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# Ethnopharmacological study of medicinal plants from Khoy city of West Azerbaijan- Iran

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The main objective of this study was to gather information on the use of plants by native people along with therapies suggested by the conventional healers of Khoy. It was analyzed and some important indices including, frequency of citation (FC), cultural importance index (IC), use report (UR) and informants consensus factor (ICF) were calculated. A total of 123 plant taxa belonging to 46 families used for cure of various ailments are reported in this investigation. Among the plants evaluated Apiaceae, Lamiaceae and Asteraceae were the dominant families. The most repeatedly utilized parts are aerial parts (23.2%), followed by leaves (18%). Most frequently used method for consumption has been raw (19.7%), followed by infusion (16.5%). Maximum value of ICF was obtained in digestive system category (with 0.81), followed by respiratory and blood use categories (each with 0.80). *Malva neglecta* Wallr. was the most cited plant, followed by *Mentha longifolia* (L.) L. and *Plantago major* L., *Cichorium intybus* L. and *Salix aegyptiaca* L. seem to be the most culturally important plants. The indices like IC and FC could be helpful in selecting important medicinal plant species for further pharmacological investigations in order to find new biologically active compounds.

**Keywords**: Ethnopharmacology, Iran, Khoy city, West Azerbaijan

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In spite of great progress in modern pharmacology and introduction of several new synthetic medicines, plants and their natural derivatives are widely used for various pharmacological purposes by the people in different regions[1-6]. These consumptions are due to the presence of different phytochemicals, which makes plants a major source of natural products for various medicinal applications. However, for more than 1000 years people have used plants based on mouth to mouth information from past generations, without any detailed information regarding their phytochemical constituents[4-8].

These studies are lately gaining much significance among research workers. Some studies have been published on the traditional and tribal medicine where use of different plant species has been reported[9-12]. There is a much ethnic diversity in different regions of Iran. The highest percentage of Persians is followed by Turkish and Turkmeni, Kurdish, Lori and Balouchi. Each one of these ethnic groups speaks its own language in addition to the 'Persian'. All of them possess valuable knowledge on different plants and their applications[13-15]. The number of papers published from 2004 to 2016 on ethnopharmacological studies of different regions of Iran has been reviewed at length. This published data reveals that in all 53 studies have been conducted in this connection in Iran. However, in spite of the distribution of different medicinal herbs and their historical significance in the folk medicine, the contribution from the Azerbaijani region in this connection is very weak, as only 5 studies reported information from this area[16]. In general, there are few reports published on the ethnobotanical information and medicinal plants of West Azerbaijan, The papers published by Miraldi *et al.*[17] and Bahmani *et al.*[18] are the most cited ones which present information on the medicinal plants of this province to some extent. Another ethnopharmacological study has been

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conducted in the southern part of West Azerbaijan province, possessing completely different culture, ethnic origin and language[19]. However, these studies are quite insufficient keeping in mind the existing high plant diversity and different ethnical groups in the Azerbaijan region of Iran. In fact, individual and regional studies on the tribal medicinal applications of different plants will be useful to visualize the ethnobotanical information of an area like West Azerbaijan province. In view of this, we selected the Khoy city in the north of this province with a population density of 348664. Almost 20% from these live in rural districts. They routinely collect medicinal plants from the natural wild habitats for their use for different purposes.

Khoy city possesses rich sources of different herbs. People have a ready access to them, especially in rural areas[17,18]. Main objective of the current study was to compile and document information on the applications of plants used by the people and the therapies offered by conventional healers in this area.

## Methodology

***Study area***

Khoy is located in the north of West Azerbaijan province, at an altitude ranging from 1050 to 2200 m above sea level, between 44°14'49.45"-45°15'18" longitude, 38°16'56"-39°06'01" latitude (Fig. 1). It shares its borders with Turkey in the west. The area includes Khoy, Gotur, Ivugli, Safaieh and Chaipara, spread over relatively large plain surrounded by mountains. The area is also locally named as 'Khoy Chukhuru' due to its position as a low-altitude area.

Khoy plain is located on the Southeast side of Armenian plateau with an average elevation of 1139 m. Gotur river originating from the highlands of Turkey flows into Khoy plain near the Chaoshgoli village. The river separates into two branches in the south of Khoy city. The area experiences a continental type local steppe climate with very cold winters but cool summers. The average annual temperature and rainfall is 12.2°C and 285 mm, respectively. The favourable climatic and topographical features have created conditions for a rich plant growth with more than 1000 plant taxa out of 8000 known taxa in Iran.


Fig. 1 — Study area map showing Khoy city, West Azerbaijan Province, Iran.

***Data collection and plant identification***

Ethnobotanical information was recorded from different villages and regions of Khoy city, during 2017 and 2018. Most common diseases in this area are; pneumonia and flu in winter and gastrointestinal during summer. Some of these ailments are associated with seasonal changes. Keeping this in view, we collected data during different seasons. A questionnaire was filled by locals out and open interviews held were with the locals. The informants included, house women, farmers, local vendors of medicinal plants and others. Majority of the informants were over 65 years of age (45 out of 50 informants), all from rural areas. Few other informants interviewed included apothecaries having a store in the municipal area. The interviews were made in Azeri Turkish. 50 informants (12 men and 38 women) were aged between 35-80 years. The plant taxa were collected from their natural habitats, tagged and kept at the Herbarium of Forestry and medicinal plants Department, University of Tabriz for identifications. These were determined by using the voucher samples presented in the Flora Iranica[20,21]. In addition, pre-prepared photos of some native plants were also used to check the vernacular names with scientific names. The information from the informants was noted with vernacular and scientific names, medicinal applications, part of plants used for treatment, frequency of citation, use report/category, voucher numbers and mode of their preparation (Appendix 1). ICPC-2 (International Classification of Primary Care-2nd edition) was used to categorieze all ailments expressed by informants into 15 different groups including general, skin, blood, endocrine/ metabolic, musculoskeletal, neurological, urological, psychological, digestive, genital (male/ female), pregnancy, eye, ear, cardiovascular and respiratory disorders.

***Data analysis***

All the quantitative analysis was based on use-reports (US), which is the combination of three variables including, i, u and s: informant i mentions

Appendix 1 — Medicinal plants used in Khoy city for treatment of different ailments

| Scientific name | Vernacular name (Azerbaijan Turkish) | Plant part used | Medicine application | Use Categories (number of use report) | Preparation | Mode of use | Voucher number | FC | UR | CI |
|---|---|---|---|---|---|---|---|---|---|---|
| **AMARANTHACEAE** | | | | | | | | | | |
| *Beta vulgaris* L. | Bina | Lf | Hematopoietic, jaundice | Digestive (2), Blood (4) | Edible | Or | Kh204 | 6 | 6 | 0.12 |
| *Chenopodium album* L. | Shoran | Ae, Lf | Stomach problems, Bladder infection, Gallbladder, Warts treatment, Rheumatic therapy, Diarrhea, female genital | Digestive (4), Musculoskeletal (2), Genital (1), Urological (1) | Distillation, Edible | Or | Kh207 | 6 | 8 | 0.16 |
| *Seidlitzia rosmarinus* Bunge ex Boiss. | Choghan | Ae | Disinfectant of clothes and insecticide, diuretic, blood purifier, Menstruation regulator | General (9), Blood (1), Genital (1), Urological (1), | Moisturized in water | Top, Or | Kh128 | 11 | 12 | 0.24 |
| *Spinacia oleracea* L. | Shomoon | Lf | Hematopoietic, lung Inflammation, intestinal inflammation, diabetes, sedative, rheumatic | Blood (7), Respiratory (1), Digestive (1), Endocrine (2), Neurological (3), Musculoskeletal (1) | Edible | Or | Kh108 | 8 | 15 | 0.3 |
| **AMARYLLIDACEAE** | | | | | | | | | | |
| *Allium ampeloprasum* L. | Yaglija | Lf | Laxatives, Intestinal cleansers, Heart protection, Liver and vision enhancement | Digestive (2), Eye (2), Cardiovascular (1) | Infusion, Edible, In compound | Or | Kh177 | 4 | 5 | 0.1 |
| *Allium sativum* L. | Sarimsakh | Bl | Antiseptic, teeth pains, skin problems, anti-bleeding, lipid disorders, hypertension, diabetes | Digestive (9), Blood (8), Cardiovascular (1), Skin (2), Endocrine (1) | Edible, Powder, compound in food | Or | Kh114 | 16 | 21 | 0.42 |
| *Allium schoenoprasum*L. | Kavar | Lf | Nosebleed, hemorrhoid | Digestive (1), Blood (9) | Extract | Top | Kh148 | 10 | 10 | 0.2 |
| **ANACARDIACEAE** | | | | | | | | | | |
| *Rhus coriaria* L. | Sumakh | Fr | Hypertension, Blood purifier, (1)Blood glucose, Anti-bleeding(1), mouth cleaner(1), blood lipid reduction, Anti-nausea, anti-diabetes | Blood (5), Endocrine (3), Digestive (2) | Edible, compound in food | Or | Kh209 | 9 | 10 | 0.2 |
| **APIACEAE** | | | | | | | | | | |
| *Anethum graveolens* L. | Shivlid | Ar | For hot temperament, lipid disorders, stomach reinforcement, Arthritis | General (1), Endocrine (4), Digestive (2), Musculoskeletal (2) | Compound in food | Or | Kh188 | 6 | 9 | 0.18 |
| *Apium graveolens* L. | Karafs | Lf, St | Lipid disorders, hypertension, diabetes, rheumatic therapy, asthma, | Endocrine (2), Blood (1), Musculoskeletal (2), Respiratory (1) | Edible | Or | Kh185 | 4 | 6 | 0.12 |
| *Carum carvi* L. | zireh | Se, Ae | Anti-obesity (2), Anti-flatulence(3), Dyspnea, Breastfeeding, Blood purification, Stomach and liver reinforcement(2), and Anti-inflammatory, breast milk increasing (3),seizure | Endocrine (4), Blood (2), Digestive (7), Pregnancy and childbearing (5), Neurological (3) | Distillation, Infusion, Edible, in compound | Or | Kh175 | 12 | 21 | 0.42 |
| *Coriandrum sativum* L. | Kishnish | Lf | Constipation, Anti-fever, Anti-flatulence, diabetes, | General (2), Digestive (3), Endocrine (1) | Edible | Or | Kh134 | 6 | 6 | 0.12 |
| *Dorema aucheri* Boiss. | Manda | Lf | Bone strength, For hot temperament | General (1), Musculoskeletal (1) | Edible | Or | Kh139 | 2 | 2 | 0.04 |
| *Eryngium amethystinum* L. | Tusdu dibi | Ar | Diabetes, eye pain, Intestinal colitis treatment, | Endocrine (4 ), Eye (1), Digestive (2) | Distillation | Or | Kh171 | 5 | 7 | 0.14 |

