Review Article

Traditional Knowledge of Medicinal Plants Used in the Northeastern Part of Morocco

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The knowledge of the plants that are used may provide insight on their properties for further exploration. This study aimed to identify and collect data about medicinal plants used in traditional medicine by the population of the provincial region of Taza, Morocco. An ethnobotanical survey was carried out among 200 informants, competent villagers, herbalists, and traditional healers from the provincial region of Taza city through direct interviews using a structured questionnaire. The survey reported 55 plant species belonging to 28 families used in the folk medicine. Informants’ results showed that the most frequently used plants were Origanum compactum, Mentha pulegium, Rosmarinus officinalis L., Aloysia citrodora, Calamintha officinalis Moench, and Artemisia herba-alba Asso., with a relative frequency of citation of 76%, 72%, 60%, 42%, 40%, and 30%, respectively. Moreover, in this study, the Lamiaceae family was the most commonly reported plant family, and the leaves were the most frequently used parts of the plants; otherwise, decoction and infusion were the most used modes in the preparation of remedies from medicinal plants in the traditional medicine. The sociodemographic characteristics showed that women use medicinal plants slightly more than men, the illiterate people use the medicinal plant the most, and old people have more information about the medicinal plants than the new generations. The region of Taza of Morocco has an important floristic biodiversity of medicinal plants which are used in traditional medicine practice. This result provides a good database for pharmacological screening in the search for new plants that can contain new bioactive molecules that can be used as a bioactive ingredient of medicament or as a biological alternative in pharmacology.

1. Introduction

For a long time, plants have played a very important role in the daily lives of human life [1]. Herbal medicines have traditionally been used because of several benefits; they are affordable and easily accessible, and there is no evidence of resistance to whole plant extracts or of effectiveness [2]. This sort of traditional medicinal knowledge has been regularly practiced in homes and is transferred from generation to generation with the passage of time [3]. Nowadays, the use of plants as a way of treatment is still very important for many rural and urban Moroccans [4]. In recent decades, scientific studies have increasingly focused on plants used in traditional medicine to treat various diseases through botanical surveys and laboratory biological tests on animal models to discover certain species with medicinal properties that may
replace certain chemical drugs with side effects [5, 6]. Morocco is a Mediterranean country which is crisscrossed from east to west and from southwest to northeast by four mountain ranges, the Rif, the Middle Atlas, the High Atlas, and the Anti-Atlas; his position between two seas and a vast desert results in a complete range of Mediterranean bio-climates. This varied climate provides habitat for rich and varied flora: more than 4200 spontaneous species and some 1500 introduced species have been catalogued [1, 7, 8]. His varied climate provides habitat for rich and varied flora. More than 4200 spontaneous species and some 1500 introduced species have been catalogued [1, 7, 8].

2. Materials and Methods

2.1. Study Area. Taza city is administratively part of the Region of Fez-Meknes, it is located in the northeast of Morocco, and it is located in a mountain pass where the mountain range of the Rif and that of the Middle Atlas meet (Figure 1). Taza province is bordered to the north by the province of Al Hoceima, to the northeast by the province of Nador, to the east by the province of Taourirt, to the south by that of Boulemane, and to the west by the province of Taounate and that of Sefrou (latitude: 34°13′00″N, longitude: 4°01′00″W, and altitude: 550 m). This city covers an area of 37 km² with a population of 148,456 inhabitants in 2014.

During the interviews, structured questionnaires were used for data documentation, 20 questionnaires for each zone, and the selected zones were dispersed between the city of Taza, the villages, and the douars of the Rif Mountains and the Middle Atlas belonging administratively to the province of Taza. Each questionnaire consisted of two parts. The first part concerns demographic information such as sex, age, educational level, source of information, and the profession of the participants, while the second part has informative questions on local names of plant species, mode preparation (decoction, maceration, infusion, etc.), the plant part used (stems, roots, leaves, seeds, aerial part, etc.), the method of administration, and the diseases treated by the plants mentioned by the informant. In each interview, the names of the plants were recorded in Moroccan Arabic when they were mentioned.

The botanical materials of 55 plant species were collected from the informants and kept in special glass frames; they were later identified by Dr. Abdelilah Rahou (Faculty of Sciences, Moulay Ismail University, Meknès). The confirmation was carried out by Dr. Mohamed Reda Kachmar using means of the literature.

These samples of plant materials were given herbarium specimen codes, and the voucher plant samples were kept in the Herbarium of the Botany Department of the Scientific Institute of Rabat, Morocco. The complete floristic list was established after the identification and verification of the samples; the identification process was realized using the following references: Moroccan Medicinal and Aromatic Plants [9], Vascular Flora of Morocco [10], Practical Flora of Morocco [10], and Traditional Moroccan Pharmacopoeia [11]. The taxonomy was confirmed on the basis of data available on the International Plant Names Index website: https://www.ipni.org/.

