Ethnobotanical investigations on plants used in folk medicine by native people of Kumaun Himalayan Region of India
Devesh Tewari, Archana N. Sah, Sweta Bawari and Rainer W. Bussmann

Databased and Inventories

Abstract

Background: A large population in the rural area of Uttarakhand is still dependent upon traditional plant-based knowledge to combat various disease conditions. This study aimed to explore the ethnopharmacological information and document traditional uses of plants in the Kumaun Himalayan region. Here we show the study of nine villages of three districts of the Uttarakhand state in India, located in the western Himalayan region.

Methods: A total of 26 traditional healers and experienced inhabitants between 30-85 years of age were interviewed by a semi-structured questionnaire. The data obtained was quantitatively evaluated using use value (UV). Further, the informant consensus factor (ICF) and fidelity level (FL) were also calculated for species having UV higher than 0.15.

Results: A total of 56 plant species were reported from 34 families. The highest number of plant species were collected from Asteraceae and Lamiaceae families followed by Rosaceae. Primary uses of plants were categorized into 29 disease categories. The highest number of species was reported to be used for gastrointestinal disorders (11.21%) followed by immuno-modulation, anti-stress, as adaptogens (10.2%), analgesics (7.47%), for nervous system related disorders (6.54%) and as antimicrobials (6.54%).

Conclusions: Local traditional knowledge and practice of plant-based medicine is quite widespread in the rural areas of Uttarakhand and is an indispensable part of the healthcare system. It plays a vital role in the absence of basic medical facilities and tremendous paucity of trained medical personnel.

Keywords: Ethnobotany, Himalaya, Cordyceps, Uttarakhand

Correspondence

Devesh Tewari1-2, Archana N. Sah2, Sweta Bawari3, Rainer W. Bussmann4

1Department of Pharmacognosy, School of Pharmaceutical Sciences, Lovely Professional University, Phagwara, 144411, Punjab, India
2Department of Pharmaceutical Sciences, Faculty of Technology, Kumaun University Campus, Bhimtal (Nainital), Uttarakhand-263136, India
3School of Pharmacy, Sharda University, Knowledge Park-III, Greater Noida, Uttar Pradesh, 201310, India
4Department of Ethnobotany, Institute of Botany, Ilia State University, Tbilisi, Georgia.

*Corresponding Author: dtewari3@gmail.com

Background

Ethnopharmacology is a multidisciplinary science which deals with underlying anthropological principles and pharmacological basis of various natural products. These natural entities include plants, animals, minerals, microbes, fungi, and herbo-minerals which are utilized in different human cultures (Rivier, Bruhn 1979). Hundreds of years of beliefs and observations are the basis of various traditional medicine systems, which predate the expansion and spread of modern medicine. Such
Several of medicinal plants are used by the natives of the Kumaun Himalayan region for numerous disorders. Although studies have been conducted to explore the Uttarakhand region (Farooquee et al. 2004, Kala et al. 2005, Negi et al. 2011, Phondani et al. 2010, Sharma et al. 2011, Kumari et al. 2012) still there is a vast potential in the Himalayan region concerning the ethnomedical wealth.

Uttarakhand (formerly known as Uttaranchal) is the newest state among the Himalayan provinces of India and came in existence as the 27th state of the Republic of India. The state comprises 13 districts and is divided into two divisions, namely Kumaun and Garhwal. A large population of the state is dependent on the surrounding natural environment, and a large population is dependent on agriculture for livelihood. However, agriculture is difficult in this mountainous region due to geographical and climatic factors. The state is gifted with large forest cover and water resources providing for the origins of several important rivers as well. Although, studies have been conducted in the Kumaun Himalayan region to explore medicinal plant diversity and in some places the use of medicinal plants in the different ailments by the inhabitants (Bhatt et al. 2012, Gangwar, Gangwar 2010, Kapkoti et al. 2011, Mathur, Joshi 2013, Shah, Joshi 1971, Upreti et al. 2009). However, most of the area covered in this study is still unexplored and to the best of our knowledge no study is available with the quantitative analysis of the ethnopharmacological information from this area so far. Therefore, the study was conducted to collect and evaluate data from traditional healers and experienced inhabitants on medicinal plant-based remedies from the middle and high-altitude region of western Himalaya.

Materials and Methods

Study area
Uttarakhand state is a part of the North-Western Himalayas and is located between 28° 43’ - 31° 27’N latitudes and 77°34’ - 81°02’E longitudes. The state is affluent in culture, religious attributes and the beautiful natural sights. The state is full of biodiversity and natural resources in context to flora, fauna or people. It is different from other states due to its mountainous geography. The state is mainly a mountainous state and most of the people of Uttarakhand are known as “Paharis” which means ‘people of the hills’, and similar “Pahari” people with different cultural and linguistic characters are found in the neighboring state in west Himachal Pradesh and east Nepal (Mawdsley, 1997, Joshi, Negi 1994). Uttarakhand is the place of origin of the holy river ‘Ganga’ and it is also important due to the presence of the Himalayan ranges that form the border of the neighboring countries. The state is separated by the

In the 1990s ethnopharmacological based screening of bioactive natural products gained tremendous importance, due to information on therapeutic indications which serves as a lead in the ethnopharmacological approach (e.g. Artemisinin:(Klayman 1985); Cyclohexidine:(Koehbach, Gruber 2013)), however, this approach subsequently declined. The popularity of complementary medicine is, however, increasing rapidly since past few decades. Traditional systems of medicine, for instance Ayurveda, traditional Chinese medicine system and other indigenous systems of medicine are widely used worldwide, and the traditional preparations are marketed in many developed countries as dietary supplements. It was reported in a survey that approximately 48.5% respondents from Australia and 34% respondents from the USA had used at least one form of alternative therapy including herbal medicine (Eisenberg et al. 1998, Grover et al. 2001, MacLennan et al. 1996). The World Health Organization (1980) have recommended that the proper evaluation of the effectiveness of plants should be done for conditions that lack safe modern drugs for therapeutic interventions (Grover et al. 2001, MacLennan et al. 1996, Upadhyay, Pandey 1984).

Ethnopharmacological studies are gaining tremendous importance these days. There are several such studies that are being conducted in recent times (Barkaoui et al. 2017, Davids et al. 2016, Eddouks et al. 2016, Kose et al. 2015, Motetee, Kose 2016, Rahman et al. 2016, Shawahna, Jaradat et al. 2017, Zhao et al. 2017). Significance of ethnopharmacological studies could be well understood by its importance in the drug discovery process. A search in the PubMed database showed 194 items by searching the keywords “ethnopharmacology and drug discovery” and 1810 items with the word “ethnopharmacology”. Same keywords were searched in Google Scholar database and a total 33300 web hits were found with the keywords “ethnopharmacology and drug discovery” and 136000 web hits were found with the keywords “ethnopharmacology” alone (as accessed on 05.08.2017).

systems were developed by our ancestors who learned very comprehensively from nature initially by tasting of what was available in their surrounding areas (Aburjai et al. 2007). This knowledge regarding traditionally used medicines is rapidly vanishing and it is believed that the rate of disappearance of traditional medicinal knowledge is even faster than that of plant species biodiversity and a large amount of priceless information is at the verge of irrevocable depletion (Appendino et al. 2010).

There is a vast potential in the Uttarakhand region concerning the ethnomedical wealth.
river Tons from Himachal Pradesh in the north-west and the river Kali separates it from Nepal in the east.

An explorative study was conducted in the Kumuan Himalayan region (Figure 1). Different villages namely: Jauljibi, Mostamanu, Ucheti, Fafa, Askot (Pithoragarh district), Binsar (Almora district), Ratighat, Bohrakun, Ghinghrani, Gagar, Betalghat (Nainital district) were surveyed. The main focus area during the survey was Pithoragarh district in general and Jauljibi and adjoining villages in particular, which are situated at Indo-Nepal border and lies at the confluence of Gori and Mahakali rivers. The major town of Dharchula is around 30 Km away from the main study area. Jauljibi is well known for the trade. Several migrants and workers from Nepal come and do their business in this small town.

The region is mainly famous for the small markets of both India and Nepal and an old famous festival locally known as “Jaljibi Mela” is celebrated here every year to celebrate the trade relations of India and Nepal and thousands of people from many villages from both the sides participate in this fair. Most of the respondents belonged to the Bhotia tribes who are resident of the upper Himalayan regions in summer, and due to extreme weather conditions move to the lower parts of the region during September-October to Jauljibi to spend the winter season. The area is also famous for about a century-old trade fare popularly known as “Jualjibi Mela” which is a symbol of trade between India and Nepal. The details of the study area are provided in Figure 2.
**Data collection**

The study was based on field surveys conducted from the years 2014-2016. The surveys were done throughout the day in different seasons including the last part of the summer season and the onset of monsoon. Verbal prior informed consent was taken from all the participants after telling them the purpose of the study. Data about the therapeutically important medicinal plants were gathered with the help of open ended semi-structured interviews. Interviews were conducted in Hindi and local language Kumauni depending upon the social and educational status of the respondents. Most of the people were interviewed at their homes but some of them were also interviewed in the forest areas and in groups as per the suitability for drawing maximum information. Field surveys were conducted with traditional healers and experienced natives of the villages, and plants were collected accordingly. Stays were also made in different villages with the help of the villagers. An extensive literature review was also done to verify the pharmacological relevance of collected information.

**Collection, identification and authentication of the plants**

Medicinal plants were collected in different seasons throughout the year from the fields and forest areas. Most of the plants were collected from areas at the altitudes of 970-3000 m above sea level. Collected medicinal plants were dried, mounted on herbarium sheets and identified in government identification centers, including the Botanical Survey of India, Dehradun, Regional Ayurveda Research Institute (RARI), Jhansi, RARI Tarikhet, Systemic Botany Division, Forest Research Institute (FRI), Dehradun and Botany Department, Kumaun University, Nainital. The plant specimens were identified by expert taxonomists and deposited in the respective herbaria. One set of vouchers was kept at the herbarium of Department of Pharmaceutical Sciences, Bhimtal for future reference.

**Data analysis**

**Use value**

Obtained informant data were analyzed by quantitative index: use value (UV). The use value (Phillips, Gentry, 1993, Ngarivhume et al. 2015) is a quantitative method that is used to demonstrate the relative importance of a species known locally. UV was calculated using the formula:

\[ UV = \frac{U}{N} \]

Where, UV denotes the use value of a species; U is number of citations per species; and N refers to the number of informants. Range of UV is 0 to 1. UV is high when several use reports exist for a plant, which means that the plant is imperative. UV drops to 0 when only few use related reports of a plant are found. However, UV does not differentiate if a plant is used for one or more purposes (Khattak et al. 2015).

**Informant consensus factor (ICF)**

After calculation of the UV of all reported species, only plants having higher UV (>0.15) were selected for the calculation of ICF. ICF value was calculated using the formula (Heinrich et al. 1998; Trotter and Logan, 1986).
ICF = (Nur-Nt)/(Nur-1)

Where, Nur is the total number of use reports for each ailment category and Nt is number of taxa used in that category.

ICF is the indicative of the extent of homogeneity within the information between the informants.

**Fidelity level (FL)**

Similarly to ICF, plants with higher UV (>0.15) were selected for the calculation of FL. FL index was calculated using following formula (Friedman et al. 1986):

\[
FL(\%) = (Np/N \times 100)
\]

Where Np is the number of informants citing the use of the plant for a particular disease category and N is the whole number of informants citing the plant for any disease category.

Higher FL is an indicative of frequent use of a particular plant species for the treatment of a disease or ailment of specific category by the informants of the studied area (Musa et al. 2011).

**Photography**

Photographs of the plants used as traditional medicines were captured in the study area. In most of the cases, habitat was also taken into account along with the study area. Images of the plants were captured along with flowers, fruits and inflorescence for identification as and when available (Plate 2-8).

