Ethnopharmacological preparations used for digestive system disorders by the population in Talassemtane National Park (North of Morocco)

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Research

Abstract

Background: The present ethnobotanical-ethnopharmacological study of plants used to treat ailments of the digestive system was carried out in the north of Morocco. The study aims to collect data on the plants used, their vernacular names, the parts used, and their modes of preparation and administration.

Methods: Surveys and interviews were carried between 2014 and 2017 in Talassemtane National Park, North of Morocco. Data were collected through open semi structured interviews with the informants. A sample of 200 people aged from 20 to 60 years, including 24 herbalists and 28 traditional healers were included.

Results: We identified 96 taxa belonging to 33 botanical families. With a total of 3270 use reports, we have identified 20 medicinal uses to treat 174 conditions or symptoms classified in digestive diseases according to the international classification of primary care (ICPC-2). The main families used in this pathological group are: Lamiaceae (24 species), Asteraceae (13 species), Apiaceae (11 species), Fabaceae (8 species). Most remedies are prepared as a decoction (48%), the most used parts of the plant are: leaves (29%), fruits (16%), seeds (11%) and the most common mode of administration is oral (84%).

Conclusion: Knowledge of medicinal plants used to treat acute digestive system problems was common. All the local population used medicinal plants as a first choice to deal with the illness. This study represents a useful inventory to preserve and spread this knowledge.

Keywords: Ethnobotanical survey; Digestive system problems; Medicinal plants; Talassemtane National Park.

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Background

In recent decades, there has been an increasing interest in the study of medicinal plants and their traditional use in different regions of the world (de Albuquerque & Hanazaki 2009, Muthu *et al.* 2006, Thirumalai *et al.* 2009). Ethnobotanical research was primarily an investigation of plants used by indigenous peoples (Heinrich *et al.* 2006, Leonti *et al.* 2009; Leonti *et al.* 2010, de Vos 2010, Leonti 2011, Staub *et al.* 2016, van Andel *et al.* 2018, Rivera *et al.* 2017, 2019). The World Health Organization is strongly interested in documenting the use of medicinal plants by indigenous people in different countries of the world (Buragohain 2011, Choudhary *et al.* 2008).

Ethnobotanical studies often report the most important plant families based on a simple count of species used as medicines (Colombo *et al.* 2012, McClatchey *et al.* 2009, Weckerle 2012).

At the beginning of the 20th century, the field of ethnobotany experienced a shift from the crude compilation of data to greater methodological efficiency and conceptual reorientation (Cotton 1996). It also marks the beginning of the academic ethnobotany, which has proven to be one of the most reliable approaches for the discovery of new active ingredients as well as the discovery of new pharmacological properties (Choudhary *et al.* 2008, Heinrich & Bremner 2006, Leonti *et al.* 2015, Pieroni 2017, Ritter *et al.* 2015, Totelin 2016).

Less than 10% of the species has been evaluated for potential biological activity, many have reportedly been scientifically studied for their pharmacological properties, originating over 50% of all pharmaceutical drugs dates to ethnomedicine (Anthony *et al.* 2005, Diallo 2002, Van Wyk *et al.* 1997). As part of the enhancement of traditional medicine, there has been growing interest in recent decades in the study of medicinal plants, and their traditional uses in different regions of the world (De Vos 2010, Heinrich *et al.* 2005, Heinrich *et al.* 2006, Leonti 2011, Leonti *et al.* 2015, Pieroni *et al.* 2013, Ritter *et al.* 2015, Totelin 2016, Touwaide & Appetiti 2013, Touwaide 2010, Pieroni 2017). The field of ethnobotany requires a variety of skills, mainly: botanical training for the identification and preservation of plant specimens; anthropological training to understand cultural concepts around the perception of plants; language training, at least sufficient to transcribe local terms and understand the mother tongue morphology, syntax and semantics (Choudhary *et al.* 2008). However, it is necessary to clarify that ethnopharmacology is currently considered to be a well-established scientific discipline, consisting in the study of the phytochemical properties of any preparation used by man, which presents, like official medicine, to both advantages and disadvantages (Heinrich 2014, Guedje *et al.* 2010).

The use of herbal remedies as an adjuvant or alternative to conventional medicine is also increasingly popular around the world. According to the World Health Organization (WHO), nearly 80% of populations depend on traditional medicine for primary health care (Balick & Cox 1997, de Sliva 1997, Islam 2006, Lewu & Afolayan 2009, Mukherjee & Wahil 2006, WHO 2013).

There are many disorders of the digestive system, which have a considerable influence on morbidity and mortality rates around the world. The World Health Organization (WHO 2014) has reported that disorders of the digestive system, particularly Diarrheal disease, kills an estimated 1.5 million children each year and is the second leading cause of death in children under 5 years (Wardlaw *et al.* 2010, WHO 2017). The considerable economic benefits in the development of traditional medicine and in the use of medicinal plants, hence the need to promote this sector (Muthu *et al.* 2006).

Ethnobotanical knowledge is transmitted verbally from generation to generation and most of this knowledge has not been formally documented (Nadembega *et al.* 2011, Asase *et al.* 2008, Leonti 2011, Touwaide & Appetiti 2013). The loss of this rich knowledge on medical treatment through natural ways is due to the decreased interest of the younger generations in traditional herbal therapies, and the migration of therapists to other jobs (Kadir *et al.* 2013). On the other hand, ethnobotanical research has aroused the interest of the scientific community. There has been a worldwide tendency to renew interest in a traditional system of treatments (Balick 1996, Bellakhdar 2006, Leonti, 2011, Heinrich 2000, Henrich *et al.* 2006, Rivera *et al.* 1995, 2014).

Morocco has a rich indigenous population who preserve traditional knowledge of medicinal plants used in the treatment of diseases. Studies on several medicinal plants have been carried out in different floristic regions of Morocco (Merzouki *et al.* 1997, 2000, 2003, Teixidor-Toneu *et al.* 2016, Redouan *et al.* 2020a, 2020b, Yebouk *et al.* 2020). Traditional medicine in Morocco is the result of the intersection of Berber and Arab-Islamic civilizations. This heritage is based on Berber and Arab-Muslim knowledge, which has long aroused the curiosity of Moroccan and Arab ethnobotanists (Bellakhdar 1992, 1997, Dâûd al-Antaki 1592, Ibn Al Baytar 1992, Merzouki *et al.* 1997).

The Talassemtane National Park (PNTLS), located in northern Morocco, is considered the most original ecological entity in the Rif chain (Aafi 1995, Benabid 2000). Plants of ethnobotanical interest occupy a large place among these natural resources and also play a large role in the national and eventually regional economy (Bellakhdar 1997, 2006, 1978, Eddouks *et al.* 2017, El Alami *et al.* 2016, El-Gharbaoui *et al.* 2017, El Hafian *et al.* 2014, El-Hilaly *et al.* 2003, El Rhaffari 2002, El Yahyaoui *et al.* 2015, Fakchich & Elachouri 2014, Hafse *et al.* 2015, Jouad *et al.* 2001, Hmamouchi *et al.* 2012, Hachi *et al.* 2015, Merzouki *et al.* 1997, 2000, Ouarghidi *et al.* 2013, Rhafouri et *al.*, 2015, Tahraoui *et al.* 2007, Teixidor-Toneu *et al.* 2016, Zerkani *et al.* 2015). These plants are increasingly used in different fields: food, food industry, cannery, pharmacy, herbal medicine, fibers / textiles, construction, fuelwood etc.

The aim of this study is to document traditional herbal remedies that are used by the local population of PNTLS for the treatment of digestive disorders. Indigenous people of this biodiversity hotspot region of Morocco (Rif) usually inhabit the mountainous areas which are rich with medicinal plants flora (Benabid 2000). As a result, they have accumulated rich experience in disease prevention and treatment by herbal remedies, and they have developed distinctive knowledge of traditional medicine. In this study, we establish for each disease the different medicinal plants used by the local population at PNTLS.