2.2. Ethnobotanical Survey. The first interview was conducted with the informants, giving them a brief explanation of the objective of the study and the importance of the information they were going to provide in order to sensitize them to participate in this study. In total, 200 people were interviewed directly between May and August 2016 through ethnobotanical surveys in different localities, cities, towns, villages, and douars in the province of Taza.

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2.3. Ethnopharmacological Parameter Analysis

2.3.1. Relative Frequency of Citation. On the basis of the local therapeutic importance of each plant species, the relative frequency of citation (RFC) was calculated according to the following formula [12]:

$\text{RFC} = \frac{FC}{N}$

where FC is the number of participants who mentioned the use of a plant species and $N$ is the total number of participants.

2.4. Statistical Analysis. The results obtained were processed and analysed using Excel 2010 software.

3. Results

3.1. Sociodemographic Characteristics. A total of 200 participants comprising herbalists, competent villagers, traditional healers, and normal people from Taza city, including 114 women (57%) and 86 men (43%), were interviewed. Their average age was 52 years with a minimum of 19 years and a maximum of 85 years. The majority of the informants belonged to the rural area (90%), and 61% were illiterate. The majority of participants received their education about herbal medicine from herbalists (54%), while the rest learned from their older family members or from other people (Table 1).

3.2. Medicinal Plants

3.2.1. Medicinal Plants Used by the Informants in the Treatment of Various Diseases. The survey reached 56 plant...
species used in the treatment of various diseases by the participants in the Taza region. The most used species were *Origanum compactum* with the highest RFC ratio (76%), followed by *Mentha pulegium*, *Rosmarinus officinalis* L., *Aloysia citrodora*, *Calamintha officinalis* Moench, and *Artemisia herba-alba* Asso., with the RFC value of 72%, 60%, 42%, 40%, and 30%, respectively (Table 2). The images of the plants with the highest RFC values are shown in Figure 2.

Plants were grouped into 28 families; this census also shows different routes of administration of the drugs, the preparation methods, and the part of the plants used in the traditional medicine as presented in Table 1. The most presented families were Lamiaceae (14 species), Apiaceae (6 species), Asteraceae (5 species), and Myrtaceae (3 species) followed by Cupressaceae, Lauraceae, and Zingiberaceae (2 species). All other families were presented by one species as shown in Figure 3.

3.3. Used Parts, Methods of Preparation, and Modes of Administration. Results obtained in this study showed that leaves were the most used part of the plants (57.35%) followed by the stems (13.23%), seeds (11.76%), roots (7.35%), flowers (5.88%), fruits (2.94%), and barks (1.47%) (Figure 4). Our survey also showed that decoction and infusion were the most used methods of preparation with frequencies of 29.11% and 27.84%, respectively, followed by the raw form (20.25%), powder form (17.72%), fumigation (3.79%), and vegetable oil (1.26%) (Figure 5). Oral administration of the drugs had the highest frequency (70%), while the other
administration modes (brushing, rinsing, massage, and inhalation) presented the rest 30% (Figure 6).

4. Discussion

The main goal of this study is to identify the medicinal plants used in the province of Taza city. This region has an important and diversified heritage of aromatic and medicinal plants widely used in traditional medicine by the local population. This richness is also reflected by broad culture in phytotherapy and phytopharmacology among the selected informants, particularly herbalists and traditional healers.

Sociodemographic results showed that the age of all participants was between 20 and 86 years, and the most presented group of the informants having the age between 30 and 50 years (48%). The result also showed that females use medicinal plants a little bit more than males. Our results confirm those obtained by other ethnobotanical studies made in other regions in Morocco [7, 128]. This must be due to that women are in charge of drying, stocking of medicinal plants, and preparing recipes for the care of family members.

Interviews showed that older people are particularly competent than the young generation and had a greater knowledge of the uses of medicinal plants for the cure of various diseases; similar results were observed by other studies [30, 129]. However, this finding did not exclude other age groups with valuable knowledge about herbal remedies. In fact, older people are expected to provide more reliable information because they hold more ancestral knowledge transmitted orally. The transmission of this valuable knowledge and medicinal recipes from the old to the new generation is not always assured and is now in decline [129].