**Results and Discussion**

**Respondent biographic details**

The data were collected by open informal and sometimes group interviews. The samples were selected on the basis of stratified sampling procedure and mainly two methods were used to select the respondents. Firstly, the information was collected from the district level officers about their known folklore practitioners and secondly the information about the respondents were collected from the local villagers or sometimes from the respondents themselves. Twenty-six traditional medicine practitioners and experienced local inhabitants were interviewed, out of which 84.61% were male and 15.38% were female. This is an important information which represent that the substantially higher male population is aware about the folklore medicine practices. Most of these folk healers do not charge any fee for giving their treatment, even though their economic conditions were poor. The details of the respondents are presented in Table 1 and Figure 3.

| Characteristic | Frequency |
|---------------|-----------|
| Gender        |           |
| Male          | 22        |
| Female        | 04        |
| Education     |           |
| No formal education | 10       |
| Primary education | 08       |
| Secondary education | 07       |
| Special education | 01       |
| Religion      |           |
| Hindu         | 26        |
| Other         | Nil       |
| Ethnicity     |           |
| Bhotia Tribe  | 07        |
| Non tribe     | 19        |
| Year of experience of the healer |     |
| Less than 5 year | Nil      |
| Between 1-10 years | 05       |
| Between 11-20 years | 08       |
| Between 21-30 years | 05       |
| Between 31-40 years | 01       |
| Between 41-50 years | 02       |
| 51+ years     | 05        |

**Social life and challenges**

Different sections of the study area had almost similar socioeconomic conditions. One of the major problems observed in the remote mountainous regions like Ucheti, Phapha and Jauljibi was that of the migration of the local inhabitants from the hilly areas to the nearby plain areas for better economic conditions and in search of job opportunities. The problem of migration was not a big concern in villages neighboring to comparatively bigger towns, such as Jeolikot, Bohrakoon and Ghinghrani villages, but in the remote areas like Ucheti, Phapha and Jauljibi migration is a common problem and a great matter of concern. Most inhabitants of these villages are either dependent on agriculture, or dependent on their livestock for their daily needs. Several geriatric people were found living alone or as couple, while their children were living in the cities for earning livelihood. Sometimes elderly people didn’t desire to leave their villages either. The life in these
areas is very challenging. Some of the major challenges are poor connectivity of roads, lack of basic facilities such as schools, hospitals etc. The area is prone to the natural disasters such as earthquakes, landslides, and cloudburst. Although, in some areas schools and hospitals are present, but teachers and medical practitioners are unwilling to work in these remote areas, and the children of these villages remain deprived of the fundamental rights of education and healthcare. People used to travel from one side of the river to the other by using a typical rope way as seen in Plate 1. Often people have to walk for miles in the rocky terrains to access even the most basic needs. Socioeconomic conditions of the study area are presented in Plate 1. Still, it cannot be said that all the villagers are poor, but the majority certainly are in a difficult economic situation. It was also found during the study that the basic facilities and economic conditions were better in the villages that are in close vicinity of the towns and/or plain areas.

Species distribution
A total of 56 plants were reported, belonging to 34 families. The highest numbers of plant species were collected from Asteraceae and Lamiaceae families, followed by Rosaceae. Other important families were Acoraceae, Ranunculaceae, Araceae, Berberidaceae, Rutaceae, Zingiberaceae, Scrophulariaceae, Euphorbiaceae, Bignoniaceae, Oxalidaceae, Amarylliacae, and Rubiaceae. The caterpillar fungus *Ophiocordyceps sinensis* and one herbo-mineral drug "Shilajeet" was also recorded from the study area. The details of species distribution are presented in Figure 4.

![Figure 3](image1.png)

**Figure 3.** Graph showing the number of traditional medicinal practitioners from different villages

![Figure 4](image2.png)

**Figure 4.** Graphical representation of the family and number of species
Quantitative data analysis of plants used in various disease conditions

Primary uses of plants were organized in 29 disease categories. The highest number of plants were used for gastrointestinal disorders (11.21%), followed by immunomodulation, anti-stress, adaptogens (10.2%), analgesic (7.47%), for nervous system related disorders (6.54%), and as antimicrobials (6.54%). The explanatory details of primary uses of plants are presented in Figure 5. The use values of the plant species fell between 0.01-0.5. Most of the plants fell below an UV of 0.15, and 11 species, Acorus calamus L., Berberis aristata DC., Bergenia ciliata (Haw.) Sternb, Carum carvi L., Euphorbia pilosa L., Ficus palmata Forssk., Ocimum tenuiflorum L., Ocimum basilicum L., Pyracantha crenulata (Roxb. ex. D Don), Rhododendron arboreum Sm. and Swertia chirata Buch.-Ham. ex Wall. were found with UV higher than 0.15, and further considered for calculation of ICF and FL %.

The details of the documented plant species along with their traditional uses and UV are presented in Table 2.

