

## The status and perception of medicinal plants by local population of Talassemtane National Park (Northern Morocco)

Fatima Zahrae Redouan\*<sup>1</sup>, Guillermo Benitez<sup>2</sup>, Boutahar Aboubakr <sup>1</sup>, El Bakkouri Bassma<sup>1</sup>, Rosa Maria Picone<sup>3</sup>, Alessandro Crisafulli<sup>3</sup>, Abdenbi Ben Driss<sup>1</sup>, Mohamed Kadiri<sup>1</sup>, Joaquin Molero Messa<sup>2</sup>, Abderrahmane Merzouki<sup>1</sup>

1. Flora Research, Ethnobotany and Ethnopharmacology Group. Laboratory of Applied Botany, Department of Biology, Faculty of Sciences, UAE, Tetouan, Morocco

2. Department ChiBioFarAm, University of Messina, Messina, Italy

3. F. V. E., Botany, Faculty of pharmacy, Campus de Cartuja, UGR, Granada, Spain

\*Corresponding Author's Email: [fati.z.ref@gmail.com](mailto:fati.z.ref@gmail.com)

### ABSTRACT

The humans have the capacity to transmit knowledge to other individuals remote in space and time by verbal and written means. Ethno-pharmacology is based on approaches from the sociocultural and natural sciences. Ethnobotanical research in the Talassemtane National Park was undertaken following a perspective to establish the base of comparative study with Andalusian and Sicilian regions. The aim of these studies was to analyze the data regarding interviewees (socio-demographic), status, perception of inhabitants of the Northern Morocco, confidence in the healing properties of medicinal plants, and conserving the traditional medicinal heritage of the Talassemtane National Park (TLSNP). This study was conducted in the National Park of Talassemtane for a three-year survey (2014-2017). In total, 200 local traditional informers were interviewed to explore the traditional ethnobotanical and ethno-pharmacological knowledge of the local population. Information was collected using open-ended and semi-structured interviews, followed by the analysis of data regarding the interviewees (socio-demographic) and the ethnobotanical or ethno-pharmacological data. In this study, we have identified a total of 152 medicinal plant species belonging to 44 botanical families. The most important family is that of the *Apiaceae* represented by 31 species. We identified 567 symptoms and diseases for the 152 taxa belonging to 44 included families, with a total of 9402 use reports (UR). They are used to treat up to 123 conditions or symptoms classified into 15 pathological groups according to the ICPC-2 classification of diseases. Concerning the diseases, the main pathological group treated is the one for digestive symptoms (D, 24%). The results show that 50 % of the local population still prefer to use traditional medicine for daily healthcare, and a few of them support these traditional medicines along with conventional drugs. The analysis of data obtained in this ethnobotanical study allowed us to identify the most commonly used medicinal plants in the TLSNP. The knowledge reported in this study is a very original source of information on the local traditional medical flora and provide an additional value to the emblematic Talassemtane National Park.

**Keywords:** Ethnobotanical approach; Medicinal plants; traditional medicine; Talassemtane National Park; North of Morocco.

### INTRODUCTION

Relationship between human food and medicines are integral part of human life (Ford 1979; Harshberger 1986; Johns 1990; Berlin 1992; Balick & Cox 1996; Johns 1996; Endicott & Welsch 2003; Etkin 2006; Heinrich *et al.* 2006; Totelin 2009; Benítez *et al.* 2010; Leonti 2011; Nolan & Turner 2011; Mandal *et al.* 2012). There are societies that use plants to cure diseases and traditional medicine still taking a very important position in the life

of many people around the world (Matu & Van Staden 2003; Ahmad *et al.* 2015; Datir & Bhore 2017). Over 25,000 plants are used in traditional medicine for the discovery of new drugs in pharmacology around the world (Van Wyk *et al.* 1997; Diallo 2000; Hamilton 2003; Limem-Ben Amor *et al.* 2009; Huang 2011; Rafieian-Kopaei 2012). From the 20<sup>th</sup> century the plants has been revalued by ethnobotanists and the field of ethnobotany has changed with the compilation of raw data (Jhons 1996; Guarrera 2003). The most important ethnobotanical studies involve the dynamics between human populations, plant foods and medicines that have historic significance in maintaining human nutrition and health. The populations are known to develop social networks to aid in the procurement of plant materials needed to retain traditional medicine (Arber 1938; Corsi & Pagni 1979; Riddle 1985; Lardos 2006; Volpato *et al.* 2007; Weckerle *et al.* 2009; DeVos 2010). The population has always had resort, for centuries, to medicinal plants as a solution and the only way to solve many of their health-related problems. In fact, nowadays, many people still use herbal medicine, and popular herbal therapeutic knowledge is being passed down from generation to generation, even though this tradition is disappearing (Schultes 1994; Johns 1996; Pieroni & Price 2006; Etkin *et al.* 2011; Touwaide & Appetiti 2013). People who lack this tradition continue to turn to herbalists to buy plants or consult traditional healers for any type of health-related problems. The ethnobotanists consider traditional plants and medicines in their efforts to interpret health belief systems (Quave & Pieroni 2007). Ethno-ecological studies also highlight the forces that continuously shape how information is transferred from one generation to the next (Nolan 1998; Zent 1999; Zarger & Stepp 2004). The ethnobotanical knowledge is passed on verbally among generations and most of this knowledge has not been formally documented (Asase *et al.* 2008; Nadembega *et al.* 2011). The documentation of knowledge is an essential step in ethnobiology, since it provides data for further studies and evaluates indigenous pharmacopoeias (Berlin 1992; Robineau & Soejarto 1996; Frei *et al.* 1998; Leonti *et al.* 2001; Touwaide 2010; Leonti 2011). Notwithstanding the humanistic ideas, technological innovations and discoveries during our century, the broad perspective of ethno-pharmacology contextualizes ecology and addresses the perception of plants, plant use, and pharmacology in human communities (Ginzburg 1990). Humans have the capacity to transmit knowledge to other individuals remote in space and time by verbal and written means. Ethno-pharmacology is based on approaches from the sociocultural sciences and the natural sciences, historical aspect overview will have to be based on the development of this scientific approach (Buenz *et al.* 2005; Leonti *et al.* 2010; Touwaide 2010; Adams *et al.* 2011; Lardos & Heinrich 2013; dal Cero *et al.* 2014). However, written document of using remedy and the medical practice are of course available from many cultures (Heinrich 2000; Rivera *et al.* 2006; Heinrich *et al.* 2006; Heinrich 2010; Leonti *et al.* 2010, 2011). Today, according to the World Health Organization (WHO 2007), over 80% of the world's population rely more often on traditional drugs, mainly plants, serving as the main source of health care (Farnsworth *et al.* 1995; Ganesan 2008; Jiofack *et al.* 2010). The most population's diseases are currently being treated more often through medicines of synthetic origin and specifically developed in laboratories, and their definite effects on the treatment of diseases have contributed to the development of their use. The use of some medications leads to certain damages to the body. Actually, the 50% of the available drugs are basically derived from medicinal plants. The importance of medicinal plants and their products is increasingly recognized, and the public confidence in their use is constantly strengthened (Yarnell & Abascal 2002; Harvey 2008). So, the global trend of synthetic compounds has turned to herbal drugs (Fabricant & Farnsworth 2001).

### **Aim of the study**

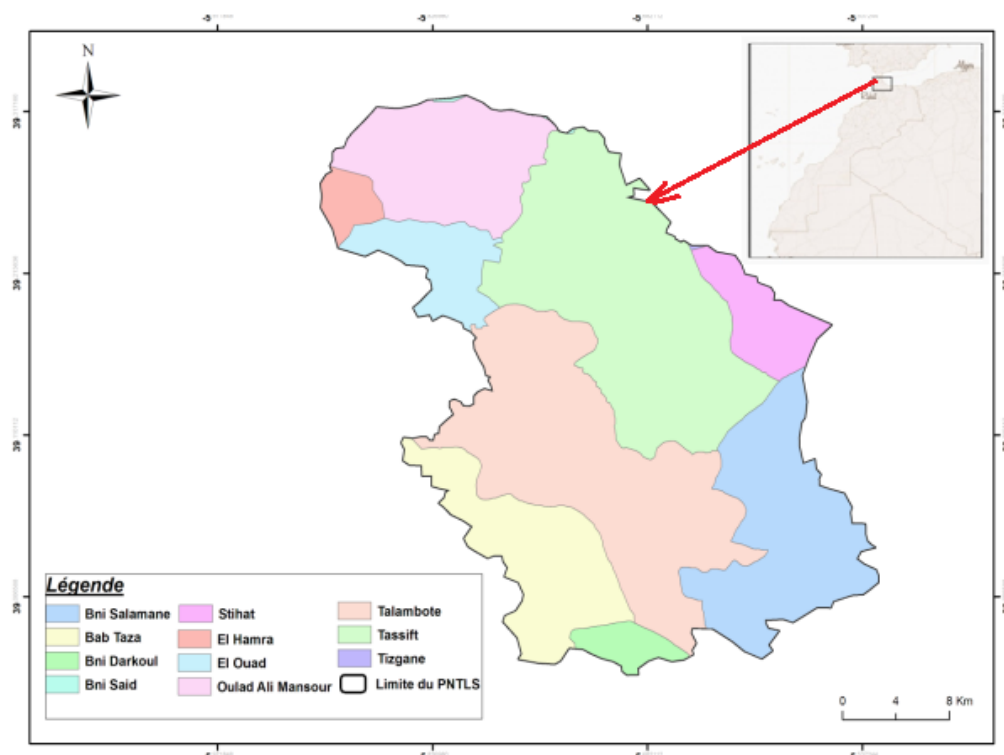
This study documents traditional medicinal plants that are used by the indigenous population of Talasemtane National Park, the analysis of data regarding the interviewees (socio-demographic), the status, perception of the inhabitants of the Northern Morocco, confidence in the healing properties of medicinal plants, and conserving the traditional medicinal heritage of the local population.

## **MATERIALS AND METHODS**

### **Study area**

The present study was conducted in Talasemtane National Park (TLSNP), Northern Morocco (Fig. 1). The TLSNP is located on the Mediterranean coast. It is limited to the north by Wadi Tissikiste, douars Amahousse, Arhiniame, and Souk El Had. To the east by Oued Kanar and douars Assimrane and Assifane, to the south by the way connecting Assifane to the main road to Bab Taza, and to the west by douar Benizid, Ain Tissimlane, Tarhzoute, Jble Sidi Salah, and Tamalout. The study area has Mediterranean climate with maximum temperature beyond 45°C during summer (July and August) and below 0°C during winter (December and January) and annual rainfall

is about 1000 mm. In the area, economy of the local people is very much dependent on subsistence agriculture, is generally based of cannabis cultivation (Chouvy & Afsahi 2014; Afsahi 2015; Meklach *et al.* 2017; Chouvy & Macfarlane 2018; Redouan *et al.* 2020).



**Fig. 1.** Situation and delimitation of PNTLS (Edited with QGIS from designed using QGIS 3.4.2.).

### Data collection

Ethnobotanical survey was conducted from 2014 through 2017. Semi-structured interviews were administered, and free listings were conducted, through face-to-face interviews and focus group.

