Medicinal plant resources in Skuru watershed of Karakoram wildlife sanctuary and their uses in traditional medicines system of Ladakh, India

Abstract

Background: The objectives of the present study were to document the medicinal plant resources of Skuru watershed in Karakoram Wildlife Sanctuary and their uses in traditional medicines system (Amchi) of Ladakh. Amchi system of medicines is a complementary medicines system in Ladakh. The medicinal plants were collected in the summer season of 2015 and 2016. These medicinal plants were identified at H.N.B. Garhwal University Herbarium and from some published literature. During these surveys, 73 plant species belonging to 31 families were recorded. It was also found that maximum plant species were being in use for ailments related to digestive system, followed by musculoskeletal, respiratory system, skin, cardiovascular system and blood, and nervous system. Among the plant parts used, leaves were in maximum use for herbal medicines preparations followed by whole plants, flowers, shoot, roots, stem, seeds, fruits, bulbs, bark, rhizomes and tuber.

Keywords: amchi, leh ladakh, medicinal plants, traditional knowledge

Introduction

India is considered as one of the leading countries in the world regarding the wealth of traditional knowledge systems for the use of plant species. The country is blessed with the rich and diverse heritage of traditional medicinal systems like Ayurveda, Siddha, Unani and Sowa-Rigpa. Sowa-Rigpa is also known as Tibetan medicine system in Western countries. It is one of the oldest/ancient surviving and thoroughly documented medical traditions/wisdom of the world. It has been widely practiced in Himalayan regions of India, Tibet, Bhutan, Mongolia, Nepal, some parts of China, and few parts of Soviet Union. In India, this traditional medicines system is practiced in the Ladakh region of Jammu and Kashmir, Lahoul and Spiti (Himachal Pradesh), Sikkim, Darjeeling (West Bengal) and Arunachal Pradesh.1 In Ladakh, Sowa-Rigpa is also known as Amchi medicine system. Most of the population in Ladakh is Buddhist and they depend on the Amchi system of medicine, which has been in vogue for a long time and widely in practice. It offers fascinating knowledge of the ancient medicinal system.2 Medicinal plants of this region can open opportunities for economic growth in the rising global market. It has been understood further, medicinal plants of the trans-Himalaya, offer the favorable position in having considerably more prominent potential outcomes of giving novel bio-molecules in perspective of the natural pressure.3 These medicinal plant resources offer alternative remedies along with great opportunities for the generation of employment, income and foreign exchange for developing nations.4

Ladakh is situated in the extreme altitude of the Trans-Himalayan region of India, which lies between latitude 31°44’57”–32°59’57”N and longitude 76°46’29”–78°41’34”E and covers an area of more than 65,000km².5 Ladakh is comprised of two districts, namely Leh and Kargil in the Jammu and Kashmir state of India. More than, 1,180 vascular plant taxa were recorded by klimes and Dickore6 through systematic floristic survey in these regions; this number is considerably higher than those reported by Kachroo et al.,7 611 species and 880 species by Kachroo8 in previously published volumes of flora of the area.7,8 The vegetation of Ladakh is in the range of 2,700m to 6,000m a.s.l. altitude and comes under alpine to high alpine zone. Physiographically, Ladakh can be divided into five valleys - Leh, Nubra, Changthang, Zanskar and Suru. Ethno-floral studies for traditional medicines in Ladakh have been carried out by many authors like Gurmet,1 Bath and Navecho,2 Angmo et al.,3 Angmo et al.,4 Abrol Chopra,1 Stewart,12 Namgyal and Phuntsog,12 Singh et al.,14 Kala,15–17 Ballabh and Chaurasia,18–20 Kumar et al.,21 Rinchen and Pant.22 However, very few researchers like Kumar et al.,21 and Pal et al.,24 have focused on Ethno-floral studies with special reference to Nubra valley.21,24

