephedra alata</i>	Éphédra. éphèdre.	1	0.01



	(1 Esp)			uvette		
19	<i>Euphorbiaceae</i>	39	<i>Euphorbia helioscopia</i>	Euphorbe réveil	8	0.10
	(2 Esp)			matin. Herbe aux		
				verrues		
		40	<i>Ricinus communis</i>	Ricin	4	0.05
20	<i>Fabaceae</i>	41	<i>Medicago laciniata</i>	Luzerne laciniée	1	0.01
	(4 Esp)	42	<i>Retama raetam</i>	Rétam. R'tam	5	0.06
		43	<i>Trigonella foenum-graecum</i>	Fenugrec.	7	0.09
				Trigonelle Fenugrec		
			<i>Ceratonia siliqua</i>	Caroubier	2	0.02
21	<i>Geraniaceae</i>	44	<i>Erodium glaucophyllum</i>	becs-de-grue	4	0.72
	(2 Esp)					
		45	<i>Erodium laciniatum</i>	Érodium à .leaves	3	0.04
				découpées. Bec-de-		
				grue lacinié.		
				Érodium lacinié		
22	<i>Asparagaceae</i>	46	<i>Drimia maritima</i>	Scille maritime.	1	0.01
	(1 Esp)			Urginée maritime.		
				Squille		
23	<i>Iridaceae</i>	47	<i>Gladiolus italicus</i>	Glaïeul des	7	0.09
	(1 Esp)			moissons. Glaïeul		
				d'Italie		
24	<i>Juncaceae</i>	48	<i>Juncus acutus</i>	Jonc aigu. Jonc à	1	0.01
	(1 Esp)			tépales pointus		
25	<i>Lamiaceae</i>	49	<i>Ajuga iva</i>	Bugle Ivette. Ivette-	5	0.06
	(7 Esp)			musquée		
		50	<i>Lavandula stoechas</i>	Lavande à toupet.	7	0.09
				Lavande papillon.		
				Lavande Stéchade		
		51	<i>Marrubium vulgare</i>	Marrube blanc.	8	0.10
				Marrube commun.		

				Marrube vulgaire		
		52	<i>Mentha aquatica</i>	Menthe aquatique	1	0.01
		53	<i>Mentha spicata</i>	Menthe en épi.	2	0.02
				Menthe verte		
		54	<i>Origanum majorana</i>	Marjolaine. Origan des jardins	2	0.02
		55	<i>Teucrium polium</i>	Germandrée blanc-grisâtre.	2	0.02
				Germandrée Polium		
26	<i>Lauraceae</i> (1 Esp)	56	<i>Laurus nobilis</i>	Laurier.	1	0.01
				Laurier-sauce		
27	<i>Lythraceae</i> (1 Esp)	57	<i>Lawsonia inermis</i>	Henné.Hina. al-henna. mignonette. plante du paradis.	2	0.02
				Réséda arbuste		
28	<i>Myrtaceae</i> (2 Esp)	58	<i>Eucalyptus globulus</i>	Eucalyptus commun. Eucalyptus.	4	0.05
				Gommier bleu		
		59	<i>Myrtus communis</i>	Myrte commun	1	0.01
29	<i>Malvaceae</i> (1 Esp)	60	<i>Malva sylvestris</i>	Mauve sauvage. Mauve sylvestre.	39	0.52
				Grande mauve		
30	<i>Oleaceae</i> (1 Esp)	61	<i>Olea europaea</i>	Olivier.	5	0.06
				Olivier d'Europe		
31	<i>Papaveraceae</i> (2 Esp)	62	<i>Papaver hybridum</i>	Coquelicot hispide. Pavot hybride	1	0.01
		63	<i>Papaver rhoeas</i>	Coquelicot	29	0.38
32	<i>Plantaginaceae</i> (1 Esp)	64	<i>Plantago albicans</i>	Plantain blanchissant	1	0.01
33	<i>Poaceae</i> (7 Esp)	65	<i>Cynodon dactylon</i>	Chiendent pied-de-poule. Gros	19	0.25

