

Biodiversity of wild edible-medicinal and cosmetic plants with traditional uses in in the Moroccan province of Taounat in the Rif mountain

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RESUMEN

Los estudios etnobotánicos han revelado la importancia central de las plantas silvestres comestibles-medicinales y cosméticas en varios tipos de usos por parte de la población rural marroquí. El conocimiento de la biodiversidad y de los usos tradicionales de estas plantas debe salvaguardarse y transmitirse a las generaciones más jóvenes, para evitar el peligro de su desaparición. El objetivo de este estudio fue inventariar y caracterizar los usos tradicionales de las plantas comestibles espontáneas entre la población de la región de Taounat, situada al sur de la montaña del Rif. Se realizó una encuesta etnobotánica mediante entrevistas a la población del Rif, utilizando un cuestionario para recoger información sobre el órgano comestible, el modo de consumo, la frecuencia y el tipo de uso y las enfermedades tratadas. Se analizan los datos sobre el valor de uso, la frecuencia relativa de citas, el nivel de fidelidad y el factor de consenso de los informantes. Se identificaron 103 especies vegetales pertenecientes a 46 familias y se citaron 48 recetas. La mayoría eran de uso medicinal (35,29 %) y principalmente en el tratamiento de trastornos digestivos. Las partes más consumidas fueron las hojas. Los índices más elevados de Valor de Uso y la frecuencia relativa de citas corresponden a las plantas citadas por todos los informantes, a saber, *Lavandula stoechas* L. (*Halhal*) para uso medicinal, *Juglans* L. (*Ljawz*) para usos alimentarios y medicinales, mientras que los valores más elevados del Factor de Consenso de los Informantes se registraron para los problemas gástricos y la diabetes. Este estudio reveló la contribución de las plantas comestibles espontáneas a la riqueza de la biodiversidad vegetal y su riqueza en fitoterapia, etno-culinaria y otros usos en la región de estudio.

Palabras claves:

Planta silvestre comestible-medicinal y cosmética
Estudio etnobotánico
Provincia de Taounat
Marruecos.

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ABSTRACT

Ethnobotanical studies have revealed the central importance of wild edible-medicinal and cosmetic plants in several types of uses by the rural Moroccan population. Knowledge of these plants biodiversity and uses would make it possible safeguarding and transmission these traditional uses to younger generations and avoid their disappearance. The aim of this study is to inventory and characterize the traditional uses of spontaneous edible plants among the population of Taounat region, located in the south of the Rif Mountain. An ethnobotanical survey was carried out by interviews with the population, using a questionnaire to collect information on the edible organ, the mode of consumption (recipes), the frequency and the type of use and diseases treated. Use value, relative citation frequency, fidelity level and informant consensus factor data are assessed. One hundred and three plant species belonging to 46 families were identified and 48 recipes cited. The majority were of medicinal use (35.29 %) and mainly in the treatment of digestive disorders. The most consumed parts were the leaves. The highest rates of Use Value and relative citation frequency belong to the plants cited by all the informants, namely *Lavandula stoechas* L. (*Halhal*) for medicinal use, *Juglans* L. (*Ljawz*) for food and medicinal uses, while the highest informant consensus factor values were recorded for gastric problems and diabetes. This study revealed the contribution of spontaneous edible plants to the richness of plant biodiversity

Introduction

Wild edible-medicinal and cosmetic plants (WEMCPs) are natural resources that were an integral part of the livelihoods of rural populations (Al Hatmi & Lupton, 2021), (Sundriyal & Eklabya, 2004). However, there is a need of more scientific research on the valorization of traditional knowledge of their uses in relation to their biodiversity in the literature. Previous studies have reported different uses of these plants as medicines, traditional handicrafts and as foods with significant nutritional value etc., (Tardio et al., 2006; Ullah et al., 2020; Nadiroğlu et Behçet, 2018; Bhatia, 2018; Ugulu, 2012. The WEMCs were also a food source in famine and crises periods (Reyes-García, 2015) and can currently contribute to diversifying the diet (Tbatou et al., 2016). In the current context, these WEMCPs, which respect seasonality and protect the environment, would in addition, contribute to biodiversity and the sustainability of food (Serra-Majem, 2020). However, neglect and underuse of these plants is observed today, due to globalization and food abundance, the development of profitable crops and monocultures, constituting a threat to the disappearance of the traditional knowledge and biodiversity that these plants hold. Morocco, characterized by a variable geography, climate and ecology, is known for its great plant biodiversity. Among this, a large number of WEMCs species and subspecies was identified with variability of their uses depending on the populations and sites studied (Nassif et Tanji, 2013; Aboukhalaf et al., 2022; Naciri et al., 2022; Fennane et al., 1999;

Fennane & Ibn Tattou, 2005; Fennane & Ibn Tattou, 1998).

As part of the strategic orientations and public policies in Morocco (ADA, 2008) this study constitutes a contribution to the safeguarding of local cultural traditions around WEMCs for the proper exploitation, protection and conservation of these natural resources. The objective was therefore to discover the biodiversity and the methods of use and marketing of this WEMCPs plants used by the population of the Taounat region, located south of the Rif Mountain in Morocco.

Materials and Methods

The survey setting

The study took place in the Taounat province located in the Fez – Meknes Great Region. This predominantly rural province, is located in the southern Rif and is part of the Jbala country. The province borders are Chefchaouen province to the north, Taza province to the east, Ouezzane province to the northwest, Sidi Kacem province to the west, and the prefecture of Fez to the south (HCP, 2009).

Four localities, the commune of Ansar, the commune of Zrizer, the commune of Ghafssay and the commune of Khemis Zrizer, located in the study province (Figure 1), are selected to conduct the survey (Table 1).

Table 1. Geographical coordinates and ecological conditions of the Study Province.

Province of Taounate		
Ecological conditions (DRAFM 2018)	Climate	semi-arid with temperate winter and hot dry summer
	Temperature	Max 37°C, Min 10°C
	Altitude	521 m Douar Al Onsar and 467m of Khemis Zrizer
	Average annual rainfall	Declining from north (1,800 mm/year) to south (500 mm/year)
Geographic location (DRAFM 2018)		North: Chefchaouen et Al Hoceima South: Fez East: Taza West: Sidi Kacem
Geographical coordinates (DRAFM 2018)		Latitude: 34° 32' 09" North, Longitude 4° 38' 24" West

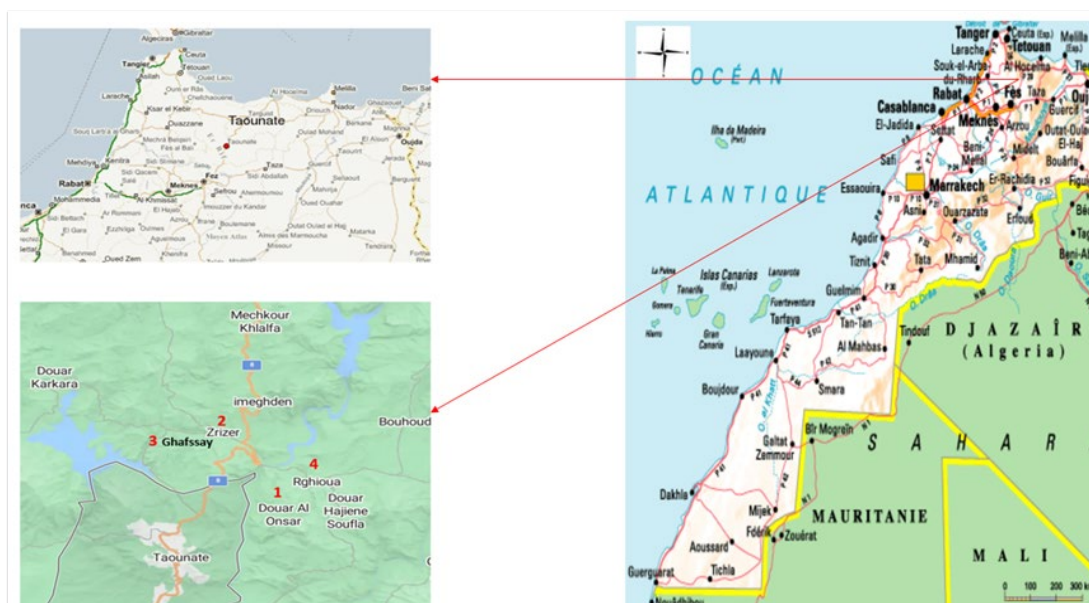


Figure 1. Map of the study area Taounate province (DRAFM, 2018)

Study region climate

The Taounate province, as a whole is characterized by a semi-arid climate with temperate winter and hot, dry summer, with rainfall declining from the north (1800 mm/year) to the south (500 mm/year).

The Taounate province is divided into two distinct parts:

- The northern part with mountainous terrain, which covers approximately 40% of the total area of the province, with altitudes varying up to 1800 m. It is crossed by six large rivers constituting the main tributaries of Wadi Ouergha.
- The southern part with hilly relief covers an area of approximately 3,300 km², and altitudes varying from 1000 m at Jbel Zeddour to 150 m along Wadi Inaouen (HCP, 2009) (Table 2).

Table 2. Distribution of the informant sample by localities.

Zone Name	Localities	Locality name	Participants number
Taounat	Locality 1	Douar El Ansar	30
	Locality 2	Zrizer	35
	Locality 3	Ghafssay	25
	Locality 4	Rghioua	10
	Sample size		100

Survey Data Collection

The survey was conducted, using a questionnaire, in the local Arabic dialect language, during several visits to the study areas and over a period of 6 months from March to September 2022. The sample involved 100 people, aged 14 to 90 years, of both sexes and with different levels of education. It included people from rural areas and wild food plant sellers in local markets in four localities, distributed as shown in Table 3.

The information collected by the questionnaire used included a first part for the identification of the respondents sociodemographic and socioeconomic characteristics of each respondent, including age, gender, household size, occupation, education level, marital status, and place of residence (Table 3).

The second part concerned a participatory ethnobotanical survey (Betti et al., 2016). This part of the questionnaire is completed using individual direct interviews or in “focus groups”, and semi-structured group interviews carried out according to the method described by (Wentholt et al., 2001) consisting of interviewing women and men separately. In each interview, data for each plant cited included the local common name, information on local people's knowledge of this plants, their traditional uses (as food, medicinal, cosmetic, etc.), and when they use them (in

the past or in the present), as well as the parts of the plant used, the method of preparation, their uses as food in combination or not with other foods (recipes). For medicinal plants, information on the method of administration and the diseases treated were also recorded. The time spent on each interview was approximately one hour.

Plant samples were also collected, photographed and packaged in labeled plastic bags and brought back to the laboratory for scientific identification. Some plant samples were purchased from rural women participating in the survey.

Table 3. Socio-demographic and economic characteristics of participant.

		N (%)
Total respondents		100(100)
Gender		
	Females	77(77)
	Males	23(23)
Type of survey		
	Individual	35 (35)
	Focus group	65 (65)
Area of residence		
	Rural	100 (100)
Distribution by profession		
	Housewife	48 (48)
	Farmer	40 (40)
	Others	12 (12)
Age (years)		
	[14-30]	15 (15)
	[31- 40]	24 (25)
	[41- 90]	61(61)
Education level		
	Middle and high school	12(12)
	Primary	28(28)
	Koranic	20(20)
	Illiterate	40(40)
Marital status		
	Married	43 (43)
	Widowed	30 (30)
	Single	27 (27)

Consent of participants

Participants, before being included in the study sample, were informed about the purpose of the study, voluntary participation and the possibility of ending their participation at any time, if they wish it. The confidentiality of their data is also respected.

