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Article

Pharmaceutical ethnobotany in the Mahabad (West Azerbaijan) biosphere reserve: ethno-pharmaceutical formulations, nutraceutical uses and quantitative aspects

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This study endeavors to overcome the limits of an orally transmitted pharmacopoeia, and tries to utilize the large ethnobotany patrimony of the area to investigate the biological diversity. Thirty-five traditional practitioners from dissimilar ethnic groups including traditional health practitioners (THPs) and indigenous people were interviewed. A total of 35 species of plants, belonging to 20 families were recognized for the treatment of more than 26 types of ailments. Informant consensus factor (FIC) values of this study reflected the high agreement in the use of plants in the treatment of gastro-intestinal complaints, infectious, parasitic diseases and constipation among the informants. Constipation had the highest use-reports and 8 species of plants had the highest fidelity level (FL) of 100%. In addition one of the species showed the highest relative importance (RI) value of 2.00. Priority should be given to phytochemical investigation of plants that scored the highest FL, FIC, RI values; as such values could be considered as a good indicator of potential plants for discovering new drugs. In addition, traditional knowledge of THPs should be taken into consideration in order to smooth continuation and extension of the nutraceutical aspects and biological diversity of the region.

Keywords: Pharmaceutical Ethnobotany. Ethno-Medicinal Knowledge. Indigenous people. Nutraceutical aspects. Ethnobotany/trends. Biosphere/analysis. Medicine tradicional/utilization. Ethnopharmacology. Plants/drug effects. Phytochemicals/pharmacology.

INTRODUCTION

Ethno-Medicinal studies of plants with therapeutic properties are very beneficial for the discovery of modern remedies (Cox, Balick, 1994; Bitu *et al.*, 2015; Baydoun *et al.*, 2015; Heinrich, Gibbons, 2001; Kpodar *et al.*, 2015; Samoisy, Mahomoodally, 2015; Tchouya *et al.*, 2015). According to the World Health Organization (WHO), about 4 billion people in developing countries not only trust in the therapeutic properties of medicinal plant but also use them consistently (Rai, Prasad, Sharma, 2000; Chintamunnee, Fawzi Mahomoodally, 2012; Yavuz *et al.*, 2015). Among developing countries, Iran is a vast country of rich plant resources including considerable number of medicinal plants (Mosaddegh *et al.*, 2012; Jafarirad, Damanafshan, 2017) (Figure 1). Increasing attention to medicinal plants use in Iran could be attributed to both the increasing price of modern remedy drugs and prevalence of side effects of chemical drugs (Mosaddegh *et al.*, 2012). In the villages of Mahabad, there are only a few pharmacies or they are totally absent; the villagers cannot easily reach cities to receive chemical remedies. For this reason, in every village there is a bazaar in which all commercial activities are situated. Among the various shops there are those where traditional remedies, seeds, fruits, drugs and spices are sold.

Mahabad, in West Azerbaijan and parts of Kurdistan, has a variety of vegetation zones due to climate and good rainfall years. The first name of Mahabad was Savoujbolagh. Savoujbolagh is a Turkish word meaning cold spring. Later, the town was called Savoujbolagh Mokri, meaning Savoujbolagh of the Mukri tribe, due to the residence of the Mukri tribe in the town (McDowall, 1996).

Documentation of the traditional knowledge through ethnopharmacological evaluations is vital for conservation of bio-resources (Heinrich, Gibbons, 2001). The diverse manners of people life in district of Mahabad have resulted

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in a various local health care system. Unfortunately, in the recent years, medicinal plants and the related data are being extremely exhausted in Mahabad. It could be as a result of deforestation, environmental degradation and migrations of traditional medicinal healers to other jobs. It has been taking place in the country for rather an extensive time, which could ultimately result in the quick loss of the traditional knowledge. Moreover, the information on traditional preparation of medicinal plants has been passed from one generation to the next only orally. Thus most of the written documents of this field are not available. In general, in the past decades a few of pharmacological surveys have been carried out as the customary uses of plants in Iran (Miraldi, Ferri, Mostaghimi, 2001; Ghorbani, 2005; Mosaddegh *et al.*, 2012). In particular, in spite of the existence of a rich culture of use of traditional herbs in Mahabad, there are not any ethnobotanical investigations so far. Therefore, an ethnobotanical survey of medicinal plants utilized by the indigenous people in Mahabad was conducted in order to document the information regarding traditional uses of medicinal plants and identify the most important species used in traditional medicine. Moreover, a comparative investigation on acquired data and goals of application of these traditionally used plants was attempted.

