Ethnomedicinal knowledge of a marginal hill community of Central Himalaya: Diversity, usage pattern and conservation concerns

S. N. Ojha

Govind Ballabh Pant National Institute of Himalayan Environment and Sustainable Development

Deepti Tiwari

Govind Ballabh Pant National Institute of Himalayan Environment and Sustainable Development

Aryan Anand

Govind Ballabh Pant National Institute of Himalayan Environment and Sustainable Development

R.C. Sundriyal (✉ sundriyalrc@yahoo.com)

G.B. Pant Institute of Himalayan Environment and Development

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Abstract

Background Indigenous communities use wild plants to cure human ailments since ancient times, such knowledge has significant potential for formulating new drugs and administering future health care. Considering this the present study was undertaken to assess use value, diversity, and conservation concerns of medicinal plants used in traditional herbal care system of a marginal hill community in Bageshwar district of Uttarakhand in the Central Himalayan region of India.

Methodology Extensive surveys were made in 73 villages to gather information on ethnomedicinal use of plant species used in traditional herbal healing system. A total of 100 respondents were identified (30 herbal healers called 'Vaidyas' and 70 non-healers/natives) and interviewed using semi-structured questionnaires, target interviews and group discussion. Some important indices such as the use value index (UV), relative frequency citation (RFC), cultural importance index (CI), and informant consensus factor (F_{ic}) were calculated for the medicinal plants included in the present study.

Result It was recorded that the community use a total of 70 species with 64 genera and 35 families for curing various ailments. Family Lamiaceae recorded maximum number of medicinal plants. 21 species used most extensively in traditional health care system. The major parts of the identified plants used for treatment of various ailments were root/rhizome and leaf. The most common methods used for preparation of these plants were decoction and infusion. *Ocimum basilicum* L., *Cannabis sativa* L., *Citrus aurantifolia* (Christm) Sw., *Curcuma longa* L. and *Setaria italic* L. had the highest rate of use report. RFC value ranged between 0.03 to 0.91 with highest values for *Setaria italica*, *Zingiber officinale*, *Ocimum basilicum*, and *Rephanus sativus*. The traditional knowledge is passed verbally to generations and needs to be preserved for the future bio-prospecting of plants that could be a potential cure to any future disease.

Conclusion In recent years the community has access to modern hospitals and medicinal facilities, although a considerable number still prefer medicinal plants for curing select ailments. It is suggested that these ethnomedicinal species need to be screened and evaluated further for their effectiveness for pharmacological activity. Also, significant efforts are required to conserve traditional knowledge and natural habitats of wild medicinal plants.

Introduction

Medicinal plants have been utilized for the treatment of various diseases since ancient time, thus form an important element of aboriginal curative systems. The Indian *Rishis* first documented the use of medicinal plants in the form of Samhitas. *Charak Samhita* (1000-800BC) and *Shushrut Samhita* (800-700BC) by Maharshi Charak and Maharshi Shashurur respectively, are the baselines of the Indian Medicinal System. Maharshi Charak mentioned over 500 medicinal plants, out of which 340 plants used in the production of herbal medicine[1-2]. AYUSH (i.e. Ayurveda, Unani, Siddha, and Homeopathy) is another traditional Indian healthcare system that is considered a great knowledge-based in herbal medicines. Ayurveda reports over 2000 medicinal plant species, Siddha 1121 plant species, Unani 751 species, and homeopathy 422 species[3]. Nearly 70-80% population worldwide still relies on traditional medicinal systems for their primary healthcare because of their effectiveness, cultural preferences, and lack of modern healthcare alternatives[4-5]. The global demand for herbal medicine continues to increase over the past few decades. The earlier studies stated that out of 2,50,000 flowering plants in the world only less than 10% have been examined successfully for their medicinal potency and still, 90% remains unexplored[2]. In recent times there is an increased interest regarding use of medicinal plant to develop new drugs and medicines for fulfilling the demand of growing population[6-8]. Therefore information on plants of ethnomedicinal importance holds high potential. Uttarakhand Himalaya is a mountainous region in the northern India that has unique geography, rich biological resources, cultural heritage and diverse climatic conditions which supports the highest number of medicinal plant species[9]. Over two-third population live in rural areas and depend on diverse natural resources to fulfil their need of food, fuel, fodder, timber, medicine, etc. Communities use large variety of medicinal plants for treating diverse ailments[10-11]. However, it is strongly being realized that the indigenous knowledge related to herbal medicines is continuously being eroded despite of high significance to humanity. The subject needs further research such as documentation of potential medicinal species, analyzing their active constituents, clinical trials for validations, and developing new drugs and medicines[1,4,8-12]. Considering this the present study was undertaken. We hypothesize that sustainable management and conservation of medicinal plants can be achieved when information about medicinal plants that are utilized for treating ailments and traditional herbal practices within particular areas are available. Such information is strongly desired to be preserved from being lost for the use of both present and future generations. For the purpose of this study we selected marginal community and local herbal practitioners (*Vaidyas*) of Bageshwar district in Uttarakhand state in north India and documented ethnomedicinal plant diversity and traditional medicinal practices being used by them. Efforts are also made to scientifically validate

and interpret the data using several indices such as Relative Frequency Citation (RFC), Use report (Categorical and disease-based), Cultural Importance Index (CI), and Informant Consensus Index (F_{ci}) so as to verify the homogeneity, importance, cultural similarity of the medicinal plants in communities. It is expected that the qualitative and quantitative information generated from this study will have immense utility for conservation and sustainable utilization of medicinal plants as well as for managing traditional health care system.

Materials And Methods

Study area

The aim of this study was to investigate the medicinal species used by the marginal hill community living in remote and high-altitude areas where medical healthcare facilities are not easily available. These practices are being used since eternity descended from the inherited knowledge of the locals and indigenous population of Uttarakhand. The study was carried out at Bageshwar district (geographical area 1687.8 km²) of Uttarakhand State and lies between latitudes 29°42'40" to 30°18'56"N and longitudes 79°23' to 80°10'E (Fig.1). The district is situated on the confluence of Gomti river and Saryu river which is a tributary of Kali river. It is bounded by Almora district in the southwest, Chamoli district in the north and northwest, and Pithoragarh district in the east. Administratively the district is divisible into four Tehsils, viz. Bageshwar, Kapkot, Kanda (Sub-tehsil) and Garur, and three blocks, viz. Bageshwar, Garur and Kapkot. There are 947 revenue villages, out of which 874 villages are inhabited and 73 villages are uninhabited. As per the 2011 census the total population of Bageshwar district is 270,332. 259,898 (male 48%, female 52%) with 96% living in the rural areas.

The community of the area divided into 3 categories viz., General, Scheduled Class (SC), Scheduled Tribe (ST), and majority of them involved in primary sector (agricultural activities), while some also work in secondary and tertiary sectors, such as private works, businesses, govt. jobs etc. As such the community is highly marginal with small and scattered land holdings, low production and low income; therefore, highly dependent on natural resources. Male population out-migrates to earn better livelihoods that lead to continuous increase in fallow lands and culturable waste lands.

Data collection:

The study was conducted in 39 villages covering Garur-Ganga valley (23 villages) and Saryu valley (16 villages) of Garur and Kapkot Blocks during 2016-2018. To fulfil the objectives of the study, extensive field visits were made to gather information from traditional herbal healers (*Vaidyas*) and indigenous people using semi-structured questionnaires, target interviews, visual interpretation through snowball methodology. A total of 100 respondents were randomly selected for the present study from both valleys, 37 being male and 63 female respondents. Of them 30 were *Vaidyas* (male 19, female 11). Female informants were given preference in view of their dominance in villages when selecting the population due to their dominance in household and foraging sector. The age group of informants varied between 30 to 83 year although most of them vary between 50-65 years of age (Fig.2). The questionnaire contains information about the ethnomedicinal plants with their local name, parts used, habit, ailment treated by medicinal plants and mode of utilization of herbal formulation. Two general meetings and interviews were also organized at each valley with *Vaidyas* and natives. The documented medicinal plant species were collected and validated for identification using available literature [13-16]. The specimens matched with the herbarium lodged in CCRAS-RARI, Tarikhet, Ranikhet, Uttarakhand (acronym RKT), which houses largest medicinal plant herbariums in the northern India. A few generally available species were matched with the plant database of Centre for Socio-Economic Development deposited at G.B. Pant National Institute of Himalayan Environment (GBP-NIHE), Almora, Uttarakhand.

Ethno-botanical Analysis

The information on ethnomedicinal important species were recorded including the local names of the species, habit, their uses in different forms, the part used in the medical practice, mode of administration and the condition of the plant (fresh or dry). The plants were classified into 12 main categories of ailments which were further divided into different respective sub-categories on the basis of disease and affected body part. The data were then statistically analyzed for different parameters. In order to enhance the indicative value of the ethnomedicinal study suitable quantitative methods and approaches were used in the form of indices, such as relative frequency of citation (RFC); use report (on the basis of illness, on the basis of taxa); cultural importance (CI) and consensus factor of informants (F_{ci}).

