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Traditional therapeutic uses of some important medicinal and aromatic plants of the tribal area of Lahaul valley of Himachal Pradesh, India

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Lahaul valley of Himachal Pradesh is inhabited by the tribal communities who believe in *Amchi* system of medicine which is being practiced in this region from a long time. The *Amchi* system of medicine is similar to the Ayurvedic medicine as this system involves the use of plants as the main source of drug or treatment strategy. Considering the importance of this system of medicine, an extensive field work was conducted in 8 different villages of Lahaul valley to explore the information on usage of ethnomedicinal plants by tribal communities and traditional healers. Questionnaire based interviews of 150 informants were conducted. The data generated were analysed using quantitative tools, i.e., use-value (UV), factor informant consensus (F_{ic}) and fidelity level (Fl). Information related to 64 plants was collected which possess effectiveness against 35 ailment categories. The maximum number of medicinal plants were recorded from the family Compositae followed by Lamiaceae, Apiaceae and Rosaceae. On the basis of use value, the most important medicinal plants were *Arnebia euchroma*, *Artemisia maritima*, *Asparagus filicinus*, *Picrorhiza kurrooa*, *Podophyllum hexandrum*, *Taraxacum officinale* and *Thymus linearis.* On the basis of factor informant consensus, important ailment categories of this region were related to respiratory and gastrointestinal disorders. This research involves the documentation of medicinal and aromatic plants used by tribal communities and traditional healers of the Lahaul valley. However, further phytochemical and pharmacological research is required for scientific validation of this information so as to determine the efficacy and safety of these ethnomedicinal plants for curing various ailments.

Keywords: *Amchi* system, Ethnomedicinal plants, Factor informant consensus, Fidelity level, Lahaul, Traditional use, Use-value

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Lahaul-Spiti district of Himachal Pradesh, India is one of the remote areas situated in North-East part of the state. In Lahaul-Spiti, there are two different mountainous tracts or sub-divisions, i.e., Lahaul and Spiti. Lahaul valley is a mountainous area located between Ladakh and Tibet in the North and the Kullu valley in the South. It is situated on the western side of the district with 6097 km^2 area. The elevation of Lahaul sub-division varies between 2575 to 6700 m amsl, however, the cultivation occurs only up to 4400 m amsl. Lahaul is accessible through Rohtang pass (3980 m amsl) and the area remains cut off for most part of the year due to heavy snowfall on Rohtang. The district headquarter is situated at Keylong (3400 m amsl).

This valley falls under temperate dry zone of Himachal Pradesh and generally described as the high-altitude cold desert. Precipitation rate is very low in this region and varies from 100 to 700 mm annually. Heavy snowfall (200 to 400 cm^{-1}) occurs during winters from November to March. Despite of these extreme climatic conditions, Lahaul valley harbors a valuable medicinal plant wealth being used in traditional system of medicine[1-2].

The soil of Lahaul valley is sandy to sandy loam in texture. It is chemically neutral and low to medium in fertility. Farmers raise willow (*Salix alba*) and seabuckthorn (*Hippophae* spp.) on field bunds. They also grow medicinal plants like *Saussurea costus* (local name Kuth) and *Inula racemosa* (Manu) in their fields. Inhabitants of Lahaul valley collect important medicinal and aromatic plants like *Picrorhiza kurroa* (Karu), *Aconitum heterophyllum*

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(Patish), *Dactylorhiza hatagirea* (Panja), *Podophyllum hexandrum* (Bankakri), *Angelica glauca* (Chora) and *Bunium persicum* (Kala zira) from the high-altitude areas for their use in crude drug preparation. Land utilization statistics of Lahaul is shown in Table 1.

Lahaul valley is inhabited by different communities including Lahaulas and Bodhs or Buddhists. These communities have deep faith in the *Amchi* system of medicine. This system of medicine is commonly known as *Sowa-Rigpa* and is one of the indigenous traditional systems of medicine which is being practiced in this region from a long time. The *Amchi* system is one of the most ancient medical traditions and has similarities with Ayurvedic medicine. The local practitioners are named as Larje as they prescribe medicines and treat people[3].

Materials and Methods

Study area

This study was carried out in Lahaul valley of Himachal Pradesh, India, which is situated between 31°44'57" and 32°59'57"N latitude and 76°46'2" and 78°41'34"E longitude (Fig. 1). On the north, it is bordered by the main Himalayan ranges mainly Baralacha Pass, whereas on the South there is mid Himalayan range or Pir Punjal. On the East, there lies the Kunjum range which differentiates Lahaul from Spiti, while on the West there is the off-shoot of the Pir Punjal range. In the West region of Lahaul valley, the Chenab river flows into Pangi, while in the North-East region, the Yunan river flows into Zanskar. The snow covered peaks, huge glaciers, view of bleak, higher mountain ranges and narrow river valleys are the distinctive features of this valley.

Table 1 — Land utilization statistics of Lahaul (ha)

Particulars	Statistics
Total geographical area	2,01,041
Forests	1,34,887 (67.09)*
Barren and uncultivable land	1,557 (0.77)
Cultivable waste land	287 (0.14)
Permanent pastures and other grasslands	62,079 (30.88)
Land under miscellaneous trees	51 (0.03)
Fallow land	58 (0.03)
Net sown area	2,122 (1.06)
Area sown more than once	121 (0.06)
Total cropped area	2,243 (1.12)

*Values in the parentheses are the percentage of the total geographical area.

Ethnobotanical survey and collection of data

The field surveys were done in 8 villages of Lahaul valley which are situated at different altitudes such as Tindi (2541 m amsl), Udaipur (2742 m amsl), Trilokinath (2760 m amsl), Tandi (3000 m amsl), Koksar (3200 m amsl), Sissu (3300 m amsl), Keylong (3400 m amsl) and Rhotang Pass (4500 m amsl) during the month of September, 2016 to collect the information pertaining to the traditional usage of medicinal and aromatic plants of these places. To collect the information, interviews and group discussions were conducted among local people as well as traditional healers regarding the indigenous usage of plant species as medicine. A questionnaire was prepared and a total of 150 informants including 52 males and 48 females of the age group varying from 20 to 79 years were interviewed. Prior consent was taken from the participants before their participation in the study. Various aspects were covered under the collection of information including local name of plant species, mode of usage and type of disease treated by the plant species. The voucher specimens along with flowers and fruits were also collected so as to facilitate the identification process. A permanent record was maintained in the herbarium of Institute of Himalayan Bioresource Technology, Palampur, Himachal Pradesh by assigning a field book number to each of the specimen.

Data analysis

Data analysis was done by using three different quantitative indices *viz.*, use-value (UV), factor informant consensus (F_{ic}) and fidelity level (Fl%).

The relative importance of various plants was calculated by determining the use-value[4], which is a quantitative measure for the relative importance of species known locally.

$$UV = \Sigma U/n$$

where, U is the number of citations for plant species among all informants and n is the total number of informants. Higher use-value of the plant means that there are many use reports for that plant among informants and vice versa.

Plant names and families were validated from the website http://www.theplantlist.org.