FIGURE 1 - Location of study area, Mahabad, in Iran Map

MATERIALS AND METHODS

Study area

Mahabad city and its villages (Figure 1), with an area of 2591 km², are approximately located in the north west of Iran at 36°45′47″N and 45°43′20″E. The city lying south of Urmia Lake in a narrow valley 1,300 meters above sea level with annual average temperature of 12 °C as well as annual rainfall is 330mm. The area has a continental climate with rather hot summers and cold winters. The area is characterized by two main ecosystems; forest and steppe. In the wild areas we mostly observe vegetation and the land is covered in lush, but due to human activities and lack of rainfall it is significantly declined in recent years. At the 2006 census, the city's population was 197,441 (Bakhtiyari, 2015). The main language of the indigenous population is Kurdish (Laizer, 1996).

Selection of informants

Interviewees were local traditional health practitioners (THPs) in addition to native people with practical or experiential information on medicinal plants. A total of 35 people were interviewed for this study. The informants were selected as they were known as being traditional health practitioners by the local Mahabad community. Besides THPs, elderly individuals of the region, experienced people, shepherds and medicinal plant vendors were also interviewed. During the selection of informants, gender, age, educational background, and experience on use of traditional medicinal plants were taken into consideration (Table I). The interviews were conducted by the second author at the THPs house and Bazar (markets in local language) in Mahabad. Local Kurdish language was used in the interview. Informants were asked to report the wild, cultivated or bought medicinal plants that had been traditionally used in the area, what ailments were treated with them, and whether they were still in use or abandoned. We also asked the local names of the plants, and how they were collected, conserved, prepared, and administered. During the interview, informants also mentioned medicinal plant uses that they had learned via non-traditional sources such as internet courses and books. This information was registered as modern medicinal uses and was not included as medicinal plants traditionally used in the region.

Ethnomedicinal data collection

The aims of the study were obviously clarified and consents were obtained by interviewers from each

TABLE I - Demographic data of the informants

Variable	Categories	No. of person	Percent
Informants category	Traditional health practitioners	3	8.57
	Indigenous people	32	91.43
Gender	Male	25	71.42
	Female	10	28.59
Age	Less than 20 years	-	-
	20–30 years	1	2.85
	30–40 years	4	11.42
	40–50 years	14	40
	50–60 years	10	28.5
	More than 60 years	6	17.14
Educational background	Illiterate	16	45.7
	Completed five years education	11	31.42
	Completed eight years education	4	11.42
	Completed 12 years education	1	2.86
	Some under grade degree (16 years education)	1	2.86
	Graduate (higher education)	2	5.71
Experience of the traditional health practitioners	10–20 years	5	14.28
	More than 20 years	30	85.72

informant. Each informant was questioned alone to ensure confidentiality among them.

Open-ended and semi-structured questionnaire (Cotton, 1996) was used for the purpose. The questionnaire was presented in two parts. Part 1 covered personal information including age, sex, educational background, and experiences of the informants related to medicinal plants (Table I). Part 2 was about their practice including the following information (Table II); (i) local name of the plants, (ii) used part(s) of plants, (iii) mode of preparation, (iv) medicinal uses of particular plants, (v) harvest time and (vi) relative abundance of species at the area, they are found up to 80-90%, 40-50% and less than 10% in which stand for abundant, medium and rare, respectively. In addition, it must be mentioned that the local people had not any information about the toxicity effects of the species that they have used.

The collected voucher specimens were pressed, preserved and later identified by the Herbarium of research institute of natural resources of West Azerbaijan, Urmia. Most plant species were collected together with the informants and in some cases; plants were collected in a later visit in the same location where the informant lived. Research articles, books and relevant web pages were studied with the purpose to collect data of phytochemicals present in the plants. Then frequently found compounds in the reported plant species were listed.

Data analysis

The plants were recorded in alphabetical instruction by scientific name, family, local name, general name, used part(s) of plants, mode of preparation, mode of application, relative abundance, conservation status and frequency of citation (FC) (Table IV). The FC of the plants species being utilized was evaluated using the formula:

FC = (Number of times a particular species was mentioned/ total number of times that all species were mentioned) × 100

The informant consensus factor (FIC) was considered with the following (Heinrich, Gibbons, 2001).

$$FIC = (Nur-Nt)/ (Nur-1)$$

where 'Nur' refers to the number of use-reports for a particular ailment category and 'Nt' refers to the number of taxa used for a particular ailment category by all informants. FIC was applied to focus the sameness of the information about a specific plant use to treat a specific kind of illnesses (Table V). In other words, the FIC is a symbolic value of stability of the informants that how regularly they agree about the use of certain plant species for the dealing of a particular ailments category. The product of this factor ranges from 0 to 1. An illness having a high FIC value (close to 1) shows that relatively few taxa are used by a large proportion of the informants. A low