				chiendent		
		66	<i>Ampelodesmos mauritanicus</i>	Ampelodesmos de Mauritanie. Diss	8	0.10
		67	<i>Avena barbata</i>	Avoine barbue	1	0.01
		68	<i>Hordeum murinum</i>	Orge des rats. Orge sauvage. Orge Queue-de-rat	1	0.01
		69	<i>Lolium rigidum</i>	Ivraie à épis serrés. Ivraie à épi serré	3	0.04
		70	<i>Lygeum spartum</i>	sparte	1	0.01
		71	<i>Stipa capensis</i>	Stipe du Cap. Plumet du Cap	4	0.05
34	<i>Polygonaceae</i> (3 Esp)	72	<i>Emex spinosa</i>	Emex	20	0.26
		73	<i>Polygonum equisetiforme</i>	Renouée à balais	8	0.10
		74	<i>Rumex bucephalophorus</i>	Oseille tête-de-bœuf. Rumex Tête-de-boeuf	1	0.01
35	<i>Ranunculaceae</i> (1 Esp)	75	<i>Adonis dentata</i>	Adonis à petits fruits	1	0.01
36	<i>Resedaceae</i> (1 Esp)	76	<i>Reseda alba</i>	Réséda blanc	3	0.04
37	<i>Rhamnaceae</i> (1 Esp)	77	<i>Ziziphus lotus</i>	Lotus des anciens	1	0.01
38	<i>Rutaceae</i> (1 Esp)	78	<i>Ruta graveolens</i>	Rue des jardins. Rue odorante. Rue fétide	7	0.09
39	<i>Solanaceae</i> (3 Esp)	79	<i>Hyoscyamus albus</i>	Jusquiame blanche	2	0.02
		80	<i>Lycium europaeum</i>	Lyciet d'Europe	8	0.10
		81	<i>Solanum nigrum</i>	Morelle noire	1	0.01
40	<i>Thymelaeaceae</i>	82	<i>Thymelaea hirsuta</i>	Passerine hérissée.	5	0.06

	(1 Esp)			Passerine hirsute		
41	<i>Urticaceae</i>	83	<i>Urtica dioica</i>	Ortie dioïque.	14	0.18
	(1 Esp)			Grande ortie		
42	<i>Zygophyllaceae</i>	84	<i>Fagonia cretica</i>	Fagonie de Crête	1	0.01
	(2 Esp)	85	<i>Peganum harmala</i>	Harmal	6	0.08

### 3.3 Knowledge of Uses

Some species cited by informants were used in different categories: medicinal use, food use, pasture and cosmetics (Table 3). Other types of use have been mentioned such as insecticidal effect, detergent for dishwashing and washing, dyeing, and manufacture of ink and were classified into category "Other".

**Table 3:** Use categories of species cited by informants in the study area

Item	Scientific name	Nombre de citation					RU	IC
		Med.	Al.	Pa.	Cos.	others		
1	<i>Mesembryanthemum nodiflorum</i>	0	0	2	5	3	10	0.132
2	<i>Allium porrum</i>	1	12	1	0	0	14	0.186
3	<i>Allium roseum</i>	1	24	0	0	0	25	0.333
4	<i>Aloe vera</i>	12	1	0	6	0	19	0.253
5	<i>Anethum graveolens</i>	0	1	0	0	0	1	0.026
6	<i>Pimpinella anisum</i>	1	2	0	0	0	3	0.033
7	<i>Deverra scoparia</i>	1	0	0	0	1	2	0.026
8	<i>Asparagus horridus</i>	1	0	0	0	0	1	0.013
9	<i>Asphodelus tenuifolius</i>	1	18	1	0	0	20	0.266
10	<i>Anacyclus clavatus</i>	5	0	5	0	0	10	0.132
11	<i>Anthemis arvensis</i>	2	0	1	0	1	4	0.099
12	<i>Artemisia campestris</i>	8	0	0	0	0	8	0.106
13	<i>Artemisia saharae</i>	6	0	0	0	0	6	0.080
14	<i>Centaurea bimorpha</i>	0	0	1	0	0	1	0.013
15	<i>Centaurea calcitrapa</i>	1	2	6	0	0	9	0.113
16	<i>Cyanus segetum</i>	0	1	0	0	0	1	0.013