Taxonomic identification of plants

The determination of the scientific nomenclature was carried out by comparing our samples with those kept in the herbarium of our laboratory (biotechnology, biochemistry, and nutrition laboratory of Chouaib Doukkali University) and out using a digital herbarium. Certain species were identified with the help of the National Herbarium (Rabat, Morocco), Agronomic and Veterinary Institute, and a botanist from the Faculty of Sciences in El-Jadida (UCD, Morocco) as well as using literature documents (Nègre, 1961; Quezel & Santa, 1962; Sijelmassi, 1993; Fennane & Ibn Tattou, 1998; Fennane et al., 1999; Valdés et al., 2002; Fennane & Ibn Tattou, 2005; Fennane et al., 2007; Dobignard & Chatelain, 2011, Tbatou et al., 2016).

Data analysis

The survey data concerning the number of citations and recipes of WEMCPs plants are entered using an Excel software database (Betti et al., 2001, 2002). Statistical analyzes are carried out using version 21 of SPSS software for Windows (Statistical Package for the Social Sciences).

The relative frequency of citations index (RFC) was used by Betti (2001, 2002), Tardio et al. (2006), Aboukhalaf et al (2022), Ghanimi et al (2022), Essaih et al. (2023) and calculated using the following formula:

$$RFC = FC/N \quad (0 \leq RFC \leq 1)$$

where:

FC = Number of informants mentioning the uses of the species

N = Total number of informants in the study

Informant consensus factor

The informant consensus factor (ICF) is used to indicate the degree of homogeneity of informants' knowledge for the use of the cited plants, and is calculated by the formula:

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

where (Nur) denotes the number of usage reports and (Nt) refers to the number of taxa used. The value of the ICF is between 0 and 1. When this value tends towards 1, it indicates a high rate of consensus among informants (Ghanimi et al., 2022; Essaih et al., 2023).

Use value

The use value (UV) index assesses the relative importance of each plant species known locally to be used as herbal remedy. The use value is calculated according to the following formula:

$$UV = U/N$$

where U refers to the number of citations per species; and N is the number of informants who reported on the plant species (Salih & Ali, 2014).

Results and discussion

Sociodemographic and socioeconomic profile of respondents

A percentage of 65% of the data is collected using questionnaires completed in group surveys, namely during exchanges and debates with participants in focus groups (Table 2), (Figure 2), while individual surveys accounted for 35% of the data. In all the locations studied, the participants were aged 14 to 90 years, the most representative age group was 41 to 80 years old, followed by the age group 31 to 40 years old and finally the youngest group ages 14 to 30.

The majority (100%) of respondents were from rural areas with 77% female and 23% male. Socioeconomic status included farmers, housewives, herders, students, unemployed, traders, teachers, and fkih (religious teachers). The socio-economic categories most represented in rural areas are housewives (48%) and farmers (40%), followed by traders and teachers representing the socio-professional status of the population who travel to work in rural areas (12%). The Table 3 also shows that according to their distribution by level of education, the majority of



Figure 2. Photos of focus group (1), (2), (3), the individual (4), (5), and surveys (6). Plants collected by the housewife (Seloua ESSAIH)

respondents (40%) were illiterate, 28% were with primary level, 12% included both those with secondary and tertiary level and 20% attended Koranic school. According to their marital status, the majority of survey participants were married (43%), followed by widowers (30%) and singles (27%).

The data reported on the plant species cited in this work are obtained in the ethnobotanical study carried out among women and men aged 14 to 90 years in the mountainous province of Taounat, through individual surveys and focus group. This region is represented by the municipalities of Douar El ansar, Khemis Zrizer, Ghafsay and Rghioua. The results of this work revealed the identification of 103 plant species belonging to 46 families. The study also revealed a higher use of these plants in women (77%) than in men (23%). These results corroborate with the results of other work carried out in other provinces in the country, such as Tarfaya region (Idm'hand, Masnada and Cherifi, 2020) and in Casablanca Settatt region (Essaih et al., 2023).

Floristic analysis and botanical families of the species mentioned

As presented in the Table 4, the plants collected and identified in this study are classified according to the alphabetical order of their botanical families, their local vernacular name, the type of use, the part used and for food category plants the form of their consumption and processing, for the medicinal and cosmetic plants, their mode and form of administration, the method of preparation used, uses in traditional medicine by the local community and ethnobotanical indices (use value (UV), relative citation frequency (RFC), fidelity level (FL) and informant consensus factor (ICF)).

The total of 103 species of WEMCPs, divided into 46 families were identified in the present study, being used in the past or are still used currently as declared by the population in the study areas. This number of the wild species cited by the surveyed population, is to our knowledge, higher than that found in the numerous studies carried out in the Mediterranean region. Indeed, this number exceeds those reported in the literature by other authors, namely 69 WEMCPs documented in the Guzman region of Spain (Tardio, Pardo-de-Santayana and Morales, 2006)

and 66 WEMCPs in Bologna, Italy (Sansanelli and Tassoni, 2014). Similarly, 64 WEMCPs were recorded in the regions of Sidi Bennour (Aboukhalaf et al., 2023) and 78 WEMCPs in the region of Casablanca - Settatt (Essaih et al., 2023) in Morocco.

Figure 3 shows the distribution of WEMCPs species cited by their families, and table 4 presents the number and percentages of citations of these species in alphabetical order as well as the type of their uses. The results show that botanically, the most represented families were herbaceous plants with a significant representation of Asteraceae in 16 different species (34.78%). These results are consistent with those of previous work carried out in other regions of Morocco by Ghanimi et al. (2022), Tbatou et al. (2016), Briguiche and Zidane (2019). These studies also reported that this family is considered to be at the top of the list of vascular flora naturally available and widely used by the Moroccan population (Essaih et al., 2023).

Other families grouped represented simultaneously (65,1%); these are: The Amaryllidaceae, Arecaceae, Berberidaceae, Ericaceae, Cannabaceae, Cupressaceae, Cortinariaceae, Euphorbiaceae, Ericaceae, Fagaceae, Iridaceae, Illicaceae, Juncaceae, Juglandaceae, Lythraceae, Molliginaceae, Malvaceae, Moraceae, Oleaceae, Oxalidaceae, Palmaceae, Portulacaceae, Papaveraceae, Rubiaceae, Salicaceae, Tuberaceae, Thymelaeaceae, Urticaceae, Vervaceae and the Zingibellaceae simultaneously.

In second place, among the families cited come the Lamiaceae family with 15 citations (32.6%), the Apiaceae with 7 citations (15.21%), the Fabaceae with 5 citations (10,86%), the Brassicaceae with 4 citations, the Brassicaceae (8.69%), Myrtaceae (6.52%), Poaceae and Solanaceae with 3 citations (6.52%) simultaneously, the Anacardiaceae (4.34%), Apocynaceae (4.34%), Cappariaceae (4.34%), Caryophyllaceae (4.34%), Chenopodiaceae (4.34%), Cactaceae (4.34%), Rosaceae (4.34%), and Verbenaceae (4.34%), with 2 citations simultaneously. The other families grouped represented simultaneously (65.1%); these are: The Amaryllidaceae, Arecaceae, Berberidaceae, Ericaceae, Cannabaceae, Cupressaceae, Cortinariaceae, Euphorbiaceae, Ericaceae, Fagaceae, Iridaceae, Illicaceae, Juncaceae, Juglandaceae,

Table 4. List of the plants recorded in the survey localities and their ethnobotanical characteristics

Scientific Names / Vernacular Names (Voucher specimen)	Families	RFC	UV	Type of use	Form of consumption and processing (Food category)	P P used U	Part	Preparation Med. Cos * / Administration	Traditional medicine uses
<i>Allium roseum</i> L / Baslat dib (BD 18)	Amaryllidaceae	0,85	0,86	Food	Fruit used as vegetables, cooked foods and to flavored salads (Vegetables). Also used dried as a condiment (Spices).	Fruit			
<i>Pistacia atlantica</i> Desf / Lbtem (BT33)	Anacardiaceae	0,75	0,75	Medicinal	Leaves prepared as infusion for Rheumatism.	Leaves		Infusion / Oral	Rheumatism
<i>Pistacia lentiscus</i> L / Drou (DR49)	Anacardiaceae	0,79	0,80	Food Medicinal	Extraction of the (oil) for ' donut preparation. Also used as nose drip and to cure asthma and angina. Use of the oil on the umbilical cord trace 'Belly' for menstrual pain. Infusion of leaves for gastric problems.	Seed Leaves		Oil / Externally Infusion / Oral Poultice / Externally Nose drip / inspiration	Gastric problems Menstrual pain Asthma Angina
<i>Ammi majus</i> L. / Begueramel trilal (TR2)	Apiaceae	0,65	0,70	Food Medicinal	The roots are used as a condiment with traditional Moroccan spices in infusion "Msakhen", to prepare balboula soup to activate the reproductive glands. Also used to flavor chicken (Spices)	Root		Infusion / Oral	Reproductive glands
<i>Foeniculum vulgare</i> P.Mill./ Besbas lbouri (BS22)	Apiaceae	1	1	Food	Aerial part used as (vegetables) to prepared tajines or dried to flavor the traditional recipes like barbecue. Stem used with the milk to prepare a different couscous from the mountains of Morocco (Vegetable).	Aerial part Stem			
<i>Daucus crinitus</i> Desf./ Bû- zfûr (BZ 15)	Apiaceae	0,54	0,54	Medicinal	Root Raw or cooked Oral for Gastric pain.	Root		Snack / Oral	Gastric pain
<i>Ammodaucus leucotrichus</i> Coss& Dur / Al camoun soufi (CS10)	Apiaceae	1	1	Medicinal	Graine Cru Oral Tube digested for respiratory system infections.	Seed		Infusion / Oral	Digestif pains

<i>Carum carvi</i> / Karwiya (KW 57)	Apiaceae	0,89	0,89	Medicinal	Fruit used as snack for respiratory system infections.	Fruit	Snack/ Oral	Respiratory system infections
<i>Ammi visnaga</i> L. Lam. / Maticht dib – Boukhnina (BK 13)	Apiaceae	0,65	0,65	Food	Fruit used as (Vegetables).	Fruit		
<i>Ammi visnaga</i> L. Lam. / Bouchnikh (BC 10)	Apiaceae	0,89	0,90	Other Food	Seeds used fresh or dried to perfume tea (Drinks), garnish cake and bread (Food decoration). Stems are used as toothpicks.	Seed Stem		
<i>Laurier rose</i> / Defla (DF 19)	Apocynaceae	0,12	0,12	Medicinal	Aerial part boiled in water and used after as a foot bath for diabetics.	Aerial part	Foot bath/ Externally	Diabetes
<i>Laurier rose</i> / Defla roumya (DR 28)	Apocynaceae	0,74	0,74	Medicinal	Leaves used for foot bath for diabetic person.	Leaves	Foot bath/ Externally	Diabetes
<i>Chamaerops humilis</i> L. / Jemmakh doum (JM72)	Arecaceae	0,80	0,90	Food Medicinal Others	Fruit consumed as snack for calming the digestif pains (Snack) Root-Aerial parts used to prepare home decorations such as small rugs and other traditional objects.	Fruit Root- Aerial part	Snack/ Oral	Digestif pains
<i>Centaurea chamaerhaponticum</i> Ball / Tafgha (TG 84)	Asteraceae	0,41	0,41	Medicinal	Dried leaves transformed into powder used with honey against fever.	Dried leaves	Compote/ Oral	Fever
<i>Chamaemelum fuscatum</i> (Brot.) Vasc. / Babounj (BJ12)	Asteraceae	0,76	0,80	Food Medicinal	Flowers used fresh or dried as an infusion for gastric pains and as a natural sedative (Drink). As well as for decorating cakes. (Garnish). Tender stems consumed raw by shepherds and children (Snacks). Basals leaves, mixed with <i>Lavatera cretica</i> L. to make "Beqoula" dish (Vegetables).	Flowers Tender stems Basal leaves	Infusion/ Oral	Gastric pains / sedative
<i>Dittrichia viscosa</i> (L.) Greuter / Tarehla (TH90)	Asteraceae	0,80	0,80	Medicinal	Dried and powdered roots to heal wounds. Also used as an infusion for skin problems.	Root	Powdered/ Oral	Heal wounds Skin problems
<i>Chrysanthemum coronarium</i> L Rjel djaja/ Kraa djaja (JD 12)	Asteraceae	0,47	0,47	Food	Tender stems, consumed raw by shepherds and children (Snacks). Basal leaves, mixed with <i>Lavatera cretica</i> L. to make "Beqoula" dish (Vegetables).	Tender stem Basal leaves		

