



ETHNOBOTANICAL USES OF MEDICINAL PLANTS AMONG THE RURAL PEOPLE OF PABBAR VALLEY IN DISTRICT SHIMLA, HIMACHAL PRADESH, INDIA

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Abstract

An ethnobotanical survey was carried out on traditional use of medicinal plants in folk medicine by local people in Pabbar valley of Himachal Pradesh state, in western Himalaya. The information was gathered from 92 informants through interviews, group discussions and semi structure questionnaire. A total of 61 plant species belonging to 53 genera and 34 families were used as medicinal plants. Leaves (32.91%) were the most used part followed by roots (22.78%). The medicinal plants were used for treating various ailments like; diarrhea, dysentery, cough, cold, fever, wounds, skin problems and reproductive disorder. The traditional prescription of folk medicine include paste, powder, decoction, tea, smoking and direct applications etc. Informant Consensus Factor (ICF) ranges from (0.59) to (0.86) with an average of (0.73); highest ICF for gastrointestinal problems and the Use value varied from (0.2) to (0.83), with *Rheum australe* being most valued plant. The anthropogenic pressure on forest, unscientific exploitation of medicinal plants is causing severe depletion of species in nature. 18 medicinal species reported from the area are in different categories of threat. Suitable measures are needed to conserve and protect the medicinal plant species in local ecosystem for future sustainable use. Further research and documentation of traditional knowledge on medicinal plant should be done before it is lost forever.

Key words : Ethnobotany, Informant Consensus Factor, medicinal plants, Pabbar valley, traditional use, Use value.

Introduction

Utilizing the healing properties of plants is an ancient practice. There are many remote areas in Himalayan region where rural population depend on traditional health care, even though allopathic medicine are available. According to WHO, 65- 80% people of developing countries are dependent on traditional care system (WHO. 2011). The dependency of large number of poor on traditional practices can be thought of as an alternative type of medicine, where the cost and side effects are negligible (Namsa *et al.*, 2011). Today more than 90% of plant species used in herbal industries comes from wild and a large percentage of crude drug (50%) to market comes from western Himalayas (Singh & Rawat,2011). There has been increasing pressure on the

commercially valuable biological resources such as medicinal plants. To cater to pharmaceutical industries of state and outside the state about 165 MPS are traded in Himachal Pradesh every year. Out of these species, 24 species are amongst the most traded 100 medicinal plants in India. The total harvest of medicinal plants is more than 2,500 tonnes, which contributes to about INR 14, 000/- annually to the household economy of the collectors (HPMPSP, 2006; Kaisth & Sharma, 2006). The many medicinal plant species are threatened due to over harvesting.

Himachal Pradesh state is part of Western Himalayas, one of the biodiversity hotspots, has 8 forest types and 38 sub-types as per Champion and Seth's classification (1968). The region of Pabbar Valley is located in district Shimla, the eastern most part of state. The area is rich in

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floral diversity owing to unique physiographic and climatic conditions. There are around 3400 species of plants found in state (Kumar *et al.*, 2017) and present area is represented by 1326 species (Collet, 1921). The cultivations of some endangered and marketable medicinal plants has been encouraged by the Govt. under diversified economic policy and to avoid over exploitation of species in nature. One medicinal garden has been established in the region at village Dumreda (2438 m) to promote cultivation of rare and endangered species and encourage villagers to learn and adopt the method of cultivation of these medicinal plants. But only a few species are cultivated successfully like *Aconitum heterophyllum*, *Angelica glauca* etc.. However, at village level only one plant species *Saussurea costus* (Kuth) is cultivated successfully.

Until nineties, the traditional way of life had seen little change over the centuries. However, in past two decades ways of life has changed tremendously, with the introduction of fruit crops, construction of more roads and expanding tourist industry. The economic conditions of local people is also improving. There is now less dependency on traditional medicinal practices, consequently the knowledge on use of medicinal plants is also eroding. Therefore, it is essential to carry out the systematic ethnobotanical investigations and research on local traditional medicinal knowledge before it is lost completely.

The aim of present study was to investigate the traditional knowledge on the plants used for medicinal purpose with botanical name, family, common name, plant part used, prescriptions and preparation of folk medicine and supplemented with statistical data such as Use value (UV) and Informant Consensus Factor (ICF). The ethnobotanical studies of plants have taken many paths, sometime testing hypothesis of use knowledge (Reyes-Garcia *et al.*, 2005) and sometime describing the use of plants in given cultural context. (Gazzaneo *et al.*, 2005; El-Darier & El-Mogapsi, 2009). No quantitative analysis of medicinal flora from the region has been done so far and only a limited records of medicinal flora of Shimla district is available (Chauhan, 1999; Chauhan *et al.*, 2012; Singh & Thakur, 2014). The study would contribute to collection and enrichment of data on medicinal plants and would contribute to conservation and sustainable use of medicinal plants in the region.

Materials and Methods

Study area

The study was conducted in Pabbar Valley of District Shimla, Himachal Pradesh located in the eastern most

part of state. The mountains and river valley stretches from North to South forming undulating terrace, having natural long and open pastures at the high area. The elevation ranges from 1200m to 5200m. The area is located between 77°-29'-40" to 78°-18'-42" and 30°-57'-0" to 31°-25'-20" North in Rohru Sub division consisting of three different blocks Jubbal, Rohru and Chirgaon. The study area shares its border with tribal district of Kinnaur and Uttarakhand state (Fig.1 & Fig.2).