Material and Methods

Study area

Data were collected in PNTLS (35° 14′ N, 5° 08′ O), Northern Morocco (Figure 1). PNTLS is surrounded by mountain ranges of Rif and covers an area of approximately 60,000 ha. It was created as a botanical reserve in 1972, then considered as a National Park in 1995, and officially established in November 2004. The PNTLS 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 road joining Assifane to the main road to Bab Taza, and to the west by douar Benizid, Ain Tissimlane, Tarhzoute, Jble Sidi Salah, and Tamalout. The villagers get their source of income through the sale of forest products, livestock, production of fruit trees, beekeeping and as workers in the agriculture sector. Their socioeconomic status is generally based on cannabis cultivation for self-consumption and ritual purposes. The traditional agro-systems are thus being increasingly abandoned and are now being replaced by cannabis crops (Afsahi 2015, Chouvy & Afsahi 2014, Chouvy & Macfarlane 2018, Meklach *et al.* 2017).

Ethnobotanical data collection

During many field trips to the PNTLS between 2014 and 2017, an ethnobotanical study of the flora was conducted based on the knowledge of the local population about these plants, for collecting plants and associated ethnomedicinal information relating to digestive system disorders from population of PNTLS. The field survey is based on the previous findings of our research team (Benitez *et al.* 2021, El-Gharbaoui *et al.* 2017, Merzouki *et al.* 1997, 2000, 2003, Redouan, *et al.* 2020a, 2020b, and Yebouk, *et al.* 2020), taking into consideration the recommended standards for ethnopharmacological field studies (Weckerle *et al.* 2018). Initial contacts were made with the director of the PNTLS, to whom we explained the purpose and techniques of the proposed research. 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 (sociodemographic) and the ethnobotanical or ethno-pharmacological data (as described in Merzouki *et al.* 1997, 2000). These questionnaires contained questions about both, the informant (including gender, age, education level, and family situation), and the plant medicinal use (vernacular name, therapeutic use, etc.). Results from the initial analysis of the questionnaires were used to develop open and semi-structured interviews with the informants (Cotton 1996, Martin 2004). Interviews were performed individually with each informant and in the field, in Arabic local dialects (*darija).* Through these interviews, information on informants knowledge about medicinal plants were collected. The gathered information included plant local name, parts of the plant used, preparation methods, intake modes, and conditions or symptoms treated. Voucher specimens was also collected during the fieldwork with our informants or from their prior own collections.

The plant samples were identified, authenticated and deposited at Abdelmalek Essaâdi University Herbarium (TMP), Voucher numbers for the included plants are provided in the results section. For each plant sample, a specific code was given (e.g.," TMP-B001", as the international herbarium code for this herbarium is TMP-B). Vernacular names were included as our informants in both Arabic and Roman alphabets referred them. For the transliteration of the vernacular names from Arabic into the Roman alphabet, we followed Bellakhdar (1997). All scientific names were reviewed and updated using the plant list website (www.theplantlist.org, Rivera *et al.* 2014). The WHO international classifications of diseases (ICPC-2, International Classification of Primary Care 2015; Staub *et al.* 2015).

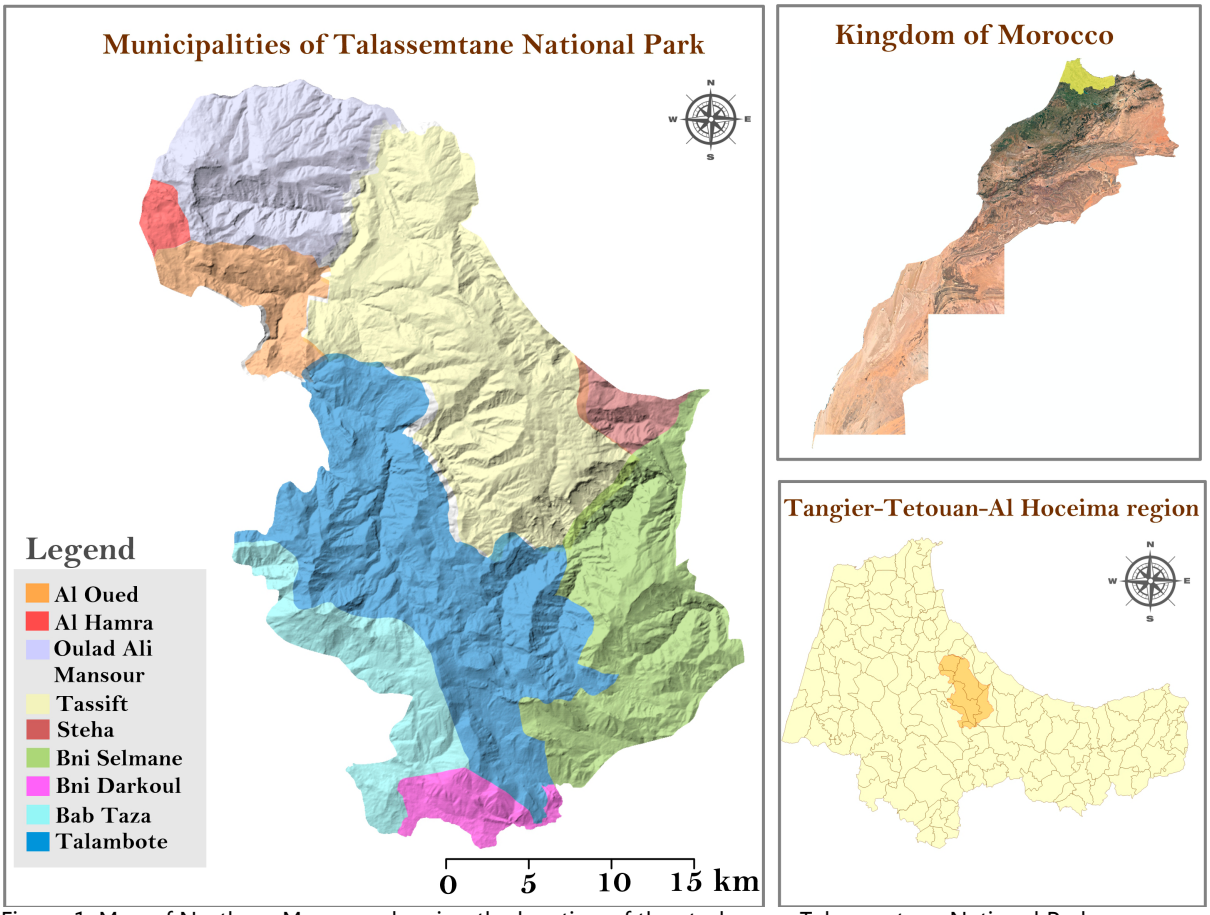

Figure 1. Map of Northern Morocco showing the location of the study area, Talassemtane National Park

Classification of Diseases of the Digestive System

According to the International Classification of Primary Care 2015 (ICPC-2), the digestive group contains 58 symptoms and conditions (Staub *et al.* 2015). Diseases of the digestive system form a set of acute and chronic conditions which vary in terms of natural history, risk and prognosis factors that may affect the digestive tract (from the oral cavity to the rectum), as well as the liver, and bile ducts (Neamsuvan *et al.* 2012, Gajamer & Tiwari 2014). These disorders can be caused by bacteria, viruses, parasitic organisms (e.g., protozoa and intestinal worms), and even fungi (Mathabe *et al.* 2006, Karki & Tiwari 2007, Kaushal *et al.* 2012).

Data analysis

A database on MySQL and Microsoft Excel was developed using the obtained information. The consistency of the information was checked according to the data comparison technique of El-Gharbaoui *et al.* 2017. The total numbers of use reports (UR, Weckerle *et al.* 2018) was calculates the total uses for the species by all informants within each use-category for that species (Prance *et al.* 1987). Nevertheless, some indexes were also calculated to know the extension of the knowledge of the medicinal plants and their uses, as well as for an easy numerical comparison with other studied territories within our research group. The following indices were calculated: Medicinal Plant Knowledge index (MPKi), the Medicinal Plant Use index (MPUi) and the Confidence level (Cl, measured as MPUi/MPKi) was also calculated for each plant species (Merzouki *et al.* 2000) using following formulae:

MPKi (%) = (Ik / N) × 100
MPUi (%) = (IU / N) × 100
Cl = MPUi / MPKi

Where Ik is the number of informants who cited the plant; IU is the number of interviewers who reported the use of a specific medicinal plant in each pathological category; and N is the total number of interviewers.