There is no information available on the public domain regarding the medicinal plants from Skuru watershed till date. This watershed has rich medicinal plants resources. The pressure of tourism activities is already high on the fragile ecosystem of Ladakh, but this study area is still not affected considerably. The Rakuru village can only be reached by nearly 10km trek. Tourists were not allowed to visit beyond Hunder village (20km from the nearest survey site) till recently due to security reasons, as these villages are close to the border of Pakistan. The area is now open for trekking, but very few trekkers cross the area. In near future, the number of trekkers in this area likely to increase, as the tourist influx in Leh district is increasing considerably year by year. So, before any drastic transformation takes place in the area, documentation of the medicinal plant’s resources of Skuru watershed is very important. Therefore, the present research was carried out to document the medicinal plant’s resources in the area and their uses for different ailments in traditional Amchi system of medicines.

Materials and methods

The study area

The Nubra valley lies between the two mountain ranges- Ladakh and Karakoram on the South and North respectively. The valley located between 34°15’45” to 35°31’00” N and 76°55’ to 78°05’E
co-ordinates.28 The valley is broad and well vegetated with groves of seabuckthorn (Hippophae rhamnoides) then the other valleys of Ladakh. It is a thorny shrub, used by the villagers at a large scale for fuel and fencing their agriculture fields, to protect their crops from the domestic, stray and wild animals. The altitude ranges are approximately between 2,700 to 6,000m above m.s.l. The climatic condition of the region is a cold arid type, precipitation is erratic and scanty (<80mm per annum) and temperature reaches lower than 0°C to as high as 38°C.28

The Skuru watershed is a part of the Shayok river basin (Figure 1). The elevation is in the range of 2981–6061m a.s.l. The medicinal plants were collected from three sites Skuru village (3,115m above m.s.l.; 34°40′21″N and 77°15′13″E), Rakuru village (4,000m above m.s.l.; 34°35′10″N and 77°15′13″E) and high altitude pasture land (Phu) (5,000m above m.s.l.; 34°32′27″N and 77°13′23″E). The elevations and coordinates were recorded during the field visits. Skuru village is the lowest point in the watershed situated on the bank of the river Shayok. A stream from the eastern side of village flows from south-north direction. There is an open area grazing land covered scantily with shrubs in western side. The vegetation on the banks of the stream and river are covered with shrub and bush species like Hippophae rhamnoides, Myricaria elegans, Tamarix gallica, Rosa webbiania, Phragmites spp., Clematis tibetana and Berberis ulcina. The commonly cultivated crops, vegetables, timber plants, fruit trees and fodder plants of the village include Triticum vulgare, Hordeum vulgare, Pisum sativum, Brassica nigra, Raphanus sativus, Brassica rapa, Brassica oleracea, Allium cepa, Allium sativum, Solanum tuberosum, Daucus carota, Cucurbita spp. Spinacia spp. Lycopersicon esculentum, trees Populus nigra, Prunus persica, Elaeagnus angustifolius, Medicago sativa and M. falcata. Rakuru village, situated at a higher altitude than Skuru, grows few cultivated crops of cereals, pulses, vegetables and stunted tree species like Hordeum vulgare, Pisum sativum, Raphanus sativus, Brassica rapa, Daucus carota, Salix divergence and S. alba. The high altitude pastures land, which is only used in the summer season by villagers for grazing livestock (dZo, dZomo, cow, yak, donkey, goat and sheep). The area is covered with important medicinal plant resources. The pasture is used for grazing by the people of three villages Skuru, Rakuru and Terchey.

Data collection

Information regarding the landscape, natural habitat and medicinal plants resources were collected from intensive field observations during the period of two years (2015;16). The plants were photographed and collected in the months of June-July for identification. Identification of the medicinal plants was done at H.N.B. Garhwal University Herbarium and also with the help of published literature especially by Klimies and Dickoré,29 Kachroo et al.,1 Stewart,30 Chaurasia et al.31 The uses of medicinal plants were reviewed from the published literature on Amchi medicine system. The commonly cultivated crops, vegetables, timber plants, fruit trees and fodder plants of these villages were documented through observations and interviews with the locals during field visits. The coordinates and elevations of the study sites were recorded with the help of GPS (Garmin eTrex 30x).

