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Ethnobotanical and Ethnopharmacological Study of Medicinal Plants Used for Respiratory Diseases in the Sefrou Region, Morocco

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ABSTRACT

The wide variety of flora in the Sefrou region indicates the great potential of traditional knowledge. Despite being a perfect place to research aromatic and medicinal plants, this area has not yet received much attention. In Morocco, respiratory disorders represent a major public health concern. Our study aims to investigate the traditional knowledge of the Sefrou population regarding the use of medicinal plants to treat respiratory ailments. The survey included 199 individuals from various age groups, gender, study level, family situation, income, and source of information. Data was gathered and analyzed to determine parameters, including fidelity level and family importance value. The floristic analysis of this study identified 38 plant species belonging to 19 families. The two dominant families were Lamiaceae (12 species) and Asteraceae (4 species). The data shows the frequency of *Mentha pulegium* L., *Artemisia herba alba* Asso, and *Origanum compactum* Benth with RFC values of 59.4%, 49.7%, and 35.5%, respectively. The infusion was the most common preparation method. According to our results, the leaf was the most commonly used part to treat respiratory diseases (PPV=0.397), and Tuberculosis was the most treated category with an ICF=0.97. The current survey indicates that, despite the advancement of modern medicine, the indigenous people of the Sefrou region mostly utilize medicinal plants to treat ailments. It is also necessary to carry out laboratory studies to extract and determine these plants phytochemical constituent, and identify their toxicological effects.

Keywords: Ethnobotany, Ethnopharmacology, Medicinal plants, ~~Morocco~~, Respiratory diseases, Sefrou region, Morocco.

Introduction

Ever since the beginning of human civilization, traditional plant-based medicine, or "herbal" medicine, has been widely derived from plants. [1] Human customs have evolved over the ages to include the knowledge and application of medicinal plants to alleviate suffering, promote human health, and mollify grievances. [2] About 1/4 of the approximately 4500 species of the vascular flora are endemic, with their main centers being the high mountain peaks. These species are organized into 940 genera and 135 families.[2,3] It is noteworthy that a significant proportion of Moroccans use traditional medicine to treat their primary health needs.[4] Even with the widespread availability of numerous contemporary pharmaceutical medications, plant-based medications, and aromatics are still in high demand worldwide in the healthcare industry. They are used not just to cure illness, but also as a prophylactic measure to preserve health.[1] The first step in finding novel compounds from medicinal plants that can be used in the preparation of contemporary pharmaceutical medications is the documentation of this traditional knowledge.[5] Since ancient times, people have utilized aromatic and medicinal plants to prepare natural treatments for respiratory disorders. Morocco is one of the Mediterranean nations with a rich history of medicine and traditional expertise in phytotherapy.[6] of the 4500 species of plants that exist today, around 280 are considered valuable.[7] Among the Mediterranean nations, Morocco has a long history of using aromatic and medicinal herbs to prepare traditional remedies.[8] Due to differences in meteorological and biological conditions, it exhibits a rather large floristic richness. Regretfully, the knowledge of traditional plants for future generations are vanishing. Rapid loss of traditional knowledge is caused by a variety of circumstances, including migration, acculturation, environmental changes, rural-to-urban migration, news media, and the demise of the older generation. Respiratory illnesses rank among the world's major causes of death, and according to WHO[9] traditional herbal remedies are scientifically proven to treat seasonal diseases and moderate psychological challenges.[10] Acute respiratory infections and chronic respiratory disorders, including asthma, chronic obstructive pulmonary disease, and lung cancer, are examples of ailments that affect the airways, which include the nasal passages, bronchial tubes, and lungs.[11] The use of medicinal plants to treat respiratory system ailments has not been studied in this province, even though there have been several ethnobotanical studies conducted in the Sefrou region on the treatment of skin burns[10], hypertension[12], and diabetic disorders.[13] There is scarce research on the ethnobotanical survey of medicinal therapeutics in this region geared towards listing therapeutic plants used in the treatment of respiratory problems. Several medicinal bioactive compounds have been isolated from these plants. Examples include the anticholinergic atropine from *Atropa belladonna*, the cardiac glycosides digoxin and digoxin (from *Digitalis purpurea*), the antimalarial quinine and antiarrhythmic quinidine from Cinchona bark, and the painkillers morphine and codeine (from *Papaver somniferum*).[13] According to WHO estimates, 80% of people in poor nations receive their primary medical care from traditional medicine practitioners.[9] Studies within the Sefrou region details the use of medicinal herbs from there to cure diabetes [13], skin burns [10], hypertension [12], however, no study has focused on the ethnobotanical

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survey of medicinal herbs derived from the Sefrou region as regards respiratory diseases, therefore, this study aims to fill the gap. Hence, this study is aim at evaluating the ethnobotany and ethnopharmacology of medicinal plants used for respiratory diseases in the Sefrou region, Morocco

Materials and Methods

Study Area

An extensive knowledge of traditional herbal medicine is available to the local community in the Sefrou region. This region was selected for the ethnobotanical survey due to its diverse floral, ecological, and climatic features. This area is bounded to the south by the provinces of El Hajeb and Moulay Yacoub, to the west by the province of Moulay Yacoub, to the east by the province of Taza, and to the north by the prefecture of Fez. According to the HCP 2024, the province has 304748 inhabitants, of which 43% reside in rural areas and 56% in the urban areas.[14] Its total area is 4008.76 km^2, and both Arabs and Amazighs make up its population.[12] There are 23 communities in the province, comprising of 5 urban and 18 rural communities.[14] The current study was conducted in the four regions of Sefrou i.e. Ribate El Kheir (12654 inhabitants), Ighzrane (11050 inhabitants), Dar El Hamra (4022 inhabitants), and Adrej (2236 inhabitants), which are located in the East of the province. (Figure 1, Figure 2, and Figure 3)

Data collection

This ethnopharmacological survey commenced in January 2022 and was finished in January 2023. A semi-structured questionnaire was established to list the therapeutic plants that are utilized in this area, comprising of information about the interviewees (gender, age, academic level, and family status). A total of 199 surveys were garnered to obtain information on medicinal and aromatic plants used for the treatment of respiratory disorders. Open-ended interviews were carried out in focus groups and in-person interviews. Each interview lasted between 20 and 30 minutes, depending on the age, gender, amount and quality of plant-related information. The questionnaire was divided into two sections - the first discusses the informants' demographic characteristics, and the second concentrates on the MAPs used to treat the diseases (vernacular name, parts used, modes of preparation, and method of utilization).

Botanical identification of plant species

The plants were collected in cooperation with the interviewees or the ethnomedicine practitioners. Dry plant samples that were garnered for the study were assembled in plastic bags, and labeled using their common names, which allowed for the identification and authentication of the plant species at the Natural Resources and Sustainable Development Laboratory, Department of Biology, Faculty of Sciences, Ibn Tofail University, Kénitra, Morocco, and then subsequently supplemented by a thorough literature review.[15,16,17,18,19]

Statistical analysis

The ethnobotanical data gathered during the surveys were recorded, handled, and statistically examined using Microsoft Office Excel 2019 and SPSS Statistics 26 software (IBM USA). The following quantitative ethnobotanical indices were adopted to analyze the ethnopharmacological data – plant part value (PPV), family importance value (FIV), fidelity level (FL), relative frequency of citations (RFC), and informant consensus factor (ICF).