Results and Discussion

Demography of informants

A total of 200 informants were interviewed. Out of these, 113 (56.5%) were male and 87 (43.5%) were female (Redouan *et al.* 2020b). The informants were categorized into four different age groups, Status and education as documented in Table 1. In this survey we have (43.5%) women who use medicinal plants, this rate is due to the availability of women, they are more often at home during the hours of the survey. The results of other surveys reported contrary findings in many regions of Morocco and have showed that generally women used medicinal plants more than men (Hamdani 1984, El Beghdadi 1991, Jouad 1992, Nabih 1992, Ziyyat *et al.* 1997, Jouad *et al.* 2001, El-Hilaly *et al.* 2003, Tahraoui *et al.* 2006).

Table 1. Demographic and socio-educational features of the interviewees(Redouan *et al.* 2020b)

	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

Medicinal plants and traditional uses

A total of 96 ethnomedicinal species in 33 families were recorded as being used by the PNTLS in treating different types of digestive system disorders (Table 2). The list of the species, sorted in alphabetical order, is presented in Table 2 detailing their family, the local vernacular names, treated diseases and symptoms (with the ICPC-2 code), part used, mode of preparation, and mode of administration, use report (UR), the Medicinal Plant Knowledge index (MPKi), the Medicinal Plant Use index (MPUi) and the Confidence level (Cl).

The reported plant families include: Lamiaceae (24 species), Asteraceae (13 species), Apiaceae (11 species), Fabaceae (8 species), Polygonaceae (4 species), Oleaceae and Rosaceae (3 species each), Amaryllidaceae, Euphorbiaceae, Fagaceae and Myrtaceae (2 species each), Anacardiaceae, Apocynaceae, Arecaceae, Boraginaceae, Cactaceae, Chenopdiaceae, Cistaceae, Cupresaceae, Ericaceae, Gentianaceae, Iridaceae, Juglandaceae, Laureaceae, Pteridaceae, Punicaceae, Ranunculaceae, Rutaceae, Thymelaeaceae, Ulmaceae, Verbenaceae, Vitaceae, and Zingiberaceae (1 species each) (Figure 2).

The prominence of Lamiaceae, Asteraceae and Apiaceae is possibly due to their chemical compositions. The Lamiaceae family is characterized by a high variety of phenolic compounds in addition to polyphenols, tannins, iridoids, quinones, coumarins, diterpenoids, triterpenoids, saponins and, in some cases, pyridine and pyrrolidine alkaloids (Evans 1996, Cimanga *et al.* 2002, Lamiri *et al.* 2001). The Apiaceae family includes (furano-) coumarins (responsible for phototoxic effects), polyacetylens (Heinrich *et al.* 2012) and, in several species, alkaloids, triterpenoid saponins and is rich in petroselinic acid (Bruneton 2009, Kleiman and Spencer 1982). The Asteraceae family is characterized by the presence of active secondary metabolites, such as chlorogenic acid, flavonoids, pentacyclic triterpene alcohols, terpenoid essential oils, alkaloids, a variety of fatty acids in the seeds, tannins, iridoids and polyacetylenes (Stevens 2018, Yaoita *et al.* 2012, Konovalov 2014). Lamiaceae it is the most important family for different circum-Mediterranean areas studied comparatively (González-Tejero *et al.* 2008, Benítez *et al.* 2012, Heinrich 1992, Bouyahya *et al.* 2017, Eddouks *et al.* 2002, Eddouks *et al.* 2017, El Hilah *et al.* 2015, Fakchich & Elachouri 2014, Ouakrouch *et al.* 2015, Tahraoui *et al.* 2007).

Table 2. List of 96 medicinal plants used in the PNTLS with local names, treated diseases, used parts, modes of preparation and administration, use reports, Knowledge index (MPKi), the use index (MPUi), and the confidence level index.

Species	Local Names In Arabic & Roman Alphabets	Part used	Modes of preparation	Condition & Symptoms	Mode of administration	UR	MPUi %	MPKi %	CI
Adiantum capillus-veneris L. (Pteridaceae) TMP-B172	Chaâr شعر الغول، قزبور البئر lghol, kuzbur lbir	Aerial part	Decoction	Abdominal pain epigastric D02	Oral	12	18,5	37,3	0,50
Ajuga chamaepitys L. Schreb. (Lamiaceae) TMP-B111	Sendgûra شندكورة	Whole plant	Decoction	Abdominal pain/cramps general D01	Oral	22	25,2	62,5	0,40
		Leaves	Decoction	Abdominal pain epigastric D02	Oral	22			
		Whole plant	Decoction	Dyspepsia/indigestion D07	Oral	22			
Ajuga iva (L.) Schreb. (Lamiaceae) TMP-B112	Sendgûra شندكورة	Whole plant	Decoction	Dyspepsia/indigestion D07	Oral	22	18,3	43,5	0,42
		Whole plant	Decoction	Stomach function disorder D87	Oral	22			
Aloysia citrodora Palau (Verbenaceae) TMP-B165	Lwiza لويزة	Leaves	Infusion	Dyspepsia/indigestion D07	Oral	47	100	100	1,00
		Leaves	Infusion	Flatulence/gas/belching D08	Oral	47			
Allium cepa L. (Amaryllidaceae) TMP-B168	Bassla بصلة	Bulb	Mashed	Abdominal pain epigastric D02	Oral	12	100	100	1,00
		Bulb	Mashed	Dyspepsia/indigestion D07	Oral	10			
		Bulb	Mashed	Vomiting D10	Oral	6			
		Bulb	Mashed	Teeth/gum symptom/complaint D19	Cataplasm	4			
Allium sativum L. (Amaryllidaceae) TMP-B169	Thouma التومة	Bulb	Cooked	Abdominal pain epigastric D02	Oral	16	100	100	1,00
		Bulb	Cooked	Diarrhea D11	Oral	11			
		Bulb	Decoction	Teeth/gum symptom/complaint D19	Gargle	4			
Alkanna tinctoria L. (Boraginaceae) TMP-B080	Hourraisha الحريشة الملسة elmalsa	Aerial part	Decoction	Abdominal pain epigastric D02	Oral	16	25,2	45,5	0,55
		Aerial part	Decoction	Constipation D12	Oral	18			
Ammi majus L. (Apiaceae) TMP-B001	Atrillal اتريلا ل	Fruits	Decoction	Dyspepsia/indigestion D07	Oral	15	60	92,5	0,65
		Fruits	Decoction	Flatulence/gas/belching D08	Oral	27			
Ammi visnaga (L.) Lam. (Apiaceae) TMP-B002	Bùchenikha البشنيخة	Fruits	Decoction	Teeth/gum symptom/complaint D19	Oral	64	52,1	96,6	0,54
		Fruits	Decoction	Mouth/tongue/lip symptom D20	Gargle	69			
		Fruits	Powder with water	Mouth/tongue/lip disease D83	Gargle	78			

