

Full Length Research Paper

Ethnopharmacological survey of plants used for the treatment of diabetes in the town of Sidi Slimane (Morocco)

M. Laadim*, M. L. Ouahidi, L. Zidane, A. El Hessni, A. Ouichou and A. Mesfioui

Laboratory of Genetics, Neuroendocrinology and Biotechnology, Department of Biology, Faculty of Sciences, Ibn Tofail University, Kenitra, Morocco.

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The study aimed to screen the antidiabetic plants used by 700 diabetic patients in the town of Sidi Slimane (northwestern Morocco). The results identified 59 species belonging to 28 botanical families, four of which are predominant (*Lamiaceae*: 9 species; *Apiaceae*: 7 species; *Asteraceae*: 5 species; *Fabaceae*: 4 species). The most used species are: *Trigonella foenum-graecum*, *Oreganum vulgare*, *Salvia officinalis*, *Marrubium vulgare* and *Olea europaea*. Similarly, majority of the anti-diabetic recipes are prepared as infusion and decoction. Further, seeds and leaves are the most used parts and are administered orally. These results constitute a database for subsequent studies to experimentally assess the potential of these plants.

Key words: Ethnopharmacological survey, medicinal plants, town of Sidi Slimane, diabetes mellitus.

INTRODUCTION

Diabetes is a complex disease due to its physiopathological mechanisms, its genetic determinism, as well as the genesis of its complications. It is a heterogeneous group of metabolic diseases whose main feature is a chronic hyperglycemia resulting from a defect in insulin secretion, of its action, or the association of these two anomalies (OMS, 2002). This disease affects more than 285 million people throughout the world, and the number of people provided for diabetic should increase in an outstanding manner to more than 380 million in 2025, thus becoming quickly the epidemic of the 21st century (International Diabetes Federation, 2009).

The OMS estimates that, in 2030, the diabetes will be the seventh leading cause of death in the world (OMS, 2013).

Across all the continents, Africa is the most affected by this disease (Erasto et al., 2005). In Morocco, the diabetes constitutes a major public health problem, indeed, according to a national survey conducted in 2000, the prevalence of this epidemic is located in the vicinity with about 6.6% (Tazi et al., 2000). In addition, according to another study, the number of diabetics exceeds 2.5 million, 7.81% of the Moroccan population, which makes the situation of national public health

*Corresponding author. E-mail: majda3amal-85@hotmail.com.

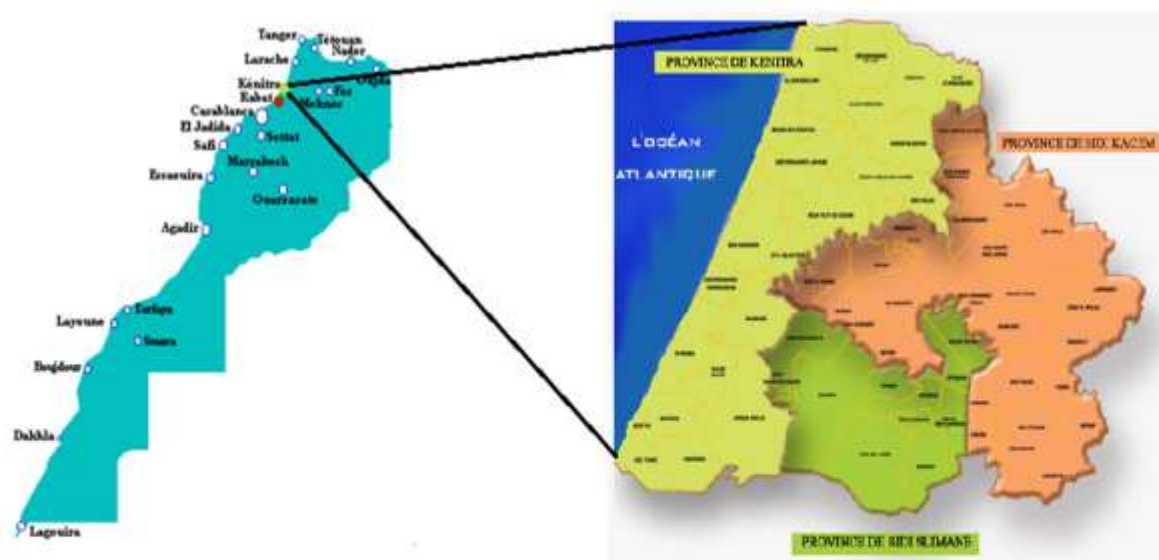


Figure 1. Map of Morocco showing the surveyed city.