Fidelity Level (%FL)

The percentage of informants in the research area who admitted utilizing a particular plant species to treat a specific condition is represented by the fidelity level (FL) i.e. equation 1.

$$FL = \frac{Np}{N} \times 100 \qquad \text{Equation 1}$$

Where: *Np* is the number of use reports for a given species reported for a particular ailment category, and *N* is the total number of use reports cited for any given species.[20]

Relative Frequency of Citation (RFC)

The RFC was applied to determine the value of each plant species in the study area. The relative frequency of citation (RFC) was calculated by dividing the frequency of citation (FC) by the total number of survey informants (N), its value was calculated using the formula (equation 2)

$$RFC = \frac{FC}{N} \qquad \text{Equation 2}$$

Where: *FC* is the number of reports of use of particular plant taxa mentioned by several informants; *N* is the total number of informants) , with (0 < RFC < 1. [21]

Family Importance Value (FIV)

To determine the essential families of medicinal plants in the study area, the use value for each family was calculated using equation 3

$$FIV = \frac{FCfamily}{Ns} \qquad \text{Equation 3}$$

Where: *FC* family is the sum of the use value of the species in a given family, and *Ns* is the total number of species in the given family. [22] In ethnobotany, the FIV is an index of cultural importance that can be used to determine the species value of plants.[23]

Plant Part Value (PPV)

The percentage of plant parts (stem, leaves, roots, fruit, bark, and flowers) exploited as bioresources for therapeutic purposes is identified as the plant part value. The PPV was calculated using equation 4:

$$PPV\ (\%) = 100\ [\sum RU\ (plant\ part) / \sum RU] \qquad \text{Equation 4}$$

Where: $\sum RU$ *(plant part)* represents the sum of the cited plant parts, and $\sum RU$ represents the total number of cited uses for a given plant.[24] The part with the highest PPV is the most used by the respondents.

Informant Consensus Factor (ICF)

The ICF for each species was calculated to determine the importance of every distinct species.[25] The ICF was calculated by the following formula (equation 5).

$$ICF = \frac{Nur - Nt}{Nur - 1} \qquad \text{Equation 5}$$

Where: *Nur* is the total number of citations for each taxon that have been recorded, and *Nt* is the total number of ailment categories that species serve to treat. A value of zero (0) signifies that the number of citations and illness categories is equal, while a value of one (1) indicates that all participants referenced the plant species for a given ailment.[26]

Results and Discussion

Age and gender

The investigation of 199 participants proved that herbal medicine concerns both genders. However, gender predominance is 56.28% female and 43.72% male (Table 1). In the West-Central region of Morocco, it was likewise observed that women dominated the use of medicinal plants.[27] The devotion of women to medicinal herbs and their practical care for their family members can account for this occurrence. In the study area, most informants (49.75%) fell within the age range of 30-60 years, with the remaining two groups each accounting for 25.13%.

The oldest respondents display an intense attachment to medicinal plants due to possessing a significant amount of ancestral knowledge integral to the oral tradition. The lack of interest in medicinal plants among young people may contribute to a significant deficiency of generational knowledge. These findings are in line with results obtained in other regions of Morocco.[28,29]

Family situation and income

Regarding the family situation, more than 100 respondents were married (50.75%), 42 were single (21.11%), 46 were widowers (23.12%), and only 10 were divorced (5.03%). In this study, 138 informants were unemployed (69.35%), and only 11 of the interviewees had a higher socioeconomic level (5.53%), compared to 10 who had a medium level (5.03%) and 40 who had a low level (20.10%) (Table 1). As a result, the authors observed that the use of plants grew as these informants' monthly income climbed. Furthermore, married people are more interested in herbal medicine due to their low cost and efficiency. The same results were found by other ethnobotanical surveys conducted in the province of Taza. [30]

Academic level and source of information

In our study, 51.26% of informants were illiterate, 26.13% had completed primary education, 10.55% had completed high school, and 12.06% had continued their studies at a university.

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Table 1: Socio-demographic characteristics of informants (N=199).

Variable	Choice	Informants	Percentage %
	Woman	112	56.28
Gender	Man	87	43.72
	17-30	50	25.13
Age classes	30-60	99	49.75
	≥60 years	50	25.13
	Single	42	21.11
Family situation	Married	101	50.75
	Divorced	10	05.03
	Widower	46	23.12
Study level	Analphabet	102	51.26
	Primary	52	26.13
	Secondary	21	10.55
	University	24	12.06
	Unemployed	138	69.35
Income/Month	250-1500	40	20.10
(Moroccan dirham)	1500-5000	10	05.03
	≥5000	11	05.53
	Parents	129	64.82
	Experience	28	14.07
Source of the information	Reading	16	08.04
	Others	26	13.06

Thus, the authors had the opportunity to see that as education levels rose, MAPs use declined. Similar results were found in a previous study in the Sefrou region.[10] In our research, 64.82% of informants derived their knowledge of medicinal plants usage and recipes from their parents; 14.07% gathered their knowledge from personal experience; 13.06% obtained their knowledge from outside sources like the media; and only 8.04% gained their knowledge from reading (Table 1). According to previous researches, the inhabitants of the Fez-Meknes region inherit their ancestral knowledge of how to use therapeutic herbs.[31,32]

Variety of MAPs in the Survey Area

Our study focused principally on identifying the maximum number of MAPs used by the population of Sefrou to treat respiratory illnesses. Thirty-eight plant species belonging to 19 botanical families were identified. An alphabetical list of these plants were provided. The table below shows the scientific and vernacular names of each plant, the families identified, the parts used, the modes of preparation adopted by the local population, the diseases treated, as well as the results related to %FL, FC, RFC, and FIV. (Table 2)

Plant therapeutic potential

Based on the FIV and the number of species, Lamiaceae was the most dominant family used to treat respiratory disorders with 12 species (FIV=0.205), followed by Asteraceae with four species (FIV=0.223), and Amaryllidaceae (FIV=0.088), Apocynaceae (FIV=0.081), Asparagaceae (FIV=0.050), Cupressaceae (FIV=0.160), Myrtaceae (FIV=0.175) with 2 species each, while other families were represented by one species only (Figure 4). The same results were found in the Sefrou region, [12] and the Rif region.[33] The dominance of these seven families can be explained by their ubiquity and their wide distribution in Morocco. Other ethnobotanical studies have confirmed the preponderance of the main families mentioned above.[34, 35]

Table 2 also indicated other important families such as Myrtaceae (2 species, FIV 0.175), Oleaceae (1 species, FIV 0.279), Papaveraceae (1 species, FIV 0.162), and Zingiberaceae (1 species, FIV 0.162). Another

earlier research conducted in the Seksaoua region of the Western High Moroccan Atlas identified these families [50].

Table 2: Medicinal plants used in the Sefrou region for treatment of respiratory diseases

Family and scientific name	Vernacular name	Parts used	Modes of preparation	Medicinal uses	%FL	FC	RFC	FIV
Amaranthaceae								0.076
Chenopodium ambbrosioides L.	Mkhinza	Leaf	Raw	CL, CV, LC	26.7	15	0.076	
Amaryllidaceae								0.088
Allium cepa L.	L-basla L-hamra|	Bulb	Crushed	AT, CV, TB	47	17	0.086	
Allium sativum L.	Touma	Bulb	Raw	AT, CG, CL, CV, TB	22	18	0.091	
Apiaceae								0.005
Pimpinella anisum L.	Habbat hlawa	Seed	Infusion	AT	100	01	0.005	
Apocynaceae								0.081
Caralluma europaea (Guss.) N.E. Br	Deghmouz	Pulp	Crushed	LC	100	11	0.056	

