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Original Article

Ethnobotanical study of plants used for medicinal, cosmetic, and food purposes in the region of Moulay Yacoub, Northeast of Morocco

[Estudio etnobotánico de plantas utilizadas con fines medicinales, cosméticos y alimenticios en la región de Moulay Yacoub, noreste de Marruecos]

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Abstract

Context: Medicinal and aromatic plants are used by people for various purposes, whether for health care, beauty, or as a food source.

Aims: To valorize the knowledge about their uses, therapeutic, cosmetic, and food.

Methods: The ethnobotanical study was conducted from November 1, 2019, to March 1, 2021, in the Moulay Yacoub region. A total of 407 local informants were interviewed. The methodological approach was open-ended and semi-structured interviews with open-ended questions based on therapeutic, cosmetic, and dietary criteria. Quantitative analyses were performed using basic statistics, use value (UV), family use value (FUV), plant part value (PPV), and informant agreement ratio (IAR).

Results: A total of 104 plant species belonging to 46 families were identified. The majority of plants are used in phytotherapy (78.30%). The most frequent ailments reported were digestive (IAR = 0.9). The most used method of preparation was infusion (42.68%), the leaves were the most used part of the plant (PPV = 0.45), and *Anchusa italica* Retz (UV = 0.196) was the most commonly prescribed species by local herbalists, and *Oleaceae* (FUV = 0.16) was the most dominant family.

Conclusions: This study showed the richness of the plants and the consistency of the knowledge of the natives on medicinal and aromatic plants. As part of this study, we are currently working on plants with curative effects to prove their efficacy in animal models, including *Anchusa italica* Retz, which was widely cited in this ethnobotanical study. Authors invite scientists to conduct further phytochemical and pharmacological research on medicinal plants from this region based on this study.

Keywords: food; medicinal and aromatic plants; Moulay Yacoub; phytocosmetics; phytotherapy.

Resumen

Contexto: Las personas utilizan plantas medicinales y aromáticas para diversos fines, ya sea para el cuidado de la salud, la belleza o como fuente de alimento.

Objetivos: Valorar el conocimiento sobre sus usos, terapéuticos, cosméticos y alimentarios.

Métodos: El estudio etnobotánico se realizó del 1 de noviembre de 2019 al 1 de marzo de 2021 en la región de Moulay Yacoub. Se entrevistó a un total de 407 informantes locales. El abordaje metodológico fue entrevistas abiertas y semiestructuradas con preguntas abiertas basadas en criterios terapéuticos, cosméticos y dietéticos. Se realizaron análisis cuantitativos utilizando estadísticas básicas, valor de uso (UV), valor de uso familiar (FUV), valor de parte de la planta (PPV) y razón de acuerdo de informantes (IAR).

Resultados: Se identificaron un total de 104 especies de plantas pertenecientes a 46 familias. La mayoría de las plantas se utilizan en fitoterapia (78,30%). Las dolencias más frecuentes reportadas fueron las digestivas (IAR = 0,9). El método de preparación más utilizado fue la infusión (42,68%), las hojas fueron la parte más utilizada de la planta (VPP = 0,45), y *Anchusa italica* Retz (UV = 0,196) fue la especie más prescrita por los herbolarios locales, y *Oleaceae* (FUV = 0,16) fue la familia más dominante.

Conclusiones: Este estudio mostró la riqueza de las plantas y la consistencia del conocimiento de los nativos sobre plantas medicinales y aromáticas. Como parte de este estudio, actualmente se trabaja en plantas con efectos curativos para demostrar su eficacia en modelos animales, incluida *Anchusa italica* Retz, que fue ampliamente citada en este estudio etnobotánico. Los autores invitan a los científicos a realizar más investigaciones fitoquímicas y farmacológicas sobre plantas medicinales de esta región con base en este estudio.

Palabras Clave: extracción; cicatrización de herida; formulación; *Linum usitatissimum*; revisión sistemática; semilla de lino.

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INTRODUCTION

Medicinal and aromatic plants have been used in herbal medicine by humans since ancient times (Mishra et al., 2018). The Moroccan people are characterized by a rich and ancient culture and tradition in the field of herbal medicine (Bellakhdar, 1997). Many plants are used for the treatment of numerous diseases and phytotherapy is an integral part of Moroccan culture. People still practice the art of herbal medicine. The culture of the use of medicinal plants and their benefits is passed down through the generations (Bousta et al., 2014). Morocco, by its biogeographical position, is characterized by a very rich ecological and floristic diversity constituting a true plant genetic reserve, with about 4500 species belonging to 940 genera and 135 families (Chaachouay et al., 2019a).

This biodiversity is characterized by very marked endemism (Ghanmi et al., 2011). Allows it to occupy a privileged place among the Mediterranean countries to be a which have a long medical tradition and traditional know-how based on medicinal plants (Scherrer et al., 2005). The analysis of the Moroccan medicinal bibliography shows that the data on regional medicinal plants are very fragmentary and dispersed. We believe that the heritage of the medicinal flora requires regular monitoring and evaluation in terms of quality and quantity (Chaachouay et al., 2019b).

Cosmetic plants have often been overlooked in ethnobotanical surveys that focus primarily on plants for medicinal or food use (Jost et al., 2016). Phytocosmetics is art in the domestic medicine of many cultures. The majority of cosmetic plants are used to enhance beauty, eliminate body odor, purify and treat certain skin diseases (Fred-Jaiyesimi et al., 2015).

The objective of the present survey was to valorize the plants medicinal and aromatic that grow in the province of Moulay Yacoub and to analyze the results concerning the existing relations between the plants and their uses. Indeed, it is very important to transform this traditional knowledge into scientific knowledge to revalue, preserve and use it rationally.

