



Ethno-Pharmacological Study on Medicinal and Aromatic Plants Commonly Used in the Fez-Meknes and Beni Mellal-Khenifra regions: Insights from Pharmacy-Based Surveys

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ABSTRACT

Ethno-pharmacology delves into ancestral medicinal and aromatic plant (MAP) knowledge, which is crucial in folk medicine and community health. This ethno-pharmaceutical study focused on exploring the use of MAPs in the Meknes and Khenifra regions. A questionnaire targeted 149 respondents, gathering data on MAP usage, preparation methods, adverse effects, and influencing factors. Predominantly, users aged 30-45 in urban areas utilized MAPs with a balanced gender distribution. Lamiaceae was the most utilized plant family, primarily for gastrointestinal disorders. Rosemary (47%), star anise (46.3%), and thyme (43.6%) were the most commonly used. Sourcing methods included gathering from the wild (47.9%), herbalists (43.8%), and pharmacies (17.1%). The decoction (63.8%) was the favored preparation, often consumed short-term or regularly (68.5%) as part of the daily diet. Adverse health effects included vomiting (47.3%) and diarrhea (29.7%), underscoring the importance of understanding herbal remedies-drug interactions, given that 54% reported concurrent use of drugs. Media (54.4%) significantly influenced the MAP recipe choice, in contrast to the minimal influence of phytotherapy (16.10%). This study underscores the importance of MAPs in the studied regions and the necessity for their safe and effective use. It highlights the significant role of media and intergenerational transmission in traditional recipe selection, emphasizing the pivotal roles of culture and communication in preserving traditional medicinal practices.

Keywords: Ethno-pharmaceutical study, health effects, herbal remedies, medicinal and aromatic plants, media influence, traditional recipe

Introduction

Since ancient times, great civilizations such as the Chinese, Egyptians, Babylonians, Greeks, Romans, and others have exploited medicinal plants for their multiple properties. These plants are used for therapeutic, cosmetic, chemical, dietary, pharmaceutical, agri-food, and industrial applications. The varied use of plants has been at the heart of many traditional practices and has helped shape the basis of medicine and healthcare practices in different cultures throughout history.^{1,2} Africa is renowned for its rich flora, which lends significant importance to traditional medicine and phytotherapy in the lives of its citizens, particularly in rural areas.¹ Due to its biogeographical position, Morocco offers exceptional ecological and floristic diversity, constituting a considerable phylogenetic reserve. It is estimated that there are approximately 4,500 species belonging to 940 genera and 135 families of plants in this territory.³

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Modern medicine, which is sometimes inaccessible because of its high cost or sometimes ineffective in treating serious or chronic illnesses, is replaced by traditional medicine, often practiced by herbalists or traditional practitioners.⁴ Unfortunately, these practitioners often lack adequate training to diagnose illnesses and correctly use phytotherapy.⁵ The use of medicinal and aromatic plants (MAP) for phyto-therapeutic purposes by the local population is often associated with risks, mainly owing to the inappropriate use of these plants.⁶ This may result from incorrect dosage, inadequate choice of the active plant part, or simply the use of highly toxic plants due to a lack of knowledge, or, worse still, consuming them at the same time as medicines without any idea of plant-drug interactions.⁷ These practices can lead to therapeutic failure or toxic accidents, which can be fatal. It is important to note that toxicity caused by MAP accounts for approximately 5.1% of all intoxications, excluding scorpionic stings and envenomations.^{8,9} The objectives of this pharmacy-based study were to target patients affected by various pathologies, such as gastrointestinal, cardiovascular, urinary, gynecological, and endocrine diseases, as well as cancer cases, in the provinces of Meknes, Lhajeb, Boufkrane, Azrou, Lkbab, Aguelmouss, Ifrane, and Khenifra. This study aimed to document and analyze the medicinal and aromatic plant use practices in the Moroccan Middle Atlas region. In addition, this study aimed to identify the most frequently used plants, analyze preparation methods, explore the most commonly used plant parts, assess their possible adverse effects and their associations with drugs, and evaluate the factors influencing the choice of MAP use.

Material and Methods

Study area

The study area lies at the core of the Middle Atlas and encompasses four distinct prefectures. Among these, Meknès, Ifrane, and El Hajeb comprise two small villages, Boufkrane and Azrou, which are integrated into the Fes-Meknes region. The fourth prefecture, Khenifra, encompasses two additional small villages, Lkbab and Aguelmous, which are affiliated with the Beni Mellal-Khenifra region (Figure 1).

The climate of the study area is the Mediterranean continental mountains. Winters are rainy and cold, with periods of snow at higher elevations, whereas summers are dry and hot with, occasional periods of precipitation. This region is considered to be Morocco's reservoir or a water tower.^{10,11}

Survey

Proportional random sampling was performed to ensure accurate representation of the study region. The questionnaire included several axes established in previous studies.¹²⁻¹⁵ These axes included the identification of informants' sociodemographic characteristics (location, gender, age, etc.), specific information on plants (identification, method of preparation, part used, method of preparation, dosage, duration of use, adverse effects, toxicity), disease treatment, the origin of traditional recipes (media, herbalists, etc.), and the influence of the media on the choice of medicinal plants. It is important to note that all participants provided verbal informed consent and willingly shared necessary information.

Following the collection of questionnaires from the pharmacies, 149 patients were included in the study. The results were analyzed using indicators such as Family Use Value (FUV), Consensus Index (CI), Plant Part Value (PPV), and Relative Frequency of Citation (RFC).

