Ethnomedicinal plants used by local inhabitants of Jakholi block, Rudraprayag district, western Himalaya, India

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Abstract

Background: Ethnomedicinal knowledge of the Indian Himalayas is very interesting because of the wide range of medicinal plants used in traditional medical practice. However, there is a danger of knowledge being lost because the knowledge sharing is very limited and passed on orally. The present study is the first ethnomedicinal study in Jakholi area of Rudraprayag district of Northwestern India. The aim of present study was to identify traditional medicinal plants used by the inhabitants to treat different ailments and document the associated knowledge of these medicinal plants.

Methods: An ethnomedicinal survey was carried out in 72 of 133 villages and alpine pastures of Jakholi block (800–4000 m asl). Door to door surveys and group discussions, applying semi-structured questionnaires were conducted with traditional healers and villagers in local language (Garhwali). Informant Consensus Factor (ICF) was computed to analyse collected ethnomedicinal data.

Results: A total of 78 species (Gymnosperms 3 species, Monocotyledons 12 and 63Dicotyledons) belonging to 73 genera in 46 families were identified to treat 14 different ailments categories. Most dominant family is Asteraceae (5 species). In disease treated categories, Diseases of the skin (DE) have the highest proportion (29.55%) followed by Gastro-intestinal disorder (GA) (25.89%). The most life form of plants used was herb (56%) followed by tree (23%) while root was the most frequently used part of the plants and the traditional preparation was mainly applied in the form of paste (37%). The highest ICF value (0.99) was found for hair ailments (HA) followed ophthalmologic complaints (OP) and mental afflictions (MA) (0.98).

Conclusions: The present study provides valuable information about traditional knowledge of medicinal plants of Jakholi Block in the Northwestern Himalaya, India. Local communities still possess large traditional knowledge of plants and their therapeutic uses and that the link of that traditional knowledge to modern research could be of importance for the isolation of new phytotherapeutic compounds leading to the development of novel therapeutic active agents. Some of the ethnomedicinal plants are facing high threats and are becoming rare, and conservation initiatives are needed to conserve them for sustainable management in the region.

Keywords: Conservation, Informant consensus factor, Medicinal plants, Sustainable use, Traditional knowledge, Western Himalaya

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Background

The Himalaya is a dynamic area, covering over 18% of the Indian subcontinent and harbouring about 8000 species of angiosperms, 1748 of which are used for their therapeutic properties [1]. The region has been well known for its rich ethnomedicinal flora since ancient times [2].

Plants are used since long time to cure intense chronic diseases, and also as a source of food, shelter and clothing. Due to very low expense and good results these medicinal practices are transmitted through generation to generation and still practiced in different communities. These valuable medicinal plants contain rich bioactive compounds which serve various pharmacological activity. Ethnic people depend on the plants around them to gain economic values and primary health care benefits which is based on need, observation, experience of older ethnic people, and trial and error [3]. About 65% of the Indian population depend on traditional medicine [4]. The study area is interesting due to wide geographic and climatic condition and medicinal plants diversity of Jakholi Block makes this region an especially valuable treasure home of a wide range of wild medicinal and aromatic plants. Ethnic people, shepherd and traditional medicinal practitioner (Vaidyas and Daai) inhabit within a range of 700–3800 m asl and have high knowledge of medicinal plants uses. Local wooden and stone tools are commonly used to prepare medicinal remedies. Most diseases cured by local herbalist are common problems such as respiratory diseases, aches and pains, wounds and musculoskeletal ailments. Inhabitants often use local medicinal plants without prior advice of local traditional healers because they are using these plants since generations. In these connections, the present study was carried out to provide an overview of the knowledge of medicinal plants of the local and traditional healers of Jakholi area and to evaluate the status of these useful medicinal flora for identification of new drugs for health needs and suitable source of income for livelihood of inhabitants. We hypothesize that plant use at Jakholi would show similar response to other Himalayan regions, and that the local medicinal flora would have been overharvested.

The first step of diagnosis by local healers is checking the pulse rate and heartbeat, then examining the forehead, eyes, tongue and in some cases also the urine. The body temperature and colour are major key factors to identify health problems. Medicinal plants play a vital role in the local economy and health care, and demand is increasing. Many populations of medicinal plants seem to drastically decline due to overexploitation and unsustainable harvesting. Most of the important alpine medicinal plants are becoming rare and endangered.

Methods

Study area and sites

The Jakholi Block is located between the coordinates 30° 37′ 08.88″ to 30° 15′ 13.47″N and 79° 03′ 43.79″ to 78° 50′ 07.97″E (Google Earth Pro Us dept. of State Geographer 2017) in district Rudraprayag western Himalayas India. Medicinal plants sampling was done from alpine meadows of Panwali Kantha (3500 – 4000 m) to lower altitudes (800 m) (Fig. 1). Annual average rain fall is around 1850–2000 mm with temperature ranging from −5 to 15 °C in winter and 20 to 35 °C in summer (High land to lower hills).

This study was conducted in Jakholi Block of Rudraprayag district, located in north west Uttarakhand. The total area is about 500 km² including 133 villages [5], with a total estimated population of 74,759 (34,126 male and 40,633 female) [6]. Most of the inhabitants live in small villages, and few families are shepherds and stay mostly in alpine areas (Bugyal and Kharka) for 7 – 10 months a year. Most of the inhabitants are farmers. Medical facilities are rare in Jakholi block, and most of the health problems are cured traditionally by local medicine. For chronic diseases people have to travel more than 100 – 200 km from their village to get attention at health facilities. Most of the younger generation, especially men, migrate to cities in order to find employment. Women and elder people live in the villages. Inhabitants are generally belonging to three major cast group, Jajman, Brahman and Oji (about 65%, 15%, 20% respectively), and Hinduism is the major religion of the inhabitants. Most people speak Garhwali, and Hindi is the secondary major language of the region. Mountain terrace farming is abundant in region, (Fig. 2a), with three crops a year: Rabi (October–April/May e.g. Wheat, Barley, Mustard), Khairi (April–October e.g. Rice, Corn), and Jayad (May–October e.g. Cucumber, Pumpkin, Beans).

Data collection

A total of 220 individuals were surveyed during the study. Among them some key participants which were experienced and rich knowledge of the medicinal flora were selected for collection and identification of local medicinal plants. All interviews were conducted after obtaining oral and verbal prior informed consents from all individual participants.

The study was conducted during October 2014 to September 2015 in randomly selected villages of Jakholi and information about local medicinal plants was also gathered from shepherds (Bakrwal) and ranchers (Maur) in the alpine regions, and their homesteads (commonly called Kharka and Maira/Chani viz. Panwali Kantha, Jadi, Koni and Matya, Fig. 2b).

Household survey was conducted using individual personal meetings and group discussions as well as field
surveys [7–9]. (Fig. 2c). Questionnaires were prepared in English, but interviews were conducted in local language (Garhwali) (Appendix 1) for more convenience and accuracy. As the first author is local person of region so easy understanding and conversations with local people, together more information.

List of local medicinal plants with common name were prepared and photographs were also supplemented for more information about uses and identification. For more reliable information, diseases base questionnaires were used. Information about medicinal plants include local name, plant parts used, drug preparation, mode of administration and doses were recorded. For verification and agreement about the medicinal uses, information given by a respondent was discussed in households as group discussion.

Twenty-five key participants including 11 traditional healers, two shepherds, and 12 other local inhabitants were interviewed and their experience, knowledge of medicinal plants, methods of drug preparation, and practicing with traditional tools (Fig. 2d), etc. were recorded. Monthly schedules were made for data and plant collection including two alpine/pasture surveys were made in July and September. So the participants were
interviewed at their homes or at pastures. Medicinal plants were catalogued, and their voucher specimens were collected [10]. Dried specimens were poisoned using 0.1% HgCl$_2$ and ethyl-alcohol, and then mounted on herbarium sheets. Collected samples were identified with the help of a local flora [11, 12] and further verified through comparison with prior collections from the botanical survey of India (BSI, Northern circle Herbarium, Dehradun). Plant names were also checked in “Tropicos” http://www.tropicos.org as well as “The Plant List” (http://www.theplantlist.org), and all preserved specimens deposited at the Herbarium of HNB Garhwal University, Srinagar (HAPPRC).

**Data analysis**

Data were simply evaluated through informant consensus factor (ICF) described by Trotter and Logan [13, 14] and ethnomedicinal data were checked and compared with previous literature for new use reports. The ICF measures the consensus in using plants in a group about treating an illness in the study area. The ICF was calculated following:

\[
ICF = \frac{Nur - Ntaxa}{(Nur-1)}
\]

Where Nur refers to the number of use-reports for a particular ailment category and N taxa refers to the number of taxa used for a particular ailment category by all participants. ICF value ranges from 0 to 1. It should be stressed that high ICF value (close to 1.0) indicates that relatively few taxa are used by a large proportion of participants. On the contrary low ICF value (close to 0) indicates a randomly use of plants by participants in treating illness.

Jaccard index (JI) is calculated by comparison of previously published studies from Himalaya and analyzed the percentages of quoted species and their medicinal uses by using the following formula:

\[
JI = \frac{c \times 100}{a + b - c}
\]

where “a” is the number of species of the area A, “b” is the number of species of the area B, and “c” is the number of species common to A and B [15].

A comparison with previously published data collected from different regions was performed by evaluating percentages of the quoted species and their medicinal uses by applying Sorensen’s similarity index formula [16].

\[
QS = \frac{2c}{a + b} \times 100
\]

where, “a” is number of species in an area A, “b” is number of species in area B and “c” is number of species common to area A and B.

