Ethnomedicinal use of plant resources in Kirtinagar Block of Tehri Garhwal in Western Himalaya

Atul Pratap Singh, Munesh Kumar, Bhuvnesh Nagar, Nazir A. Pala, and Rainer W. Bussmann

Databases and Inventories

Abstract

Background: The aim of the present study is to report the cultural importance and utilization of ethnomedicinal plant species among the communities of Tehri district in Garhwal Himalaya, India.

Methods: The ethnomedicinal uses of plants were collected from participants of the villages based on randomly selected inhabitants through semi structured interviews. A total of 93 respondents provided information.

Results: The documentation recorded a total of 92 ethnobotanical plant species including trees (52), shrubs (19), herbs (18) and climbers (3). Out of 92 species, only 35 species were used for ethnomedicinal purposes to cure 30 different ailments prevailing in the area. The maximum number of species (9) was used for stomach disorders followed by diabetes and wounds (4 each), and fractures and tooth problems (3 each). The informant consensus factor (F_{ic}) for joint pain was 0.0 whereas F_{ic} value for other species ranged from 0.600 to 1.0. The fidelity level (FL) was highest (100%) for 14 species and the lowest value of FL (20%) was recorded for *Eupatorium adenophorum*. The Cultural Importance Index (CI) was highest for *Barleria cristata* (0.15) and lowest (0.01) for *Azadirachta indica* and *Boehmeria rugulosa* each.

Conclusion: The study revealed that the large number of ethnobotanical plant species exists in the area. Increased awareness on conservation and developmental strategies is needed to utilize resources through sustainable development.

Keywords: Villagers, dependency, ethnomedicinal plants, cures, diseases

सार

पृष्ठभूमिः वर्तमान अध्ययन का उद्देष्य गढ़वाल हिमालय (भारत) में टिहरी गढ़वाल जिले के समुदायों के बीच पारम्परिक औषधीय पौधों के सांस्कृतिक महत्व और उपयोग का मूल्यांकन करना है।

विधिः पौधों की औषधीय उपयोग की जानकारी गॉव के निवासी प्रतिभागियों से अर्द्ध.संचरित साक्षात्कार के माध्यम से यादृच्छिक रूप से एकत्रित की गयी । कुल 93 उत्तरदाताओं द्वारा जानकारी प्रदान की गयी है।

परिणामः इस प्रलेखन में कुल 92 औषधीय पौधों की प्रजातियों को दर्ज किया गयाए में 52 पेड़ों, 19 झाड़ियों, 18 जड़ी बूटियों और 03 बेलों की प्रजातियों को दर्ज किया गया। 92 प्रजातियों में से केवल 35 प्रजातियॉ ही औषधीय उद्देष्यों के लिए उपयोग की जाती है। जो इस क्षेत्र में प्रचलित 30 विभिन्न बिमारियों का ईलाज करती हैं। उक्त प्रजातियों में से सर्वाधिक 09 प्रजातियों का अधिकतम संख्या में पेट के रोगों के लिए उपयोग किया जाता है। इसके बाद 04 प्रजातियों का उपयोग मधुमेह और जख्म के निदान हेतु उपयोग किया गया है। हड्डी टूटने एवं दॉतों की समस्या के समाधान के लिए 03 प्रजातियों का उपयोग किया गया। संयुक्त दर्द के लिए सर्वसम्मति के आधार पर सूचना देने वाला कारक (Informant Consensus Factor - F_{IC}) का मान 0.0 था। जबकि अन्य औषधीय पौधों के लिए यह मान 0.600 से लेकर 1.0 था। 14 प्रजातियों के प्रति रोग निवारक आस्था (Fidelity Level - FL) का स्तर 100: पाया गया। और *Eupatorium adenophorum* प्रजाति के प्रति रोग निवारक आस्था का स्तर सबसे कम (20%) पाया गया। सांस्कृतिक महत्व का सूचकांक

Correspondence

Atul Pratap Singh
Munesh Kumar*
Bhuvnesh Nagar
Nazir A. Pala
Rainer W. Bussmann
Department of Forestry and Natural Resources, HNB Garhwal University (A Central University), Srinagar Garhwal, Uttarakhand 249161, India***Corresponding author:**
muneshmzu@yahoo.com

Ethnobotany Research & Applications
18:14 (2019)

Published: 02 May 2019

http://dx.doi.org/10.32859/era.18.14.1-11

(Cultural Importance Index) ब्द्ध सबसे अधिक (0.15), *Barleria cristala* प्रजाति के लिए पाया गया। जबकि सबसे कम स्तर (0.01) *Azadirachta indica* और *Boehmeria rugulosa* के लिए अंकित किया गया है।

निष्कर्ष: अध्ययन से पता चला कि क्षेत्र में बड़ी संख्या में औषधीय पौधों की प्रजातियों मौजूद हैं। सतत विकास के माध्यम से इन औषधीय पौधों के प्रति संरक्षण के लिए जागरूकता बढ़ाना

एवं विकासात्मक रणनीति आवष्यक है।

कीवर्ड: ग्रामीणए आधारित पारम्परिक औषधीय पादप, ईलाज, बिमारी।

Background

Plants are an integral part of human society and are fulfilling many primary needs (e.g. food and shelter), and serve as cure for many diseases (WHO 2002; Jima and Megersa, 2018). India is one of the leading countries in Asia in the use of plants and harbors diverse traditional knowledge systems (Kala, 2005). Traditional medicine has been used by practitioners for thousands of years as primary human health care at community level and maintained its popularity worldwide (WHO, 2008). The practice of traditional medicine is widespread in China, India, Japan, Pakistan, Sri Lanka, Thailand, and Korea (Park et al. 2012), where several plants are used for the purposes.

