



ETHNOBOTANICAL SURVEY OF MEDICINAL PLANTS USED IN THE TRADITIONAL TREATMENT OF DIABETES AND GOUT IN THE NORTH OF MOROCCO (TANGIER, TETOUAN AND CHEFCHAOUEN CITIES)

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Abstract

The objective of this study is to inventory the medicinal plants used in the traditional treatment of diabetes and gout in the region of Tangier Tetouan Al-Hoceima specifically the cities of Tangier, Tetouan and Chefchaouen. During the month of May 2016 and April 2017, we carried out a fieldwork research to conduct an *ethnobotanical* survey of the local population of the studied areas to gather as much information as possible on the use of medicinal plants.

This study was focused on 300 respondents. Our study made it possible to draw up an inventory encompassing 44 species of medicinal plants divided into 33 genera and belonging to 27 botanical families in which the Lamiaceae family is the majority, followed by the Fabaceae, the Poaceae as well as the Rosaceae. Among these species, 35 are traditionally used against the diabetes, 16 against the gout and 08 plants are used to treat both the gout and the diabetes.

These species are presented as follows: *the Allium cepa (Onion); the Phoenix dactylifera (Date palm); the Trigonella foenum-graecum (Fenugreek); the Rosmarinus officinalis (Rosemary); the Olea europaea (Olive); the Citrus × paradisi (Grapefruit) and the Aloe succotrina (Aloe vera). The leaves remain as the most used organs and the decoction is the most dominant mode of preparation.*

Key words : Ethnobotany, Medicinal Plants, Diabetes, Gout, Morocco.

Introduction

The ethnobotany includes plant studies that describe the interaction of the local populations with the natural environment, the uses and other relationships that exist between humans and plants (Martin 1995; Cotton 1996). The discovery of plants for medicinal purposes for humans has a long antecedent history dating back to ancient civilizations (Noman, 2003). The plants are considered as the most important sources of medicines that are used in the treatment of various categories of human diseases. Thus, the importance of medicinal plants and the contribution of phytomedicine to the well-being of a significant number of the world's population have attracted the interest of various disciplines (Biapaetal, 2007). Obviously, the need for natural medicine is increasing day by day; about 64% of the total world population depends on traditional medicine for the management of

different diseases and traumas [2]. Morocco has a long tradition of natural medicine and knowledge of medicinal plants. Indeed, among the 5000 species and subspecies listed in North Africa, 4200 grow in Morocco, of which at least 500 are potentially medicinal and 250 are already used (Sijelmassi, 1993).

It is in this perspective that an ethnobotanical survey was conducted in the north of Morocco (Tangier, Tetouan and Chefchaouen) in order to inventory the medicinal plants used in the traditional treatment of diabetes and gout and to valorize them for the purpose of subsequent production of improved traditional medicines.

This study is organized around two main axes: the first axe is based on a field survey which is undertaken among the local population having knowledge of the use of medicinal plants. The second axe concerns the listed plants which are identified in the fieldwork research and sampled to establish the catalogue of plants and to gather

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the maximum amount of information concerning the therapeutic uses practiced by the local population of the studied areas.