In this study, women were the most presented (57%) than men (43%). These results agree with those of a previous ethnobotanical study done in the province of Tata, Souss-Massa region in Morocco [19]. This study was led in the southeast region of Morocco, while our study was conducted in the northeast region of Morocco; these two regions differ by their geographical locations and their climatic zones and consequently a difference in their plant biodiversity, which obviously affects the choice of the plant’s species used in traditional medicine. Therefore, our survey showed that the most used plants in the Taza region were *Origanum compactum*, *Mentha pulegium*, *Rosmarinus officinalis*, *Aloysia citrodora*, *Calamintha officinalis* Moench, and *Artemisia herba-alba* Asso., while *Artemisia huguetii*, *Mentha pulegium*, *Trigonella*...
| Family name     | Plant species                  | Voucher codes | Vernacular name | Parts used | Preparation mode | Administration mode | RFC (%) | Utilisation                                                                 | Ethnomedicinal uses recorded in the literature inside Morocco                                                                 | Pharmacological properties verified in vivo and/or in vitro                                                                 |
|-----------------|--------------------------------|---------------|-----------------|------------|------------------|---------------------|---------|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Amaranthaceae   | *Chenopodium ambrosioides* L.  | RAB135-16     | Mkhinza         | Leaves    | Raw with juice, raw | Oral Basting        | 13      | Digestive tract infections, Asthma, hepatitis                                  | Headaches, migraine, measles, jaundice, syphilis, fever [4]                                                                   | Antioxidant and immunostimulant [13]                                                                                     |
| Amaryllidaceae  | *Allium sativum* L.            | RAB15-16      | Touma           | Leaves    | Powder            | Oral                | 3       | Diabetes, Cold Gripe, Hypertension                                            | Scorpion and snake bite, intestinal pain, hypertension [1]                                                                  | Antioxidative and antigenotoxic effects [15]                                                                                |
| Anacardiaceae   | *Pistacia lentiscus* L.        | RAB14-16      | Drou            | Leaves    | Decoction         | Oral                | 5       | Digestive system pathologies                                                  | Digestive diseases and evil eye [1]                                                                                         | Antibacterial activity [16]                                                                                             |
| Apiaceae        | *Daucus crinitus* Desf.       | RAB92-16      | Lbesbas Nafaa   | Leaves    | Raw               | Oral Inhalation     | 2       | Digestive system disorders                                                    | Digestive system [8]                                                                                                        | Antimicrobial [17]                                                                                                      |
| Apiaceae        | *Foeniculum vulgare* Mill.    | RAB234-16     | Habbat Hlawa    | Seeds      | Raw               | Oral                | 3.5     | Gastrointestinal diseases, Rheumatism, Asthma                                 | Mouthwash [18] Kidney diseases, digestive, pain, diabetes [19]                                                              | Anti-inflammatory, analgesic, and antioxidant [20]                                                                     |
| Apiaceae        | *Pimpinella anisum* L.        | RAB231-16     | Habbat Hlawa    | Seeds      | Raw               | Oral                | 3       | Diabetes, allergy, asthma, digestive system stimulation, tooth care          | Spasmodic, carminative, stomachic, diuretic, expectorant, stimulant kidney diseases, gastric pain, diabetes, antiemetic, tooth care [19] | Antioxidant and antimicrobial [22] Antimicrobial and cytotoxic [23]                                                     |
| Apiaceae        | *Petroselinum sativum*        | RAB266-16     | Maâdrous        | Stems      | Decoction         | Oral                | 3       | Gastrointestinal infections, heart disease, hypertension, allergy            | Cardiac disease and hypertension [24]                                                                                      | Antioxidant and antibacterial [25] Antihypertensive [26]                                                                |
| Apiaceae        | *Cuminum cyminum* L.          | Lkamoun        | Seeds           | Infusion   | Oral              | Gastrointestinal infections, stomach ache | 6       | Diabetes, cardiovascular diseases, and pathologies of the digestive system [4] | Diabetic, cardiovascular diseases, and pathologies of the digestive system [4] | Antimicrobial and cytotoxic activities [27]                                                                              |
| Apiaceae        | *Coriandrum sativum* L.       | Lkazber        | Leaves Stems    | Infusion   | Oral              | Hypertension        | 5.5     | Cardiac disease and hypertension [24]                                        | Cardiac disease and hypertension [24]                                                                                      | Antioxidant effect [28] Protection of gastric mucosal damage [29]                                                        |
| Family name | Plant species          | Voucher codes | Vernacular name | Parts used | Preparation mode | Administration mode | RFC (%) | Utilisation                                                                 | Ethnomedicinal uses recorded in the literature inside Morocco                                                                 | Pharmacological properties verified in vivo and/or in vitro   |
|-------------|------------------------|---------------|----------------|-----------|------------------|---------------------|---------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Apocynaceae | *Nerium oleander* L.   | RAB188-16     | Defla          | Leaves    | Infusion Raw     | Oral Basting       | 2       | Heart disease, hypertension, diabetes, dermatosis, fever, headache, sciatic nerve pain | Hypertension, cardiac disease, and diabetes [24] Rheumatism, osteoporosis, arthrosis [30] | Antioxidant, antimicrobial, and antitumor [31]              |
| Aristolochiaceae | *Aristolochia longa* | Baraztam | Roots | Decoction Powder | Oral Basting Rinsing | 17 | Cold, tooth pain, osteoarticular pain, inflammation, allergy | Cardiovascular diseases, neurological diseases [32] | Cytotoxic and antimicrobial [33] Antibacterial [34]               |
| Asteraceae  | *Dittrichia viscosa*   | Bagramane     | Leaves         | Raw Infusion | Basting Oral Massage | 5 | Cold, osteoarticular pain Diabetes Wormer | Dental abscesses [35]                                                                                                                                 |
