

*Full Length Research Paper*

# Study on ethnomedicinal plants of Kibber Wildlife Sanctuary: A cold desert in Trans Himalaya, India

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The present study aimed to document the use of ethnomedicinal plants by Bodh or Bhotia tribe residing around Kibber Wildlife Sanctuary, a cold desert protected area in trans Himalayan Region. First-hand information on traditional knowledge was collected from Amchis (Folk healers) and local knowledgeable people of age groups that are between 30 and 75 years along with thorough review of previous studies in Indian Himalayan Region. Informants citations were also recorded for various ailments for which the species were used by which authenticity of the uses made can be assessed. The study provides information on the indigenous uses of 69 plant species, which are distributed among 25 families and 54 genera, that is, Angiosperms (24 families, 53 genera and 68 species), Gymnosperms (1 family, 1 genus and 2 species). Out of the total plants, 65 were herbs and four were shrubs.

**Key words:** Cold desert, ethnomedicinal, medicinal plants, traditional knowledge, Indian Himalaya.

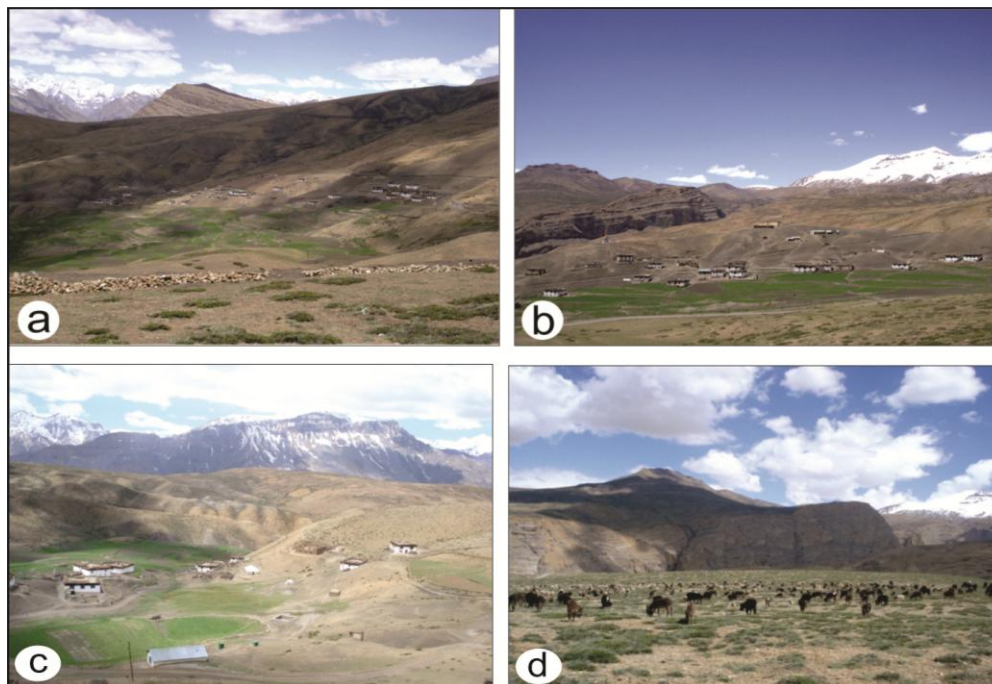
## INTRODUCTION

Himalayan region covers roughly 10% of India total land surface and harbours 18,440 species of the flora (Singh and Hajra, 1996) out of which 1750 species are medicinal (Samant et al., 1998). To conserve such a rich biological diversity, 9.2% of its area is under protected area network (Kala, 2005a).

Cold desert is the 16th Biosphere Reserve of India and comprising about 7,770 km<sup>2</sup> area including Pin Valley National Park and Kibber Wildlife Sanctuary (Henceforth, KWLS) in Spiti valley (Srivastava, 2010). More than 900 plant species have been recorded from the area (Aswal and Mehrotra, 1994) of which many plant species are of local importance and are hitherto unexploited. Though the indigenous knowledge about medicinal plants usually passed through words of mouths from one generation to the next or their descendants inherit the medico-spiritual manuscripts (Malik et al., 2011).

Hence, many important species that leads to drug

discovery may be lost in absence of proper documentation. Moreover, in the face of the emerging threats of destructive harvesting, habitat destruction and bio-piracy (Gadgil, 1996; Utarsh et al., 1999) it becomes imperative to document the valuable indigenous knowledge of these plants. Therefore, this study has been undertaken with the aim of collecting, identifying and recording the details of ethnomedicinal plants along with their mode of preparation/application, status, nativity and range of utility of the species. In addition to this, comparative studies of the recorded information with previous works from Indian Himalaya (Ballabh and Chaurasia, 2007, 2009; Ballabh et al., 2008; Chandrasekar and Srivastava, 2009; Jain, 1991; Kala, 2005b; Lal and Singh, 2008; Sharma et al., 2004, 2006, 2011; Singh et al., 2009, 2012; Singh, 2012; Singh and Lal, 2008; Sood et al., 2000; Srivastava et al., 1992; Uniyal et al., 2006) was also done.



**Plate 1.** Villages around KWS and Grazing pressure: (a) Hikkim village; (b) Langza village; (c) Komic village; (d) Grazing animals in KWS.

## MATERIALS AND METHODS

### Study area

Famous among the tourists all over the world, Spiti division in Trans Himalaya region of Lahaul and Spiti district of Himachal Pradesh, India includes Kibber Wildlife Sanctuary. It lies between 32°50' and 32°30' N latitudes and 78° to 77°32' E longitudes (Figure 1). It spreads over an area of about 1400 km<sup>2</sup> and bordered in the northern catchment of the Spiti River and is flanked by Ladakh to the north and Tibet to the east (Kala, 2005a). The altitude of sanctuary varies from 3,500 to 6,700 m above mean sea level (Green, 1993).

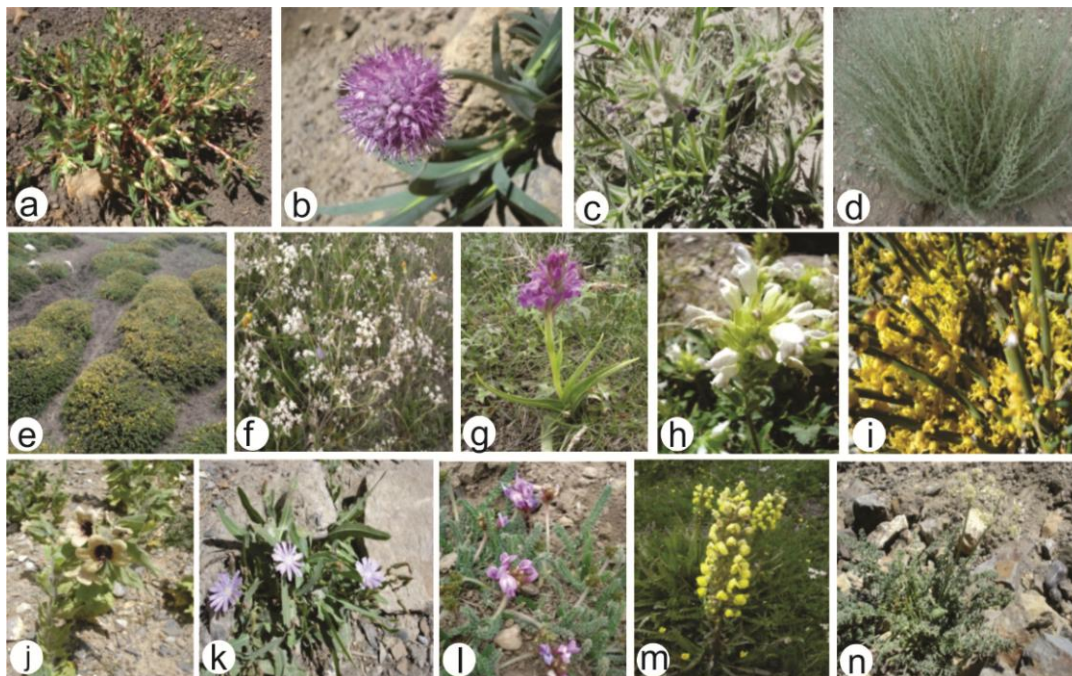
During winters, the temperature drops up to -35°C. Summer has mean maximum temperatures around 25°C. Precipitation is mainly in form of winter snow (Mishra, 2001). In winter months (October to April), the region remains cut-off from adjoining area due to very heavy snowfall. Flowering in the flora initiates in April to July months, when snow starts melting. The vegetation is dry alpine steppe type and shrubs seldom exceed a height of 1 m. The vegetation is mainly dominated by shrubs like *Caragana*, *Lonicera*, *Artemisia* and *Ephedra* and herbaceous plants like *Allium*, *Aquilegia*, *Arnebia*, *Primula* and *Thymus*. There are about 13 villages situated nearby the periphery of the sanctuary except one village (Kibber) which has only two households which exists inside the sanctuary area (Plate 1).