eratical in relation to other health and conditions requirements of the population (Ghourri, 2013). More than 1200 species of plants have been used empirically for their presumed glucose lowering activity (Marles and Farnsworth, 1995). The medicinal plants are still a source of medical care in developing countries in the absence of a modern medicinal system (Tabuti et al., 2003).

The objective of this study is to identify the medicinal plants used for the traditional treatment by the diabetic patients in the town of Sidi Slimane which has never been a subject of an ethnobotanical study.

MATERIALS AND METHODS

Description of the studied area

Sidi Slimane is a North West city in Morocco (Figure 1), situated between 34° 15' 36" N and 5° 55' 12" West with a population of 92,989 people in 2014 (Monography of Sidi Slimane City, 2015). It is centrally located in the region of West by its location in a privileged geo-economic space, and very valued by its demographic weight and the importance of its economic apparatus segment in particular agro-industrial.

The region of Sidi Slimane corresponds to a marked oceanic influence, belonging to the semi-arid bioclimatic stage to temperate winter, the high air humidity, prevailing winds from the west. Hydrologically, Sidi Slimane is part of the Sebou catchment. One of its main tributaries (OuedBeht) passes through the agglomeration. The predominant crop of the area is beets, oranges, cotton, vegetable and grain growing (Monography of Sidi Slimane City, 2015).

Ethnopharmacological survey

The survey was conducted among 700 subjects with diabetes in the

province of Sidi Slimane (Rabat- Sale- Kenitra's region). The survey was conducted in three different centers: Laghmariyin, Essalam and Wlad Lghazi, where diabetic patients receive consultations and necessary medicines.

Patients surveyed were of both sexes and aged between 8 and 98 years old.

For the achievement of the survey, a predetermined questionnaire used includes information on the diabetic patients, the disease, the remedy used and the outcome of therapy. The study investigation lasted for 8 months, from September 2013 to April 2014.

The content of the used questionnaire

The study was conducted with the help of a questionnaire which consists of three parts:

1. Identification: information on the diabetic patient (sex, age, weight, level of education, physical activity and socio-economic level)
2. The disease information (type of diabetes, diabetes discovery circumstances, diabetes complications and family history).
3. Traditional remedy: source of supply of medicinal plants, reasons, doses accuracy, plants used, information (parts used, quantity) preparation and cure's dosage, treatment duration and toxic plants knowledge.

RESULTS AND DISCUSSION

Diabetic population's characteristics

The study was carried out on 700 diabetic patients living in the city of Sidi Slimane, the studied population was between 8 and 98 years old, among the two sexes; women were the most affected (72.28%). The results are

