Indian Journal of Traditional Knowledge
Vol 20(1), January 2021, pp

Ethnobotanical plants used in health care and traditional practices by local inhabitants (Gujjars) of Rajaji Tiger Reserve, Uttarakhand, India

Akash[a,*,†], Navneet[a] & B S Bhandari[b]

[a]Department of Botany and Microbiology, Gurukul Kangri University; Haridwar 249 401, Uttarakhand, India

[b]Ecology Laboratory, Department of Botany and Microbiology, H.N.B. Garhwal University; Srinagar 246 174, Uttarakhand, India

E-mail: [†]saklanibotany@gmail.com

Recived

The present investigation aims to identify the ethnobotanical plants collected by local inhabitants (Gujjars) of Rajaji tiger reserve for medical purposes. Data was collected from 2015-2018 about the uses to ethnomedicinal plants through personal interview, group discussion and questionnaire with predetermined informants. During the period, a total of 60 ethnomedicinal plants were collected in which majority of the plants were wild which was used by the local community in the treatment of different problems. At the time of the survey, demographic characteristics of the Gujjars and other related data was also noted. The collected data was also analysed through use value (UV), informants census factors (Fic), Fidelity level (FL) etc. Various ethnomedicinal plants species which we have collected from the study area have not been explored from the other areas of the Western Himalaya. These ethnomedicnal plant species could be used for phytochemical, antimicrobial and pharmacological aspects in future.

Keywords: Ailments, Ethnomedicinal plant, Gujjars, Rajaji tiger reserve**,** Traditional

IPC Code: Int. Cl.[21]: A61K 9/00, F02C 7/14, A61K 36/00

Human being used plants as a source of food, clothes and shelter from the beginning of civilization on earth. All these plants have medicinally and pharmacological contents with unique properties and combinations. So, the ethnic inhabitants depend on these medicinally important plants around them to acquire great knowledge of the medicinal properties and economic value based on need, experience as well as the observation and on trial and error bases. As per the report of WHO, approximately 25% of the recent drugs are prepared from the parts of plants based on the traditional knowledge and research which further lead to the development of approximately 75% new herbal drug[1]. Further WHO also recorded more than 21 thousand species of plants with their medicinal value around the world. Today, trade of medicines from the origins is getting popularity and recognition as it is a profitable source of money. It was observed that the essential phyto-compounds from the plants could be used as a healing agent and various phytochemical play essential role in preparing the potentials medicines to cure different human and animals ailments[2]. In traditional medicine system, higher plants have got more attraction for drug therapy[3]. So medicinal plants are used by billions of people worldwide not only by the tribal community but also in morden healthcare system both in developing and developed countries[4,5]. Approximately, 60% of the world's total population in developing countries depends on ethnomedicinal plants for the treatment of various ailments due the insufficient facilities of healthcare.

The Indian Himalayan region has about 51 million people, in which most of them have practices hill farming in fragile and most diverse environment, including species varied forests. In Western Himalayas, changes in structure of forests dramatically produced a very different pattern of vegetation which includes subtropical forests, conifer mountain and alluvial grasslands as well as the alpine pastures. The local inhabitants and various trial communities like Gujjars, Tharu, Jaunsari, Raji, Buksa and Bhotiyas are great concern for changing the vegetation pattern and ethnomedicinal plants diversity. They are mainly responsible for food on the forest and non wood forest products on the local ecosystem.

Western Himalayas include elevations from 300-6000 m and where species migration and depletion are controlled by the mountains[6]. The name Rajaji

*Corresponding author

National park came from Rajaji Sanctuary, created in 1983in Uttarakhand state[7]. Now it has been designated as tiger reserve by the government due to the viable population of tiger. This tiger reserve is an important part of Western Himalaya in terms of the conservation of biodiversity. It includes Northern dry deciduous, *Acacia - Dalbergia* forest, mixed forest of *Shorea- Mallotus* and some area represents the Savannah. The area has traditionally been inhabited by Gujjars (a pastoralist community). They herd buffalo between high Himalayan pastures in summer and lower foothills in winters. There are different types of Gujjar community settlements within the tiger reserve. The three ranges namely Chilla and Motichur and Gohri are very famous for wildlife tourism of the tiger reserve but at the same time these two ranges are facing most of the degradation, fragmentation as well as habitat lose due to increasing of various pressures. The pressure in Gohri and Chilla especially from the Western boundary and sometime also due to the discontinuity of the forest and which is a worst examples of anthropogenic influences[8]. The activity of the elephant near different corridor affected due to construction of roads, National highways[9]. Many alien and indigenous weeds like *Parthenium hysterophorus, Trewia nudiflora, Lantana camara* dominated in few areas of the tiger reserve with their worst canopy. Gujjars community of Gohri range are mainly depends on the plants for their food and fodder purposes. These Gujjars and villagers were found dependent on forest products for their livelihood, which primarily includes activities like collection of fodder and fuelwood. At present Gohri range is facing severe threat due to the Gujjars settlement.

Materials and Methods

Study Area

The study was conducted in Gohri forest division (adjacent area of Chilla forest division) of Rajaji tiger reserve where we have covered all the Deras of Gujjars and information also taken from the other locals inhabitants (Garhwali and Kumaoni peoples). The Gohri forest range of the reserve comprises the forest area of 10177.90 ha. The other forest range 'Chilla range' of Rajaji tiger reserve is one of the great centres of attractions for tourists[10]. Van Gujjars are now permanently residing in the Gohri forest division of the tiger reserve and raising their cattle for milk. The river Ganga flows through the Rajaji tiger reserve for a distance of 24 km. The Chilla and Gohri forest division is facing most of the habitat lose, degradation and fragmentation due to the increase of human population. The vegetation is mainly comprises of *Dalbergia sissoo, Acacia catechu , Helicteres isora, Shorea robusta, Cassia fistula, Mallotus philippensis* along with the herbal species like *Cynodon dactylon, Achyranthus aspera*, *Peporomia* spp, *Tridex procumbens, Bidens pilosa*, etc. whereas the Pauri forest division is mainly comprises of *Pinus* spp., *Pinus-Quarcus* forest and mixed forest vegetation[10,11].

Collection of Data

All of the deras (shelters) of the Gujjars were frequently visited for the survey of ethnomedicinal plants which is carried out from for a period of three years (2015-2018). Data was collected about the different uses to these plants through personal interview, group discussion, semi-structured interview and questionnaire with predetermined informants from Kumao chaur, Kumbi chaur, Talla chaur, Kodiya talla and Kunao just ahead the been river from Gohri range of Rajaji tiger reserve. All these areas are adjacent to the Chilla forest division. Earlier ethnobotanical surveys, published data were also checked for comparison and to observe how the plants are utilized by the ethnic groups along with the mode of preparation. Data was gathered from 37 traditional medical healer comprises 19 men and 18 women aged between 40 - 65 in the study areas from the traditional medical practioners-Vaidhya, Gujjars and other local peoples. The local informants from the study area were selected of their popularity among locals with respect to ethnobotanical knowledge about the plants and were divided into two main age groups which include 40 to 50 years and 50-65 years. Further the ethical approvals were also taken from the informants in the form of declaration along with prepared questionnaire. The information was cross checked several times to verify and confirm the authenticity of the ethnomedicinal knowledge of the participants. On the other hand, local name, treatment method, used plant parts, preparation and administration of doses was recorded. Further, the traditional healer was asked about the diagnosis period. The preliminary identification of plants was done with the help of traditional healer and other locals. All the specimens were collected by assigning the number and identified with the help of local flora[12] (Fig. 1).