TABLE II - Ethnomedicinal data collection

Local name	Persian name	Scientific Name	Used part	How to use	Usage	Harvest time	Abundance	No. of person
Gala rakesha	Barhang	*Plantago major L.*	Leaf	unprepared	Analgesic for toothache, extirpation of body acne and suppurative	Spring	Abundant	9
Talkhe talkhe	Talkhe Talkhe	*Acropilon repens*	Stem	unprepared	Diabetes	Spring	Abundant	4
Gharbang	Panj Angosht	*Vitex agnus castus*	Seed	Burning	Elimination of Dental larva	Spring	Abundant	12
Bezhan	Boomadaran	*Achillea millefolium*	Leaf	Decoction	Kidney Stones , Hematological diseases, Fungal disease, haematuria and scabies	Spring	Abundant	4
Bezhan	Boomadaran	*Achillea millefolium*	Leaf	Decoction	Washing	Spring	Abundant	1
Gogam	Gole mahoor	*Verbascum thapsus*	Leaf	Unprepared	Skin burning	Spring	Abundant	1
Jatra	A'avishan	*Thymus kotschyanus*	Leaf, Stem	Infusion	Laxative, stomach ache	Spring	Abundant	25
Shilan	Nastaran	*Rosa Canina*	Fruit Leaf	Infusion	Elimination of Diabetes	Autumn	Abundant	3
Revas	Rivas	*Rheum ribes*	Root	Infusion	Elimination of Diabetes	Spring	Abundant	6
Memook	Shirin bayan	*Glycyrrhiza echinata*	Bulb	Infusion	stomach ache	Spring	Abundant	30
Hero	Khatmi	*Althaea officinalis*	Flower	Decoction	Strong laxative, Extirpation of body acne, Expectorant	Spring	Abundant	3
Hamisha bahar	Hamishe bahar	*Calendula Officinalis*	Sap	Unprepared	Laxative	Spring	Abundant	15
Gog nasa	Piaz e Anasal	*Drimia maritima*	Bulb	Powder	Extirpation of body acne, softener	Spring	Abundant	5
Pr Pra	Kharfe	*Portulaca oleraceae L.*	Leaf	Infusion	Elimination of Diabetes	Spring	Abundant	5
Trsha ga	Torshak	*Rumex acetosella*	Bulb	Infusion	Extirpation of body acne	Spring	Abundant	6
Goli ghamish	Gol- e-ney	*Phragmites australis*	Bulb	Deccotion	Skin burning	Spring	Abundant	8
Gaz gask	Gazeneh	*Urtica dioica*	Leaf Bark, Stem	Infusion	Respiratory problem	Spring	Abundant	6
Kartashi	Shekar tighali	*Echinops ritrodes Bunge*	Flower	Infusion	Keep Solid Oil	Spring	Abundant	15
Kartashi	Shekar tighali	*Echinops ritrodes Bunge*	Sap	Infusion	Laxative	Spring	Abundant	13
Pnga	Pooneh	*Mentha longiflorum*	Leaf, Stem	Infusion	Laxative, Carminative	Spring	Abundant	15
Yonje	Yonje	*Medicago Sativa*	Leaf	Infusion	Hematological diseases,	Spring, summer	Abundant	7
Haji laklak	Panirak	*Malvasyl vestris*	Leaf	Decoction	Laxative, cough	Spring	Abundant	1
Galay havidar	Baba Adam	*Artium lappa*	Leaf, Root	Infusion, Decoction	Cardiovascular diseases, Dermatology problem, Stomach worms, Sore throat,	Summer, Autumn	Rare	1
Chagh chagha	Ka'asnii	*Chicoriom Intybus*	Leaf	Decoction	Cardiovascular diseases	Spring	Abundant	1
Dara bii	Biid	*Salix alba*	Leaf, Fruit	Infusion	Sedative an Sleeping	Spring	Abundant	3
Bayboon	Babooneh	*Anthemis tinctoria*	Leaf, Fruit	Infusion	stomach ache, vomiting	Spring	Abundant	4
Voshtr khorka	Khar shotor	*Alhagi camelorum*	Bark, Stem Fruit	Infusion	Kidney Stones	Spring	Abundant	3

TABLE II - Ethnomedicinal data collection (cont.)