MATERIAL AND METHODS

Study area

This study was carried out in the province of Moulay Yacoub. The latter is located 25 km to the N-W of the city of Fez and covers an area of 1700 km². According to data from the General Population and Housing Census of September 2014 (HCP, 2014). The legal population of this province is estimated at 174,079 inhabitants, which represents 4.1% of the population of the Fez-Meknes region. This area is limited to the north by the province of Taounate, to the east and southeast by the prefecture of Fez, to the south by the provinces of Sefrou and Elhajeb, to the west by the prefecture of Meknes and the province of Sidi Kacem (Mimad et al. 2010). The province has 11 municipalities including 10 rural municipalities and one urban municipality: Louadaine, Ain Bouali, Laajajra, Oulad Mimoun, Sidi Daoud, Sebt Loudaya, Moulay Yacoub, Sbaa Rouadi, Ain Kansra, Ain Chkef, and Mikkes (Fig. 1).

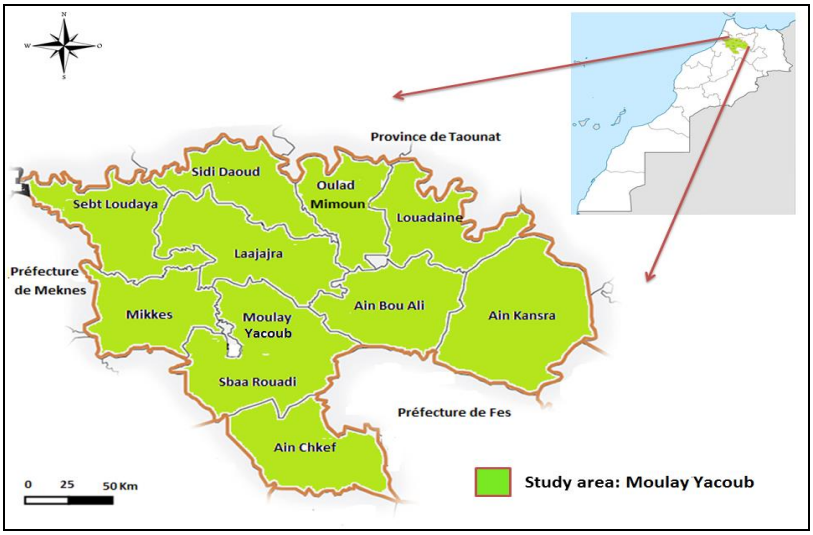

Figure 1. Mapping representation of study area.

In the area, the economy of the local people depends on subsistence agriculture, livestock, and to a lesser extent, several industrial activities (agro-food, textiles, etc.) and tourism, particularly near the thermal springs of Moulay Yacoub and that of Ain Allah. Rainfall in the Moulay Yacoub region is generally quite high in winter and almost zero in summer. The average annual rainfall is around 600 mm / year. As for the temperature generally varies from 6 to 36°C and is rarely below 2°C or above 42°C.

Ethnobotanical survey

To collect data on medicinal and aromatic plants, which is used for therapeutic and cosmetic purposes, an ethnobotanical survey was conducted from November 1, 2019, to March 1, 2021. Semi-structured questionnaires were administered, and free lists were conducted, through face-to-face interviews and focus groups, adopting the standard methodology of Martin (2014). The questionnaire was composed of two parts. The first one contained the demographic characteristics of the informants, generalities on the plant, its name, and availability on the market and field of use. The second one was on the pharmacological and cosmetic use of the plant: type of treatment, preparation technique, formulas, mode of administration, duration of application, and side effects (Annex A). The people interviewed, randomly selected from the study population, were women and men between the ages of 14 and 80. A total of 407 people were interviewed, 258 women and 149 men, including men and women who depended on plants as a source of medicine or cosmetic care either for themselves or to treat others.

Plant species identification and preservation

The plants used by the informants were placed in the herbarium. They were photographed and sampled for identification at the Biodiversity and Resources Laboratory, Department of Biology Faculty of Science, Ibn Tofail University Kenitra, Morocco, using the botanical works following: the medicinal plants of Morocco (Sijelmassi, 1993). The practical flora of Morocco (Fennane et al., 1999).

Data analysis

The socio-demographic data of the informants were analyzed using a descriptive and quantitative statistical method (ANOVA One-way and Independent Samples t-Test, p-values of 0.05 or less were considered significant). The results of the ethnobotanical survey were analyzed using the Family Use Value (FUV), Use Value (UV), Plant Part Value (PPV), and Informant Agreement Ratio (IAR). All statistical analyses were carried out with Statistical Package for Social Science (SPSS) version 20 and Microsoft Excel 2010.

Family use-value (FUV)

To show the importance of plant families we used FUV. This is an index of the cultural importance that can be applied in ethnobotany to calculate the value of a biological plant taxon. To calculate the FUV, we used the following formula [1].

$$\mathrm{FUV} = \frac{\mathrm{UVs}}{\mathrm{Ns}} \quad [1]$$

Where UVs = UV is the number of informants mentioning the family and Ns is the total number of species in each family (Sreekeesoon and Mahomoodally, 2014).

Use Value (UV)

The use-value of species (UV), a quantitative method for evidencing the value of locally known species (Vitalini et al., 2013). Was also calculated according to the following formula [2].

$$\mathrm{UV} = \frac{\sum \mathrm{UR}}{\mathrm{N}} \quad [2]$$

Where UR is the number of use reports mentioned by each informant (i) and N is the total number of informants interviewed for a given plant species.

Plant part value (PPV)

The plant part value (PPV) was determined using the following formula [3] (Chaachouay et al., 2019b).

$$\mathrm{PPV} = \frac{\mathrm{RU}}{\mathrm{RUplant\ part}} \quad [3]$$

Where RU is the number of reported uses of all plant parts and RUplant part is the sum of reported uses per plant part. The part with the highest PPV is the most used by respondents.

Informant agreement ratio (IAR)

To calculate IAR we used the following formula [4] (Heinrich et al., 1998).

$$\mathrm{IAR} = \frac{\mathrm{Nur} - \mathrm{Nt}}{\mathrm{Nur} - 1} \quad [4]$$

Where IAR is the informant agreement ratio, Nur is the number of mentions in each category and Nt is the number of taxa used in each category. The values of the factor are between 0 and 1.