Amchi system of medicines

Amchi system of medicines is synonymous to Sowa-Rigpa or Tibetan medicine, as the fundamental concepts and basic practices that they follow are the same. The Sowa-Rigpa medicine system reveals a holistic way of thinking in which sickness is treated as a physical, emotional and spiritual whole. The rGyud-bZhi, or ‘Four Tantras’, is the holy scripts containing the body of medical knowledge.31,32 According to the Four Tantras, Sowa-Rigpa is based on the principles of Jung-wa-in (five elements), and Nespas gsum (three humors). All living beings are formed by the five cosmo-physical elements—S (Earth), Chu (Water), May (Fire), rLung (Air or wind) and Nam-kha (Space). Therefore, all the diseases and their antidotes are five elements of origin and composition respectively.32 The three humours—rLung (wind), mKris-pa ( bile) and Badkhan (phlegm) are considered the functional physiological units of the five cosmo-physical elements.31 These humoral created certain physical, physiological and emotional characteristics.32 The rGyud-bZhi states that the composition of our body is same as the universe. This relationship between the macrocosm (the universe) and the microcosm (body), clarifies the equal impacts that one element has on the others and the reliance that associates the individuals to the environment.31 In view of this connection, any changes in our environment may be it positive or negative brought comparable changes in our body system. The Law of Interdependence is a basic principle in Buddhist teaching and which can be seen in this medical system also. Every substance on the Earth believes to have medicinal properties and therapeutic value in Sowa-Rigpa.33 Medicinal substances are categorized into eight major category: Rinoipo sman (prized metal and stone), sa sman (drugs from mud and earth), rdo sman (stones), shing sman (drugs from trees), rtsi sman (essence and exudates medicines), thang sman (ingredient for decoction/shrub), snas sman (herb) and srog chags sman (animal parts). The constituents of medicine are used in both single and compound forms; compound medicine is based on two major combinations, ro (taste) and nus-pa (potencies). From, nearly seventeen different types of preparation, decoction, powder, paste, pills, medicated ghee, linctus, bhasmas, medicated wine and medicated bath are some of the main medicinal preparation.1

Reference

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Results and discussion

The medicinal plants in Skuru watershed grow in the diverse range of habitats, such as valley plains, alpine pastures, rocky, dry slopes, boulders and alpine mountains. The Amchi system is totally dependent upon natural resources for the collection of plants and their parts.13 During the survey, 73 medicinal plant species belonging to 61 genera of 37 families from the area were recorded (Table 1). The uses of the collected medicinal plants for Amchi medicine system were reviewed from secondary published sources. Asteraceae was the most dominant (19%) family with 14 plant species, followed by Fabaceae and Lamiaceae families (8%) with six species each. Polygonaceae was represented by five species (7%) and Amaryllidaceae by four species (5%). Ranunculaceae, Rosaceae and Scrophulariaceae were represented by three species each (4%). Amaranthaceae, Apiaceae, Chenopodiaceae Geraniaceae, Solanaceae and Urticaceae families were represented by 2 species each (3%). Remaining 17 families (Berberidaceae, Boraginaceae, Brassicaceae, Campanulaceae, Capparaceae, Convolvulaceae, Crassulaceae, Elaeagnaceae, Ephedraceae, Juglandaceae, Malvacaeae, Orchidaceae, Orobancheae, Plantaginaceae, Plumbaginaceae, Salicaceae and Tamaricaceae) were monotypic (1%) used for traditional medicine system (Figure 2). The results of the present study revealed that from the recorded 73 species of medicinal plants, maximum (72.6%) plant species were used for ailments related to digestive system, followed by musculoskeletal (30.14%), respiratory system (27.4%) cardio-vascular system and blood related problems (24.66%), skin related problems (24.66%), renal system related problems (17.81%), nervous system (13.7%), gynaecological (10.96%) and men’s sexual health (5.48%). A bulk (45.21%) was used for other ailments (Table 2). Except for the seven plant species, all medicinal plants recorded were used for more than one ailment. The plant parts which were in maximum use for herbal medicines were leaves (33%) followed by whole plant (12%), flowers (12%), shoots (11%), roots (8%), stems (8%) seeds (7%), fruits (4%) bulbs (2%), bark (1%), rhizomes (1%) and tubers (1%) (Figure 3). Some of the most important medicinal plants photographs have also been given in Figure 4.