The climate of region ranges from Sub-temperate to Alpine. The area has average rainfall of 1310.8 mm mostly in July & August (Prasad & Sharma, 2016). The maximum temperature during summer rises to 34°-36° C and winters are very cold with temperature falling to subzero and most of the area remains snow covered. The villagers are very simple, hard working with agri-horticulture and animal husbandry as primary source of food and income.

Field data collection

Present study was conducted to explore and identify the medicinal plants and record the indigenous knowledge of utilization of these plants. The field survey was conducted from 2014-2016. The information was gathered from 92 informants both male and female. The ages of informants were between 29 to 83 years. The informants were briefed about study requirements and prior oral consent was taken from the informants about sharing the knowledge. The information was gathered by conducting interviews, group discussions, semi structured questionnaire and field observations. The informants were asked to share the knowledge about common name of medicinal plant species, place where species were gathered, life forms, plant parts used, mode of drug preparation and its application.

The specimens of plants were photographed, collected from the study site preserved as herbarium after mounting on standard herbarium sheets (Jain & Rao, 1977). The plants were identified with the help of existing standard literature available on the flora of the region; Flora Simlensis; Collett, (1921); Flora of Bashahr Himalayas; Nair, (1977); Flora of Himachal Pradesh; Chowdhery & Wadhwa, (1984); Flowers of Himalaya; Polunin & Stainton, (1984) and deposited at LBS GC Saraswati Nagar College, Distt. Shimla H.P. The name of plants were further verified following the website; <http://www.theplantlist.org/>.

Data analysis

The analysis of ethnomedicinal data was done statistically. Over the last decade in particular, ethnobotany has tended to become more analytical, quantitative, and



Fig. 1: Map of Himachal Pradesh.



Fig. 2: Map of study area (Marked).

multi-institutional (Hamilton *et al.*, 2003). In present study also two statistical parameters viz; Use value(UV) and Informant Consensus Factor (ICF) were analysed.

Use Value (UV)

In order to calculate the relative importance of native medicinally important plant species for a particular disease Use value by Phillips & Gentry (1993); a quantitative method was applied by taking the number of informants mentioning uses of a given plant into account. The Use values index is calculated as:

$$UV = \sum U_i / n$$

Where U_i is the number of use-reports cited by each informant for a given species; where N refers to the total number of informants.

Informant Consensus Factor (ICF)

In order to determine potentially effective medicinal plants the Informant Consensus Factor (ICF) was calculated based on Trotter and Logan (1986); Heinrich (1998); Ugulu *et al.*, (2009); Upadhyay *et al.*(2011). This index has been used for assessing the importance of medicinal plants used for treatment of particular ailments or use-categories. This can be calculated using the formula:

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

Where N_{ur} refers to the number of use-reports for a particular use category; N_t refers to the numbers to taxa

used for a particular use category by all informants.

Results and Discussion

Informants

A total of 92 informants (62 Males and 30 females) were interviewed. The age of informants ranged between 29 to 82 years. Out of 62 males, 18 male informants have no formal education (29.03%) and (70.97 % were literate. Similarly in case of female informants (62.50%)

Table 1: Demographic description of the informants.

	Male	Female
Informants	67.39%	32.60%
Age Class		
21-30	2 (3.22%)	4(13.33%)
31-40	5(8.06%)	5(16.66%)
41-50	18(29.03%)	11(36.66%)
51-60	14(22.58%)	3(10.00%)
61-70	13(20.96%)	4(13.33%)
71-80	9(14.51%)	3(10.00%)
81-90	1((1.61%)	—
Educational Level		
Never attended School	18(29.03%)	12(43.33%)
Up to 1-5 th class	11(17.74%)	3(10.00%)
Up to 6-10 th Class	20(32.25%)	7(23.33%)
Up to 12 th Class	8(12.90%)	4(13.33%)
Graduation	5(8.06%)	4(13.33%)

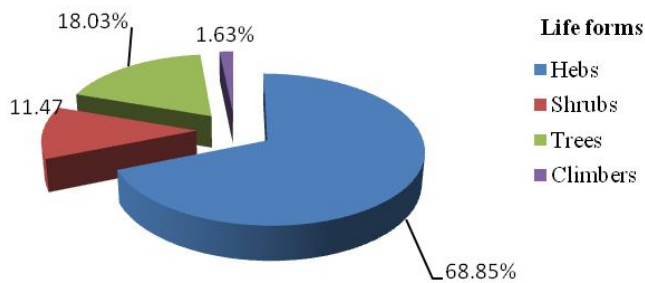


Fig. 3: Life forms of ethnomedicinal plants.

literate and (37.50%) were illiterate (Table 1). The knowledge on medicinal plants was not homogenous as elderly people were more knowledgeable than young.

Taxonomic diversity of Medicinal plants in the study area

The North Western Himalaya region has wide variation in altitudes, dissimilar topography and different climatic conditions, consequently this area becomes extraordinarily rich repository of medicinal wealth. The study reported the use of 61 ethnomedicinal plants species belonging to 34 families. (Table 2) provide the information on scientific name, family, vernacular name, life forms, plant parts used and mode of a preparation of drug and administration.

The life form of medicinal plants includes trees, shrubs, herbs and climbers (Fig. 3). Herbs were the most common form used (68.85 %) followed by trees (18 %), shrubs (11.47%) and climbers (1.63%), similar to other studies by (Rani *et al.*, 2013; Pangal *et al.*, 2010; Kumar *et al.*, 2011; Singh *et al.*, 2017). The dominance of herbs (68.85%) in preparation of medicine may be because they are easily found in nearby area than trees and shrubs (Lulekal *et al.*, 2013; Bhat *et al.*, 2013).