Consensus Index (CI)

The Consensus Index (CI) is a measure used to assess the agreement between informants or experts in an ethnobotanical survey. It is often used to determine how similar or different the knowledge and opinions of respondents are. The following formula was used to obtain the Consensus Index as a percentage: $CI = Nt/NT$ where (Nt) is the number of species cited by several informants, and (NT) is the total number of species cited.¹⁶

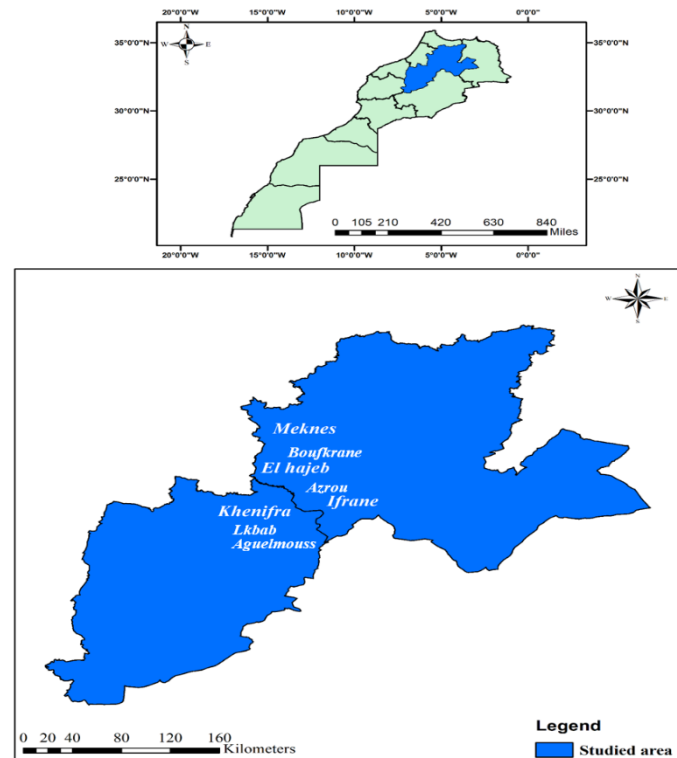


Figure 1: Geolocation of study area.

Family Use Value (FUV)

The family use value (FUV) represents the relative importance of families and is a taxonomical evaluation index. It was obtained by dividing the number of respondents revealing the family (UVs) by the number of species within each family (Ns) according to following the formula:¹⁷

$$FUV = UVs/Ns$$

Plant Part Value (PPV)

PPV (Plant Part Value) indicates the frequency of use of each plant part. It is calculated by dividing the number of uses declared for all plant parts (RU) by the sum of uses declared per plant part (RU), according to the formula in Chaachouay *et al.*¹⁸: $PPV = RU_{\text{plant part}}/RU$

Relative Frequency of Citation (RFC)

The relative frequency of citations is an index that indicates the importance of a species in the studied region. It was obtained by dividing the number of respondents having cited the species (FC) by the number of species N according to the formula: $RFC = FC/N$ with $[0 < RFC < 1]$.¹⁹

Statistical analysis

Statistical analysis of the results obtained was carried out using descriptive statistics, presented in both headcounts and percentages, to highlight the groupings of plants used, various traditional therapeutic applications, diseases treated, and any adverse effects that appeared as a result of poor MAP practices. In addition, the interactions between MAP and drugs were investigated. In addition, the Chi-square/Cramer's V test was applied to determine the significance of the qualitative variables. All statistical analyses were conducted using computer software such as SPSS (Statistical Package for the Social Sciences, version 25) and Microsoft Office Excel (2016).

Results and Discussion

Sociodemographic characteristics

The ethnopharmaceutical study conducted in the Meknes and Khenifra regions enabled us to establish the sociodemographic characteristics listed in Table 1. The survey participants were distributed according to their place of residence, as shown in Figure 2. The use of medicinal and aromatic plants (MAP) covers all age groups, with the 30-45 age group being the most predominant (53.0%), followed by the 45-60 age group (16.6%), which is mainly located in urban areas (77.9%). These results are consistent with those of other studies.^{20,21}

In terms of gender distribution, there was near equality between men (53.7%) and women (43.3%). However, other studies have highlighted the predominance of women using the MAP. Indeed, women use them more frequently than men do, as reported in previous studies.²² Travel to nearby towns is often attributed to male households. Thus, their number was almost equivalent to that of women.

Traditionally, it has been assumed that residents of rural areas tend to favor traditional medicine over those in urban areas. However, the results of this questionnaire revealed the opposite trend. This trend reversal can be attributed primarily to the specific context of pharmacy surveys, unlike other studies, which often focus on the practices of herbalists. It is also linked to the movement of rural dwellers to nearby towns for medical consultations or to buy medicines from the most accessible pharmacies, which often do not exist in their localities (Douar) (Table 1).

Analysis of plant families used and their importance in the community

The results of plant families revealed that Lamiaceae was the most frequently used family, accounting for 27% of the total (Figure 3). They are widely used to treat a variety of health problems such as gastrointestinal diseases, influenza, and cough (Table 2). The Asteraceae (10%) and Apiaceae (10%) families also underlined their importance in the community of informants in the study region. Nevertheless, analysis of the family use value (FUV) showed that the Schisandraceae and Caesalpiniodeae families had the highest FUVs, reaching 0.463 and 0.369, respectively. Similarly, Lamiaceae had a high

FUV of 0.329 (Table 3). These results highlight the importance of this plant family to the study area. El Hilah *et al.*²³ based on the fact that species in this family present therapeutic indications related to the digestive system, a pathology commonly encountered among the local population.

Most commonly used plants and their frequency in traditional remedies
According to this study, the most frequently used plant is rosemary, with a frequency of 47% and an RFC of 0.076, followed by star anise with 46.3% and an RFC of 0.075, followed by thyme (43.6 %) and RFC (0.070) (Figure 4; Table 3). Another study carried out in northeastern Morocco identified the most commonly used species as *Origanum compactum* (76%), *Mentha pulegium* (72%), and *Rosmarinus officinalis* L. (60%).²⁴

Rhattas *et al.*²⁵ identified the species most frequently used by the local population in Morocco's RIF region as *Cistus varius* and *Marrubium vulgare*, accounting for 14.59%, followed by *Mentha pulegium* (12.46%) and *Matricaria chamomilla* (9.25%). This variation in species use among different areas stems mainly from the specific knowledge of the respondents in each region. This reflects the traditional culture encompassing all medical practices, knowledge, and beliefs handed down from one generation to another.