Use Report Values (UR) provides information on the total number of reported uses for each species. It is similar to the use-value of a species but for use report, the number of events (interviews) the process of asking one informant on one day about the uses they know

for one species, is one because the respondents were interviewed only once. And response use values are broken down by the number of uses reported for each plant species part.

Use Value Index (UV) depicts the importance of each species for each informant and calculated by $UV = \sum U/N$ formula where U is the number of uses quoted in each interview by N number of informants. Use values are high when there are many useful reports for a plant representing its importance, and come within reach of to zero (0) when the use reports are low[17].

Relative Frequency Citation (RFC) index reveals the usage importance of a particular species used by different informants. The index is calculated by dividing the total number of informants referring to a particular taxon with the total number of informants given ($RFC = FC_s/N$) Where FC is the total number of informants that referred to the taxon and N is the total number of informants[18].

Cultural Importance Index (CI) is estimated for each locality as the summation of Use-Report (UR) in every use category mentioned for a species in the locality divided by the total number of informants. This index provides an implication of the involvement of a particular taxon in the community and a greater value signifies that a particular is widely distributed amongst communities. A null value indicates non-existence of the species in the area. CI is calculated as: $CI = UR/N$ where UR is the total number of use reports for each species in every category of illness mentioned and N is the total number of informants[19].

Informant consensus Factor (F_{ic}) is used to test the consistency of information knowledge in treating a particular illness category. The values obtained, are near one (1) if there lie well-defined selection criteria in the community and/or if the information is exchanged between the informants. A value approaching zero (0) represents that the plants are chosen randomly and/or there is no information exchanged between the communities about their use. F_{ic} is calculated as $F_{ic} = (N_{ur} - N_t) / (N_{ur} - 1)$. Where N_{ur} refers to the number of use reports for a particular use category and N_t refers to the number of taxa used for a particular use category by all informants [20].

Result And Discussion

Ethnomedicinal uses of plants and mode of practice

The residents of different age groups were surveyed to assess ethnomedicinal uses of plant species (Fig. 2). The survey revealed that a total of 70 medicinal plant species varying from 35 families and 64 genera have been used by the inhabitants of 39 villages for different (Table 1). Family Lamiaceae recorded maximum species (8) followed by Asteraceae (6 species), Fabaceae (5 species), Rosaceae (4 species) and Apiaceae, Liliaceae, Ranunculaceae, Rutaceae, Zingiberaceae (3 species each). The remaining families were represented with just one or two species. Almost all the species are widely used by the community. Of the total documented medicinal plant species the herbaceous habit (51 species) was most dominant life form, followed by the tree (10), shrub (7) and climbers (2 species)(Fig.3).

It was interesting to note that nearly 70% population still use prescription of *Vaidyas* for common ailments, although the *Vaidyas* were having an age of >50 years. The diseases cured by *Vaidyas* comprised fever, stomach problem, cough, cold, headache, etc. from centuries. The most common plant parts used was root/rhizome, followed by leaf, whole plant, seeds, fruits, flower, and bulb and latex (Fig. 4). The collection of plant part was very selective keeping into consideration the time of collection, plant matureness, and quantity of use thus ensuring a conservation approach. *Vaidyas* comprised sound knowledge and species-specific method of preparing drugs to cure various ailments (Table 2). Making decoction and ingestion was the most common modes of plant part use (Fig.5). Poultice and cooking were also favored for many medicinal plants. Another mode of application include cooking and making into powder (9.42%), direct application (7.97%), emulsion and infusion (5.80%), and ointment (2.17%) (Fig. 5). Decoction is most commonly used method to cure ailments in traditional herbal systems [38-42]. It is considered to extract all potential bioactive compounds after heating [43]. The pleasant taste of the herbal drug can be attuned by adding together honey or sugar [44]. Ingestion and poultice was also common after crushing and/or mixing the plant parts with some solvent for application as paste and band-aid. In skeletal, muscle and dermatological issues application of plant parts as ointment was most prevalent.

The community and *Vaidyas* identify each medicinal plants with a specific vernacular name. For example, *Berginia ciliata* is identified by the community with a local name 'Pattharchatta' (stone destroyer) and it is used in curing kidney stone. *Plantago ovate* is called 'Jonkpuri' (jonk resembles worms) is used in the treatment of *Ascaris* and other worms. *Viola betonicifolia* named as 'Garur-Jadi' (Garur means eagle) and it is used as an antidote to treat snake bites. It is common that community identify a native name for species based on its local uses, ecology, physiology, anatomy, pharmacological activity, etc.[45].

It was recorded that the species were used to cure a total of 12 major ailments (Fig. 6). Most species were used for curing gastrointestinal and general health disorders. It was followed by species used for treating dermatological and respiratory problems.

Lamiaceae has been the most dominating family for ethnomedicinal uses in trans-Himalayan zone of Nepal [26] and Garhwal Himalaya in India as well [27]. Although the people in remote areas are still dependent on the traditional herbal cure system, it is being practiced by a few elderly people only. Young generation is not interested to take up this profession in view of minimal profit [3,10,12]. The common plant part in the present study is similar to other investigations [28-32]. The roots being the storage part of the plant it contains valuable bioactive compounds [33]. Apart from the root part, leaves also contain a high concentration of health-beneficial secondary metabolites, phytochemicals, and essential oils, which contribute significantly to phototherapy or treatment of various health disorders [34-37]. The study reports 60% more species than reported earlier for the area under investigation[21-25].

Quantitative analysis of ethnomedicinal information

Use value of important ethnomedicinal species was also calculated to depict number of uses reported by the informants related to the utility of a species for a specific ailment or different ailments (Table 1,3). Two forms of use reports were analyzed; the UR^c defines use of a particular species to cure specific ailments as reported by all the informants, while UR^d reports the sum of all the uses for a particular disease/ailment. *Ocimum basilicum*, *Cannabis sativa*, *Citrus aurantifolia*, *Curcuma longa* and *Setaria italica* have been top positioned in terms of use-reports and different ailments cured.

The usefulness of a species can be represented through its RFC value, which ranged 0.03 to 0.91 for different species (Table 1). Species with maximum RFC value were *Setaria italica*, *Zingiber officinale*, *Ocimum basilicum*, and *Rephanus sativus* which depict their higher use, while those with least value comprised *Duchesnea indica* and *Thalictrum foliosum*.

The Cultural importance index (CI_s) specifies the distribution and importance of species in traditional herbal system and the value ranged from 0.03 to 0.97. A total of 21 species have been identified as most commonly used (Table 3). *Ocimum basilicum*, *Cannabis sativa*, and *Citrus aurantifolia* registered highest cultural importance in traditional herbal cure system. Low CI values specify that these species are either least used or their use is declining up in traditional herbal cure system [49].

An analysis of Informant Consensus Factor (F_{ic}) for 12 broad treatment categories most ranged between 0.92 to 1.0 (Table 4). The data revealed high homogeneity as per local people for all treatments. Immuno-regulatory category was assigned the value 1 due to presence of only one taxa in the particular category. Apart from this, hepatic health care and urogenital categories obtained the value of 0.98 indicating a well-defines criteria among the local population and non-random selection of species for the ailment category. *Asparagus recemosus*, *Glycine max*, *Hordium vulgare*, *Polygonatum cirrhifolium*, *Punica granatum*, *Rephanus sativus* and *Urtica dioica* not only used in hepatic health care but also provide nutritive benefits and warm-potency particularly at higher altitude areas. These species are commonly used in daily food habit of the local community. Also, a higher value of F_{ic} verifies the distribution of the different species used for a specific ailment. The urogenital category, with only 4 taxa included comes second in terms of CI as there is a widely accepted notion of using these species for such disorders. The higher value of informant consensus factor for all the ailment categories also imply that the documented species are the most commonly used thin traditional healing system.

