

Medicinal Plant Biodiversity used among the rural communities of Arid Regions of Northern Punjab, Pakistan

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One-third of the earth's surface is categorized as arid. Arid regions throughout the world having unique biodiversity comprising of different climatic conditions. The current study focused on Medicinal Plant Biodiversity used among the rural communities of Arid regions of Northern Punjab, Pakistan. Total 225 households were interviewed by using a semi-structured questionnaire. By using different quantitative indices, results were analyzed that includes frequency of citation (FC), the relative frequency of citation (RFC), fidelity level (FL), Informant consensus factor (ICF) and use value (UV). In this study 98 plants, species were reported, used for medicinal purposes. Asteraceae was found to be a dominant family. The most frequently used parts were leaves (46%) as compared to other plants parts. The mostly used herbal medicinal preparation method was a powder (44%) as compared to decoction (43%), paste (20%). The highest ICF was reported for respiratory system disorders (Asthma, cold, chest problems, flue, and cough). The fidelity level varies from 50% to 96%. Species having the highest use value was *Ficus benghalensis* (0.16) while the plant species with the highest RFC was *Ficus palmate* (0.42). The findings exposed that medicinal plants are the main source of medicines for primary health care. Medicinal plants having high used value help to identify a phytochemical compound that are bio-active that are essential for the synthesis of new drugs for various diseases.

Keywords: Arid environment, Integrative health care, Medicinal plants, Phytochemical compounds, Quantitative indices

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Pakistan is blessed with a wide range of medicinal plants due to its climatic conditions, ecological zones and topography¹. In Pakistan, almost 400-600 identified medicinal plants are used in traditional health care². Medicinal plants from the arid area are well known for its nutritional and therapeutic potential. There are about 350 traditional herbal preparations used to treat numerous infectious diseases³.

In arid zones, vegetation is typically sparse, the climates share extreme temperature ranges and unpredictable but have immense potential of medicinal plants and have excessive social and economic improvement potential. However, due to lack of palatable and agricultural water, the bulk of these areas is unexploited. There is a need for the development of innovatory methods and practices specifically suited to arid lands. Majority land area of

Pakistan is classified as arid to semi-arid covering 40.9 million hectares (ha) of land. About 68% of land in Pakistan gets less than 250 mm rainfalls yearly. About 24% of the geographical area falls under an annual rainfall of 250- 500 mm. Only 8% area obtains annual rainfall greater than 500 mm^{4,5}.

Plants have been exploited broadly, and their utilization has been recorded for their therapeutic potential in several parts of the world^{6,7}. Traditional knowledge of medicinal plants provides a phototherapeutic activity for the treatment of disease⁸. People have fewer access to the current drugs in the developing world so they mainly used diverse herbal formulations to treat serious illnesses⁹. There are few studies that address the Medicinal Plant Biodiversity in Arid Regions of Northern Punjab, Pakistan. The indigenous knowledge related to therapeutic uses of plants has been documented extensively throughout the world¹⁰. These kinds of documentation provide a

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baseline study for future research as well as promote the cultural diversity and sustainable use of plants resources¹¹. Arid areas are present in every province where medicinal plants grow naturally but the rich medicinal flora is under genetic erosion and the need of the hour is to conserve the medicinally important plant for human welfare¹².

The four districts of the arid region (Rawalpindi, Chakwal, Jhelum and Attock) were selected for detail ethno medicinal. The key objective is to assess the traditional usages of medicinal plants and to get evidence about their natural habitat and varieties of wild species. The Ethno-medicinal data of present study evaluated on the basis of numerous indexes such as use value (UV), use reports (UR) and fidelity level (FL), frequency citations (FC) and relative frequency citations (RFC). It is expected that these plants will be further studied in order to examine their pharmacology and photochemistry.

Materials and Methods

Study area

The Punjab province of Pakistan comprises of 34 administrative districts with a total area of 205,346 sq. km. The province is divided into three agro-ecological zones depending on agro-climatic conditions, namely Southern Irrigated Zone, Northern Irrigated Zone and Northern Arid Zone (Rain fed). Four districts of northern arid zone namely, Rawalpindi, Chakwal, Jhelum and Attock were selected for the study.

Geographically, the arid zone is located between (30°N-34°N and 70°E-74°E). The total Area is about 13,000 km² that is about 2.9% of the total area of Punjab. The arid area with low humidity and rain. Most of the arid area received less than 200 mm annual rain fall¹³ (Fig. 1), Total cultivated areas are 1.0 Mha approximately managerial, Average height of the range is 600 m which rises to 1525 m in Sakesar¹⁴. Arid regions have comparatively low yearly precipitation. Arid regions have been sacred with varied flora including medicinal plants that are uncounted. Total 5691 known species of flowering plants in Pakistan about 40% of these plants is restricted to the arid and semi-arid regions¹⁵. The rural areas are still reliant on therapeutic plants for their healthiness because of the absence of hospitals in the area. The main incomes of the people is agriculture. Nearly 60% of the population of the arid region depends on agriculture.

Collection of ethno medicinal data

The study area was surveyed from January 2015 to

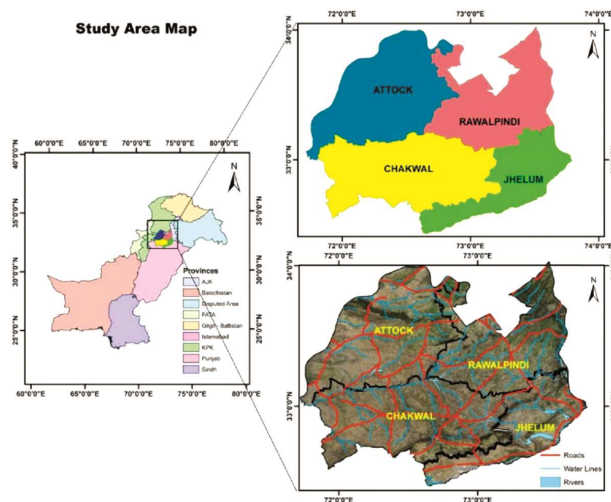


Fig. 1 — Map of Pakistan, showing the Study Area

December 2016 in all the seasons of the year. The ethnomedicinal information was collected¹⁶. A questionnaire was made to collect information about the uses of medicinal herbs used by the local inhabitants of the arid region to cure various diseases. The elderly known people including men and women, who were familiar, were interviewed by using local languages (Punjabi, seriki and Urdu). A total of 225 inhabitants of the study area were interviewed that mainly include women, men and traditional healers. The informants were divided into different age groups i.e., 20–30, 30–40, 40–50, 50–60 and more than 60 years old. The International Plant Name Index (IPNI) (www.ipni.org) was used to obtain the precise and correct botanical names authorization. The identified specimens were deposited in the Herbarium of Pakistan (ISL), Quaid-I-Azam University Islamabad, Pakistan. The necessary equipment mainly includes maps, questionnaire's, note book, pencils, blotting papers, plants pressers, knife, GPS, polythene bags and digital camera were used during this research study.