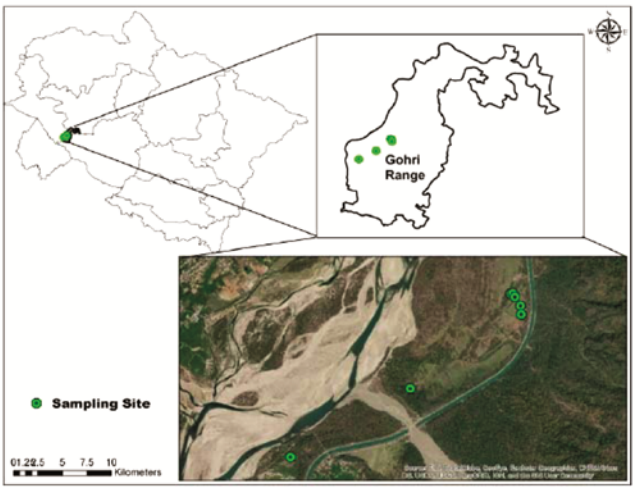

Fig. 1— Map of the study area

Analysis of data

Informant consensus factor (Fic)

The informant consensus factor (Fic) was calculated if there was agreement in the use of plant parts in an ailment category by the locals in the study area.

$$Fic = \frac{Nur - Nt}{Nur - 1}$$

Here, Nur = number of use-reports for a special ailment category

and Nt = number of plants used for a special ailment by all participants in the study area.

Generally, the product of Informant consensus factor varied from 0 to 1. Greater value reveals that very few ethnomedicinal plants are utilized by the maximum informants whereas low value reveals locals disagree for plants in treatment of an ailment.

Use value (UV)

The relative importance of each plant species known locally to be used as a particular herbal remedy is reported as the use value(UV) and was calculated as per the following method[51].

$$UV = \frac{\Sigma U}{n}$$

where UV = the use value of a species,

U= is the number of use reports cited by each informant for a given plant species in the study area

n = is the total number of local people interviewed for a given plant.

The UV is helpful in revealing the plants with the highest use in the treatment of an ailment. On the other hand, UVs are high when there are many use-reports for a plant species and low when there are few reports related to its use.

Fidelity level (FL)

To determine the most frequently used plant species for treating a particular ailment category by the informants of the study area, we calculated the fidelity level (FL). The FL was calculated using the following formula[52].

$$FL\ (\%) = Np/\ N \times 100$$

Here, Np = is the number of use-reports cited for a given species for a particular disorder/ ailment category and N = the total number of use reports cited for any plant species

Frequency of citation (FC) and Relative frequency of citation (RFC)

FC is generally used for determining the most used or more preferred plant species. Further, RFC was used to analyze the indigenous knowledge about usage of plants which is calculated by the following formula.

$$RFC = FC/N\ (0 < RFC < 1)$$

Where RFC = relative frequency citation, FC = Frequency of Citation, N= whole number of informants Table 1.

*Gujjars have been relocated due to the strong implementation of wildlife protection act, 1972 (in 1985 and 1998) but they are still presents in Gohri forest range of the tiger reserve

Results

Demographic data and ethnobotanical description

The demographical depiction and comparison of the present study with other similar studies revealed that all the Gujjars are close to an average age group. The interviewed of communal Gujjars and local inhabitants, traditional healers as well as the herbalist also revealed that they were more experienced in traditional medicinal system. Gujjars uses the plants very frequently as compared to the locals. It may be due to the improper sharing of the traditional medicinal knowledge of plants. The present study also revealed the poly medicinal extract combination which can be used in the treatment of a numbers of

Table 1 —Status of Gujjars Communities in Rajaji Tiger Reserve

S.No.	Range Name	No. of Family 1985	1998	Relocated in Gaindikhatta	Relocated in Pathri	Relocated in All
1	Haridwar	85	254	60	194	254
2	Chilla	181	193	193	-	193
3	Kansrao	11	85	42	43	85
4	Motichur	37	116	15	101	116
5	Dholkhand	116	234	102	130	232
6	Gohri	-	149	67	-	67
7	Ramgarh	17	99	51	42	93
8	Chillawali	65	260	83	2	85

Source: Information was collected at the time of survey and management plant of the tiger reserve[7,13]

ailments and other associated. So it clearly shows that the various molecular and active compounds are responsible for the ethnomedicinal properties in plants like *Adhatoda vasica, Tinospora cordifolia, Acacia catechu, Ocimum sanctum, Ficus benghalensis, F. racemosa, Mimosa pudica, Holarrhena pubescens, Oroxylon indicum, Celosia argentea, Cassia fistula*.

General figure of most representative species and families

A total of 60 ethnomedicinal plant were collected from tribal areas of Gohri range of the tiger reserve. These plants belongs to the 33 families. These ethnomedicinal plant belongs to the families Fabaceae (9) followed by Asteraceae (8), Amaranthaceae (5), Lamiaceae, Combretaceae (3), Moraceae, Polygonaceae, Rhamnaceae (2 each), Apiaceae, Papaveraceae, Nyctaginaceae, Betulaceae, Sexifragaceae, Poaceae, Brassicaceae, Pinaceae, Lythraceae, Sterculaceae, Apocynaceae, Sapotaceae, Bignoniaceae, Bombecaceae, Euphorbiaceae, Lauraceae, Phyllanthaceae, Urticaceae, Cannabaceae, Acanthaceae, Oxallidaceae, Convolvulaceae, Memispermaceae and Myrtaceae, Malvaceae (1species each). Among all of the 60 wild plants, 26 were tree, 7 shrubs, 25 herbs and 2 climbers recorded from the study area. Maximum of these plants are verycommon in the other areas of Haridwar excluding *Acacia catechu*, *Anogeissus latiflolia*, *Fagopyrum esculantum, Helicteres isora, Holarrhaena pubescens, Celtis australis, Centella asiatica, Rumex hastatus.* It was observed from our study that some ethnomedicinal plants were extensively used for commercial purposes like *Eclipta alba, Terminalia bellirica, Tinospora cordifolia, Acacia catechu, Boerhavia diffusa, Brassica compestris, Ocium sanctum, Helicteres isora, Phyllanthus emblica*. These all plants are essential part of the Gujjars and villagers for their basic necessity and in other uses. Some of them also gets benefits from their own villages or from nearby villages by making medicines and other ointments but high commercialization of these plants are not possible for Gujjars due to the conservation status of the tiger reserve. Out of the 60 ethnomedicinal plants, Fabaceae was dominant family with 9 species followed by Asteraceae (with 8 species), Amaranthaceae (with 5 species), Lamiaceae and Combretaceae (with 3 species each), Moraceae, Polygonaceae, Rhamnaceae (with 2 species each) Table 2.

Plant part used as Ethnomedicine

The most frequent parts used in ailments were, leaves, bark, roots, seeds, whole plant, latex, gum, flowers, fruit, seeds and oil. Despite of these, bulbs and tubers were also used in some of the disorder along with the same plant. Sometime Gujjars and the villagers also used other things like milk, honey and oil to prepare the remedies. It was also observed that more than one part of plants of same species is used in different problem. Gum, seed and flowers of *Butea monosperma* is used to treat diarrhoea dysentery, roots of *Fagopyrum esculantum* is used in urinary infection whereas leaves in headache. On the other hand, bark of *Celtis australis* is used in fractured bone and seeds in constipation.