Materials and Methods

Description of the study areas

The cities of Tangier, Tetouan and Chefchaouen are located in the extreme north of Morocco, within the region of Tangier-Tetouan-Al Hoceima (Fig. 1). To begin with, Tangier is geographically situated in the northwest of Morocco. It is limited by the Mediterranean Sea and the Strait of Gibraltar (14 km) north, the province of Larache south, the province of Tetouan east and the Atlantic Ocean west. According to the General Census of Population and Housing (GCPH) of 2014, Tangier counts 947 952 inhabitants. More significantly, Tangier has a temperate Mediterranean climate with oceanic influence. The summer is relatively hot and sunny and the winter is wet and mild. It is considered as the most important industrial centers after Casablanca. The industrial sectors are diversified into various branches such as: textile, chemical, mechanical, metallurgical and naval. Currently, the city has four industrial parks of which two have the status of free economic zone. The first Free Zone is named Gzenaya whereas the second is named the Tangier-Mediterranean port (Couissi, 2017). Second, the city of Tetouan is located about 60 kilometers southeast of the city of Tangier and near the Strait of Gibraltar, in a valley dug by the river of Mhannech in the mountains of the Rif limestone chain to the north and south. It is considered as one of the two major ports of Morocco on the Mediterranean Sea. According to the General Census of Population and Housing (GCPH) of 2014, the city has 380 787 inhabitants and 92606 number of households. In addition, it is characterized by a Mediterranean type climate. It usually has a wet and rainy season from October to April, followed by a dry season from May until September. Once again, the climate of this city is marked by strong winds felt throughout the year: the Gharbi of oceanic origin which usually causes precipitation from November to March, and the Chergui coming from the east, which gives rise to foggy and cloudy weather in the spring, and a dry and stable weather from the month of May. Furthermore, Tetouan's economy relies heavily on different sectors: agriculture, forest, tourism, industry as well as fishing which economically plays an important role in this area (Haut Commissariat au Plan, 2015). Last of all, the city of Chefchaouen is geographically situated in the Rif Mountains close to the Tangier city and the Mediterranean Sea. In the 2014 Moroccan census, the city recorded a population of 42786 inhabitants and 10295 number of households. The city of Chafchaouen *has a*

Mediterranean type climate characterized by rainy and cool winters from October to April and dry and hot summers from May until September. The economy of this city is highly based on various sectors such as: agriculture, industry and tourism (Haut Commissariat au Plan, 2018).

Methodology

For the present study, a stratified random sampling is adopted (Gounot, 1969), the *ethnobotanical interviews* with the local population of the *northern region of Morocco* were carried out between 2016 and 2017. This sampling technique aims to have the most complete floristic inventory and to carry out the *ethnobotanical surveys* varied from one zone to another in the said region. By

Table 1: Demographic data of participants in the North of Morocco.

Specifications	Numbers	(%)
Users of traditional medicine	177	59
Users of modern medicine	16	5,33
Users of traditional and modern medicine	107	35,66
Ages		
21–30 ans	02	0,66
31–40 ans	18	6
41–50 ans	57	19
51–60 ans	81	27
>61 ans	142	47,33
Sex		
Female	217	72,33
Male	83	27,66
Education level		
Illiterate / Primary	177	59
Secondary	102	35,66
University	05	5,33

Table 2: Principal taxonomic families with medicinal plants for the treatment of diabetes and gout.

Family*	Number of medicinal plants	%
Lamiaceae	6	13,63
Fabaceae	3	6,81
Poaceae	3	6,81
Rosaceae	3	6,81
Amarylidaceae	2	4,54
Apiaceae	2	4,54
Asteraceae	2	4,54
Lythraceae	2	4,54
Myrtaceae	2	4,54
Rutaceae	2	4,54

*Only families with more than 2 species are shown.

Table 3: List of medicinal plants used in the traditional treatment of diabetes and gout in the north of Morocco. (D: diabetes; G: gout)

