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Ethnobotanical study of medicinal and aromatic plants used in the treatment of genito-urinary diseases in the Moroccan Rif

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Abstract

The aim of this study was to assess the potential of the Moroccan Rif (northern Morocco) with regard to medicinal and aromatic plants used in the treatment of genito-urinary diseases. The ethnobotanical survey was conducted in Moroccan Rif region for two campaigns from 2016 to 2018. In total, 548 local traditional healers were interviewed. Information was collected using open-ended and semi-structured interviews, analysed and compared by quantitative ethnobotanical indices such as family importance value (FIV), relative frequency of citation (RFC), plant part value (PPV), fidelity level (FL) and informant consensus factor (ICF) were used to analyze the obtained data. The study identified a total of 27 medicinal and aromatic plant species belonging to 18 botanical families. The most important family is that of the Rutaceae represented by 04 species. Concerning the diseases treated, kidney stones diseases have the highest ICF (0.97), the leaf was considered the most used part of the plant (PPV=0.443) and the majority of the remedies were prepared in the form of decoction. The results of the present study showed the existence of indigenous ethnomedicinal knowledge of medicinal and aromatic plants in the Moroccan Rif to treat genito-urinary diseases. Further research on phytochemical, pharmacological and other biological activities should be considered to discover new drugs from these documented plants.

1. Introduction

Humans have always used medicinal and aromatic plants (MAPs) to treat themselves and fight against diseases. In all ancient civilizations and in all continents, one finds traces of this use [1]. Thus, even today, despite the progress of pharmacology, the therapeutic use of plants is very present in some countries, especially in developing countries [2]. Morocco, by its biogeographical position, offers a very rich ecological and floristic diversity constituting a true plant genetic reserve, with about 4,500 species belonging to 940 genera and 135 families, the mountainous regions of Rif and Atlas being the most important areas for endemism [3]. This biodiversity is characterized by a very marked endemism that [4] allows it to occupy a privileged place among the Mediterranean countries to be a which have a long medical tradition and traditional know-how based on medicinal and aromatic plants [5]. Indeed, traditional medicine has always occupied an important place in the traditions of medication in Morocco and the Rif region (Northern Morocco) is a concrete example.

The analysis of the Moroccan medicinal bibliography shows that the data on regional medicinal plants are very fragmentary and dispersed, due to of the few thousand plant species, the medicinal species counted do not exceed the 600 species [6] or 14.28% of the total Moroccan flora. We believe that the heritage of the medicinal flora requires regular monitoring and evaluation in terms of quality and quantity.

It is with this in mind that, we conducted this ethnobotanical study in the Moroccan Rif, which has a considerable lithological, structural, biological and floristic diversity, because of its relief, its topography and its geographical

location. The aim of this study is to contribute to indigenous knowledge of medicinal plants, to make a catalog of these plants in the selected region and to analyze the results concerning the existing relationships between medicinal species and genito-urinary diseases. Indeed, it is very important to transform this traditional knowledge into scientific knowledge in order to revalue it, to preserve it and use it rationally.

2. Material and Methods

2.1. Description of the study area

Tangier Tetouan-Al Hoceima are part of the Rif region, which is one of the twelve regions of Morocco established by the territorial division of 2015 [7]. This region is limited to the north by the Strait of Gibraltar and the Mediterranean Sea, to the west by the Atlantic Ocean, to the south-west by the Rabat-Sale-Kenitra region, to the south-east by the Fez-Meknes region and to the east by the Eastern region as shown in Figure 1.