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|---|---|---|---|---|---|---|---|---|---|---|
| *Falcaria vulgaris* Bernh. | Ghaz ayaqi | Lf | Vitiligo, liver, lipid disorders, | Digestive (3), Endocrine (2), Skin (2) | Liniment. distillation, compound in food | Or, Top | Kh103 | 6 | 7 | 0.14 |
| *Foeniculum vulgare* Mill. | Sary ot | Se | Abscess treatment, kidney disorders, breast milk increasing, hasten menstruation | General (1), Genital (1), Urological (2), Pregnancy and childbearing (3) | Infusion | Or | Kh125 | 4 | 7 | 0.14 |
| *Heracleum persicum* Desf. Ex Fisch. | Baldirgan | Lf | Anti-fever, sedative, anti- seizure, Anti-flatulence | General (2), Neurological (2), Digestive (1) | Decoction | Or | Kh172 | 4 | 5 | 0.1 |
| *Pastinaca sativa* L. | Qum keshiri | Rt | Eye disorders, Anti-nausea, Diarrhea, kidney disorders, | Eye (1), Digestive (3), Urological (2) | Edible | Or | Kh116 | 3 | 6 | 0.12 |
| *Petroselinum crispum* (Mill.) Fuss | Jafari | Ae | Blood increasing, sedative | Blood (1), Neurological (1) | Distillation / Edible | Or | Kh135 | 2 | 2 | 0.04 |
| *Prangos ferulacea* (L.) Lindl. | Chashir | Ar | Body toner, diabetes, toot pain, urinary tract opening, breast milk increasing, stomach pain, Anti-flatulence, sedative | General (4), Endocrine (1), Urological (3), Pregnancy and childbearing (2), Digestive (7) | Edible | Or | Kh206 | 12 | 17 | 0.34 |
| *Trachyspermum ammi* (L.) Sprague | Zenyan | Se | Anti-flatulence, anti-drug addiction, | Digestive (3), Psychological (2) | Infusion, Distillaion | Or | Kh160 | 3 | 5 | 0.1 |
| **ARACEAE** | | | | | | | | | | |
| *Zantedeschia aethiopica* (L.) Spreng. | Livik | Fl, St | Respiratory diseases, asthma | Respiratory (1) | Compound in food | Or | Kh144 | 1 | 1 | 0.02 |
| **ASPARAGACEAE** | | | | | | | | | | |
| *Asparagus officinalis* L. | Malchoova | Rt | Kidney stone, anti-flatulence, repellent toxins | Urological (1), Digestive (1), General (1) | Edible, Powder | Or | Kh140 | 1 | 3 | 0.06 |
| *Muscari armeniacum* Leichtlin ex Baker | Iyt soghalaghi | Bl | Foot pain | Musculoskeletal (2) | Decoction | Or | Kh167 | 2 | 2 | 0.04 |
| **ASTERACEAE** | | | | | | | | | | |
| *Achillea santolinoides* Lag. ssp. *wilhelmsii* (K.Koch) Greuter | Sanjigolo | Fl | Heart disorders, anti-spasms, anti-parasite, diuretic, digestive pain, kidney pain, psychosis, blood purifier | Cardiovascular (6), Musculoskeletal (3), Digestive (18), Urological (6), Psychological (6), Blood (2) | Distillation, infusion, powder | Or | Kh154 | 21 | 41 | 0.82 |
| *Arctium lappa* L. | Taghala, Kal kale | Lf | Foot pains, acne removing, Infectious wound, Hemorrhoid, snake bit, | Musculoskeletal (3), General (4), Digestive (1) | Liniment | Top | Kh159 | 8 | 8 | 0.16 |
| *Artemisia dracunculus* L. | Talkhoon | Lf | Useful for the stomach, anti-worth, teeth pain, anti-flatulence | Digestive (5) | Compound in food | Or | Kh152 | 5 | 5 | 0.1 |
| *Carthamus tinctorius* L. | Saritikan | Ae | Vulnerary | General (1) | Powder | Top | Kh147 | 1 | 1 | 0.02 |
| ***Cichorium intybus* L.** | Chatdan goosh | Ar | Liver disorders, jaundice and skin itching treatment, nervous disorders, constipation, lipid disorders, diabetes, stomach pain, heart pain, facilitating delivery, blood purifier | **Digestive (28)**, Skin (5), Neurological (1), Endocrine (6), Cardiovascular (3), Pregnancy (2), Blood (4) | Distillation | Or | Kh195 | **33** | 49 | 0.98 |
| *Cirsium vulgare* (Savi) Ten. | Galgan | St | Intestinal tract, stomach disorders, frequent urination, hemorrhoid | Digestive (3), Urological (1) | Edible | Or | Kh149 | 3 | 4 | 0.08 |

(*Contd*.)