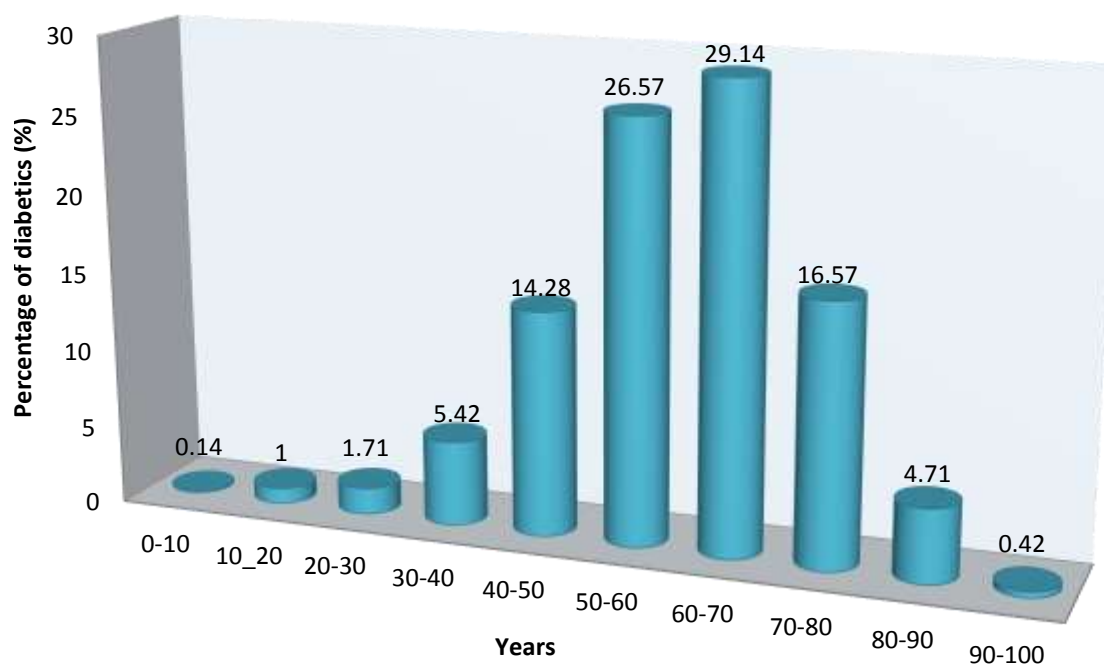


Figure 2. Distribution of diabetics by age.

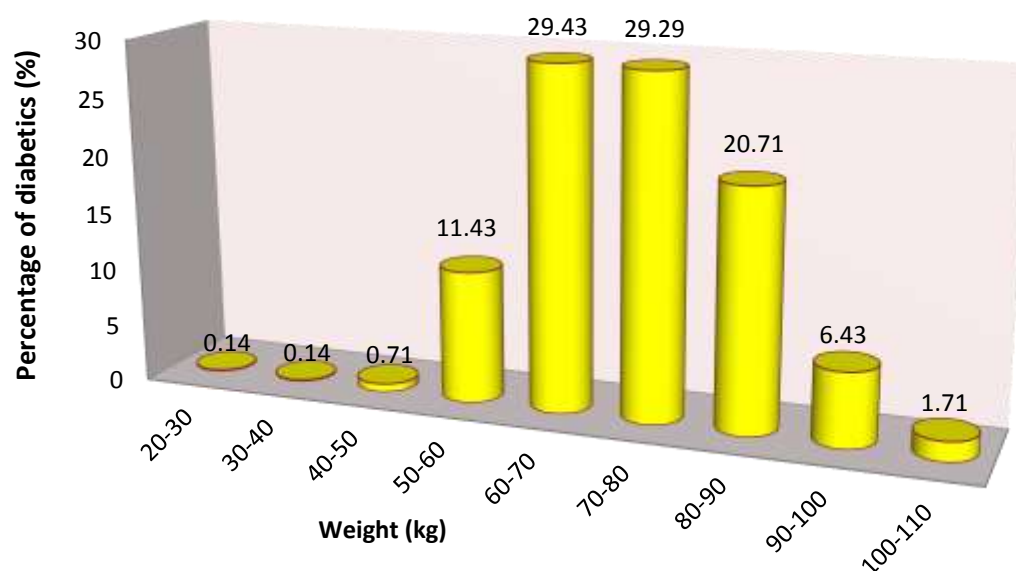


Figure 3. Distribution of diabetics based on weight.

shown in Figure 2. The age group most affected by diabetes is between 60 and 70 years old, concerning the weight, more than 29% have a weight between 60 and 70 kg (Figure 3).

The feeding behavior, physical activity, aging and stress are often considered as factors causing obesity which leads to diabetes (King et al., 1998). This assumes the good control of the food supply, a reasonable level of

physical activity and adapted policies to the populations at risk, particularly for the people older than 60 years (Fagot-Campagna, 2005).

The study has shown that illiteracy is widespread (60%) among those with diabetes in Sidi Slimane, while 19.42% have a level of primary schooling, 11% medium (college), 6% secondary and only 3.57% have pursued graduate studies. As regards the socio-economic level, only

Table 1. Percentage of complications associated with diabetes.