Bhot or Bhotia tribal community that inhabits in the area is overwhelmingly Buddhists (Census of India, 1991). They have a wealth of knowledge on the use of medicinal plants in their locality. Furthermore, due to its remoteness and lack of modern health facilities, local people depend on available plant resources and traditional medicine systems known as Amchi system of medicine, which is principally based on Tibetan system of medicine. The Amchi (herbal practitioners) considered experts in medicinal uses of plants and are playing an important role in providing health coverage to local people.

### Ethnomedicinal surveys, identification and data presentation

Field surveys were carried out in and around KWS during the period of 2009 to 2012 for studying details of ethnomedicinal plants. First-hand information on traditional knowledge related to plant species was collected from the stakeholders, that is, by interacting and interviewing Amchi (Traditional/Folk healers of Spiti valley), elderly knowledgeable people of age group between 30 and 75 years. Total 5 Amchis and 20 local knowledgeable inhabitants of different age group were interviewed through semi-structured questionnaires of which 23 were male and only two were female (Table 1). Details for local names of the plants, parts used, ailments treated, mode of administration, and curative properties were recorded. Altitude of the area was noted down with the help of GPS (Make; Garmin GPSmap76CSx). Status of occurrence of plants was recorded through visual observations and information provided by local inhabitants.

Most of the plants were identified on spot and the rests were brought to the laboratory and identified through local floras (Aswal and Mehrotra, 1994; Chowdhery and Wadhwa, 1984; Dhaliwal and Sharma, 1999; Murti, 2001; Polunin and Stainton, 1984; Singh and Rawat, 2000) and available literature. Standard procedures were adopted for collection, preserving and identifying the specimens (Jain and Rao, 1977). The voucher specimens were also matched and compared with the authentic specimens available in the herbarium (BSD) of Botanical Survey of India (BSI), Dehradun and deposited in the laboratory herbarium of Himachal Pradesh University, Shimla, as reference material. Nativity (denotes the place of origin/first record of the species) of the plants (Anonymous, 1970; Samant et al., 1998; <http://www.ipni.org>; <http://tropicos.org/>) is also determined. The information is given in a tabular form as scientific names of plants in alphabetic order along with family, local names, altitudinal range, nativity, status, habit, parts used, ethnomedicinal uses reported, names of ailments, and modes of administration/formulations (Table 2). Study was compared with previous works and informant's citations also recorded for various



**Plate 2.** Few ethnomedicinal plants of KWLS: (a) *Aconogonum tortuosum*; (b) *Allium carolinianum*; (c) *Arnebia euchroma*; (d) *Artemisia maritima*; (e) *Caragana brevifolia*; (f) *Carum carvi*; (g) *Dactylorhiza hatagirea*; (h) *Dracocephalum heterophyllum*; (i) *Ephedra intermedia*; (j) *Hyoscyamus niger*; (k) *Lactuca tatarica*; (l) *Oxytropis microphylla*; (m) *Pedicularis bicornuta*; (n) *Semenovia thomsonii*

ailments for which the species were used so that the validity of the uses can be assessed (Table 4).

## RESULTS AND DISCUSSION

In the Indian Himalayan Region (IHR), the use of medicinal plants is still a tradition continued by local people or ethnic communities (Kala, 2005a) and traditional medicine systems play an important role in daily health care of poor people. Strong belief in the traditional medicinal system and efficient curative properties are the reasons to prefer traditional medicine over modern medication. Each plant has some medicinal value and all of the informants (100%) use medicinal plants to treat at least some ailments. Here, the study provides information on the indigenous uses of 69 species of ethnomedicinal plants (Plate 2). These plants were distributed among 25 families and 54 genera, that is, Angiosperms (24 families, 53 genera and 68 species), Gymnosperms (1 family, 1 genus and 2 species). As study area falls under cold desert, herbs constitute higher number of medicinal plants with 65 species and only four species were shrubs. Among the angiosperms, the largest proportion of medicinal plants collected belonged to the family Asteraceae (13 species) followed by Apiaceae and Polygonaceae (6 species each), Lamiaceae (05 species), Ranunculaceae and Scrophulariaceae (4 species each), Gentianaceae and Fabaceae (3 species each). Gymno-

sperms were represented by Ephedraceae family only. As species richness decreases along altitudinal gradient (Trigas et al., 2013), distribution of maximum species (49 species) occurred between 3500 and 4500 m zone and only 20 species were present above 4500 m. 26 species were native to the Himalayan region and remaining 43 species were non-natives. Notable native species were *Aconitum violaceum* Jacq. ex Stapf, *Dactylorhiza hatagirea* (D. Don.), *Heracleum candicans* Lindl, *Hyoscyamus niger* L., *Picrorhiza kurrooa* Royle ex Benth, *Saussurea bracteata* Decne, *Rheum moorcroftianum* Royle, etc. High-altitude Himalayan zone is full of fragile habitats and is rich in native species (Dhar et al., 1993; Kumar et al., 2011); therefore, presence of large number of native species highlights its conservation priority.

Majority of these plants were used for fever, joint pain, headache, cough, indigestion, cuts/wounds, blood purification, jaundice, skin problem, asthma, cold, sexual problems, etc. These ailments were grouped under 15 ailment categories (Figure 2). Maximum species were used to cure gastrointestinal problem such as indigestion, stomachache gastric problems, food poisoning, constipation, diarrhea, dysentery, etc., which is in compliance with earlier works from cold desert (Sood et al., 2001; Ballabh and Chaurasia, 2009). Different plant parts used for making herbal preparations to cure these ailments were roots, leaves, stem, seeds, rhizomes and seeds, etc (Figure 3). Mode of administration of the herbal preparation included oral administration, paste

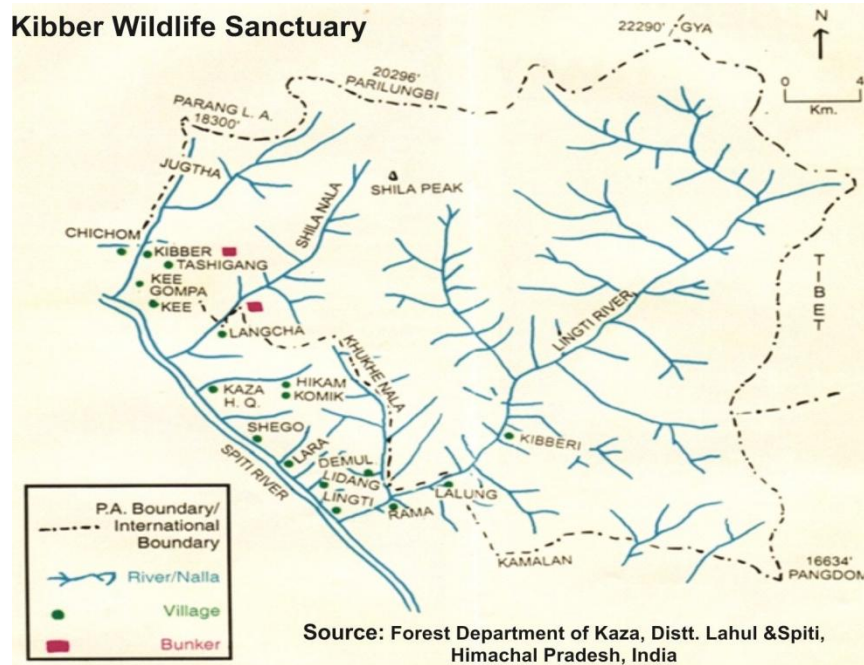
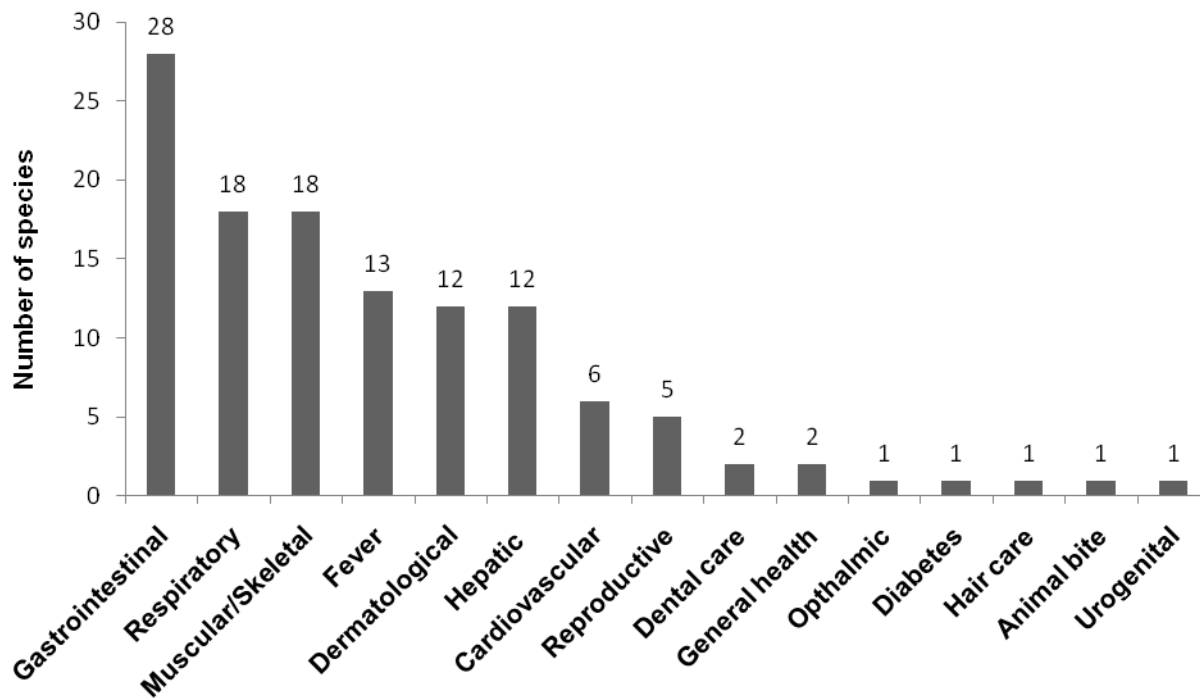


