



USES AND KNOWLEDGE OF WILD AND CULTIVATED EDIBLE MEDICINAL PLANTS BY INDIGENOUS GROUPS OF RAJAJI TIGER RESERVE, UTTARAKHAND, INDIA

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Abstract

The ethnomedicinal study of wild and cultivated medicinal plants was carried out in the year 2015-2018 in the adjacent areas of Chilla forest of Rajaji tiger reserve. Information was gathered from the ethnic and local communities. A total of 59 wild and cultivated plants from 32 families was recorded from the study area in which 45 was wild and 14 were cultivated. The lifeforms, in which herbs (30) makes the higher proportion of wild and edible cultivated plants followed by trees (21), shrubs (6) and climbers (2). The plants was used by the people in different forms like raw, boiled, fried and sometime also consumed in form of pickle.

Key words: Indigenous groups, Rajaji tiger reserve, Edible plants, Chilla, Wild and cultivated.

Introduction

Himalayan region in India covers about an area of 591000 km², which is approximately 11% of the total geographical area of the country. This area occupied 40% of the total endemic species and about 50% of the country's forest cover (Saxena *et al.*, 2001). In India, there are about 1 million community based traditional workers which used plants in different forms. These all medicinal system cures a large number of different human and animal ailments.

The state Uttarakhand is an important state of Western Himalaya which cover about 53,485 sq.km. of the geographical area. Uttarakhand is well known for its vast floristic diversity due to great variation in altitude and climatic conditions. This type of climatic conditions favour rich diversity of medicinal plants through which a large number of raw drugs can be obtained which also has been mentioned in Ayurvedic manuscripts (Gangwar *et al.*, 2010). Indian pharmaceutical has been consuming more than 280 medicinal plants in which 175 plants are obtained from Himalayan region (Dhar, 2002). Himalayan region supports the growth of approximately 1748 species

of plants which have great medicinal value. (Samant *et al.*, 1998). The highest number of medicinal wealth has been recorded by various workers from the foothills of Uttarakhand Himalaya (Akash and Navneet, 2018 ; Akash *et al.*, 2018 a,b,c,d; Akash and Navneet, 2019). Maximum of the plant species were collected from the alpine and sub-alpine areas of the Uttarakhand Himalaya which are mostly used in herbal formulations (Anonymous, 1997). Major problems associated with these medicinal plants are their excessive utilization and slow rate of growing resulting into their loss and finally extinction of species (Dhyani and Kala, 2005; Jablonski, 2004). Secondly, due to the high commercial demand for herbal medicines and dependency of locals and other forest communities on these plants for livelihood and on non-wood forest products (NWFPs) has further led to the rapid depletion of these plants (Akash *et al.*, 2020; Nautiyal *et al.*, 2001). Therefore, to maintain the sustainability of these edible medicinal plants it is essential to manage the indigenous knowledge and to develop better conservation strategies.

Study area

The study was carried out in Chilla-Pauri forest

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division of Rajaji tiger reserve where we have collected all the information from the indigenous groups which includes the Villagers, Muslims Gujjars traditional experts etc. The Chilla forest range of Rajaji tiger reserve comprises an area of 249.00 km² and situated between 29° 5'26" to 30° 03'00" N latitude and 78° 3'26" to 78° 23' 36"E longitude. This area lies between the Haridwar-Pauri forest division. The Haridwar forest division of Rajaji tiger reserve cover 7304.60 hectare of forest cover in Uttarakhand state (Akash and navneet, 2018). The Chilla forest range of Rajaji tiger reserve is one of the great centres of attractions for tourists (Akash *et al.*, 2018 b). Although the Gujjars and indigenous groups were relocated from the forest areas due to the strong provision of Wildlife protection act, 1972 but Van Gujjars and villagers are still residing in the Chilla range of the tiger reserve. They raising their cattle for milk and meat feed them by grazing and lopping of the different plant species. This forest division faced severe pressure in past in form of degradation, habitat lose and fragmentation due to the increasing of human population but at the same time due to the large area of the forest the tiger reserve maintained its integrity due to rich floristic diversity. The dominant flora of the tiger reserve area *Dalbergia sissoo*, *Shorea robusta*, *Mallotus philippensis*, *Acacia catechu*, *Helicteres isora*, *Cassia fistula* and the ground

vegetation is mainly comprising of *Ageratun conyzoides*, *Anagallis arvensis*, *Cynodon dactylon*, *Kyllinga monocephala*, *Abutilon indicum*, *Sida spinosa* etc. On the other hand the high altitudinal regions of Pauri Garhwal is mainly comprises of *Pinus* spp., Pinus-Oak forest and mixed forest vegetation Himalaya (Akash and Navneet, 2018 ; Akash *et al.*, 2018 a,b,c,d; Akash and Navneet, 2019).