Quantitative analysis of ethnobotanical data

Various quantitative indices were applied to analyze the collected ethno medicinal data that include informant consensus factor (ICF), fidelity level (FL), frequency citation (FC), relative frequency citation (RFC), use report (UR) and the use value (UV). The ethno medicinal data documented were exposed to describe the most-cited used species method of preparation and plant parts¹⁷.

Informant consensus factor (ICF)

Informant consensus factor (ICF) was obtained¹⁸

by using the following formula:

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

Where as N_{ur} refers to the total number of use reports on each disease category and N_t is the number of taxa used in that category. It is used to test the homogeneity of knowledge on the use of species in the illness categories between the populations. The ICF provides a range of (0–1). High ICF illustrates that there are a narrow well-defined group of species used to cure a specific disease category or that information is exchanged with informants and low ICF values (close to zero) show that informants disagree over which plant to use due to random choosing or lack of exchange of evidence about the use amongst informants¹⁹.

Fidelity level (FL)

Fidelity level (FL) indexed was designed by using the following formula as described by²⁰ to determine the most favored species used in the treatment of a specific ailment as more than one plant species are used in the cure in the same category:

$$FL = \frac{N_p}{N} \times 100$$

Where as N_p shows the number of informants that is citing the use of the plant for a specific disease and N is the informant's total number that is mentioning the plant species for any ailment. High FL demonstrates a higher frequency of utilization of the plant species for treating a particular illness classification by the informants of the study region.

Frequency citation (FC) and relative frequency citation (RFC)

The Frequency of citation of the plant species was calculated by using the following relation;

$$FC = \frac{\text{Number of times a specific species was cited}}{\text{Total number of times that all species were cited}} \times 100$$

Where as the relative frequency of citation (RFC) index was done²¹ by using the given formula:

$$RFC = \frac{FC}{N} (0 < RFC < 1)$$

This index is gained by dividing the number of informants citing a useful species FC or frequency of citation by the total number of informants in the investigation (N). RFC values to vary from 0 to 1 (when no one refers to a plant as a useful one the RFC value is 0 and when all the informant's discussion it

as useful then the RFC value is 1). RFC index, which does not consider the use-category (UR or use report is a solitary record for utilization of a plant said by a person)

Use report (UR) and the Use value (UV)

The use value (UV) shows the relative significance of plants known locally, was done by the help of following formula²²:

$$UV = \frac{\sum U}{n}$$

Whereas, UV is the use value of a plant species, 'U' shows the number of use reports cited by each informant for a particular plant species and 'n' shows the total number of informants questioned for that particular plant. The UV is applied to defining the plants with the highest use (most often indicated) in the treatment of an ailment, while use report (UR) is the utilization recorded for each species.

Results and discussion

The inclusive information on ethnomedicinal flora of arid region with respect to scientific and local names, family, part used, and diseases treated have been provided in Table 1.

Demographic data

In total 225 informants, 20 were traditional healers (THs) and 205 indigenous people (Table 2). Majority of the informants were in the age range 40–50 years (20%) and 50–60 years (34%). The intermediate ages were 70 years. The majority of informants (44%) were uneducated because of the absence of educational services in the area. Only a few have some higher education. Most of them had done primary education and speak in the Punjabi language. Male informants were in the majority, while there were few female informants. The main reason behind this is that the majority of female informants were not allowed to talk with males so their contribution was too less during the ethnomedicinal data documentation¹⁷.

Medicinal plant diversity

Medicinal plants species are useful in traditionally curing human diseases in the arid region of Pakistan (Table 1). In the present study 98 medicinal plants belonging to 19 Families were reported. The largest proportion of medicinal plants collected belongs to the families Asteraceae (ten species), followed by Fabaceae (eight species) and Solanaceae (six species). Other frequently used families include Lamiaceae

and Poaceae with five species each (Fig. 2). Plants

Table 1 — Ethno-medicinal uses of plants in the Arid zone of Punjab, Pakistan

Taxonomic name/ Voucher specimen No	Family	Local Name	Habit	Part Used	Mode Of Utilization	Disease Treated	FC*	UV*	RFC*	FL*
<i>Abutilon indicum</i> (L.) Sweet/ SA-400	Malvaceae	PeeliBooti	Herb	Leaves, flowers	Juice, Poultice	Jaundice , Stomach inflammation, Boils	47	0.09	0.21	70.21
<i>Acacia modesta</i> Wall./ SA-89	Fabaceae	Phulahi	Tree	Bark	Powder, Ash	Chest pains, Dysentery, Paralysis, and Asthma , Sexual disorders	50	0.1	0.22	82
<i>Acacia nilotica</i> subsp. <i>indica</i> (Benth.) Brenan/ SA-29	Leguminosae	Kiker	Tree	Leaves, Pod, Bark, Gum, Fruit	Powder, Decoction, Paste	Leucorrhoea, Kidney pain, Diabetes, Sexual disorders , Dysen- tery, Eye diseases	59	0.1	0.26	50.84
<i>Achyranthes aspera</i> L./ SA-90	Amaranthaceae	Puthkanda	Herb	Leaves, Stem	Decoction, Syrup, Ash	Piles, kidney stone, Skin diseases, Asthma , Dysentery, Stomach Ulcer, Pneumonia	67	0.1	0.3	68.65
<i>Aervaj avanica</i> (Burm.f.) Juss. ex Schult./ SA-304	Amaranthaceae	Sufaidbui	Herb	Leaves, Aerial parts	Powder, Smoke	Kidney stone , urinary disorders, Epilepsy and insanity	45	0.09	0.2	84.44
<i>Albizia lebeck</i> (L.) Benth./ SA-908	Fabaceae	Shirin	Tree	Seeds, Leaves, Bark	Powder, Decoction, Extract	Toothache , Gum diseases , Piles, Diarrhea, Skin diseases, and Headache	53	0.09	0.24	81.13
<i>Albizia procera</i> (Roxb.) Benth./ SA-91	Fabaceae	ChhitaSirin	Tree	Bark, flowers, seeds, pods	Powder, Decoction, Paste	Piles , Diarrhea, Dysentery, snake bite, eye diseases, skin disorders	63	0.1	0.28	90.47
<i>Alhagi maurorum</i> Medik./ SA-49	Fabaceae	Jawansa	Shrub	Whole plant	Extract, Maceration	Digestive disorders , Jaundice, rheumatism	40	0.08	0.18	50
<i>Allium cepa</i> L./ SA-950	Amaryllidaceae	Piaz	Herb	Bulb, Leaves	Juice	Cholera, Diarrhea, Dysentery, Skin diseases , Pimples, Stomach disorder and Fever (cattle)	66	0.09	0.29	74.24
<i>Allium sativum</i> L./ SA-92	Amaryllidaceae	Thoom	Herb	Bulb	Juice	Blood pressure , Stomach disorders, Diabetes	42	0.07	0.19	69.04