Complications associated with diabetes	Number of patients	Percentage
Arterial tension	91	13.43
Cholesterol	10	1.43
Diabetic foot	4	0.57
Heart disease	4	0.57
Eye disease	1	0.14
Kidney disease	1	0.14

15.85% of the patients have a low socio-economic level, 84.14% belong to a medium level, and while only one person lives an easy situation. Sport is neglected by the patients; it was found that only 32.14% part take in sports.

Disease characteristics

The distribution of the studied population according to the type of diabetes is as follows: 1) 72.57% correspond to type 1; 2) 27.42% correspond to type 2.

87.71 %, of diabetics have discovered the disease by suggestive symptoms, 9.28% by a screening test, and 3% of them have discovered it late. Indeed, more than 65% is hereditary, and less than 18% of patients have presented complications associated with diabetes (Table 1).

Characteristics of the diabetic population according to their use of the phytotherapy

More than 61% of people with diabetes have recourse in herbal medicine to treat diabetes and 38.57% use only the conventional treatment. In previous studies, many authors have shown that the percentage of the use of medicinal plants varies between 52 and 90%, depending on the region or where the investigation has been undertaken (Sekkat, 1987; Magoua, 1991; Nabih, 1992; Bellakhdar, 1997; Ziyat et al., 1997; Eddouks et al., 2007; Benkhniue et al., 2011). This strong use of medicinal plants is due to the strong belief of diabetic patients in their efficiency (95.86%), accessibility (2.86%) as well as their low cost (1.29%).

This choice of the use of herbal remedies is based on the advice of other diabetics (54.65%) who have already used them (either from media or from other people), and 45.12% have accounted on the advice of the herbalists while only one person was advised by a doctor in herbal medicine.

With regards to the use of these antidiabetic plants, 54.19% of diabetics use them according to a specific doses, 24.42% in non-specific doses and 21.40% of the use by easy acquisition. These patients have shown great satisfaction in relation to the phytotherapy of more than 58%. In addition to these factors, the contribution of

religion in the field of medicinal plants among the plants cited as anti-hyperglycaemic, some are drawn directly from the Koran and religious manuscripts. This is particularly the case of *Lawsonia inermis*, *Trigonella foenum-graecum*, *Ziziphus lotus*, *Punica granatum*, *Myrtus communis*, *Nigella sativa*, *Allium sativum*, *Allium cepa*, *Olea europaea*, *Ficus garcia*, and *Zingiber officinalis* (Eddouks et al., 2007).

The richness of the Moroccan gastronomy in plant species is used both as food ingredients and for their therapeutic properties (Eddouks, 2006), as well as nutritional life style. All these factors are considered as the cornerstone in the treatment and prevention of diabetes (Srivastava and Mehdi, 2005).

The use of the herbal medicine according to sex

Among the 430 (61%) diabetics using the medicinal plants; 76.28% are women, while 23.72% are men, and the study is consistent with other studies which are between 61 and 69 and 31 to 39%, respectively (Eddouks et al., 2002; Jouad et al., 2001; El Beghdadi, 1991; Hamdani, 1984; Jaouad, 1992; Nabih, 1992; Ziyat et al., 1997). This could be explained by the relative frequency of illiteracy of women in our society, and their commitment to traditional knowledge (Hamdani, 1984; Jaouad, 1992; Nabih, 1992).

Knowledge on toxic plants

In this study, more than 74% of the people with diabetes have no information on the toxicity of medicinal plants and only 26% take into account, the illiteracy of a large number of the patients, and the lack of awareness primarily by the indirect harm. Patients using herbal medicine have reported nine plants that have side effects and they are grouped as shown in Table 2 with their side effects.