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|---|---|---|---|---|---|---|---|---|---|---|
| *Helianthus tuberosus* L. | Shalgam | Rt | Hypoglycemia | Endocrine (1 ) | Compound in food | Or | Kh214 | 1 | 1 | 0.02 |
| ***Matricaria chamomilla* L.** | Babanak | Fl | Anti-seizure, Sleep disturbance, sedative, skin brightening, breast milk increasing, anti-flatulence, menstruation regulator, migraine, abdominal pains, teeth pain, blood purifier, diuretic, foot pain, menstruation pain, teeth infection, reinforce fertility of females, headache, joint pains | Neurological (2), Skin (3), Pregnancy (3), Genital (2), Digestive (10), Blood (2), Endocrine (1) Musculoskeletal (7), Urological (3), General (7), Psychological (1) | Infusion, vapor | Or, respiratory | Kh105 | **36** | 41 | 0.82 |
| *Rhaponticum repens* (L.) Hidalgo | Kakireh | Lf | Asthma | Respiratory (1) | Distillation | Or | Kh219 | 1 | 1 | 0.02 |
| *Tanacetum balsamita* L. | Shasparim | Se | Abdominal pains, | Digestive (3) | Distillation | Or | Kh126 | 3 | 3 | 0.06 |
| *Taraxacum campylodes* G.E. Haglund | Panpangulu | Lf | Rheumatic therapy, laxative, blood purifier, jaundice, hepatitis, lipid disorders, hypertension, eye reinforcement | Musculoskeletal (1), Digestive (2), Blood (2), Endocrine (1), Eye (1) | Edible | Or | Kh100 | 5 | 7 | 0.14 |
| *Tragopogon dubius* Scop. | Yemlik | Lf | For hot temperament, stomach bleeding, rheumatic treatment, | General (1), Digestive (2), Musculoskeletal (2) | Compound in food | Or | Kh112 | 3 | 5 | 0.1 |
| **BERBERIDACEAE** | | | | | | | | | | |
| *Berberis vulgaris* L. | Zarish | Fr | Blood purifier, heart attack, stomach acidity, diabetes, liver disorders, hypertension, stomach pains, | Cardiovascular (1), Blood (14), Digestive (6), Endocrine (6 ) | Edible, compound in food | Or | Kh215 | 21 | 27 | 0.54 |
| **BORAGINACEAE** | | | | | | | | | | |
| *Borago officinalis*L. | Sighir dili | Fl | Rheumatic treatment, nervous sedative, asthma, foot pain, abdominal pains, | Musculoskeletal (5), **Neurological (15),** Respiratory (1), Digestive (1) | Infusion | Or | Kh200 | 22 | 22 | 0.44 |
| **BRASSICACEAE** | | | | | | | | | | |
| *Brassica oleracea* L. | Agh/Dash kalam | Lf | Back, joints and backbone pain, laxative, Intestinal cleaner, stomach disorders, slimming, heart reinforcement | Digestive (4), Musculoskeletal (6), Endocrine (1), Cardiovascular (2) | Liniment, Compound in food | Or, Top | Kh189 | 8 | 13 | 0.26 |
| *Capsella bursa-pastoris* (L.) Medik. | Goosh abahi | Ae | Uterine prolapse, uterine bleeding, for hot temperament, diuretic, Menstruation regulator, nyctalopia, | Pregnancy (3), General (3), Urological (3), Eye (3), Genital (4), | Decoction, Powder | Or | Kh212 | 13 | 16 | 0.32 |
| *Descurainia sophia* (L.) Webb. ex Prantl | Shovaran | Se | Refrigerant, fever, constipation, heat rash, Intestinal performance regulator, foot pain, laxative, hypertension, stomach pain, diuretic, infectious cyst, | General (15), Digestive (8), Skin (2), Musculoskeletal (1), Cardiovascular (1), Urological (2) | Syrup | Or | Kh176 | 28 | 29 | 0.58 |
| *Nasturtium officinale* R.Br. | Bulaq oti | WP | for hot temperament, body pains, foot pains, Goiter treatment, diuretic, anti-spasms, rheumatic, stomach reinforcement, blood purifier, bone reinforcement, anti-flatulence | General (2), Musculoskeletal (9), Endocrine (15), Urological (5), Digestive (5), Blood (2), | Edible, compound | Or | Kh136 | 27 | 38 | 0.76 |

(*Contd*.)

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| Scientific name | Vernacular name (Azerbaijan Turkish) | Plant part used | Medicine application | Use Categories (number of use report) | Preparation | Mode of use | Voucher number | FC | UR | CI |
|---|---|---|---|---|---|---|---|---|---|---|
| *Raphanus raphanistrum* L. ssp. *sativus* (L.) Domin | Qara toop | Rt | Dry cough treatment, bile disorders, gallstone, stomach reinforcement, bladder stones | Digestive (5), General (7),Urological (5) | Compound | Or | Kh197 | 12 | 17 | 0.34 |
| **BURSERACEAE** | | | | | | | | | | |
| *Boswellia serrata* Roxb. ex Colebr. | Agh sagiz | Gm | Teeth pain, joint pains, stomach problems, anti-flatulence, | Digestive (13), Musculoskeletal (11) | Chewy, liniment | Top. Or | Kh179 | 19 | 24 | 0.48 |
| **CANNABACEAE** | | | | | | | | | | |
| *Cannabis sativa* L. | Chadana | Se, Lf | Narcotic, muscle reinforcement, treatment for pregnant, skin eczema, digestive system, ear pain, | Pregnancy (1), Musculoskeletal (1), Psychological (1), Skin (4), Digestive (2), Ear (1) | Powder, edible | Or | Kh150 | 7 | 10 | 0.2 |
| **CAPPARACEAE** | | | | | | | | | | |
| *Capparis spinosa* L. | Dag garpuzi | Fr, Fl | Constipation, hemorrhoid, Anemia, back reinforcement, liver disorders, uterine infection, for hot temperament, arthritis, tooth pain, seizure | Digestive (20), Blood (1), General (4), Musculoskeletal (1), Pregnancy (1), Neurological (1) | Suppository | Top | Kh202 | 26 | 28 | 0.56 |
| **CAPRIFOLIACEAE** | | | | | | | | | | |
| ***Dipsacus laciniatus* L.** | Khojabashi | Fl, Se | Constipation treatment, mouth treatment, for hot temperament, arthritis, rheumatic, stomach pain, blood increasing, kidney disorders, diuretic, | **Digestive (21),** General (6), Musculoskeletal (11), Blood (1), Urological (3) | Powder/ compound | Or | Kh120 | **31** | 42 | 0.84 |
| *Valeriana officinalis* L. | Pishik oti | Rt | Sedative, anti-seizure, anti-depression, stress treatment, Sleep disturbance | Neurological (6), Psychological (3) | Powder | Or | Kh97 | 6 | 9 | 0.18 |
| **CARYOPHYLLACEAE** | | | | | | | | | | |
| *Dianthus caryophyllus* L. | Mookhah | Fl | Toothache, Sleep disturbance | Digestive (4), Psychological (2) | Liniment, infusion | Or, Top | Kh170 | 6 | 6 | 0.12 |
| **CONVOLVULACEAE** | | | | | | | | | | |
| *Convolvulus arvensis* L. | Dolashig | Ae | For hot, cold temperament, anti-fever, abdominal pains, anti-infectious | General (3), Digestive (1) | Compound in food | Or | Kh141 | 3 | 4 | 0.08 |
| **CUCURBITACEAE** | | | | | | | | | | |
| *Cucurbita pepo* L. | Bal qabakh | Fr | Prostate treatment, dry cough treatment, anti-pneumonia, foot pain, anti-ulcer, wound treatment, | Genital (1), Digestive (1), Respiratory (2), Musculoskeletal (1), General (3) | Edible | Or | Kh182 | 8 | 8 | 0.16 |
| *Ecballium elaterium* (L.) A.Rich | Dagh khiari | Fr | Sinusitis treatment, | Respiratory (1) | Extract | Respiratory | Kh109 | 1 | 1 | 0.02 |
| **ELAEAGNACEAE** | | | | | | | | | | |
| *Elaeagnus angustifolia* L. | Iyda | Fr | Bone reinforcement, diarrhea, stomach acidity, arthritis, osteoporosis, | Digestive (7), Musculoskeletal (15) | Edible | Or | Kh183 | 18 | 22 | 0.44 |
| **EUPHORBIACEAE** | | | | | | | | | | |
| *Euphorbia amygdaloides* L. | Sootbayan | Ae | Diarrhea, diuretic, infectious wounds, skin infectious, diuretic, scorpion poison | Digestive (1), Urological (1), Skin (2), General (5), Urological (1) | Distillation | Or | Kh119 | 7 | 10 | 0.2 |
| *Ricinus communis* L. | Geychah | Se | Laxative, constipation, intestinal tract cleaning, arthritis | Digestive (19), Musculoskeletal (1) | Oil | Or | Kh118 | 19 | 20 | 0.4 |

(*Contd*.)