At the time of survey with Gujjars, it was observed that they uses ethnomedicinal plants in different ailments. Same plants are also used in the treatment of more than one or two ailments. *Ziziphus mauritiana*, *Z. nummularis, Terminalia bellirica*, *Tinospora cordifolia, Acacia catechu, Adhatoda vasica, Anogeissus latifolia, Albizia lebbeck, Butea monosperma, Cynodon dactylon, Dalbergia sissoo, Ocimum santum, Ficus benghalensis, F. racemosa, Mimosa pudica, Holarrhena pubescens, Oroxylon indicum, Celosia argentea, Cassia fistula* are used in the treatment of Diarrhoea and dysentery. Plants like

Table 2 — Total number of taxa and parts used in different ailments

Category of Ailments.	Number of Taxa	Plant Parts Used
Diarrhoea and Dysentery	16	Leaves, Bark, roots, seeds, bark, whole plant, latex, gum, flowers, fruit
Skin diseases	2	Oil, leaves
Cosmetic purpose	1	Leaves
Healing cut and wounds	5	Root, Whole plant, roots, leaves, oil
Urinary disorder and headache	1	Root
Menstrual disorder	1	Leaves
Stomach problems	3	Roots, Whole plant, fruits, leaves
Female problems and Infertility	1	Leaves
Other liver problems	1	Leaves, fruits, stem, bark, seeds
Tooth problems	1	Leaves
Stone problems	2	Roots, leaves
Blood dysentery	2	Roots
Cold and Cough	1	Leaves, fruits
Epilepsy	1	Whole plant, roots
Muscle pain and Swelling	2	Bark, leaves, roots
Piles	1	Flowers, gums
Asthma	1	Fruit, leaves, seeds
Fractured bones	1	Bark, wood
Scorpion bite	1	Leaves
Memory enhancer	1	Leaves
Indigestion	1	Seeds
Killing of liver worms in Children	1	Seeds
Insects repellent	1	Whole plant

Bidens pilosa, Cedrus deodara is used in skin diseases, , *Eclipta alba, Mallotus philippensis, Boehmeria rugulosa, Celtis australis* in constipation and other liver disorder, *Artemisia annua* in cosmetic purposes, *Parthenium hysterophorus* in insects bites and infertility, *Chenopodium album, Berginia ciliata* in stone problems, *Xanthium strumarium* in tooth problems, *Boerhavia diffusa, Sterculia villosa* in blood dysentery, *Helicteres isora*, *Artemisia japonica* in epilepsy, *Betula utilis, Achyranthus aspera* in muscular pain and swelling, *Berginia ciliata, Colebrookia oppositifolia, Rumex hastus, Ageratum conyzoides, Brassica campestris* in cut and wound, *Fagopyrum esculantum* in urinary disorder, headache and in menstrual disorders, *Amaranthus paniculatus* in killing of worms in childrens, *Cynodon dactylon, Syzygium cumini, Artimisia maritime,* in stomach problems. The other ethnomedicinal plants like *Bombax ceiba* used in piles, *Terminalia chebula* in indigestion, *Phyllanthus emblica* in asthma, *Litsea chinensis* in fractured bone, *Amaranthus spinosus* in scorpion bite, *Centella asiatica* in memory enhancer.

Preparation methods of drug and its activities

The result revealed that the milk of *Calotropis procera* is generally dangerous, is used in various problems like tooth pain, liver pain and cough. The leaves of *Chenopodium album* after boiling are used for curing bladder stone. Further, decoction from the stem of *Bergenia ciliata* has been mentioned in various ancient literatures due to its different wound healing property and in cut as well as in liver stone. Bark oil from *Cedrus deodara* is used in skin diseases as it effetely works.

As per the results of questionnaires the most used ethnomedicinal plants are *Eclipta alba, Chenopodium album, Ziziphus mauritiana, Vitex negundo, Tiinopsora cordifoila, Syzygium cumini, Acacia catechu, Anogeissus latifolia, Boerhavia diffusa, Butea monosperma, Bergenia ciliata, Brassica campestris, Fagopyrum esculantum, Ocimum sanctum, Amaranthus paniculatus, Bauhinia variegata, Helicteres isora, Bombax ceiba, Terminalia chebula, Mallotus philippensis, Phyllanthus emblica, Rumex hastus, Achyranthus aspera,*and *Ageratum conyzoides.*

There are different methods of preparation like powdering, decoction, chewing, water suspension, infusion and crushing cooked for various types of disorder. During the survey, it was observed that oil of the plant is mixed with *Allium cepa* applied in wound. On the other hand, bark of *Cassia fistula* is crushed with pepper grain to treat liver problems. The whole parts of *Tinospora cordifolia* are picked, boiled and then cooled and given before an hour of meal thrice a day to cure severe fever and in diarrhoea as well as dysentery. Infusion of *Tinospora cordifolia* is affective in chronic dysentery. It is believed for *Tinospora cordifolia* that it kills the bacteria. Further, Gujjars also boiled the leaves of *Boehmeria rugulosa* is given in decoction form to treat fractured bones and liver disorder. Paste of leaves from *Centella asiatica* is applied to enhance memory power. Powder of leaves from *Vitex negundo* is used in doses about 5 teaspoons with milk in diarrhoea, cough and cold. In case of *Ziziphus mauritiana*, root decoction approximately 5-7 teaspoon was given to treat diarrhoea and dysentery Fig. 2 (a-f), (Table. 3).

Fig. 2 — (a-f): Some of the extracted parts of the ethnomedicinal plants form Chilla forest division of Rajaji tiger reserve by Gujjars (a). Extracted Bark of *Syzygium cumini (*b). *Ficus racemosa* (c). Powder of *Ocimum santum* (d). *Helicteres isora* (e). Trifla (*Phyllanthus emblica, Terminallia bellerica, Terminalia chebula*) (f). *Centella asiatica*

Quantitative ethnobotany

Used Value

Quantitative tool were used for analysis of indigenous information so that cross verification of data can be done. Highest use value was recorded for *Acacia catechu* (0.143) where as other species

Viz. *Eclipta alba* (0.100) followed by *Listea chinensis* (0.083). *Ziziphus nummularia* had has been observed for low use value (0.023) (Table 4).

Relative frequency of citation (RFC %)

The Relative frequency of citation in present study varied from 0.07 to 0.26. We further classified all the ethnobotanical species into 3 categories: RFC 0.07 to 0.12 with 18 species; RFC, 0.13 to 0.18 with 24 species; RFC 0.19 to 0.26 with 18 species (Table 4). *Ziziphus nummularia* (0.26) has been recorded with highest RFC and its decoction is used in dysentary, *Syzygium cumini* (0.26) in diarrhoea and dysentery and the powder of *Argemone mexicana* (0.23) in dysentery. *Tinospora cordifolia*, *Terminalia bellirica*, *Vitex negundo* and *Bombex ceiba* etc. also has been observed for high RFC.

Fidelity level (FL)

FL value was classified into three classes and it was observed that ethnomedicinal plants which were used in curing most frequent category for Fidelity level value was 96.87% and lowest FL value was 58.32%. FL value of class one was 96.87% (7 species), class two 96.86 to 79.00% (22 species), class three 78.00 to 58.32% (31 species). Highest FL (96.87%) was observed for *Cassia fistula, Mallotus philippensis, Colebrookia oppositifolia, Phyllanthus emblica, Boehmeria rugulosa, Terminalia chebula and Mimosa pudica* in the study area (Fig. 3a-c).

Discussion

Demography and Ethnomedicinal plant diversity

The Himalayan zone is rich in biodiversity and medicinal plants[39] as it has great potentials for species survival. The allopathic medicinal system cures wide range of diseases but at the same time this system has various side effects and high cost as compared to the traditional medicinal system which does not cause side effects and has very low cost. Despite being great development in treating human health issues, local residents still use ethnomedicinal plant for medicinal purpose to a good extent as remedial measures due their availability, effectiveness and low prize in comparison to the modern medicines[40]. In present study, we have interrogated a large group of people aged between 40 - 65 in the Chilla forest range of Rajaji tiger reserve. This investigation also revealed the ethnobotanical uses of 60 ethnomedicinal plant of 33 families and 52 genera in which 26 were tree, 7 shrubs, 25 herbs and 2 climbers to cure more than 24 different human ailments and other uses of these plants. The information on the ethnomedicinal plants used by the Gujjars community was arranged on the basis of the assigned number along with the ethnomedicinal uses. There was a mixed combination of ethnomedicinal plants with herbs, climbers, shrubs and trees as the study area comes under a protected area network so there are various restrictions for humans. We also have observed that Gujjars collected ethnomedicinal plants in forest or by nearby residing areas which showed area is not well managed by valuable etnnomedicinal plants.