(Contd.)

Table 1 — Ethno-medicinal uses of plants In the Arid zone of Punjab, Pakistan (Contd.)

Taxonomic name/ Voucher specimen No	Family	Local Name	Habit	Part Used	Mode Of Utilization	Disease Treated	FC*	UV*	RFC*	FL*
<i>Aloe vera</i> (L.) Burm.f./ SA-941	Xanthorrhoeaceae	Kanwargandal	Herb	Bulb, Leaves	Juice, Poultice	Diabetes , Cholera, Diarrhea, Dysentery, Skin diseases, Pimples, Stomach disorder, and Fever	68	0.09	0.3	73.52
<i>Amaranthus viridis</i> L./ SA-303	Amaranthaceae	Chulai	Herb	Leaves, Stem	Decoction, Cooked	Cough , Inflammation, Blood pressure, Urinary problems, Snake and scorpion bite	56	0.09	0.25	78.57
<i>Anagalli sarvensis</i> L./ SA-93	Primulaceae	Cheri mava	Herb	Whole plant	Decoction	Kidney disorders , Stomach inflammation, epilepsy and leprosy	47	0.09	0.21	85.10
<i>Anethum sowa</i> Roxb. ex Fleming/ SA-16	Apiaceae	Dill weed	Herb	Seeds	Decoction	Gastritis disorders , liver disorders, Stomach infection,	37	0.08	0.16	75.67
<i>Arachis hypogaea</i> L./ SA-209	Fabaceae	Moong phalli	Herb	Seeds	Powder, Oil	Sexual tonic , skin disorders, Urinary Inflammation	34	0.09	0.15	73.52
<i>Artemisia scoparia</i> Waldst. & Kit. / SA-94	Asteraceae	Cahhu	Herb	Whole plant	Infusion	Ear ache , Antiseptic, snake and scorpion bite	32	0.09	0.14	84.37
<i>Asphodelus tenuifolius</i> Cav./ SA-445	Xanthorrhoeaceae	Bhokaat	Herb	Seeds	Powder, Poultice	Piles , Fever jaundice, Skin disorders	48	0.08	0.21	83.33
<i>Avena sativa</i> L./ SA-302	Poaceae	Jounda	Grass	Whole plant	Powder	Brain disorders Skin infections	35	0.06	0.16	85.71
<i>Azadirachta indica</i> A. Juss./ SA-95	Meliaceae	Nim	Tree	Fruit, Leaves	Paste, Raw	Heart diseases, Blood purification , Liver and stomach disorders, Skin diseases	57	0.09	0.25	84.21
<i>Brassica oleracea</i> L./ SA-15	Brassicaceae	Chittisurian	Herb	Seeds, Leaves, Stem	Paste, Decoction, Cooked	Heart disorders , Skin problems, Constipation	38	0.08	0.17	78.94
<i>Bryophyllum pinnatum</i> (Lam.) Oken/ SA-301	Crassulaceae	Patharchutt	Herb	Leaves	Powder, Decoction	Kidney stones , Digestive disorders, Hair problems, Skin disorders.	44	0.09	0.2	75

(Contd.)

Table 1 — Ethno-medicinal uses of plants In the Arid zone of Punjab, Pakistan (Contd.)

Taxonomic name/ Voucher specimen No	Family	Local Name	Habit	Part Used	Mode Of Utilization	Disease Treated	FC*	UV*	RFC*	FL*
<i>Calendula arvensis</i> (Vaill.) L./ SA-12	Asteraceae	Zergul	Herb	Leaves, Flowers	Ointment, Decoction, paste	Eye disorders, Heart diseases , Skin cuts	49	0.06	0.22	81.63
<i>Calotropis procera</i> (Aiton) W.T.Aiton/ SA-901	Asclepiadaceae	Akk	Shrub	Roots, Leaves	Poultice	Snake bite , Hair disorders, Piles, Scabies, Eczema Wounds	66	0.09	0.29	75.75
<i>Cannabis sativa</i> L./ SA-900	Cannabaceae	Bhung	Herb	Whole plant	Smoke, Decoction	A bleeding nose, Diarrhea, Leucorrhea, Sexual disorders	43	0.09	0.19	76.74
<i>Capparis decidua</i> (Forssk.) Edgew./ SA-300	Capparaceae	Daila	Shrub	Whole plant, Branches, flowers, fruits	Paste, Decoction, Cooked	Asthma , Cough, Inflammation, Rheumatism, Cardiac disorders	55	0.09	0.24	80
<i>Caralluma edulis</i> (Edge w.) Benth. exHook.f./ SA-932	Asclepiadaceae	Chounga	Herb	Whole plant	Juice, Decoction	Diabetes , Blood purification, Boils	36	0.08	0.16	83.33
<i>Carthamus oxyacantha</i> M.Bieb./ SA-861	Asteraceae	Poli	Herb	Leaves, Seeds	Infusion, Powder	Jaundice , Skin disease, Fever, Scabies, Eye disease, and Dysentery	66	0.09	0.29	90.90
<i>Chenopodium album</i> L./ SA-860	Amaranthaceae	Bathu	Herb	Leaves, Stem	Decoction, Cooked	Tuberculosis, Jaundice , Fever, Blood purification, Flue, Kidney and Gall bladder stones.	80	0.09	0.36	96.25
<i>Cicer arietinum</i> L./ SA-909	Fabaceae	Cholay	Herb	Fruit	Decoction, Paste	Flue , Cough, Jaundice, Diabetes, Tuberculosis, Sexual tonic, Skin diseases	82	0.09	0.36	85.36
<i>Cichorium intybus</i> L./ SA-841	Asteraceae	Kasni	Herb	Leaves	Juice, Powder	Gastritis and Liver disorders, Fever, Jaundice	40	0.1	0.18	95
<i>Convolvulus arvensis</i> L./ SA-840	Convolvulaceae	Poli	Herb	Whole plant	Decoction, Cooked, Powder	Skin disease , Blood purification, Constipation	39	0.08	0.17	51.28
<i>Cucumis melo</i> L./ SA-208	Cucurbitaceae	Chibbar	Herb	Fruit	Paste, Decoction	Digestive disorders , Liver diseases	37	0.08	0.16	59.45
<i>Cucumis sativus</i> L./ SA-802	Cucurbitaceae	Kheera	Climber	Roots, Seeds,	Powder, Poultice	Tooth ache , Stomach disorders, Skin infections	37	0.08	0.16	81.08
<i>Cuscuta reflexa</i> Roxb./ SA-800	Convolvulaceae	Akas Bel	Herb	Whole plant	Maceration, Poultice, Powder	Baldness , Hair Falling	35	0.06	0.16	85.71