| Asteraceae  | *Atractylis gummifera* | Addade | Roots | Decoction | Oral | 3 | Cold Rheumatism Abdominal pain | Tooth whitening, toothache, mouth ulcers, gingival bleeding, gingivitis, herpes labialis, bad breath, stomatitis [35] | Antidiabetic [39]                                                             |
| Asteraceae  | *Artemisia herba-alba* | RAB26-16      | Chih           | Leaves Stems | Decoction | Oral | 30 | Gastrointestinal infections Abdominal pain Cold Nausea | Wounds, rheumatism, appetite stimulant, indigestion, diarrhea, bad breath, anelminetic, emmenagogue, nausea, stomach pain [40] | Nephroprotective [41] Antimicrobial and antioxidant [42] Antioxidant, anticancer, and anti-inflammatory [43] |
| Asteraceae  | *Artemisia absinthium* | RAB33-16      | Chiba          | Leaves    | Infusion | Oral | 4 | Intestinal parasites Dyspepsia Renal colic | Cold and flu, cholagogue, diuretic [44]                                                                                                                                 | Antioxidant and antimicrobial activities [45] |
| Asteraceae  | *Matricaria chamomilla* | RAB151-15     | Babounj        | Flowers   | Infusion Powder | Oral Rinsing | 16 | Ecema Psoriasis Depression Intestinal colic | Colic, Diarrhée, Nervosité, Depression, Angines, Aphiès, Ménstruations douloresuses, Fièvre, Absès, infections [46] | Antibiofilm and anticaries [47], radical scavenging and antioxidant activity [48] |
| Family name    | Plant species          | Voucher codes | Vernacular name | Parts used | Preparation mode | Administration mode | RFC (%) | Utilisation                                                                 | Ethnomedicinal uses recorded in the literature inside Morocco                                                                 | Pharmacological properties verified in vivo and/or in vitro                       |
|---------------|------------------------|---------------|-----------------|------------|------------------|---------------------|---------|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Capparaceae   | Capparis spinosa L.    |               | Lkabbar         | Fruits     | Raw Powder       | Oral Basting        | 6       | Digestive tract disorders, Dermatological affections, Diabetes               | Stomach pain, asthma \[40\]                                                     | Antidiabetic and antihyperlipidemic \[49\]                                               |
|               |                        |               |                 |            |                  |                     |         | Heliomithiasis, Respiratory problems, rheumatic pain, kidney stones          |                                                                                  | Antioxidant \[50\]                                                             |
| Caryophyllaceae| Herniaria cinerea DC.  | Harast lahjer | Leaves          | Stems      | Decoction        | Oral                | 13      | Diabetes, Kidney stones                                                      | Antiurolithiasis \[51\] Bladder disorders, kidney stones, diuretic, reduced blood levels of uric acid \[52\] | Diuretic and decreased renal stone formation \[53\]                                 |
| Cistaceae     | Cistus ladanifer L.    | RAB 108848    | Touzala lbayda  | Leaves     | Decoction        | Oral                | 1       | Gastric pain                                                               |                                                                                   | Hypoglycemic and hypolipidemic \[55\]                                              |
|               |                        |               |                 |            |                  |                     |         |                                                                 |                                                                                   | Antibacterial \[56\]                                                               |
| Cupressaceae  | Juniperus phoenicea     | RAB 108845    | Al’Araâr Elbeldi| Leaves     | Decoction, raw   | Oral                | 2       | Gastrointestinal infections, Asthma                                           | Asthma, hepatitis, and rheumatism \[57\]                                        | Antibacterial activity \[58\]                                                      |
|               |                        |               |                 |            |                  |                     |         |                                                                 |                                                                                   |                                                                                  |
| Cupressaceae  | *Tetraclinis articulata* (Vahl) Mast. | RAB187-16  | Al’Araâr        | Leaves     | Infusion Fumigation | Oral Inhalation     | 14      | Stomach ache, Hypotensive Diabetes                                           | Endocrinological, general health, gastrointestinal, otolaryngological, and respiratory \[59\] | Antioxidant, antimicrobial, anti-inflammatory, and cytotoxic \[60\] |
|               |                        |               |                 |            |                  |                     |         |                                                                 |                                                                                   | Antibacterial \[61\]                                                               |
| Euphorbiaceae | Ricinus communis       | Lkherwaa      | Seeds           | Oil        | Massage Rinsing   |                     | 8.5     | Skin diseases, hair loss                                                    | Hair and face care \[19\]                                                       | Antiviral \[62\]                                                               |
| Fabaceae      | Trigonella foenum-    | Lhelba        | Seeds           | Raw        | Oral             |                     | 4       | Stomach ache, Diuretic Diseases                                             | Diabetes, cardiovascular diseases, power problems \[4\]                        | Antimicrobial \[63\]                                                            |
|               | graccium L.            |               |                 |            |                  |                     |         |                                                                 |                                                                                   | Hypcholesterolomic and anti-inflammatory \[64\]                                      |
|               |                        |               |                 |            |                  |                     |         |                                                                 |                                                                                   | Antiallergic \[65\]                                                             |
| Gentianaceae  | Centaurium erythraea   | RAB 108847    | Gossat lhaya    | Leaves     | Decoction Powder | Oral Rinsing        | 9       | Diabetes, Wound healing, Stomach ache, Wound inflammation                   | Analgesic                                                                      | Antioxidant and anti-inflammatory effects \[66\]                                 |
|               | Rafn.                  |               |                 | Stems      |                  |                     |         | Wound inflammation, Analgesic                                              |                                                                                  | Antihyperglycemic activity \[67\]                                               |