<i>Compositae</i> <i>Artemisia arborescens</i> L. / Chiba (CB5)	Asteraceae	1	1	Medicinal Food	Aerial part used as infusion for gastric pains also to flavor (infusion).	Aerial part	Infusion / Oral	Gastric pains
<i>Cynara humilis</i> L / Timta (TM 97)	Asteraceae	0,42	0,50	Food Medicinal Other	Flowers, net and stamens used for milk curdling. Receptacle cooked as a substitute for (vegetables). Roots dried and used as spices (Seasoning). Peeled or crushed and cooked as a garnish in traditional recipes (Food decoration). Dried and powdered roots to heal wounds.	Flower Root dried	Powder / Oral	Heal wounds.
<i>Carlina gummifera</i> (L.) Less / Dad lamlas (DM45)	Asteraceae	0,12	0,13	Food Other	Fresh leaves used for milk curdling. Seed chewed like a (chewing-gum). Fruit consumed as (Vegetable).	Leaves Seed Fruit		
<i>Echinops spinosus</i> L / Tasekra (SK 13)	Asteraceae	0,42	0,42	Others				
<i>Leontodon saxatilis</i> Lam / El-harricha (EH 13)	Asteraceae	0,41	0,41	Food	Flowers used fresh or dried with tea dried (Drinks) and consumed as spices (Seasoning).	Flower		
<i>Scolymus hispanicus</i> L / El-gernina (GR18)	Asteraceae	0,44	0,44	Food	Basal leaves, mixed with <i>Lavatera cretica</i> L. to make "Beqoula" dish or cooked as vegetable on traditional recipes including tajines after being peeled from spines (Vegetables). Tender stems, consumed raw by shepherds and children (Snacks). Roots, peeled, cut or crushed and cooked as a garnish of traditional recipes (Cooked roots).	Basal leaves Tender stem Root		
<i>Chrysanthemum macrocarpum</i> (Sch. Bip) Batt / Gahwan (GH 29)	Asteraceae	0,32	0,32	Food	Stem eaten in the raw state by children and shepherds (snack).	Stem		
<i>Cirsium eriophorum</i> (L.) Scop / Aalk (Al 18)	Asteraceae	0,38	0,38	Food	Seeds consumed in the raw state as chewing gum ,	Seed		
<i>Vertus de l'armoise blanche</i> / Chih (CH30)	Asteraceae	0,12	0,12	Medicinal	Aerial part boiled in water and used after as a foot bath for diabetics.	Aerial part	Foot bath / Externally	Diabet

<i>Pallenis spinosa</i> (L.) Cass/ Ttafs (TF68)	Asteraceae	0,34	0,34	Medicinal	Leaves prepared as infusion for digestif pains.	Leaves	Infusion / Oral	Digestif pains
<i>Artemisia campestris</i> L / Chih lakhrisi (CL 21)	Asteraceae	0,47	0,47	Cosmetic	Decoction leaves as infusion, drops used as face masks to treat "kleff" pregnancy marks or certain eye diseases.	Leaves	Infusion / Externally	Face care / Eye diseases
<i>Cynara scolymus</i> / Lkherchouf lbeldi (KB48)	Asteraceae	0,56	0,57	Food Medicinal	Stems Raw or coocked in Tagine (Snack or vegetables). Root decoction as infusion recommended in the treatment liver disease	Stem Root	Infusion / Oral	Liver disease
<i>Berberis</i> / Berztem (BE 19)	Berberidaceae	0,04	0,04	Medicinal	Powder of seeds mixed with honey to prepare balls taken each morning to cure cancer.	Seed	Compote / Oral	Cancer
<i>Raphanus raphanistrum</i> L / Bouhammou (BH12)	Brassicaceae	0,42	0,42	Food	Young leaves, mixed with <i>Lavatera cretica</i> L. to make "Beqoula" dish (Vegetables) Flowers, cooked as a garnish for traditional bread (Food decoration).	Young leaves Flower		
<i>Lepiduum sativum</i> / Hab rechad (HD 94)	Brassicaceae	0,78	0,78	Medicinal	Fruit used as infusion for respiratory system infections and with milk and	Fruit	Infusion / Oral	Respiratory system infections
<i>Diploaxis catholica</i> (L) / El-harra/ El-kelkaza (KK 50)	Brassicaceae	0,79	0,80	Food Medicinal	Young leaves, mixed with <i>Lavatera cretica</i> L. to make "Beqoula" dish (Vegetables) Flowers, cooked as a garnish for traditional bread (Food decoration). Drops recovered after infusion concentrated flowers to Oriel pain.	Young leaves Flower	Infusion / Oral Infusion / Externally	Oriel pain
<i>Telephium imperati</i> L. / Khayata (HY 62)	Brassicaceae	0,54	0,54	Medicinal	Leaves prepared as poultice for dried and powdered Leaves to heal wounds.	Leaves	Poultice / Externally	Heal wounds
<i>Calluna vulgaris</i> / Khlanj (KJ 14)	Ericaceae	0,30	0,31	Food Medicinal	Leaves prepared as (infusion) for digestif pains. Powdered seeds mixed with flour and corn to make traditional local bread.	Leaves Seed	Infusion / Oral	digestif pains
<i>Puntiafcus-indica</i> (L.) Mill. / Lwarnaxi (karmous byad) (KY)	Cactaceae	0,85	0,86	Food Medicinal	Fruit eaten fresh (Snack) or dried, mixed with olive oil and garlic in a paste to treat coughs.	Fruit	Snack / Oral	Coughs

<i>Opuntia ficus-indica</i> (L.) Mill./ Sebbar, aknari, kermous enssara, lkermous lhendi (AK88)	Cactaceae	1	1	Food Medicinal Cosmetic	Fruit eaten as a snack and as a treatment to stop diarrhea (Snack) The gel from the inner surface of the leaves is used as a poultice for hair and face care.	Fruit leaves	Snack / Oral Poultice / Externally	Diarrhea / hair and face care
<i>Chanvre</i> (<i>Cannabis saliva</i> L.)/ Kif (KF91)	Cannabaceae	0,52	0,54	Medicinal Cosmetic Psycho actif use	Oil seed extraction to stop hair loss Decoction of Pistil, stigma and Bracté part for preparation the psycho-actif tobacco. The rest of the plant used for other purposes.	Seed Pistil Stigmat Bract Calyx	Poultice / Externally Steam / Externally Tobacco / Inhalation	Hair loss / Psychological state
<i>Capparis spinosa</i> / Kbar (KR81)	Capparaceae	0,34	0,34	Medicinal	Fruit dried used for respiratory system infections	Fruit	Snack / Oral	Respiratory system infections
<i>Capparis spinosa</i> L / Kebbar Afsas (KS20)	Capparaceae	0,56	0,56	Medicinal	Fruit seed consumed as snack or as infusion for os pains.	Fruit	Infusion / Oral	Rheumatology
<i>Tetraclinis articulate</i> (Vahl) Masters / Learaar (AR 38)	Cupressaceae	1	1	Food Medicinal Others	Seeds used in decoction (Seasoning Arome), Leaves used in infusion combined with rosemary, with lavender and pennyroyal. Leaves Perfuming the environment.	Seed Leaves	Infusion / Oral	Hypoglycaemic - Diuretic against bronchitis
<i>Herniaria cinerea</i> DC / Harras lehjar (HL63)	Caryophyllaceae	0,38	0,39	Food Medicinal	Roots dried and consumed as spices (Seasoning). Aerial parts, used with tea (Drinks) Stems, used fresh or dried boiled to fight against diseases of the kidneys and gallbladder.	Root dried	Infusion / Oral	Diseases of the kidneys and gallbladder
<i>Silene vulgaris</i> (Moench) Garcke / Tirecht (TC39)	Caryophyllaceae	0,57	0,57	Others	Flowers used as detergent for washing clothes and white carpets it has a brightening effect.	Flower		
<i>Chenopodium murale</i> L. / Berremram (BR5)	Chenopodiaceae	0,28	0,29	Food Medicinal	Aerial parts dried and consumed in powder to fight against gastric pains. Roots boiled and consumed in Drinks to fight against kidney diseases. (Drinks) Aerial parts, mixed with <i>L.cretica</i> to prepare the dish beqoula (Vegetable). Aerial parts. Dried and consumed as	Aerial part Root	Powder / Oral	Gastric pains / kidney diseases

spices (Seasoning).								
<i>Chenopodium ambrosioides</i> L / Mkhinza (MZ5)	Chenopodiaceae	0,88	0,89	Food Medicinal	Aerial parts crushed and mixed with orange juice to fight fever. Aerial parts, cooked as a garnish in some traditional recipes of soups (Food decoration).	Aerial part	Drink / Oral	Fever
<i>Cortinarius</i> / Champignon (CM 40)	Cortinariaceae	0,59	0,59	Food	Same use today as the aerial part used with eggs or to prepare other Moroccan dishes such as <i>pastille</i> (Vegetable).	Aerial part		
<i>Mercurialis annua</i> L / Horiga lmalssa (HM 12)	Euphorbiaceae	0,85	0,86	Medicinal Cosmetic	An infusion of the powder prepared from the leaves is recommended as a rinse for pruritus itchy skin of the scalp, skin and poultice applied for hair straightening.	Leaves	Infusion / Externally Poultice / Externally	Pruritus / Hair care
<i>Arbutus unedo</i> L./ Sasnou, boukhennou (SS12)	Ericaceae	1	1	Food	Fruit consumed as (Snacks).	Fruit		
Oak / Balout (AT21)	Fagaceae	1	1	Food	Seeds consumed raw (Snacks).	Seed		
<i>Astragalus boeticus</i> L./ Krinbouch (KN40)	Fabaceae	0,99	0,99	Food	Seeds, consumed raw by shepherds and children (Snacks).	Seed		
<i>Lathyrus clymenum</i> L./ Rik el-hench (RN40)	Fabaceae	0,22	0,22	Food	Seeds, consumed raw by shepherds and children (Snacks).	Seed		
<i>Vicia sativa</i> L / Bouzghiba (BG78)	Fabaceae	0,17	0,17	Food	Seeds eaten raw by children and shepherds (Snacks)	Seed		
<i>Lotus corniculatus</i> / Karn laghzal (KW37)	Fabaceae	0,17	0,17	Others	Aerial parts for animal feed.			
<i>Ceratonia celua</i> Kharoub / Slaghwa (SG27)	Fabaceae	0,87	0,88	Food Medicinal	Fruit consumed as (snack), Dried fruit with honey or water for estomac pain.	Fruit	Drinks / Oral	Estomac pain