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Nerium oleander L.	Defla/ Alili	Leaf	Fumigation	CV, TB	71.4	21	0.106	
Aristolochiaceae								0.030
Aristolochia baetica	Berrezta	Root	Crushed	AT	100	6	0.030	
Asparagaceae								0.050
Agave sisalana Linnaeus	Aloe vera	Leaf	Crushed	AT, CV, TB	47.4	19	0.096	
Muscari comosum (L.) Mill.	Bssyla	Whole plant	Infusion	CV	100	01	0.005	
Asteraceae								0.223
Artemisia absinthium L.	Chiba	Leaf	Decoction	CL, CV	64.3	14	0.071	
Artemisia herba alba Asso	Chih/ Izr	Whole plant	Decoction	AT, CG, CL, CV, TB	42.8	98	0.497	
Inula viscosa L.	Tarhlla/ Magraman	Leaf	Decoction	AT, CL, CV, LC, TB	28.6	49	0.249	
Matricaria chamomilla	Babounj	Flower	Infusion	TB	100	15	0.077	
Cupressaceae								0.16
Tetraclinis articulata Linnaeus	A-ara	Branch	Fumigation	AT, CG, CL, CV, TB	27.3	55	0.279	
Trigonella foenum-graecum L.	L-halba	Seed	Raw	AT	100	08	0.041	
Fagaceae								0.015
Quercus ilex L.	L-bllout	Fruit	Raw	AT	100	03	0.015	
Lamiaceae								0.205
Calamintha officinalis Moench	Manta	Leaf	Infusion	AT, CG, CL, CV, LC	37.8	37	0.188	
Lavandula dentala L.	L-khzama	Whole plant	Decoction	CL	100	01	0.005	
Lavandula stoechas L.	L-halhal	Whole plant	Decoction	AT, CG, CL, CV, TB	37.2	43	0.218	
Marrubium vulgare L.	Mrriwa/ Mrriout	Leaf	Crushed	LC	100	25	0.127	
Mentha pulegium L.	Fliyou	Whole plant	Infusion	AT, CG, CL, CV	49.6	117	0.594	
Mentha rotundifolia (L.) Huds.	Marcita/ Marsada	Leaf	Cooked	AT, CL, CV	40	25	0.127	
Nepeta amethystina1	Tahlimt	Leaf	Decoction	CL	100	39	0.198	
Ocimum basilicum L.	L-hbaq	Leaf	Infusion	CV, TB	76.2	21	0.106	
Origanum compactum Benth.	Za-atar	Whole plant	Infusion	AT, CG, CL, CV, LC	50	70	0.355	
Rosmarinus officinalis L.	Azir/ Zir	Whole plant	Infusion	AT, CG, CL, CV	52	48	0.244	
Salvia officinalis L.	Salmia	Leaf	Decoction	AT, CL, CV, LC, TB	44.4	18	0.091	
Thymus capitatus (L.) Hoffmanns. & Link	Z-aitra/ Zouchen/ Zouknni	Whole plant	Decoction	CG	100	40	0.203	
Myrtaceae								0.175
Eucalyptus globulus Labil.	Kalitus	Leaf	Fumigation	AT, CG, CL, CV	40.5	42	0.213	
Eugenia caryophyllata Thunb.	L-qronfel/ Oud nawar	Flower	Powder	CG, CV	59.3	27	0.137	
Oleaceae								0.279
Olea europaea L.	Zitou	Seed	Oil	CG, LC	43.6	55	0.279	
Papaveraceae								0.162
Papaver rhoeas L.	Benna-aman	Flower	Infusion	TB	100	32	0.162	
Ranunculaceae								0.046

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Nigella sativa L.	Sanuj	Seed	Infusion	CG, TB	66.7	09	0.046	
Rhamnaceae *Ziziphus lotus* (L.) Lam.	Sedra	Leaf	Infusion	TB	100	01	0.005	0.005
Rosaceae *Rosa damascena* Herrm	L-ward L-baldi	Flower	Infusion	AT, CV	77.8	09	0.046	0.046
Rutaceae *Citrus sinensis* (L.) Osbeck.	L-hamed	Fruit	Raw	AT, CG, CV, LC	41.2	17	0.086	0.086
Verbenaceae *Aloysia citriodora* Linnaeus	Lwiza	Leaf	Infusion	CL, CV	80	05	0.025	0.025
Zingiberaceae *Zingeber officinalis* Roscoe	Skkin jbir	Root	Crushed	AT, CG, CV, LC, TB	28.1	32	0.162	0.162

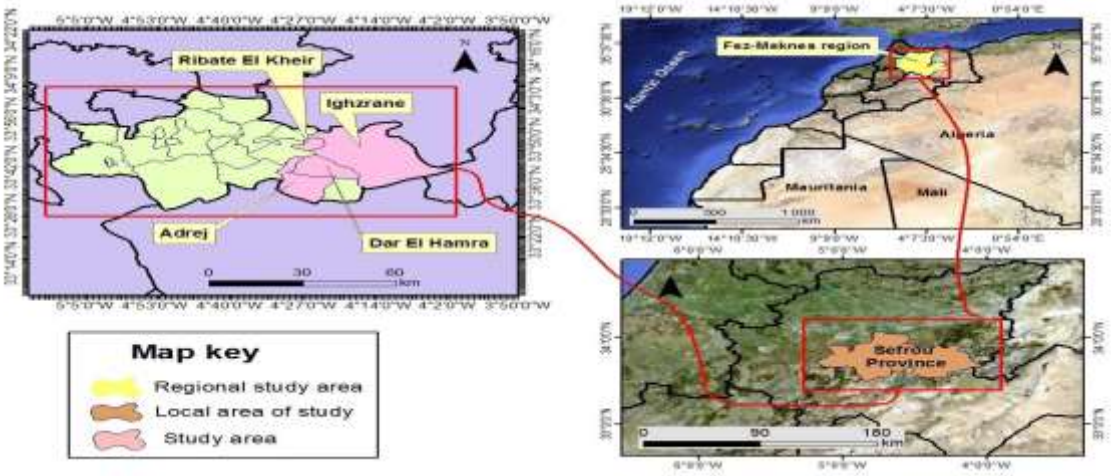

Figure 1: Location map of the study area in Sefrou province, Morocco (map realized by ArcGIS software).

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Figure 3: The vegetation cover of the Sefrou region (photographed by the corresponding author).

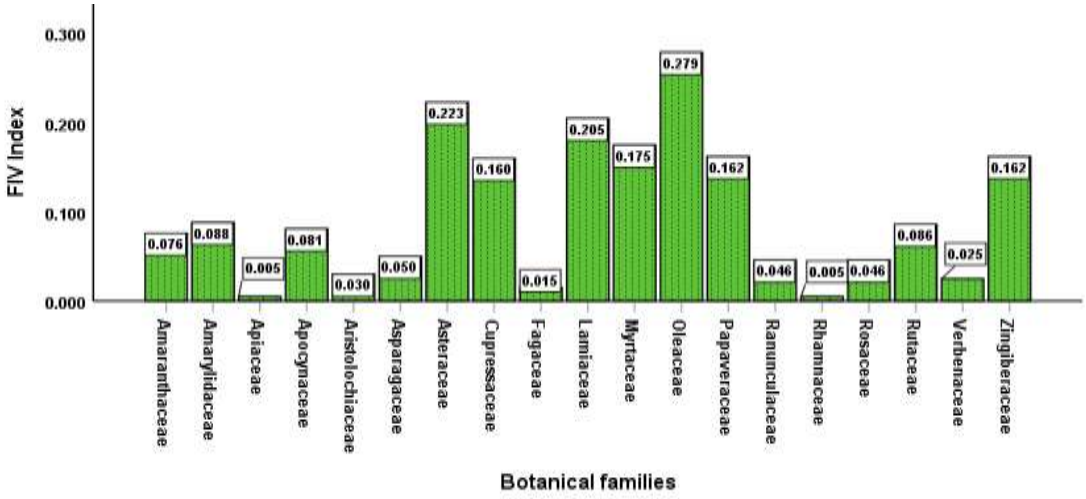

Figure 4: Family Importance Value (FIV) of medicinal plants.