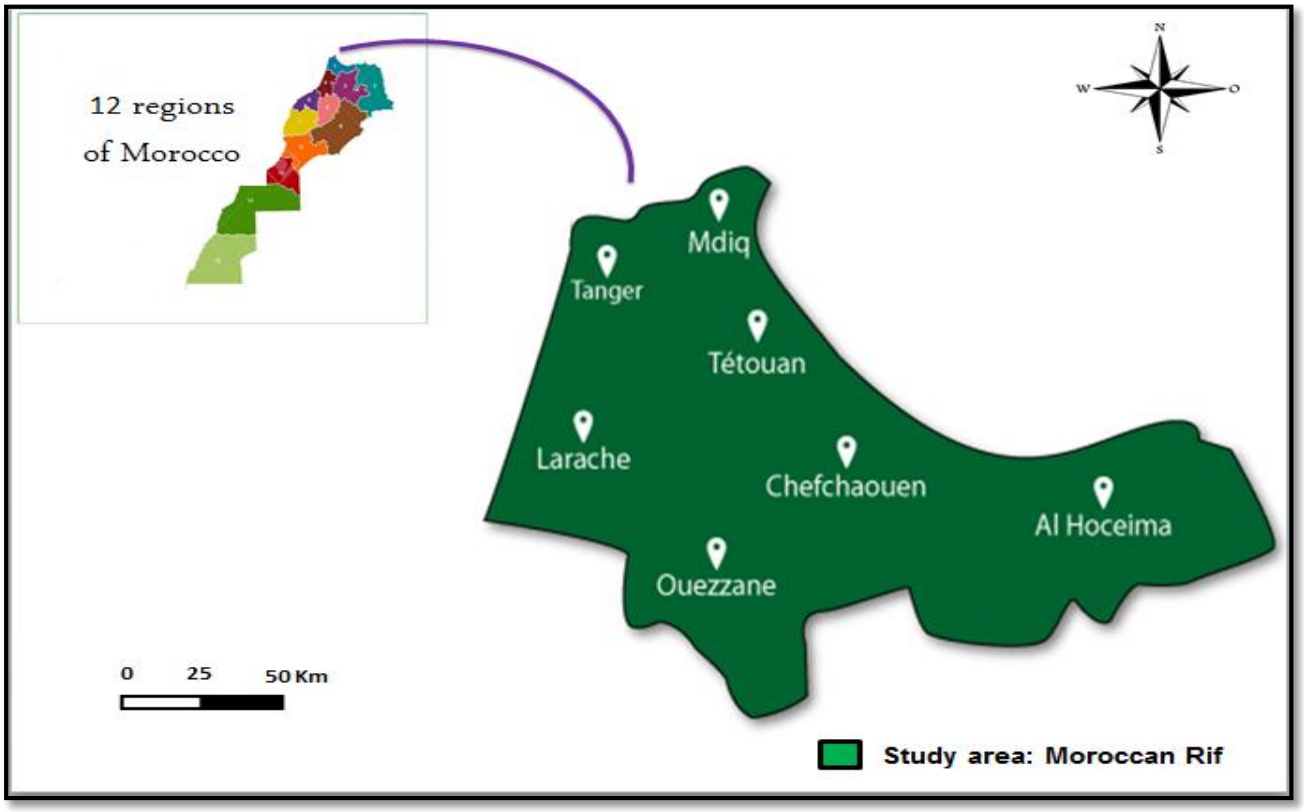

Figure 1. Map of the study area.

According to the 2014 national census report [8], the total area of study area is about 11,570 km² with an average population density of 222.2/km², and the human population is 3 549512. The study area has Mediterranean climate with maximum temperature beyond 45°C during summer (July- August) and below 0°C during winter (December-January) and annual rainfall is about 1000 mm.

2.2. Methodology

2.2.1. Data collection

In order to gather information on MPs used for treating genito-urinary disorders, an ethnobotanical survey was conducted from June 30th, 2016 to June 1st, 2018. Interviews as semi-structured were administered and open-ended interviews were conducted, through face to face interviews and focus groups. The inclusion criteria: A lot of people may believe they are knowledgeable about plants used to treat genito-urinary disorders. It must be specified that qualified healthcare professionals such as "pharmacists, herbalists, practitioners and therapists" were selected for the study. While the exclusion criteria were informants who are not living in the study area. Totally, 548 informants within aged 18 to 85 were randomly selected for interviews (pharmacists, herbalists, practitioners and therapists) in the study area (hospitals, pharmacies, houses, mosques, and weekly markets). The healthcare professionals were informed about the objective of this study, after having them sign a consent form,

they were regularly to collect and document indigenous knowledge of plants usage against genito-urinary diseases. The questionnaire used consists of two parts: the first part deals with the demographic characteristic of the informants and the second one focuses on the plants used in the treatment of the nervous system diseases (Appendix). The sample is made up of 287 females and 261 males from different socio-economic strata, chosen at random from the Rif's population. In this study, the sample is developed using a stratified random sampling method [9] to conduct various surveys from a site to another in the study area. According to this sampling method, we have divided our study area into sites (Sn), so we have 28 sites that correspond to the number of divisions in the study area (Figure 2).

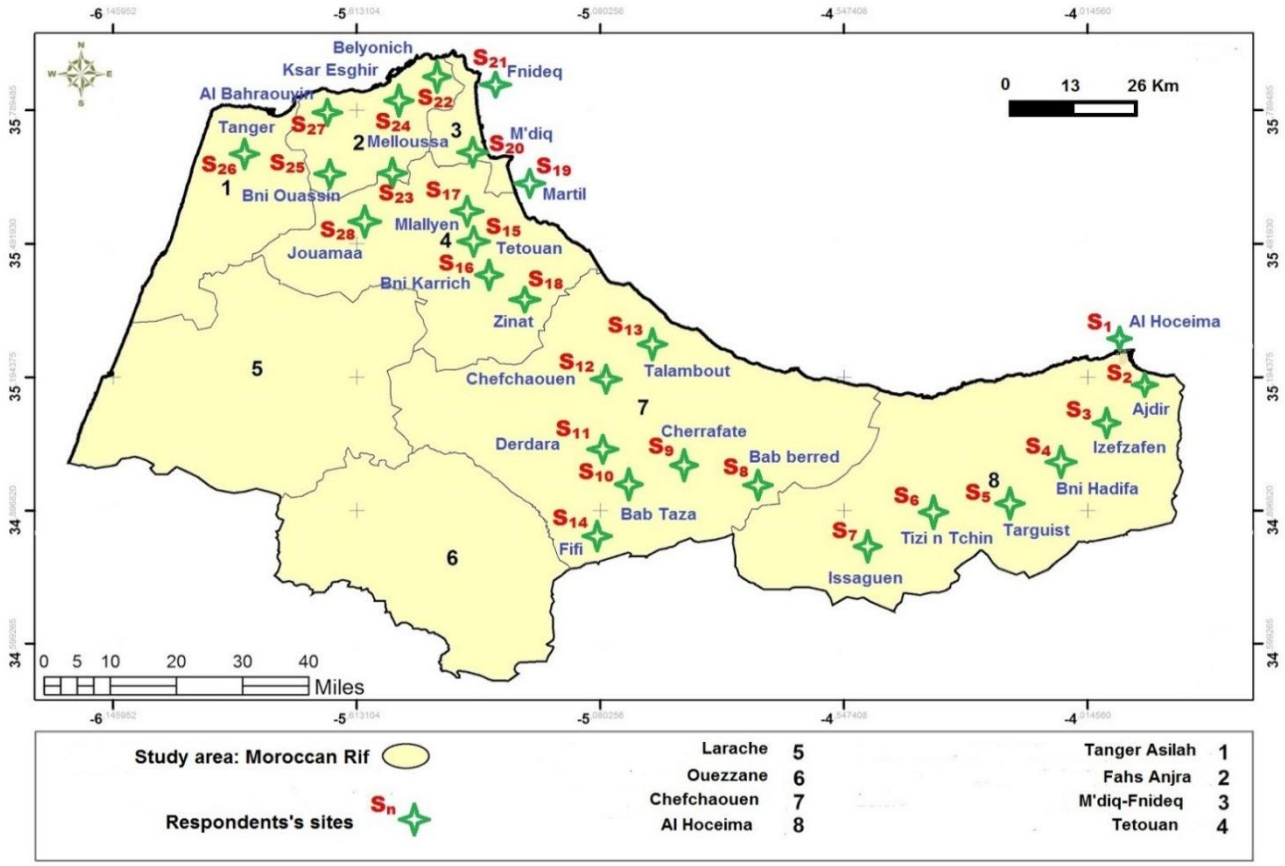

Figure 2. Distribution of survey points at the study area level.