**Results and discussion**

**Socio-economy**

During the ethnomedicinal survey, a total of 220 people were interviewed, including shepherds at Panwali Kantha
(3500 – 4000 m asl), forests and Kharka (their homes) during June–September 2015. The sociological profile of the participants is given in Table 1. Most participants were from 50 to 59 age group. Only 25 participants were traditional healers (Vaidyas and Daai) and the key informants for this study. Less than 9% participants were < 40 years old, about 30% were illiterate, while many of the young practitioners hold a degree/diploma (Table 2). Almost all illiterates were > 50 years older.

Ethnomedicinal plants
A total of 78 medicinal plant species belonging to 72 genera of 46 families including 3 gymnosperm species and 75 angiosperms (12 monocotyledons and 63 dicotyledonous) presented in (Table 3) was reported. The most represented families were Asteraceae (5 species), followed by Polygonaceae, Ranunculaceae, Rosaceae (4 species each) and Berberidaceae, Poaceae, Zingiberaceae (3 species each) (Fig. 3). Picrorhiza kurroa and Aconitum heterophyllum were common ethnomedicinal plants among all participants because these plants are culturally important as they have long been using for generations and due to their rich bioactive constituents.

Life forms and plant parts used
In present study, 56% of the species were herbs, followed by trees (23%), shrubs (12%), and climbers (9%) (Fig. 4), similar to other studies carried out in Himalaya [1, 17, 18], probably due to the presence of a wide range of rich bioactive medicinal plants in the Himalaya [19]. Traditional healers often use herbs and trees most commonly as medicine because of their easy availability [20]. Besides this, herbs can be manipulated with easiness in herbal preparation methods and extraction of bioactive compounds [21]. Less percentage of climbers might be due to less availability and difficult to harvest from huge growth of supporting material (Tree) in temperate area. Availability is found as a major reason to use the plants in Himalaya followed by cultural reason.

In present study different plant parts were used to prepare herbal preparation of drugs (Fig. 5). The common plants parts were roots (26%) followed by leaves (20%), fruit (8%), bark and rhizome (7%) whole plant, tuber and seeds (each 6%), aerial part and stem or branches (each 5%), flower, latex resin or gum, bulb, (each 1%). Root were frequently used in folklore of Jakholi for herbal preparations similar to [1, 22] Root proportion is high probably due to root consist rich of active ingredients [23]. Leaves were second most useful plant part it might be due to easy availability and it is thought that leaves contain more easily extractable phytochemicals, crude drugs and many other mixtures which may be proven as valuable regarding phytotherapy [24].

Mode of drug preparation and traditional tools
Out of total 148 preparations, the herbal medicine formulations prepared according to the traditional uses as follows: paste (lepa) (37%), juice/extract (rasa) (29%), powder (churna, 21%), decoction (kwath/kaada) (6%), semi-dried (avleha) (4%), oil (taila/ghee), solid extract (sattva), and cooked with milk (paka) (each 1%) (Figs. 6, 7 and 8). The most frequent use of paste and juice might be due to easy preparation and effectiveness of herbal drugs. Water was commonly used as solvent if required for the preparation. Sometimes milk or honey was used as a matrix or added to increase viscosity of the preparation as reported in earlier study [25]. Paste is made by crushing plant parts and then mixing it with oil or water. Administration of dosages was taken mostly twice and thrice a day. Besides above, according to few participants the dosage depends on the age and physical appearance of the patient [24].

Table 1 Age and gender information of inhabitants and local practitioners

| Age group | Gender | Vaidyas (male) | Daai (female) | No of persons | Percentage |
|-----------|--------|----------------|---------------|---------------|------------|
| 30 – 39   | 14     | 6              | 0             | 20            | 9.09       |
| 40 – 49   | 23     | 14             | 3             | 41            | 18.63      |
| 50 – 59   | 27     | 36             | 2             | 69            | 31.36      |
| 60 – 69   | 30     | 29             | 3             | 65            | 29.54      |
| 70 – 79   | 9      | 7              | 4             | 22            | 10         |
| 80 +      | –      | –              | 3             | 3             | 1.36       |
| Total     | 103    | 92             | 15            | 220           |            |

Table 2 Literacy rate of participants

| Education level | No. of individuals | Percent |
|-----------------|--------------------|---------|
| Illiterate      | 64                 | 29.11   |
| 1 - 5th         | 87                 | 39.54   |
| 6 - 10th        | 43                 | 19.54   |
| 11 - 12th       | 19                 | 8.63    |
| ≤ 12th          | 7                  | 3.18    |
| Total           | 220                |         |
| Plant Family, botanical name and collection number | Common/English name | LF | Parts used | Preparation, Doses, application and ailments categories | Z Citation | Previous uses reported |
|--------------------------------------------------|---------------------|----|------------|--------------------------------------------------------|------------|------------------------|
| **Acanthaceae**                                  |                     |    |            |                                                        |            |                        |
| Barkania crispa L. ASR HAPPRC 1461              | Kulakaty / Kuladya/ Philippine violet | H | Leaves, Root | Leaf and root paste applied in cuts and wounds. (60, DE) | 60         |                        |
| Justice adhatoda L. ASR HAPPRC 1601             | Basingu/Malabar nut | S | Leaves, Stem, Flower | Leaf buds (5-10 decoction kwath) 100 ml a time taken thrice a day for treatment of stomachache and fever (12, 23 GA, F). Stem used for cleaning teeth. (3, LP) Flower powder (churna) used for cough and cold (15, RE) Leaf extract / juice applied for treatment of cut and wounds. (3, DE) | 84         |                        |
| **Acoraceae**                                   |                     |    |            |                                                        |            |                        |
| Acorus calamus L. ASR HAPPRC 1456               | Bauj / Baj/Sweet flag | H | Rhizome | Rhizome powder (churna) (2-4 g) + ½ teaspoon Mishri (Sugar lumps) (2-4 g) gently mixed in cold water (250 ml) drunk thrice a day as it acts as refrigerant. (11, GA) Rhizome powder (churna) used for cleaning teeth. (12, DP) Fresh or dried rhizome extract dose of 2-3 teaspoons taken orally thrice a day including 1 taken early morning before eating, for treatment of stomachache (Jonka). (15, GA) Rhizome garland used to increase child immunity (17, DU) and also used to cure jaundice. (16 GA) Rhizome paste applied in burns, cuts and wounds. (4, DE) | 75         |                        |
| **Amaryllidaceae**                              |                     |    |            |                                                        |            |                        |
| Allium cepa L. ASR HAPPRC 1404                  | Pyaz/Onion          | H | Bulb | Bulb juice (swarasa) used for treatment of burns, and skin diseases. (69, DE) Bulb juice 1–2 drop is used for ear ache. (29, EC) | 98         |                        |
| **Anacardiaceae**                               |                     |    |            |                                                        |            |                        |
| Mangifera indica L. ASR HAPPRC 1618             | Aam/Mango           | T | Seeds | Seed extract / juice (rasa) (Fig. 1) 1 teaspoon used to cure stomachache, dysentery and diarrhoea (especially for child) (12, 19, GA) | 31         |                        |
| **Apliaceae**                                   |                     |    |            |                                                        |            |                        |
| Centella asiatica (L.) Urban ASR HAPPRC 1408    | Brahmi/Asiatic pennywort | H | Aerial part | Brahmi leaf paste applied for treatment of headache. (25, HA) Daily use of brahmi juice beneficial for eyesight, leaf powder (churna) is also used for same action. (40, OP) | 65         |                        |
| **Apocynaceae**                                 |                     |    |            |                                                        |            |                        |
| Calotropis gigantea (L.) Dyand. ASR HAPPRC 1413  | Aal/Crown Flower    | S | Leaves, Latex | Leaves used for treatment of joint pain, swelling (used as gosam patti). (37, SK) Latex is useful in skin diseases. (2, DE) | 39         |                        |
| **Asphodelaceae**                               |                     |    |            |                                                        |            |                        |
| Aloe vera (L.) Brunn. f. ASR HAPPRC 1627        | Aloevera / Gwrpatha | H | Leaves | Leaves are used for treatment of skin diseases and burns. (65, DE) | 65         |                        |
Table 3  Ethnomedicinal plants used by local inhabitants of Jakholi Block, Rudraprayag district, Uttarakhand, India (Continued)

| Asparagaceae          |                                            |                        |                        |                        |                        |                        |
|-----------------------|--------------------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Asparagus adscendens  | Jhimi/Asparagus                            | S Root, Seeds          | Root bark (100 g) +   | Seeds (5-10 g) are ground mixed with ghee(clarified butter) (1 tablespoon) and then shade dried prepared powder (churan) is taken 1 teaspoon orally thrice a day with milk to remove weakness. (98, DU) | 124 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 |
| Roxb. ASR HAPPRC 1456 |                                            |                        | Root (50-60 g) cooked with cow milk (100 ml) (sudha) + 1-2 tablespoon sugar, (gula) taken orally thrice a day to increase memory power and body weight. Tuberous roots are also galactagogue (increasing and activating mammary gland). (26, GF) |                        |                        |                        |                        |