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| Scientific name | Vernacular name (Azerbaijan Turkish) | Plant part used | Medicine application | Use Categories (number of use report) | Preparation | Mode of use | Voucher number | FC | UR | CI |
|---|---|---|---|---|---|---|---|---|---|---|
| **FABACEAE** | | | | | | | | | | |
| *Alhagi maurorum* Medik. | Dava garni | Ae | Ovarian infection, kidney stone, blood purifier, diuretic, sedative, | Pregnancy (2), Urological (5), Blood (4), Neurological (1) | Distillation | Or | Kh110 | 8 | 12 | 0.24 |
| *Glycyrrhiza glabra* L. | Shirin bayan | Rt, Gm | Stomach problems, lung pains, opening heart arteries | Digestive (16), Respiratory (4), Cardiovascular (1) | Distillation, Powder | Or | Kh164 | 21 | 21 | 0.42 |
| ***Medicago sativa* L.** | Yonja | Lf, Ae | blood coagulation, intestinal problems, anemia, abdominal pains, infant length increasing, blood sugar, obesity, diuretic | Blood (18), Digestive (6), Endocrine (12) | Edible, liniment | Or, Top | Kh173 | **30** | 36 | 0.72 |
| *Melilotus officinalis* (L.) Pall. | Qizil yonja | Fl | Anemia | Blood (1) | Distillation | Or | Kh169 | 1 | 1 | 0.02 |
| *Trigonella foenum-graecum* L. | Shanbalileh | Ae | Hyperlipidemia, blood sugar reducing, slimming, anemia, anti-hair loss, foot pain, | Blood (1), Endocrine (9), Skin (3), Musculoskeletal (1) | Compound in food | | Kh143 | 14 | 14 | 0.28 |
| **FAGACEAE** | | | | | | | | | | |
| *Quercus infectoria* G. Olivier | Palit | Gal, Fr | Skin blister, Enuresis, skin reinforcement (for carpet weavers), head skin problems, baby's umbilical infection | Skin (11), Urological (1) | Liniment, Edible | Top, Or | Kh194 | 12 | 12 | 0.24 |
| **IRIDACEAE** | | | | | | | | | | |
| *Crocus sativus* L. | Zafarn | St | Stomach augmentation, Asthma treatment, Menstrual regulation, Antispasmodic, | Digestive (3), Respiratory (3), Genital (2), Musculoskeletal (1) | Distillation, Infusion | Or, | Kh190 | 3 | 9 | 0.18 |
| **JUGLANDACEAE** | | | | | | | | | | |
| *Juglans regia* L. | Gaviz | Fr, Lf | Joint pains, hyperlipidemia, blood sugar, arthritis, brain reinforcement, stomach pain, anti-spasm, skin problems, breast milk finishing | Endocrine (15), Musculoskeletal (6), Digestive (3), Skin (3), Pregnancy (1) | Edible | Or | Kh163 | 24 | 28 | 0.56 |
| **LAMIACEAE** | | | | | | | | | | |
| *Dracocephalum moldavica* L. | Badrashm | Ae | Heart boosting, sedative, blood purifier, | Cardiovascular (14), Blood (4), Neurological (14) | Distillation, oil, infusion | Or | Kh158 | 23 | 32 | 0.64 |
| *Lavandula angustifolia* Mill. | Ostokodoos | Ae | Nervous reliever, infant cough, menstrual regulation, stomach problems, asthma | Neurological (3), Respiratory (4), Digestive (6), Genital (1) | Infusion | Or | Kh138 | 12 | 14 | 0.28 |
| ***Mentha longifolia* (L.) L.** | Yarpiz | Lf | Antiseptic, cough treatment, angina, abdominal pains, flu, appetizer, uterus cysts, skin allergy, constipation, diarrhea, sedative, blood sugar reducing, menstrual regulation | General (11), Respiratory (9), Skin (1), Digestive (17), Neurological (4), Endocrine (1), Genital (1) | Infusion, distillation, decoction, compound in food | Or | Kh198 | **38** | 44 | 0.88 |
| ***Mentha spicata*L.** | Nana | Ae | Antiseptic, anti-flatulence, diarrhea, abdominal pains, blood flow improving, stomach problems, ear pains, greasy skin cleaning, teeth pain | General (2), **Digestive (33)**, Blood (1), Ear (3), Skin (1) | Distillation, oil, infusion | Or | Kh166 | **34** | 40 | 0.8 |
| *Ocimum basilicum* L. | Reyhan | Lf, Se | Pneumonia, anti-depression, nervous system boosting, mouth freshener, | Respiratory (8), Neurologic (1), Psychological (1), Digestive (2) | Edible, moisturized in water | Or | Kh186 | 12 | 12 | 0.24 |

(*Contd*.)

Appendix 1 — Medicinal plants used in Khoy city for treatment of different ailments

| Scientific name | Vernacular name (Azerbaijan Turkish) | Plant part used | Medicine application | Use Categories (number of use report) | Preparation | Mode of use | Voucher number | FC | UR | CI |
|---|---|---|---|---|---|---|---|---|---|---|
| *Phlomoides laevigata* (Bunge) Kamelin & Malchm. | Chila daghi | Rt | Joint pains, rheumatism, arthritis, | Musculoskeletal (19) | Compound | Top | Kh101 | 19 | 19 | 0.38 |
| *Salvia officinalis* L. | Qara khot | Fl | Headache, mouth cleaning, lipid disorders, | Neurological (1), Endocrine (2), Digestive (2) | Infusion | Or | Kh178 | 3 | 5 | 0.1 |
| *Satureja montana* L. | Daagh marzasi | Ae | Gout, genital boosting, scorch, rheumatic, sedative, stomach reinforcement, flu, uterus cyst, abdominal pains, diarrhea, | Skin (2), Musculoskeletal (3), Genital (3), Digestive (6), Pregnancy (4), General (5) | Infusion, distillation, Compound in food | Or | Kh130 | 20 | 22 | 0.44 |
| *Stachys lavandulifolia* Vahl | Tuklooja | Fl, Lf | Uterus cyst, headache, stomach pains, uretic, skin problems, heart reinforcement, abdominal pains, | Cardiovascular (2), Digestive (4), Skin (1), Urological (1), Neurological (4), Pregnancy (2) | Infusion, | Or | Kh199 | 13 | 14 | 0.28 |
| *Stachys schtschegleevii* Sosn. ex Grossh. | Choban kibriti/sicha n goolaghi | Ae | Infection treatment, fever, abdominal pains, stomach pains, flu, anti-flatulence, blood sugar, nervous improvement, pneumonia, urinary tract infections, asthma, stomach problems, rheumatic, | General (12), Digestive (3), Endocrine (1), Neurological (4), Respiratory (6), Musculoskeletal (2), Urological (2) | Compound in food, infusion | Or | Kh191 | 29 | 30 | 0.6 |
| *Teucrium polium* L. | Maryam nokhodi | Ae, Fl | Fever, Infectious wound | General (4) | Liniment, decoction | Or, Top | Kh142 | 4 | 4 | 0.08 |
| ***Thymus vulgaris* L.** | Kahlik oti | Lf | Cough, flu treatment, abdominal pains, fortifies the stomach, Improve vision in eyes, headache, sedative, angina, blood pressure, urinary tract cleaning, hypertension, lung pains, pregnant women pains, joint pains, fever, anti-seizure, uterus cyst | Musculoskeletal (4), Pregnancy (3), Cardiovascular (2), Digestive (11), Respiratory (9), Neurological (7), General (6), Eye (4), Urological (1) | Infusion, distillation/ compound | Or | Kh193 | **34** | 47 | 0.94 |
| **LAURACEAE** | | | | | | | | | | |
| *Cinnamomum verum* J. Presl | Darchin | Bk | Headache, menstrual regulation, sedative, blood purifier, anti-diarrhea, anti-spasm, | Neurological (2), Blood (1), Genital (2), Digestive (2), Musculoskeletal (2) | Infusion, Powder, in compound | Or | Kh146 | 4 | 9 | 0.18 |
| **LINACEAE** | | | | | | | | | | |
| *Linum usitatissimum* L. | Zarayak | Se | Slimming, child birth problems, pneumonia, eye problems, diarrhea, blood increasing, menstrual regulation, anti-hair loss | Endocrine (2), Pregnancy (4), Eye (2), Digestive (3), Genital (1), Skin (1) | Liniment | Top, Or | Kh203 | 13 | 13 | 0.26 |
| **LYTHRACEAE** | | | | | | | | | | |
| *Punica granatum* L. | Nar | Fr | Liver disease, blood purifier, teeth cleaning, sedative, anemia, blood sugar, heart boosting, anti-bleeding, anti-nausea, skin itching, hemorrhoid | Digestive (8), Blood (8), Endocrine (1), Skin (1), Cardiovascular (1), Neurological (7) | Edible | Or | Kh156 | 14 | 26 | 0.52 |
| **MALVACEAE** | | | | | | | | | | |
| *Althaea officinalis* L. | khatmi | Fl | Cough, stomach problems, pneumonia, acne, abdominal pains, scorches, kidney infection, throat ache, asthma | Respiratory (21), Digestive (6), Skin (4) | Infusion | Or | Kh115 | 29 | 31 | 0.62 |
| *Gossypium hirsutum*L. | Pamukh | Fl | Backache | Musculoskeletal (1) | Balm | Top | Kh162 | 1 | 1 | 0.02 |

(*Contd*.)