Material and Methods

The aim of the present study was thus to carried out the survey with an objective to explore the indigenous knowledge associated in the Chilla and its allied areas of Rajaji tiger reserve. Further, we have attempt (i) to enumerate and documents all the wild edible medicinal plants which are also domesticated by the locals, (ii) to investigate the consumption of these plants, mode of using and different traditional knowledge associated with these plants. The field survey was carried out from for a period of three years (2015-2018). All of the deras (Shelters) of the locals, Gujjar and traditional experts were asked for the information. Data was collected about the different uses to wild and cultivated medicinal plants through group discussion, personal interview and questionnaire with predetermined informants. The data was gathered between the age groups of 40-65 in the study areas from Gujjars, local residing people and traditional medical

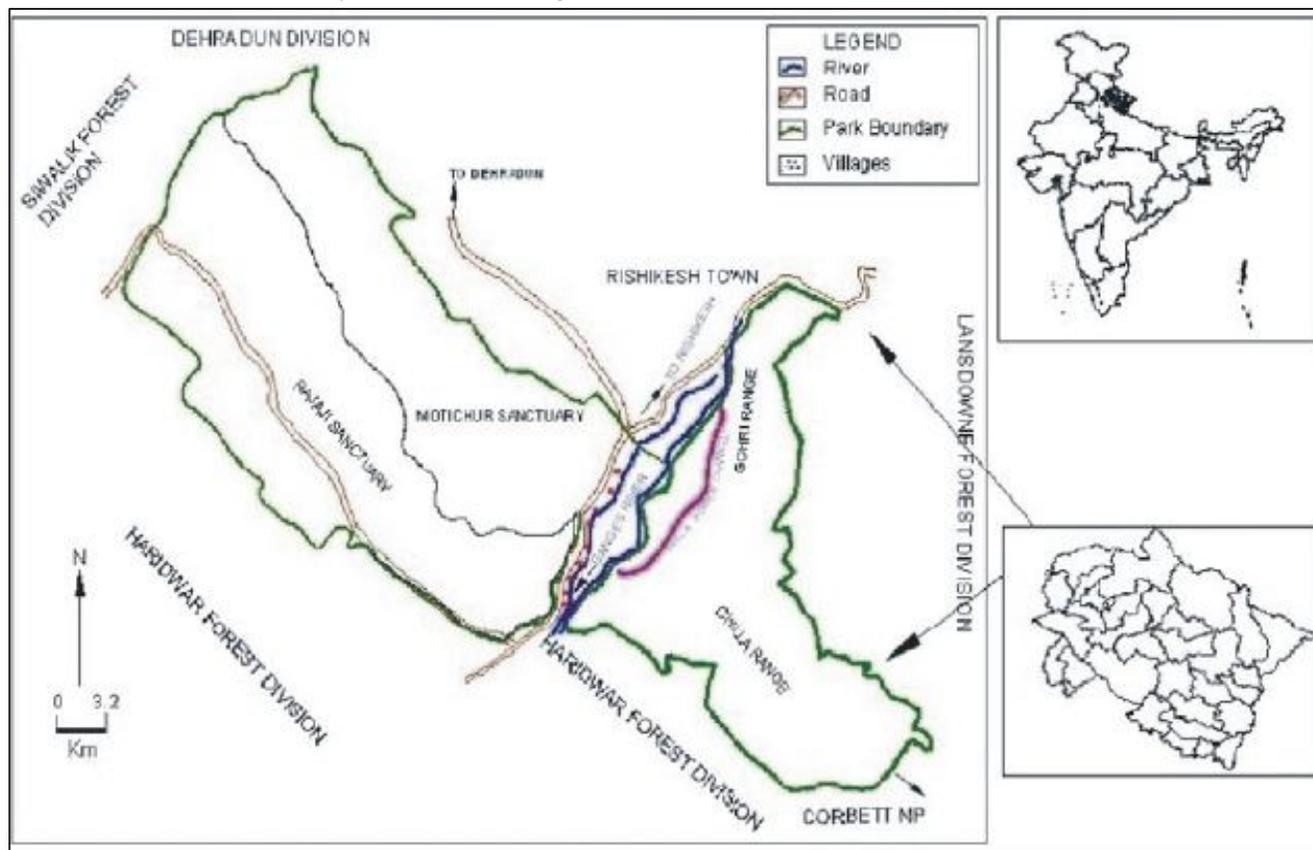


Fig. 1: Map of the Study area.

Table 1: District wise distribution of area of Rajaji tiger reserve.

S. No.	District	Area (ha)
1.	Dehradun	23677.90
2.	Pauri Garhwal	25007.70
3.	Haridwar	33356.59
Total		82042.19

practioner and Vaidhya. The respondent or the local villagers and Muslims Gujjars which have the indigenous knowledge of the medicinal plants accompanied us in the area to gets the herbarium specimens of the plants for authentication. Further all the specimens of the plants were given as assigning number and identified from the regional flora (Gaur, 1999) and submitted to the department of Botany and Microbiology, Gurukul kangri University, Haridwar for further record.