The field survey is based on the previous works of our research group (Merzouki *et al.* 1997; 2000; 2001; El Gharbaoui *et al.* 2017; Redouan *et al.* 2020; Cheikh *et al.* 2020). Totally, 200 informants aged 20-40 and 40-60. The survey consists of two parts: the first part deals with the demographic characteristics of the informants and the second one focuses on the used plants (disease and symptoms), the used parts, and the preparation of the remedies. Interviews were performed in the field individually for each informant, in Arabic local dialects (darija). The plant samples were identified in the Abdelmalek Essaâdi University Herbarium, Voucher numbers for the included plants are provided in the results. For each plant sample, a specific code was given (e.g. "TMP-B001", since the international herbarium code for this herbarium is TMP-B). Vernacular names were included as referred by our informants in both Arabic and Roman alphabets. For the transliteration of the vernacular names from Arabic into the Roman alphabet, we followed Bellakhdar (1997).

The treated diseases were classified according to the international classifications of diseases (ICPC-2, International Classification of Primary Care, 2015) of the WHO (as suggested by Staub *et al.* 2015).

### Statistical analysis

For the analysis of data regarding the interviewees (socio-demographic) and the ethnobotanical or ethnopharmacological data (used parts, administration modes, etc.) we first used Excel ® sheet to introduce the transcribed data. To evaluate knowledge, use, and motivation of medicinal plants versus conventional drugs, we used the Principal Component Analysis (PCA) in SPSS ®. For this PCA analysis, we mainly include questions that refer to the use of medicinal plants (closed question: Yes/No), the knowledge or know-how of traditional medicine recipes (closed question: Yes/No), and finally the motivation to whether or not they use medicinal plants for ailments relief (open question for which answers were regrouped into appropriate clusters). The data resulted from these questions were imported into and recoded in SPSS, and then the PCA analysis was carried out by

including the socio-demographic data (gender, age, education level, and civic status). SPSS allows recording the coordinates of principal dimensions or factors in form of new variables that allow plotting the main information explained as a 2D scatter plot (Figs. 2, 3 and 4). It is important to highlight that these questions focused on the medicinal plants, rather they asked in a general manner, with the aim to establish a general perception of the local use, knowledge, and motivation toward medicinal plants.

## RESULTS & DISCUSSIONS

The sample was made up of 87 females and 113 males from different socio-economic strata, the 47% of our interviewees were illiterate and their knowledge on the medicinal plants use was therefore originated from verbal transmission (Table 1).

**Table 1.** Demographic and socio-educational features of the interviewees.

	Categories	Statistics (200)	Percentages (%)
Age	<20	11	5.5
	[20-40[	99	49.5
	[40-60[	67	33.5
	>60	23	11.5
Gender	F	87	43.5
	M	113	56.5
Status	Divorced	2	1
	Married	150	75
	Single	42	21
	Widow	6	3
Education	Illiterate	94	47
	Koranic School	32	16
	Literacy Center	4	2
	Primary School	28	14
	Secondary School	21	10.5
	High School	3	1.5
	University	18	9

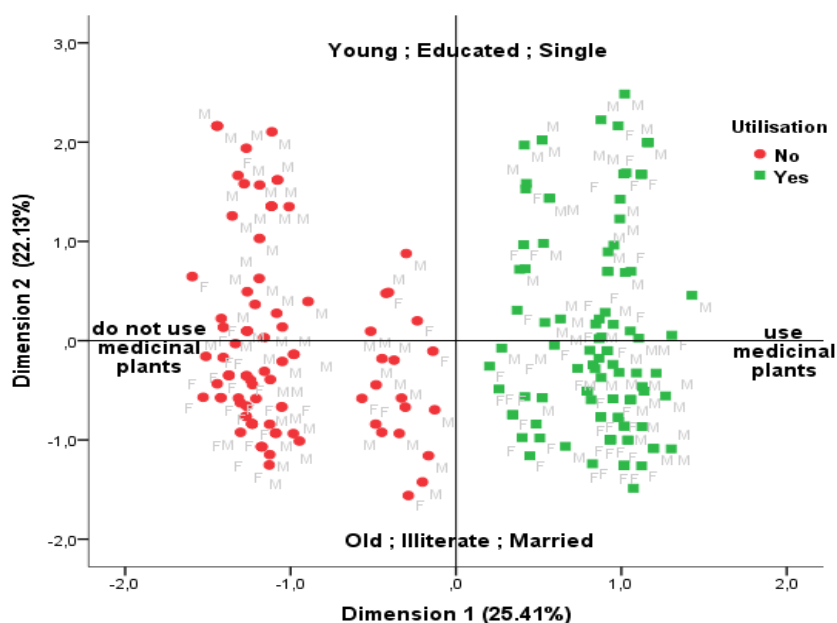
### Perceptions and attitudes of the Talassemthane National Park inhabitants towards medicinal plants

In order to visualize the perception and attitude of the Talassemthane National Park inhabitants regarding medicinal plants (use, knowledge, and motivation) versus conventional medicine, a principal component analysis (PCA) was conducted. The obtained KMO index, that measures the validity of both our survey and PCA analysis, is satisfactory (0.517) with a very significant Bartlett Sphericity test ( $Khi-2 = 422.21$ ;  $p < 0.001$ ).

PCA revealed three main dimensions representing 65.56% of the total information explained in our sample, and the first two dimensions explain 47.54%. SPSS allows recording the coordinates of these three dimensions in form of new three variables or factors that allow plotting the main (47.54%) information explained in a 2D scatter plot. The variables included in this analysis are age, educational level, matrimonial status, use of medicinal plants, knowledge of medicinal plants recipes, and motivation to use medicinal plants (Figs. 2, 3, and 4). Notably, according to PCA analysis of our sample, gender (M: male; F: female) did not exhibit any significant differences regarding the use of medicinal plants.

### Use of medicinal plants by the Talassemthane National Park Inhabitants

Fig. 2 shows the utilization of medicinal plants by the Talassemthane National Park inhabitants. The scatter plot highlights two distinct groups following the first dimension that describes 25.41% of total information embedded in our sample. It highlights the use of medicinal plants as well. The first group (■) represents the individuals that integrate the utilization of medicinal plants in their tradition and costumes for healing purposes. This group inherited these habits from their grandparents. While the second group (●) represents the individuals that are not used to consume medicinal plants for several motivations (see Fig. 4). These observations show plausible information erosion that threatens the high value of traditional medicine in Talassemthane National Park.



**Fig. 2.** Utilization of medicinal plants by TLSNP inhabitants, Dimension 1 represents the utilization of medicinal plants, and Dimension 2 represents age, education, and matrimonial status; M: males; F: females.

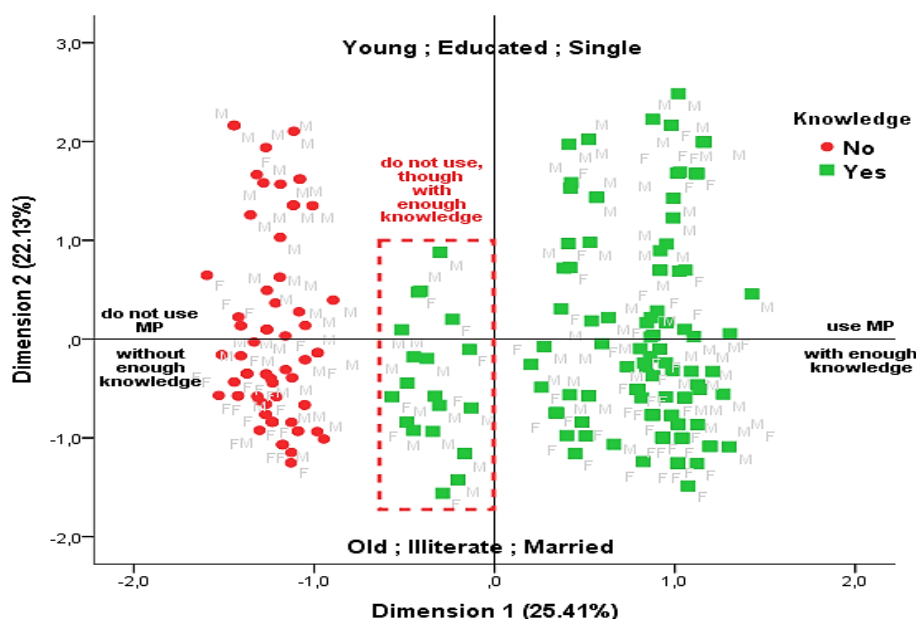
### Knowledge of Medicinal Plants by Talassemthane National Park Inhabitants

Fig. 3 presents the analysis of TLSNP inhabitants' medicinal plant knowledge. It shows three main groups: the first group (■) has sufficient traditional knowledge of healing and therapeutic practices, likewise, the second group (■ bordered) shows enough traditional knowledge of healing and therapeutic practices, nevertheless, these individuals do not use medicinal plants as shown in Fig. 2. Finally, the third group (●) does not have any traditional knowledge of healing and therapeutic practices, and therefore does not use medicinal plants (see Fig. 3). The fact that we obtained through the PCA analysis a group of people which have the knowledge on the use of medicinal plants for healing purposes but they do not currently use neither medicinal plants nor their inherited knowledge, show a scary trend in TLSNP toward losing confidence on the high valued heritage of traditional medicine in this region.

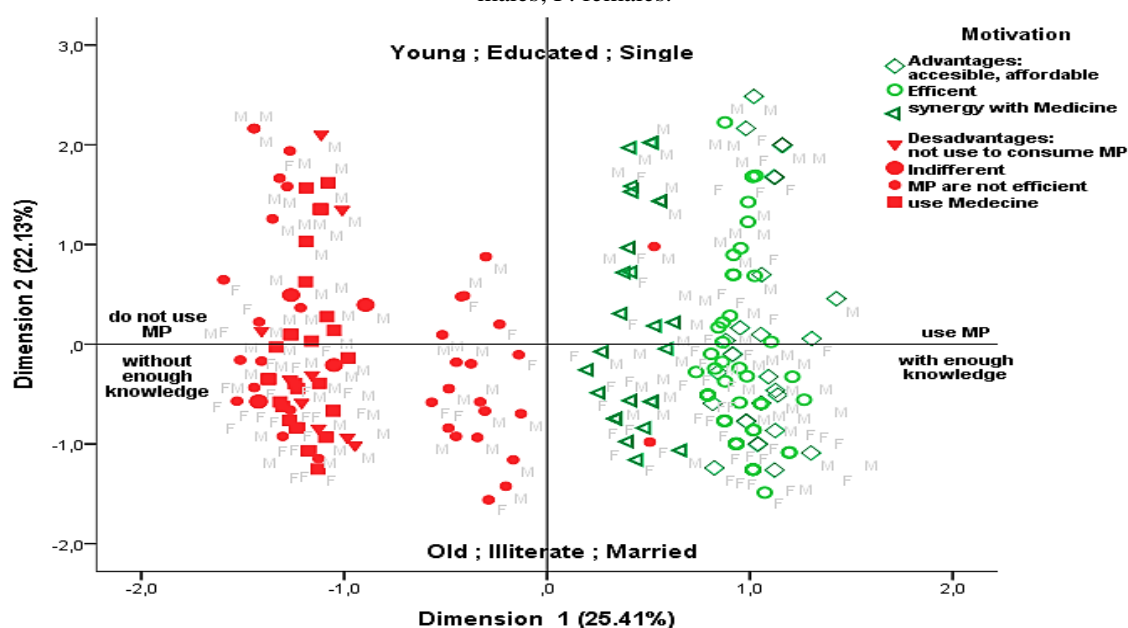
### Motivations to use medicinal plants by the Talassemthane National Park inhabitants

The motivations and perception analysis of TLSNP inhabitants to use medicinal plants can be analyzed according to two main groups representing the data plotted in Fig. 4. In order to analyze the motivation of the first group (◇○◁), i.e. individuals who use medicinal plants and got enough traditional knowledge of therapeutic practices, one can easily identify three subsets. The first subset (◇) uses medicinal plants because they are accessible and affordable, the second (○) says that medicinal plants are effective, and the third (◁) uses medicinal plants in synergy with conventional drugs.