![Table 1 Medicinal plants species, their vernacular names and parts used in treatment of ailments in Amchi system of medicines](https://example.com/table1.png)

| Species | Family | Vernacular name | Part use | Medicinal properties | Sources* |
|---------|--------|----------------|----------|----------------------|----------|
| 1 Aconogonum tortuosum (D. Don) H. Harata | Polygonaceae | Snyalo | Leaves & whole | Blood purifier & painful urination | 5,10 |
| 2 Aconogonum tortuosum (D. Don) H. Harata | Polygonaceae | Longze | Whole plant | Cardiac disorders | 10,23,27 |
| 3 Allium cepa L. | Amaryllidaceae | Tsong | Bulb & leaves | Loss of appetite & vomiting | 10,19 |
| 4 Allium humile Kunth | Amaryllidaceae | Kfu | Leaves & bulb | Stomach complaints & indigestion | 22 |
| 5 Allium przewalskianum Regel | Amaryllidaceae | Skose, Kangmar | Shoot & leaf | Dysentery & stomachache | 10,19,23 |
| 6 Allium sativum L. | Amaryllidaceae | sGagba | Leaves & bulb | Indigestion & loss of appetite | 10,19 |
| 7 Amaranthus spinosus L. | Aamaranthaceae | Roots & leaves | Spasm, gastric troubles, irregular menstruation & kidney problems | 5,22,24 |
| 8 Arabidopsis wallichii (Hk. F. & Th.) N. Busch. | Brassicaceae | Imatso. | Leaves | Appetizer | 23 |
| 9 Arnedia euchroma (Royle) I.M. Johnst. | Boraginaceae | Demog | Leaves & roots | Hair tonic, backache, cough, cold, lungs & pulmonary problems, blood purifier, blood vomiting & kidney problems | 0,22,23 |
| 10 Artemisia maritima L. ex Hook.f. | Asteraceae | Burtse | Leaves & stem | Skin diseases & intestinal parasites | 10 |
| 11 Artemisia absinthium L. | Asteraceae | Burs-ka | Whole plant | Rheumatism, malaria, anti-worm | 10 |
| 12 Artemisia brevifolia Wall. Ex DC | Asteraceae | Khampa | Leaves & flowers | Gastrointestinal disorder, intestinal worm, aphrodisiac, antiseptic, laxative & blood purifier | 10,19,27 |
| 13 Artemisia moorcroftiana Wall. Ex DC. | Asteraceae | Burtse | Whole plant | Malaria fever | 10 |
| 14 Aster fistulosus Bunge | Asteraceae | Lukunik | Flowers & stem | Eye problem, liver disease, fever, cold & cough | 10,27 |
| 15 Berberis ulicina Hk. f. & Th. | Berberidaceae | Khitser | Stem, bark, roots & fruits | Arthritis, cough, fever, ring worm, skin diseases, constipation, antiseptic & tonic | 2,22,23,27 |