(Contd.)

Table 1 — Ethno-medicinal uses of plants In the Arid zone of Punjab, Pakistan (Contd.)

Taxonomic name/ Voucher specimen No	Family	Local Name	Habit	Part Used	Mode Of Utilization	Disease Treated	FC*	UV*	RFC*	FL*
<i>Cynodon dactylon</i> (L.) Pers./ SA-207	Poaceae	Khubleghass	Grass	Whole plant	Decoction, Powder, Paste	Eye disorders, Cuts and wounds, Digestive disorders	39	0.08	0.17	89.74
<i>Dalbergia sissoo</i> Roxb. ex DC./ SA-898	Fabaceae	Tali	Tree	Leaves	Powder	Hair disorders , skin diseases, blood diseases, syphilis, stomach problems, dysentery, Nausea	78	0.09	0.35	88.46
<i>Datura innoxia</i> Mill./ SA-55	Solanaceae	Datura	Shrub	Whole plant	Powder, Smoke, Decoction	Piles , Asthma, Chronic Headache, Urinary problems	46	0.09	0.2	86.95
<i>Dodonaea viscosa</i> (L.) Jacq./ SA-67	Sapindaceae	Sanatha	Shrub	Seeds	Powder	Wounds, Swelling, Burns, Fever, Rheumatism, Diabetes	50	0.1	0.22	96
<i>Echinops echinatus</i> Roxb./ SA-66	Asteraceae	Untakatara	Shrub	Roots	Poultice, Extract	Gyne problems Rheumatism and Kidney stones	33	0.09	0.15	90.90
<i>Eruca vesicaria</i> (L.) Cav./ SA-789	Brassicaceae	Jumian	Herb	Leaves	Decoction, Juice	Hairs and skin problems , intestinal worms, Rheumatism	46	0.09	0.2	89.13
<i>Eucalyptus camaldulensis</i> Dehnh./ SA-206	Myrtaceae	Sufaida	Tree	Leaves	Infusion	Flue, Cough and cold, Malaria Toothache	55	0.09	0.24	69.09
<i>Euphorbia helioscopia</i> L./ SA-760	Euphorbiaceae	Chattridodak	Herb	Whole plant	Powder	Abdominal disorders , Stomach Diseases	35	0.06	0.16	85.71
<i>Euphorbia hirta</i> L./ SA-777	Euphorbiaceae	Dudhi	Herb	Latex	Poultice, Ointments	Cuts wounds, Eye disorders	36	0.06	0.16	83.33
<i>Fagonia indica</i> Burm.f., Fl./ SA-143	Zygophyllaceae	Dhamian	Herb	Whole plant	Maceration, Decoction, Extract	Scabies, Blood Purification, Pimples, Diabetes , and High blood pressure	53	0.09	0.24	88.67
<i>Ficus benghalensis</i> L./ SA-205	Moraceae	Bohr	Tree	Roots, Leaves, Latex	Decoction, Paste	Sexual tonic, Diabetes , Skin disorders. flue and influenza, Piles	37	0.16	0.16	78.37
<i>Ficus palmata</i> Forssk./ SA-16	Moraceae	Khabara	Tree	Bark, Leaves	Paste, powder,	Constipation, Asthma, Diabetes, Cough, Liver diseases, Kidney disorders , Gall bladder stone, Rheumatism, Toothache	95	0.09	0.42	92.63

(Contd.)

Table 1 — Ethno-medicinal uses of plants In the Arid zone of Punjab, Pakistan (Contd.)

Taxonomic name/ Voucher specimen No	Family	Local Name	Habit	Part Used	Mode Of Utilization	Disease Treated	FC*	UV*	RFC*	FL*
<i>Ficus religiosa</i> L./ SA-159	Moraceae	Pipal	Tree	Leaves, bark	Decoction	Asthma , Constipation, Vomiting, Urinary disorders	40	0.1	0.18	75
<i>Foeniculum vulgare</i> Mill./ SA-11	Apiaceae	Sounf	Herb	Fruits	Powder	Digestive disorders , Vomiting	37	0.05	0.16	81.08
<i>Fumaria indica</i> (Hausskn.) Pugsley/ SA-204	Papaveraceae	Papra	Herb	Whole plant	Juice, Decoction	Fever, Abdominal worms, Blood purification, Diabetes, Urinary bladder infections, Skin Allergy, Digestive disorders	77	0.09	0.34	85.71
<i>Helianthus annuus</i> L./ SA-444	Asteraceae	SurajMukhi	Herb	Seeds	Decoction	Cold, Cough, Bronchitis, Malaria, Fever	56	0.09	0.25	89.28
<i>Hordeum vulgare</i> L. / SA-754	Poaceae	Joa	Herb	Fruit	Powder, Cooked	Fever, Dysentery , Blood purification, Typhoid, Heart diseases, Cough, Tuberculosis, Constipation.	89	0.09	0.4	78.65
<i>Justicia adhatoda</i> L./ SA-44	Acanthaceae	Bahakar	Shrub	Leaves, flowers	Decoction, Powder	Diabetes , Cough, Wounds, Asthma, Menses, Fever	64	0.09	0.28	84.37
<i>Lactuca sativa</i> L./ SA-203	Asteraceae	Salad	Herb	Leaves	Raw	Stomach ulcer, Digestive disorders	38	0.05	0.17	73.68
<i>Malva parviflora</i> L./ SA-35	Malvaceae	Sonchal/ KotriSaag	Herb	Leaves, Stem	Decoction, Cooked	Phlegm, Constipation , Rickets	40	0.08	0.18	75
<i>Melia azedarach</i> L./ SA-22	Meliaceae	Daraik	Tree	Leaves	Decoction	Leprosy, Constipation, Allergy, Skin diseases , Piles, Itching, Hair tonic, Inflammation	80	0.1	0.36	87.5
<i>Mentha longifolia</i> (L.) Huds./ SA-202	Lamiaceae	PehariPodina	Herb	Leaves	Powder, Decoction	Dysentery , Colic pain, Asthma, Jaundice, Intestinal worms, Liver and Stomach disease.	77	0.09	0.34	85.71
<i>Mirabilis jalapa</i> L./ SA-32	Nyctaginaceae	GulBasi	Herb	Leaves, Seeds, Flowers	Powder, Poultice, Cooked	Wounds, Jaundice, Dropsy, Menses disorders, Blood purification, Piles , Jaundice, Skin diseases	82	0.1	0.36	95.12