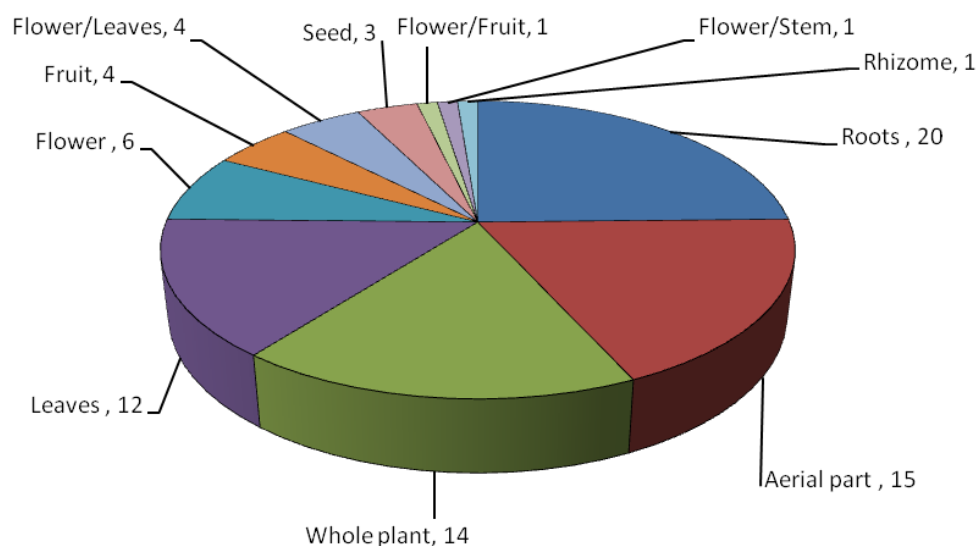
Figure 1. Map of the study area showing KWLS.

application and inhalation (Table 3). Internal ailments were commonly treated by making herbal preparations in powder or in decoction form. To make powder, plant part is dried in shade and grinded into fine powder and stored for future use. The decoction was prepared by boiling the plant parts in water until the volume of the water reduced to the minimum or required amount. However, extract of

the plant part is prepared by straining well-pounded fresh material, e.g. extraction of fresh leaves of *Potentilla bifurca* L. used for headache. Seeds of *H. niger* are burnt on fire and smoke is inhaled in case of toothache. Raw leaves of *Christolea crassifolia* Camb. are chewed for improving eye site. Most of the formulations of herbal plants were taken once or twice a day as a full dose,



**Figure 2.** Graph showing categories of ailments cured by different plants species.



**Figure 3.** Pie diagram showing different plant part used for curing various ailments.

**Table 1.** Age group of informants.

Age group	Male	Female
>70	3	-
61-70	9	1
51-60	6	-
41-50	3	-
30-40	2	1

depending on age, health and types of ailment.

As investigation of records of plant based on medicinal treatments, it becomes obvious that some of the plants are being used more frequently than the others to cure various ailments. Therefore, the ailments considered under present explorations, were analyzed further for comprehensive details on the indigenous use pattern. For specific uses of the plants, citations of the informants were assessed (Table 4). The most cited species were:

**Table 2.** Ethnomedicinal plants of KWLS.

Taxa	LN	Altitude (m)	Nativity	Occ	Hb	PU	Ethnobotanical uses reported in KWLS
<b>Alliaceae</b>							
<i>Allium carolinianum</i> DC	Lapod	3600-4600	Carolina USA	C	H	Wp	Whole plant is powdered and ½ teaspoon taken for joints pains.
<i>Allium przewalskianum</i> Regel	Kocho	3700-4300	China Occ	S	H	Lf	Leave are dried in shade and made into powder. Powder boiled with one glass of water till ½ glass of decoction left and taken for cold
<b>Apiaceae</b>							
<i>Bupleurum falcatum</i> L.	Thonpu	3593-4200	Reg Himal	S	H	Rt	½ teaspoon dried root powder used for fever and cold.
<i>Bupleurum hamiltonii</i> Balakr.	-	3700-4500	As Trop	C	H	Ap, Rt	5-6 g powder of dried aerial part used for fever. Roots are boiled with water and decoction are taken for cough and influenza
<i>Carum carvi</i> L.	Mao, Siazira	3650-3900	Europe Or Asia	S	H	Sd	Powder of dried seeds used for indigestion, dysentery, cold and ulcers twice in a day with meals. For rheumatism bulk of seeds tied in a cotton cloth, than soaked into hot apricot oil and applied on affected part
<i>Heracleum candicans</i> Wall. ex DC.	Chogot	3635-4450	Reg Himal	S	H	Rt	One teaspoon of dried root powder taken orally for food poisoning and sexual problems
<i>Heracleum canescens</i> Lindl	Chogt	3700-4200	Reg Himal	S	H	Rt	Root paste used for skin problem
<i>Semenovia thomsonii</i> (C.B.Clarke) Manden,	Carpo	3587-4530	Reg Himal	S	H	Sd	Seeds are boiled with 100 ml water, when 50 ml left decoction taken for headache and gastric problem
<b>Asteraceae</b>							
<i>Anaphalis triplinervis</i> (Spreng.) Hand, Mazz.	Morping	4000-4650	Reg Himal	S	H	Lf	Paste of fresh leaves applied on the cuts and wounds for healing
<i>Artemisia dracunculus</i> L.	Bhurma	3500-3900	Europe Or Reg	S	H	Wp	Extraction of whole plant used to relief toothache and fever.

Table 2. Contd.

<i>Artemisia maritima</i> L.	Burse	3560-4200	Europe Reg Caucas Sibir	C	Sh	Wp, Lf	Paste of whole plant applied on cuts, wounds. Decoction of leaves is used to cure cough, joint pains and fever
<i>Aster flaccidus</i> Bunge	Seertik	4500-4790	Sibir	S	H	Wp	5-6 g powder of dried whole plant taken for cold
<i>Cousinia thomsoni</i> C. B. Clarke	Tawa	3564-4680	Reg Himal	C	H	Rt	½ teaspoon of dried root powder used to cure joint pains twice in a day
<i>Lactuca macrorhiza</i> (Royle) Hook. f.	Thumpu	3780-4300	Reg Himal	S	H	Ap	½ teaspoon powder of aerial parts used in jaundice and headache one in a day
<i>Lactuca tatarica</i> (L.) C.A. Meyer	Thonpu	4200-4500	As Occ Ind Or	C	H	Wp	Decoction of whole plant used for joint pains
<i>Saussurea bracteata</i> Decne	Pangchi-tawo	4510-4760	Reg Himal	R	H	Fl	Decoction of flower head given in fever and to improve blood circulation once in a day
<i>Scorzonera virgata</i> DC	Chactik	3604-4387	China Mongol	C	H	Ap	Decoction of aerial parts used in jaundice
<i>Taraxacum officinale</i> Weber	Khur-khang	3580-4700	Reg Temp Bor et Austr	C	H	St, Fl	Powdered of stem and flowers are used for stomachache and cough with lukewarm water once in a day
<i>Waldheimia stoliczkai</i> Ostenf.	Lucmik-serpo	4600-4700	Tibet	S	H	Fl	5-6 g powder of dried flowers used for food poisoning
<i>Waldheimia tomentosa</i> (Decne.) Regel	Lukmik	4500-4750	Tibet Occ	S	H	Ap	½ teaspoon powder of aerial parts used for food poisoning once in a day
<i>Youngia glauca</i> Edgew	Seertik	3627-4450	Reg Temp As Bor	C	H	Ap	3-5 g powder of dried aerial part used for jaundice, indigestion and fever twice in a day
<b>Boraginaceae</b>							
<i>Arnebia euchroma</i> (Royle ex Benth.) I.M. Johnston	Khamet	3850-4500	Reg Himal Turkest	C	H	Lf, Rt	Powder of leaves used to control cough. Root paste used on cuts and wounds. Roots are used with mustered oil to control dandruff
<i>Arnebia guttata</i> Bunge.	Dimo	3600-4100	Sibir	C	H	Rt	Root paste used on cuts and wounds

Table 2. Contd.