Table 3 — Ailments category with Informant consensus factor

Ailments Category	Nt	Nur	Fic	Plant Parts Used
Diarrhoea and Dysentery	29	30	0.77	Bark, roots, leaves, seeds, bark, whole plant, latex, gum, flowers, fruit
Skin diseases	1	3	1	Oil, leaves
Healing cut and wounds	2	4	0.45	Root, Whole plant, roots, leaves, oil
Urinary disorder and headache	1	5	1	Root
Menstrual disorder	1	3	0.43	Leaves
Infertility	1	5	0.47	Leaves
Other liver problems	7	9	0.56	Leaves, fruits, stem, bark, seeds
Tooth problems	2	4	0.45	Leaves
Stone problems	1	5	1	Roots, leaves
Blood dysentery	2	4	0.45	Roots
Cold and Cough	1	3	1	Leaves, fruits
Muscle pain and Swelling	1	6	1	Bark, leaves, roots
Piles	2	5	0.47	Flowers, gums
Asthma	2	6	0.59	Fruit, leaves, seeds
Fractured bones	2	4	0.45	Bark, wood
Scorpion/insects bite	2	4	0.45	Leaves
Memory enhancer	1	3	1	Leaves
Killing of liver worms in Children	1	3	1	Seeds
Insects repellent	1	4	0.46	Whole plant Whole plants

*A Taxa could be reported two ailments
Number of use reports= Nur, Number of taxa = Nt, Informant consensus factor= Fic

Table. 4 — Ethnomedicinal plants used by Gujjars community and other locals inhabitants of Chilla Forest Division of Rajaji Tiger Reserve

Local Name	Plant name	Family	RFC	UV	FL	Habit	Collector No. Assigned	Ethnomedicinal Used From Present study	Earlier Literature
Kattha	*Acacia catechu* (L.f.) Willd.	Fabaceae	0.17	0.143	79.33	Tree	RNP-101	The bark of the plant is used to treat dysentery and diarrhoea	14
Vasaka	*Adhatoda vasica* Medik.	Acanthaceae	0.10	0.067	62.11	Shrub	RNP-102	Roots are used to treat amoebic dysentery	15
Bakuli	*Anogeissus latifolia* Roxb.exDC.	Combretaceae	0.17	0.031	82.25	Tree	RNP-103	Leaves are used to treat diarrhoea	16
Sirish	*Albizia lebbeck* (L.) Benth.	Fabaceae	0.22	0.059	87.11	Tree	RNP-105	Bark decoction is used in dysentery and diarrhoea	17
Kantkari	*Argemone mexicana* L.	Papaveraceae	0.23	0.029	82.78	Herb	RNP-108	The powder of the seed used to treat dysentery	18
Chota ghokru	*Boerhavia diffusa* L.	Nyctaginaceae	0.19	0.034	71.85	Herb	RNP-110	Root paste of this plant is used to cure bloody dysentery	19
Patee	*Artemisia japonica* L.	Asteraceae	0.18	0.033	61.21	Herb	RNP-111	Juice taken fresh to cure stomach disorder whereas dried root in epilepsy	20,21
Bhojpatra	*Betula utilis* D.Don	Betulacaea	0.17	0.343	60.12	Tree	RNP-112	Bark is used in muscular pain and swelling	22
Dandola, pashanbhed	*Bergenia ciliata* Sternb.Rev	Saxifragaceae	0.16	0.058	61.21	Herb	RNP-113	Decoction of root used in wound and cut	23

(*Contd*.)

Table. 4 — Ethnomedicinal plants used by Gujjars community and other locals inhabitants of Chilla Forest Division of Rajaji Tiger Reserve (*Contd*.)

Local Name	Plant name	Family	RFC	UV	FL	Habit	Collector No. Assigned	Ethnomedicinal Used From Present study	Earlier Literature
Dubla	*Cynodon dactylon* L.	Poaceae	0.16	0.040	88.80	Herb	RNP-114	The whole plant is orally taken in diarrhoea and dysentery	24
Pili sarson	*Brassica campestris* L.	Brassicaceae	0.17	0.034	86.85	Herb	RNP-115	Oil of plant is mixed with *Allium cepa* applied in wound	25,26
Shiham	*Dalbergia sissoo* DC.	Fabaceae	0.17	0.037	76.66	Tree	RNP-116	The juice of leaves are mixed with sugar and curd is used to cure blood dysentery whereas bark decoction in diarrhoea	12
Devdar	*Cedrus deodara* G.Don	Pinaceae	0.17	0.037	76.66	Herb	RNP-117	The oil of bark is used to cure skin diseases	12
Garkha	*Celosia argentea* L.	Amaranthaceae	0.19	0.028	91.42	Herb	RNP-118	Decoction of seed twice is given twice a day in diarrhoea	12
Gular	*Ficus racemosa* L.	Moraceae	0.19	0.029	76.47	Tree	RNP-119	The latex of the plant is used to treat dysentery	27
Amaltas	*Cassia fistula* L.	Fabaceae	0.18	0.032	96.87	Tree	RNP-120	The bark of the plant is crushed with pepper grains and the prepared extract is given in dysentery	12
Bhettu	*Fagopyrum esculentum* Moench.	Polygonaceae	0.21	0.051	95.00	Herb	RNP-121	The root are used in urinary disorder and paste of leaves in headache as ointment	22, 28
Tulsi	*Ocimum sanctum* L.	Lamiaceae	0.10	0.050	72.91	Herb	RNP-122	Leaf paste along with black pepper used in diarrhoea, Leaves in menstrual disorder	24
Timla	*Ficus auriculata* L.	Moraceae	0.19	0.028	91.42	Tree	RNP-123	Milky latex is poured into the navel in every two hours to cure diarrhoea	29
Marchu	*Amaranthus paniculatus* L.	Amaranthaceae	0.10	0.050	72.91	Herb	RNP-125	Fried seed of the plant are eaten to kill liver worm in children	28
Kikar	*Acacia nilotica* L.	Fabaceae	0.12	0.040	70.91	Tree	RNP-126	Bark of the plant is used to treat dysentery	12
Gwiryal	*Bauhinia variegate* L.	Fabaceae	0.20	0.026	75.00	Tree	RNP-127	Flowers buds of plants are used in diarrhoea whereas the leaves are used in dysentery and sometime eaten as raw	23
Dhak or Plas	*Butea monosperma* Taub	Fabaceae	0.11	0.056	61.12	Tree	RNP-128	Seed, gum and flowers are used to treat dysentery	12
Bargad	*Ficus benghalensis* L.	Moraceae	0.18	0.063	84.84	Tree	RNP-129	Bark infusion is used to treat diarrhoea	30
Marorfali	*Helicteres isora* L.	Sterculaceae	0.18	0.063	84.84	Shrub	RNP-130	Powder of fruit is used in diarrhoea, dysentery whereas decoction in cough and cold	12, 30
Lajwanti	*Mimosa pudica* L.	Fabaceae	0.18	0.030	96.87	Herb	RNP-131	Whole plant is used in dysentery	31

(*Contd*.)

Table. 4 — Ethnomedicinal plants used by Gujjars community and other locals inhabitants of Chilla Forest Division of Rajaji Tiger Reserve (*Contd*.)

