Traditional usage of plant resources in Ethnoveterinary practices in Spiti valley of Himachal Pradesh, Northwestern Himalayas India

Rohit Bishist, Deachen Wangmo, Bhupender Dutt and Krishan Lal Gautam

Correspondence

Rohit Bishist[a], Deachen Wangmo, Bhupender Dutt and Krishan Lal Gautam*

Department of Silviculture and Agroforestry, College of Forestry, Dr. Yashwant Singh Parmar University of Horticulture and Forestry Nauni, Solan, 173230, Himachal Pradesh, India.

*Corresponding Author: krishanlalgautam99@gmail.com

Ethnobotany Research and Applications 24:11 (2022)

Research

Abstract

Background: To best of our knowledge it is first quantitative study of ethnoveterinary practices from Spiti valley of Northwestern Himalayas. Spiti valley lies in cold arid zone of Himachal Pradesh and most of the high-altitude villages in this region remains cut off from rest of the world during a major part of the year (November-May).

Methods: A total of 48 respondents, 45-80 years old and including farmers, shepherds, housewives and herbalists familiar with livestock problems and use of conventional recipes, were interviewed and their responses recorded in detail. The data was analyzed by using three different quantitative indices *viz*. Use value (UV), Informant consensus factor (ICF) and Fidelity level (FL %).

Results: A total of 26 species were used in ethnoveterinary practices, distributed among 17 families and 25 genera. The UV was found to be highest in *Brassica campestris* (UV=0.95) followed by *Lactuca macrorhiza* (UV=0.62). The FL was found to be highest (100%) in *Bunium persicum, Oxytropis lapponica, Sassurea bractaeta, Lactuca macrorhiza* and *Cousinia thomsonii* for its use in treatment of diarrhea, dysentery, wound healing, neck sore, as a galactagogue and for the treatment of local swellings. Highest ICF was found in case of anestrus, animal bite followed by galactagogue.

Conclusion: Study concluded that 26 plant species used in ethnoveterinary practices to cure the various ailments. Scientific validation of different plant species with high UV and FL should be conducted in future for the optimum utilization of these species in animal health care.

Keywords: Amchis, Cold desert, Ethnoveterinary, Medicinal plants, Spiti valley

Background

Ethnoveterinary medicine is a system that is based on folk beliefs, traditional knowledge, skills, methods and practices used for curing diseases and maintaining health of animals (Tabuti *et al.* 2003). Traditional medicine forms a valuable resource for the development of new pharmaceuticals (Iwu, 1994). Botanical derived medicinal plants play a major role in human society (Lewis and Elwin 2003). Traditional veterinary medicine knowledge is handed down orally from generation to generation and it may disappear because of galloping socioeconomic,

Manuscript received: 19/07/2022 – Revised manuscript received: 19/09/2022 - Published: 22/09/2022
http://dx.doi.org/10.32859/era.24.11.1-24

environmental, technological changes and as an upshot the loss of cultural heritage under the guise of civilization (Nfi *et al.* 2001). For primary medical care and keeping animals healthy and productive, ethnoveterinary medicine has been used extensively and effectively since ages. Ethnoveterinary medicines are often cheap, safe, time tested and based on local resources and strength and can provide useful alternatives to conventional animal health care (Kumar, 2002). Information from indigenous traditional herbal medicine has a played vital role in the discovery of novel products from plants as chemotherapeutic agents (Katwa *et al.* 2004). Notable studies in respect of herbal medicinal plants have been conducted in different districts of Himachal Pradesh by (Arya *et al.* 2012) in Kangra; (Sharma and Sood, 2013) in Solan; (Singh and Thakur 2014) in Shimla; (Thakur *et al.* 2014) in Chamba; (Rani *et al.* 2015) in Chamba, Kangra Hamirpur and Mandi; (Prakash *et al.* 2021) in Shimla and (Thakur *et al.* 2016) in Chamba. Similar studies have been reported by (Mir *et al.* 2021) in Jammu and Kashmir; (Mir *et al.* 2022) in Bandipora district of Kashmir Himalayas; (Mir *et al.* 2021) in Lolab valley, Kashmir Himalaya; (Rajkumar and Shivanna 2009) in Shimoga district of Karnatka and (Jan *et al.* 2021) in Baramullah district of Jammu and Kashmir. However, the literature pertaining to the ethnoveterinary practices followed in the Spiti region of Himalayas is still unavailable.

Spiti, a land of rugged mountains, deep gorges and sparsely distributed vegetation, is remote region in northern most part of India which spans over an area of 5582 km^2, It is a typical cold desert with bare mountain; however it encompasses the rich Trans-Himalayan fauna and flora. The vegetation is broadly classified as dry alpine steppe (Champion and Seth 1968). Due to unavailability of modern health care facilities people of the region rely upon "Amchis medicinal system" for curing human and animal diseases and this practice of herbal use in medicine is also known as "Tibetan system of medicines". People of Spiti collect medicinal plants mostly in August and September from different parts of valley and as most of the medicinal parts are much localized. With the changing lifestyle of Buddhist community this old age practice of herbal use is also in jeopardy. The plants used by the local dwellers of Spiti valley in ethnoveterinary practices need to be documented properly to preserve the valuable information about ethnoveterinary practices used by local dwellers of Spiti valley. We hypothesized that due to the remoteness of the area, ethnoveterinary practices of Spiti valley would considerably differ from other parts of the Himachal Pradesh and the study was planned with the objective to document the traditional usage of plant resources in ethnoveterinary practices. The data collected from the informants was further analyzed by using various numerical indices and compared with previous studies to determine the novelty of the research

Materials and Methods

Study area

The present study was carried out at Mane, Hansa, Kibber and Kaza villages of Spiti valley of Himachal Pradesh, India which is located at an elevation of 3400-4200 m above mean sea level (Fig. 1). The area comes under Trans Himalayan arid zone, bounded by Tibet in the northeast, Kinnaur in southeast, Kullu in west and Ladakh in north. In Spiti region of Himachal Pradesh cattle, yak, churu (cross of local cattle with Yak), sheep and goat are primarily reared by local farmers to meet out their household nutrient demands. Spiti a typical cold desert, bare mountain and sparsely distributed vegetation covers an area of 5582 km^2 is a sub-division of Lahaul and Spiti district where only Bodh community is confined. Spiti valley lies between 31^0 42′-32^0 58' N and 77^0 21′-78^0 35′ E. Being in a unique geographical location, the climate of the area is extremely dry and cold with high diurnal temperature variation with a minimum of -18°C to a maximum of 10°C in peak winter, and with a minimum of 13°C to a maximum of 24°C during hot summer with a scorching sunlight due to intensive ultraviolet radiation. June and July are considered as the hottest months whereas December and January as the coldest months, winters are accompanied by a heavy snowfall which suppress large amount of regeneration in the area, but rainfall is witnessed rarely. The average annual rainfall is 170 mm (6.7 inches).

Most of the population in the study area depends on agriculture and animal husbandry for their livelihoods. In Spiti, vegetation is quite sparse and mostly represented by shrubs (*Hippophae rhamnoides, Artemisia maritima* and *Ephedra gerardiana*) and herbaceous plants like *Allium carolinianum, Aquilegia fragrans, Arnebia euchroma, Dactylorhiza hatagirea, Thymus linearis*) etc. Tree species are almost absent except Juniper, Poplar, *Robinia* and Willows planted around human habitations.

Ethnoveterinary survey, data collection and identification

Ethnoveterinary information on shrubs, herbs, trees and their products used for animal health care are collected through semi structured (Annexure 1) interviews and guided fieldtrips with the help of traditional healers. A total of 48 respondents, ranging from 45-80 years old and including farmers, shepherds, housewives and herbalists (Amchis) familiar with livestock problems and use of conventional recipes, were interviewed and their responses recorded in detail. The information regarding plant species and parts of the plant used in ethnoveterinary practice,

dosage of plant preparation, mode of administration and efficacy against particular disease condition was collected. The unidentified plants were photographed in the field and verified with the help of expert consultation. Number of traditional healers were low due to population density of 2 km^{-2} of Lahaul Spiti district has the lowest population density in Himachal Pradesh. Plant species were collected; photographed and essential data were documented on the spot. Ethnomedicinal plants were collected during the flowering and fruiting stages in triplicate.

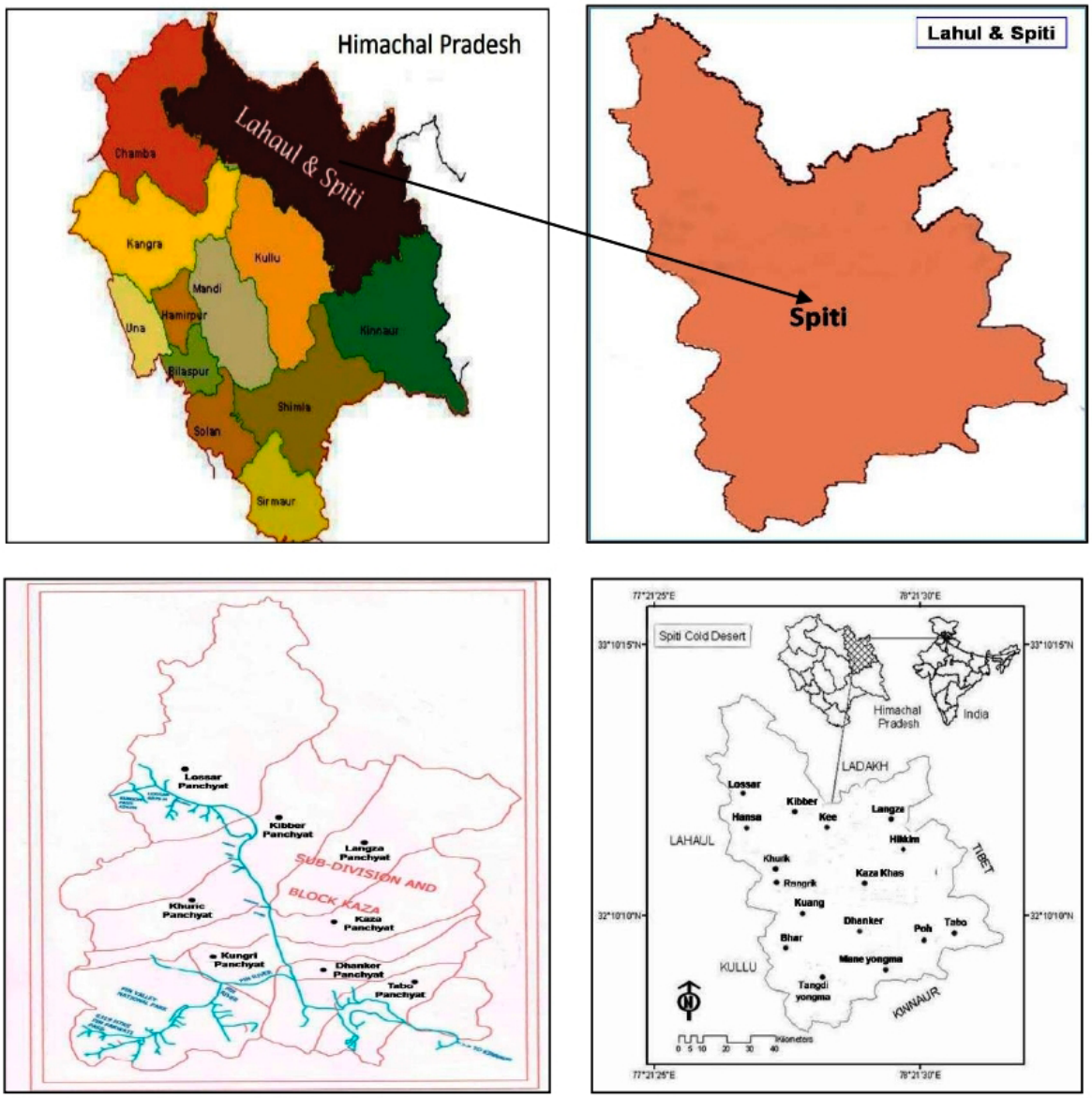

Figure 1. Map of the study area

All the plants were dried, pressed, preserved and mounted on the standard herbarium sheets. The plant species were identified by a plant taxonomist and names of medicinal plant species were verified and specimens were deposited in the herbarium of the Department of Forest Products, Dr YSP University of Horticulture and Forestry Nauni Solan HP India for future reference. The secondary information was accumulated by using several research papers, textbooks, publications and from online portals like Research Gate, Cera and google scholar. The size of the family and education status of households is shown in Table 1.