The plants were distributed in 34 plants families with Polygonaceae (5 sp.) most represented family followed by Lamiaceae, Apiaceae Ericaceae, Ranunculaceae with

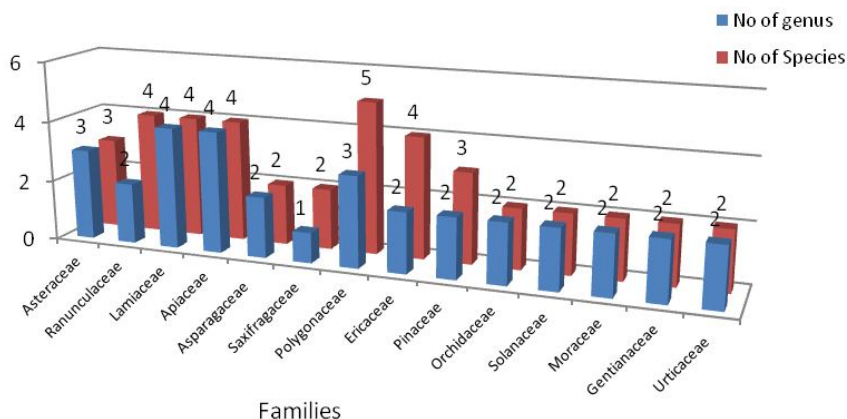


Fig. 4: Most represented families of ethnomedicinal plants from Pabbar Valley.

(4 sp.) each, Asteraceae and Pinaceae with (3 sp.) each, and 20 families were represented by single genera and single species each (Fig. 4). The medicinal plants belonging to families Polygonaceae, Lamiaceae, and Apiaceae were also cited as important in many pharmacological works of Wali *et al.* (2019); Sharma *et al.* (2014); Ahmad *et al.* (2014) in Western Himalayas.

Plant parts used, mode of drug preparation and administration

For the preparation of folk medicine different plant parts such as whole plant, leaves, flowers, fruits, seeds, stem, roots, rhizomes, tubers, bark/gall, resin, latex, and oil were used. Leaves were the most part used (32.91%), followed by roots (22.78%), whole plant (7.59%), fruits & rhizome (6.32% each), flowers (5%), stem & bark (3.79% each), seed, tuber, resin (2.53% each), latex, oil and gall contributing (1.26%) each (Fig. 5). Use of aerial parts (60.78%) was higher than underground parts (31.63%) and whole plant use was only (7.59 %). Use of leaves (32.91%) in present study and in most of the studies suggests that they were mostly used for the preparation of medicines. The reasons why leaves are mostly used is that they can be collected very easily than underground parts. Leaves are active site for photosynthesis and for production of active metabolites and volatile compounds, which makes them medicinally important, hence, mostly used in medicine preparation (Castellani, 1999; Ghorbani, 2005; Giday *et al.*, 2009). The preference of leaves have also been recorded by Namsa *et al.* (2011) in Monpa ethnic group; Ragupathy *et al.* (2008) in Kani tribe; Bhattarai *et al.* (2010) in Nepal. Roots were second preferred part for the preparation of folk medicine probably roots consist of actively rich ingredients and can be stored for future use which is a common practice in the area and elsewhere (Gorbani, 2005; Bisht *et al.*, 2013; Kunwar *et al.*, 2006).

Information on ethnomedicinal plants were recorded widely used for treatment of various ailments such as common day to day problems or infections, fever, cold, cough, congestion, stomachache, headache, toothache, diabetes, diarrhoea, dysentery, jaundice, poisonous, tonic, cuts, wounds, sprains and skin problems. All the ailments were categorized into 12 broad ailment categories. Different plant parts preparations such as paste, powder, decoction, extract/juice, poultice, tea, cooked, oil and smoking were used

Table 2: Ethnomedicinal plants used by rural people of Pabbar Valley, Himachal Pradesh.