|               |                        |               |                 |            |                  |                     |         |                                                                 |                                                                                   | Diuretic effects \[68\]                                                         |
| Family name | Plant species | Voucher codes | Vernacular name | Parts used | Preparation mode | Administration mode | RFC (%) | Utilisation | Ethnomedicinal uses recorded in the literature inside Morocco | Pharmacological properties verified in vivo and/or in vitro |
|-------------|---------------|---------------|----------------|------------|------------------|---------------------|---------|-------------|------------------------------------------------------|--------------------------------------------------|
| Lamiaceae   | Mentha pulegium |               | Flio | Leaves | Infusion | Decoction | Oral | 72 | Flu Cold | Cold, respiratory canals Pathologies of the digestive system, cold problems, and pathologies of the respiratory system | Antioxidant and antimitagentic activities [69] |
| Lamiaceae   | Origanum compactum Benth. | RAB69-16 | Zaâatar | Leaves | Decoction | Infusion Powder | Oral Rinsing | 76 | Gastrointestinal infection Stomach ache Fever Cold | Emmenagogue, nausea, food poisoning, asthma [40] | Antioxidant and antibacterial activities [70] Antiproliferative effect [71] Antimutagenic effect [72] |
| Lamiaceae   | Calamintha officinalis Moench | RAB69-16 | Manta | Leaves | Decoction | Infusion | Oral | 40 | Flu Cold | Against different aches, antipyretic [73] | Antioxidant [74] Antioxidant and antimicrobial [75] |
| Lamiaceae   | Marrubium vulgare L. | RAB364-16 | Mriwta | Leaves | Decoction | Raw | Oral Basling | 11 | Liver disease, respiratory problems, fever, diabetes Toothache, gingival bleeding, bad breath, gingivitis [35] | Hepatoprotective [76] Antioxidant and antifungal [77] |
| Lamiaceae   | Mentha rotundifolia |               | Mchichetru | Leaves | Infusion | Oral | 16 | Cold Grippe | Skin pathologies, respiratory disorders, digestive disorders [78] | Anti-inflammatory, analgesic, and antioxidant [79] Insecticidal and antifungal [80] |
| Lamiaceae   | Ajuga iva (L.) Schreb. | RAB23-16 | Chengdoura | Leaves | Raw | Infusion Powder | Oral | 4 | Diabetes Rheumatism Allergy Digestive disorders Antidiarrhea | Rheumatism, allergy, cancer [57] Cardiovascular diseases, pathologies of the digestive system, pathologies of the respiratory system [4] | Antibacterial activity [81] Antihyperglycemic activity [82,83] |
| Family name | Plant species | Voucher codes | Vernacular name | Parts used | Preparation mode | Administration mode | RFC (%) | Utilisation | Ethnomedicinal uses recorded in the literature inside Morocco | Pharmacological properties verified in vivo and/or in vitro |
|-------------|---------------|---------------|-----------------|------------|------------------|---------------------|---------|-------------|-------------------------------------------------------------|-------------------------------------------------------------|
| Lamiaceae   | *Rosmarinus officinalis* L. | Azir | Leaves Flowers | Decoction Infusion | Oral Massage | 60 | Gastric disorders Digestive system pathologies Heart disease | Cardiac disease, hypertension, and diabetes [24] | Antibacterial activity [84] Diuretic effects [68] |
| Lamiaceae   | *Salvia officinalis* L. | Salmia | Leaves Infusion | Oral | 21 | Diabetes | Diabetes [6] Respiratory, digestive, circulatory [85] Cold, cough, diabetes, rheumatism, stomachic, carminative, choleretic, tonic, antisuiderific, spasmodic, throat pain, stomach pain, antiseptic, haemostatic [19] | Antioxidant, antibacterial, and antileishmanial activities [86] |
| Lamiaceae   | *Lavandula stoechas* L. | Lhalhal | Leaves Infusion | Oral | 2.5 | Gastrointestinal disorders | Rheumatism and asthma [57] Rheumatism and digestive system [1] Pathologies of the digestive system and diabetes [4] | Antibacterial activity [81] |
| Lamiaceae   | *Thymus vulgaris* L. | Zaitra | Stems Leaves Decoction | Oral | 17 | Cold Asthma Digestive tract infections | Colic, Diarrhea, Digestive disorders, Flatulence, Cooling, Bronchitis, Flu, Cough, Toothache, Painful menstruation, and Anemia infections [46] Gum disease, halitosis, oral ulcers [18] | Antioxidant and antibacterial [87] Antioxidative [88] |
| Lamiaceae   | *Lavandula* Lkhzama | Lkhzama | Leaves Flowers | Powder | Oral | 20 | Urinary system disorder | ND | ND |
| Lamiaceae   | *Mentha spicata* L. | Naanaa | Leaves Stems Infusion | Oral | 4 | Cold Grippe | Migraine [89] Respiratory, skin [85] | Antibacterial [90] Antioxidant [91] |
| Family name | Plant species    | Voucher codes | Vernacular name | Parts used | Preparation mode | Administration mode | RFC (%) | Utilisation               | Ethnomedicinal uses recorded in the literature inside Morocco | Pharmacological properties verified in vivo                        |
|-------------|------------------|---------------|-----------------|------------|------------------|---------------------|---------|---------------------------|-----------------------------------------------------------------|------------------------------------------------------------------|
| Lamiaceae   | *Origanum majorana* L. |               | Mardedoch       | Leaves     | Infusion          | Oral                | 7       | Gastrointestinal infections | Cephhalgia [40] Gum disease, dental pain [18]                    | Antidepressant-like effects [92] Antioxidant, antimicrobial, cytotoxicity, and antiacetylcholinesterase [93] |
| Lamiaceae   | *Ocimum basilicum* L. |               | Hbeq            | Leaves     | Infusion          | Oral                | 10      | Urinary system disorder    | Allergy, cardiovascular diseases, and pathologies of the urinary system [4] Against mosquito, sinusitis, and tachycardia [94] | Antibacterial activity of essential oil [84] |
| Lauraceae   | *Laurus nobilis* L. |               | Warkat sidna mossa | Leaves     | Infusion          | Oral                | 7       | Respiratory problems       | Liver, pancreas, and digestive pain, face care, rheumatism, antiseptic, diuretic, sedative, rheumatism, calefacient [19] | Gastroprotective [95] Antibacterial and antibiofilm [96] |
| Lauraceae   | *Cinnamomum verum* J. Presl |             | Lkarfa          | Bark       | Powder            | Oral Rinsing        | 4       | Cold                        | Emmenagogue, hypercholesterolemia, obesity, painful periods [40] | Antibacterial [97] Antifungal [98] |
| Lythraceae  | *Lawsonia inermis* L. |               | Lhana           | Leaves     | Powder            | Basting             | 8       | Hair protection             | Hair care, antifungal, burns, sprains, hypotensive, emetic, stomach pains, digestive disorders [19] | Antibacterial and antifungal [99] Wound healing [100] Antibacterial [101] |
| Moraceae    | *Ficus carica* L. | RAB82-16      | Chriha Lkarmous | Fruits     | Raw               | Oral                | 1.5     | Asthma                      | Digestive system [1] Pathologies of the digestive system, pathologies of the circulatory system, and cardiovascular diseases [4] | Anticancer [102] Hepatoprotective and nephroprotective [103] |