2.2.2. Plant species identification and preservation

Standard method was followed with record to collection of plant materials, drying, mounting, preparation and preservation of plant specimens [10], medicinal plants species in bi-plicate were collected prepared and identified. Plants with their correct nomenclature were arranged alphabetically by family names, vernacular names, and ethnomedicinal uses. The identification and nomenclature of the listed plants were based on The medicinal plants of the Morocco [11], Practical flora of Morocco [12] and Catalogs of vascular plants of northern Morocco, including identification keys [13], volumes I and II. They were later verified at nutrition, health and environment Laboratory, department of biology faculty of sciences, Ibn Tofail University Kenitra, Morocco. All the preserved specimens were deposited at the Herbariam of Ibn Tofail University.

2.2.3. Ethics statement and consent to participate

Letters of consent were taken from department of biology, Ibn Tofail University and an agreement with the local authorities of Chefchaouen, Al Hoceima, Tetouan and Tangier. All data collections were done with special care on the base of the cultural view of the local sites in the study area. Informants were also informed that the objectives of the research were not for commercial purposes but for academic reasons. Participants provided

verbal informed consent to participate in this study. They were free to withdraw their information at any point of time. Finally, informants were accepted the idea and they have clearly agreed to have their names and personal data to be published.

2.2.4. Data Analysis

A descriptive and quantitative statistical method was used to analyze the socio-demographic data of the informants (ANOVA One-way and Independent Samples T-Test, P-values of 0.05 or less were considered significant). The results of the ethnobotanical survey were analyzed using the Family Importance Value (FIV), Relative Frequency of Citation (RFC), Plant Part Value (PPV), Fidelity Level (FL) and Informant Consensus Factor (ICF). All statistical analyses were carried out with Statistical Package for Social Science (SPSS) version 21 and Microsoft Excel 2010.

- *Family Importance Value (FIV)*

The FIV identify the significance of plant families. It is as an index of cultural importance which can be applied in ethnobotany to calculate a value of biological plant taxon. To calculate FIV, we use the following formula: $\text{FIV} = \frac{FC_{family}}{\text{N}_\text{S}}$. Where $\text{FC}_{\text{family}}$ = RFC is the number of informants mentioning the family and Ns = Total number of species within each family [14].

- *Frequency (FC) and Relative Frequency of Citation (RFC)*

Relative frequency of citation (RFC) is obtained by dividing frequency citation (FC) by total number of informants in the survey (N). The value of RFC for species of medicinal plants is based on the citing percentage of informants for every species. RFC was calculated by using the following formula [15]: $\text{RFC} = \frac{FC}{\text{N}}$ with (0 < RFC < 1).

- *Plant Part Value (PPV)*

Plant part value (PPV) was calculated using the following formula: $\text{PPV} = \frac{\text{RU}_{\text{Plant part}}}{\text{RU}}$. Where RU is the number of uses reported of all parts of the plant and $\text{RU}_{\text{plant part}}$ is the sum of uses reported per part of the plant. The part with the highest PPV is the most used by the respondents.

- *Fidelity Level (FL)*

Fidelity level (FL) is the percentage of informants who mentioned the uses of certain plant species to treat a particular ailment in the study area. The FL index is calculated using this formula [16]: $\text{FL}\,(\%) = \frac{\text{Np}}{\text{N}} \text{x}\, 100$. Where Np is the number of informants that claim a use of a plant species to treat a particular disease, and N is the number of informants that use the plants as a medicine to treat any given disease.

- *Informant Consensus Factor (ICF)*

Informant consensus factor was derived in order to seek an agreement between the informants on the reported cures for each group of diseases [17]. $\text{ICF} = \frac{\text{Nur}-\text{Nt}}{\text{Nur}-1}$. Where Nur is the number of use-reports in each disease category and Nt is number of species used.

3. Results and discussion

3.1. Socio-demographic features of the respondents (N=548; Table 1)

A total of 548 local informants including 287 females and 261 males (with a sex ratio female/male of 1.1) were interviewed. The percentage of MAPs reported by females (52.3%) was greater than males (47.7%) though the difference was not statistically significant (P = 0.375). This predominance of females can be explained by the vigilance of women for the balance of the disease, and their attachment to all that is traditional; indeed, it is women who give sustenance and healthcare to their families in case of an illness. These results confirm the results of other ethnobotanical work carried out at national scale [18–21].

Table 1. Sociodemographic details of the respondents in Moroccan Rif.

Variables	Catrgories	Number of informants	Percentages (%)	P-values
Gender	Female	287	52.3	0.375
	Male	261	47.7	
Age groups	< 20 years	21	3.8	0.000
	20-40	134	24.5	
	40-60	224	40.9	
	> 60 years	169	30.8	
Family situation	Married	392	71.5	0.000
	Divorced	12	17.5	
	Widower	96	8.8	
	Single	48	2.2	
Educational level	Illiterate	310	56.6	0.000
	Primary	192	35	
	Secondary	37	6.8	
	University	9	1.6	
Income/month	Unemployed	156	28.5	0.000
	250 - 1500 DH	261	47.6	
	1500 - 5000 DH	98	17.9	
	> 5000 DH	33	6	

The majority of respondents were with the age range between 40 and 60 (40.9%) followed by informants who were more than 60 years (30.8%), informants who were between 20 and 40 years (24.5%). Finally informants with an age less than 20 come in last position (3.8%). The difference between age groups and indigenous knowledge was significant (P = 0.000). The highest age respondents provide more reliable information because they hold much of the ancestral knowledge that is part of the oral tradition. So there is a loss of information on MAPs, which can be explained by the mistrust of certain young people, who tend not to believe this herbal medicine due to the influence of modernization and exotic culture influence. At present, the traditional medical knowledge transmitted from generation to generation is in danger, because transmission between old people and younger generation is not always assured [22]. These values confirm the results obtained in other regions of Morocco [23–25].

