

Medicinal and aromatic plants used in the treatment of genito-urinary diseases in the Rif, Morocco

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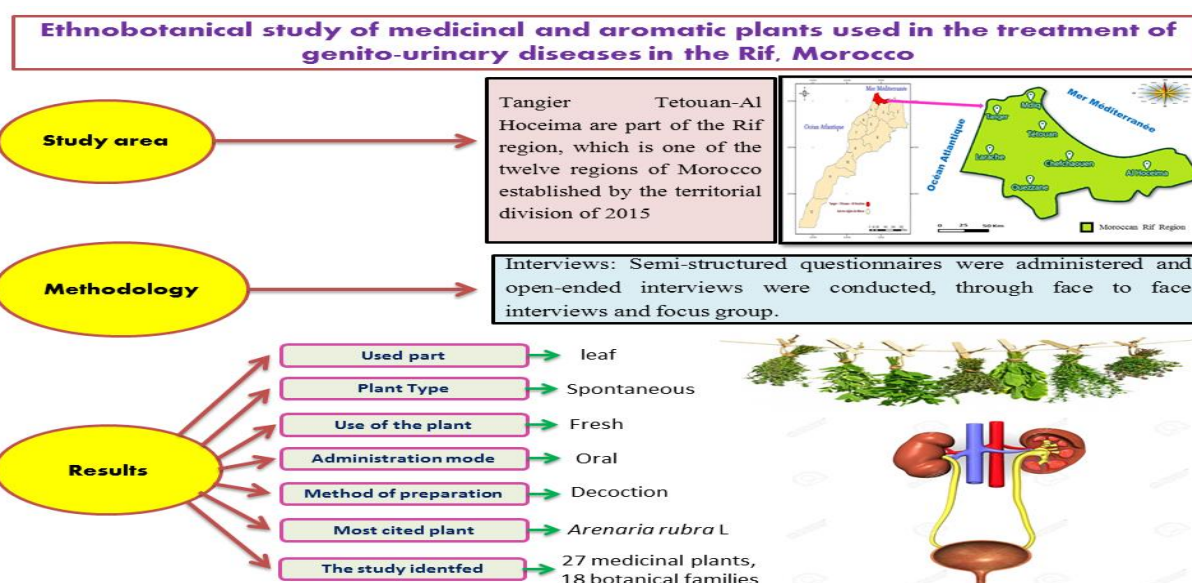
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Abstract

Background: 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. **Materials and Methods:** 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, analyzed 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. **Results:** 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. **Conclusion:** 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.

Graphical Abstract



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. Thus, even today, despite the progress of pharmacology, the therapeutic use of plants is very present in some countries, especially in developing countries.

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 ([Matuhe 2001](#)). This biodiversity is characterized by a very marked endemism ([Ghanmi et al. 2011](#)) allows it to occupy a privileged place among the Mediterranean countries which have a long medical tradition and traditional know-how based on medicinal and aromatic plants ([Scherrer et al., 2005](#)). 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 and aromatic plants are very fragmentary and dispersed. Because of the few thousand plant species, the medicinal species counted do not exceed the 600 species ([Rejdali 1996](#)) 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 analyse 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

The present study aimed to document the traditional ethnomedicinal knowledge of the population in the Moroccan Rif region. The study area is part of the region of Tangier-Tetouan-Al Hoceima which is one of the twelve regions of Morocco established by the territorial division of 2015 ([Bulletin officiel 2015](#)). It consists of the former Tangier-Tetouan region and the province of Al Hoceima of the former Taza Taounate Al Hoceima region. It is located in the extreme north-west of Morocco; it is limited to the north by the Strait of Gibraltar and the Mediterranean, to the west by the Atlantic

Ocean, to the south-west by the Rabat-Sale-Kenitra region, to south-east by region Fes-Meknes and east by the region of Oriental. The region has two prefectures (Tangier-Asilah and M'Diq-Fnideq) and six provinces (Al Hoceima, Chefchaouen, Fahs-Anjra, Larache, Ouezzane and Tetouan). Its main town is Tangier--Asilah.

According to the last census of the population of 2014, the region of Tangier Tetouan-Al Hoceima is ranked the fifth of the regions with a population of 3,549,512 inhabitants, or a rate of 10.49% of the total population of the country. In general, the inhabitants depend on agriculture, livestock and to a lesser extent, from forest resources for their livelihood. The climate of the region is Mediterranean on the coasts and the surroundings, but rather continental and with abundant snow on the interior areas of the region, thanks to its altitude and its triple maritime façade (+ 1000 mm), the region is one of the most watered areas in Morocco ([HCP 2018](#)).