Data analysis

The data collected through direct interviews of the local people and traditional healers using semi structured questionnaire in different villages of Spiti valley was analyzed by using three different quantitative indices *viz*. Use value (UV), Informant consensus factor (ICF) and Fidelity level (FL %). For each species the use value was calculated employing the methods as described by (Phillips *et al.* 1994).

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

Where, U is the number of plants reported by each informant for a given species, n is the total number of informants and ∑U is total reports of that particular plant for any disease. Second quantitative method was fidelity level (FL %) which determine the most preferred species used in treatment of particular ailment because many plant species may be used in the same use category (Friedman *et al.* 1986). Fidelity level was calculated as:

$$FL\ (\%) = \frac{(np)}{N} * 100$$

Where, np is use report of a particular species in a particular ailment and N is total use reports of a particular species in any ailment. High FL value (near 100%) was obtained for plants for which almost all use reports refer to the same way of using it. Low FL value was obtained for plants that are used for many different purposes.
The third method employed in the data analysis was calculating the informant consensus factor (ICF), which test homogeneity of knowledge about the use of ethno medicinal plants (Heinrich *et al.* 1998). ICF was calculated as:

$$ICF = \frac{nur - nt}{nur - 1}$$

Where, n_{ur} is total use reports of all the species in particular ailment and nt is the number of species used per category of use. ICF values ranges from (0-1). ICF values are low near (0) if plants are chosen randomly or if there is no exchange of information about their use among informants. ICF approaches one (1) if information is exchanged between informants or there is high agreement between them (Gazzaneo *et al.* 2005).

Table 1 .Size of the family and education status of sampled households in Spiti valley

Particulars	Marginal	Small	Semi medium	Overall
Average number of men	4.22 (51.91)	4.33 (53.66)	3.87 (52.51)	4.18 (52.58)
Average number of women	3.91 (48.09)	3.73 (46.22)	3.5 (47.49)	3.77 (47.38)
Average size of family	8.13 (100)	8.07 (100)	7.37 (100)	7.95 (100)
Sex Ratio	**926.54**	**861.43**	**904.39**	**901.58**
Illiterate	2.13 (26.17)	1.6 (20.67)	0.94 (14.3)	1.72 (22.32)
Primary	1.91 (23.46)	2.00 (25.84)	1.69 (25.7)	1.89 (24.61)
Middle	2.09 (25.68)	2.13 (27.52)	1.57 (23.8)	1.99 (25.92)
Matric	0.91 (11.18)	1.27 (16.41)	1.63 (24.71)	1.17 (15.24)
Senior Secondary	0.78 (9.58)	0.47 (6.07)	0.57 (8.59)	0.64 (8.3)
Graduate	0.32 (3.93)	0.27 (3.49)	0.19 (2.89)	0.28 (3.61)
Total	8.14 (100)	7.74 (100)	6.58 (100)	7.69 (100)
Literacy rate	73.83	79.33	85.70	78.02

Results

Herbs and plant species used in ethnoveterinary practices

Information on 26 species used in ethnoveterinary practices was collected from 48 respondents of Spiti valley. These plants were distributed among 17 families, 25 genera and 26 species *i.e.* Angiosperm (16 family, 24 genera and 25 species) and Gymnosperm (1 family, 1 genera and 1 species). In the study, 22 spp. of herbs, 1 tree spp. and 3 shrub spp. were identified for ethnoveterinary uses. As species richness decreases along the altitudinal gradient, distribution of species (20 species) was found in the 3000- and 4000-meter zone and 6 species were found between 4100-5500 meter above mean sea level. The medicinal plants used in ethnoveterinary practices belonged to the family Asteraceae (5 species), Lamiaceae (3 species), Polygonaceae, Apiaceae, Ranunculaceae (2 species each), Scrophulariaceae, Ephedraceae, Leguminosae, Berberidaceae, Tamaricaceae, Elaeganaceae, Poaceae, Salicaceae,

Brassicaseae, Oleaceae, Boraginaceae and Alliaceae (1 species each). Notable native species used in ethnoveterinary practice were *Aconitum violaceum, Aconitum heterophyllum, Arnebia euchroma, Picrorhiza kurroa*, *Saussurea bracteata, Podophyllum hexandrum, Carum carvi, Artemisia maritima, Bunium persicum, Myricaria germanica, Mentha longifolia, Lactuaca macrorhiza, Rheum emodi, Hyssopus officinalis, Hordeum vulgare, Salix daphnoides, Thymus serphyllum, Cicer microphyllum,* etc. Dominance of medicinal plant species could be attributed to their wider distribution, abundance and availability for their use in the study area. Distribution of plants in different families is represented in Figure 2.

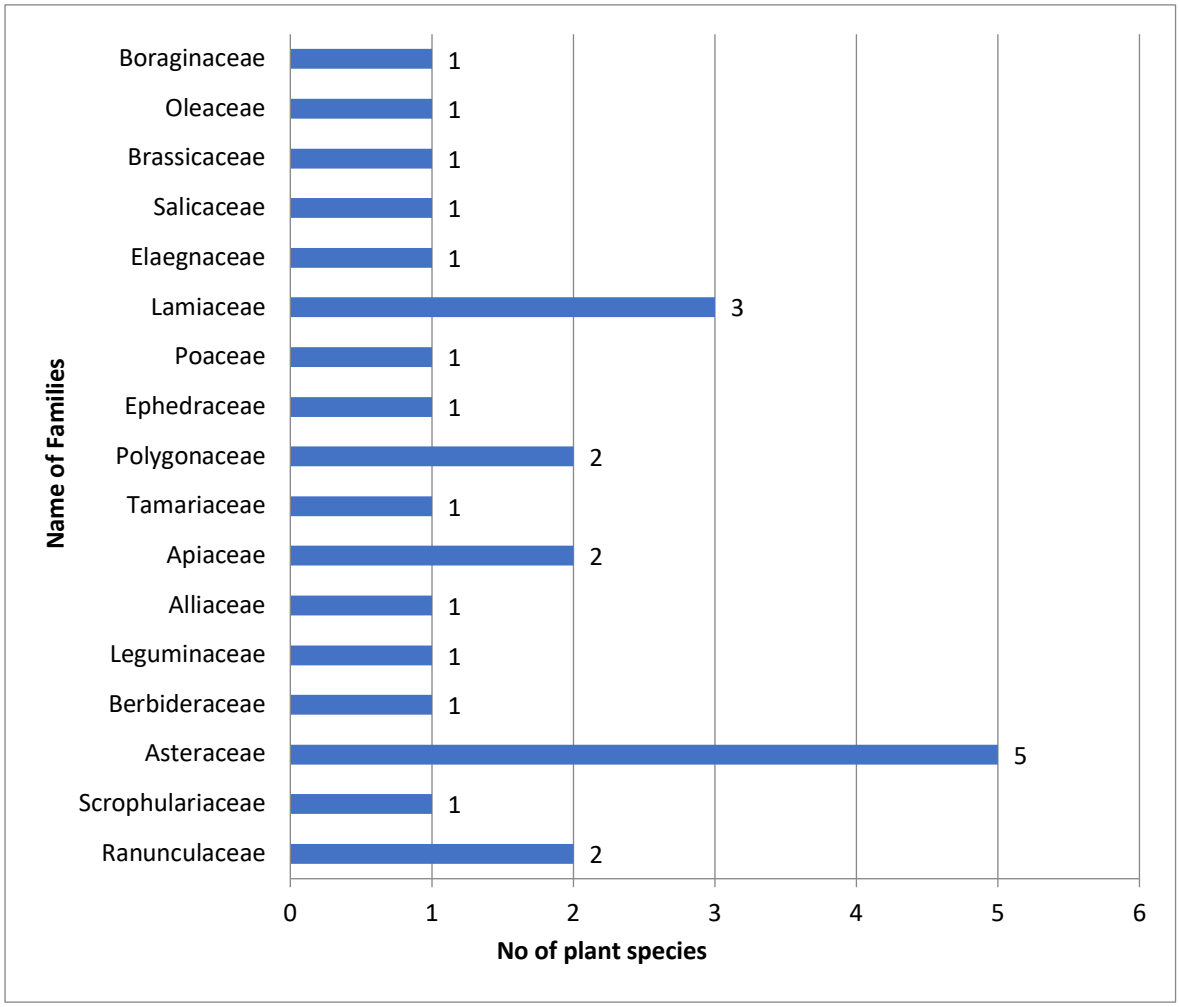

Figure 2. Families and species of plants used in ethnoveterinary practice

Ethnoveterinary approaches

The respondents in the study revealed that the disease is identified and diagnosed by the local farmers and Amchis by different methods like noticing the breath sounds, palpation of pulse in the tail of the animal and symptoms like restlessness, frequent sitting and standing and rolling on ground etc. Different plant parts were used by the local people and traditional healers for the treatment of various diseases of animals. Among the plant parts, roots/rhizomes (9) were found to be the most frequently used part for the treatment of various ailments followed by aerial parts (10), whole plant (4), seeds (3), fruits/fruit residue and stem (2). Use of aerial parts (leaves, flower) for medicinal purpose indicates either easy availability of these plant parts or they may have strong medicinal properties. Distribution of plant parts used for treating various ailments is represented in Figure 3.

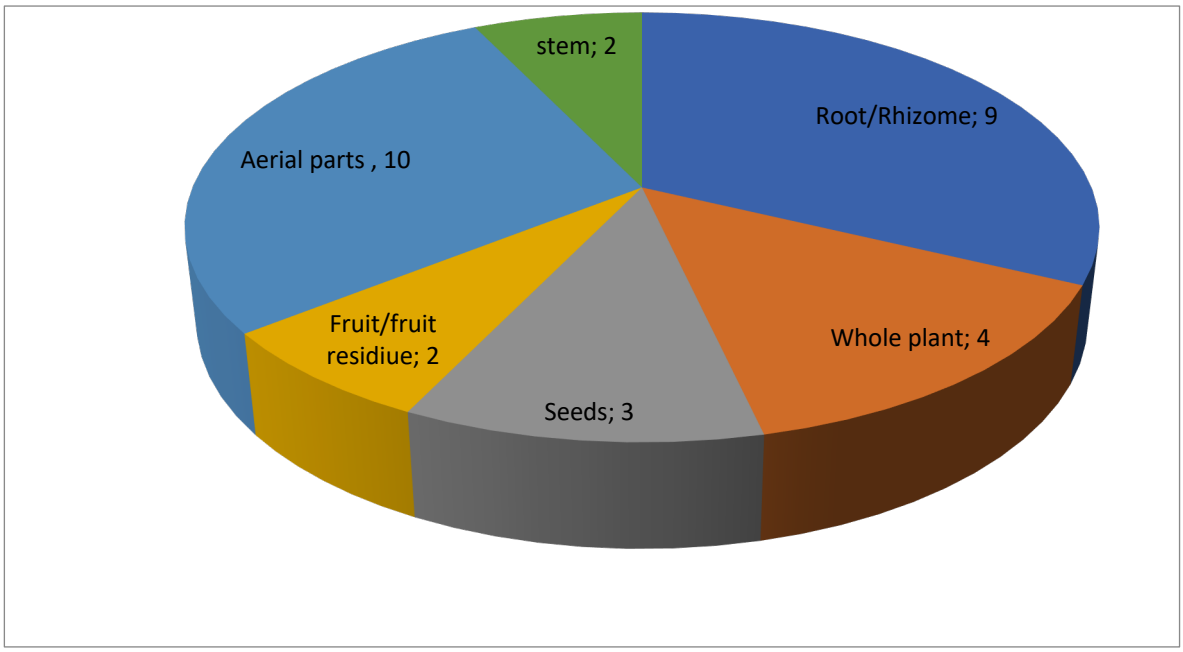

Figure 3. Plant parts used in treating various ailments

The herbal preparations made for treatment of various disorders are administered orally, paste application, though inhalation and fomentation etc. Herbal preparations were administered in the form of powder (15), raw (8), decoction and paste (6 each), leaf extract (4), oil (3), fruit and seed residue (2) and fomentation (1). Forms of administration of plant species for treating various ailments is represented in Figure 4.