Medicinal plants used for the treatment of diabetes in Sidi Slimane

The plants used by the diabetics are divided into 59

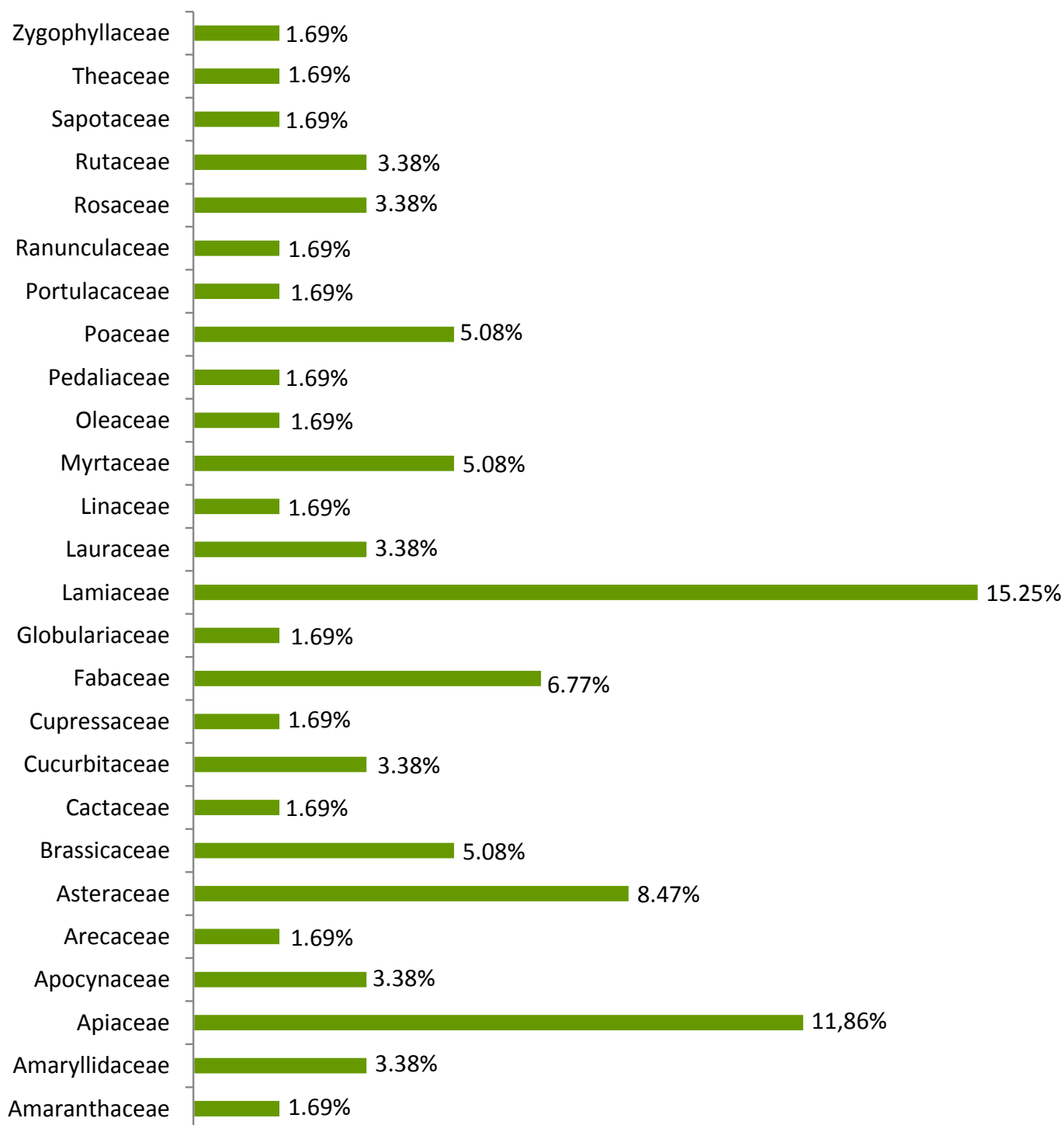


Figure 4. Frequency of botanical families.

species, belonging to 28 botanical families and the most represented are the Lamiaceae: 9 species; Apiaceae: 7 species; Asteraceae: 5 species and Fabaceae: 4 species (Figure 4).