Local Name	Plant name	Family	RFC	UV	FL	Habit	Collector No. Assigned	Ethnomedicinal Used From Present study	Earlier Literature
Kutaj	*Holarrhena pubescens* G. Don	Apocynaceae	0.16	0.033	72.42	Tree	RNP-132	The bark is used to treat dysentery	32
Mahua	*Madhuca longifolia* J.F. Macbr.	Sapotaceae	0.16	0.033	72.42	Tree	RNP-133	The infusion of flowers is used to treat diarrhoea	14
Bhutiya talwar	*Oroxylum indicum* L.	Bignoniaceae	0.19	0.029	76.47	Tree	RNP-134	Root bark and fruit is used to treat diarrhoea and dysentery	31
Semal	*Bombex c eiba L.*	Bombacaceae	0.20	0.026	75.00	Tree	RNP-135	Flowers and Gum are used in digestive disorder and piles	33
Heda	*Terminalia chebula* Retz.	Combretaceae	0.18	0.030	96.87	Tree	RNP-136	The seeds are used to cure Asthma and indigestion	30
Runi	*Mallotus philippensis Muell-Arg.*	Euphorbiaceae	0.18	0.032	96.87	Tree	RNP-137	The red fruit of the tree is used to treat problem of constipation	30
Binda	*Colebrookia oppositifolia* Smith.	Lamiaceae	0.18	0.032	96.87	Shrub	RNP-138	Leaves are used to treat wound	12
Anwla	*Phyllanthus emblica* Linn.	Phyllanthaceae	0.18	0.030	96.87	Tree	RNP-139	Fruit and leaves are used to treat hair falling, asthma and indigestion	28
Kuda	*Litsea chinensis* Lour.	Lauraceae	0.07	0.083	58.32	Tree	RNP-140	The bark and hard wood of the tree is applied in fractured bones	34
Ghenthein	*Boehmeria rugulosa.* Wedd.	Urticaceae	0.18	0.030	96.87	Shrub	RNP-141	Stem is used in fractures whereas fruit in liver disorder	12
Dhaula	*Woodfordia fruticosa* Kurz.	Lythraceae	0.10	0.056	83.32	Shrub	RNP-142	Red flower used in piles	32
Apamarg, Chirchita, Latjeera	*Achyranthus aspera* Linn.	Amaranthaceae	0.17	0.031	82.25	Herb	RNP-143	The leaves and roots in muscular pain	14
Almera	*Rumex hastatus* D.Don.	Polygonaceae	0.18	0.062	84.84	Herb	RNP-144	Paste is applied in cut and to check quick bleeding	12
Khadeek	*Celtis australis* Linn.	Cannabaceae	0.18	0.061	84.85	Tree	RNP-145	Bark is used in fractured bones and seed in constipation	35
Khatti buti	*Oxalis corniculata* Linn.	Oxallidaceae	0.19	0.062	84.75	Herb	RNP-146	Leaves are used in fever	33
Chaulayi	*Amaranthus spinosus* L.	Amaranthaceae	0.10	0.050	72.91	Herb	RNP-147	Leaves are used are used in snake and scorpion bite	12
Bhrami	*Centella asiatica* L.	Apiceae	0.12	0.055	83.31	Herb	RNP-148	Leaves of the plant are used as memory enhancer	12
Jangli pudina	*Ageratum conyzoides* L.	Asteraceae	0.10	0.050	72.91	Herb	RNP-149	Leaves are used in cuts and wound dressing	12
Sweet wormwood/	*Artemisia annua* L.	Asteraceae	0.11	0.045	82.63	Herb	RNP-150	Leaves are used in cosmetics medicinal	12
Kunwar	*Bidens pilosa* L.	Asteraceae	0.18	0.061	84.85	Herb	RNP-151	The paste of leaf in skin diseases.	36
Bhringraj	*Eclipta alba* Hassak.	Asteraceae	0.11	0.100	60.01	Herb	RNP-152	Leaves are used to treat liver problems	36

(*Contd*.)

Table. 4 — Ethnomedicinal plants used by Gujjars community and other locals inhabitants of Chilla Forest Division of Rajaji Tiger Reserve (*Contd*.)

Local Name	Plant name	Family	RFC	UV	FL	Habit	Collector No. Assigned	Ethnomedicinal Used From Present study	Earlier Literature
Gajarghas	*Parthenium hysterophorus* L.	Asteraceae	0.22	0.053	76.31	Herb	RNP-153	Leaves in toothaches, insect bites and infertility	12
Ghamra	*Tridax procumbens* L.	Asteraceae	0.21	0.051	79.40	Herb	RNP-154	Plant leaves are insect repellent and also used in bronchial catarrh and diarrhoea	12
Ghokru	*Xanthium strumarium* L.)	Asteraceae	0.10	0.056	83.32	Herb	RNP-155	Leaves are used in tooth infection	36
Udal	*Sterculia villosa* Roxb.	Malvaceae	0.10	0.050	72.91	Tree	RNP-156	The juice of the root mixed with honey used against blood dysentery	12
Bathua	*Chenopodium album* L.	Amaranthaceae	0.11	0.054	78.96	Herb	RNP-157	The leaves of plant used in bladder stone.	12
Amarbel	*Cuscuta reflexa* Roxb.	Convolvulaceae	0.21	0.051	79.40	Herb	RNP-158	Plant paste is used as insect repellent	35
Baer	*Ziziphus nummularia* (Burm. f.) Wight & Arn.	Rhamnaceae	0.26	0.023	90.00	Shrub	RNP-159	Decoction in dysentery	12
Badi baer	*Ziziphus mauritiana* Lam.	Rhamnaceae	0.12	0.045	77.95	Tree	RNP-160	Decoction of plant root and bark powder is given in diarrhoea	30
Nirgundi	*Vitex negundo* L.	Lamiaceae	0.22	0.053	76.31	Shrub	RNP-161	The powdered of flowers with milk in diarrhoea	37
Bahera	*Terminalia bellirica* (Gaertner) Roxb.	Combretaceae	0.21	0.051	79.40	Tree	RNP-162	Fruits in dysentery and diarrhoea	12
Giloy	*Tinospora cordifolia* (Willd.) Miers	Memispermaceae	0.21	0.051	79.40	Herb	RNP-163	The whole plant decoction in diarrhoea and infusion of plant pepper and honey is given in chronic dysentery	37
Jamun	*Syzygium cumini* (L.)	Myrtaceae	0.26	0.023	90.00	Tree	RNP-164	Root extract given twice in dysentery and diarrhoea whereas paste of fruit in liver problems	29
Sandan	*Ougeinia oojeinensis* (Roxb.) Hochr.	Fabaceae	0.10	0.050	72.91	Tree	RNP-165	The bark of plant in diarrhoea and dysentery	38

Use Value = UV, Informants Census factors (Fic), Fidelity level (FL) etc

The present investigation has revealed that the Gujjars living in the forest of Gohri and adjacent areas of Pauri-Chilla area in Gohri Range but very close to Chilla are well versed with traditional knowledge in compared to the locals viz., Pahadi of Chilla- Pauri and Gohri. The villagers have less information than the Gujjars, so we obtained most of our information from Gujjars. It was also observed that Gujjars aged above 50 were well versed with ethnomedicinal knowledge as compared to age group of 40. The accumulation of the traditional knowledge with old aged people is a great concern but it's been losing up generation after generation. Effect of modernization, less sources of income from these types of occupation and protected status of the present study area are major reasons for this. The various methods of preparation of drugs are decoctions, infusions, juices, extracts, and powders as described in earlier studies[41]. The herbal medicine used with, honey, milk and boiled water. It was consumed in stomach, fever, cold, cough and other ailments.