The use of medicinal plants to treat various diseases has been a part of human culture since ancient times (van der Merwe *et al.* 2001). Historically, medicinal plants played a major role in the human societies (Lewis & Lewis 2003). According to the World Health Organization (WHO), the use of traditional herbal medicine is widely practiced in both developing and industrialized countries as a complementary way to treat and to prevent illnesses (WHO 2003) and according the WHO estimates that 70-95% of the populations of developing countries rely mainly on medicinal plants for primary healthcare (WHO 2011), and in many cases their sale accounts for 15-30% of the total income of poorer households (Hamilton 2004). Traditionally medicinal plants have gained an important position in rural communities, particularly where Western style health care facilities are still not available.

The use of medicinal plants plays a significant role in the subsistence economy of local populations, especially those living in the mid-altitudes and the highlands (Sati 2013). About 65% of the Indian population depends on the traditional systems of medicine (Timmermans 2003). In addition to their daily use, some medicinal plants might have a potential for the development of allopathic drugs (Flaster 1996; Teklehaymanot&Giday 2007).

The conservation of such plant genetic resources (PGR) is highly needed (Prakash 2011) to maintain the resources for future demand. The Indian Himalayan Region covers only about 18% of the Indian subcontinent, but harbours about 8000 angiosperms, 44 gymnosperms and 600 pteridophytes species (Singh & Hajara 1996), of which 1748 species are used medicinally (Kala 2005; Samant *et al.* 1998). Presently, the pharmaceutical industry of India is using 280 medicinal plant species, of which 175 are found in the Himalayan region (Dhar *et al.* 2000). In the rural areas of Garhwal Himalaya, the dependency of people on forests for ethnomedicine is increasing, especially with climate change allowing disease vectors to reach higher altitudes. However, the available resources are decreasing due to land use change and overharvesting. Keeping the dependency of local populations on forest resources in view, the hypotheses developed in the present study were (i) Villagers depend to a large extent on forest resources for fulfilling their daily livelihood needs. (ii) Plant selection for treating particular diseases is highly selective. (iii) Participants will have a high consensus, fidelity level and cultural importance level for the use of ethnomedicinal plants. With these hypotheses, our research focused on (i) documentation of ethnomedicinal plants used by the local population (ii) assessment of informant consensus, fidelity level and cultural importance of ethnomedicinal plants.

Materials and Methods

Study site

The present study was conducted in nine villages (Manjakot, Bhaisawada, Ghargaon, Pathawara, Sendri, Naugad, Chachakinda, Goni and Ulana) situated in close vicinity of forest fringes in Tehri district of Garhwal Himalaya (Table 1). The altitudinal range of the study villages ranged between 835 to 1547 m above sea level (Fig. 1). The mean recorded maximum temperature was 32˚C (in June), and mean minimum temperature 4˚C (in December). The mean relative humidity varies from 35% to 92% from May to August, respectively. The mean monthly rainfall ranges from 129 mm in July to 600 mm in August, and the average annual rainfall has been recorded as 1630 mm. Tehri Garhwal is one of the western most districts of the Uttarakhand state. It is located at 30˚3'00" to 30˚53'00" N latitude and 77˚56'00" to 79˚04'00" E longitude on the outer ranges of the Central Himalaya, which includes low lying peaks rising contiguously from the plains of the northern India. The majority of the population depends on subsistence agriculture and animal husbandry. In addition the villagers use nearby forests for fuel, fodder, fibres, medicine and other daily needs. The dominant forest forming species close to study area are *Anogeissus latifolia*, *Lannea coromendelica*, *Acacia catechu* (tree layer) and *Carrisa spinarum* and *Woodfordia fruticose* (shrub layer) in the lower altitude of the study area. However; at higher altitude, the dominant species is *Quercus leucotricophora* with some common associated species (tree layer) and *Berberis* sp., *Prenspia utilis*, *Rubus ellipticus* (shrub layer). *Pinus roxburghii* is reported in the tree layer from lower to higher altitudes and providing basic needs to villagers. The literacy rate of the district is above 70%.

Fieldwork and data collection

Published: 02 May 2019

http://dx.doi.org/10.32859/era.18.14.1-11

The fieldwork was carried out from January to October 2016. Information on ethnomedicinal plants uses was collected from those participants living close to the forest, which was done after establishing oral prior informed consent from the villagers. Of the total population, randomly selected inhabitants were chosen for semi structured interviews about their dependence on ethnomedicinal plants. Informants of all age groups and both genders were randomly selected (Table 1). The data about ethnomedicinal plants was collected from 93 respondents including 61 men and 32 women. All participants provided prior informed consent before the interviews. The participants were of 30-85 years of age. The interviews were conducted in both Hindi and local dialect (Garhwali) using semi-structured questionnaires to obtain information on ethnomedicinal plant use, including detailed information on local names of plants, applications for a particular disease, plant parts used. To verify scientific names, the participants were asked to show the plants in their natural habitat. Specimens of all plants were collected and identified from Garhwal University Herbarium (GUH).

