Cystitis treatment with phytotherapy within the Rif, Northern Morocco

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Abstract

Background: Cystitis is often caused by a bacterial infection, which is the most widespread type among other urinary infections. This investigation was aimed to document detailed ethnobotanical information of medicinal plants used to heal cystitis problems because of their effective therapeutic properties. The study was carried in the Rif, from March 1, 2015, to April 15, 2017. Semi-structured direct interviews were carried with 657 interviewees to collect the indigenous therapeutic knowledge. Surveys included interviewed demographic profile and ethnomedicinal information. UR and MUV were applied in data analysis.

Results: A total of 60 plant species distributed in 51 genera and 31 families were commonly used by our interviewees in the therapy of cystitis. Apiaceae was designed by the highest number of species (7 species); Capparis spinosa L. was the medicinal plant most frequently prescribed by regional people. Leaves were the most commonly used plant part (41.5%), and the majority of herbal remedies were prepared from decoction (55%).

Conclusions: This research is the first contribution to the ethnobotanical study of this region. It is suggested that the ingredients of natural plant species documented are being investigated to discover the therapeutic effects and mechanisms of action. Primary consideration must be paid to the preservation of medicinal species, comprehensive documentation of popular medicinal data, and biological validation of listed species.

Keywords: Rif, Morocco, Phytotherapy, Cystitis, Ethnomedicinal, Knowledge

Background

Urinary infections are a real public health problem around the world. Infections are classified as urethritis, simple acute cystitis, recurrent acute cystitis, simple acute pyelonephritis, and urinary infection of pregnant and postmenopausal women [1].

Cystitis (Nboula in the Moroccan dialect) is a medical term that describes inflammation of the bladder. Inflammation is most usually produced by a bacterial infection (Escherichia coli, Proteus, and Enterobacter), called a urinary tract infection. A bladder infection can be painful and irritating and can display a dangerous health difficulty if the infection reaches the kidneys.

The specificity of the management of urinary infections in Morocco lies in the difficulties of accessing care, whether in private or public health facilities. Besides, the evaluation of the management and follow-up of the patient is unknown, as well as the evolution of resistance and the misuse of antibiotics.

Today, despite the development of chemical drugs to combat urinary tract diseases, there is often a return to plants as a source of active ingredients. Besides, an important part of the population, especially in rural areas, prefers medicinal plants, for economic reasons and sometimes because of difficulty in accessing medical care. It is also added that between 8 and 65% of Escherichia coli associated with urinary infections are resistant to ciprofloxacin, an antibiotic commonly used against these infections [2].

This research aims to establish, from an ethnobotanical survey of local people, the list of plant drugs available in...
the Rif and that are used in the treatment of cystitis. We suggest, subsequently, a classification of these medicinal plant species reported, according to the use, and we present them in the form of a catalog.

Methods
Study area
The current study was conducted out in the Rif region. It extends between 34 and 36° of latitude in the North and 4 to 6° of longitude in the East. It is bounded in the North by the Strait of Gibraltar and the Mediterranean Sea, in the South by the Rabat-Sale-Kenitra region and Fez-Meknes region, in the East by the Eastern Region, and in the West by the Atlantic Ocean (Fig. 1). The total geographical area of the Rif is 11,570 km², and the population of the city is about 3,549,512 inhabitants with an average population density of 222.2/km² [3]. The Rif is marked by Mediterranean weather with the highest temperature up to 45 °C during summer (July–August) and below 0 °C during winter (December–January), and the average annual rainfall ranges from 700 to 1300 mm which falls mainly between October and February [4]. The area is dominated by species such as Abies marocana Trab., Pinus halepensis Mill., Cannabis sativa L., and Cedrus atlantica (Endl.). The population is mixed between Arabic and Amazigh ethnicity. Principally, families of this region are very much dependent on subsistence farming, livestock, and, to a more secondary space, forest resources for their livelihood.