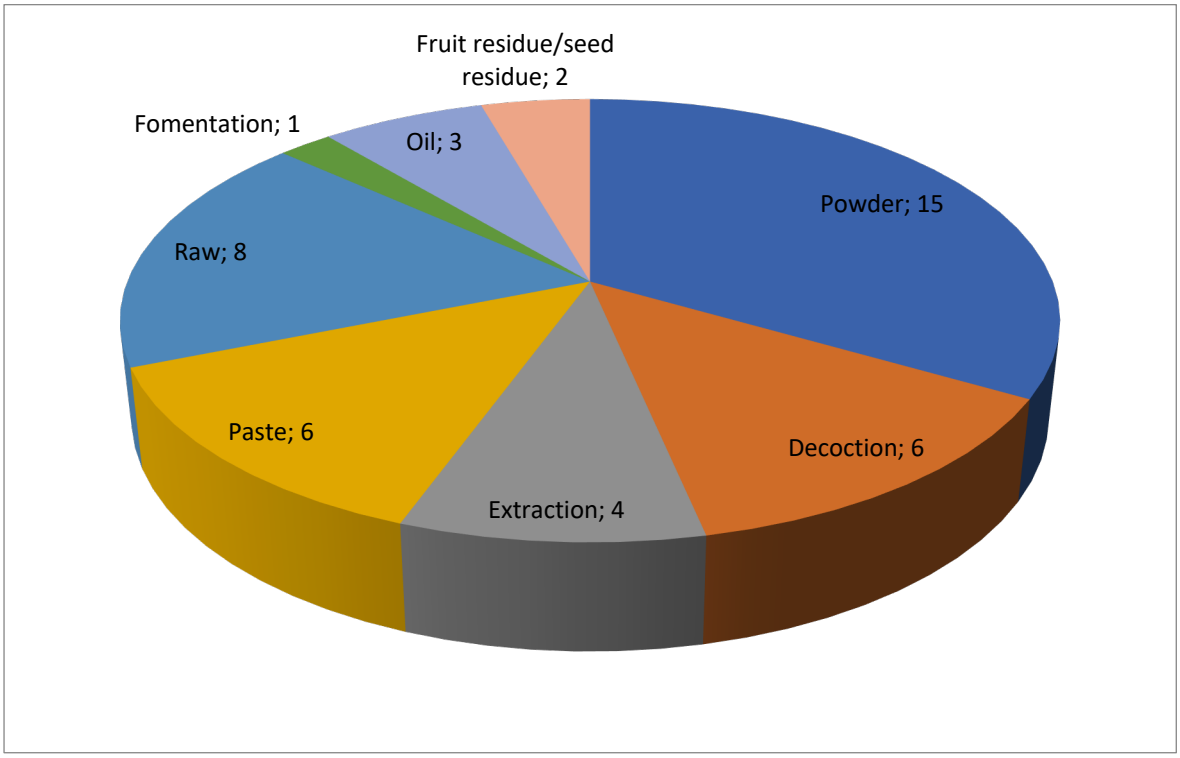

Figure 4. Forms of administration of plant species in various ailments

Use value

Use value demonstrates the relative importance of species known locally or to the informants. The use-value (UV) of each species is therefore based objectively on the importance attributed by the informants and does not depend on the opinion of the researcher. The results emerging out are represented in Fig 5. and Table 2.

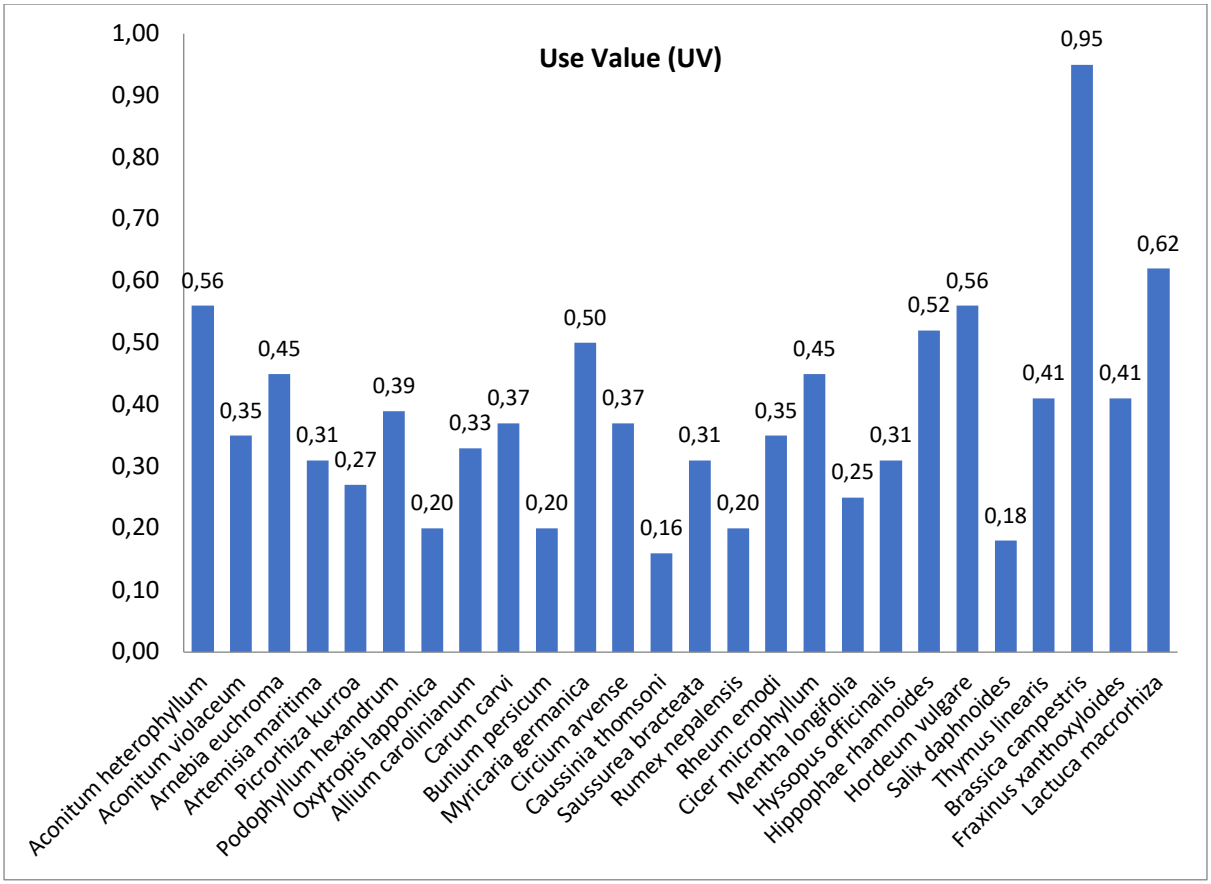

Figure 5. Use value of flora of Spiti valley used in ethnoveterinary practices

The trend of use value found in present study is higher in *Brassica campestris* (UV=0.95) followed by *Lactuca macrorhiza* (UV=0.62) and *Hordeum vulgare* (UV=0.56). Lowest use value was observed in case of *Salix daphnoides* (UV=0.18). Respondents described that *Brassica campestris* was most widely used medicinal plant as it is used in treatment of several conditions like, horn break, FMD, wound on udder/ teats and skin disease etc. Similarly, *Lactuca macrorhiza* was used as a galactagogue and *Hordeum vulgare* used as galactagogue and for treatment of diarrhea and general weakness, respectively.

Fidelity level (FL %)

High FL value (near100%) was obtained for plants for which almost all use reports refer to the same way of using it, whereas low FL value was obtained for plants that are used for many different purposes. The fidelity level is represented in Table 3 and Fig 6. The fidelity level (%) was highest in case of *Bunium persicum* for its use in treatment of diarrhea and dysentery (100%), *Oxytropis lapponica* (100%) in wound healing*, Sassurea bractaeta* in case of neck sore (100%), *Lactuca macrorhiza* as a galactagogue (100%) *Cousinia thomsonii* in the treatment of localized swellings (100%), followed by *Myricaria germanica* (83.33%) in retention of placenta and *Hyssopus officinalis* (73.33%) in fodder poisoning.

In this case total citation of *Bunium persicum, Oxytropis lapponica, Sassurea bractaeta* and *Lactuca macrorhiza* was 10, 10, 15 and 30 and these species were reported to treat single ailment each *i.e.* dysentery, wound healing, neck sore and galactagogue, respectively. It indicates that *Bunium persicum, Sassurea bractaeta* ,and *Lactuca macrorhiza* are mainly used in case of treatment of dysentery, neck sore and as a galactagogue, respectively.

The majority of plants are used in treatment of gastrointestinal problems such as indigestion, stomachache, gastric problem, diarrhea (12) followed by cut and wound, neck sore, horn break (7), respiratory (6), poisoning(3), foot and mouth disease, foot rot, mouth and tongue infection and ecto and endoparasiticide (4), general weakness, post calving problems, inflammation, musculoskeletal disorders (3), anorexia, galactagogue (2) and lack of estrus is treated by 1 species only.

Table 2:.Use value of flora of Spiti valley used in ethnoveterinary practices: (n=48) in the present study

Plant name, family	Local name	Part(s) used	Diseases treated	Total citation (∑U)	Use value (UV)	Mode of usage
Aconitum heterophyllum (Ranunculaceae)	Bhon-karpo (Atees)	Roots	Diarrhoea (10), leopard bite (5), fodder poisoning (7), endoparasite (5)	27	0.56	Special pain killer named "Khunaya" is made by mixing root powder of *Aconitum heterophyllum* with other herbs powder (fruits of *Terminalia chebula*, flower bracts of *Sausurea obvallatta*,) and is fed to the animal suffering from leopard bite as a painkiller. Root powder of *Aconitum heterophyllum* is mixed with powder of trifla (*Terminalia chebula, Terminalia bellirica, Phyllanthus emblica*) and is drenched to the animals suffering from endoparasites.
Aconitum violaceum (Ranunculaceae)	Bhon-nag/ (Patees)	Roots	Cough and fever and respiratory problems (7), fodder poisoning (10)	17	0.35	Roots of the species were the most frequently used part against the treatment of fever, respiratory problems and grass poisoning. For the treatment of grass poisoning the powdered roots of *Aconitum violaceum*, fruits of *Terminalia chebula*, rock salt and musk mixed with water are drenched to the suffering animal.
Arnebia euchroma (Boraginaceae)	Khamet (Ratanjot)	Root, leaf	Cut and wound (8), cough and fever (4), skin problem and hair loss (10).	22	0.45	Roots of *Arnebia euchroma* is effectively used in treatment of cut and wounds, cough and fever, skin problem with hair loss. To cure cough and fever, palm full of fresh leaves of *Arnebia euchroma* mixed with grass is fed to animals one time a day. Root of *Arnebia euchroma* mixed with mustard oil and wild apricot oil is applied over the body of animal to cure skin problems and hair loss in animal.
Artemisia maritima (Asteraceae)	Burse	Leaves	Boils (10), internal parasite (5)	15	0.31	The juice of fresh leaves is applied on animal skin to cure boils problem. Fresh leaves of *Artemisia maritima* are fed to animal to kill stomach worms.
Picrorhiza kurroa (Scrophulariaceae)	Honglen	Stolon	Dysentery and laxative (7), respiratory problem (6)	13	0.27	Species was the most frequently used against the treatment of dysentery and respiratory problems. Root powder of *Piccrorza kurroa* is mixed with ingredients like flower of *Santalum album*, whole plant of *Gentiana moorcroftiana* flower of *Justicia adhatoda,* whole plant of *Aconitum heterophylum*, branch of *Ephedra gerardiana,* branch of *Artemisia maritima*, leaves and fruit of *Juniperus macropoda* and musk ground together and powder is mixed with fodder and fed to sick animal for respiratory problems.
Podophyllum hexandrum (Berberidaceae)	Ban-kakri	Roots	Bloating (10), hoof disease(4), Anorexia (5)	19	0.39	Roots are ground to form a paste mixed with barley flour; this mixture is used as appetizer in case of anorexia in animal. Root paste of