17	<i>Scorzonera undulata</i>	7	0	0	0	0	7	0.093
18	<i>Silybum marianum</i>	0	5	0	0	0	5	0.066
19	<i>Sonchus oleraceus</i>	0	1	0	0	0	1	0.013
20	<i>Anastatica hierochuntica</i>	4	0	0	0	0	4	0.053
21	<i>Cakile maritima</i>	1	0	0	1	0	2	0.026
22	<i>Eruca vesicaria</i>	6	7	1	1	0	15	0.199
23	<i>Opuntia ficus-indica</i>	2	3	0	1	0	6	0.073
24	<i>Ceratonia siliqua</i>	1	0	0	0	0	1	0.013
25	<i>Chenopodium ambrosioides</i>	0	0	1	0	0	1	0.013
26	<i>Citrullus colocynthis</i>	0	1	0	0	1	2	0.026
27	<i>Ecballium elaterium</i>	2	0	0	0	0	2	0.020
28	<i>Juniperus phoenicea</i>	2	0	0	0	0	2	0.020
29	<i>Cyperus rotundus</i>	0	1	0	0	0	1	0.013
30	<i>Euphorbia helioscopia</i>	1	0	2	0	0	3	0.033
31	<i>Ricinus communis</i>	4	0	0	0	0	4	0.053
32	<i>Retama raetam</i>	2	0	0	0	0	2	0.020
33	<i>Trigonella foenum-graecum</i>	1	1	1	0	0	3	0.039
34	<i>Erodium glaucophyllum</i>	0	2	0	0	0	2	0.020
35	<i>Gladiolus italicus</i>	1	0	1	0	0	2	0.026
36	<i>Juncus acutus</i>	0	0	0	0	1	1	0.013
37	<i>Ajuga iva</i>	3	0	0	0	0	3	0.040
38	<i>Lavandula stoechas</i>	4	1	0	0	0	5	0.066
39	<i>Marrubium vulgare</i>	4	0	0	0	0	4	0.053
40	<i>Mentha aquatica</i>	0	1	0	0	0	1	0.013
41	<i>Mentha spicata</i>	0	1	0	0	0	1	0.013
42	<i>Origanum majorana</i>	2	0	0	0	0	2	0.020
43	<i>Teucrium polium</i>	2	0	0	0	0	2	0.020
44	<i>Lawsonia inermis</i>	0	0	0	1	0	1	0.013
45	<i>Eucalyptus globulus</i>	1	0	0	0	0	1	0.013

46	<i>Myrtus communis</i>	1	0	0	0	0	1	0.013
47	<i>Malva sylvestris</i>	11	17	5	0	0	33	0.432
48	<i>Olea europaea</i>	4	0	0	1	0	5	0.066
49	<i>Papaver hybridum</i>	0	1	0	0	0	1	0.013
50	<i>Papaver rhoeas</i>	2	11	3	0	0	16	0.212
51	<i>Cynodon dactylon</i>	5	0	5	0	0	10	0.132
52	<i>Ampelodesmos mauritanicus</i>	0	6	0	0	0	6	0.080
53	<i>Avena barbata</i>	1	0	0	0	0	1	0.013
54	<i>Lolium rigidum</i>	0	0	1	0	0	1	0.013
55	<i>Stipa capensis</i>	0	0	1	0	0	1	0.013
56	<i>Emex spinosa</i>	0	5	8	0	0	13	0.172
57	<i>Polygonum equisetiforme</i>	6	0	0	0	0	6	0.080
58	<i>Rumex bucephalophorus</i>	0	0	1	0	0	1	0.013
59	<i>Adonis dentata</i>	1	0	0	0	1	2	0.026
60	<i>Ruta graveolens</i>	4	0	0	0	0	4	0.053
61	<i>Hyoscyamus albus</i>	2	0	0	0	0	2	0.026
62	<i>Lycium europaeum</i>	0	0	0	0	1	1	0.013
63	<i>Solanum nigrum</i>	0	1	0	0	0	1	0.013
64	<i>Thymelaea hirsuta</i>	2	0	0	0	0	2	0.026
65	<i>Urtica dioica</i>	8	0	0	0	0	8	0.106
66	<i>Fagonia cretica</i>	0	0	1	0	0	1	0.013
67	<i>Peganum harmala</i>	6	0	0	0	0	6	0.080
Citation number by category use		143	126	48	16	9		

According to Table 3, the most cited use category of species was medicinal use (41.81%) followed by food use (raw or cooked) (36.48%). Informants also used the cited species in the pasture (14.03%) with low cosmetic use and others. The number of reported use was considered as the most objective index for quantifying ethnobotanical knowledge. It allowed to calculate another parameter; the cultural importance of a species that could be used to compare the use of plants among different populations.

According to the calculation of reported use (UR), the importance of the uses varied according to the species. We noted a high UR for *Malva sylvestris* followed by *Allium roseum*. These two species have been characterized by the highest CIs that showed their cultural importance while they have not been exploited in all the categories of studied use.

The most frequently mentioned family of medicinal plants was the *Asteraceae* (20% of the citations). Approximately, 36.36% of the citations concerned the cures of the digestive and respiratory system.

Concerning food use, there are 25 species prepared according to different recipes (couscous, salad). The *Amaryllidaceae* family was the most commonly used (28.57%) by its two species *Allium roseum* and *Allium porrum* followed by the family *Xanthorrhoeaceae* (*Asphodelus tenuifolius*). Informants also mentioned the use of some species for grazing. In fact, their way of life included the breeding of domestic animals and the long period of drought in the island, the inhabitants took advantage during the spring to mow the spontaneous plants (*Emex spinosa*, *Centaurea calcitrapa*, *Malva sylvestris* and *Cynodon dactylon*) and kept them for the summer period. On the other hand, the actual use and cited use by the informants does not reflect the same importance. Actual use could be influenced by seasonality, resource shortage, age and gender, traditions and loss of knowledge. In fact, we have noted a loss of this traditional knowledge among younger generations. This observation could be explained by easy access to modern medications and lack of information exchange between the generations.