Sr. No.	Botanical Name	Common Name	Habit	Part used	Disease/disorder cured	Mode of preparation	Use value $\sum U_i/N$
1	<i>Achillea millefolium</i> L. (Asteraceae) (PVR-6)	Banajwain	Herb	Leaves	Cold, fever	Leaves are boiled in water with sugar or jaggery, decoction taken orally.	0.065
2	<i>Aconitum deinorrhizum</i> Stapf. (Ranunculaceae) (PVR-8)	Roots, leaves	Herb	Roots	Asthma, allergy, psychoactive, poisoning.	Smoking root powder in hubble-bubble. Root powder applied on skin to treat allergy, care has to be taken to avoid application on bruised parts.	0.141
3	<i>Aconitum heterophyllum</i> Wall. ex Royle (Ranunculaceae) (PVR-9)	Patish	Herb	Roots	Digestive and respiratory disorders.	Root powder taken with jaggery	0.293
4	<i>Aconitum violaceum</i> Jacq. ex Stapf, (Ranunculaceae) (PVR-10)	Dudhi-Mora	Herb	Roots	Digestive disorders, respiratory disorders, tonic, skin problems.	Roots are chewed or root powder taken orally. Root paste applied on the affected area topically.	0.391
5	<i>Acorus calamus</i> L. (Acoraceae) (PVR-11)	Boi	Herb	Roots	Fever, galactagouge, headache and oral ulcers	Dried root powder or paste applied on the affected part.	0.141
6	<i>Aesculus indica</i> (Colebr. ex Camb.) Hook (Hippocastanaceae) (PVR-13)	Kanor	Tree	Fruits	Colic pain, galactagouge	Fruit peeling given to livestock. Seed powder taken orally.	0.184
7	<i>Ajuga parviflora</i> Benth. (Lamiaceae) (PVR-15)	Ratpacha	Herb	Leaves	Dysentery, fever, haematuria and hydrocele	Leaves are boiled in water, decoction taken orally.	0.13
8	<i>Angelica glauca</i> Edgew. (Apiaceae) (PVR-22)	Chura	Herb	Roots	Digestive disorders and tonic	Root powder is drunk with water or cooked with food.	0.239
9	<i>Arnebia benthamii</i> (Wall. ex GDon) Johnst (Boraginaceae) (PVR-23)	Lal jari	Herb	Whole plant	Fever, throat problems	Juice /Extract of plant is taken orally	0.043
10	<i>Artemisia vulgaris</i> L. (Asteraceae) (PVR-25)	Chambra	Herb	Leaves	Cuts, wounds, nasal bleeding	Leaves are crushed in hands, juice squeezed and applied on cuts or wounds.	0.043
11	<i>Asparagus adscendens</i> Roxb. (Asparagaceae) (PVR-27)	Satjari, Sainsarbuti	Shrub	Tubers	Aphrodisiac, diarrhoea	Cooked tubers are eaten.	0.054
12	<i>Asplenium dalhousiae</i> Hooker (Aspleniaceae) (PVR-28)	Barun	Herb	Leaves	Boils, pimples	Leaves are crushed in pestle and mortar. paste and poultice applied on boils or pimples.	0.032
13	<i>Berberis aristata</i> DC (Berberidaceae) (PVR-29)	Karmashal	Shrub	Roots, Stem	Jaundice, pyorrhea,	Root or stem pieces are dipped in water for overnight. The extract is taken in the morning.	0.13
14	<i>Bergenia ciliata</i> (Haw.) Sternb. (Saxifragaceae) (PVR-32)	Doklambu	Herb	Rhizome, leaves	Boils, pimples, kidney stones, sprains, toothache.	Rhizome powder taken orally. Fresh leaves are mashed and poultice applied on sprains or boils. Fresh leaves are wrapped from outside.	0.141

Table 2 contd....

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Sr. No.	Botanical Name	Common Name	Habit	Part used	Disease/disorder cured	Mode of preparation	Use value $\sum U_i/N$
15	<i>Bergenia stracheyi</i> (Hook.f. & Thomon) Engl. (Saxifragaceae) (PVR-33)	Dhok-lambu	Herb	Rhizome Leaves	Kidney stones, sprains and toothache.	Root powder taken orally. Fresh leaves poultice is applied externally.	0.097
16	<i>Betula utilis</i> D.Don (Betulaceae) (PVR-35)	Bhuj	Tree	Stem, galls, leaves	Allergy, antiseptic, detoxification, headache, sprains and wounds	Powder taken orally and paste is applied externally on affected part.	0.532
17	<i>Bistorta amplexicaulis</i> (D.Don) Greene (Polygonaceae) (PVR-37)	Badi Ninahi	Herb	Roots	Fever and skin diseases	Dried root paste applied on the skin and powder is taken orally.	0.086
18	<i>Bistorta macrophylla</i> (D.Don) Sojak (Polygonaceae) (PVR-38)	Kanda re Ninahi	Herb	Roots	Skin disease, antipyretic, oral ulcers and toothache	Root is rubbed on hard surface (stone) with few drop of water, paste applied to affected part. Powder is taken orally.	0.489
19	<i>Cassiope fastigiata</i> (Wall.) D.Don (Ericaceae) (PVR-43)	Hieunshelo	Herb	Whole plant	Burns, frost bite	Whole plant is crushed in water, paste is applied on burns or frost bites.	0.054
20	<i>Cedrus deodara</i> (Roxb.) Louden (Pinaceae)	Keval	Tree	Wood oil	Skin diseases, insecticidal, rheumatism	Oil is rubbed on skin or on joints.	0.173
21	<i>Cuscuta reflexa</i> Roxb. (Convolvulaceae) (PVR-58)	Satraila	Climber	Whole plant	Diarrhoea, sprain and wounds	Crushed plant infusion taken orally or poultice applied externally	0.086
22	<i>Dactylorhiza hatagirea</i> (D.Don.) Soo (Orchidaceae) (PVR-61)	Panja, hathpanja	Herb	Roots	Burns, cuts, dysentery	Root is milled with a few drop of water, paste applied topically. Powder is taken orally or added to food.	0.228
23	<i>Datura stramonium</i> L. (Solanaceae) (PVR-62)	Datura	Herb	Seeds, leaves	Psychoactive, asthma, congestion	Smoking with Hubble-bubble. Insanity application.	0.13
24	<i>Elscholtzia polystacha</i> Benth.(Lamiaceae) (PVR-68)	Pothi	Shrub	Leaves	Cracks in feet	Crushed leaf paste applied on cracks.	0.032
25	<i>Ficus palmata</i> Forssk.(Moraceae)	Pheru	Tree	Latex	Warts	Latex applied directly on warts.	0.065
26	<i>Gastrodia falconeri</i> D.L. Jones & M.A. Clem. (Orchidaceae)	Ullu, Jangli alu	Herb	Tuber	Bloody dysentery, cuts, wounds	Tuber roasted on fire and made into small pieces given orally or tuber paste applied externally on wounds.	0.02
27	<i>Gentiana kurroo</i> Royle (Gentianaceae) (PVR-76)	Kadu	Herb	Roots	Diabetes, digestive disorders, toothache	Root powder taken orally.	0.163
28	<i>Gerardinia diversifolia</i> (Link) Friis (Urticaceae)	Kalur	Herb	Leaves	Blood purifier, boils, pimples	Leaves are meshed to a paste & applied externally. Leaves are cooked as vegetable.	0.043
29	<i>Hedychium spicatum</i> Buch.-Ham.(Zingiberaceae) (PVR-80)	Van haldi	Herb	Rhizome	Digestive disorders, cough	Rhizome powder taken orally or cooked with food .	0.097