						Podophyllum hexandrum is applied on hoofs of animal to cure foot rot.
Oxytropis lapponica (Leguminaceae)	Taksha nakpo	Flower, leaf	Wound healing (10)	10	0.20	That leaves and flowers paste is applied on wounds caused by dog bite. It is believed that this paste helped to remove toxin and facilitate healing of wounds *i.e.* copper sulphate powder and sea salt (sancha namak) is mixed with local wine made from barley seeds to make a viscous solution. It helps in wound healing and skin regeneration.
Allium carolinianum (Aliaceae)	Kochey	Leaves, flower	Cold and fever (6), restlessness (3), ectoparasite (7)	16	0.33	Leaf powder is boiled in water till half of water is left and decoction is finally given orally to the animals for treatment of cold and fever**.** It is useful in disease named "Lingual" which means restlessness and to improve immunity. The flower head are dried and ground to a fine powder mixed with fodder and is fed to animals.
Carum carvi (Apiaceae)	Sia zeera	Seeds	Rheumatism (5), cold and coryza (10), indigestion (3)	18	0.37	Handful of seeds is tied in a cotton cloth, dipped in hot apricot oil and are applied over the paining part in case of rheumatism to animal. The powder of *Carum carvi* seeds is tied in a cotton cloth, which is dipped in warm ghee and the warm fomentation of this pouch is given around nose behind ear lobes and forehead. This is very good cure for common cold and fever in animals**.**
Bunium persicum (Apiaceae)	Kala zira	Seeds	Dysentery/abdominal disorders (10)	10	0.20	Seed powder of *Bunium persicum* is mixed with fodder and fed to animals suffering from dysentery
Myricaria germanica (Tamaricaceaee)	Vumbu-reral	Roots	Retention of placenta (20), Fracture (4)	24	0.50	Root decoction of *Myricaria germanica* is fed to animal which helps in easy draining out of placenta. The sharp stem of this species is used to prick the swollen leg to drain pus from it.
Cirsium arvense (Asteraceae)	Tulse sa	Whole plant	Diarrhoea(6), post calving care(12)	18	0.37	In case of diarrhea, whole plant is fed to animal along with salt water. Whole plant of *Cirsium arvense* mixed with barley residue (after making of local wine) given to animal along with lots of water after calving.
Coussinia thomsonii (Asteraceae)	Tultang	Roots	Swelling limbs and joint pain (8)	8	0.16	When cattle fall down from high hills and there is swelling in their limbs, 50gm of root powder mixed with water and paste is applied to cure swelling.
Saussurea bracteata (Asteraceae)	Panchi-towo	Roots	Neck sore (Gindea) (15)	15	0.31	It is very effective in neck sore problem locally known as **"**Gindea". For the treatment of this condition a pain killer named (Khunya) in which *Saussurea bracteata* powder is an ingredient, is mixed with barley flour and the dough so made is fed to animal. After that flame is given around wounds of neck, so that it can't spread from that

						portion, and after few days, needle is inserted on the middle of wound to drain out the pus, and thermocautary is done.
Rumex nepalensis (Polygonaceae)	Shoma	Flower, roots	Boil (3), gastric problem (7)	10	0.20	Decoction of roots is fed to animal to cure gastric problems. *Rumex nepalensis* is administered to control dysentery and diarrhea in animals.
Rheum emodi (Polygonaceae)	Lichu	Rhizomes	Wound (4), joint pain (5), broken horn (8)	17	0.35	Root powder is mixed with mustard oil and is massaged on swollen and painful joints to get quick relief. The paste made from whole plant powder of rheum and wild thyme with urine of local cattle is applied on broken horn, and then tie cloth around horn.
Cicer microphyllum (Ephederaceae)	Tseri-sa	Whole plant	Foot and mouth disease (10), dysentery(5), anorexia (7),	22	0.45	Respondents reported that they allow their animal to chew *Cicer microphollium* leaves and then Bhul (pigeon feces, smoke, jaggery) and Jukpa (whole plant of *Thymus linearis,* root of *Rheum emodi*, leaves of *Terminalia chebula, Terminalia bellirica, Phyllanthus emblica*) in powder form are mixed in water and given to animal, which cure the animal suffering from FMD. The animals suffering from FMD are segregated from rest of herd and kept in dry place, as it is communicable disease and may spread.
Mentha longifolia (Lamiaceae)	Koth	Whole plant	Wounds (4), ticks (2), bloat (6)	12	0.25	The paste of whole herb is applied externally on wounds for at least a week for quick relief. Decoction of fresh leaves of *Mentha longifolia* after cooling are mixed with small amount of cattle urine and drop of kerosene oil and is poured on the affected area where ticks are present. The ticks will immediately shed off due to suffocation.
Hyssopus officinalis (Lamiaceae)	Tyangu	Flower tops	Indigestion (4), grass poisoning (11)	15	0.31	Flowering tops are ground and mixed with feed and are given to improve digestion. Whole plant powder of *Hysoppus officinalis* and ingredients like whole plant of *Aconitum violaceum*, fruits of Trifla (*Terminalia chebula, Terminalia bellirica*, *Phyllanthus emblica*), and root of *Picrorhiza kurroa* are mixed with water and boiled for 30 minutes. The decoction thus prepared is drenched to animal for curing fodder poisoning**.**
Hippophae rhamnoides (Elaegnaceae)	Tirkuk	Fruit residue	Wounds (7), General weakness (18)	25	0.52	Fruit residue of *Hippophae rhamnoides* is boiled in water and the lukewarm water is given to animals in general weakness. Seed oil is applied on cut and wound of animals.
Hordeum vulgare (Poaceae)	Jau	seeds	Galactagogue (15), diarrhea (5), General weakness (7)	27	0.56	*Hordeum vulgare* seed residue left after preparation of local wine (chang) are given to lactating animal to increase milk yield. roasted barley seeds are grinded into fine powder (sattu) which is mixed with water and fed to the animal for treating diarrhea. Dough made of

						barley flour and tea leaves residue is fed to goat and sheep during winters for overcoming weakness.
Salix daphnoides (Salicaceae)	Changma	Leaves, stem	Foot and mouth disease (6), fracture leg (3)	9	0.18	Extract of fresh leaves is poured on the feet of animal suffering from FMD, and it was observed that the lesions cure easily if FMD happens in wintertime. Its use in treating fractured bones *i.e*. Willow sticks are placed around the fracture part and the bandage is applied, within 21 days of observation if they start keeping their legs on ground and walk as a sign of recovery then few sticks are loosened. Initially 20 sticks are applied and are reduced to 14 and subsequently to 6 sticks till recovery achieved.
Thymus linearis (Lamiaceae)	Wild thyme	Aerial parts	Bloat (7), lack of estrus (6),cough and fever (7)	20	0.41	Whole plant of wild thyme is boiled with rock salt and decoction is fed to animals suffering from bloat**.** Aerial parts are fed as such to animal for curing cough and fever. Powder of wild thyme seeds is given with jaggery to bring animal into estrus.
Brassica campestris (Brassicaceae)	Sarson	Leaf, seeds	Horn break (7), FMD (4), wound on udder/ teats (15), Skin disease (20)	46	0.95	Seeds of this species are most frequently used for the treatment of horn break, FMD, teat cracks and skin diseases. Mustard oil mixed with wild apricot oil and *Curcuma longa* powder is applied on teat to cure teat cracks. Hot *Brassica* oil is applied on feet of sheep and goats suffering from foot rot.
Fraxinus xanthoxyloides (Oleaceae)	Pipjul	Stem	Retention of placenta (10), Fracture (10)	20	0.41	Decoction of *Fraxinus xanthoxyloides* wood is given to animal which helps in faster recovery in case of fractures and is drenched to cattle for easy expulsion of placenta.
Lactuca macrorhiza (Asteraceae)	Bhasa	Whole plant	Galactagogue (30)	30	0.62	Whole plant is given as such to animals at the time of milking to increase milk yield.

Table 3. Fidelity level of flora of Spiti valley used in ethnoveterinary practices

Ailment categories	Important species	np	N	Fidelity level (%)
Dermatological (boils, burn, scabies, skin problem)	*Artemisia maritime*	10	15	66.67
	Arnebia euchroma	10	22	45.45
	Brassica campestris	20	34	58.82
	Rumex nepalensis	3	10	30.00
Gastrointestinal (dysentery, diarrhea, constipation, indigestion, bloat)	*Aconitum heterophyllum*	10	27	37.04
	Picrorhiza kurroa	7	13	53.85
	Podophyllum hexandrum	10	19	52.63
	Carum carvi	3	18	16.67
	Bunium persicum	10	10	100.00
	Cirsium arvense	6	18	33.33
	Rumex nepalensis	7	10	70.00
	Cicer microphyllum	5	22	22.73
	Mentha longifolia	6	12	50.00
	Hyssopus officinalis	4	15	26.67
	Hordeum vulgare	5	27	18.52
	Thymus linearis	7	20	35.00
Poisoning (fodder poisoning)	*Aconitum heterophyllum*	7	27	25.93
	Aconitum violaceum	10	17	58.82
	Hyssopus officinalis	11	15	73.33
Animal bite	*Aconitum heterophyllum*	5	27	18.52
Inflammation (swelling, rheumatoid)	*Carum carvi*	5	18	27.78
	Cousinia thomsonii	8	8	100.00
	Rheum emodi	5	17	29.41
Respiratory problems (cold, cough, fever, nasal discharge)	*Aconitum violaceum*	7	17	41.18
	Arnebia euchroma	4	22	18.18
	Picrorhiza kurroa	6	13	46.15
	Allium carolinianum	6	16	37.50
	Carum carvi	10	18	55.56
	Thymus linearis	7	20	35.00
Musculo-skeletal disorders (bone fracture)	*Fraxinus xanthoxyloides*	10	20	50.00
	Myricaria germanica	4	24	16.67
	Salix daphnoides	3	9	33.33
Wound related problem (Cut and wound, udder sore, neck sore, horn break)	*Arnebia euchroma*	8	22	36.36
	Oxytropis lapponica	10	10	100.00
	Saussurea bracteata	15	15	100.00
	Rheum emodi	12	17	70.58
	Mentha longifolia	4	12	33.33
	Hippophae rhamnoides	7	25	28.00
	Brassica campestris	22	34	64.70
Post calving problems (Retention of placenta, after calving care)	*Fraxinus xanthoxyloides*	10	20	50.00
	Cirsium arvense	12	18	66.67
	Myricaria germanica	20	24	83.33
Lack of estrus	*Thymus linearis*	6	20	30.00
Anorexia (Loss of appetite)	*Cicer microphyllum*	7	22	31.82
	Podophyllum hexandrum	5	19	26.32

Parasite related disease (ticks, lice, worm infestation)	*Artemisia maritima*	5	15	33.33
	Allium carolinianum	7	16	43.75
	Aconitum heterophyllum	5	27	18.52
	Mentha longifolia	2	12	16.67
General weakness (poor immunity, restlessness)	*Allium carolinianum*	3	16	18.75
	Hippophae rhamnoides	18	25	72.00
	Hordeum vulgare	7	27	25.93
Foot and mouth disease (foot rot, mouth and tongue infection)	*Brassica campestris*	4	34	11.76
	Salix daphnoides	6	9	66.67
	Podophyllum hexandrum	4	19	21.05
	Cicer microphyllum	10	22	45.45
Galactagogue	*Hordeum vulgare*	15	27	55.56
	Lactuca macrorhiza	30	30	100.00