Local name	Persian name	Scientific Name	Used part	How to use	Usage	Harvest time	Abundance	No. of person
Pakoola	Khar khasak	*Tribulus terrestris*	Leaf, Fruit	Infusion	Kidney Stones	Spring	Medium	2
Friizoo	Biid giyah	*Cyndon dactylon*	Leaf, Fruit	Infusion	Kidney Stones, epilepsy and antidepressive	Spring	Medium	2
Gppzrovan	Gav zaban	*Borago officinalis*	Leaf, Fruit	Infusion	Kidney Stones	Spring	Medium	2
Baroo	Shah baloot	*Castanea sativa*	Fruit	Infusion	Ulcerative colitis	Autumn	Medium	4
Mazoo	Mazoo	*Quercus infectoria*	Fruit	Infusion	eyesight	Autumn	Abundant	3
Darbnav	Zaban gonjeshk	*Fraxinus excelsior L.*	Bark	Unprepared	Cyst weakness, vermifuge and sterility	Summer, Autumn	Rare	3
Giasalma	Sa'alab	*Orchis palustris*	Bulb	Infusion	Ice cream , Weak laxative	Spring	Rare	
Gevizh	Zalzalak	*Crataegus aronia*	Fruit	Unprepared infusion	Cardiovascular diseases	Autumn	Abundant	4
Drdook	Tameshk	*Rubus fruticosus*	Fruit	Unprepared	Cardiovascular diseases	Summer	Abundant	4
Chnar	Chenar	*Platanus orientalis*	Stem	Infusion	Tonic	-	Abundant	1

value indicates that informants disagree on the taxa to be used to heal a specific category of illness.

Relative Importance Value (RI) was determined according to the work of Bennett, Prance (2000) as:

$$RI = PP+AC$$

where PP is obtained by the number of pharmacological properties, reported specific ailments, attributed to a species divided by the maximum number of properties attributed to the most resourceful species (species with the highest number of properties). The AC stands for number of Ailment Categories treated by a given species divided by the maximum number of ailment categories treated by the most resourceful species. The highest possible value of RI is 2.0, which indicates the highest diversity of medicinal uses of a plant (Table VI).

Fidelity Level (FL) was intended using the following formula (Friedman *et al.*, 1986) as:

$$FL = Ip/Iu\times100$$

where Ip is the number of informants who independently indicated the use of a species for the same major ailment and Iu is the total number of informants who mentioned the plant for any major ailment. High FL value shows high frequency of use of the plant species for dealing a particular ailment category by the informants of the study area (Table VII).

RESULTS

Informants

Among the 35 interviewees, 3 people are THPs and the others are indigenous people. Percentage of men and women in this study were 28 and 72, respectively. There was a high percentage, nearly 50%, of interviewees who were around 40-50 years old. In addition, the majority of interviewees were illiterate (Table I).

Medicinal plants reported

In the present study, 35 plant species belonging to 20 plant families are identified as having medicinal values by THPs in mahabad. Asteraceae with 7 species (belonging to *Acroptilon repens , Achillea millefolium, Calendula Officinalis, Echinops adenocaulos, Arctium Lappa, Chicoriom Intubus* and *Matricaria chamomilla*), Rosaceae with 3 species (belonging to *Rosa Canina, Crataegus aronia* and *Rubus fruticosus*), Fabaceae with 3 species (belonging to *Glycyrrhiza glabra, Castanea sativa and Quercus infectoria*) and the other family are according the Table 3 and Figure 2.

Information regarding the preparation

Depending on plant and illness sometimes whole plant and in many cases different parts of the same plant including leaf, root, bark, fruit, flower, rhizome, seed,