<b>Brassicaceae</b>							
<i>Christolea crassifolia</i> Camb.	Lukmic	3700-4400	Tibet	C	H	Lf	Raw leaves are chewed for improving eye site
<b>Campanulaceae</b>							
<i>Codonopsis clematidea</i> (Schrenk) Clarke	Ludud	3780-4200	Reg Himal	C	H	Ap, Rt	About 6 g powder of aerial parts given in joint pains once or twice a day. Root powder used as aphrodisiac
<i>Codonopsis ovata</i> Benth.	Ruchukpa	3658-4200	Reg Himal	C	H	Rt	Root paste used on cuts/wounds
<b>Caryophyllaceae</b>							
<i>Gypsophilla cerasitoides</i> D. Don	Mendok	4120-4558	Reg Himal	C	H	Ap	Paste of aerial parts used for cuts/wounds
<b>Chenopodiaceae</b>							
<i>Chenopodium album</i> L.	Chilm	3600-4350	Reg Temp et Trop	C	H	Wp	½ teaspoon powder of whole plant used for headache and seminal weakness
<i>Chenopodium botrys</i> L.	Zanchi	3600-4400	Reg Bor	C	H	Wp	Decoction of whole plant used in headache, stomachache and disturbed menstruation
<b>Crassulaceae</b>							
<i>Rhodiola cretinii</i> (R. Hamet) H. Ohba.	Solo-marpo	4000-4690	Reg Himal	S	H	Rt	About 50 ml of decoction of roots powder used for kidney problem and asthma
<b>Ephedraceae</b>							
<i>Ephedra gerardiana</i> Wall. Ex Stapf	Chhedum	3980-4300	China	C	H	Ap	Decoction of aerial parts given for joint pain, blood purification, pneumonia, gastric problems and as a liver tonic
<i>Ephedra intermedia</i> Schrenk et C.A. Meyer	Khaut	3600-4100	As Centr Himal China	C	H	Ap	½ teaspoon powder of aerial parts given for asthma twice in a day
<b>Fumariaceae</b>							
<i>Corydalis gowaniana</i> Wall.	Togsil	4500-4700	Reg Himal	S	H	Fl	½ teaspoon of powder of dried flowers used in blood purification twice in a day
<b>Gentianaceae</b>							
<i>Gentiana leucomelaena</i> Maxim. ex Kush.	Tikta	4263-4500	Mongol Tibet	C	H	Wp	Whole plant is powdered and ½ teaspoon consumed to cure jaundice



Table 2. Contd.

<i>Gentianella moorcroftiana</i> (Wall. ex D. Don) Airy Shaw.	Chaktik	3635-4800	Reg Himal	C	H	Ap	½ teaspoon powder of aerial parts used to cure jaundice and indigestion
<i>Gentianella tenella</i> (Rottb.) Borner	Tikta	4500-4650	Reg Bor et Arct	C	H	Wp	Decoction of whole plant used in liver and spleen complaints once or twice in a day
<b>Geraniaceae</b>							
<i>Geranium pretense</i> L.	Pollo-Mendok	3600-4500	Europe As Bor	C	H	Lf	Decoction of leaves are given to cure diarrhoea and as liver tonic
<i>Geranium wallichianum</i> D. Don ex Sweet	Likatur	3950-4309	Reg Himal	C	H	Fl	½ teaspoon powder of flowers used for fever and to improve digestion once or twice a day depending on patient condition
<b>Grossulariaceae</b>							
<i>Ribes orientale</i> Desf.	Nayangay	3640-4000	Reg Himal	C	Sh	Fr, Rt	Extraction of fruits used for constipation. Roots paste used for joints pain
<b>Lamiaceae</b>							
<i>Dracocephalum heterophyllum</i> Benth.	Toksa	4285- 4722	Reg Himal Turkest	C	H	Wp	Powder of whole plant used to control cough and headache twice in a day
<i>Elsholtzia eriostachya</i> (Benth.) Benth.	Jirug serpo	4000-4500	Reg Himal	C	H	Wp	½ glass decoction of whole plant used to remove intestinal parasites
<i>Mentha longifolia</i> (L.) Huds.	Khoit	3900-4300	Reg Bor Temp	C	H	Lf, Wp	1 teaspoon powder of dried leaves is used to treat headache and joint pain. Plant extract of whole plant used for indigestion
<i>Nepeta podostachys</i> Benth.	Ribuksu	3780-4550	Afghan	C	H	Lf	Decoction of leaves used for fever
<i>Thymus linearis</i> Benth.	Tumba	3950-4558	Pakistan	C	H	Wp	About 40-50 ml decoction of whole plant used for stomachache, cold and cough. Paste of whole plant applied for skin problem
<b>Orchidaceae</b>							

Table 2. Contd.

<i>Dactylorhiza hatagirea</i> (D. Don.) Soo	Wang-luck	3600-4150	Reg Himal	S	H	Rt	One teaspoon powdered of root used for backache, sexual problems, and as tonic with milk at bed time. Patient suffering from high blood pressure should avoid this. Root paste used on cuts and wounds for healing
<b>Papilionaceae</b>							
<i>Caragana brevifolia</i> Komarov.	Chhato	3854-4542	China Ind Or	C	Sh	Rt	Decoction of root used for controlling blood cholesterol
<i>Oxytropis microphylla</i> (Pallas) DC.	Taksa Nakpo	4132-4800	Sibir	C	H	Fl, Lf	½ teaspoon powder of flowers and leaves used in case of animal bite twice in a day.
<i>Trigonella pubescens</i> Edgew. ex Baker	Pusu-khang	3773-4532	Ind Or	C	H	Fl, Lf	Powder of flowers and leaves is used to cure fever and in past for m for skin problem
<b>Polygonaceae</b>							
<i>Aconogonum tortuosum</i> (D. Don) Hara	Nyalo	4134 -4700	Reg Himal	C	H	Ap	1 teaspoon (adult) or ½ teaspoon (child) powder of dried aerial part used as liver tonic twice in a day
<i>Bistorta affinis</i> (D. Don) Greene	Retheram	4124-4760	Reg Himal	C	H	Wp	½ teaspoon of powder of whole plant used to cure diarrhea and vomiting
<i>Oxyria digyna</i> (L.) Hill	Chumcha	3893 -4660	Reg Bor Alp et Arct	C	H	Ap	½ teaspoon powder of aerial part used for indigestion and as liver tonic once in a day
<i>Polygonum viviparum</i> L.	Chulti	4124-4700	Reg Bor et Arct	C	H	Rt	Root extract used for piles and vomiting
<i>Rheum moorcroftianum</i> Royle.	Lachu	4650 -4780	Reg Himal	R	H	Rt	½ teaspoon powder of roots used for indigestion and constipation twice in a day
<i>Rumex nepalensis</i> Spreng.	Chumcha	3700-4450	Europe As Bor	C	H	Rt	Decoction of roots used to cure gastric problem
<b>Primulaceae</b>							
<i>Primula reptans</i> Hook. f. ex Watt	Sang-tik	4500-4650	Reg Himal	S	H	Fl	Powder of flowers used for curing cough with lukewarm water

Table 2. Contd.

<b>Ranunculaceae</b>							
<i>Aconitum rotundifolium</i> Kar. et. Kir.	Bonkar	4500-4600	As Centr	R	H	Rt	5-6 g root powder used for cough, fever and headache
<i>Aconitum violaceum</i> Jacq. ex Stapf	Bonkar, Phonkhar	4500-4760	Reg Himal	R	H	Rt	Roots are dried, grind into fine powder and boiled with water and ½ glass of decoction use for stomachache, fever, cough and as liver tonic once in a day
<i>Aquilegia fragrans</i> Benth.	Ludud dorge	3920-4200	Reg Himal	C	H	Ap	½ teaspoon powder of aerial parts given in diabetes and joint pains twice in a day
<i>Clematis orientalis</i> L.	Nakpo	3628-4270	Reg Himal Oriens	C	H	Fl, Fr, Rt	Powder of flowers and fruits are used for dysentery and extraction of roots is given for stomachache
<b>Rosaceae</b>							
<i>Potentilla atosanguinea</i> Lodd.	Marpu	3800-4600	Reg Bor Temp	C	H	Lf	Paste of leaves used for healing of cuts/wounds
<i>Potentilla bifurca</i> L.	Mendhok	3600-4760	Reg Caucas As Bor	C	H	Lf	Extraction of leaves used for headache
<i>Rosa webbiana</i> Wall. ex Royle	Sia-mendo	3680-4560	Reg Himal	C	Sh	Fr	½ teaspoon fruit powder used for lung problems and headache
<b>Rubiaceae</b>							
<i>Rubia tibetica</i> Hook. f.	Thokpa	3627-4250	Tibet Occ	S	H	Fr	1 teaspoon dried fruit powdered are taken orally for blood purification
<b>Saxifragaceae</b>							
<i>Bergenia Stracheyi</i> (Hook. F. & Thoms.) Engle.	Khilche	4250-4570	California	R	H	Lf, Fl, Rt	½ glass of decoction of leaves and flowers used for indigestion and fever twice in a day. Roots paste applied for body pain
<b>Scrophulariaceae</b>							
<i>Pedicularis bicornuta</i> Klotzsch ex Klotzsch and Garcke	Lukru-karpo	3970-4400	Reg Himal	S	H	Ap	¼ powder of aerial parts used for joint pain once in a day and past of aerial part cuts/wounds
<i>Pedicularis longiflora</i> Rudoph ssp. <i>tubiformis</i> (Klotzsch) Pennell	Lukru-serpo	4509-4880	Reg Himal	C	H	Fl, Lf	½ teaspoon powder made up of flowers and leaves used in general weakness twice in a day

Table 2. Contd.