Family	Scientific name	Common name	Local name	Therapeutic use		Part used	Mode of preparation	Frequency
				D	G			
Amaryllidaceae	<i>Allium sativum</i> L.	Garlic	Thouma	x		Bulb	Crude/ Cooked	10
	<i>Allium cepa</i> L.	Onion	Al Bassla		x	Bulb	Crude/ Cooked/ Juice	15
Anacardiaceae	<i>Pistacia lentiscus</i> L.	Mastic	Drô	x		Leaf/Bark	Decoction /Infusion	4
Apiaceae	<i>Coriandrum sativum</i> L.	Coriander	Kouzebar		x	Seeds/Leaf	Infusion/Powder	3
	<i>Cuminum Cuminum</i> L.	Hairy cumin	Kammoun	x		Seeds	Decoction /Powder	1
Apocynaceae	<i>Nerium oleander</i> L.	Laurier -rose	Defla	x		Leaf	Decoction/Cataplasme	1
Areaceae	<i>Phoenix dactylifera</i> L.	Date-palm	Tmar	x	x	Core / Root /Fruit	Decoction/Powder	5
Asteraceae	<i>Artemisia absinthium</i> L.	Absinthe	Chiba	x		Leafy stems	Infusion	3
	<i>Stevia rebaudiana</i> Willd.	Stevia	Stevia	x		Leaf	Infusion/Powder	12
Brassicaceae	<i>Lepidium sativum</i> L.	Cressonnette	Hab Er -rhad	x		Seeds	Maceration	18
Cactaceae	<i>Opuntia ficus indica</i> Mill.	Fig tree	L'handiya	x		Racket / Fruit/Flower	Crude/ Infusion	2
Cannabaceae	<i>Cannabis sativa</i> L.	Indian hemp	AlIkif	x		Seeds / Leaf/ Flowery top	Powder	1
Cucurbitaceae	<i>Cucurbita pepo</i> L.	Pumpkin	L' garâa	x		Fruit	Cooked	12
Cupressaceae	<i>Tetraclinis articulata</i> Masters.	Thuja	El'ar'ar	x		Leaf	Maceration/Powder	11
Fabaceae	<i>Trigonella foenumgraecum</i> L.		Fenugreek Al'Houlba	x		Seeds	Maceration/Powder	33
	<i>Glycine max</i> (L.) Merr.	Soy	Ssoja	x		Seeds	Infusion/Decoction/Powder	1
	<i>Glycyrrhiza glabra</i> L.	Licorice	Aark assus	x		Stem	Powder	1
Globulariaceae	<i>Globularia alypum</i> L.	Globular turbith	Ain larneb	x		Leaf	Infusion/Decoction	12
Lamiaceae	<i>Calamintha officinalis</i> Moench.	Mint of mountains	Manta			Leafy stems	Infusion/Decoction	2
	<i>Lavandula stoechas</i> L.	Lavender	Helhal	x		Leafy stems/Inflorescence	Infusion/Decoction	5
	<i>Mentha pelugium</i> L.	Pennyroyal mint	Fliyou	x		Leafy stems/ Leaf	Infusion/Decoction	7
	<i>Origanum compactum</i>	Oregano	Sahtar	x		Leafy stems	Infusion/Decoction	6
	<i>Rosmarinus officinalis</i> L.	Rosemary	Azir	x		'Leafy stems	Infusion	5
	<i>Thymus vulgaris</i> L.	Thyme	Zaitra	x		Leaf	Infusion/Decoction	5
Lauraceae	<i>Laurus nobilis</i> L.	Laurel sauce	Warekat sidha Moussa	x		Leaf	Infusion/Decoction	3
Linaceae	<i>Linum usitatissimum</i> L.	Linen	Zeriaat ktan		x	Seeds	Powder	11
Lythraceae	<i>Lawsonia inermis</i> L.	Henna	L-henna		x	Leaf	Cataplasme/Decoction	6
	<i>Punica granatum</i> L.	Grenadier	Romman	x		Bark	Powder	2

Table 3 contd.....