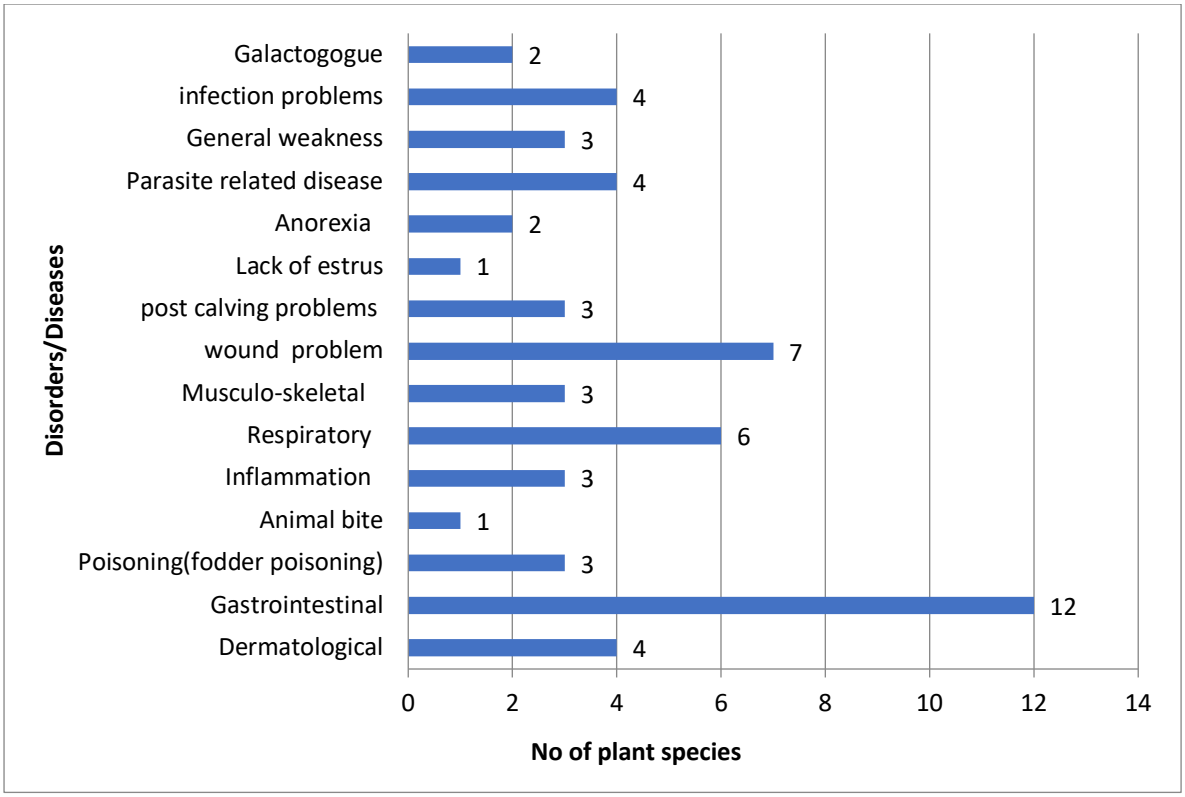

Figure 6. Categories of ailment cured by different plant species in ethnoveterinary practices

Informant consensus factor (ICF)

The highest ICF was found in case of lack of estrus and animal bite (1) followed by galactagogue (0.98), post calving problems (0.95), grass poisoning, dermatological, general weakness (0.93), anorexia and wound related problems (0.91), inflammation and musculo-skeletal disorders (0.88) and lowest in parasite related disease (0.83). Study revealed that the single plant species i.e. *Thymus linearis* was used for the treatment of lack of estrus by the respondents and hence the respondents agreed to each other regarding the use of particular species for the treatment of lack of estrus. On the similar lines 2 species i.e. *Lactuca macrorhiza* and *Hordeum vulgare* were the main plant species which were employed by the respondents as a galactagogue with ICF of 0.98. This indicated high agreement of respondents among themselves regarding use of these plant species. Informant consensus factor (ICF) is used to test homogeneity of knowledge about the use of ethnomedicinal plants. It is represented in Table 4 and Fig. 7.

Table 4. Informant consensus factor of flora of Spiti valley in ethnoveterinary practices

Ailment categories	nt	nur	ICF
Dermatological (boils, burn, scabies, skin problem)	4	43	0.93
Gastrointestinal (dysentery, diarrhea, constipation, indigestion, bloat)	12	80	0.86
Poisoning (fodder poisoning)	3	28	0.93
Animal bite	1	5	1
Inflammation (swelling, rheumatoid)	3	18	0.88
Respiratory (cold, cough, fever, nasal discharge)	6	40	0.87
Musculo-skeletal disorders (bone fracture)	3	17	0.88
Wound related problem (Cut and wound, udder sore, neck sore, horn break)	7	78	0.92
Post calving problems (Retention of placenta, after calving care)	3	42	0.95
Lack of estrus	1	6	1
Anorexia (Loss of appetite)	2	12	0.91
Parasite related disease (ticks, lice, worm infestation)	4	19	0.83
General weakness (poor immunity, restlessness)	3	28	0.93
Foot and mouth disease, (foot rot, mouth and tongue infection)	4	29	0.89
Galactagogue	2	45	0.98

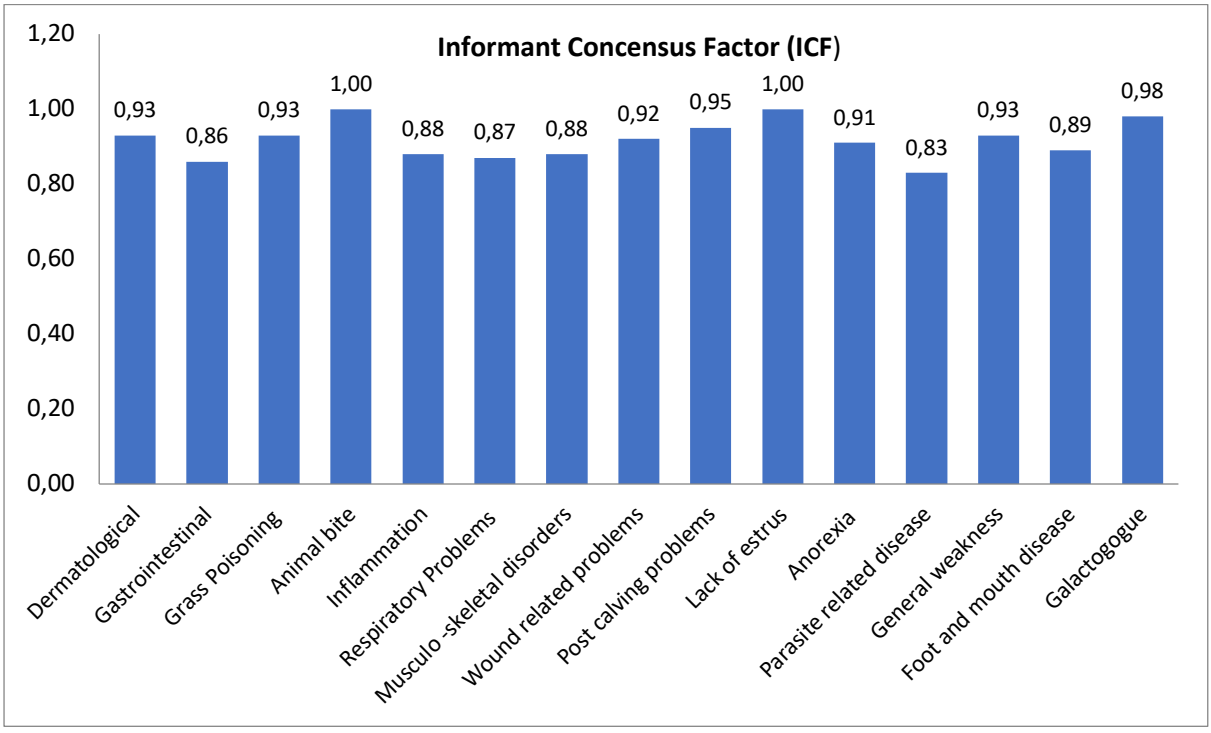

Figure 7. Disease category and their Informant Consensus Factor (ICF)

Discussion

Different species of family Asteraceae (8), Lamiaceae (7), Apiaceae (4) were employed in ethnoveterinary practice in Chamba district of Himachal Pradesh reported by (Thakur *et al.* 2016). There are ample of similar documentation of (Thakur *et al.* 2016; Sharma *et al.* 2012; Farouji and Khodavari, 2016) which reported that leaves were the most frequently used plant parts in treatment of various animal diseases. Similar results were observed in findings of (Devi *et al.* 2013) which reported that 44 species were used in powder form, 17 species in decoction form, 14 species as paste, 4 species as extraction and 1 species through inhalation. Use value found in present study is higher in *Brassica campestris* (UV=0.95) followed by *Lactuca macrorhiza* (UV=0.62) and *Hordeum vulgare* (UV=0.56). Lowest use value was observed in case of *Salix daphnoides* (UV=0.18). There are many studies that similarly documented

Brassica campestris and *Hordeum vulgare* with (UV=7.52) and (UV=1.95), respectively (Sharma *et al.* 2012). Shah *et al.* (2012) also reported the use of *Brassica campestris* seed oil which is given to ploughing bulls for providing strength to their legs. The use of *Lactuca* agrees with (Ahmed *et al.* 2015) who reported use of *Lactuca brunoniana* in removal of pinworms in children. (Sood *et al.* 2001; Singh *et al.* 2012) also reported use of powder of aerial part of *Lactuca* species is used as laxative in chronic constipation and in humans. The uses of *Hordeum vulgare* in ethnoveterinary practice agrees with (Sharma *et al.* 2012) who reported *Hordeum vulgare* brans is fed to the animals in general weakness and to increase milk yield. (Pande *et al.* 2007) also reported that *Hordeum vulgare* is used to cure anemia, skin disease and for post calving care. Similar results reported by (Mir *et al.* 2021) in Jammu and Kashmir; (Mir *et al.* 2022) Bandipora district of Kashmir Himalayas and (Mir *et al.* 2021) Lolab valley, Kashmir Himalaya.

The fidelity level was highest (100(%) in case of *Bunium persicum*, *Oxytropis lapponica Sassurea bractaeta*, *Lactuca macrorhiza*, *Cousinia thomsonii* in the treatment of swelling (100%), followed by *Aconitum violaceum* (76.92%) and *Hippophae rhamnoides* (72%) . The fidelity level (%) is similar with the documentation of (Thakur *et al.* 2016) *i.e.* *Justicia adhatoda* in digestive disorders (100%). Maximum species were used to cure gastrointestinal problem, which is following earlier works in cold desert region as reported by (Sood *et al.* 2001; Ballabh and Chaurasia 2009). Observation of species use agrees with (Kumar and Bharti 2013) who reported *Bunium persicum* seeds powder mixed with wheat flour and given to animals for treatment of flatulence. *Oxytropis microphylla* is used to treat animal bite and acidity (Devi *et al.* 2013). (Ahmed *et al.* 2015) reported that use of *Lactuca brunoniana* removal of pinworms in children. Similarly, (Sood *et al.* 2001) and (Singh *et al.* 2012) also reported use of powder of aerial part of *Lactuca* species is used as laxative in chronic constipation and stomachache in humans. The findings of the present study on use of particular species are comparable to **(**Shah *et al.* 2012), who reported grinded rhizome of *Aconitum violaceum* mixed with wheat flour is given to cattle for the treatment of lungs diseases. On the similar lines (Kumar *et al.* 2017) and (Ballabh and Chaurasia, 2007) reported that dried roots of *Aconitum violaceum* are used to cure cough, abdominal pain and are sometimes used as a substitute of *Aconitum heterophyllum*.

Similar results were observed in study of (Kumar and Pandey 2012) who reported that (0.84) ICF was found in lack of estrus, delayed expulsion of placenta (1), general weakness and reduced lactation (0.91), skin problems (0.88), respectively. Similar results were found in study of (Bhat *et al.* 2013) who reported that highest ICF was found in hematological (1), dermatological (0.98), gastroenterological (0.92), respectively.