| Asteraceae             |                                            |                        |                        |                        |                        |                        |
| Eupatorium adenophora  | Basya/Crofton weed                        | S Leaves, Stem         | Leaves extract / juice applied in cuts and wounds (antiseptic) and burns. (108, DE) | 138 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 |
| Spreng. Syn-Ageratina adenophora (Spreng.) RM.King & H. Rob. ASR HAPPRC 1529 |                                            |                        | Stem piece (7-9 each 10-15 cm) dipped in 500 ml water for a night then this extract is drunk early morning for prompt treatment of pimples. (12, DE) |                        |                        |                        |                        |
| Ageratum conyzoides 5. L. | Kalabasa / Gundyaya/ Bilygoat-weed | H Aerial parts | Aerial plant parts extract and paste applied for treatment of burns, cuts and wounds. (34, DE) | 36 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 |
| ASR HAPPRC 1585 |                                            |                        | Fresh leaves decoction (kwath) is used for treatment of cough and cold (5-10 ml taken orally thrice a day). |                        |                        |                        |                        |
| Jutinea macrocephala  | Bishkandaroop | H Root | Root paste applied for treatment of boils, pimples, cuts and wounds, and skin diseases. (33, 30, 7 DE) | 96 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 |
| DC. ASR HAPPRC 1620 |                                            |                        | Fresh leaves juice (swarasa) or extract is used for treatment of ear problem (earache, pus in ear etc.). |                        |                        |                        |                        |
| Senecio radiatus  | Neelbadi | H Whole plant | Whole plants juice with Mishri (Sugar lumps) (4-6 g) used as astringent. (21, GA) | 75 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 |
| Buch-Ham ex D.Don. ASR HAPPRC 1605 |                                            |                        | Leaves juice (1 teaspoon) is used for treatment of stomach problems (junku, mostly occurring in children). (33, GA) |                        |                        |                        |                        |
| Taraxacum officinale | Kadatu/Clommon Dandelion | H Whole plant | Tuberous root paste (lep) applied for treatment of cuts and wounds, headache. (6, 17 DE, HA) | 65 | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 |
| (L.) L. Syn- Taraxacum campylodes G.E. Haglund Weber ex F.H.Wigg. ASR HAPPRC 1434 |                                            |                        | Root decoction (kwath) used for treatment of mouth and throat infection. (2, RE) |                        |                        |                        |                        |
|                                            |                                            |                        | Whole plant paste (lep) used for skin diseases and boils. (9, DE) |                        |                        |                        |                        |
|                                            |                                            |                        | Fresh or dried root extract / juice used for treatment of fever. (21, FI) |                        |                        |                        |                        |
**Table 3** Ethnomedicinal plants used by local inhabitants of Jakholi Block, Rudraprayag district, Uttarakhand, India (Continued)

| Berberidaceae       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Berberis chitria Buch. Hamex Lindl | Totar / Totru | S Root | Decoction (Rasout) (Fig. 8) is used for treatment of eye flu and conjunctivitis. (110, OP) Root (5-10 g) rubbed with water then ½ teaspoon taken orally thrice a day for treatment of stomachache. (3, GA) Fresh root extract / juice ½ teaspoon thrice a day for treatment of diabetes. (7, DI) | 1,0 | 10,1,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35 |
| Berberis lyceum Royce ASR HAPPRC 1594 | Kingo/Banberry | S Root, Inflorescence | Decoction (Rasout) (Fig. 8) of root is used for treatment of conjunctivitis (2-3 drop administered for 3-5 days). (1, OP) ½-1 teaspoon rasout taken orally thrice a day for treatment of stomachache. (3, GA) Flower extract / juice is also used for treatment of eye infection. (1, OP) Root is also used in treatment of diabetes. (7, DI) | 11,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35 |
| Podophyllum hexandrum Royce Syn- Sinopodophyllum hexandrum (Royce) T.S. Ying ASR HAPPRC 1611 | Bankakhri/Indian Podophyllum | H Root | Root paste (lppa) used for treatment of cuts and wounds, boils, skin diseases. (3,3,1,8, DE) | 42 |
| Betulaceae          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Betula utilis D. Don ASR HAPPRC 1624 | Bhoj / Bhojpatra/ Himalayan birch | T Leaves, Bark | Leaf and bark extract / juice is used for treatment of cut and wounds, boil. (17, DE) | 17 |
| Brassicaceae        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Brassica juncea (L) Czem. ASR HAPPRC 1626 | Sarson/Indian mustard | H Seeds | Seeds oil used as hair tonic and in ear problems. Also used to cure skin diseases (12, 42, 15, HP, EC, DE) | 69 |
| Megacarpaea polyandra Benth. ex Maiden ASR HAPPRC 1616 | Barmolu / Barmou | H Whole plant | Root (4-6 g fresh or dried) rubbed or crushed and mixed with 500 ml water and stayed outside in night covered with cloth and drunk early morning for treatment of fever. (7, FA) Other preparation for fever (Jaar) and refrigerant: root rubbed in chauthi and ½-1 spoon mixed with 1 glass whey / butter-milk (charchh) and 1 spoon sugar lumps (Mishri (Sugar lumps)) taken twice a day. Whole plant is refrigerant (cooling effect) (56, GA). Root powder is also beneficial for abdominal problems (17, GA) Root powder also used as antidote of snake bite and scorpion sting (root paste or powder prepared with ghee (clarified butter) and applied thrice a day) (9, PB) | 89 |
| Caprifoliaceae      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Nardostachys jatamansi (D. Don) DC. ASR HAPPRC 1428 | Maasi/Spikekand | H Rhizome | Rhizome powder ½ teaspoon taken orally thrice a day with water to cure mental disorder and insomnia. (29,35, MA) | 64 |
**Table 3** Ethnomedicinal plants used by local inhabitants of Jakholi Block, Rudraprayag district, Uttarakhand, India (Continued)

| Scientific Name                  | Common Name          | Part Used | Use/Description                                                                 | Reference |
|----------------------------------|----------------------|-----------|---------------------------------------------------------------------------------|-----------|
| *Valeriana jatamansi* Jones      | Sumayja/Indian Valerian | H Rhizome | Rhizome powder 1 tsp teaspoon and 5-10 g Mahini (Sugar lumps) taken orally twice a day with lukewarm water for treatment of insomnia (7, MA), abdominal pain, digestive problems (2, GA), cough and cold. (2, RA) Rhizome paste applied in cuts and wounds, boils, skin diseases and headache (4, 13, 2, DE, HA) | 35        |
| *Dymaria cordata* (L.) Wild. ex Schult. | ASR HAPPRC 1406 | H Aerial part | Paste of aerial part is used to cure herpes (Makia/Daacid). (6, DE) Leaves juice is used for treatment of fever and headache. (13, FI) | 19        |
| *Terminalia bellirica* Gaertn. Roxb. | ASR HAPPRC 1582 | T Fruit | Fruit peel powder is useful in cough and respiratory diseases. (22, 10, RE) | 32        |
| *Terminalia chebula* Retz.        | ASR HAPPRC 1598 | T Fruit | Fruit dipped in cow urine for 1 week, and then dried in partial shade and stored in jam bottle. 1-1 teaspoon taken orally thrice a day for treatment of cough. (42, RE) Fruit peel rubbed with mustard oil is applied for treatment of skin diseases. (7, DE) | 49        |
| *Cucumis sativus* L.             | ASR HAPPRC 1414 | Cl Seeds | Seeds (5-10) rubbed with water and 2 teaspoon of the prepared juice (swarasa) is given to child twice a day for treatment of fever (swas). Massages through juice / swarasa on whole body as refrigerant in fever (swap). (65, FI) | 65        |
| *Trichosanthes cucupiifolia* Lour. | ASR HAPPRC 1599 | Cl Fruit, Seeds | Extract / juice (swarasa) of skin / peel of yaladu fruit ½-1 teaspoon taken orally thrice a day for treatment of fever. (31, GA) Seed powder (chuma) (½-1 teaspoon) taken orally thrice a day for treatment of internal injury. (11, DU) | 42        |
| *Dioscorea bulbifera* L.         | ASR HAPPRC 1552 | Cl Tuber | Tuber powder (chuma) ½-1 teaspoon taken orally thrice a day for curing fever. (17, FI) Tuber paste (lep) applied for treatment of boils. (16, DE) | 33        |
| *Lyonia ovalifolia* (Wall.) Drude | ASR HAPPRC 1520 | T Leaves, Bark | Leaves (4-5) and bark (5-10 g) crushed with 10-20 ml water, prepared in a semi-dried (avleha) preparation (anyarkutu) applied to cure boils, skin diseases (antiallergic). (3, 10, DE) | 43        |
Table 3: Ethnomedicinal plants used by local inhabitants of Jakholi Block, Rudraprayag district, Uttarakhand, India (Continued)

| Family | Scientific Name | Local Name | Part Used | Description | Value |
|--------|----------------|------------|-----------|-------------|-------|
| Juglans | Juglans regia L. | ASR HAPPRC 1581 | Whole plant | Leaves, stem or branches, root, used for cleaning teeth and for treatment of pyorrhoea and for shining teeth. (2, GP) | 126 |
| | | | | Bark and leaves paste is applied for skin diseases, cuts and wounds. (9, DE) | |
| Lamiaceae | Ajuga reptans Benth. | ASR HAPPRC 1573 | Aerial part | Leaves crushed and mixed with water, then the mixture filtered through cloth. This preparation of extract / juice (sawarasa) is used in case of boils, cuts and wounds. (25, DE) | 44 |
| | | | | Fresh aerial part extract / juice (sawarasa) 1–2 drop thrice a day for treatment of boils, cuts and wounds. (25, DE) | |
| | | | | Aerial part paste applied for treatment of burns (3, DE) | |
| Lauraceae | Cinnamomum tamala (Buch.-Ham.) T. Nees & Eberm. | ASR HAPPRC 1505 | Bark, Leaves | Bark powder is used to cure heart diseases (22, DU). ¼-1 teaspoon bark powder taken orally thrice a day for treatment of stomachache. (25, GA) | 47 |
| | | | | Bark powder used to cure heart diseases (22, DU). ¼-1 teaspoon bark powder taken orally thrice a day for treatment of stomachache. (25, GA) | |
| | | | | Aerial part paste applied for treatment of burns (3, DE) | |