Fig. 5. Pie chart showing the main uses of medicinal plants encountered.
| Botanical Name and accession number | Family         | Part used | Therapeutic use                                                                 | Local / Common Name① | UV  | Use described earlier                                                                                                                                                                                                 |
|-----------------------------------|----------------|-----------|----------------------------------------------------------------------------------|----------------------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Acorus calamus L. 115195          | Acoraceae      | Rhizomes  | Aromatic, tonic, antigout, dyspepsia, to reduce cough                             | Vacha                | 0.19| Emetic (Srivastava et al. 1986), to kill lice (Rao 1983), nervous system, throat related disorders, diarrheal, antitumor (Jha & Varma 1996, Viswanathan, 1995), used for protection against smallpox (Jain 1989), ringworm (Bajpai et al. 1995), for respiratory and gastrointestinal tract diseases and snakebite (Bist & Badoni 1990, Mohanty et al. 1996, Singh, 1995), for gout and rheumatism (Jain & Puri 1994), and for dysmenorrhea (Borthakur & Goswami 1995, Mukherjee et al. 2007). |
| Zephyranthes minuta (Kunth) D.Dietr. (Syn. Zaphyranthes grandiflora Lindle) RKT 947 | Amarylliaceae | Bulbs    | Antimicrobial, antitumor                                                         | Gulabi lily          | 0.07| Details not found in our search                                                                                                                                                                                      |
| Carum carvi L. JHS 25275          | Apiaecae       | Fruit, seed | Stomach pain, itching, fever, dyspepsia, menstrual pain and morning sickness, spice, condiment and preparation of expensive oil | Kala jeera, Dhave    | 0.23| Aphrodisiac, lactiferous diuretic, menstrual disorders (Sadeghi & Mahmood, 2014).                                                                                                                                 |
| Hydrocotyle javanica Thunb. (Hydrocotyle nepalensis Hook. f) 115209 | Apiaceae       | Leaf     | Memory enhancer, relieve constipation in children                                | Brahmbheda also known as Brahmi in some area | 0.07| Jaundice, diarrhea, dysentery, peptic ulcer (Borah et al. 2006), typhoid fever (Choudhury et al. 2010).                                                                                                             |
| Cascabella thevatia (L.) Lippold. 115194 | Apocynaceae    | Flowers  | Toxic                                                                             | Peela Kaner         | 0.01| Leaf paste with castor oil used for external injuries as a pain alleviator (Nayak et al. 2004) toxicity from leaves (Koch et al. 2015).                                                                 |
| Arisaema tortuosum (Wallich) Schott RKT 8486, 115181 | Araceae        | Whole plant | Gastrointestinal disorders, jaundice and other liver ailments believed in snake bite | Bagh Jandhra, Snake plant Sarapabheda | 0.11| Snake bite (Kumar 2017), anthelmintic (Verma et al. 2012).                                                                                                        |
| Scientific Name                      | Family         | Part Used | Medicinal Uses                                                                                           | EO % | Notes                                                                                      |
|-------------------------------------|----------------|-----------|----------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------|
| *Anaphalis margaritacea* (L.) Benth. & Hook. f. RKT 19962 | Asteraceae     | Flower, whole plant | Poultice is used for burns, anti-inflammatory, joint pain                                                 | 0.11 | Root liquid used for diarrhea (Balami, 2004) and in veterinary diseases (Lans *et al.* 2007). |
| *Bidens pilosa* L. 115510           | Asteraceae     | Root, Whole plant | Constipation in children                                                                                  | 0.03 | Stomachache (Ayyanar & Ignacimuthu 2005), constipation and malaria, (Geissberger & Sequin 1991) and dysmenorrhea (Bartolome *et al.* 2013; Noumi *et al.* 1999). |
| *Erigeron karvinskianus* DC. 115511 | Asteraceae     | Leaves    | Wound healing, analgesic, anti-inflammatory                                                              | NA   | Skin diseases (Sharmila *et al.* 2014).                                                    |
| *Inula cuspidata* (Wall ex.DC) CB Clarke 115516 | Asteraceae     | Root      | Anthelmintic                                                                                             | 0.07 | Decoction of fresh roots in empty stomach used to expel worms (Rana *et al.* 2014, Sharma & Sood 2013). |
| *Taraxacum officinale* G.E. Hugland 115512 | Asteraceae     | Whole plant | Jaundice, anti-inflammatory, anti-urolithiasis                                                            | 0.11 | Used for bile and vesicular disorders, kidney and liver pain, stomach ulcer, antitussive, diabetes, rheumatism, anemia and irregular menstruation and as appetizer (Martinez *et al.* 2015, Mustafa *et al.* 2012, Šarić-Kundalić *et al.* 2011). |
| *Berberis aristata* DC. JHS 25270   | Berberidaceae  | Root, root bark, stem | Jaundice, antidiabetic, eye diseases                                                                       | 0.38 | Jaundice, fever, weakness (Kumar 2017), ulcer and malaria fever (Bhushan & Kumar 2013). |
| *Jacaranda mimosifolia* D. Don 115184 | Bigoniaceae    | Flower, leaves, bark | Wound healing, sexually transmitted diseases and as dye,                                                  | 0.11 | Wound healing and skin infections also used as a substitute for the Unani herb in Pakistan (Khare, 2008), bark used for treating wounds and dermatitis, astringent and diuretic (Roth & Lindorf, 2002), blood purifier (Babu *et al.* 2015; Yu *et al.* 2006). |
| *Cannabis sativa* L. JHS 25269      | Cannabinaceae  | Seeds, leaf, resin | Analgesic, dietetic preparation, narcotic                                                                | 0.02 | Used for urinary tract diseases, asthma, depression, insomnia and depression due to its sedative and analgesic effects (Aziz *et al.* 2016), analgesic, antispasmodic , diuretic and astringent and narcotic (Aziz *et al.* 2017). |
| *Ipomoea purpurea* (L) Roth. 115508  | Convolvulaceae | Seed      | Anthelmintic, diuretic                                                                                   | 0.06 | Anti-syphilitic and emetic (Farhhaar *et al.* 2014), bronchitis (Amjad 2015).               |
| *Lyonia ovalifolia* (Wall) RKT 25902 | Ericaceae      | Bark      | Scar, burning scar, anti-herpes, eczema itching, skin diseases                                           | 0.11 | Leaf paste for pain and for ring worm infection (Joshi *et al.* 2011), treatment eczema and boils (Dangwal *et al.* 2010). |
| *Rhododendron arboreum* Sm. JHS 25277 | Ericaceae      | Flower juice, wood | Cardiac disorders, antihypertensive, anti-                                                          | 0.5  | Dysentery, diarrhea, throat clearance when fish bones get stuck in the gullet, remove stuck thorn of fish (Namsa *et al.* 2011, Paudyal & |
| Species                        | Family       | Part Used     | Other Uses                                                                                     | Notes                                                                                           |
|-------------------------------|--------------|---------------|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| *Euphorbia pilosa* L.         | Euphorbiaceae| Latex         | Purgative, emetic, antiseptic, antimicrobial                                                    | Sataala 0.15 Cuts, wounds and sores in livestock (Pande et al. 2007).                           |
| *Euphorbia obvata* Decne      | Euphorbiaceae| Latex         | Antimicrobial                                                                                  | NA 0.01 For constipation, emetic (Prajapati 2003), food poisoning (Farooquee et al. 2004).         |
| *(Euphorbia prolifera* Buch. (Ham) ex ) | Euphorbiaceae | Latex         |                                                                                               |                                                                                                |
| *Swertia chirata* 10429A     | Gentianaceae | Whole plant   | Fever, veterinary disorders, blood purifier, diuretic, gastric disorders                        | Chirayta 0.19 For headaches, blood pressure (de Rus Jacquet et al. 2014, Malla et al. 2015), for tremor fever (de Rus Jacquet et al. 2014), to cure malaria (Chakraborty et al. 2017, Shaf et al. 2014), and also used as a purgative and laxative (Chakraborty et al. 2017). |
| *Hypericum oblongifolium* Choist 115193 | Hypericaceae | Leaf         | Mental disorders                                                                               | Pendant St. John’s Wort 0.01 Leaves and fruits used as antihypertensive, in gastric ulcer and removing prolepsis in cattle (Amjad et al. 2017), powder of flowers given in jaundice (Kapkoti et al. 2014). |
| *Juglans regia* L. JHS 25272  | Juglandaceae | Bark, fruit   | Toothache, memory enhancer, alopecia                                                           | Akhrot 0.03 Leaf decoction for diabetes (Barkaoui 2017), aromatize cheese and for protection of it from dust and parasites (Guarrera et al. 2005), jaundice (Jaradat et al. 2017). |
| *Mentha longifolia* L. JHS 25271 | Lamiaceae    | Leaf         | Aromatic, spice, food, condiment, gastritis, liver disorders, itching, anti-acne               | Pudina 0.03 Carminative, for rheumatic pain, nausea, sickness and vomiting, diarrhea, dysentery, stomach pain and cooling effect (Aziz et al. 2016, Tariq et al. 2015). |
| *Nepeta hindostana* (Roth) Haiens. RKT 4082 | Lamiaceae    | Leaf         | Ornamental, antimicrobial                                                                      | Billillotan 0.01 It has anti-asthmatic, anti-catarrhal, sedative properties (Awan 1960), also used for fever, body ache, diarrhea, dysentery, carminative, antispasmodic (Quattrocchi 2012), as a gargle for sore throat and bad breath, gonorrhoea (Nadkami 1996), hypo-cholesterolemic and central nervous system (CNS) depressant effects (Khare 2008, Mahmood et al. 2017). |
| Scientific Name                      | Family               | Part                | Uses                                                                                           | References                                      |
|--------------------------------------|----------------------|---------------------|================================================================------------------------------|------------------------------------------------|
| Ocimum tenuiflorum L. 113663          | Lamiaceae            | Whole plant         | Cough, fever, antioxidant, spider bite                                                           | Ram tulasi (Flue, cough, ring warm infection)   |
| Ocimum basilicum L. 113664            | Lamiaceae            | Whole plant         | Cold, fever, cough, spider bite                                                                  | Kali tulasi (For headache, bad breath, cold, skin diseases) |
| Salvia leucantha Cav. 115506          | Lamiaceae            | Inflorescence       | Essential oil used as antimicrobial, memory enhancer                                             | White Mischief (Stomachache, weakness, mal aire) |
| Rienwarditia indica Dumortier 115206  | Linaceae             | Flower              | Dye                                                                                           | Basanti (Tongue wash)                           |
| Punica granatum L. JHS 25267          | Lythraceae           | Fruit peels         | Antitussive                                                                                   | Dadim (Fruit, fruit rind for jaundice)          |
| Malva verticillata L. 115513          | Malvaceae            | Leaf                | Antidiabetic, galactagogue, stomach disorders, immunomodulator, antistress                     | Suverchala (Anthrax (livestock) crush)          |
| Ficus palmata Forssk. JHS 25273       | Moraceae             | Fruits, leaves, latex | Bachache, analgesic, adaptogen, male sexual disorders, anti-helentic (Ascaris in stomach), jaundice | Bedu (Use as wild edible fruit and vegetable)    |
| Ophiocordyceps sinensis               | Ophiocordycipitaceae | Whole parts         | Aphrodisiac, adaptogen, immunomodulator                                                         | Yar-tsa-gambo, Yarsa gumba, Keeda jadi (Increase longevity) |
| Satyrium nepalensis Summerh. RKT 2817 | Orchidaceae          | Root                | Memory enhancer, immunomodulator, antipyretic                                                   | Mushri, Mishri (Root powder is given with cow-milk as tonic) |
| Species Name                      | Family     | Part Used                  | Usage/Active Constituents                                                                 | Chemical Constituent | Note                                                                 |
|----------------------------------|------------|----------------------------|-----------------------------------------------------------------------------------------|----------------------|---------------------------------------------------------------------|
| Oxalis intermedia                | Oxalidaceae| Leaf                       | Wound healing, antioxidant                                                                | Changeri, khatti meethi | 0.02 | Dysentery, stomach disorders, rheumatism, toothache (Arbiastutie et al. 2017; Sen et al. 2011). |
| Phytolacca acinosa               | Phytolaccaceae | Leaf, root           | Anticancer, vegetable, immunomodulator                                                   | -                    | 0.11 | Veterinary diseases (Khateeb et al. 2015), wild edible (Lata et al. 2013). |
| Anemone vitifolia                | Ranunculaceae | Roots                  | Antimicrobial, anthelminthic                                                               | Agali                | 0.07 | Ringworm, eczema (Kumar 2017, Pande et al. 2007), for anti-leech (Balami 2004). |
| Prinsepia utilis                 | Rosaceae    | Fruits and seeds         | Analgesic, immunomodulator                                                                | Jhitalu              | 0.02 | Fruit used for body pain, joint pain, rheumatism, wound healing (Balami 2004, Uniyal et al. 2006), root extract is taken orally as an antidote to neutralize the effect of poison intake (Uniyal et al. 2006). |
| Prunus persica                   | Rosaceae    | Fruits                   | Antioxidant, immunomodulator                                                              | Aadu                 | 0.07 | Leaf extract used in diarrhea (Maroyi 2013), leaf paste is applied on animal’s body to remove external parasites (Bhatia et al. 2014). |
| Pyracantha crenulata             | Rosaceae    | Fruits, leaf and roots    | Analgesic, adaptogen, coagulant                                                          | Ghingharu            | 0.30 | Edible fruit (Wt et al. 2013), constipation, in burns in livestock (Pande et al. 2007). |
| Rubus ellipticus                 | Rosaceae    | Root                     | Analgesic, stomach disorders, antiulcer, anthelminthic                                   | Hisalu               | 0.11 | Plant is used in diarrhea, cough, fever and dysentery (Haq 2012, Parhaaar et al. 2014), wound healing, fruit juice is used in the treatment of fever, colic, cough and sore throat (Haq 2012). Fruit is edible and is useful for removal of kidney stone (Ahmad et al. 2011). |
| Rubia cordifolia                 | Rubiaceae   | Leaves, root             | Blood purifier, skin diseases, leukoderma                                                  | Manjishtha           | 0.11 | Used for diabetes in combination of other drugs (Kumar & Janardhana 2012). |
| Wendlandia heynei                | Rubiaceae   | Leaves                   | Antihypertensive                                                                           | Tillak               | 0.02 | Furuncle (Tayade & Patil 2006), and as a toothbrush (Rawat et al. 2009). |
| Boenninghausenia albiflora       | Rutaceae    | Whole plant              | Mosquito repellent                                                                         | Pissumar, upaniyajhar| 0.02 | Used for wound healing and to relieve headache and for scabies (Thakur and Sarika, 2016). |
| Murraya koengii                  | Rutaceae    | Leaf                     | Food, condiment                                                                           | Curry patta          | 0.01 | Leaves smell to patients with epilepsy, used for malaria, diarrhea, dysentery, and fever (Bajpai et al. 2016, Silja et al. 2008). |
| Bergenia ciliata                 | Saxifragaceae| Root                    | Lithotriptic, stomachache, wound healing (dry powder of root),                            | Pattharchatta, Pashanbhed, Silfoda | 0.61 | Kidney stone, sores, swelling (Kumar, 2017), veterinary diseases (Pande et al. 2007), gastrointestinal disorders and diabetes (Begum et al. 2014). |
| Scientific Name | Family | Part | Condition | Local Name | Elevation | Description |
|-----------------|--------|------|-----------|------------|-----------|-------------|
| *Digitalis purpurea* L. | Scrophulariaceae | Leaf | Cardiac disorders | Hritpayyi, Tilpushpi | 0.02 | Used in cardiac disorders, coughs, skin diseases, wounds, sprains, inflammation, tuberculosis, old ulcers, burns, festering of stone-bruises, and as a repellent (Allen & Hatfield 2004). |
| *Datura innoxia* Mill 115505 | Solanaceae | Fruit | Toxic and spiritual purpose | Dhatura | 0.03 | Leaf powder orally taken with honey, to cure asthma, smoke as narcotic and skin diseases (Patil 2015). |
| *Solanum nigrum* L. 115191 | Solanaceae | Leaf | Anticoagulant in veterinary preparation | Makoi, Ninoni, Gaiwai | 0.03 | Leaves are crushed and mixed in water and applied topically, used for washing painful eyes (Abbasi *et al.* 2013), pain in body (Mahmood *et al.* 2011). |
| *Daphne papyracea* Wall. Ex. G. Don 115504 | Thymelaeaceae | Leaf, seed | Leucoderma, constipation | Satpura /skin diseases | 0.07 | In preparation of hand-made paper for painting and writing religious scripts in Buddhist monasteries (Namsa *et al.*., 2011). |
| *Callicarpa macrophylla* Vohl 115507 | Verbenaceae | Fruits | Mouth ulcer, gout | Priyangu, betmaalu | 0.03 | Dry fruit powder blend with honey too treat acne, pimples, blisters, and allergic skin patches (Bhatt *et al.* 2012), in traditional agroforestry (Deb *et al.* 2009). |
| *Duranta plumieri* Jacq. RKT 1755 | Verbenaceae | Flower | Mosquito repellant | Duranta | 0.01 | The fruits are used for intoxicating and catching fishes (Kalita *et al.* 2010). |
| *Verbena bonariensis* L. 115208 | Verbenaceae | Leaves | Antimicrobial, galactagogue | NA | 0.01 | Mouth infection in babies (Ngari 2010). |
| *Viburnum cylindricum* Buch-Ham ex. D. Don 115514 | Verbenaceae | Seeds | Laxative | NA | 0.01 | Edible (Geng *et al.* 2016; Zhang *et al.* 2016), to control the sweatiness and heat from body especially from hands and feet after washing (Dangwal & Singh 2013). |
| *Cautleya spicata* (JE Smith) Baker RKT 25842 | Zingiberaceae | Root | Skin diseases | Ban Haldi, Jaharu Haldi | 0.02 | In veterinary practices for internal wounds (Tiwari & Pande 2004), and for gastritis (Acharya & Rokaya, 2005). |
| *Roscoea purpurea* Sm. (Syn. *Roscoea procera* Wall) RKT 15325 | Zingiberaceae | Root, rhizomes | Immunomodulator, wound healing | Kakoli | 0.07 | Rhizome juice is used in cleaning wounds (Kunwar & Adhikari 2005). |
We also correlated the plant families with the number of diseases for which they were being indicated. It was found that the representatives of Asteraceae followed by Lamiaceae, Rosaceae and Verbenaceae were being employed as remedies for the majority of diseases. These results are also justified as the species which were recorded at large are being used in the treatment of a large number of disorders. The details are illustrated in Figure 6.

Leaves were found to be the highest used part of the plants (27.14%). Next to leaves, roots (18.57%), fruits, flowers and whole plants (9.99%) were used, followed by seeds (7.14%), stem bark (4.28%) and rhizomes (2.85%). Some other parts like stem, fruit peel and wood (1.42%) were also used for different disease conditions. These findings resonate with the observations of Bekalo et al. (2009), Ogbe et al. (2009), and Rahmatullah et al. (2012) who also reported that leaves were the most used parts. Sometimes leaves, bark and roots of the same plants were used interchangeably by various healers.

Our findings deviate from the work of Bussmann (2006), Musa et al. (2011), Cheikhroussef et al. (2011), Maroyi (2013) and Ngarivhume et al. (2015) who reported roots as the highest used parts for treatment of diseases and ailments (Ngarivhume et al. 2015, Friedman et al. 1986, Bussmann 2006, Cheikhroussef et al, 2011, Maroyi 2013) (Details are presented in Figure 7). Moreover, among all plants, herbs (56.14%) had the highest prevalence in being used among all plants followed by shrubs (24.56%) and trees (15.78%) (Figure 8).