The gastrointestinal ailments comprised of 695 use reports from the total categories with a medicinal importance index value of 30.22 (Table 4). Some most sought species in this category are *Cannabis sativa*, *Citrus aurantifolia*, *Angelica galuca*, *Ajuga parviflora*, and *Embllica officinalis*. These species are placed in accordance with their use reports mentioned during data collection. In the category of general health care, 22 species are being used with 524 numbers of use-reports & medical importance of 23.82. The species indicated with the highest number of use-reports are *Ocimum basilicum*, *Citrus aurantifolia*, *Curcuma longa*, *Ajuga parviflora* and *Picorhiza kurrooa* on the basis of user reports. Dermatological category ranks third with 21 taxa in use and use report value of 617 and medicinal importance of 29.82. The main species employed for this category on the basis of use reports are *Setaria italica*, *Eupatorium adenophorum*, *Artemisia martima*. Although the hepatic health cure category comprised of only 8 taxa, it has a medicinal importance index values of 45.50, which is highest of all the categories since the species used under the category are of daily usage and are often included in daily food products with nutritive values. The species include *Glycine max*, *Hordium vulgare*, *Punica granatum*, *Urtica dioica*, *Polygonatum cirrhifolium* etc. In other works carried out in Uttarakhand, they were reported these medicinal plants and use different plant parts in different ratio to cure disease or ailments [16,21-23,25,27,28,46-48].

A correlation analysis was done among RFC, CI, UR, number of species used in treating different ailments, Informant consensus factor (F_{ic}) and Medical Importance. No evidence of any correlation was observed in most of the parameters, a highly positive correlation was

only observed in Number of taxa used and number of use reports (0.963). Also, there has been a moderately positive correlation observed between F_{ic} and RFC which is of no significance in the study as both the parameters have been described differently.

Some species are also used in ethnoveterinary purposes for curing domestic animals. *Ajuga parviflora* is used to cure throat infection, *Coriandrum sativum* against poison, *Taraxacum officinale*, *Verbascum thapsus* and *Viola canescens* to increase lactation in milching animals.

Weakening of traditional ethnobotanical knowledge

It is alarming to note that there has been continued decline in traditional ethnobotanical knowledge in the target area (Fig.7). An analysis of community perception on change in use pattern of medicinal plants in 2018 and a decade earlier (i.e. 2008) revealed that there are less number of species used for curing different ailments in recent years (Table 5). People are moving away from traditional herbal cure system and the young generation has no interest in the traditional customs and values. Earlier the people of remote areas preferred to consult with *Vaidyas* for primary healthcare but for last one decade since there is an increase in accessibility, availability and affordability towards the allopathic medicinal system, the local community is also opting for such options. Despite of that 57% of the total respondents believe that these plants are highly effective, 30% found moderately effective, while only 13% feel it less effective (Fig. 8). Interestingly, to cure selective diseases in children, such as *Juga* (removal of Ascaris), *Chupad* (heavy cough), and *Kasar* (constipation) still people prefer traditional cure system as it has no side effects. During the study it was observed that the *Vaidyas* do not share their knowledge, they believed that the treatment will not be effective if they share the knowledge with anybody. In the changing lifestyle and socioeconomic scenarios, most of the inhabitants are reluctant to live with their traditional heritage leading to the vanishing of the knowledge [50].

Conclusion

Community knowledge on use and management of wild plant resources has always been integral to the survival, sustenance and adaptation of human cultures [46,50,56]. This study revealed 70 medicinal plant species being used by local marginal community of which 21 are most extensively used species to treat various ailments. The significance of traditional herbal healing system is highly relevant due to its effectiveness. It is cost effective and based on local resources, and still only means of cure for marginal communities in remote localities. Uttarakhand and with population growth and lack of health care there is a need to adhere to the locally available resources to be utilized for general health care and provisioning of suitable side-effect free treatment to the communities. The community still use these species, however the level of use is decreasing in view of upcoming modern allopathic based health-care services. At the same time there is also a decline in number of local *Vaidhyas* and herbal practitioners. This is because increased access to modern hospitals and medicinal facilities in recent times. This possess significance challenge to the continuity of traditional herbal cure system. The impoverishment of such knowledge may lead to an enormous loss to the scientific community. The ethnomedicinal knowledge and information provided in this study is of significant value for scientific validation, product development, conservation and policy planners for sustainable management of medicinal plants and traditional herbal cure system. It is suggested to explore and establish linkage between traditional health practices and modern health-care systems. It can be done by testing bioactive compound and biological activity of most preferred plant species, and assessing safety and efficacy of local herbal formulation. Such an investigation may lead to many new and novel drug discovery. It is also recommended that the natural habitats of medicinal plants should be protected for conservation of valuable gene pool and to control over exploitation of species. Since ethnomedicinal information is strongly linked to local livelihoods, culture and environment, it is strongly recommended to further continue studying the subject so as to serve the humanity with healthier and operative health care measures.

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Declarations

Author Information:

1. Dr. Saraswati Nandan Ojha; Email: ojhasn16@gmail.com
2. Deepti Tiwari; Email: pandeydeepti1990@gmail.com
3. Aryan Anand; Email: aryananand2010@gmail.com
4. Dr. Rakesh Chandra Sundriyal; Email: sundriyalrc@yahoo.com

Institute Name:

G. B. Pant National Institute of Himalayan Environment, Kosi – Katarmal, Almora – 263643, Uttarakhand, India.

Authors' contributions

SNO, DT and AA planned and performed the study and field survey, writing the draft manuscript, and analyzed the data and RCY revised the manuscript and data analysis. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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Availability of data and materials

The authors already included all data in the manuscript collected during the field surveys. The documented medicinal plant species were deposited at Centre of Socio-economic Development (CSED), GBPNIHE, Kosi-Katarmal, Almora, Uttarakhand.

Ethics approval and consent to participate

During field work prior consent of the informants was taken conducting these studies. This was done to adhere to the ethical standards of community participation in scientific research.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Tables

Table 1. Quantitative enumeration of ethno-medicinal plants used by marginal hill community of district Bageshwar.

Botanical Name	Local Name	Voucher/ Ident. No.	Habit	Part Used	Popular Ailment Uses (Group & Categories)	Used in	Preparation	FC ^a	RFC ^b	UR ^c	UR ^d	CI ^e
Family: Alliaceae												
<i>Allium sativum</i> L.	Lasan	GBPCSED1	H	B	Skeleton & muscles- Joint Pain (Arthritis)	Hu	O	59	0.59	59	59	0.59
Family: Apiaceae												
<i>Angelica glauca</i> Edgew.	Gandaraini	RKT 27789	H	Rt	Gastrointestinal- Stomach ache, vomiting, Other - Spices & condiment, Herbal tea	Hu	Po Co, Inf	44	0.44	35	89	0.89
<i>Centella asiatica</i> L.	Brahmi	RKT 28186	H	L	General health care - Headache	Hu	Po	28	0.28	28	28	0.28
<i>Coriandrum sativum</i> L.	Dhaniya	RKT 28118	H	Sd	Antidote - Against poison	C	Em	36	0.36	36	36	0.36
Family: Araceae												
<i>Acorus calamus</i> L.	Bojh/Buch	RKT 27965	H	Rh	Skeleton & muscles- Sprain, Inflammation Other - Insect repellent	Hu I	Pw, O Da	55	0.55	21	74	0.74
Family: Asteraceae												
<i>Ageratina adenophora</i> (Spreng.) King & H. Rob.	Nargadiya/Pagaljhad	RKT 22106	H	L	Dermatological- Cuts & wounds	Hu	Po	80	0.8	80	80	0.8
<i>Artemisia martima</i> L.	Pati/Titpati	RKT 23793	H	L	Dermatological- Cuts & wounds, skin ailments	Hu	Po	55	0.55	77	77	0.77
<i>Saussurea costus</i> (Falc.) Lipsch.	Kut/Kuth	RKT 28203	H	Rt	General health care- Fever Respiratory- Cough Gastrointestinal- Stomach ache, Dysentery	Hu	Pw Pw De	28	0.28	27	64	0.64
<i>Taraxacum officinale</i> Weber.	Dudhil	RKT 27817	H	L,Rt	Antidote- Snake bite Other- To increase lactation in mulching animals	Hu C	In, Po Inf	50	0.5	13	39	0.39
<i>Tegetus erecta</i> L.	Hazari	GBPCSED2	H	L	General health care- Fever, ear infection Dermatological- wounds	Hu	Po Po	51	0.51	46	61	0.61
Family: Berberidaceae												
<i>Berberis asiatica</i> Roxb. ex DC	Kilmori	RKT 22109	S	Rt	General health care - Fever Circulatory- Diabetes	Hu	Pw Pw	42	0.42	13	54	0.54
Family: Boraginaceae												
<i>Cynoglossum zeylanicum</i> Thunb. Ex Lehm.	Chtkura	RKT 22969	H	Rt	Dermatological- Boils	Hu	Da	54	0.54	54	54	0.54
Family: Brassicaceae												
<i>Rephanus</i>	Mooli	RKT 27049	H	WP	Hepatic health	Hu	Co	87	0.87	87	87	0.87