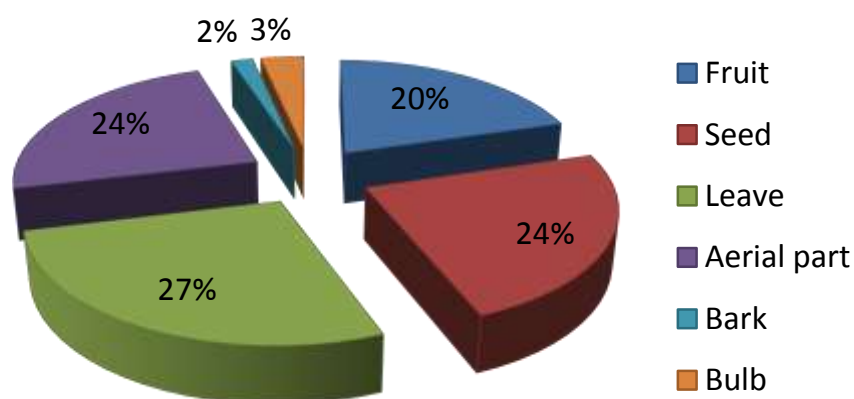
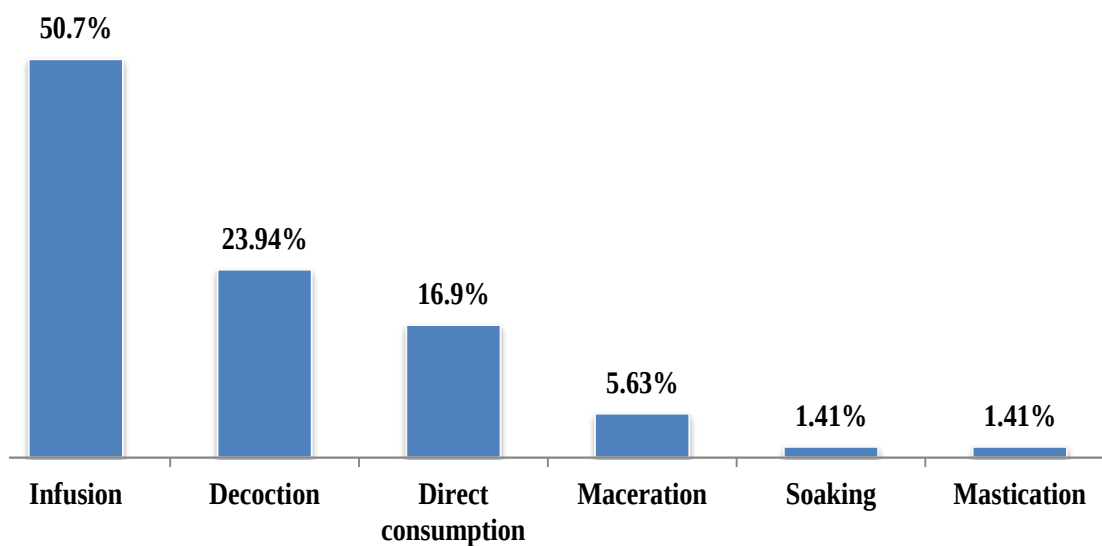
The most used species by diabetic patients are: *T.*

foenum-graecum: 63 persons; *O. vulgare*: 38 persons; *S. officinalis*: 37 persons; *M. vulgare*: 25 persons and *O. europaea*: 24 persons) Also, the most used parts are the seeds and the leaves (Figure 5).

For the mode of preparation, the infusion and decoction

Table 2. List of plants with side effects.

Plant name	Side effects
<i>Lavandula stoeckas</i>	Sore stomach
<i>Rosmarinus officinalis</i>	Generalized pain
<i>Origanum vulgare</i> L.	Abdominal pain
<i>Tetralinis articulata</i>	Abdominal pain
<i>Olea europaea</i> L.	Vomiting
<i>Artemisia absinthium</i>	Vomiting
<i>Medicago sativa</i>	Sore stomach
<i>Chenopodium ambrosioides</i> L.	Heart ailments
<i>Allium sativum</i> L.	Blood pressure drop

**Figure 5.** Part of plants used.**Figure 6.** Frequency of form of use of anti-diabetic plants.

are the most used (Figure 6), the bitter taste of plants is widespread, and the remedies are taken orally. Table 3

shows the various plants mentioned, the part used and the method of preparation.