Anacyclus pyrethrum L. Link (Asteraceae) TMP-B059	Oud el atass عود العطاس	Roots	Decoction	Teeth/gum symptom/complaint D19	Gargle	9	13,4	48	0,28
		Roots	Decoction	Liver disease NOS D97	Oral	7			
Anagyris foetida L. (Fabaceae) TMP-B095	Foul , فول الديب, خروب الخنزير eddib, harrub l-hanzir	Seeds	Decoction	Constipation D12	Oral	7	25,8	50	0,52
Arbutus unedo L. (Ericaceae) TMP-B091	Boukhanno بوخنو، سسنو، اسنو sesnou, asennu	Fruits	Fresh	Diarrhea D11	Oral	4	60	82,2	0,73
Artemisia absinthium L. (Asteraceae) TMP-B060	Chiba الشيبة	Aerial part	Infusion	Worms/other parasites D96	Oral	8	80,5	100	0,81
		Aerial part	Infusion	Dyspepsia/indigestion D07	Oral	18			
Carthamus tinctorius L. (Asteraceae) TMP-B063	Chouka -El الشوكة - العصفر ûsfar	Flowers	Decoction	Constipation D12	Oral	10	12,5	30,6	0,41
Chamaerops humilis L. (Arecaceae) TMP-B057	Doum الدوم	Fruits	Fresh	Abdominal pain epigastric D02	Oral	10	12,5	35	0,36
		Fruits	Fresh	Duodenal ulcer D85	Oral	7			
Celtis australis L. (Ulmaceae) TMP-B163	Tagzaz تكزاز	Fruits	Fresh	Diarrhea D11	Oral	11	12,5	27,3	0,46
Centaurea pullata L. (Asteraceae) (TMP-B065)	Laltha لتهة	Roots	Infusion	Abdominal pain epigastric D02	Oral	13	18	35,3	0,51
Centaurea acaulis L. (Asteraceae) TMP-B064	Taimart تيمرت	Aerial part	Powder	Worms/other parasites D96	Oral	8	12,7	25,4	0,50
Ceratonia siliqua L. (Fabaceae) TMP-B096	Slaghwa El - سلاغوة- الخروب Kharroub	Fruits	Decoction	Abdominal pain epigastric D02	Oral	20	38,9	63	0,62
Centaurium erythraea Rafn. (Gentianaceae) TMP-B107	Qussat el haiya قصة الحية	Aerial part	Infusion	Abdominal pain epigastric D02	Oral	10	22,3	85,3	0,26
Chenopodium acuminatum Willd. (Chenopdiaceae) TMP-B088	Mkhinza مخينزة	Whole plant	Decoction	Abdominal pain/cramps general D01	Oral	8	35	52	0,67
Clematis flammula L. (Ranunculaceae) TMP-B150	Annar albarda النار الباردة	Leaves	Decoction	Abdominal pain epigastric D02	Oral	15	16	62	0,26
Cichorium intybus L. (Asteraceae) TMP-B067	Merrar مرار	Leaves	Fresh	Abdominal pain epigastric D02	Oral	9	9,4	16,5	0,57
Cistus albidus L. (Cistaceae) TMP-B089	Shtappa شتبا	Leaves	Infusion	Dyspepsia/indigestion D07	Oral	7	23	45	0,51
Citrus limon (L.) Burm. fil. (Rutaceae) TMP-B160	Laymon el beldi الليمون البلدي	Fruits	Juice	Abdominal pain epigastric D02	Oral	45	71,3	100	0,71
		Fruits	Juice	Dyspepsia/indigestion D07	Oral	45			
Crataegus monogyna Jacq. (Rosaceae) TMP-B155	Admam ادمام	Flowers	Infusion	Diarrhea D11	Oral	6	17,3	34,2	0,51
Crocus sativus L. (Iridaceae) TMP-B108	Zaâfran hurr الزعفران الحر	Styles	Infusion	Dyspepsia/indigestion D07	Oral	15	32	100	0,32
		Styles	Infusion	Liver disease NOS D97	Oral	12			

Cydonia oblonga Mill. (Rosaceae) TMP-B156	Sfarjel سفرجل	Fruits	Fresh	Teeth/gum symptom/complaint D19	Gargle	8	12,3	45	0,27
		Fruits	Cooked	Diarrhoea D11	Oral	10			
		Fruits	Cooked	Abdominal pain epigastric D02	Oral	10			
Daphne gnidium L. (Thymelaeaceae) TMP-B162	Lezzaz-Metnan اللزاز - المتنان	Leaves	Decoction	Teeth/gum symptom/complaint D19	Gargle	12	32,5	68,2	0,48
Daucus muricatus (L.) L. (Apiaceae) TMP-B021	Khizo berri خيزو البري	Roots	Fresh	Abdominal pain epigastric D02	Oral	12	63	100	0,63
Dittrichia viscosa (L.) Greuter (Asteraceae) TMP-B069	Terreklan تركلان	Aerial part	Decoction	Abdominal pain epigastric D02	Oral	9	45,3	58,5	0,77
Eryngium bourgatii Gouan (Apiaceae) TMP-B023	Al chuka zaraka الشوكة الزرقا	Leaves	Infusion	Constipation D12	Oral	11	10,5	13,5	0,78
Eryngium glaciale Boiss. (Apiaceae*)* TMP-B025	Al chuka zaraka الشوكة الزرقا	Roots	Decoction	Constipation D12	Oral	9	9	20,5	0,44
Eryngium huteri Porta (Apiaceae) TMP-B026	Al chuka zaraka الشوكة الزرقا	Roots	Decoction	Constipation D12	Oral	5	5,5	8,5	0,65
Echinops glaberrimus DC. (Asteraceae) TMP-B070	Tasekra تسكر	Roots	Decoction	Abdominal pain epigastric D02	Oral	12	15	28,6	0,52
Foeniculum vulgare Mill. (Apiaceae) TMP-B031	Besbass- البسباس –النافع Annafaâ	Fruits	Decoction	Abdominal pain epigastric D02	Oral	62	70,5	100	0,71
		Fruits	Decoction	Flatulence/gas/belching D08	Oral	52			
		Fruits	Decoction	Dyspepsia/indigestion D07	Oral	20			
		Fruits	Decoction	Mouth/tongue/lip symptom D20	Oral	32			
		Fruits	Decoction	Swallowing problem D21	Oral	54			
		Roots	Decoction	Irritable bowel syndrome D93	Oral	87			
Fraxinus angustifolia Vahl, nom. cons. (Oleaceae) TMP-B141	Dardar الدردار	Seeds	Powder with honey	Liver disease NOS D97	Oral	7	10,5	34	0,31
		Seeds	Powder	Teeth/gum symptom/complaint D19	Gargle	9			
Glycyrrhiza glabra L. (Fabaceae) TMP-B100	Arq as-sûs عرق السوس	Roots	Infusion	Abdominal pain epigastric D02	Oral	17	16	25,4	0,63
		Roots	Infusion	Mouth/tongue/lip symptom D20	Oral	32			
Juglans regia L. (Juglandaceae) TMP-B109	Siwak سواك	Bark of tronc	Decoction	Abdominal pain epigastric D02	Oral	22	58,3	100	0,58
		Bark of tronc	Decoction	Teeth/gum symptom/complaint D19	Gargle	31			

		Bark of tronc	Decoction	Mouth/tongue/lip symptom/complt. D20	Gargle	31			
Kundmannia sicula (L.) DC. (Apiaceae) TMP-B032	Ziyata الزياتة	Roots	Decoction	Abdominal pain epigastric D02	Oral	10	12,7	27,3	0,47
		Roots	Decoction	Irritable bowel syndrome D93	Oral	16			
Lactuca sativa L. (Asteraceae) TMP-B038	Khass خس	Leaves	Fresh	Abdominal pain epigastric D02	Oral	13	100	100	1,00
Lavandula angustifolia Mill. (Lamiaceae) TMP-B115	khzâma الخزامى	Flowery summit	Infusion	Abdominal pain epigastric D02	Oral	29	36,2	86	0,42
		Leaves	Infusion	Teeth/gum symptom/complaint D19	Gargle	6			
Lavandula dentata L. (Lamiaceae*)* TMP-B116	Khzama lbeldiya الخزامى البلدية	Flowery summit	Decoction	Liver disease NOS D97	Oral	12	46,3	72	0,64
		Flowery summit	Decoction	Gastrointestinal infection D70	Oral	8			
Lavandula stoechas L. (Lamiaceae) TMP-B117	Al'halhal الحلحال	Aerial part	Decoction	Dyspepsia/indigestion D07	Oral	23	32,1	69,2	0,46
Laurus nobilis L. (Laureaceae) TMP-B137	Errand الرند	Leaves	Decoction	Dyspepsia/indigestion D07	Oral	24	39,5	85,4	0,46
		Leaves	Decoction	Teeth/gum symptom/complaint D19	Gargle	12			
		Leaves	Decoction	Mouth/tongue/lip symptom/complt. D20	Gargle	12			
Lupinus angustifolius L. (Fabaceae) TMP-B098	Termas الترمس	Seeds	Decoction	Diarrhea D11	Oral	8	20,3	60,1	0,34
		Seeds	Decoction	Worms/other parasites D96	Oral	7			
Matricaria chamomilla L. (Asteraceae) TMP-B074	Mansania منصنية	Leaves	Fresh	Abdominal pain epigastric D02	Oral	13	58,7	90	0,65
Marrubium vulgare L. (Lamiaceae) TMP-B118	Merrîw مرو	Leaves and stems	Decoction	Abdominal pain/cramps general D01	Oral	12	43,5	100	0,44
		Leaves and stems	Decoction	Stomach function disorder D87	Oral	12			
		Whole plant	Fresh	Teeth/gum symptom/complaint D19	Mastication	6			
Melissa officinalis L. (Lamiaceae) TMP-B039	Naânaâ trunji نعناع الترونجي	Whole plant	Infusion	Stomach function disorder D87	Oral	13	51,2	100	0,51
		Whole plant	Infusion	Dyspepsia/indigestion D07	Oral	12			
		Whole plant	Infusion	Abdominal pain/cramps general D01	Oral	12			
		Whole plant	Infusion	Abdominal pain epigastric D02	Oral	16			