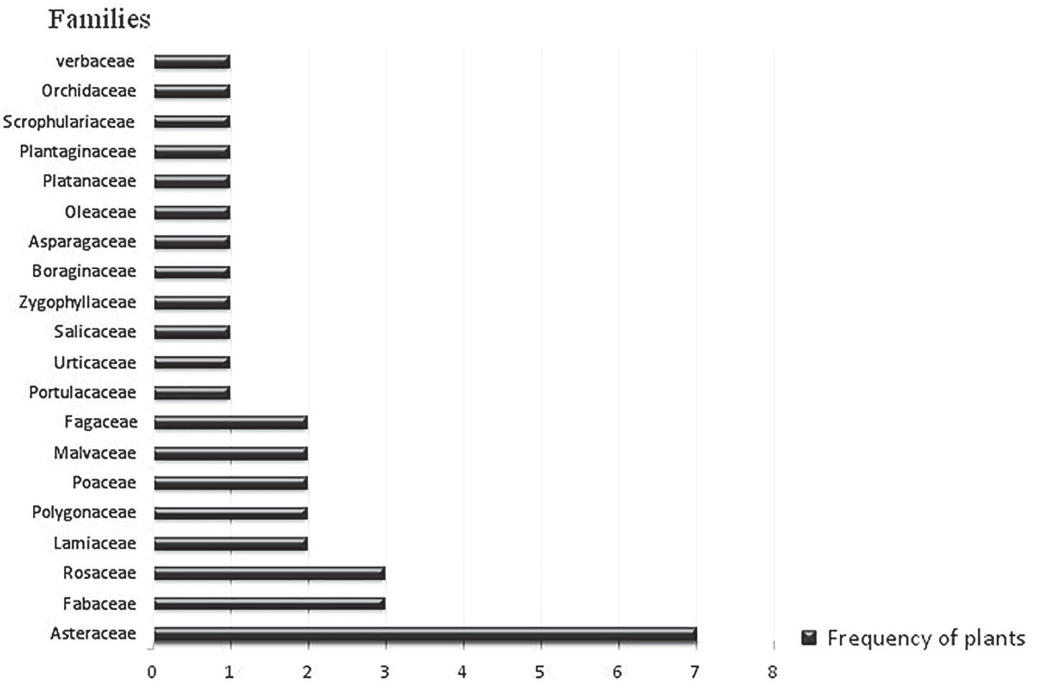

FIGURE 2 - Families of the plants with their frequencies

stem, tuber and bulb are used for the management of various ailments. Most of time, different parts are blended together for a medicinal preparation. Approximately, for all plants, the leaves were used. Different preparation methods are used for ordering herbal medicinal plants including decoction, infusion, juice, powder, maceration and raw. The main mode of preparation is infusion followed by decoction. Moreover, the most cited plants are *Glycyrrhiza glabra* L., *Thymus kotschyanus* Boiss. and *Echinops ritrodes* Bunge.

Other relevant information of the recorded medicinal plants

As shown in Table IV, the majority of reported plants have been used for more than one type of illness. The highest proportions of medicinal plants are used to treat constipation (7 species), infectious and parasitic diseases (6 species), cardiovascular diseases (5 species), gastro-intestinal complaints (4 species) and diabetes (5 species).

Table V summarizes the FIC values obtained for the categorized ailment. The FIC values in our investigation ranged from 0 to 1. The ailments categories with more than 8 use-reports are constipation (79 use-reports, 7 species), gastrointestinal complaints (60 use-reports, 4 species), infectious and parasitic diseases (31 use-reports), 6 species and cardiovascular (17 use-reports, 5 species). In our study, the highest FIC value (0.95) was found for gastrointestinal complaints, followed by constipation (0.92) and infectious and parasitic diseases (0.83).

Arctium lappa L. possessed the maximum number of pharmacological properties (5 properties) so it had a regularized PP value of 1.00 (5/5). *Arctium lappa* L. has been employed to treat 5 ailments categories and had a regularized AC value of 1.00 (5/5) which possessed the highest RI value of 2.00 followed by RI 1.2 of *Achillea millefolium* L. (Table VI). Moreover, 19 plants mentioned by 5 or more informants for being used against a given ailment category. Among these plants 4 species were cited for constipation and dermatology problem separately. Furthermore, 9 plants showed the maximum amount of FL including *Thymus kotschyanus* Boiss., *Mentha longiflia* L., *Arctium lappa* L., *Glycyrrhiza glabra*, *Arctium lappa*, *Drimia maritimia*, *Platanus orientalis*, *Medicago sativa* and *Rheum ribes*.

A detailed evaluation on FL, FIC, RI values

In the present investigation, about 45% of THPs were illiterate, but they had rather good knowledge on traditional remedies (Table I). For example, they used more than one part of the plant for the preparation of remedies based on the rules of Iranian traditional medicine which is consisted of four humours concept: Phlegm (Balgham), Blood (Dam), Yellow bile (Safra) and Black bile (Sauda) (Afshar, 1992; Zargari, 1992; Mir Heidari, 1993). These THPs firmly conserve certain rules in regards to collecting plants at some particular months of the year, and in

TABLE III - Genus and species of the plants

Species	Genus	Family	Local name
Plantago major L.	Plantago	Plantaginaceae	Gala rakesha
Acroptilon repens	Acroptilon	Asteraceae	Talkhe talkhe
Vitex agnus castus	Vitex	Verbaceae	Gharbang
Achillea millefolium	Achillea	Asteraceae	Bezhan
Verbascum thapsus	Verbascum	Scrophulariaceae	Gogam
Thymus kotschyanus	Thymus	Lamiaceae	Jatra
Rosa canina	Rosa	Rosaceae	Shilan
Rheum ribes	Rheum	Polygonaceae	Revas
Glycyrrhiza glabra	Glycyrrhiza	Fabaceae	Memook
Althaea officinalis	Althaea	Malvaceae	Hero
Calendula officinalis	Calnedula	Asteraceae	Hamisha bahar
Drimia maritima	Drimia	Asparagaceae	Gog nasa
Portulaca oleraceae L.	portulaca	Portulacaceae	Pr Pra
Rumex acetosella	Rumex	Polygonaceae	Trsha ga
Phragmites australis	Phragmites	Poaceae	Goli ghamish
Urtica dioica	Urtica	Urticaceae	Gaz gask
Echinops adenocaulos	Echinops	Asteraceae	Kartashi
Mentha pulegium	Mentha	Lamiaceae	Pnga
Medicago sativa	Medicago	Fabaceae	Yonje
Malva sylvestris	Malva	Malvaceae	Haji laklak
Arctium lappa	Aectium	Asteraceae	Galay havidar
Chicoriom intubus	cichorium	Asteraceae	Chagh chagha
Salix alba	salix	Salicaceae	Dara bii
Matricaria chamomilla	Matricaria	Asteraceae	Bayboon
Alhagi mamurorum	Alhagi	Fabaceae	Voshtr khorka
Tribulus terrestris	Tribulus	Zygophyllaceae	Pakoola
Cyndodom mactylon	Cynodon	Poaceae	Friizoo
Borago officinalis	borago	Boraginaceae	Gppzrovan
Castanea sativa	Castanea	Fabaceae	Baroo
Quercus infectoria	Quercus	Fabaceae	Mazoo
Fraxinus excelsior	Fraximus	Oleaceae	Darbnav
Crataegus aronia	Crataegus	Rosaceae	Zalzalak
Rubus fruticosus	Rubus	Rosaceae	Drdook
Platanus orientalis	Platanus	Platanaceae	Chnar
Orchis masculata	Orchis	Orchidaceae	Giasalma