The analysis of the collected data shows that, MAPs are much more used by married (71.5%) than by divorced (17.5%), knowing that widowers have a percentage of 8.8% and only 2.2% for singles, because the married people can avoid or minimize the material charges required by the doctor and the pharmacist. The difference between family status and indigenous knowledge for the treatment of genito-urinary diseases was statistically significant (P = 0.000). Those findings coincide with those of similar study conducted in the central plateau of Morocco [26].

Regarding the level of education, 56.6% of the informants were illiterate, the 43.4% of the remaining informants were divided between primary schooling (35%), secondary schooling (6.8%), and only 1.6% with higher education. Thus, the difference between educational level and indigenous knowledge was significant (P = 0.000). We can therefore see that the use of MAPs decreases as the level of study increases. This result is similar to the findings reported [26–28].

In our study, 47.6% of the interviewees had a low socio-economic level, (28.5%) were unemployed, (17.9%) with average level, and only 6% with higher level. The difference between income/month and indigenous knowledge

was significant (P = 0.000). The high cost of modern medical treatments and their side effects are among the main reasons why respondents used herbal medicine. We can therefore see that the use of plants increases with the increase in monthly income of these informants. These results are similar to those obtained in Moyen Moulouya of Morocco [29].

3.2. Floristic Analysis

3.2.1. Diversity of MAPs in the study area

In total, five hundred forty eight people were interviewed in this study and 27 species and subspecies of MAPs belonging to 18 botanical families, including 17 from di-cotyledons and 01 from mono-cotyledons were used to treat genito-urinary diseases in the study area. These plants are presented in alphabetical order. For each plant listed, we give the scientific name, the family, the local name, the part used, the method of preparation adopted by the local population, as well as the data of FIV, RFC and FL are shown in Tables 2. The most botanical family of medicinal plant species, used to treat genito-urinary diseases based on the number of species and FIV index, was Rutaceae (04 species with FIV=0.019), followed by Apiaceae (03 species with FIV=0.092), while other families were represented by one or two species only (Figure 3).

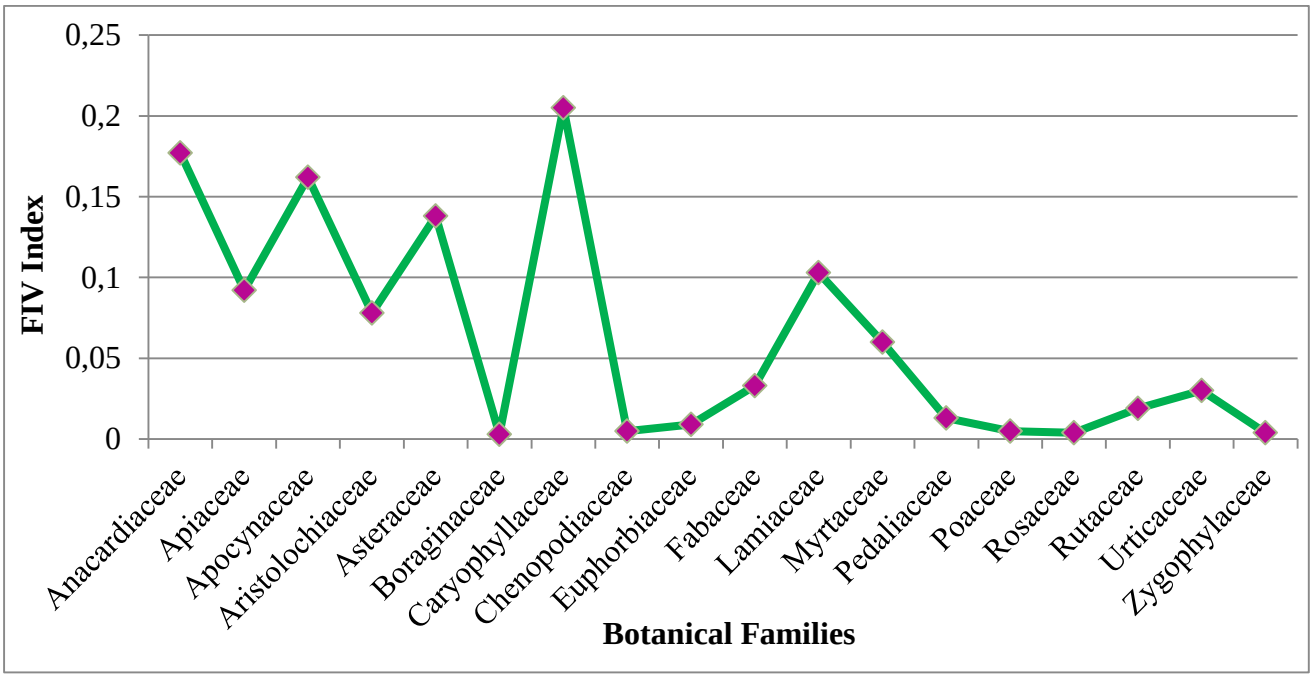

Figure 3. Family Importance value (FIV) of medicinal and aromatic plants.

This high proportion of Rutaceae could be explained by the high representation of this family in the Rif's flora because of the ecological factors that favour the development and adaptation of the majority of the species of this family. This representation has also been observed, with some differences, in other ethnomedicinal surveys conducted in other regions of the country [18], [20], [30].