Methodology
Ethnobotanical data collection
To document an indigenous anticystitis plant ancestral knowledge and discover the level of utilization of traditional medicinal plants for prevention and therapy of cystitis by the local people (Fig. 2) (412 males and 245 females) from different rural and urban communes of the Rif region, namely, S1: Al Hoceim (30), S2: Ajdir (20), S3: Izefzafen (15), S4: Bni Hadifa (15), S5: Targuist
S 6: Tizi n Tchin (22), S 7: Issaguen (30), S 8: Bab Berred (30), S 9: Cherrafate (30), S 10: Bab Taza (20), S 11: Derdara (10), S 12: Chefchaouen (30), S 13: Akchour (30), S 14: Fifi (30), S 15: Tétouan (30), S 16: Bni Karrich (30), S 17: Mallalyène (15), S 18: Zinat (30), S 19: Martil (20), S 20: Md’q (20), S 21: Fnideq (20), S 22: Belyounich (30), S 23: Melloussa (30), S 24: Ksar Esghir (25), S 25: Bni Ouassin (15), S 26: Tanger (30), S 27: Al Bahraouiyne (15), and S 28: Jouamaa (10), a semi-structured questionnaire was prepared, and data were collected through face-to-face interviews over a period between March 1, 2015, and April 15, 2017.

The information collected during this study includes the sociodemographic characteristics of the surveyed (age, gender, level academic) and ethnobotanical data, including the local and scientific name of the species, local names, plant parts used, methods of use, preservation technique, administration mode, and toxicity (Appendix). Interviews were generally carried in the local language (Arab dialect and Tamazight); all documented data were then translated to English.

**Taxonomic nomenclature of the plant species**
Medicinal species being mentioned by the informants were registered with local names and photographed. For each reported plant species, the plant species were accumulated and classified, and voucher specimens were archived. The identification and nomenclature of the collected vegetal material were done first in the field and completed at the Plant, Animal Productions and Agroindustry Laboratory by one of the authors using some floristic literatures as well as The medicinal plants of Morocco [5]; Practical Flora of Morocco; tomes I, II, and III [6–8]; and Catalogs of vascular plants of northern Morocco, including identification keys and tomes I and II [9]. Taxonomy and denominations of species were validated using “The Plant List 2020” database (http://www.theplantlist.org). Voucher specimens have been kept at our university, for future reference.

**Statistical analysis**
The data collected from the field and obtained from the local people were organized and studied with the statistical program IBM SPSS Statistics 21 Premium (SPSS 2019), to determine the proportions of various variable sociodemographics of the interviewees and ethnobotanical data. Quantitative value records were also determined for the general practices of these medicinal plants using the use reports (UR) and medicinal use value (MUV).

**Use reports (UR)**
The use reports (UR) of a plant or its significance in the practice of a community is recognized by its mentioning degree or its mention frequency by informants. It was determined by the formula [10]: UR = \( \frac{N_i}{n} \) where \( N_i \) is the
sum of the informant who cited the species and \( n \) is the entire of respondents interviewed.

**Medicinal use value (MUV)**

The MUV of documented therapeutic plants was defined by using this formula \[ 11\]:  
\[
\text{MUV} = \frac{1}{N} \sum UR_i
\]
where \( \sum UR_i \) is the total sum of use reports per plants and \( N \) is the total of interviewees interrogated for given medicinal species. The MUV rate will be more significant if there are several useful reports for a species, indicating that the plant is significant, whereas they will be near 0 if there are few reports compared to its use \[ 12\].

**Results**

**Demographic information of informants**

A total of 657 study informants, including 213 herbalists, 178 herbal sellers, 46 pharmacists, 40 midwives, and 180 other healers (bonesetters, Fouqha, cautery installer, farmers, elder people, and nobles), were interrogated using semistructured surveys and group interviews. In the study area, both sexes are interested in phytotherapy. However, the numbers of male participants were more important (412 informants) than those of females (245 informants). In this study, results showed that the utilization of medicinal species is widespread in all age groups with different percentages. The bulk of informants surveyed were over 50 years old (350), and between 30 and 50 years old (304), while 3 of the informants were aged less than 30 years old. Concerning the educational level, our results revealed that the majority of the informants (43%) were uneducated, 29.4% have secondary education, 26.8% have primary education, and only 0.8% of the informants had high education (Table 1).