The consensus analysis and FL revealed that Bergenia ciliata had highest FL and ICF value as an anti-urolithiatic. B. ciliata is a well-known and well-established plant for the treatment of kidney stones (Bashir, Gilani 2009, Byahatti et al. 2010). Some plants with high FL and ICF were Pyracantha crenulata for analgesic activity with 100% FL and 0.5 ICF, Rhododendron arboreum with 85.71% FL and 0.4 ICF, Ocimum basilicum and O. tenuiflorum with (100%) FL but comparatively lower ICF (0.33%). Similar results were obtained for Swertia chirayita. Additionally, Berberis aristata, as an antidiabetic, showed high (71.42%) FL and even higher (0.75) ICF, and for jaundice, the plant showed 42.85% FL and 0.5 ICF. Ficus palmata exhibited an FL of (66.66%) and ICF (0.25). The details of FL and ICF are presented in Table 3.
Figure 7. Schematic representation of % of plant parts used

Figure 8. Distribution of plant habits and other products used
A literature survey on ethno-medicinal uses was carried out to verify whether the plants utilized by people of Kumaun Himalayan region were previously known for their therapeutic uses against similar or other disease conditions or not. The detailed comparative results are enlisted in Table 2. Some of the plants were found to be used for similar indications as recorded in the survey.

Acorus calamus L. is reported to be used in throat related disorders and for the treatment of gout; Artisiaem tortuosum (Wallich) Schott is reported to be used for snake bite; Anemone vitifolia Buch. as anthelmintic, Berberis aristata DC. was used for jaundice, B. ciliata (Haw.) Sternb for the treatment of kidney stones, Digitalis purpurea L. in cardiac disorders, Hydrocotyle javanica Thunb. in gastrointestinal disorders, Inula cuspidata (Wall ex. DC) CB Clarke as anthelmintic, Jacaranda mimosifolia D. Don for wound healing effect, Lyonia ovalifolia (Wall) for skin related disorders and antipruritic effect, Mentha longifolia L. for carminative effect and in gastrointestinal disorders, Prinsepia utilis Roxb. for analgesic effect, Swertia chirayita (Roxb.) Buch.-Ham. ex C.B. Clarke for antipyretic effect, Roscoea purpurea Sm. for wound healing effect, Rubus elipticus Sm. for gastro-intestinal disorders, Taraxacum officinale G.E. Hugland for jaundice and biliary diffusion, and Verbena bonariensis L. for microbial infections and related diseases.

Several other important therapeutic claims were also documented from different medicinal plants apart from already reported claims such as cure of alopecia by bark and fruits of Juglans regia L., antidepressant effect of Rhododendron arboreum flower juice, anti-herpes effect of Lyonia ovalifolia Wall., beneficial effect of the fruits of Callicarpa macrophylla Voh against mouth ulcers, Boenninghausenia albiflora (Hook) Rchb. ex. Meisn as mosquito repellant, seeds of Carum carvi L. in dysmenorrhea, Rubia cordifolia in vitiligo, Jacaranda mimosifolia D. Don in sexually transmitted diseases and others. The lists of these plants are presented in Table 4.

Table 3. Plants used in different therapeutic conditions with FL and ICF

| Species                          | Therapeutic indication       | FL (%) | ICF  |
|----------------------------------|------------------------------|--------|------|
| Acorus calamus L.                | Nervous system related disorders | 50     | 0.25 |
| Berberis aristata DC.            | Antidiabetic                 | 71.42  | 0.75 |
| Bergenia ciliata (Haw.) Sternb   | Jaundice                     | 42.85  | 0.50 |
| Carum carvi L.                   | Lithotriptic                 | 100    | 1.00 |
| Euphorbia pilosa L.              | GIT disorders                | 33.33  | 0.25 |
| Ficus palmata Forssk.            | Antimicrobial                | 100    | 0.03 |
| Ocimum tenuiflorum L.            | Cold, fever, cough           | 100    | 0.33 |
| Ocimum basilicum L.              | Cough, fever, cough          | 100    | 0.33 |
| Pyracantha crenulata (Roxb. ex. D Don ) | Analgesic                  | 100    | 0.5  |
| Rhododendron arboreum Sm.        | Antidepressant               | 85.71  | 0.4  |
| Swertia chirata                  | Fever                        | 100    | 0.33 |

Comparative analysis of documented data with previous literature

A literature survey on ethno-medicinal uses was carried out to verify whether the plants utilized by people of Kumaun Himalayan region were previously known for their therapeutic uses against similar or other disease conditions or not. The detailed comparative results are enlisted in Table 2. Some of the plants were found to be used for similar indications as recorded in the survey.

Acorus calamus L. is reported to be used in throat related disorders and for the treatment of gout; Artisaem tortuosum (Wallich) Schott is reported to be used for snake bite; Anemone vitifolia Buch. as an anthelmintic, Berberis aristata DC. was used for jaundice, B. ciliata (Haw.) Sternb for the treatment of kidney stones, Digitalis purpurea L. in cardiac disorders, Hydrocotyle javanica Thunb. in gastrointestinal disorders, Inula cuspidata (Wall ex. DC) CB Clarke as anthelmintic, Jacaranda mimosifolia D. Don for wound healing effect, Lyonia ovalifolia (Wall) for skin related disorders and antipruritic effect, Mentha longifolia L. for carminative effect and in gastrointestinal disorders, Prinsepia utilis Roxb. for analgesic effect, Swertia chirayita (Roxb.) Buch.-Ham. ex C.B. Clarke for antipyretic effect, Roscoea purpurea Sm. for wound healing effect, Rubus elipticus Sm. for gastro-intestinal disorders, Taraxacum officinale G.E. Hugland for jaundice and biliary diffusion, and Verbena bonariensis L. for microbial infections and related diseases.

Several other important therapeutic claims were also documented from different medicinal plants apart from already reported claims such as cure of alopecia by bark and fruits of Juglans regia L., antidepressant effect of Rhododendron arboreum flower juice, anti-herpes effect of Lyonia ovalifolia Wall., beneficial effect of the fruits of Callicarpa macrophylla Voh against mouth ulcers, Boenninghausenia albiflora (Hook) Rchb. ex. Meisn as mosquito repellant, seeds of Carum carvi L. in dysmenorrhea, Rubia cordifolia in vitiligo, Jacaranda mimosifolia D. Don in sexually transmitted diseases and others. The lists of these plants are presented in Table 4.

Table 4. List of medicinal plants reported during the study along with their therapeutic effects

| Botanical Name                  | Family          | Part use     | Common name           | Therapeutic effect                                 |
|---------------------------------|-----------------|--------------|-----------------------|----------------------------------------------------|
| Allium stracheyi                | Alliaceae       | Root/stem    | Sekua, chota jambu    | Stomachache, gastritis, jaundice                   |
| Achyranthes aspera              | Amaranthaceae   | Root, stem   | Latjeera, Apamarg     | Asthma, cough                                      |
| Angelica archangelica L.        | Apiaceae        | Root         | Gandarain             | Gastritis & stomachache                            |
| Cetella aciatica                | Apiaceae        | Leaf         | Mandukparni           | Memory enhancer, constipation in child             |
| Eryngium foetidum L.            | Apiaceae        |              | Jangli gajar          | Leukoderma                                         |
| Saussurea obvallata wall.eEx. C. B. Clarke | Asteraceae     | flower       | Brahmakamal Kwani ka phool |                                                    |
| Podophyllum emodi               | Berberidaceae   | Rhizomes, fruit | Bankakadi            | Gastritis                                          |
| Amebia euchroma (Royle) Johnston | Boraginaceae    | Root         | Bajhadi               | Hair loss/hair dye                                 |
| Raphnus sativus L.              | Brassicaceae    | Leaf         | Mooli                 | Scorpion bite                                      |
| Valeriana hardwickii            | Caprifoliaceae  | Root         | Tag , samewa          | Stomachache                                        |
| Scientific Name | Family | Part | Common Name | Uses |
|-----------------|--------|------|-------------|------|
| *Terminalia chebula* | Combretaceae | Fruit | Harad | Cough & fever, stomachache |
| *Dioscorea bulbiflora* | Dioscoreaceae | Tubor | Gethi | To prevent cold |
| *Embellica officinalis* | Euphorbiaceae | Fruit | Aonla | Food muraba, cold |
| *Accacia catechu* (L.F.) Wild. | Fabaceae | Stem | Khair | Analgesic |
| *Bauhinia vahlii* W & A. | Fabaceae | Leaf | Maluka | Food |
| *Beutea utilis* D. Don. | Fabaceae | Leaf | Boijtra | Wound healing |
| *Millettia racemosa* | Fabaceae | Root | Junga | In the removal of umbilical cord |
| *Ougeinia dalbergioides* | Fabaceae | Sanan | Wound healing, coagulant |
| *Coleus parviflorus* Bentham. | Lamiaceae | Root | Colis | Fever in cow, |
| *Colebrookea oppositifolia* J. E. Smith | Lamiaceae | Fruit, root | Bhekmalu | Oral ulcer, Gout |
| *Thymus vulgaris* L. | Lamiaceae | Leaf | Vanajwoin | Expectorant |
| *Cinnamomum tamala* (Buch-Ham.) T.Nees & Eberm | Lauraceae | Leaf | Tej patta | Food preparations as condiment and flavoring agent |
| *Cinnamomum zeylanicum* Blume | Lauraceae | Bark | Dalchini | Condiment and gastritis |
| *Paris polyphylla* Sm. | Melanthiaceae | Root | Satua | Stomachache |
| *Azadirachta indica* Juss. | Meliaceae | Leaf | Neem | Fever |
| *Tinospora cordifolia* | Menispermaceae | Stem | Galactagogue cow, arthritis, bp |
| *Ficus ariculata* Lour. | Moraceae | Fruit | Timil | Heat in stomach |
| *Musks muskone* | Moschidae | | Kasriri mrig | Aromatic |
| *Myrica nagi* Hook f. non Thunb | Myricaceae | Seed | Kafal | Blood purifier, kidney stone, immunomodulatory, Relieve constipation |
| *Syzygium Caryophyllum* (L.) Alston | Myrtaceae | Fruit | Jamun | Antiemetic, diarrhea |
| *Orchis latifolia* L./ *Cissus quadrangularis* L. | Orchidaceae. | Root | Salampanja Hathajadi | Wound healing, coagulant |
| *Pinus roxburghii* | Pinaceae | Wood | Chir | Building |
| *Cynodon dactylon* Pers. | Poaceae | | Doob | Piles |
| *Rgeum emodii* | Polygonaceae | Root | Dolu, arch | Bone disorders, wound healing, eye pain, fracture |
| *Aconitum heterophyllum* Wall ex. Royle | Ranunculaceae | Root | Atees | Fever, wound healing, stomachache |
| *Coptis teeta* Wall | Ranunculaceae | Leaf juice | Mamera | Eye diseases |
| *Delphinium denudatum* Wall | Ranunculaceae | Root | Nirvishi | Antitoxin, aromatic, |
| *Potentilla arbuscula* D. Don. | Rosaceae | Whole plant | Bajradanti | Toothache |
| *Cinchona spp.* | Rubiaceae | Bark | Dabada | Wound healing, adhesive |
| *Citrus limon* | Rutaceae | Root | Nimbu | Antiemetic in children |
| *Xanthozylum armatum* | Rutaceae | Fruit | Timur /inna | Cold, fever, in spice, toothache, anthelmintic |
| *Aesculus indica* (Wall. ex Cambess.) Hook | Sapindaceae | Fruit | Pangar | poisonous, veterinary disease in cow fever, galactagogue in veterinary |
| *Bacopa monnieri* (L.) Wettst. | Scrophulariaceae | Leaf | Brahmi | Memory enhancer |
| *Picrorhiza kurrooa* | Scrophulariaceae | Root | Kutaki | Fever, stomachache and analgesic/diabetes/hypertension, fever, bone fracture |
| *Solanum xanthocarpum* | Solanaceae | Root | Kantakari | Jaundice |
| *Urtica dioca*/ *Gerardiana diversifolia* Eriss. | Urticaceae | | Bichhu | Galactagogue for cow, food and tea |
| *Fagonia cretica* | Zygophyllaceae | Whole plant | Dhamaku | Fever |
Occurrence of a unique plant and mushroom
Apart from the above-mentioned species, *Strobilanthes wallichii* Nees. was also recorded during the survey as a special ceremonial plant (Figure 9). The purple blooms of the plant are believed to appear only once in every twelve years, when the festival of “Kangdali” is celebrated in the Pithoragarh district. The festival is celebrated by the Rung tribe of the district who are closely related to the Bhotia tribes of the studied area, and. Festival is held in “Chaundas” valley between the months of August and October. The festival is celebrated to rejoice and commemorate the defeat of Zorawar Singh’s army (from Ladakh), who attacked in 1841 from Ladakh. Several tales are associated with the blooming of the flower of the plant. One of these tales is of “a boy who died after applying the paste of the root from a shrub known as Kang-Dali on his wound. His enraged mother cursed the shrub and ordered the “Shauka” women uproot the “Kang-Dali” plant off its ground upon reaching its full bloom, which happens once in twelve years” (Negi, 2003).