<i>sativus</i> L.					cure- Jaundice								
Family: Cannabaceae													
<i>Cannabis sativa</i> L.	Bhaang	GBPCSED3	H	Sd, L	Gastrointestinal-Purgative & Laxative, Carminative, Constipation, Stomach ache	Hu	In	63	0.63	46	94	0.94	
					Antidote- Insect bite		Da			5			
					Other- Warm effect in winters		In, Co			43			
Botanical Name	Local Name	Voucher/ Ident. No.	Habit	Part Used	Popular Ailment Uses (Group & Categories)	Used in	Preparation	FC ^a	RFC ^b	UR ^c	UR ^d	CI ^e	
Family: Caryophyllaceae													
<i>Drymaria cordata</i> (L.) Willd. ex Schult	--	RKT 19989	H	WP	Respiratory-Cough	Hu	In	19	0.19	7	7	0.07	
<i>Silene vulgaris</i> (Moench) Garcke	Pyankura	GBPCSED4	H	WP	General health care- Fever Gastrointestinal-Removal of Ascaris (antiparasitic) locally known as <i>juga</i>	Hu	De	15	0.15	4	17	0.17	
							De			13			
Family: Combretaceae													
<i>Terminalia chebula</i> (Gaertner) Retz.	Harar	RKT 15469	T	Fr	Gastrointestinal-Purgative & laxative, Carminative, Constipation, Digestive problems, Diarrhoea	Hu	Pw, Po	12	0.12	64	64	0.64	
Family: Cucurbitaceae													
<i>Momordica charantia</i> L.	Karela	RKT 27529	Cl	Fr	Circulatory-Diabetes	Hu	Co, In	39	0.39	39	39	0.39	
Family: Dioscoreaceae													
<i>Dioscorea deltoidea</i> Wall.	Genthi	RKT 27301	Cl	Fr (Atu)	Respiratory-Cough & cold	Hu	Co	32	0.32	32	32	0.32	
Family: Ericaceae													
<i>Rhododendron arboreum</i> Smth	Burans	RKT 27288	T	F	Hepatic health cure- Liver complaints, Tonic	Hu	De	47	0.47	64	64	0.64	
Family: Euphorbiaceae													
<i>Emblica officinalis</i> Gaertn.	Aanwla	RKT 21022	T	Fr	Circulatory-Diabetes	Hu	In	35	0.35	8	85	0.85	
					Gastrointestinal-Purgative & Laxative, Carminative, Stomach ache		In			54			
					Respiratory-Cough		In			6			
					Other- Source of vitamin 'C'		In			17			
<i>Euphorbia prolifera</i> Ehrenb. Ex. Boiss	Dudhiya, Maikuri	RKT 29216	H	WP	Other-Insect repellent	I	Da	7	0.07	7	7	0.07	
Family: Gentianeae													

<i>Swertia angustifolia</i> Buch.-Ham. ex D.Don	Chiraita	RKT 25110	H	WP	General health care- Fever Dermatological- Skin ailments	Hu	In	37	0.37	19	24	0.24
Family: Fabaceae												
<i>Glycine max</i> (L.) Merri	Kala Bhatt	RKT 15664	H	Sd	Hepatic health cure - Jaundice	Hu	Co	84	0.84	84	84	0.84
<i>Microtyloma uniflorum</i> (Lam) Verdc.	Gahat/Kulthi	GBPCSED5	H	Sd	Urinogenital disorder- Stone	Hu	Co	69	0.69	69	69	0.69
<i>Trifolium repens</i> L.	Chalmoda	RKT 26479	H	L	General health care - Headache Dermatological- Skin disease of dogs-Luta	Hu C	Po Po	44	0.44	18	22	0.22
<i>Trigonella foemun-graecum</i> L.	Maithi	RKT 28507	H	L,Sd	Circulatory- Diabetes Gastrointestinal- Carminative, Obesity, Indigestion, Constipation Skeleton & muscles - Joint pain	Hu	Inf Inf Inf	31	0.31	11	61	0.61
Botanical Name	Local Name	Voucher/ Ident. No.	Habit	Part Used	Popular Ailment Uses (Group & Categories)	Used in	Preparation	FC ^a	RFC ^b	UR ^c	UR ^d	CI ^e
<i>Vigna mungo</i> L. (Fabaceae)	Mass, Urad	RKT 27199	H	Sd	Skeleton & muscles- Fracture	Hu	In	61	0.61	61	61	0.61
Family: Lamiaceae												
<i>Ajuga bracteosa</i> Wall. ex Benth.	Ratpatia	RKT 25182	H	WP	General health care- Fever Gastrointestinal- Constipation Urinogenital- Diuretic	Hu	De	55	0.55	53	72	0.72
<i>Ajuga parviflora</i> Benth.	Ratpatia	RKT 26408	H	Rt	General health care- Fever, Throat infection in animal (<i>Galghotu</i>) Gastrointestinal- Constipation, Stomach ache Urinogenital- Stone	Hu & C Hu	De, Em De, In De	56	0.56	58	87	0.87
<i>Leucas lanata</i> Benth	Nirasi Jhad	RKT 29214	H	L	Respiratory- Cough	Hu	De	80	0.8	80	80	0.8
<i>Mentha arvensis</i> L.	Pudina	RKT 4355	H	L	Gastrointestinal- Stomach ache, vomiting,	Hu	De	43	0.43	50	50	0.5
<i>Micromeria biflora</i> Benth.	--	RKT 22949	H	WP	General health care- Fever	Hu	De	6	0.06	6	6	0.06
<i>Ocimum basilicum</i> L.	Tulsi	RKT 19325	S	L, Sd	General health care- Fever Respiratory- Cough & cold Other- Herbal tea, Warm effect in winters	Hu	De De De	88	0.88	33	97	0.97
<i>Origanum vulgare</i> L.	Van Tulsi	RKT 29244		L, Rt	General health care- Fever	Hu	De	31	0.31	15	71	0.71

					Respiratory- Cough & cold		De			18			
					Dermatological- wounds		Em			29			
					Other- Herbal tea		Inf			9			
<i>Thymus serpyllum</i> L.	Van- ajwayan	RKT 27966	H	WP	Skeleton & muscles- Joint pain	Hu	Em	18	0.18	3	14	0.14	
					Respiratory- Asthma		Em			3			
					Gastrointestinal- Digestive & Stomach problems		Em			4			
					Other- Spices & condiments		Da			4			

Family: Liliaceae

<i>Asparagus racemosus</i>	Keruwa	RKT 28055	S	Rt	Immuno- regulatory- Stimulant	Hu	Pw	46	0.46	15	65	0.65	
Willd.					Hepatic health cure- Tonic		Pw			39			
					Gastrointestinal- Stomach ache		De			11			
<i>Polygonatum cirrhifolium</i> (Wall.) Royle	Maha- Meda	RKT 26144	H	WP	Hepatic health cure- Tonic	Hu	De	21	0.21	13	34	0.34	
					Dermatological- Cuts & wounds		Po			14			
					Circulatory - Blood purifier		Co			7			
<i>Polygonatum verticillatum</i> L.	Meda	RKT 25894	H	Rt	Gastrointestinal- Carminative	Hu	In	15	0.15	8	19	0.19	
					Dermatological- wounds		Po			11			

Family: Moraceae

<i>Ficus palmata</i> Forsk.	Bedu	RKT 28094	T	Lt	Dermatological- Cuts & wounds	Hu	Da	48	0.48	39	39	0.39	
<i>Ficus roxburghii</i> Wall.	Timul	GBPCSED6	T	Fr	Gastrointestinal- Acidity, Carminative	Hu	Co	26	0.26	45	48	0.48	
					Circulatory - Blood pressure		Co		0	3		0	

Botanical Name	Local Name	Voucher/ Ident. No.	Habit	Part Used	Popular Ailment Uses (Group & Categories)	Used in	Preparation	FC ^a	RFC ^b	UR ^c	UR ^d	CI ^e	
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Family: Myricaceae

<i>Psidium guajava</i> L.	Amrood	GBPCSED7	T	L	General health care- Mouth blisters (astringent)	Hu	In	12	0.12	12	12	0.12	
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Family: Orchidaceae

<i>Dactylorhiza hatagirea</i> (D.Don) Soo	Salmpanja/ Hattajari	RKT 26089	H	Rt	Circulatory- Bleeding Dermatological- Wounds	Hu	De	17	0.17	17	34	0.34	
							Po			17			