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Sr. No.	Botanical Name	Common Name	Habit	Part used	Disease/disorder cured	Mode of preparation	Use value $\sum U_i/N$
30	<i>Heracleum lanatum</i> Michx.(Apiaceae) (PVR-81)	Shalendalohgass	Herb	Whole plant	Boils, pimples	Crushed plant paste applied externally.	0.021
31	<i>Juglans regia</i> L. (Juglandaceae) (PVR-87)	Khod	Tree	Fruits, leaves, bark	Tonic, toothache, alopecia,	Fruit peelings are rubbed directly on affected skin. Leaves or bark chewed to relieve toothache.	0.228
32	<i>Malva verticillata</i> L. Malvaceae (PVR-93)	Shrotali	Herb	Roots	Galactagouge, placental removal	Roots are cooked with grains and given as feed.	0.054
33	<i>Meconopsis aculeata</i> Royle (Papaveraceae) PVR-94	Kakdewla	Herb	Roots	Stomachache, tonic	Dried root powder taken orally	0.021
34	<i>Morina longifolia</i> Wall.(Caprifoliaceae) (PVR-98)	Katrandra	Herb	Roots, Leaves	Digestive disorders	Dried powder taken orally	0.054
35	<i>Morus serrata</i> Roxb. (Moraceae) (PVR-99)	Keemu	Tree	Bark	Cough, fever, toothache	Bark powder boiled with water decoction taken orally. Bark chewed directly.	0.097
36	<i>Nicotiana tobacum</i> L. (Solanaceae) (PVR-101)	Tambaku	Herb	Leaves	Sprains, psychoactive	Fresh leaves are heated with clarified butter (<i>ghee</i>) and applied on swollen surface. Dried leaves powder is smoked.	0.076
37	<i>Origanum vulgare</i> L. (Lamiaceae) PVR-102)	Jakham Buti	Herb	Leaves	Wound healing, antiseptic	Leaves are crushed inside the hands with saliva or water drops. Extract applied on wounds.	0.163
38	<i>Picrorrhiza kurooa</i> Royle ex Benth.(Scophulariaceae) (PVR-111)	Kadvi	Herb	Roots Leaves	Stomachache, diabetes, antipyretic, jaundice, vomiting	Root powder boiled in water with addition of some sweetener taken orally. Leaves are chewed.	0.478
39	<i>Pinus roxburghii</i> Sarg. (Pinaceae)	Chaluta, Chirh	Tree	Resins	Antiseptic, cracks in feet	Resin applied directly	0.032
40	<i>Pinus wallichiana</i> A.B. Jackson Pinaceae)	Chilta, kail	Tree	Resins	Antiseptic, cracks in feet, fracture	Resin applied directly on the cracks.The bark pieces from young shoots are tied on broken bones as bandage.	0.097
41	<i>Pistacia integerrima</i> J.L.Stewart ex Brandis (Anacardiaceae) PVR- 114)	Kakda	Tree	Fruits (galls)	Cough, eye inflammations, fever	Dried fruits (gall) are powdered & taken orally or paste applied externally.	0.097
42	<i>Plectranthus rugosus</i> Wall. ex Benth (Lamiaceae). (PVR-117)	Chichri	Shrub	Leaves	Insecticidal	Leaves are crushed , the extract is applied on skin or rubbing leaves directly on the skin surface.	0.076
43	<i>Pleurospermum brunonis</i> (DC.) C. B. Clarke (Apiaceae) (PVR-118)	Nesar	Herb	Leaves, flowers	Fever, insecticidal	Crushed powder taken with water or tea. Dried plant parts are kept along with woolen clothes to keep insects away.	0.119
44	<i>Podophyllum hexandrum</i> Royle (Podophyllaceae) (PVR-119)	Halu	Herb	Roots, fruits	Aphrodisiac, stomachache	Fruits eaten. Dried root powder taken orally	0.043
45	<i>Polygonatum verticillatum</i> (L.) All.(Asparagaceae) (PVR-120)	Mithadudhia	Herb	Rhizome	Fever, piles, rheumatic pain, toothache	Dried rhizome paste applied externally. Powder taken orally.	0.054