compounding those various plants along with their time usage. In general, the local people of Mahabad were more familiar than urban people in respect of recognition of local medical knowledge of plants. It may be due to the fact that the local people have much more experience concerning plants from their childhood. Most plants reported in this study were related to the family Asteraceae as the largest family with 23,000 species. The wide-spread popularity of this family was similar to published ethnophamacological report from Golestan province, Iran (Ghorbani, 2005). It appears that the great success of Asteraceae as the largest family was due to the development of the highly

TABLE IV - Aliments grouped by different ailment categories (several diseases based on the similarity in one category)

Illness categories	Medical terms	No of species used
Gastro-intestinal complaints	Stomachic, leprous ulcer, obstinate ulcer, anthelmintic, diarrhea, Dysentery	4
Respiratory problems	Cough, chronic bronchitis, asthma, hemoptysis, expectorant	3
Diabetes	Diuretic, antihyperglycemic	4
Cardiovascular diseases	Hypertension	5
Infectious and parasitic diseases	Antiseptic	6
Ear, nose, throat disorder (ENT)	Gout , catarrhal	1
Venomous bites	scorpion-sting, snake-bite	1
Tonics	Stimulant, alterative	2
Female problems	Emmenagogue , menorrhagia	1
Constipation	Laxative, cathartic, Purgative	7
Dermatology problem	Demulcent, emollient, eruptions, Singe	3
Kidney problems	All kides of disorders	5

TABLE V - Informant consensus factor (FIC) for categorized ailments

Ailment category	Number of use reports (Nur)	Number of taxa (Nt)	Informant consensus factor (FIC)
Gastro-intestinal Complaints	60	4	0.95
Respiratory problems	10	3	0.77
Diabetes	18	4	0.82
Cardiovascular diseases	17	5	0.75
Infectious and parasitic diseases	31	6	0.83
Ear, nose, throat disorder (ENT)	1	1	0.00
Venomous bites	1	1	0.00
Tonics	4	2	0.66
Female problems	1	1	0.00
Constipation	79	7	0.92
Dermatology problem	10	3	0.77
Kidney stone	13	5	0.66

specialized capitulum as well as its ability to store energy as fructans (Stevens, 2001). Most parts of the plants used by the indigenous people were leaves followed by roots and stems (Table III). It may be as a result of the fact that the leaves are leading organs of photosynthesis and accordingly have photosynthetic chemicals which might be responsible for medicinal values (Balick, Cox, 1996; Ghorbani, 2005). Moreover, the leaves could be picked easier than the other part of plants such as root and stem. In addition, there are much more methods for preparing them as herbal remedies (Poffenberger *et al.*, 1992; Giday, Asfaw, Woldu, 2010; Rehecho *et al.*, 2011; Telefo *et al.*, 2011). Based on our results, the frequently used mode of preparation is decoctions, infusions and powder, which are practiced by the patients themselves. Powder form of remedies is often administered with honey. Most plants used in this study were as annuals and perennial plants.