Most commonly used plant parts, origin of collection and predominant preparation methods

Among the organs studied, the leaves were the most commonly used, accounting for over 85.4% of citations, followed by fruits and grains (22.9%). In contrast, stems and roots were the least frequently used (15.3% and 11.8%, respectively) (Figure 5). As other studies have indicated, the leaf is the preferred organ because of its ease of collection.

Moreover, it is recognized as the main seat of various phytochemical reactions, thus harboring essential active ingredients.²⁴

A graphical representation of the origin of the collection of medicinal and aromatic plants highlights the various locations where these plants were obtained (Figure 6). Nearly half of the respondents (47.9 %) obtained these plants directly from nature, suggesting that they should be gathered from natural environments or wild habitats. Herbalists were a significant source used by 43.8% of the individuals. Dried medicinal plants or herbal products are often supplied for therapeutic purposes. Finally, 17.1% of respondents mentioned pharmacies and para-pharmacies as sources of medicinal and aromatic plants.

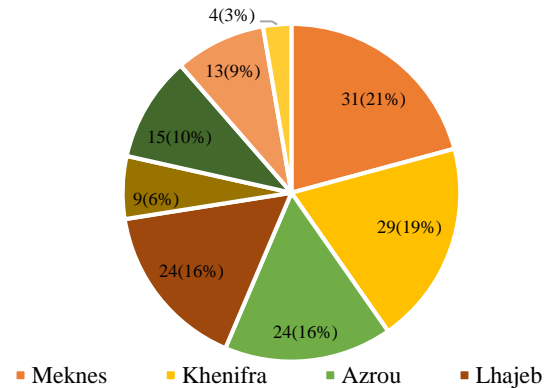


Figure 2: Distribution frequency of respondents in the study area.

Table 1: Socio-demographic characteristics of the investigated informants

	Total	Percentage (%)	Chi-square/ Cramer's V
Gender			
Man	80	53.7	$\chi^2=0.307$
Women	69	46.3	V=0.307
Place of residence			
Urban	116	77.9	$\chi^2<0.001$
Periurban	5	3.4	V=0.06
Rural	28	18.8	
Age			
15-30 years	13	8.7	$\chi^2=0.006$
30-45 years	79	53.0	V=0.022
45-60 years	42	28.2	
Over 60 years	15	10.1	
Family situation			
Married	93	62.42	$\chi^2=0.041$
Single	34	22.82	V=0.250
Divorced	22	14.76	
Academic level			
Illiterate	24	16.11	$\chi^2=0.086$
Primary	47	31.54	V=0.080
Secondary	53	35.57	
University	25	16.78	

Chi-square χ^2 tests and Cramer's V analysis were conducted to assess the relationship between various provinces, revealing a statistically significant association at the 5% significance level.

Table 2: Summary of Plant Aromatic and Medicinal species (MAP) used within the study area, detailing the ethnobotanical family, parts utilized, collection origin, and the indications for their use

Scientific name	Vernacular name	Family	Organ used	Method of preparation	Collection origin	Indication
<i>Datura stramonium</i> L.	Apple thorn (Chdek Jmel)	Solanaceae	Fruit	Decoction	Nature Herbalist	This plant is used to treat ulcers, wounds, inflammation, rheumatism and gout, sciatica, bruising and swelling, fever, asthma and bronchitis, as well as toothache ³⁶
<i>Cuminum cyminum</i> L.	Cumin (Kamoune)	Apiaceae	Fruit and seed	Powder, Decoction, and infusion	Herbalist Pharmacy/para pharmacy	Cumin is used in traditional medicine to treat hypolipidemia, cancer and diabetes, intestinal gas, insomnia, fever, lactation, rheumatism, asthma and bronchitis ^{37,38}
<i>Foeniculum vulgare</i> Mill.	Fennel (Nafaa)	Apiaceae	Root and fruit	Decoction and infusion	Nature Herbalist Pharmacy/para pharmacy	The plant has antioxidant, anti-inflammatory, anticancer, antifungal, antibacterial, antinociceptive, and antiviral activities and is also used to treat gastrointestinal diseases ^{39,40}
<i>Lavandula angustifolia</i> Mill.	Lavender (Lkhzama)	Lamiaceae	Whole plant	Decoction and infusion	Herbalist Pharmacy/para pharmacy	Carminative, diuretic, antiepileptic, antirheumatic, analgesic, anticonvulsant, sedative, spasmolytic, antioxidant and antibacterial ³⁷
<i>Thymus vulgaris</i> L.	Thyme (Zietra)	Lamiaceae	Flowering stem and leaf	Decoction and infusion	Nature Herbalist Pharmacy/para pharmacy	Antibacterial, antifungal, antiviral, antioxidant, antispasmodic, antitussive and antimutagenic ³⁷
<i>Ocimum basilicum</i> L.	Basil (Lhbek)	Lamiaceae	Flowering tops and leaves	Decoction and infusion	Herbalist Pharmacy/para pharmacy	Antispasmodic, stomachic and antiseptic, relieves headaches and migraines ⁴¹
<i>Mentha pulegium</i> L.	Mint Pouliot (Fliyo)	Lamiaceae	Stem, flower and leaf	Decoction and infusion	Herbalist Pharmacy/para pharmacy	Mint is an antispasmodic, laxative, and refreshing agent. Used for colds and coughs. Effective for stomach upsets ⁴²
<i>Rosmarinus officinalis</i> L.	Rosemary (Azir)	Lamiaceae	Leaves, flowering tops and stem	Decoction and infusion	Nature Herbalist Pharmacy/para pharmacy	Liver disorders, intestinal gas, leg pain. Antiasthmatic, anti-dysenteric, anti-inflammatory, antineuralgic, antirheumatic, antiseptic, antispasmodic, antivertiginous, anxiolytic, bronchodilator and diuretic ^{37,41}
<i>Origanum vulgare</i> L.	Oregano (Zeaater)	Lamiaceae	Leaves and flowers	Decoction and infusion	Nature Herbalist Pharmacy/para pharmacy	Antimicrobial, antifungal, antioxidant, antiparasitic, analgesic, anti-inflammatory, antihyperglycemic ³⁷
<i>Marrubium vulgare</i> L.	Marrube (Mrioute)	Lamiaceae	Leaves, stem, and whole plant	Decoction and infusion	Nature Herbalist Pharmacy/para pharmacy	<i>Marrubium vulgare</i> has hypoglycemic, lipid-lowering, vasorelaxant, antihypertensive, antioxidant, antimicrobial, antispasmodic, anti-inflammatory, and analgesic effects. Also used to treat gastrointestinal and respiratory disorders ^{43,44}
<i>Origanum majorana</i> L.	Sweet marjoram (Mardadouch)	Lamiaceae	Stem and flowers	Decoction and infusion	Nature Herbalist Pharmacy/para pharmacy	<i>Origanum majorana</i> L. is widely used in traditional medicine for the treatment of many illnesses such as allergies, hypertension, respiratory infections, diabetes, stomach aches and intestinal antispasmodics ⁴⁵