From the geological point of view, the Rif region is part of the Alpine chains and is characterized by thrusts which have determined its structure. The Rif's chain is the framework of the Rif's geological domain, with an exceptional location with two maritime facades: the Mediterranean Sea in the north and the Atlantic Ocean in the west.

2.2. Methodology

2.2.1. Data collection

In order to gather information on MAPs used for curing genito-urinary disorders, an ethnobotanical survey was conducted from June 30th, 2016 to June 1st, 2018. Semi-structured questionnaires were administered and open-ended interviews were conducted, through face to face interviews and focus group. The inclusion criteria were people who are knowledgeable about plants used for genito-urinary problems, 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). Who have been informed about the objective of this study, after obtaining their trust and were regularly interviewed in Amazigh or Arabic dialects depending on the variety of language spoken by each case, in order to collect and document indigenous knowledge of plants usage against genito-urinary diseases. They are people reputedly experienced and serious. 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 diseases. 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 ([Godron 1971](#)) 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.

2.2.2. *Plant species collection and identification*

Each plant used by our informants was placed in the Herbarium or in a plastic bag with a label indicating its vernacular name. We photographed them and took samples for identification later in the resources and biodiversity laboratory, department of biology faculty of sciences, Ibn Tofail University Kenitra, Morocco, using the following botanical works: the medicinal plants of the Morocco (Sijelmassi 1993), practical flora of Morocco (Fennane et al. 1999) and catalogs of vascular plants of Northern Morocco, including identification keys (Valdés 2002), volumes I and II.

2.2.3. *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 plants 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: $FIV = \frac{FC_{family}}{N_s}$. Where $FC_{family} = RFC$ is the number of informants mentioning the family and $N_s =$ Total number of species within each family (Sreekeesoon and Mahomoodally 2014).

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 (Tardío and Pardo-de-Santayana 2008): $RFC = \frac{FC}{N}$ with $(0 < RFC < 1)$.

Plant Part Value (PPV)

Plant part value (PPV) was calculated using the following formula: $PPV = \frac{RU_{plant\ part}}{RU}$. Where RU is the number of uses reported of all parts of the plant and $RU_{plant\ part}$ 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 (Friedman et al. 1986): $FL (\%) = \frac{N_p}{N} \times 100$. Where N_p 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 (Heinrich et al. 1998). $ICF = \frac{Nur - Nt}{Nur - 1}$. 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)

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 (Jouad et al. 2001; Salhi et al. 2010; Tahraoui et al. 2007; Ziyat et al. 1997).

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 (Anyinam 1995). These values confirm the results obtained in other regions of Morocco (Aribi 2013; Benlamdini et al. 2014; El Hafian et al. 2014).

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 by (El Hilah et al. 2015) in the central plateau of Morocco.

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 by (Bouزيد et al., 2017; El Hilah et al. 2015; Lahsissene et al., 2009).

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 by (Douiri et al. 2007).

| Variables | Catrgories | Number of informants | Percentages (%) | P-values |
|-------------------|----------------|----------------------|-----------------|----------|
| Gender | Female | 287 | 52.3 | 0.375 |
| | Male | 261 | 47.7 | |
| Age groups | < 18 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 | |

Table 1 : Sociodemographic details of the respondents in Moroccan Rif

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, FL, and ICF 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 ([Fig.3](#)). 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 ([Eddouks et al. 2002](#); [Jouad et al. 2001](#); [Tahraoui et al. 2007](#)).