Thus, we can confirm this previously mentioned trend of losing confidence toward medicinal plants as we move from first subset to third one (from right to left on the 1<sup>st</sup> dimension), even though this later is less represented.



**Fig. 3.** knowledge of medicinal plants inherited by TLSNP inhabitants. Dimension 1 represents the utilization of medicinal plants, and Dimension 2 represents age, education, and matrimonial status; MP: medicinal plants; M: males; F: females.



**Fig. 4.** Motivation of TLSNP inhabitants for using medicinal plants. Dimension 1 represents the utilization of medicinal plants, and Dimension 2 represents age, education, and matrimonial status; MP: medicinal plants; M: males; F: females.

On the other hand, the motivations of the second group ( $\blacktriangledown \bullet \bullet \blacksquare$ ) i.e. individuals who do not use medicinal plants, are divided into 4 subsets. The first subset ( $\blacktriangledown$ ) represents individuals who are not used to consume medicinal plants or it is not a tradition in their families. The second ( $\bullet$ ) seems indifferent regarding the use of medicinal plants, while the third ( $\bullet$ ) believes that medicinal plants are not efficient to use for daily care. Finally, the fourth ( $\blacksquare$ ) undoubtedly relies on conventional medicine to treat symptoms and diseases.

All the individuals of the second groups argue that their confidence towards the use of medicinal plants for therapeutic purposes is deteriorating in recent decades. According to our finding, this trend is mostly related to changing lifestyle and access to commodities such as electricity, health care campaigns, and satellite TV channels.

### Medicinal plants and groups of diseases

Medicinal plants used to treat 15 groups of diseases are the biological material for this study. A total of 152 ethno-medicinal species in 44 families were recorded as being used by the TLSNP in treating different types of diseases and symptoms (Table 2). The list of the species, sorted in alphabetical order of groups of diseases (with the ICPC-2 code).

**Table 2.** Medicinal plants with voucher, pathological groups and treated diseases & symptoms codes.

Species (Vouchers)	Pathological groups	Treated diseases & symptoms codes
<i>Agave americana</i> L. (TMP-B170); <i>Apium repens</i> (Jacq.) Lag. (TMP-B005); <i>Athamanta sicula</i> L. (TMP-B047); <i>Daucus muricatus</i> (L.) L. (TMP-B021); <i>Eryngium bourgatii</i> Gouan (TMP-B023); <i>Eryngium caespitiferum</i> Font Quer & Pau (TMP-B023); <i>Eryngium triquetrum</i> Vahl (TMP-B030); <i>Kundmannia sicula</i> (L.) DC. (TMP-B032); <i>Smyrniololus atrum</i> L. (TMP-B044); <i>Centaurea calcitrapa</i> L. (TMP-B010); <i>Cynara cardunculus</i> L. (TMP-B068); <i>Matricaria chamomilla</i> L. (TMP-B074); <i>Silybum marianum</i> L. (TMP-B078); <i>Sonchus oleraceus</i> L. (TMP-B079); <i>Alkanna tinctoria</i> L. (TMP-B080); <i>Trachelium caeruleum</i> L. (TMP-B084); <i>Chenopodium acuminatum</i> Willd. (TMP-B088); <i>Euphorbia helioscopia</i> L. (TMP-B092); <i>Lathyrus tingitanus</i> L. (TMP-B099); <i>Scorpiurus muricatus</i> L. (TMP-B101); <i>Centaurium erythraea</i> Rafn. (TMP-B107); <i>Ajuga iva</i> (L.) Schreb. (TMP-B112); <i>Clinopodium nepeta</i> (L.) Kuntze (TMP-B114); <i>Lavandula angustifolia</i> Mill. (TMP-B115); <i>Lavandula dentata</i> L. (TMP-B116); <i>Lavandula stoechas</i> L. (TMP-B117); <i>Marrubium vulgare</i> L. (TMP-B118); <i>Mentha piperita</i> L. (TMP-B119); <i>Mentha pulegium</i> L. (TMP-B120); <i>Mentha rotundifolia</i> (L.) Huds. (TMP-B121); <i>Ocimum basilicum</i> L. (TMP-B124); <i>Origanum majorana</i> L. (TMP-B126); <i>Origanum elongatum</i> (Bonnet) Emb. & Maire (TMP-B127); <i>Origanum vulgare</i> L. (TMP-B128); <i>Salvia officinalis</i> L. (TMP-B130); <i>Teucrium polium</i> L. (TMP-B132); <i>Thymbra capitata</i> L. (TMP-B133); <i>Thymus willdenowii</i> Boiss. (TMP-B135); <i>Allium cepa</i> L. (TMP-B168); <i>Allium sativum</i> L. (TMP-B169); <i>Phillyrea latifolia</i> L. (TMP-B143); <i>Citrus limon</i> (L.) Burm. fil. (TMP-B160); <i>Aloysia citrodora</i> Palau (TMP-B165); <i>Zingiber officinale</i> Roscoe (TMP-B167)	A. General and Unspecified	Sweating problem A09 ; Leprosy A78 ; Intoxication A86 ; Swelling A08 ; Chills A02 ; Fever A03 ; Tiredness general A04 ; Pain general A01 ; Tuberculosis A70
<i>Adiantum capillus-veneris</i> L. (TMP-B172); <i>Pistacia lentiscus</i> L. (TMP-B054); <i>Ammi majus</i> L. (TMP-B001); <i>Ammi visnaga</i> (L.) Lam. (TMP-B002); <i>Daucus muricatus</i> (L.) L. (TMP-B021); <i>Eryngium bourgatii</i> Gouan (TMP-B023); <i>Eryngium glaciale</i> Boiss. (TMP-B025); <i>Eryngium huteri</i> Porta (TMP-B026); <i>Foeniculum vulgare</i> Mill. (TMP-B031); <i>Kundmannia sicula</i> (L.) DC. (TMP-B032); <i>Ridolfia segetum</i> (L.) Moris (TMP-B042); <i>Smyrniololus atrum</i> L. (TMP-B044); <i>Stoibrax pomeliana</i> (Maire) B.L. Burt (TMP-B006); <i>Nerium oleander</i> L. (TMP-B055); <i>Chamaerops humilis</i> L. (TMP-B057); <i>Anacyclus pyrethrum</i> (L.) Link (TMP-B059); <i>Artemisia absinthium</i> L. (TMP-B060); <i>Seriphidium herba-alba</i> (Asso) J. Soják (TMP-B061); <i>Carthamus tinctorius</i> L. (TMP-B063); <i>Centaurea acaulis</i> L. (TMP-B064); <i>Centaurea pullata</i> L. (TMP-B065); <i>Cichorium intybus</i> L. (TMP-B067); <i>Dittrichia viscosa</i> (L.) Greuter (TMP-B069); <i>Echinops glaberrimus</i> DC. (TMP-B070); <i>Lactuca sativa</i> L. (TMP-B038); <i>Matricaria chamomilla</i> L. (TMP-B074); <i>Scolymus hispanicus</i> L. (TMP-B076); <i>Scolymus maculatus</i> L. (TMP-B077); <i>Alkanna tinctoria</i> L. (TMP-B080); <i>Opuntia ficus-indica</i> (L.) Mill. (TMP-B083); <i>Chenopodium acuminatum</i> Willd. (TMP-B088); <i>Cistus albidus</i> L. (TMP-B089); <i>Tetraclinis articulata</i> (Vahl) Mast. (TMP-B090); <i>Arbutus unedo</i> L. (TMP-B091); <i>Mercurialis annua</i> L. (TMP-B093); <i>Ricinus communis</i> L. (TMP-B094); <i>Anagyris foetida</i> L. (TMP-B095); <i>Cerantonia siliqua</i> L. (TMP-B096); <i>Lupinus angustifolius</i> L. (TMP-B098); <i>Glycyrrhiza glabra</i> L. (TMP-B100); <i>Scorpiurus muricatus</i> L. (TMP-B101); <i>Trigonella foenum-graecum</i> L. (TMP-B102); <i>Vicia faba</i> L. (TMP-B103); <i>Vicia sativa</i> L. (TMP-B104); <i>Quercus rotundifolia</i> Lam. (TMP-B105); <i>Quercus suber</i> L. (TMP-B106); <i>Centaurium erythraea</i> Rafn. (TMP-B107); <i>Crocus sativus</i> L. (TMP-B108); <i>Juglans regia</i> L. (TMP-B109); <i>Ajuga chamaepitys</i> L. Schreb. (TMP-B111); <i>Ajuga iva</i> (L.) Schreb. (TMP-B112); <i>Lavandula angustifolia</i> Mill. (TMP-B115); <i>Lavandula dentata</i> L. (TMP-B116); <i>Lavandula stoechas</i> L. (TMP-B117); <i>Marrubium vulgare</i> L. (TMP-B118); <i>Melissa officinalis</i> L. (TMP-B039); <i>Mentha piperita</i> L. (TMP-B119); <i>Mentha pulegium</i> L. (TMP-B120); <i>Mentha rotundifolia</i> (L.) Huds. (TMP-B121); <i>Mentha suaveolens</i> Ehrh. (TMP-B122); <i>Mentha viridis</i> (L.) L. (TMP-B123); <i>Ocimum</i>	D. Digestive	Abdominal pain epigastric D02; Dyspepsia/indigestion D07; Teeth/gum symptom/complaint D19; Diarrhoea D11; Constipation D12; Abdominal pain/cramps general D01; Gastrointestinal infection D70; Flatulence/gas/belching D08; Liver disease NOS D97; Mouth/tongue/lip symptom/compl. D20; Irritable bowel syndrome D93; Mouth/tongue/lip disease D83; Jaundice D13; Stomach function disorder D87; Worms/other parasites D96; Swallowing problem D21; Rectal/anal pain D04 ; Mumps D71; Vomiting D10; Duodenal ulcer D85