| Myrtaceae   | *Eucalyptus globulus* Labill (sp) | RAB93-16   | Al’Kalitouss    | Leaves     | Fumigation        | Inhalation          | 11      | Flu                        | Diabetes [6] Asthma [57] | Antibacterial activity [104] Hypoglycemic activity [105] |
| Family name | Plant species | Voucher codes | Vernacular name | Parts used | Preparation mode | Administration mode | RFC (%) | Utilisation |
|-------------|---------------|---------------|-----------------|------------|------------------|---------------------|---------|-------------|
| Myrtaceae   | *Myrtus communis* L. | RAB496-16 | Arraihan | Leaves | Raw Decoction | Massage Oral | 13 | Hair loss, Diarrhea |
|             |               |              |                   |            |                  |                     |         | Ethnomedicinal uses recorded in the literature inside Morocco |
|             |               |              |                   |            |                  |                     |         | Pharmacological properties verified in *vivo* and/or in *vitro* |
|             |               |              |                   |            |                  |                     |         | Diabetes [6] Cardiac weakness, digestive system [1] |
|             |               |              |                   |            |                  |                     |         | Antioxidant activity [106] Antigenotoxic effect [107] Hypoglycemic effect [108] |
| Myrtaceae   | *Eugenia caryophyllata* | RAB412-16 | Qronfel | Flowers | Decoction Powder | Inhalation Massage Rinsing | 3 | Grippe, Tooth pain |
|             |               |              |                   |            |                  |                     |         | Headaches, migraine, pathologies of the digestive system, dermocosmetology [4] |
|             |               |              |                   |            |                  |                     |         | Antibacterial and antioxidant [109] Antioxidant capacity and cytotoxic activity [110] |
| Nitriaceae  | *Peganum harmala* L. | Lharmal | Seeds | Fumigation | Inhalation | 6.5 | Rheumatism, back pain, fever |
|             |               |              |                   |            |                  |                     |         | Gingivitis, toothache, mouth ulcers, herpes labialis, bad breath, stomatitis [35] |
|             |               |              |                   |            |                  |                     |         | Spasmolitic, sterility, uterine diseases, verminfuge, abortilatent, ritual, magic practice, and to relieve bad fate, hair care, eczema, neoplasms [19] |
| Pedaliaceae | *Sesamum indicum* L. | RAB528-16 | Ajenjlane | Seeds | Raw | Oral | 1 | Digestive system disorders |
|             |               |              |                   |            |                  |                     |         | Appetite stimulant [40] Bloating, digestion problems [73] |
|             |               |              |                   |            |                  |                     |         | Antiulcer [113] Gastroprotective [114] Antirheumatoid [115] |
| Ranunculaceae | *Nigella sativa* L. | RAB358-16 | Lhaba sawa Sanûj | Seeds | Oil | Massage | 2 | Eczema, Psoriasis |
|             |               |              |                   |            |                  |                     |         | Appetite stimulant, kidney diseases, cough [40] Nephron-protective [116] Antibacterial [117] |
| Rhamnaceae  | *Ziziphus lotus* (L.) Lam. | RAB622-16 | Sedra | Leaves Stems | Infusion | Oral | 1.5 | Headache, Joint pain |
|             |               |              |                   |            |                  |                     |         | Cardiac ailments, pulmonary infection, haemostatic, colic animals, diabetes, stomach pain, diarrhea, kidney stones, throat pain, pectoral and emollient, jaundice [19] |
|             |               |              |                   |            |                  |                     |         | Antiglycaemic, anticholesterolemic, antioxidant, and antimicrobial [118] |
| Rosaceae    | *Alchemilla vulgaris* | Gdam sbââ | Leaves | Raw Powder | Rinsing | 4.5 | Wound healing Inflammation of wounds |
|             |               |              |                   |            |                  |                     |         | ND |
|             |               |              |                   |            |                  |                     |         | ND |
| Thymelaeaceae | *Daphne gnidium* L. | Lzaz | Leaves | Raw | Basting | 9 | Hair loss |
|             |               |              |                   |            |                  |                     |         | Hair care and hair strengthening [1] Dermocosmetology, fever, and head problems [4] |
|             |               |              |                   |            |                  |                     |         | Anti-inflammatory [119] Antimicrobial [120] |
| Urticaceae  | *Urtica dioica* L. | RAB565-16 | Lhriga | Leaves | Decoction | Oral | 8 | Urinary system problem |
|             |               |              |                   |            |                  |                     |         | Diabetes [6] Osteoporosis [30] Renal weakness, digestive system [1] |
|             |               |              |                   |            |                  |                     |         | Antibacterial [121] Antioxidant, antimicrobial, antulcer, and analgesic [22] |
| Family name | Plant species     | Voucher codes | Vernacular name | Parts used | Preparation mode | Administration mode | RFC (%) | Ethnomedicinal uses recorded in the literature inside Morocco | Pharmacological properties verified in vivo and/or in vitro |
|-------------|-------------------|---------------|-----------------|------------|------------------|---------------------|---------|---------------------------------------------------------------|-------------------------------------------------------------|
| Verbenaceae | *Aloysia citrodora* Palau | Lwiza         | Leaves          | Infusion   | Decoction        | Oral                | 42      | Stomach ache, Hypertension, Diabetes                          | Antioxidant activity and antimicrobial properties [122]     |
|             |                   |               |                 |            |                  |                     |         | Sedative, hypertension, cold [40]                            |                                                             |
|             |                   |               |                 |            |                  |                     |         | Digestive, antiseptic, carminative, sedative, gastric lavage, calming, calefacient [19] |                                                             |
|             | Zingiberaceae     | *Curcuma longa* L. | Lkharkoum      | Roots      | Powder           | Basting             | 1       | Skin diseases                                                | Antibacterial [124] Cytotoxic, antioxidant, and anti-inflammatory [125] |
|             | *Zingiber officinale* Roscoe. | Skine jbir   | Roots           | Cooked powder | Oral             |                     | 3       | Cough                                                        | Antioxidant activity [126] Antimicrobial [127]             |
foenum-graecum, Mentha suaveolens, Lavandula mairei, and Nigella sativa were the most cited for their use in the traditional medicine in the study [19].