![Figure 9. Strobilanthes wallichii Nees.](image)

Another important occurrence was the caterpillar fungus *Ophiocordyceps sinensis*. It is also very popular in the entire region due to its very high cost and demand. Most of the people from the Jualjibi valley go back to the high-altitude Himalayan areas in the month of March-April with their kids when the snow melts in search of the so-called magic remedy Yar-tsa-gumbo. *O. sinensis* is an annual Ascomycete, widely used in traditional Tibetan and Chinese medicine and also reported from Sikkim. The people of the study area were very much engaged in the collection of *O. sinensis* due to its high cost. At the same time local people of the area were not much satisfied with the government policy for the exploitation of this traditionally used drug and they believed that the government should increase the trade rate for this mushroom. Even a single piece of *O. sinensis* costs about Rs. 500 and people were very much aware about its sale. A favorable policy for its exploitation at a mutual consent with the government and local people is required for sustainable development.

The significant plant wealth in the Himalayan region can be potential source for the development of the socioeconomic conditions of the populations residing in the study area. As mentioned earlier that there are several socio-economic challenges are present in front of the rural people of the study area. The gathered plants can substantially improve the economic conditions of the native people of the study area. For instance, cultivation of different important plants like *Berberis*, and *Bergenia* could provide high economic outcomes in terms as these plants are endangered and possess a huge market value due to their potential uses in the Ayurvedic and other traditional medicine formulations. Moreover, value addition in the form of product development from various Himalayan medicinal plants like *Rhododendron, Ficus palmata, Carum carvi*, *Ophiocordyceps* and many others have the potential to generate great market values.

Due to changing lifestyles, great secrecy of traditional healers and disinterest of youngsters, the practice of, and dependence of ethnic societies on folk medicines is in rapid decline globally. Therefore, ethno-botanical exploitation and documentation of indigenous knowledge about the usefulness of such a vast pool of genetic resources is deliberately needed (Behera, Misra 2005, Bussmann, Sharan 2006, Kunwar et al. 2006, Longuefousse, Nossin 1996, Saikia et al. 2006, Singh et al. 2012). It was already mentioned by “Charak” and “Sushrut”(ancient scholars of Ayurveda) that “knowledge of medicinal plants and their identification should be gained with the help of cowherds, hermits, hunters, forest-dwellers and those who gather plants of the forest for food” (https://www.ncbs.res.in/HistoryScienceSociety/content/overview-indian-healing-traditions, accessed on 3.8.2017). The original *shloka* is mentioned in Figure 10.

Although, the healers were much sentient of the occurrence of inequitable bioprospecting practices from different pharmaceutical companies and other institutions, however, they were not much aware about the legal protection of their intellectual properties. Similar information about the legal protection of plant was also also described by others as well (Ngarivhume et al. 2015, Uprety et al. 2012). It was very surprising to see the behavior and awareness of the healers as well as old informants
about their willingness of sharing their information. They also knew that their knowledge on traditional practices for healing is very precious and needs to be conserved. Moreover, the informants were also disappointed to see the negligence of youngsters towards the extinction of traditional knowledge.

Another reason for this is the death of many healers and traditional medicine practitioners without documenting or communicating their invaluable knowledge, which have lead to the irrevocable loss of lots of the precious data.

The average age of the respondents for the present study was 57 years which is approximately the similar to the average age of informants reported in another studies from Egypt and Morocco (50 and 55 years, respectively) (Gonzalez-Tejero et al. 2008). Asteraceae, Lamiaceae and Rosaceae were found to be the majorly used families for different therapeutic purposes. This may be due to the presence of higher quantities of phytoconstituents such as terpenoids, phenolic and flavonoid compounds in Lamiaceae and lactones in Asteraceae which are responsible for the antioxidant and other therapeutic activities (Brahmi et al. 2016, Candan et al. 2003, Khaled-Khodja et al. 2014, Miliauskas et al. 2004, Ouelbani et al. 2013). The healers also believed that in most cases cultivated plants were less potent than wild plants, similar to what has been reported from Zimbabwe (Ngarivhume et al. 2015). Such findings agree with the findings of Okello and Ssegawa (2007) in Uganda (Okello, Ssegawa 2007), Bussmann (2006) in South Turkana, Kenya, and Babungo (Camroon) (Bussmann, 2006), Moosa et al. (2011) in Sudan (Musa et al. 2011) and Ngarivhume et al. (2015) in Chipinge, Zimbabwe (Ngarivhume et al. 2015). During the survey it was observed that the number of practitioners were declining rapidly. Several inhabitants of the surrounding areas and different villages told that most of the practitioners were either already dead or migrated to other areas, and therefore, a comprehensive anthropological study would be required to quantify such data. One of the most common problems mentioned by most of the respondents was that their children were not interested to acquire the knowledge related to medicinal plants and local treatments due to poor economic conditions and general lack of interest.

Asteraceae, Lamiaceae and Rosaceae were found to be the majorly used families for different therapeutic purposes. This may be due to the presence of higher quantities of phytoconstituents such as terpenoids, phenolic and flavonoid compounds in Lamiaceae and lactones in Asteraceae which are responsible for the antioxidant and other therapeutic activities (Brahmi et al. 2016, Candan et al. 2003, Khaled-Khodja et al. 2014, Miliauskas et al. 2004, Ouelbani et al. 2013). The healers also believed that in most cases cultivated plants were less potent than wild plants, similar to what has been reported from Zimbabwe (Ngarivhume et al. 2015). Such findings agree with the findings of Okello and Ssegawa (2007) in Uganda (Okello, Ssegawa 2007), Bussmann (2006) in South Turkana, Kenya, and Babungo (Camroon) (Bussmann, 2006), Moosa et al. (2011) in Sudan (Musa et al. 2011) and Ngarivhume et al. (2015) in Chipinge, Zimbabwe (Ngarivhume et al. 2015). During the survey it was observed that the number of practitioners were declining rapidly. Several inhabitants of the surrounding areas and different villages told that most of the practitioners were either already dead or migrated to other areas, and therefore, a comprehensive anthropological study would be required to quantify such data. One of the most common problems mentioned by most of the respondents was that their children were not interested to acquire the knowledge related to medicinal plants and local treatments due to poor economic conditions and general lack of interest.

Another reason for this is the death of many healers and traditional medicine practitioners without documenting or communicating their invaluable knowledge, which have lead to the irrevocable loss of lots of the precious data.

The average age of the respondents for the present study was 57 years which is approximately the similar to the average age of informants reported in another studies from Egypt and Morocco (50 and 55 years, respectively) (Gonzalez-Tejero et al. 2008). Asteraceae, Lamiaceae and Rosaceae were found to be the majorly used families for different therapeutic purposes. This may be due to the presence of higher quantities of phytoconstituents such as terpenoids, phenolic and flavonoid compounds in Lamiaceae and lactones in Asteraceae which are responsible for the antioxidant and other therapeutic activities (Brahmi et al. 2016, Candan et al. 2003, Khaled-Khodja et al. 2014, Miliauskas et al. 2004, Ouelbani et al. 2013). The healers also believed that in most cases cultivated plants were less potent than wild plants, similar to what has been reported from Zimbabwe (Ngarivhume et al. 2015). Such findings agree with the findings of Okello and Ssegawa (2007) in Uganda (Okello, Ssegawa 2007), Bussmann (2006) in South Turkana, Kenya, and Babungo (Camroon) (Bussmann, 2006), Moosa et al. (2011) in Sudan (Musa et al. 2011) and Ngarivhume et al. (2015) in Chipinge, Zimbabwe (Ngarivhume et al. 2015). During the survey it was observed that the number of practitioners were declining rapidly. Several inhabitants of the surrounding areas and different villages told that most of the practitioners were either already dead or migrated to other areas, and therefore, a comprehensive anthropological study would be required to quantify such data. One of the most common problems mentioned by most of the respondents was that their children were not interested to acquire the knowledge related to medicinal plants and local treatments due to poor economic conditions and general lack of interest.

This kind of situation is really very threatening for the traditional knowledge in the whole Himalayan region.

The villagers were also concerned about their forest wealth. Due to exploitation of vegetation from forest areas as fodder for cattle, and unwanted human interruption, which also sometimes leads to forest fires, another prime concern in the entire region. In some communities the inhabitants mutually surrendered the whole forests of some regions as “forest of the village god”. After such surrender no one is allowed to exploit these forests. Based on the conversations with the villagers, it was found that this practice of forest surrender has dramatically reduced forest use and squatting in such forests.

Conclusions
In the rural areas of Uttarakhand, practice of plant-based medicine and local traditional knowledge plays a vital role in people’s lives, and such knowledge is widespread. This knowledge is becoming even more important in the primary healthcare system of the rural mountainous areas where there is a huge scarcity of registered medical practitioners. This explorative survey accentuated the importance of preservation and documentation of traditional knowledge for various disease conditions and for additional elaborative scientific research on these as well as other plants for the evaluation of their therapeutic efficacy and safety. Proper scientific validation is an important step for the standardization and optimum utilization of the therapeutic claims in the field of drug discovery from natural products. We are also working on the validation of some of the reported traditional applications and claims such as antidepressant potential of *R. arboreum* and analgesic potential of *F. palmata* and *P. crenulata*.
Declarations:
List of abbreviations: Not applicable
Ethics approval and consent to participate: The study was approved by University Research Degree Committee of Kumaun University Nainital. All participants provided oral prior informed consent and signed in the questionnaire as their consent.
Consent for publication: Not applicable
Availability of data and materials: Not applicable
Competing interests: The authors declare no competing interest.
Funding: The study did not receive any specific grant from funding agencies in the commercial, public or non-profit sectors.
Authors’ contributions: DT conceived the study, participated in conceptualization, implementation, data and plant collection, interpretation, drafting of manuscript, ANS participated in study design and overall guidance, SW participated in data interpretation and RWB critically revised and edited the manuscript. All the authors participated in writing and giving feedback on the manuscript and approved the final version of the manuscript.

Acknowledgements
We are highly grateful to all the informants of the study area involved in the study for sharing their precious information. We also sincerely thank to all the traditional healers for their participation in the study. Particular thanks to Officer in-charges of Botanical Survey of India, Dehradun, RARI, Jhansi including Dr. S.K. Lale, Dr. R. K. Mudhaiya; Dr. G.C. Joshi, Dr. J. C. Arya from RARI, Tarikhet, Prof. Lalit Tewari, Botany Department, Kumaun University, Nainital and Systemic Botany division, FRI, Dehradun for identification of plant samples. The first author is highly grateful to Mr. Lal Singh Negri for accompanying in several interviews and to put in touch with several important informants and also for arrangement of stays in the villages during survey and also efforts of Mr. Neeraj Pandey and Mr. Deepak Janoti for accompanying in the forests and managing stays are highly appreciated. Special thanks to Dr. Y. C. Tripathi, FRI for his motivation and Mr. P. C. Pathi district administration Pithoragarh for his valuable support during the survey; many thanks to Ms. Priyanka Harbola for her accompanying and enthusiasm during the initial survey and first author is also very thankful to every driver who helped to reach in the study area despite of very dangerous roads and every other person involved in the study directly and indirectly. We are also very thankful to Dr. Andrei Mocan for giving technical inputs for the improvement of manuscript.