Mentha piperita L. (Lamiaceae) TMP-B119	Naânaâ beldi النعناع البلدي	Whole plant	Infusion	Stomach function disorder D87	Oral	13	63	100	0,63
Mentha pulegium L. (Lamiaceae) TMP-B120	Flaio فلايو	Leaves and Stems	Infusion	Dyspepsia/indigestion D07	Oral	22	69	100	0,69
		Leaves and Stems	Infusion	Abdominal pain epigastric D02	Oral	22			
Mentha rotundifolia (L.) Huds. (Lamiaceae) TMP-B121	Mchichtro مششترو	Leaves and Stems	Infusion	Flatulence/gas/belching D08	Oral	13	35,6	72,5	0,49
		Leaves and Stems	Decoction	Abdominal pain epigastric D02	Oral	13			
		Aerial part	Infusion	Dyspepsia/indigestion D07	Oral	13			
Mentha suaveolens Ehrh. (Lamiaceae) TMP-B122	Mchichtro مششترو	Aerial part	Infusion	Abdominal pain epigastric D02	Oral	23	38	74	0,51
Mentha viridis (L.) L. (Lamiaceae) TMP-B123	Naânaâ النعناع	Aerial part	Infusion	Worms/other parasites D96	Oral	21	78,3	100	0,78
Mercurialis annua L. (Euphorbiaceae) TMP-B093	Hourraiqa el malsa حريقة الملسة	Whole plant	Infusion	Constipation D12	Oral	11	35	60,4	0,58
Myrtus communis L. (Myrtaceae) TMP-B140	Arraihan الريحان	Leaves	Decoction	Abdominal pain epigastric D02	Oral	11	48	89,5	0,54
		Leaves	Decoction	Diarrhea D11	Oral	11			
Nerium oleander L. (Apocinaceae) TMP-B055	Ddefla الدفلة	Leaves	Decoction	Teeth/gum symptom/complaint D19	Gargle	7	42	100	0,42
Ocimum basilicum L.(Lamiaceae) TMP-B124	Al'Hbak الحباق	Leaves	Infusion	Dyspepsia/indigestion D07	Oral	21	62,3	100	0,62
		Leaves	Fresh	Mouth/tongue/lip symptom/complt. D20	Mastication	9			
Olea europaea L. (Oleaceae) TMP-B142	Zaitoun الزيتون	Fruits	Oil extraction	Constipation D12	Oral	28	35,8	93	0,38
		Leaves	Decoction	Gastrointestinal infection D70	Oral	28			
Opuntia ficus-indica (L.) Mill. (Cactaceae) TMP-B083	El hindi الهندي	Fruits	Fresh	Abdominal pain epigastric D02	Oral	11	100	100	1,00
		Fruits	Fresh	Diarrhea D11	Oral	20			
Origanum compactum Benth. (Lamiaceae) TMP-B125	Azzaatar الزعتر	Aerial part	Infusion	Abdominal pain epigastric D02	Oral	42	100	100	1,00
		Aerial part	Decoction	Diarrhea D11	Oral	35			
		Aerial part	Infusion	Teeth/gum symptom/complaint D19	Gargle	22			
Origanum elongatum (Bonnet) Emb. & Maire (Lamiaceae) TMP-B127	Zâatar الزعتر	Aerial part	Infusin	Dyspepsia/indigestion D07	Oral	24	100	100	1,00

Origanum majorana L. (Lamiaceae) TMP-B126	Merdeddush مرددوش	Aerial part	Infusion	Abdominal pain epigastric D02	Oral	35	95	100	0,95
Origanum vulgare L. (Lamiaceae) TMP-B128	Assahtar السحتر	Aerial part	Decoction	Abdominal pain epigastric D02	Oral	25	100	100	1,00
		Aerial part	Decoction	Dyspepsia/indigestion D07	Oral	25			
		Aerial part	Infusion	Flatulence/gas/belching D08	Oral	25			
Phillyrea latifolia L. (Oleaceae) TMP-B143	Metwal متوال	Bark of tronc	Decoction	Abdominal pain epigastric D02	Oral	12	8,3	33	0,25
Pistacia lentiscus L. (Anacardiaceae) TMP-B054	Addrou الدرو	Fruits and leaves	Infusion	Abdominal pain epigastric D02	Oral	12	60,2	85,1	0,71
		Leaves	Powder	Constipation D12	Oral	8			
		Leaves	Decoction	Teeth/gum symptom/complaint D19	Gargle	15			
Prunus dulcis (Mill.) D. A. Webb (Rosaceae) TMP-B157	Lawz اللوز	Fruits	Fresh	Diarrhea D11	Oral	9	65,3	100	0,65
Punica granatum L. (Punicaceae) TMP-B149	Errouman الرمان	Bark of Fruits	Decoction	Abdominal pain epigastric D02	Oral	72	37,6	100	0,38
		Bark of Fruits	Decoction	Mouth/tongue/lip symptom/complt. D20	Gargle	13			
Quercus suber L. (Fagaceae) TMP-B106	Edlem- El ballot الدلم -البلوط	Bark of tronc	Powder	Abdominal pain epigastric D02	Oral	17	25,5	62,4	0,41
		Bark of tronc	Powder	Gastrointestinal infection D70	Oral	17			
Quercus rotundifolia Lam. (Fagaceae) TMP-B105	El Jarb الجرب	Bark of tronc	Decoction	Diarrhea D11	Oral	12	20,3	40,5	0,50
Rosmarinus officinalis L. (Lamiaceae) TMP-B129	Azir أزير	Leaves	Infusion	Mouth/tongue/lip symptom D20	Gargle	14	68,3	100	0,68
		Leaves and Stems	Decoction	Abdominal pain epigastric D02	Oral	29			
Ricinus communis L. (Euphorbiaceae) TMP-B094	kherwaâ خروع	Seeds	Infusion	Constipation D12	Oral	5	45,9	70	0,66
Ridolfia segetum (L.) Moris (Apiavceae) TMP-B042	Slilo- Slili سليلو - سليلي	Fruits	Decoction	Dyspepsia/indigestion D07	Oral	10	15,4	30,5	0,50
		Whole plant	Infusion	Jaundice D13	Oral	14			
Rumex acetosa L. (Polygonaceae) TMP-B145	Houmaida الحميضة	Seeds	Infusion	Flatulence/gas/belching D08	Oral	10	15,6	62,5	0,25
		Seeds	Decoction	Diarrhea D11	Oral	17			
		Seeds	Decoction	Abdominal pain epigastric D02	Oral	17			
Rumex bucephalophorus L. (Polygonaceae) TMP-B148	Houmaida الحميضة	Seeds	Decoction	Abdominal pain epigastric D02	Oral	17	15,7	62,5	0,25