### 3.4. Medicinal use of plants by informants from Djerba

Table 4 showed all species for medicinal use, their methods of preparation and the used parts of the plant. Decoction has been showed as the most widely adopted method for preparing cures from medicinal plants, as other studies have reported (Gurdal and Kultu, 2013; Ahmad et al., 2014). The dry matter could also be used. The whole plant and leaves were the most used by informants. This could be explained by the accessibility and availability of leaves in nature than other parts of the plant. The abundant use of the whole plant could be explained by the low rainfall of the area and most of the plants were wild herbs.

**Table 4:** Medicinal uses of species cited by informants.

Item N.S.	Scientific name	Medicinal use	Used part	Preparation method	Therapeutic effects based on bibliographic data
1	<i>Allium porrum</i>	Against cough and rheumatism	Whole plant	Raw	Inhibition of glucose intestinal intake in rats, Gastroprotective effect (Blemkar et al., 2013; Malafaia et al., 2015)
2	<i>Allium roseum</i>	cold and angina	Pods	Raw	Antimicrobial and antioxidants properties (Sakka Rouis-Soussi et al., 2014; Snoussi et al., 2016)
3	<i>Aloe vera</i>	Hair and Skin Care wound healing influenza stomach ache and abdominal pain rheumatism inflammation of the joints inflammation of the ears and eyes	leaves gel	Raw Topical application	Treatment of wounds. Immunomodulatory effect. Improvement of intestinal absorption. Antidiabetic effect. Antioxidant, hepatoprotective effect, anti-cancer activity, antimicrobial and antiviral drugs (Maharjan and Nampoothiri, 2015).
4	<i>Pimpinella anisum</i>	Gastric disorders	Whole plant	Decoction	Antifungal and antibacterial activity, treatment of dyspepsia and gastrointestinal complications. hepatoprotective activity. antidiabetic and hypolipidemic effect (Asadollahpoor et al., 2017)
5	<i>Deverra scoparia</i>	Gastroesophageal reflux insect repellent	Stem	Raw	Inhibition of hepatic carboxylesterase (Djeridane et al., 2008)
6	<i>Asparagus horridus</i>	Gout	Whole plant	Maceration	Anti-inflammatory activity (Bremner et al., 2009)



7	<i>Asphodelus tenuifolius</i>	rheumatisme	Whole plant	ND	ND
8	<i>Anacyclus clavatus</i>	Gastric Disorders bronchitis urinary system relaxing	Leaves and flower	Decoction	ND
9	<i>Anthemis arvensis</i>	Digestive disorders	Whole plant	Decoction	ND
10	<i>Artemisia campestris</i>	headache Digestive disorders. worming Wound Care and Scorpion Stitch	Leaves	Cataplastm (only or with clove) decoction	Antivenin, anticancer. Antidiabetic, antihypertensive. Antimicrobial, wormer effects (Dib et al., 2017)
11	<i>Artemisia saharae</i>	Traitment of Flu symptoms coughing Hypotension, worm Fungal fingers infection gastroesophageal reflux gastric disorders	Leaves and stem	Decoction Fumigation	Antibacterial, antioxidant effect (Zouri et al., 2014;)
12	<i>Centaurea calcitrapa</i>	Digestive disorders in children	leaves	Decoction (with anise)	ND
13	<i>Scorzonera undulata</i>	Facilitates digestion Against oral inflammation and digestive disorders, Antidiarrheal effect Eye treatment	Leaves Roots	Raw Sap (milk) Drops in the eye	ND
14	<i>Anastatica hierochuntica</i>	Treatment of influenza throat pain kidneys	Leaves	Decoction	Antioxidant, antimicrobial. Antifungal, hypolipédimique. Hypoglycemic, anti-inflammatory

		and hypertension			activity hepatoprotective, gastroprotective, anti-mélanogénétique, immuno-stimulator effects (Siti Rosmani et al., 2017).
15	<i>Cakile maritima</i>	rheumatism	Leaves	Massage paste	ND
16	<i>Eruca vesicaria</i>	Face care Against Cough and Flu Treatment of the prostate Gastric Disorders Increase fertility in men	Dry leaves Whole plant	Decoction Chewing Massage with macerate	ND
17	<i>Opuntia ficus-indica</i>	Elimination of kidney stones Stomach ache antidiarrheal Wound healing (burns, wounds)	Leaves Fruits	Decoction Cataplasm Raw	Hypoglycemic, antidiabetic, anticancer, immunoprotective and antioxidant effect (Ben Saada et al., 2017)
18	<i>Ceratoniasiliqua</i>	Hypotensive effect	Leaves	Infusion	Antioxidant, Antidiarrheal. antibacterial, antidiabetic, anti-inflammatory and hypoglycaemic effect and free radical scavenger activity (Rtibia et al., 2017).
19	<i>Ecballium elaterium</i>	Sinusite ORL	Fruits	drop of the fruit in the nose Maceration with warm oil	Anti-inflammatory activity Hepatoprotective and anticancer effects (Touihri et al., 2015)
20	<i>Juniperus phoenicea</i>	hypotensive and hypoglycemic effect treatment of infertility	Leaves Whole plant	Decoction	Anti-inflammatory activity. Diuretic, antiseptic, analgesic and anticancer Wormering effect