Results

General description of most abundant species and families

A total number of the 59 species under 48 genera belonging to the 32 families of vascular plants were recorded from the study area. Among all of the medicinal plants, majority of the species were collected from wild areas (57.62% species) and rest of the species semi / wild cultivated plants (42.33%) species. The major life forms are herbs (30) followed by trees (21) shrubs (6) and climbers (2) in which Amaranthaceae (6) was the dominant family followed by Fabaceae, Moraceae, (4 species each), Rhamnaceae, Solanaceae, Limiaceae (3 species each), Polygonaceae, Rutaceae, Oxalidaceae, Brassicaceae, Cannabaceae, Capparaceae, Myrtaceae, Zingiberaceae (2 species each) and rest of the family like Asteraceae, Dioscoreaceae, Araceae, Malvaceae, Chenopodiaceae, Sexifragaceae, Bombicaceae, Phyllanthaceae, Anacardiaceae, Moringaceae,

Tropaeolaceae, Caricaceae, Acanthaceae, Apocynaceae, Cucurbitaceae, Boraginaceae, Rosaceae, Caryophyllaceae was represented by only 1 species of wild and cultivated medicinal plants.

Many of the traditional recipe or cuisines was prepared from these wild and cultivated plants in the study area. These cuisines were Chutneys, Vegetable Salad, Bhajii, Pakori, Stewed vegetable Soup and Chaai/Herbal tea. Different parts of a single plants were also used in different way by the indigenous groups in the study area. The consumed part of the plants by the indigenous people are fruits (27) followed by leaves (17), flower (7), seed (6), shoot (4), stem (4), rhizome (4), twigs (3), petiole (1), whole plants (1).

Plants consumed through cooking

The productivity of the pulses in the study area is very low. So plant species like *Colocasia esculanta*, *Amaranthus spinosus*, *Fagopyrum esculantum*, *Rumex hastus* are used as a substitute of these pulses. Apart from the common edible plants and vegetable in Northern India, there are many traditional vegetable cuisines which are only cooked only in this region. Although these plants are seasonal but these have great medicinal value. Saag of *Amaranthus spinosus*, *Fagopyrum esculantum* and cooked leafy dishes from the leaves of *Colocasia esculanta* is famous in the study area. It was observed from the study area that plants like *Amaranthus spinosus*, *Fagopyrum esculantum*, *Bidens pilosa*, *Dioscorea bulbifera*, *Colocasia esculanta*, *Amaranthus paniculatus*, *Bombax ceiba*, *Rumex hastus* is cooked and consumed. In case of *Colocasia esculanta* leaves are cut and boiled and then water is decanted to remove the toxic and thought itching substances and finally later is used as gravy.



Fig. 2: (a-b) Colse view of villagers shelters (Deras) in the study area.

Plants consumed as raw and cooked

Oxalis corniculata, *O. Latifolia*, *Bergenia ciliata* are the plant species which are eaten raw while *Murraya koenighii*, *Bauhinia variegata* are the plants which are used through both cooked and eaten raw. Ripe fruit of *Syzygium cumini*, *Morus alba*, *Mangifera indica*, *Psidium Guajava*, *Zizyphus nummulris*, *Z. mauritiana*,

Z. jujupa, *Ficus racemosa*, *F. auriculata*, *Grewia optiva*, *Celtris australis*, are eaten directly while *Terminalia chebula*, *Phyllanthus emblica*, *Terminalia bellirica* are eaten raw. *Aegle marmelos* is used in making fresh juice.

Traditional Recipe

The leaves of *Chenopodium album*, *Amaranthus*

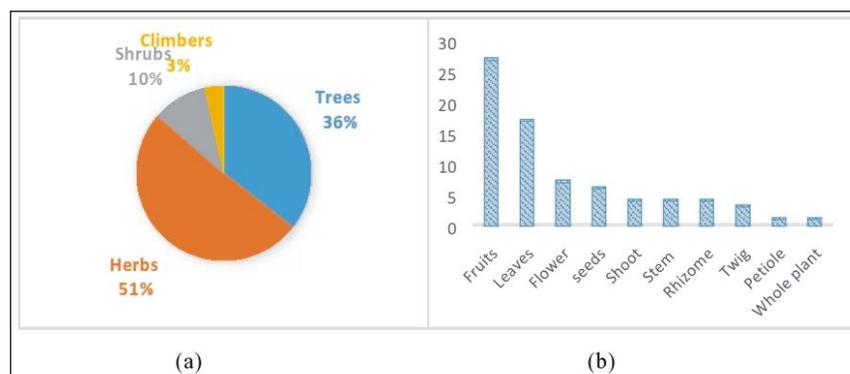


Fig. 3: (a) Contribution of life forms in the study area; (b) Contributed edible by different plants in different recipe.