RESULTS

A total number of 407 respondents were interviewed, of which 63.4% were women and 36.6% men. Also, 37.3% were within the age range of 20-40 years, 45% within the age range of 40-60 years, while 14.7% exceed the age range of 60 years. At the educational level, the majority of the respondents were illiterate (57.2%), and 20.4% of the informants have been in elementary school, 9.6% in middle school, and 7.9% in high school. Academics, on the other hand, make very little use of medicinal plants (4.9%). The result is summarized in Table 1.

Table 1. Demographic profile of respondents.

Variables	Categories	Total	Percentages (%)
Gender	Female	258	63.4
	Male	149	36.6
Age	<20 years	12	3.0
	20–40	152	37.3
	40–60	183	45
	>60 years	60	14.7
Level of study	Illiterate	233	57.2
	Primary	83	20.4
	College	39	9.6
	Secondary	32	7.9
	University	20	4.9

Ethnobotanical survey

In the present survey, 104 medicinal plants belonging to 46 different botanical families were used in phytotherapy, phytocosmetics, and food by the local population. The families *Lamiaceae*, *Asteraceae*, *Apiaceaeare*, *Fabaceae*, *Solanaceae*, and *Poaceae* were the most frequently mentioned families in this study. Based on the FUV index, the most cited families were *Oleaceae* (FUV = 0.16), (FUV = 0.105), *Amaryllidaceae* (FUV = 0.083). Also, the present study showed that *Anchusa italica* Retz. had the highest value (UV = 0.196), followed by *Olea europaea* L. (UV = 0.16), and *Origanum compactum* Benth. (UV = 0.135) (Table 2).

The domain of use of plants

Results showed that the majority of plants used by the inhabitants of Moulay Yacoub province have therapeutic uses with a percentage of 78.30%, followed by the food and cosmetic domains with percentages of 12.24% and 9.26%, respectively (Fig. 2).

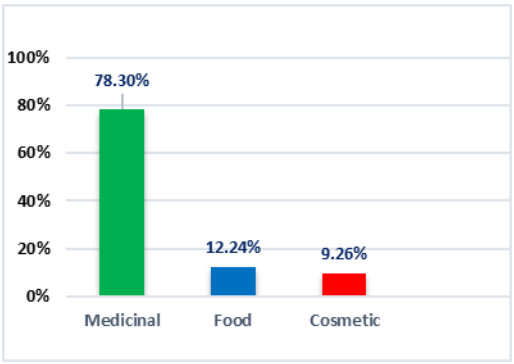

Figure 2. Frequency of domain of use of plants

Pharmacological uses and their IAR values

The IAR values are used to determine the most effective plants, and they also determine the level of disease prevalence in the study area. The IAR values revealed that digestive disorders were the most prevalent disease in the study area, with an IAR value of 0.9, followed by respiratory disorders (0.89). Then skin diseases (0.87), rheumatic (0.86), metabolic (0.85), nervous system (0.84), and urogenital disorders (0.83) (Table 3).

Plant parts used

The plant contains several parts, each part has therapeutic properties. Based on the PPV index of the value of plant parts, leaves were reported as the dominant plant part in the preparation's leaves (PPV = 0.45), followed by fruits (PPV = 0.279), roots (PPV = 0.154), stems (PPV = 0.045), bulbs (PPV = 0.04), flowers (PPV = 0.023), rhizomes (PPV = 0.007) (Fig. 3).

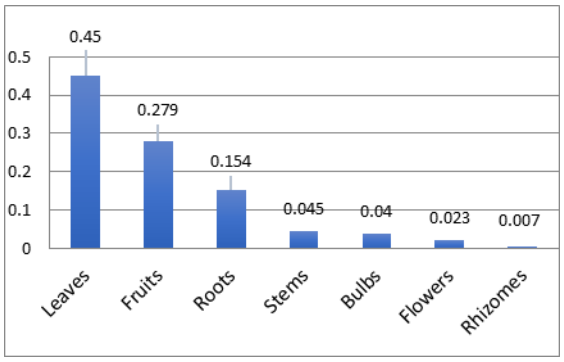

Figure 3. Part plant used for medicinal, cosmetic and food preparation

Table 2. Medicinal plants used for medicinal, food, and cosmetic purposes.

Family and botanical name	Common name	Part used	Preparation and administration mode	Therapeutic and cosmetic uses	UR	UV	FUV
Agavaceae							0.005
Agave sisalana Perrine	Sabra	Leaves	*Agave sisalana* gel mixed with *Lawsonia inermis* and vinegar / LO	Eczema	2	0.005	
Amaryllidaceae							0.083
Allium cepa L.	Al'Bassla	Bulb	Infusion / Or	Tension, weakness of heart, respiratory tract	28	0.07	
			Allium cepa juice with olive oil / LO	Fortify hair			
Allium sativum L.	Touma	Bulb	*Allium sativum* L. / Ge	Diarrhea, antibacterial	36	0.09	
			Allium sativum L. with olive oil / LO	Antifungal, ringworm, fortify hair			
Asphodelus microcarpus Salzm. & Viv.	Berwâg	Rhizome	Warming of olive oil in *Asphodelus microcarpus*	Antibacterial, Injuries, wounds	03	0.007	
			Tubers and distilled in the ears and on wounds/ LO				
Amaranthaceae							0069
Beta vulgaris L.	L'barba	Fruits	Infusion / Or	Anemia, food	8	0.019	
Dysphania ambrosioides (L.) Mosyakin & Clemants	M'khinza	Leaves	Compress / LO	Fever	49	0.12	
			Maceration / Or				
Anacardiaceae							0.007
Pistacia lentiscus L.	Drou	Fruits	Infusion / Or	Stomachache	03	0.007	
Apiaceae							0012
Ammi majus L.	Atrilal	Fruits	Infusion / Or	Stomachache	2	0.005	
Ammi visnaga (L.) Lam.	Bechnikha	Fruits	Infusion / mouthwash	Gingivitis and antifungal	9	0.022	
Cuminum cyminum L.	Kemmân	Fruits	Infusion / Or	Stomachache, soothing and calming	7	0.017	
Coriandrum sativum L.	L' qezbour	Leaves	Infusion / Or	Depurative, analgesic, nephritis, lack of sleep	3	0.007	
Daucus carota L.	Khizzo	Roots	Infusion / Or	Xerophthalmia, food	8	0.019	
			Carrot juice / Or				
Foeniculum vulgare Mill.	Besbes	Stems	Juice distilled in the eyes / Or	Purify the eyes, food	6	0.014	
Petroselinum crispum (Mill.) Fuss	Maadnos	Leaves	Decoction / Or	Depurative, renal filtration, stomachache	3	0.007	