<i>Picrorhiza kurrooa</i> Royle ex Benth	Honglen	4500-4750	Reg Himal	R	H	Rz, Lf	Decoction of rhizome given for jaundice, asthma, fever, stomachache and also used as liver tonic once in a day. ½ glass decoction of leaves used for cough
<i>Scrophularia dentata</i> Royle ex Benth.	Karpa	3900-4200	Reg Himal	C	H	Lf	Powder of dried leaves used for heart problem
<b>Solanaceae</b>							
<i>Hyoscyamus niger</i> L.	Thuklang	3600-3850	Reg Himal	S	H	Sd	Paste made up of seeds used to cure boils. Smoke of seeds is inhaled in toothache

Afr: Africa, Alp: Alpine, Am: America, Amphig: Amphigaea, Ap: Aerial part, Arab: Arabia, Arct: Arctic, As: Asia, Austr: Australia, Baluchist: Baluchistan, Bor: Borealis, C: Common, Caucas: Caucasus, Centr: Central, Cosmop: Cosmopolitan, et: And, Fl: Flower, Geront: Gerontia, H: Herb, Hb: Habit, Himal: Himalayan, Hisp: Hispan, Ind: Indian, Lf: Leaves, Mediterr: Mediterranean, Min: Minor, Mongol: Mongolia, N. Zel: New Zeyland, Occ: Occidentalis, Occ: Occurrences, Or: Oriental, PU: Part used R: Rare, Reg: Region, Rt: Root, Rz: Rhizome, S: Scattered, Sh: Shrub, Sd: Seed, Sibir: Siberia, Soongar: Soongarica, SubTrop: SubTropical, Temp: Temperate, Trop: Tropical and Turkist: Turkistan, Wp: Whole plant.

Table 3. Mode of administration of various plant species.

Species	Powder	Decoction	Extraction	Paste	Inhale	Raw
Number of Species	44	17	4	14	1	1

*Carum carvi* L. (96%, cold; 76%, Indigestion), *Arnebia euchroma* (Royle ex Benth.) (88%, dandruff; 60.0%, cuts/wounds), *H. niger* (84%, toothache), etc. These plants are preferred for medicinal preparation and the high percentages of the informant's citations indicate reliability of reported uses and good evidences of their effectiveness. Similarly, to assess the range of utility of the species, recorded information about medicinal plant was compared with previous works which indicates that 45 species were known to cure 37 ailments, which are either new or less known for the area (marked with asterisk\*). The species with high frequency of utilization and those which have news or less known uses need further analysis for the discovery of potential new drugs. Comparing the present study with previous work, the uses of a lot of medicinal plants was

noted comparable with our findings which have strengthened the observations recorded under the present work and might indicate their pharmacological effectiveness. *Ephedra gerardiana* Wall. Ex Stapf, *Corydalis govaniiana* Wall. and *Rubia tibetica* Hook. f. were reported for blood purification (Jain, 1991; Sharma et al., 2011; Singh, 2012; Singh et al., 2012, 2009; Singh and Lal, 2008); root paste of *Bergenia stracheyi* (Hook. F. & Thoms.) Engle. used for joint pains and general body pain (Sharma et al., 2006; Sood et al., 2001); leaf paste of *Potentilla atrosanguinea* Lodd. used for healing of wounds (Jain, 1991). Similarly, the use of *P. kurrooa* to cure fever recorded from Eastern Himalaya Region (Kala, 2005b) also support information gathered under the present investigation. The findings of similar plants for same medicinal uses justify poten-

tialities of these plants. However, for some species, information on their biological activity and chemical constituents is also available in the literature (Chandel et al., 1996; Chauhan, 1999; Kirtikar and Basu, 1981) that evidence the mode of application being practiced by the local people is likely to be effective.

Analysis of data regarding the status of medicinal plants showed majority of species in the study area were common (44 species) and few scattered (19 species). Six of the plant species were rarely found in the study area, namely, *Aconitum rotundifolia* Kar. et. Kir., *A. violaceum*, *B. stracheyi*, *P. karrooa*, *R. moorcroftianum*, *S. bracteata*. Most of the common plants were found in the vicinity of the villages, but rare and threats species which are used in herbal preparation frequently, are collected from the high altitude

**Table 4.** Ailmentwise informant's citation and previous uses reported.

Taxa	Ailment	Citation	%	Reported ethnomedicinal use
<i>Aconitum rotundifolium</i>	Cough	9	36	Fever, joint pain, jaundice, blood purification, cough (Singh, 2012; Singh et al., 2012; Chandra Sekar and Srivastava, 2009); antipyretic, insect bite, headache (Jain, 1991)
	Fever	12	48	
	Headache	8	32	
<i>Aconitum violaceum</i>	Stomachache	19	76	Gastrointestinal complaints, renal pain, rheumatism, stomachache (Sharma et al., 2011; Jain, 1991), fever (Chandra Sekar and Srivastava, 2009; Ballabh and Chaurasia, 2007)
	Fever	13	52	
	Cough*	9	36	
	Liver tonic*	14	56	
<i>Aconogonum tortuosum</i>	Liver tonic	16	64	Liver, stomach disorder (Singh, 2012; Singh et al., 2012; Chandra Sekar and Srivastava, 2009; Singh and Lal, 2008; Sood et al., 2001), kidney and urinary disorders (Ballabh et al., 2008); blood purifier (Singh et al., 2009)
<i>Allium carolinianum</i>	Joints pain *	16	64	Stomach disorder (Singh, 2012; Singh et al., 2012; Singh and Lal, 2008; Sharma et al., 2006); diuretic, stimulant (Sharma et al., 2011; Singh et al., 2009; Jain, 1991)
<i>Allium przewalskianum</i>	Cold*	17	68	Stomach complaints (Ballabh and Chaurasia, 2009)
<i>Anaphalis triplinervis</i>	Cuts/Wounds*	15	60	-
<i>Aquilegia fragrans</i>	Diabetes*	15	60	Cystitis, gout, eczema, psoriasis, blood sugar (Singh, 2012; Lal and Singh, 2008; Sharma et al., 2006); snake bite, body pain, boils, headache (Singh et al., 2009)
	Joint pains*	17	68	
<i>Arnebia euchroma</i>	Cough	8	32	Cough and dryness in throat, blood purification (Singh, 2012; Singh et al., 2012; Ballabh and Chaurasia, 2007); abortifacient, hair tonic, blood pressure, backache, headache (Sharma et al., 2011; Singh et al., 2009; Sood et al., 2001; Jain, 1991); anti-inflammatory, eye disease, cuts, wounds, toothache, antimicrobial, antipyretic, earache (Lal and Singh, 2008; Sharma et al., 2006); kidney and urinary disorders (Ballabh et al., 2008)
	Cuts/Wounds	15	60	
	Dandruff	22	88	
<i>Arnebia guttata</i>	Cuts /Wounds	19	76	Cold and cough, wounds (Chandra Sekar and Srivastava, 2009; Ballabh and Chaurasia, 2007)
<i>Artemisia dracunculus</i>	Toothache	13	52	Stomach complaints (Ballabh and Chaurasia, 2009); carminative for animals, throat infection, toothache and in menstrual cycle (Sharma et al., 2011; Singh et al., 2009); kidney and urinary disorders (Ballabh et al., 2008)
	Fever*	10	40	
<i>Artemisia maritima</i>	Cuts /Wounds	18	72	Skin diseases, joint pains (Singh, 2012; Lal and Singh, 2008); tonic, abdominal parasites, antiseptic, blood purifier, gastric disorders (Singh et al., 2012; Sharma et al., 2011; Ballabh and Chaurasia, 2009; Singh et al., 2009; Singh and Lal, 2008; Kala, 2005; Sood et al., 2001; Srivastava et al., 1992; Jain, 1991)
	Fever*	16	64	
	Cough	11	44	
	Joint pain	14	56	

Table 4. Contd.