<i>Iris sisyrinchium</i> L. / Lmessiw (SW10)	Iridaceae	0,18	0,18	Food	Rhizome, consumed raw or roasted (Snack).	Rhizomes		
<i>Illicium verum</i> / Lyansoun (YS8)	Illiciaceae	0,93	0,93	Medicinal	Leaves dried prepared as an (infusion) to calm the nerves.	Leaves dried	infusion/ Oral	Nerves
<i>Juncus acutus</i> L./ Essmar Igelmi (SE60)	Juncaceae	0,62	0,62	Others	To prepare carpets, traditional bags and brooms.			
<i>Juglans</i> L./ Ljawz (JW80)	Juglandaceae	1	1	Medicinal Food	Their nut consumed as dried fruit (Snack). The leaves prepared as an infusion to calm the nerves.	Dried fruit Leaves	Infusion/ Oral	Nerves
<i>Rosmarinus officinalis</i> / Azir lhour (AZ90)	Lamiaceae	1	1	Medicinal Food	Aerial part used in infusion to cure gastric problems. Leaves, used as condiment to perfume tajines of chicken and fish (Seasoning).	Aerial part Leaves	Infusion / Oral	Gastric problems
<i>Calamanta officinalis</i> / Manta (MT4)	Lamiaceae	0,99	1	Food Medicinal	Aerial part used for seasoning olives using the traditional Moroccan Meslala method. (Seasoning) Also to flavor tea and milk and to attack the flu (infusion).	Aerial part	Infusion / Oral	Flu
<i>Origanum majorana</i> / Merd douch (MD10)	Lamiaceae	0,89	0,89	Medicinal	Leaves used in infusion to treat anxiety. Aerial part used to flavor tea and milk (Drink), prepared as (infusion) to attack the flu.	Leaves	Infusion / Oral	Anxiety, flu
<i>Lavandula officinalis</i> / Khezama (KZ 53)	Lamiaceae	0,96	0,96	Medicinal Other	Aerial part the steam from boiling the aerial part is indicated for genital problems delayed menstruation. The water from this boiling is indicated as a hygiene wash for the genital tract. Aerial part used with <i>Peganum harmala</i> other beliefs, which are ancient traditions "Bkhour" as conveying positive energy to clean the environment and leave a good scent.	Aerial part	Infusion / Externally	Delayed menstruation and genital tract

<i>Lavandula stoechas</i> L. / Halhal (HA 29)	Lamiaceae	1	1	Medicinal	Aerial part crushed used externally for treatment of hair loss, leaves used for footbath for diabetic person.	Aerial part Leaves	Poultice Applied/ Externally Foot bath/ Externally	Hair loss/ Diabetes
<i>Thymus serpyllum</i> / Ziitra (ZT 15)	Lamiaceae	1	1	Food Medicinal	Leaves used in infusion to cure gastric problems, used as condiment to perfume tajines of chicken and fish (Seasoning), Used to perfume tea and milk (Drink).	Leaves	Infusion / Oral	Gastric problems
<i>Mentha suaveolens</i> Ehrh / Mersita (MS3)	Lamiaceae	1	1	Food Other (insecticide)	Aerial part used to flavour tea, powder of leaves for (seasoning) the pancakes, used also as an insecticide after crushing the leaves.	Aerial part Leaves		
<i>Melissa officinalis</i> / Hbak tranj (HT50)	Lamiaceae	0,94	0,94	Food	Aerial part, used with tea or milk (Drink).	Aerial part		
<i>Romarinus officinalis</i> / Azir Eklil ljabal (EB39)	Lamiaceae	0,17	0,18	Food Medicinal	Aerial part are consumed fresh or dried to flavor tea or as an infusion to minimize gastric and head pains (Drink). Leaves, crashed and used as a garnish in traditional bread recipes (Garnish).	Leaves Aerial part		Gastric pain
<i>Salvia officinalis</i> / Mrimeya (MM 87)	Lamiaceae	0,70	0,70	Medicinal	Aerial part boiled in water and used after as a foot bath for diabetics.	Aerial part	Foot bath / Externally	Diabetics
<i>Thymus broussonetii</i> Bois. / Zaatar (ZH30)	Lamiacées	1	1	Food Medicinal	Aerial parts, used as seasoning of traditional recipes (Seasoning). Aerial parts, used as infusion or to perfume tea or milk (Drinks) and for gastric pain.	Aerial parts	Drink / Oral	Gastric pain
<i>Marrubium vulgare</i> / Mreout (MR87)	Lamiaceae	0,78	0,78	Medicinal	Aerial part used as infusion for respiratory system infections	Aerial part	Infusion / Oral	Respiratory system infections

<i>Mentha pulegium</i> L. / Fleuo (FU 15)	Lamiaceae	1	1	Medicinal	leaves consumed as an infusion with tea or to flavor milk. (Drink) for flu.	Leaves Aerial part		
<i>Ajuga iva</i> (L.) Schreb / Chendgoura (CG5)	Lamiaceae	0,98	0,98	Food	Aerial parts, cooked as a garnish in traditional breads, soups and couscous (Garnish). Aerial parts dried and consumed as spices (Seasoning).	Aerial parts		
<i>Salvia officinalis</i> / Salmia (SM22)	Lamiaceae	0,78	0,78	Medicinal	Leaves consumed as infusion to uterus pains and for diabetes. Aerial part are consumed fresh or dried to flavor tea. (Drinks).	Leaves Aerial part	infusion/ Oral	Uterus pains diabetes
<i>Lawsowia inermis</i> / Henna (HN 52)	Lythraceae	0,84	0,85	Cosmetic Medicinal	Dried leaves are used as a poultice with water for the skin and hair during Moroccan baths. So for the art of Elhenna Moroccan Nakch tattoo on women's hands and feet at traditional Moroccan festivals. Dried leaves mixed in powder with <i>Chenopodium ambrosioides</i> L (Mkhinza) leaves to lower temperature immediately. Dried leaves mixed in powder with the leaves of <i>Chenopodium ambrosioides</i> L - Mkhinza as a head poultice to stop fever immediately.	Leaves	Poultice / Externally Poultice / Externally	Hair and face care Fever
<i>Corrigiola telephiifolia</i> Pourr. / Serghina (SH28)	Molluginaceae	0,65	0,66	Food Medicinal Other	Aerial parts used as an infusion and mixed with natural yogurt for gastric problems, used to eliminate certain undigested non-food compounds in the case of Toukal in rural culture. Dried roots consumed as spices (Seasoning). The steam from burning the aerial parts of the plant is used as a disinfectant for the clothes of newborns. Incense disinfecting the environment and for other beliefs which are "ancient traditions : "Bkhour" as conveying positive energy.	Aerial parts, Dried roots	Infusion – steam Oral/ Externally	Gastric problems/ disinfectant

<i>Syzygium aromaticum</i> / Krounfoul (KF80)	Myrtaceae	0,75	0,76	Medicinal Food	Flower bud used to season, decorate traditional cakes (Garnish) and used for oral hygiene. Flower bud used as infusion to treat anxiety.	Flower bud	Infusion / Oral Machining / Oral	Anxiety Oral hygiene
<i>Eucalyptus globulus</i> Labill. / Lkalitos, Caliptus (KS82)	Myrtaceae	0,92	0,93	Medicinal Others	Leaves used as an infusion to fight fever. The stem produced by burning the plant's leaves is used as a household disinfectant.	Leaves Stems	Infusion / Oral Steam / Externally	Fever / Disinfectant
<i>Myrtus</i> / Rihan (RH 48)	Myrtaceae	0,68	0,68	Medicinal	Leaves used in infusion to cure gastric problems, flavored tea and poultice applied for hair straightening.	leaves	Infusion / Oral Poultice Applied / Externally.	Gastric problems / Hair care
<i>Lavatera cretica</i> L. / El-khobbiza / El-bakkoula (KZ1)	Malvaceae	1	1	Food	Moroccan dish Beqoula obtained from the aerial part of <i>Lavatera cretica</i> . (Vegetables)	Aerial parts		
<i>Ficus carica</i> L. / Lghodan, karmouss, El karma, Chreha. (GK18)	Moraceae	1	1	Medicinal	Fruit consumed fresh or dried in powder form as an antioxidant and anticancer agent.	Fruit	Powder / Oral	Antioxidant and anticancer
<i>Olea europaea</i> / Zitoun Ibari (TB 10)	Oleaceae	1	1	Medicinal	Olive For the diet for diabetics.	Fruit, Leaves	Oil / Oral	Diabetics
<i>Oxalis pes-caprae</i> L. / El-hommaida essaфра (MD10)	Oxalidaceae	0,81	0,81	Food	Stems, chewed raw by shepherds and children (Snacks).	Stems		
<i>Phragmites communis</i> Trin. / Lakssiba (AB 12)	Poaceae	0,41	0,41	Medicinal	An infusion of the powder prepared from the rhizome is recommended as a rinse for pruritus of the scalp and skin.	Rhizome	Infusion / Externally	Pruritus
<i>Phragmites communis</i> Trin / Leksseb (EB39)	Poaceae	0,49	0,49	Medicinal	Raw root for face skin	Root	Poultice / Externally	Face skin
<i>Cynodon dactylon</i> (L.) Pers /	Poaceae	0,67	0,68	Food Medicinal	Rhizomes dried and consumed as spices (Seasoning). Roots used as an infusion	Rhizomes	Infusion / Oral	Flu

Ennejem (EN35)		to attack the condition of the flu.							
<i>Chamaerops humilis</i> L. / Eddoum (DD53)	Palmaceae	0,87	0,88	Food	Heart of the root consumed in the raw state by the shepherds and the children (Snacks).	Root			
Others									
<i>Portulaca oleracea</i> L. / Errejla (ER5)	Portulacaceae	0,91	0,91	Food	Tender leaves and stems, cooked as vegetables in traditional recipes (Vegetables).	leaves			
<i>Rumex pulcher</i> L./ Homaida (HI15)	Polygonaceae	0,79	0,79	Food	Young leaves, mixed with <i>Lavatera cretica</i> L. to make "Beqoula" dish. (Vegetables). Flowers, cooked as a garnish for traditional bread (Garnish).	leaves, Flowers			
<i>Papaver rhoeas</i> L./ Belaaman (LA44)	Papaveraceae	0,97	0,99	Food Cosmetic	Flowers dried and consumed as spices. (Seasoning) or mixed with flower water for traditional make-up called "Matleya akar Fassi".	Flowers	Powder / Externally	Facial treatment	
<i>Cyperus rotundus</i> L./ Olique (OG14)	Rosaceae	0,44	0,46	Food Medicinal Others	Fruit consumed fresh (Snack). Dried leaves are used in herbal teas as deterrentive gargles, to treat angina and used as infusion for gastric problems.	Fruit Leaves	Drink / Oral	Angina / Gastric problems	
<i>Prunus amygdalus</i> <i>Stokes var amara</i> DC./ Louz lhar (LH 45)	Rosaceae	0,59	0,59	Medicinal	Dried fruit mixed in powder with honey to treat allergies.	Dried fruit	Compote / Oral	Allergies	
<i>Rubia peregrina</i> L./ El-fouwa (FW29)	Rubiaceae	0,37	0,38	Food Medicinal	He stems are dried and prepared as an infusion (Drinks). The roots are dried, powdered and used as an ingredient in the Moroccan soup "Hssoua" for people suffering from anemia or for young brides.	Stems, roots	Powder / Oral	Anemia	
<i>Lycium intricatum</i> Boiss/ Seder (ER 5)	Solanaceae	0,67	0,68	Food Medicinal	Fruits eaten raw (Snaks) or prepared as an infusion (Drink) for people suffering from kidney diseases. Liquid from the leaves in a fresh state used to fight against skin disease. The steam from the burning stems is also used to disinfect the environment and to have positive	Fruits Leaves stems	Snack / Oral Infusion / Oral Poultice / Externally	Skin disease / positive energy / disinfectant Hare care	

					energy - rural tradition. The leaves are dried and powdered with Henna poultice for hare care.			
<i>Mandragora autumnalis</i> Bertolt / Bayd elghoul (AH22)	Solanaceae	0,87	0,87	Medicinal	Rhizome powder mixed with olive oil is used to prepare suppositories for rectal use against hemorrhoids and vaginal use against uterine problems.	Rhizome	Suppositories/ Rectal Suppositories/ Vaginal	Hemorrhoids Uterine problems
<i>Lycium intricatum</i> Boiss / Sedra lmalssa (SM 22)	Solanaceae	0,66	0,67	Others Cosmetic	The aerial part is used as a protective seat around houses against snakes. leaves dried and powdered, used as a cataplasma to leave hair soft.	Aerial part	Poultice/ Externally	
<i>Populus alba</i> L. / Sefsaf (SF23)	Salicaceae	0,47	0,47	Medicinal	Leaves decocted for Gastric pain.	Leaves	Snack / Oral	Gastric pain
<i>Tuber oligospermum</i> / Terfas (TF91)	Tuberaceae	0,95	0,95	Food	Tuber used as a (Vegetable).	Tuber		
<i>Daphné garou</i> / Lazzaz LZ29)	Thymelaeaceae	0,72	0,72	Cosmetic	Green leaves dried and powdered, used as a cataplasma to leave hair soft.	Leaves	Poultice/ Externally	Hair care
<i>Urtica urens</i> L. / Horriga lharcha/ Horriga lharra (HU12)	Urticaceae	0,76	0,76	Medicinal	Aerial parts used as a foot bath to fight against rheumatic diseases.	Aerial parts	Foot bath/ Externally	Rheumatic
<i>Verveine officinale</i> L./ Baymût (BY15)	Verbenaceae	0,47	0,47	Medicinal	Leaves used as infusion as a painkiller	Leaves	Infusion / Oral	Nerves
<i>Aloysia citrodora</i> Palau / Lwiza (LW12)	Verbenaceae	1	1	Medicinal	Leaves Decoction	Leaves	Decoction / Oral	Sedative, hypertension
<i>Peganum harmala</i> / Harmal (HR49)	Vervaceae	0,92	0,92	Other	Incense disinfecting the environment and for other beliefs, which are "ancient traditions: "Bkhour" as conveying positive energy.			
<i>Alpinia officinarum</i> Hance/ Khudenjal (DJ60)	Zingiberaceae	0,48	0,48	Medicinal	Decoction root for emmenagogue	Root	Infusion / Oral	Emmenog-ogue