**Botanical families of plants used**

This investigation revealed that a total of 60 plant species belonging to 51 genera and 31 families were commonly used by local people from the Rif region in the treatment of cystitis. The family Apiaceae was designed by the largest number of plant species (7 species), followed by Ericaceae with 6 species; Lamiaceae, Poaceae, and Rutaceae (4 species each); and Asteraceae and Caryophyllaceae (3 species each), whereas the rest of botanical families were represented by one or two species in each. The vernacular names, scientific names of documented species, their families, mode of preparations, used parts, MUV, and UR are illustrated in Table 2.

**Table 1**

| Variables        | Categories | Number of informants | % |
|------------------|------------|----------------------|---|
| Sex              | Male       | 412                  | 62.7 |
|                  | Female     | 245                  | 37.3 |
| Age groups       | Less 30 years | 3                    | 0.5 |
|                  | Between 30 and 50 | 304               | 46.3 |
|                  | Above 50 years | 350                | 53.2 |
| Educational level| Illiterate | 283                  | 43 |
|                  | Primary    | 176                  | 26.8 |
|                  | Secondary  | 193                  | 29.4 |
|                  | University | 5                    | 0.8 |
| Profession       | Herbalist  | 213                  | 32.4 |
|                  | Herb seller| 178                  | 27.1 |
|                  | Pharmacist | 46                   | 7 |
|                  | Midwives   | 40                   | 6.1 |
|                  | Other healers | 180                | 27.4 |

**Medicinal use plants (MUV)**

MUV is used to find the most frequently used plant species in the study area. Its value ranged from 0.200 to 0.277 (Table 2). The calculated results of MUV showed that *Capparis spinosa* L. was ranked first (MUV=0.277) followed by *Apium graveolens* L. (MUV=0.267), *Ziziphus vulgaris* Lam. (MUV=0.247), *Herniaria glabra* L. (MUV=0.233), *Anethum graveolens* L. (MUV=0.224), *Spergularia rubra* (L.) J.Presl & C.Presl (MUV=0.216), and *Nigella sativa* L. (MUV=0.210), while the lowest value was found for *Citrus reticulata* Blanco., *Convolvulus althaeoides* L., and *Eleusine indica* (L.) Gaertn. (MUV=0.200 each).

**Parts of the plant used**

In the Rif region, indigenous people collect diverse plant parts for the preparation of phytotherapy (e.g., seed, root, flower, and leaf). The discussion result revealed that leaves are the most frequently used part of the medicinal plants 41.5% of the sum, followed by the whole plant (26.5%), fruit (10%), seed (9%), flower (7%), and rhizome (6%).