Literature cited
Abbasi AM, Khan MA., Zafar M. 2013. Ethnomedicinal assessment of some selected wild edible fruits and vegetables of Lesser-Himalayas, Pakistan. Pakistan Journal of Botany 45:215-222.
Abbasi AM, Khan MA, Shah MH, Shah MM, Pervez A, Ahmad MI.2013. Ethnobotanical appraisal and cultural values of medicinally important wild edible vegetables of Lesser Himalayas-Pakistan. Journal of Ethnobiology and Ethnomedicine 9:66.
Aburjai T, Hudaib M, Tayyem R, Yousef M, Qishawi M. 2007. Ethnopharmacological survey of medicinal herbs in Jordan, the Ajloun Heights region. Journal of Ethnopharmacology 110:294-304.
Acharya KP, Rokaya MB. 2005. Ethnobotanical survey of medicinal plants traded in the streets of Kathmandu valley, Scientific World 3:44-48.
Agyare C, Asase A, Lechtenberg M, Niehues M, Deters A, Hensel A. 2009. An ethnopharmacological survey and in vitro confirmation of ethnopharmacological use of medicinal plants used for wound healing in Bosomtwi-Atwima-Kwanwoma area, Ghana. Journal of Ethnopharmacology, 125:393-403.
Ahmad I, Ibrar M, Ali N. 2011. Ethnobotanical study of Tehsil Kabal, Swat District, KPK, Pakistan. Journal of Botany 68572.
Ahmed HM. 2016. Ethnopharmacobotanical study on the medicinal plants used by herbalists in Sulaymaniyah Province, Kurdistan, Iraq. Journal of Ethnobiology and Ethnomedicine 12:8.
Allen DE, Hatfield G. 2004. Medicinal plants in folk tradition:an ethnobotany of Britain, Ireland. Tiomber Press.
Amjad MS, Arshad M, Saboor A, Page S, Chaudhari SK. 2017. Ethnobotanical profiling of the medicinal flora of Kotli, Azad Jammu and Kashmir, Pakistan:Empirical reflections on multinomial logit specifications. Asian Pacific Journal of Tropical Medicine 10:503-514.
Amjad MS. 2015. Ethnobotanical profiling and floristic diversity of Bana Valley, Kotli (Azad Jammu and Kashmir), Pakistan. Asian Pacific Journal of Tropical Biomedicine 5:292-299.
Arbiastutie Y, Marsono D, Hartati Maesri, Purwanto R. 2017. The potential of understorey plants from Gunung Gede Pangrango National Park (West Java, Indonesia) as cervixs anticancer agents. Biodiversitas Journal of Biological Diversity 18:109-115.
Atanasov AG, Blunder M, Fakhrudin N, Liu X, Noha SM, et al. 2013. Polyacetylenes from Notopterygium incisum--new selective partial agonists of peroxisome proliferator-activated receptor-gamma. PLoS One, 8:e61755.
Atanasov AG, Waltenberger B, Pferschy-Wenzig EM, Linder T, Wawrosch C, Uhrin P, Temml V, Wang L, Scxhwaiager S, Heiss EH, Rollinger JM, Schuster D, Breuss JM, Boocckov V, Mihovolovic MD, Kopp B, Bauer R, Dirsch VM, Stuppner H. 2015. Discovery and resupply of pharmacologically active plant-derived natural products: A review. Biotechnology Advances. 33:1582-1614.

Ayyanar M, Ignacimuthu S. 2005. Traditional knowledge of Kani tribes in Kouthalai of Tirunelveli hills, Tamil Nadu, India. Journal of Ethnopharmacology, 102:246-255.

Aziz MA, Adnan M, Khan AH, Rehman AU, Jan R, Khan J. 2016. Ethno-medicinal survey of important plants practiced by indigenous community at Ladha subdivision, South Waziristan agency, Pakistan. Journal of Ethnobiology and Ethnomedicine 12:53.

Aziz MA, Khan AH, Adnan M, Izatullah I. 2017. Traditional uses of medicinal plants reported by the indigenous communities and local herbal practitioners of Bajaur Agency, Federally Administered Tribal Areas, Pakistan. Journal of Ethnopharmacology 198:268-281.

Bajpai A, Ojha JK, Sant HR. 1995. Medicobotany of the Varanasi District, Uttar Pradesh, India. International Journal of Pharmacognosy 33:172-176.

Bajpai O, Pandey J, Chaudhary LB. 2016. Ethnomedicinal uses of tree species by Tharu tribes in the Himalayan Terai region of India. Research Journal of Medicinal Plant, 10:19-41.

Balami NP. 2004. Ethnomedicinal uses of plants among the Newar community of Pharping village of Kathmandu District, Nepal. Tribhuvan University Journal 24:13-19.

Barkaoui M, Katiri A, Boubaker H, Msanda F. 2017. Ethnobotanical survey of medicinal plants used in the traditional treatment of diabetes in Chtouka Ait Baha and Tiznit (Western Anti-Atlas), Morocco. Journal of Ethnopharmacology 198:338-350.

Barkaoui M. 2017. Ethnobotanical Survey of Medicinal Plants Used for the Treatment of Diabetes in the Tiznit Test Region (Taroudant Province, Morocco). Journal of Pharmacognosy and Natural Products 3:1-10.

Bartolome AP, Villaseñor IM., Yang W-C. 2013. Bidens pilosa L.(Asteraceae):botanical properties, traditional uses, phytochemistry, and pharmacology. Evidence-based Complementary and Alternative Medicine 340215.

Bashir S, Gilani AH. 2009. Antiurolithic effect of Bergenia ligulata rhizome:an explanation of the underlying mechanisms. Journal of Ethnopharmacology 122:106-116.

Begum S, Abd EI Islam NM, Adnan M, Tariq A, Yasmin A, Hameed R. 2014. Ethnomedicines of Highly Utilized Plants in the Temperate Himalayan Region. African Journal of Traditional Complementary and Alternative Medicine 11:132-142.

Behera SK, Misra MK. 2005. Indigenous phytotherapy for genito-urinary diseases used by the Kandha tribe of Orissa, India. Journal of Ethnopharmacology 102:319-325.

Bekalo TH, Woodmatas SD, Woldemariam ZA. 2009. An ethnobotanical study of medicinal plants used by local people in the lowlands of Konta Special Woreda, southern nations, nationalities and peoples regional state, Ethiopia. Journal of Ethnobiology and Ethnomedicine 5:26.

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.

Bhatia H, Sharma YP, Manhas RK, Kumar K. 2014. Ethnomedicinal plants used by the villagers of district Udhampur, J&K, India. Journal of Ethnopharmacology 151:1005-1018.

Bhatt D, Sharma P, Sharma L, Joshi GC. 2012. Folk herbal remedies for skin care in Kumaun Himalaya. Journal of Non-Timber Forest Products 19:309-312.

Bhushan B, Kumar M. 2013. Ethnobotanically important medicinal plants of Tehsil Billawar, District Kathua, J&K, India. Journal of Pharmacognosy and Phytochemistry 2:14-21.

Bist MK, Badoni AK. 1990. Araceae in the folk life of the tribal populace in Garhwal Himalayas. Journal of Economic Botany and Phytochemistry 1:21-24.

Borah PK, Gogoi P, Phukan AC, Mahanta J. 2006. Traditional medicine in the treatment of gastrointestinal diseases in upper Assam. Indian Journal of Traditional Knowledge 5:510-512.

Borthakur SK, Goswami N. 1995. Herbal remedies from Dimoria of Kamrup district of Assam in northeastern India. Fitoterapia. 66:333-340.

Brahmi F, Abdenour A, Bruno M, Silvia P, Alessandra P, Danilo F, Drifa YG, Fahim EM, Khodir M, Mohamed C. 2016. Chemical composition and in vitro antimicrobial, insecticidal and antioxidant activities of the essential oils of Mentha pulegium L. and Mentha rotundifolia (L.) Huds growing in Algeria, Industrial Crops and Products, 88:96-105.

Bussmann RW, Sharon D. 2006. Traditional
medicinal plant use in Northern Peru: tracking two thousand years of healing culture. Journal of Ethnopharmacology 2:1-18.

Bussmann RW. 2006. Ethnobotany of the Samburu of Mt. Nyiru, South Turkana, Kenya. Journal of Ethnobiology and Ethnomedicine 2:35.

Byahatti VV, Pai KV, D’Souza MG. 2010. Effect of Phenolic Compounds from Bergenia ciliata (Haw.) Sternb. leaves on Experimental kidney stones. Ancient Science of Life 30:14-17.

Candan F, Unlu M, Tepe B, Daferera D, Polissiou M, et al. 2003. Antioxidant and antimicrobial activity of the essential oil and methanol extracts of Achillea millefolium subsp. millefolium Afan. (Asteraceae). Journal of Ethnopharmacology 87:215-220.

Cheikhyoussef A, Shapi M, Matengu K, Mu Ashekele H. 2011. Ethnobotanical study of indigenous knowledge on medicinal plant use by traditional healers in Oshikoto region, Namibia. Journal of Ethnobiology and Ethnomedicine, 7:10.

Dangwal LR, Sharma A. 2011. Indigenous traditional knowledge recorded on some medicinal plants in Narendra Nagar Block (Tehri Garhwal), Uttarakhand. Indian Journal of Traditional Knowledge 2:110-115.

Dangwal LR, Sharma A, Rana CS. 2010. Ethnomedicinal plants of the Garhwal Himalaya used to cure various diseases: A case study. New York Science Journal 3:28-31.

Das PN. 2003, Handbook of medicinal plants, Agrobios.

Eisenberg DM, Davis RB, Ettner SL, Appel S, Wilkey S, et al. 1998. Trends in alternative medicine use in the United States, 1990-1997: results of a follow-up national survey. The Journal of the American Medical Association: 280.

Eldouks M, Ajebli M, Hebi M. 2016. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. Journal of Ethnopharmacology 198:516-530.

Eisenberg DM, Davis RB, Ettner SL, Appel S, Wilkey S, et al. 1998. Trends in alternative medicine use in the United States, 1990-1997: results of a follow-up national survey. The Journal of the American Medical Association: 280.

Eldouks M, Ajebli M, Hebi M. 2016. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. Journal of Ethnopharmacology 198:516-530.

Eldouks M, Ajebli M, Hebi M. 2016. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. Journal of Ethnopharmacology 198:516-530.

Eldouks M, Ajebli M, Hebi M. 2016. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. Journal of Ethnopharmacology 198:516-530.

Eldouks M, Ajebli M, Hebi M. 2016. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. Journal of Ethnopharmacology 198:516-530.

Eldouks M, Ajebli M, Hebi M. 2016. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. Journal of Ethnopharmacology 198:516-530.

Eldouks M, Ajebli M, Hebi M. 2016. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. Journal of Ethnopharmacology 198:516-530.

Eldouks M, Ajebli M, Hebi M. 2016. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. Journal of Ethnopharmacology 198:516-530.

Eldouks M, Ajebli M, Hebi M. 2016. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. Journal of Ethnopharmacology 198:516-530.

Eldouks M, Ajebli M, Hebi M. 2016. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. Journal of Ethnopharmacology 198:516-530.

Eldouks M, Ajebli M, Hebi M. 2016. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. Journal of Ethnopharmacology 198:516-530.

Eldouks M, Ajebli M, Hebi M. 2016. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (Province of Errachidia), Morocco. Journal of Ethnopharmacology 198:516-530.
Indigenous knowledge systems and sustainable management of natural resources in a high altitude society in Kumaun Himalaya, India, Journal of Human Ecology 16:33-42.

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

Gangwar KK, Gangwar RS. 2010. Ethnomedicinal Plant Diversity in Kumaun Himalaya of Uttarakhand, India. Distribution 8:66-78.

Geissberger P, Sequin U. 1991. Constituents of Bidens pilosa L.: do the components found so far explain the use of this plant in traditional medicine? Acta Tropica 48:251-261.

Geng Y, Zhang Y, Ranjitkar S, Huai H, Wang Y. 2016. Traditional knowledge and its transmission of wild edibles used by the Naxi in Baidi Village, northwest Yunnan province. Journal of Ethnobiology and Ethnopharmacology 12:10.

Getnet Z, Chandrodyam S, Masresha G. 2016. Studies on traditional medicinal plants in Ambagiorjs area of Wogera District, Amhara Regional State, Ethiopia. International Journal of Pure and Applied Bioscience 4:38-45.

Gonzalez-Tejero MR, Casares-Porcel M, Sanchez-Rojas CP, Ramiro-Gutierrez JM, Molero-Mesa J, Pieroni A, Giusti MA, Censori E, da Pasquale C, Della A, Paraskeva-Hadjichambli D, Hadijcambis A, Hounani Z, El-Dermerdashi M, EEI-Zayat M, Hmamouchi M, Eljohrig S. 2005. Medicinal plants in the Mediterranean area: synthesis of the results of the project Rubia. Journal of Ethnopharmacology, 116:341-357.

Grover JK, Vats V, Rathi SS, Dawar R. 2001. Traditional Indian anti-diabetic plants attenuate progression of renal damage in streptozotocin induced diabetic mice. Journal of Ethnopharmacology 78:233-238.