Results showed that 61% of the informants were illiterate, and their age was older than 40 years. These results are in agreement with other ethnobotanical studies carried out in Morocco [130] and Algeria [131]. The use of medicinal plants in traditional medicine is more widespread among illiterate people. These results are confirmed by other studies, which have shown that people with a lower level of education have more expertise in the uses of plants in traditional medicine [132, 133]. On the contrary, the results of this survey indicate the predominance of some plant families such as the Lamiaceae, the Apiaceae, and the Asteraceae. The
Figure 4: Frequency of different parts used.

Figure 5: Frequency of different preparation methods.

Figure 6: Frequency of the administration mode.
predominance of these families has already been observed in
a study carried out in another African country [134] and
another study carried out in southeast Morocco [19]. Fur-
thermore, the most used species by the population of Taza
province were *Origanum compactum* with the highest RFC
(76%), followed by *Mentha pulegium, Rosmarinus officinalis,
Aloysia citrodora* Palau, *Calamintha officinalis* Moench, and
*Artemisia herba-alba* Asso., with RFC values of 72%, 60%,
42%, 40%, and 30%, respectively. The medicinal properties
that these plants have were experimentally proven by several
studies carried out in vivo and/or in vitro by [135–141]. The
plants used mainly by the population of the Taza region are
almost the same as those previously mentioned in Morocco
[4, 7] and in Algeria [142].