Table 2. Medicinal plants used for medicinal, food, and cosmetic purposes (continued…)

Family and botanical name	Common name	Part used	Preparation and administration mode	Therapeutic and cosmetic uses	UR	UV	FUV
Pimpinella anisum L.	Nafaa	Fruits	Infusion / Or	Soothing and calming	2	0.005	
Apocynaceae							0.027
Nerium oleander L.	Defla	Stems	Infusion/ mouthwash	Gingivitis, toothache	11	0.027	
			Fumigation / inhalation	Headaches			
			Decoction with *Salix* L. leaf and salt in water are used for foot washing/LO	Rheumatism			
Araliaceae							0.003
Chamaerops humilis L.	Doum	Roots	Infusion / Or	Antibacterial, stomachache	1	0.002	
Hedera helix L.	Lwaya	Leaves	Powder / LO	Injuries and wounds	2	0.005	
Aristolochiaceae							0.019
Aristolochia longa L.	Bereztem	Leaves	Powder mixed with honey / Or	Cancer, tumors	8	0.019	
			Powder / LO	Wounds, burns			
Asparagaceae							0.002
Drimia maritima (L.) Stearn	Onsale	Bulb	Juice massage / LO	Eczema	1	0.002	
Asteraceae							0.029
Artemisia absinthium L.	Chiba	Leaves	Infusion / LO	Antibacterial, rheumatism	12	0.029	
Calendula officinalis L.	L'jamra	Leaves	Powder / LO	Wounds, burns	3	0.007	
			Infusion/ Or	Cancer, diabetes			
Carlina acaulis L.	Tafgha	Roots	Infusion with *Ziziphus lotus* / Or	Cough and stomach pain	3	0.007	
Chamaemelum achilleifolium (DC.) E.H.L.Krause.	Babounej	Fruits	Infusion / Or	Appeasing, stomachache	17	0.041	
Cynara auranitica Post	Kanariya	Stems	Infusion / decoction / Or	Stomachache	14	0.034	
Cynara cardunculus L.	Kharchaf	Stems	Infusion / Or	Stomachache	1	0.002	
Cynara humilis L.	Taymat	Roots	Powder / LO	Wounds, burns	17	0.041	
Dittrichia viscosa (L.) Greuter	Magraman	Leaves	Powder / LO	Burns and wounds	49	0.12	
Echinops spinosissimus Turra	Jarenij	Stems	Stem milk / LO	Lichen planus	2	0.005	
			Stem / Or	Food			

Table 2. Medicinal plants used for medicinal, food, and cosmetic purposes (continued…)

Family and botanical name	Common name	Part used	Preparation and administration mode	Therapeutic and cosmetic uses	UR	UV	FUV
Lactuca sativa L.	Khasse	Leaves	Powder mixed with turnip and cucumber and carrots / LO	Mask for face care	2	0.005	
Boraginaceae							0.105
Anchusa italica Retz.	Ouachem	Roots	Powder / LO	Burns and wounds	80	0.196	
Cynoglossum clandestinum Desf.		Roots	Cataplasm / LO	Burns, ulcers	6	0.014	
Brassicaceae							0.019
Lepidium sativum L.	Hab rechad	Fruit	Infusion / Or	Strengthen bones	2	0.005	
Raphanus sativus L.	Lfjel	Fruits	Infusion / Or	Stomachache, appetite, stimulates digestion, food	14	0.034	
Cactaceae							0.017
Opuntia ficus-indica (L.) Mill.	Hindiya	Flowers	Powder mixed with honey / Or	Stomachache, cancer	7	0.017	
Cannabaceae							0.002
Cannabis sativa L.	Taba	Leaves	Powder / LO	Eczema	1	0.002	
	Elkif	Fruits	Powder mixed with *Lawsonia inermis* powder / LO	Fortify hair	1	0.002	
Capparaceae							0.068
Capparis spinosa L.	Kabbar	Fruits	Infusion with water and salt / Or	Rheumatism and antidiabetic, food	28	0.068	
Caryophyllaceae							0.004
Herniaria hirsuta L.	Haraste Lahjer	Leaves	Infusion / Or	Diuretic	2	0.005	
Silene vulgaris (Moench) Garcke	Tighighacht	Leaves	Powder mixed with honey / Or	Stomachache	1	0.002	
Spergularia rubra (L.) J.Presl & C.Presl	Haras lahjar	Leaves	Infusion / Or	Diuretic, urinary antiseptic	2	0.005	
Cucurbitaceae							0.013
Citrullus lanatus (Thunb.) Matsum. & Nakai	Dalah	Fruits	Infusion / Or	Stomachache, depurative, food	6	0.014	
Cucumis sativus L.	Khyar	Fruits	Compress / LO	Eye fatigue	9	0.022	
Cucurbita maxima Duchesne	Gueraa lhamra	Fruits	Infusion / Or	Prostate disorders	2	0.005	

Table 2. Medicinal plants used for medicinal, food, and cosmetic purposes (continued…)