Table 2: Demographic data of the two major district (Pauri and Haridwar) in which the study area comes.

	Haridwar district		Pauri district	
	2001	2011	2001	2011
Area	2,360 Km ²	2,360 Km ²	5,329 Km ²	5,329 Km ²
Population	1,447,187	1,890,422	697,078	687,271
Male	776,021	1,005,295	331,061	326,829
Female	671,166	885,127	366,017	360,442
Growth of population	28.70%	30.63%	3.91%	-1.41%
Sex ratio (per 1000)	865	880	1106	1103
Literacy	63.75	73.43	77.49	82.02

Source: Census of 2001 and 2011 by Government of India

Table 3: Productivity of Major Crops of Pauri Garhwal.

Crop	Productivity (Q/ha)		
	2015-2016	2016-2017	2017-2018
<i>Oryza sativa</i> (Rice)	13.00	13.00	14.03
<i>Triticum vulgare</i> (Wheat)	10.79	110.66	15.04
<i>Zea mays</i> (Maize)	18.00	18.00	20.64
<i>Penisetum spp</i> (Madua)	14.00	14.00	13.59
<i>Brassica campestris</i> (Mustard)	5.24	8.37	3.58

Source : Agriculture department Uttarakhand

Table 4: Productivity of Major Crops of Pauri Garhwal.

Crop	Productivity (Q/ha)		
	2014-2015	2015-2016	2016-2017
<i>Oryza sativa</i> (Rice)	22.22	21.42	20.46
<i>Triticum vulgare</i> (Wheat)	20.66	29.29	32.25
<i>Zea mays</i> (Maize)	14.10	14.13	22.07
<i>Solanum tuberosum</i> (Potato)	207.43	195.36	217.98
<i>Arachis hyogea</i> (Groundnut)	11.03	14.39	12.99

Source : Agriculture department Uttarakhand

paniculatus, *Colocasia esculanta*, *Amaranthus spinosus*, *Fagopyrum esculantum*, *Brassica campestris* are used in the different traditional foods. Liquid recipe is also prepared from the leaves of *Fagopyrum esculantum*, *Brassica campestris*. Plants like *Oxalis corniculata*, *Fagopyrum esculantum*, *Colocasia esculanta*, *Amaranthus spinosus* is consumed throughout the year. Fried seeds of *Brassica campestris* and leaves of *Murraya koenighii* are used in Rayatas which is a great substitute of vegetable and pulses. Seeds of Rai and curry leaves are greatly used for fragrance, flavour and taste in every type of Rayatas. In addition of this, Indian snacks (pakories) prepared from the leaves of *Murraya paniculata*, *Fagopyrum esculantum* *Colocasis esculanta*. Chutney which is also an alternate cuisines or substitute of pulses and vegetable in the area prepared from the fruit of *Mangifera indica*, *Solanum melongena* (roasted), leaves of *Mentha longifolia*, *Fagopyrum esculantum*, rhizome of *Zingiber officinalis*, *Cannabis sativa* (roasted or raw seed). Sometime people also makes different salts which are alternate of dal (pulses) and sbji (vegetable). Different salt is prepared from with mixing of the seeds of *Cannabis sativa* and garlic, turmeric, seeds of *Brassica campestris* along with chillies.

Plants as pickle and substitute

In addition to the different food items, plants are also utilized for another purpose like pickle. *Murraya paniculata*, *Mangifera indica*, *Phyllanthus emblica* are the plants which are used as pickle. Leaves of