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Family	Scientific name	Common name	Local name	Therapeutic use		Part used	Mode of preparation	Frequency
				D	G			
Moraceae	<i>Ficus carica</i> L.	Fig tree	El karmos		×	Fruit	Crude	2
Myrtaceae	<i>Eucalyptus globulus</i> Labill.	Eucalyptus	Kalybtus	×		Leaf	Decoction	5
Oleaceae	<i>Myrtus communis</i> L.	Myrthe	Rihan	×		Leaf	Infusion	7
	<i>Olea europaea</i> L.	Olivier	Zaytoûn	×		Leaf/Oil/ Fruit	Decoction /Oil/ Chewing	21
Pedaliaceae	<i>Sesamum indicum</i> L.	Sesame	Zenjlane	×		Seeds	Powder	2
Poaceae	<i>Hordeum vulgare</i> L.	Barley	Cheir	×		Seeds	Maceration/ Powder	2
	<i>Triticum durum</i> Desf.	Durum wheat	Zraa	×		Straw/ Seed	Decoction/ Maceration	2
	<i>Triticum sativum</i> L.	Sprouted Wheat	Zraa lmbt		×	Seeds	Maceration	2
Ranunculaceae	<i>Nigella sativa</i> L.	Nigella	Lhaba ssawda	×		Seeds	Decoction	15
Rosaceae	<i>Prunus amygdalus</i> L.	Almond	Luz-murr	×		Leaf/Seeds	Decoction	5
	<i>Eriobotrya japonica</i> (Thunb.) Lindl.		Loquat of Japan L-Mezah			Fruit	Juice/Crude	7
Rutaceae	<i>Prunus cerasus</i> L.	Red cherry	Hab lmlouk		×	Fruit	Juice/Crude	12
	<i>Citrus ×paradisii</i> Macfad.	Grapefruit	Pamplemousse	×		Fruit	Juice	3
	<i>Citrus sinensis</i> (L.) Osbeck.	Orange	Laymoun		×	Fruit	Juice	11
Sapotaceae	<i>Argania spinosa</i> (L.) Skeels.	Argan	argane	×		Fruit (almond)	Infusion/ Powder /Oil	13
Xanthorrhoeaceae	<i>Aloe succotrina</i> Lamk.	Aloe socotra	Ssabra		×	Leaf	Juice/ Maceration	7

proceeding a stratified random sampling, the samples of 100 people are surveyed in each of the 3 strata and they put together to constitute the overall sample (300 people). Clearly, the *ethnobotanical* surveys were conducted using 300 question sheets that were used to investigate the traditional healers, the herbalists as well as the users of medicinal plants in order to have a better representation of our sample. These questionnaires include precise questions about the informant, the common name of each species, the part used, the mode of preparation and administration, the dose and the toxicity. So, the objective of this study is to elaborate the most exhaustive possible catalogue of medicinal plants used in the treatment of diabetes and gout specifically in the three study areas.

Similarly, the spontaneous medicinal species were collected and brought back to the laboratory for their determination thanks to botanical works: «*Flore pratique du Maroc. Manuel de détermination des plantes*, Vol 1 et 2» (Fennane *et al.*, 1999 and 2007), «*La pharmacopée marocaine traditionnelle, médecine arabe ancienne et savoir populaire*» (Bellakhdar, 1997) and «*Les plantes médicinales du Maroc*» (Sijelmassi, 1993).

Results and Discussion

Demographic characteristics of interviewed persons

Concerning the gout, this is the first study of this kind realized in the region. The *ethnobotanical surveys conducted in the fieldwork permitted to interview 300 people*, 72.33% of whom were female compared to 27.66% of male (Table 1). Some previous studies have also shown this trend (13- 18). This could be explained by the fact that women were most often at home during the survey hours (Jaouad *et al.*, 2001). They are the ones who give first aid particularly for their children (Benkhniq *et al.*, 2011). The age ranged from 21 to 82 years old. The persons over 61 years of age have a use percentage of 47, 33%, followed by the age groups of [51-60 years old], [41-50 years old], [31-40 years old] and [21-30 years old] with a respective percentage of 27%, 19%, 6% and 0.66 % of the studied population (Table 1). Indeed, these persons provide more

reliable information because they retain much of the ancestral knowledge. The transmission of this knowledge is actually endangered because it is not always assured (Weniger, 1991; Anyinam, 1995). Effectively, 64.33% of those persons surveyed were illiterate or had a primary school level and 42.33% had a secondary level. The utilization percentage of traditional medicine has been estimated at 59% (Table1). This strong use of medicinal plants could be explained by the efficiency and also the confidence in the efficiency of medicinal plants as a treatment (Cunningham *et al.*, 2008).