<i>Nigella sativa</i> L.	Nigella (Habba sawda)	Ranunculaceae	Seeds	Maceration and infusion	Herbalist Pharmacy/para pharmacy	Widely used as an antihypertensive, liver tonic, diuretic, digestive, antidiarrheal, appetite stimulant, analgesic, antibacterial and in skin disorders ⁴⁶
<i>Lippia citriodora</i> Kunth.	Verbena (Lwiza)	Verbenaceae	Leaf and stem	Decoction and infusion	Herbalist Pharmacy/para pharmacy	Neurological disorders. Leaf infusion is recommended for infants with stomach pain, stimulants, and carminatives. A decoction of the leaves is used against gas and gastric pain ^{25,47}
<i>Curcuma longa</i> L.	Turmeric (Kharloum)	Zingiberaceae	Root	Powder, infusion and maceration	Herbalist Pharmacy/para pharmacy	In the traditional medical system, turmeric is used as an anti-inflammatory, antineoplastic, antioxidant, anticoagulant, antidiabetic, cardioprotective, antiulcer, hypotensive, neuroprotective, antivenom and hypocholesterolemic ⁴⁸
<i>Zingiber officinalis</i> Rosc.	Ginger (Skinjibir)	Zingiberaceae	Rhizome	Powder, infusion and maceration	Herbalist Pharmacy/para pharmacy	Ginger is used in powdered form for coughs, as a decoction with hot milk, to treat influenza, and to treat liver problems. Ginger is also used externally, in a linear form, against back pain and rheumatism ¹¹
<i>Atractylis gummifera</i> L.	Thistle (Addad)	Asteraceae	Whole plant	Infusion and decoction	Nature, Herbalist	It is a toxic plant widely used in traditional Mediterranean medicine for colds, dizziness, and headaches; as an antisyphilitic; for boils; and as a purgative, emetic and vermifuge ⁴⁹
<i>Matricaria chamomilla</i> L.	Chamomile (Babounj)	Asteraceae	Leaves and fruit	Infusion and decoction	Nature Herbalist Pharmacy/para pharmacy	Well known for its Antidiabetic and Antioxidant activity; Acaricide; Antimicrobial, antifungal and sedative ²⁷
<i>Artemisia herba-alba</i> Asso.	White wormwood (Chih)	Asteraceae	Stem, flowers and leaves	Infusion and decoction	Nature, Herbalist	The plant is used as an antibacterial, antimycotic, antidiabetic, and against colds, coughs, and intestinal disorders ⁵⁰
<i>Ceratonia siliqua</i> L.	Carob tree (Kharoub)	Leguminosae-Caesalpiniodeae	Seed, pod, leaf and bark	Powder and infusion	Nature, Herbalist Pharmacy/para pharmacy	Used as antioxidant, antimutagenic, anticarcinogenic, antiproliferative and anti-estrogenic ⁵¹
<i>Illicium verum</i> Hook. F.	Star anise (Badiane)	Schisandraceae	Fruit	Decoction and infusion	Nature, Herbalist Pharmacy/para pharmacy	Antimicrobial, antioxidant, insecticide, analgesic, sedative, and convulsant activity. In addition, it is the main source of shikimic acid, a key ingredient in anti-influenza medication ⁵²
<i>Cinnamomum cassia</i> Presl.	Cinnamon (Qrfa)	Lauraceae	Aerial part and bark	Infusion	Herbalist Pharmacy/para pharmacy	It is a traditional spice, with a wide range of pharmacological effects, including anti-tumor, anti-inflammatory and analgesic, anti-diabetic and anti-obesity, antibacterial, antiviral, cardiovascular protective, cytoprotective and neuroprotective effects ⁵³
<i>Allium sativum</i> L.	Garlic (Touma)	Alliaceae	Bulb	Raw and dried	Herbalist Pharmacy/para pharmacy	Hypertension, hyperglycemia, anthelmintic and warts ⁴¹
<i>Myristica fragrans</i> Houtt.	Nutmeg (Gouza)	Myristicaceae	Nut	Infusion and herbal tea	Herbalist Pharmacy/para pharmacy	The plant has antioxidant, anticonvulsant, analgesic, anti-inflammatory, antidiabetic, antibacterial and antifungal activities ⁵⁴
<i>Trigonella foenum-graecum</i> L.	Fenugreek (Lholba)	Fabaceae	Seed	Maceration and Infusion	Herbalist Pharmacy/para pharmacy	Fenugreek is an aperitif, fortifier, emollient, and depurative. Useful for intelligence and diabetes ⁴²