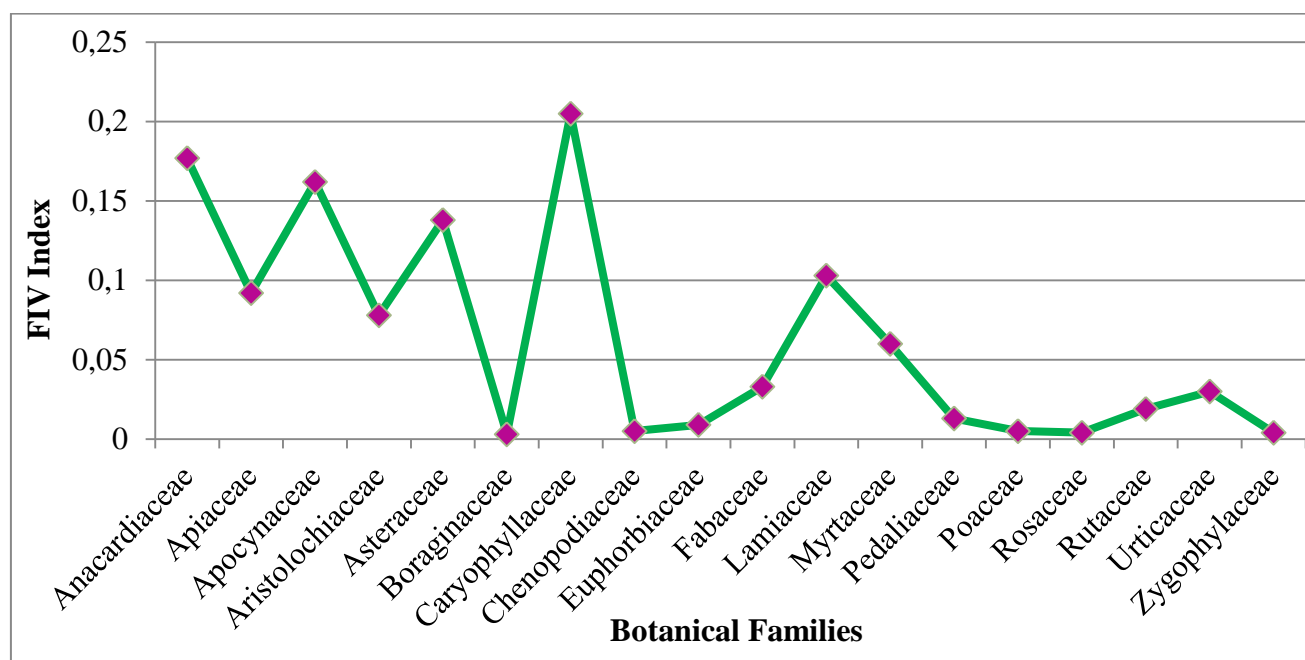


Figure 1 : Family Importance value (FIV) of medicinal and aromatic plants.

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) followed by *Lavandula officinalis* L. (RFC 0.204) *Petroselinum sativum* Hoffm (RFC 0.188), *Pistacia lentiscus* L. (RFC 0.177) and *Caralluma europaea* L. (RFC 0.162). 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 (Vitalini et al. 2013).

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 PAMs 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* L. (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.

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

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 | Part used | Mode of Preparation | Medicinal uses | FL % | FC | RFC | FIV |
|--|-----------------|-------------|---------------------|----------------|------|----|-------|-------|
| Myrtaceae | | | | | | | | 0.06 |
| <i>Myrtus communis</i> L. | Rayhan | Leaf | Decoction | CC, BV | 76.8 | 56 | 0.102 | |
| <i>Pimenta dioica</i> L. | Nwiwira | Fruit | Infusion | CRF | 100 | 08 | 0.015 | |
| Pedaliaceae | | | | | | | | 0.013 |
| <i>Sesamum indicum</i> L. | Jenjlane | Seed | Infusion | KS, | 100 | 07 | 0.013 | |
| Poaceae | | | | | | | | 0.005 |
| <i>Festuca glauca</i> L. | Aguzmir | Seed | Infusion | KS, | 100 | 05 | 0.009 | |
| <i>Eleusine indica</i> L. | Njem | Whole plant | Decoction | CRF | 100 | 01 | 0.001 | |
| Rosaceae | | | | | | | | 0.004 |
| <i>Eriobotrya japonica</i> L. | Lemzah | Leaf | Infusion | BV, | 100 | 02 | 0.004 | |
| Rutaceae | | | | | | | | 0.019 |
| <i>Citrus limon</i> L. | Lhamed | Fruit | Other | KS, | 100 | 06 | 0.011 | |
| <i>Citrus limetta</i> Risso L. var <i>bergamia</i> | Lhamed Beldi | Fruit | Cooked | RC | 100 | 06 | 0.011 | |
| <i>Citrus aurantium</i> L. | Larnef | Flower | Cooked | CC | 100 | 25 | 0.050 | |
| <i>Citrus reticulata</i> L. | Lmandarine | Fruit | Cooked | CC | 100 | 01 | 0.001 | |
| Urticaceae | | | | | | | | 0.030 |
| <i>Urtica urens</i> L. | Lhurriga | Leaf | Decoction | KS | 100 | 14 | 0.030 | |
| Zygophyllaceae | | | | | | | | 0.004 |
| <i>Tribulus terrestris</i> L. | Ders Elajouz | Whole plant | Cooked | CRF | 100 | 02 | 0.004 | |

Table 2: Continued.