Appendix 1 — Medicinal plants used in Khoy city for treatment of different ailments

| Scientific name | Vernacular name (Azerbaijan Turkish) | Plant part used | Medicine application | Use Categories (number of use report) | Preparation | Mode of use | Voucher number | FC | UR | CI |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Malva neglecta* Wallr.** | Aman komanji | Lf | Infectious wound, sinusitis, teeth pain, acne removing, abdominal pains, foot infection, uterus infection, laxative, cough | Pregnancy (8), Respiratory (11), Musculoskeletal (6), Digestive (10), Skin (13) | Distillation, infusion | Or | Kh217 | **42** | 48 | 0.96 |
| **MORACEAE** | | | | | | | | | | |
| *Ficus carica* L. | Injir | Fr | Constipation, lung pains, laxative, kidney problems | Digestive (2), Respiratory (2) | Edible | Or | Kh180 | 2 | 4 | 0.08 |
| *Morus alba* L. | Agh toot | Fr | Hypertension, rheumatism, blood sugar, | Cardiovascular (1), Musculoskeletal (3), Endocrine (6) | Edible | Or | Kh165 | 6 | 10 | 0.2 |
| *Morus nigra* L. | Qara toot | Fr | Mouth ulcers | Digestive (1) | Syrup | Or | Kh213 | 1 | 1 | 0.02 |
| **NITRARIACEAE** | | | | | | | | | | |
| *Peganum harmala* L. | Uzarlik | Se | Asthma, menstrual regulation, rheumatism, anti-flatulence, diarrhea, blood sugar and lipid, anti-obesity, anti-nausea, snivel, stomach problems, foot pain, sedative, antiseptic | Digestive (10), Respiratory (2), Genital (1), Musculoskeletal (2), Endocrine (8), Neurological (3), General (4) | Swallowing, Smoke | Res | Kh122 | 25 | 30 | 0.6 |
| **ORCHIDACEAE** | | | | | | | | | | |
| *Dactylorhiza incarnata* (L.) Soo | Sahlab | Rt | Anemia, laxative, mucus removing, lung lightening, anti-seizure, sedative | Respiratory (4), Digestive (1), Blood (4), Neurological (3) | Powder | Or | Kh174 | 7 | 12 | 0.24 |
| **PAPAVERACEAE** | | | | | | | | | | |
| *Fumaria officinalis* L. | Shatara | Ae | Skin itching, skin allergy, Top inflammation, hair reinforcement, liver problems, jaundice, blood purifier | Skin (25), Digestive (4), Neurological (2), Blood (3) | Distillation | Or | Kh218 | 28 | 34 | 0.68 |
| *Papaver dubium* L. | Khshkhash | Fl, Se | Intestinal parasites, sedative | Neurological (2), Digestive (1) | Edible, compound, liniment | Or | Kh124 | 3 | 3 | 0.06 |
| **PEDALIACEAE** | | | | | | | | | | |
| *Sesamum indicum* L. | Konjood | Se | Brain reinforcement, hair boosting, menstrual regulation, scorching | Neurological (1), Skin (2), Genital (1) | Oil | Or | Kh104 | 2 | 3 | 0.06 |
| **PLANTAGINACEAE** | | | | | | | | | | |
| *Plantago indica* L. | Qarni yarihk | Se | Amaurosis, asthma, diarrhea, hemorrhoid | Eye (3), Respiratory (1), Digestive (2) | Infusion | Or | Kh157 | 6 | 6 | 0.12 |
| *Plantago lanceolata* L. | Bagh yarpaghi, | Lf, Se | Cough, acne | Respiratory (1), Skin (5) | Liniment, infusion | Or, Top | Kh113 | 6 | 6 | 0.12 |
| ***Plantago major* L.** | Bizovsha | Se | Pneumonia, mouth wounds, constipation, cough, abdominal pains, lung inflammation, throat pains, sedative, acne | Digestive (9), Respiratory (31), Neurological (1), Skin (3) | Infusion | Or | Kh127 | **38** | 44 | 0.88 |
| **POACEAE** | | | | | | | | | | |
| *Alopecurus pratensis* L. | Tulku goyrugu | Ae | Kidney and stomach problems | Digestive (1), Urological (1) | Infusion | Or | Kh181 | 2 | 2 | 0.04 |
| *Elymus repens* (L.) Gould | Chayir oyi | Rt | Heart reinforcement, heart vessel opening, cholesterol reducing, blood sugar, foot pain, kidney problems | Cardiovascular (22), Endocrine (6), Musculoskeletal (3), Urological (4) | Distillation, Decoction | Or | Kh129 | 27 | 35 | 0.7 |
| *Triticum aestivum* L. | Saman | Straw | Scorpion bit | General (1) | Smoke | Top | Kh211 | 1 | 1 | 0.02 |
| **POLYGONACEAE** | | | | | | | | | | |
| *Polygonum arenastrum* Boreau | Girkh boghoom, At goyrooghoo | Ae | Blood sugar, skin rash, rheumatic, arthritis, abdominal pains, | Skin (2), Musculoskeletal (3), Endocrine (4), Digestive (1) | Distillation, Decoction | Or | Kh155 | 6 | 10 | 0.2 |

(*Contd*.)

Appendix 1 — Medicinal plants used in Khoy city for treatment of different ailments

| Scientific name | Vernacular name (Azerbaijan Turkish) | Plant part used | Medicine application | Use Categories (number of use report) | Preparation | Mode of use | Voucher number | FC | UR | CI |
|---|---|---|---|---|---|---|---|---|---|---|
| *Rheum rhabarbarum* L. | Avalik | Se | Kidney stone, uterus cyst, lipid disorders, | Endocrine (1), Pregnancy (5), Urological (2) | Infusion | Or | Kh201 | 8 | 8 | 0.16 |
| *Rheum ribes* L. | Ushgun | Ae, Fl | Constipation treatment, Blood purifier, blood sugar, diarrhea, lipid disorders, abdominal pains, kidney stone, skin itching, hypertension | Blood (6), Urological (3), Digestive (4), Skin (3), Endocrine (7), Cardiovascular (3) | Edible, compound in food | Or | Kh107 | 25 | 26 | 0.52 |
| *Rumex acetosella* L. | Toorshah | Lf | Hypertension, pneumonia, diuretic, laxative, blood purifier | Respiratory (2), Urological (2), Digestive (5), Cardiovascular (3), Blood (6) | Edible | Or | Kh145 | 15 | 18 | 0.36 |
| **PORTULACACEAE** | | | | | | | | | | |
| *Portulaca oleracea* L. | Parpina | Lf, Ae | Hypertension, skin itching, migraine, kidney problems stomach problems, scorching, anti-flatulence, prostate, anti-fever | Cardiovascular (3), Skin (6),Neurological (4), Urological (4), Digestive (5), Genital (3), General (4) | Compound in food | Or | Kh95 | 22 | 29 | 0.58 |
| **RANUNCULACEAE** | | | | | | | | | | |
| *Adonis aestivalis* L. | Oghlan oti | Lf | For hot temperament | General (2) | Edible | Or | Kh137 | 2 | 2 | 0.04 |
| **ROSACEAE** | | | | | | | | | | |
| *Crataegus rhipidophylla* Gand. | Yemishan | Fr | Heart vessel opening, diuretic, stomach problems, blood sugar, throat pain | Cardiovascular (10), Digestive (2), Endocrine (1), Respiratory (1) | Edible | Or | Kh111 | 14 | 14 | 0.28 |
| *Cydonia oblonga* Mill. | Heyva | Fr, Se | Strengthen the heart, pneumonia, skin lightening, blood purifier, blood sugar, hypertension | Respiratory (12), Cardiovascular (13), Endocrine (4) | Edible, moisturized in water | Or, Top | Kh151 | 25 | 29 | 0.58 |
| *Malus pumila* Mill. | Qirmizi alma | Fr | Ear pain, teeth pain, anti-hair loss, lipid problems, stomach disease | Ear (1), Digestive (1), Skin (4), Endocrine (3) | Powder | Or | Kh123 | 8 | 9 | 0.18 |
| *Prunus armeniaca* L. | Qeysi | Gm | Pneumonia, anti-flatulence | Respiratory (3), Digestive (1) | Moisturized in water | Or | Kh106 | 3 | 4 | 0.08 |
| *Prunus cerasus* L. | Gilas | Fr | Urinary tract problems, heart pains, liver problems | Urological (3), Digestive (3), Cardiovascular (1) | Edible | Or | Kh208 | 5 | 7 | 0.14 |
| *Prunus dulcis* (Mill.) D.A. Webb | Shirin badam | Fr | Strengthening the root of the hair, bon and brain, constipation | Skin (1), Musculoskeletal (1), Neurological (1), Digestive (1) | Oil | Top | Kh192 | 4 | 4 | 0.08 |
| *Prunus scoparia* (Spach) C.K.Schneid. | Dagh badami | Se | Foot and hand pains, cold | Musculoskeletal (1), General (1) | Oil | Top | Kh133 | 2 | 2 | 0.04 |
| ***Rosa canina* L.** | Iyt burnu | Fr | Kidney stone, intestinal tract cleaning, diarrhea, diuretic, sedative, hypertension, rheumatic, abortionskin problems | Urological (3), Digestive (6), Neurological (16), Cardiovascular (5), Pregnancy (1), Skin (4) | Decoction, compound | Or | Kh205 | **32** | 35 | 0.7 |
| *Rosa damascena* Herrm. | Qizil gul | Fl | Sedative, pneumonia, heart problems, skin lightening, anti-menstrual bleeding | **Neurological (18),** Cardiovascular (4), Respiratory (4), Skin (2), Genital (3) | Distillation, oil, infusion | Or, Top | Kh121 | 24 | 31 | 0.62 |
| **RUBIACEAE** | | | | | | | | | | |
| *Rubia tinctorum* L. | Baghcha boyaqi | Rt | Eye disease, bone fracture, joint pains | Eye (1), Musculoskeletal (17) | Liniment | Top | Kh210 | 18 | 18 | 0.36 |
| **SALICACEAE** | | | | | | | | | | |
| *Salix alba* L. | Sovood aghaji | Lf | Sedative, anti-fever, liver problems, anti-allergy | Neurological (6), Skin (4), Digestive (2), General (16) | Lie down on intact leaves, bathing with its extract | Top | Kh187 | 19 | 28 | 0.56 |

(*Contd*.)