The factor informant consensus (F_{ic}) was used to test the homogeneity of knowledge about the usage of medicinal plants among the informants[5]. The F_{ic} was calculated as

$F_{ic} = (N_{ur}-N_t)/(N_{ur}-1)$

where, N_{ur} is the number of use reports cited by the informants for a particular use category and N_t is the number of plant species used for a particular use category by all informants. Low F_{ic} values depicts that there is no exchange of information among informants about the use of medicinal plants. F_{ic} values approach one (1) if there is complete exchange of information between informants[6-7].

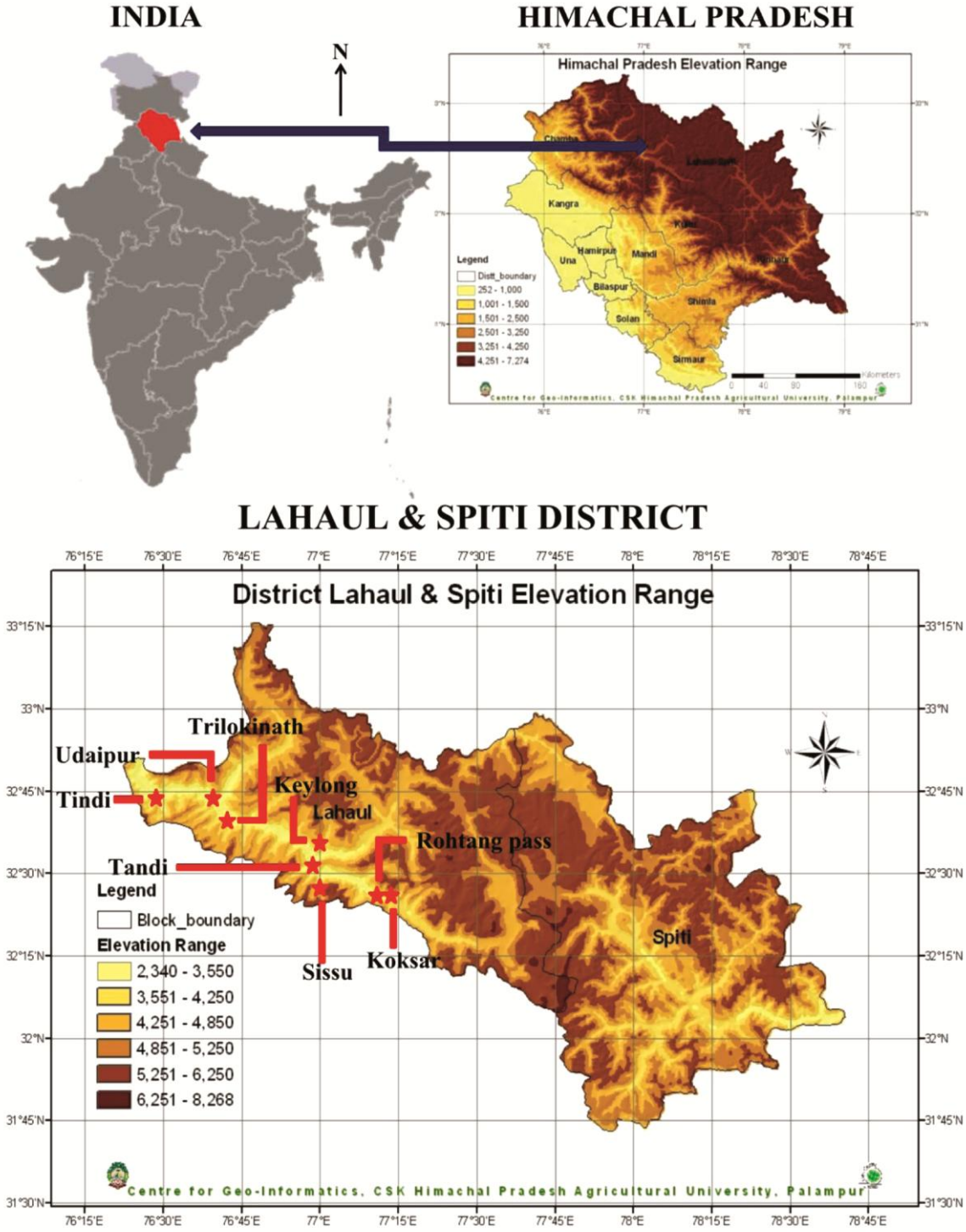

Fig. 1 — Location map of Lahaul district indicating the study sites (Adapted from the Centre for Geo-Informatics, CSK Himachal Pradesh Agricultural University, Palampur)

Fidelity level (Fl%) is used to determine the most preferred or common plant species used in treatment of particular ailment by all the informants[8]. The Fl is calculated as

$$Fl\ (\%) = N_p/N \times 100$$

where, N_p is the number of use reports cited for a given plant species for a particular disease category and N is the total number of use reports cited for any given species. Maximum Fl value (100%) is obtained for plants for which all the informants cite same method of using it, whereas minimum Fl value is obtained for plants that are used for different purposes by the informants[8-10].

Results

Characteristics of informants

Out of total 150 informants (52 males and 48 females), 31% female and 33% male informants were among the age group of 40 to 49 years (Fig. 2).

Floristic characteristics of medicinal plants

In the study area, a total of 64 plant species from 59 genera and 27 families were documented (Table 2). The maximum number of ethnomedicinal plants was from the family Compositae (16 plants) followed by Lamiaceae (9 plants), Apiaceae (6 plants) and Rosaceae (4 plants). Polygonaceae and Ranunculaceae families contributed 3 plant species each. Families namely Asparagaceae and Crassulaceae contributed 2 plant species each. Remaining families contributed 1 species each (Fig. 3).

Use-value of medicinal pants

On the basis of use value (UV), various medicinal plants of the study site were found to be the most

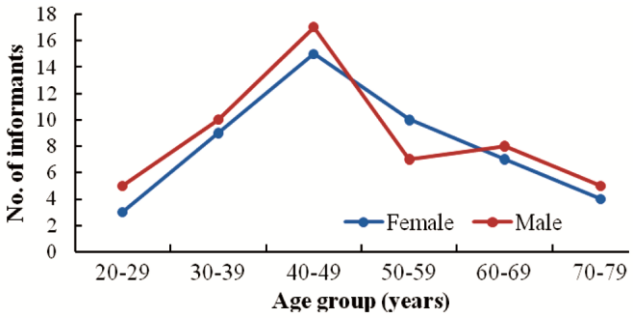

Fig. 2 — Demographic description of the informants

Table 2 — Uses of ethnomedicinal plants of Lahaul valley, Himachal Pradesh, India