Note: The table includes various plant species and their uses, along with their ASR HAPPRC codes and values assigned. The values may refer to different parameters such as frequency of use, strength of effect, and other relevant factors.
Table 3 Ethnomedicinal plants used by local inhabitants of Jakholi Block, Rudraprayag district, Uttarakhand, India (Continued)

| Family                  | Common Name                          | Plant Part(s)          | Medicinal Use                                                                 | Reference |
|-------------------------|--------------------------------------|------------------------|-------------------------------------------------------------------------------|-----------|
| Menispermaceae           | Stephania elegans Hook. F. & Thomson | Aerial part            | Leaf paste applied for treatment of headache. (4, HA)                        |           |
|                         |                                      |                        | Aerial part (1–2 ft) bearing 6–8 leaves + Mishri (Sugar lumps) (10–15 g) are crushed and dipped in water (500 ml) for a night, then taken as drink in early morning, as it acts as refrigerant. (15, GA) |           |
|                         |                                      |                        | Leaf (4–5) extract ½ teaspoon taken orally thrice a day for treatment of fever. (4, FI) |           |
|                         |                                      |                        | (36, 1, DE, D)                                                               |           |
| Myricaceae               | Syzygium cumini                     | Bark, Root             | Bark powder (churna) ½-1 teaspoon is taken with lukewarm water thrice a day for treatment of stomachache. (9, GA) |           |
|                         |                                      |                        | Bark extract / juice used to cure cuts and wounds. (17, DE)                  |           |
|                         |                                      |                        | Root paste (kpa) applied for treatment of headache. (9, HA)                  |           |
|                         |                                      |                        | (32, 1)                                                                       |           |
| Myrtaceae                | Podium guajava L.                   | Leaves                 | Leaves (2–3) rubbed with water, mixed in 250 ml water, and prepared extract is taken orally twice a day to cure stomachache. (21, GA) |           |
|                         |                                      |                        | Leaves' semi-dried paste (avaleh) 2–3 teaspoon taken thrice a day with 250 ml water for treatment of dysentery and diarrhea. (22, GA) |           |
|                         |                                      |                        | (43, 1)                                                                       |           |
| Moraceae                 | Musa balbisiana Colla               | Bark, Fruit            | Bark extract (juice) / rota is used as refrigerant (cooling effect). (13, GA) |           |
|                         |                                      |                        | Immature fruit is also used for treatment of dysentery and diarrhea. (11, GA) |           |
|                         |                                      |                        | (24, 1)                                                                       |           |
| Myrtaceae                | Myrica esculenta Buch.-Ham. ex D. Don| Bark, Box myrtle       | Bark extract / juice used to cure cuts and wounds. (17, DE)                  |           |
|                         |                                      |                        | (32, 1)                                                                       |           |
| Myrtaceae                | Syzygium cumini                     | Bark, Root             | Jaamun bark crushed with water, filtered through cloth and 10 ml (2 tablespoon) taken with 250 ml water thrice a day for treatment of dysentery and diarrhea. (14, GA) |           |
|                         |                                      |                        | Root and bark paste applied for treatment of headache. (11, HA)              |           |
|                         |                                      |                        | (25, 1)                                                                       |           |

*Note: All references are from Singh et al. (2017)*
| Family       | Genus                  | Common Name                                           | Plant Type | Part Used | Plant Use                                                                                   | Reference(s) |
|--------------|------------------------|-------------------------------------------------------|------------|-----------|--------------------------------------------------------------------------------------------|---------------|
| Orchidaceae  | Dactylorhiza hatagirea | Himalayan Marsh Orchid                                  | H Tuber    | Leaves   | Tuber paste (lepo) applied on cut and wounds as an antiseptic. (14, DD) Leaves rubbed and 1/4 teaspoon semi-dried preparation (avesia) taken orally with 1 glass water for treatment of abdominal heat or as refrigerant. (20, GA) Tuber powder 1/2-1 teaspoon taken with milk or water to act as tonic. (19, DU) | 73            |
| Oxalidaceae  | Oxalis corniculata     | Woodsorrel                                             | H Aerial part | Aerial parts crushed with lukewarm water, filtered through cloth and 1-2 drops of the fresh juice (swara) are used to cure earache. (14, EC) Aerial part paste (lepo) is used for treatment of pimples, skin diseases, cuts and wounds, burns (11, DE). Aerial parts juice (swara) is used to cure cataract (jack me phoo). (8, OP) Aerial parts or stem pieces used to cure boils. (12, DE) | 46            |
| Paeoniaceae  | Paeonia emodi Royle    | Himalayan Peony                                        | H Leaves   |          | 1 teaspoon leaves decoction given thrice a day for treatment of child stomach ache (jonku) (12, GA) and vermifuge (expelling or destroying intestinal worms). (17, GA) It is also used to cure fever. (20, FI) | 49            |
| Phyllanthaceae | Phyllanthus emblica    | Indian gooseberry                                       | T Fruit    |          | Crushed 3-4 fruits and soaked in water (250 ml) for 1 night then filtered through cloth and the prepared extract / juice (vesa) taken orally once a day, acting as refrigerant (cooling effect). (5, GA) | 51            |
| Pinaceae     | Cedrus deodara         | Deodar/Indian cedar                                    | T Bark, Resin |          | Bark powder (dhum) 1/2-1 teaspoon with lukewarm water taken orally thrice a day for treatment of abdominal problem. (11, GA) Leaf and resin paste applied in boils, cuts and wounds. (7, DE) Resin applied for treatment of cracked feet. (8, DE) | 24            |
|              | Pinus roxburghii Sarg. | Cheed / Kulain / longleaf Indian pine                  | T Root, Resin |          | 2-3 year old plant root (2-4 g) extract / juice with a dose of 1-2 teaspoon taken orally thrice a day for treatment of tuberculosis. (1, RE) Resin is used for cracked feet, cuts and wounds, and bone fracture. (41, 27, DE, SK) | 69            |
### Table 3: Ethnomedicinal plants used by local inhabitants of Jakholi Block, Rudraprayag district, Uttarakhand, India (Continued)

| Family             | Genus, Common Name | Part Used | Action | Dosage | Refs |
|--------------------|--------------------|-----------|--------|--------|------|
| Plantaginaceae     | Picrorhiza kurroa Royce ex Benth, Syn. Neopicrorhiza scrupuliflora (Khanelli) D.Y.Hong | Root, Leaves | Root or stolon paste (leps) applied in cuts and wounds, boils, burns and burning sensation, headache (leaves paste also used for same action) | 1,2,10,11,12,13  | 2,20 |
| Plantaago depressa Willd. | Syamatu | Whole plant | Leaves paste applied for treatment of herpes, and burns. | 26, 51 | 37 |
| Poaceae            | Cynodon dactylon (L.) Pers. | Grass | Root rubbed and dipped in water for 4–5 h then 1½-1 glass drunk thrice a day for refrigerant quality. (79, GA) | 20, 27, 28, 29 | 43 |
|                     | Echinochloa frumentacea Link | Seeds | Bhaat (cooked like rice) made by jhangha seeds is used to cure jaundice. Sometimes it is given with whey or butter milk for similar effect. | 1, 10, 11, 12, 13, 14  | 79 |
|                     | Hordeum vulgare L. | Seeds | Seeds are dipped in water for 6–8 h and then the water is used as refrigerant. (17, GA) Fried seeds' flour used for remove to weakness (sattoo). (9, DU) | 20, 27, 28, 29, 30, 31, 32, 33, 34, 35  | 29 |
| Polygonaceae       | Polygonum capitatum Buch.-Ham. ex D.Don, Syn. Persicaria capitata (Buch.-Ham. ex D. Don) | Aerial part | Leaves rubbed with mustard oil and the prepared paste is applied in the treatment of herpes. | 1, 20, 27, 28, 29, 30, 31, 32, 33, 34, 35  | 22 |
Table 3 Ethnomedicinal plants used by local inhabitants of Jakhali Block, Rudraprayag district, Uttarakhand, India (Continued)