(Contd.)

Table 1 — Ethno-medicinal uses of plants In the Arid zone of Punjab, Pakistan (Contd.)

Taxonomic name/ Voucher specimen No	Family	Local Name	Habit	Part Used	Mode Of Utilization	Disease Treated	FC*	UV*	RFC*	FL*
<i>Momordica charantia</i> L./ SA-667	Cucurbitaceae	Karela	Herb	Fruit	Juice, Cooked	Diabetes, Abdominal worms, Blood purification	37	0.08	0.16	83.78
<i>Morus alba</i> L./ SA-666	Moraceae	Chitta toot	Tree	Fruit	Extract	Sexual tonic, Heart and chest diseases	35	0.06	0.16	77.14
<i>Morus nigra</i> L./ SA-201	Moraceae	Kala toot	Tree	Fruits, Leaves	Extract, Decoction	Cough, Throat diseases	36	0.06	0.16	86.11
<i>Nerium oleander</i> L./ SA-650	Apocynaceae	Gulabigunaira	Shrub	Bark, Root	Paste	Skin disorders, Abortion, Scorpion and snake bite	45	0.07	0.2	86.66
<i>Ocimum basilicum</i> L./ SA-200	Lamiaceae	Niazbo	Herb	Leaves	Paste, Decoction	Insects repellent, Gastric, and hepatic disorders	43	0.07	0.19	93.02
<i>Olea ferruginea</i> Wall. ex Aitch./ SA-634	Oleaceae	Kao	Tree	Leaves	Decoction, Paste	Skin diseases, Cough, Cold, Toothache	44	0.09	0.2	75
<i>Oxalis corniculata</i> L./ SA-623	Oxalidaceae	KhattiMitthib ooti	Herb	Whole plant	Cooked, Decoction	Liver and Stomach disorders, Jaundice, Abdominal worms	43	0.09	0.19	69.76
<i>Peganum harmala</i> L./ SA-620	Nitrariaceae	Harmal	Herb	Leaves, Seeds	Decoction, poultice	Paralysis, Blood purification, Epilepsy, Cough, Sexual tonic, Worms	66	0.09	0.29	83.33
<i>Periploca caaphylla</i> Decne. / SA-109	Asclepiadacea e	Barara	Shrub	Roots	Paste	Urticarial disorder, Constipation, Tumor	40	0.08	0.18	75
<i>Phyla nodiflora</i> (L.) Greene/ SA-600	Verbenaceae	SawiBooti	Herb	Whole plant	Powder	Piles, Urinary infections	38	0.05	0.17	73.68
<i>Phyllanthu semblica</i> L./ SA-645	Phyllanthaceae	Amla	Tree	Fruit	Juice, Poultice	Eye disorders, Hair diseases	39	0.05	0.17	76.92
<i>Plantago ovata</i> Forssk./ SA-45	Plantaginaceae	Ispagol	Herb	Fruit	Maceration	Digestive disorders, Constipation, Urine problems	44	0.07	0.2	90.90
<i>Prosopis juliflora</i> (Sw.) DC./ SA-551	Fabaceae	KabliKikri	Shrub	Branches	Paste	Asthma, Cough, Leucorrhoea, Pimples	48	0.08	0.21	75
<i>Psidium guajava</i> L./ SA-108	Myrtaceae	Amrood	Tree	Fruit, Leaves	Raw, Powder, Infusion	Abdominal Worms Digestive disorders, Diarrhea, Diabetes	49	0.08	0.22	81.63
<i>Raphanus raphanistrum</i> subsp. sativus (L.) Domin/ SA-556	Brassicaceae	Mooli	Herb	Whole plant	Raw, Poultice	Piles, Skin disorders	35	0.06	0.16	82.85

(Contd.)

Table 1 — Ethno-medicinal uses of plants In the Arid zone of Punjab, Pakistan (Contd.)