Plant name (Voucher No.) and family	Local name	Plant part used	Diseases treated	Total citations (ΣU)	Use-value (UV)	Mode of usage
Achillea millefolium L. (PLP 16/17), Compositae	Chabu, Shugumentog	AP	Carminative (4), tonic (4), stimulant (4), diaphoretic (2), hepatoprotective (5), insect repellent (3); cure toothache (3), cough (5), cold (5) and fever (5).	40	0.27	Decoction of aerial parts is taken.
Aconitum heterophyllum Wall. ex Royle[a,b] (PLP 19/37/74), Ranunculaceae	Bonga, Atis, Patis, Boa	Rt	Anthelmintic (4); antitode against snake and scorpion bite (3); cure cold (5), cough (5), fever (5), tuberculosis (3), typhoid (2), diarrhea (4), dyspepsia (4), piles (1), abdominal pain (4) and infections of intestine (4).	44	0.29	Dried powdered roots (0.5 g for children and 1.0 g for adults) along with honey and lukewarm water or milk are recommended.
Aconitum rotundifolium Kar. & Kir. (PLP 28), Ranunculaceae	Bonkar, Pongtha, Vashi	WP	Act as blood purifier (3); treat jaundice (2), fever (5) and joint pain (4).	14	0.09	Juice is extracted from whole plant and is mixed with water in equal ratio and is recommended orally to treat jaundice. Dried root powder (4 to 5 g) is taken with water once a day to cure joint pain and fever.
Ajuga bracteosa Wall. ex Benth. [a] (PLP 58), Lamiacaeae	Karku, Neelkanthi	Lf	Astringent (3), febrifuge (4), purify blood (4), tonic for gastric problems (3); treat cough (3), asthma (2) and malarial fever (4).	23	0.15	Leaf juice is taken twice a day to cure cough and asthma. Dried powdered leaves (4 to 5 g) are prescribed for treating malarial fever. Leaf juice is used to purify blood.

(*Contd*.)

Table 2 — Uses of ethnomedicinal plants of Lahaul valley, Himachal Pradesh, India (*Contd*.)

Plant name (Voucher No.) and family	Local name	Plant part used	Diseases treated	Total citations (ΣU)	Use value (UV)	Mode of usage
Allium stracheyi Baker[b] (PLP 40), Amaryllidaceae	Kochay, Gyamen	Bb, Lf	Edible (30).	30	0.20	Bulbs and leaves are eaten as vegetable.
Anaphalis busua (Buch.-Ham.) DC. (PLP 70), Compositae	Prathog	AP	Antibacterial (4); prevent bleeding (5); antidote against poisons (6); treat epidemic fever (4) and glandular diseases (2).	21	0.14	Leaf paste is used to heal wounds. Dried powdered aerial plant parts are used to treat fever and glandular diseases.
Androsace sarmentosa Wall. (PLP 77), Primulaceae	Thoris	WP	Treat tumors (5), inflammation (3), fever (5), wounds (6) and reduces excess serous fluid (3).	22	0.15	Dried powdered whole plant is used.
Angelica glauca Edgew.[a,b] (PLP 42), Apiaceae	Chaura, Chonra	Rt	Cure debility (6), joint problems (5), bronchitis (7), dysentery (6), menorrhea (6), stomach disorders (19) and vomiting (5).	54	0.36	Dried powdered roots (3 g) along with lukewarm water are taken orally to cure gastric troubles, bronchitis, menorrhea and vomiting. Roots are ground, mixed with clarified butter in 2:1 ratio, heated and applied externally on joints to cure pain and swelling. Roots are used as a flavoring agent in various cuisines.
Anthemis cotula L. (PLP 71), Compositae	-	WP	Treat piles (26).	26	0.17	Poultice of the whole plant is used.
Arenaria festucoides Benth. (PLP 78), Caryophyllaceae	-	AP	Expectorant (5); cure lung disorders (8).	13	0.09	Dried powdered aerial plant parts are used.
Arnebia euchroma (Royle) I.M. Johnst.[a,b] (PLP 15), Boraginaceae	Ratanjot, Khomig	Rt	Antiseptic (6), purify blood (7), abortifacient (6), hair tonic (18), regulate blood pressure (8); cure cough (8), cold (9), cuts (5), wounds (5), backache (10) and headache (7).	89	0.59	Dried powdered roots are used to treat cough and cold. Root paste is used to heal cuts and wounds. Roots are used with mustard oil to prevent dandruff.
Artemisia gmelinii Weber ex Stechm. (PLP 52/53), Compositae	Nurcha, Karkatang	Lf	Carminative (7) and vermifuge (10).	17	0.11	Dried powdered leaves are used.
Artemisia maritima L. (PLP 54), Compositae	Seski, Nyurcha, Garpeg, Nyurchi, Sensi	WP	Anthelmintic (8), antiseptic (6), blood purifier (9), tonic (5); remove abdominal parasites and intestinal worms (4); cure cuts (8), wounds (8), cough (6), joint pain (5), gastric disorders (5), fever (6), stomachache (5) and asthma (7).	82	0.55	Ash of burnt leaves is used to remove worms. Dried powdered roots along with water are given twice a day to asthma patients. Whole plant paste is applied on cuts and wounds. Decoction of leaves is used to treat cough and fever. Dried powdered aerial plant parts are used to expel intestinal worms. Juice of fresh roots is taken orally to cure stomach pain. Dried powdered seeds are taken twice a day to cure joint pain.

(*Contd*.)

Table 2 — Uses of ethnomedicinal plants of Lahaul valley, Himachal Pradesh, India (*Contd*.)