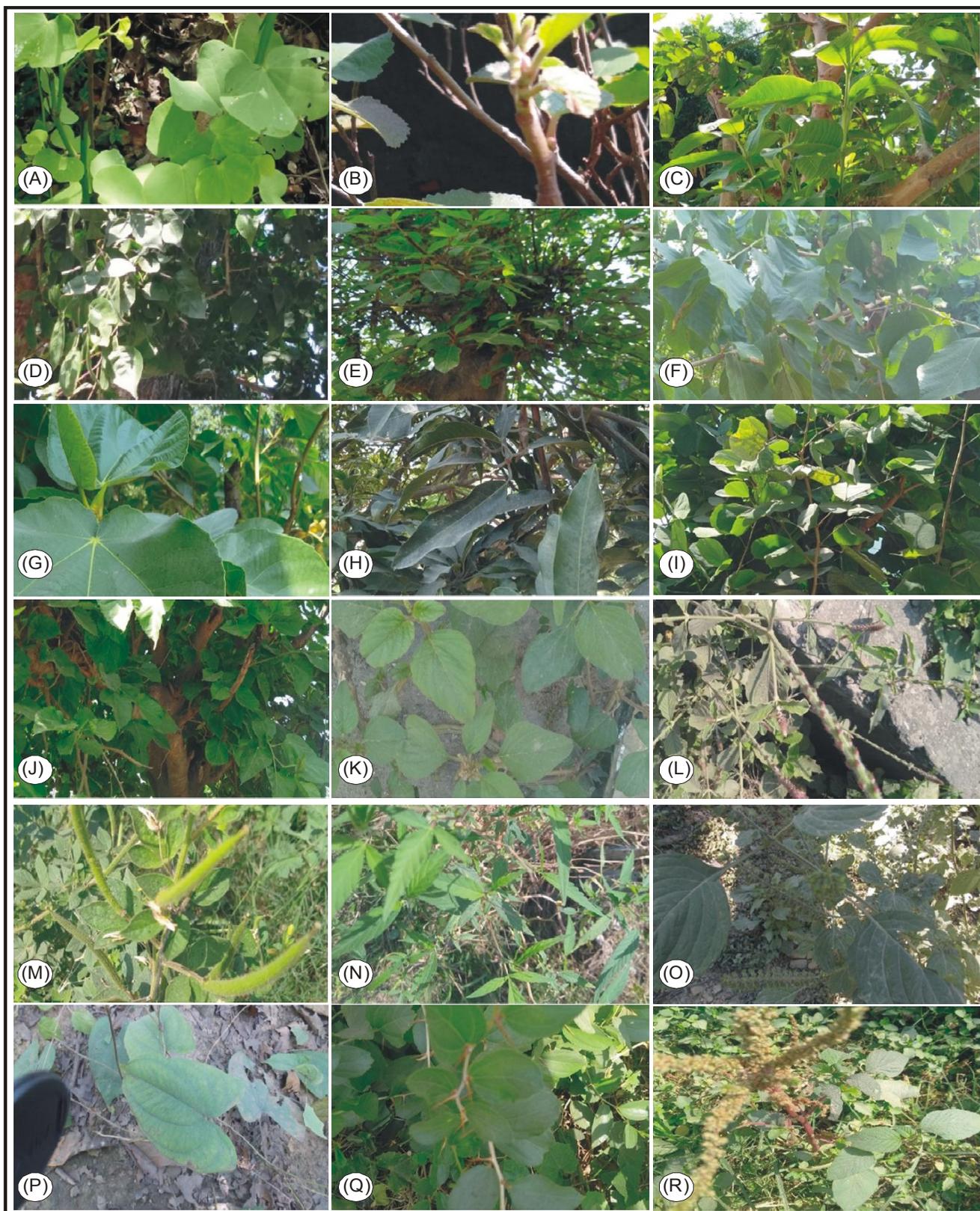


Fig. 4: (A-R) Some of the important edible wild and cultivated medicinal plants from the study area. (A) *Bauhinia purpurea*; (B) *Ficus palmata*; (C) *Psidium Guajava*; (D) *Aegle marmelos*; (E) *Ficus racemosa*; (F) *Grewia optiva*; (G) *Ficus auriculata*; (H) *Mangifera indica*; (I) *Bauhinia variegata*; (J) *Morus alba*; (K) *Amaranthus paniculatus*; (L) *Achyranthus aspera*; (M) *Cleome viscosa*; (N) *Cannabis sativa*; (O) *Perllia frutescens*; (P) *Dioscoea bulbifera*; (Q) *Zizyphus zuzupa* and (R) *Amaranthus spinosus*.

Table 5: Traditional knowledge associated with wild edible and cultivated plants by indigenous groups of Rajaji tiger Reserve.