					(Tavares et al., 2012)
21	<i>Euphorbia helioscopia</i>	Wart treatment	stem	Sap (milk) direct application	Worming, febrifuge, antibacterial, (Lone et al., 2012)
22	<i>Ricinus communis</i>	Treatment of skin wounds, hair loss, cough, digestive disorders and pulmonary inflammation	Leaves and fruits	cataplasm (leaves with warm oil) maceration	Cytotoxic, antioxidant, antimicrobial, antidiabetic and anti-inflammatory activity (Ribeiro et al., 2016)
23	<i>Retama raetam</i>	Treatment of rheumatism and infected skin wounds	Whole plant	Decoction and massage with fresh material	Hypoglycemic, hypotriglyceridemic and diuretic effect (Saada et al., 2014).
24	<i>Trigonella foenum-graecum</i>	Antidiarrheal effect	seed	Swallow the seed alone	Anti-atherosclerosis, antioxidant. Antidiabetic, hypocholesterolemic and weight loss effect (Hamza et al., 2012 ; Mbarkia et al., 2017)
25	<i>Gladiolus italicus</i>	Antifungal effect Treatment of Heart disease	ND	ND	ND
26	<i>Ajuga iva</i>	Antidiabetic, hypotensive and relaxing effect Treatments for gastric disorders	leaves	Decoction	Hypoglycemic, diuretic. Antipyretic and hypotensive effect Treatment of dysentery and toothache (El-Hilaly et al., 2004).
27	<i>Lavandula stoechas</i>	Treatment of flu and cough Relaxing effect	leaves flower	Infusion Mixing powder and oil	Antibacterial, antifungal, antioxidant activity, treatment of headache (Zuzarte et al., 2013)
28	<i>Marrubium vulgare</i>	Hypotensive effect Itching of fingers	Leaves	Decoction Decoction of fingers in the warm decoction	Antibacterial, antioxidant. Hypotensive, hypoglycemic. And hypolipidemic effect. Improvement of liver function (Boudjelal et al., 2012)

29	<i>Origanum majorana</i>	Cough and sore throat treatment Expectorant effect and relaxing	Leaves	Decoction	Treatment of the stomach. Insomnia, rheumatism, migraine, dysmenorrhea and diarrhea Antiseptic, expectorant and sedative effect (Hajlaoui et al., 2016).
30	<i>Teucrium polium</i>	Treatment of constipation and gastric disorders in children	Whole plant	Decoction	Anti-inflammatory. Antinociceptive, antibacterial. Hypotensive, hypolipidemic, anti-rheumatoid, hypoglycaemic and antioxidant drugs activity (Bektas et al., 2011)
31	<i>Eucalyptus globulus</i>	Respiratory diseases prevention	Leaves	Decoction	Antibacterial, antidiabetic, antioxidant, Antiplatelet, antiviral, anti-inflammatory and antifungal agents activity (Škrovánková et al., 2012)
32	<i>Myrtus communis</i>	Cough treatment	flowers	Powder mixed with oil or honey	Antibacterial, antifungal, antiviral, antioxidant, anti-inflammatoir, antidiabetic, antimutagenic effect (Aleksic and Knezevic, 2014)
33	<i>Malva sylvestris</i>	Treatment of infections, abdominal pain rheumatism, burning urination, cough, constipation and respiratory system (expectorant effect), cardiovascular diseases. fingers itching, and dental ailments Decreases leg swelling	Leaves	Decoction Chewing of leaves raws Deceiving hands in the warm decoction poultice decoction gargle	Anti-inflammatory activity. antidiabetic. antioxidant. hepatoprotective and nephroprotective (Ben Saada et al., 2017)