Plant name (Voucher No.) and family	Local name	Plant part used	Diseases treated	Total citations (ΣU)	Use value (UV)	Mode of usage
Asparagus filicinus Buch.-Ham. ex D.Don (PLP 7), Asparagaceae	Satavar	Rt	Appetizer (8), diuretic (5), aphrodisiac (11), laxative (7), astringent (3); treat diabetes (4), diarrhea (6), dysentery (6), throat complaints (3) and leprosy (3). Used as demulcent in veterinary medicines (5). Also used to increase milk yield in cattle (10).	71	0.47	Dried powdered roots are used.
Aster flaccidus Bunge (PLP 76), Compositae	Seertik	WP	Cure cold (16).	16	0.11	Dried powdered whole plant is used.
Astragalus rhizanthus Benth. (PLP 13), Leguminosae	Zomoshing	Rt, Lf	Heart stimulant (5); cure skin diseases (7), gastric and liver disorders (8).	20	0.13	Dried powdered roots and leaves are used.
Bergenia stracheyi (Hook.f. & Thomson) Engl.[a] (PLP 8/44), Saxifragaceae	Silpayi	Rt, Lf	Astringent (6), diuretic (5), antiscorbutic (4), tonic (4); remove kidney stones (10); cure dysentery (6), mouth ulcers (7), cuts and wounds (8).	50	0.33	Raw roots are eaten to cure dysentery. Root paste is used to cure mouth ulcers, cuts and wounds. Dried powdered leaves are used to treat kidney stones.
Brachyactis roylei (DC.) Wendelbo (PLP 66), Compositae	Sathi	WP	Anticancerous (7); used to cure rheumatism (8).	15	0.10	Dried powdered whole plant is used.
Cynanthus lobatus Wall. ex Benth. (PLP 82), Campanulaceae	Lingya	WP	Purgative (6), reduces serous fluid (5); treat flatulence (7).	18	0.12	Dried powdered whole plant is used.
Dactylorhiza hatagirea (D.Don) Soo[a,b] (PLP 27), Orchidaceae	Salampanja, Hathpanja	Rh	Antibiotic (7), aphrodisiac (5), blood purifier (5), expectorant (4), tonic (3); cure wound (4), bone fracture (3), cough (5), cold (5), rheumatism (6), kidney problems (4), leucorrhoea (4) and respiratory problems (3).	58	0.39	Dried powdered rhizomes are used to cure leucorrhoea and impotency. Paste of rhizomes is used to heal wounds. Dried powdered rhizomes of *Dactylorhiza hatagirea* and *Aconitum heterophyllum* are used to treat respiratory problems. Paste of rhizome is applied externally to treat bone fracture.
Fragaria vesca L. (PLP 10), Rosaceae	Palla	Fr	Cure earache (6) and nerve inflammation (5).	11	0.07	Fruits are eaten.
Fraxinus xanthoxyloides (G.Don) Wall. ex A.DC. (PLP 57), Oleaceae	Thrung, Sanjal, Shunu	Bk	Cure stomachache (6) and fractured bones (9).	15	0.10	Decoction of bark is used to cure stomachache and fractured bones in both humans and animals.
Geum elatum Wall. ex Hook.f. (PLP 83), Rosaceae	Jungli Gunnglu, Masreen	Rt	Astringent (6); cure dysentery (5), diarrhea (5) and wounds (7).	23	0.15	Dried powdered roots are used.
Heracleum lanatum Michx.[a] (PLP 20), Apiaceae	Tunak, Tukar, Rasal	Lf, Rt	Cure menstrual problems (7), leucoderma (4), piles (5), arthritis (6), toothache (3), liver and gastric complaints (2).	27	0.18	Dried powdered leaves are taken along with milk or water to treat menstrual problems, leucoderma, piles, liver and gastric problems. Root decoction is used externally to treat arthritis. Paste of leaves is used to relieve toothache.

(*Contd*.)

Table 2 — Uses of ethnomedicinal plants of Lahaul valley, Himachal Pradesh, India (*Contd*.)

Plant name (Voucher No.) and family	Local name	Plant part used	Diseases treated	Total citations (ΣU)	Use value (UV)	Mode of usage
Hippophae salicifolia D.Don (PLP 61), Elaeagnaceae	Sarla	Fr	Blood purifier (10); cure cough (8), fever (5), wounds (8), ulcer and skin disease (5).	36	0.24	Fruit jam is prepared.
Hyssopus officinalis L.[a,b] (PLP 23), Lamiaceae	Jip-Chi, Chibu	AP	Carminative (6), blood purifier (3), stimulant (5), digestive (3), vermifuge (5); cure cough (4), cold (4), fever (3), toothache (4), nervous disorders (2), wounds (2), muscular rheumatism (3) and stress (3).	47	0.31	Dried powdered aerial plant parts are taken with water to cure fever, cough, cold, rheumatism and nervous disorders. Decoction is prepared from the aerial parts and is used to cure fever. Paste of leaves and flowers is used to heal wounds. Leaves are chewed to relieve toothache.
Juniperus communis L.[a,b] (PLP 26), Cupressaceae	Petada, Shukpa	WP	Cure impotency (8), skin disorders (8) and boils (8).	24	0.16	Small pieces of the heartwood are placed in an earthen pot and then heated at high temperature so as to extract oil. The oil thus extracted is applied on male genital organs to treat impotency. The oil is also used to treat skin itching, infection and boils.
Jurinella macrocephala (Royle) Aswal & Goel (PLP 41), Asteraceae	Dhoop	Rt	Antiseptic (4), colic (3), reduced fever during child birth (5), laxative (6); cure skin eruption (6) and itching (5).	29	0.19	Dried powdered roots are used to relieve constipation. Root decoction is given once in a day to treat fever, cough and cold. Juice extracted from roots is used to treat skin eruptions and itching.
Lactuca macrorhiza (Royle) Hook.f. (PLP 38/80), Compositae	Gonpu	WP	Treat headache (4), stomachache (5) and jaundice (6).	15	0.10	Dried powdered whole plant is used to cure stomachache. Half teaspoon dried powder of aerial parts is administered daily to treat jaundice and headache.
Lactuca tatarica (L.) C.A.Mey. (PLP 36), Compositae	Thonpu	WP	Treat joint pain (10).	10	0.07	Decoction of whole plant used.
Ligusticum sp. (PLP 63), Apiaceae		Rt	Reduce inflammation (12) and pain (9).	21	0.14	Dried powdered roots are used.
Meconopsis aculeata Royle (PLP 29), Papaveraceae	Chharbongcha, Chharmen	Lf, Rt	Aphrodisiac (8), tonic (4); cure backache (6), colic (2), renal pain (3), inflammation (4), disorders of lungs and liver (3).	30	0.20	Dried powdered roots are used as aphrodisiac. Paste of leaves is used to treat inflammation. Dried powdered leaves are used to treat disorders of lungs and liver.
Mentha longifolia (L.) L.[a] (PLP 24/35), Lamiaceae	Takchi, Marini, Madaen, Chrup	WP	Antiseptic (8), carminative (4), digestive (5), wormicide (5); heal wounds (5); cure cough (4), cold (4) and gastric pain (8).	43	0.29	Paste prepared from leaves is used to heal wounds. Leaf decoction is used to treat gastric pain. Whole plant decoction is used as carminative. Tea of leaves is prepared to relieve cough and cold.
Myricaria germanica (L.) Desv. (PLP 60), Tamaricaceae	Hombuk, Hombug	Lf, Sh	Treat rheumatism (16).	16	0.11	Juice is extracted from shoots and leaves.

(*Contd*.)

Table 2 — Uses of ethnomedicinal plants of Lahaul valley, Himachal Pradesh, India (*Contd*.)