Relative Frequency of Citation (RFC) of MAPs

The data shows the frequency of distinct species, with *Mentha pulegium* L. having the most significant RFC (59.4%) among them, followed by *Artemisia herba alba* Asso and *Origanum compactum* Benth with RFC values of 49.7% and 35.5%, respectively. This result accords with the findings in the region of Fes, Morocco [33,] and north of Algeria. [36] The Sefrou population mentioned other significant species for treating respiratory disorders, such *as Tetraclinis articulata* Linnaeus, *Olea europaea* L., *Inula viscosa* L., *Rosmarinus officinalis* L., *Lavandula stoechas* L., *Eucalyptus globulus* Labil., *Thymus capitatus* (L.) Hoffmanns. & Link with RFC values varied between 20.3% and 27.9%. (Table 2) Some other species had a significant RFC because of their quotidien utilization by the local population of the Sefrou region, such as *Nepeta amethystinal* (RFC 0.198), *Calamintha officinalis* Moench (RFC 0.188), *Papaver rhoeas* L., and *Zingeber officinalis* Roscoe (RFC 0.162), *Marrubium vulgare* L. (RFC 0.127), *Nerium oleander* L. and *Ocimum bacilicum* L. (RFC 0.106). The indigenous population mentioned these plant species as medicinal plants because they are usually used in winter in the frigid region of Sefrou to prevent and treat seasonal diseases such as cold and cough. (Table 2)

Fidelity level index (%FL)

The fidelity level (FL) value, ranging from 22% to 100% in this study, is an important indicator for determining which ailment an individual species is most useful for. One quantitative method of selecting MAPs from ethnopharmacological field investigations to be used in further pharmacological screening is the Fidelity Level (FL) [36]. Thirteen (13) plant species (*Pimpinella anisum* L., *Caralluma europaea* (Guss.) N.E. Br, *Aristolochia baetica, Muscari comosum* (L.) Mill., *Matricaria chamomilla, Trigonella foenum-graecum* L., *Quercus ilex* L., *Lavandula dentala* L., *Marrubium vulgare* L., *Nepeta amethystina1, Thymus capitatus* (L.) Hoffmanns. & Link, *Papaver rhoeas* L., and *Ziziphus lotus* (L.) Lam.), had a high-fidelity level (100%). Informants used these plant species to treat asthma, lung cancer, coronavirus, tuberculosis, cold, and cough. Seven (7) had fidelity level values ranging between 59.3% and 80%, and the fidelity level values of the rest of the 18 plant species ranged from 22% to 52%. (Table 2)

Plant parts and field of uses

We obtained ten plant parts for counting purposes: i.e. bark, branch, bulb, flower, fruit, leaf, pulp, root, seed, and the whole plant. Based on

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the PPV index value, leaf was the most cited by the informants to cure respiratory diseases in the study area (PPV= 0.397), followed by the utilization of the whole plant (PPV= 0.309), flower (PPV= 0.092), seed (PPV= 0.061), branch (PPV= 0.052), root (PPV= 0.039), bulb, pulp and fruit (PPV= 0.015 for each), and bark (PPV= 0.005), respectively (Figure 5). Most participants selected leaves as a cure because of their greater availability and ease of collection and application.[4] Furthermore, removing leaves harms plants less than removing other plant parts, which may have a major effect on the growth and development of the plant. [37, 38] The preference for employing the whole plant in the treatment pertains to the potential for preserving the plant after drying and its simplicity of preparation.[39] Similar results in the North of Algeria revealed that leaves were the primary dominating plant part, followed by the whole plant.[36] The respondents verified employing 9 techniques to prepare medicinal plants for interventions against respiratory illnesses. The infusion method is a preparation technique used to extract the active components of plants, accounting for 37.54% of the total. Second in terms of percentage is decoction at 27.61%, followed by fumigation at 10.27%. Regarding additional preparation methods, the crushed plant is employed in 9.09% of cases, powder in 4.88% of cases, raw in 4.21%, oil in 3.03%, cooked plant and maceration in 2.86% and 0.51% of cases, respectively (Figure 6). Similar findings were revealed in the treatment of COVID-19 in Sale prefecture, located in the North-Western region of Morocco.[40] In the Fes region, infusion emerges as the predominant therapeutic approach for genitourinary disorders. [31]

Route of administration and duration of treatment

The toxicity level and composition of the active components determine how medicinal plants should be administered. They can be applied physically (massage, rinsing) or internally (oral, inhalation).[41] According to our analysis, the oral mode was most frequently used to facilitate the administration (72.49%), followed by inhalation (21.79%), rinsing (2.65%), massage (2.09%), and other forms (0.98%). Similar modes of administration were documented in the examination of ethnomedicinal research conducted internationally, [42] including in Morocco. [43] (Figure 7) Concerning the duration of treatment of respiratory diseases, 48.74% of the respondents used the recipes of MAPs daily, 29.15% continued their herbal treatment until they are cured, 17.09% affirmed that the remediation was weekly, and only 5.03% used MAPs monthly (Figure 8). The findings presented here are largely consistent with those of previous research carried out in Algeria by Benlarbi et *al*. [44] and in Morocco by Ourgha et *al*. [29] and Jeddi et *al*. [45]

Methods of harvesting and preservation of MAPs

About 72.36% of participants confirmed that the most effective approach to preserve MAPs is to shield them from light, whereas only 8.54% indicated that MAPs should be exposed to light for optimal drying. In contrast, 19.10% used additional preservation techniques, such as oil, animal derma, lemon, and other recipes (Figure 9). According to our data, 77.39% of inhabitants in the Sefrou region harvested plants on average by hand, while only 22.61% employed mechanized techniques. Since most of the population is low-income and unable to purchase materials, manual approaches are used (Figure 10). In Taounate, the same finding was observed.[46]

Treatment and prevention of COVID-19 by MAPs

Coronavirus disease 2019 (COVID-19) is induced by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is classified among several respiratory illnesses. African ethnomedicine has likely significantly influenced the development of many plant-based treatments that target COVID-19 symptoms, such as Apivirine, Fagaricin, Covid Elixir, and Covid Adsak.[47] Initiatives to create COVID-19 treatments, such as traditional medications and drug repositioning, are being encouraged by the World Health Organization (WHO).[48] Additionally, using plants by population for medical purposes is growing in importance in the fight against COVID-19.[48] Therefore, this research investigates the efficacy of traditional herbal medicine, including the application of medicinal herbs, as prospective treatments for COVID-19. We were curious to learn more about using MAPs for treating or preventing coronavirus infections among Sefrou inhabitants. About 42.71% of the respondents use MAPs to prevent coronavirus infection (Figure 11), and only 19.10% use MAPs to treat it (Figure 12).