Medicinal plants used by the population

The *ethnobotanical* study of medicinal plants permitted us to identify 44 species belonging to the *ethnobotanical* study of medicinal plants permitted us to identify 44 species belonging to 27 families and divided into 33 genera. The most represented families are the Lamiaceae (6 species), which are considered as the majority species, followed by the Fabaceae, the Poaceae and the Rosaceae (3 species). The other remaining families have only one or two species (29 species) (Table 2). Furthermore, the obtained results also show that the leaves are the most used organs. This can be explained by the fact that the leaves are the seat of photosynthesis and sometimes the storage of secondary metabolites responsible for the biological properties of the plant (Bigendako-Polygenis *et al.*, 2008). They are followed by the seeds, the fruits and the leafy stems (Fig. 2). Similarly, the decoction and the infusion are considered as the main modes of preparation (Fig. 3). These two forms were also the most widely used herbal preparations in other regions of Morocco and in the World (Ziyat *et al.*, 1997; Eddouks *et al.*, 2007; El-Hilaly *et al.*, 2003 ; Kadir *et al.*, 2012 ; Tahraoui *et al.*, 2007 ; Nowbandegani *et al.*, 2015 ; Afolayan *et al.*, 2014 ; Urso *et al.*, 2016).

In our study, the analysis of data collected in the fieldwork, permitted us to determine 35 *antidiabetic* plants (Fig 4). The most frequently used by diabetic subjects were: the *Trigonella foenum-graecum* (Fenugreek); the *Olea europaea* (Olive); the *Lepidium sativum* (Garden cress); the *Nigella sativa* (Fennel flower); the *Argania spinosa* (Argan tree); the *Stevia rebaudiana* (Stevia); the *Globularia alypum* (Globular turbit); the *Cucurbita pepo* (Pumpkin); the *Tetraclinis articulata* (Thuya); the *Allium sativum* (Garlic).

In table 2, we found that 16 plants are used against gout: the *Allium cepa* (Onion); the *Prunus cerasus* (Sour Cherry); the *Linum usitatissimum* (Flax); the *Citrus × sinensis* (Orange); the *Aloe succotrina* (Aloe vera); the *Eriobotrya japonica* (Loquat); the *Olea europaea* (Olive); the *Lawsonia inermis* (Henna); the *Phoenix*

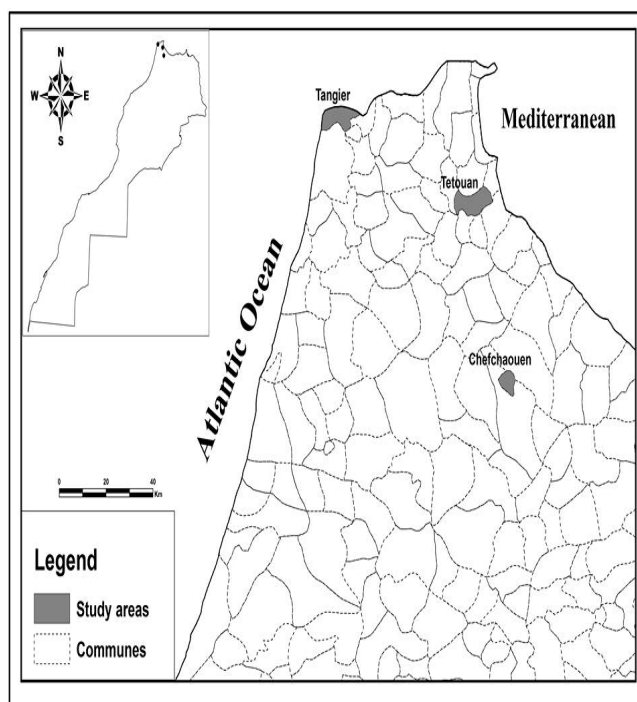


Fig. 1: Geographical location of three study areas.

Source: Elaborated by Fouad ZAOUAI, 2018.

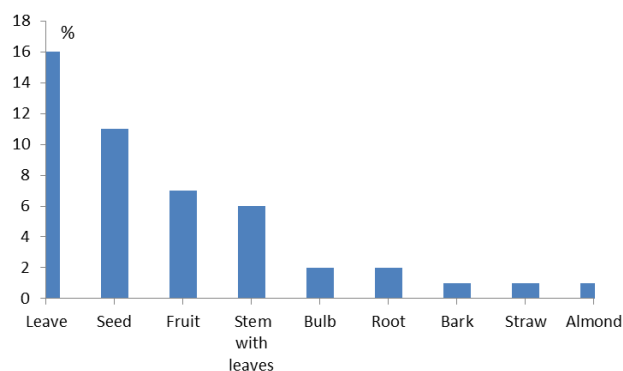


Fig. 2: Plant parts used (%).