Cultural dimensions of documented ethnomedicinal plants

Informant consensus factor

The Informant Consensus was calculated on the basis of people's response on the plants number used for a particular purpose or ailment. The consensus factor (F_{ic}) tests the homogeneity of the respondent's knowledge (Ragupathy *et al.* 2008; Trotter & Logan 1986) and was calculated as follows:

$$F_{ic} = \frac{N_{ur} - N_t}{N_{ur} - 1}$$

Where N_{ur}= number of use-reports of respondents for a particular illness

N_t=number of taxa used for a particular illness category by all respondents. The resulting range values between 0 to 1. Here high value indicates for a high rate informant consensus.

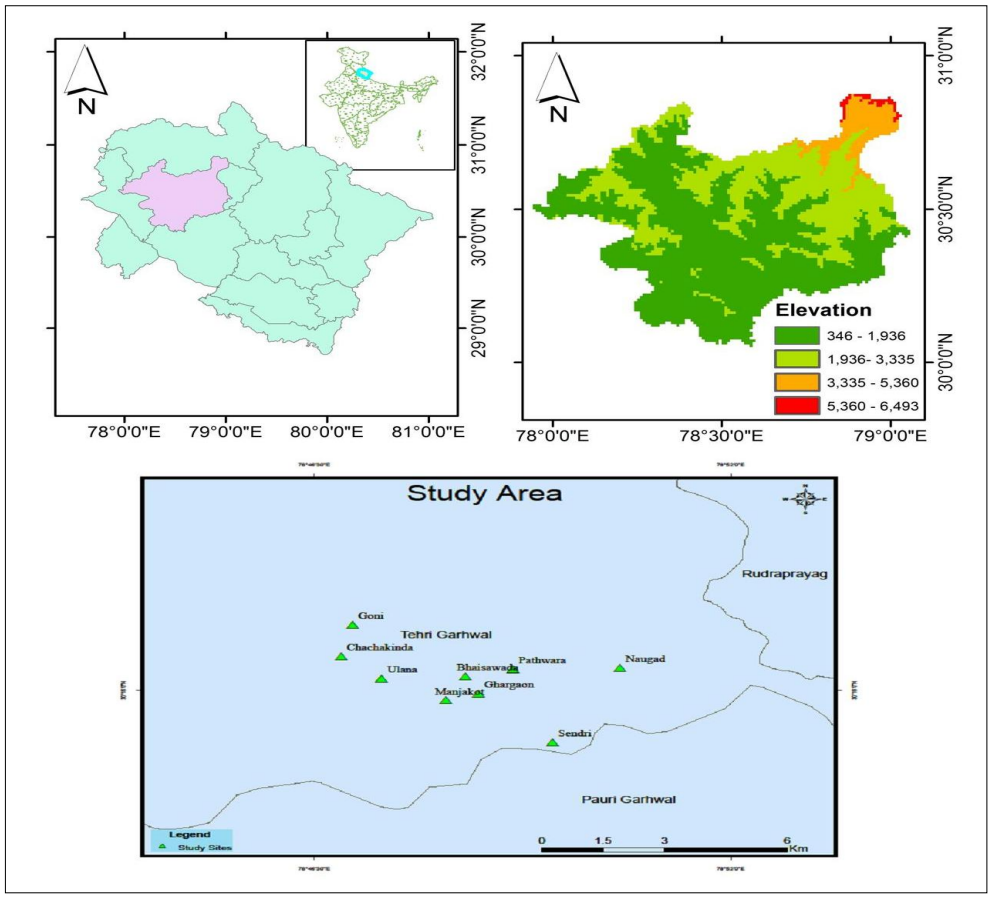

Figure 1. Location of study area

Published: 02 May 2019

http://dx.doi.org/10.32859/era.18.14.1-11

Table 1. Details of the study villages

Village	Latitude	Longitude	Elevation (m)
Manjakot	30°15'47.60"N	78°48'14.33"E	835
Bhaisawada	30°16'15.52"N	78°48'29.75"E	969
Ghargaon	30°15'55.45"N	78°48'40.24"E	1069
Pathwara	30°16'24.57"N	78°49'07.57"E	1421
Sendri	30°14'58.27"N	78°49'39.12"E	947
Naugad	30°16'25.54"N	78°50'32.23"E	1144
Chachakinda	30°16'39.08"N	78°46'51.46"E	1547
Goni	30°17'16.72"N	78°47'00.56"E	1169
Ulana	30°16'13.75"N	78°47'23.44"E	1427

Fidelity level (FL)
The Fidelity level (FL) was calculated to elucidate the importance of a species in each group (Friedman *et al.* 1986; Pandikumar *et al.* 2010) as follows:

$$\text{Fidelity level (FL\%)} = \left(\frac{N_p}{N}\right) \times 100$$

N_p is the number of informants citing the use of plants for a particular use category and N is the total number of informants citing the species of any use category Increasing value of FL for a species indicates its uniqueness to use a particular purpose.

Cultural Importance Index (CI)
The Cultural Importance Index (CI) is used to assess the importance of each species (CIs). It is calculated by dividing the number of use reports of the species by the number of informants (Aceituno-Mata 2010; Pardo-de-Santayana *et al.* 2007; Tardío& Pardo-de-Santayana 2008).

$$CI_s = \sum_{u=u_1}^{u_{NC}} \sum_{i=i_1}^{i_N} UR_{ui}/N$$

Where, UR =number of use reports of species for different use category (NC) and N=number of total informants.