Treated diseases and informant consensus factor (ICF)

The informant consensus factor (ICF) measures the consistency of information across multiple informants about MAPs used to treat a category of diseases. Six categories were defined in the table 3, namely, asthma, cold, cough, coronavirus, lung cancer, and tuberculosis. The derived ICF values for the specified categories show the extent of common understanding of the applications of medicinal plants. Ailments with the highest ICF were tuberculosis (ICF 0.97) with 15 species, followed by cough (ICF 0.94) with 15 species, then cold (ICF 0.92) with 17 species, and finally lung cancer and coronavirus (ICF 0.89) with 10 and 25 species, respectively. In the Rif region, the most represented category was asthma with a high ICF value. [49] These high ICF values demonstrated that the use of MAPs by informants was reasonably reliable. [50] The *Papaver rhoeas* L. was the most used plant to treat tuberculosis by informants; this herb is used in the Northeast region of Algeria to cure digestive problems.[36] *Mentha pulegium* L.)- was the most cited plant by the participants to treat cough and asthma. The same results were found in Kabylia, North of Algeria.[51] The 39 participants from the Sefrou region confirmed using *Nepeta amethystina* to cure colds (Figure 13). This plant was only discovered in the Sefrou region, specifically in Ribat Elkheir, northwest of the research area. *Marrubium vulgare* L. and *Olea europaea* L. were the most cited by the inhabitants of Sefrou to cure lung cancer. In the Doukkala region (West-Central Morocco), these plants are prescribed for treating colds, coughs, and influenza.[50]

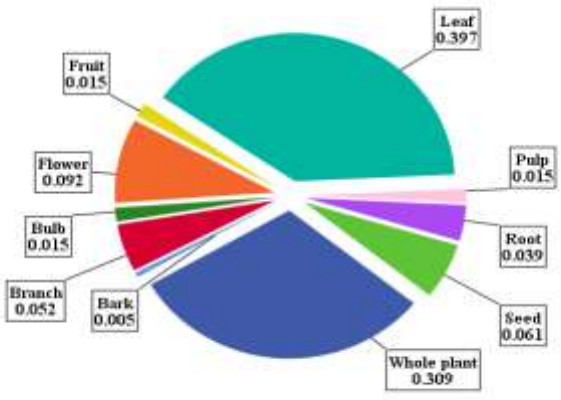

Figure 5: Plant part used to treat respiratory diseases in the Sefrou region.

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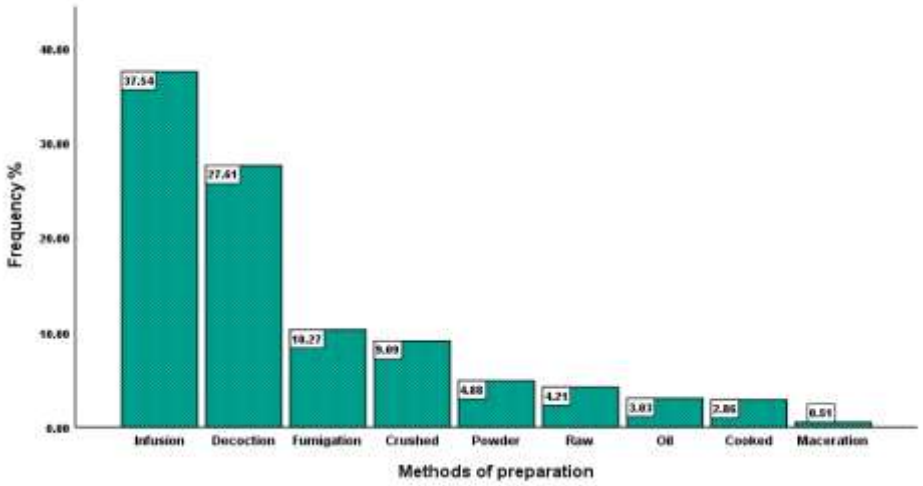

Figure 6: Frequency of various forms of uses.

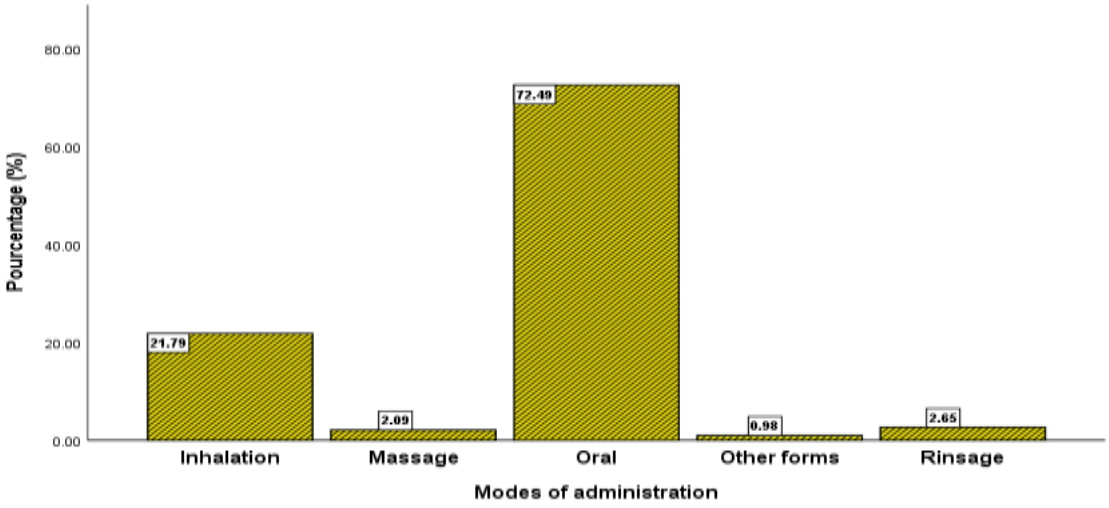

Figure 7: Modes of administration of MAPs.

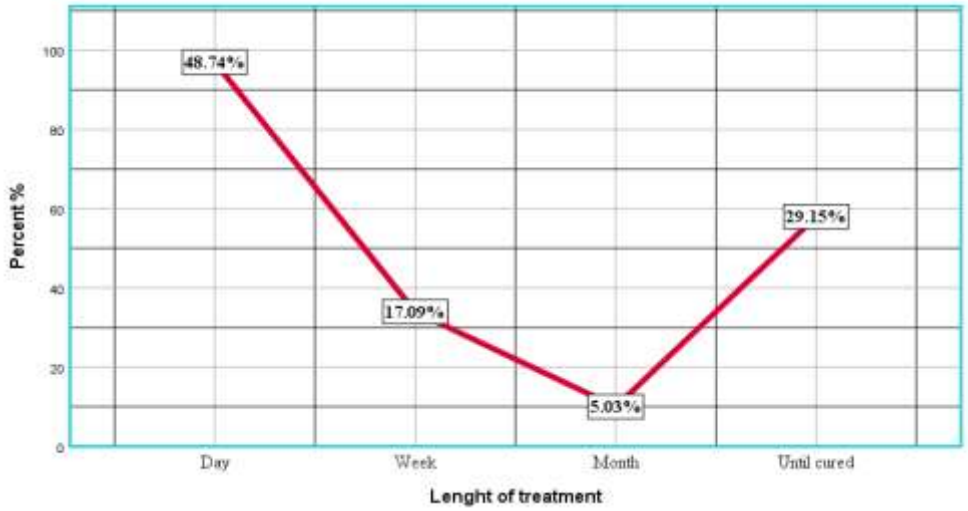

Figure 8: Duration of treatment of respiratory diseases in the Sefrou region.

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Figure 9: Different methods of preservation of MAPs in Sefrou province.

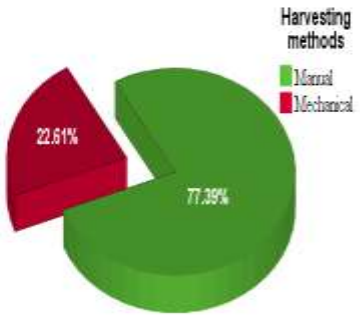

Figure 10: Harvesting methods of the plants.

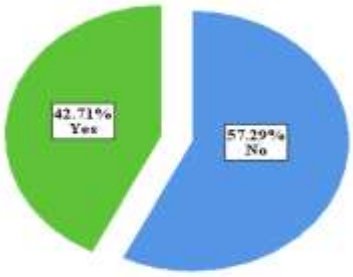

Figure 11: Using medicinal plants for prevention of coronavirus infection.