<i>Salvia officinalis</i> L.	Sage (Salmiya)	Fabaceae	Leaves and flowers	Infusion and decoction	Herbalist Pharmacy/para pharmacy	Antidiaphoretic, antiasthenic, antidyseric, anti-galactagogue, antipyretic, antispasmodic, carminative, gastroprotective, hypertensive, infertility treatment and oral antiseptic ³⁷
<i>Crataegus laciniata</i> Ucr.	Hawthorn (Admam)	Rosaceae	Flower, leaf and fruit	Infusion	Nature Herbalist	Infused flowers are used for hypertension ¹¹
<i>Olea europaea</i> L.	Olive (Zitoune)	Oleaceae	Leaf and fruit	Decoction	Nature Herbalist Pharmacy/para pharmacy	Hemorrhoids, constipation, ear pain, high blood pressure ⁴¹
<i>Tilia cordata</i> Mill.	Linden (Zizfoun)	Tiliaceae	Leaves, flowers and wood	Decoction and infusion	Herbalist Pharmacy/para pharmacy	Flowers have antitussive, diaphoretic, diuretic, sedative, antispasmodic and hypotensive properties ⁵⁵
<i>Aristolochia paucinervis</i> Pomel.	Aristolochie (Bereztam)	Aristolochiaceae	Root	Decoction	Herbalist, Nature	It is a wild species commonly used in traditional Moroccan medicine to treat a wide variety of illnesses such as skin infections and abdominal pain. Powder prepared from rhizomes is used with salted butter to treat skin wounds, infections, bites and stings and cancer treatment ⁵⁶
<i>Chenopodium ambrosioides</i> L.	Anserine (Mkhinza)	Chenopodiaceae	Leaves and flowers	Decoction	Nature, Herbalist, Pharmacy/para pharmacy	Medicinal properties encompass antiasthmatic, anthelmintic, antitussive, emmenagogue, hypoglycemic and antispasmodic effects ³⁷

This indicates a preference for purchasing these plants from commercial establishments specializing in health products. The diversity of origins of MAP collection may reflect personal choices, cultural preferences, or specific needs in terms of the quality and accessibility of medicinal plants.²⁶

In this study, the most widely adopted preparation method was the decoction, accounting for a significant proportion (63.8 %) (Figure 7). This technique involves boiling plant parts in water to extract the beneficial components. Infusion was also popular (40.9% of quotes). Infusion involves immersing plants in hot water to allow their medicinal properties to diffuse into the liquid. Finally, 24.2% of respondents reported the use of plants in powder form. This method involves transformation of plant parts into a powder, which facilitates their use and storage for various therapeutic purposes. Studies conducted by Kachmar *et al.*²⁴ and Bammou *et al.*²⁷ validated that decoction and infusion remain the most predominant methods for preparing herbal remedies in traditional medicine.

Utilization and satisfaction intensity of MAP

Figure 8 illustrates the distribution of MAP use. Most users (68.5%) employed these products for less than a week, probably for temporary,

short-term needs, or as part of regular use in their daily diet, given that the use of aromatic plants in food products represents added value to these foods.^{28,29} Second, 12.8% of the respondents said they had used them for less than one month, while 18.8% indicated use extending beyond one month. The latter proportion suggests that a significant proportion of users resorted to MAP over an extended period of time, potentially for long-term or chronic medical needs.

For plants prepared in decoction or infusion form, the results indicated that most users (63.5%) consumed a quantity corresponding to a small glass, followed by 28.4% who consumed a quantity equivalent to a medium glass, and finally 6.10% who used a larger quantity, represented by a large glass. Concerning plants consumed in powder form, the data showed that 50.7% of respondents used a dose corresponding to one spoon, while 8.1% opted for a dose corresponding to two spoons (Figure 9). These results suggest a general preference for moderate quantities when prepared as decoctions or infusions, with the predominance of small glass. For use in the powder form, a significant proportion of users preferred a dose equivalent to that of a spoon.

The importance of doses of medicinal and aromatic plants is closely linked to their efficacy and safety.

Table 3: Relative frequency of citation (RFC), use value (UV), family use value (FUV), and consensus index (CI)

Nom scientifique	UV	RFC	FUV	CI
<i>Datura stramonium</i> L.	0.154	0.025	0.154	0.025
<i>Cuminum cyminum</i> L.	0.221	0.036	0.151	0.036
<i>Foeniculum vulgare</i> Mill.	0.081	0.013	0.151	0.012
<i>Lavandula angustifolia</i> Mill.	0.396	0.064	0.332	0.064
<i>Thymus vulgaris</i> L.	0.436	0.070	0.332	0.072
<i>Ocimum basilicum</i> L.	0.121	0.020	0.332	0.019
<i>Mentha pulegium</i> L.	0.383	0.062	0.332	0.065
<i>Rosmarinus officinalis</i> L.	0.470	0.076	0.332	0.077
<i>Origanum vulgare</i> L.	0.362	0.059	0.332	0.058
<i>Marrubium vulgare</i> L.	0.275	0.031	0.332	0.045
<i>Origanum majorana</i> L.	0.215	0.035	0.332	0.035
<i>Nigella sativa</i> L.	0.174	0.028	0.174	0.029
<i>Lippia citriodora</i> H.B.K.	0.248	0.040	0.248	0.037
<i>Curcuma longa</i> L.	0.128	0.021	0.131	0.019
<i>Zingiber officinalis</i> Rosc.	0.134	0.022	0.131	0.021
<i>Atractylis gummifera</i> L.	0.047	0.008	0.132	0.008
<i>Matricaria chamomilla</i> L.	0.154	0.025	0.132	0.025
<i>Artemisia herba-alba</i> Asso.	0.195	0.044	0.132	0.032
<i>Ceratonia siliqua</i> L.	0.369	0.060	0.369	0.054
<i>Illicium verum</i> Hook.f.	0.463	0.075	0.463	0.075
<i>Cinnamomum cassia</i> Presl.	0.081	0.013	0.081	0.012
<i>Allium sativum</i> L.	0.174	0.028	0.174	0.026
<i>Myristica fragrans</i> Houtt.	0.174	0.028	0.174	0.028
<i>Trigonella foenum-graecum</i> L.	0.161	0.026	0.111	0.025
<i>Salvia officinalis</i> L.	0.060	0.010	0.111	0.010
<i>Crataegus laciniata</i> Ucr.	0.074	0.012	0.074	0.012
<i>Olea europaea</i> L.	0.094	0.015	0.094	0.015
<i>Tilia cordata</i> Mill.	0.060	0.010	0.060	0.101
<i>Aristolochia paucinervis</i> Pomel	0.101	0.016	0.101	0.016
<i>Chenopodium ambrosioides</i> L.	0.188	0.030	0.188	0.031