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

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 (Fig.1). 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 (Daoudi et al. 2016; Douiri et al. 2007; Hachi et al. 2015) or in Africa (Asase et al., 2010; Asnake et al. 2016; Mukungu et al. 2016; Nouri 2016) for herbal medicine preparation.

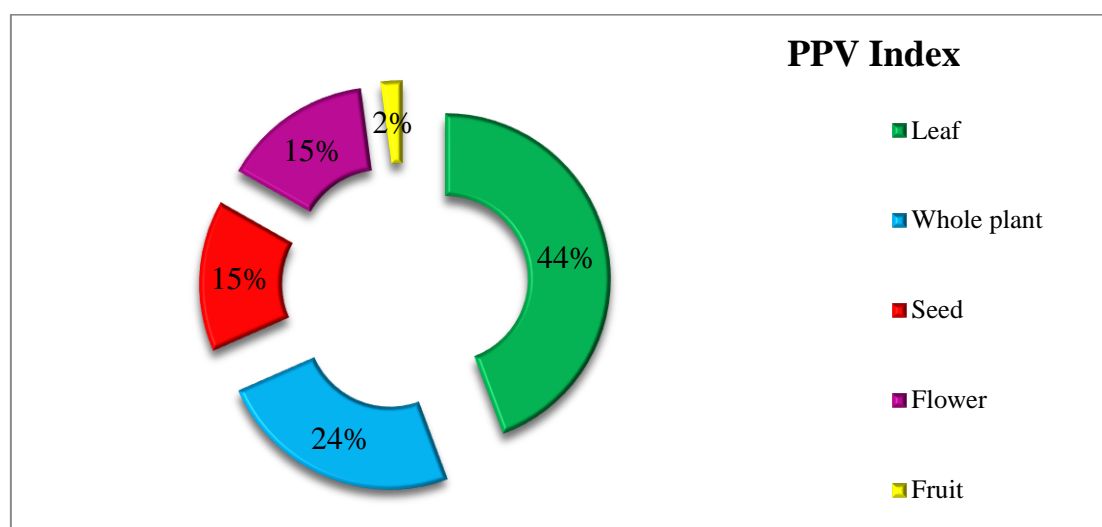


Figure 1 : Plant part used in the treatment of genito-urinary diseases in the study area.

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 (Fig.2). 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 (El Hilah et al. 2015; Salhi et al. 2010; Slimani et al. 2016). 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 (Okello et al. 2010; Stangeland et al. 2011; Yetein et al. 2013).

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 (Polat and Satil 2012). 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 (Benarba et al., 2014; Chermat and Gharzouli 2015; El Hafian et al. 2014).

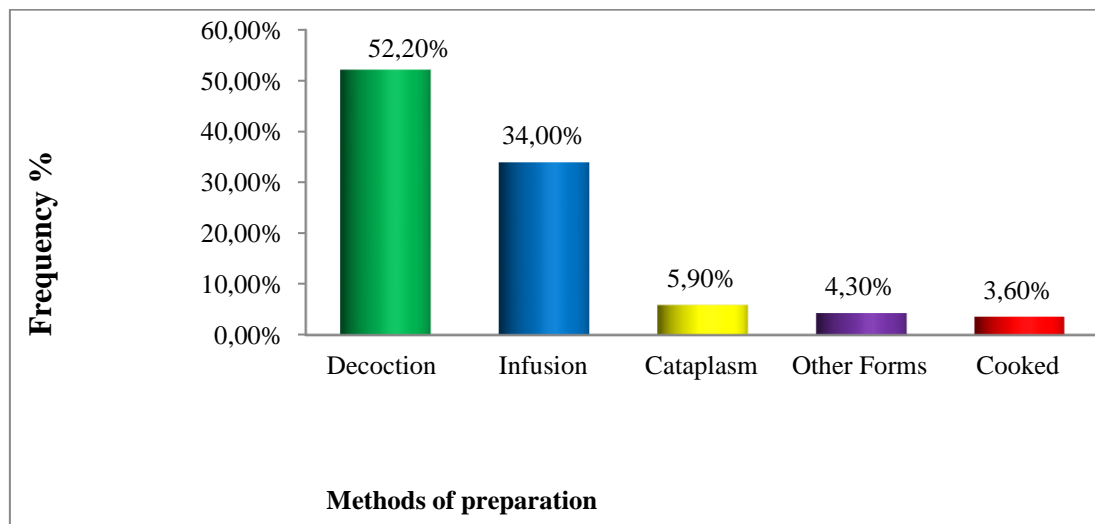


Figure 2 : Frequency of different methods of preparation.