Family and botanical name	Common name	Part used	Preparation and administration mode	Therapeutic and cosmetic uses	UR	UV	FUV
Cupressaceae							0.012
Tetraclinis articulata (Vahl) Mast	l-araar	Leaves	Fumigation/ inhalation	Nose and eye bleeds	5	0.012	
Cyperaceae							0.002
Scirpus abactus Ohwi	Smar	Roots	Cooked / LO	Warts	1	0.002	
Euphorbiaceae							0.012
Euphorbia aaron-rossii A.H.Holmgren & N.H.Holmgren	Ddaghmûs	Roots	Root powder with hot milk / Or	Tumor, cancer	2	0.005	
Ricinus communis L.	L'kharwaâ	Fruits	Ricinus oil with olive oil / LO	Fortify hair	8	0.019	
Fabaceae							0.052
Ceratonia siliqua L	Kharoub	Fruits	Powder mixed with honey / Or	Stomachache, food	30	0.073	
Cicer arietinum L.	L'hamass	Stems	Cooked / LO	Warts and tumors	24	0.058	
		Fruits	Infusion / decoction / Or	Food			
Lens culinaris Medik.	Laâdas	Fruits	Infusion / decoction / Or	Anemia, food	9	0.022	
Trigonella adscendens (Nevski) Afan. & Gontsch.	Halba	Fruits	Infusion / decoction / Or	Stomachache, appetite, food	42	0.103	
			Trigonella adscendens with *Tetraclinis articulata* and *Origanum compactum* / Inhalation	Headaches			
Vicia ervilia (L.) Willd.	Karessana	Fruits	Infusion / Or	Stomachache	1	0.002	
Vicia faba L.	L'foul	Fruits	Powder mixed with *Cicer arietinum* / LO	Face mask	22	0.054	
			Fruits / Or	Food			
Lamiaceae							0.057
Ajuga iva (L.) Schreb.	Chendgura	Leaves	Powder mixed with honey / Or	Cough, rheumatism	8	0.019	
Lavandula angustifolia Mill.	Khzâma	Leaves	Infusion / Or	Calming, soothing	29	0.071	
			Powder / LO	Hair loss, wounds, antiseptic			
Marrubium vulgare L.	Merrîwa	Leaves	Infusion / Or	Rheumatism, antibacterial, cough, cold	27	0.066	
			Infusion / LO	Antibacterial, wounds			

Table 2. Medicinal plants used for medicinal, food, and cosmetic purposes (continued…)

Family and botanical name	Common name	Part used	Preparation and administration mode	Therapeutic and cosmetic uses	UR	UV	FUV
Melissa officinalis L.	Naânaâ	Leaves	Massage with E.O / LO	Rheumatism	4	0.009	
Mentha suaveolens Ehrh.	Marsita	Leaves	Maceration in milk / Or	Antiseptic, antitoxic	13	0.031	
			Leaves with durum wheat / Or	Stomachache, food			
Mentha suaveolens Ehrh.	Mentha	Leaves	Infusion of *Mentha* and *Camellia* / Or	Calming, soothing	2	0.005	
Mentha pulegium L.	Fliyyo	Leaves	Infusion in hot milk / Or	Cold, flu, cough	44	0.108	
Origanum compactum Benth.	Zaâtar	Leaves	Infusion / decoction / Or	Stomachache, swelling, cough, antibacterial	55	0.135	
Origanum majorana L.	Merdedouche	Leaves	Powder mixed with *Trigonella foenum-greacum, Peganum harmala* and olive oil/ LO	Hair care	3	0.007	
Rosmarinus officinalis L.	Azîr	Leaves	Infusion / Or	Antibacterial, measles, stomachache	40	0.099	
			Powder mixed with olive oil / LO	Hair care			
Salvia officinalis L.	Salmia	Leaves	Infusion / Or	Calming, soothing	52	0.127	
Thymus vulgaris L.	Zaitra	Leavess	Infusion in hot milk / Or	Respiratory tract	3	0.007	
Lauraceae							0.002
Cinnamomum verum J.Presl	L'karfa	Fruits	Powder mixed with *Zingiber* and egg and honey / LO	Hair care	1	0.002	
Linaceae							0.005
Linum usitatissimum L.	Zariat katan	Fruits	Powder / LO	Soften hair	2	0.005	
Lythraceae							0.029
Lawsonia inermis L.	L'hana	Leaves	Powder / LO	Wounds, anti-inflammatory, fortify hair	12	0.029	
Malvaceae							0.017
Malva neglecta Wallr.	L'khebbiza	Leaves	*Malva neglecta* mixed with *Rumex acetosa* / Or	Anemia, tension, constipation, food	07	0.017	
Moraceae							0.018
Ficus carica L.	Karmous	Fruits	*Ficus* mixed with *A. sativum* are evaporated macerated in olive oil / Or	Cough, cold, stomachache	11	0.027	
Morus alba L.	Tût	Fruits	Fruits / Or	Stomachache, food	4	0.01	

Table 2. Medicinal plants used for medicinal, food, and cosmetic purposes (continued…)

Family and botanical name	Common name	Part used	Preparation and administration mode	Therapeutic and cosmetic uses	UR	UV	FUV
Musaceae							0.017
Musa acuminata Colla	Qchour banane	Fruits	Massage / LO	Warts	7	0.017	
Myrtaceae							0.03
Eucalyptus globulus Labill.	Kalitous	Leaves	Vapour inhalation of boiled fire in water	Cold, flu, cough, antiviral	03	0.007	
Syzygium aromaticum (L.) Merr. & L.M.Perry	Qronfal	Flowers	Infusion / mouthwash	Toothache	22	0.054	
Oleaceae							0.16
Olea europaea L.	Zitoun	Leaves	Infusion / mouthwash	Toothache, gingivitis	67	0.16	
			Infusion / Or	Antidiabetic, stomachache, cholesterol			
			Fumigation / inhalation	Eye irritation			
		Fruits	Massage / LO	Psoriasis, eczema, food			
Papaveraceae							0.01
Papaver rhoeas L.	Bellaâman	Leaves	Powder / LO	Cold	4	0.01	
Poaceae							0.006
Arundo donax L.	Laqsab	Stems	Fumigation / inhalation	Headaches	2	0.005	
Avena sativa L.	Choufane	Fruits	Powder mixed with egg yolk and *Sesamum indicum* and *Brassica* water / LO	Facial skin	2	0.005	
			Infusion in hot milk / Or	Stomachache			
Cynodon dactylon Pers.	Anjem	Roots	Infusion /Or	Antibacterial and antitoxic	4	0.01	
Hordeum vulgare L.	Chair	Fruits	Powder / Or	Strengthen bones, depurative, food	3	0.007	
Triticum turgidum L.	Nakhala	Fruits	Powder mixed with *Linum usitatissimum* and *Apium graveolens* and butter / LO	Allergy	1	0.002	
	Kamh	Fruits	Powder / Or	Stomachache			
Polygonaceae							0.019
Rumex acetosa L.	Al'hummidha	Leaves	Leaves mixed with leaves of *M. neglecta* / Or	Stomachache, anemia, food	8	0.019	