Results and discussion

Floristic composition
In the present study, a total of 92 plant species belonging to 82 genera and 49 families were reported. These life forms were dominated by trees (52) followed by shrubs (19), herbs (18) and climbers (3). Out of the 92 reported species, only 35 plant species belonging to 25 families were used for medicinal purposes. The dominant families were Combretaceae and Euphorbiaceae with three plant species each followed by Anacardiaceae, Lamiaceae, Moraceae, Rutaceae, Urticaceae and Verbenaceae (2) each. In each village people used preferentially trees, followed by shrubs, herbs and climbers, except in the village Chachkinda, where the highest numbers of useful species were herbs, followed by trees and shrubs. The maximum number of species (44) was reported in Bhainswara followed by Manjakot (36 species), Sendri (34 species), Ulana (25 species), Pathawara and Goni (23 species each), Chachakinda (15 species), Ghargaon (7 species), and a minimum in Naugad (3 species). The highest number of species used for medicinal purposes was found in Bhainswara, where most species served medicinal values purposes.

Consensus survey of medicinal plants
In the present study the consensus factor for joint pain was 0.00 followed by healing wounds (0.600), stomach problems (including indigestion and stomach ache) (0.600), fractures (0.714), constipation (0.750), diabetes (0.824), tooth problems includes cleaning, tooth ache and swelling of gum (0.846), dysentery (0.875), cough (0.889) and 1.0 for arthritis, eye irritation, kidney stone, blister of the mouth, piles, killing insects (parasites of animals), garget (mastitis), removing spines, heart problems, thirst, typhoid fever, anaemia, headache, jaundice, blood clothing, cuts, spider bite blisters, acidity, glowing face, boils ,and neck pain. The consensus survey indicated that twenty one plant species with informant's consensus index factor of (1.0) were used most commonly for individual diseases. Two taxa were often used for cough and dysentery, with consensus factors values of 0.889 and 0.875, respectively. Three taxa were used for tooth problems (cleaning, tooth ache and swelling of gum), fractures and healing wounds, with consensus factors of 0.846, 0.714 and 0.600. Four taxa were used for diabetes (0.906) and constipation (0.750). Stomach problems (indigestion and stomach ache) were cured with the highest number of taxa (5) having a consensus factor of 0.600 (Table 2). The respondents had a high level of agreement on plants use for specific ailments. Uddin and Hassan (2014) reported values of F_{ic} from 0.50 to 0.95 with an average value of 0.73, with highest (0.95) F_{ic} value for dysentery. The highest consensus species was *Litsea glutinosa*. The very high F_{IC} value for dysentery indicates that this ailment is common in the study area due to poor sanitation and there is wide communication established among informants for treating this ailment.

A study by Bhat *et al.* (2013) in Kedarnath Wildlife Sanctuary from Garhwal Himalaya found higher F_{ic} for Haematological illnesses (1.00), followed by

Published: 02 May 2019

http://dx.doi.org/10.32859/era.18.14.1-11

dermatological and ophthalmological illnesses (0.98). The F_{ic} for urological problems and general surgery in their study was (0.97) while for gastroenterological problems and general medicine categories F_{ic} was 0.92 and 0.85 respectively. Kumar *et al.* (2011) conducted a study in the lower belts of the Himalayas and also found high levels of agreement regarding the usages of single plants with F_{ic} value in the range of 0.33 to 1.0. The F_{ic} was highest for warts, vomiting, carminative, pain, boils and antiseptic uses (1.0), and lowest for bronchitis (0.33). Namsa et al. (2011) documented 50 plants species belonging to 29 families used for treating 22 human and 4 veterinary ailments among the Monpa ethnic community of Arunachal Pradesh. The consensus analysis revealed that dermatological ailments had the highest F_{ic} (0.56), while the F_{ic} for gastro-intestinal diseases was 0.43. However, general health and miscellaneous diseased had values of 0.20 and 0.17 respectively. High informant consensus (0.875) was also recorded by Owuor and Kisangau (2006) among the snakebite healers in Kamba of Africa and treating 'mich' or febrile diseases (0.80) among North-western Ethiopia (Teklehaymanot &nGiday 2007). Uddin and Hassan (2014) suggested that the plant species have high informant consensus factor, use report and fidelity level should be given priority to carry out studies on efficacy and toxicity.

Table 2. Informant consensus for ethnomedicinal plants

Illness category	Number of taxa used (N_t)	Number of use-reports (N_{ur})	Informant consensus index factor (F_{ic})*
Acidity	1	2	1.000
Anaemia	1	3	1.000
Arthritis	1	5	1.000
Blister of mouth	1	3	1.000
Blood clotting	1	2	1.000
Boils	1	2	1.000
Constipation	4	13	0.750
Cough	2	10	0.889
Cuts	1	2	1.000
Diabetes	4	18	0.824
Dysentery	2	9	0.875
Eye irritation	1	3	1.000
Fractures	3	8	0.714
Garget(mastitis)	1	2	1.000
Glowing face	1	6	1.000
Headache	1	2	1.000
Healing wounds	3	6	0.600
Heart problems	1	3	1.000
Jaundice	1	3	1.000
Joint pain	1	1	0.000
Kidney stone	1	3	1.000
Killing insects (parasites of animals)	1	2	1.000
Neck pain	1	2	1.000
Piles	1	2	1.000
Remove spines	1	3	1.000
Spider bite blister	1	4	1.000
Stomach problems (indigestion and stomach ache)	5	11	0.600
Thirst	1	4	1.000
Tooth problems (cleaning, tooth ache and swelling of gum)	3	14	0.846
Typhoid fever	1	3	1.000

*F_{ic}= N_{ur}-N_t/(N_{ur}-1), providing a value between 0 and 1, where high value indicates a high rate of informants consensus.