<i>Aster flaccidus</i>	Cold*	11	44	Pulmonary infection, malaria (Singh et al., 2009); cuts (Chandra Sekar and Srivastava, 2009)
<i>Bergenia Stracheyi</i>	Indigestion	9	36	Ulcers and blisters in mouth (Singh, 2012; Singh et al., 2012); antiscorbutic, astringent, diuretic, febrifuge, kidney stone, ophthalmic, scurvy, tonic, joint dislocation, cuts, wounds, astringent, fever, ophthalmic, tonic (Sharma et al., 2011; Singh et al., 2009; Jain, 1991); stomach complaints (Ballabh and Chaurasia, 2009; Srivastava et al., 1992); body swelling (Sharma et al., 2006); kidney stone, diuretic, joint pains (Ballabh et al., 2008; Sood et al., 2001)
	Fever	6	24	
	Body pain	13	52	
<i>Bistorta affinis</i>	Diarrhea	11	44	Flatulence, dysentery (Chandra Sekar and Srivastava, 2009; Sood et al., 2001); cold, diarrhea, cough, irritation of throat (Sharma et al., 2004; Jain, 1991).
	Vomiting*	11	44	
<i>Bupleurum falcatum</i>	Fever *	9	36	Stomach complaint, abdominal inflammation, fever and liver complaints (Singh et al., 2012; Singh, 2012; Srivastava et al., 1992; Jain, 1991).
	Cold*	7	28	
<i>Bupleurum hamiltonii</i>	Fever *	8	32	-
	Coughs*	6	24	
	Influenza*	5	20	
<i>Caragana brevifolia</i>	Blood cholesterol*	6	24	-
<i>Carum carvi</i>	Dysentery	12	48	Stomach complaint, earache, cold, cough, fever, rheumatism, liver disease (Singh, 2012; Ballabh and Chaurasia, 2009; Singh et al., 2009; Srivastava et al., 1992; Jain, 1991); skin infection (Lal and Singh, 2008), kidney and urinary disorders (Ballabh et al., 2008); body weakness (Sood et al., 2001)
	Cold	24	96	
	Ulcers*	9	36	
	Indigestion	19	76	
	Joint pain	16	64	
<i>Chenopodium album</i>	Headache*	11	44	Constipation (Singh et al., 2009; Sood et al., 2001); skin diseases, urine complaint (Ballabh et al., 2008; Jain, 1991)
	Seminal weakness*	6	24	
<i>Chenopodium botrys</i>	Headache	4	16	Anthelmintic, diuretic, headache, laxative, liver complaints, stomachache, headache (Singh, 2012; Singh et al., 2012; Sharma et al., 2011; Singh et al., 2009; Sood et al., 2001; Jain, 1991); asthma, expectorant, stomach disease, weakness, vomiting (Malik et al., 2011)
	Stomachache	7	28	
	Menstruation problem*	9	36	
<i>Christolea crassifolia</i>	Improving eye site	9	36	Boils (Sood et al., 2001), improving eye site( Chandra Sekar and Srivastava, 2009)
<i>Clematis orientalis</i>	Dysentery*	11	44	Fever (Singh et al., 2009)
	Stomachache*	13	52	

Table 4. Contd.

<i>Codonopsis clematidea</i>	Joint pains	18	72	Rheumatism, skin disease (Sharma et al., 2011, Singh et al., 2009; Sood et al., 2001; Jain, 1991), diarrhea (Chandra Sekar and Srivastava, 2009)
	Aphrodisiac*	8	32	
<i>Codonopsis ovata</i>	Cuts/wounds	15	60	Swollen joint, bruises (Jain, 1991); oxytoxic, wound healing (Sharma et al., 2011; Singh et al., 2009; Chandra Sekar and Srivastava, 2009); vigor vitality (Sharma et al., 2004)
<i>Corydalis govaniiana</i>	Blood purification	12	48	Blood purification, drying up of excess pus, wounds, fractured bones (Sharma et al., 2011); antipyretic, diuretic, eye disease, gastric pain, liver complaints, muscular pain, skin disease, syphilis, tonic (Singh et al., 2009; Ballabh and Chaurasia, 2007; Sharma et al., 2004; Jain, 1991)
<i>Cousinia thomsoni</i>	Joint pain	10	40	Swellings and joint pains (Singh et al., 2012; Sharma et al., 2011; Sood et al., 2001)
<i>Dactylorhiza hatagirea</i>	Backache	8	32	Antibiotic, wound healing, bone fracture, cough, cold, cuts, sexual dysfunction, rheumatism, blood purifier, tonic, many ayurvedic and unani medicine preparations (Singh et al., 2012; Sharma et al., 2011; Singh et al., 2009; Singh and Lal, 2008; Lal and Singh, 2008; Jain, 1991); kills round worms (Ballabh and Chaurasia, 2009; Sharma et al., 2006); kidney and urinary disorders (Chandra Sekar and Srivastava, 2009; Ballabh et al., 2008); fever (Ballabh and Chaurasia, 2007), sexual power and nerve debility (Sharma et al., 2004)
	Sexual problems	16	64	
	Health tonic	19	76	
	Cuts/wounds	14	56	
<i>Dracocephalum heterophyllum</i>	Cough	7	28	Eye complaints (Singh, 2012; Singh et al., 2012; Sood et al., 2001; Jain, 1991); cold, cough (Ballabh and Chaurasia, 2007)
	Headache*	5	20	
<i>Elsholtzia eriostachya</i>	Intestinal parasites*	9	36	-
<i>Ephedra gerardiana</i>	Joint pains	16	64	Asthma, blood purifier, cardiac ailments, headache, hepatic disease, pneumonia fever, rheumatism (Singh, 2012; Singh et al., 2012; Singh et al., 2009; Singh and Lal, 2008; Jain, 1991); asthma, hay fever, allergy, respiratory disorder, sunburn, (Sharma et al., 2006); liver problem, cough, fever, cardiac ailments (Sharma et al., 2011; Sood et al., 2001; Jain, 1991), toothache, blood and bile complaints (Srivastava et al., 1992), Fever (Ballabh and Chaurasia, 2007)
	Blood purification	9	36	
	Pneumonia	13	52	
	Gastric problems	8	32	
	Liver tonic	12	48	
<i>Ephedra intermedia</i>	Asthma *	9	36	-
<i>Gentiana leucomelaena</i>	Jaundice	18	72	Jaundice (Chandra Sekar and Srivastava, 2009)
<i>Gentianella moorcroftiana</i>	Jaundice	11	44	Liver disorders (Singh, 2012; Singh et al., 2012; Singh and Lal, 2008); fever, cough, rheumatism, gastric problems blood purification, cold, headache (Singh et al., 2009; Chandra Sekar and Srivastava, 2009; Ballabh and Chaurasia, 2007; Sood et al., 2001; Jain, 1991)
	Indigestion	8	32	
<i>Gentianella tenella</i>	Liver complaint*	14	56	Fever (Jain, 1991)

Table 4. Contd.

	Spleen complaint*	9	36	
<i>Geranium pretense</i>	Diarrhea	8	32	Liver and stomach disorders, cold, cough (Singh, 2012; Singh et al., 2012; Sharma et al., 2011; Ballabh and Chaurasia, 2009; Chandra Sekar and Srivastava, 2009; Singh and Lal, 2008; Sood et al., 2001; Jain, 1991), fever (Ballabh and Chaurasia, 2007); black dye, poultice to bruises, cough, jaundice, gastric disorder, headache (Singh et al., 2009)
	Liver tonic	11	44	
<i>Geranium wallichianum</i>	Fever	8	32	Astringent, ear and eye diseases and toothache (Jain, 1991)
	Indigestion*	7	28	
<i>Gypsophilla cerasitoides</i>	Cut/wounds	9	36	Boils, wounds (Singh et al., 2009; Chandra Sekar and Srivastava, 2009)
<i>Heracleum candicans</i>	Food poisoning	10	40	Abdominal pain and gastric disorder (Chandra Sekar and Srivastava, 2009; Sood et al., 2001); fever, hemorrhage and abdominal cramps caused by the intestinal worms (Sharma et al., 2011), leucoderma, menstrual complaints (Jain, 1991), eczema, ringworm infection, leucoderma, menstrual disorders (Singh et al., 2009)
	Sexual problems*	8	32	
<i>Heracleum canescens</i>	Skin problems*	12	48	-
<i>Hyoscyamus niger</i>	Boils	11	44	Astringent, asthma, hysteria, muscular pain, sedative, toothache, vermifuge, whooping cough (Singh et al., 2009; Chandra Sekar and Srivastava, 2009; Sood et al., 2001; Jain, 1991), toothache, pharyngitis and malignant ulcers (Singh, 2012; Singh et al., 2012; Sharma, et al., 2011), toothache (Srivastava et al., 1992)
	Toothache	21	84	
<i>Lactuca macrorhiza</i>	Jaundice *	15	60	Stomach disorders (Singh, 2012; Singh et al., 2012; Singh and Lal, 2008; Sood et al., 2001)
	Headache*	9	36	
<i>Lactuca tatarica</i>	Joint pain*	9	36	-
<i>Mentha longifolia</i>	Headache *	16	64	Stomach complaints (Ballabh and Chaurasia, 2009; Srivastava et al., 1992; Jain, 1991); antiseptic, carminative, stimulant, applied on wound to kill maggots (Sharma et al., 2011; Singh et al., 2009; Jain, 1991), boils (Sharma et al., 2004)
	Joint pain*	14	56	
	Indigestion	18	72	
<i>Nepeta podostachys</i>	Fever*	8	32	Kidney and urinary disorders (Singh et al., 2009; Ballabh et al., 2008)
<i>Oxyria digyna</i>	Indigestion*	9	36	Appetizer, fever, laxative (Ballabh and Chaurasia, 2009; Singh et al., 2009; Jain, 1991); cold, cough (Srivastava et al., 1992)
	Liver tonic*	17	68	
<i>Oxytropis microphylla</i>	Animal bite *	15	60	-
	Acidity	9	36	



Table 4. Contd.