**Table 2 (continued).** Medicinal plants with voucher, pathological groups and treated diseases & symptoms codes.

Species (Vouchers)	Pathological groups	Treated diseases & symptoms codes
<i>basilicum</i> L. (TMP-B124); <i>Origanum compactum</i> Benth. (TMP-B125); <i>Origanum majorana</i> L. (TMP-B126); <i>Origanum elongatum</i> (Bonnet) Emb. & Maire (TMP-B127); <i>Origanum vulgare</i> L. (TMP-B128); <i>Rosmarinus officinalis</i> L. (TMP-B129); <i>Salvia officinalis</i> L. (TMP-B130); <i>Teucrium polium</i> L. (TMP-B132); <i>Thymbra capitata</i> L. (TMP-B133); <i>Thymus capitellatus</i> Hoffmanns. & Link. (TMP-B134); <i>Thymus willdenowii</i> Boiss. (TMP-B135); <i>Thymus algeriensis</i> Boiss. & Reut (TMP-B136); <i>Laurus nobilis</i> L. (TMP-B137); <i>Allium cepa</i> L. (TMP-B168); <i>Allium sativum</i> L. (TMP-B169); <i>Syzygium aromaticum</i> (L.) Merr. & Perry (TMP-B139); <i>Myrtus communis</i> L. (TMP-B140); <i>Fraxinus angustifolia</i> Vahl, nom. cons. (TMP-B141); <i>Olea europaea</i> L. (TMP-B142); <i>Phillyrea latifolia</i> L. (TMP-B143); <i>Rumex acetosa</i> L. (TMP-B145); <i>Rumex pulcher</i> L. (TMP-B146); <i>Rumex spinosus</i> L. (TMP-B147); <i>Rumex bucephalophorus</i> L. (TMP-B148); <i>Punica granatum</i> L. (TMP-B149); <i>Clematis flammula</i> L. (TMP-B150); <i>Crataegus monogyna</i> Jacq. (TMP-B155); <i>Cydonia oblonga</i> Mill. (TMP-B156); <i>Prunus dulcis</i> (Mill.) D. A. Webb (TMP-B157); <i>Citrus limon</i> (L.) Burm. fil. (TMP-B160); <i>Daphne gnidium</i> L. (TMP-B162); <i>Celtis australis</i> L. (TMP-B163); <i>Aloysia citrodora</i> Palau (TMP-B165); <i>Vitis vinifera</i> L. (TMP-B166); <i>Zingiber officinale</i> Roscoe (TMP-B167)		
<i>Adiantum capillus-veneris</i> L. (TMP-B172); <i>Daucus muricatus</i> (L.) L. (TMP-B021); <i>Matricaria chamomilla</i> L. (TMP-B074)	F. Eye	Eye infection/inflammation F73; Weakness of vision F28; Eye pain F01
<i>Daucus muricatus</i> (L.) L. (TMP-B021); <i>Torilis arvensis</i> (Huds.) Link subsp. <i>neglecta</i> (Schult.) Thell. (TMP-B048); <i>Torilis japonica</i> (Houtt.) DC. (TMP-B053); <i>Arum maculatum</i> L. (TMP-B056); <i>Artemisia absinthium</i> L. (TMP-B060); <i>Lactuca sativa</i> L. (TMP-B038); <i>Matricaria chamomilla</i> L. (TMP-B074); <i>Alkanna tinctoria</i> L. (TMP-B080); <i>Cannabis sativa</i> L. (TMP-B085); <i>Arbutus unedo</i> L. (TMP-B091); <i>Trigonella foenum-graecum</i> L. (TMP-B102); <i>Crocus sativus</i> L. (TMP-B108); <i>Melissa officinalis</i> L. (TMP-B039); <i>Mentha suaveolens</i> Ehrh. (TMP-B122); <i>Ocimum basilicum</i> L. (TMP-B124); <i>Origanum compactum</i> Benth. (TMP-B125); <i>Thymus capitellatus</i> Hoffmanns. & Link. (TMP-B134); <i>Allium cepa</i> L. (TMP-B168); <i>Allium sativum</i> L. (TMP-B169); <i>Fraxinus angustifolia</i> Vahl, nom. cons. (TMP-B141); <i>Prunus dulcis</i> (Mill.) D. A. Webb (TMP-B157); <i>Zingiber officinale</i> Roscoe (TMP-B167)	P. Psychological	Sexual fulfilment reduced P08; Sleep disturbance P06; Feeling anxious/nervous P01; Sexual desire reduced P07; Anorexia P86; Feeling Anxiety disorder P74
<i>Stoibrax pomeliana</i> (Maire) B.L. Burt (TMP-B006); <i>Marrubium vulgare</i> L. (TMP-B118)	H. Ear	Ear pain H01
<i>Pistacia lentiscus</i> L. (TMP-B054); <i>Ammi visnaga</i> (L.) Lam. (TMP-B002); <i>Elaeoselinum foetidum</i> (L.) Boiss. (TMP-B022); <i>Nerium oleander</i> L. (TMP-B055); <i>Chamaeleon gummifer</i> (L.) Cass. (TMP-B066); <i>Matricaria chamomilla</i> L. (TMP-B074); <i>Pulicaria odora</i> (L.) Rchb. (TMP-B075); <i>Chenopodium acuminatum</i> Willd. (TMP-B088); <i>Lavandula angustifolia</i> Mill. (TMP-B115); <i>Lavandula dentata</i> L. (TMP-B116); <i>Lavandula stoechas</i> L. (TMP-B117); <i>Origanum majorana</i> L. (TMP-B126); <i>Thymbra capitata</i> L. (TMP-B133); <i>Nigella damascena</i> L. (TMP-B152); <i>Nigella sativa</i> L. (TMP-B153); <i>Ruta graveolens</i> L. (TMP-B161)	N. Neurological	Vertigo/Dizziness N17; Cluster headache N90; Migraine N89; Trigeminal neuralgia N92; Weakness N18; Neurological symptom N29; Headache N01; Epilepsy N88
<i>Agave americana</i> L. (TMP-B170); <i>Cachrys libanotis</i> L. (TMP-B016); <i>Thapsia villosa</i> L. (TMP-B046); <i>Arum maculatum</i> L. (TMP-B056); <i>Anacyclus pyrethrum</i> (L.) Link (TMP-B059); <i>Seriphidium herba-alba</i> (Asso) J. Soják (TMP-B061); <i>Cynara cardunculus</i> L. (TMP-B068); <i>Ricinus communis</i> L. (TMP-B094); <i>Erophaca baetica</i> (L.) Boiss. (TMP-B097); <i>Juncus acutus</i> L. (TMP-B110); <i>Lavandula angustifolia</i> Mill. (TMP-B115); <i>Lavandula dentata</i> L. (TMP-B116); <i>Lavandula stoechas</i> L. (TMP-B117); <i>Mentha suaveolens</i> Ehrh. (TMP-B122); <i>Thymus capitellatus</i> Hoffmanns & Link. (TMP-B134); <i>Allium sativum</i> L. (TMP-B169); <i>Olea europaea</i> L. (TMP-B142)	L. Musculoskeletal	Joint symptom L20; Elbow symptom L10; Knee symptom L15
<i>Ammi visnaga</i> (L.) Lam. (TMP-B002); <i>Magydaris pastinacea</i> (Lam.) Paol (TMP-B033); <i>Aristolochia baetica</i> L. (TMP-B058); <i>Seriphidium herba-alba</i> (Asso) J. Soják (TMP-B061); <i>Centaurea calcitrapa</i> L. (TMP-B010); <i>Opuntia ficus-indica</i> (L.) Mill. (TMP-B083); <i>Lathyrus tingitanus</i> L. (TMP-B099); <i>Trigonella foenum-graecum</i> L. (TMP-B102); <i>Centaureum erythraea</i> Rafn. (TMP-B107); <i>Ajuga chamaepitys</i> L. Schreb. (TMP-B111); <i>Clinopodium nepeta</i> (L.) Kuntze (TMP-B114); <i>Mentha piperita</i> L. (TMP-B119); <i>Mentha rotundifolia</i> (L.) Huds. (TMP-B121); <i>Mentha viridis</i> (L.) L. (TMP-B123); <i>Origanum compactum</i> Benth. (TMP-B125); <i>Allium cepa</i> L. (TMP-B168); <i>Myrtus communis</i> L. (TMP-B140); <i>Nigella sativa</i> L. (TMP-B153); <i>Citrus limon</i> (L.) Burm. fil. (TMP-B160)	K. Cardiovascular	Palpitations K04; Head pains K01; Haemorrhoids K96; hypotension K88; Hypertension K86