Plant name (Voucher No.) and family	Local name	Plant part used	Diseases treated	Total citations (ΣU)	Use value (UV)	Mode of usage
Nepeta eriostachya Benth. (PLP 75), Lamiaceae	-	Sd	Diuretic (6); treat dysentery (8).	14	0.09	Infusion of seeds is used.
Origanum vulgare L.[a] (PLP 59/46), Lamiaceae	Lamay masha, Massow	WP	Antiseptic (6); cure asthma (7), cold (8), gastric disorders (6), rheumatism (5), bronchitis (4), diarrhea (6) and influenza (4).	46	0.31	Decoction of whole plant is used.
Phlomis bracteosa Royle ex Benth. (PLP 69), Lamiaceae	Ghasangsan	AP	Cure arthritis (4), joint pain (4) and stomach disorders (6).	14	0.09	Dried powdered leaves and flowers are used to treat arthritis. Dried powdered aerial plant parts are mixed with dried powdered leaves of *Heracleum thomsonii*, *Mentha longifolia*, *Thymus linearis* and roots of *Angelica glauca* in equal ratio and administered with lukewarm water to treat stomach disorders.
Picrorhiza kurrooa Royle[a,b] (PLP 33/39/67), Scrophulariaceae	Karu, Honglen, Kutki	WP	Tonic (7), diuretic (4), laxative (4), hepatoprotective (8), purify blood (5); cure anemia (4), rheumatism (6), asthma (5), cold (5), dyspepsia (6), diarrhea (6), influenza (4), fever (4), jaundice (4) and remove stomach worms (5).	77	0.51	Decoction of whole plant of *Picrorhiza kurrooa* and *Artemisia maritima* is used to remove stomach worms. Smoke of roots is used to cure asthma. Roots decoction is used to cure gastritis, colic pain, rheumatism and jaundice.
Pimpinella diversifolia DC. (PLP 14), Apiaceae	-	WP	Carminative (6); cure stomach disorders (5), cold and cough (5).	16	0.11	Dried powdered whole plant is used.
Plantago depressa Willd.) (PLP 56), Plantaginaceae	Maran	Lf	Cure fever (6), dysentery (8), wounds (6) and piles (5).	25	0.17	Leaves paste is used to heal wounds and piles. Dried powdered leaves are used to treat dysentery and fever.
Pleurospermum brunonis Benth. ex C.B.Clarke (PLP 25), Apiaceae	Nesar	WP	Anthelmintic (16).	16	0.11	Dried, powdered whole plant is used as a spice and flavoring agent.
Podophyllum hexandrum Royle[a,b] (PLP 18), Podophyllaceae	Bankakri, Omo-shey, Braburchoi, Pindiyali	Rh, Fr	Purgative (6), vermifuge (6); improve blood circulation (5); treat skin disorders (4), cough (6), asthma (3), tuberculosis (2), diarrhea (6), gastric ulcer (5), cancer (8) and gynecological disorders (9).	60	0.40	Fruits are used to treat constipation. Decoction of rhizome is used to treat asthma.
Polygonatum verticillatum (L.) All.[a,b] (PLP 3), Asparagaceae	Salam-Misri	Rh	Appetizer (8), nervine tonic (6); heal wounds (6) and cure kidney problems (7).	27	0.18	Eaten as such due to their sweet taste.
Polygonum affine D. Don (PLP 73), Polygonaceae	Machruo	Rt	Cure cold (7), rheumatism (6) and diarrhea (8).	21	0.14	Decoction of roots is used.
Polygonum polystachyum Wall. ex Meisn. (PLP 22), Polygonaceae	Khabin	AP	Cure mouth ulcers (7), acidity (6) and indigestion (6).	19	0.13	Aerial plant parts have cooling effect and consumed empty stomach during morning.

(*Contd*.)

Table 2 — Uses of ethnomedicinal plants of Lahaul valley, Himachal Pradesh, India (*Contd*.)

Plant name (Voucher No.) and family	Local name	Plant part used	Diseases treated	Total citations (ΣU)	Use value (UV)	Mode of usage
Potentilla atrosanguinea G.Lodd. ex D.Don (PLP 11), Rosaceae	Marpu	Lf	Heal cuts (6) and wounds (6).	12	0.08	Paste of leaves is used.
Prunus jacquemontii Hook.f. (PLP 51), Rosaceae	-	Fr	Fruits are rich in antioxidants and anthocyanins (16).	16	0.11	Fruits are eaten as such.
Rabdosia rugosa (Wall. ex Benth.) H.Hara (PLP 4), Lamiaceae	Maldah	Lf	Cure stomachache (7) and acidity (7).	14	0.09	Decoction of leaves is used.
Rheum webbianum Royle[a,b] (PLP 5/79), Polygonaceae	Chukri, Archo	Rt, Fl, Sd	Astringent (7), purgative (6), suppress hunger (6); cure stomach disorders (6), indigestion (7), boils (5), wounds (5), kidney stones (6) and urine blockage (6).	54	0.36	Roots are eaten as vegetable to suppress hunger. Dried powdered flowers and seeds are used to treat urine blockage, kidney stones and indigestion. Paste of flowers is applied on wounds and boils.
Rhodiola heterodonta (Hook. f. & Thomson) Boriss. (PLP 84), Crassulaceae	Churupa	AP	Cure cough (9) and lungs infection (11).	20	0.13	Dried powdered aerial plant parts are used.
Rhododendron anthopogon D. Don[a] (PLP 68), Ericaceae	Balu, Talisapatara	Fl	Cure bronchitis (7), cold (4), cough (4), gonorrhea (3), stomach ailments (2) and reduce pain during child birth (4).	24	0.16	Flowers are boiled in water and taken as a tea.
Salix lindleyana Wall. ex Andersson (PLP 12), Salicaceae	Chikas	AP	Antipyretic (7).	7	0.05	Dried powdered aerial plant parts are used.
Sambucus wightiana Wall. ex Wight & Arn. (PLP 2), Adoxaceae		WP	Purgative (6), anti-inflammatory (4), diaphoretic (3), diuretic (5), expectorant (2), hypotensive (2) and cure skin diseases (2).	24	0.16	Dried powdered plant is used.
Sasaurrea lappa (Decne.) Sch.Bip. (PLP 21), Compositae	Ruta	Rt	Blood purifier (10); treat chicken pox (5), cough (5), cold (5), fever (6), gastric problems (4), joint pain (4) and stomachache (5).	44	0.29	Roots are ground and applied on head, chest and feet to relieve fever. Root oil is used to treat joint pain. Dried powdered roots (1 spoon per day) are used to treat stomachache, cough and cold.
Scutellaria prostrata Jacquem. ex Benth. (PLP 43/50), Lamiaceae	-	AP	Nerve tonic (4); cure fever (8) and jaundice (5).	17	0.11	Dried powdered aerial plant parts are used.
Sedum ewersii Ledeb. (PLP 1), Crassulaceae	Shrollo	AP	Appetizer (3); cure toothache (6), headache (6), weakness (4) and chest pain (3).	22	0.15	Paste of flowers is applied on forehead to treat headache. Dried powdered leaves and flowers are used to treat chest pain and weakness. Rhizomes are cooked as vegetable to enhance appetite.
Selinum vaginatum C.B. Clarke[b] (PLP 86), Apiaceae	Matosal	Rh	Nervine sedative (7), dysmenorrheal (8); treat hysteria (6) and skin diseases (7).	28	0.19	Dried powdered roots are used.

(*Contd*.)

Table 2 — Uses of ethnomedicinal plants of Lahaul valley, Himachal Pradesh, India (*Contd*.)