Family: Plantaginaceae

<i>Plantago ovate</i> Forsk.	Isabgoal	RKT 1899	H	Sd	Gastrointestinal- Constipation, digestive problems, Diarrhoea	Hu	In	74	0.74	83	83	0.83	
<i>Plantago lanceolata</i> L.	Jonkpuri	RKT 8154	H	Rt	Gastrointestinal- Removal of	C	In	43	0.43	43	43	0.43	

stomach worm of
domestic animals

Family: Poaceae													
<i>Hordium vulgare</i> L.	Jau	RKT 26630	H	Sd	Hepatic health cure- Warm & nutritive effect Dermatological Burns	-	Hu	Co	46	0.46	46	63	0.63
								O			17		
<i>Setaria italica</i> L.	Kouni	RKT 7389	H	Sd	Dermatological Measles & Chicken pox	-	Hu	Co	91	0.91	91	91	0.91
Family: Podophyllaceae													
<i>Podophyllum hexandrum</i> Royle	Van-Kakri	RKT 27764	H	Fr, Rt	Dermatological Wounds	-	Hu	Po	19	0.19	19	19	0.19
Family: Polygonaceae													
<i>Rheum emodi</i> Wall.	Dolu	RKT 27793	H	Rt	General health care - Fever Dermatological Wounds	-	Hu	De	31	0.31	15	42	0.42
								Po			27		
Family: Punicaceae													
<i>Punica granatum</i> L.	Darim	RKT 28845	T	Fr	Respiratory Cough & cold Hepatic health cure - Anaemia Other- Source of vitamin 'C'	-	Hu	In	59	0.59	49	71	0.71
								De			10		
								De, In			12		
Family: Ranunculaceae													
<i>Aconitum heterophyllum</i> Wall.	Atis	RKT 29008	H	Rt	General health care - Fever Gastrointestinal vomiting	-	Hu	Pw	34	0.34	34	51	0.51
								In			17		
<i>Ranunculus repens</i> L.	Aingadua	GBPCSED8	H	Rt	Dermatological Boils Gastrointestinal- Intestinal pains (NasPalatana)	-	Hu	Po	21	0.21	21	27	0.27
								In			6		
<i>Thalictrum foliosum</i> DC.	Uppankat hi/Mamira	RKT 29204	H	WP	Ophthalmic- Eye infection (White dot-cataract) Other- Insect repellent	-	Hu	Inf	4	0.04	9	21	0.21
							I	Da			12		
Family: Rosaceae													
<i>Duchesnea indica</i> (Andrews) Focke	Van Kafal	GBPCSED9	H	L	Dermatological- Burns and removal of burn scars	-	Hu	Po	3	0.03	3	3	0.03
Botanical Name	Local Name	Voucher/ Ident. No.	Habit	Part Used	Popular Ailment Uses	Used in	Preparation	FC^a	RFC^b	UR^c	UR^d	CI^e	
					(Group & Categories)								
<i>Prunus persica</i> Stokes.	Aaru	RKT 26465	T	L	General health care- Headache	Hu	Po	6	0.06	6	6	0.06	
<i>Rosa moschata</i> Hermm.	Kunja	RKT 28695	S	L, F	Dermatological- Cuts & wounds, boils, Ophthalmic- Eye diseases	Hu	Po	9	0.09	27	32	0.32	
							Ste			5			
<i>Rubus ellipticus</i> Smith.	Hisalu	RKT 29240	S	Rt	General health care- Fever Gastrointestinal- Stomach ache	Hu	De	9	0.09	9	18	0.18	
							De			9			
Family: Rubiaceae													

<i>Rubia cordifolia</i> L.	Manjistha	RKT 27933	H	Rt	General health	Hu	De	27	0.27	23	23	0.23
Family: Rutaceae												
<i>Citrus aurantifolia</i> (Christm) Sw.	Kagji Nimboo	GBPCSED10	T	Fr	General health	Hu	De	38	0.38	20	94	0.94
					care - Headache							
					Gastrointestinal-Constipation, weight loss		De			23		
					Respiratory - Cold		De			19		
					Other - Herbal tea, Source of vitamin 'C'		De			32		
<i>Citrus hystrix</i> DC.	Jamer/ Jamir	GBPCSED11	T	Fr	Gastrointestinal-Removal of ascaris (antiparasitic) locally known as <i>juga</i> .	Hu	In	38	0.38	27	50	0.5
					Respiratory- Cold		In			7		
					Antidote - Against poison	C	Em			16		
<i>Zanthoxylum armatum</i> DC	Timoor/ Timuru	RKT 28615	S	Sd	General health	Hu	In	61	0.61	21	77	0.77
					care- Toothache							
					Respiratory- Cough & cold		In			19		
					Gastrointestinal- Carminative,		In			6		
					Other- Spices & condiments		In			31		
Family: Saxifragaceae												
<i>Bergenia ciliata</i> (Haw) Sternb	Silphora	RKT 25124	H	Rt	Urinogenital- Urinary infection, Stone	Hu	Inf, Pw	51	0.51	61	61	0.61
Family: Scrophulariaceae												
<i>Picrorhiza kurrooa</i> Royle.	Kutki	RKT 27765	H	Rt	General health	Hu	In	53	0.53	53	80	0.8
					care- Fever							
					Gastrointestinal - Abdominal pain		In			27		
<i>Verbascum thapsus</i> L.	Akalveer	RKT 27890	H	WP	Dermatological - Boils	Hu	Po	63	0.63	17	42	0.42
					Other- To increase lactation in milching animals		Da			25		
Family: Urticaceae												
<i>Urtica dioica</i> L.	Shishun/ Bichhu ghas	RKT 22903	S	L	Skeleton & Joint muscles- pain	Hu	Da	37	0.37	31	52	0.52
					Hepatic health cure-Warm and nutritive effect	Hu	Co			21		
Family: Violaceae												
<i>Viola betonicifolia</i> J.E. Smith	Garurjadi/ garurabuti	GBPCSED12	H	WP	Antidote - Snake bite	Hu	Po	12	0.12	13	13	0.13
<i>Viola canescens</i> Wall. Ex Roxb	Gulovansh	RKT 17561	H	WP	Other- To increase lactation in milching animals	C	Da	29	0.29	29	29	0.29
Botanical Name	Local Name	Voucher/ Ident. No.	Habit	Part Used	Popular Ailment Uses (Group & Categories)	Used in	Preparation	FC ^a	RFC ^b	UR ^c	UR ^d	CI ^e
Family:												

Zingiberaceae													
<i>Curcuma longa</i> L.	Haldi	RKT 5970	H	Rh	General health care - Internal injury	Hu	De	78	0.78	39	91	0.91	
					Dermatological-Cuts & wounds, cosmetics		Da			36			
					Respiratory Cough	-	De			16			
<i>Hedychium spicatum</i> Buch. Ham. ex Smith.	Van Haldi	RKT 24059	H	Rh	Gastrointestinal problems, Purgative & Laxative, Carminative	-	Hu	Pw	13	0.13	30	52	0.52
					Respiratory Cough	-		Pw			8		
					Dermatological Cosmetics, anti-lice	- Hu & C		Pw			14		
<i>Zingiber officinale</i> Rosc.	Adrak	RKT 5921	H	Rh	Respiratory Cough & cold	-	Hu	Em	89	0.89	89	89	0.89

^aUse Citation of Taxa (The no. of informants that referred the taxon); ^bRFC= FC/N, Where N is the total no. of informants; ^cUse-reports of the taxon; ^dUse-reports of the taxon; ^eCI= UR/N_t, where N_t is the total no. of reported taxa;

Aerial tuber(Atu); Bulb (B); Cattle (C); Climber (Cl); Cooking (Co); Decoction (De); Direct application (Da); Emulsion (Em); Flower (F); Fruit (Fr); (H); Insect (I); Infusion (Inf); Ingestion (In); Hour (hr); Human (Hu); Leaves (L); Latex (Lt); Ointment (O); Poultice (Po); Powder (Pw); Rhizome (Rt); Shrub (S); Seed (Sd); Steam (Ste); Tree (T); Whole Plant (WP).

Table 2. Bio-processing of Medicinal Plants of District Bageshwar.