Appendix 1 — Medicinal plants used in Khoy city for treatment of different ailments

| Scientific name | Vernacular name (Azerbaijan Turkish) | Plant part used | Medicine application | Use Categories (number of use report) | Preparation | Mode of use | Voucher number | FC | UR | CI |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Salix aegyptiaca* L.** | Bidmish | Fl | Blood increasing, sedative, laxative, heart problems | Blood (29), Neurological (4), Digestive (5), Cardiovascular (11) | Distillation | Or | Kh168 | **30** | 49 | 0.98 |
| **SCROPHULARIACEAE** | | | | | | | | | | |
| *Verbascum thapsus* L. | Sigir gurughi | Lf, Fl | Mucus stimulation, sedative | Respiratory (1), Neurological (1) | Distillation, Balm | Or, Top | Kh216 | 1 | 2 | 0.04 |
| **SOLANACEAE** | | | | | | | | | | |
| *Hyoscyamus niger* L. | Bat bat | Lf | Acne, blood sugar, asthma, | Skin (1), Endocrine (1), Respiratory (2), | Liniment | Top | Kh96 | 4 | 4 | 0.08 |
| *Nicotiana tabacum* L. | Tootoon | Lf | Ear pain | Ear (1) | Smoking | Top | Kh161 | 1 | 1 | 0.02 |
| *Solanum americanum* Mill. | Goosh uzumi | Fr | Sedative, anti-bleeding | Blood (1), Neurological (1) | Edible | Or | Kh131 | 2 | 2 | 0.04 |
| *Solanum tuberosum* L. | Yeralma | Tb | Treatment of scorching | Skin (3) | Liniment | Top | Kh196 | 3 | 3 | 0.06 |
| **URTICACEAE** | | | | | | | | | | |
| *Urtica andicola* Wedd. | Gijitikani | Ae | Kidney stone, hypertension, blood sugar, foot pain, diarrhea, prostate, anemia, skin problems | Urological (4), Musculoskeletal (1), Cardiovascular (3), Genital (4), Endocrine (7), Blood (4), Skin (3), Digestive (1) | Distillation, infusion | Or | Kh99 | 23 | 27 | 0.54 |
| **ZINGIBERACEAE** | | | | | | | | | | |
| *Alpinia officinarum* Hance | Qolenjan | Rt | Abdominal pains, asthma | Respiratory (2), Digestive (5) | Powder, decoction | Or | Kh117 | 7 | 7 | 0.14 |
| *Curcuma longa* L. | Sarikook | Rt | Skin lightening, fracture, heart vessel problems, anti-bleeding, teeth pain, stomach pain, blood sugar, brain reinforcement | Musculoskeletal (4), Skin (3), Digestive (4), Blood (6), Endocrine (2), Neurological (2) | Compound, liniment | Or, Top | Kh98 | 20 | 21 | 0.42 |
| *Zingiber officinale* Roscoe | Znajabil | Rt | Stomach reinforcement, intestinal cleaning, sexual tonic | Digestive (5), Genital (3) | Distillation, Infusion, Edible | Or | Kh184 | 6 | 8 | 0.16 |
| **ZYGOPHYLLACEAE** | | | | | | | | | | |
| *Tribulus terrestris* L. | Damir tikani | Ae | Kidney stone, liver disease, hemorrhoid, cough | Urological (8), Digestive (2), Respiratory (3) | Distillation | Or | Kh102 | 10 | 13 | 0.26 |

**Ae**: Aerial part; **Bl**: Bulb; **Bk**: Bark; **CI**: Cultural importance index; **FC**: Frequency of citation; **Fl**: Flower; **Fr**: Fruit; **Gm**: Gum; **Lf:** Leaf; **Or**: Orally; **Rt**: Root; **Se**: Seed; **Top**: Topical; **UR**: Use report; **WP**: Whole plant.

the use of the species s in the use-category u. To obtain the US for each species, the following formula was used:

$$\mathrm{UR_s} = \sum_{\substack{i=i1 \\ u=u1}}^{\substack{iN \\ uN}} \mathrm{UR_{ui}}$$

We summed up the UR of all informants (from $i_1$ to iN) within each use-category (from u1 to uN) for a species (s), i.e., the number of informants who mention each use-category for the species. The importance of each species was represented by using different indices including, FC, ICF and CI. FC is defined as the number of informants who refer to a useful species. ICF index was used to determine the uniformity of the recorded information. At first the ailments were categorized and then all the citations were located into the related categories that each plant was claimed to affect. This index was calculated by using following formula:

$$ICF = \frac{\mathrm{N_{ur}} - \mathrm{N_t}}{\mathrm{N_{ur}} - 1}$$

where

$\mathrm{N_{ur}}$ number of use report in each use category

$\mathrm{N_t}$ number of use report in each use category and number of taxa taken as medicine, respectively. The higher the value of the ICF, the more informants agree on the use of the species in the use-category.

CI was calculated using the following formula:

$$CI = \frac{\sum_{\substack{i=i1 \\ u=u1}}^{\substack{iN \\ uN}} \mathrm{UR_{ui}}}{\mathrm{N}}$$

Actually this index is obtained by summing the proportion of informants mentioning each use of the species. CI is an additive index that takes into accounts both spread and diversity of the use of each species. In addition, each addend of this index determines the relative importance of the species used in the concerned use-category[22].

**Results and discussion**

A total of 123 plant taxa belonging to 46 families are reported which have been used for the cure of various ailments. An evaluation of the data from the Appendix 1 enlightens the fact that among the families Apiaceae (13 taxa), Lamiaceae (12 taxa) and Asteraceae (12 taxa) are the most dominant families, followed by Rosaceae (9 taxa). Khoy ecologically is included in the Irano-Turanian phytogeographical region. Nearly 69% of plants distributed here are found in the flora of Iran. Ethnobotanical information of Sardasht people (southernpart of West Azerbaijan province) has revealed that families mostly used here are approximately the same as recorded in our study presented here. The report by Azizi and Keshavarzi[19] shows the most used plant families in that part are Apiaceae, Asteraceae, Lamiaceae and Rosaceae each represented by 7, 6, 6 and 6 plant taxa respectively. In a study from the Urmia city, West Azerbaijan province medicinal plants used for gastrointestinal ailments have been investigated. In all 138 plant species belonging to 52 families have been identified, dominant ones being Asteraceae (11 species) followed by Lamiaceae and Rosaceae each with 5 and 3 species respectively[18]. These families have also been reported in previous investigations undertaken in different regions of Iran suchas; Kohghiluyeh va Boyer Ahmad[14], south of Kerman[11] and Saravan region, Baluchistan[12]. The reason why Asteraceae and Lamiaceae are mostly used in Iran and West Azerbaijan province is that they include hundreds of species with diverse medicinal application for different ailments. In addition to these, two other plant families as the most cited families in ethno-pharmacological studies in Iran during 2004-2016 are Apiaceae and Fabaceae; especially in the northern regions of Iran, Azerbaijan provinces[16].