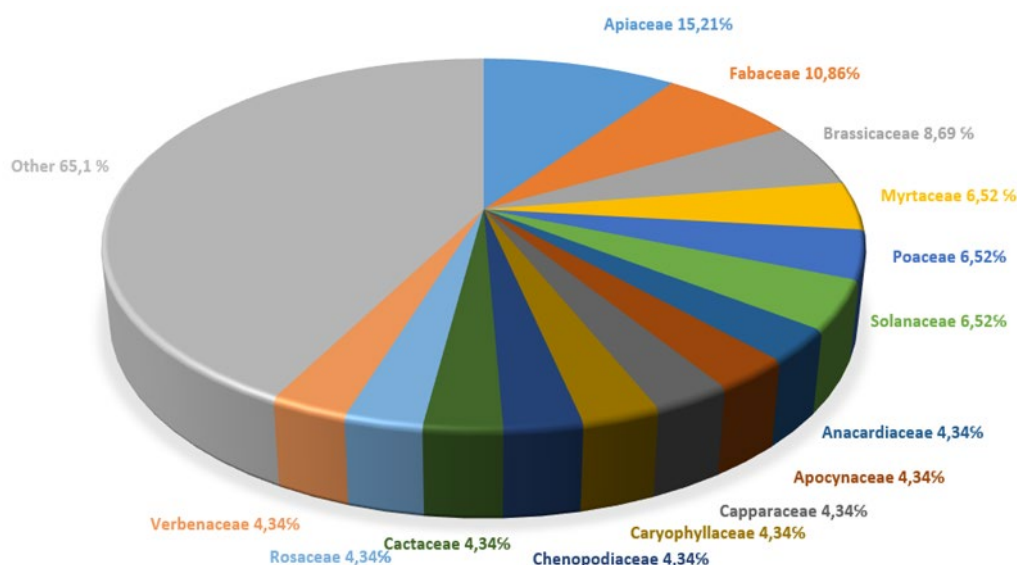


Figure 3. Distribution of the identified species by botanical families of the cited WEMCPs

Lythraceae, Molliginaceae, Malvaceae, Moraceae, Oleaceae, Oxalidaceae, Palmaceae, Portulacaceae, Papaveraceae, Rubiaceae, Salicaceae, Tuberaceae, Thymelaeaceae, Urticaceae, Vervaceae and the Zingibelaceae simultaneously. The other families grouped represented simultaneously (65.1%) ; these are: The Amaryllidaceae, Arecaceae, Berberidaceae, Ericaceae, Cannabaceae, Cupressaceae Cortinariaceae, Euphorbiaceae, Ericaceae, Fagaceae, Iridaceae, Illicaceae, Juncaceae, Juglandaceae, Lythraceae, Molliginaceae, Malvaceae, Moraceae, Oleaceae, Oxalidaceae, Palmaceae, Portulacaceae, Papaveraceae, Rubiaceae, Salicaceae, Tuberaceae, Thymelaeaceae, Urticaceae, Vervaceae and the Zingibelaceae simultaneously.

The predominance of Asteraceae is consistent with ethnobotanical studies conducted in North Africa such as Morocco (Ghanimi et al., 2022; Essaih et al., 2023; Aboukhalaf et al., 2022; Khabbach et al., 2012; Briguiche and Zidane, 2019), and Algeria (Sarri et al., 2014).

The different use types of the species mentioned

The results show that among all the uses of WEMCPs mentioned by the respondents, medicinal use is the majority in this region (35.29%), followed by food use (22.54%), then as both food and medicinal use

(20.58%), other uses (5.88%), followed by both food - medicinal and other use (4.9%), both food and other use (3.92%), cosmetic use (1.96%), both cosmetic and medicinal use (1.96%), both cosmetic - medicinal and psychoactive use (0.98%) which is a use revealed for the first time in this study and which marks a difference in the use of WEMCPs with other regions of the country (Essaih et al., 2023; Aboukhalaf et al., 2022; Ghanimi et al., 2022; Khabbach et al., 2012; Briguiche and Zidane, 2016) and countries in the region such as Algeria (Sarri et al., 2014). Finally, both food - medicinal and cosmetic use and medicinal and other use simultaneously represent a 0.98%.

The identification of all of these uses shows that most of the WEMCPs are used by the population of the study area for various purposes in addition to being primary sources of food for the population in the study region and other regions such as CasaBlanca Settat province (Essaih et al., 2023), Al Haouz Region (Ghanimi et al., 2022), Sidi Bennour province (Aboukhalaf et al., 2022). These plants contribute to the therapy of people in the study region in the same way as in other national regions, in the Rif (Chaachouay et al., 2019), in the province of Tarfaya (Idm'hand et al., 2020), and in other international regions including Ethiopia (Hankiso et al., 2023).

This widespread use of medicinal plants has been explained by the lack of access to health care and

the insufficiency of health infrastructure and medicines as well as low income of the populations by (Liu et al., 2023; Guedje et al., 2010).

The culinary uses

In addition to their medicinal, cosmetic and psychoactive uses, the WEMCPs cited could also be classified into seven food categories, based on their culinary uses and consumption patterns of the population (Figure 4). The majority (37%) of these WEMCPs cited was used as a mainly warming drink in winter to combat the cold in this mountainous study region, 17% is consumed raw as a snack by shepherds and young people in the fields, due to their abundance and ease of access and the abundance of several fruit-producing plant species such as *Juglans L./ Ljawz* and *Oak / Balout*. A proportion of 16 % of WEMCPs is used as vegetables and spices simultaneously and 12 % for food decoration to enhance dishes. Other wild plants were used simultaneously in the form of gum and oil (1%).

The results of this study revealed a very great diversity of culinary uses where the difference in plant biodiversity determines the difference in frequency of use between the different culinary categories determined in comparison with other regions. This is in agreement with the difference in culinary uses revealed in this work with other regions of the country where the

majority of plants are consumed as vegetables e.g. in the populations of the regions of Chaouias and Doukalla (Essaih et al., 2023). This also confirms that culinary cultural traditions correspond to the conditions of the living environment to which populations adapt by exploiting local biodiversity. Thus, the appearance of a very high number 103 species compared to other research studies (Aboukhalaf et al., 2022) reflected this diversity of culinary uses with the appearance of new modes of consumption such as *Pisticia oil lentiscus L* which is extracted and was used in the past for the preparation of fritters.

Use value (UV) and relative frequency of citation (RFC)

The most popular plants are those with the highest RFC and UV index. The RFC frequency was calculated on the basis of the number of respondents having mentioned wild plants consumed in the municipality (RFC) and the UV index was calculated on the basis of the number of citations per species and the number of informants having declared the plant species. The highest RFC and UV value (RFC = 1, UV = 1) belongs to the plants cited by all informants. According to the data from this survey in the study region, these are *Lavandula stoechas L./ Halhal* which is for medicinal use, *Juglans L./ Ljawz* for food and medicinal use (UV = 1; RFC = 1), *Lavatera cretica L. / El-khobbiza / El-bakkoula* (UV = 1; RFC = 1) for food use, *Thymus serpyllum / Ziitra* (UV = 1; RFC = 1) for food and medicinal use, *Olea europaea / Zitoun Ibari* (UV = 1; RFC = 1) for food and medicinal use, *Mentha pulegium L. / Fleuo* (UV = 1; RFC = 1), *Foeniculum vulgare P.Mill / Besbas lbouri* (UV = 1; RFC = 1) for use food, *Ammodaucus leucotrichus Coss & Dur / Al camoun soufi* (UV = 1; RFC = 1) for medicinal use, *Ammi visnaga L. Lam. / Bouchnikh* (UV = 0.90; RFC = 0.89) for food and other use, Compositae *Artemisia arborescens L. / Chiba* (UV = 1; RFC = 1) for food and medicinal use, *Opuntia ficus-indica (L.) Mill. / Sebbar, aknari* (UV = 1; RFC = 1) for food-medical and cosmetic use, *Arbutus unedo L./ Sasnou, boukhennou* (UV = 1; RFC = 1) for food use, *Oak/ Balout* (UV = 1; RFC = 1) for food use, *Rosmarinus officinalis / Azir lhour* (UV = 1; RFC = 1) for medicinal and food use, *Mentha suaveolens Ehrh / Mersita* (UV = 1; RFC = 1)

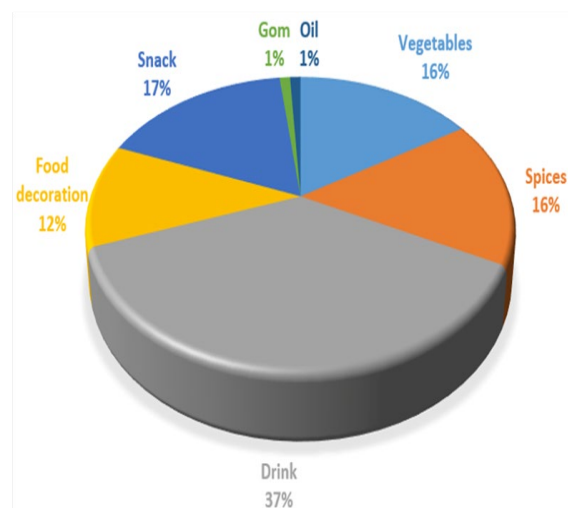


Figure 4. The consumption mode of the cited wild plants

for food and other use, *Ficus carica* L/ *Lghodan*, *karmouss*, *El karma*, *Chreha* (UV=1; RFC=1) for food and medicinal use, *Thymus broussonetii* Bois. / *Zaatar* (UV = 1; RFC = 1) for food and medicinal use, *Aloysia citriodora* Palau / *Lwiza* (UV = 1; RFC = 1) for food and medicinal use.