The efficacy of preparations based on standardized plant extracts depends on the dose applied, as corroborated by experimental and clinical tests.³⁰ The diversity in the quantities of medicinal and aromatic plants used may reflect individual preferences, traditional practices, or specific indications linked to the plants studied.²⁹ Extensive research into the use of medicinal plants in healthcare has been conducted worldwide to validate their efficacy. Some of these findings have contributed to the recognition and integration of medicinal plants in the design and implementation of disease-prevention strategies.³¹

The diversity of the respondents' post-MAP experiences is shown (Figure 10). Approximately 63% of the participants expressed average satisfaction, suggesting that a significant proportion of users found their experience with these products moderately satisfactory. A further 21.9% expressed low satisfaction, indicating a less favorable experience or some degree of dissatisfaction with the MAP. Finally, 15.1% indicated high satisfaction, highlighting a positive and enriching experience for this specific fraction of the sample. These results highlight a variation in satisfaction levels among MAP users, ranging from moderate to high satisfaction but with a notable proportion of individuals expressing low satisfaction. Further analysis is needed to understand the underlying reasons for this diversity in satisfaction, to improve the overall experience of MAP users.

Association between MAPs-Drug, and frequency of undesirable effects of MAP

The fate of a drug in the body is influenced by various physicochemical and pharmacokinetic factors. The simultaneous use of herbal preparations and drugs can alter one of these kinetic mechanisms, resulting in plant-drug interactions.³² This study revealed that more than half of the participants (54%) consumed their medication at the same time as herbal medicines without consulting professionals to determine the possible interaction between the two substances (Figure 11). This interaction can lead to under- or overdosing of the drug, with clinical consequences such as loss of therapeutic efficacy, appearance of side effects, or even a reduction or total absence of efficacy. Interactions between certain medicinal plants and drugs can manifest differently, affecting treatment efficacy or patient safety. Garlic (*Allium sativum*) is associated with marginal reduction in certain cardiovascular risk factors.³³

Analysis of the results showed that the interaction between medicinal and aromatic plants (MAP), or their inappropriate use, can result in adverse effects of varying intensity and severity. Vomiting was the most frequently reported adverse effect, accounting for almost 47.3%, followed by diarrhea and colic or spasms (29.7%) and migraines or headaches (21.6%), with other adverse effects accounting for only 11.5% (Figure 12). These symptoms result from the pharmacodynamic and pharmacokinetic mechanisms of the products used in herbal medicine, the understanding of which is less advanced than that of drugs.³⁴

Influences and determining factors in the choice of traditional recipes

The data show that the media account for more than half of the influence on the choice of traditional recipes, representing 54.4% of the total influence (Figure 13). This trend is confirmed in Figure 14, which shows that the intensity of media influence is often moderate compared with that of other actors influencing the choice of traditional recipes. Family members, who occupy a dominant position, also have a significant influence, with 49.7% of the decisions concerning the adoption of these recipes. On the other hand, oral recommendations had less influence, accounting for only 30.2% of responses. This distribution suggests that intergenerational transmission and the media have a significant impact on the choice of traditional recipes, followed by a substantial influence from families, while the influence of herbalists and phytotherapy is relatively limited in the specific context of this pharmacy study.

Distribution of diseases studied and their prevalence in the community

The graph illustrates the distribution of illnesses as percentages according to the specific categories. Gastrointestinal diseases (stomach pain, colic, and colopathy) were the most common, accounting for 55% of the cases studied. Cardiovascular diseases (such as hypertension and

heart attacks) and rheumatic diseases accounted for the same proportion (11%), followed by respiratory diseases (9%), endocrine diseases (such as diabetes and thyroid disorders), and sexually transmitted diseases (STDs), which accounted for 7% of the cases. This distribution demonstrated a relatively higher prevalence of gastrointestinal disorders than the other disease categories studied (Figure 15). This conclusion was corroborated by the research of Mikou *et al.*³⁵, who stressed that these results are attributable to the population's eating habits and lifestyle, particularly a sedentary lifestyle, among the many factors influencing digestive ailments.

Conclusion

In conclusion, Lamiaceae species play a significant role in traditional medicine in the Meknes and Khenifra regions of Morocco. Common practices, such as decoction and dietary integration of remedies, have been identified, but the occurrence of adverse effects stresses the importance of understanding plant-drug interactions. This study also highlights the influence of media and intergenerational transmission on traditional recipe preferences, emphasizing the cultural and therapeutic significance of MAP. It advocates cautious and informed usage, urges heightened awareness, thorough comprehension of interactions, and precise documentation for safe and effective medicinal practices.

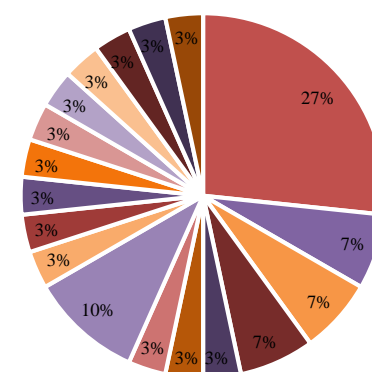


Figure 3: Percentage of botanical family distribution.