**Table 2 (continued).** Medicinal plants with voucher, pathological groups and treated diseases & symptoms codes.

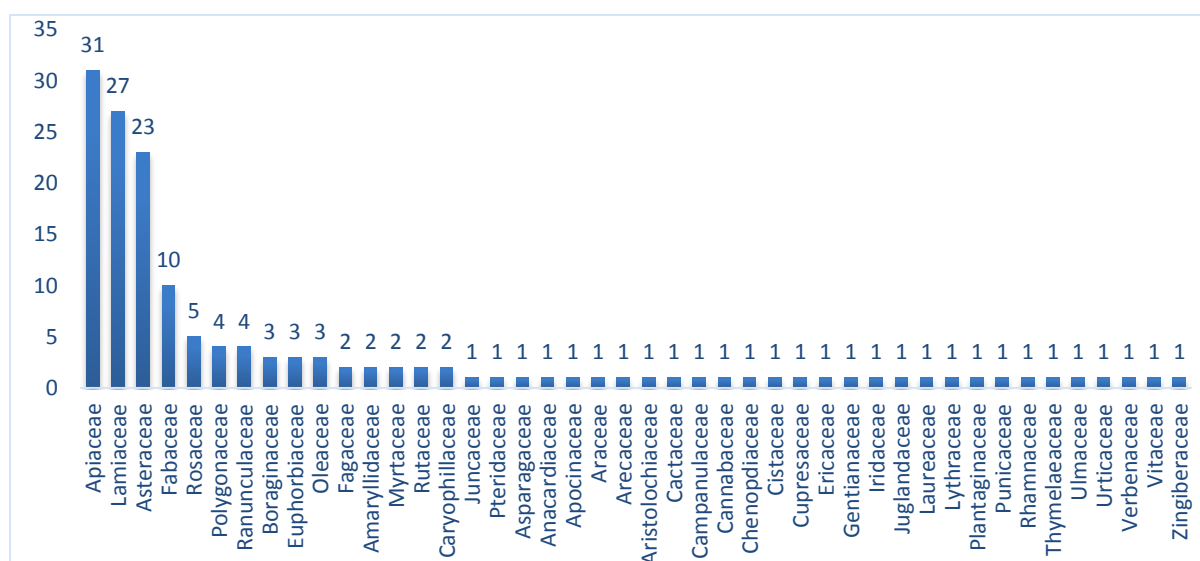
Species (Vouchers)	Pathological groups	Treated diseases & symptoms codes
<i>Adiantum capillus-veneris</i> L. (TMP-B172); <i>Agave americana</i> L. TMP-B170; <i>Ammi majus</i> L. (TMP-B001); <i>Apium nodiflorum</i> (L.) Lag. (TMP-B004); <i>Bunium alpinum</i> Waldst. & Kit. (TMP-B007); <i>Bunium bulbocastanum</i> L. (TMP-B008); <i>Daucus muricatus</i> (L.) L. (TMP-B021); <i>Magydaris pastinacea</i> (Lam.) Paol (TMP-B033); <i>Thapsia villosa</i> L. (TMP-B046); <i>Nerium oleander</i> L. (TMP-B055); <i>Aristolochia baetica</i> L. (TMP-B058); <i>Anacyclus pyrethrum</i> (L.) Link (TMP-B059); <i>Calendula officinalis</i> L. (TMP-B062); <i>Carthamus tinctorius</i> L. (TMP-B063); <i>Centaurea calcitrapa</i> L. TMP-B010; <i>Centaurea acaulis</i> L. (TMP-B064); <i>Chamaeleon gummifer</i> (L.) Cass. (TMP-B066); <i>Cichorium intybus</i> L. (TMP-B067); <i>Cynara cardunculus</i> L. (TMP-B068); <i>Dittrichia viscosa</i> (L.) Greuter (TMP-B069); <i>Glebionis coronaria</i> (L.) N.N. Tzvel. (TMP-B071); <i>Helianthus annuus</i> L.(TMP-B072); <i>Lactuca virosa</i> L. (TMP-B073); <i>Matricaria chamomilla</i> L. (TMP-B074); <i>Anchusa ochroleuca</i> M. Bieb. ( <i>Anchusa officinalis</i> L.) (TMP-B081); <i>Borago officinalis</i> L. (TMP-B082); <i>Opuntia ficus-indica</i> (L.) Mill. (TMP-B083); <i>Cannabis sativa</i> L. (TMP-B085); <i>Silene vulgaris</i> (Moench.) Garck (TMP-B086); <i>Anagyris foetida</i> L. (TMP-B095); <i>Trigonella foenum-graecum</i> L. (TMP-B102); <i>Vicia faba</i> L. (TMP-B103); <i>Quercus suber</i> L. (TMP-B106) ; <i>Centaurium erythraea</i> Rafn. (TMP-B107); <i>Ajuga chamaepitys</i> L. Schreb. (TMP-B111); <i>Ajuga iva</i> (L.) Schreb. (TMP-B112); <i>Lavandula angustifolia</i> Mill. (TMP-B115); <i>Lavandula dentata</i> L. (TMP-B116); <i>Lavandula stoechas</i> L. (TMP-B117); <i>Mentha pulegium</i> L. (TMP-B120); <i>Mentha rotundifolia</i> (L.) Huds. (TMP-B121); <i>Ocimum basilicum</i> L. (TMP-B124); <i>Origanum compactum</i> Benth. (TMP-B125); <i>Rosmarinus officinalis</i> L. (TMP-B129); <i>Salvia officinalis</i> L. (TMP-B130); <i>Teucrium polium</i> L. (TMP-B132); <i>Thymus willdenowii</i> Boiss. (TMP-B135); <i>Laurus nobilis</i> L. (TMP-B137); <i>Allium cepa</i> L. (TMP-B168); <i>Allium sativum</i> L. (TMP-B169); <i>Lawsonia inermis</i> L. (TMP-B138); <i>Myrtus communis</i> L. (TMP-B140); <i>Olea europaea</i> L. (TMP-B142); <i>Plantago rugelii</i> Decne. (TMP-B144); <i>Clematis flammula</i> L. (TMP-B150); <i>Delphinium staphisagria</i> L. (TMP-B151); <i>Nigella damascena</i> L. (TMP-B152); <i>Ziziphus lotus</i> (L.) Lam. (TMP-B154); <i>Prunus dulcis</i> (Mill.) D. A. Webb (TMP-B157); <i>Rosa canina</i> L. (TMP-B158); <i>Rubus ulmifolius</i> Schott (TMP-B159); <i>Daphne gnidium</i> L. (TMP-B162); <i>Vitis vinifera</i> L. (TMP-B166)	S. Skin	Laceration S18; Contusion S16; Eczema S87; Warts S03; Contusion S16; Pediculosis S73; Skin injury S19; Pruritus S02; Pain of skin S01; Burn S14; Acne S96; Hair loss S23; Eczema S87; Scabies S72; Insect bite S12; Animal bite S13; Hair symptom S24; Wart S03; Skin inflammation S11; Skin symptom S29; Dermatitis contact/allergic S88 ; Skin colour change S08; Mouth symptom S20
<i>Adiantum capillus-veneris</i> L. (TMP-B172); <i>Ammi visnaga</i> (L.) Lam. (TMP-B002); <i>Foeniculum vulgare</i> Mill. (TMP-B031); <i>Thapsia transtagana</i> Brot. (TMP-B045); <i>Thapsia villosa</i> L. (TMP-B046); <i>Artemisia absinthium</i> L. <i>Artemisia arborescens</i> L. (TMP-B060); <i>Glebionis coronaria</i> (L.) N.N. Tzvel. (TMP-B071); <i>Helianthus annuus</i> L.(TMP-B072); <i>Pulicaria odora</i> (L.) Rchb. (TMP-B075); <i>Borago officinalis</i> L. (TMP-B082); <i>Glycyrrhiza glabra</i> L. (TMP-B100); <i>Clinopodium nepeta</i> (L.) Kuntze (TMP-B114); <i>Lavandula angustifolia</i> Mill. (TMP-B115); <i>Lavandula stoechas</i> L. (TMP-B117); <i>Marrubium vulgare</i> L. (TMP-B118); <i>Mentha pulegium</i> L. (TMP-B120); <i>Mentha suaveolens</i> Ehrh. (TMP-B122); <i>Origanum compactum</i> Benth. (TMP-B125); <i>Origanum majorana</i> L.(TMP-B126); <i>Origanum elongatum</i> (Bonnet) Emb. & Maire (TMP-B127); <i>Origanum vulgare</i> L. (TMP-B128); <i>Salvia officinalis</i> L. (TMP-B130); <i>Teucrium polium</i> L. (TMP-B132); <i>Thymbra capitata</i> L. (TMP-B133); <i>Thymus capitellatus</i> Hoffmanns. & Link. (TMP-B134); <i>Thymus willdenowii</i> Boiss. (TMP-B135); <i>Laurus nobilis</i> L. (TMP-B137); <i>Allium cepa</i> L. (TMP-B168); <i>Allium sativum</i> L. (TMP-B169); <i>Olea europaea</i> L. (TMP-B142); <i>Clematis flammula</i> L. (TMP-B150); <i>Nigella sativa</i> L. (TMP-B153); <i>Citrus limon</i> (L.) Burm. fil. (TMP-B160); <i>Zingiber officinale</i> Roscoe (TMP-B167)	R. Respiratory	Sputum/phlegm abnormal R25 ; Asthma R96 ; Bronchitis R78 ; Cough R05 ; Influenza R80 ; Breathing problem R04 ; Sinus symptom R09; Pain respiratory system R01 ; Throat symptom R21 ; Pneumonia R81 ; Respiratory infection R74 ; Shortness of breath R02 ; Grippe R80 ; Respiratory infection R83 ; Hypertrophy tonsils/adenoids R90 ; Voice symptom R23
<i>Ammi visnaga</i> (L.) Lam. (TMP-B002); <i>Apium inundatum</i> (L.) Rchb. f. (TMP-B003); <i>Daucus carota</i> L. (TMP-B020); <i>Eryngium tricuspdatum</i> L. (TMP-B029); <i>Stoibrax pomeliana</i> (Maire) B.L. Burt (TMP-B006); <i>Aristolochia baetica</i> L. (TMP-B058); <i>Artemisia absinthium</i> L. <i>Artemisia arborescens</i> L. (TMP-B060); <i>Cynara cardunculus</i> L. (TMP-B068); <i>Borago officinalis</i> L. (TMP-B082); <i>Herniaria hirsuta</i> L. (TMP-B087); <i>Anagyris foetida</i> L. (TMP-B095); <i>Crocus sativus</i> L. (TMP-B108) ; <i>Juncus acutus</i> L. (TMP-B110) ; <i>Lavandula angustifolia</i> Mill. (TMP-B115); <i>Lavandula dentata</i> L. (TMP-B116); <i>Lavandula stoechas</i> L. (TMP-B117); <i>Marrubium vulgare</i> L. (TMP-B118); <i>Origanum vulgare</i> L. (TMP-B128); <i>Rosmarinus officinalis</i> L. (TMP-B129); <i>Salvia officinalis</i> L. (TMP-B130); <i>Salvia argentea</i> L. (TMP-B131); <i>Allium cepa</i> L. (TMP-B168); <i>Allium sativum</i> L. (TMP-B169); <i>Syzygium aromaticum</i> (L.) Merr. & Perry (TMP-B139); <i>Myrtus communis</i> L. (TMP-B140); <i>Urtica dioica</i> L. (TMP-B164)	U. Urological	Kidney symptom U14 ; Bladder pain U13 ; Urine retention U08 ; Urinary infection U71 ; Urinary calculus U95

**Table 2 (continued).** Medicinal plants with voucher, pathological groups and treated diseases & symptoms codes.

Species (Vouchers)	Pathological groups	Treated diseases & symptoms codes
<i>Ammi majus</i> L. (TMP-B001); <i>Eryngium ilicifolium</i> Lam. (TMP-B027); <i>Artemisia absinthium</i> L. <i>Artemisia arborescens</i> L. (TMP-B060); <i>Seriphidium herba-alba</i> (Asso) J. Soják (TMP-B061); <i>Matricaria chamomilla</i> L. (TMP-B074); <i>Ricinus communis</i> L. (TMP-B094); <i>Lavandula angustifolia</i> Mill. (TMP-B115); <i>Lavandula dentata</i> L. (TMP-B116); <i>Marrubium vulgare</i> L. (TMP-B118); <i>Origanum majorana</i> L. (TMP-B126); <i>Origanum vulgare</i> L. (TMP-B128); <i>Rosmarinus officinalis</i> L. (TMP-B129); <i>Salvia officinalis</i> L. (TMP-B130); <i>Salvia argentea</i> L. (TMP-B131); <i>Allium sativum</i> L. (TMP-B169); <i>Punica granatum</i> L. (TMP-B149); <i>Nigella sativa</i> L. (TMP-B153)	X. Female Genital	Menstrual pain X02 ; Menstruation absent X05 ; Vaginal infections X14 ; Menstruation Excessive X06 ; Menstrual irregular X07 ; Genital pain female X01 ; Vaginal symptom X15
<i>Adiantum capillus-veneris</i> L. (TMP-B172); <i>Eryngium bourgatii</i> Gouan (TMP-B023); <i>Smyrniolus olusatrum</i> L. (TMP-B044); <i>Thapsia villosa</i> L. (TMP-B046); <i>Anacyclus pyrethrum</i> (L.) Link (TMP-B059); <i>Chamaeleon gummifer</i> (L.) Cass. (TMP-B066); <i>Cichorium intybus</i> L. (TMP-B067); <i>Echinops glaberrimus</i> DC. (TMP-B070); <i>Lactuca sativa</i> L. (TMP-B038); <i>Euphorbia helioscopia</i> L. (TMP-B092); <i>Trigonella foenum-graecum</i> L. (TMP-B102); <i>Salvia officinalis</i> L. (TMP-B130)	W. Pregnancy, Childbearing, Family Planning	Abortion induced W83 ; Post-partum symptom W18 ; Antepartum bleeding W03 ; Infertility W15 ; Post-partum bleeding W17 ; Lactation symptom W19
<i>Ammi visnaga</i> (L.) Lam. (TMP-B002); <i>Daucus muricatus</i> (L.) L. (TMP-B021); <i>Nerium oleander</i> L. (TMP-B055); <i>Artemisia absinthium</i> L. <i>Artemisia arborescens</i> L. (TMP-B060); <i>Opuntia ficus-indica</i> (L.) Mill. (TMP-B083); <i>Tetraclinis articulata</i> (Vahl) Mast. (TMP-B090); <i>Lathyrus tingitanus</i> L. (TMP-B099); <i>Trigonella foenum-graecum</i> L. (TMP-B102); <i>Quercus rotundifolia</i> Lam. (TMP-B105); <i>Juglans regia</i> L. (TMP-B109); <i>Ajuga chamaepitys</i> L. Schreb. (TMP-B111); <i>Ajuga iva</i> (L.) Schreb. (TMP-B112); <i>Ballota hirsuta</i> Benth. (TMP-B113); <i>Lavandula angustifolia</i> Mill. (TMP-B115); <i>Lavandula stoechas</i> L. (TMP-B117); <i>Marrubium vulgare</i> L. (TMP-B118); <i>Origanum compactum</i> Benth. (TMP-B125); <i>Origanum vulgare</i> L. (TMP-B128); <i>Rosmarinus officinalis</i> L. (TMP-B129); <i>Salvia officinalis</i> L. (TMP-B130); <i>Teucrium polium</i> L. (TMP-B132); <i>Allium cepa</i> L. (TMP-B168); <i>Allium sativum</i> L. (TMP-B169)	T. Endocrine/Metabolic and Nutritional	Diabetes non-insulin dependent T90; Hypoglycaemia T87; Lose of appetite T03; Weight gain T07
<i>Ammi visnaga</i> (L.) Lam. (TMP-B002)	Y. Male Genital	Prostate symptom Y06