| Genus                        | Common Name | Part Used | Plant Form | Dosage | Preparation | Application                                                                 |
|------------------------------|-------------|-----------|------------|--------|-------------|----------------------------------------------------------------------------|
| Rheum emodi  Wall. ex Meisn, Syn. Rheum austrole D. Don | Archu/Rhubarb | Root, Leaves | Fresh or dried root extract / juice | 10 ml with 250 ml water taken twice a day as a refrigerant. (41, GA) | Root powder 1-1 teaspoon taken with water for treatment of internal body injury. (31, DU) | Fresh root and leaves paste applied for treatment of headache, muscles and boneache, burns, cuts and wounds. (44, HA, SK, DE) |
| Rheum hastatus D. Don       | Amedu/Arrowleaf Dock | Whole plant | Shade dried root powder (chuma) 1-1 teaspoon taken orally thrice a day for treatment of stomachache. (21, GA) | 39 | Aerial parts extract / juice used for treatment of burns, cuts and wounds. (18, DE) |
| Rheum nepalensis Speng.     | Khuldya/Nepal Dock | Root, Leaves | Leaf and root paste applied in burns, cuts and wounds, skin diseases and boils. (5,9,12, DE) | 43 | Leaf powder 1-1 teaspoon is taken orally thrice a day for treatment of body pain. (2, DU) |
| Rumex nepalensis            | Root paste applied for treatment of toothache. (1, DP) | Root powder 1-1 teaspoon is taken orally thrice a day for treatment of body pain. (2, DU) | Root paste applied for treatment of stomachache. (21, GA) | 39 | Root powder 1-1 teaspoon is taken orally thrice a day for treatment of stomachache. (21, GA) |
| Aconitum baikuri Stapf Syn- Aconitum lethale Griff. ASR HAPPRC 1424 | Bikh | Tuber | Tuber paste with ghee (clarified butter) applied for treatment of snake bite and scorpion sting, boils, gout, joint pain and body pain (iod). Fresh or dried tuber extract / juice also used for same action. (62, 73, PB, DES) | 72 | Tuber paste with ghee (clarified butter) applied for treatment of snake bite and scorpion sting, boils, gout, joint pain and body pain (iod). Fresh or dried tuber extract / juice also used for same action. (62, 73, PB, DES) |
| Aconitum heterophyllum Wall. ex Royle ASR HAPPRC 1426 | Atees/Indian Atees | Tuber | Tuber paste applied for treatment of cut and wounds, boils, headache. (25, DE, HA) | 153 | Tuber paste applied for treatment of cut and wounds, boils, headache. (25, DE, HA) |
| Delphinium denudatum Wall. ex Hook. f. & Thomson ASR HAPPRC 1417 | Nimbishi | Root | Root paste (bips) applied for treatment of boils, pimples, cuts and wounds. (22, 33, DE) | 46 | Root paste (bips) applied for treatment of boils, pimples, cuts and wounds. (22, 33, DE) |
| Thalictrum foliolosum DC. ASR HAPPRC 1562 | Maniri / Peelijad/Leafy Meadow-Rue | Whole plant | Leaf and root extract / swaasa (fresh juice) or paste applied for treatment of boils, skin diseases, cuts and wounds. It also heals burns. (42, 48, DE) | 54 | Leaf and root extract / swaasa (fresh juice) or paste applied for treatment of boils, skin diseases, cuts and wounds. It also heals burns. (42, 48, DE) |
| Rosaceae                                      | Plant Name               | Part Used | Application Details                                                                 | Reference(s) |
|----------------------------------------------|--------------------------|-----------|--------------------------------------------------------------------------------------|---------------|
| **Duchesnea indica (Jacks.) Focke** ASR HAPPRC 1575 | Bhuikafal/Indian Strawberry | H Fruit   | Fruit paste (leps) applied for treatment of white patches, and skin diseases. (12, DE) 4-5 fruits rubbed and mix with water (250 ml) taken once a day, as it acts as refrigerant (cooling effect). (14, GA) | 26            |
| **Potentilla fulgens Wall. ex Sims** Syn: Potentilla linata Trev. ASR HAPPRC 1553 | Bajradanti/ Silver weed | H Whole plant | Roots and leaves used for cleaning teeth and also used for treatment of toothache. (79, DP) Leaves are chewed to cure throat infection (khad). (15, RE) | 94            |
| **Prunus persica (L.) Batsch** ASR HAPPRC 1457 | Aaru/Peach Seeds | T Bark, Leaves, Seeds | Seed with petiarc rubbed in dhorini, prepared paste is applied in boils and skin diseases. (12, DE) Fine seed (1) powder gently mix in 20 ml water, filter it through cloth then 1 tablespoon given for child as refrigerant (cooling effect). (30, GA) | 42            |
| **Rubus ellipticus Sm.** ASR HAPPRC 1444 | Hisaur/Golden Himalayan raspberry | S Root, Leaves, Fruit | Young shoots are chewed for treatment of throat infection (khad). (17, RE) Root and leaves paste applied for treatment of skin diseases, and boils. (9, DE) Stem is used as tooth brush for cleaning teeth. (26, DP) | 52            |
| **Rubus manjith Roxb. ex Fleming** ASR HAPPRC 1473 | Lyachikuru/Indian madder | CI Whole plant | Aerial plant paste applied for treatment of skin diseases, burns, boils and headache. (7,6,3, DE, HA) Whole plant powder (churna) ½-1 teaspoon with lukewarm water is taken thrice a day for treatment of abdominal problems. (3, GA) | 19            |
| **Citrus aurantiifolia (Christm.) Swingle** ASR HAPPRC 1579 | Kaagji/Lime | S Fruit | 1 Fruit juice prepared with 250–500 ml water + ½–1 teaspoon salt + 4–5 g Mishri (Sugar lumps) (sugar lumps) taken orally for treatment of dryness and diarrhea, acts as a refrigerant (cooling effect) (42, GA), and it is also used to cure fever and headache. (29, FI, HA) Fruit juice applied for treatment of pimples, cuts and wounds. (9, DE) | 80            |
| Saxifragaceae                                 | Barentia ciliata (Haw.) Sternb. ASR HAPPRC 1578 | H Root, Leaves | Fresh (5 g) or dried (2 g) root ground with ghee (clarified butter) (1 teaspoon) mixed with 250 ml water, taken once a day for abdominal irritation. (3, GA) Root and leaf paste is used for treatment of burns, boils, cuts and wounds. (7, DE) Root juice (sravak d) 1 teaspoon in 250 ml water used as refrigerant (cooling effect). Root ground with water, made into semi dried preparation, then ½ teaspoon is given with milk to child thrice a day to cure syphile (when child go to cool side rapidly or kind of fever). Root decoction also used for cure stone (8, FI, GA) Root is also useful in leucorrhoea. (4, GY) Root powder (½–1 teaspoon) taken thrice with lukewarm water for cure stomachache and stone (pathra). (45, GA) | 67            |
Table 3  Ethnomedicinal plants used by local inhabitants of Jakholi Block, Rudraprayag district, Uttarakhand, India (Continued)

| Family          | Genus/Species | Common Name | Part Used | Mode of Use     | Reference |
|-----------------|---------------|-------------|-----------|----------------|-----------|
| Solanaceae      | Solanum khasianum C.B. Clarke | Bhugundroo / Konlbdey/ Dutch eggplant | S Fruit, Root | Fruit garnud is used to cure jaundice. (61, GA) | 76 |
|                 |               |             |           | Root decoction (15-1 teaspoon) taken thrice a day for 5-7 days to cure jaundice (Kotbdhey, 11, GA) |           |
|                 |               |             |           | Root paste applied to cure boils and burns. (14, DE) |           |
|                 | Solanum nigrum L. Syn- Solanum americanum Mill | Kiwaini / Kyawen/Black nightshade | H Fruit, Leaves | Mature fruit (4-5 juice (swarasa) mixed with 250 ml water taken orally twice a day to cure fever, indigestion, and acts as refrigerant (cooling effect). (11, 16, Fl, GA) | 39 |
|                 |               |             |           | Fruit paste (lepa) applied on forehead for treatment of headache. (1, HA) |           |
|                 |               |             |           | Leaves juice (swarasa) applied in cuts and wounds, boils. (2, DE) |           |
| Violaceae       | Taxus wallichiana Zucc. | Thunam/Himalayan yew | T Leaves | Leaves extract / juice applied for treatment of boils, cuts and wounds. (27, 15, DE) | 42 |
|                 |               |             |           |                                                       |           |
| Ursicaceae      | Gratidinia diversibila (Linn) Friis | Dhek/Himalayan nettle | H Whole plant | Root decoction is used for treatment of boils, swelling and joint pain. (10, 94, DE, 9K) | 29 |
|                 |               |             |           | Fresh root is also used for treatment of boils. (6, DE) |           |
|                 | Pouzobla hirta Blume ex Harsk. | Kanchriyay | H Root | Root paste used to remove dandruff and prevent hair fall. (92, HP) | 92 |
| Violaceae       | Viola canescens Wall. | Bansal/Banaasa/Himalayan White Violet | H Aerial part | Aerial plant paste used for cuts and wounds, (9, DE), flowers powder (churma) 1/2 teaspoon taken orally thrice a day with lukewarm water to cure cough. (11, RE) | 20 |
| Zingiberaceae   | Curcuma longa L | Hold/Hawamic | H Rhizome | Rhizome paste applied in cuts and wounds acts as antiseptic. (87, DE) | 106 |
|                 |               |             |           | To cure deep bone wounds and internal body injury rhizome powder 1/2 teaspoon (1 g) mixed with 1 glass milk is drunk 1 glass a day. (19, DU) |           |
Table 3 Ethnomedicinal plants used by local inhabitants of Jakholi Block, Rudraprayag district, Uttarakhand, India (Continued)

| Plant Name                     | Life Form | Genus/Species | Part Used | Preparation Method | Uses                                                                 |
|--------------------------------|-----------|---------------|-----------|--------------------|----------------------------------------------------------------------|
| Hedychium spicatum Sm.          | Herb      | ASR HAPPRC 1416 | Rhizome, Spiked Ginger Lily | Rhizomes (40-50 g) boiled in 100 ml water then the paste is applied for treatment of joint pain, burns, boils, and skin diseases. (4, SK, DE) | Rhizome powder (½-1 teaspoon taken orally thrice a day with lukewarm water for treatment of cough and cold. (66, RE) |
| Zingiber officinale Roscoe      | Herb      | ASR HAPPRC 1609 | Rhizome  | Rhizome paste (lepa) also used for curing burns and boils. (6,2, DE) | Rhizome paste (lepa) also used for curing burns and boils. (6,2, DE) |

**Life forms:** H herb, S shrub, T tree, C climber

**GA** gastro-intestinal disorders, **RE** respiratory complaints, **FI** fever and aches, **DE** Diseases of the skin, **GA** women’s health, **SK** skeletonmuscular disorders, **DI** diabetes, **OP** ophthalmologic complaints, **PB** poisonous bite, **DP** dental problems, **HP** hair problems, **EC** ear complaints, **HA** headache, **MA** mental afflictions, **DU** different uses

**()** Similar use, **(Δ)** Dissimilar use, **(●)** Not reported

1 [35]2 [31]3 [30]4 [41]5 [43]6 [1]7 [48]8 [46]9 [22]10 [26]11 [49]12 [32]13 [50]14 [51]15 [52]16 [53]17 [54]18 [39]19 [55]20 [56]21 [57]22 [38]23 [45]24 [33]25 [38]26 [29]27 [11]28 [27]29 [59]30 [44]31 [28]32 [36]33 [37]34 [17]35 [18]
inhabitants for drug preparation are: Chhonthri (made of stone in the shape of plate 10 – 12 mm thick and with a diameter of 15 – 20 cm and a weigh of about 0.5 – 1.0 kg (Fig. 2d), Kharad (also made of stone 20 cm x 45 cm, 3 – 5 kg weight), Silbatta/Silotu (made of stone 30 x 60 cm, 15 – 25 kg weight) (Fig. 2d), Imaamdasta (made of stone or readymade china ceramic, 3 – 5 kg weigh).