		Seeds	Decoction	Diarrhea D11	Oral	17			
Rumex pulcher L. (Polygonaceae) TMP-B146	Houmaida الحميضة	Seeds	Decoction	Abdominal pain epigastric D02	Oral	17	16,3	62,5	0,26
		Seeds	Infusion	Dyspepsia/indigestion D07	Oral	6			
		Seeds	Decoction	Diarrhea D11	Oral	17			
Rumex spinosus L. (Polygonaceae) TMP-B147	Houmaida الحميضة	Seeds	Infusion	Rectal/anal pain D04	Oral	4	13,5	62,5	0,22
		Seeds	Decoction	Abdominal pain epigastric D02	Oral	17			
		Seeds	Decoction	Diarrhea D11	Oral	17			
Salvia officinalis L. (Lamiaceae) TMP-B130	Assalmiya السالمية	Leaves	Infusion	Teeth/gum symptom/complaint D19	Gargle	8	52,3	82,7	0,63
		Leaves	Decoction	Flatulence/gas/belching D08	Oral	13			
		Leaves	Fresh	Teeth/gum symptom/complaint D19	Mastication	8			
Seriphidium herba-alba (Asso) J. Soják (Asteraceae) TMP-B061	Chih الشيح	Leaves	Decoction	Gastrointestinal infection D70	Oral	19	17	32,2	0,53
		Leaves	Decoction	Constipation D12	Oral	9			
Scolymus maculatus L. (Asteraceae) TMP-B077	Ezzarnij الزرنيج	Leaves	Cooked	Irritable bowel syndrome D93	Oral	15	12,8	25	0,51
Scolymus hispanicus L. (Asteraceae) TMP-B076	El gournine الكرنين	Leaves	Cooked	Worms/other parasites D96	Oral	10	9	24,3	0,37
Scorpiurus muricatus L. (Fabaceae) TMP-B101	El Ûguif الأكوف	Leaves	Infusion	Diarrhea D11	Oral	8	17,5	35	0,50
Smyrnium olusatrum L. (Apiaceae) TMP-B044	Al hayar الحيار	Leaves	Powder	Abdominal pain epigastric D02	Oral	11	17	28,5	0,60
		Leaves	Powder with honey	Abdominal pain/cramps general D01	Oral	16			
Stoibrax pomeliana (Maire) B.L. Burtt (Apiaceae) TMP-B006	Krafess berri كرفس البري	Fruits	Powder	Abdominal pain epigastric D02	Oral	20	13,5	7,9	1,71
		Flowers and leaves	Decoction	Mumps D71	Oral	15			
Syzygium aromaticum (L.) Merr. & Perry (Myrtaceae) TMP-B139	Qrunfel قرنفل	Fruits	Decoction	Abdominal pain epigastric D02	Oral	13	45,6	72	0,63
		Fruits	Decoction	Teeth/gum symptom/complaint D19	Gargle	36			
		Fruits	Decoction	Mouth/tongue/lip symptom/complt. D20	Gargle	36			
Tetraclinis articulata (Vahl) Mast. (Cupresaceae) TMP-B090	El ârâr العرعار	Leaves	Macerated in water	Diarrhea D11	Oral	22	52	75	0,69

Teucrium polium L. (Lamiaceae) TMP-B132	Jaada الجعدة	Aerial part	Decoction	Liver disease NOS D97	Oral	17	23,4	55,4	0,42
Trigonella foenum-graecum L. (Fabaceae) TMP-B102	El hulba الحلبة	Seeds	Infusion	Abdominal pain epigastric D02	Oral	65	53	100	0,53
Thymus algeriensis Boiss. & Reut (Lamiaceae) TMP-B136	Zîtra الزعيترة	Leaves, flowery summit	Infusion	Stomach function disorder D87	Gargle	13	23,5	48	0,49
		Leaves	Fresh with cold water	Teeth/gum symptom/complaint D19	Oral	26			
Thymus capitellatus Hoffmanns. & Link. (Lamiaceae) TMP-B134	Zîtra الزعتيرة	Leaves, flowery summit	Decoction	Stomach function disorder D87	Oral	28	39	74,9	0,52
Thymbra capitata L. (Lamiaceae) TMP-B133	Zîtra الزعيترة	Leaves, flowery summit	Decoction	Stomach function disorder D87	Oral	16	32,5	86	0,38
Thymus willdenowii Boiss. (Lamiaceae) TMP-B135	Zîtra الزعيترة	Leaves	Decoction	Abdominal pain/cramps general D01	Oral	19	49	83,3	0,59
		Leaves	Decoction	Teeth/gum symptom/complaint D19	Gargle	8			
		Leaves	Decoction	Diarrhea D11	Oral	19			
		Leaves	Decoction	Mouth/tongue/lip disease D83	Cataplasm	10			
		Leaves	Decoction	Stomach function disorder D87	Oral	26			
		Leaves	Decoction	Liver disease NOS D97	Oral	9			
Vicia faba L. (Fabaceae) TMP-B103	Foul فول	Seeds	Cooked	Abdominal pain epigastric D02	Oral	12	86,3	100	0,86
Vicia sativa L. (Fabaceae) TMP-B104	Kurfalla كرفلة	Seeds	Cooked	Abdominal pain epigastric D02	Oral	12	32	67,5	0,47
Vitis vinifera L. (Vitaceae) TMP-B166	Addelya الدالية	Leaves	Decoction	Abdominal pain epigastric D02	Oral	12	17,5	70	0,25
Zingiber officinale Roscoe (Zingiberaceae) TMP-B167	Sekenjbir سكنجبير	Rhizome	Infusion	Abdominal pain epigastric D02	Oral	37	100	100	1,00
		Rhizome	Infusion	Dyspepsia/indigestion D07	Oral	37			

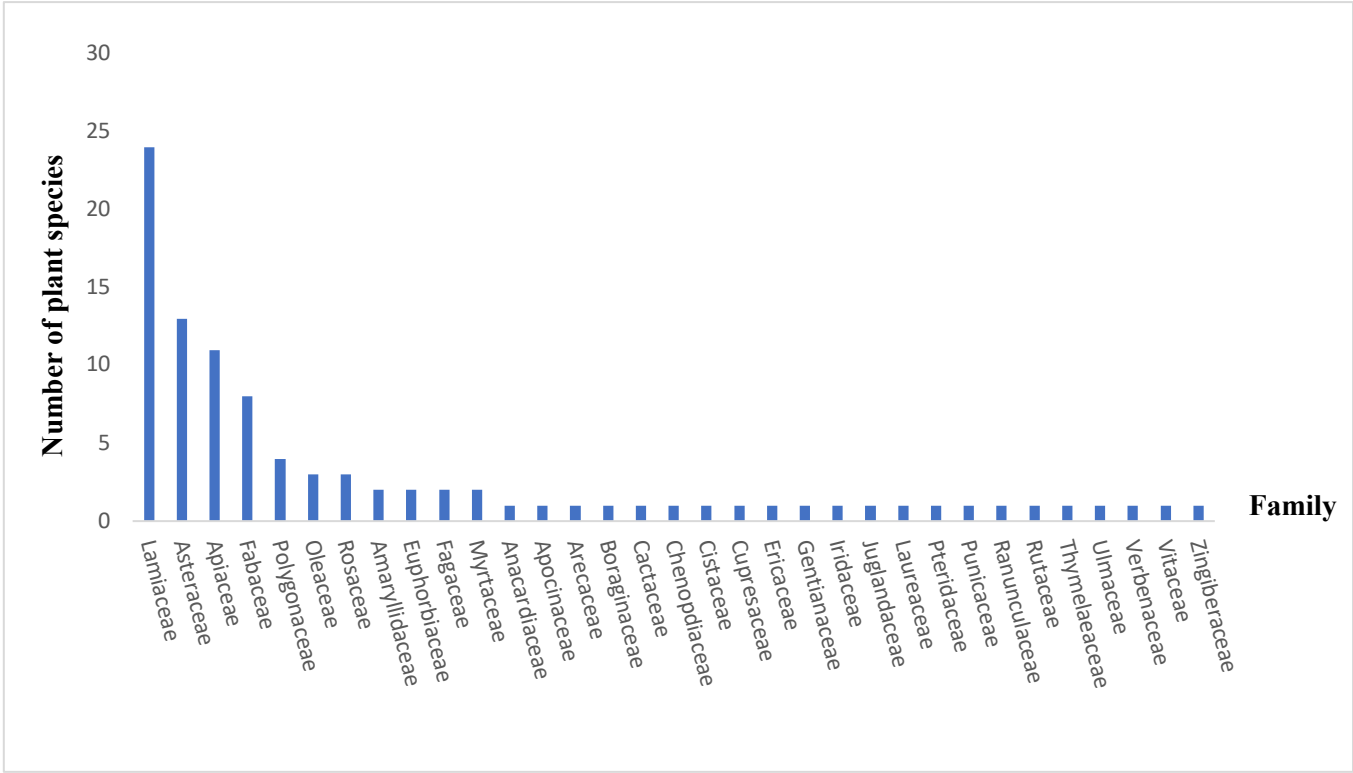

Figure 2. Ethnomedicinal plant species distribution among botanical families of PNTLS