### Family contribution

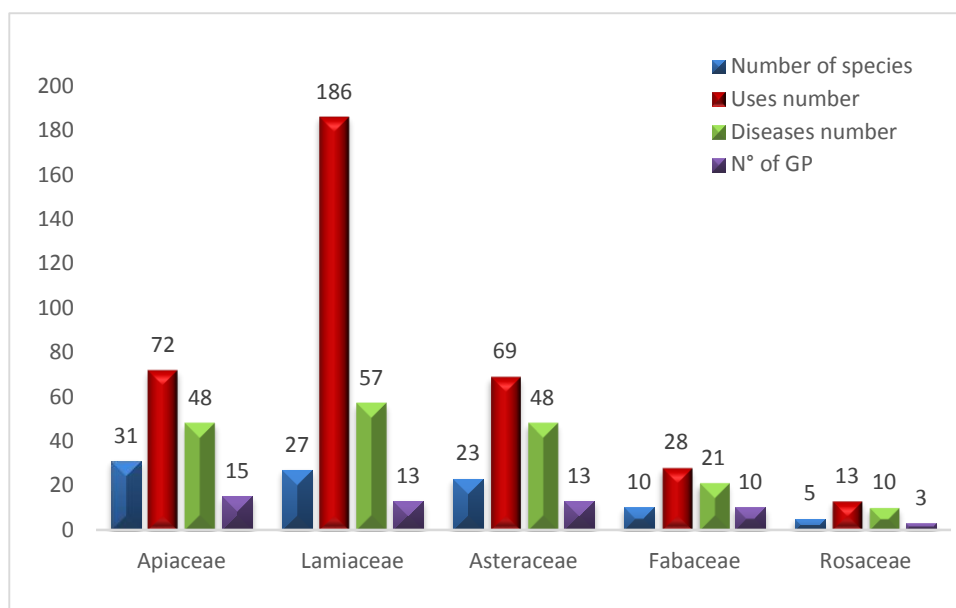
The most dominant botanical family with respect to the number of species used was *Apiaceae* (31 species) followed by *Lamiaceae* (27 species) *Asteraceae* (23 species) and *Fabaceae* (10 species). *Rosaceae* (5 species), *Polygonaceae* and *Ranunculaceae* (4 species each), *Boraginaceae*, *Euphorbiaceae*, and *Oleaceae* (3 species each), *Fagaceae*, *Amaryllidaceae*, *Myrtaceae*, *Caryophyllaceae* and *Rutaceae* (2 species each), while all other families shared one species each (Fig. 5). The high number of species presented by these families reflects that the study area has rich biodiversity and the inhabitants have sound knowledge of the use of these plants in locally prepared medicines. In fact, the total amount of species in these 4 families reaches the 59% of total ones.

**Fig. 5.** Number of species per botanical family.

In this study, we identified 567 symptoms and diseases for the 152 taxa belonging to 44 included botanical families, with a total of 9402 use reports (UR). Among the five most representative families in this survey, TLSNP therapists prepare 186 remedies from 27 taxa that belong to the *Lamiaceae* family which have been found to treat 57 diseases from 13 disease groups (Fig. 6).

However, *Lamiaceae* have considerable economic importance, many species of horticultural value, many used as culinary herbs or in perfumery and many are used in medicine.

In particular, many species of *Lamiaceae* are known for their aromatic oils, and many are of commercial or cultural importance, such as: *Salvia officinalis* L., *Rosmarinus officinalis* L., *Mentha* L. spp., *Thymus vulgaris* L., *Origanum* L. spp., *Melissa officinalis* L., *Lavandula* L. spp., *Ocimum* spp., (Harley et al. 2010).



**Fig. 6.** Number of species, use frequency, diseases number, and number of diseases groups, for the five botanical families most represented in TLSNP.

### Conditions, symptoms and pathological groups

A total of 567 medicinal uses have been reported for the included plants. They are used to treat up to 123 conditions or symptoms classified into 15 pathological groups according to the ICPC-2 classification of diseases (Fig. 7). The main pathological group treated is the one for digestive symptoms (D, with 174 use, 24%), with 20 mentioned conditions, and for which 96 plants can be used. As several ethno-pharmacological studies has pointed out (e.g. in nearby territories Merzouki et al. 2000; González-Tejero et al. 2008; Benítez 2009; Benítez et al. 2010; Benlamdini et al. 2014; El Haouari et al. 2018). This situation is the most typical one because digestive conditions used to be frequent and not medically important (i.e., not complicated and frequently fleeting). In our case, the explanation is because of, on one hand, it is the group (D, 24%) with the higher number of conditions cited in our interviews. Most of them with a high number of UR (abdominal pains, diarrhea, tooth age and constipations), being also conditions with a high prevalence in the studied area; on the other hand, because these conditions can be threatened with a high number of local resources (Table 3). This high UR for digestive conditions can also be explained because of the lack of domestic hygiene in some houses, and the frequent consumption of non-well treated water. Skin symptoms (S, 103 UR, 16%) are also important in this territory, including 10 different conditions and 26 medicinal uses for their treatment.

### Use report of medicinal plants in Talassemtane National Park

In this study, we identified 567 medicinal uses for the 152 taxa belonging to 44 included families, with a total of 9402 use reports (UR). In general, we have obtained very high use ratios for most uses. Most of the reported cases are *Lawsonia inermis* leaf powder as a poultice against eczema (120 UR), as well as fennel root decoction (*Foeniculum vulgare*) against colon pain (87 UR) or its fruits to treat abdominal pain (78 UR) and indigestion (62 UR) (Table 2). Plants are used in the study area to treat 123 conditions or symptoms classified into 15 disease groups according to the disease classification used (International Classification of Primary Care, 2015).

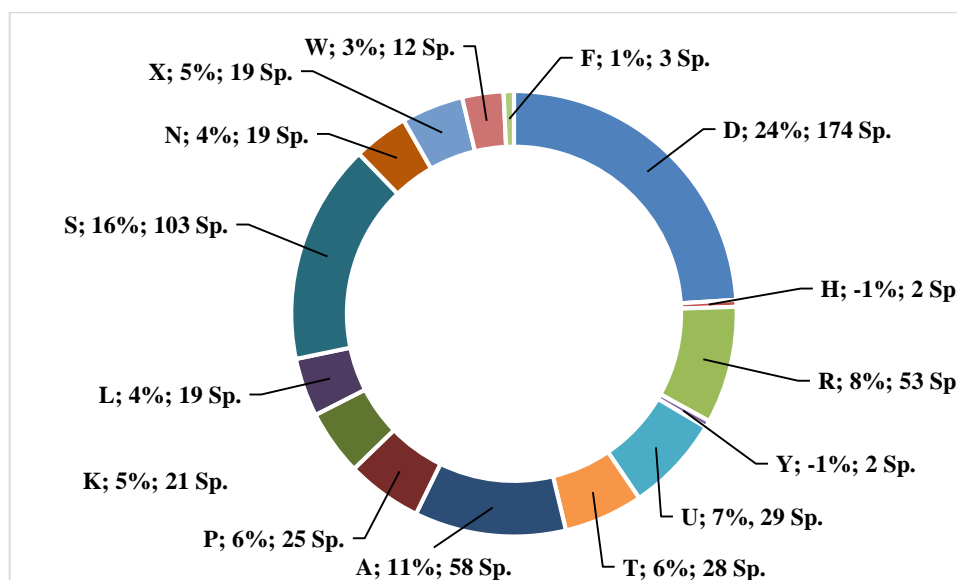


Fig. 7. Frequency of disease groups according to number of uses.

## CONCLUSIONS

The inhabitants express the ethnobotanical interest of TLSNP plants in terms of the rate of their use. Results of data analysis obtained in this ethnobotanical study allowed us to identify the most commonly used medicinal plants in the studied Park.

Our fieldwork provided ethnobotanical information on 152 species from 44 botanical families. For the latter, 567 different medicinal uses were collected to treat 114 diseases from 15 different disease groups. The *Apiaceae* family was the most represented, with 31 species, followed by *Lamiaceae* 27 species, *Asteraceae* 23 species, *Fabaceae* 10 species, and *Rosaceae* with 5 species. Families with lower than 5 species together account for 40.13% of the total.

The results show as well that the local population has accumulated a rich traditional knowledge regarding the use of medicinal plants. 50% of them still prefer to use traditional medicine for daily healthcare, and a few of them support these traditional medicines along with conventional drugs. Furthermore, inhabitants of TLSNP rely solely on the experience of others (elders) to access information. This reflects the image of the relative transmission of traditional practices from one generation to the next one. Nevertheless, the perception and attitude of TLSNP inhabitants revealed a serious threat towards the trend of losing confidence on healing properties of medicinal plants, which call for urgent need for the transcription, and conservation of the traditional medicinal heritage of TLSNP.

## ACKNOWLEDGEMENTS

The authors are indebted to the informants, healers and local communities for cooperating and sharing their indigenous knowledge, Mr. Abdeltif EL OUAHRANI for his help in the statistical analysis of our data, and the director of the TLSNP (Anouar JAOUI) for their time and effort dedicated to our interviews and field trips.