<i>Pedicularis bicornuta</i>	Joint pain	11	44	Liver and gall bladder problems, excessive seminal discharge, oedema (Sharma et al., 2011); chest pain, backache, bleeding through mouth (Sood et al., 2001), cold, fever (Ballabh and Chaurasia, 2007); burns, rheumatism, gout (Singh et al., 2009)
	Cuts/wounds	8	32	
<i>Pedicularis longiflora</i>	General weakness*	9	36	Gastric pain, blood vomiting, dysentery (Chandra Sekar and Srivastava, 2009; Sood et al., 2001)
<i>Picrorhiza kurrooa</i>	Jaundice	18	72	Fever (Chandra Sekar and Srivastava, 2009; Sharma et al., 2006; Uniyal et al., 2006); abdominal pain, anemia, antispasmodic, arthritis, asthma, cardiotoxic, cold, cholera, diarrhea, dysentery, dyspepsia, fever, cold influenza, jaundice, bile secretion, purgative, laxative, circulation, neck pain, internal wound, stomach disease (Sharma et al., 2011; Ballabh and Chaurasia, 2009; Singh et al., 2009; Kala, 2005; Srivastava et al., 1992; Jain, 1991); kidney and urinary disorders (Ballabh et al., 2008); Abdominal pains, stop nose bleeding (Sharma et al., 2004)
	Asthma	12	48	
	Fever	9	36	
	Stomachache	7	28	
	Cough*		20	
<i>Polygonum viviparum</i>	Piles *	8	32	Bloody dysentery, blood pressure, wounds (Singh, 2012); abscess, astringent, diarrhea, dysentery, ulcer, leucoderma, sore throat, lung diseases (Sood et al., 2001; Jain, 1991)
	Vomiting*	6	24	
<i>Potentilla atrosanguinea</i>	Cuts/Wounds	9	36	Toothache (Sharma et al., 2004), wound healing (Jain, 1991)
<i>Potentilla bifurca</i>	Headache	11	44	Headache (Chandra Sekar and Srivastava, 2009)
<i>Primula reptans</i>	Cough*	7	28	-
<i>Rheum moorcroftianum</i>	Indigestion *	17	68	Internal injury (Singh et al., 2009)
	Constipation*	10	40	
<i>Rhodiola cretinii</i>	Kidney problem *	8	32	-
	Asthma*	6	24	
<i>Ribes orientale</i>	Constipation	6	24	Purgative and diuretic (Singh et al., 2009; Sood et al., 2001)
	Joints pains*	8	32	
<i>Rosa webbiana</i>	Lung problem*	6	24	Sexual dysfunctions (Singh and Lal, 2008); Jaundice, stomachache, vigour vitality, hepatitis, (Singh et al., 2012; Jain, 1999); Impotency and jaundice (Singh, 2012; Singh et al., 2009), constipation, throat irritation (Srivastava et al., 1992), fever (Ballabh and Chaurasia, 2007)
	Headache*	8	32	
<i>Rubia tibetica</i>	Blood purification	8	32	Blood purification (Singh, 2012; Singh et al., 2012)

Table 4. Contd.

<i>Rumex nepalensis</i>	Gastric problems	9	36	Boils, colic, diuretic, dysmenorrheal, purgative, scurvy, swelling of muscle, stomachache preparations (Sharma et al., 2011; Singh et al., 2009; Jain, 1991); rheumatism, liver disorder, burn (Singh, 2012; Singh and Lal, 2008); indigestion (Kala, 2005); anti allergic (Uniyal et al., 2006)
<i>Saussurea bracteata</i>	Fever	14	56	Cold, cough, fever (Ballabh and Chaurasia, 2007; Jain, 1991)
	Improve blood circulation*	16	64	
<i>Scorzonera virgata</i>	Jaundice	13	52	Stomach and liver disorders (Singh et al., 2012; Singh et al., 2009; Singh and Lal, 2008; Sood et al., 2001)
<i>Scrophularia dentata</i>	Heart problems*	5	20	-
<i>Semenovia thomsonii</i>	Headache	14	56	Headache (Chandra Sekar and Srivastava, 2009)
	Gastric problem*	8	32	
<i>Taraxacum officinale</i>	Stomachache *	12	48	Liver complaints, blood purification, bowel complain, dislocation of joints, dysentery, gastric ulcer, headache, kidney disease, wounds ( Singh, 2012; Singh et al., 2012; Sharma et al., 2011; Ballabh and Chaurasia, 2009; Singh et al., 2009; Ballabh et al., 2008; Singh and Lal, 2008; Lal and Singh, 2008; Sharma et al., 2004; Sood et al., 2001; Srivastava et al., 1992; Jain, 1991)
	Cough*	9	36	
<i>Thymus linearis</i>	Stomachache	8	32	Antifungal, antibacterial, pain reliever during childbirth' whooping cough, epilepsy, skin eruption, bile secretion, hair loss, stomach complaint, cold, toothache, kill hookworms, liver compliant (Sharma et al., 2011; Ballabh and Chaurasia, 2009; Singh and Lal, 2008; Sharma et al., 2006; Sood et al., 2001; Jain, 1991); stomach complaint, infection in teeth (Singh, 2012); to improve memory in child ((Chandra Sekar and Srivastava, 2009)
	Cold	10	40	
	Cough	8	32	
	Skin problem	13	52	
<i>Trigonella pubescens</i>	Fever *	8	32	-
	Skin problem*	11	44	
<i>Waldheimia stoliczkai</i>	Food poisoning*	14	56	Blood purification, cold, cough, fever, headache, vomiting, diarrhea (Chandra Sekar and Srivastava, 2009; Ballabh and Chaurasia, 2007; Jain, 1991)
<i>Waldheimia tomentosa</i>	Food poisoning*	17	68	Rheumatism ( Srivastava et al., 1992; Jain, 1991)
<i>Youngia glauca</i>	Jaundice	16	64	Jaundice (Singh et al., 2012; Singh and Lal, 2008); burns, heart disease (Jain, 1991)
	Indigestion*	12	48	-
	Fever *	14	56	-

area of the sanctuary. These species are thinly distributed in the region and seen at a few spots only; however, the local people declare about their wide occurrence in several localities quite sometimes ago. In addition to overexploitation, migratory livestock of sheep and goats grazed on the unrivalled pasture of Kibber Wildlife Sanctuary (KWLS) destroy the vegetation through physical injury and affected the regeneration of herbaceous vegetation and most of these plants are becoming locally threatened. As the use of aerial parts and leaves is safe and sustainable (Giday et al., 2003; Mahmood et al., 2012) as compared to use of roots, seeds, fruits, flower and whole plant which leads destructive effects on the growth of plants population in nature (Amri and Kisangau, 2012; Ghimire et al., 2008). In most cases, aerial parts are used but they uprooted as whole plant. This lack of effort to sustain use of resources may result in their permanent depletion from natural habitats. Therefore, local people and herbal practitioners should be educated on sustainable methods of harvesting medicinal plants without compromising their availability for future use. Encouragement of cultivation is likely to be useful. Most of the high altitude medicinal plant species are used by the leading herbal industry in the country (Chauhan, 2011). Therefore, information regarding commercial value of these high valued medicinal plants may be disseminated to the local farmers. This would not be a viable option of income generation to local people but in turn it would help in the conservation of species and also help to take the pressure off wild stocks, thus helping conserve genetic diversity.

## Conclusion

The observations and findings made under the present investigation concluded that abundant indigenous knowledge on traditional medicine mainly involving the use of the natural plant resources, still exist and plays a significant role in meeting the primary healthcare needs of the tribal people of this cold desert. They use 100% of locally available plant resources to cure various ailments which provide a cheaper and accessible alternative to the high cost pharmaceutical remedies. High dependability and strong belief of the local people on the curable properties of the available plants resources depicts their pharmaceutical potential. Thus, study should be of great use to pharmaceuticals point of view which would provide baseline information for future research and biological resources management. However, overexploitation, habitat destruction, overgrazing, increasing tourism, environmental degradation and unsustainable utilization of rare and high valued medicinal plants from the wild are the major threat to their existence. Therefore, *ex situ* conservation and sustainable utilization would prevent their permanent depletion from the area.