3.2.2. RFC and FL of medicinal and aromatic plants.

RFC is used to find the most frequently used species of plants used for genito-urinary diseases in the study area. Its value ranged from 0.001 to 0.280 (Table 2), which demonstrates from the least relative importance with *Convolvulus althaeoides* L., *Festuca glauca* L. and *Citrus reticulata* L. (RFC=0.001 species each) to the highest importance with *Arenaria rubra* L. (RFC=0.280) followd by *Lavandula officinalis* Chaix. (RFC=0.204) *Petroselinum sativum* Hoffm. (RFC=0.188), *Pistacia lentiscus* L. (RFC=0.177) and *Caralluma europaea* (Guss.) N.E.Br. (RFC=0.162).

Table 2. List of medicinal and aromatic plants actives on the genito-urinary diseases in the Moroccan Rif region.

Family and Scientific name	Vernacular name	Used parts	Preparation	Therapeutic uses	FL %	FC	RFC	FIV
Anacardiaceae								0.177
Pistacia lentiscus L.	Drou	Leaf	Infusion	KS, CC, RC	83.5	97	0.177	
Apiaceae								0.092
Petroselinum sativum Hoffm.	Maâdnous	Leaf	Decoction	KS,	100	103	0.188	
Pimpinella anisum L.	Habbat Hlawa	Seed	Other	KS,	100	35	0.064	
Conium maculatum L.	Choukran	Leaf	Cataplasm	KS,	100	13	0.024	
Apocynaceae								0.162
Caralluma europaea (Guss.) N.E.Br.	Daghmous	Leaf	Infusion	KS,	100	89	0.162	
Aristolochiaceae								0.078
Aristolochia baetica L.	Berztem	Leaf	Cataplasm	KS,	100	43	0.078	
Asteraceae								0.138
Silybum marianum (L.) Gaertn.	Tawra,	Seed	Decoction	CC	100	76	0.138	
Boraginaceae								0.003
Borago officinalis L.	El Hamhem	Flower	Infusion	KS,	100	02	0.003	
Caryophyllaceae								0.205
Arenaria rubra L.	Herras Lehjar	Whole plant	Decoction	KS, BV, CRF	53	153	0.280	
Corrigiola telephiifolia Pourr.	Sarghina	Whole plant	Decoction	KS	100	71	0.130	
Chenopodiaceae								0.005
Atriplex halimus L.	Legtef	Leaf	Infusion	CC	100	03	0.005	
Euphorbiaceae								0.009
Mercurialis annua L.	Hrriyga Lmelsa	Whole plant	Decoction	CC	100	05	0.009	
Fabaceae								0.033
Cicer arietinum L.	Hommes	Seed	Decoction	KS, BV	83.3	18	0.033	
Lamiaceae								
Convolvulus althaeoides L.	Louwaya	Leaf	Decoction	CC	100	01	0.001	0.103
Lavandula officinalis Chaix.	Lkhzama	Flower	Infusion	KS, CC, BV	45.5	112	0.204	

Family and Scientific name	Vernacular name	Used parts	Mode of Preparation	Medicinal uses	FL %	FC	RFC	FIV
Myrtaceae								0.06
Myrtus communis L.	Rayhan	Leaf	Decoction	CC, BV	76.8	56	0.102	
Pimenta dioica (L.) Merr.	Nwiwira	Fruit	Infusion	CRF	100	08	0.015	
Pedaliaceae								0.013
Sesamum indicum L.	Jenjlane	Seed	Infusion	KS,	100	07	0.013	
Poaceae								0.005
Festuca glauca Vill.	Aguzmir	Seed	Infusion	KS,	100	05	0.009	
Eleusine indica (L.) Gaertn.	Njem	Whole plant	Decoction	CRF	100	01	0.001	
Rosaceae								0.004
Eriobotrya japonica (Thunb.) Lindl.	Lemzah	Leaf	Infusion	BV,	100	02	0.004	
Rutaceae								0.019
Citrus limon (L.) Osbeck.	Lhamed	Fruit	Other	KS,	100	06	0.011	
Citrus limetta Risso.	Lhamed Beldi	Fruit	Cooked	RC	100	06	0.011	
Citrus × *aurantium* L.	Larnej	Flower	Cooked	CC	100	25	0.050	
Citrus reticulata Blanco.	Lmandarine	Fruit	Cooked	CC	100	01	0.001	
Urticaceae								0.030
Urtica urens L.	Lhurriga	Leaf	Decoction	KS	100	14	0.030	
Zygophylaceae								0.004
Tribulus terrestris L.	Ders Elajouz	Whole plant	Cooked	CRF	100	02	0.004	

FC: Frequency of citations, **BV:** Bacterial vaginosis, **CRF:** Chronic renal failure, **KS:** Kidney stones, **CC:** Cervical cancer.

This shows that *Arenaria rubra* L. and *Lavandula officinalis* L. have the maximum citation in the treatment of genito-urinary diseases in the Moroccan Rif region. These species had the highest RFC index, because these plants were mentioned by a large number of informants and RFC directly depends on the number of informants mentioning the use of a specific plant. Those medicinal plant species having high RFC must be further assessed for phytochemical and pharmaceutical analysis to identify their active constituents for any drug extraction [31]. Using the ethnobotanical indices like FL, the traditional knowledge on ethnomedicinal plants used in the treatment of genito-urinary diseases were analysed (Table 2). In the present study, the majority of the plants had high fidelity value (FL), twenty two plant species reported showed high values were used in the treatment of kidney stones, cervical cancer, bacterial vaginosis and chronic renal failure by the informants. The MAPs with high fidelity level are considered as having better healing potential in Moroccan Rif region and possess more natural products (tannins, flavonoids and alkaloids). The remedies such as *Lavandula officinalis* Chaix. (45.5%) have low FL value because the majority of the informants do not know the dosage and the methods of preparation of the remedies.