Study has revealed that flavonoid compounds, phenolic acids, alkaloids, tannins, sterols, triterpenes Indaconitine, Diterpenses, flavnoides, fatty acids, aconitine, indaconitine and polysaccharide, aconine, benzoicacid, sparteine, tannins, resins, glycoside, flavones glycosidesorientoside and podophyllin are the major chemical constituents of the medicinal plants used in ethnoveterinary practices in Spiti Valley oh Himachal Pradesh. Due to the presence of these chemical constituents the plants are responsible for various biological activities in animals as well as in human beings such as whooping cough, galactagogue, epilepsy, suppression of urine, menstrual catarrh, stomach ache and gastrointestinal (Shah *et al.* 2008; Sharma *et al.* 2006; Ballabh and Chaurasia 2009), cure mouth disease, tongue infection, internal parasites, lactation in animals, eczema and scabies (Pande *et al.* 2007; Shah *et al.* 2008), diarrhea, fever, stomachache and jaundice (Bisht *et al.* 2013 and Uniyal *et al.* 2006; Sharma *et al.* 2011) (Table 5).

Conclusions

The people of Spiti valley are very prosperous in ethnoveterinary knowledge and are employing varieties of plants to cure and heal different disease, health related problems and usefulness of these medicinal plants in livestock care. The present study concluded that the 26 plant species used in ethnoveterinary practices by the local dwellers of Spiti region to cure the various ailments. Scientific validation of different plant species with high use value and fidelity level should be conducted in future for the optimum utilization of these species in animal health care. The young generation should be promoted and encouraged in traditional medicinal knowledge. Due to the lack of proper management, the richness and abundance of plant species is declining because of harvesting in younger stage haphazardly and overexploitation. The lack of cultivation of most plant species in the study area is a concern and needs to be addressed by the relevant authorities so that proper initiatives could be developed.

Table 5 Similar ethnoveterinary/ethnobotanical/ethnopharmacological uses/biological activities reported for the target plants with their chemical constituents.

Plant name and family	Ethnoveterinary/Ethnobotanical/ethnophamacological/ Biological activities	Chemical constituents
Aconitum heterophyllum (Ranunculaceae)	Intestinal worm, cough, Hysteria fever, stomachache, dysentery and diarrhea Liver dysfunction, throat infections, dysepsia, abdominal pain, Joint pain, Malaria (Pande *et al.*, 2007; Khateeb *et al.*, 2015; Singh and Rawat, 2011; Choudhary *et al.*, 2005)	Alkaloids including astine, heteratisine heterophyllistine, atidine and hetidine heterophylline, heterophylline, atidine and hetidine (Sharma *et al.*, 2010)
Aconitum violaceum (Ranunculaceae)	Lungs diseases, cough problem, abdominal pain (Shah *et al.*, 2012 ; Ballabh and Chaurasia, 2007; Kumar et al,. 2017)	Indaconitine, Diterpenses, flavnoides, fatty acids, aconitine, indaconitine and polysaccharide, aconine, benzoicacid, sparteine, tannins and resins (Miana *et al.*, 1971; Braca et al 2003)
Arnebia euchroma (Boraginaceae)	Cut and wound, cough and fever, skin problem with hair loss (Verma and Tewari, 2016; Lal and Singh, 2008)	Shikonin, naphthoquinees, alkanin and isohexeny Inaphthazarin esters derivatives that have many pharmacological properties (Hosseini *et al.*,2007; Pirbalouti *et al.*, 2009)
Artemisia maritima (Asteraceae)	Internal parasites and digestive disorders (Lans *et al.*, 2006; Sharma *et al.*, 2012; Thakur *et al.*, 2016)	1-Keto-6 β, 7α, 11 β -4(5)-en-6, 12-olide, vugarin, and maritimin (Gonzalez *et al.*, 1977; Gonzalez *et al.*,1981)
Picrorhiza kurroa (Scrophulariaceae)	Diarrhea, fever, stomachache and jaundice (Bisht *et al.*, 2013 and Uniyal *et al.*, 2006; Sharma *et al.*, 2011)	Phenolic glycoside, Iridoid glycoside, Cucurbitacin, Triterpenoids, Fatty acid, Secoiridoids (Weinges *et al.*, 1972; Rastogi *et al.*, 1949; Singh and Rastogi, 1972; Laurie *et al.*, 1998; Zhang *et al.*, 2005; Zou *et al.*, 2007; Zou *et al.*, 2008)
Podophyllum hexandrum (Berberidaceae)	Hoof diseases, improve blood circulation, bloating, appetite loss and nasal discharge, join pain , skin allergies, lung cancer, brain cancer, diseases of uterus, dysentery and diarrhea (Thakur *et al.,* 2016; Sharma *et al.,* 2003; Bharti and Sharma, 2012; Pande *et al.,* 2007; Sharma and Chauhan, 2000; Thakur *et al.,* 2014 Kayani *et al.,* 2015 and Rao *et al.,* 2015).	Podophyllin (Sharma *et al.*, 2010)
Oxytropis lapponica (Leguminaceae)	Wound healing, acidity (Devi *et al.*, 2013)	Flavonoid glycoside, Phenolcarbonic acids, alkaloids, coumarins, and the following flavonoids: Quercetin, mono- and diglyco-sides of quercetin, and kaempferol (Cao *et al.*, 1988; Sakanyan, 1988)
Allium carolinianum (Aliaceae)	Ectoparasites, external parasites and fever (Verma 2014, Shah *et al.* 2012).	Flavonoids and phenolic compounds (Bonaccorsi*et al.*, 2008)
Carum carvi (Apiaceae)	Digestive and gastric troubles, fever, dehydration, mouth infection, disorders of the lungs, eyes ailments, cure skin infection, piles, endoparasitism and	Carvone and limonene, monoterpene hydrocarbons, oxygenated monoterpenes, oxygenated sesquiterpenes,

	intermittent fever. (Pande *et al.*, 2007, Sharma *et al.*, 2012, Singh and Lal 2008, and Sharma *et al.*, 2006)	saturated and unsaturated fatty acids, aldehydes, ketones and esters, α-Pinene 0.3, Camphene 0.2, β-Pinene 0.1, β-Myrcene 0.1, Limonene 5.1, γTerpinene 12.6, β-Ocimene 0.1, Carvone 70.1, β- Selinene 0.2, αFarnesene 0.4, Citronellol 0.1, δ-Cadinene 0.3, γ-Cadinene 0.5, Cuminaldhyde 0.1, Nerol 0.2 and Carvacrol 0.2 (Sedlakova *et al.*, 2003; Tewari and Mathela, 2003; Arganosa *et al.*, 1998; Wichtmann and Stahl. 1987; Bouwmeester *et al.*, 1998; Zheng *et al.*, 1992; Abou *et al.*, 2014)
Bunium persicum (Apiaceae)	Flatulence, carminative, stomachic and general debility (Kumar and Bharti, 2013; Wagay, 2016)	Cuminaldehyde, γ-terpinene, c-Terpinen-7-al, p-Cymen, limonene, Trans-3-Caren-2-ol, Acetic acid, 3-cyclohex-1-enyl-1-methylprop2-ynyl ester, Terpinolene. (Chizzola *et al.*, 2014; Jalizadeh *et al.*, 2011)
Myricaria germanica (Tamaricaceaee)	Retention of placenta, fracture and joint pains (Pande *et al.*, 2007; Singh 2012)	Alkanediols (Jetter, R, and Long-chain, 2000)
Cirsium arvense (Asteraceae)	Diarrhea, diarrhea and post calving	Flavonoid compounds, phenolic acids, tannins, sterols and triterpenes (Nazaruk and Jakoniuk, 2005)
Cousinia thomsoni (Asteraceae)	Inflammation and Joint pains (Singh *et al.*, 2012 and Sood *et al.*, 2001)	Chemical constituents of *Cousinia spp* are tannins, flavonoids and terpenoids (Mohammad *et al.*, 2014)
Saussurea bracteata (Asteraceae)	Abscess and cough (Bhat *et al.*, 2013; Singh and Lal, 2008)	Records not found for *Saussurea bracteata* , chemical constituents of *Saussurea* spp are Costunolide, dehydrocostuslactone, costic, palmitic, linoleic acids, -sitosterol, -cyclocostunolide, alantolactone, -cyclocostunolide, isoalantolactone (Govindan and Bhattacharaya, 1977),
Rumex nepalensis (Polygonaceae)	Dysentery and diarrhea infected parts of animal body (Pande *et al.*, 2007; Abbasi *et al.*, 2013)	Anthraquinones, emodin glycoside, chrysophanein pulmatin, glycosides, aglycones, neopodin, pentadecanoic acid (Farooq *et al.*, 2013; Vasas *et al.*, 2015; Devkota *et al.*, 2015; Gautam *et al.*, 2011; Grover *et al.*, 2014; Shrestha and Timilsina, 2017)
Rheum emodi (Polygonaceae)	Fractured bone, stomachache, to cure cuts, wounds and muscular swelling (Shah *et al.*, 2008; Sharma *et al.*, 2006)	Anthraquinones, anthrones, stilbenes, oxanthrone ethers and esters, flavonoids, lignans, phenols, carbohydrate and oxalic acid (Parvaiz *et al.*, 2009)
Cicer microphyllum (Ephederaceae)	To cure mouth disease, tongue infection, internal parasites, lactation in animals, eczema and scabies (Pande *et al.*, 2007; Shah *et al.*, 2008)	Formononetin glucoside, biochanin A-7-O-glucoside, 3,4',7-trihydroxy flavones and biochanin A (Kour *et al.*, 2011)
Mentha longifolia (Lamiaceae)	Anorexia and to cure bloat, diarrhea, stomachache and vomiting (Sharma *et al.*, 2012; Ballabh and Chaurasia, 2009)	Luteolin-glucuronide, luteolin-diglucuronide, luteolin-glucopyranosyl-rhamnopyranoside, eriodictyol-glucopyranosyl-rhamnopyranoside, methylated luteolin-

		glucuronide, rosmarinic, salvianolic acid L, dedihydro-salvianolic acid (Krzyzanowska *et al.*, 2011)
Hyssopus officinalis (Lamiaceae)	Heart tonic, nervous disorder, toothache and urinary troubles liver and blood disorders cure cough and cold (Lans *et al.*, 2006; Chauhan, 2006; Sharma *et al.*, 2006; Singh, 2012)	Flavonoids, isoferulyl D-glucose ester chlorogenic, protocatechuic, ferulic, syringic, p-hydroxybenzoic and caffeic acids followed by vanillic, p-coumaric, rosmarinic and gentisic acids (Murakami *et al.*, 1998; Varga *et al.*, 1998; Kochan *et al.*, 1999; Zgorka and Głowniak, 2001; Marin *et al.*, 1998)
Hippophae rhamnoides (Elaegnaceae)	Tumours, liver ailments, skin wrinkles, high blood cholesterol, cuts, ulcer, wounds, cough, fever, skin disease, congestion, jaundice and as blood purifier (Sharma *et al.*, 2006; Sharma *et al.*, 2011; Singh *et al.*, 2012)	Tocopherols, Carotenoids, Vitamin K, Vitamin C, Vitamin B complex, Phytosterols, Polyphenolic components, Polyunsaturated fatty acids (PUFA), Organic acids, Coumarins and triterpens, Zinc(Michel *et al.*, 2012)
Hordeum vulgare (Poaceae)	In general weakness, to increase milk yield, cure anemia, skin disease and for post calving care. (Sharma *et al.*, 2012; Pande *et al.*, 2007)	Coumaroylagmatine, hordenine and its derivative, pyrrolidine, luteolin glycoside, flavones glycosidesorientoside and orientin, cynoglucosides – 3 – beta – D – glucopyranosyloxy - 2-methylpropene, 4- beta-D- glucopyranosyloxy - 3-hydroxyl -3 - hydroxymethybutyrobitrile (Dhiman. 2006; Ross, 2005).
Salix daphnoides (Salicaceae)	Contagious pleura pneumonia, foot and mouth disease, arthritis, stomach lining, muscle soreness in horses. (Ahmad *et al.*, 2015; Lans *et al.*, 2006)	No records
Thymus linearis (Lamiaceae)	whooping cough, galactagogue, epilepsy, suppression of urine, menstrual catarrh, stomachache and gastrointestinal (Shah *et al.*, 2008; Sharma *et al.*, 2006; Ballabh and Chaurasia, 2009)	Carvacrol, borneol, isobutyl acetate, caryophyllene, 1,8-cineole, citral, citronellal, citronellol, *p*-cymene, geraniol, linalool, α-pinene, γ-terpinene, α-terpineol, terpinyl acetate, and thymol. (Thomson, 2004).
Brassica campestris (Brassicaceae)	Horn break, teat cracks and skin diseases (Sharma *et al.*, 2012; Shah *et al.*, 2012)	**I**ndole-3-carboxaldehyde, blumenol A, vinylsyringol, sinapinic acid, sinapic acid ethyl ester, protocatechuic acid, crinosterol, campesterol, 7-oxo-stigmasterol. (Jing *et al.*, 2014)
Fraxinus xanthoxyloides (Oleaceae)	Food poisoning, curing bone fracture and internal injuries (Tiwari and Pandey, 2006; Sharma *et al.*, 2006; Singh, 2012)	Esculetin, esculin, fraxin, and fraxetin (Liang *et al.*, 2017)
Lactuca macrorhiza (Asteraceae)	Pinworms, laxative in chronic constipation and (Ahmed *et al.*, 2015; Sood *et al.*, 2001; Singh *et al.*, 2012)	No records