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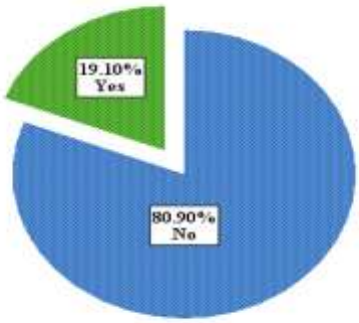

Figure 12: Using medicinal plants for treatment of coronavirus infection.

Table 3: Informant consensus factor (ICF) values for respiratory disease categories treated with medicinal plants sourced from Sefrou Region of Morocco

Categories	Plant species used (number of citations)	Total number of		ICF
		Species	Use of citations	
Asthma (AT)	*Rosmarinus officinalis* L.(10), *Origanum compactum* Benth.(11), *Mentha pulegium* L.(24), *Artemisia herba alba* Asso (19), *Calamintha officinalis* Moench *(11), Inula viscosa* L. (9), *Lavandula stoechas* L. *(*16*), Tetraclinis articulata* Linnaeus (14), *Allium cepa* L.(8), *Trigonella foenum-graecum* L.(8*), Allium sativum* L.(3), *Citrus sinensis* (L.) Osbeck.(2), *Salvia officinalis* L.(2), *Zingeber officinalis* Roscoe(9), *Mentha rotundifolia* (L.) Huds.(9), *Agave sisalana* Linnaeus(9), *Aristolochia baetica(*6*), Quercus ilex* L.(3), *Rosa damascena* Herrm(7), *Pimpinella anisum* L.(1), *Eucalyptus globulus* Labil.(11)	21	192	0.9
Cough (CG)	*Rosmarinus officinalis* L.(4), *Origanum compactum* Benth.(5), *Mentha pulegium* L.(58), *Artemisia herba alba* Asso (42), *Calamintha officinalis* Moench *(*5*), Lavandula stoechas* L. *(2), Tetraclinis articulata* Linnaeus (13), *Thymus capitatus* (L.) Hoffmanns. & Link (40), *Eugenia caryophyllata* Thunb(16), *Allium sativum* L.(3), *Citrus sinensis* (L.) Osbeck.(6), *Zingeber officinalis* Roscoe(8), *Nigella sativa* L.*(3), Olea europaea* L.(21), *Eucalyptus globulus* Labil.(10)	15	236	0.94
Cold (CL)	*Rosmarinus officinalis* L.(25), *Origanum compactum* Benth.(35), *Mentha pulegium* L.(7), *Artemisia herba alba* Asso (7), *Aloysia citriodora* Linnaeus (4), *Calamintha officinalis* Moench *(*14*), Inula viscosa* L. (6), *Lavandula stoechas* L.*(*5*), Tetraclinis articulata* Linnaeus (15), *Allium sativum* L.(3), *Nepeta amethystina (*39*), Salvia officinalis* L.(8), *Mentha rotundifolia* (L.) Huds.(10), *Artemisia absinthium* L.(9), *Chenopodium ambbrosioides* L.(4), *Lavandula dentala* L.(1), *Eucalyptus globulus* Labil.(4)	17	196	0.92
Coronavirus (CV)	*Rosmarinus officinalis* L.(9), *Origanum compactum* Benth.(18), *Mentha pulegium* L.(25), *Artemisia herba alba* Asso(26), *Aloysia citriodora* Linnaeus (1), *Calamintha officinalis* Moench *(*6*), Inula viscosa* L. (11), *Lavandula stoechas* L. *(*10*), Tetraclinis articulata* Linnaeus (11), *Citrus sinensis* (L.) Osbeck.(7),*Eugenia caryophyllata* Thunb. (11), *Allium cepa* L.(5), *Allium sativum* L.(4), *Salvia officinalis* L.(6), *Zingeber officinalis* Roscoe(7),	24	203	0.89

	Mentha rotundifolia (L.) Huds.(6), *Agave sisalana* Linnaeus(5), *Artemisia absinthium* L.(5), *Chenopodium ambbrosioides* L.(3), *Nerium oleander* L.(7), *Rosa damascena* Herrm(2), *Ocimum basilicum* L.(5), *Muscari comosum* (L.) Mill.(1), *Eucalyptus globulus* Labil.(17)			
Lung cancer (LC)	*Origanum compactum* Benth.(1), *Calamintha officinalis* Moench (1), *Inula viscosa* L. (14), *Marrubium vulgare* L.(25), *Citrus sinensis* (L.) Osbeck.(2), *Salvia officinalis* L.(1), *Zingeber officinalis* Roscoe(3), *Caralluma europaea* (Guss.) N.E. Br (11), *Chenopodium ambbrosioides* L. (4), *Olea europaea* L.(24)	10	86	0.89
Tuberculosis (TB)	*Artemisia herba alba* Asso (2), *Inula viscosa* L. (9), *Lavandula stoechas* L. (6), *Tetraclinis articulata* Linnaeus (2), *Allium cepa* L. (3), *Allium sativum* L.(2), *Papaver rhoeas* L.(32), *Salvia officinalis* L.(1), *Zingeber officinalis* Roscoe(5), *Agave sisalana* Linnaeus(2), *Matricaria chamomilla* (15), *Nigella sativa* L.(6), *Nerium oleander* L.(15), *Ocimum basilicum* L.(16), *Ziziphus lotus* (L.) Lam(1)	15	117	0.97

To treat or prevent coronavirus, *Mentha pulegium* L.[52] and *Artemisia herba alba* Asso were mentioned in the research. Previous ethnobotanical studies report similar results.[46,49] (Table 3)

Table 3 highlights explicit details of important plant species with high ICFs, such as *Tetraclinis articulata* Linnaeus, indicated for the treatment of Asthma[14]; *Caralluma europaea* (Guss) N.E.Br, utilized for the treatment of Lung cancer[11]; and *Ocimum basilicum* for the treatment of Tuberculosis[16].

Conclusion

Some rural areas in Sefrou province possess distinct plant species, such as *Nepeta amethystina*, which contain several unexamined phytochemicals. This plant is essential for the daily medicinal routine of Sefrou's inhabitants. They utilize it to cure diabetes and digestive disorders, in addition to using it as a herbal drink and as food during winter. Our study identified 38 plant species from 19 botanical families that are used to treat respiratory system illnesses. The Lamiaceae family was the most represented, with 12 plant species, with the leaves being the predominant plant part used. *Mentha pulegium* L., *Artemisia herba alba* Asso, and *Origanum compactum* Benth were the most used to treat respiratory system illnesses. Further studies should validate the pharmacological attributes of these plants, so that they can be assessed and included in sustainable development. Also, afterwards they should be included in indigenous species through the establishment of effective national programs. Therefore, the present study validated the necessity for further explicit study and discovery regarding the biodiversity of the study area.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article are original and that any liability for claims relating to the content of this article will be borne by them.