In the present study area, out of 33 families Fabaceae (17.64%) and Asteraceae (15.68%) contributed the

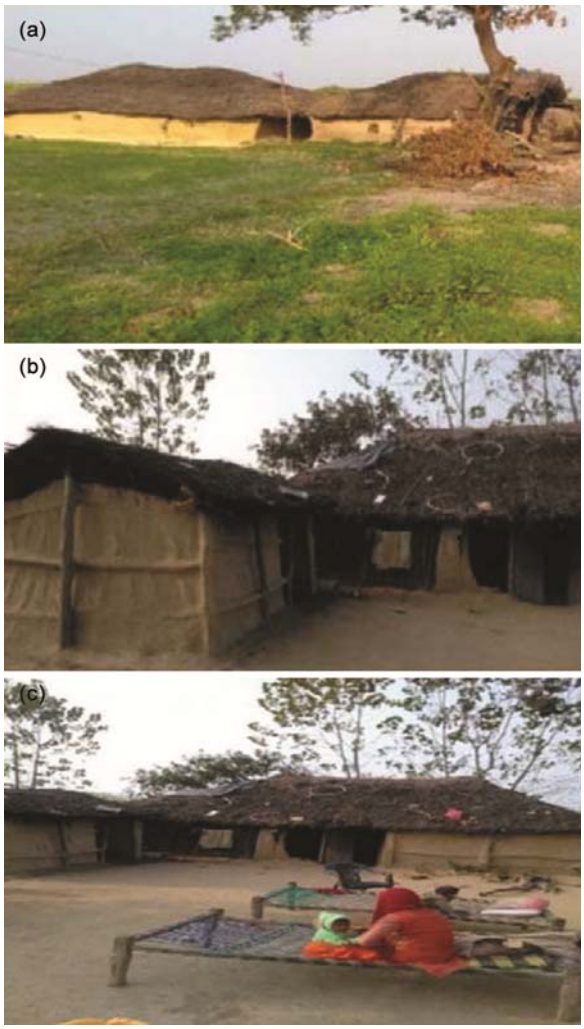

Fig. 3 — (a-c): View of Gujjars's shelter (deras) in Chilla forest division of Rajaji tiger reserve

maximum number of ethnomedicinal plants followed by Amaranthaceae (8.47%), Combretaceae and Lamiaceae (5.88%), Moraceae, Polygonaceae and Rhamnaceae (3.38% each), while rest of the family has contributed 1.69% of the total ethnomedicinal plant species. Our results are comparable with the earlier studies of worker[42] whose study reported Asteraceae with the leading family in terms of highest number of ethnomedicinal plants (Table 5).

In the present study area, old aged Gujjars have ample knowledge of the traditional medicines but their children are not able to get the knowledge. At the time of interview, it was recorded that Gujjars above the age of 55 gave more information about the ethnomedicinal plants whereas Gujjars in the age of 45-60 in the study area have shared much relevant and great information of the ethnomedicinal plants. Similar study was carried out by different workers[35,43]. on the status of the Gujjars and other inhabitants in Western Himalaya. When comparisons were made with these ethnomedicinal plants with earlier studies it clearly showed the different types of uses of these plants. These ethnomedicinal plants also have showed great variation from area to area in Chilla forest division[10,44]. The utilization of ethnomedicinal plant parts such as leaf, bark, roots and seeds to treat different ailments was correlated with various ethnobotanical surveys which also support the uses of other plants. This is due to the fact that plants are the depositor of various chemicals so it does not denote the special parts like roots and leaves which contain more bioactive compounds is fewer essentials than other. (Fig. 4a-b).

Table 5 — Taxonomic diversity of ethnomedicinal plants in Chilla Forest Division of Rajaji Tiger Reserve

Family	No. of Genera	Percentage of Genera	No. of Species	Percentage of Species
Fabaceae	8	15.68	9	17.64
Acanthaceae	1	1.96	1	1.69
Combretaceae	2	3.92	3	5.88
Papaveraceae	1	1.96	1	1.69
Apiaceae	1	1.96	1	1.69
Nyctaginaceae	1	1.96	1	1.69
Asteraceae	8	15.68	8	15.68
Betulaceae	1	1.96	1	1.69
Sexifragaceae	1	1.96	1	1.69
Poaceae	1	1.96	1	1.69
Brassicaceae	1	1.96	1	1.69
Pinaceae	1	1.96	1	1.69
Amaranthaceae	4	7.84	5	8.47
Moraceae	1	1.96	2	3.38
Polygonaceae	1	1.96	2	3.38
Lamiaceae	1	1.96	3	5.88
Lythraceae	1	1.96	1	1.69
Sterculaceae	1	1.96	1	1.69
Apocynaceae	1	1.96	1	1.69
Sapotaceae	1	1.96	1	1.69
Bignoniaceae	1	1.96	1	1.69
Bombecaceae	1	1.96	1	1.69
Euphorbiaceae	1	1.96	1	1.69
Lauraceae	1	1.96	1	1.69
Phyllanthaceae	1	1.96	1	1.69
Urticaceae	1	1.96	1	1.69
Cannabaceae	1	1.96	1	1.69
Oxallidaceae	1	1.96	1	1.69
Malvaceae	1	1.96	1	1.69
Convolvulaceae	1	1.96	1	1.69
Rhamnaceae	1	1.96	2	3.38
Memispermaceae	1	1.96	1	1.69
Myrtaceae	1	1.96	1	1.69

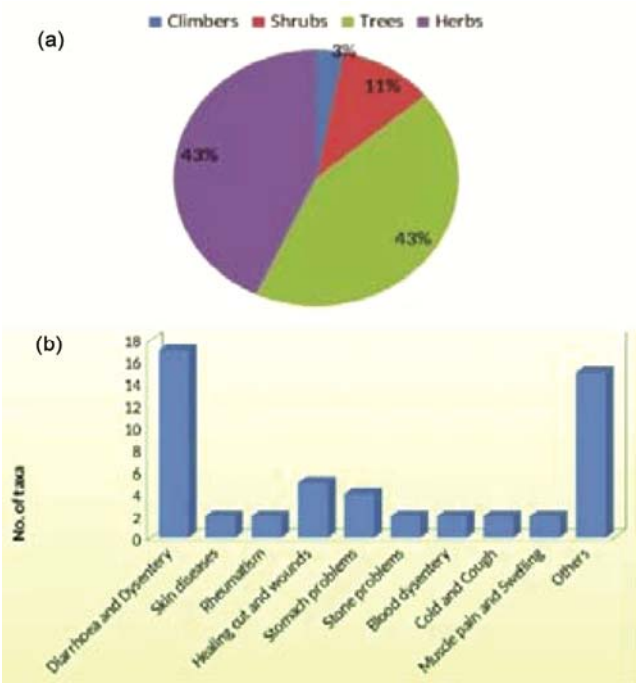

Fig. 4 — (a-c) View of shelter of Gujjars in Gohri forest division of Rajaji Tiger reserve, (d) Contributed percentage by ethnomedicinal Plants (e) Number of taxa in different ailements

Plant parts used

The traditional information from the tribal areas is now subsequently decreasing due to modernization[22]. Due to the strong implementation of wildlife act, the Gujjars are facing the problem of collecting NWFPs (non -wood forest products) from Gohri and adjacent areas of Chilla and Pauri.

Most widely used parts of the ethnomedicinal plants for preparations in the present study were leaves, roots, seeds, whole plant and so on. It was seen that an ethnomedicinal plant can be used for more than one ailment and one problem can be diagnosed by more than one ethnomedicinal plant parts. Various parts of plants are used in preparation of herbal decoction, powder etc which is similar to the earlier studies on the tribal communities by different workers on Uttarakhand Himalayan. Study of earlier worker [42] recorded 97 ethnomedicinal plants from the Kedaranth wildlife sanctuary in which in which leaves and roots was most frequent part used followed by bark, flowers and seeds in different ailments. Similar study was carried out in which they observed roots and rhizome was the most commonly used parts followed by seeds and fruits[17]. It was observed that in most of the studies on the ethnomedicinal aspects of plants in Himalayan zone; roots and leaves were most frequently used parts for different ailments[42,45]. It was also observed from other studies that leaves were the most frequently used part followed by roots and other parts. This is due to the fact that leaves contain large accumulation of chemicals and minerals. The higher use of the ethnomedicinal plants by Gujjars community in the study area is due to the poverty and belief in the folk medicine. Secondly many of the deras (home or shelters) of the Gujjars are very far from the roads or transport facility so they still used traditional way of treatment. At the time of our earlier study[10,11,42] on the forest structure, resource pattern and diversity of the Chilla forest division of Rajaji tiger reserve concluded that deprived socioeconomic status of Gujjars and inaccessibility of the forest are mainly responsible for great dependency of denizen on the forest for their basic needs and for ethnomedicinal plants. Some of the Gujjars and locals regularly visit the nearby areas of the Ghasiram sroath and Kharasroath along with their cattle to collects the fodder and the plants for their daily needs. Plants like *Bauhinia variegata, Desmodium gangeticum, Amaranthus panicuatus, Bombax ceiba,* and various other rhizomatous rooted plants was used by Gujjars for vegetable purposes which they collect from the forested areas. These plants provide ample livelihood to the Gujjars and other inhabitants in the study but further enumeration should be done properly.