Different medicinal plant parts used for curing diverse ailments included aerial parts, seed, leaves, tuber, root, stem, gum, flower, fruit and the whole plant. Most frequently used parts are aerial parts (23.2%), followed by leaves (18%), flowers (14.8%) and seeds (13%) (Fig. 2). The preferred parts of some

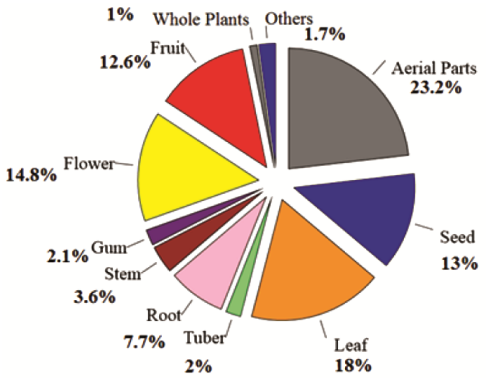


Fig. 2 — Different plant parts used by people and their related percentages in the study area

medicinal plants may have high concentration of bioactive compounds, leading to efficient responses in curing the concerned ailment. It has been documented that families like Apiaceae, Lamiaceae, and Asteraceae usually as such these parts are preferred by local people in different regions of Iran[11,14,23]. Second reason why aerial parts and leaves are preferred is that they are easier to harvest as compared to underground parts. Moreover, aerial parts are accessible in most of year than flowers, seeds or fruits, which are accessible only in the reproductive stages of plants, limiting harvesting time to a short period. Another reason is associated with harvesting time of the plants, since in Khoy region people mainly harvest the medicinal plants in late spring, when herbs are in their vegetative stage so that there would be no flower or seed to be harvested.

Different approaches used for medicinal preparations of plants are presented in Appendix 1. The consumption of plants in raw form is the most frequently used way (19.7%), followed by infusion (16.5%), distillation (15.7%) and liniment (9.5%). Nearly 15% of the plants are mixed with other plants or agents, including honey and milk. Latter two ingredients are the main production of farmers in the region and easily accessible for use with medicinal plants. Infusions are prepared by placing the plant material in the water over time, to extract the active compounds; whereas for distillation, the plant materials are boiled in the water followed by evaporation for a while so as to get cooled in a condensation process. To obtain a liniment the fresh or dried plant material is crushed with oil.

Majority of the medicinal plant preparations are administrated orally (82.2%), followed by topical (15.3%). However, *Peganum harmala* L. and *Ecballium elaterium* (L.) are administrated only in

respiratory mode. Gastrointestinal ailments are highly prevalent in the region[24] and people use medicinal plants orally to improve their intestinal disorders. Most interesting herbs applied to cure skin and musculoskeletal disorders including acne, allergy, bite and sting of reptiles and insects, joint pains, arthritis and rheumatism.

Sadat-Hosseini *et al.*[11] have carried out ethnobotanical studies in the south of Kerman Province. They have collected data from the native people. Majority of the medicinal plants are used as decoction followed by liniment and infusion. As in our findings, most of the herbal preparations are consumed orally, whereas in a few cases Topical mode is used. The oral mode of application is the most preferred form of herbal preparations among different ethnical groups of Iran[11,14,23]. However, according to Vijayakumar *et al.*[8] most plant preparations are used in the form of paste (32%), followed by powder (22%), decoction and juice (20%). Similarly, oral use too is the most frequently applied mode, followed by topical use. A perusal of the studies published reveals big differences between various cultures, in terms of mode of herbal preparations and application ways, but most are applied orally.

The treated ailments using ICPC-2 system were categorized in the corresponding groups (Table 1). The number of plant species and use reports in each use category are given in Table 1. The highest number of plant species (86) was used for digestive disorders, followed by musculoskeletal (41) and endocrine/ metabolic (37). Epidemiological and other related studies have shown that these are common diseases in the area, that is why people use many herbs to treat them[16,18,24,25]. Our findings covering Sardasht; south of West Azerbaijan; show that majority of the medicinal plants are used for the treatment of diabetes and lipid (endocrine/metabolic) and digestive system disorders[19]. In another study from Urmia; West Azerbaijan; majority of the 30 recorded medicinal plants are used for the treatment of digestive ailments, including constipation, diarrhoea and stomach problems[17]. The most popular plant used for digestive ailments as medicine is *Mentha spicata* L., cited by 33 out of 50 informants. In addition, in different regions of Iran, more species have been used for curing digestive system problems, as compared to other ailments[11,14,23]. In rural border areas, due to lack of access to appropriate drinking water, prevalence of common diseases in humans and animals include digestive problems, including intestinal parasites and diarrhoea. On the other hand, intensive labour work in the agricultural and gardening activities leads to musculoskeletal problems such as pain in the joints, hands and feet. These ailments have clear symptoms and are easily recognizable by the people. The difficulty in identifying an ailment by the natives does affect the consideration of folks[26].

ICF index was calculated for the categorized ailments (Table 1). Maximum value of ICF was obtained in digestive disorders (with 0.81), followed

Table 1 — Different ICPC-2 based categories of diseases, their related ICFvalues and popular plants in the related categories

| Use category | Use Report | Number of Species | ICF | Popular plant in the category |
|---|---|---|---|---|
| Digestive disorders | 472 | 86 | 0.81 | *Mentha spicata* L. |
| Endocrine/Metabolic | 151 | 37 | 0.76 | *Nasturtium officinale* R.Br. |
| Neurological | 148 | 35 | 0.77 | *Rosa damascene* Herrm. |
| Blood | 163 | 33 | 0.80 | *Salix aegyptiaca* L. |
| Eye problems | 16 | 9 | 0.46 | *Thymus vulgaris* L. |
| Respiratory | 154 | 31 | 0.80 | *Plantago major* L. |
| Urological | 78 | 30 | 0.62 | *Tribulus terrestris* L. |
| Musculoskeletal | 162 | 41 | 0.75 | *Phlomoides laevigata* (Bunge) Kamelin & Makhm. |
| Skin | 131 | 34 | 0.74 | *Falcaria vulgaris* Bernh. |
| Genital (male and female) | 35 | 18 | 0.5 | *Urtica andicola* Wedd. |
| Psychological | 16 | 7 | 0.6 | *Achillea santolinoides* Lag. ssp. *wilhelmsii* (K.Koch) Greuter |
| Cardiovascular | 114 | 24 | 0.79 | *Elymus repens* (L.) Gould |
| Ear problems | 4 | 4 | 0 | *Mentha spicata* L. |
| Pregnancy | 49 | 17 | 0.66 | *Malva neglecta* Wallr. |
| General (cold, fever, infectious, etc.) | 122 | 33 | 0.73 | *Salix alba* L. |

by blood and respiratory diseases (each with 0.80). In digestive system use category, informants have a common knowledge of medicinal plants, which may be due to the regular use of herbal preparations by them for digestive disorders, compared to other ailments. The use categories of ear problems had 0 value. This is due to equal number of species and use report in each use category. However, the findings of Mosadegh *et al*.[14] report the ICF value near to zero (0.032 and 0.0652) for respiratory and digestive system categories which contradicts with our findings. In general, maximum number of plant species (47 and 31) are used for digestive and respiratory ailments respectively[14]. Although digestive, musculoskeletal, respiratory and endocrine/metabolic disorders are similar in terms of maximum number of plants used to treat them, but different ethnic groups in Iran differ in terms of agreeing on a specific disease. This indicates differential importance of various ailments among different ethnic groups[11,14]. Low ICF values in case of unknown diseases such as insomnia and antiparasitic may be due to lack of information exchanged between informants[1,12]. ICF values may be associated to local cultural practices about an ailment, for example in rural areas it is inappropriate to talk about genital ailments in the public culture, therefore its ICF is low. The low ICF values may also be related to the low prevalence of the ailments including ear and eye problems, as compared to common diseases like gastrointestinal disorders. The climatic conditions of a region do affect the prevalence of an ailment, which in turn changes the ICF value. In south of Kerman, after digestive system disorders, most plant species (18 out of 115) are used for curing skin problems, since this area is characterized by extreme sunlight and exposure to such condition results in different skin problems including sunburn, photoaging and sun allergies[11].