3.3. Ethnobotanical and pharmacological aspect

3.3.1. Plant parts used for remedy preparation

The traditional healers of the Moroccan Rif use various plant parts such as seed, fruit, flower and leaf. Based on the plant part value PPV index, leaf was reported as the dominant plant part for genito-urinary diseases remedy preparation in the study area (PPV=0.443), followed by whole plant (PPV=0.241), seed (PPV=0.148), flower (PPV=0.147) and fruit (PPV=0.021) respectively (Figure 4). The preference of leaves was due to its easy availability, easy harvesting and simplicity in remedy preparation. In addition the leaves are the center of phytochemical reactions, making them rich in metabolites. Similar findings indicated leaf as a major dominant plant part in Morocco [29], [32], [33] or in Africa [34–37] for herbal medicine preparation.

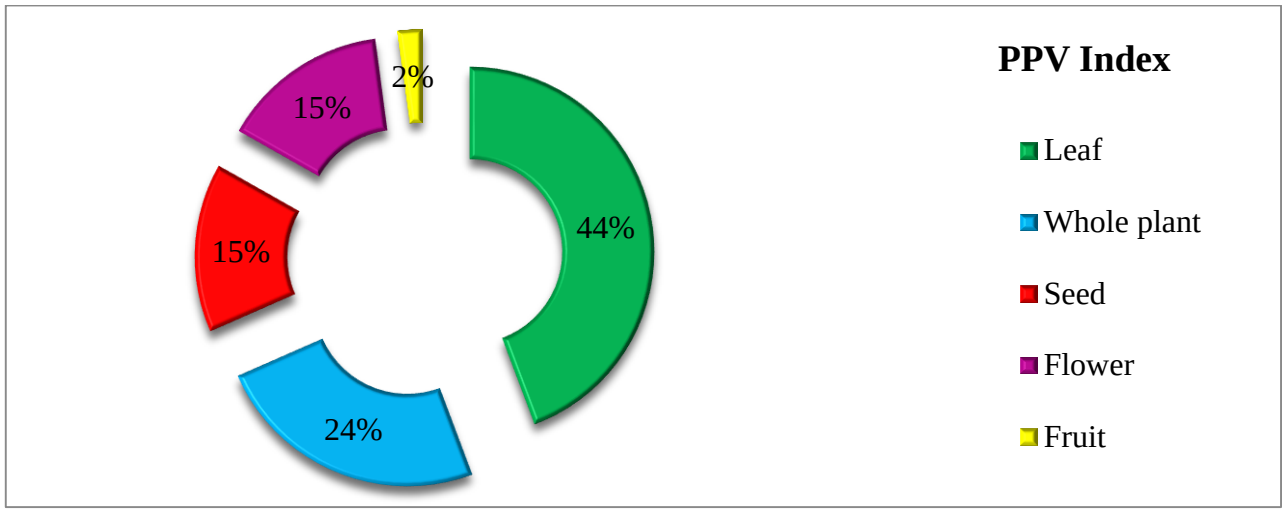

Figure 4. Plant part used in the treatment of genito-urinary diseases in the study area.

3.3.2. Method of preparation and route of administration

The preparations are divided into 5 categories including cataplasm, decoction, infusion, cooked and other forms of preparation (Figure 5). The majority of the remedies in the study area were prepared by decoction (52.2%) and infusion (34%), followed by cataplasm (5.9%), other forms of preparation (4.3%) and cooked (3.6%). The frequent use of the decoction can be explained by the fact that the decoction makes it possible to collect the most active ingredients and attenuates or cancels out the toxic effect of certain recipes. Ethnobotanical research surveys conducted elsewhere in Morocco showed the majority of the interviewees prepared the remedy by decoction [19], [26], [38]. This confirms that there is a perpetual exchange of information on the use of medicinal and aromatic plants between the people of Morocco. Decoction mentioned as the major method of preparation at the continental level [39–41].

Route of administration also varies depends on the disease and materials used. In general, the medicines are administrated by oral (87%) followed by massage (8.6%), swabbing (2.1%), rinsing (1.3%) and other modes of

administration (1%). The predominance of oral administration may be explained by a high incidence of internal ailments in the region [42]. On the other hand, it's thought that oral route is the most acceptable for the patient. The predominance of oral administration of the different medicinal plants in Moroccan Rif is in total agreement with most of the carried out ethnobotanical studies in Africa [25], [43], [44].