Table 2. Medicinal plants used for medicinal, food, and cosmetic purposes (continued…)

Family and botanical name	Common name	Part used	Preparation and administration mode	Therapeutic and cosmetic uses	UR	UV	FUV
Portulacaceae							0.017
Portulaca oleracea L.	Rajla	Leaves	Leaves mixed with leaves of *M. neglecta* / Or	Constipation, antidiabetic, high cholesterol, fever, food	7	0.017	
Punicaceae							0.049
Punica granatum L.	Qchor Arromman	Fruits	Powder mixed with honey / Or	Stomachache	20	0.049	
Renonculaceae							0.01
Nigella sativa L.	Sanouj	Fruits	Powder / Or	Cough, cold, headache	4	0.01	
Rhamnaceae							0.014
Ziziphus lotus (L.) Lam.	Asadra	Leaves	Infusion / Or	Stomachache	6	0.014	
			Powder mixed with *Lawsonia inermis* powder / LO	Hair care			
Rosaceae							0.022
Rosa × *damascena* Herrm.	Al'Ward al'Baldi	Leaves	Powder mixed with *Lawsonia inermis* powder / LO	Hair care	9	0.022	
			Rosa damascena water / LO	Face care			
Rutaceae							0.016
Citrus limon (L.) Osbeck	L'hamd	Fruits	*Citrus limon* juice mixed with honey /Or	Angina, headaches	13	0.031	
			Citrus limon juice / LO	Face care			
Ruta montana (L.) L.	Al'fijel	Leaves	Infusion /LO	Rheumatism, allergy, eczema	6	0.014	
Verbascum sinuatum L.	Slah ndar	Leaves	Infusion/ mouthwash	Toothache	2	0.005	
Salicaceae							0.005
Salix pentandra L.	Safsaf	Leaves	*Salix pentandra* with *Dysphania Ambrosioides* are used as compressed / LO	Tension, headaches	2	0.005	
Solanaceae							0.021
Capsicum annuum L.	Tahmira	Fruits	Powder / LO	Wounds, burns	15	0.036	
			Maceration in olive oil / LO	Soften hair, food			

Table 2. Medicinal plants used for medicinal, food, and cosmetic purposes (continued…)

Family and botanical name	Common name	Part used	Preparation and administration mode	Therapeutic and cosmetic uses	UR	UV	FUV
Lycium acutifolium E. Mey. ex Dunal	Awsaj	Stems	Stem juice /LO	Purify the eyes	3	0.007	
Mandragora officinarum L.	Bayd lghol	Leaves	Powder mixed with *Lawsonia inermis* powder / LO	Fortify hair	7	0.017	
Solanum lycopersicum L.	Maticha	Fruits	Pieces of fruit and *Citrus limon* are used as compressed / LO	Headaches	9	0.022	
Solanum nigrum L.	Aneb Eddib	Fruits	Powder / LO	Eczema, burns	1	0.002	
Solanum tuberosum L.	B'tata	Fruits	Face mask /LO	Whitening of the face	18	0.044	
Thymelaeaceae							0.024
Daphne gnidium L.	Lazzaz	Leaves	Powder mixed with *Lawsonia inermis* powder / LO	Soften hair, skin care	10	0.024	
Urticaceae							0.017
Urtica membranacea Poir. ex Savigny	Horriga	Leaves	Infusion /Or	Stomachache	7	0.017	
Verbenaceae							0.11
Aloysia aloysioides Loes. & Moldenke	Louiza	Leaves	Infusion / Or	Calming, soothing	45	0.11	
Zingiberaceae							0.014
Curcuma longa L.	Kharkoum	Stems	Powder / LO	Face mask	2	0.005	
Zingiber acuminatum Valeton	S'canj 'bir	Fruits	Infusion /Or	Cough, rheumatism, spices	10	0.024	
Zygophyllaceae							0.017
Peganum harmala L.	L'harmal	Fruits	Fumigation / inhalation	Bad eyes	7	0.017	

UR: Use report; UV: Use value; FUV: Family use-value; LO: Local; Or: Oral; Ge: Genital; E.O: Essential oil. The scientific names were proposed according to The Plant List (2020) (http://www.theplantlist.org/).

Table 3. Disease's category and their number of taxa (Nt), number of mentions (Nur) and informant agreement ratio (IAR).