**Modes and routes of medicine preparation**

The preparation of herbal remedies needs liquids. The main solution was water, but milk, butter, tea, and honey are also used by the Rif’s population. The principal method of traditional medicine preparation reported was decoction (55%), followed by infusion (33.1%), cataplasm (1.4%), and cooking (1.1%). The percentage of the other modes of preparation grouped (fumigation, bath, maceration, powder, and plaster) does not exceed 9.4%. Concerning the route of administration, the majority of informants’ prepared remedies were applied mostly by oral (73.2%) followed by topical (18.7%) and dermal (8.1%).
| Family and scientific name | Vernacular name | Used parts | Preparation mode | Route of administration | UR | MUV |
|----------------------------|----------------|------------|------------------|------------------------|----|-----|
| **Amaranthaceae**          |                |            |                  |                        |    |     |
| *Atriplex halimus* L.       | Legtef         | Leaf       | Infusion         | Oral                   | 03 | 0.005 |
| **Anacardiaceae**          |                |            |                  |                        |    |     |
| *Pistacia lentiscus* L.     | Drou           | Leaf       | Infusion         | Topical                | 97 | 0.145 |
| **Apiaceae**               |                |            |                  |                        |    |     |
| *Anmmi visnaga* (L.) Lam.  | Khella         | Fruit      | Decoction        | Oral                   | 116| 0.177 |
| *Anethum graveolens* L.    | Karviya Amia   | Whole plant| Infusion         | Oral                   | 147| 0.224 |
| *Apium graveolens* L.      | Lkrafes        | Whole plant| Infusion         | Oral                   | 175| 0.267 |
| *Conium maculatum* L.      | Choukran       | Leaf       | Cataplasm        | Oral                   | 13 | 0.020 |
| *Ferula communis* L.       | Lkalikha       | Leaf       | Decoction        | Topical                | 93 | 0.142 |
| *Petroselinum sativum* Hoffm. | Maládnous   | Leaf       | Decoction        | Oral                   | 103| 0.157 |
| *Pimpinella anisum* L.     | Habbat Hlawa   | Seed       | Other            | Oral                   | 35 | 0.053 |
| **Apocynaceae**            |                |            |                  |                        |    |     |
| *Caralluma europaea* (Guss.) N.E.Br. | Daghmous   | Leaf       | Infusion         | Oral                   | 89 | 0.135 |
| **Arecaceae**              |                |            |                  |                        |    |     |
| *Serenoa repens* (W.Bartram) Small | Nakhil Florida | Fruit     | Infusion         | Topical                | 05 | 0.008 |
| **Aristolochiaceae**       |                |            |                  |                        |    |     |
| *Aristolochia baetica* L.  | Berzetn        | Leaf       | Cataplasm        | Dermal                 | 43 | 0.065 |
| **Asparagaceae**           |                |            |                  |                        |    |     |
| *Asparagus officinalis* L. | Sekkoun        | Rhizome    | Decoction        | Topical                | 117| 0.178 |
| *Urginea maritima* L.      | Bisel Edib, Ansel | Whole plant | Other           | Dermal                 | 28 | 0.043 |
| **Asteraceae**             |                |            |                  |                        |    |     |
| *Hieracium pilosella* L.   | Wden Lfar      | Whole plant| Decoction        | Oral                   | 61 | 0.093 |
| *Silybum marianum* (L.) Gaertn. | Tawra        | Seed       | Decoction        | Dermal                 | 66 | 0.100 |
| *Taraxacum vulgare* Lam.   | Lhindbae, Ûdjem | Leaf       | Decoction        | Oral                   | 08 | 0.012 |
| **Betulaceae**             |                |            |                  |                        |    |     |
| *Betula pendula* Roth      | Al Kodban      | Whole plant| Infusion         | Oral                   | 46 | 0.070 |
| **Boraginaceae**           |                |            |                  |                        |    |     |
| *Borago officinalis* L.    | Harricha, Lsan Tor | Flower   | Infusion         | Oral                   | 02 | 0.003 |
| **Brassicaceae**           |                |            |                  |                        |    |     |
| *Nasturtium officinale* R.Br. | El Jerjir   | Leaf       | Decoction        | Oral                   | 72 | 0.110 |
| **Cactaceae**              |                |            |                  |                        |    |     |
| *Opuntia vulgaris* Mill.   | Lhendya        | Flower     | Decoction        | Topical                | 40 | 0.061 |
| **Capparaceae**            |                |            |                  |                        |    |     |
| *Capparis spinosa* L.      | Lkabbar        | Leaf       | Decoction        | Oral                   | 182| 0.277 |
| **Caryophyllaceae**        |                |            |                  |                        |    |     |
| *Corrigiola telephifolia* Pourr. | Sarghina   | Whole plant| Decoction        | Oral                   | 71 | 0.108 |
| *Herniaia glabra* L.       | Herras Lehjar  | Whole plant| Decoction        | Oral                   | 153| 0.233 |
| *Spergularia rubra* (L.) J.Presl & C.Presl | Ftat Lhjer | Leaf       | Infusion         | Oral                   | 142| 0.216 |
| **Cucurbitaceae**          |                |            |                  |                        |    |     |
| *Cucurbita pepo* L.        | Lgraa Lhamra   | Seed       | Decoction        | Dermal                 | 25 | 0.038 |
| **Cupressaceae**           |                |            |                  |                        |    |     |
| *Juniperus communis* L.    | Taqa           | Leaf       | Decoction        | Topical                | 45 | 0.068 |
| *Tetraclinis articulata* (Vahl) Mast. | Araar   | Leaf       | Decoction        | Dermal                 | 87 | 0.132 |
Table 2 Catalog of medicinal plants used to treat cystitis problems in the Rif, Morocco (Continued)