Scientific Name	Mode of administration
<i>Aconitum heterophyllum</i> Wall.	Dry root powder (1TS) taken orally with boiled water twice a day for 2-3 days against fever; 1-2 roots chewed to control vomiting.
<i>Acorus calamus</i> L.	Root powder mixed with grains used as insect repellent, 3-4 dry roots heated with musterd oil applied on the sprain and inflammatory region.
<i>Ageratina adenophora</i> (Spreng.) King & H. Rob	Leaf paste prepared from 100g fresh leaf twigs applied on affected parts for early healing.
<i>Ajuga bracteosa</i> Wall. ex Benth.	Juice of whole plant (10-20 ml) taken twice a day for 2-3 days.
<i>Ajuga parviflora</i> Benth.	Decoction prepared from 100g fresh or dried roots with water given 3-5TS orally in fever, stomach ache and constipation for 5 days; this decoction taken orally in empty stomach regularly for stone; 1-2 leaves chewed on empty stomach for gastric problem; decoction of whole plant (5-8) crushed with red chilli (3) and 100g Jiggery (<i>Gur</i>) given twice a day for 2-3 days to treat throat infection in domestic animals.
<i>Allium sativum</i> L.	Paste prepared from 5-7 Spilled bulb heated with 20 ml mustered oil, massage on joints
<i>Angelica glauca</i> Edgew.	Root powder (50g) mixed with 100ml water used to control vomiting & stomach ache; rhizomes are used as spices & condiments and tea (as flavour).
<i>Artemisia martima</i> L.	Juice (5-10ml) of fresh leaf applied on the affected area.
<i>Asparagus racemosus</i> Willd.	Root decoction (100 gm) prepared in water given to cure stomach ache (5 ml for adult, 1TS for children) for 3-5 days, one palm full root powder taken with water as stimulant and tonic.
<i>Berberis asiatica</i> Roxb. ex DC	Root powder (100-150g) taken with warm water given twice a day for 3 days against fever; fresh or dried roots soaked in water overnight, filtered and taken orally to cure diabetes in empty stomach.
<i>Bergenia ciliata</i> (Haw) Sternb.	Fresh or dried roots (50-100g) soaked overnight and filtered, taken orally in morning for kidney stone. Root powder (50g) taken with water twice a day for urinary infection.
<i>Cannabis sativa</i> L.	Grinded seeds cooked with some local vegetables (e.g. <i>Colacasia esculanta</i> , <i>Brassica oleracea</i>) for warm effect; broiled seeds are grinded with salt and green chilli to prepare salt (<i>Pahadi namak</i>), Broiled seeds grinded with <i>Punica garnatum</i> mixed with green leaves of coriandum, green chilli, salt and sugar to prepare <i>Chatni</i> ; Fresh leaves crushed with 3-5 seeds of black pepper and applied on insect bite.
<i>Centella asiatica</i> L.	Fresh leaf paste is applied on forehead.
<i>Citrus aurantifolia</i> (Christm) Sw.	Juice extracted from fruit mixed with 1TS honey and 50 ml water taken orally in empty stomach for constipation and weight loss; lemon tea used in Fever & Cold.
<i>Citrus hystrix</i> DC.	Fruit juice given orally (1TS) to children for removal of ascaris; cough & cold 10 ml thrice a day; fruit juice with mentha leaves (100g) and coriander seeds made into paste given to domestic animals against poison.
<i>Coriandrum sativum</i> L.	Seed (80-100g) paste mixed with 1-2 ltr. processed curd (<i>Mattha</i>) is given to domestic animals against poison for 2-3 days.
<i>Curcuma longa</i> L.	Haldi powder (5g) mixed with a full glass of warm milk for internal injury; paste of rhizome applied on cuts and wounds.
<i>Cynoglossum zeylanicum</i> Thunb. Ex Lehm.	Fresh or dried root paste applied on the affected parts
<i>Dactylorhiza hatagirea</i> (D.Don) Soo.	Decoction of 100 gm root with water taken orally (10-15ml) twice a day for excessive bleeding; root paste applied on wounds
<i>Dioscorea bulbifera</i> L.	Broiled fruit and cooked vegetable.
<i>Drymaria cordata</i> (L.).	Juice of aerial parts (2-4 drops) taken orally for 2-3 days.
Scientific Name	Mode of administration
<i>Duchesnea indica</i> (Andrews) Focke	Leaf paste is regularly applied on affected part.
<i>Emblica officinalis</i>	Fresh fruits are chewed regularly to control diabetes; dried fruits (3-5) boiled with water, filtered and taken orally against cough, stomach ache; fresh and processed fruits are source of Vitamin 'C'.

Gaertn.	
<i>Euphorbia</i> sp.	Whole plant (50-100) mixed with FYM.
<i>Ficus palmata</i> Forsk.	Milky latex applied on cuts & wounds.
<i>Ficus roxburghii</i> Wall.	Fresh fruits are cooked as vegetable.
<i>Glycine max</i> (L.) Merri	<i>Bhatt ka Jaula</i> (an indigenous dish) is prepared from paste of seeds (soaked overnight) & cooked with rice in an iron vessel " <i>Kadah</i> ".
<i>Hedychium spicatum</i> Buch. Ham. ex Smith.	Dried rhizome powder (2-3g) taken with hot water once a day; paste of fresh rhizome used as anti-lice
<i>Hordium vulgare</i> L.	<i>Sattu</i> prepared from 200g broiled seeds mixed with 100g jaggery (<i>Gur</i>) and 100g <i>Ghee</i> for warm and nutritive effect; 50g broiled seeds heated with 40ml mustard oil applied on burns.
<i>Leucas lanata</i> Benth	Leaf juice with 3-5 drops of breast milk taken orally twice a day for one week.
<i>Mentha arvensis</i> L.	Leaves (100g) boiled with water and filter, the filtrate (50ml) given orally twice a day.
<i>Micromeria biflora</i> Benth.	Juice of whole plant with water (1-2 times in a day).
<i>Macrotyloma uniflorum</i> (Lam) Verdc.	<i>Gahat ka Ras</i> (an indigenous dish) prepared by 150g seeds cooked with water (1 ltr.) until the volume reduced (100ml) and taken regularly.
<i>Momordica charanti</i> L.	Vegetable and juice (50ml) of fresh fruit taken regularly.
<i>Ocimum basilicum</i> L.	Decoction of 100g leaves and seeds, zinger (50g), 5 seeds black paper with 150 ml water taken orally 2-3 times a day for fever, cough & cold; aerial part used to make herbal tea.
<i>Origanum vulgare</i> L.	Decoction of 1 00g fresh & dried leaves with water taken orally (10ml) for a week in cough, cold & fever; root paste applied on wounds.
<i>Picrorhiza kurrooa</i> Royle.	Decoction of 50g root with water taken orally against fever and abdominal pain for 5-7 days.
<i>Plantago ovate</i> Forsk.	Seeds (10g) soaked overnight or consumed directly with water twice a day for 30 days against constipation and digestive problems; Isabgoal (15g) mixed with 10TS fresh curd taken after meal for diarrhoea.
<i>Plantago lanceolata</i> L.	Paste of roots (100g) given to domestic animals.
<i>Podophyllum hexandrum</i> Royle	Root paste applied on wound.
<i>Polygonatum cirrhifolium</i> (Wall.) Royle	Small pieces of tuber (8-10) soaked in water for overnight, taken in empty stomach for weakness and develop immunity; cooked green leaves eaten as blood purifier; root paste applied on cuts and wounds.
<i>Polygonatum verticillatum</i> L. All	Root powder (50g) is taken with warm water in gastric complaints; fresh root paste applied for wound healing.
<i>Prunus persica</i> Stokes.	Fresh leaf paste applied on head for 2-3 hr.
<i>Psidium guajava</i> L.	Fresh leaves are chewed.
<i>Punica granatum</i> L.	Powder (50g) of dried fruit peel taken orally with warm water for old cough; Fruit juice (50ml) given twice a day to anaemic patient.
<i>Ranunculus repens</i> L.	Root paste (50g) applied for boils and 30-50ml filtered root extract (juice) is given twice a day against intestinal pain.
<i>Rephanus sativus</i> L.	Vegetable prepared from fresh leaves and root as salad.
<i>Rheum emodi</i> Wall.	Decoction of 100g root with warm water taken orally (10ml) for fever twice a day; root paste applied on wounds.
<i>Rhododendron arboreum</i> Smth	Juice extracted from fresh flowers
Scientific Name	Mode of administration
<i>Rosa moschata</i> Hermm.	Fresh leaf paste is applied on cuts, wounds and boils; water extracted from fresh flowers used in eye diseases.
<i>Rubia cordifolia</i> L.	Root decoction with water given orally (1-2TS) against fever twice a day to children (5 months-10years)
<i>Rubus ellipticus</i>	Decoction (10ml) of 100g roots with water taken orally against fever and stomach ache for 5 days.