From the interviews it could be considered that traditional medicine exploits only *Glycyrrhiza echinata*, wild species which grow in the Mahabad, whereas the formal Iranian traditional medicine reports only *Glycyrrhiza glabra* (Table II). Moreover, *Thymus*

TABLE VI - Relative Importance (RI) values for Mahabad medicinal plants used against or more specific use categories and three or more ailments categories treated

Species	PP	AC	RI
Artium lappa	1	1	2.00
Achillea millefolium	0.6	0.6	1.2
Fraxinus excelsior L.	0.6	0.4	1.00
Thymus kotschyanus	0.4	0.2	0.6
Medicago sativa	0.4	0.2	0.6
Anthemis tinctoria	0.4	0.4	0.8

kotschyanus Boiss.is employed by local people to provide refreshing baths, but they never know its toxicity. It is due to the fact that its protracted use can cause hyperemia and serious inflammations. Furthermore, this toxicity is known for *Thymus kotschyanus* Boiss.in Iranian sources (Afshar, 1992; Zargari, 1992; Mir Heidari, 1993), and for other species of the genus *Thymus* in other scientific reports (Duke, 1988; Longo, 1994). Hence, it appears that a good knowledge of folk healers of medicinal plants is necessary to educate local people on the toxicity of plants. Therefore, it appears that in some cases, medicinal plants must be assessed scientifically. This may be performed via confirmation of the pharmacological effects of the used species and correlating their effects with their phytochemicals. Thus, such recognition could supply further progress to modify the efficacy and safety of the local remedies.

Several plants like *Achillea millefolium* L. are known for their value in veterinary medicine, for example against haematuria and scabies. Most of the reported species are present in formal Iranian traditional medicine, but not in every occasion the actions attributed to a plant were the same. For instance, the formal traditional sources do not report the use of *Plantago major* as an analgesic for toothache, the use of *Cynodon dactylon* (L.) Pers. as an antidepressant and antiepileptic, and finally the use of *Fraxinus excelsior* L.as a vermifuge (Table II).

In several cases, the consumed part of the species exploited in traditional remedies is different from that employed in Iranian formal sources. For example, the informants used all parts of *Cynodon dactylon* (L.) Pers. to provide infusions, whereas only the roots and rhizomes were reported by Iranian formal sources (Rojhan, 1991; Amin, 1991; Afshar, 1992; Zargari, 1992; Mir Heidari, 1993).

Judging by the information obtained, a great number of indigenous plants are used to treat both gastrointestinal diseases and skin problems including burns, bites and purulent rash (Table IV). This was mainly because there are no proper medical facilities especially in rural areas where indigenous people are physically involved with various kinds of both gastrointestinal and skin problems. It is interesting that THPs use remedies consisting of several plants mixed together in order to have a more effective action, while in local medicine of Mahabad it is more common to use only one plant for each remedy, but there are a few mixtures widely known and used such as the "four seeds" which is famous in the area.

Respiratory diseases with maximum FIC show the most consent of the indigenous people in using the species of *Urtica dioica* L.to treat these problems (Kadir *et al.*, 2012) (Table V). A high FIC also depicts the possibility of containing key phytochemical ingredient(s) in these plants (Neves *et al.*, 2009). The reasons for the low value of the FIC can be due to (i) development of human society which followed by local people (Al-Qura'n, 2009); (ii) lack of exact classification of these illnesses in the rural regions (Ragupathy *et al.*, 2008); (iii) lack of proper connect between local people owing to lack appropriate facilities (Rokaya, Münzbergová, Timsina, 2010) and (iv) large number of medicinal plants to treat a particular kind of illness that causes lack of inconsistency (Ragupathy *et al.*, 2008; Al-Qura'n, 2009; Rokaya, Münzbergová, Timsina, 2010).

Arctium lappa L. scored the maximum amount of RI (Table VI). It may be attributed to two parameters as (i) more versatility against more illnesss (Ayyanar, Ignacimuthu, 2011) and (ii) more abundance in the area (Giday, Asfaw, Woldu, 2010).

The FL values of medicinal species are cited by THPs for being used against a given ailment category. It means that whatever the amount of FL is greater, then THPs have used these plants further. Hence, the species with the highest FL values are more likely to be bio-active; accordingly, they possess good healing potential for a specific ailment. In other words, it implies the prevalence of particular ailments, in Mahabad, that are treated with the medicinal plants with high FL values. Table VII shows the maximum value of the FL for 9 species.

The obtaining of the highest core of *Glycyrrhiza glabra* L., *Thymus kotschyanus* Boiss.and *Mentha longiflia* L.in the results of our survey could be assigned to four reasons; (i) their excellent, rapid and versatile healing properties (ii) their high abundance around the area and finally (iii) and their ease of preparation as medicine.