Diseases	List of plant species used and number of uses	Nt	Nur	IAR
Digestive	*Allium cepa* L. (3), *Allium sativum* L. (14), *Ammi majus* L. (2), *Artemisia absinthium* L. (8), *Avena sativa* L. (2), *Carlina acaulis* L. (3), *Ceratonia siliqua* L. (21), *Chamaemelum fuscatum* (Brot.) Vasc. (3), *Chamaerops humilis* L. (1), *Clinopodium nepeta* (L.) Kuntze (2), *Cuminum cyminum* L. (7), *Cynara cardunnculus* L. (3), *Cynodon dactylon* Pers. (4), *Ficus carica* L. (9), *Hordeum vulgare* L. (1), *Malva neglecta* Wallr. (3), *Mentha suaveolens* Ehrh. (9), *Marrubium vulgare* L. (24), *Olea europaea* L. (44), *Opuntia ficus-indica* (L.) Mill. (7), *Origanum compactum* Benth. (55), *Pistacia lentiscus* L. (3), *Punica granatum* L. (18), *Raphanus sativus* L. (4), *Rosmarinus officinalis* L. (36), *Rumex acetosa* L. (2), *Salvia officinalis* L. (5), *Scolymus hispanicus* L. (1), *Silene vulgaris* (Moench) Garcke (1), *Trigonella adscendens* (Nevski) Afan. & Gontsch. (39), *Triticum turgidum* L. (2), *Urtica membranacea* Poir. (7), *Vicia ervilia* (L.) Willd. (1), *Ziziphus lotus* (L.) Lam. (5)	34	349	0.9
Skin	*Agave sisalana* L. (2), *Aloysia citrodora* Palau. (1), *Anchusa italica* Retz. (80), *Aristolochia longa* L. (2), *Artemisia absinthium* L. (2), *Asphodelus microcarpus* Salzm. Viv. (3), *Calendula officinalis* L. (3), *Cannabis sativa* L. (1), *Capsicum annuum* L. (7), *Cicer arietinum* L. (11), *Cynara humilis* L. (17), *Cynoglossum clandestinum* Desf. (6), *Dittrichia viscosa* (L.) Greuter. (49), *Drimia maritima* (L.) Stearn (1), *Echinops spinosissimus* Turra. (1), *Eucalyptus globulus* Labill. (1), *Hedera helix* L. (2), *Lavandula angustifolia* Mill. (14), *Lawsonia inermis* L. (4), *Marrubium vulgare* L. (2), *Musa acuminata* Colla (1), *Olea europaea* L. (2), *Papaver rhoeas* L. (4), *Raphanus sativus* L. (1), *Rosa damascena* Mill. (9), *Rosmarinus officinalis* L. (1), *Salvia officinalis* L. (1), *Scirpus holoscholenus* L. (1), *Solanum nigrum* L. (1), *Triticum turgidum* L. (1)	30	231	0.87
Urogenital	*Citrullus lanatus* (Thunb.) Matsum. & Nakai (3), *Coriandrum sativum* L. (3), *Cucurbita maxima* Duchesne. (2), *Petroselinum crispum* (Mill.) Fuss. (3), *Salvia officinalis* L. (17), *Spergularia rubra* (L.) J.Presl & C.Presl. (2)	6	30	0.83
Rheumatic	*Allium sativum* L. (2), *Artemisia absinthium* L. (2), *Capparis spinosa* L. (22), *Melissa officinalis* L. (4), *Rosmarinus officinalis* L. (1), *Ruta montana* (L.) L. (6), *Zingiber acuminatum* Valeton. (8)	7	45	0.86
Respiratory	*Ajuga iva* (L.) Schreb (6), *Allium cepa* L. (2), *Eucalyptus globulus* Labill. (2), *Ficus carica* L. (2), *Mentha pulegium* L. (44), *Nigella sativa* L. (4), *Thymus vulgaris* L. (3), *Zingiber acuminatum* Valeton. (2)	8	65	0.89
Metabolic	*Allium cepa* L. (19), *Aristolochia longa* L. (6), *Beta vulgaris* L. (5), *Aloysia aloysioides* Loes & Moldenke. (1), *Chamaemelum fuscatum* (Brot.) Vasc. (1), *Daucus carota* L. (5), *Lens culinaris* Medik. (3), *Olea europaea* L. (7), *Portulaca oleracea* L. (2), *Rumex acetosa* L. (2), *Salix pentandra* L. (1), *Salvia officinalis* L. (24)	12	76	0.85
Nervous system	*Allium cepa* L. (3), *Aloysia aloysioides* Loes. & Moldenke. (43), *Arundo donax* L. (1), *Chamaemelum achilleifolium* (DC.) E.H.L.Krause. (9), *Chamaemelum fuscatum* (Brot) Vasc. (1), *Citrus limon* (L.) Osbeck (1), *Dysphania ambrosioides* (L.) Mosyakin & Clemants (1), *Lavandula angustifolia* Mill. (5), *Marrubium vulgare* L. (1), *Pimpinella anisum* L. (2), *Salix pentandra* L. (1), *Salvia officinalis* L. (5)	12	73	0.84

Preparation method

Statistical analysis shows that infusion is the most commonly used method (42.68%), it is followed by powder (26.77%), then preparation by decoction (6.75%), and the other methods of preparation (23.8%) (Fig. 4).

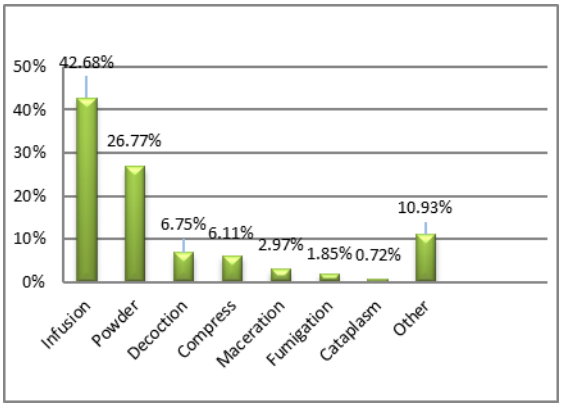

Figure 4. Frequency of different methods of preparation

DISCUSSION

The present study has documented the medicinal and aromatic plants of the Moulay Yacoub region, The indigenous population still relies on medicinal plants to meet their healthcare needs because of the effectiveness, safety, moderate side effects, accessibility, and affordability (Vliathan, 1998). The *Lamiaceae* and *Asteraceae* families are well represented in this area and other areas as in (Ennabili et al., 2006; El Mansouri et al., 2011; El Alami et al., 2016; Fatima et al., 2016). Medicinal plant species with high UV index should be subjected to phytochemical and pharmaceutical analysis to identify their active components for drug extraction (Vitalini et al., 2013). These species should also be prioritized for conservation as their preferred uses may threaten their populations due to overexploitation.