Guarrera PM, Forti G, Marignoli S. 2005. Ethnobotanical and ethnomedicinal uses of plants in the district of Acquapendente (Latium, Central Italy). Journal of Ethnopharmacology 96:429-444.

Haq F. 2012. The ethno botanical uses of medicinal plants of Allai Valley, Western Himalaya Pakistan. International Journal of Plant Research 2:21-34.

Heinrich M. 2010. Ethnopharmacology in the 21st century-grand challenges, Frontiers in Pharmacology 1.

Jain SP, Puri HS 1994. An ethno-medico-botanical survey of Parbati Valley in Himachal Pradesh (India). Journal of Economic and Taxonomic Botany 18:321-327.

Jain SP. 1989. Tribal Remedies from Saranda Forest, Bihar, India-I. International Journal of Crude Drug Research 27:29-32.

Jaradat NA, Zaid AN, Al-Ramahi R, Alqub MA, Hussein F, Hamadan Z, Mustafa M, Qneibi M, Ali I. 2017. Ethnopharmaceutical survey of medicinal plants practiced by traditional healers and herbalists for treatment of some urological diseases in the West Bank/Palestine. BMC Complementary and Alternative Medicine, 17:255.

Jha RR, Varma SK. 1996. Ethnobotany of Sauria Paharias of Santhal Pargana, Bihar-I. medicinal plants. Ethnobotany 8:31-35.

Joshi K, Joshi R, Joshi AR. 2011. Indigenous knowledge and uses of medicinal plants in Macchegaun, Nepal. Indian Journal of Traditional Knowledge 10:281-286.

Joshi MP, Negi VS. 1994. Was there a Central Pahari? An appraisal of Grierson’s classification of three Pahari languages groups. Himalaya past Present 3:259-273.

Juarez-Vazquez M del C, Carranza-Alvarez C, Alonso-Castro AJ, Gonzalez-Alcaraz VF, Bravo-Acevedo E, Chimarro-Tinajero FJ, Solano E. 2013. Ethnobotany of medicinal plants used in Xalpatlahuac, Guerrero, Mexico. Journal of Ethnopharmacology 148:521-527.

Kala CP, Farooque NA, Majila BS. 2005. Indigenous knowledge and medicinal plants used by Vaidyas in Uttarakanch, India. Natural Product Radiance 4:195-206.

Kala CP. 2005. Health traditions of Buddhist community and role of amchis in trans-Himalayan region of India. Current Science 89:1331.

Kalita B, Dutta A, Bhagabati SK, Sharma A. 2010. Indigenous technical knowledge for fish harvesting in Karbi-Anglong district of Assam. Indian Journal of Traditional Knowledge 9:252-255.

Kapkoti B, Lodhiyal N., Lodhiyal LS. 2014. Ethno-Medicinal plants and their uses by Van Panchayat people in Nainital of Kumaun Region, Uttarakhand. Biolife, 2:526-532.

Khaleed-Khodja N, Boulekbach-Makhlouf L, Madani K. 2014. Phytochemical screening of antioxidant and...
antibacterial activities of methanolic extracts of some Lamiaceae. Industrial Crops and Products 61:41-48.

Khare CP. 2008. Indian medicinal plants: an illustrated dictionary. Springer Science, Business Media.

Khateeb AM, Khandi SA, Kumar P, Bhadwal MS, Jeelani R. 2015. Ethno-veterinary practices used for the treatment of animal diseases in Doda district, Jammu, Kashmir. Indian Journal of Traditional Knowledge 14:306-312.

Khattak NS, Nouroz F, Rahman IU, Noreen S. 2015. Ethno veterinary uses of medicinal plants of district Karak, Pakistan. Journal of Ethnopharmacology 171:273-279.

Koch M, Kehop DA, Kinminja B, Sabak M, Wavimbukie G, Barrows KM, Matainaho TK, Barrows LR, Rai PP. 2015. An ethnobotanical survey of medicinal plants used in the East Sepik province of Papua New Guinea, Journal of Ethnobiology and Ethnomedicine 11:79.

Koehbach J, Gruber CW. 2013. From ethnopharmacology to drug design. Communicative and Integrative Biology 6:27583.

Kose LS, Moteetee A., Van Vuuren S. 2015. Medicinal plants used for the treatment of tuberculosis in Lesotho: An ethnobotanical survey. South African Journal of Botany 98:183.

Kumar A. 2017. Ethno-Botanical Diversity and Conservation Status of Medicinal Flora at High Terrains of Garhwal (Uttarakhand) Himalaya, India: A Case Study in Context to Multifarious Tourism Growth and Peri-Urban Encroachments. International Journal of Agricultural and Biological Engineering 11:320-325.

Kumar DEK, Janardhana GR. 2012. Ethno botanical polypharmacy of traditional healers in Wayanad (Kerala) to treat type 2 diabetes. Indian Journal of Traditional Knowledge 11:667-673.

Kunwar RM, Bussmann RW. 2006. Ficus (Fig) species in Nepal: a review of diversity and indigenous uses. Lyonia 11:85-97.

Kunwar RM, Adhikari N. 2005. Ethnomedicine of Dolpa district, Nepal: the plants, their vernacular names and uses. Lyonia 8:43-49.

Kunwar RM, Nepal BK, Khsetri HB, Rai SK, Bussmann RW. 2006. Ethnomedicine in Himalaya: a case study from Dolpa, Humila, Jumla and Mustang districts of Nepal. Journal of Ethnobiology and Ethnomedicine, 2:27.

Lans C, Turner N, Khan T, Brauer G, Boepple W. 2007. Ethnoveterinary medicines used for ruminants in British Columbia, Canada. Journal of Ethnobiology and Ethnomedicine 3:11.

Lata S, Seth MK., Kaushal P. 2016. Ethnobotanical Studies on Wild Edible Plants of Tidong Valley of District Kinnaur (HP). International Journal of Science and Research 5:1790-1792.

Longuefosse JL, Nossin E. 1996. Medical ethnobotany survey in Martinique. Journal of Ethnopharmacology 53:117-142.

MacLennan AH, Wilson DH, Taylor AW. 1996. Prevalence and cost of alternative medicine in Australia. Lancet 347:569-573.

Mahmood A, Mahmood A, Shaheen H, Qureshi RA, Sangi Y, Gilani SI. 2011. Ethno medicinal survey of plants from district Bhimber Azad Jammu and Kashmir, Pakistan. Journal of Medicinal Plants Research 5:2348-2360.

Mahmood H, Chaudhry MA, Masood Z, Saeed MA, Adnan S. 2017. A mechanistic evaluation of the traditional uses of Nepeta ruderalis in gastrointestinal and airway disorders. Pharmaceutical Biology 55:1017-1021.

Mallia B, Gauchan DP, Chhetri RB. 2015. An ethnobotanical study of medicinal plants used by ethnic people in Parbat district of western Nepal. Journal of Ethnopharmacology, 165:103-117.

Manandhar NP. 1998. A survey of medicinal plants of Jajarkot district, Nepal, Journal of Ethnopharmacology 48:1-6.

Maroyi A. 2013. Traditional use of medicinal plants in south-central Zimbabwe: review and perspectives, Journal of Ethnobiology and Ethnomedicine, 9:31.

Maroyi A. 2013. Traditional use of medicinal plants in south-central Zimbabwe: review and perspectives, Journal of Ethnobiology and Ethnomedicine 9:31.

Martinez M, Poirrier P, Chamy R, Pruefer D, Schulze-Gronover C, Jorquera L, Ruiz G. 2015. Taraxacum officinale and related species: An ethnopharmacological review and its potential as a commercial medicinal plant. Journal of Ethnopharmacology 169:244-262.

Mathur A, Joshi H. 2013. Ethnobotanical studies of the Tarai Region of Kumaun, Uttarakhand, India. Ethnobotany Research and Applications 11:175-203.

Mawdsley E. 1997. Nonsecessionist regionalism in India: The Uttarakhand separate State movement.
Environment and Planning A 29:2217-2235.

Miliauskas G, Venskutonis PR, Van Beek TA. 2004. Screening of radical scavenging activity of some medicinal and aromatic plant extracts. Food Chemistry 85:231-237.

Moerman DE. 1996. Native North American food and medicinal plants: epistemological considerations, In: Plants for food and medicine. Proceedings of the joint conference of the Society for Economic Botany and the International Society for Ethnopharmacology London 1-6.

Mohanty RB, Padhy SN, Dash SK. 1996. Traditional phytotherapy for diarrhoeal diseases in Ganjam and Phulbani Districts of South Orissa, India. Ethnobotany 8:60-65.

Moteetee A, Seleteng Kose L. 2016. Medicinal plants used in Lesotho for treatment of reproductive and post reproductive problems. Journal of Ethnopharmacology 194:827-849.

Mujtaba Shah G, Abbasi AM, Khan N, Guo X, Ajab Khan M, et al. 2014. Traditional uses of medicinal plants against malarial disease by the tribal communities of Lesser Himalayas-Pakistan. Journal of Ethnopharmacology 155:450-462.

Mukherjee PK, Kumar V, Mal M, Houghton PJ. 2007. Acorus calamus.: Scientific Validation of Ayurvedic Tradition from Natural Resources. Pharmaceutical Biology, 45:651-666.

Musa MS, Abdelrasool FE, Elsheikh EA, Ahmed LAMN, Mahmoud ALE, Yagi SM. 2011. Ethnobotanical study of medicinal plants in the Blue Nile State, South-eastern Sudan Journal of Medicinal Plant Research 5:4287-4297.

Mustafa B, Hajdari A, Krasniqi F, Hoxda E, Ademi H, et al. 2012. Medical ethnobotany of the Albanian Alps in Kosovo. Journal of Ethnobiology and Ethnmedicine 8:6.

Nadkami KM. 1996. Indian materia medica. Dr. KM Nadkami's Indian materia medica:with Ayurvedic, Unani-Tibbi, allopathic, homeopathic, naturopathic, home remedies, appendices, indexes. Volume 1, Popular Prakashan.

Namsa ND, Mandal M, Tangjang S, Mandal SC. 2011. Ethnobotany of the Monpa ethnic group at Arunachal Pradesh, India. Journal of Ethnobiology and Ethnomedicine, 7:31.

Nayak S, Behera SK, Misra MK. 2004. Ethnobotanical survey of Kalahandi district of Orissa. Indian Journal of Traditional Knowledge 3:72-79.

Negi CS. 2003. Role of traditional knowledge and beliefs in conservation- case studies from Central Himalaya, India. Man in India 83:371-391.

Negi VS, Maikhuri RK, Rawat LS. 2011. Non-timber forest products (NTFPs):A viable option for biodiversity conservation and livelihood enhancement in central Himalaya, Biodiversity Conservation, 20:545-559.

Ngarivhume T, van’t Klooster CIEA, de Jong JTVM, Van der Westhuizen JH. 2015. Medicinal plants used by traditional healers for the treatment of malaria in the Chipinge district in Zimbabwe. Journal of Ethnopharmacology 159:224-237.

Noreen Y, el-Seedi H, Perera P, Bohlin L. 1998. Two new isoflavones from Celba pentandra and their effect on cyclooxygenase-catalyzed prostaglandin biosynthesis. Journal of Natural Products 61:8-12.

Noumi E, Hounge F, Lontsi D. 1999. Traditional medicines in primary health care: plants used for the treatment of hypertension in Bafia, Cameroon. Fitoterapia 70:134-139.

Ogbe FMD, Eruogun OL, Uwagboe M. 2009. Plants used for female reproductive health care in Oredo local government area, Nigeria. Scientific Research and Essays 4:120-130.

Okello J, Ssegawa P. 2007. Medicinal plants used by communities of Ngai Subcounty, Apac District, northern Uganda. African Journal of Ecology 45:76-83.

Ouelbani R, Bensari S, Mouas TN, Khelifi D. 2016. Ethnobotanical investigations on plants used in folk medicine in the regions of Constantine and Mila (North-East of Algeria). Journal of Ethnopharmacology 194:196-218.

Panda AK, Swain KC. 2011. Traditional uses and medicinal potential of Cordyceps sinensis of Sikkim. Journal of Ayurveda and Integrative Medicine 2:9-13.

Pande PC, Tiwari L, Pande HC. 2007. Ethnoveterinary plants of Uttarakanchal - A review. Indian Journal of Traditional Knowledge 6:444-458.