Declarations

List of abbreviations: Fig=Figure, ICF=Informant Consensus Factor, FL:Fidelity Level, %=Per cent, UV =Use value
Ethics approval and consent to participate: Prior informed consent was obtained from the participants before conducting interviews to gather the ethnoveterinary knowledge (Annexure 2). No further ethics approval was required. All work was done in accordance with the rules of the Convention on Biological Diversity's Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Resulting from their Utilization
Consent for publication: Oral permission (Annexure 2)
Availability of data and materials: All data generated or analyzed during the conduct and writing up of the manuscript is incorporated in the manuscript.
Competing interests: The authors declare that no potential conflict of interest reported.
Funding: The research received no external funding.
Author contributions: This research was conceptualized by Rohit Bishist and the field surveys were conducted by Deachen Wangmo to collect the information on ethnoveterinary practices. Bhupender Dutt helped in identification of the plant samples. Krishan Lal Gautam and Rohit Bishist edited and contributedin preparing the final manuscript. All authors have read and agreed to the published version of the manuscript.

Literature cited

Abou El-Soud NH, El-Lithy NA, El-Saeed G, Wahby, MS, Khalil MY, Morsy F, Shaffie N., 2014. Renoprotective effects of caraway (*Carum carvi* L.) essential oil in streptozotocin induced diabetic rats. Journal of Applied Pharmaceutical Sciences 4(02):27-33.

Arganosa GC, Sosulski FW, Slinkard AE, 1998. Seed yields and essential oils of annual and biennial caraway (*Carum carvi* L.) grown in Western Canada. Journal of Herbs Spices and Medicinal Plants 6(1) 9-17.

Arya V, Thakur R, Kashyap CP. 2012. Ethnomedicinal flora of Kangra valley of Himachal Pradesh, India. Recent Advances in Pharmaceutical Science Research 1(2):15-29.

Ballabh B, Chaurassia OP. 2007. Traditional medicinal plants of cold desert Ladakh-used in treatment of cold cough and fever. Journal of Ethnopharmacology 112(2):341-349.

Bharti KA, Sharma BL. 2012. Plants used as ethnoveterinary medicines in Sikkim Himalayas. Ethnobotany Research and Applications 10:339-356.

Bhatt A, Singh P, Kumar V, Baunthiyal M. 2013. Documentation of ethnoveterinary practice used for treatments of different ailments in Garhwal Himalayan region. Journal of Environmental Nanotechnology 2:22-29.

Bisht VK, Kandari LS, Negi JS, Bhandari AK, Sundriya RC. 2013. Traditional use of medicinal plants in district Chamoli, Uttarakhand, India. Journal of Medicinal Plant Research 7(15):918-929.

Bonaccorsi P, Caristi C, Gargiulli C, Leuzzi U. 2008. Flavonol glucosides in *Allium* species: A comparative study by means of HPLC-DAD-ESI-MS-MS. Food Chemistry 107:1668–1673.

Bouwmeester HJ, Gershenzon J, Konings MC, Croteau R, 1998. Biosynthesis of the monoterpenes limonene and carvone in the fruit of caraway: I: Demonstration of enzyme activities and their changes with development. Plant Physiology 117(3):901-912.

Braca A, Fico G, Morelli I, De-Simone F, Tome F, De-Tommasi N. 2003. Antioxidant and free radical scavenging activity of flavonol glycosides from different Aconitum species. Journal of Ethnopharmacology 86(1):63-67.

Cao GR, Li SJ, Duan DX, Zhao XW. 1988. Analysis of toxic component in *Oxytropis ochrocephala*. Veterinary Science China 3:41-43.

Champion HG, Seth SK. 1968. A revised survey of forest types of India. Manager of publication, Government of India, Delhi. 404p.

Chizzola R, Saeidnejad AH, Azizi M, Oroojalian F, Mardani H. 2014. *Bunium persicum*: variability in essential oil and antioxidants activity of fruits from different Iranian wild populations. Genetic Resource and Crop Evolution 61(8):1621-1631.

Choudhary AK, Punam, Sharma PK. 2005. A study on physiography and biodi- versity with special reference to medicinal, aromatic and dye plants of Parvati valley of Himachal Northwest Himalayas. Indian Journal Natcon 17(2):315–323.

Devi U, Seth MK, Sharma P, Rana, JC. 2013. Study on ethnomedicinal plants of Kibber wildlife sanctuary: a cold desert in Trans Himalaya. India. Journal of Medicinal Plant Research 7(1):3400-3419.

Devkota SR, Paudel KR, Sharma K, Baral A, Chhetri SB, Parajuli P. 2015. Investigation of antioxidant and anti-inflammatory activity of roots of *Rumex nepalensis*. World Journal of Pharmaceutical Sciences 4(3):582-594.

Dhiman AK. 2006. Ayurvedic Drug Plants, Daya Publishing House, Delhi. P,171.

Farooq U, Pandith SA, Saggoo MI, Lattoo SK. 2013. Altitudinal variability in anthraquinone constituents from novel cytotypes of *Rumex nepalensis* Spreng. a high value medicinal herb of Northwestern Himalayas. Industrial Crops and Products 50(10):112-117.

Farouji AE, Khodavari H. 2016. Ethnomedicinal plants of Farouj district, North Khorasan province, Iran. Journal of Herbal Drugs 7(1): 21-36.

Friedman J, Yaniv Z, Dafni A, Palewitch D. 1986. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethno harmacological field survey among bedouins in the Negev desert, Israel. Journal of Ethnopharmacology 16(2-3):275-287.

Gautam R, Srivastava A, Jachak SM. 2011. Simultaneous determination of naphthalene and anthraquinone derivatives in *Rumex nepalensis* Spreng. roots by HPLC: comparison of different extraction methods and validation. Phytochemical Analysis 22(2):153-157.

Gonzalez AG, Bermejo J, Mansilla H, Massanet GM, Cabrera I, Amaro JM, Gllindo A. 1977. The structure and stereochemistry of artemin. Phytochemistry 16(11):1836-1837.

Gonzalez AG, Galindo A, Mansilla H, Guiterez A. 1981. Structure of maritimin, a sesquiterpene lactone from *Artemisia maritima* Phytochemistry 20(10):2367-2369.

Govindan SV, Bhattacharaya SC. 1977. Alantolides and cyclocostunolides from *Saussurea lappa*. Indian Journal of Chemistry 15:956-958.

Grover J, Kumar V, Singh V, Bairwa K, Sobhia ME, Jachak SM. 2014. Synthesis, biological evaluation, molecular docking and theoretical evaluation of ADMET properties of nepodin and chrysophanol derivatives as potential cyclooxygenase (COX-1, COX-2) inhibitors. European Journal of Medicinal Chemistry 80(80C):47-56.

Heinrich M, Ankli A, Frei B, Weimann C, Sticher O. 1998. Medicinal plants in Mexico: healers consensus and cultural importance. Social Science and Medicine 47(11):1863-1875.

Hosseini SV, Tanideh N, Kohanteb J, Ghodrati Z, Mehrabani D, Yarmohammadi H. 2007. Comparison between Alpha and silver sulfadiazine ointments in treatment of pseudomonas infections in 3rd degree burns. International Journal of Surgery 5(1):23-26.

Iwu MM, 1994. African medicinal plants in the search for new drugs based on ethnomedicinal leads. In: Chadwick DJ, Marsh J, editors. Ethnobotany and the search for new drugs, Ciba foundation symposium 185. Chichester: Wiley, p. 116-129.

Jalilzadeh-Amin G, Maham M, Dalir-Naghadeh B, Kheiri F. 2011. Effects of *Bunium persicum* (Boiss.) essential oil on the contractile responses of smooth muscle (An In vitro Study).Veterinary Research Forum 2(2):87-96.

Jan M, Khare RK, Mir TA. 2021. Medicinal plants used during Pregnancy and Childbirth in Baramulla District of Jammu and Kashmir, India. Ethnobotany Research and Applications 22:1-19.

Jetter R. 2000. Long-chain alkanediols from *Myricaria germanica* leaf cuticular waxes. Phytochemistry 55(2):69-76.

Jing WG, Wang ZM, Zhao Y, Fu J, Zhao XL, Liu A. 2014. Chemical constituents from seeds of *Brassica campestris*. Zhonggua Zhong Yao Za Zhi 39(13):2521-2525.

Kayani S, Ahmad M, Sultana S, Shinwari ZK, Zafar M, Yaseen G, Hussain M, Bibi T. 2015. Ethnobotany of medicinal plants among the communities of alpine and subalpine regions of Pakistan. Journal of Ethnopharmacology. 164:186-202.

Khateeb AM, Khandi SA, Kumar P, Bhadwal MS, Jeelani R. 2015. Ethnoveterinary practices used for the treatment of animal diseases in Doda district Jammu and Kashmir. Indian Journal of Traditional Knowledge 14(2):306-312.

Kochan E, Wysokinska H, Chmiel A, Grabias B, 1999. Rosmarinic acid and other phenolic acids in hairy roots of Hyssopus officinalis. Bioscience 54(1-2):11-16.

Kour K, Sangwan PL, Khan I, Koul S, Sharma SN, Kitchlu S, Bani S. 2011. Alcoholic extract of *Cicer microphyllum* augments Th1 immune response in normal and chronically stressed Swiss albino mice. Journal of Pharmacy and Pharmcology 62(2):267-277.

Krzyzanowska J, Janda B, Pecio L, Stochmal A, Oleszek W, Czubacka A, Przybys M, Doroszewska T. 2011. Determination of polyphenols in *Mentha longifolia* and *Mentha piperita* field-grown and in vitro plant samples using UPLC-TQ-MS. Journal of AOAC International 94(1):43-50.

Kumar A, Pandey VC. 2012. Documentation and determination of consensus about phytotherapeutic veterinary practices among the Tharu tribal community of Uttar Pradesh, India. Tropical Animal Health and Production 44(4):863-872.

Kumar D. 2002. The use and relevance of ethnoveterinary practices in sheep. Indian Journal of Small Ruminants. 8(2):124-128.

Kumar P, Manikandan R, Panwar GS, Srivastava SK. 2017. Diversity of high altitude ethnomedicinal plants in Himachal Pradesh, India. Indian Forester 143(2): 165-179.

Kumar R, Bharti KA, 2013. New claims in folk veterinary medicines from Uttar Pradesh, India. Journal of Ethnopharmacology 146(2):581-593.

Lal B, Singh KN. 2008. Indigenous herbal remedies used to cure skin disorders by the native of Lahaul-Spiti in Himachal Pradesh. Indian Journal of Traditional Knowledge 7(2):237-241.

Lans C, Turner N, Brauer G, Lourenco G, Georges K. 2006. Ethnoveterinary medicines used for horses in Trinidad and in British Columbia, Canada. Journal of Ethnobiology and Ethnomedicine 2(1):1-20.

Laurie WA, McHale D, Sheeridan JB. 1985. Cucurbitacin glycoside from *Picrorhiza kurroa*. Phytochemistry 24(11):2659-2661

Lewis WH, Elwi-Lewis MP, Medical botany plants affecting human health. New York: Wiley; 2003. p. 812.