According to our results, the experiences of THPs have not been acquired via scientific sources and this experience is transmitted from generation to generation as orally. However, currently, the uses of medicinal

TABLE VII - Fidelity Level (FL) values of medicinal plants

Medicinal plants	Aliment category	Specific ailment	Ip[a]	Iu[b]	FL value (%)
Thymus kotschyanus	Constipation	Laxative	25	25	100.00
Calendula officinalis	Constipation	Laxative	15	18	83.00
Echinops ritrodes Bunge	Constipation	Laxative	11	13	85.00
Mentha longiflorum	Constipation	Laxative	15	15	100.00
Anthemis tinctoria	Gastro-intestinal complaints	vomiting	5	7	71.00
Artium lappa	Gastro-intestinal complaints	Anthelmintic	1	1	100.00
Glycyrrhiza echinata	Gastro-intestinal complaints	Stomachic	35	35	100.00
Urtica dioica	Respiratory problem	Asthma	6	7	86.00
Artium lappa	Respiratory problem	Expectorant	1	1	100.00
Plantago major	Dermatology problem	acne	9	11	82.00
Drimia maritimia L.	Dermatology problem	acne	5	5	100.00
Rumex acetosella	Dermatology problem	acne	6	7	86.00
Phragmites australis	Dermatology problem	Skin burns	8	10	80.00
Platanus orientalis	Tonic	tonic	1	1	100.00
Crataegus aronia	Cardiovascular diseases	Blood pressure	5	6	83.00
Rubus fruticosus	Cardiovascular diseases	Blood pressure	5	7	71.00
Medicago sativa	Hematological diseases	hemorrhage	7	7	100.00
Portulaca oleraceae L.	Diabetes	Diabetes	5	6	83.00
Rheum ribes	Diabetes	Diabetes	6	6	100.00

[a]Ip=The number of informants who independently indicated the use of a species for the same major ailment. [b]Iu=Total number of informants who mentioned the plant for any major ailment.

species are entering into the local medicine of people via non-traditional sources such as internet and books. Therefore, these new ways are now being exploited to introduce several traditional remedies to the new social and environmental conditions that previously were orally transmitted.

Thus, medicinal plants are often the only easily accessible health care alternative for most of the population in rural areas of Mahabad. Based on the presented results, it can be said that the use of other kinds of treatment not only do not belong to their tradition, but also are of difficult application or too expensive. However, nowadays, the use of the conventional remedies gradually changes the local medicine systems of Mahabad.

Through the investigation on the Kurdish Academy of Language (KAL) web page (http://www.kurdishacademy.org), the plant names used in Mahabad were found to be Kurdish. Based on KAL's web page, it appears that several plant names were barrowed from Persian (talkhetalkhe, revas and mazoo) and Turkish (shilan, golighamish and yonje). The most of the plant names were found to be derived from Kurdish. The plants used in Mahabad are known by the same or different local names in various parts of west Azerbayjan province (Figure 1). Nagadeh and Miyandoab are close to our field of study and placed in west Azerbayjan province. However, names of some local plants used in these areas are different since the local people in these regions are from Turkisk tribes. In addition, it was seen that the local names of some plants used in Mahabad were not the same between other kurdish tribes in West Azerbaijan and parts of Kurdistan. For example, the local names of the plants for Thymus kotschyanus (jatra; hezbi), Glycyrrhiza echinata (memook; giyah belk), Echinops ritrodes Bunge (kartashi; toosi), Medicago sativa (yonje; vinjh), Malvasyl vestris (haji laklak; tuleke), Anthemis tinctoria (bayboon; gole hajianeh) and Rubus fruticosus (drdook; toork) in which the former and latter names in practices stand for local names in Kurdish tribes of Mahabad and Kurdish tribes of other regions, respectively.

Finally, it appears that the participation of indigenous people in conservation of Mahabad bio-diversity is important. Strengthening protected area and indigenous land management could lead to the conservation of Mahabad forest and its biodiversity. On the other hand, conservation programs can also promote the livelihoods

of indigenous people by consolidating their land rights. Therefore, conservation programs could help in increasing family incomes and, accordingly, greater control of Mahabad forests by indigenous peoples.

CONCLUSION

In the recent years, medicinal plants and the related data are being extremely exhausted in Mahabad due to deforestation, environmental degradation and migrations of traditional medicinal healers to other jobs. Several negative features of the local medicine of Mahabad lie in its dependence on low levels of information. The results of our ethnobotanical survey show that, for example, THPs are not aware of the toxicity of the medicinal plants in the area. However, it should be highlighted that despite this drawback, it is rational to affirm that large portions of the Mahabad population use local medicines due to lack of proper medical treatment as well as being far away from urban areas to rural areas. Moreover, this study shows that traditional knowledge is constantly changing and adapting, using non-traditional sources. It seems that the most cited species in terms of RI, FL, Fic and UV are significance enough to be analyzed in laboratories in order to assay their pharmaceutical aspects. Therefore, high quantitative indexes in this area may potentially lead to future investigations of global interest. Furthermore, it appears that if ethnobotanical survey is supported by phytochemical investigation could open the way toward the discovery of bioactive compounds. In this direct, priority should be given to phytochemical investigation of plants that scored the highest FL, FIC, RI values; as such values could be considered as a good indicator of potential plants for discovering new drugs. Finally, it appears the incorporating local medicinal plants in the health care delivery system will be a fruitful stage in the country.

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