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## REFERENCES

- Amri E, Kisangau DP (2012). Ethnomedicinal study of plants used in villages around Kimboza forest reserve in Morogoro, Tanzania. *J. Ethnobiol. Ethnomed.* 8:1.
- Anonymous (1970). *Index Kewensis. Plantarum Phanerogamarum* Vol. 1-2 (1883-1885) and 15 Suppl. (1886-1970). Clarendon Press, Oxford.
- Aswal BS, Mehrotra BN (1994). *Flora of Lahaul Spiti (A Cold Desert in North-West Himalaya)*. Bishen Singh Mahendra Pal Singh, Dehradun, India.
- Ballabh B, Chaurasia OP (2007). Traditional medicinal plants of cold desert Ladakh—Used in treatment of cold, cough and fever. *J Ethnopharma.* 112:341-349.
- Ballabh B, Chaurasia OP (2009). Medicinal plants of cold desert of Ladakh in treatment of stomach disorder. *Ind J Trad Knowl.* 8(2):185-190.
- Ballabh B, Chaurasia OP, Ahmed Z, Singh SB (2008). Traditional medicinal plants of cold desert Ladakh—Used against kidney and urinary disorders. *J Ethnopharma.* 118(2):331-339.
- Census of India (1991). *District Census Hand Book - Lahul and Spiti, Series-9*, Directorate of Census Operations, Himachal Pradesh, India.
- Chandel KPS, Shukla G, Sharma N (1996). *Biodiversity in medicinal and aromatic plants in India: Conservation and Utilization*. National Bureau of Plant Genetic Resources, New Delhi;
- Chandrasekar K, Srivastava SK (2009). *Flora of Pin Valley National Park, Himachal Pradesh*. Botanical Survey of India, Kolkata, India.
- Chauhan NS (1999). *Medicinal and aromatic plants of Himachal Pradesh*. Indus Publishing Company, New Delhi, India.
- Chauhan NS (2011). *ENVIS Bulletin: Himalayan Ecology* p. 19.
- Chowdhery HJ, Wadhwa BM (1984). *Flora of Himachal Pradesh, Vol. 1-3*. Botanical Survey of India, Calcutta.
- Dhaliwal DS, Sharma M (1999). *Flora of Kullu District (Himachal Pradesh)*. Bishen Singh Mahendra Pal Singh, Dehra Dun.
- Dhar U, Samant SS (1993). Endemic diversity of Indian Himalaya. I. Ranunculaceae and II. Paeoniaceae. *J Biogeography.* 20:659-668.
- Gadgil M (1996). Documenting diversity: An experiment. *Curr Sci.* 70(1):36-44.
- Ghimire SK, Gimenez O, Pradel R, McKey D, Aumeeruddy-Thomas Y (2008). Demographic variation and population viability in a threatened Himalayan medicinal and aromatic herb *Nardostachys grandiflora*: matrix modelling of harvesting effects in two contrasting habitats. *J Appl Ecol.* 45:41-51.
- Giday M, Asfaw Z, Elmqvist T, Woldu Z (2003). An ethnobotanical study of medicinal plants used by the Zay people in Ethiopia. *J Ethnopharma.* 85:43-52.
- Green MJB (1993). *Nature Reserves of the Himalaya and the Mountains of Central Asia*. New Delhi, India, World Conservation Monitoring Centre, IUCN and Oxford Press University. <http://tropicos.org>. <http://www.ipni.org/ipni/idPlantName>.
- Jain SK (1991). *Dictionary of Indian folk medicine and ethnobotany*. Deep Publications, New Delhi, India.
- Jain SK, Rao RR (1977). *Handbook of field and Herbarium methods*. Today and Tomorrow's Printers and Publishers, New Delhi, India.
- Kala CP (2005a). Indigenous Uses, Population Density, and Conservation of Threatened Medicinal Plants in Protected Areas of the Indian Himalayas. *Conserv. Biol.* 19(2):368-378.
- Kala CP (2005b). Ethnomedicinal botany of the Apatani in the Eastern Himalayan region of India. *J. Ethnobiol. Ethnomed.* 1:11.
- Kirtikar KR, Basu BD (1981). *Indian Medicinal Plants, Vol I, II III and IV (second reprint)* IBD, Dehradun.

- Kumar PG, Kumar R, Chaurasia OP (2011). Conservation Status of Medicinal Plants in Ladakh: Cold Arid Zone of Trans-Himalayas. *Res. J. Med. Plants* 5:685-694.
- Lal B, Singh KN (2008). Indigenous herbal remedies used to cure skin disorders by the native of Lahaul-Spiti in Himachal Pradesh. *Ind. J. Trad. Knowl.* 7(2):237-241.
- Mahmood A, Mahmood A, Malik RN (2012). Indigenous knowledge of medicinal plants from Leepa valley, Azad Jammu and Kashmir, Pakistan. *J. Ethnopharm.* 143:338–346.
- Malik AH, Khuroo AA, Dar GH, Khan ZS (2011). Ethnomedicinal uses of some plants in the Kashmir Himalaya. *Ind. J. Trad. Knowl.* 10(2):362-366.
- Mishra C (2001). High Altitude Survival: Conflicts between pastoralism and wildlife in the trans-Himalaya. Ph.D. dissertation. Wageningen University, Netherlands.
- Murti SK (2001). Flora of cold deserts of western Himalaya. Vol. I (Monocotyledons). Botanical Survey of India, Calcutta, India.
- Polunin O, Stainton A (1984). *Flowers of the Himalaya*. Oxford University Press, Delhi.
- Samant SS, Dhar U, Palni LMS (1998). Medicinal Plants of Indian Himalaya: Diversity Distribution Potential Values. Gyanodaya Prakashan, Nainital.
- Sharma PK, Chauhan NS, Lal B (2004). Observations on the traditional phytotherapy among the inhabitants of Parvati valley in western Himalaya. *J. Ethnopharm.* 92:167–176
- Sharma PK, Sethi GS, Sharma SK, Sharma TK (2006). Ethnomedicinal observation among the inhabitants of cold desert area of Himachal Pradesh. *Ind. J. Trad. Knowl.* 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 North Western Himalayas. *Ind. Chin. Med.* 2:93-102.
- Singh A, Lal M, Samant SS (2009). Diversity, indigenous uses and conservation prioritization of medicinal plants in Lahaul valley, proposed Cold Desert Biosphere Reserve, India. *Int. J. Biodivers. Sci. Manage.* 5(3):132–154.
- Singh DK, Hajra K (1996). Floristic diversity. In: G.S. Gujral and V. Sharma (eds.), *Changing Perspectives of biodiversity status in the Himalayas*. British Counsel Division, New Delhi pp. 23-38.
- Singh KN (2012). Traditional knowledge on ethnobotanical uses of plant biodiversity: a detailed study from the Indian western Himalaya. *Biodiver. Res. Conserv.* 28:63-77.
- Singh KN, Lal B (2008). Ethnomedicines used against four common ailments by the tribal communities of Lahaul-Spiti in western Himalaya. *J. Ethnopharm.* 115:147–159.
- Singh KN, Lal B, Todaria NP (2012). Ethnobotany of Higher Plants in Spiti Cold Desert of Western Himalaya. *Natur Sci.* 10(5):7-14.
- Singh SK, Rawat GS (2000). *Flora of Great Himalayan National Park, Himachal Pradesh*. Bishen Singh Mahendra Pal Singh, Dehradun.
- Sood SK, Ram N, Kalia DC (2001). *Ethnobotany of cold desert tribes of Lahaul-Spiti (N.W. Himalaya)*. Deep Publications, New Delhi.
- Srivastava SK (2010). Floristic diversity and conservation strategies in cold desert of western Himalaya, India. *J. Plant Sci.* 7:18–25
- Srivastava TN, Kapahi BK, Sarin YK (1992). *Ethnobotanical Studies In Lahul And Spiti, Himachal Pradesh*. *Anc. Sci. Life* 119:126-130.
- Trigas P, Panitsa M, Tsiftsis S (2013). Elevational Gradient of Vascular Plant Species Richness and Endemism in Crete – The Effect of Post-Isolation Mountain Uplift on a Continental Island System. *PLOS ONE* 8(3):1-13.
- Uniyal SK, Singh KN, Jamwal P, Brij L (2006). Traditional use of medicinal Plants among the Tribal communities of Chhota Bhagal, Western Himalaya. *J. Ethnobiol. Ethnomed.* 2:14.
- Utarsh GM, Gadgil M, Rao PRS (1999). Intellectual property biological resources: Benefiting from Biodiversity and peoples knowledge. *Curr. Sci.* 77(11):1418.