Taxonomic name/ Voucher specimen No	Family	Local Name	Habit	Part Used	Mode Of Utilization	Disease Treated	FC*	UV*	RFC*	FL*
<i>Rhazya stricta</i> Decne./ SA-555	Apocynaceae	SawaVeirno	Shrub	Leaves, branches	Powder	Digestive disorders, Dysentery Toothache Diabetes	49	0.08	0.22	81.63
<i>Ricinus communis</i> L./ SA-107	Euphorbiaceae	Harnoli	Shrub	Seeds, Leaves	Decoction, Poultice	Jaundice, Intestinal Swelling, Constipation	38	0.08	0.17	76.31
<i>Rosa × damascene</i> Herm./ SA-523	Rosaceae	Gulab	Shrub	Petals, Buds	Paste	Cardiac diseases, Skin disorders, Stomach disorder, Brain disorder	30	0.13	0.13	93.33
<i>Rumex dentatus</i> L./ SA-532	Polygonaceae	Janglipalak	Herb	Leaves, stem	Paste, Cooked	Urinary disorders, Inflammation, Gastric problems, Constipation , Kidney stones	58	0.09	0.26	84.48
<i>Salvia moorcroftiana</i> Wall. exBenth./ SA-106	Lamiaceae	Ghoulkund	Herb	Leaves	Poultice, Decoction	Headache, Fever, Skin disorders	36	0.08	0.16	83.33
<i>Salvia officinalis</i> L./ SA-530	Lamiaceae	Garden Sage	Shrub	Leaves	Powder	Fever, Ulcer, Liver disorders, Kidney infections, Hair tonic	55	0.09	0.24	81.81
<i>Sesamum indicum</i> L./ SA-499	Pedaliaceae	Til	Herb	Seeds	Powder, Poultice	Urinary disease, Hair disorders, Skin diseases	39	0.08	0.17	76.92
<i>Silene conoidea</i> L./ SA-493	Caryophyllaceae	ChhotaTakla	Herb	Whole plant	Powder	Skin disorders, Allergy and infections	36	0.06	0.16	88.88
<i>Solanum incanum</i> L./ SA-491	Solanaceae	Mahori	Shrub	Leaves	Powder	Abdominal disease, Digestive disorders	38	0.05	0.17	52.63
<i>Solanum nigrum</i> L./ SA-105	Solanaceae	Kanchmanch	Herb	Leaves, Fruit	Decoction, Cooked	Diabetes, Liver disorders, Rheumatism, Diarrhoea, Constipation, Skin disorder, Heart diseases	76	0.09	0.34	52.63
<i>Solanum virginianum</i> L./ SA-490	Solanaceae	Mohakrfi	Herb	Fruit, leaves, Seeds	Decoction, powder	Cough, Abdominal disorders, Blood purification, Toothache	40	0.1	0.18	55
<i>Sonchus asper</i> (L.) Hill/ SA-485	Asteraceae	Dodal	Herb	Whole plant	Infusion	Urinary infection, cough, Asthma	48	0.08	0.21	81.25
<i>Syzygium cumini</i> (L.) Skeels/ SA-104	Myrtaceae	Jaman	Tree	Seeds, Bark	Decoction, Powder	Fever, Stomach disorders, Diabetes	39	0.08	0.17	76.92
<i>Taraxacum officinale</i> aggr. F.H.Wigg./ SA-480	Asteraceae	DudalBumbol a.	Herb	Leaves, Roots	Powder, Paste	Diabetes, Snake bite, Joint pain and swelling	46	0.09	0.2	86.95

(Contd.)

Table 1 — Ethno-medicinal uses of plants In the Arid zone of Punjab, Pakistan (Contd.)

Taxonomic name/ Voucher specimen No	Family	Local Name	Habit	Part Used	Mode Of Utilization	Disease Treated	FC*	UV*	RFC*	FL*
<i>Trachyspermum ammi</i> (L.) Sprague/ SA-476	Apiaceae	Ajwain	Herb	Seeds	Raw, Powder	Digestive disorders , Sexual disorders, Fever, Diarrhea,	44	0.09	0.2	86.36
<i>Trianthema portulacastrum</i> L./ SA-103	Aizoaceae	Itsit	Herb	Whole Plant	Powder	Jaundice, Liver disorders, Urinary problems, Fever , Asthma	54	0.09	0.24	83.33
<i>Tribulu terrestris</i> L./ SA-72	Zygophyllaceae	Bukhra	Herb	Fruit	Powder	Menses, Urinary problems, Heart disorder, Back bone pain, Kidney stones	59	0.08	0.26	79.66
<i>Triticum aestivum</i> L./ SA-102	Poaceae	Gandum	Herb	Fruits, Seeds	Poultice, Maceration, Powder	Belly ache, Joint Pains , Diabetes, Piles, Urinary problems, Sexual disorders, Constipation, Asthma	88	0.09	0.39	79.54
<i>Verbascum thapsus</i> L./ SA-71	Scrophulariaceae	Giddertambakoo	Herb	Leaves	Smoke, Powder	Tuberculosis, Asthma, Cough	37	0.08	0.16	81.08
<i>Vitex negundo</i> L./ SA-101	Lamiaceae	Marvand	Shrub	Leaves, Roots	Poultice, Smoke	Backache , Toothache, Backbone pain, Skin allergy	41	0.1	0.18	82.92
<i>Vitis vinifera</i> L./ SA-944	Vitaceae	Angoor	Climber	Fruit	Raw	Typhoid , Digestive problems	35	0.06	0.16	85.71429
<i>Withania coagulans</i> (Stocks) Dunal/ SA-70	Solanaceae	Chitta Verna	Herb	Seeds	Maceration, Decoction	Digestive disorders , Blood purification, Diabetes, Sexual disorders	48	0.08	0.21	72.91
<i>Withania somnifera</i> (L.) Dunal/ SA-100	Solanaceae	Aksin	Shrub	Roots, Leaves	Decoction, Poultice	Cough, Asthma, Gastritis problems Dysentery, Itching, Allergy ,	66	0.09	0.29	83.33
<i>Xanthium strumarium</i> L./ SA-443	Asteraceae	Kanda/Chhotadhatura	Herb	Seeds, Roots	Powder, Decoction	Stomach disorders , Urinary problems, Small pox, Dysentery, Malaria	57	0.09	0.25	68.42
<i>Zea mays</i> L./ SA-440	Poaceae	Makie	Grass	Fruit	Decoction	Kidney disorders, Urinary problems , Digestive disorders	36	0.08	0.16	91.66
<i>Ziziphus nummularia</i> (Burm.f.) Wight & Arn./ SA-99	Rhamnaceae	Beri	Shrub	Leaves, Fruit	Raw, Paste	Stomach disorders , Vomiting, Hair disorders	38	0.08	0.17	52.63

FC*: Frequency of citation (Frequency of Citation of Plants); *RFC: Relative frequency of citation; *UV: Use Value; *R.I: Relative Importance; *FL: Fidelity level

Bold Ailments treated=Main use of Plant (IU) on which FL % is based.