| Family and scientific name | Vernacular name | Used parts | Preparation mode | Route of administration | UR | MUV |
|-----------------------------|----------------|------------|------------------|-------------------------|----|-----|
| **Ericaceae**               |                |            |                  |                         |    |     |
| *Erica australis* L.        | Bouhadad       | Flower     | Infusion         | Oral                    | 36 | 0.055 |
| *Erica ciliaris* L.         | El Khlenj      | Leaf       | Infusion         | Oral                    | 53 | 0.081 |
| *Erica multiflora* L.       | El Khlenj      | Flower     | Decoction        | Oral                    | 5  | 0.008 |
| *Erica scoparia* L.         | El Khlenj      | Leaf       | Infusion         | Oral                    | 14 | 0.021 |
| *Erica terminalis* Salisb.  | El Khlenj      | Flower     | Decoction        | Oral                    | 10 | 0.015 |
| *Erica umbellata* L.        | El Khlenj      | Flower     | Infusion         | Oral                    | 8  | 0.012 |
| **Euphorbiaceae**           |                |            |                  |                         |    |     |
| *Mercurialis annua* L.      | Hrriya lmelsa  | Whole plant | Decoction     | Topical                | 05 | 0.008 |
| **Fabaceae**                |                |            |                  |                         |    |     |
| *Cicer arietinum* L.        | Hommes         | Seed       | Decoction        | Oral                    | 18 | 0.027 |
| **Gentianaceae**            |                |            |                  |                         |    |     |
| *Centaurium erythraea* Rafn | Merarat El hnech | Leaf | Decoction     | Topical                | 17 | 0.026 |
| **Grossulariaceae**         |                |            |                  |                         |    |     |
| *Ribes nigrum* L.           | Kashmesh khel  | Leaf       | Decoction        | Oral                    | 56 | 0.085 |
| **Lamiaceae**               |                |            |                  |                         |    |     |
| *Convolvulus althaeoides* L.| Louwaya        | Leaf       | Decoction        | Oral                    | 01 | 0.002 |
| *Lavandula officinalis* Chaix.| Lkhzama      | Flower     | Infusion         | Oral                    | 112| 0.170 |
| *Marrubium vulgare* L.      | Merriwt        | Leaf       | Other            | Topical                | 69 | 0.105 |
| *Origanum vulgare* L.       | Merdkkouch     | Leaf       | Infusion         | Oral                    | 83 | 0.126 |
| **Myrtaceae**               |                |            |                  |                         |    |     |
| *Myrtus communis* L.        | Rayhan         | Leaf       | Decoction        | Topical                | 56 | 0.0185 |
| *Pimenta dioica* (L.) Merr. | Nwiwira        | Fruit      | Infusion         | Dermal                  | 08 | 0.012 |
| **Pedaliaceae**             |                |            |                  |                         |    |     |
| *Sesamum indicum* L.        | Jenjlane       | Seed       | Infusion         | Oral                    | 07 | 0.011 |
| **Poaceae**                 |                |            |                  |                         |    |     |
| *Agropyrum repens* (L.) P.B.| Njem           | Rhizome    | Decoction        | Oral                    | 76 | 0.116 |
| *Festuca glauca* Vill.      | Aguzmir        | Seed       | Infusion         | Oral                    | 05 | 0.008 |
| *Eleusine indica* (L.) Gaerth.| Njem           | Whole plant | Decoction     | Oral                    | 01 | 0.002 |
| *Zea mays* L.               | Dra            | Whole plant | Decoction     | Oral                    | 79 | 0.120 |
| **Ranunculaceae**           |                |            |                  |                         |    |     |
| *Nigella sativa* L.         | Lhabba Ssawda  | Seed       | Decoction        | Oral                    | 138| 0.210 |
| **Rhamnaceae**              |                |            |                  |                         |    |     |
| *Zyphus vulgaris* Lam.      | Zefzouf        | Fruit      | Other            | Oral                    | 162| 0.247 |
| **Rosaceae**                |                |            |                  |                         |    |     |
| *Eriobotrya japonica* (Thunb.) Lindl.| Lernzah | Leaf | Infusion         | Oral                    | 02 | 0.003 |
| *Prunus cerasus* L.         | Habb Lmlouk    | Fruit      | Infusion         | Oral                    | 19 | 0.029 |
| **Rutaceae**                |                |            |                  |                         |    |     |
| *Citrus limon* (L.) Osbeck. | Lhamed         | Fruit      | Other            | Oral                    | 06 | 0.009 |
| *Citrus limetta* Risco.     | Lhamed Beldi   | Fruit      | Cooked           | Oral                    | 06 | 0.009 |
| *Citrus x aurantium* L.     | Lannej         | Flower     | Cooked           | Oral                    | 25 | 0.038 |
| *Citrus reticulata* Blanco. | Lmandarine     | Fruit      | Cooked           | Oral                    | 01 | 0.002 |
| **Urticaceae**              |                |            |                  |                         |    |     |
| *Urtica dioica* L.          | Lhurriga       | Whole plant | Decoction     | Topical                | 38 | 0.058 |
Discussion