Scientific name	Family	Vernacular Name	Voucher No.	Habit	Part Used	Uses
<i>Amaranthus spinosus</i> L.	Amaranthaceae	Chaulayi	RNP 147	H	Tw/L	Young twigs and leaves are cooked as leafy vegetable
<i>Fagopyrum esculantum</i> Moench.	Polygonaceae	Bhettu	RNP 121	H	L	Young leaves are cooked as leafy vegetable
<i>Bidens pilosa</i> L.	Asteraceae	Kunwar	RNP 151	H	L	Young terminal shoots are cooked and eaten
<i>Murraya koenighii</i> L.	Rutaceae	Kadi patta	RNP 166	S	L	Leaves are eaten as raw and also used as a flavour agent
<i>Oxalis corniculata</i> L.	Oxallidaceae	Khatti buti	RNP 146	H	L	Leaves are eaten raw
<i>O. latifolia</i> L.	Oxallidaceae	Bdi khatti buti		H	L	Leaves are eaten raw
<i>Brassica campestris</i> L.	Brassicaceae	Pili sarson	RNP 115	H	T	Young twigs are cooked and eaten as vegetable
<i>Dioscorea bulbifera</i> L.	Dioscoreaceae	Gimikand	RNP 167	C	R	Rhizome are cooked and eaten as vegetable
<i>Colocasia esculanta</i> L.	Araceae	Pindalu	RNP 168	H	L,P	Young leaves/petiole and rhizome are cooked and eaten as vegetable
<i>Zizyphus nummularis</i> Burm.	Rhamnaceae	Beri	RNP 159	S	F	Ripe fruit are eaten without cooking
<i>Z. mauritiana</i> Lam.	Rhamnaceae	Bdi ber	RNP 160	S	F	Ripe fruit are eaten without cooking
<i>Z. Jujupa</i> Mil.	Rhamnaceae	Baer	RNP 169	S	F	Ripe fruit are eaten without cooking
<i>Grewia optiva</i> L.	Malvaceae	Bhimlu	RNP 170	T	F	Ripe blue fruit are eaten without cooking
<i>Celtris australis</i> L.	Cannabaceae	Khareek	RNP 145	T	F	Ripe red fruit are eaten without cooking
<i>Chenopodium album</i> L.	Chenopodiaceae	Bathua	RNP 157	H	Tw/L	Young Twigs/Leaves are cooked and eaten as vegetable
<i>Bergenia ciliata</i> Wall. (Engl.)	Sexifragaceae	Dandola	RNP 113	H	S	Fleshy stem is eaten raw for medicinal purpose
<i>Amaranthus paniculatus</i> L.	Amaranthaceae	Marchu	RNP 125	H	S	Leafy shoot is cooked and eaten as vegetable
<i>Bauhinia variegata</i> L. (Menth.)	Fabaceae	Gwiriyal	RNP 127	T	Fl	Flowers are eaten raw as well as cooked for vegetable
<i>Bombax ceiba</i> L.	Bombicaceae	Simbl	RNP 135	T	I	Flower buds cooked as vegetable.
<i>Terminalia chebula</i> Retz.	Capparaceae	Heda	RNP 136	T	F	Raw and ripe fruit is edible for medicinal purpose
<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Amla	RNP 139	T	F	Both ripe and raw fruit is eaten for medicinal purpose. Pickle is also prepared
<i>Achyranthus aspera</i> L.	Amaranthaceae	Chirchita	RNP 143	H	S	Stem is eaten raw for medicinal purpose
<i>Rumex hastus</i> L.	Polygonaceae	Amora	RNP 144	H	L	Leaves are cooked for vegetable
<i>Ficus racemosa</i> L.	Moraceae	Pikhda	RNP 119	T	F	Ripe fruit is eaten
<i>F. auriculata</i> L.	Moraceae	Gular	RNP 123	T	F	Ripe fruit is eaten
<i>Terminalia bellirica</i> Gaertn (Roxb.)	Capparaceae	Baheda	RNP 162	T	S	Seed and fruit is eaten for medicinal purpose
<i>Syzygium cumini</i> L.	Myrtaceae	Jamun	RNP 164	T	F	Ripened fruit is eaten
<i>Mangifera indica</i> L.	Anacardiaceae	Aam	RNP 171	T	F	Ripe fruit is eaten directly but unripe fruit is used in making pickle
<i>Psidium Guajava</i> L.	Myrtaceae	Amrud	RNP 172	T	F	Ripe fruits are eaten
<i>Aegle marmelos</i> L.	Rutaceae	Bel	RNP 173	T	F	Ripe fruits are used in making juice
<i>Morus alba</i> L.	Moraceae	Sehtut	RNP 174	T	F	Blue berry are eaten directly

Table 5 Continue ...

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<i>Ocimum santum</i> L.	Lamiaceae	Tulsi	RNP 122	H	L,S	Leave/Stem are used as tea powder for medicinal purpose
<i>Zingiber officinalis</i> Roscoe.	Zingiberaceae	Adrak	RNP 175	H	R	Extract of rhizome is used as medicinal purpose
<i>Curcuma Longa</i> L.	Zingiberaceae	Haldi	RNP 176	H	P	Rhizome is used in different food dishes and for medicinal purpose
<i>Bauhinia purpurea</i> L.	Fabaceae	Puple Gwiriyal	RNP 177	T	Fl	Flowers are used as vegetables
<i>Ficus palmata</i> Forsskal.	Moraceae	Bedu	RNP 178	S	F	Ripe fruit is edible
W= whole plant; S= seed; St= shoot; F=Fruit; L= leaves; Fl= flower; P= petiole; R= rhizome; Tw= twig; H= Herb; S= shrub; T= tree; C= climber						

Murraya paniculata with *Phyllanthus emblica* and fruit of *Phyllanthus emblica* with *Murraya paniculata* treated with oil, salt and lemon and used as pickle. The traditional pickle is very good combination of karri patta along with lemon and kala namak.