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### Table Continued

| Species | Family | Vernacular name | Part use | Medicinal properties | Sources* |
|---------|--------|----------------|----------|----------------------|----------|
| 16 | Biebersteinia odorata Stephan ex Fisch | Geraniaceae | Drakspos, Sari | Whole plant & roots | Urino-genital disorder, peptic ulcer, diarrhea, blood purifier, cuts, wounds, & skin sore | 10,22,27 |
| 17 | Bisorta vivipara (L.) Gray | Polygonaceae | Langna | Flowers & stem | Abdominal pain & backache | 10 |
| 18 | Capparis spinosa L | Capparaceae | Kabra | Leaves & stem | Paralysis, rheumatism, gout, tonic, toothache, hyperacidity, liver, skin & stomach problem | 2,10,23,27 |
| 19 | Caragana versicolor Benth. | Fabaceae | Tsan | Whole plant | Food poisoning, fever & throat infection | 10 |
| 20 | Carum carvi L. | Apiaceae | Kasnyot | Leaves, roots & seeds | Rheumatism, spasm, acidity, gastric troubles, indigestion, intestinal worm, stomachache, irritable condition of bladder, promotes urination, cold, promote menstruation & tonic | 2.5,10,19,22,23 |
| 21 | Chenopodium album L. | Amaranthaceae | Janchikarpo | Leaves, seeds & flowers | Gastric troubles, painful urination & diuretic | 2.22 |
| 22 | Chenopodium botrys L | Chenopodiaceae | Snue | Flower & leaves | Intestinal worm, constipation, stomach complaints | 10,27 |
| 23 | Chenopodium glaucum L | Chenopodiaceae | Sanek | Leaves | Constipation | 10 |
| 24 | Chesneya cuneata (Benth.) Ali | Fabaceae | Bigangbo | Roots | Antiseptic | 35 |
| 25 | Cicer microphyllum Benth. | Fabaceae | Sari | Leaves & seed | Stress, fatigue, jaundice, tongue infections & sore throat | 10,27 |
| 26 | Cirsium arvense (L.) Scop | Asteraceae | Biangtser | Shoot | Vomiting & headache | 10 |
| 27 | Clematis orientalis L | Ranunculaceae | rBisho, Emong | Shoot | Indigestion | 10,19 |
| 28 | Clematis tibetana kuntze | Ranunculaceae | Sanek | Whole plant | Indigestion & scabies | 10,27 |
| 29 | Codonopsis ovata Benth | Campanulaceae | Lurdud-dorjey | Shoot & leaves | Ulcer, lungs & liver problems, chest conjunction, blood purifier, rheumatism. | 10,27 |
| 30 | Convolvulus arvensis L. | Convolvulaceae | Whole plant | Rheumatic, pain, cuts & wounds | 22 |
| 31 | Dactylorhiza hatagirea (D.Don) Soó | Orchidaceae | Angbo-iaikpa, Sanchu | Tuber | Round worm, asthma, lungs & pulmonary problems, hypoactive sexual desire disorder, nerverine tonic, skin problems, wounds, kidney disorder, burning sensation of urine, regulation of urine discharge, sedative & restoring regenerative fluids | 5,19,23,34 |
| 32 | Datura stramonium L | Solanaceae | Datura | Leaves & stem | Ear problems, impotence, intestinal worms & respiratory problems | 10 |
| 33 | Delphinium brunonianum Royle | Ranunculaceae | Ladhar-mentok | Leaf, flower & whole plant | Colic, malaria & throat pain | 2.22,27 |
| 34 | Droaconcephalum heterophyllum Benth. | Lamiaceae | Kachor tsa, Zoysi | Shoot, leaves flowers & whole plant | Peptic ulcer, hypertension, headache, cough & cold. | 23,27 |
| 35 | Echinops cornigerus DC | Asteraceae | Aczema, Kaqtsaymaq | Leaves, seeds, flower & shoot | Food poisoning, tonic, septic wound & jaundice | 10,27 |
Table Continued....