Our analysis of the results shows that both sexes are involved in phytotherapy. But, the numbers of male informants were more important than those of females. Men were predominantly represented in the sampling because of working. Because of the customs and traditions of the inhabitants of the Rif region, women must remain at home. They tend to abide by religious laws and close down the community. This explains the absence of females in the field during our discussions. This result reinforces the conclusions of other ethno-botanical national and international investigations [13–17] which have besides verified that males are more popular for vegetative information. For age groups, results revealed that interviewees above 50 years old had higher knowledge of medicinal species, while interviewees age less than 30 years old were less informed about it; this is due to the high secrecy of ancestral knowledge by older peoples. Concerning the academic level, our results revealed that the bulk of the informants (43 %) were illiterate. Preceding ethno-botanical investigation studies have comparable conclusions [14, 18]. This means that with a greater level of education, the experience of traditional phytotherapy decreases. Consequently, advanced instruction diminishes the ancestral therapeutic experience of the young generation [19, 20].

The floristic analysis showed that a total of 60 plant species belonging to 51 genera and 31 botanical families were commonly utilized by local people in the therapy of cystitis. The botanical family Apiaceae was described by the most important number of medicinal plants (7 species) followed by Ericaceae with 6 species. The determined results of MUV noted that *Capparis spinosa L.* was ranked first (MUV=0.277) followed by *Apium graveolens* L. (MUV=0.267) and *Zizyphus vulgaris* Lam. (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran [20, 21]. These plant species producing leading MUV studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247). These results are compared to other studies especially in Morocco and Fars Province of Iran (MUV=0.247).

The selection of leaves was due to its natural availability, easy gathering, and simplicity in herbal remedy preparation. Besides, the leaves are the site of photosynthesis and sometimes the storage of the secondary metabolites active for the pharmaceutical properties of the medicinal plant. Similar results indicated that the leaf is used as a principal part of plants in phytotherapy in different studies [22–26]. The principal method of remedy preparation described by our interviewees was decoction (55%). The frequent employment of the decoction can be justified by the evidence that this method makes it possible to conserve the effective multiple ingredients and attenuates or eliminates out the poisonous result of some plant constituents. Ethnobotanical researches carried in many regions of the globe discovered that the majority of informants prepared herbal remedies by decoction and infusion [13, 17, 27–29]. This result confirms that there is a continual transfer of information on the effectiveness of medicinal plants between the people of Morocco. Concerning the route of administration, the main route of application for herbal medicines was oral (82.4%). Moreover, the oral form of treatment is a preferred route all over the planet [18, 30–37]. The predominance of oral treatment can be explained by the fact that cystitis is a common internal disease that is decimating the health of the Rif’s population.