Quantitative ethnobotany

The ethnomedicinal plants described in the present study for human ailments could be practiced in pharmacological and phytochemical activities. The highest UV for important ethnomedicinal plants like *Acacia catechu* (0.143), *Adhatoda vasica* (0.067), *Listea chinensis* (0.083) *Helicteres isora* and *Ficus benghalensis* (0.063) from the present study might be the trend of using herbal drugs in different human problems. Plant species used in various ailments repeatedly could have great biological and healing activity[49]. The high FL value of a species represent about the use of a species by participants in a specific ailment in an area[50]. Highest FL (96.87%) was recorded for *Cassia fistula, Mallotus philippensis, Colebrookia oppositifolia, Phyllanthus emblica, Boehmeria diffusa, Terminalia chebula* and *Mimosa pudica* in the study area. Ehnomedicinal plants with significant activities could be further verified as source for pharmaceutical and phytochemical.

In present study area, plants were found more significant as 70 FL%.

The Relative frequency of citation is generally used to choose the greatest ethnomedicinal plant in new disease drug development and discovery[51]. *Ziziphus nummularia* (0.26) in dysentery has been recorded with high RFC value, *Syzygium cumini* (0.26) used in the treatment of diarrhoea and dysentery, *Argemone mexicana* (0.23) for treatment of dysentery. All these finding can be used in future drug discovery and sustainable drug development programe[52]. So the present study revealed that Gujjars or traditional healer used conventional method in recent science period which could be study subject for future studies and further, the study can contribute the wellbeing of human by natural products. Plants with greater fidelity level (FL) and use values (UV) from our study may reveal the possible aspects of these plants for future biological and pharmaceutical activities.

Conclusion

The present investigation reveals that the Gujjars of the study area have sound knowledge of traditional medicine for different human ailments and healthcare management. The old aged peoples of the area have acquired the knowledge through long practices, experiences and from their ancestors. Remedies from different ailments and disorder come out with the help of various ethnmedicinal plants like *Anogeissus latiflolia*, *Acacia catechu*, *Fagopyrum esculantum, Helicteres isora, Holarrhaena pubescens, Phyllanthus emblica, Celtis australis, Centella asiatica, Rumex hastatus, Eclipta alba, Terminalia bellirica, Tinospora cordifolia, Acacia catechu, Boerhavia diffusa, Brassica campestris, Ocimum sanctum,*and *Helicteres isora* in the study area. At the same time, the serious and immediate threat to these ethnomedicinal practices in Chilla forest division seems to have come with the influence of excessive anthropogenic activities, pressures imposed by wild animals and migration of the young aged peoples to the cities leaving a gap between indigenous society and in cultural beliefs. Therefore, it is necessary to explore the traditional ethnomedicinal wealth and knowledge with pharmacological aspects. Due to the conservation status, wild animals and geographical structure of the study area there was hardly any study carried out on plants. So, this study could be a suggestive and important source for further ecological, ethnomedicinal studies in the study area.

Acknowledgement

The authors are thankful to the Director, Forest guards and the local inhabitants for their help during the field work.

Conflict of Interest

All the authors declare that they have no conflict of interest.

Author contributions

Navneet and B S B conceived the idea and supervise the whole research work. Akash, collected the data, performed and analyzed whole the work. Further, all authors discussed the results and contributed to the final manuscript.

References

1 Johnsy G, Beena S & Kaviyarasan V, Ethno-botanical survey of medicinal plants used for the treatment of diarrhea and dysentery, *Int J Med Med Sci* 3 (1) (2013) 332-338.

2 Panda S K, Rout S D, Mishra N & Panda T, Phytotherapy and traditional knowledge of tribal communities of Mayurbhanj district, Orissa, India, *J. Pharmacognosy Phytother 3* (7) (2011) 101-113.

3 Shanmugasundaram R V, Kalpana D P, Soris T, Maruthupandian A & Mohan V R, Ethnomedicinal legumes of southern Western Ghats, Tamil Nadu, *J Econ Tax Bot* 35 (2) *(*2011) 2-10.

4 World Health Organization (WHO), Traditional Medicine Strategy. WHO, Geneva. 2002, 1-345.

5 Brandão M G, Acúrcio F A, Montemor R L & Marlière L D, Complementary/alternative medicine in Latin America: use of herbal remedies among a Brazilian metropolitan area population, *J Complement Integr Med* 3 (1) (2006) 11-24.

6 Padma T V, "Himalayan plants seek cooler climes," *Nat. New,* 512 (7515) (2014) 1- 359.

7 Rasily S S,. Management plane of Rajaji tiger reserve, Uttarakhand, India. 2008, 1-500.

8 Kushwaha SPS & Jyothishi M, Browse biomass assessment for Asiatic elephant in Chilla sanctuary. Proceding of ISRS Symposium, 4-6 december, Pune, India. 1996 182-191

9 Johnsingh A J, Prasad S N & Goyal S P, Conservation status of the Chila-Motichur corridor for elephant movement in Rajaji-Corbett National Parks area, India, *Biol Conserv* 51(2) (1990) 125-38.

10 Akash, Navneet & Bhandari B S, Phyto-sociological studies, biodiversity conservation in a sub tropical moist deciduous forest of Rajaji Tiger reserve; Uttarakhand, India, *Int. J. of Res. Ana. Rev.* 5 (3) (2018a) 39-51.

11 Akash, Navneet & Bhandari, B S, A Community Analysis of Woody Species in a Tropical Forest of Rajaji Tiger Reserve, *Environment and Ecology* 37 (1) (2019) 48-55.

12 Gaur R D. Flora of the District Garhwal, North West Himalaya. Transmedia Publication, Srinagar, Garhwal, Uttarakhand. 1999, 1-670

13 13 Joshi R & Singh R, Gujjar community rehabilitation from Rajaji National Park: Moving towards an integrated approach

for Asian elephant (*Elephas maximus*) conservation, *J Hum Ecol* 28(3) (2009) 199-206.

14 Tiwari J K, Ballabha R & Tiwari P, Diversity and present status of medicinal plants in and around Srinagar hydroelectric power project in Garhwal Himalaya, India: needs for conservation, *Reseacher* 2(2) (2010) 50-60.

15 Bhatt V P & Negi GCS, Ethnomedicinal plant resources of Jaunsari tribe of Garhwal Himalaya, Uttaranchal, *Indian J. Tradit Know* 5 (3) (2006) 331–335

16 Panda S K, Rout S D, Mishra N & Panda T, Phytotherapy and traditional knowledge of tribal communities of Mayurbhanj district, Orissa, India, *J. Pharmacognosy Phytother* 3 (7) (2011) 101-113.

17 Johnsy G, Beena S & Kaviyarasan V, Ethno-botanical survey of medicinal plants used for the treatment of diarrhea and dysentery, *International J of Medi and Medi Sci* 3 (1) (2013) 332-8.