Table 3. Inventory of anti-diabetic plants cited in the survey.

Species	Latin name	Vernacular name	Part of plant used	Method of preparation	Number of citations	Treatment duration	Corresponding References
Amaranthaceae	<i>Chenopodium ambrosioides</i>	Mkhinza	Leaves	Infusion	2	1 Week	Eddouks et al., 2002
Amaryllidaceae	<i>Allium cepa</i>	Basla	Bulbs	Direct consumption	5	6 Month - 1 year	
	<i>Allium sativum</i>	Touma	Bulbs	Decoction	5	3 Year	
	<i>Ammi visnaga</i>	Bachnikha	Fruits	Infusion	9	10 Days	Eddouks et al., 2002
	<i>Pimpinella anisum</i>	Habathlawa	Seeds	Decoction	8		
				Direct consumption			
	<i>Ammodaucus leucotrichus</i>	Kamounsoufi	Seeds	Infusion	5	2 Month	
Apiaceae	<i>Coriandrum sativum</i> L.	Kosbor	Seeds	Infusion	5	3 Month	
	<i>Apium graveolens</i>	Krafess	Seeds	Infusion	8	15 day- 1ans	
	<i>Petroselinum sativum</i>	Maadnouss	Seeds	Infusion	5	1 year	Brouham et al., 2002
	<i>Foeniculum vulgare</i>	Basbas	Seeds	Infusion- decoction	7	6 month - 1ans	
	<i>Nerium oleander</i>	Defla	Leaves	Decoction- infusion	2	ND	
Apocynaceae	<i>Caralluma europaea</i>	Daghmous	Aerial parts	Maceration	18	1weeks- 4month	
Arecaceae	<i>Phoenix dactylifera</i>	Tmar	Fruits	Direct consumption	3	2 month -6 month	-
	<i>Matricaria nrecutita</i>	Babounj	Aerial parts	Infusion	7		-
	<i>Artemisia absinthium</i>	Chiba	Aerial parts	Infusion	6	1 year -2 year	-
Asteraceae	<i>Artemisia herba-alba</i>	Chih	Aerial parts	Decoction	12		-
	<i>Cynara cardunculus</i>	Kharchouf	Aerial parts	Decoction	8	2 month - 2 year	-
	<i>Lactuca sativa</i>	Khes	Leaves	Direct consumption	4	1 year	-
	<i>Raphanus raphanistrum</i> subsp. <i>sativus</i>	Fjal	Fruits	Direct consumption	1	ND	Ziyyat et al., 1997; Jouad et al., 2001; Jaouhari, 2002
Brassicaceae	<i>Lepidium sativum</i>	Haberrechad	Seeds	Infusion -decoction	8	6 month - 1 year	Eddouks et al., 2002; Merzouki et al., 2003
	<i>Brassica oleracea</i> var. <i>capitata</i>	Krounb-mkaouar	Aerial parts	Maceration	4	6 month -2 year	Jouad et al., 2001

Table 3. Contd.