dactylifera (Date palm). Among the 35 species used in the treatment of diabetes, 08 species are also employed to treat gout. For instance, the *Allium cepa* (Onion), the *Phoenix dactylifera* (Date palm), the *Tetraclinis articulata* (Thuya), the *Trigonella foenum-graecum* (Fenugreek), the *Rosmarinus officinalis* (Rosemary), the *Olea europaea* (Olive), the *Citrus × paradisi* (Grapefruit) and the *Aloe succotrina* (Aloe vera).

Thus, the eight plants that we have reported against these two emerging pathologies open up interesting perspectives in the search for medicines that can be prescribed to treat simultaneously the gout as well as the diabetes. Among the identified plants, some of them are recognized by their toxic power such as: the *Nerium oleander* (Langford *et al.*, 1996; Al-Yahya *et al.*, 2000), the *Nigella sativa* (Zaoui *et al.*, 2002; Ali *et al.*, 2003),

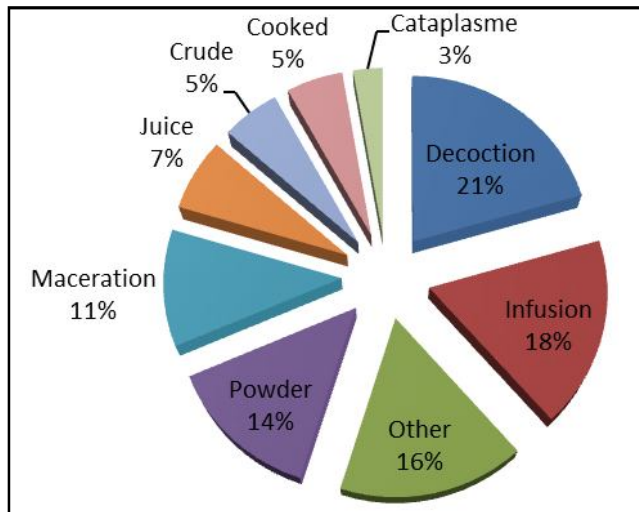


Fig. 3: Percentage of types of administration.

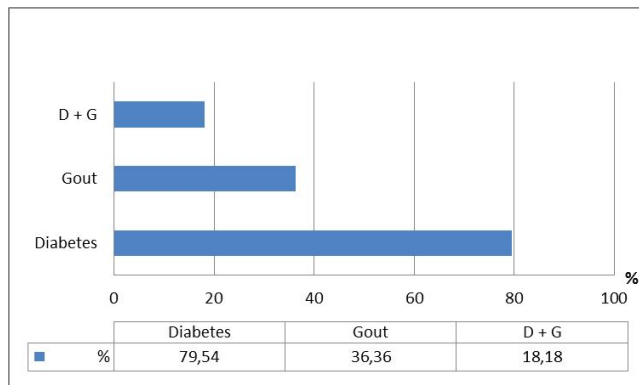


Fig. 4: Distribution of different uses of medicinal plants against Diabetes and gout.

the *Artemisia absinthium* (Bellakhdar, 1997; Sijelmassi, 1993), the *Eucalyptus globulus* (Hmammouchi, 1999; El Ouafi, 1997), and the *Cannabis sativa* (Charnot, 1945; Phan *et al.*, 2005.).

Conclusion

The *ethnobotanical* surveys that we conducted in the cities of Tangier, Tetouan and Chefchaouen permitted to list and identify 44 species of medicinal plants divided into 33 genera and belonging to 27 botanical families. In addition to this, 35 species are traditionally used against the diabetes, 16 against the gout and 08 plants are used to treat both the gout and the diabetes. The *traditional phytotherapy* is still deeply rooted in the habits of the local population, mainly among older people, especially women. In addition, the leaf remains the most used part of medicinal plants and the decoction of the most common method of preparation. These results constitute a good database for the biological screening in the search for molecules treating diabetes as well as plant-based gout.

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