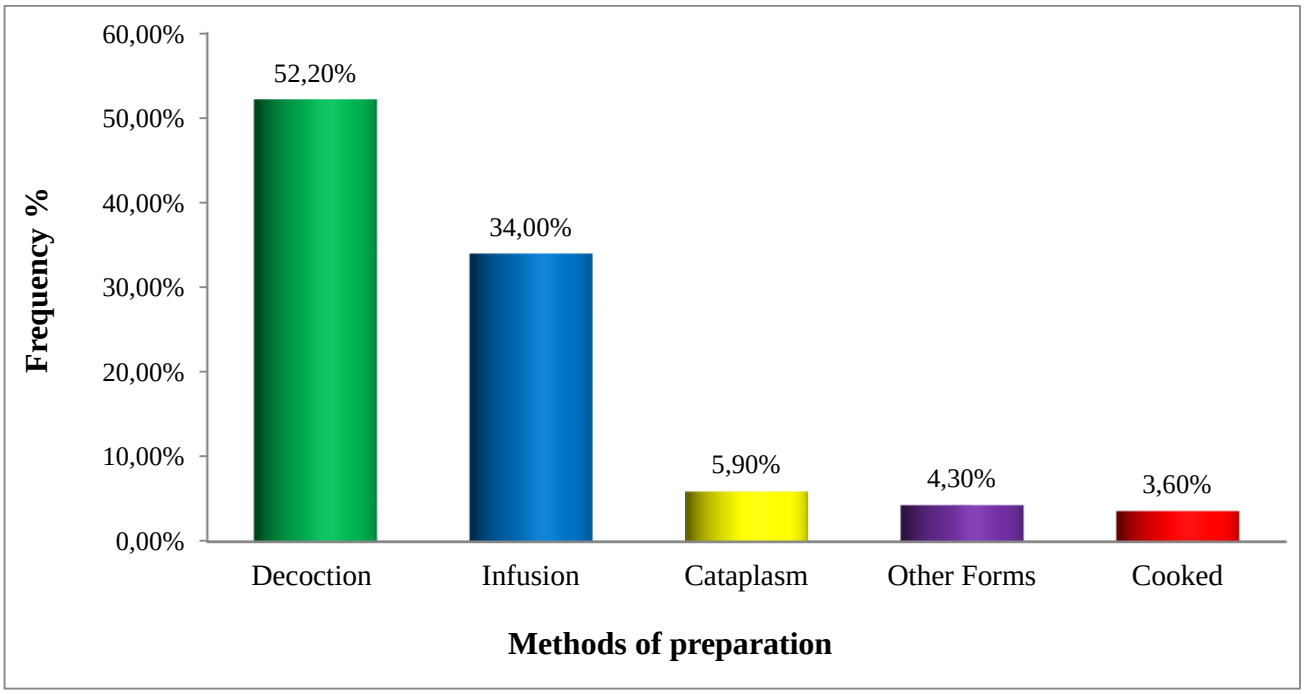

Figure 5. Frequency of different methods of preparation.

3.3.3. Treated ailments and informant consensus factor (ICF)

The informant consensus factor (ICF) depends upon the availability of plants within the study area to treat diseases. In the present study, the ICF values ranged from 0.88 to 0.97 per uses categories. A total of 27 species were identified to treat genito-urinary diseases. The categories with the highest ICF values were kidney stones (0.97), followed by bacterial vaginosis (0.96), cervical cancer (0.95), chronic renal failure (0.89) and renal colic (0.88) as shown in Table 3. A high ICF value (0.97) indicates the informants use relatively many taxa to manage the kidney stones disease. This high ICF values indicated reasonable reliability of informants on the use of medicinal plant species [45]. This shows that the interviewees are interested in herbal medicine to treat kidney stones caused by the water rich in lime material that characterizes the study area. Therefore, species with high FIC are to be prioritized for further pharmacological and phytochemical studies. According to the informant consensus data analysis, *Petroselinum sativum* Hoffm. with citation by 103 informants ranked first followed by *Caralluma europaea* (Guss.) N.E.Br. (89 informants) and *Arenaria rubra* L. (81 informants) for kidney stones disease category. For cervical cancer disease category, *Pistacia lentiscus* L. scored the first rank with (81 informants citation), followed by *Silybum marianum* (L.) Gaertn. (76 informants), and *Lavandula officinalis* Chaix. (49 informants).

3.3.4. Source of knowledge about medicinal plants

In our ethno-botanical survey, 63.4% of the population acquired knowledge about medicinal use of plants as remedy for genito-urinary diseases through others' experiences (Figure 6). This reflects the relative transmission of traditional practices from generation to generation. 21% practise herbal medicine according to herbalists' advice, (14%) of respondents' information is taken from pharmacists and only 1.6% had built this knowledge by reading books about traditional Arab medicine, by watching television programs or by their own experience with a large number of medicinal plants in their surroundings. The environment and others' experiences remain therefore the most effective means of transmitting knowledge about medicinal purposes of plants.

Table 2. ICF values by categories for treating genito-urinary diseases.

Categories	List of plant species used and number of citations	Total number of		ICF
		Species	Use citations	
Kidney stones (KS)	*Pistacia lentiscus* L.(5), *Petroselinum sativum* Hoffm. (103), *Pimpinella anisum* (L.) Merr. (35), *Conium maculatum* L. (13), *Caralluma europaea* (Guss.) N.E.Br. (89), *Aristolochia baetica* L.(43), *Borago officinalis* L. (2), *Arenaria rubra* L.(81), *Corrigiola telephiifolia* Pourr. (71), *Cicer arietinum* L.(15), *Lavandula officinalis* Chaix.(51), *Sesamum indicum* L .(7), *Festuca glauca* Vill. (5), *Citrus limon* (L.) Osbeck. (6), *Urtica urens* L. (14).	15	540	0.97
Cervical cancer (CC)	*Pistacia lentiscus* L. (81), *Silybum marianum* (L.) Gaertn. (76), *Lavandula officinalis* Chaix. (49), *Citrus reticulata* Blanco. (1), *Convolvulus althaeoides* L. (1), *Atriplex halimus* L. (3), *Mercurialis annua* L. (5), *Myrtus communis* L. (21), *Citrus* × *aurantium* L. (25).	9	262	0.96
Bacterial vaginosis (BV)	*Arenaria rubra* L. (46), *Lavandula officinalis* Chaix. (12), *Eriobotrya japonica* (Thunb.) Lindl. (2), *Myrtus communis* L. (43), *Cicer arietinum* L. (3).	5	106	0.95
Chronic renal failure (CRF)	*Arenaria rubra* L. (26), *Tribulus terrestris* L. (2), *Eleusine indica* (L.) Gaertn. (1), *Pimenta dioica* L. (8).	4	37	0.89
Renal colic (RC)	*Pistacia lentiscus* L. (11), *Citrus limetta* Risso. (6).	2	17	0.88