Liang C, Ju W, Pei S, Tang Y, Xiao Y. 2017. Pharmacological activities and synthesis of esculetin and its derivatives: a mini-review. Molecules 22(3): 387.

Marin FR, Ortuno A, Benavente-Garcia O, Del-Rio JA. 1998. distribution of flavone glycoside diosmin in *Hyssopus officinalis* plants: changes during growth. Planta Medica 64(2):181-182.

Miana GA, Ikram M, Khan MI, Sultana F. 1971. Alkaloids of *Aconitum violaceum*. Phytochemistry 10(12):3320-3332

Michel T, Destandau E, Le-Floch G, Lucchesi ME, Elfakir C. 2012: Antimicrobial, antioxidant and phytochemical investigations of sea buckthorn (*Hippophae rhamnoides* L.) leaf, stem, root and seed. Food Chemistry 131(3):754-760

Mir TA, Jan M, Khare RK, Dhyani S. 2021. Ethno-Survey of Traditional Use of Plants in Lolab Valley, Kashmir Himalaya. Indian Forester 147(3):281-287.

Mir TA, Jan M, Khare RK. 2021. Ethnomedicinal application of plants in Doodhganga forest range of district Budgam, Jammu and Kashmir, India. European Journal of Integrative Medicine 46:101366.

MirT A, Jan M, Khare R K. 2022. Ethnomedicinal Practices and Conservation Status of Medicinal Plants in the Bandipora District of Kashmir Himalaya. Journal of Herbs, Spices and Medicinal Plants 28(2):125-142.

Mohammad SA, Hasan AH, Peyman R. 2014. Preliminary investigation on phytochemical composition and antibacterial activity of the root of *Cousinia microcarpa* Boiss. Asian Journal of Medical and Pharmaceutical Research 4(4):156-159.

Murakami Y, Omoto T, Asai I, Shimomura K, Yoshihira K, Ishimaru K. 1998. Rosmarinic acid and related phenolics in transformed root cultures of *Hyssopus officinalis*. Plant Cell, Tissue and Organ Culture 53(1):75-78.

Nazaruk J, Jakoniuk P. 2005. Flavonoid composition and antimicrobial activity of *Cirsium rivulare* (Jacq.) all flowers. Journal of Ethnopharmacology 102(2): 208-212.

Nfi AN, Mbanya JN, Ndi C, Kameni A, Vabi M, Pingpoh D, Yonken S, Moussa C. 2001. Ethnoveterinary medicine in the northern provinces of Cameroon. Veterinary Research Communications 25(1):71-76.

Pande PC, Tiwari L, Pande HC. 2007. Ethnoveterinary plants of Uttaranchal: a review. Indian Journal of Traditional Knowledge 6(3):444-458.

Phillips O, Gentry AH, Reynel C, Wilki P, Gavez-Durand CB. 1994. Quantitative ethnobotany and Amazonian conservation. Conservation Biology 8(1):225-248.

Pirbalouti AG, Yousefi M, Nazari H, Karimi I. 2009. Evaluation of burn healing properties of *Arnebia euchroma* and Malva sylvestris. Electronic Journal of Biology 5(3):62-66.

Prakash P, Radha, Kumar M, Pundir A, Puri S, Prakash S, Kumari N, Thakur M, Rathour S, Jamwal R, Janjua S, Ali M *et al.* 2021. Documentation of Commonly used Ethnoveterinary Medicines from wild plants of the high mountains in Shimla District, Himachal Pradesh India. Horticulture 7(10):351.

Rajakumar N, Shivanna M B. 2009. Ethno-medicinal application of plants in the eastern region of Shimoga district, Karnataka, India. Journal of Ethnopharmacology 126(1):64-73.

Rani S, Chahota RK, Sharma TR. 2015. Ethnobotanical survey and traditional knowledge of some medicinal and aromatic plants of Himachal Pradesh, North- West Himalayas. International Journal of Applied and Pure Science and Agriculture 1(12):1-22.

Rao PK, Hasan SS, Bhellum BL, Manhas RK. 2015. Ethnomedicinal plants of Kathua district, JandK, India. Journal of Ethnopharmacology 171:12-27.

Rastogi RP, Sharma VN, Siddiqui S. 1949. Chemical examination of *Picrorhiza kurroa* Benth Part 1. Journal of Scientific and Industrial Research 5:173-178.

Ross, Ivan S. 2005. Medicinal plants of the world, chemical constituents, traditional and modern medicinal uses, Humana Press 3:235-250

Sakanyan, E.A., 1988. Pharmacognostic study of some plants of the genus *Oxytropis* DC. used in Tibetan medicine. Cand. Diss. p. 21.

Sedlakova J, Kocourkova B, Lojkova L, Kuban V. 2003. Determination of essential oil content in caraway (*Carum carvi* L.) species by means of supercritical fluid extraction. Plant Soil and Environment 49(6):277-282.

Shah GM, Ahmad M, Arshad M, Khan A, Zafar M, Sultana S. 2012. Ethno-phyto-veterinary medicines in northern Pakistan. Journal of Animal and Plant Sciences 22(3):791-797.

Sharma M, Sood SK. 2013. Ethnobotanical survey for wild plants of District Solan, Himachal Pradesh, India. International Journal of Environmental Biology 3(3):87-95.

Sharma PK, Chauhan NS, Lal B, Husaini AM, Teixeira da Silva JA, Punam. 2010. Conservation of phyto-diversity of Parvati valley in Northwestern Hi- malayas of Himachal Pradesh-India. In: Husaini, A.M. (Ed.), Medicinal Plants of the Himalayas: Advances and Insights, vol. 4(Special Issue 1), pp. 47-63.

Sharma PK, Chauhan NS, Lal B. 2003. Commercially important medicinal and aromatic plants of Parvati valley, Himachal Pradesh. Journal of Economic and Taxonomic Botany 27(4):937-942.

Sharma PK, Chauhan NS. 2000. Ethnobotanical studies of gaddies-A tribal community of district Kangra (Himachal Pradesh). In: Kohli, R.K., Singh, H.P., Vij. S.P., Dhir, K.K., Batish, D.R., Khurana, D.K. (Eds.), Man and Forests, pp. 301-312.

Sharma PK, Sethi GS, Sharma SK, Sharma TK. 2006. Ethnomedicinal observation among the inhabitants of cold desert of Himachal Pradesh. Indian Journal of Traditional Knowledge 5(3):358-361.

Sharma PK, Thakur SK, Manuja S, Rana RK, Kumar P, Sharma S, Chand J, Singh A, Katoch KK. 2011. Observations on traditional phytotherapy among the inhabitants of Lahaul valley through amchi system of medicine: a cold desert area of Himachal Pradesh in Northwestern Himalayas, India. Chinese Medical 2(3): 93-102.

Sharma R, Manhas RK, Magotra R. 2012. Ethnoveterinary remedies of diseases among milk yielding animals in Kathua, Jammu and Kashmir, India. Journal of Ethnopharmacology 141(1):265-272.

Shrestha R, Timilsina N. 2017. Antioxidant and antimicrobial activity and GC-MS analysis of extract of Rumex nepalensis Spreng. Pharmaceutical Innovation. 6(9):155-158.

Singh B, Rastogi RP. 1972. Chemical examination of *Picrorhiza kurroa* Benth. Part VI. Reinvestigation of kutkin. Indian Journal of Chemistry 10:29-31.

Singh G, Rawat GS. 2011. Ethnomedicinal survey of Kedarnath wildlife sanctuary in western Himalaya, India. Indian Journal of Fundamental and Applied Life Sciences 1(1):35-46.

Singh KJ, Thakur AK. 2014. Medicinal plants of the Shimla hills, Himachal Pradesh: a survey. International Journal of Herbal Medicine 2(2):118-127.

Singh KN, Lal B, Todaria NP. 2012. Ethnobotany of higher plants in Spiti cold desert of Western Himalaya. Natural Sciences 10(5): 7-14.

Sood SK, Ram N, Kalia DC. 2001. Ethnobotany of cold desert tribes of Lahaul-Spiti (N.W Himalaya) Deep publications, New Delhi. 345p.

Tabuti JRS, Dillon SS, Lye KA. 2003. Ethnoveterinary medicine for cattle (*Bos indicus*) in Bulamogi country Uganda: plant species and their mode of use. Journal of Ethnopharmacology. 88:279-286.

Tewari M, Mathela CS. 2003. Compositions of the essential oils from seeds of *Carum carvi* Linn. and *Carum bulbocastanum* Koch. Indian Perfumer 47(4):347-349.

Thakur KS, Kumar M, Bawa R, Bussmann RW. 2014. Ethnobotanical study of herbaceous flora along an altitudinal gradient in Bharmour forest division, District Chamba of Himachal Pradesh, India. Evidence Based Complementary and Alternative Medicine 2014, 1-7.

Thakur M, Asrani RK, Thakur S, Sharma PK, Patil RD, Lal B, Parkash O. 2016. Observations on traditional usage of ethnomedicinal plants in humans and animals of Kangra and Chamba districts of Himachal Pradesh in North-Western Himalaya, India. Journal of Ethnopharmacology 191:280-300.

Thomson PDR. 2004. PDR for Herbal Medicines, Thompson PDR, Montvale, NJ, USA, 3rd edition.

Varga E, Hajdu Z, Veres K, Mathe I, Nemeth E, Pluhar Z, Bernath J. 1998. Investigation of variation of the production of biological and chemical compounds of *Hyssopus officinalis*. L Acta Pharmceutica Hungarica 68:183-188.

Vasas A, Orban-Gyapai O, Hohmann J. 2015. The Genus Rumex: Review of traditional uses, phytochemistry and pharmacology. Journal of Ethnopharmacology 175:198-228.

Verma RK, Tewari VP. 2016. Some important medicinal plants of cold desert regions of district Kinnaur of Himachal Pradesh state in India: their uses and chemical ingredients Journal of Plant Chemistry Ecophysiology. 1(2):1-8.

Verma RK. 2014. An ethnobotanical study of plants used for the treatment of livestock diseases in Tikamgarh district of Bundelkhand, central India. Asian Pacific Journal Tropical Biomedicine 4:460-467.

Wagay NA. 2016. Ethnobotany from north Kashmir: a review. Life sciences leaflets 80: 38-60.

Wani PA, Nawchoo IA, Wafai BA. 2009. The role of phenotypic plasticity, phenology, breeding behaviour and pollination systems in conservation of *Rheum emodi* Wall. exMeisn. (Polygonaceae) - A threatened medicinal herb of Northwest Himalaya. The International Journal of Plant Reproductive Biology 1(2):179-189,

Weinges K, Kloss P, Henkels WD. 1972. Natural products from medicinal plants. XVII. Picroside-II, A New 6-Vanilloylcatapol from Picrorhiza kurroa Royle and Benth. Justus Liebigs Annalen der Chemie 759:173-182.

Wichtmann EM, Stahl-Biskup E. 1987. Composition of the essential oils from caraway herb and root. Flavour and Fragrance Journal 2(2), 83-89.

Zgorka G, Głowniak K. 2001. Variation of free phenolic acids in medicinal plants belonging to the Lamiaceae family. Journal of Pharmaceutical Biomedical Analysis. 26(1):79-87.

Zhang Y, Witt DLD, Murugesan S, Nair MG. 2005. Cyclogenase-2-enzyme inhibitory triterpenes from *Picrorhiza kurroa* Seeds. Life Sciences 77(25):3222-3230.

Zheng GQ, Kenney PM, Lamm LK. 1992. Anethofuran, carvone, and limonene: Potential cancer chemopreventive agents from dill weed oil and caraway oil. Planta Medica 58(4):338-341.

Zou ALC, Zhu TF, Gan SC, Wang DC, Zhang Y, Deng XM. 2008. Two new from the roots *Picrorhiza scrophulariiflora*. Chinease Chemical Letters. 19(10):1224-1227.

Zou X, Liao X, Ding LS, Peng SL. 2007. Phenyl and phenylethyl glycosides from *Picrorhiza scrophulariiflora*. Journal of Asian Natural Products Research 9(3-5):443-448.