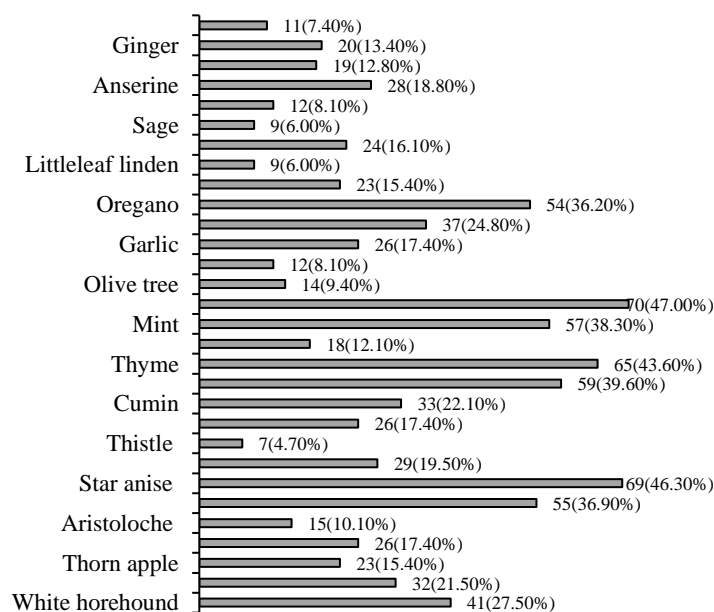


Figure 4: Frequency use of Medicinal and Aromatic Plants (N=923).

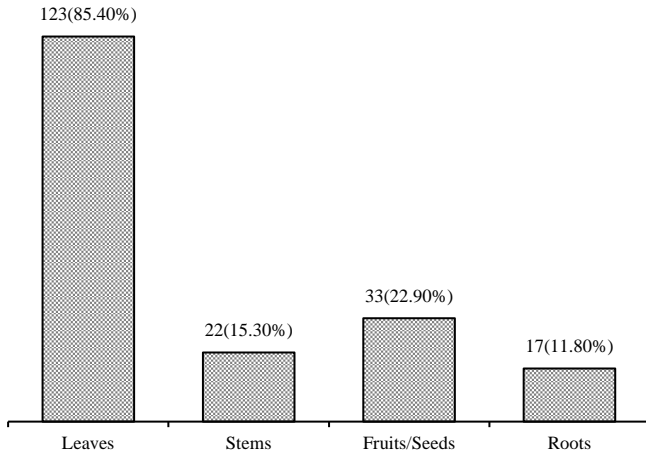


Figure 5: Percentage of plant part value (PPV) (N=195).

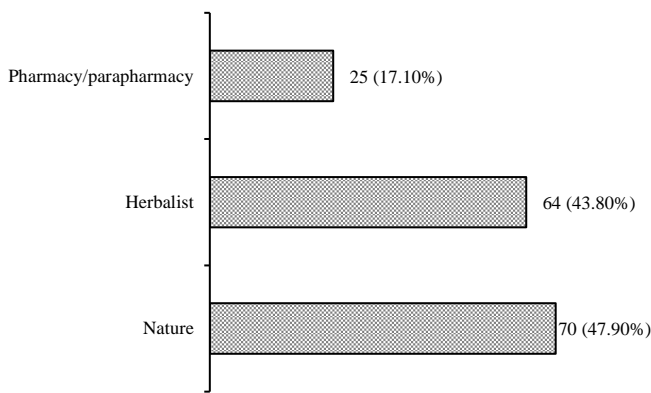


Figure 6: Collection origin of used MAPs (N=159)

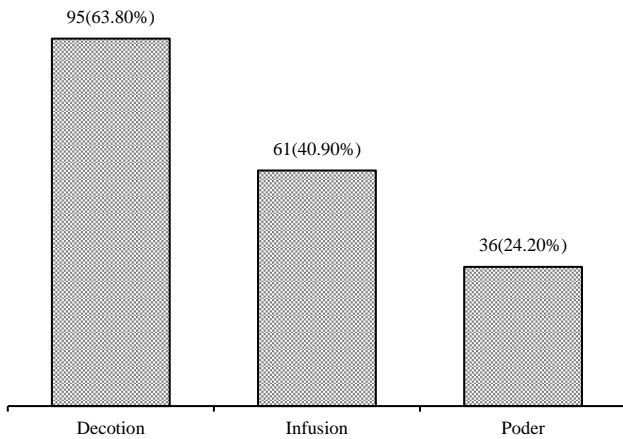


Figure 7: Preparation of medicinal and aromatic plants (N=192).

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

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

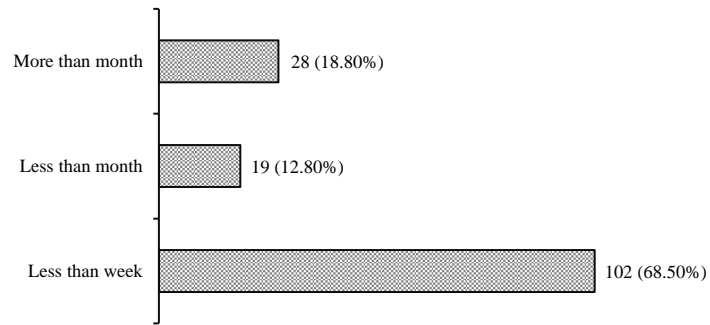


Figure 8: Last use duration of MAPs (N=149).

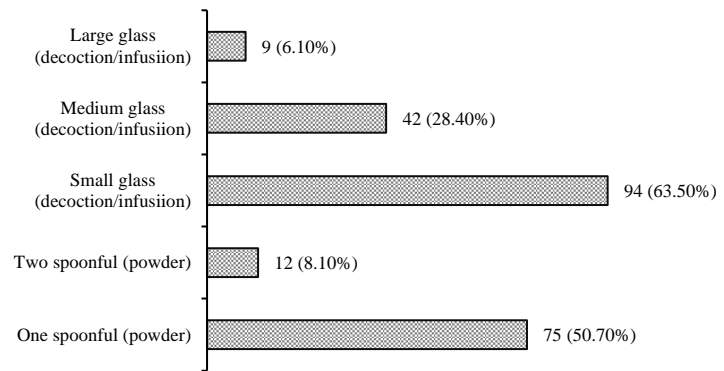


Figure 9: Dose used of MAPs in powder or decoction/infusion preparation mode (N=232).