		Hypotensive, hypoglycemic, antipyretic and antiseptic (dermal) effect.			
34	<i>Olea europaea</i>	Hypotensive and antidiabetic effect Treatment of the skin and oral infections	leaves and fruits	Decoction Infusion Massage oil Chewing raw leaves with salt	Antidiabetic, hypotensive. Antiarrhythmic, vasodilator. Antimicrobial, antiviral and anti- tumoral effect (Al-Attar and Alsalmi, 2017)
35	<i>Papaver rhoeas</i>	Treatment of Cough, gastric and dental ailments	flowers	decoction	Sedative, narcotic, emollient and spasmolytic effect Treatment of urinary irritations, bronchitis, pneumonia and rash (Soulimani et al., 2001)
36	<i>Cynodon dactylon</i>	Treatment of Kidney, and gout Disease and fever	roots leaves	Decoction	Antioxidant, diuretic, antilithiasis and antidiabetic activity (Karthik and Ravikumar, 2011; Golshan et al., 2017).
37	<i>Avena barbata</i>	Treatment of rheumatism and constipation	ND	ND	ND
38	<i>Polygonum equisetiforme</i>	Skin care Treatment of warts, partridge eye (skin) and urinary system. Elimination of intestinal gas Antihemorrhagic effec	leaves Whole plant Dry stem	Smoke Application of milk Decoction In powder Live after ignition	ND
39	<i>Adonis dentata</i>	Treatment of the female reproductive system	flowers	Decoction	ND

40	<i>Ruta graveolens</i>	Treatment of rheumatism Ear pain and stomach gas for children	Leaves Leaves	Decoction chewing then swallowing	Worming, abortive, healing, anti-inflammatory, antipyretic. Antidiarrheal, and antimicrobial effect. Treatment of rheumatism and ulcers (França Orlanda and Nascimento, 2015)
41	<i>Hyoscyamus albus</i>	Treatment of eczema	leaves and stem	By fumigation and then launching of the feet	Mydriatic, antispasmodic, anticholinergic, analgesic, sedative and anti-dabetic effect (Bourebaba et al., 2016)
42	<i>Thymelaea hirsuta</i>	Treatment of infected pimples (boils) and sciatic nerve	stem	Induce a scratch and rub with the plant	Hypoglycemic, antioxidant. antidiabetics and anti-melanogenesis effect (Akrouit et al., 2011)
43	<i>Urtica dioica</i>	Treatment of rheumatism, itchy skin and arthritis inflammation Hypoglycemic and soothing antidiuretic effect	Dry leaves	Decoction	Treatment of benign prostatic hyperplasia, Anti-inflammatory, antioxidant and anti-aging effect. Skin Care (Bourgeois et al., 2016)
44	<i>Peganum harmala</i>	Treatment of wounds, skin infection, conjunctivitis, musculoskeletal Influenza, Antidiabetic sleeping pill and antipyretic effect Skin care	leaves Whole plant Seed	Powder (oral) Powder alone or with oil for massage	Hypotensive, vasodilator, angiogenesis inhibitor, atispsamodique, anticholinergic, antihistamine, and anti-marking effect Increased cardiac consystemile force (Niroumand et al., 1996)

ND : no determined

Some species have been reported for their therapeutic effects without being mentioned in scientific journals such as *Asphodelus tenuifolius* (Asphodelaceae), *Anacyclus clavatus*, *Anthemis arvensis*, *Centaurea calcitrapa*, and *Scorzonera undulata* (Asteraceae), *Cakile maritima* and *Eruca vesicaria* (Brassicaceae) *Gladiolus italicus* (Iridaceae), *Avena barbata* (Poaceae), *Polygonum equisetiforme* (Polygonaceae), *Adonis dentata* (Ranunculaceae). This would open up new ways of research to scientifically prove the therapeutic effects of these species that were mentioned by informants

Table 5 showed the consensus of informants on the use of species for the treatment of some diseases. The informant consensus factor, calculated for each type of condition, ranges from 0.27 to 1. The scorpion sting treatment has the highest ICF. Indeed, it was one of the most responded type of affection in the study area seen that it was characterized by a Saharan climate and the scorpions were very common in this region. *Artemisia campestris* was the most common species to treat this kind of sting. We also found an important ICF varying between 0.50 and 0.56 for the care of various conditions such as influenza, intestinal worms, eyes inflammation and infertility. In addition, the importance given by the Djerbian population to the care of the hair and the skin (consensus on 8 plant species).