Appendix 1 also shows that *Malva neglecta* Wallr. (with 42 informants) is the most cited plant, followed by *Mentha longifolia* (L.) L. and *Plantago major* L. (each with 38 informants) and *Thymus vulgaris* L. (with 34 informants). *Malva neglecta* Wallr. is used mainly for skin, respiratory and digestive system ailments. Similar to our results, Ozturk *et al*.[2,3] have stressed similar applications for this plant in their study while comparing the cities from Iran (Tabriz), Turkey (Iğdır) and Nakhchivan (Azerbaijan). This plant has been used for curing various ailments including, sore throat, constipation, abscess, edema, asthma, stomachic, abdominal pain, abortive and so on[2,3]. Majority of these applications with a few differences can be seen in our results in the Appendix 1. In addition, this plant is used as laxative and for anti-abdominal pains in central regions (Urmia) and southern areas (Sardasht) of West Azarbaijan[18,19]. Besides Azerbaijan region, this plant has been shown as a popular medicinal plant in other regions of Iran like Sirjan, where it is used for the treatment of sore throat, acne and hypertension problems[27]. *Mentha longifolia* (L.) L. is applied for treatment of cough, abdominal pains, flu, uterus cysts, constipation, diarrhea and menstrual regulation problems. Ozturk *et al*.[2,3] too have shown the same medicinal uses for this plant. However, this plant is used for respiratory tract and stomach problems in Sardasht and Urmia, respectively[2,3,18,19]. This plants is also among the most cited plants (with FC=13), used for abdominal pains in Sirjan[27]. In south of Kerman it has been used for flavoring of foods and in Taftan for curing stomach ache, cold, relieving of pains and kidney issues[11,26]. *Plantago major* L. is mainly used as an analgesic and for treatmet of mouth wounds, cough and abdominal pains. This plant has various biologically active compounds such as; alkaloids, terpenoids, flavonoids and cafeic acid derivatives. Its extract has various biological activities like; ulcer healing, anti-inflamation, sedative, boosting immune system and as antibiotic[28]. The plant has also been used in different folk medicines in Iran such as for wound healing and anti-infection in Sardasht, peptic ulcer treatment in Urmia, cough curing in Turkmen Sahra, treatment of sniffle in Tabriz, treatment of cough in Sirjan[2,3,18,19,23,27]. *Thymus vulgaris* L. is mainly used in the treatment of digestive disorders (e.g., abdominal pains), respiratory diseases (e.g., lung pain) and neurological ailments (e.g., headache). It is also used for cough, relieving pains of pregnant women and removing uterus cysts. The plant mainly has been used for curing the common cold and digestive ailments in Azerbaijan and other regions of Iran, which coincides with our findings. Its vernacular name is Kahlik oti or Kekli oti in Turkish which is similar in phonetic terms to the Persian word Kakoti (the common name of *Ziziphora persica* Bunge), therefore in Turkish speaking regions this plant is confused with later one[2,3,17,23]. In general popular plants may vary in different geographical regions, depending on their flora distribution which is controlled by climatic variations. *Lycium depressum* stocks has been reported as the most popular medicinal plant of Ilam Province, followed by

*Pistacia khinjuk* stocks. The region is a part of Zagros mountains and more or less, forested, with a growth of a large number of shrubs[29]. In a study in south of Kerman Province, Sadat-Hosseini *et al.*[11] have reported that *Zataria multiflora* Boiss. and *Bunium persicum* (Boiss.) B Fedtsch. are the most cited plants.

In terms of CI, *Cichorium intybus* L., *Salix aegyptiaca* L. (each with 0.98 ICF), *Malva neglecta* Wallr. (with 0.96 ICF), *Thymus vulgari*s L. (with 0.94 ICF), *Mentha longifolia* (L.) L. and *Plantago major* L. (each with 0.88 ICF) are the most culturally important plants. All these together with few other important plants flourish in natural habitats and are harvested by people for use in curing different ailments. Not only the FC, but also the diversity of uses of a given species changes the value of CI. In addition to the well-known plants, other plants with a high diversity of uses, rank highly in terms of CI. Some of these plants include *Mentha longifolia* (L.) L. (known as yarpiz in Turkish) and its medicinal application has been quoted in Azerbaijan folk poetry, known as 'Bayati'. This plant was one of the most important herbs in folk medicine and has been used as a sedative, anti-inflammatory and antiseptic medicine[30]. These applications were also reported by the informants in the Khoy region, indicating the constant cultural importance of this plant from past to now. None of the plants with high cultural importance in Khoy region, as well as other areas, including south of Kerman province and Kohghiluyeh va Boyer Ahmad province, in Iran are included among the top 10 culturally important plants[11,14]. However, out of our findings from Sirjan, Kerman province of Iran, *Malva neglecta* Wallr., *Mentha longifolia* (L.) L. and *Plantago major* L. are considered as the culturally important plants[27].

Important plants in different regions of Iran show considerable variation even between two closer regions like Jiroft and Sirjan in Kerman province[11,27]. We observe a significant impact of different ethnic cultures on the identification of important plant species. Some of the low cultural values in this region, such as Almond, in the Kerman province, is due to different culture here than Khoy. Culturally valuable plants, possessing high CI may be preferred by the people for treatment of different diseases, in spite of the health services provided by the government. In addition, these plants must be subjected to further analysis for identifying biologically active compounds to be used by the pharmacological industry. Moreover, the value of index would be effective to address the important medicinal plants[12]. The culturally popular and important plants, are more attentive to local people and they are harvested indiscriminately. In local markets of the Khoy region important medicinal species sold are; *Cichorium intybus* L., *Malva neglecta* Wallr., *Thymus vulgaris* L., and *Mentha longifolia* (L) L. These are widely sold by local vendors, consequently their excessive harvesting is leading towards their destruction.

It is worth to mention here, the identified culturally important plants of this study, have been reported in previous ethno-pharmacological works done in Azerbaijan region of Iran[17]. As against the provincial investigations the regional studies for subsequent gathering of cumulative information of different regions seems to us more appropriate for studying ethno-botanical information of a culture. This will help to avoid loss of information on important medicinal plants. Moreover, with the aim of recognizing specific medicinal plants of the region, all reported plants compared with previous ethnopharmacological works done in different regions of Iran gives different aspect to this study[9-15,19,23,26,27,29,31-33]. This comparative analysis has resulted in identifying new region-specific newly recorded plants, which have not been presented in previous studies. These include; *Allium ampeloprasum* L., *A. schoenoprasum* L., *Alpinia officinarum* Hance, *Alopecurus pratensis* L., *Beta vulgaris* L., *Borago officinalis* L., *Boswellia serrate* Roxb. ex Colebr., *Cannabis sativa* L., *Cucurbita pepo* L., *Curcuma longa* L., *Ecballium elaterium* (L.) A. Rich., *Elymus repens* (L.) Gould, *Gossypium hirsutum* L., *Helianthus tuberosus* L., *Hyoscyamus niger* L., *Dactylorhiza incarnata* (L.) Soo, *Prunus armeniaca* L., *P. cerasus* L., *P. dulcis* (Mill.) D.A.Webb, *Rheum rhabarbarum* L., *Solanum tuberosum* L., *Stachys schtschegleevii* Sosn. ex Grossh., *Triticum aestivum* L. and *Zantedeschia aethiopica* (L.) Spreng.

In addition to all this information, we need to emphasize an important issue here for the medicinal plants of our study area; *Euphorbia amygdaloides* L. and *Peganum harmala* L. are important poisonous plants identified during the current study. Local people have advised that some plants, including *Mentha longifolia* (L.) L., *Matricaria chamomilla* L., *Arctium lappa* L. and *Ricinus communis* L. should not be used by pregnant women. In addition, excessive use of *Ecballium elaterium* (L.) A Rich can cause poisoning and death.

## Conclusions

Due to appropriate climate conditions, Khoy is one of the richest regions in terms of distribution of different medicinal plant in its natural habitats. People in this region mainly use medicinal plants to cure common ailments like digestive and respiratory diseases. Sometimes they prefer medicinal plants instead of available health services or use them as an alternative medicine, since they are readily accessible without any cost and used for medicine with no side effects. In addition to this, because of great historical importance of herbs, their consumption has promoted in this region. In this study ethnobotanical information of native people in Khoy city has been evaluated on quantitative basis and descriptive as well by identifying important medicinal plants in curing different ailments. Apiaceae, Lamiaceae and Asteraceae are the most dominant families, which at the same time are most popular families in other Irano-Turanian phytogeographical regions. Almost 69% of the plant taxa from Iranian flora are distributed here. Many plants reported from this region are the popular ones which have been recorded in other ethnopharmacological reports from our study area. The reason being its high prevalence as compared to other ailments. Some of the plant taxa like *Cichorium intybus* L., *Salix aegyptiaca* L., *Malva neglecta* Wallr., *Thymus vulgaris* L. and *Plantago major* L. are recorded as culturally important plants. Similarly, *Malva neglecta* Wallr., *Mentha longifolia* (L.) L., *Plantago major* L. and *Thymus vulgaris* L. are the most popular plants distributed in this region with much medicinal use. Comparative analysis of results of different studies has revealed the fact that different ethnic groups in Iran possess different cultures and they prefer different plants for treatment of their ailments. Our findings stress the fact that valuable medicinal plants should be preserved and analyzed in detail in terms of their pharmaceutical applications. Ethno-pharmacological studies will be effective in the preservation of local culture and traditional custom of medicinal plant use of native people.

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