The use of leaves in traditional medicine could be attributed to their availability, the simplicity of their harvest,
and their richness in therapeutic substances [143]. On the
contrary, decoction was the most used method of preparing
medicinal plants (29.11%) followed by infusion (27.84%),
the raw form (20.25%), the powder form (17.72%), fumigation
(3.79%), and the vegetable oil form (1.26%). This observation
is in agreement with other ethnobotanical studies [57],
which indicate that the recipes were essentially prepared by
decocion, about 67% of herbal preparations were in the
liquid form, and water was the solvent of choice in the
preparation of herbal recipes because it is abundant and easy
to access. The vast majority of remedies were taken orally
(70%); similar results have been obtained in other studies
[7, 57].

5. Conclusion

This study showed that Taza region has a rich and varied
patrimony of medicinal plant species used in the folk
medicine to treat different diseases. In fact, the traditional
recipes based on those plants must be validated and grouped
into databases to become as a source for alternative therapeu-
tic compounds, and their use must be conducted by
safety and efficacy data, especially for herbalists and tradi-
tional healers. Nonetheless, chemical, pharmacological, and
toxicological investigations in the medicinal plant area are
required to determine and confirm their chemical compo-
sition and clinical uses to standardize their correct therapeu-
tic doses.

Data Availability

The data used to support the findings of this study are in-
cluded within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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