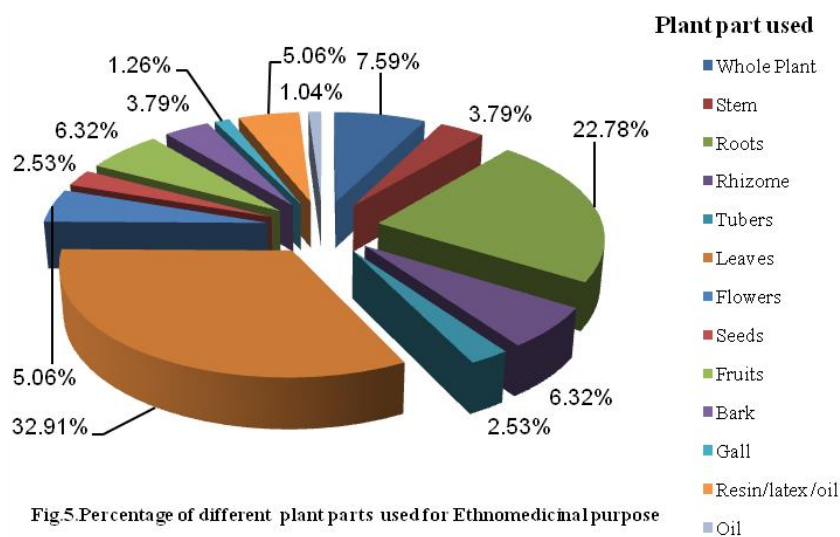
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Sr. No.	Botanical Name	Common Name	Habit	Part used	Disease/disorder cured	Mode of preparation	Use value $\sum U_i/N$
46	<i>Rheum australe</i> D.Don (Polygonaceae) (PVR-139)	Chukri	Herb	Rhizome	Digestive disorders, wounds, fever, headache, toothache	Roots are milled paste taken orally or applied externally. Dried roots are ground into a powder taken orally.	0.836
47	<i>Rhododendron anthopogon</i> D.Don (Ericaceae) (PVR-140)	Talsar	Tree	Flowers, leaves	Blood purifier and digestive disorders	Chewing fresh flowers. Decoction taken orally.	0.086
48	<i>Rhododendron campanulatum</i> D.Don (Ericaceae) (PVR-142)	Simrat	Shrub	Flowers, leaves	Skin diseases and nasal bleeding	Leaves or flowers are crushed, paste applied externally. A few drops of juice are dropped internally into the nose.	0.108
49	<i>Rhododendron lapidotum</i> Wall. ex G.Don (Ericaceae) (PVR-143)	Simrish	Shrub	Leaves	Pain, headache, wounds	Fresh leaves are crushed, paste applied externally	0.076
50	<i>Rumex hastatus</i> D.Don (Polygonaceae) (PVR-152)	Malodi	Herb	Leaves	Sprains, wounds, appetizer	Fresh leaves are meshed and applied on wounds and sprains.	0.13
51	<i>Rumex nepalensis</i> Spreng. (Polygonaceae) (PVR-153)	Malora	Herb	Leaves	Sprains, wounds and appetizer	Fresh leaves are meshed and applied on affected part.	0.086
52	<i>Saussurea costus</i> (Falc.) Lipsch (Asteraceae) (PVR-157)	Kuth	Herb	Roots	Respiratory disorders, headache and skin diseases	Dried root powder taken orally. Root paste is rubbed on forehead for headache or on affected skin.	0.271
53	<i>Swertia chirayita</i> Buch.–Ham ex Wall. (Gentianaceae) (PVR-166)	Chirata	Herb	Whole plant	Respiratory disorders, swellings	Milled plant parts are boiled in water or tea & drunk.	0.141
54	<i>Taxus wallichiana</i> Zucc. (Taxaceae)	Thuna, birmi	Tree	Fruits, bark, needles	Blood purifier	Bark or needles are boiled with tea and drunk.	0.032
55	<i>Thalictrum foliolosum</i> DC (Ranunculaceae) (PVR-170)	Bishkaral	Herb	Leaves, roots	Eye inflammations	Fresh leaves or roots are crushed to get an extract. The extract is diluted ten times before application of one or two drops at a time.	0.065
56	<i>Thymus serpyllum</i> L. (Apiaceae) (PVR-171)	Lepte	Herb	Leaves	Respirator and digestive disorders	Fresh leaves are boiled with tea and drunk.	0.195
57	<i>Trillium govanianum</i> Wall. ex D.Don (Trilliaceae) (PVR-172)	Satva	Herb	Roots	Digestive disorders, wounds and tonic	Powder or paste from dried roots taken orally or added to food.	0.304
58	<i>Urtica dioica</i> L. (Urticaceae)	Kungshee	Herb	Leaves	Blood purifier and sprains	Fresh leaves are mashed and applied externally. Cooked as vegetable.	0.086
59	<i>Viola canescens</i> Wall. ex Roxb. (Violaceae) (PVR-182)	Banafsha	Herb	Flowers	Respiratory disorders and nasal bleeding	Dried flowers after boiling with tea are drunk. Flowers powder is applied on skin and chest to alleviate fever etc.	0.239
60	<i>Viscum album</i> L. (Loranthaceae) (PVR-183)	Zaira	Herb	Whole plant	Colic pain, haematuria	Fruits are taken raw. Whole plants are fed to animals.	0.032
61	<i>Zanthoxylum armatum</i> DC (Rutaceae)	Timur	Shrub	Stem, seeds	Toothache	Chewing the young shoots or fruits.	0.076

Table 3: Consensus index (ICF) for medicinal plants.