Table 2 — Demographic data of informants in Arid zone of Punjab (Pakistan)

S.No	Variable	Categories	No. of Persons	Percentage
1	Category of Informant	Traditional health practitioners	20	8.8
		Indigenous people	205	91.1
2	Gender	Female	95	42.2
		Male	130	57.7
3	Age	20-30	15	6.66
		30-40	50	22.2
		40-50	60	26.6
		50-60	80	35.5
		More than 60 years	20	8.88
4	Educational background	Illiterate	90	40
		Completed 5 years education	55	24.4
		Completed 8 years education	30	13.3
		Completed 10 years of education	22	9.77
		Some under grade degree	15	6.66
		Graduate	13	5.77
5	Traditional health practitioners experience	Less than 2 years	2	10
		2-8 years	8	40
		8-14 years	4	20
		14-20 years	4	20

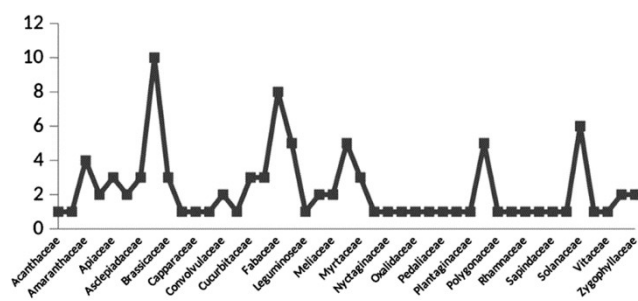


Fig. 2 — Plant Families of medicinal plants

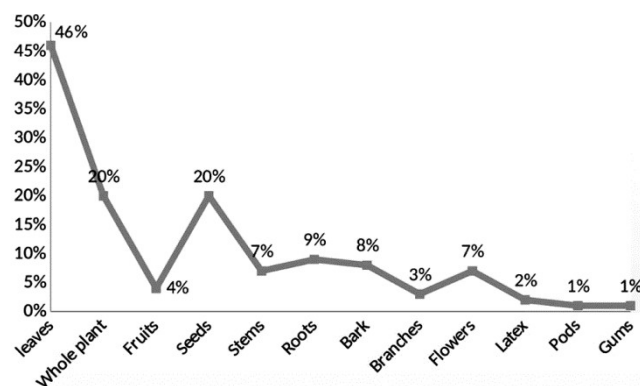


Fig. 3 — Life forms of medicinal plants

belonging to family Asteraceae are reported as medicinal plants used to treat various diseases throughout the world^{23, 24,25}. Bhattarai *et al.* (2010) and Mesfin *et al.* (2009) cited Asteraceae as the prominent family with a maximum number of medicinal plants species to cure illnesses^{26,27}. One of the possible reasons is due to the high rate of seed dispersal; pollination rate is high in family Asteraceae.

Utilization of Plant parts

Plants as a whole and different parts are commonly used to cure different diseases in the study area. In this survey, the plant part frequently used is leaves (46%), followed by the whole plant (20%) and seeds (20%). Percentage of all plants parts used is represented in Fig. 3. Leaves as the most dominant part used have also been reported in other

ethnobotanical studies in Pakistan, China, Thailand, Bangladesh and India²⁸. Primary used part of the plant is leaves because they are easily collected and less effort is required to obtain it as compared with other parts such as roots, flowers and fruits²⁴. Leaves, roots, bark and fruits are used for the treatment of various diseases like stomach infections boils, burns and fever²⁹. Tea made by the leaves and fruits are used against different stomach problems could be of interest in further phytopharmacological researches³⁰. Moreover, from a physiological perspective, leaves are dynamic in photosynthesis and in the aggregation of metabolites³¹.

Growth forms

The highest frequency is documented for herbs (59%), followed by shrubs (22%) (Fig. 4) Wild documented species was in majority of (90.5%),

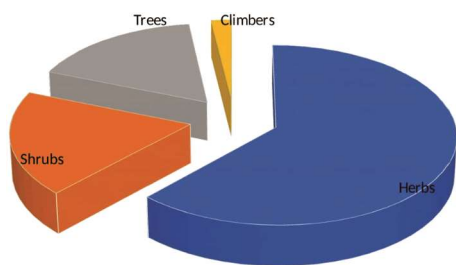


Fig. 4 — Mode of utilization of medicinal plants

followed by those cultivated (8.5%). According to Upreti *et al.* (2010), herb was most dominant growth form used for medicinal purposes³². Possible reasons that herbs are predominant may be because they contain rich bioactive compounds and that can be easily extracted³³. The growth forms were also cited by other authors and herbs were found to be the highest frequency, while most of the documented species were wild and are few are cultivated³⁴. In the analysis of growth forms, herbaceous species were found to be the largest in proportion³⁵.

Diagnosis and treatment of diseases

In methods of herbal drug preparation, Powder (44%), decoction (43%) and paste (20%) (Fig. 5) are prominently used in the study area.

The decoction was the most generally utilized preparation method followed by powder infusion or paste³⁶. Mode of utilization of some herbs is multiple that they may be used as a decoction or used as a powder so that's why the percentage of the mode of utilization as the powder is higher. Fourteen modes of utilization were documented that is decoction, cooked, extract, infusion, juice, maceration, milk/sap, ointments, paste, poultice, powder, raw, smoke, syrup etc. The most used mode of preparation was decoction and then demulcent, plant to extract used as demulcent for the external application while internal application includes decoction, infusion, pills and syrup and external administration includes demulcent and poultice³¹.

Traditional healers generally investigate ailments by visual review, talking with patients for manifestations and the term of the medical issue. Variation in heartbeat rate, eye and skin shading, mouth diseases, body temperature and state of injuries, are generally side effects identified. Internal disorders are normally cured by suggesting the natural arrangements as syrup, while external injuries and dermal diseases are treated by applying and rubbing herbal preparations on the influenced parts. Ethno-

pharmacologically arranged medications are generally managed with either medium like water, goat and sheep milk. These media are normally advised by the condition with respect to the patient, age and nature of the sickness. The main reason behind is these liquids show good absorptions of herbal medicine and to minimize the side effects³⁷