| Species | Family | Vernacular name | Part use | Medicinal properties | Sources* |
|---------|--------|-----------------|----------|----------------------|----------|
| Elsholtzia densa Benth. | Lamiaceae | Sanik | Leaves | Menorrhagia, pathogenic diseases of uterus, pain due to cuts & burns | 18,22 |
| Ephedra gerardiana Wall. Ex Stapf | Ephedraceae | Tseopath | Roots, stem, leave, branches, fruits & shoot | Bronchitis, asthma, rheumatism, syphilis, heart ailments, fever, hepatic diseases, irregular menstruation, bleeding, blood purification, liver disorders & tonic | 2,10,22, 27,35 |
| Euphrasia himalayica Wettst | Scrophulariaceae | Skianglo | Leaves | Eye problems & cardiac ailments | 10 |
| Geranium pratense L. | Geraniaceae | Gugchuk, Godur, | Leaves & whole | Fever, pneumonia, influenza, inflammation of lungs & veins, swelling of limbs, dysentery, diarrhoea, analgesic, & tonic | 10,19,27 |
| Heracleum pinnatum C.B. Clarke | Apiaceae | Spru | Shoot & root | Inflammation & pain caused by fever, leprosy, chicken pox, small pox, irregular menstruation, haemorrhage & abdominal cramps | 10,27 |
| Hippophae rhamnoides L. | Elaeagnaceae | Tsog, tSestalulu | Fruit, flower, seed & stems | Anti-ageing, anti-cold, memory restoration, energy boosting, blood purifier, peptic ulcer, lung disorders, cuts, wounds, tonic for malnourished children & pregnant ladies & multi vitamins source especially ‘C’. | 2,10,27, 22,19 |
| Juglans regia L | Juglandaceae | Storga | Seeds, leaf & bark | Itch, rheumatism, constipation, tooth & gums related problems | 2,10,22 |
| Lactuca lessertiana (Wall. Ex DC.) Wall. Ex C.B.Clarke | Asteraceae | Leaves & shoot | Rheumatism & skin diseases | 10,27 |
| Lactuca tatarica (L.) C.A.Mey | Asteraceae | Bshakha | leaves | Headache, fever, internal wounds & vomiting | 10,22 |
| Lancea tibetica Hook. F. & Thomson | Scrophulariaceae | Raikse, Chagna, Spang-ali | Root, & Leaves | Tonic, wound, heart diseases, cough, & chest congestion | 10,23 |
| Leontopodium alpinum Colm. Ex Cass | Asteraceae | Tzima | Whole plant | Septic wounds | 10 |
| Malva verticillata L | Malvaceae | Chiroti/ Suchuli | Roots & stem | Liver tonic & piles | 10 |
| Melilotus officinalis (L.) Pall. | Fabaceae | Buksuk | Whole plant | Relieves gas, induce urination, improve blood circulation, nervous tension, painful menstruation, insomnia, palpitations, wounds, cut & bruises, | 35 |
| Mentha longifolia (L.) Huds. | Lamiaceae | Phaling | Leaves & shoot | Abdominal pain, dysentery, diarrhoea, stimulant, vomiting, diuretic, headache & rheumatism. | 19,23, 24,27 |
| Myricaria elegans Royle | Tamaricaceae | Umbu | leaves | Blood purifier | 10 |
| Nepeta floccosa Benth. | Lamiaceae | Changmagog | Leaves & flowers | Fever, cough & cold | 10,27 |
| Oxyria digyna (L.) Hill | Polygonaceae | Changskur, Chu-chum, Lamanchu | Leaves & shoot | Indigestion, loss of appetite & gastritis | 2,10,19,22 |