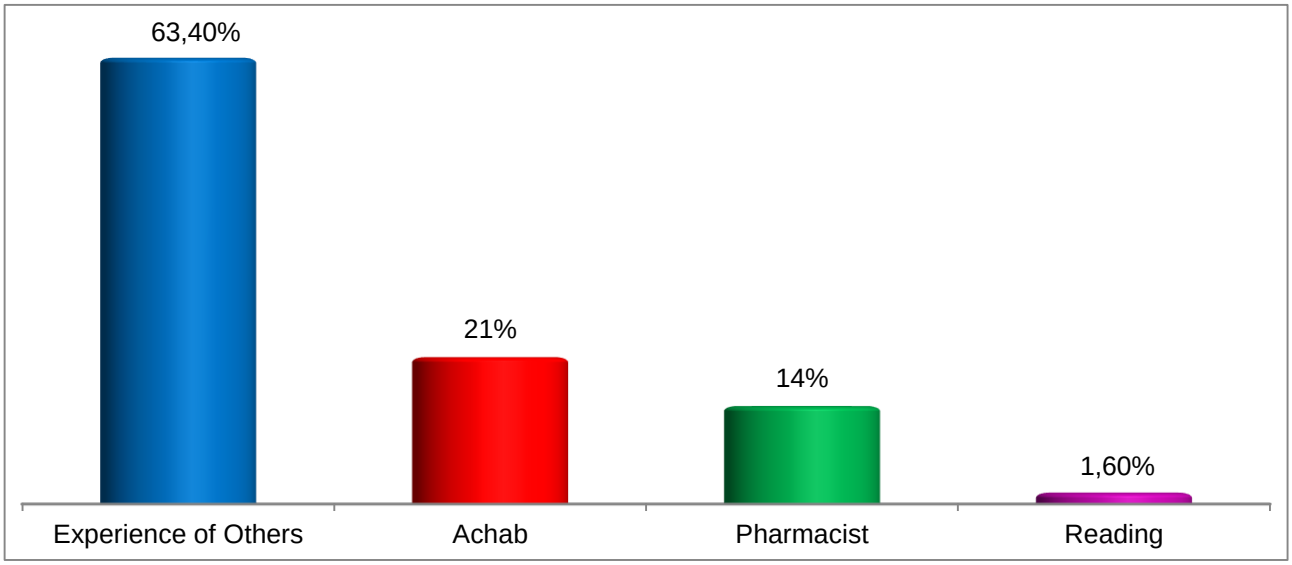

Figure 6. Traditional knowledge acquisition modes.

Conclusion

The ethnobotanical and ethnopharmacological survey revealed that, the study area has a great biodiversity with a variety of medicinal and aromatic plants and still needs more explorations. This rich floral indicates the high potential of traditional knowledge to serve for the development of natural product-derivate as affordable medicines. These plants still play a crucial role for people in the Moroccan Rif, but medicinal plants used to treat genito-urinary diseases in this region lack ethnomedicinal evidence.

Unfortunately, medicinal flora of Moroccan Rif region is under threat to the extinction as people are unaware of the conservation strategies for future uses. Deforestation, overgrazing, anthropogenic activities, and extensive eradication of medicinal herbs from root, threatened the flora.

On the basis of results of the present study, medicinal and aromatic plants scoring high relative frequency of citation, informant consensus factor and fidelity level values should be further tested for their pharmaceutical, phytochemical and biological studies to explore their potential to discover new drugs with limited side effects. In this connection, attention should be drawn to the conservation of traditional medicinal plants and associated indigenous knowledge in the Moroccan Rif area to sustain them in the future.

Limitations of the study

This study was limited to only a part of Morocco (Moroccan Rif region). The same study in various parts of Morocco is suggested.

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Appendix

Questionnaire sheets: Medicinal plants and herbal medicine

Date.....

Region ……

Commune.....

Survey number.....

Informant:

Profession: .....

Sex: Male ☐ Female ☐

Age: { ≤ 20} ☐ {20 - 40} ☐ {40 - 60} ☐ { ≥ 60 ☐

Family situation: Single ☐ Divorced ☐ Widower ☐ Married ☐

Level of study: Illiterate ☐ Primary ☐ Secondary ☐ University ☐

Locality: Nomadic ☐ Town ☐ Village ☐ City ☐

Income / month (MAD): Unemployed ☐ {250 - 1500} ☐ {1500 - 5000} ☐ { ≥5000} ☐

Therapeutic practices :

When you feel sick, you address:

To traditional medicine, why?

Effective ☐ Cheapest ☐ Acquisition ☐ Ineffective medication ☐

To modern medicine, why? Effective ☐ More precise ☐ Toxicity of plants ☐

If it is two that it is the first: Traditional medicine ☐ Modern medicine ☐

Vegetal material:

Vernacular name:……...

Scientific Name: .....

Plant Type: Spontaneous ☐ Cultivated ☐ Introduced ☐

Use of the plant: Therapeutic ☐ Cosmetic ☐ Other ☐

Harvesting technique: Manual ☐ Mechanical ☐

Harvest Time: Summer ☐ Fall ☐ Winter ☐ Spring ☐ Any year ☐

Drug preparation: Plant alone ☐ Possible association (of plants) ☐

If association of plants, quote the recipe:……..

Use of the plant: Fresh ☐ Desiccated ☐ After treatment ☐

If desiccated, drying method: Sun exposure ☐ In the Shade ☐

Used part: Stem ☐ Flower ☐ Fruit ☐ Seed ☐ Bark ☐ Bulb ☐

Root ☐ Rhizome ☐ Leaf ☐ Whole plant ☐ Other combination ☐

Form of employment: Tisane ☐ Powder ☐ Essential oil ☐ Oily oil ☐ Tincture ☐

Method of preparation: Infusion ☐ Decoction ☐ Cataplasm ☐ Raw ☐ cooked ☐ Other ☐

Dose used: Pinch ☐ Handle ☐ Spoonful ☐

Precise Dose: Quantity in g / glass: …….. Quantity in g / liter: ……... Other: .....

Administration mode: Oral ☐ Massage ☐ Rinse ☐ Swabbing ☐ Other ☐

Dosage: number of doses per day:

For children: 1time / day ☐ 2time / day ☐ 3time / day ☐ Other ☐

For adults: 1time / day ☐ 2time / day ☐ 3time / day ☐ Other ☐

For older people: 1time / day ☐ 2time / day ☐ 3time / day ☐ Other ☐

Length of Use: One Day ☐ A Week ☐ One month ☐ Until healing ☐

Conservation method: Sheltered from the light ☐ Exposed to light ☐ Other ☐

Expiration date:…… ……..……

Use :

Diagnosis By: Himself ☐ Doctor ☐ Herbalist ☐ Other ☐

Results: Healing ☐ Improvement ☐ Ineffective ☐

Side effect: ..... Toxicity: ..... Caution of use: .....

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