In the following positions come the plants which were cited by more than 90% of the informants. These are *Astragalus boeticus* L. / *Krinbouch* for food use (UV = 0.99; RFC = 0.99), *Papaver rhoeas* L. / *Belaaman* as food and cosmetic (UV = 0.99; RFC = 0.97) *Calamanta officinalis* / *Manta* (UV = 0.99; RFC = 0.97) as food and medicinal, *Ajuga iva* (L.) Schreb. / *Chendgoura* (UV = 0.98; RFC = 0.98) for food use, *Lavandula officinalis* / *Khezama* for medicinal use (UV = 0.96; RFC = 0.96), *Tuber oligospermum* / *Terfas* for food use (UV = 0.95; RFC = 0.95), *Melissa officinalis* / *Hbak tranj* for food use (UV = 0.94; RFC = 0.94), *Illicium verum* / *Lyansoun* for medicinal use (UV = 0.93; RFC = 0.93), *Eucalyptus globulus* Labill / *Lkalitos*, *Caliptus* for medicinal and other uses (UV = 0.92; RFC = 0.93), *Peganum harmala* / *Harmal* for other uses (UV = 0.92; RFC = 0.92), *Portulaca oleracea* L/ *Errejla* for food use (UV = 0.91; RFC = 0.91). (Table 4).

All of these species have the highest UV index and RFC, as they were mentioned by a large number of informants in the survey population. Medicinal and food plant species with a high UV index must be subject to quantitative, qualitative, phytochemical and pharmaceutical analysis in order to identify and quantify their active components. These species must also be prioritized for conservation because of their preferred uses to avoid overexploitation that can threaten their populations. This observation has also been the subject of subsequent studies and is shared by other authors in the field at the national and international level (Sarri et al., 2014).

The used parts

The analysis of the information collected showed that the leaves are the most used part with a percentage of 42% (Figure 5), followed by the aerial part (28%), then the fruits (18%), the roots (15%), seeds (13%), flowers (11%), stems (11%), then rhizomes

(4%), and finally, tubers, pistil, stigma, bract and calyx (1%) simultaneously.

These results corroborate those of other previous ethnobotanical research which reported that the leaves were the most commonly used part for the treatment of various diseases and in food recipes (Essaih et al., 2023; Hankiso et al., 2023). The wide use of these parts can be attributed to the fact that they are easy to access and can be collected quickly. Additionally, leaves serve as the primary site of photosynthesis in plants and in some cases, as a storage site for organic compounds responsible for the plant's biological characteristics. All of these factors contribute to the widespread use of this organ in various recipes, applications and remedies (Djamel et al., 2019; Eichert & Fernandez, 2023; Tamang et al., 2023).

Method of preparation and administration

Among the various methods of preparing WEMCPs used to facilitate administration, infusion constitutes the majority method of preparation declared by the population in this study region (41.25%), followed by poultice (13.75%), as snack (8.75%), foot bath and powder (7.5%) simultaneously, drink (6.25%), steam (5%), compote (3.75%), oil (2.5%) and finally smoking, this use appears for the first time in the research studies carried out by our team, and especially characterizes the region followed by the use as nose drops, chewing and suppositories (1.25 %) (Figure 6).

The decoction makes it possible to collect the most active ingredients and to attenuate or cancel the toxic effect of certain recipes (Wentholt et al., 2001). These figures confirm the results obtained by various authors at the national level in the Moroccan province of Tarfaya (Idm'hand, Msanda & Cherifi, 2020) and internationally in Nigeria (Ekpo et al., 2008), in Burkina Faso (Nadembega et al., 2011) and in Rawalpindi - Pakistan (Ahmad et al., 2017) where the preparations were made with water as a solvent. The decoction and infusion are highly valued and often preferred by local healers in Africa (Benarba, 2016).

The local population mainly uses external application (49%), especially in the treatment of skin diseases and hair care. Other methods of administration (rectal, vaginal, inhalation) are represented by a percentage of 9% (Figure 7, Table 4). The

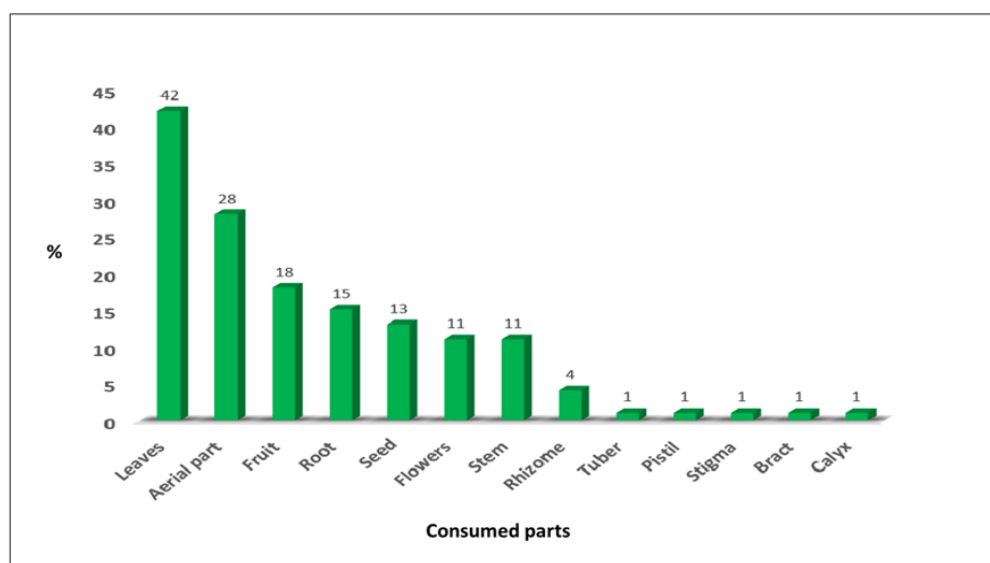


Figure 5. Distribution of the cited wild plants according to their consumed parts

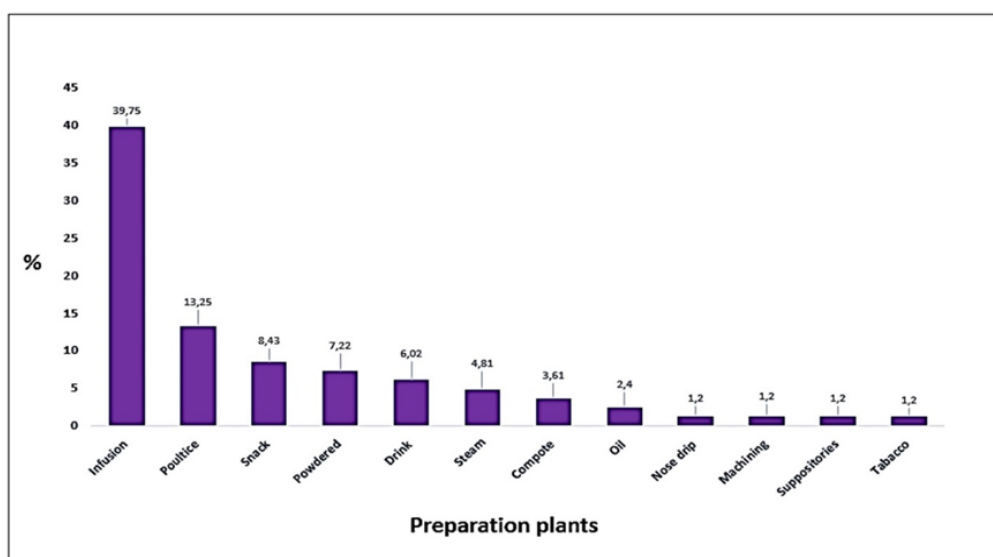


Figure 6. Methods of preparation of plants (%)

predominance of the external route makes the uses original in the study region (north of the country) and their difference well documented in the ethnobotanical studies carried out in the south of Morocco in Tarfaya (Idm'hand et al., 2020) and in Tata (Abouri et al., 2012) as well as in countries in the region such as Algeria, where the main route used and statistically in the majority is the oral route (Hadjadj et al. 2015; Madani et al., 2017).

In the present work, oral application is also used and constitutes the majority of preparation methods

(42%) such as snacks, compote, oil, decoction, powder, infusion.

Informant consensus factor (ICF)

The very high value (0.999) of the study informants consensus factor for WEMCP was cited for gastric problems and digestif pain, diabetes, Heal wounds and skin problems, Face care, Cancer, Respiratory system infection, face care, respiratory system infection, hair care, fever, nerves, flu,

rheumatism, and others category (Table 5). This very high value confirms the robustness of the information. These results corroborate with those reported before other regions of the country such as in Messiwa region (Ghanimi et al., 2022) and in Casablanca- Settat region (Essaih et al., 2023).

Table 5. Informant consensus factor (ICF)

Category	Number of used reports	% of used reports	Number of taxa	ICF
Gastric problems and digestif pain	20	20,4	20	0,999
Diabetes	7	7,14	7	0,999
Heal wonds and skin problems	3	3,06	3	0,999
Face care	5	5,10	5	0,999
Cancer	3	3,06	3	0,999
Respiratory system infection	3	3,06	3	0,999
Hair care	9	9,18	9	0,998
Fever	3	3,06	3	0,999
Nerves	3	3,06	3	0,999
Flu	3	3,06	3	0,999
Rheumatism	3	3,06	3	0,999
Other	36	36,73	36	0,994

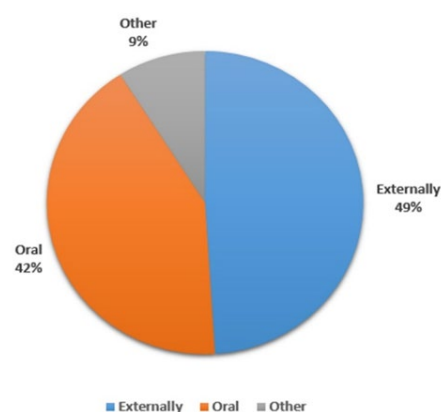


Figure 7. Routes of administration for herbal remedies (%)

Medicinal species used

The data from the present study shows that in this region, the medicinal plant species collected are consumed to treat a wide range of symptoms (Figure 8). Among these, gastric problems constituted the majority of pathologies (20.4%) treated with spontaneous plants in the study region. The same findings were recorded for medicinal plants listed in the town of El Jadida (Morocco) recommended to treat gastrointestinal disorders (Briguiche and Zidane, 2016) and in the region of Taounate (Northern Morocco) where these

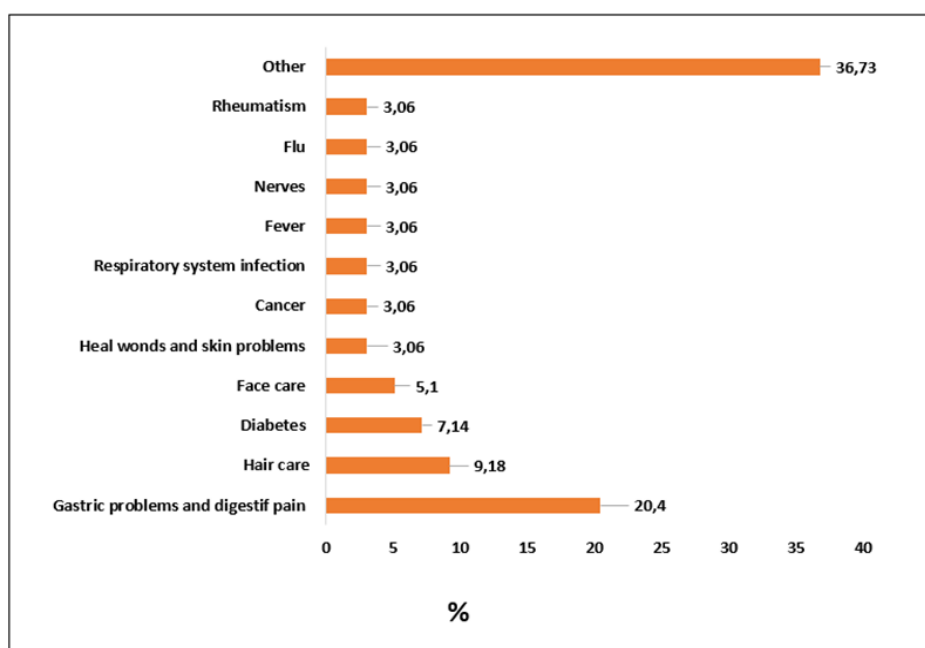


Figure 8. Pathologies groups

plants are reported to be the most used in the treatment of digestive problems (Sijelmassi, 1993).