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 (Lin et al., 2002). 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* L. (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. (76 informants), and *Lavandula officinalis* L. (49 informants).

| Categories | List of plant species used and number of citations | Total number of | | ICF |
|--------------------|--|-----------------|---------------|------|
| | | Species | Use citations | |
| Kidney stones (KS) | <i>Pistacia lentiscus</i> L.(5), <i>Petroselinum sativum Hoffm</i> (103), <i>Pimpinella anisum</i> L.(35), <i>Conium maculatum</i> L.(13), <i>Caralluma europaea</i> L. (89), <i>Aristolochia baetica</i> L.(43), <i>Borago officinalis</i> L. (2), <i>Arenaria rubra</i> L.(81), <i>Corrigiola telephiifolia</i> L.(71), <i>Cicer</i> | 15 | 540 | 0.97 |

| | | | | |
|-----------------------------|---|---|-----|------|
| | <i>arietinum</i> L.(15), <i>Lavandula officinalis</i> L.(51), <i>Sesamum indicum</i> L.(7), <i>Festuca glauca</i> L.(5), <i>Citrus limon</i> L.(6), <i>Urtica urens</i> L. (14). | | | |
| Cervical cancer (CC) | <i>Pistacia lentiscus</i> L. (81), <i>Silybum marianum</i> L. (76), <i>Lavandula officinalis</i> L. (49), <i>Citrus reticulata</i> L. (1), <i>Convolvulus althaeoides</i> L. (1), <i>Atriplex halimus</i> L. (3), <i>Mercurialis annua</i> L. (5), <i>Myrtus communis</i> L. (21), <i>Citrus aurantium</i> L. (25). | 9 | 262 | 0.96 |
| Bacterial vaginosis (BV) | <i>Arenaria rubra</i> L. (46), <i>Lavandula officinalis</i> L. (12), <i>Eriobotrya japonica</i> L. (2), <i>Myrtus communis</i> L. (43), <i>Cicer arietinum</i> L. (3). | 5 | 106 | 0.95 |
| Chronic renal failure (CRF) | <i>Arenaria rubra</i> L. (26), <i>Tribulus terrestris</i> L. (2), <i>Eleusine indica</i> L. (1), <i>Pimenta dioica</i> L. (8). | 4 | 37 | 0.89 |
| Renal colic (RC) | <i>Pistacia lentiscus</i> L. (11), <i>Citrus limetta</i> Risso L. var <i>bergamia</i> (6). | 2 | 17 | 0.88 |

Table 3: ICF values by categories for treating genito-urinary diseases.

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 (Fig.3). 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.

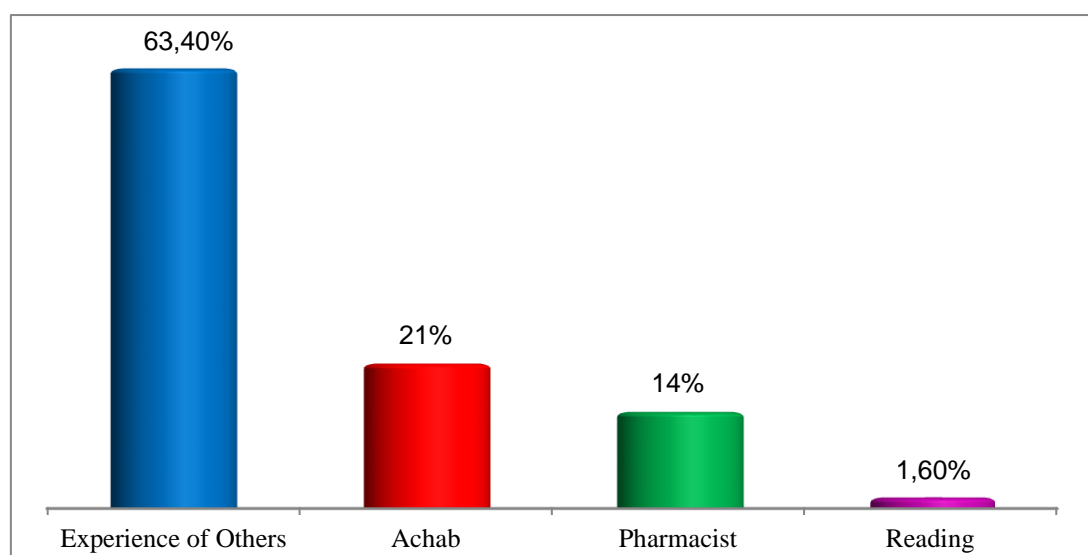


Figure 3: Traditional knowledge acquisition modes.

4. Conclusions

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.

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