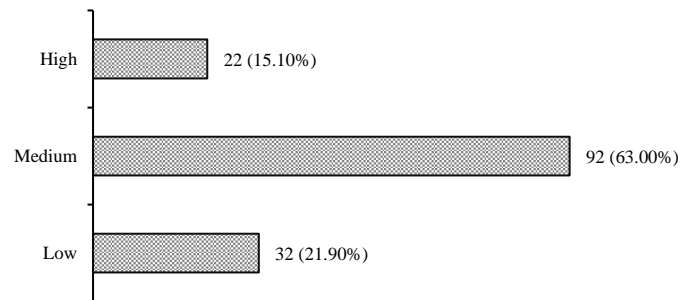


Figure 10: Satisfaction intensity after the use of MAPs (N=146).

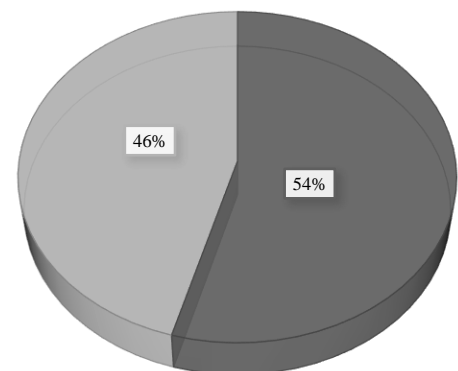


Figure 11: Association of Medicinal and Aromatic Plants utilization and drugs (N=149).

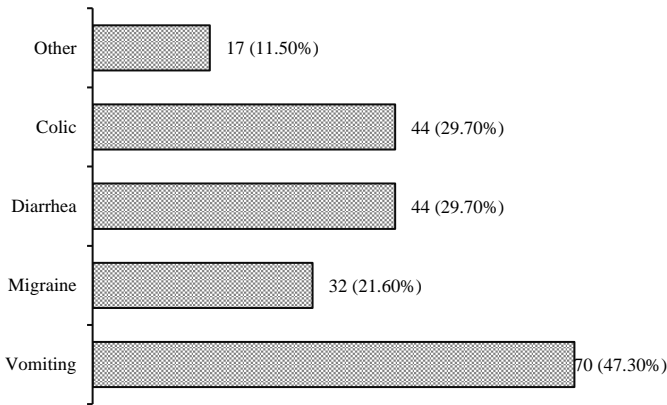


Figure 12: Frequency of undesirable effects following the use of MAPs (N=207)

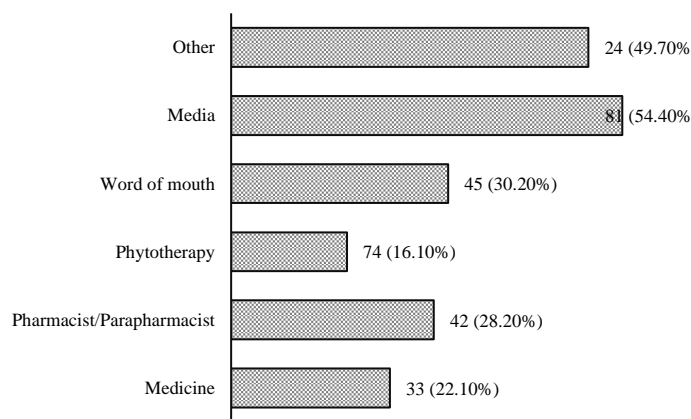


Figure 13: Basis for choosing the traditional recipe (N=299).

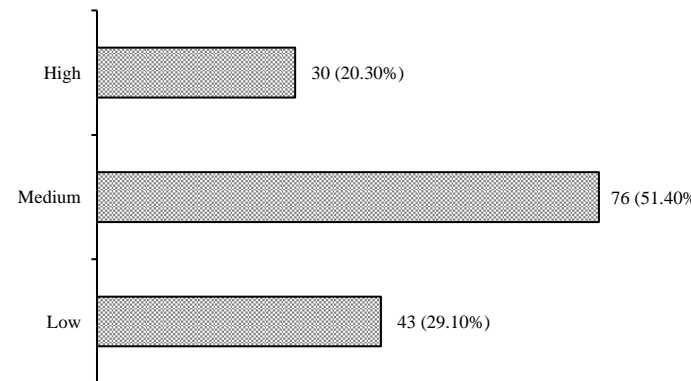


Figure 14: Intensity of media influence on traditional MAPs recipe choice (N=149).

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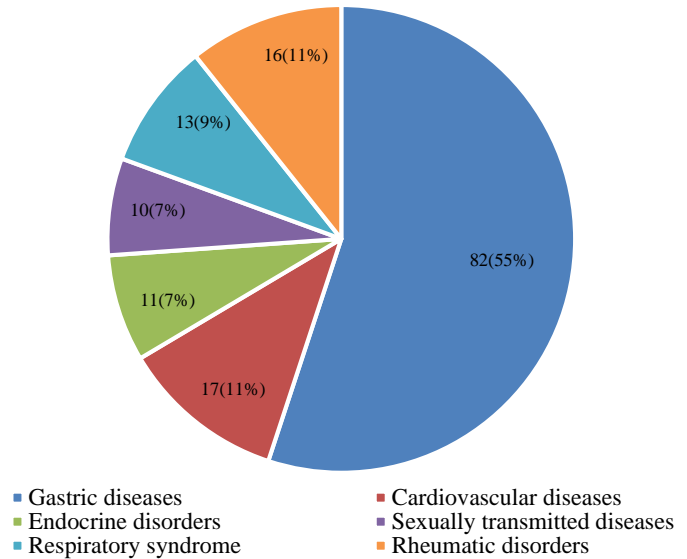


Figure 15: Frequency of diseases treated by MAPs in the study area.

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