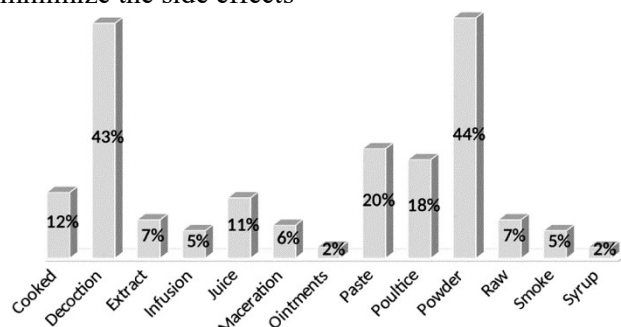


Fig. 5 — Percentage of plant parts used

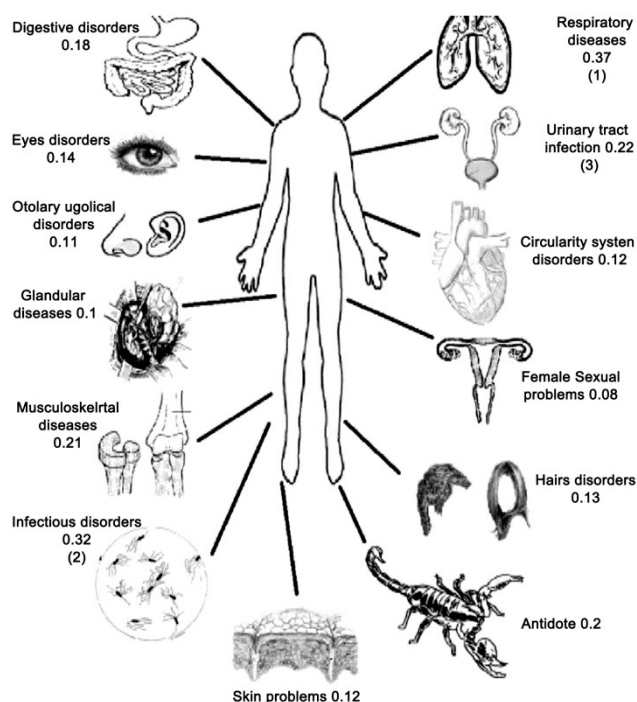


Fig. 6 — The highest ICF value

Quantitative analyses of ethnomedicinal data

The records collected from ethno medicinal knowledge were analyzed using quantitative indices.

Informant consensus factor

In the present study, the ICF values of medicinal plants range from 0.08 to 0.37 (Table 3 and Fig. 6). Respiratory diseases category (Asthma, cold, chest problems, flue, and cough) has the highest ICF value (0.37) followed by infectious disorders (Measles,

Table 3 — ICF Value of medicinal plants used for the treatment of different diseases

S. #	Disease category	N _{ur} ^{*1}	N _{ur} % ^{*2}	N _t ^{*3}	N _t % ^{*4}	ICF ^{*5}
1	Respiratory diseases (Asthma, cold, chest problems, flue, cough)	39	13.68	25	25.51	0.37
2	Antidote (Scorpion bite, snake bite and insects bite)	6	2.10	5	5.10	0.2
3	Female Sexual problems (Delivery, pregnancy, menstrual)	14	4.91	13	13.26	0.08
4	Urinary tract infection UTI (kidney pain ,urinary and bladder inflammation)	28	9.82	22	22.44	0.22
5	Digestive disorders (Constipation, digestion, dysentery, diarrhea, piles, stomach ache, vomiting)	51	17.89	42	42.85	0.18
6	Glandular diseases(Diabetes Jaundice, diabetes, tonsils, hepatitis, liver inflammation)	32	11.22	29	29.59	0.1
7	Infectious disorders (Measles, malaria, typhoid)	20	7.017	14	14.28	0.32
8	Circularity system disorders (High blood pressure, blood purifiers, heart diseases)	18	6.31	16	16.32	0.12
9	Eyes disorders	8	2.80	7	7.14	0.14
10	Otolaryngological disorders (Ear, nose and throat diseases)	10	3.50	9	9.18	0.11
11	Skin problems (Pimples, skin allergy, irritation, wounds, burns)	35	12.28	31	31.63	0.12
12	Musculoskeletal diseases (Bones fracture, joints pain, pain in feet, toothache)	15	5.26	12	12.24	0.21
13	Hair tonics	9	3.15	8	8.16	0.13

*1 = Number of Use reports; *2 = % age of use reports; *3=Number of taxa used; *4*= % age of taxa; *5*=Informant Consensus Factor.

malaria, typhoid) 0.32, and urinary tract infection UTI (kidney pain, urinary, and bladder inflammation) 0.22. The least contract between the informants was observed for plant used for female sexual problems (delivery, pregnancy, menstrual) 0.08. Similar results were reported by Jamila *et al.* (2014), who reported respiratory diseases highest ICF value (ICF: 0.83)³⁸.

Fidelity Level

The Fidelity level calculated from data of the current study varies from from 50% to 96%. The plant species with the highest fidelity level was *Chenopodium album* L. (96.25%), *Mirabilis jalapa* L. (95.12%), *Rosa × damascena* Herrm (93.33%), *Ocimum basilicum* L. (93.02%), *Ficus palmata* Forssk. (92.6%), *Zea mays* L. (91.66%) (Table 1). The high value of FL shows the occurrence of particular disease in the study area that is treated with the medicinal plant having high FL. Maximum FL shows the choice of informants for handling the specific ailment³⁹. Our study is close agreement with the study of Pandikumar *et al.*, 2011⁴⁰.

Relative Frequency of Citation

Relative frequency of citation values ranges of 0.13 to 0.42. The highest RFC value was calculated for by *Ficus palmate* (0.42), *Cicer arietinum* (0.36), *Chenopodium album* (0.36) and smallest RFC were calculated for *Rosa × damascena* Herrm. (0.13) as shown in Table 1. It implies that these species are the most prominent medicinal plants concurred by most

of the informants and they are the most well-known plants in the study zone.

Similar results were reported by Bibi *et al.* (2014), according to her medicinal plants having high RFC are the most popular medicinal plants of the area and are not only collected from fields but also purchased by local herb sellers⁴¹.

Use Value

In this study, UV extent was from 0.05 to 0.16. High UV was noted in *Ficus benghalensis* (0.16), *Rosa × damascena* (0.13) *Foeniculum vulgare* was noted as a plant with lower most used value (0.05) Table 2. Most of the plants with higher UV are also often used in other parts of Pakistan. Plants with high UVs show that these plants are considered to be very important by the informants⁴². It is proposed that species with higher UV should be studied further for phytochemical screening to develop new herbal drugs in the future⁴³. The study of Rokaya *et al.* (2010), use value was lower because informants had not much knowledge about the plant species, which might be of exotic origin or rare availability in the study area⁴⁴.

Conclusions and recommendations

Medicinal plants belonging to arid zones have been utilized for Integrative health care for about a thousand years. The practice has been kept up until today because of their therapeutic advantages. Vegetation of the area generally threatened because arid environment shares extreme temperature ranges.

Other biotic and abiotic factors such as over grazing, deforestation, habitat fragmentation were the visible risk. It is recommended that the preservation of the documented indigenous knowledge of arid regions. Hence conservation methodologies are intensely required to preserve the genetic makeup of the significant spp. of the arid zones. Locals should be educated and be trained for the farming of these important therapeutic plants. It is expected that it may lead to pharmacological assessments by the discovery of new bioactive compounds for the food and pharmaceutical industries. The current study is an attempt to generate better awareness among the people about the medicinal values of these plants of arid zone, so that this heritage may be intelligently used and continued through the sensible organization in Health sector.

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Conflict of Interest

The authors have no conflicts of interest.

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