Plant part used and modes of preparation and administration

The most utilized plant parts were leaves (29%), followed by fruits (16%), seeds (11%), roots and whole plant (7% each), and other parts of the plants (see Figure 3). Leaves are commonly used for the preparation of herbal medicines due to likely presence of active compounds and comparative ease of phytochemical and pharmacological studies compared to other parts (Choudhury *et al.* 2015, Maduka *et al.* 2014, Fakchich & Elachouri 2014, Shil *et al.* 2014, Telefo *et al.* 2011, González *et al.* 2010, Abo *et al.* 2008, Vall 2008, Mahishi *et al.* 2005).

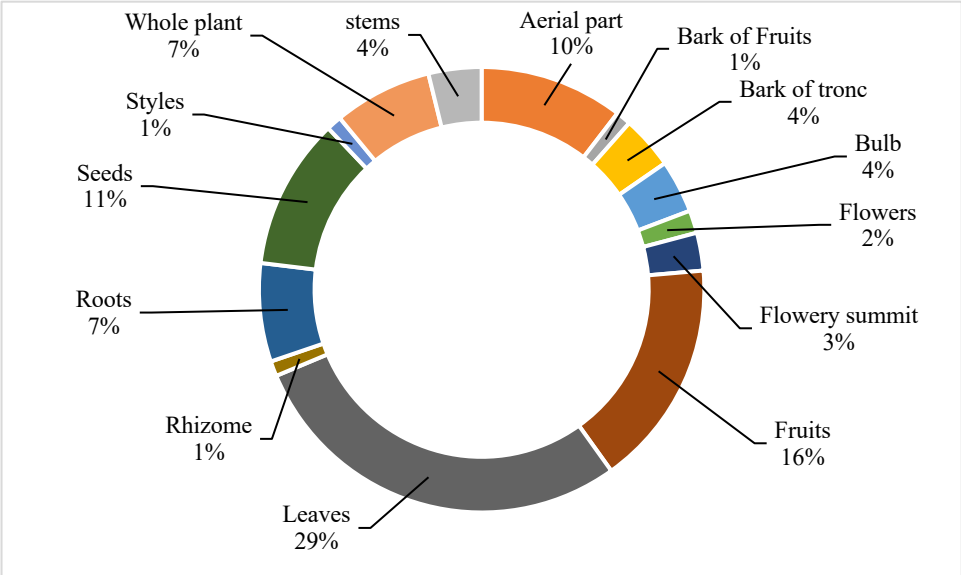

Figure 3. Frequencies of part used of the medicinal plants for treatment digestive symptom in PNTLS

The most frequently used mode of preparation was decoction (48%), followed by infusion (27%), fresh (10%), powder (6%), cooked (5%). In the other regions of the world, the most common methods of preparation are decoction and infusion for internal use (Alzweiri *et al.* 2011, Nadembega *et al.* 2011, Rehecho *et al.* 2011).

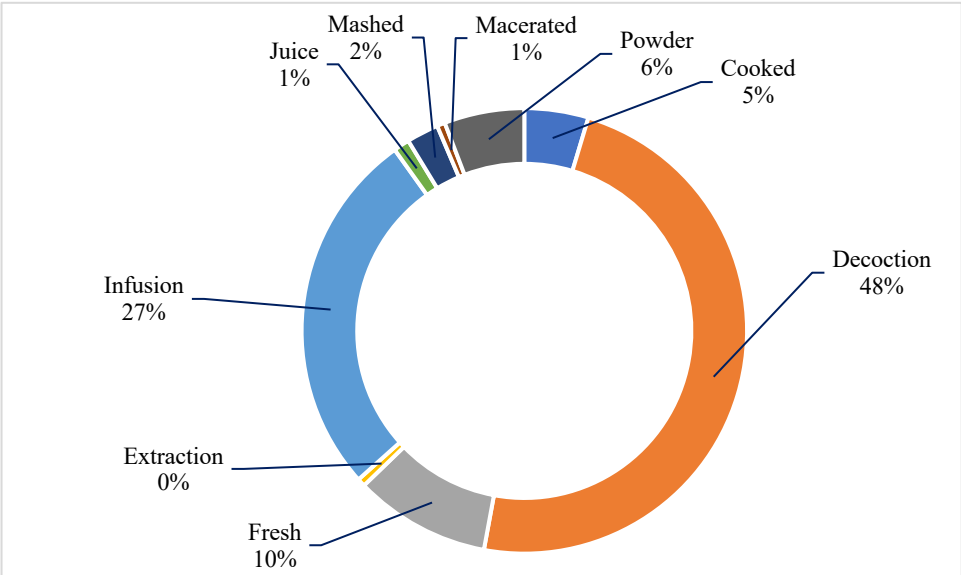

Figure 4. Modes of preparation of the medicinal plants used for digestive symptom in PNTLS

The results show that most of the informants suggested taking herbal medicines orally in an interne mode (orally 84%). As main external administration forms, we have cataplasm (1%), gargle (13%) and mastication (2%). The showed that the oral route allows a better absorption of active compounds contained in an herbal remedy (Yebouk *et al.* 2020).

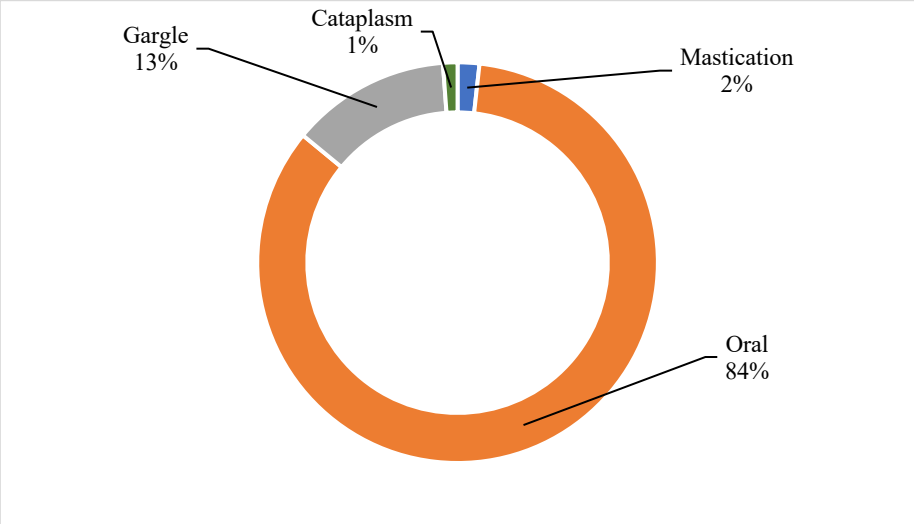

Figure 5. Modes of administration of the medicinal plants used for digestive symptoms in PNTLS

Conditions and symptoms of digestive group

The inhabitants of PNTLS use 96 species mainly to cure 20 digestive symptoms and conditions. These conditions are among the 58 symptoms and conditions that have been cited in the International Classification of Primary Care 2015 (ICPC-2) (Staub *et al.* 2015). It is important to note that 28% of inventoried revenues are devoted to the treatment of abdominal pain epigastric (D02), Dyspepsia/indigestion (D07) (12%), Teeth/gum symptom/complaint (D19) (11%), Diarrhea (D11) (10%), and Constipation D12 (6%). Subsequently, the diseases such as Mouth/tongue/lip symptom (D20) and Stomach function disorder (D87) (5% each), Flatulence/gas/belching (D08) (4%), Abdominal pain/cramps general (D01), Worms/other parasites (D96), and Liver disease NOS (D97) (3% each), Gastrointestinal infection (D70) and Irritable bowel syndrome (D93) (2% each). Jaundice (D13), Swallowing problem (D21), Mumps (D71), Vomiting (D10), Mouth/tongue/lip disease (D83), Rectal/anal pain (D04), and Duodenal ulcer (D85) (<1% each), these 7 symptoms represent values less than 0.58% for each (Figure 6). Many research works focused on the studies of medicinal plants in the treatment of chronic diseases such as diabetes, Hypertension, asthma, cardiac diseases, respiratory system and kidney diseases, is part of the traditional Moroccan phytotherapy in different regions (Barkaoui *et al.* 2017, Bousta *et al.* 2014, Eddouks *et al.* 2002, Jouad *et al.* 2001, Orch *et al.* 2015, Ouakrouch *et al.* 2017, Mechchate *et al.* 2020, Skalli *et al.* 2019, Tahraoui *et al.* 2007, Youbi *et al.* 2016, Ziyyat *et al.* 1997, Zougagh *et al.* 2019). However studies on the treatment of digestive diseases in the regions of Morocco are less published.