Sr.No.	Ailment category	Number of use report (N _{ur})	Number of taxa (N)	ICF
1	Gastrointestinal Problem	155	23	0.86
2	Dermatological disorders	197	31	0.84
3	Diabetes	5	2	0.75
4	Respiratory disorders	59	15	0.76
5	Fever	137	22	0.85
6	Hepatic	9	4	0.63
7	ENT	17	5	0.75
8	Poisoning	29	6	0.82
9	Muscular / Skeletal disorder	33	14	0.59
10	Circulatory disorder	33	14	0.59
11	Urinogenital / Reproductive disorders	22	9	0.62
12	Dental Care	49	15	0.71

**Fig.5.**Percentage of different plant parts used for Ethnomedicinal purpose

for the preparation of drugs (folk medicine). The leaves were used either in paste, poultice, decoction or tea by boiling in water. In decoction form, the efficacy of herbal remedies increases due to the maximum extraction of health-beneficial secondary metabolites and other bioactive compounds (Farooq *et al.*, 2019). Some aerial parts were eaten raw for their medicinal properties. The roots were used either paste or powder form administered with water or jaggery. The mode of preparation from roots included mostly paste made by rubbing/ maceration of roots with drops of water on smooth surface of stones. The paste so formed was administered orally. Preparation of paste for the treatment of ailments was a common practice among the other tribal communities in India such as Taungya, Abor, Garo and Khasi (Poonam and Singh, 2009; Rajakumar and Shivanna, 2009; Tushar *et al.*, 2010; Upadhyay *et al.*, 2011). The mode of smoking root or

seed powder was occasionally practiced by elderly people. Preparation of tea by adding medicinal herbs for treatment of cold, cough and congestion was common remedy in every household. For the treatment of skin problems, headache and other external diseases, paste or powder was applied topically. *Aconitum violaceum* “*dudhi mora*” finds a new use pattern where the root paste is applied externally to breast of feeding mothers, so that it can be administered to infants while feeding. This is helpful in keeping digestive system of infants strong and also act as body tonic.

Statistical analysis of ethnomedicinal plants

In present times ethnobotany has

become more investigative and quantitative in studies (Hamilton *et al.*, 2003). During last decades there have been different indices formulated and applied to ethnobotany by researchers. In present survey two indices, Use value and Informant Consensus Factor were applied.

Use value

In present study Use value of ethnomedicinal plants varied from (0.02) to (0.826). The most valued plant of the area on the basis of Use value was *Rheum australe* (0.83) followed by, *Betula utilis* (0.53), *Bistorta macrophylla* (0.49),

Picrorhiza kurooa (0.48), *Aconitum violaceum* (0.39) and least valued plants were *Gastrodia falconeri*, *Heracleum lanatum*, and *Meconopsis aculeata* (0.021) each (Table 2). The value of Use Value is dynamic and changes with location and with the knowledge of the people, so the values can vary from area to area or within same area depending on the knowledge of people. This revealed that there are differences in most of the cited species and their quantitative value in similar studies in Himalayan region (Bano *et al.*, 2014; Lone *et al.*, 2015; Amjad *et al.*, 2017).

The most of the species with high Use value were alpine or high altitude The values are indicative of a general perception in the area that, *Aushadhi* or *Jadi Buti* with curing potential are found at higher altitude. *Rheum australe* is one of such example of rare and

endangered but high use value species. The species was used individually or in combination with *Picrorhiza kurooa* to cure a large number of ailments.

Informant Consensus Factor (ICF)

The informant consensus factor (ICF) value of various ailments categories in present study ranges from (0.59) to (0.86) (Table 3). Gastrointestinal ailments had maximum (0.86 ICF) followed by fever (0.85 ICF), dermatological (0.85 ICF), respiratory disorder (0.76 ICF), poisoning (0.82 ICF) and the lowest ICF was for hepatic disorder (0.63 ICF). The ICF value ranges from 0 to 1, where increasing values of this factor indicate a higher rate of informant consensus among the illness category. The average value of ICF in present study was (0.73 ICF). The highest numbers of taxa (31) were used in dermatological diseases and least number (2) were in diabetes. The harsh and extreme weather conditions, poor sanitation conditions may be the reason for the gastrointestinal and dermatological ailments. The least ICF value of (0.63) for jaundice may be due to the ratio of use-reports to number of taxa used.

Ragupathy *et al.* (2008) first published the informant consensus of medicinal plant usage with the Malasars in India and reported ICF ranging from (0.5 to 0.92) per illness category with average value for all illness categories was (0.71 ICF), indicating the value more or less similar to present study. The ICF value reported by different researchers in India, Namsa *et al.* (2011) from (0.17 to 0.56.); Kumar & Bharati (2014) of Tharu tribe in India from (0.94 to 0.98) and by (Kumar *et al.* (2011) in Garhwal Himalayas (0.33 to 1.0).

Comparison of Important medicinal plant species with previous work

In the present survey the most valued species *Rheum australe* was used for stomachache, allergy, boils, cuts, dysentery, fever, headache, swelling, toothache and wounds healing; this species was reported by Phondani *et al.* (2010) for goiter; Uniyal *et al.* (2006) to cure swelling and by Boktapa & Sharma (2010) for small pox. *Betula utilis* was the second most used plant, find its application in allergy, antiseptic, detoxification, blood purifier, cuts, headache, sprains and wounds and same plant was reported by Negi *et al.* (2011) for rheumatism, blood purifier, bone fracture and asthma; Negi & Chauhan (2009) for muscular pain and swellings. Third most cited species was *Bistorta macrophylla* used as antipyretic, oral ulcers, skin disease and blood purifier and it was documented by Kumari *et al.* (2013) for menorrhagia, asthma, joint inflammation; Khan *et al.* (2013) for sore throat, swelling of mouth and tongue. *Aconitum*

violaceum “*dudhi mora*” was another high value species used for digestive disorders, respiratory disorders, tonic, skin problems and similar use were reported by (Devi *et al.*, 2013; Negi & Chauhan 2009).