Ethnomedical uses of the plants in different ailments

There is no any demarcation between food and medicinal plants which are available for various indigenous groups of the Rajaji tiger reserve. Different wild medicinal plants of Rajaji tiger reserve are used by these groups because of their healing and curing property. So they can be called as medicinal food. Plants like *Berginia ciliata*, *Terminalia bellirica*, *T. chebula*, *Phyllanthus emblica*, *Achyranthus aspera*, *Ocimum santum*, *Zingiber officinalis*, *Curcuma longa*, *Moringa longifolia*, *Mentha longifolia* also have great potential of curing different ailments.

The most commonly used part of plants in different disease are leaves followed, roots, bark, seeds, whole plant, latex, flowers, fruit, seeds and oil. The indigenous groups also used oil, honey and milk to cure different diseases. It was also observed from the study area that a part of plant or a single plant is used in the treatment of different ailments. All of the wild and cultivated plants are used in form of raw, decoction, powder, water suspension, chewing, infusion, fried and crushing for various types of ailments. Leaves of *Fagopyrum esculantum* is used as vegetable purpose but its roots are used in treatment of urinary infection whereas ripe fruits of *Celtis australis* is consumed without cooking but at the same time it is used in constipation. It was observed from the study that plants like *Ziziphus mauritiana*, *Z. nummularis*, *Adhatoda vasica*, *Terminalia bellirica* and cultivated plants like *Ocimum santum*, *Celosia argentea*, are used in the treatment of diarrhoea and dysentery. Plants like *Bidens pilosa*, is used in skin diseases *Chenopodium album*, *Berginia ciliata* in stone problems, *Achyranthus aspera* in muscular pain and swelling, *Rumex hastus*, *Brassica campestris* in cut and wound, *Amaranthus paniculatus*

in killing of worms in childrens, *Syzygium cumini*, in dysentery and diarrhoea. The other ethnomedicinal plants like *Bombax ceiba* used in piles, *Terminalia chebula* in indigestion, *Phyllanthus emblica* in asthma, *Amaranthus spinosus* in scorpion bite. Further it was also observed from the study that the leaves of *Chenopodium album* is boiled and consumed as it is thought that it cures bladder stone.

Discussion

The wild and edible plants of Uttarakhand has been explored by different workers at different times (Duthie, 1906; Kanjilal, 1928; Uniyal *et al.*, 2007) but the main purpose of their study was to worked out the status of taxonomic description and of phytogeographical interest. Although there were several studies which have focused on the status of wild and cultivated medicinal plants but all of these studies only have provided a little enumeration and description (Akash and Navneet, 2018; Akash *et al.*, 2018a,b,c,d; Akash and Navneet, 2019; Negi and Gaur, 1991, 1994; Uniyal *et al.*, 2007). Therefore, the present study has provided a vast description of all the wild and edible plants used by indigenous groups of Rajaji tiger reserve. Wild and cultivated edible plants are an essentials source of food for sustaining mankind before the dawn of civilization. *Murraya paniculata*, *Mangifera indica*, *Phyllanthus emblica*, *Amaranthus spinosus*, *Fagopyrum esculantum*, *Bidens pilosa*, *Dioscorea bulbifera*, *Colocasia esculanta*, *Amaranthus paniculatus*, *Bombax ceiba*, *Rumex hastus* etc are used in making various unique cuisine in the study area. These plants have played a significant role in supplementing the diet of the various forest residing communities and people. Local inhabitants in forest areas mostly depend these forest based products and sources which are often collected from nearby forest areas (Ros-Tonen, 2000). The Chilla forest division is occupied with large floristic diversity which have been used by indigenous groups for their livelihood and sustainability. As they do not have much income sources and land to cultivate the cash crops due to the conservation status of the forest, therefore

Table 6: Wild and cultivated plants used in different human ailments.