Cactaceae	<i>Opuntia ficus-indica</i>	Sabbar-zaaboul-lhendi	Aerial parts	Maceration	12	1 year -2 year	Jouad et al., 2001; Jaouhari, 2002; Merzouki et al., 2003
	<i>Citrullus colocynthis</i>	Hdej	Fruits	Maceration	4	15 year	Bellakhdar et al., 1991; Bellakhdar, 1997; Ziyat et al., 1997; Merzouki and al., 2000; Jouad et al., 2001; Eddouks et al., 2002 Jaouhari, 2002; Merzouki et al., 2003); Jouad et al., 2001
Cucurbitaceae	<i>Cucumis sativus</i>	Khiar	Fruits	Direct consumption	2	6 month	
Cupressaceae	<i>Tetraclinis articulata</i>	Araar	Leaves	Infusion	9	1week-1month	Eddouks et al., 2002
	<i>Medicago sativa</i>	Fassa	Aerial parts	Infusion	2	1month	-
	<i>Trigonella foenum-graecum</i>	Halba	Seeds	Soaking	63	week -4	Bnouham et al., 2002
Fabaceae	<i>Ceratonia siliqua</i>	Kharoub	Fruits	Direct infusion	4	1month	-
	<i>Glycine max</i>	Soja	Seeds	Decoction	3	1month	Bnouham et al., 2002
Globulariaceae	<i>Globularia repens</i>	Ainlernab	Leaves	Decoction	1	ND	Bellakhdar et al., 1991; Bellakhdar, 1997; Ziyat et al., 1997; Merzouki et al., 2000; Jouad et al., 2001; Eddouks et al., 2002; Jaouhari, 2002; Merzouki et al., 2003
	<i>Rosmarinus officinalis</i>	Azir	Leaves	Infusion - decoction	16	3month	
	<i>Mentha pulegium</i>	Fliou	Aerial parts	Infusion-decoction	14	week -3 month	
	<i>Lavandula stoechas</i>	Halhal	Leaves	Infusion-decoction	6	2 month	
Lamiaceae	<i>Lavandula dentata</i>	Khzama	Aerial parts	Infusion	7	6 month -1 year	
	<i>Marrubium vulgare</i>	Meriout	Aerial parts	Infusion	25	2 month -1year	
	<i>Salvia officinalis</i>	Salmiya	Leaves	Infusion	37	week -5 year	
	<i>Origanum vulgare</i>	Zaatar	Leaves	Infusion	38	15 day -4 year	Eddouks et al., 2002
	<i>Thymus vulgaris</i>	Zaitra	Leaves	Infusion	6	6 month	
	<i>Ajuga iva</i>	Chandgoura	Aerial parts	Infusion	7	2month	
	<i>Cinnamomum cassia</i>	Karfa	Ecorce	Infusion	8	1 month - 6 month	
Lauraceae	<i>Laurus nobilis</i>	Ouraksidnamoussa	Leaves	Infusion- decoction	3	1 year	
Linaceae	<i>Linum usitatissimum</i>	Zariatelkattan	Seeds	Decoction	8	6 week -2 month	
Myrtaceae	<i>Eugenia caryophyllata</i>	Kranfal	Fruits	Infusion	4	6 month	

Table 3. Contd.

	<i>Eucalyptus globules</i>	Kritouss	Leaves	Infusion	1	ND	
	<i>Myrtus communis</i>	Rayhan	Leaves	Infusion	2	1month	
Oleaceae	<i>Olea europaea</i>	Zitoun	Leaves	Infusion	24	1 month -5 year	
Pedaliaceae	<i>Sesamum indicum</i>	Janjlan	Seeds	Infusion-decoction	5	2 month	
	<i>Pennisetum typhoides</i>	Illan	Seeds	Infusion	7	2 month	
Poaceae	<i>Hordeum vulgare</i>	Chair	Aerial parts	Infusion	2	1 year	Eddouks et al., 2002
	<i>Phalaris canariensis</i>	Zouan	Seeds	Infusion	4	2weeks	
Portulacaceae	<i>Portulaca oleracea</i>	Rejla	Aerial parts	Decoction	4	ND	
Ranunculaceae	<i>Nigella sativa</i>	Sanouj	Seeds	Infusion	17	2 month -1 year	Bnouham et al., 2002
	<i>Prunus amygdalus</i>	Louzalmar	Fruits	Direct consumption	1	ND	
Rosaceae	<i>Malus communis</i>	Tofah	Fruits	Direct consumption	1	ND	
	<i>Citrus sinensis</i>	Limoun	Fruits	Direct consumption	3	6 month	Eddouks et al., 2002
Rutaceae	<i>Citrus bigaradia</i>	Ranj	Fruits	Direct consumption	3	6 month -1 year	
Sapotaceae	<i>Argania spinosa</i>	Argan	Fruits	Direct consumption	5	2 month -1 year	-
Theaceae	<i>Camellia sinensis</i>	Atay	Leaves	Decoction- infusion	10	ND	-
Zygophyllaceae	<i>Zygophyllum gaetulum</i>	Agaia	Leaves	Infusion	10	1month-1years	Eddouks et al., 2002

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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