We found use of *Achillea millefolium* mainly for cold and fever; same species was reported by Kumari *et al.* (2013) for inflamed gums, toothache and as antipyretic; by Haq (2012) as stimulant, tonic, diaphoretic and diuretic. Two species *Aconitum deinorrhizum* and *Datura stramonium* were cited mainly for poisoning and insanity; similar use reports were cited by (Kumari *et al.*, 2013; Haq, 2012). *Aconitum heterophyllum* was used for respiratory and digestive disorders in present study; Uniyal *et al.* (2006); Negi *et al.* (2011) also reported its use for fever, cough and stomachache. *Acorus calamus* was used to alleviate fever, headache, oral ulcers and as galactagogue, but Boktapa & Sharma (2010) reported its use in chest congestion and bronchitis; Haq (2012) for diarrhea and dysentery. In present work *Aesculus indica* was used in colic pain and galactagogue in cattle; Rajasekaran & Sing (2009) reported its use in rheumatism and wounds. *Angelica glauca* was cited for strengthening digestive system, appetizer and tonic, while, Dutt *et al.* (2011) reported it to cure obesity.

We found *Berberis aristata* useful in jaundice and pyorrhea, but Gautam *et al.* (2011) blood purifier; Negi *et al.* (2011) in stomachache, diaphoretic and hemorrhoids. *Asparagus adscendens* was reported aphrodisiac and tonic; Kumari *et al.* (2013) also found it aphrodisiac and for hair falls. We found *Bergenia* species useful in kidney stones, boils and sprains; Negi *et al.* (2011) for stones, piles and paralysis; Phondani *et al.* (2010) for paralysis and kidney stone. In survey three species *Cedrus deodara*, *Plectranthus rugosus* and *Pleurospermum brunonis* have insecticidal properties and also used to cure skin diseases. Similar use was reported by (Sharma *et al.*, 2005; Phondani *et al.*, 2010) for *Cedrus deodara*.

Two orchid species, *Dactylorhiza hatagirea* and *Gastrodia falconeri* were used mainly for dysentery, burns, cuts and tonic. *Dactylorhiza hatagirea* was reported by Devi *et al.* (2013) for backache, sexual problems, tonic, cuts and wounds; Lal & Singh (2008) for wounds; Negi *et al.* (2011) to cure wounds, cuts, fever and dysentery.

Gentiana kurroo found its use in diabetes, diarrhoea, gastritis, toothache and vomiting; (Dutt *et al.*, 2011; Thakur *et al.*, 2014) for fever. *Picrorrhiza kurrooa* was mostly used for stomachache, diabetes, antipyretic, jaundice and vomiting, similar use were

reported by Rani *et al.* (2013). *Juglans regia* was used in toothache and alopecia, similar use were documented by Singh *et al.* (2017; Semwal *et al.* (2010).

Origanum vulgare, *Meconopsis aculeata*, *Morina longifolia*, *Podophyllum hexandrum*, *Rhododendron spp.*, *Saussurea costus*, *Swertia chirayita*, *Taxus wallichiana*, *Thymus serpyllum*, *Trillium govanianum*, *Viola canescens* and *Zanthoxylum armatum* were other important species reported from area for its medicinal properties. The plants reported in present study, some of them were also documented in the other studies conducted on ethnomedicinal plants of Himachal Pradesh by (Dutta *et al.*, 2011; Negi *et al.*, 2011; Devi *et al.*, 2013; Rani *et al.*, 2013; Thakur *et al.*, 2014), but they vary in their mode of use.

Most of the species, reported in present work for curing many ailments are high altitude species. Out of these (18) species have been listed by IUCN Red List Criteria as endangered, vulnerable and threatened due to over harvesting for commercial value by individuals or agencies and some are at the verge of extinction (Pandey *et al.*, 2006). Beside this indigenous knowledge and practice of use of medicinal plants in rural areas is passed down through oral traditions. Among young generation due to change in life style and refocusing of interest were some of the reasons for loss of interest in traditional knowledge on medicinal plants. Preserving and enhancing the traditional knowledge on medicinal plants is equivalent to “rescuing a global heritage” Kunwar & Bussamann (2008). So high priority need to be given to the documentation and conservation of traditional knowledge of these plants in interior places like Pabbar valley.

Conclusions

The traditional ethnobotanical knowledge on use of medicinal plant species is passed orally from generation to generation without any written record in the present area and world over. With the developmental activities traditional healing knowledge on medicinal plants is also declining. The study was conducted for the documentation of use of medicinal plant species by local communities of Pabbar Valley. A total of 61 species belonging to 34 families were used to treat one or other ailments. *Cassiope fastigiata* and *Gastrodia falconeri* with medicinal use was reported for first time and need further investigations. The harvesting of medicinal plants through destructive means i.e. underground parts in present study are very high (31.63%) which could be dangerous to survival of these species in nature. Anthropogenic pressure on forest, unscientific commercial gathering of

medicinal plants for trade are some of the reasons for severe depletion of species in the area.. Suitable measures are needed to conserve and protect the medicinal plant species in local ecosystem for future sustainable use. Encouraging commercial cultivation is one of the measures for fulfilling the ever increasing demand of medicinal plants market. One species *Saussurea costus* is cultivated in the area. Many more species needed to be brought to this ambit by providing all needed training and financial help to people to promote such activities. The cultivation of high value medicinal plants by farmers will help in improving their economy and at the same time conserving endangered species.

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