Informant consensus factor (ICF)
The consensus of participants on medicinal plants reported for treating different ailments was quantitatively analyzed. To develop this consensus, all treated diseases are grouped into 15 categories. ICF value ranged from 0.91 – 0.99, inferring the high consensus value among participants, however the 100% consensus was not reported. The highest ICF value (0.99) was for hair problems (HP), followed by Ophtalmologic complaints (OP) Mental afflictions (MA) 0.98 (Table 4). Our result repudiated the earlier findings and found the highest ICF for HP and OP. It may be due to low availability of market based nutraceuticals and OP was attributed by the poor sanitation, frequent injuries made by scrubs, wind, insects and poisonous flowers/pollens. Low consumption of water, high intensity light, hard work might be one of the important factors causing MA. High ICF values from adjoining areas were recorded for haematological disorder (1.00) [26], Liver disorder (0.56) [27], Malaria, Measles, Giddiness (each 1.00) [28].

Ailments and useful species
A total of 4967 therapeutic URs were documented for 15 different ailments categories and the most (1468 reports) were related to diseases of skin (DE) (29.55%). This account was accorded to the findings of Saha et al. [29] confirming that dermatology is the most represented therapeutic category in India, followed by Gastro-intestinal disorder (GA) (25.89%) (Table 4). Women’s health (GY) cited less UR (0.70%).

A total of 1286 URs from 39 medicinal plants were reported to treat gastrointestinal ailments (GA) (killing intestinal worms, dysentery and diarrhoea, refrigerant, stomach ache, abdominal sanitation, indigestion,
Fig. 5 Proportion of different plant parts used for ethnomedicinal purpose in Jakholi

Fig. 6 Paste (Lepa) and Extract (Rasa) preparation by local inhabitants of Jakholi
carminative, and constipation) with ICF value 0.97. *Tinospora cordifolia* was highly cited for refrigerant in this ailments category with 91 URs it is commonly known as Giley. *Echinochloa frumentacea* was frequently cited for jaundice with 79 URs. *Megacarpaea polyandra* used as refrigerant with 56 URs, however Semwal et al. [30] and Singh and Rawat [22] reported it for fever, asthma, stomach ache and dysentery. *Bergenia ciliata* commonly known as Pashanbhed / Syalmadi / Kaamalhighly was cited for curing gallstone with 53 URs, similar account was made by Uniyal and Shiva [31].

Total 219 URs and 10 taxa were cited for respiratory complaints (RE) categories and ICF value is 0.95. Cough and cold, tuberculosis and throat infection use reports were common in RE due to cold, fluctuation in temperature, and high smoking. *Zingiber officinale* commonly known *Aadu*, was highly cited for cough and cold with 66 UR as reported by Semwal et al. [30] for cough and cold with honey. Alien and invasive plant *Eupatorium adenophora* was used for cough and cold with 18 URs. A total of 437 URs and 15 taxa were mentioned for fever and aches complaints (FI) categories with ICF value (0.96). *Picrorhiza kurroa* and *Aconitum heterophyllum* highly cited for fever and headaches with 81 and 78 URs, substantiate the findings from Garhwal by Uniyal and Shiva [31], Semwal et al. [30], Malik et al. [1], Singh and Rawat [22]., Highest number of URs (1468) from 53 species for skin diseases (DE) with ICF value (0.96) was noted for treatment of cuts and wounds, boils, burnt, pimples, white patches and herpes. Cut and wounds and boils are commonly occurred in hilly areas due to narrow trails and intensive thorny shrubs, tiresome work with sharp tools and implements, etc. *Eupatorium adenophora* was highly cited for cut and wounds with 108 URs followed by *Curcuma longa* with 87 URs, consistent with the findings of Phondani et al. [32], Tewari et al. [33] and Gaur [11]. Women’s health problems like galactogogue and leucorrhoea were
treated by *Asparagus adscendens*, *Picrorhiza kurroa*, *Bergenia ciliata* and *Quercus leucotrichophora*. This result is consistent with the findings of Azad and Bhat [34]. *Rheum emodii* was highly cited for bone ache with 44 URs as noted by Semwal et al. [30]. *Tinospora cordifolia* was highly cited for diabetes with URs 35 followed by *Berberis chitria* and *Berberis lyceum* with 7 URs for treatment of diabetes. However, Chandra et al. reported *Berberis lyceum* for ophthalmic complaints [35], Uniyal and Shiva for antiseptic, blood purifier, conjunctivitis [31]. Ophthalmologic complaints (OP) was the second highest ICF value recorder. *Berberis chitria* commonly known Totar/Totru root decoction commonly called Rasout 1–2 drops was used to treat eye infection with 110 URs followed by 101 URs of *Berberis lyceum* for eye complaints, similar observations were made in Himalayan areas [1, 28, 36, 37]. *Centella asiatica* was also beneficial for eye sight with 40 URs. The use of plants or poisonous bite (PB) was moderately consented and only 91 URs from 4 taxa were cited for poisonous bite (PB) complaints with ICF value 0.96. *Aconitum balfourii* was used for Snake bite and Scorpion sting with 62 URs as Rana et al. [38] recorded. *Juglans regia* was cited for cleaning teeth and for treatment of pyorrhoea with 89 URs similar to Uniyal and Shiva [31], Semwal et al. [30], Malik et al. [1] Highest consensus was reported for treatment of hair problems. A total of 104 URs from only 2 species *Pouzolzia hirta* and *Brassica juncea* were cited for hair problems. *Pouzolzia hirta* commonly known as Kanchwalya tuberous root paste is used as shampoo and highly cited for to remove dandruff and prevent hair fall. *Brassica juncea* was also cited for ear problems with 42 URs similar to Semwal et al. [30] and Kumari et al. [39]. *Rheum emodii* root and leaf paste was cited for headache, consistent with the observation of Rehman et al. [40]. Species *Nardostachys jatamansi* and *Valeriana jatamansi* were cited for mental disorder and insomnia, as evidenced by Semwal et al. [30], Sharma et al. [41] and Shah et al. [29]. In sense of plants used, the highest number was observed for DE categories (67.94%) followed by Gastro-intestinal ailments (GA) (50%). It has been affirmed that the local people are interested to use herbal therapies predominantly for the management of dermatological and gastro-intestinal ailments. The reported plants having high citations against above mentioned diseases should be further evaluated and analyze through pharmaceutical and biological properties [24, 42].

### Threatened species

Of the plants recorded for ethnomedicinal, 29 plant species are prioritized for conservation (Table 5). These threatened species are available in restricted pocket of Garhwal Himalaya, and locally threatened due to premature and over-exploitations (Fig. 9). Eleven local highly threatened species were cited by local inhabitants of Jakholi and overexploitation as principle cause of threat cited by local inhabitants for all local threatened species. Alpine species are highly threatened, which may be influence by other cause viz. long vegetative phase and less propagation, decreasing natural water resources and global warming. (Table 6/ Fig. 10).
| S.No | Botanical name | IUCN (1993) | CAMP (Conservation Assessment and Management Plan) (1998) | RDB (Nayar and Shastry, 1987, 1988, 1990) | Gaur (1999) | Dhar et al. (2002) | Nautiyal and Nautiyal (2004) | IUCN (2017) |
|------|----------------|-------------|-----------------------------------------------------------|--------------------------------------------|-------------|------------------|-----------------------------|-------------|
| 1    | Aconitum balfourii Stapf | CR | VU | CR | EN | EN | EN | EN |
| 2    | Aconitum heterophyllum Wall. ex Royle | VU | CR | EN | EN | EN | EN | EN |
| 3    | Acorus calamus L. | VU | VU | VU | EN | EN | EN | EN |
| 4    | Berberis lyceum Royle | EN | EN | EN | EN | EN | EN | EN |
| 5    | Berberis chitria Buch. Ham & Lindl | EN | EN | EN | EN | EN | EN | EN |
| 6    | Bergenia ciliata (Haw.): Sternb. | VU | VU | VU | EN | EN | EN | EN |
| 7    | Betula utilis D. Don | EN | EN | EN | EN | EN | EN | EN |
| 8    | Cedrus deodara (Roxb. ex D. Don) G. Don | LC | LC | LC | LC | LC | LC | LC |
| 9    | Centella asiatica (L.): Urban | LC | LC | LC | LC | LC | LC | LC |
| 10   | Cinnamomum tamala (Buch.-Ham.) T. Nees & Eberm. | LR | VU | VU | VU | VU | VU | VU |
| 11   | Dactylorhiza hatagirea (D. Don) Soo | CR | EN | R | R | R | R | R |
| 12   | Delphinium denudatum Wall. ex. Hook, f. & Thomson | CR | CR | CR | CR | CR | CR | CR |
| 13   | Engelhardtia spicata Lechen ex Blume | LC | LC | LC | LC | LC | LC | LC |
| 14   | Girardinia diversifolia (Link): Friis | | | | | | | |
| 15   | Hedychium spicatum Sm. | VU | VU | VU | VU | VU | VU | VU |
| 16   | Juglans regia L. | NT | NT | NT | NT | NT | NT | NT |
| 17   | Jurinea macrocephala DC. | LR | VU | R | R | R | R | R |
| 18   | Mangifera indica L. | DD | DD | DD | DD | DD | DD | DD |
| 19   | Megacarpaea polyantra Benth. ex Madden | VU | VU | VU | VU | VU | VU | VU |
| 20   | Nardostachys jatamansi (D. Don) DC. | CR | CR | CR | CR | CR | CR | CR |
| 21   | Paeonia emodi Royle | VU | VU | VU | VU | VU | VU | VU |
| 22   | Paris polyphylla Sm. | VU | VU | VU | VU | VU | VU | VU |
| 23   | Picrorhiza kurroa Royle ex Benth. | VU | VU | VU | VU | VU | VU | VU |
| 24   | Pinus roxburghii Sarg. | LC | LC | LC | LC | LC | LC | LC |
| 25   | Rheum emodi Wall. ex Mein. | VU | VU | VU | VU | VU | VU | VU |
| 26   | Podophyllum hexandrum Royle | EN | CR | EN | EN | EN | EN | EN |
| 27   | Taxus wallichiana Zucc. | CR | CR | CR | CR | CR | CR | CR |
| 28   | Thalictrum foliolosum DC. | VU | VU | VU | VU | VU | VU | VU |
| 29   | Valeriana jatamansi Jones | CR | CR | CR | CR | CR | CR | CR |