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| Species | Family | Vernacular name | Part use | Medicinal properties | Sources* |
|---------|--------|-----------------|----------|----------------------|----------|
| 53 | Pedicularis cheilanthifolia var. Albida (Pennis) P.C.Tsoong | Orobanchaceae | Lugru-serpo, Landay-snumpo, | Whole plant | Stomachache, leucorrhoea & menorrhagia | 18,19,27 |
| 54 | Perovskia abrotanoides Kar. | Lamiaceae | burtey | Leaves & flower | Cough, headache, infection, constipation, & painful urination | 5,23,27 |
| 55 | Physoclinga proealta (Decne.) Miers | Solanaceae | Langtang | Whole, leaves flowers, stem, seeds & oil | Rheumatic pains, toothache, ulcer & eye diseases | 23,27,36 |
| 56 | Plantago himalaica Pilg. | Plantaginaceae | Thorum, Humbuknsuk | Seeds & leaves | Diarrhoea, gastric disorder & liver related problems | 2,10,22 |
| 57 | Potentilla anserina L | Rosaceae | Troma | Rhizome & leaves | Diarrhoea, kidney stone & stomach complaints | 10 |
| 58 | Prunus armeniaca Linn. | Rosaceae | Chuli | Oil | Tonic & stimulate long and healthy hair | 2 |
| 59 | Rheum spiciforme Royle | Polygonaceae | Lachu | Roots & Leaves | Swellings, wounds, chronic bronchitis, piles, constipation & rheumatism. | 10,23,27 |
| 60 | Rhodiola tibetica (Hook. F. & Thoms.) Fu | Rosaceae | Choango, Sholo | Leaves & shoot | Headache, stress, memory loss, tonic | 10,18,27 |
| 61 | Rosa webbiana Wall. Ex Royle | Rosaceae | Sai marpo | Flowers & fruits | Bleeding, hepatitis, jaundice, deficiency of vitamin C & liver problems | 10,27 |
| 62 | Rumex patientia L | Polygonaceae | Shama | Leaves & shoot | Constipation, fever, skin disorder, rheumatism & backache | 10,27 |
| 63 | Salix alba L | Salicaceae | Malchang | Tender leaves | Knee, hip pain & fever | 10,23 |
| 64 | Stachys tibetica Vatke | Lamiaceae | Churukpa | Shoot | Insecticide, mites & lice control | 10 |
| 65 | Tanacetum dolichophyllum (Kitam.) Kitam. | Asteraceae | Khampa-serpo | Leaves & flower | Intestinal-worm | 19,20,27 |
| 66 | Tanacetum gracile Hook. F. & Thomson | Asteraceae | Ribong-sbtursey, Khamchu, | Leaves & flower | Intestinal-worm | 10,19 |
| 67 | Taraxacum officinale Webb | Asteraceae | Han, Kharkhorna | Roots, leaves & flower | Blisters, liver problems, digestive problems, intestinal worms, blood purifier, headache, weak immune system, kidney disorder, painful urination, diuretic, alcoholism, skin problems, back ache, stomach, hepatic stimulant, tonic, sedative & analgesic | 5,10,19,22,23,27 |
| 68 | Thermopsis inflata Cambess | Fabaceae | Dugsrod | Whole plant | Swelling | 10 |
| 69 | Trigonella emodi Benth | Fabaceae | Bugsug | Leaves & stem | Fever, anaemia & peptic ulcer | 10 |
| 70 | Urtica dioica L. | Urticaceae | Roostat | Shoot | Paralysed limbs & rheumatism. | 35 |
| 71 | Urtica hyperborea Jacq. ex Wedd. | Urticaceae | Zatsod | Leaves & whole plant | Cold & cough, stomachache, rheumatism & joint pain | 10 |
| 72 | Verbascum thapsus L | Scrophulariaceae | Shandok | Shoot, stem, leaves, flowers & fruit | Asthma , frost bite, aphrodisiac, impotency, amenorrhoea, menorrhagia, chest problems, diarrhoea, bleeding, diuretic, blood disorder, sores, infections, bleeding wounds & cuts | 10,27,35 |
| 73 | Waldheimia tomentosa (Decne.) Regel | Asteraceae | Polu | Leaves, seeds & whole plant | Acidity, headache, wound & arthritis | 2,10,22,27 |
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Table 2 Percentage of recorded plant species used against ailments of different human organ systems