In the popular tradition, plants could be used both as medicine and food (Soulimani et al., 1997; Greche et al., 2009; Akdime et al., 2015). With the therapeutic predominance of plants (Benlamdini et al., 2014; Hachi et al., 2015; El Alami et al., 2016). Moreover, it is difficult to draw a clear line between the two groups; foods can be used as medicines and vice versa (Pieroni et al., 2002; Etkin, 2008). This could be explained by the fact that they contain a lot of active ingredients. In the Moulay Yacoub region *Olea europaea* L., *Capsicum annuum* L., *Capparis spinosa* L., *Daucus carota* L., *Lens culinaris* Medik, *Trigonella adscendens* (Nevski) Afan. & Gontsch, *Cicer arietinum* L., *Rumex acetosa* L., *Beta vulgaris* L. are ingested in a food context in the form of culinary preparations perceived as homemade medicines. About the use of plants in cosmetics, People in the study area have little knowledge about cosmetic plants and their uses, this could be explained by the lack of ethnobotanical studies on cosmetic plants and their uses. (Pereki et al., 2012; Jost et al., 2016). The level of disease prevalence in the study area is also determined by the RAI values. These high RAI values indicate reasonable reliability of informants on the use of medicinal plant species (Lin et al., 2002). Digestive disorders were also found to be the most frequent application of medicinal plants in other ethnobotanical studies (Tahri et al., 2012; Akdime et al., 2015; El Alami et al., 2016).

The leaves formed the most frequently used in the present study. The high frequency of use of leaves is explained by their availability, acceptability, and ease of preparation of remedies. Besides, the leaves are the site of photosynthesis and sometimes the storage of secondary metabolites responsible for the therapeutic properties of the plant. Similar results have indicated that the leaf is the dominant plant part in Morocco used in traditional medicine (Salhi et al., 2011; El Hassani et al., 2013; Hachi et al., 2015; Daoudi et al., 2016; Chaachouay et al., 2019a) or in Africa (Asnake et al., 2016; Jdaidi and Hasnaoui, 2016).

Infusion is the most commonly used method in the preparation of recipes, it can be explained by the fact that infusion allows more of the active ingredients to be extracted and decreases the toxic effect of some recipes (Okello et al., 2010; Yetein et al., 2013; Chaachouay et al., 2021).

CONCLUSION

This study has described the medicinal and aromatic flora of the province of Moulay Yacoub and its uses. This field survey which gathers medicinal, food, and cosmetic plants is the first one carried out in this province has shown that 104 species are belonging to 46 families, which shows that there is a great diversity of plants for therapeutic, cosmetic, and food use, which could be useful documentation, which can contribute to preserving the knowledge about the use of medicinal and aromatic plants in this region. Thus, this ethnobotanical concerning these species reveals that the traditional phytotherapy is still very anchored in the habits of the local population, especially among the elderly, especially women. Based on results of the present studies, higher use value, informant agreement ratio scores of the recorded medicinal plant species would empower the future pharmaceutical and phytochemical studies on the chemical constituents, pharmacological actions, and toxicity of the plants will be needed to prove their medicinal, cosmetic, and dietary efficacy before they are prescribed to humans.

As part of this study, we are currently working on plants with healing effects to prove their effectiveness in animal models, including *Anshusa italica* Retz, which was cited extensively in this ethnobotanical study.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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AUTHOR CONTRIBUTION:

Contribution	El Khomsi M	Dandani Y	Chaachouay N	Hmouni D
Concepts or ideas	x	x		x
Design	x	x	x	x
Definition of intellectual content	x	x		x
Literature search	x		x	x
Experimental studies	x	x		
Data acquisition	x	x	x	x
Data analysis	x		x	x
Statistical analysis	x		x	
Manuscript preparation	x	x	x	x
Manuscript editing	x		x	x
Manuscript review	x	x	x	x

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Annex A. Survey used in the present study.

N° form:……
Area: ……
Gender: ☐ Men ☐ Woman
Age: ……
School level: ☐ Illiterate ☐ Primary ☐ College ☐ High School ☐ University
Intervener: ☐ Producer ☐ Intermediary ☐ User

General

Vernacular name: ……
Harvest period: ……
Harvesting technique: ……
……
Availability in the market: ☐ Available ☐ Not available ☐ Others ……..
Individual frequency of use: ☐ Low ☐ Medium ☐ High
The condition of the plant used: ☐Dry ☐ Fresh
Field of use: ☐ Cosmetic ☐ Medicinal ☐ Agri-food ☐ Others ……

Pharmacological uses

Skin: ☐ Antifungal ☐ Antibacterial ☐ Thickening ☐ Dehydration ☐ Hydration ☐ Tissue regeneration ☐ Calming ☐ Others ……..
Non-skinned: ☐ Digestive ☐ Respiratory ☐ Urogenital ☐ Rheumatism ☐ Others……
Part used: ☐ Leave ☐ Roots ☐ Stems ☐ Fruits ☐ Flowers
Formulas: ……..…
Technique of preparation: ☐ Decoction ☐ Infusion ☐ Maceration ☐ Compress ☐ Mastication ☐ Vaporization ☐ Broth ☐ Others ……
Duration of application: ……..
Frequency of use: ……
How to store the formulas: ……
Target population: ☐ Children ☐ Adult ☐ Elderly ☐ Others……..
Satisfaction with the formulas: ☐ Satisfied ☐ Not satisfied
Precautions to be taken when using the formulas: ……
……..
Side effects: ☐ Yes ☐ No
If so, what are these effects……
……..

Cosmetic uses

☐ Coloring ☐ Cream ☐ Mask ☐ Scrub ☐ Anti-dandruff ☐ Others ……..……
Part used: ☐ Leave ☐ Roots ☐ Stems ☐ Fruits ☐ Flowers
Formulas: ……..…
Technique of preparation: ☐ Decoction ☐ Infusion ☐ Maceration ☐ Compress ☐ Mastication ☐ Vaporization ☐ Broth ☐ Others……
Duration of application: ……
Frequency of use: ……
How to store the formulas: ……
Target population: ☐ Children ☐ Adult ☐ Aged ☐ Others……..
Satisfaction with the formulas: ☐ Satisfied ☐ Not satisfied
Precautions to be taken when using the formulas: ……..
……
Side effects: ☐ Yes ☐ No
If so, what are these effects ……