CR critically endangered, VU vulnerable, EN endangered, LR lower risk near threatened, LC least concern, DD data deficient, NT near threatened, R rare
IUCN: The International Union for Conservation of Nature and Natural Resources
http://www.iucnredlist.org 28 May 2017 Data base
Reliability and comparison

Cultural practices of particular region directly affected by floral and faunal wealth and variance among them indicate importance of particular region. For similarity, dissimilarity and new use reports uses of plants documented in our study were compared to 35 published ethno-botanical studies from Indian Himalaya as well as neighbouring countries (Table 7). In the present study, the similarity of uses as compared to other studies ranged from 0 to 30% while dissimilar uses varied widely from 42.5 [43] to 1.58% [44]. JI range between 2.86 – 56.66 and Sorensen’s index 5.56 – 72.34 were obtain. The highest degree of similarity was found with studies conducted by Kala [45] with JI 55.66 and SI 72.34 and Uniyal and Siva [31] with JI 49.35, SI 66.08. The lowest indices of similarity are found with studies of Samant et al. [36] and Ghildiyal et al. [46] (JI 2.86 and 3, SI 5.56 and 5.83). Comparison of medicinal flora and uses within district and block only two reports were found which have more than 30 JI and 50% SI similarity (49.35 JI, 66.08 SI Uniyal and Siva [31] and 39.68JI, 56.81 SI Semwal et al.) [30]. It appears that the distance between study area and neighbouring region is responsible for any change in JI [24]. The highest similarity index was not surprisingly observed with the nearest areas, which had high similarity indices with respect to plant use and modes of applications.

This occurrence may be due to the sharing of a similar flora and the cross-cultural exchange of medicinal plant knowledge in past and present. It also indicates similar ethno-genesis of people in comparative areas [47]. Besides, low similarity indices may be likely due to minimal cultural exchange between the mountains region as they are disconnected through mountain ranges and other cultural variations [24]. However, region to region similar medicinal flora are used in various way. Low similarity with the other report may be due to different topography and climatic condition and medicinal flora or it could be a sign of loss of cultural practices.
Novelty and future prospects

The present study was compared with the previous studies related to analysis of ethnomedicinal plants and their uses in Himalaya. This comparative analysis in the ethnomedicinal point of view found the following new reports as *Calotropis gigantea* for joint pain, swelling (37 UR) and skin diseases (2 UR); *Citrus aurantiifolia* for dysentery, diarrhea and as refrigerant with 42 UR; *Cucumis sativus* for fever with 65 UR; *Dioscorea bulbifera* for fever (17 UR) and boils (16 UR); *Drymaria cordata* for herpes (6 UR) fever and headache (13 UR); *Duchesnea indica* for Skin diseases (12 UR) and as refrigerant (14 UR); *Engelharditia spicata* for cleansing teeth (37) and treatments of boils, cut and wounds (50 UR); *Hedychium spicatum* for skin diseases and boils, cut and wounds, joint pain (26 UR); *Hordeum vulgare* for weakness (9 UR) as refrigerant (17 UR); *Mangifera indica* used for stomachache (12 UR), dysentery and diarrhea (19 UR) (especially for child); *Prunus persica* used for boils, skin diseases (12 UR) and as refrigerant (30 UR); *Polygonum capitatum* for boils, burnt (21) herpes (1); *Pouzolzia hirta* to remove dandruff and prevent hair fall (92 UR); *Rubus ellipticus* for throat infection (17 UR), boils and skin diseases (9 UR) and cleaning teeth (26 UR); *Stephania\n
Table 6 Consensus and observation for local threatened medicinal plants and their causes by local inhabitants of Jakholi

| Botanical name                  | Availability / Citation | Restricted pockets / Citation | Long vegetative phase/ less propagation / Citation | Global warming / Decreasing natural water resources / Citation | Unfair trade / Overexploitation / Citation | No idea / Citation |
|--------------------------------|-------------------------|------------------------------|---------------------------------|------------------------------------------------|-----------------------------|-------------------|
| Aconitum balfouri Stapf         | R/98                    | 113                          | 42                              | 14                                             | 109                          | 15                |
| Aconitum heterophyllum Wall. ex Royle | VR/183               | 106                          | 78                              | 26                                             | 193                          | 4                 |
| Acorus calamus L.               | S/93                    | 10                           | 5                               | 32                                             | 168                          | 12                |
| Dactylorhiza hatagirea (D. Don) Soo | R/109                | 165                          | 69                              | 19                                             | 143                          | 7                 |
| Megacarpa olyandra Bent. ex Madden | R/103                | 142                          | 49                              | 25                                             | 91                           | 12                |
| Nardostachys jatamansi (D. Don) DC. | VR/176            | 125                          | 65                              | 32                                             | 125                          | 11                |
| Paris polyphylla Sm.            | S/91                    | 45                           | 33                              | 23                                             | 102                          | 9                 |
| Picrorhiza kurroa Royle ex Benth. | VR/174              | 198                          | 64                              | 21                                             | 201                          | 9                 |
| Rheum emodi Wall. ex Meisn. D. Don | R/125              | 164                          | 15                              | 29                                             | 95                           | 6                 |
| Podophyllum hexandrum Royle     | R/81                    | 112                          | 21                              | 13                                             | 61                           | 14                |
| Taxus wallachiana Zucc.         | R/76                    | 67                           | 46                              | 11                                             | 129                          | 5                 |