The study respondents also reported using medicinal plants in hair care (9.18%), diabetes (7.14%), facial care (5.1%), wound healing and in skin problems, in cancer, respiratory system infection, fever, nerves, influenza, rheumatism (3.06%) simultaneously (Figure 7). Category of other disorders including menstrual pain, asthma, angina, reproductive glands, fever, eye diseases, live diseases, oriel pain, cough, psychological condition, rheumatology, hypoglycemic diuretic against bronchitis, kidney and gallbladder diseases, kidney diseases, pruritus, uterine pain, liver diseases, psychological state, anxiety, oral hygiene, disinfectant, allergies, anemia, skin diseases, hemorrhoids, emmenagogue, as a sedative, hypertension, positive energy represented in total with (36.73%) distributed over the different pathologies. This diversity of pathologies treated and medicinal uses of these plants,

confirms the close relationship between the population studied and their good exploitation of their local floral biodiversity. Other work carried out in the Mediterranean region has confirmed the same results in Spain (Tardio et al., 2006), Algeria (Madani et al., 2017) and Italy (Sansanelli & Tassoni, 2014).

The insufficiency of health infrastructure and essential medicines, the low income of the population surveyed as well as the lack of access to health care also explain this important herbal medicine (Guedje et al., 2010; Idm'hand et al., 2020).

Socio-demographic and socio-economic characteristics

Figure 9 presents the distribution of knowledge of wild plants cited according to the sociodemographic characteristics of the population of the study region.

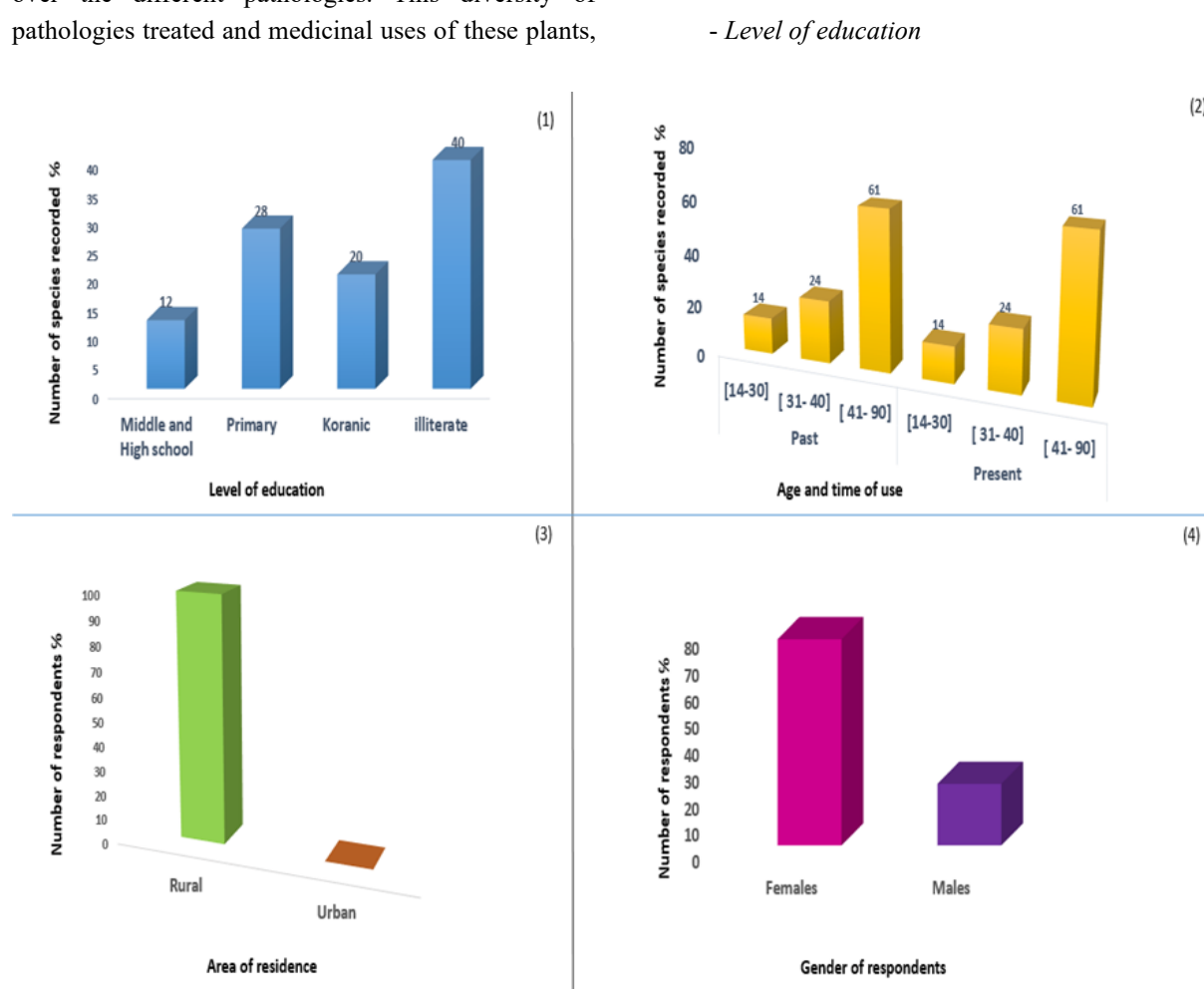


Figure 9. Number of recorded species/respondents according to education (1), age (2), area of residence (3), gender (4)

Knowledge of the plants consumed, assessed by the average number of citations, shows that the number of species cited by respondents decreases with the increase in the level of education. Figure (9-1) shows in fact that the greatest number of species of WEMCPs was cited by the illiterate (40%), followed by those at the Koranic school level (28%) then people of primary level (20%) and the smallest number was cited by those at secondary and high education levels simultaneously (12%). These results corroborate other ethnobotanical research on the same type of plants carried out in different regions of the country such as Messiwa (Ghanimi et al., 2022), and Casablanca- Settat (Essaih et al., 2023) of Morocco regions.

- Depending on age and period of use

Pleasantly surprisingly, for all age groups of the respondents, the number of WEMCPs species cited does not vary in the past and present (Figure 9-2). Indeed, the majority of people interviewed confirmed the story of their close relationship with nature explained by the ordinary uses cited linked to the consumption of these plants in the study region as well as the transmission of traditional knowledge of these uses from one generation to the next, and especially with the importance given to the region's plants on a national and international scale; the importance given to these plants is notably demonstrated by the creation of the National Agency for Medicinal and Aromatic Plants of Morocco.

- Residence area

As shown in Figure (9-3), no difference of knowledge level was revealed according to area of residence. This result is explained by the fact that all the survey respondents are (100%) rural and they carry out their professional activities at the local level. Indeed, the study area is a mountainous region with reliefs not allowing to combine work in a nearby urban environment while residing in a rural environment. Unlike in the Casa Blanca-Settat region where previous study data showing that (Essaih et al., 2023) respondents from the rural municipalities benefited

from access to work in the cities while they reside in their rural environment.

- According to gender

Figure 9-4 shows that in this study, the use of wild plants was greater among women (77%) than among men (23%). The data collected shows that women were better informed than men about ethnobotany. Similar results are obtained in other research carried out in the province of Moulay Yaakoub, in Morocco (Mahraz et al., 2023), in western Mexico (Flores et al., 2023) and in the North. Waziristan in Pakistan (Ali Shah et al., 2023). One of the examples to cite of observations made during a visit to the study region, is the observation of this crucial role of rural women making extensive use of their time in the traditional cannabis crop in the Rif which, a family farming, with a complex work organization in complementarity with men teaching women how to undertake and carry out certain cultivation stages. Nevertheless, equity to create income rewarding this considerable effort of women in this work is needed to benefit from a better social environment. The same observation was also made previously during work carried out in the Moroccan Rif (Afsahi, 2015).

Conclusion

Data from the present study of Human Ecology about ethnobotanical knowledge conducted in the Taounat province of Rif mountains in Morocco revealed the importance of the use of WEMCPs in human populations for different purposes including food, traditional herbal medicine, cosmetics, psychoactive and other uses. This study identified a considerable number of 103 species of plants belonging to 46 botanical groups, used in various food recipes, in the treatment of a variety of conditions without forgetting their intervention in the well-being of women in the region.

The results of this study showed that the best knowledge of herbal medicine and traditional cuisine are held by the elderly women and that the majority of these various uses of plants are inventoried by the respondents with a low level of education or those that are illiterate. The study data also indicates that the most

used parts are the leaves made into decoctions and infusions and are taken orally. Digestive diseases are the conditions most frequently mentioned in these traditional remedies. The results also indicate that the most common plants in this area are those used as snacks and vegetables.

All these results constitute a valuable database for future scientific research for an in-depth evaluation of the composition and scientific validation through qualitative and quantitative studies in order to protect the population against the harmful effects of the consumption of certain plants containing toxic groups, while preserving this important cultural heritage. The latter is a contribution of this work to the knowledge and protection of biodiversity in the Rif Mountains in Morocco, and precisely in the studied province of Taounate, which has an environmental value of considerable socio-economic importance for populations, which must be preserved from hazardous exploitation.

List of abbreviations: TR= Taounat region/province, WEMCPs = wild edible medicinal and cosmetic plants, RFC= Relative Citation Frequency Index, UV= Use value Index, FL= Fidelity level Index, ICF= Informant consensus factor Index.

Ethics approval and consent to participate in the survey: The participants were informed about the survey objectives and a formal consent was given from all of them before any interviews were conducted.

References

- Aboukhalaf A., Tbatou M., Kalili A., Naciri K., Moujabbir S., Sahel K., Rocha JM., Belahsen R. (2022). Traditional knowledge and use of wild edible plants in the Sidi Bennour region (Central Morocco). *J. Ethnobot. Res. Appl.* 23.11: 1-18.
- Aboukhalaf A., Moujabbir S., El Amraoui B., Naciri K., Kalili A., Essaih S., Rocha JM., Belahsen R. (2023). Phytochemical screening nutritional value antioxidant and antimicrobial activities and acute toxicity of *Scolymus hispanicus* A wild edible plant in Morocco. *J. Food Sci. Appl. Biotechnol.* 6, 2: 372-382.
- Abouri M., El Mousadik A., Msanda F., Boubaker H., Saadi B., Cherifi K. (2012). An ethnobotanical survey of medicinal plants used in the Tata Province, Morocco. *J. Int. Med. Plant Res.* 1, 7: 99–123.
- Agricultural Development Agency (ADA). Ministry of Agriculture of Morocco. (2008). Fisheries, Rural Development, Water and Forests: <https://www.ada.gov.ma> (Accessed on 07/01/2022).
- Afsahi K. (2015). No cannabis cultivation without women. The case of the Rif in Morocco. *J. Dev. Soc.* 1:73-97.
- Ali Shah I., Burni T., Badshah L., Ul Uza N. (2023). Indigenous knowledge and conservation status of wild plants collected from Garyaum, North Waziristan, Pakistan. *J. Ethnobot. Res. Appl.* 25:1-17 32.
- Benarba B. (2016). Medicinal plants used by traditional healers from south-West Algeria: an ethnobotanical study. *J. Intercult. Ethnopharmacol.* 5, 4:320.
- Betti JL., Ngankoué CM., Dibong SD., Singa AE. (2016). Ethnobotanical study of spontaneous food plants sold in the markets of Yaoundé, Cameroon. *J. Int. Biol. Chem. Sci.* 10, 4: 1678-1693.
- Betti JL. (2001). Usages traditionnels et vulnérabilité des plantes médicinales dans la réserve du Dja et dans les marchés de Yaoundé, Cameroun. Doctoral thesis, Université Libre de Bruxelles, Brussels.
- Betti JL. (2002). Medicinal plants sold in Yaoundé markets, Cameroon. *J. Afr. Study Monogr.* 23, 2: 47-64.
- Bhatia H., Sharma YP., Manhas RK., Kumar K. (2018). Traditionally used wild edible plants of district Udhampur, J&K, India. *J. Ethnobiol. Ethnomedicine* 14, 1:73.
- Briguiche H, Zidane L. (2019). A floristic and ethnobotanical study of medicinal plants used in the treatment of diseases of the respiratory system in the region of Doukkala. *Bulletin of the Scientific Institute, Rabat, Life Science Section.* 41:33–41
- Chaachouay N., Benkhniq O., Fadli M., El Ibaoui H., Zidane L. (2019). Ethnobotanical and ethnopharmacological studies of medicinal and aromatic plants used in the treatment of metabolic