Fidelity Level (FL %)

The Fidelity Level (FL) of plants is given in Table 3. In the present study the species with the highest FL (100%) were *Terminalia bellirica, Terminalia chebula, Mangifera indica, Juglans regia, Zanthoxylum armatum, Syzygium cumini, Quercus leucotrichophora, Boehmeria rugulosa, Euphorbia royleana, Litseag lutinosa, Aegle marmelos, Ajuga parviflora, Azadirachta indica* and *Rumex dentatus*, which were used for cough, dysentery, tooth ache,

Published: 02 May 2019

http://dx.doi.org/10.32859/era.18.14.1-11

diabetes, constipation, fractures, stomach problem and healing wounds. The lowest FL was found for *Eupatorium adenophorum* (20%) used for wound healing. High (100%) FL was also reported from other studies, e.g. for *Azadirachta indica* (Muthu*et al.* 2006).

Cultural Importance Index (CI)

The Cultural Importance Index (CI) was highest for *Barleria cristata* (0.15) followed by *Rhus parviflora* (0.11) and *Carissa carandas*(0.10). Lowest values of this index were observed for *Azadirachta indica* (0.01) and *Boehmeria rugulosa* (0.01) (Table 4).

Table 3. Fidelity level of observed species of study area

Illness category*	Fidelity level of species (%)
Cough	*Terminalia bellirica*(100.00),*Terminalia chebula*(100.00),
Dysentery	*Mangifera indica*(100.00), *Rhu sparviflora* (30.00)
Tooth problems	*Juglan sregia* (100.00), *Rhus parviflora* (30.00), *Zanthoxylum armatum* (100.00)
Diabetes	*Berberis asiatica* (57.14), *Carissa carandas* (33.33), *Syzygium cumii* (100.00), *Tinospora cordifolia* (50.00)
Constipation	*Emblica officinale* (28.57), *Flacourtia indica* (37.50), *Premna barbata* (50.00), *Quercus leucotrichophora* (100.00)
Fractures	*Boehmeria rugulosa* (100.00), *Euphorbia royleana* (100.00), *Litseag lutinosa* (100.00)
Stomach problems	*Aegle marmelos* (100.00), *Ajuga parviflora* (100.00), *Anogeissus latifolia* (66.67), *Azadirachta indicia* (100.00), *Rumex dentatus* (100.00)
Healing wounds	*Agave americana* (33.33), *Carissa carandas* (44.44), *Eupatorium adenophorum* (20.00),

*Only categories with more than one observed plant species

Ethnomedicinal uses of plant

Out of 35 plant species for which ethnomedicinal uses were reported, 5 were used for stomach problems (digestion and stomach ache), 4 for diabetes, 3 species each for healing wounds, constipation and fractures, 2 species each for cough and dysentery, and 1 species each for arthritis, joint pain, eye irritations, tooth problems (cleaning, tooth ache and swelling of gum), kidney stone, blisters of the mouth, piles, killing insect parasites in animals, garget (mastitis) of women and animals, remove spines in humans, heart problems, thirst, typhoid fever, anaemia, headache, jaundice, blood clotting, cuts, spider bite blisters, glowing face (cosmetic), acidity, boils and neck pain. Of these 35 species, 19 species were reported for the first time from this region (*Agave americana, Ajuga parviflora, Anogeissus latifolia, Azadirachta indica, Callicarpa macrophylla, Carissa carandus, Colebrookea oppositifolia, Dalbergia sissoo, Euphorbia royleana, Ficus palmata, Ficus roxburghii, Flacourtia indica, Mallotus philippensis, Mangifera indica, Nyctanthes arbor-tristis, Premna barbata, Rumex dentatus, Solanum incanum, Viola canescens* (Table 4). The uses of other sixteen species have also been reported by other authors (Table 4) (Bhat *et al.* 2013; Gaur & Sharma 2011; Malik *et al.* 2015; Semwal *et al.* 2010; Uniyal & Shiva 2005).

Conclusions

Our research confirmed the hypotheses that the local population depends to a large extent on forest resources for their daily livelihood needs. The results also confirmed that the use of the plants for treating a particular disease was highly selective. Informants had a very high consensus, fidelity level and cultural importance level for the use of ethnomedicinal plants. However; these valuable species are under pressure due to their use as fuelwood, fodder, timber therefore, there is an urgent need to formulate suitable conservation strategies for local villagers for naturally growing ethnomedicinal plants for continuous and sustainable use in the future.

Published: 02 May 2019

http://dx.doi.org/10.32859/era.18.14.1-11

Table 4. Documentation of ethnomedicinal plant species in the study area with some earlier reporting