S scattered, R rare, VR very rare (N = 220)
| Study area                                           | Study Year | Number of plants reported | Plants with similar use | Plants with dissimilar use | Total Common species in both areas | % of common plants species | Species enlisted only in aligned areas | Species enlisted only in study area | % of species enlisted only in this study | % of plants with similar uses | % of plants with dissimilar uses | Jaccard index (JI) | Sorensen’s similarity index (QS) | Reference |
|-----------------------------------------------------|------------|---------------------------|-------------------------|----------------------------|-----------------------------------|---------------------------|----------------------------------------|-----------------------------------|-----------------------------------|-------------------------------|-------------------------------|------------------------|-------------------------------|---------------------|
| Rudraprayag district, Uttarakhand                    | 2013       | 159                       | 7                       | 8                          | 15                                | 9.43                      | 144                                    | 63                                | 80.77                             | 4.40                          | 5.03                          | 7.81                   | 1449                           | Chandra et al. [35] |
| Garhwal Himalaya, Uttarakhand                        | 2005       | 113                       | 24                      | 14                         | 38                                | 33.63                     | 75                                    | 40                                | 51.28                             | 21.24                         | 12.39                         | 49.35                  | 66.08                          | Uniyal and Siva [31] |
| Ukhimath Block, Rudraprayag Himalaya                 | 2010       | 60                        | 18                      | 7                          | 25                                | 41.67                     | 35                                    | 53                                | 67.95                             | 3.00                          | 11.67                         | 39.68                  | 56.81                          | Seemwal et al. [30] |
| Sub-Himalayan region, Uttarakhand                    | 2010       | 24                        | 1                       | 7                          | 8                                 | 33.33                     | 16                                    | 70                                | 89.74                             | 4.17                          | 29.17                         | 10.25                  | 186                            | Sharma et al. [41] |
| Sub-Himalayan region, Uttarakhand                    | 2012       | 40                        | 0                       | 17                         | 17                                | 42.50                     | 23                                    | 61                                | 78.21                             | 0.00                          | 4250                          | 2537                  | 4047                            | Sharma et al. [43] |
| Western Himalaya                                     | 2015       | 97                        | 14                      | 8                          | 22                                | 22.68                     | 75                                    | 56                                | 71.79                             | 14.43                         | 8.25                          | 20.18                  | 335.8                           | Malik et al. [1] |
| Garhwal Himalaya, Uttarakhand                        | 2015       | 56                        | 2                       | 3                          | 5                                 | 8.93                      | 51                                    | 73                                | 93.59                             | 3.57                          | 5.36                          | 4.2                   | 8.06                            | Kala [48] |
| Garhwal region                                       | 2014       | 67                        | 1                       | 3                          | 4                                 | 5.97                      | 63                                    | 74                                | 94.87                             | 1.49                          | 4.48                          | 3                     | 5.83                            | Ghildiyal et al. [46] |
| Kedarnath Wildlife Sanctuary in Western Himalaya, India | 2011       | 126                       | 12                      | 17                         | 29                                | 23.02                     | 97                                    | 49                                | 62.82                             | 9.52                          | 13.49                         | 24.78                  | 3972                           | Singh and Rawat [22] |
| Kedarnath Wildlife Sanctuary, India Himalaya         | 2013       | 21                        | 6                       | 3                          | 9                                 | 42.86                     | 12                                    | 69                                | 88.46                             | 28.57                         | 14.29                         | 12.5                  | 2222                           | Bhat et al. [26] |
| Garhwal Himalaya, India                              | 2011       | 61                        | 8                       | 5                          | 13                                | 21.31                     | 48                                    | 65                                | 83.33                             | 13.11                         | 8.20                          | 13                    | 23                             | Kumar et al. [49] |
| Almora district, Garhwal Himalaya                   | 2010       | 86                        | 9                       | 11                         | 20                                | 23.26                     | 66                                    | 58                                | 74.36                             | 10.47                         | 12.79                         | 1923                  | 3225                           | Phadnis et al. [52] |
| Niti valley central Himalaya, India                  | 2010       | 23                        | 2                       | 1                          | 3                                 | 13.04                     | 20                                    | 75                                | 96.15                             | 8.70                          | 4.35                          | 3.26                  | 6.31                           | Dingwal et al. [50] |
| Uttaranchal, India                                  | 2005       | 74                        | 5                       | 10                         | 15                                | 20.27                     | 59                                    | 63                                | 80.77                             | 6.76                          | 13.51                         | 1401                  | 2459                           | Kala et al. [51] |
| Kedarnath Wildlife Sanctuary, Garhwal Himalaya India | 2013       | 152                       | 11                      | 6                          | 17                                | 11.18                     | 135                                   | 61                                | 78.21                             | 7.24                          | 3.95                          | 9.49                  | 1734                           | Bhat et al. [52] |
| Pauri Garhwal Uttaranchal                            | 2010       | 61                        | 6                       | 6                          | 12                                | 19.67                     | 49                                    | 66                                | 84.62                             | 9.84                          | 9.84                          | 11.65                 | 2086                           | Pala et al. [53] |
| Nanital of Kumaun region Uttaranchal                | 2014       | 28                        | 3                       | 8                          | 11                                | 39.29                     | 17                                    | 67                                | 85.90                             | 10.71                         | 28.57                         | 1506                  | 2619                           | Kapkoti et al. [54] |
| Almora district, Garhwal Himalaya                   | 2011       | 188                       | 10                      | 24                         | 34                                | 18.09                     | 154                                   | 44                                | 56.41                             | 5.32                          | 12.77                         | 2073                  | 3434                           | Kumar et al. [39] |
| Kumaun Himalaya, India                              | 2013       | 48                        | 3                       | 10                         | 13                                | 27.08                     | 35                                    | 65                                | 83.33                             | 6.25                          | 20.83                         | 1494                  | 26                             | Bhatt et al. [55] |
| Bhobar region of Uttaranchal                         | 2015       | 24                        | 3                       | 4                          | 7                                 | 29.17                     | 17                                    | 71                                | 91.03                             | 12.50                         | 1667                         | 8.64                  | 159                            | Pande and Joshi [56] |
Table 7 Comparison of present study with previous study from adjoining area of Himalaya region (Continued)

| Sub Himalayan tract                  | Year | N | E | I | L | T | L | K | T | S | S |
|--------------------------------------|------|---|---|---|---|---|---|---|---|---|---|
| Uttarakhand, India                   | 2010 | 54 | 2 | 6 | 8 | 14 | 46 | 70 | 89.74 | 3.70 | 11.11 | 7.4 | 13.79 |
| Nanda Devi Biosphere reserve, Uttarakhand, India | 2013 | 90 | 9 | 16 | 25 | 27.78 | 65 | 53 | 67.95 | 10.00 | 17.78 | 2688 | 4237 |
| Tons watershed, Uttarakhand Himalaya | 2015 | 84 | 17 | 17 | 34 | 40.48 | 50 | 44 | 56.41 | 20.24 | 20.24 | 5666 | 7234 |
| Garur Block of district Bageshwar, Uttarakhand, India | 2014 | 39 | 4 | 4 | 8 | 20.51 | 31 | 70 | 89.74 | 10.26 | 10.26 | 8.6 | 1584 |
| Uttarakhand                          | 2014 | 111 | 1 | 15 | 16 | 1441 | 95 | 62 | 79.49 | 0.90 | 1351 | 1134 | 2038 |
| Nainital Uttarakhand                 | 2014 | 113 | 4 | 10 | 14 | 1239 | 99 | 64 | 82.06 | 3.54 | 8.85 | 9.39 | 1717 |
| District Garhwal North West Himalaya | 1999 | 2035 | 19 | 45 | 64 | 3.14 | 1971 | 14 | 17.95 | 0.93 | 2.21 | 3.33 | 6.44 |
| Kumaon Himalaya India                | 2014 | 89 | 8 | 14 | 22 | 2472 | 67 | 56 | 71.79 | 8.99 | 1573 | 2178 | 3577 |
| Central Himalaya India               | 2002 | 50 | 3 | 2 | 5 | 1000 | 45 | 73 | 93.59 | 6.00 | 4.00 | 4.42 | 8.47 |
| Jammu Kashmir and Ladakh India       | 2014 | 948 | 25 | 15 | 40 | 4.22 | 908 | 38 | 48.72 | 2.64 | 1.58 | 4.41 | 8.45 |
| Kashmir Himalaya                     | 2011 | 30 | 5 | 7 | 12 | 4000 | 18 | 66 | 84.62 | 16.67 | 2333 | 1666 | 2857 |
| Himachal Pradesh North west Himalaya | 2016 | 73 | 11 | 8 | 19 | 2603 | 54 | 59 | 75.64 | 15.07 | 1096 | 2021 | 3362 |
| Himachal Pradesh North West Himalaya | 2007 | 643 | 7 | 12 | 19 | 2.95 | 624 | 59 | 75.64 | 1.09 | 1.87 | 2.86 | 5.56 |
| Nepal Himalaya                       | 2006 | 84 | 3 | 5 | 8 | 9.52 | 76 | 70 | 89.74 | 3.57 | 5.95 | 5.79 | 1093 |
| Arunachal Pradesh Eastern Himalayan zone | 2011 | 74 | 6 | 10 | 16 | 2162 | 58 | 62 | 79.49 | 8.11 | 1351 | 1538 | 2666 |
| Average                              | 172.14 | 7.69 | 10.23 | 17.91 | 2168 | 154.23 | 60.09 | 77.03 | 9.14 | 1254 | 1549 | 2511 |

Gaur et al. [57], Rana et al. [38], Kala [45], Tewari et al. [33], Prakash [58], Shah et al. [29], Gaur [11], Singh et al. [27], Negi et al. [18], Gonda et al. [44], Malik et al. [59], Thakur et al. [28], Samant et al. [36], Kunwar et al. [37], Tangjang et al. [17].
elegans for headache (4 UR), acts as refrigerant (4 UR), fever (4 UR); Smilax aspera for snake-bite and scorpion-sting (2 UR), Taxus wallichiana for boils (27 UR), cuts and wounds (15 UR) and Trichosanthes tricuspidata for fever (65 UR) (Table 3) were newly reported ethnomedicinal uses.

Some of plant species such as Aconitum heterophyl-
lum, Eupatorium adenophora, Echinochloa frumentacea, Engelhardtia spicata, Megacarpaea polyandra, Picror-
hiza kurroa, Polygonum capitatum, Plantago depressa, Potentilla fulgens, Quercus leucotrichophora, Senecio
nudicaulis were frequently used in Jakholi but their de-
tailed bioactive constituents and pharmacological activity are yet unknown, revealing a good candidature for pharmacological and therapeutic values and extraction of novel bioactive constituents (Fig. 11).

**Conclusions**

Present paper is the first attempt of survey in Jakholi Block, Uttarakhand, India. Asteraceae, Polygonaceae, Ranunculaceae and Rosaceae were the most used families and root were the most commonly used plant parts in the area. Aconitum heterophyllum, Megacarpaea poly-
andra, Picrorhiza kurroa and Rheum emodii are well known medicinal plant species, contributing important role in the local health care system of Jakholi area. Documentation of local medicinal knowledge is also essential due to outmigration of the younger. Study of ethnomedicinal knowledge helps identify the important species of the region for pharmacological importance and ecological sustainability and it also aids conservation of traditional knowledge. Cataloguing useful plant species supports registration of indigenous knowledge, aiding national impetus of obeying implementation of convention of biological diversity and Nagoya protocol. Traditional knowledge is based on experience passed on from generation to generation and limited only to elderly (Bujurg) people and traditional healers. We came to the following considerations to be taken while doing ethnomedicinal studies in the Himalaya: (a) local people are quite conservative in sharing traditional knowledge about the Medicinal plants; (b) the young generation is not interested and knowledgeable about the ethnomedicinal plants and their uses; and (c) outmigration is a
menace to the conservation of traditional ethnomedicinal knowledge. The present study showed that the medicinal plants are still very important for livelihood of local inhabitants of Jakholi and the Himalaya. Some medicinal plants are at the brink of threatened due to their ecology, biology and human induced exploitations. To sum, documentation of useful plants and the knowledge of their utilization is immediate before being lost.

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The raw data contain the names of all participants, and cannot be shared in this form.

Author’s contributions
A5 carried out a field survey and collected ethnomedicinal data, voucher samples and identified the plant material, analysed data and drafted the paper. MCN, RMK and RB revised the manuscript and give critical inputs. All authors have read the final manuscript and agreed to its submission.

Ethics approval and consent to participate
Before conducting interviews, prior informed consent was obtained from all participants. No further ethics approval was required.

Consent for publication
This manuscript does not contain any individual person’s data and further consent for publication is not required.

Competing interests
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