Plant name (Voucher No.) and family	Local name	Plant part used	Diseases treated	Total citations (ΣU)	Use value (UV)	Mode of usage
Senecio graciliflorus (Wall.) DC. (PLP 81), Compositae	Zerjum	WP	Antifungal (6); antidote against insect bite (5).	11	0.07	Paste of whole plant is used.
Senecio kraschenninnikovii Schischk. (PLP 62), Compositae	-	Fl	Antiseptic (8).	8	0.05	Paste of flowers is used.
Tanacetum dolichophyllum (Kitam.) Kitam. (PLP 85), Compositae	Khampa	WP	Cure headache (7) and bodyache (8).	15	0.10	Dried powdered whole plant is used.
Taraxacum officinale (L.)[a] (PLP 72), Compositae	Paranbala, Quanti	WP	Blood purifier (6), tonic (7), appetizer (8); heal wounds (5), treat headache (4), migraine (4), fever (5), cough (6), stomachache (5), backache (4), joint pain (7), jaundice (5), kidney problems (4), food poisoning (6) and hepatitis (4).	80	0.53	Dried powdered roots (5 g) are administered with milk twice a day for one week to treat jaundice. Dried powdered aerial plat parts are taken with milk or water to treat joint pain and kidney problems. Dried powdered flowers along with lukewarm water are used to cure cough and stomachache.
Thalictrum f oetidum L. (PLP 6), Ranunculaceae	Haichingshah	WP	Cure fever (5). Also used to repel insects from domestic animals (7).	12	0.08	Decoction of flowers is used to treat fever. Paste of whole plant is applied on the skin of the animals to repel insects.
Thymus linearis Benth. (PLP 34), Lamiaceae	Kochi masha	Fl, Lf	Antifungal (5), antibacterial (5), tonic (8), heating effect (6); relieves pain during child birth (4), whooping cough (6), toothache (4), skin eruptions (6), reduce excessive bile secretion (5), kill hookworms (4), prevent hair loss (3), stomach and liver complaints (9).	65	0.43	For whooping cough, 5 g dried powdered leaves are administered with lukewarm water and black salt. Decoction of leaves is given to relieve pain during child birth. Dried powdered leaves and flowers are applied on teeth to relieve toothache. Dried powdered flowers mixed with *Carum carvi* seeds in equal proportion and taken after meal (half teaspoon) along with water to improve digestion and strengthen liver.
Tussilago farfara L. (PLP 45/55), Compositae	Motilab, Thanktum Karfo	Lf	Asthma (8), cough (9), chicken pox (5) and skin diseases (5).	27	0.18	Smoke of leaves is given to treat cough and asthma. Crushed leaves are used to cure chicken pox and skin diseases.

AP: Aerial parts; Bk: Bark; Fl: Flowers; Fr: Fruits; Lf: Leaves; Rh: Rhizome; Rt: Roots; Sh: Shoots; Sd: Seeds; WP: Whole plant
[a] Non-timber forest product's species of H.P., India used commercially
[b]Threatened medicinal plants of H.P., India.

important such as *Arnebia euchroma* (UV=0.59), *Artemisia maritima* (UV=0.55), *Picrorhiza kurrooa* (UV=0.51), *Asparagus filicinus* (UV=0.47), *Podophyllum hexandrum* (UV=0.40), *Dactylorhiza hatagirea* (UV=0.39), *Berginia stracheyi* (UV=0.33), *Hyssopus officinale* (UV=0.31) and *Origanum vulgare* (UV=0.31).

People of Lahaul either use whole plant or different plant parts such as roots, stem, leaves, flowers, fruits, seeds, etc. for crude drug preparation (Fig. 4). The methods of usage of these plant parts vary according to the type of the ailment. The methods of crude drug preparation are diverse such as plants can be used by grinding, drying, as a decoction, poultice or eaten as

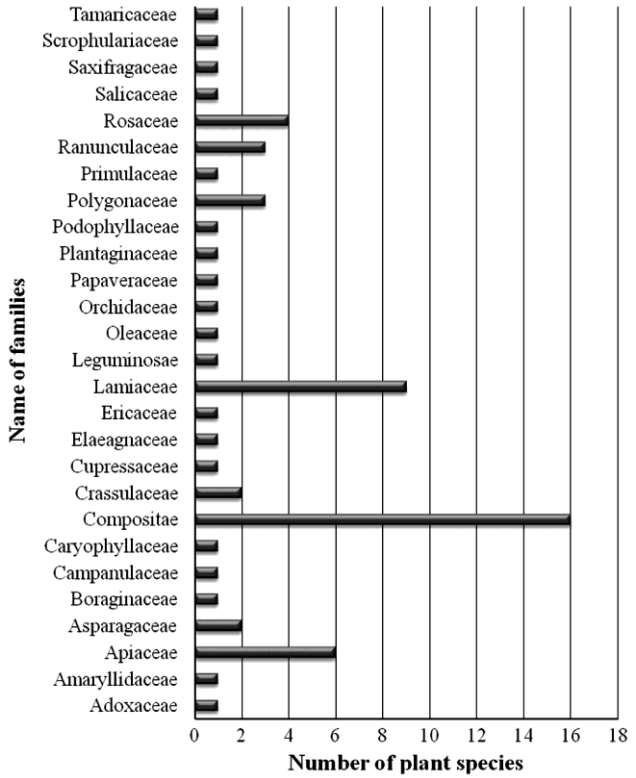

Fig. 3 — Representation of the the number of plants contributed by different families at the study site

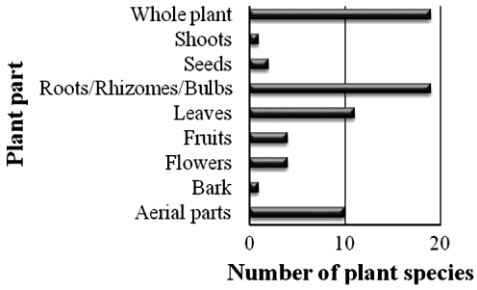

Fig. 4 — Representation of the number of plants and their parts used for treating various diseases

vegetable. Most commonly, plants or their parts are utilized by grinding along with other ingredients like honey, carom seeds, clarified butter, milk, etc.

Factor informant consensus

The diseases were classified into 33 different categories (Table 3). The maximum number of species (33) was used to treat gastrointestinal disorders, followed by respiratory disorders (32), fever (17), bacterial infections (16), circulatory disorders (16), physical pain (16), skeleto-muscular disorders (16) and wounds (14). Many informants agreed for usage of plants to treat bleeding (F_{ic}=1), diabetes (F_{ic}=1), intestinal infection (F_{ic}=1), leprosy (F_{ic}=1), gastrointestinal disorders (F_{ic}=0.91), lungs disorders (F_{ic}=0.90), tumor (F_{ic}=0.89), weakness (F_{ic}=0.89), chicken pox (F_{ic}=0.89), physical pain (F_{ic}=0.89), stomach and intestine worms (F_{ic}=0.88), respiratory disorders (F_{ic}=0.87) and stress (F_{ic}=0.87).