Pant SR, Panta IR. 2004. Indigenous knowledge on medicinal plants in Bhagawati Village Development Committee, Darchula, Nepal. Oriental Journal of Plant Science 4:79-81.

Panthi MP, Chaudhary RP. 2002. Angiosperm flora of Argbakhanchi district and adjoining areas, West Nepal. Journal of Natural History Museum 21:7-32.

Parihaar RS, Bargali K., Bargali SS. 2014. Diversity and uses of Ethno-medicinal plants associated with traditional agroforestry systems in Kumaun Himalaya. Indian Journal of Agriculture Science 84:1470-1476.
Paudyal R, Singh NB. 2015. Ethno-medicinal Uses of Animals and Plants among the Migratory Tangbetons of Pokhara, Nepal. Journal of Institute of Science and Technology 19:145-149.

Phillips O, Gentry, AH. 1993. The useful plants of Tambopata, Peru: II. Additional hypothesis testing in quantitative ethnobotany. Economic Botany 47:33-43.

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 Applications 8:233-244.

Quattrocchi U. 2012. CRC world dictionary of medicinal and poisonous plants: common names, scientific names, eponyms, synonyms, and etymology. CRC Press.

Rahman IU, Ijaz F, Iqbal Z, Ali N, Afzal M, Azhar Khan M, Muhammad S, Qadir G, Asif M. 2016. A novel survey of the ethno medicinal knowledge of dental problems in Manoor Valley (Northern Himalaya), Pakistan. Journal of Ethnopharmacology 194:877-894.

Rahmatullah M, Hossan S, Khatun A, Seraj S, Jahan R. 2012. Medicinal plants used by various tribes of Bangladesh for treatment of malaria. Malaria Research and Treatment, 2012.

Rana D, Masoodi HUR, Ul R. 2014. Ethno-botanical survey for wild plants in fringe villages around Shimla Water Catchment Sanctuary, Himachal Pradesh, India. Journal of Applied and Natural Science 1:720-724.

Rao RR. 1983. Ethnobotanical studies in Nagaland. 4. Sixty two medicinal plants used by the angamingers Journal of Economic and Taxonomic Botany 4:167-172.

Rawat DS, Kharwal AD, Rawat S. 2010. Ethnobotanical Studies on Dental Hygiene in District Hamipur, Himachal Pradesh (HP), India. Ethnobotany Leaflets, 2009:4.

Rivier L, Bruhn JG. 1979. Editorial. Journal of Ethnopharmacology 1:1.

Sadeghi Z, Mahmood A. 2014. Ethno-gynecological knowledge of medicinal plants used by Baluch tribes, southeast of Baluchistan, Iran, Revista Brasileira de Farmacognosia, 24:706-715.

Saikia AP, Ryakala VK, Sharma P, Goswami P, Bora U. 2006. Ethnobotany of medicinal plants used by Assamese people for various skin ailments and cosmetics. Journal of Ethnopharmacology 106:149-157.

Šarić-Kundalić B, Dobeš C, Klatte-Asselmeyer V, Saukel J. 2011. Ethnobotanical survey of traditionally used plants in human therapy of east, north and north-east Bosnia and Herzegovina. Journal of Ethnopharmacology 133:1051-1076.

Sen S, Chakraborty R, De B, Devanna N. 2011. An ethnobotanical survey of medicinal plants used by ethnic people in West and South district of Tripura, India. Journal of Forestry Research 22:417-426.

Shah NC, Joshi MC. 1971. An ethnobotanical study of the Kumaon region of India, Economic Botany 25:414-422.

Sharma J, Gaur RD, Painuli RM. 2011. Conservation status and diversity of some important plants in the Shivalik Himalaya of Uttarakhand , India, International Journal of Medicinal and Aromatic Plants, 1:75-82.

Sharma M, Sood SK. 2013. Ethnobotanical survey for wild plants of district Solan, Himachal Pradesh, India. International Journal of Environmental Biology 3:87-95.

Sharma P, Patti P, Agnihotry A. 2013. Ethnobotanical and ethnomedicinal uses of floristic diversity in Murari Devi and surrounding areas of Mandi District in Himachal Pradesh, India. Pakistan Journal of Biological Sciences, 16:451-468.

Sharmila S, Kalaichelvi K, Rajeswari M, Anjanadevi N. 2014. Studies on the folklore medicinal uses of some indigenous plants among the tribes of Thiazhola, Manjoor, Nilgiris South Division, Western Ghats. International Journal of Plant, Animal and Environmental Sciences 4:14-22.

Shawahna R, Jaradat NA. 2017. Ethnopharmacological survey of medicinal plants used by patients with psoriasis in the West Bank of Palestine. BMC Complementary and Alternative Medicine 17:4.

Sigdel SR, Rokaya MB, Timsina B. 2013. Plant Inventory and Ethnobotanical Study of Khimti Hydropower Project, Central Nepal. Scientific World 11:105-112.

Silja VP, Varma KS, Mohanan KV. 2008. Ethnomedicinal plant knowledge of the Mullu kuruma tribe of Wayanad district, Kerala. Indian Journal of Traditional Knowledge 7:604-612.

Singh AG, Kumar A, Tewari DD. 2012. An ethnobotanical survey of medicinal plants used in Terai forest of western Nepal. Journal of Ethnobiology and Ethnomedicine 8:19.

Singh V. 1995. Traditional remedies to treat asthma in North West and Trans-Himalayan region in J., K. state. Fitoterapia 66:507-509.
Siriwatanametanon N, Heinrich M. 2011. The Thai medicinal plant Gynura pseudochina var. hispida: chemical composition and in vitro NF-κappaB inhibitory activity. Natural Product Communication 6:627-630.

Srivastava TN, Rajasekharan S, Badola DP, Shah DC. 1986. An index of the available medicinal plants, used in indian system of medicine from Jammu and Kashmir state. Ancient Science of Life 6:49-63.

Tahvilian R, Shahriri S, Faramarzi A, Komasi A. 2014. Ethno-pharmaceutical Formulations in Kurdistan Ethno-medicine. Iranian Journal of Pharmaceutical Research 13:1029-1039.

Tariq A, Mussarat S, Adnan M, Abd Allah EF, Hashem A, Alqarawi AA, Ullah R. 2015. Ethnomedicinal evaluation of medicinal plants used against gastrointestinal complaints. Biomed Research International 892947.

Tayade SK, Patil DA. 2006. Ethnomedicinal wisdom of tribals of Nandurbar district (Maharashtra). Indian Journal of Traditional Knowledge 5:64-69.

Teklay A, Abera B, Giday M. 2013. An ethnobotanical study of medicinal plants used in Kiltie Awulaelo District, Tigray Region of Ethiopia. Journal of Ethnobiology and Ethnomedicine 9:65.

Tiwari JK, Dangwal LR, Rana CS, Tiwari P, Ballabha R. 2010. Indigenous uses of plant species in Nanda Devi Biosphere Reserve, Uttarakhand, India. Report and Opinion 2:58-61.

Tiwari L, Pande PC. 2004. Traditional veterinary practices in south-eastern part of Chamoli district, Uttaranchal. Indian Journal of Traditional Knowledge 3:397-406.

Trotter RT, Logan MH. 1989. Informants consensus: a new approach for identifying potentially effective medicinal plants. Plants in Indigenous Medicine and Diet. Edited by Etkin NL.

Uddin MZ, Hassan MA, Rahman M, Arefin K. 2012. Ethno-medico-botanical study in Lawachara National park, Bangladesh. Bangladesh Journal of Botany, 41:97-104.

Uniyal SK, Singh KN, Jamwal P, Lal B. 2006. Traditional use of medicinal plants among the tribal communities of Chhota Bhangal, Western Himalaya. Journal of Ethnobiology and Ethnomedicine 2:14.

Upadhyay VP, Pandey K. 1984. Ayurvedic approach to diabetes mellitus and its management by indigenous resources, in:Diabetes mellitus in developing countries, JS Bajaj Interprint, New Delhi:Ch. 69:375-377.

Upreti K, Jalal JS, Tewari LM, Joshi GC, Pangtey YPS, Tewari G. 2009. Ethnomedicinal uses of Pteridophytes of Kumaun Himalaya, Uttarakhand, India. Journal of American Science 5:167-170.

Upreti Y, Asselin H, Dhakal A, Julien N. 2012. Traditional use of medicinal plants in the boreal forest of Canada: review and perspectives. Journal of Ethnobiology and Ethnomedicine, 8:7.

Kumari P, Joshi GC, Tewari LM. 2012. Indigenous uses of threatened Ethno-medicinal plants used to cure different diseases by ethnic people of Almora district of Western Himalaya. International Journal of Ayurvedic and Herbal Medicine 2:661-678.

Verma H, Lal V, Pant K, Soni N. 2012. A Ethnomedicinal Review on Arisaema tortuosum. International Journal of advances in Pharmacy, Biology and Chemistry, 1:176-179.

Verma S, Chauhan NS. 2007. Indigenous medicinal plants knowledge of Kunihar forest division, district Solan. Indian Journal of Traditional Knowledge 6:494-497

Viswanathan K. 1995. Survey on medicinal spices of the Nilgiris. Ancient Science of Life, 14:258.

Wanjiku NE. 2010. Ethnomedicne of Ogiek of River Njoro watershed, Nakuru, Kenya. Ethnobotany Research and Applications 8:135-152.

Zhang L, Chai Z, Zhang Y, Geng Y, Wang Y. 2016. Ethnobotanical study of traditional edible plants used by the Naxi people during droughts. Journal of Ethnobiology and Ethnomedicine, 12:39.

Zhao L, Tian S, Wen E, Upur H. 2017. An ethnopharmacological study of aromatic Uyghur medicinal plants in Xinjiang, China. Pharmaceutical Biology 55:1114-1130.
Plate 1. Social life & Challenges (A: Poor economic condition of villagers living in hut with their Cattle’s; B: Poor situation of road towards the main block; C: People use old traditional “Chulha” for cooking in their business; D: Poor connectivity of transport; E: Agriculture in terrain system; F: Typical device to cross the river in the rainy season)
Plate 2. Plants collected during study (A: *Berberis aristata* DC. (Flowering); B: *Berberis aristata* DC. (Fruiting); C: *Rhododendron arboreum* Sm. (Tree); D: *Rhododendron arboreum* Sm. (Flower); E: *Punica granatum* L. (Fruit budding); F: *Punica granatum* L. (Flowering))
Plate 3. Plants collected during study (A: Roscoea procera Wall.; B: Hedychium spicatum Sm.; C: Nepeta hindostana (Roth) Haiens.; D: Geranium wallichianum D. Don ex Sweet.; E: Digitalis purpurea L.; F: Zephyranthes grandiflora Lindle.)
Plate 4. Plants collected during study (A: *Solanum nigrum* L.; B: *Juglans regia* L.; C: *Pyracantha crenulata* (Roxb. ex D. Don) M. Roem.; D: *Rubus ellipticus* Sm.; E: *Urtica dioca* L.; F: *Cannabis sativa* L.)
Plate 5. Plants collected during study (A: *Euphorbia prolifera* Buch.-Ham in D. Don.; B: *Phytolacca acinosa* Roxb.; C: *Carum carvi* L.; D: *Pinus roxburghii* Sarg.; E: *Allium stracheyi* Baker.; F: *Taraxacum officinale* G.E. Hugland)
Plate 6. Plants collected during study (A: Ipomoea purpurea Roth; B: Malva verticillata L.; C: Salvia leucantha Cav.; D: Satyrium nepalensis DC.; E: Areseamone tortuosum (Wallich) Schott; F: Ficus palmata L.)
Plate 7. Plants collected during study (A: *Datura innoxia* Mill.; B: *Boenninghausenia albiflora* (Hook) Meisn; C: *Murraya koenigi* (L.) Spreng.; D: *Callicarpa macrophylla* Vohl.; E: *Cautlaya spicata* (J.E. Smith) Baker; F: *Daphne papyracea* Wall. ex Don.)
Plate 8. Plants collected during study (A: Lyonia ovalifolia (Wall.) Drude.; B: Polygonum hydropiper L.; C: Bidens pilosa L.; D: Rubia cordifolia L.; E: Inula cuspidata (Wall. ex DC.) C.B. Clarke; F: Bergenia ciliata (Haw.) Sternb