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References

1. Ansari MKA, Unal BT, Ozturk M, Owens G (Eds.). Plants as Medicine and Aromatics: Pharmacognosy, Ecology and Conservation. 2023; CRC Press.
2. Benkhnigue O, Chaachouay N, Zidane L. A Floristical and Ecological Study of the Medicinal Flora Used by the Local Population of the Haouz-Rehamna Region (Middle Atlantic Morocco-4). Acta Bot Hung. 2023; 65(3-4): 247-304. https://doi.org/10.1556/034.65.2023.3-4.3
3. Benabid A. The Rif and Middle Atlas Mountains (Morocco): Biodiversity, threats, conservation. African Mountains High Summit Conference, Nairobi, Kenya. 2002. 6-10 mai 2002.
4. Chaachouay N, Douira A, Zidane L. Herbal Medicine Used in the Treatment of Human Diseases in the Rif, Northern Morocco. Arab J Sci. Eng. 47, 131–153 (2022). https://doi.org/10.1007/s13369-021-05501-1
5. Jeddi S, Ferioun M, Benkhaira N, Jeddi M, El Hachlafi N, Fikri-Benbrahim K. Ethnobotanical appraisal of indigenous medicinal plants used in the Taounate region (Northern Morocco): Qualitative and quantitative approaches. Ethnobot. Res. App. 2024; 28: 1-26. https://ethnobotanyjournal.org/index.php/era/article/view/5725
6. Ajebli M, Eddouks M. Important medicinal plants Morocco, In book: Encyclopedia of Life Support Systems (EOLSS). 2023. Publisher: UNESCO.
7. Hmamouchi, M. Edible, aromatic, condiment, medicinal and toxic plants in Morocco. Identification of wild food and non-food plants of the Mediterranean region. Chania: CIHEAM-IAMC. 1997. 89-108. http://om.ciheam.org/article.php?IDPDF=CI011066
8. Scherrer AM, Motti R, Weckerle CS. Traditional plant use in the areas of monte vesole and ascea, cilento national park (Campania, Southern Italy). J. Ethnopharmacol. 2005. 97(1): 129-143. https://doi.org/10.1016/j.jep.2004.11.002
9. World Health Organisation (WHO). The top 10 causes of death. https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death, 2020, (accessed 10 January 2021).
10. Mahraz MA, Idrissi MA, Mzali A, El Mrayej H, Lfatouhi A, Salim R, Loukili EH, Jghaoui M, Rais Z, Taleb M. Ethnobotanical survey of medicinal and aromatic plants used in the treatment of skin burns in the Province of Sefrou of Morocco. Trop J Nat Prod. Res. 2024; 8(3):6487-9. https://www.ajol.info/index.php/tjnpr/article/view/271430
11. Najem, M, Ibijbijen J, Nassiri L. Ethnobotanical treatment of respiratory diseases in the central Middle Atlas (Morocco):

Qualitative and quantitative approach. Eur. J Integr Med. 2021; 46: 101358. https://doi.org/10.1016/j.eujim.2021.101358

12. Badiaa Lyoussi, Meryem Bakour, Khadija Cherkaoui-Tangi, Jaouad El-Hilaly, Christophe Hano. Ethnobotanical Survey and Pharmacological Screening of Medicinal Plants Used as Antihypertensive in Sefrou Province (Middle-North of Morocco): Benefits and Challenges. Front. Biosci. (Schol Ed) 2023, 15(1), 4. https://doi.org/10.31083/j.fbs1501004
13. Bousta D, Boukhira S, Aafi A, Ghanmi M, El-Mansouri L. Ethnopharmacological Study of anti-diabetic medicinal plants used in the Middle-Atlas region of Morocco (Sefrou region). Int. J Pharma. Res Health Sci. 2014; 2(1), 75-79.
14. HCP, 2024. High Commission for Planning, General Population and Housing Census, Morocco.
15. Bellakhdar J. The traditional Moroccan pharmacopoeia: ancient Arabic medicine and popular knowledge. *Le Fennec: Casablanca*, 1007; 397-399.
16. Fennane, M, Tattou I. Practical Flora of Morocco (manual for identifying vascular plants. 2, Angiospermae (Leguminosae-Lentibulariaceae)).1999. Scientific Institute, Mohammed V University - Agdal, Rabat Editors: Fennane, M; Tattou, M; Mathez, J; Ouyahya, A.; Oualidi, J. ISBN: 9954-0-1456-X. 10.13140/RG.2.1.3227.8889
17. El-Hilaly J, Hmammouchi M, Lyoussi B. Ethnobotanical studies and economic evaluation of medicinal plants in Taounate province (Northern Morocco). J. Ethnopharmacol. 2002; 86: 149–158. https://doi.org/10.1016/S0378-8741(03)00012-6
18. Ajaj A, El-Assfouri A, Ouazzani Touhami A, Benkirane R, Fennane M, Douira A. Inventory of the collection of lichens and lichenicolous fungi at the National Herbarium 'RAB' of the Scientific Institute (Rabat, Morocco). Documents from the Scientific Institute, Rabat. 2007; 21: 1-70.
19. Fakchich J, Elachouri M. An overview on ethnobotanico-pharmacological studies carried out in Morocco, from 1991 to 2015: Systematic review (part 1). J. Ethnopharmacol. 2021; 267: 113200. https://doi.org/10.1016/j.jep.2020.113200
20. Friedman J, Yaniv Z, Dafni A, Palewitch, D. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. J. Ethnopharmacol. 1986: 16(2-3): 275-287.https://doi.org/10.1016/0378-8741(86)90094-2
21. Tardío J, Pardo-de-Santayana M. Cultural Importance Indices: A Comparative Analysis Based on the Useful Wild Plants of Southern Cantabria (Northern Spain). *Econ* Bot 2008 ; 62 :24–39. https://doi.org/10.1007/s12231-007-9004-5
22. Cadena-González AL, Sørensen M, Theilade I. Use and valuation of native and introduced medicinal plant species in Campo Hermoso and Zetaquira, Boyacá, Colombia. J Ethnobiol. Ethnomed. 2013; 9: 23. https://doi.org/10.1186/1746-4269-9-23
23. Gakuubi MM, Wanzala W. A survey of plants and plant products traditionally used in livestock health management in Buuri district, Meru County, Kenya. J Ethnobiol. Ethnomed. 2012; 8: 39. https://doi.org/10.1186/1746-4269-8-39
24. Gomez-Beloz A. Plant use knowledge of the Winikina Warao: The case for questionnaires in Ethnobotany. Econ Bot. 2002; 56: 231–241. https://doi.org/10.1663/0013-0001(2002)056[0231:PUKOTW]2.0.CO;2
25. Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. Medicinal plants in Mexico: Healers' consensus and cultural importance. Social Sci. Med. 1998; 47(11): 1859-1871. https://doi.org/10.1016/S0277-9536(98)00181-6
26. Thomas E, Vandebroek I, Sanca S, Van Damme P. Cultural significance of medicinal plant families and species among Quechua farmers in Apillapampa, Bolivia. J. Ethnopharmacol. 2009; 122(1): 60-67. https://doi.org/10.1016/j.jep.2008.11.021
27. Khadija EO, Abdelfattah EM, Laila B, Dalila B. Ethnobotanical Study of Medicinal Plants Used in the Treatment of Cancers in The City of Casablanca (West-Central of Morocco). Trop J Nat Prod Res. 2021; 5(6):1044-1054. https://doi.org/10.26538/tjnpr/v5i6.11
28. El-Mernissi Y, Zouhri A, Labhar A, El-Mernissi R, Ahari M H, El Barkany S, Amhamdi H. Ethnobotanical survey of medicinal plants used in cosmetics in Ketama (North of Morocco). In E3S Web of Conferences. 2024. (Vol. 527, p. 01013). EDP Sciences. https://doi.org/10.1051/e3sconf/202452701013
29. Ourgha N, ElYacoubi H, Riyahi J, Rochdi A. Inventory of herbal remedies used traditionally in the province of Taza, Northern Morocco: Ethnomedicinal survey. J Pharm Pharmacogn Res. 2025 ; 13(1): 203–226. https://doi.org/10.56499/jppres24.1995_13.1.203
30. El Brahimi R, El Barnossi A, Amrani M, Bari A. Ethnobotanical Study and Biodiversity of Medicinal Plants Used in the Province of Taza North-Eastern Morocco. Trop J Nat Prod Res. 2022; 6(11):1814-1831. http://www.doi.org/10.26538/tjnpr/v6i11.12
31. Nicerine O, Houda E, Jamila R, Atmane R. Ethnobotanical Survey of Medicinal Plants Used in the Traditional Treatment of Genito-Urinary Diseases in the Region of Fez, Morocco. J Herb Med. 2024; 45: 100861. https://doi.org/10.1016/j.hermed.2024.100861
32. Ed-dahmani I, Mabchour I, Lfitat A, Bousraf FZ, Taleb M, Abdllaoui A. Ethnobotanical study of potentially toxic plants of Fez-Meknes Region, Eastern Middle Atlas, Morocco. Trop J Nat Prod Res. 2024 ; 8(2): 6115-33. https://www.ajol.info/index.php/tjnpr/article/view/271453
33. Chaachouay N, Douira A, Zidane L. COVID-19, prevention and treatment with herbal medicine in the herbal markets of Salé Prefecture, North-Western Morocco. Eur. J Integr. Med. 2021; 42: 101285. https://doi.org/10.1016/j.eujim.2021.101285
34. El Mekkaoui A, Khamar M, Benlakhdar S, Ngadi M, Slimani C, Louafi B, Nounah A, Cherkaoui E, Balafrej T, Rais C. Traditional knowledge and biodiversity of medicinal plants in the Taounate region for treating human diseases: An ethnobotanical perspective. Ethnobot. Res. App. 2024; 29: 1-22. https://ethnobotanyjournal.org/index.php/era/article/view/6202
35. Kadir M F, Sayeed MSB, Mia M M K. Ethnopharmacological survey of medicinal plants used by traditional healers in Bangladesh for gastrointestinal disorders. J. Ethnopharmacol. 2013; 147(1): 148-156. https://doi.org/10.1016/j.jep.2013.02.023
36. Miara M D, Bendif H, Rebbas K, Rabah B, Hammou M A, Maggi F. Medicinal plants and their traditional uses in the highland region of Bordj Bou Arreridj (Northeast Algeria). J Herb Med. 2019; 16: 100262. https://doi.org/10.1016/j.hermed.2019.100262
37. Teka A, Maryo M. Ethiopian medicinal plants used for respiratory tract disorders: ethnomedicinal review. Evid Based Complement Alternat. Med. 2023; (1): 7612804. https://doi.org/10.1155/2023/7612804
38. Ghabbour I, Ghabbour N, Khabbach A, Louahlia S, Hammani K. New ethnobotanical know-how characterizing the medicinal flora of the province of Taza (northern Morocco): Valorization and quantification of qualitative knowledge. Ethnobot. Res. App. 2024; 29: 1-32. https://ethnobotanyjournal.org/index.php/era/article/view/6133
39. El Hachlafi N, Chebat A, Soulaymani Bencheikh R, Fikri-Benbrahim K. Ethnopharmacological study of medicinal plants used for chronic diseases treatment in Rabat-Sale-Kenitra region (Morocco). Ethnobot. Res. App. 2020; 20: 1-23. https://ethnobotanyjournal.org/index.php/era/article/view/2043