| Health problem related to main body parts | Specific conditions                                                                 | Percentage |
|-----------------------------------------|--------------------------------------------------------------------------------------|------------|
| Digestive system                        | Constipation, indigestion, dysentery, acidity, cramps, hepatic problems, food poisoning, peptic ulcer, diarrhoea, piles | 72.6       |
| Musculo-skeletal                        | Gout, arthritis, back pain, rheumatism                                              | 30.14      |
| Respiratory system                      | Cough, cold, bronchitis, chest congestion, sore throat, asthma                       | 27.4       |
| Cardiovascular system & blood related   | Palpitation, haemorrhage, hypertension, malaria                                       | 24.66      |
| Skin /dermatological                    | Wound, cuts, bruises, swelling, scabies, blister, frostbites                         | 24.66      |
| Renal/kidney system                     | Urinary retention, infection (pyelonephritis), painful urination, stone (kidney/bladder) | 17.81      |
| Nervous system                          | Tension/anxiety, memory loss, paralysis, insomnia, headache                         | 13.7       |
| Gynaecological                          | Painful menstruation, discharge, amenorrhea                                         | 10.96      |
| Mens health                             | Impotency                                                                            | 5.48       |
| Others                                  | Toothache, aging, eye problems, weakness etc.                                        | 45.21      |

Figure 2 Percentage of medicinal plants species recorded in each family.

Figure 3 Percentage of plant parts of recorded species used in traditional medicines.

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Central Arid Zone Research Institute (CAZRI), Sher-e-Kashmir University of Agricultural Sciences and Technology (SKUAST) and NGO like World Wildlife Fund for Nature - India (WWF) are working for the conservation of medicinal plants through their research work and organizing workshops and trainings for the people. But, these are not enough; there is a need of focussing conservation activities in the rural areas. In the surveyed villages most of the inhabitants were of the opinion that there is no profit from traditional farming. They say that the investment amount is higher than the earned income. Earlier times, all the family members work together, the children were also involved in farming. But now, the children are studying in schools and colleges. Adult men are busy in armed forces, tourism-related activities, day labor in army camps and Border Road Organization (BRO). As all the children and most of the adults in most of the villages of Nubra valley are busy in their respective works, during the period of harvesting and threshing. Therefore, the villagers are forced to hire labors for the same. Only the women and senior citizens are involved all through the agricultural season in farming and harvesting. The transportation of manure from home to the field, ploughing fields, harvesting and threshing were earlier carried out on draught animal but now these activities are carried out with hired tractors and load vehicles. All the villagers pay for it in cash.21–37 Money was not used earlier for these works. All these farming activities were performed by helping each other in the villages. Therefore, there is a dire need for sustainable alternate livelihoods like growing important medicinal plants other than traditional farming, dependent on tourism and armed forces. In the surveyed villages, growing of medicinal plants is not in practice. If the medicinal plants are obtained directly from the farmers for the traditional medicine system and herbal companies, then there will be less exploitation of medicinal plants in nature. It will certainly help to conserve these resources in wild. This will also help in conserving medicinal plants in wild. On 18 July 2016, M/S Dabar India Ltd signed a MoU with the Defence Institute of High Altitude Research (DIHAR), Leh. Under this, Dabar officials will impart training to the villagers on the sustainable cultivation of herbs with the primary focus on helping the local community and augmenting the population of medicinal herbs in the country. There is also a need of such more initiatives and also more focused research. The farmers should be given training for cultivation and marketing for medicinal plants by the Ladakh Autonomous Hill Development Council or State government or the Government of India through their respective departments for enhancing their livelihood and reducing pressure on the medicinal plants thriving in wild.

Conclusion

From the current research work, it has been concluded that the watershed of the Karakoram wildlife sanctuary was rich in Medicinal plant resources during the study period. Good knowledge of Amchi system of medicine about the uses of the local medicinal plants for different ailments was also found. The pressures to these medicinal plants were increasing from unscientific exploitation, uprooting for fuel, overgrazing, natural calamities and other activities in Ladakh region. So, to minimize the pressure on these resources, the villagers should be encouraged and well trained for growing medicinal plants. If medicinal plants are obtained directly from the farmers for the traditional medicine system and herbal companies, then there will be less exploitation of medicinal plants in nature and can also provide a sustainable alternative livelihood to the villagers.

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**Conflict of interest**

Authors declare that there is no conflict of interest.

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