Scientific name / Voucher number	Family	Local Name	Ailments	CI value	Early reports from Garhwal Himalaya
Barleria cristata L.	Acanthaceae	Marchunda	Spider bite blister	0.043	Uniyal and Shiva, 2005
Mangifera indica L. *GUH-21006*	Anacardiaceae	Aam	Dysentery	0.065	-
Rhus parviflora Roxb *GUH-21007*	Anacardiaceae	Tung	Thirst, dysentery, cleaning teeth	0.108	Semwalet al., 2010
Carissa carandas L. *GUH-21011*	Apocynaceae	Karaunda	Wounds, killing insects(parasites of animals), diabetes	0.097	-
Agave americana L.	Asparagaceae	Patavaar	Boils, wounds	0.032	-
Eupatorium adenophorum Spreng. *WR-BSD-118412*	Asteraceae	Kala baansa	Blood drawing, cssut, wound	0.054	Uniyal and Shiva, 2005; Gaur and Sharma, 2011; Semwalet al., 2010; Bhatet al., 2013; Malik et al., 2015
Berberis asiatica Roxb. ex DC. *GUH-21018*	Berberidaceae	Kingod	Diabetes, eye irritation, kidney stones	0.151	Pala et al., 2010; Kala, 2007; Malik et al., 2015; Singh et al., 2014
Anogeissus latifolia (Roxb. ex. DC.) Wall. ex Bedd.	Combretaceae	Dhauda	Stomach problems, joint pain	0.032	-
Terminalia bellirica (Gaertn.) Roxb *GUH-21024*	Combretaceae	Baheda	Cough	0.043	Uniyal and Shiva, 2005
Terminalia chebula Retz. *GUH-21025*	Combretaceae	Heda	Cough	0.065	Kala, 2007; Uniyal and Shiva, 2005
Euphorbia royleana Boissier	Euphorbiaceae	Sullu	Fractures	0.043	-
Mallotus philippensis (Lam.) Müll.-Arg.	Euphorbiaceae	Ruina	Neck pain	0.022	-
Dalbergia sissoo Robx. ex DC. *WR-BSD-118424*	Fabaceae	Shisham	Garget (mastitis in women and animals)	0.022	-
Quercus leucotrichophora A.Camus *GUH-21041*	Fagaceae	Banj	Constipation	0.022	Pala et al., 2010; Kumar at al., 2011; Uniyal and Shiva, 2005; Gaur and Sharma, 2011; Singh et al., 2014
Flacourtia indica (Burm. f.) Merrill	Flacourtiaceae	Bilangara	Constipation	0.032	-
Juglans regia L. *GUH-21042*	Juglandaceae	Akharot	Cleaning teeth, tooth ache	0.054	Kala, 2007; Kumar et al., 2009; Uniyal and Shiva, 2005; Singh and Rawat, 2011; Semwalet al., 2010; Bhatet al., 2013; Malik et al., 2015
Ajuga parviflora Benth.	Lamiaceae	Neelkanth	Stomach pain	0.022	-
Callicarpa macrophylla Vahl	Lamiaceae	Daiya	Blister of the mouth	0.032	-
Colebrookea oppositifolia Sm.	Lamiaceae	Binda	Piles	0.022	-
Premna barbata Wallich ex Schauer	Lamiaceae	Bakare	Acidity, constipation	0.043	-
Litsea glutinosa (Lour.) C.B. Rob.	Lauraceae	Maida akadi	Bone fractures	0.032	Malik et al., 2015

Published: 02 May 2019

http://dx.doi.org/10.32859/era.18.14.1-11

Azadirachta indica A. Juss.	Meliaceae	Neem	Stomach pain	0.011	-
Tinospora cordifolia(Willd.) Miers ex Hook.f. &Thomson *GUH-21055*	Menispermaceae	Giloya	Diabetes, typhoid fever	0.065	Uniyal and Shiva, 2005; Negiet al., 2002; Gaur and Sharma, 2011
Ficus palmata Forssk.	Moraceae	Bedu	Remove spines	0.032	-
Ficus roxburghii Steud.	Moraceae	Timala	Heart related	0.032	-
Syzygium cumini(L.) Skeels*GUH-21063*	Myrtaceae	Jaamun	Diabetes	0.043	Malik et al., 2015
Nyctanthes arbor-tristis L.	Oleaceae	Harsingar	Arthritis	0.054	-
Phyllanthus emblica Gaertn. *GUH-21033*	Phyllanthaceae	Amala	Constipation	0.065	Uniyal and Shiva, 2005
Rumex dentatus L. *GUH-21072*	Polygonaceae	Emada	Stomach pain	0.032	-
Aegle marmelos(L.) Corrêa*GUH-21081*	Rutaceae	Bel	Stomach problems	0.032	Kumar at al., 2011; Uniyal and Shiva, 2005
Zanthoxylu marmatum DC. *GUH-21084*	Rutaceae	Temaru	Cleaning teeth, swelling of gum	0.065	Phondaniet al., 2010; Kala, 2007; Uniyal and Shiva, 2005; Singh and Rawat, 2011; Semwalet al., 2010; Bhatet al., 2013; Malik et al., 2015
Solanum incanum L.	Solanaceae	Bukandari	Jaundice	0.032	-
Boehmeria rugulosa Wedd	Urticaceae	Genthi	Bone fractures (veterinary)	0.011	Malik et al., 2015
Urtica dioica L. *GUH-81087*	Urticaceae	Kandaali	Anaemia, headache	0.054	Phondaniet al., 2010
Viola canescens Wallich	Violaceae	Sumaya	Glowing face	0.065	-

Published: 02 May 2019

http://dx.doi.org/10.32859/era.18.14.1-11

Declarations:

List of abbreviations: Not applicable

Ethics approval and consent to participate: All participants provided oral prior informed consent.

Consent for publication: Not applicable

Competing interest: Not applicable

Funding: Not applicable

Author contributions: APS and MK designed the study and developed this manuscript, BN, NAP, and RWB improved the manuscript, gave methodological input and revised the taxonomy.

Acknowledgments: The authors are thankful to all the participants for sharing their knowledge.