**Table 5:** Informants Consensus factor for each disease category.

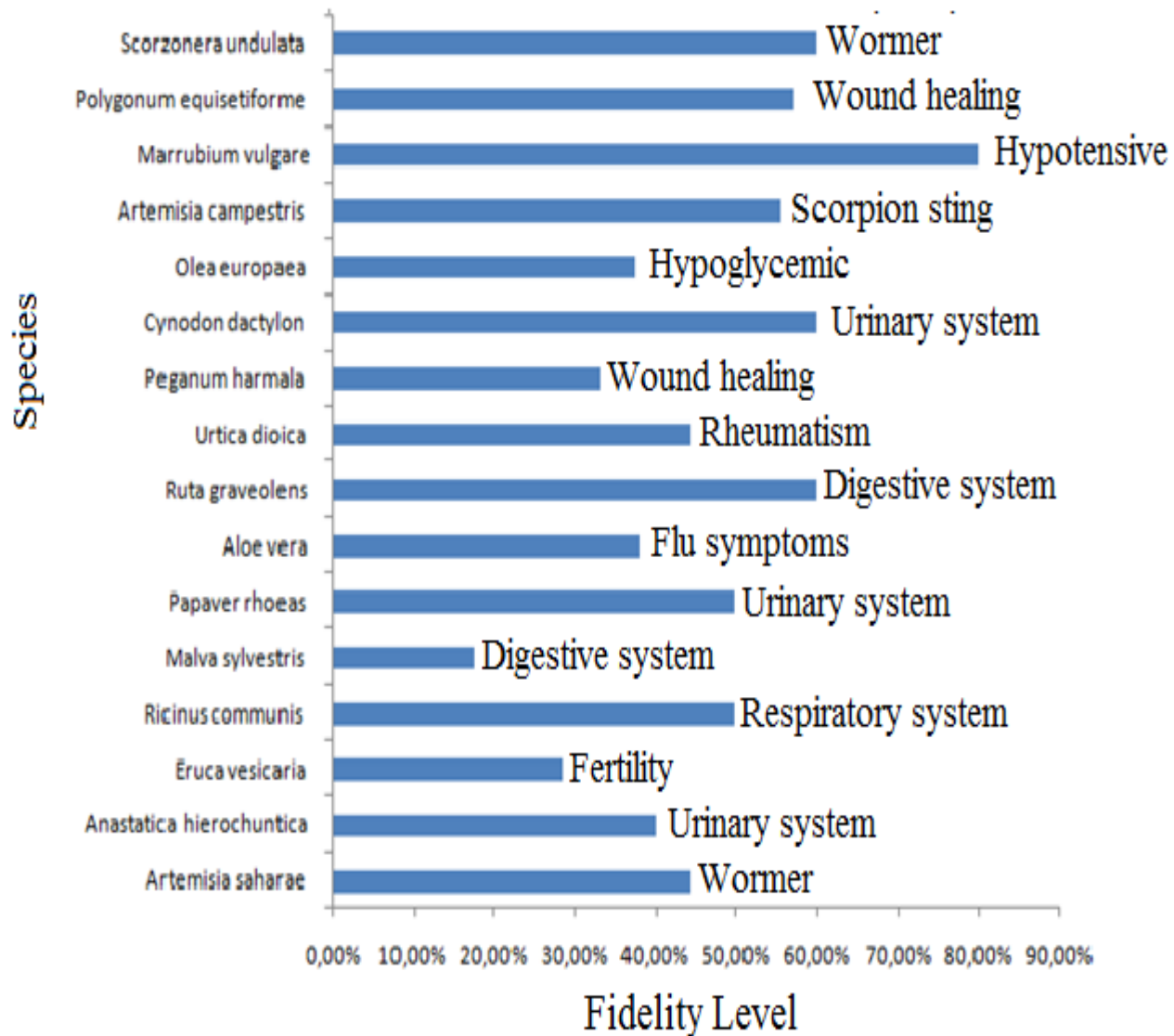
Affection	CFI	Used species
Respiratory	0.28	<i>Allium porrum</i> . <i>Artemisia saharae</i> . <i>Anastatica hierochuntica</i> . <i>Eruca vesicaria</i> . <i>Ricinus communis</i> . <i>Lavandula stoechas</i> . <i>Origanum majorana</i> . <i>Eucalyptus globulus</i> . <i>Myrtus communis</i> . <i>Malva sylvestris</i> . <i>Papaver rhoeas</i>
Rheumatism	0.27	<i>Allium porrum</i> . <i>Aloe vera</i> . <i>Cakile maritima</i> . <i>Retama raetam</i> . <i>Malva sylvestris</i> . <i>Avena barbata</i> . <i>Ruta graveolens</i> . <i>Urtica dioica</i> . <i>Peganum harmala</i>
influenza States	0.55	<i>Allium roseum</i> . <i>Aloe vera</i> . <i>Artemisia saharae</i> . <i>Anastatica hierochuntica</i> . <i>Eruca vesicaria</i> . <i>Lavandula stoechas</i> . <i>Malva sylvestris</i> . <i>Cynodon dactylon</i> . <i>Peganum harmala</i>
Hair and Skin Care	0.56	<i>Aloe vera</i> . <i>Eruca vesicaria</i> . <i>Euphorbia helioscopia</i> . <i>Ricinus communis</i> . <i>Malva sylvestris</i> . <i>Olea europaea</i> . <i>Thymelaea hirsuta</i> . <i>Urtica dioica</i>
Wound healing and care	0.42	<i>Aloe vera</i> . <i>Artemisia campestris</i> . <i>Opuntia ficus-indica</i> . <i>Retama raetam</i> . <i>Marrubium vulgare</i> . <i>Malva sylvestris</i> . <i>Polygonum equisetiforme</i> . <i>Hyoscyamus albus</i> . <i>Peganum harmala</i>