18 Senthilkumar M, Gurumoorthi P & Janardhanan K, Some medicinal plants used by Irular, the tribal people of Marudhamalai hills, Coimbatore, Tamil Nadu, *Nat Prod Rad* 5 (5) (2006) 382–388.

19 Mitra R & Gupta RC, Punarnava–An Ayurvedic drug of repute, *Appl Bot Abst* 17 (3) (1997) 209-227.

20 Bhattacharjee, K & Kumar S, Handbook of medicinal plants, Aavishkar Publishers, 2000, 1-342.

21 Kandari L S & Maikhuri R K, *Artemisia maritima* (Purchu); Option to improve local Economy of higher Himalaya. Kurukshetra (2009) 46–47.

22 Nautiyal S, Rajan K S & Shibasaki R, Environmental conservation vs compensation: Explorations from the Uttaranchal Himalaya, *Env Infor Arch* 2 (1) (2004) 24-35.

23 Negi V M & Chauhan N S, Medicinal and aromatic plants wealth of a tribal district Kinnaur in Himachal Himalayas, *Indian For* 135 (6) (2009) 838-52.

24 Negi V S, Maikhuri R K & Vashishtha D P, Traditional healthcare practices among the villages of Rawain valley, Uttarkashi, Uttarakhand, India, *Indian J. Tradit Know* 10 (3) (2011) 533–537.

25 Kadel C & Jain AK, Folklore claims on snakebite among some tribal communities of Central India, *Indian J. Tradit Know* 7 (2) (2008) 296–299.

26 Semwal D P, Saradhi P P, Kala CP & Sajwan BS, Medicinal plants used by local Vaidyas in Ukhimath block, Uttarakhand, *Indian J Tradit Know* 9 (3) (2010) 480–485.

27 Singh P K, Kumar V, Tiwari R K, Sharma A, Rao C V & Singh R H, Medico-ethnobotany of 'chatara'block of district sonebhadra, Uttar Pradesh, India, *Adv in Biol Res* 4 (1) (2010) 65-80.

28 Pant S, Samant SS & Arya SC, Diversity and indigenous household remedies of the inhabitants surrounding Mornaula reserve forest in West Himalaya, *Indian J Tradit Know* (2009) 8 (4) 606–610.

29 Sen S K, & Behera LM, Ethnomedicinal plants used by the tribals of Bargarh district to cure diarrhoea and dysentery, *Indian J Tradit Know* 7 (3) (2008) 425–428.

30 Gaur R D, & Sharma J, Indigenous knowledge on the utilization of medicinal plant diversity in the Siwalik region of Garhwal Himalaya, Uttarakhand, *J ForSci* (2011) 27 (1) 23-31.

31 Adhikari B S, Babu M M, Saklani P L, Rawat G S, Medicinal plants diversity and their conservation status in Wildlife Institute of India (WII) campus, Dehradun. *Ethnobot* Leaflets 2010 1 (6) 11-16.

32 Kumar M, Bussmann R W, Mukesh J & Kumar P, Ethnomedicinal uses of plants close to rural habitation in Garhwal Himalaya, India, *J. Med. Plants Res* 5 (11) (2011) 2252-60.

33 Singh G & Rawat G S, Ethnomedicinal survey of Kedarnath wildlife sanctuary in western Himalaya, India. *JLS* 1 (1) (2011) 35-46.

34 Sharma J, Gairola S & Gaur R D, Painuli R M, Medicinal plants used for primary healthcare by Tharu tribe of Udham Singh Nagar, Uttarakhand, India. International Journal of Medicinal and Aromatic Plants, *Int J of Med and Arom Plan* 1 (3) (2011) 228-233.

35 Sharma J, Gairola S, Gaur R D & Painuli R M, The treatment of jaundice with medicinal plants in indigenous communities of the Sub-Himalayan region of Uttarakhand, India, *J Ethnpharmocol* 143 (1) (2012) 262-91.

36 Chandra P, Sachan N & Pal D, Protective effect of *Dalbergia sissoo* Roxb. ex DC. (family: Fabaceae) leaves against experimentally induced diarrhoea and peristalsis in mice, *Toxicol Ind Health* 31 (12) (2015) 1229-35.

37 Umapriya T, Rajendran A, Aravindhan V, Thomas B & Maharajan M, Ethnobotany of irular tribe in palamalai hills, Coimbatore, Tamilnadu, *Nat Prod Res* 2 (2) (2011) 250–255

38 Srivastava A, Patel S P, Mishra R K, Vashistha R K, Singh A & Puskar A K, Ethnomedicinal importance of the plants of Amarkantak region, Madhya Pradesh, India, *IJMAP* 2 (1) (2012) 53-59.

39 Dhar U, Manjkhola S, Joshi M, Bhatt A, Bisht A K & Joshi M, Current status and future strategy for development of medicinal plants sector in Uttaranchal, India, *Curr Sci* 83 (8) (2002) 956-64.

40 Negi V S, Maikhuri R K & Vashishtha D P, Traditional healthcare practices among the villages of Rawain valley, Uttarkashi, Uttarakhand, India. *Indian J. Tradit Know* 10 (3) (2011) 533–537.

41 Bhatia H, Sharma Y P, Manhas R K & Kumar K, Traditional phytoremedies for the treatment of menstrual disorders in district Udhampur, J&K, India, *J Ethnopharmocol* 160 (1) (2015) 202-10.

42 Malik, Z A, Jahangeer A, Rainer W & Bhatt A B, Ethnomedicinal plants traditionally used in health care practices by inhabitants of Western Himalaya, *J of Ethnopharmocol* 172 (2015) 133-144.

43 Wani, Z A, Kumar N & Akash, Addition to the Ethnomedicinal Plants Used by the Local People of Gulmarg and its Allied Areas, Kashmir, Jammu and Kashmir, India, *Int J Cur Res Biosci Plant Biol* 2 (10) (2015) 18-22.

44 Akash and Navneet. Eco-Tourism as a Viable Option for Conservation of Wildlife in protected areas under Shivalik Hills of the outer Himalaya, India. In: *Environment impact of tourism in developing nations* edited by R Sharma, IGI global publishers U.S.A. (2018) 103-120.

45 Kunwar R M, Mahat L, Acharya R P, Bussmann R W, Medicinal plants, traditional medicine, markets and management in far-west Nepal, *J Ethnobiol Ethnomed* 9(1) (2013) 24-34.

46 Heinrich M, Ankli A, Frei B, Weimann C, Sticher O, Medicinal plants in Mexico: healers' consensus and cultural importance, *Soc Sci and Med* 47 (1988) 18-21.

47 Phillips O, Gentry A H, Reynel C, Wilkin P, Galvez-Durand, BC, Quantitative ethnobotany and Amazonian conservation, *Conserv Biol* 8 (1994) 225–248.

48 Friedmen J, Yaniv Z, Dafni A, Palewitch D, Apreliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedou in sin the Negevdesert, Israel, *J Ethnopharmocol* 16 (1986) 275–287.

49 Gul F, Shinwari Z K, Afzal I, Screening of indigenous knowledge of herbal remedies for skin diseases among local communities of North West Punjab, Pakistan, *Pak J Bot* 5 (2012) 1609–16.

50 Islam M K, Saha S, Mahmud I, Mohamad K, Awang K, Uddin S J, Rahman M M, Shilpi JA. An ethnobotanical study of medicinal plants used by tribal and native people of Madhupur forest area, Bangladesh, *J Ethnopharmocol* 151 (2) (2014) 921–30.

51 Asadi-Samani M, Moradi M T, Mahmoodnia L, Alaei S, Asadi-Samani F, Luther T. Traditional uses of medicinal plants to prevent and treat diabetes; an updated review of ethnobotanical studies in Iran, *J Nephropathol* 6(3) (2017) 118-212.

52 Vitalini S, Tomè F, Fico G. Traditional uses of medicinal plants in Valvestino (Italy), *J Ethnopharmocol* 121(1) (2009) 106–16