## REFERENCES

- Adams, M, Gschwind S, Zimmermann, S, Kaiser, M, Hamburger, M 2011, Renaissance remedies: Antiplasmodial protostane triterpenoids from *Alisma plantago-aquatica* L. (Alismataceae). *Journal of Ethnopharmacology*, 135, 43–47.
- Afsahi, K 2015, Are Moroccan cannabis growers able to adapt to recent European market trend. *The International Journal on Drug Policy*, 26: 327–329. DOI: 10.1016/j.drugpo.2014.11.012.
- Ahmad, L, Semotiuk, A, Zafar, M, Ahmad, M, Sultana, S, Liu, QR 2015, Ethnopharmacological documentation of medicinal plants used for hypertension among the local communities of DIR Lower, Pakistan. *Journal of Ethnopharmacology*, 175: 138–46.
- Arber, A 1938, *Herbals, their origin and evolution: A chapter in the History of Botany*. 2<sup>nd</sup> ed., Cambridge

- University Press, Cambridge, pp. 1470- 1670.
- Asase, A, Kokubun, T, Grayer, RJ, Kite, G, Simmonds, MS, Oteng-Yeboah, AA 2008, Chemical constituents and antimicrobial activity of medicinal plants from Ghana: *Cassia sieberiana*, *Haemastaphis barteri*, *Mitragyna inermis* and *Pseudocedrela kotschyi*. *Phytotherapy Research*, 22: 1013–1016. DOI: 10.1002/ptr.2392.
- Balick, MJ, Cox, PA 1996, *Plants, People, and Culture: The Science of Ethnobotany*. Scientific American Library, New York, 228 p. ISBN 0-7167-5061-9.
- Bellakhdar, J 1997, *La pharmacopée traditionnelle marocaine : Médecine arabe ancienne et savoir faire*. ISBN 2-910728-03-X. Ibis Press, pp. 465-466 (In French).
- Benitez, G, Gonzalez, Tejero, MR, Molero, Mesa, J 2010, Pharmaceutical ethnobotany in the western part of Granada Province (Southern Spain): Ethnopharmacological synthesis. *Journal of Ethnopharmacology*, 129: 87-105.
- Benítez, G 2009, *Etnobotánica y etnobiología del Poniente Granadino*. Edita: Fundación Ibn al-Jatib de Estudios de Cooperación Cultural, ISBN: 987-84-93464-3-9, 374 p.
- Benlamdini, N, Elhafian, M, Rochdi, A, Zidane, L 2014, Étude floristique et ethnobotanique de la flore médicinale du Haut Atlas oriental (Haute Moulouya). *Journal of Applied Biosciences*, 78: 6771 – 6787. ISSN 1997–5902 (In French).
- Berlin, B 1992, On the making of a comparative ethnobiology. In: B Berlin, (Ed.), *Ethnobiological Classification: Principles of Categorization of Plants and Animals in Traditional Societies*. Princeton University Press, Princeton, NJ, pp. 3–51.
- Buenz, EJ, Johnson, HE, Beekman, E.M, Motley, TJ, Bauer BA 2005, Bioprospecting Rumphius's Amboinese herbal: Vol. I. *Journal of Ethnopharmacology*, 96: 57-70.
- Cheikh, Y, Redouan FZ, Guillermo, B, Bouhbal, M, Kadiri, M, Boumediana, AI, Molero-Mesa, J, Merzouki A 2020, Ethnobotanical study of medicinal plants in the Adrar Province Mauritania. *Journal of Ethnopharmacology*, 246: 112217. <https://doi.org/10.1016/j.jep.2019.112217>
- Chouvy, PA, Afsahi K 2014, Hashish revival in Morocco. *International Journal of Drug Policy*, 25: 416-23, DOI: 10.1016/j.drugpo.2014.01.001.
- Chouvy, PA, Macfarlane, J 2018, Agricultural innovations in Morocco's cannabis industry. *The International Journal on Drug Policy*, 58: 85-91. DOI: 10.1016/j.drugpo.2018.04.013.
- Corsi, G, Pagni AM 1979, Studi sulla flora e vegetazione del Monte Pisano (Toscana Nord-Occidentale). V. Le piante spontanee nella alimentazione popolare. *Atti della Società Toscana di Scienze Naturali, Memorie, Serie B* 86: 79-201 (In Italian).
- Dal Cero, M, Saller, R, Weckerle, CS 2014, The use of the local flora in Switzerland: a comparison of past and recent medicinal plant knowledge. *Journal of Ethnopharmacology*, 192: 28–47.
- Datir, SS, Bhole, SJ 2017, Biotechnological approaches for conservation and sustainable supply of medicinal plants. In: S. Bhole, K. Marimuthu, M. Ravichandran. (Eds.). *Biotechnology for Sustainability Achievements, Challenges and Perspectives*. AIMST University, Malaysia. pp: 117-128
- De Vos, P 2010, European Materia Medica in Historical Texts: Longevity of a tradition and implications for future use. Published in final edited form as: *Journal of Ethnopharmacology*, 132: 28–47. DOI: 10.1016/j.jep.2010.05.035.
- Diallo, D 2000, *Ethnopharmacological survey of medicinal plants in Mali and phytochemical study of four of Them: Glinus oppositifolius (Aizoaceae), Diospyros abyssinica (Ebenaceae), Entada africana (Mimosaceae), Trichilia emetica (Meliaceae)*. PhD Dissertation, Faculty of Sciences, University of Lausanne, Switzerland, 221 p.
- El-Gharbaoui, A, Benítez, G, González-Tejero, MR, Molero-Mesa, J, Merzouki, A 2017, Comparison of Lamiaceae medicinal uses in eastern Morocco and eastern Andalusia and in Ibn al-Baytar's Compendium of Simple Medicaments (13<sup>th</sup> century CE). *Journal of Ethnopharmacology*, 202: 208-224.
- El Haouari, M, El Makaoui, S, Jnah, M, Haddaouy, A, 2018, A survey of medicinal plants used by herbalists in Taza (Northern Morocco) to manage various ailments. *Journal of Material Environmental Science*, 9: 1875-1888.

- Endicott, KM, Welsch, RL 2003, Taking sides, clashing views on controversial issues in anthropology, 2<sup>nd</sup> Ed. McGraw-Hill/Dushkin, USA, 416 p. ISBN-13: 978-0073043968.
- Etkin, NL 2006, Edible medicines: An ethnopharmacology of food. Tucson: University of Arizona Press. Tucson, USA, 301 p.
- Etkin, A, Egner, T, Kalisch, R 2011, Emotional processing in anterior cingulate and medial prefrontal cortex. *Journal Trends in Cognitive Sciences*, 15: 85-93.
- Fabricant, DS, Farnsworth, NR 2001, The value of plants used in traditional medicine for drug discovery. *Environmental Health Perspective*, 109 (Suppl. 1): 69-75
- Farnsworth, NR, Akerele, O, Bingel, AS, Soejarto, DD, Guo Z 1985, Medicinal plants in therapy. *Bulletin of World Health Organization*, 63: 965-981.
- Frei, B, Heinrich, MM, Bork P, Herrmann D, Jaki, B, Kato, T, Kuhnt, M, Schmitt, J, Schühly, W, Volken, C, Sticher, O 1998, Multiple screening of medicinal plants from Oaxaca, Mexico: *Ethnobotany and Bioassays as a Basis for Phytochemical Investigation*, 5: 177-186.
- Ford, RI 1979, Paleoethnobotany in American archaeology. *Advances in Archaeological Method and Theory*, 2: 285-336.
- Ganesan, A 2008, The impact of natural products upon modern drug discovery. *Current Opinion in Chemical Biology*, 12: 306-317. DOI: 10.1016/j.cbpa.2008.03.016.
- Ginzburg, C 1990, Hexensabbat – Etfzifferung einer naechtlischen Geschichte. (Original Title: Storia notturna. Una decifrazione del sabba. Giulio Einaudi editore S.p.A. Torino, 1989). Berlin: Verlag Klaus Wagenbach, 319 p. (In Germany).
- Gonzalez-Tejero, MR, Casares-Porcel, M, Sanchez-Rojas, CP, Ramiro-Gutierrez, JM, Molero-Mesa, J, Pieroni, A, Giusti, ME, Censorii, E, de Pasquale, C, Della, A, Paraskeva-Hadjichambi, D, Hadjichambis, A, Houmani, Z, El-Demerdash, M, El-Zayatf, M, Hmamouchi, M, El Johrig, S 2008, Medicinal plants in the Mediterranean area: synthesis of the results of the project Rubia. *Journal of Ethnopharmacology*, 116: 341–357.
- Guarrera, PM 2003, Food medicine and minor nourishment in the folk traditions of Central Italy (Marche, Abruzzo and Latium). *Fitoterapia*, 74: 515–544.
- Harshberger, JW 1896, The purposes of ethnobotany. *Botanical Gazette*, 21: 146–154.
- Harvey, AL 2008, Natural products in drug discovery. *Drug Discovery Today*, 13: 894-901. DOI: 10.1016/j.drudis. 07.004
- Heinrich, M 2010, Ethnopharmacology in the 21<sup>st</sup> century-grand challenges. *Frontiers in Pharmacology*, 1: 8.
- Heinrich, M, Kufer, J, Leonti, M, Pardo-de-Santayana, M 2006, Ethnobotany and ethnopharmacology, interdisciplinary links with the historical sciences. *Journal of Ethnopharmacology*, 107: 157–160.
- Heinrich, M 2000, Ethnobotany and its role in drug development. *Phytotherapy Research*, 14: 479–488.
- Huang, H 2011, Plant diversity and conservation in China: planning a strategic bioresource for a sustainable future. *Botanical Journal of the Linnean Society*, 166: 282-300.
- Jiofack, T, Fokunang, C, Guedje NM, Kemeuze, V, Fongnzossie, E, Nkongmeneck, BA, Mapongmetsem, PM, Tsabang, N 2010, Ethnobotanical uses of medicinal plants of two ethnoecological regions of Cameroon. *International Journal of Medicine and Medical Sciences*, 2: 60-79.
- Johns, T, Kokwaro, J, Kimanani, EK 1990, Herbal remedies of the Luo of Siaya District. Kenya: Establishing quantitative criteria for consensus. *Economic Botany*, 44: 369-381.
- Johns, T 1996, The origins of human diet and medicine. Tucson: University of Arizona Press, 376 p.
- Hamilton, A 2003, Medicinal plants conservation and livelihoods. *Journal of Biodiversity and Conservation*, 13: 1477–1517.
- Lardos, A 2006, The botanical *Materia medica* of the Iatrosophikon - A collection of prescriptions from a monastery in Cyprus. *Journal of Ethnopharmacology*, 104: 387–406.
- Lardos, A, Heinrich, M 2013, Continuity and change in medicinal plant use: the ex- ample of monasteries on Cyprus and historical iatrosophia texts. *Journal of Ethnopharmacology*, 150: 202–214.
- Leonti, M 2011, The future is written: impact of scripts on the cognition, selection, knowledge and transmission of medicinal plant use and its implications for ethnobotany and ethnopharmacology. *Journal of Ethnopharmacology*, 134: 542–555.
- Leonti, M, Cabras, S, Weckerle, CS, Solinas, MN, Casu, L 2010, The causal dependence of present plant