Smith.	
<i>Saussurea costus</i> (Falc.) Lipsch	Decoction of root (50g) with water given against dysentery for 3-5 days twice a day; root powder (50g) taken orally with boiled water in fever, cough and stomach ache.
<i>Setaria italica</i> L.	<i>Koni ka Jaula</i> (an indigenous dish) prepared from seeds cooked with water.
<i>Silene vulgaris</i> (Moench) Garcke	Root decoction (10ml) with warm water given against fever for 3 days; 1TS is used for removal of ascaris (<i>Juga</i>); leaves are used as a vegetable.
<i>Swertia spp</i>	Juice of fresh leaves (100g) given with boiled water 3TS for 3-5 days for fever; <i>Panchang</i> (whole plant) is used after soaking overnight and taken (50-100ml) orally in empty stomach for 15 days.
<i>Taraxacum officinale</i> Weber.	For snake bite: juice of whole plant with water taken orally (1-2TS) thrice a day & applied on injured part for one week; mixture of 100g roots with 9 seeds of black pepper, 1-2 ltr. processed curd (<i>Mattha</i>) and 250g paste of black soybean given to increase lactation in milching animals
<i>Tegetes erecta</i> L.	Fresh leaf juice with water taken against fever (3-5 TS twice a day); leaf extract (2-3 drops) in ear infection; fresh leaf paste is applied for healing cuts & wounds.
<i>Terminalia chebula</i> (Gaertner) Retz.	Dried fruit powder (100g) given orally with boiled water twice a day for 3-5 days in stomach ache; dried fruit crushed with water and given (1-2 ml) orally to children (3 months to 5 years) and small amount applied around the navel.
<i>Thalictrum foliosum</i> DC.	Fresh roots (50g) soaked in rose water (100ml) for overnight, filtered and used as eye drop.
<i>Thymus serpyllum</i> L.	Paste of whole plant mixed with mustered oil gently applied on joints; whole plants juice (10ml) mixed with honey (20g) is taken orally for cough and asthma; broiled seeds (10-15g) with warm water taken for digestive and stomach problems; leaves and seeds are used as spices & condiment.
<i>Trifolium repens</i> L.	Leaf paste (5g) with water.
<i>Trigonella foenum-graecum</i> L.	Leaf juice is taken orally for curing obesity, indigestion, joints pain and constipation; 25g seeds are soaked overnight filter, the filtrate taken orally in empty stomach for gastric problems and diabetes.
<i>Urtica dioica</i> L.	Branches with leaves are gently rubbed on joints and muscles; Fresh leaf twigs taken as vegetable; fine powder of dry leaf (5-10 g) dissolve in 50 ml water is taken orally in joints & muscular pain
<i>Verbascum thapsus</i> L.	Fresh leaf paste applied on affected part for boils; 8-10 whole plants mixed with grass given mulching animals
<i>Viola betonicifolia</i> J.E. Smith (Violaceae)	Paste of whole plant (fresh or semidry) applied on affected part for 1-2 weeks.
<i>Viola canescens</i> Wall. Ex Roxb	Fresh plants (30-50) given with grass for one to two weeks.
<i>Vigna mungo</i> L.	Paste prepared by grinding of 150g seeds with water applied on the fractured part.
<i>Zanthoxylum armatum</i> DC	Seeds (100g) boiled with water taken orally twice a day; seed bark used as a spices.
<i>Zingiber officinale</i> Rosc.	A piece (5-10g) of broiled rhizome mixed with small amount of honey and chewed.

Farm Yard Manure (FYM); Tablespoon (TS);

Table 3. Use value of important ethnomedicinal species of target area

Taxa	UR ^a	FC ^b	CI ^c	NDAS	Ailments Categories (Decreasing order)
<i>Ocimum basilicum</i> L.	97	88	0.97	5	Respiratory, general health care and others
<i>Cannabis sativa</i> L.	94	63	0.94	6	Gastrointestinal, others and antidote
<i>Citrus aurantifolia</i> (Christm) Sw.	94	38	0.94	6	Others, gastrointestinal, general health care and respiratory
<i>Curcuma longa</i> L.	91	78	0.91	5	General health care, dermatological and respiratory
<i>Setaria italica</i> L.	91	91	0.91	2	Dermatological
<i>Angelica glauca</i> Edgew.	89	44	0.89	4	Others and gastrointestinal
<i>Zingiber officinale</i> Rosc.	89	89	0.89	2	Respiratory
<i>Ajuga parviflora</i> Benth.	87	56	0.87	5	General health care, gastrointestinal and urinogenital disorder
<i>Rephanus sativus</i> L.	87	87	0.87	1	Hepatic health cure
<i>Embllica officinalis</i> Gaertn.	85	35	0.85	6	Gastrointestinal, others, circulatory and respiratory
<i>Glycine max</i> (L.) Merri	84	84	0.84	1	Hepatic health cure
<i>Plantago ovate</i> Forsk.	83	74	0.83	3	Gastrointestinal
<i>Ageratina adenophora</i> (Spreng.) King & H. Rob.	80	80	0.80	2	Dermatological
<i>Leucas lanata</i> Benth	80	80	0.80	1	Respiratory
<i>Picrorhiza kurrooa</i> Royle.	80	53	0.80	2	General health care and gastrointestinal
<i>Artemisia martima</i> L.	77	55	0.77	3	Dermatological
<i>Zanthoxylum armatum</i> DC	77	61	0.77	5	Others, general health care, respiratory and gastrointestinal
<i>Acorus calamus</i> L.	74	55	0.74	3	Others and skeleton & muscles
<i>Ajuga bracteosa</i> Wall. ex Benth.	72	55	0.72	3	General health care, gastrointestinal and urinogenital disorder
<i>Origanum vulgare</i> L.	71	31	0.71	5	Dermatological, respiratory, General health care and others
<i>Punica granatum</i> L.	71	59	0.71	4	Respiratory, others and hepatic health cure

^a Total no. of Use-reports of the taxon; ^bUse Citation of Taxa (The no. of informants that referred the taxon; ^cCI= UR/N_t , where N_t is the total no. of reported taxa; No. of different ailment subcategories (NDAS).

Table 4. Informant consensus factor (F_{ic}) and medicinal importance (MI) of Ethno-medicinal plants.

Ailments Category	No. of Taxa (N_t) ^a	Frequency (%) ^b	No. of Use -reports (N_{ur})	Informant consensus factor (F_{ic}) ^c	Medicinal Importance (MI) ^d
Gastrointestinal	23	32.86	695	0.97	30.22
General health cure	22	31.43	524	0.96	23.82
Dermatological	21	30.00	617	0.97	29.38
Respiratory	15	21.43	402	0.97	26.80
Hepatic health cure	8	11.43	364	0.98	45.50
Circulatory	7	10.00	126	0.95	18.00
Skeleton & muscles	6	8.57	178	0.97	29.67
Antidote	5	7.14	83	0.95	16.60
Urinogenital	4	5.71	137	0.98	34.25
Ophthalmic	2	2.86	14	0.92	7.00
Immuno-regulatory	1	1.43	15	1.00	15.00
Other	15	21.43	377	0.96	25.13

^aNo. of species listed in several of the categories of medicinal usage; ^bPercentage of records on the total of 70 records; ^c $F_{ic} = (N_{ur} - N_t) / (N_{ur} - 1)$; ^dMI = N_{ur}/N_t .

Table 5. Similarity between present and past ethno-medicinal uses of important species