Table 3 — Categories of diseases and factor informant consensus (F_{ic})

Disease category/Medicinal properties	No. of plant species	Use citations	F_{ic}
Antibacterial or antifungal or antiseptic	16	88	0.83
Antiscorbutic	1	4	1.00
Bleeding	1	5	1.00
Chicken pox	2	10	0.89
Circulatory (anaemia, blood purifier, blood pressure)	16	96	0.84
Colic	2	5	0.75
Cuts or wounds	14	100	0.87
Dermatological	11	72	0.86
Diabetes	1	4	1.00
Fever	17	92	0.82
Gastrointestinal (appetizer, constipation, diarrhea, dysentery, ulcers, piles)	33	358	0.91
Glandular diseases	3	7	0.67
Gynecological disorders	6	40	0.87
Hairloss	2	21	0.95
Impotency	4	42	0.93
Inflammation	6	33	0.84
Insect repellent	2	10	0.89
Intestinal infection	1	4	1.00
Leprosy	1	3	1.00
Liver complaints (hepatitis, jaundice)	11	65	0.84
Lungs disorders	3	22	0.90
Nervous disorders	4	19	0.83
Physical pain (backache, headache, earache, toothache, chest pain)	16	137	0.89
Poisoning	3	14	0.85
Respiratory (asthma, cold, cough, influenza, bronchitis, lungs disorders)	32	244	0.87
Serous fluid secretion	2	8	0.86
Skeleto-muscular (arthritis, bone fracture, joint problem)	16	111	0.86
Stress	2	9	0.87
Tonic	8	46	0.84
Tumor or cancer	3	20	0.89
Urological (Diuretic, kidney disorders)	11	65	0.84
Weakness	2	10	0.89
Worms of stomach and intestine	9	67	0.88

Fidelity level

The fidelity level ranged from 8 to 100%. Plant species with maximum fidelity level (100%) such as *Senecio krascheninnikovii* possess antimicrobial properties, *Salix lindleyana* used to cure fever, *Tanacetum dolichophyllum* for physical pain, *Polygonum polystachyum* for gastrointestinal disorders, *Lactuca tatarica* and *Myricaria germanic* for skeleto-muscular disorders and *Pleurospermum brunonis* used as wormicide. People of Lahaul use *Juniperus communis* (Fl=66.67%) for curing dermatological problems and *Thalictrum foetidum* (Fl=58.33%) as insect repellent. *Lactuca macrorhiza* with 40% fidelity level was used against liver complaints. *Senecio graciliflorus* (Fl=45.45%) was used against poisoning. *Tussilago farfara* (Fl=62.96%) was effective against respiratory disorders (Table 4). Maximum number of plants was used to treat gastrointestinal disorders followed by respiratory disorders, fever, bacterial infections, circulatory disorders, physical pain, skeleto-muscular disorders and wounds (Fig. 5).

Table 4 — Fidelity level (Fl%) of some important plants for treating various ailments

Ailments	Important plants	Fl (%)
Antibacterial or antifungal or antiseptic	*Senecio krascheninnikovii*	100.00
	Senecio graciliflorus	54.54
Antiscorbutic	*Bergenia stracheyi*	8.00
Chicken pox	*Tussilago farfara*	18.52
	Sasaurrea lappa	11.36
Circulatory (anaemia, blood purifier, blood pressure, bleeding)	*Hippophae salicifolia*	27.78
	Sasaurrea lappa	22.72
	Arnebia euchroma	16.85
Colic	*Jurinella macrocephala*	10.34
Cuts or wounds	*Bergenia stracheyi*	16.00
	Potentilla atrosanguinea	12.00
	Geum elatum	30.43
	Plantago depressa	24.00
Dermatological	*Juniperus communis*	66.67
	Jurinella macrocephala	37.93
	Astragalus rhizanthus	35.00
Fever	*Salix lindleyana*	100.00
	Scutellaria prostrate	47.06
Gastrointestinal (appetizer, acidity, constipation, diarrhea, dysentery, indigestion, piles, ulcers)	*Polygonum polystachyum*	100.00
		(*Contd*.)

Table 4 — Fidelity level (Fl%) of some important plants for treating various ailments (*Contd*.)

Ailments	Important plants	Fl (%)
	Pimpinella diversifolia	68.75
	Angelica glauca	55.55
	Geum elatum	43.48
	Asparagus filicinus	38.03
Gynecological disorders	*Juniperus communis*	33.00
	Rhododendron anthopogon	17.00
	Podophyllum hexandrum	15.00
Hairloss	*Arnebia euchroma*	20.22
Impotency	*Juniperus communis*	33.33
	Asparagus filicinus	29.58
Inflammation	*Ligusticum* sp.	57.14
	Fragaria vesca	45.45
Insect repellent	*Thalictrum foetidum*	58.33
Liver complaints (hepatitis, jaundice)	*Lactuca macrorhiza*	40.00
	Scutellaria prostrate	29.41
	Aconitum rotundifolium	14.28
Physical pain (backache, headache, earache, toothache, chest pain)	*Tanacetum dolichophyllum*	100.00
	Sedum ewersii	68.18
	Lactuca macrorhiza	60.00
Poisoning	*Senecio graciliflorus*	45.45
	Anaphalis busua	28.57
Respiratory (asthma, cold, cough, influenza, bronchitis, lungs disorders)	*Tussilago farfara*	62.96
	Origanum vulgare	32.61
	Ajuga bracteosa	21.74
Serous fluid secretion	*Cynanthus lobatus*	27.78
	Androsace sarmentosa	13.64
Skeleto-muscular (arthritis, bone fracture, joint problem)	*Lactuca tatarica*	100.00
	Myricaria germanica	100.00
	Fraxinus xanthoxyloides	60.00
	Brachyactis roylei	53.33
Stress	*Selinum vaginatum*	21.43
Tumor or cancer	*Brachyactis roylei*	46.67
	Androsace sarmentosa	22.72
Urological (Diuretic, kidney disorders)	*Nepeta eriostachya*	42.85
	Polygonatum verticillatum	25.92
	Sambucus wightiana	20.83
Weakness	*Sedum ewersii*	18.18
	Angelica glauca	11.11
Worms of stomach and intestine	*Pleurospermum brunonis*	100.00
	Artemisia gmelinii	58.82