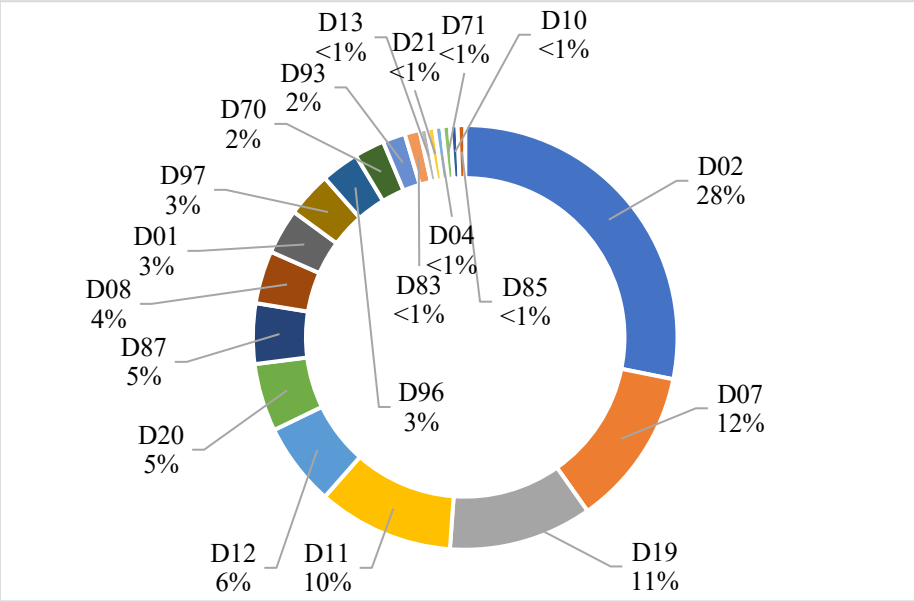

Figure 6. Frequencies of the pathological group of digestive symptoms treated in PNTLS. Codes for pathological are according to ICPC-2.

Quantitative ethnobotany

Use report (UR)

In this study, we identified 174 medicinal use for the 96 taxa included are locally used to treat 20 conditions and symptoms, classified in 58 conditions and symptoms in pathological groups of digestives (D). According to the ICPC-2 international classification of diseases, with a total of 3270 UR, overall, we got very high use ratios for most uses. The most cited condition was abdominal pain epigastric (D02) and up to 49 plant-based remedies can be used in the study area (999 UR). Several ethnopharmacological studies (e.g. in nearby territories Benítez 2009, González-Tejero *et al.* 2008, Yebouk *et al.* 2020) have pointed out that, this situation is the most typical one, mainly because digestive problems are frequent and frequently fleeting.

In our study (Dissertation PhD), we revealed that 152 species are used primarily for the treatment of 567 conditions and symptoms, with a total of 9402 UR. Among the diseases most represented in these surveys are diseases of the digestive system (24%) with 96 species used (Redouan 2019, Redouan *et al.* 2020a). Therefore, we started this article because of the high number of species (96 species), the high number of conditions (20) reported in interviews, and the high number of URs (3270) (Abdominal pain epigastric D02, Dyspepsia/indigestion D07, Teeth/gum symptom/complaint D19 and Diarrhea D11).

Most of the reported cases involved the use of a decoction of fennel roots (*Foeniculum vulgare*) treat colon pain (87 UR) or its fruits to treat abdominal pain (78 UR), and indigestion (62 UR). As well as the fruits of visnaga (*Ammi visnaga*) prepared in powder form with water and used by gargling as a treatment for oral abscesses (78 UR) or as a decoction for toothache (69 UR). Decoction of Bark from fruits of *Punica granatum* for Abdominal pain epigastric (72 UR), and an infusion of seeds of *Trigonella foenum-graecum* for Abdominal pain epigastric (65 UR).

Table 3. Conditions and symptoms with number of species and UR.

Health conditions/symptoms	Species/Uses	UR
Abdominal pain epigastric D02	49	999
Abdominal pain/cramps general D01	6	89
Constipation D12	11	121
Diarrhea D11	18	254
Dyspepsia/indigestion D07	21	438
Duodenal ulcer D85	1	7
Gastrointestinal infection D70	4	72
Flatulence/gas/belching D08	7	187
Jaundice D13	1	14
Irritable bowel syndrome D93	3	118
Mouth/tongue/lip disease D83	2	88
Liver disease NOS D97	6	64
Mouth/tongue/lip symptom D20	9	248
Mumps D71	1	15
Rectal/anal pain D04	1	4
Swallowing problem D21	1	54
Worms/other parasites D96	5	54
Vomiting D10	1	6
Teeth/gum symptom/complaint D19	19	295
Stomach function disorder D87	8	143
Total	**174 Uses**	**3270**

Knowledge index (MPKi) and the use index (MPUi)

We analyzed the level of knowledge using several indices to identify the species most used in the study area. We calculated for each plant the Knowledge Index (MPKi) and Utilization Index (MPUi) (Table 2). Knowledge of a specific medicinal plant is considered widespread when the number of people who know it (MPKi) and use it (MPUi) is high, and higher when the confidence level index (Cl = MPUi/ MPKi) close to 1. In this sense, the highest indices were obtained for *Aloysia citrodora*, *Allium cepa*, *Allium sativum*, *Artemisia absinthium*, *Lactuca sativa*, *Origanum vulgare*, *Zingiber officinale* with 100% of MPUi and PMKi (thus a Cl of 1). Overall, the indices of average use and knowledge of all the species studied in this study provide an overview of the traditional pharmacopoeia and ethnobotanical information of the studied population. The same can be said for the average confidence level.

Conclusion

The study provided ethnobotanical information for 96 taxa with several different medicinal uses, serving to treat conditions and symptoms from digestive systems used by 200 local dwellers of PNTLS. The reported plant families to treat digestive conditions is Lamiaceae which agrees with other studies in different regions (e.g. El gharbaoui *et al.* 2017, González-Tejero *et al.* 2008, Saslis-Lagoudakis *et al.* 2011).

We have registered 3270 use reports for 174 medicinal uses. The 96 taxa are used to treat 20 symptomatic conditions from digestive systems. The preferred preparation methods are decoction and are mostly administrated orally; the main referred symptoms are treated by the fruits, which are the most used part of the medicinal plants. Most of the preparations are used to treat abdominal pain epigastric, indigestion, Teeth/gum symptom and Diarrhea.

The variety of medicinal plants used to deal with acute digestive system problems clearly shows the importance of plants in the healthcare system in Morocco. The recorded information in the present study may be used as baseline data for future scientific investigations.

Declarations

List of abbreviations: PNTLS: Park National Talassemtane, UR: Use report, MPKi: Knowledge index, MPUi: Use index, CI: confidence level index
Consent for publication: Not applicable.
Availability of data and materials: All the data are presented in figures, tables and appendix in the manuscript and are available with the corresponding author.
Competing interests: The authors declare that they have no competing interests.
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