Conclusion

In light of the results obtained in this study, medical plants appear to continue to play a pivotal role in covering the basic needs of the health coverage system of the local population living in the Rif region notwithstanding technological progress in modern health. The sum of plant species used by informants to treat cystitis is also evidence that this region is full of medical knowledge inherited from generations ago.

In light of these encouraging results, additional research is suggested on the sustainable and reasonable use and conservation of medicinal plant species. Finally, it is advisable to conduct pharmacological, phytochemical, and toxicological investigations on these species that have been inventoried for laboratory validation of ancestral uses of these plants and to obtain the traditional medicine Bios.
Appendix

Appendix A

Questionnaire sheets: Medicinal plants and herbal medicine

| Date: | | |
|-----------------|-----------------|-----------------|
| Region: | | |
| Community: | | |
| Survey number: | | |

**Information**

| Sex: Male | Female |
|-----------|--------|
| Age: 15–20 | 20–40 | 40–60 | ≥ 60 |
| Family situation: Single | Married | Widowed | Others |
| Level of study: Elementary | Primary | Secondary | University |
| Locality: Nomadic | Town | Village | City |
| Income (monthly): Unemployed | (250–1500) | (1500–3000) | ≥ 3000 |

**Theophyletic medicine**

- Why you seek help, you address: To traditional medicine, why? Effective | Acupuncture | Ineffective medication |
- To modern medicine, why? Effective | More precise | Toxicity of plants |

**Vonological 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 | Possibly association (of plants) |
| If association of plants, name the recipe: | | |
| Use of the plant: Fresh | Dried | After treatment |
| Dried, decoction method: Sun exposure | In the shade |
| Used part: Stem | Flower | Root | Seed | Bark |
| Form of preparation: Tea | Powder | Essential oil | City | Tincture |
| Method of preparation: In vivo | In vitro | In Hoffman |
| Dose used: Pouch | Handle | Spontaneous |
| Proximate Data: Quantity x g / l (solution) | Quantity x g / l (solution) | Other |
| Management mode: Oral | Parenteral | Rectal | Topical |
| Dosage: Number of doses per day: | | |
| For children: 1 time / day | 2 times / day | 3 times / day | Other |
| For adults: 1 time / day | 2 times / day | 3 times / day | Other |
| For old people: 1 time / day | 2 times / day | 3 times / day | Other |
| Length of use: One Day | A Week | One month | Until healing |
| Conservation method: Stored from the light | Exposed to light | Other |
| Expiration date: | | |

**Use**

| Diagnosis: By: | | |
|-----------------|-----------------|-----------------|
| Route: | | |
| Side effect: | | |

**Abbreviations**

MUV: Medicinal use plants; UR: Use report; MPs: Medicinal plants

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**Plant identification**

Botanical identification of the plant parts was carried out at Plant, Animal Productions and Agro-industry Laboratory, Department of Biology.

**Authors’ contributions**

NC carried out field research in the Rif, compiled the literature sources, data analysis, and interpretation; and wrote the manuscript, and performed data analysis. HO helped in data and made a substantial contribution to data analysis. LZ designed the research and identification of plant species. All authors read and approved the final manuscript.

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**Availability of data and materials**

All data collected and analyzed in this paper are included in the article and attached in the form of “Appendices” as additional files. Medicinal plant specimens are deposited in our university.

**Declarations**

**Ethics approval and consent to participate**

The study was carried out following the recommendations of the Code of Ethics of the International Society of Ethnobiology. Ethics approval was authorized by the Ethics Committee of Plant, Animal Productions and Agro-industry Laboratory, Department of Biology, Faculty of Sciences, Ibn Tofail University, through No. NHEL/06/06/2016. During this discussion, the research objectives and interview procedure were explained to each informant, and confidentiality was assured. Consent for audio recording was also obtained. Interviewees were informed that the intentions of the research were not for commercial purposes or other interests but for academic reasons. Informants provided verbal informed consent to share in this study; they were free to withdraw their knowledge at any point in time. After informing the committee that we had only obtained the oral consent of the informants, the committee immediately accepted the completion of this study.

**Consent for publication**

Consent for publication was obtained from participants.

**Competing interests**

The authors declare that they have no competing interest.

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