- diseases in the Moroccan Rif. *J. Heliyon* 5,10: E02191.
- Djamel M., Bendif H., Ouabeda A., Rebbas K., Ait hammou M., Amirat M., Greene A., Teixidor I. (2019). Ethnoveterinary remedies used in the Algerian steppe: Exploring the relationship with traditional human herbal medicine. *J. Ethnopharmacol* 112-164:244.
- Dobignard A., Chatelain C. (2011). Synonymic index of the flora of North Africa. Volume I. http://www.floramaroccana.fr/files/downloads/IN_DEX_FAN_1_.pdf. (Accessed on 29/04/2022).
- Eichert T., Fernandez V. (2023). Chapter 4 - Uptake and release of elements by leaves and other aerial plant parts. (Fourth Edition), Academic Press, 2023, Pages 105-129, ISBN 9780128197738, <https://doi.org/10.1016/B978-0-12-819773-8.00014-9>.
- Ekpo BA., Bala DN., Essien EE., Adesanya SA. (2008). Ethnobotanical survey of Akwa Ibom state of Nigeria. *J. Ethnopharmacol* 115.3:387–408.
- El Houssine Bouiamrine LB., Ibijbjen J., Nassiri L. (2017). Fresh medicinal plants in middle atlas of Morocco: trade and threats to the sustainable harvesting, *J. Medicinal Plants* 5.2 :123–128.
- El-Hilaly J., Hmamouchi M., Lyoussi B. (2003). Ethnobotanical studies and economic evaluation of medicinal plants in the Taounate province (northern Morocco). *J. Ethnopharmacol* 86 (2-3):149-58.
- Essaih S., Aboukhalaf A., Naciri K., Kalili A., Tbatou M., Chamlal H., Moujabbir S., El-Amraoui B., Belahsen R. (2023). Ethnobotanical study on wild plants in some localities of Casablanca-Settat region of Morocco 3:255-7053
- Fennane M., Ibn Tattou M., Mathez J., Ouyahya A., and El Oualidi J. (1999). Practical Flora of Morocco, volume I. Scientific Institute Rabat Morocco.
- Fennane M., Ibn Tattou J., Ouyahya A., El Oualidi J. (2007). Practical flora of Morocco, volume II. Scientific Institute Rabat Morocco.
- Fennane M., Ibn Tattou M. (2005). Vascular flora of Morocco, inventory and chorology. Volume 1. Scientific Institute Rabat Morocco.
- Fennane M., Ibn Tattou M. (1998). Catalog of rare, threatened or endemic plants of Morocco. Boccone, Palermo. Scientific Institute Rabat Morocco.
- Flores A., Cuevas R., Olvera M. (2023). Ethnobotanical Knowledge of Edible Plants amongst Children from Two Rural Communities in Western Mexico. *J Hum Ecol* 51: 397– 407.
- Ghanimi R., Ouhammou A., Ahouach A., Cherkaoui M. (2022). Ethnobotanical study of wild edible plants traditionally used by Messiwa people, Morocco. *J Ethnobiol Ethnomed* 18: 16.
- Guedje NM., Fokunang CN., Jiofack R., Dongmo R. (2010). Opportunities for sustained use of medicinal plants in forest management. *J. Int. Biol. Chem. Sci* 4:4.
- Hadjadj S., Bayoussef Z., El Hadj-Khelil AO., Beggat H., Bouhafs Z., Boukaka Y., Khaldi IA., Mimouni S., Sayah F., Tey M. (2015). Ethnobotanical study and phytochemical screening of six medicinal plants used in traditional medicine in the northeastern Sahara of Algeria (area of Ouargla). *J. Med. Plant Res* 9, 41: 1049–1059.
- Hankiso M., Warkineh B., Asfaw Z., Debella A. (2023). Ethnobotany of wild edible plants in Soro District of Hadiya Zone, southern Ethiopia. *J. Ethnobiol Ethnomed* 19:21.
- Office of the High Commissioner for Planning (HCP). 2009. Monographies of Taza-Al Hoceima-Taounate region: <https://www.ada.gov.ma>. Accessed on 20/3/2023.
- Ahmad A., Buriro RS., Qureshi TA. (2017). Biochemical and Histopathological effects of Meloxicam in Rabbit. Lambert Academic Publishing. Pakistan.
- Idm'hand E., Msanda F., Cherifi K. (2020). Ethnobotanical study and biodiversity of medicinal plants used in Tarfaya province, Morocco. *J. Acta Ecol Sin* 40, 2: 134-144.
- Khabbach A., Libiad M., Ennabili A., Bousta D. (2012). Medicinal and cosmetic use of plants from the province of Taza, northern Morocco. *Boletín Latinoamericano y del Caribe de Plantas Medicinales y Aromáticas* ISSN: 0717-7917, vol. 11, 1:46–60. Universidad de Santiago de Chile. Chile.
- Liu P., Yuan W., Fu J., Jiang Z., Hayashi H., Neubig, G. (2023). Pre-training, asking and predicting: a systematic investigation of elicitation methods in

- natural language processing. *J. ACM Comput Surv* 55, 9:1-35.
- Madani S., Amel B., Noui H., Djamel S., Hadjer H. (2017). An ethnobotanical survey of galactogenic plants of the Berhoum District (M'sila, Algeria). *J. Intercult. Ethnopharmacol* 6, 3:31.
- Mahraz AM., Elhachmia C., Rais Z., Taleb M. (2023). Medicinal plants from Moulay Yaâcoub province, Morocco: an ethno-botanical and biodiversity²⁶ survey. *J.Trop.Nat. Prod. Res* 7:8.
- Mattas K., Raptou E., Alayidi A., Gizem Yener., George Baourakis. (2023). Assessing the Interlinkage between Biodiversity and Diet through the Mediterranean Diet Case. *J. Adv Nutr* 14,3:570-582.
- Nadembega P., Boussim JI., Nikiema JB., Poli F. (2011). Antognoni, F. Medicinal plants in Baskoure, Kourittenga province, Burkina Faso: an ethnobotanical study, *J. Ethnopharmacol* 133. 2:378–395.
- Nadiroğlu M., Behçet L. (2018). Traditional food uses of wild plants among the Karlıova (Bingöl-Turkey). *J. Int. Nat. Sci* 2, 2:57-71.
- Naciri K., Aboukhalaf A., Kalili A., Moujabbir S., Essaih S., Tbatou M., Belahyane A., Be-lahsen R. (2022). Ethnobotanical knowledge of wild food plants in Khénifra, a province in the Middle Atlas region of Morocco. *J. GSC Adv. Res. Rev* 13, 02:180-200.
- Nassif F., Tanji A. (2013). Gathered food plants in Morocco: the long forgotten species in ethnobotanical research. *J. Life Sci* 3:17–54.
- Nègre R. (1961). Small flora of the regions of Morocco occidental National center of scientific research in Morocco. Centre national de la recherche scientifique de Maroc Tomes I et II.
- Quezel P., Santa S. (1962). New Flora of Algeria and Southern Desert Regions. Editions Centre National de Recherche Sc, Paris, Tome 1:1170.
- Reyes-García V., Menendez-Baceta G., Aceituno-Mata L., Acosta-Naranjo R., Calvet-Mir L., Domínguez P., Garnatj T., Gómez-Baggethun E., Molina-Bustamante M., Molina M., Rodríguez-Franco R., Serrasolses G., Vallès J., Pardo-de-Santayana M. (2015). From famine foods to delicatessen: Interpreting trends in the use of wild edible plants through cultural ecosystem services. *Ecological Economics* 120: 303-311.
- Salih NKM., Ali AH. (2014). Wild food trees in Eastern Nuba Mountains, Sudan: use diversity and threatening factors; *J. Agric. Rural Dev. Trop. Subtrop* 115, 1:1-7.
- Sansanelli S., Tassoni A. (2014). Wild food plants traditionally consumed in the area of Bologna (Emilia Romagna region, Italy). *J.Ethnobiol and Ethnomed* 10:69.
- Sarri M., Mouyet FZ., Benziane M., Cheriet A. (2014). Traditional use of medicinal plants in a city at steppe character (M'sila, Algeria). *J. Pharm. Pharmacogn. Res* 2, 2: 31–35.
- Serra-Majem L., Tomaino L., Dernini S., Berry E., Lairon D., De la Cruz N. et al. (2020). Updating the Mediterranean diet pyramid towards sustainability: focus on environmental concerns. *Int. J. Environ. Res. Public Health* 17:23, 8758 .
- Silva FS., Ramos MA., Hanazaki N., Albuquerque UP. (2011). Dynamics of traditional knowledge of medicinal plants in a rural community in the Brazilian semi-arid region. *J.Braz Pharm Sci* 21, 3: 382-391.
- Sijelmassi A., (1993). Medicinal plants of Morocco en bibliothèque; Imprim Disabled; Internet Archive Livres Paperback – Large format book. Accessed on April 20, 2021.
- <https://www.amazon.fr/Plantes-M%C3%A9dicinales-du-Maroc/dp/9981838020>.
- Sundriyal Manju RC., Eklabya S. (2004). Food use of wild plant resources in the Himalayas of Sikkim. *J. Inde. Econ. Bot* 58, 4:626 - 638.
- Tardio J., Pardo-de-Santayana M., Morales R. (2006). Revue ethnobotanique des plantes sauvages comestibles en Espagne. *Botanical Journal of the Linnean Society* 152, 27–71.
- Tamang S., Singh A., Bussmann RW., Shukla V., Nautiyal M.C. (2023). Ethno-medicinal plants of tribal people: A case study in Pakyong subdivision of East Sikkim, India. *Acta Ecol Sin J* 43:34-46.
- Tbatou M., Fagroud M., Belahyan A., Belahsen R. (2016). Wild edible plants traditionally used in the rural area of El Jadida (Center of Morocco): Assessing Traditional knowledge erosion. *J. LSL* 75:30 – 51.

- Tbatou M., Kabil M., Belahyan A., Belahsen R. (2018). Dietary potential of some forgotten wild leafy vegetables from Morocco. *Int Food Res J* 525, 5: 1829-1836.
- Tbatou M., Belahyan A., Belahsen R. (2016). Wild edible plants traditionally used in the countryside of El Jadida, Coastal area in the center of Morocco. *J. Life Sci. Leaf* 75: 28 - 48.
- Ugulu I. (2012). Fidelity Level and Knowledge of Medicinal Plants Used to Make Therapeutic Turkish Baths. *Stud. Ethno-Med J* 06:01.
- Ullah K., GM Shah J., Alam MH. (2020). Ethnobotany of the Medicinal Plants Used by Indigenous Communities in the Mountain of Shishikoh Valley, Hindukush Chitral. *Ukr. J. Ecol* 10, 2:92-105.
- Valdés B., Rejdali M., Achhal El Kadmiri A., Jury SL., Montserrat JM. (2002). Catalog of vascular plants from northern Morocco. Volumes 1 & 2. Consejo Superior de Investigaciones Científicas. Biblioteca de Ciencias. Madrid.
- Wentholt W., Dembele A., Diallo M. (2001). Gender and agricultural research in Mali. Mali Book. Institut d'Economie Rurale, BP 258, Bamako.