40. Laaribya S, Alaoui A, Azmi R. Contribution to the identification of medicinal plants used against COVID-19 in North-West Morocco. Regul. Mech. Biosyst. 2022; 13(4): 339-45. https://medicine.dp.ua/index.php/med/article/view/832
41. Jeddi M, Benziane Ouaritini Z, Fikri-Benbrahim K. Ethnobotanical study of medicinal plants in northern Morocco (Taounate): case of Mernissa. Ethnobot. Res. App. 2021; 21: 1-23. https://ethnobotanyjournal.org/index.php/era/article/view/2697
42. Karimou R, Noumavo A D P, Aboudou K, Boya B, Assouma F F, Salami H A, Sina H. Nutritional and Microbial Qualities of Fermented Cereal-Based Porridges Produced in Northern Benin. J. Food Quality. 2024; (1): 7200190. https://doi.org/10.1155/2024/7200190
43. Loud N, Hamik A, Tajabrite S, Jerada R, Kourchi CE, Harhar H, Ajal EA, Chergui A, Nejjari R, Zakariya I. Ethnopharmacological Study of Aromatic and Medicinal Plants Used in the Treatment of Diabetes and Arterial Hypertension in the Laayoune Sakia El Hamra Region (Southern Morocco). Trop J Nat Prod Res. 2025; 9(4): 1423 – 1440. https://doi.org/10.26538/tjnpr/v9i4.8
44. Benlarbi F, Mimoune N, Chaachouay N, Souttou K, Saidi R, Mokhtar MR, Kaidi R, Benaissa MH. Ethnobotanical survey of the traditional antiparasitic use of medicinal plants in humans and animals in Laghouat (Southern Algeria). Vet World. 2023; 16(2):357-368. https://doi.org/10.14202/vetworld.2023.357-368 ..
45. Jeddi M, Benziane Ouaritini Z, Fikri-Benbrahim K. Ethnobotanical study of medicinal plants in northern Morocco (Taounate): case of Mernissa. Ethnobot. Res. App. 2021; 21: 1-23. https://ethnobotanyjournal.org/index.php/era/article/view/2697
46. Laftouhi A, El-assri Y, El-assri E, Elrherabi A, Mahraz MA, Eloutassi N, Rais Z, Taleb A, Taleb M.Ethnobotanical Investigation of Aromatic and Medicinal Plants Used in Traditional Treatments in Ain Mediouna and Thar Souk (Taounate; Morocco). Trop J Nat Prod Res. 2024; 8(12): 9547 – 9554. https://doi.org/10.26538/tjnpr/v8i12.28
47. Benkhaira N, Ibnsouda Koraichi S, Fikri-Benbrahim K. Ethnobotanical survey on plants used by traditional healers to fight against COVID-19 in Fez city, Northern Morocco. Ethnobot. Res. App. 2021; 21: 1-18. https://ethnobotanyjournal.org/index.php/era/article/view/2597
48. Flouchi R, El Far M, El Atrache NE, El Kassmi S, Ezzarouali Y, Benkhaira N, El Hachlafi N, Fikri-Benbrahim K. Ethnobotanical survey on plants used during the COVID-19 pandemic in Taza (Morocco) and population satisfaction according to the "Rules of Association" approach. J Pharm. Pharmacogn. Res. 2023 ; 11(3): 455–472. https://doi.org/10.56499/jppres22.1552_11.3.455
49. Chaachouay N, Benkhnigue O, Fadli M, El Ibaoui H, El Ayadi R, Zidane L. Ethnobotanical and Ethnopharmacological Study of Medicinal and Aromatic Plants Used in the Treatment of Respiratory System Disorders in the Moroccan Rif. Ethnobot. Res. App. 2019; 18: 1-16. https://ethnobotanyjournal.org/index.php/era/article/view/1437
50. Briguiche, Hanae, Zidane L. Floristic and ethnobotanical study of medicinal plants used in the treatment of diseases of the respiratory system in the region of Doukkala. Bull. Sci. Inst. Rabat Life Sci. Sect. 2019: 33-41.
51. HADJ-SAID, Dihia et BOUAZZA, Belaid. Medicinal plants used for the treatment of respiratory diseases in Kabylia, north of Algeria: an ethnomedicinal survey. J Herb Med. 2023; 40: 100685. https://doi.org/10.1016/j.hermed.2023.100685
52. Labhar A, El-Mernissi Y, Ahidar N, Zouhri A, Benamari O, Siddique F, Bashir M, Salhi A, Ahari M, Ibenmoussa S, Bourhia M, Salamatullah AM, Elyoussfi A, Amhamdi H. Seasonal Variations in the Essential Oil Composition and Biological Activities of Wild *Lavandula dentata* L. Nat Prod Com. 2024; 19(2). https://doi.org/10.1177/1934578X241230822