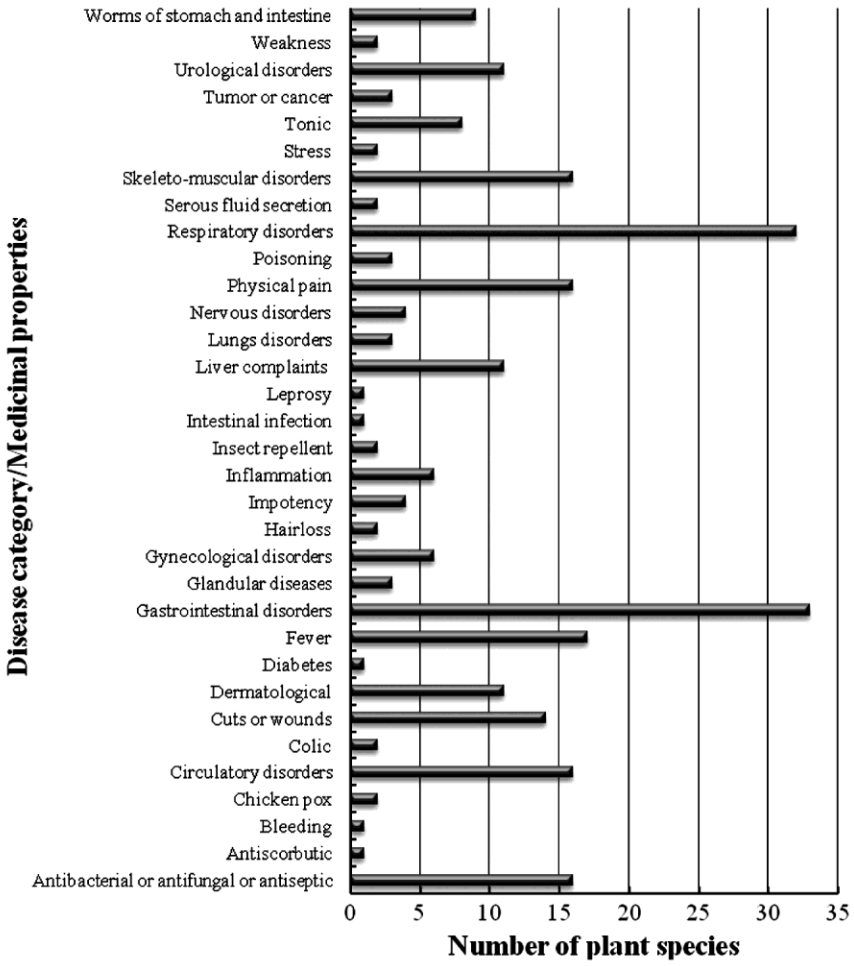

Fig. 5 — Frequency of plant species used for treating various diseases

Discussion

Maximum number of medicinal plants was from the family Compositae (16 plants). It was followed by the families Lamiaceae (9 plants), Apiaceae (6 plants) and Rosaceae (4 plants). Families Acanthaceae, Caesalpiniaceae, Polygonaceae, Ranunculaceae and Rutaceae contributed 3 plant species each. Families namely Asparagaceae and Crassulaceae contributed 2 plant species each. Remaining families contributed single species. Maximum number of plants from these families may be attributed to their wide distribution, abundance and accessibility for their use in the study area. Lamiaceae and Compositae families are the dominant medicinal plant families as reported by Bennett and Prance[11]. The wider usage of plant species from these families might be related to the presence of effective bioactive compounds against diseases[6].

Species such as *Angelica glauca*, *Arnebia euchroma*, *Artemisia maritima*, *Asparagus filicinus*, *Berginia stracheyi*, *Origanum* after *vulgare* *Picrorhiza kurrooa*, *Podophyllum hexandrum*, *Rheum webbianum*, *Taraxacum officinale* and *Thymus linearis* are of highest use-value. *Arnebia euchroma*, locally known as ratanjot/khomig is one of the threatened as well as commercially exploited wild medicinal plant species of Himachal Pradesh. People of Lahaul use dried powdered roots of *A. euchroma* for curing cough, cold and to heal cuts and wounds. Powdered roots of *A. euchroma* are also used to remove dandruff from hair. *Artemisia maritima* plant is used against asthma, cuts, wounds, cough, fever, stomach pain, joint pain and to expel intestinal worms. *Taraxacum officinale* is also exploited commercially for treating jaundice, joint pain, stomachache and kidney problems. *Picrorhiza kurrooa*, locally known as karu/honglen/kutki is a threatened and commercially exploited medicinal plant of this region. Decoction of whole plant of *P. kurrooa* and *A. maritima* is used to remove stomach worms. Smoke of roots of *P. kurrooa*

is used to cure asthma and decoction is used to treat gastritis, colic pain, rheumatism and jaundice.

The ethnomedicinal plants of Lahaul-Spiti has been studied and the uses of *A. maritima* have been reported for curing skin boils, stomach pain and joint pain; *P. hexandrum* for constipation and asthma patients; *A. euchroma* for cough and dryness in the throat; *T. officinale* for ulcers, diabetes and liver trouble; *T. linearis* for indigestion, stomach pain and gastric troubles; *A. glauca* for swelling and pain[3]. *Picrorhiza kurrooa* has been reported to cure fever in east Himalayan region[12]. Roots of *A. filicinus* are used as aphrodisiac and to enhance milk yield in cattle by the local people. *Thymus linearis* possess antifungal and antibacterial properties and used for stomach and liver complaints, whooping cough, skin eruptions, etc. *Podophyllum hexandrum*, *Angelica glauca* and *Rheum webbianum* are threatened as well as commercially exploited wild medicinal plant species of Himachal Pradesh[13]. *Podophyllum hexandrum* possess anticancerous properties, whereas *A. glauca* and *R. webbianum* are mainly used to cure digestive disorders. Several researchers have reported the use of *P. hexandrum* against constipation[14]; asthma[3], bloody diarrhoea[15-16] and liver problems[17]. *Angelica glauca* has been reported for curing pain and swelling of leg joints and feet[3]. *Bergenia stracheyi* and *Origanum vulgare* are non timber forest product species of commercial importance in this region. People of Lahaul use *B. stracheyi* for treating dysentery, mouth ulcers, kidney stones, cuts and wounds and *O. vulgare* for curing asthma. *Berginia stracheyi* has been reported for curing mouth ulcers and blisters[3].

Local people of Lahaul use *Senecio kraschenninikovii* as antimicrobial agent, *Salix lindleyana* for fever, *Polygonum polystachyum* for gastrointestinal disorders, *Tanacetum dolichophyllum* for physical pain, *Lactuca tatarica* and *Myricaria germanica* for skeleto-muscular disorders and *Pleurospermum brunonis* as wormicide with 100% fidelity. It has been reported that people of Lahaul-Spiti use *Polygonum polystachyum* as a cooling agent to cure ulcers caused by the production of excessive heat in the stomach. The juice extracted from fresh young shoots of *Myricaria germanica* has been reported to cure joint pains[3]. The leaves and flowers of *Pleurospermum brunonis* are used to treat skin diseases, stomatitis, small pox, cough and cold in Manali, Himachal Pradesh[18].

Conclusions

In this investigation it was found that Lahaul valley is rich in a plenty of medicinal plants that are used by local people and traditional healers to treat a number of diseases. A total of 64 plant species were reported by the people of the area to treat 35 different ailment categories. Maximum plants were belonged to the family Compositae followed by other families such as Lamiaceae, Apiaceae, Rosaceae, Polygonaceae, Ranunculaceae, Asparagaceae and Crassulaceae. Maximum plants were reported to cure gastrointestinal and respiratory disorders signifying the occurrence of these two disease categories in the study area. As per use-value, the most important medicinal plants were *Angelica glauca*, *Arnebia euchroma*, *Artemisia maritima*, *Asparagus filicinus*, *Berginia stracheyi*, *Origanum vulgare*, *Picrorhiza kurrooa*, *Podophyllum hexandrum*, *Rheum webbianum*, *Taraxacum officinale*, and *Thymus linearis*. Further phytochemical and pharmacological research should be done in these plant species which can potentially lead to new drug discovery.

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Conflict of interest

The authors declare no conflict of interest.

Author Contributions

MT, PKS and RKA conceptualized the study. MT, PKS, RDP and HG conducted the ethnobotanical survey and analyzed the field data. MT, RKA and PKS drafted the manuscript. All authors have read and approved the final manuscript.

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