- knowledge on herbals - contemporary medicinal plant use in Campania (Italy) compared to Matthioli (1568). *Journal of Ethnopharmacology*, 130: 379–391.
- Leonti, M, Sticher, O, Heinrich, M 2002, Medicinal plants of the Popoluca, México: organoleptic properties as indigenous selection criteria. *Journal of Ethnopharmacology*, 81: 307-315.
- Limem-Ben, Amor I, Boubaker, J, Ben Sgaier, M, Skandrani, I, Bhourri, W, Neffati, A, Kilani, S, Bouhlel I, Ghedira, K, Chekir-Ghedira, L 2009, Phytochemistry and biological activities of *Phlomis* species. *Journal of Ethnopharmacology*, 125: 183-202.
- Matu, EN, vanStaden, J 2003, Antibacterial and anti-inflammatory activities of some plants used for medicinal purposes in Kenya. *Journal of Ethnopharmacology*, 87: 35–41.
- Mandal, V, Gopal, V, Mandal, SC 2012, An inside to the better understanding of the ethnobotanical route to drug discovery – the need of the hour. *Natural Product Communication*, 7: 1551–1554.
- Meklach, Y, Haluza-Delay, R, Kadiri, M, El Ouahrani, A, Molero Mesa, J, Merzouki, A 2017, Cannabis cultivation within a religious context: A case study of Ghomara in the Rif Mountain (Northern Morocco). *Journal of ethnicity in substance abuse*, 18: 45-66. DOI: 10.1080/15332640.2017.1300972.
- Merzouki, A 2001, El cultivo del cáñamo (*Cannabis sativa* L.) en el Rif (Norte de Marruecos). Taxonomía. Biología y Etnobotánica. PhD Dissertation, Universidad de Granada. 217 p. (In Spanish).
- Merzouki, A, Ed-Derfoufi, F, Molero Mesa, J 2000, Contribution to the knowledge of Rifian traditional medicine. II: Folk medicine in Ksar Lakbir district (NW Morocco). *Fitoterapia*, 71: 278-307.
- Merzouki, A, Ed-Derfoufi, F, El Aallali, A, Molero-Mesa, J 1997, Wild medicinal plants used by local Bouhmed population (Morocco). *Fitoterapia*. Vol. LXVIII, No. 5: 444-460.
- Nadembega, P, Boussim, JI, Nikiema, JB, Poli, F, Antognoni, F 2011, Medicinal plants in Baskoure, Kourittenga Province, Burkina Faso: an ethnobotanical study. *Journal of Ethnopharmacology*, 133: 378–395, DOI: 10.1016/j.jep.2010.10.010.
- Nolan, JM 1998, The roots of tradition: social ecology, cultural geography, and medicinal plant knowledge in the Ozark – Ouachita Highlands. *Journal of Ethnobiology*, 18: 249 - 269.
- Nolan, JM, Turner, NJ 2011, Ethnobotany: The study of people–plant relationships. *Ethnobiology*. Wiley-Blackwell. Published by John Wiley & Sons, Inc. *Journal of Ethnobiology*, pp. 133-147
- Pieroni, A, Price, LL 2006, Eating and healing traditional food as medicine. Binghamton (NY): Haworth Press. 432 p. ISBN 9781560229834
- Quave, C, Pieroni, A 2007, Traditional health care and food and medicinal plant use among historic Albanian migrants and Italians in Lucania, Southern Italy. In: A, Pieroni, I, Vandebroek, Eds. *Traveling cultures and plants: the ethnobiology and ethnopharmacy of human migrations*. New York: Berghahn Books. pp. 204 - 226.
- Rafieian-Kopaei, M 2012, Medicinal plants and the human needs. *Journal of Herbal Medicine and Pharmacology*, 1: 1-2.
- Redouan, FZ, Benitez, G, Bouhbal, M, Picone, RM, Crisafulli, A, Cheikh, A, Ben Driss, A, Kadiri, M, Molero Messa, J, Merzouki, A 2020, Traditional medicinal knowledge of Apiaceae at Talassemtane National Park (Northern Morocco). *South African Journal of Botany*, 131: 118-130.
- Riddle, M 1985, *Dioscorides on Pharmacy and Medicine*, Austin, University of Texas Press, 328 p.
- Rivera, D, Obo'n, C, Inocencio, C, Verde, A, Fajardo, J 2006, Gathered Mediterranean food plants-ethnobotanical investigations and historical development. *Forum of Nutrition*, 59: 18-74.
- Robineau, L, Soejarto, DD 1996, *Tramil: A research project on the medicinal plant resources of the Caribbean*. pp. 317-325
- Schultes, RE 1994, The importance of ethnobotany in environmental conservation. *American Journal of Economics and Sociology*, 53: 202-206.
- Staub, PO, Geck, MS, Weckerle, CS, Casu, L, Leonti, M 2015, Classifying diseases and remedies in ethnomedicine and ethnopharmacology. *Journal of Ethnopharmacology*, 174: 514–519.
- Totelin, LMV 2009, Hippocratic recipes. Oral and written transmission of pharmacological knowledge in fifth- and fourth-century Greece. In: G, Scarborough, PJ, Van der Eijk, A, Hanson & N, Siraisi, (Eds.), *Studies in ancient medicine*, Vol. 34. Brill, Leiden, Boston. pp. xviii +366. DOI: <https://doi.org/10.1017/S0075426911000504>
- Touwaide, A 2010, History of botany as ethnobotany? Proposals toward a new approach to the ancient legacy. In: Pochettino, M.L., Ladio, A.H., Arenas, P.M. (Eds.), *Tradiciones & Transformaciones en*



- Etnobotànica ICEB-2009. San Salvador de Jujuy (Argentina). Red Iberoamericana de Saberes y Prácticas Locales sobre el Entorno Vegetal, pp. 55-63.
- Touwaide, A, Appetiti, E 2013, Knowledge of eastern *Materia Medica* (Indian and Chinese) in pre-modern Mediterranean medical traditions: a study in comparative historical ethnopharmacology. *Journal of Ethnopharmacology*, 148: 361-378.
- Van Wyk, B-E, Oudtshoorn, BV, Gericke, N 1997, Medicinal plants of South Africa. Johannesburg: Briza. 304 P.
- Volpato, G, Emhamed, AA, Saleh, SM, Broglia, A, Dilello, S. 2007, Procurement of traditional remedies and transmission of medicinal knowledge among Sahrawi people displaced in southwestern Algerian refugee camps. In: A, Pieroni I, Vandebroek, Eds., *Traveling cultures and plants: the ethnobiology and ethnopharmacy of human migrations*, New York: Berghahn Books. pp. 245 - 269.
- Weckerle, CS, de Boer, HJ, Puri, RK, Van Andel, T, Bussmann, RW, Leonti, M 2018, Recommended standards for conducting and reporting ethnopharmacological field studies. *Journal Ethnopharmacology*, 210: 125-132. WHO 2004-2007, Medicines strategy countries at the core world Health Organization, 12 p.
- Yarnell, E, Abascal, K 2002, Dilemmas of traditional botanical research. *HerbalEgram*, 55: 46-54.
- Zarger, RK, Stepp, JR 2004, Persistence of botanical knowledge among Tzeltal Maya children. *Current Anthropology*, 45: 413 - 418.
- Zent, S 1999, The quandary of conserving ethnoecological knowledge: a Piaroa example. In: T, Gragson, B, Lount, Eds., *Ethnoecology: knowledge, resources and rights*. Athens (GA): University of Georgia Press, pp. 90 - 124.

وضعیت و پذیرش گیاهان دارویی توسط جمعیت محلی پارک ملی تالاسمتان (شمال مراکش)  
 فاطیما زهرایی ردوان<sup>۱\*</sup>، گویلرمو بنیتز<sup>۲</sup>، بوپهر ابوبکر<sup>۱</sup>، البکوری باسما<sup>۱</sup>، روزا ماریا پیکونه<sup>۲</sup>، آلساندرو  
 کریسافولی<sup>۲</sup>، عبدنبی بن دریس<sup>۱</sup>، محمد کدیری<sup>۱</sup>، جاکوئین مولرو مسا<sup>۲</sup>، عبدالرحمان مرزوکی<sup>۱</sup>

۱- تحقیقات فلور گیاهی، گروه بوتانی نژادی و داروشناسی نژادی، آزمایشگاه بوتانی کاربردی، گروه زیست شناسی، دانشکده علوم، یو آی ای، تتوان، مراکش

۲- گروه چی بیوفارم، دانشگاه دگلی استودی، مسینا، ایتالیا

۳- اف.وی.ای، بوتانیکا، دانشکده داروشناسی، کمپ کارتوجا، یو.جی.آر، گرانادا، اسپانیا

(تاریخ دریافت: ۹۸/۰۳/۰۴ تاریخ پذیرش: ۹۸/۰۸/۱۴)

### چکیده

انسان این توانایی را دارد که دانش را به دیگران در طی زمان و مکان از طریق گفتاری یا نوشتاری منتقل کند. فارماکولوژی قومی بر پایه رهیافت‌هایی از علوم اجتماعی فرهنگی و طبیعی است. تحقیق قومی بوستانی در پارک ملی تالاسمتان انجام شد تا چشم‌اندازی برای پایه و اساس مطالعات مقایسه‌ای با مناطق آندولسی و سیسیلی ایجاد شود. هدف از این مطالعه تجزیه و تحلیل اطلاعات با توجه به نظر مصاحبه شونده‌گان (اجتماعی - جمعیتی)، وضعیت گیاهان دارویی، پذیرش آنها توسط ساکنان شمال مراکش، اطمینان به خواص این گیاهان، حفظ میراث داروهای سنتی در پارک ملی تالاسمتان بود. این مطالعه طی سه سال از ۲۰۱۴ تا ۲۰۱۷ انجام شد. در مجموع ۲۰۰ نفر مصاحبه شدند تا اطلاعات بوستانی قومی و داروشناسی قومی جمعیت محلی مشخص شود. اطلاعات با استفاده از مصاحبه‌های پایان‌پذیر نیمه‌ساختاری جمع‌آوری شد و به دنبال آن تجزیه و تحلیل اطلاعات مربوط به مصاحبه شونده‌ها (اجتماعی - جمعیتی)، و اطلاعات بوستانی قومی و داروشناسی قومی صورت گرفت. در این مطالعه ۱۵۲ گیاه دارویی متعلق به ۴۴ خانواده شناسایی شد. مهمترین خانواده آپیاسه آ بود و ۳۱ گونه را در بر می‌گرفت. ما ۵۶۷ علامت و بیماری را از ۱۵۲ تاکسا متعلق به ۴۴ خانواده شناسایی کردیم و در مجموع ۹۴۰۲ گزارش استفاده به دست آمد. آنها برای درمان ۱۲۳ بیماری یا علامت متعلق به ۱۵ گروه آسیب‌شناسی (با توجه به طبقه بندی بیماری ICPC-2) مصرف می‌شدند. با توجه به بیماری‌ها مهمترین گروه آسیب‌شناسی مورد درمان بیماری‌های گوارشی (دی. ۲۴٪) بود. نتایج نشان داد که ۵۰٪ مصاحبه شونده‌گان هنوز استفاده از داروهای سنتی را برای مراقبت بهداشتی روزانه خود ترجیح می‌دهند و بخشی از آنها هم این داروها را به همراه داروهای متداول مصرف می‌کنند. تجزیه و تحلیل داده‌ها به ما امکان داد که تا متداول‌ترین گیاهان دارویی را در پارک ملی شناسایی کنیم. اطلاعات گزارش شده در این مطالعه پایه‌ای است در خصوص فلور گیاهان دارویی سنتی و همچنین ارزش اضافی دیگری برای به تصویر کشیدن پارک ملی تالاسمتان فراهم می‌کند.

\*مؤلف مسئول

### Bibliographic information of this paper for citing:

Zahrae Redouan, F, Benitez, G, Aboubakr, B, Bakkouri Bassma, E, Maria Picone, R, Crisafulli, A, Ben Driss, A, Kadiri, M, Molero Messa, J, Merzouki, A 2020, The status and perception of medicinal plants by local population of Talassemtane National Park (Northern Morocco). Caspian Journal of Environmental Sciences, 18: 131-147

Copyright © 2020