Botanical Name	Use Reports in Study Area	Earlier Use Reports from Uttarakhand
<i>Aconitum heterophyllum</i> Wall.	Fever & Vomiting	Fever, Vomiting and cough [21,28,51,59]
<i>Acorus calamus</i> L.	*Inflammation & Insect repellent Sprain	Arthritis, Cancer, Convulsions, Diarrhoea, Dyspepsia, Epilepsy [21,23]; Sprain [51]
<i>Ageratina adenophora</i> (Spreng.)	Cuts & wounds	Cuts and Wounds [21, 28]
<i>Ajuga bracteosa</i> Wall. ex Benth.	*Constipation Diuretic, Fever	Fevers, Diuretic [21]
<i>Ajuga parviflora</i> Benth.	*Constipation, Stone, Throat infection in animal (<i>Galgotu</i>) Fever, Stomach ache	Headache, Fever, stomach-ache [54]
<i>Allium sativum</i> L.	*Joint Pain (Arthritis)	Mascular pain [23,52]; Ear pain [59]
<i>Angelica glauca</i> Edgew.	*Spices & condiment & Herbal tea Stomach ache, Vomiting,	Constipation, bronchitis and stomach disorders, Vomiting [23,28,51]
<i>Artemisia martima</i> L.	Cuts, Skin ailments, Wounds	Skin ailments [54]
<i>Asparagus racemosus</i> Willd.	*Stimulant, Tonic & Stomach ache	Leucorrhoea, Headache, Hysteria, Ulcer, Liver disorders [21,23]
<i>Berberis asiatica</i> Roxb. ex DC	*Fever Diabetes	Diabetes, Jaundice [21]
<i>Bergenia ciliata</i> (Haw) Sternb	Urinary infection & Stone	Fever, Digestive disorders, skin diseases, Urinary infection & Stone [16,28]
<i>Cannabis sativa</i> L.	*Insect bite, Stomach ache, Purgative & Laxative, Warm effect in winters Carminative, Constipation	Analgesic, Cough, Cold, Sedative, Narcotic, Skin diseases [23]
<i>Centella asiatica</i> L.	*Headache	Inflammatory infections, Wounds[21, 23]
<i>Citrus aurantifolia</i> (Christm) Sw.	Cold, Constipation, Headache, Herbal tea, Source of vitamin 'C' & Weight loss,	Diarrhoea, Dysentery, Fever, Headache [56]
<i>Citrus hystrix</i> DC.	*Against poison, Cold, Removal of <i>Ascaris</i> (Anti-parasitic)	Vomiting [52]
<i>Coriandrum sativum</i> L.	*Against poison	Stomachic and diuretic [23]
<i>Curcuma longa</i> L.	*Internal injury Cough, Cuts & wounds & Cosmetics	Skin disorders, Wound healing [23,52]
<i>Cynoglossum zeylanicum</i> Thunb. ex Lehm.	*Boils	Asthma, Bronchitis, Cough, Vomiting, [16,55]
<i>Dactylorhiza hatagirea</i> (D.Don) Soo	Bleeding & Wounds	Burns, Cuts, Checks bleeding [21,28]
<i>Dioscorea deltoidea</i> Wall	Cough & cold	Cough, Fever Urogenital disorders, [21,23,28,54]
<i>Drymaria cordata</i> (L.) Willd. ex Schult	*Cough	Laxative [48]; Bile complaints [54]
<i>Duchesnea indica</i> (Andrews) Focke	*Burns and removal of burn scars	Diarrhoea, Fever, Leucorrhoea [55]; Skin diseases [56]
<i>Emblica officinalis</i> Gaertn.	Diabetes, Purgative & Laxative, Carminative, Stomach ache & Source of vitamin 'C'	Asthma, Digestive disorders, Hair fall [28]; Dysentery, Cholera and Jaundice [21,54]
<i>Euphorbia prolifera</i> Ehrenb. ex Boiss	*Insect repellent	--
<i>Ficus palmata</i> Forsk.	*Cuts & wounds	Lungs diseases, Skin diseases [23,48,54]
<i>Ficus roxburghii</i> Wall.	*Acidity, Source of vitamin 'C'	Laxative [48]
<i>Glycine max</i> (L.) Merri	*Jaundice	--
<i>Hedychium spicatum</i> Buch. Ham. ex Smith.	Anti-lice, Cough, Cosmetics, Intestinal problems, Purgative & Laxative, Carminative	Carminative, Stomachic, Liver complaints, Fevers, Vomiting, Diarrhoea, Inflammation, Snake bite [16,21,54]
<i>Hordium vulgare</i> L.	*Burns, Warm and nutritive effect	--
Botanical Name	Uses Report in Study Area	Earlier Uses Report from Uttarakhand
<i>Leucas lanata</i> Benth	*Cough	Cuts, To check bleeding, Wounds [54]
<i>Mentha arvensis</i> L.	Stomach ache & Vomiting,	Diarrhoea, Stomach ache [53,54]
<i>Micromeria biflora</i> Benth.	*Fever	Joints pain, Worm infested wounds 21]
<i>Microtyloma uniflorum</i> (Lam) Verdc.	Stone	Stone [52]

<i>Momordica charantia</i> L.	Diabetes	Jaundice, Diabetes [23]
<i>Ocimum basilicum</i> L.	Cough & cold, Fever, Herbal tea, Warm effect in winters	Cough, Cold, Fever [16]
<i>Origanum vulgare</i> L.	Cough & cold, Fever, Herbal tea & Wounds	Cold, Diarrhoea, Fever, Indigestion, Influenza, Menstrual disorder [23, 54]
<i>Picrorhiza kurroo</i> Royle.	Abdominal pain, Fever	Anemia, Asthma, Blood troubles, Inflammation, Jaundice [21]; Fever, Stomach ache [28]; Abdominal pain, Cataract [51,54]
<i>Plantago ovate</i> Forsk.	Constipation, Digestive problems & Diarrhoea	Constipation, Dysentery & Diarrhoea [21]
<i>Plantago lanceolata</i> L.	*Removal of stomach worm of domestic animals	Dyspepsia, Sore wounds, Dysentery, Purgative, Mouth disease and chicks [21]
<i>Podophyllum hexandrum</i> Royle	Wounds	Purgative, Cancer [21]; Wounds [28]
<i>Polygonatum cirrhifolium</i> (Wall.)	*Blood purifier, Cuts, Tonic & Wounds	Anaemia, Fever, Bronchitis, General debility[54]
<i>Polygonatum verticillatum</i> L.	Carminative & Wounds	Aphrodisiac, Gastric complaints, Nervine tonic, Wound healing [23,54]
<i>Prunus persica</i> Stokes.	*Headache	Ear infection of children [28]; Antipyretic, Brain tonic[21]
<i>Psidium guajava</i> L.	Mouth blisters (astringent)	Mouth blisters [51,59]
<i>Punica granatum</i> L.	*Anaemia, Cough, Cold, Source of Vitamin 'C'	Diarrhoea, Dysentery, Piles[21]
<i>Ranunculus repens</i> L.	*Boils & Intestinal pains (Nas Palatana)	--
<i>Rephanus sativus</i> L.	Jaundice	Jaundice [52]
<i>Rheum emodi</i> Wall.	Fever & Wounds	Cuts, Fracture, Wounds [57]
<i>Rhododendron arboreum</i> Smth	Liver complaints, Tonic	Heart tonic [28], Stomach diseases [21]
<i>Rosa moschata</i> Hermm.	*Boils, Cuts, Eye diseases, Wounds	Leucorrhoea, Bleeding, Pregnancy termination [16]
<i>Rubia cordifolia</i> L.	*Fever	Blood purifier, Joints pain, Leucorrhoea, Cuts, Wounds, Insect sting [54]
<i>Rubus ellipticus</i> Smith.	*Fever & Stomach ache	Blood pressure, Diarrhoea [21]
<i>Saussurea costus</i> (Falc.) Lipsch.	Cough, Dysentery, Fever, Stomach ache,	Asthma, Cough, Dysentery, Fever [53,54]; Abdominal pain [59]
<i>Setaria italic</i> L.	*Chicken pox & Measles	--
<i>Silene vulgaris</i> (Moench)Garcke	*Fever & Removal of <i>Ascaris</i> (Anti-parasitic)	Asthma, Bronchitis [16]
<i>Swertia angustifolia</i> Buch.-Ham. ex D.Don.	*Skin ailments Fever	Pneumonia, Cold, Cough, Fever [54]
<i>Taraxacum officinale</i> Weber.	*Snake bite & To increase lactation in milching animals	Headache, acts as a heart tonic and blood purifier [28,59]
<i>Tegetus erecta</i> L.	*Ear infection, Fever & Wounds	Muscular pain, Piles, Ulcer, Wound healing [23]
<i>Terminalia chebula</i> (Gaertner) Retz.	Carminative, Constipation, Digestive problems, Diarrhoea, Purgative	Asthma, Digestive problems, Diarrhoea, Purgative[16,28]
<i>Thalictrum foliosum</i> DC.	*Eye infection (White-dot-cataract), Insect repellent	Gastric trouble, Used to control external parasites[21]
Botanical Name	Uses Report in Study Area	Earlier Uses Report from Uttarakhand
<i>Thymus serpyllum</i> L.	*Asthma, Joint pain, Spices & condiments Digestive & stomach problems,	Laxative, Stomachic [21]; Cough, Epilepsy, Itching & skin diseases, Menstrual disorders, Swelling [54]
<i>Trifolium repens</i> L.	*Headache & Skin disease of dogs	Astringent [16]
<i>Trigonella foenum-graecum</i> L.	Carminative, Constipation, Diabetes, Indigestion, Joint pain & Obesity,	Diabetes, Rheumatism [16,52]
<i>Urtica dioica</i> L.	*Joint pain, Warm & nutritive effect	Skin diseases, Boils [21,28]; Bone fracture [54]
<i>Verbascum thapsus</i> L.	*To increase lactation in milching animals Boils	Cough, Fever, Rheumatism [21]; Boils Eye cataract [54]
<i>Viola betonicifolia</i> J.E. Smith	*Snake bite	Blood diseases, Cough, Fever, Skin [58]
<i>Viola canescens</i> Wall. Ex Roxb	*To increase lactation in milching animals	Cough, Cold, Malaria, Jaundice [23,48]
<i>Vigna mungo</i> L.	*Fracture	--
<i>Zanthoxylum armatum</i> DC	Carminative, Cough & cold, Toothache,	Toothache[28]; Constipation, Gastric disorders [21,23,51]

*New ethno-medicinal use reports documented from study sites.

Figures

Figure 1

Study area and villages in Garur and Kapkot Bolcks of District Bageshwar, Uttarakhand, India

Figure 2

Age distribution of respondents

Figure 3

Distribution of medicinal plants in different life form

Figure 4

Plant part used in preparation of medicine

Figure 5

Processing of plant parts in preparation of medicine

Figure 6

Distribution of medicinal plants in different ailments category

Figure 7

Past (2008) and present (2018) use of plants in traditional healthcare system

Figure 8

Community view points on effectiveness of traditional healthcare system