Gastrointestinal Diseases	0.37	<i>Aloe vera</i> . <i>Pimpinella anisum</i> . <i>Deverra scoparia</i> . <i>Anacyclus clavatus</i> . <i>Anthemis arvensis</i> . <i>Artemisia campestris</i> . <i>Eruca vesicaria</i> . <i>Opuntia ficus-indica</i> . <i>Ricinus communis</i> . <i>Trigonella foenum-graecum</i> . <i>Ajuga iva</i> . <i>Teucrium polium</i> . <i>Malva sylvestris</i> . <i>Papaver rhoeas</i> . <i>Polygonum equisetiforme</i> . <i>Ruta graveolens</i>
wormer	0.55	<i>Artemisia campestris</i> . <i>Artemisia saharae</i> . <i>Centaurea calcitrapa</i> . <i>Scorzonera undulata</i> . <i>Avena barbata</i>
ENT	0.33	<i>Aloe vera</i> . <i>Ecballium elaterium</i> . <i>Ruta graveolens</i>
Inflammation of the eyes	0.50	<i>Aloe vera</i> . <i>Scorzonera undulata</i> . <i>Peganum harmala</i>
Scorpion Stitch	1.00	<i>Artemisia campestris</i>
Hypertension	0.46	<i>Artemisia saharae</i> . <i>Anastatica hierochuntica</i> . <i>Cerantonia siliqua</i> . <i>Juniperus phoenicea</i> . <i>Ajuga iva</i> . <i>Marrubium vulgare</i> . <i>Malva sylvestris</i> . <i>Olea europaea</i>
Mushrooms	0.33	<i>Artemisia saharae</i> . <i>Gladiolus italicus</i> . <i>Malva sylvestris</i>
Diseases of the urinary system	0.38	<i>Anastatica hierochuntica</i> . <i>Eruca vesicaria</i> . <i>Opuntia ficus-indica</i> . <i>Malva sylvestris</i> . <i>Papaver rhoeas</i> . <i>Cynodon dactylon</i> . <i>Polygonum equisetiforme</i> . <i>Adonis dentata</i> . <i>Urtica dioica</i>
Diabetes	0.28	<i>Juniperus phoenicea</i> . <i>Ajuga iva</i> . <i>Malva sylvestris</i> . <i>Olea europaea</i> . <i>Urtica dioica</i> . <i>Peganum harmala</i>
Infertility	0.50	<i>Eruca vesicaria</i> . <i>Juniperus phoenicea</i>

There are many other diseases that were treated by traditional medicine such as gout (*Asparagus horridus*, *Cynodon dactylon*), cardiovascular diseases (*Gladiolus italicus*, *Polygonum equisetiforme*), headaches (*Asparagus horridus*, *Cynodon dactylon*), bucco (*Malva sylvestris*, *Olea europaea*, *Papaver rhoeas*) and the sciatic nerve (*Thymelaea hirsuta*). Other species have been used for their repulsive action against insects such as *Deverra scoparia*. The Fidelity level (FL) allowed to identify 16 species for each category of disease. A higher level of fidelity was calculated for *Marrubium vulgare* (80%) for its deworming effect. We also noted an LF equal to 60% for; *Ruta graveolens* (digestive disorders) and *Cynodon dactylon* (disorder in the urinary system) and *Scorzonera undulata* (wormer). These results showed the importance given by informants to these species to treat these types of diseases.

The difference in knowledge of the medicinal use of the species mentioned by informants would be due to the cultural heritage. Indeed, knowledge was transmitted from generation to the next and there is a risk of information loss.





**Figure 2:** Fidelity Level of species for disease category.

According to Amorozo (1996), if a plant was universally used by a community for the same reasons, it was more likely that it is rich in active compounds justifying its use. In this case, we would talk about ethnobotanical screening, which could be a selection criterion for more advanced phytochemical and pharmacological studies and determine priorities for the conservation of bioresources.

#### 4. Conclusion

The present study reported and determined, for the first time, the ethnobotanical use of species in Djerba. This area is rich in plants for medicinal use by the indigenous population in their daily lives. However, we have noted a loss of this traditional knowledge among younger generations. Thus, it would seem important to well document and restore the old medicinal practices in order to preserve them for the future generations. In addition, phytochemical and pharmacological studies should be conducted to explore the potential of these plant species and discover new value-added molecules.

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