Author details:
Atul Pratap Singh[1]
Munesh Kumar[1*]
Bhuvnesh Nagar[2]
Nazir A. Pala[3]
Rainer W. Bussmann[4]

[1]Department of Forestry and Natural Resources, HNB Garhwal University (A Central University), Srinagar Garhwal, Uttarakhand 249161, India
[2]Department of Forest Products and Utilization, College of Horticulture and Forestry, Jhalawar, Rajasthan 326023, India
[3]Faculty of Forestry, SKUAST, Kashmir, Benhama Watlar Ganderbal (J & K)
[4]Ilia State University, Institute of Botany and Bakuriani Alpine Botanical Garden, Department of Ethnobotany, 1 Botanical Str. 0105 Tbilisi Georgia, Georgia;

***corresponding author:**
muneshmzu@yahoo.com

Literature Cited

Aceituno-Mata L. 2010. *Estudioetnobotánico y agroecológico de la Sierra Norte de Madrid*. Ph.D. Thesis. Universidad Autónoma de Madrid, Spain.

Bhat JA, Kumar M, Bussmann RW. 2013. Ecological status and traditional knowledge of medicinal plants in Kedarnath Wildlife Sanctuary of Garhwal Himalaya, India. *Journal of Ethnobiology and Ethnomedicine* 9(1). doi:10.1186/1746-4269-9-1.

Bhat JA, Kumar M, Negi AK, Todaria NP. 2013. Informants' consensus on ethnomedicinal plants in Kedarnath Wildlife Sanctuary of Indian Himalayas. *Journal of Medicinal Plants Research* 7(4):148-154.

Biodiversity status in the Himalaya. British council, New Delhi, India, pp. 19-38.

Dhar U, Rawal RS, Upreti J. 2000. Setting priorities for conservation of medicinal plants- A case study in Indian Himalaya. *Biological Conservation* 95(1): 57–65.

Flaster T. 1996. *Ethnobotanical approach to drug discovery of bioactive compounds. Process in new crops*. Proceedings of the Third Traditional Symposium, ASHS press, Alexandria, USA, pp. 561-565.

Friedman J, Yaniv Z, Dafni A, Palewitch D.1986. A preliminary classification of the healing potential of medicinal plants, based on rational analysis of an ethnopharmacological field survey among Bedouins in Negev desert, Israel. *Journal of Ethnopharmacology* 16:275-287.

Gaur RD, Sharma J. 2011. Indigenous Knowledge on the Utilization of Medicinal Plant Diversity in the Siwalik Region of Garhwal Himalaya, Uttarakhand. *Journal of Forest Science27*(1):23-31.

Jima TT, Megersa M, 2018.Ethnobotanical Study of Medicinal Plants Used to Treat Human Diseases in Berbere District, Bale Zone of Oromia Regional State, South East Ethiopia. *Evidence-Based Complementary and Alternative Medicine*18: 1-17.

Kala CP. 2005. Current status of medicinal plants used by traditional Vaidhyas in Uttaranchal State of India. *Ethnobotany Research and Application* 3:267-278.

Kala CP. 2007. Local preferences of ethnobotanical species in the Indian Himalaya: Implications for environmental conservation. *Current Science* 93:12-25.

Kumar M, Sheikh MA, Bussmann RW. 2011. Ethnomedicinal and ecological status of plants in Garhwal Himalaya, India. *Journal of Ethnobiology and Ethnomedicine7*:32.

Kumar P, Gupta S, Singh SB. 2009. Ethnobotanical Studies of Nubra Valley - A Cold Arid Zone of Himalaya. *Ethnobotanical Leaflets* 13:752–765.

Kumar S, Kumar R, Khan A. 2011. Medicinal plant resources: manifestation and prospects of life-sustaining healthcare system. Continental *Journal of Biological Science* 4(1):19-29.

Lewis WH, Elwin Lewis MP. 2003. *Medical botany - Plants affecting human health*. John Wiley and sons, New York, USA.

Malik ZA, Bhat JA, Ballabha R, Bussmann RW, Bhatt AB. 2015. Ethnomedicinal plants traditionally used in health care practices by inhabitants of Western Himalaya. *Journal of Ethnopharmacology* 172:133-144.

Muthu C, Ayyanar M, Raja N, Ignacimuthu S. 2006. Medicinal plants used by traditional healers in Kancheepuram District of Tamil Nadu, India. *Journal of Ethnobiology and Ethnomedicine2*:43.

Published: 02 May 2019

http://dx.doi.org/10.32859/era.18.14.1-11

Namsa ND, Mandal M, Tangjang S, Mandal SC. 2011. Ethnobotany of the Monpa ethnic group at Arunachal Pradesh, India. *Journal of Ethnobiology and Ethnomedicine7*:31.

Negi CS, Nautiyal S, Dasila L, Rao KS, Maikhuri RK. 2002. Ethnomedicinal Plant Uses in a Small Tribal Community in a Part of Central Himalaya, *India Journal of Human Ecology* 14(1):23-31.

Owuor BO, Kisangau DP. 2006. Kenyan medicinal plants used as antivenin: a comparison of plant usage. *Journal of Ethnobiology and Ethnomedicine* 2:(7).

Pala NA, Negi AK, Todaria NP. 2010. Traditional uses of medicinal plants of Pauri Garhwal, Uttrakhand. *Nature and Science* 8(6):57-61.

Pandikumar P, Chellappandian M, Mutheeswaran S, Ignacimuthu S. 2011. Consensus of local knowledge on medicinal plants among traditional healers in Mayiladumparai block of Theni District, Tamil Nadu, India. *Journal of Ethnopharmacology* 134:354-362.

Pardo-de-Santayana M, Tardío J, Blanco E, Carvalho AM, Lastra JJ, San Miguel E, Morales R. 2007. Traditional knowledge on wild edible plants in the northwest of the Iberian Peninsula (Spain and Portugal): a comparative study. *Journal of Ethnobiology and Ethnomedicine* 3:27.

Park HL, Lee HS, Shin BC, Shin BC, Liu JP, Shang Q, Yamashita H, Lim B. 2012. Traditional medicine in China, Korea, and Japan :a brief introduction and comparison. *Evidence-Based Complementary and Alternative Medicine* 1-9

Phondani PC, Maikhuri RK, Rawat LS, Farooquee NA, Kala CP, Vishvakarma SCR, Rao KS, Saxena KG. 2010. Ethnobotanical Uses of Plants among the Bhotiya Tribal Communities of Niti Valley in Central Himalaya, India. *Ethnobotany Research and Application*8:233-244.

Prakash A. 2011. *Uses of some threatened and potential ethnomedicinal plants among the tribals of Uttar Pradesh and Uttrakhand in India*, National Conference on Forest Biodiversity: Earth's Living Treasure. Uttar Pradesh State Biodiversity Board, Locknow, U.P., India.

Ragupathy S, Steven NG, Muruthakkutti M, Velusamy B. 2008. Consensus of the Malasars traditional aboriginal knowledge of medicinal plants in the velliangiri holy hills, India. *Journal of Ethnobiology and Ethnomedicine*4:8doi:10.1186/1746-4269-4-8.

Samant SS, Dhar U, Palni LMS. 1998. *Medicinal plants of Indian Himalaya; Diversity distribution potential value. GB Pant institute of Himalayan environment and development*. Kosi Katarmal Almora, India.

Sati VP. 2013. Cultivation of medicinal plants and its contribution to livelihood enhancement in the Indian Central Himalayan Region. *Advances in Medicinal Plant Research* 1(2):17-23.

Semwal DP, Saradhi PP, Kala CP, Sajwan BS. 2010. Medicinal plants used by local VaidyasinUkhimath block, Uttarakhand. Indian *Journal of Traditional Knowledge* 9(3):480-485.

Singh DK, Hajara PK. 1996. *Floristic diversity*. In Gujral GS, Sharma V eds.

Singh G, Rawat GS. 2011.Ethnomedicinal survey of Kedarnath wildlife sanctuary in Western Himalaya, India. Indian *Journal of Fundamental Applied Life Science1*:35-46.

Singh H, Husain T, Agnihotri P, Pande PC, Khatoon S. 2014. An ethnobotanical study of medicinal plants used in sacred groves of Kumaon Himalaya, Uttarakhand, India. *Journal of Ethnopharmacology*, 154(1): 98-108 doi:10.1016/j.jep.2014.03.026i.

Singh MP, Dey S. 2005.*Indian Medicinal Plants*. Satish Serial Publishing House, New Delhi, India.

Tardío J, Pardo de Santayana M. 2008. Cultural importance indices: a comparative analysis based on the useful wild plants of Southern Cantabria. *Economic Botany* 62 (1):24-39.

Teklehaymanot T, Giday M. 2007. Ethnobotanical study of medicinal plants used by people in Zegie Peninsula, Northwestern Ethiopia. *Journal of Ethnobiology and Ethnomedicine* 3:12.

Timmermans K. 2003. *Intellectual Property Rights and Traditional Medicine: Policy Dilemmas at the Interface*. World Health Organization, Jakarta, Indonesia.

Trotter R, Logon M. 1986. *Informant consensus: a new approach for identifying potentially effective medicinal plants. In plants indigenous medicine and diet: biobehavioural approaches*. Redgrave, New York, USA, pp. 91-112.

Uddin MZ, Hassan MA. 2014. Determination of informant consensus factor of ethnomedicinal plants used in Kalenga forest, Bangladesh. *Bangladesh Journal of Plant Taxonomy2*1(1):83-91.

Uniyal B, Shiva V. 2005. Traditional knowledge on medicinal plants among rural women of Garhwal Himalaya Uttarakhand, Indian *Journal of Traditional Knowledge* 4(3):259-266.

van der Merwea D, Swana GE, Botha CJ. 2001. Use of ethnoveterinary medicinal plants in cattle by Setswana-speaking people in the Madikwe area of the North West Province of South Africa. *Journal of South African Veterinary Association* 72:189-196.

Published: 02 May 2019

http://dx.doi.org/10.32859/era.18.14.1-11

WHO. 2001. *World Health Organization traditional medicine strategy*, 2002-2005. Geneva, Switzerland.

WHO. 2002. *Traditional Medicine: Growing Needs and Potentials*, Geneva, Switzerland.

WHO. 2003.*Traditional Medicine. Fact sheet No. 134.* Geneva, Switzerland.

WHO. 2011. *The World Medicines Situation, Traditional Medicines: Global Situation, Issues and Challenges*. Geneva, Switzerland. http://www.who.int/ medicines/areas/policy/world_medicines_situation/ WMS_ch18_wTraditionalMed.pdf.

WHO. 2012. *Traditional medicine*. http://www.who.int/ mediacentre/factsheets/fs34/en.

Published: 02 May 2019

http://dx.doi.org/10.32859/era.18.14.1-11