Local Name	Plant name	Family	Parts used	Ethnomedicinal Used from Present study	Earlier Literature
Dandola, pashanbhed	<i>Bergenia ciliata</i> Sternb.Rev	Saxifragaceae	Root	Stone problem	(Negi and Chauhan, 2009)
Pili sarson	<i>Brassica campestris</i> L.	Brassicaceae	Oil	Wound	(Kadel and Jain, 2008; Semwal <i>et al.</i> , 2010)
Garkha	<i>Celosia argentea</i> L.	Amaranthaceae	Seed	Diarrhoea	(Gaur, 1999)
Gular	<i>Ficus racemosa</i> L.	Moraceae	Latex	Dysentery	(Singh <i>et al.</i> , 2010)
Bhettu	<i>Fagopyrum esculentum</i> Moench.	Polygonaceae	Root	Urinary disorder	(Nautiyal <i>et al.</i> , 2001; Pant <i>et al.</i> , 2009)
Tulsi	<i>Ocimum sanctum</i> L.	Lamiaceae	Leaf	Diarrhoea and menstrual disorder	(Gaur and Sharma, 2011)
Timla	<i>Ficus auriculata</i> L.	Moraceae	Latex	Diarrhoea	(Pant <i>et al.</i> , 2009)
Marchu	<i>Amaranthus paniculatus</i> L.	Amaranthaceae	Seed	Killing of liver worm in children	(Pant <i>et al.</i> , 2009)
Gwiryal	<i>Bauhinia variegata</i> L.	Fabaceae	Flower	Diarrhoea	(Negi and Chauhan, 2009)
Semal	<i>Bombex ceiba</i> L.	Bombacaceae	Flower	Digestive disorder and piles	(Singh and Rawat, 2011)
Heda	<i>Terminalia chebula</i> Retz.	Combretaceae	Seed	Asthma and indigestion	(Ros-Tonen, 2000)
Anwla	<i>Phyllanthus emblica</i> Linn.	Phyllanthaceae	Fruit	Asthma and indigestion	(Negi and Gaur, 1994)
Apamarg, Chirchita, Latjeera	<i>Achyranthus aspera</i> Linn.	Amaranthaceae	Leaves	Muscular pain	(Negi and Chauhan, 2009)
Almera	<i>Rumex hastatus</i> D.Don.	Polygonaceae	Paste	Cut and Wound	(Nautiyal <i>et al.</i> , 2001)
Khadeek	<i>Celtis australis</i> Linn.	Cannabaceae	Bark	Constipation	(Tiwari <i>et al.</i> , 2010)
Khatti buti	<i>Oxalis corniculata</i> Linn.	Oxallidaceae	Leaves	Fever	(Pangtey, 1980)
Chaulayi	<i>Amaranthus spinosus</i> L.	Amaranthaceae	Leaves	Snake and scorpion bite	(Nautiyal <i>et al.</i> , 2001)
Kunwar	<i>Bidens pilosa</i> L.	Asteraceae	Paste	Skin diseases.	(Singh and Rawat, 2011)
Bathua	<i>Chenopodium album</i> L.	Amaranthaceae	Leaves	Bladder stone.	(Gaur, 1999)
Baer	<i>Ziziphus nummularia</i> (Burm. f.)Wight&Arn.	Rhamnaceae	Bark	Dysentery	(Gaur, 1999)
Badi baer	<i>Ziziphus mauritiana</i> Lam.	Rhamnaceae	Root	Diarrhoea	(Tiwari <i>et al.</i> , 2010)
Bahera	<i>Terminalia bellirica</i> (Gaertner) Roxb.	Combretaceae	Fruit	Dysentery and diarrhoea	(Gaur, 1999)
Jamun	<i>Syzygium cumini</i> (L.)	Myrtaceae	Root	Dysentery and diarrhoea	(Sen and Behera, 2008)

plants and forest based products are the important source for their livelihood.

The present investigation deals with 59 wild and cultivated plants from the conserved area where indigenous groups are still residing. Maximum of the plant species were wild and utilized as an essential source of food items in different forms. The entire area of the Rajaji tiger reserve is rich in biodiversity but at the same time due to the conservation status of the area it has been regarded as one of the most backward in terms of development. Secondly, the area remains isolated from

the main Haridwar city, which is a very developed in terms of economy and other activities. We have observed that the houses of the villagers and Gujjars community are not well equipped and the roads were mostly in worst condition. The indigenous people are mostly depending upon the forest resources for collection of plants. In spite of these, the present study area has maintained its integrity due to its large forest areas in Shivalik landscape.

People residing in the rural areas of Himalayas and adjoining areas depends on the different biological resources for livelihoods as marginal agriculture and

animal husbandry are not the sufficient source of their economy (Kala, 2005, 2007). Different plant species are used for making various mouth-watering dishes. In Uttarakhand, Roti, dal and vegetables are taken as meal for breakfast, lunch and dinner. These all dishes are well documented in the literature (Anonymous, 2011) which is totally depends on the availability of crops and surrounding vegetation. Crops and wild medicinal plants are used as raw material for making different dishes. Chaulai ki kheer and halwa are also very famous in these region. The traditional Rayatas which is prepared from seeds of *Brassica campestris* and the leaves of *Murraya koenigii* is also used as a main alternate vegetable and pulses. Different snacks (pakories), Chutneys are also prepared by using edible plants of the study area

Cultivating large number of wild trees and their varieties in the adjacent areas of the village and at the place where different indigenous groups are residing is not only essential for increasing the diversity of the areas but it also increases the rate of food security. This type of pattern of cultivating plant species fulfils the requirement of locals and also help them to sustain the livelihood of the people in forest residents. Plant species like *Zizyphus jujuba*, *Z. mauritiana*, *Celtris australis*, *Murraya paniculata*, *Mangifera indica*, *Phyllanthus emblica*, *Fagopyrum esculantum*, *Bidens pilosa*, *Dioscorea bulbifera*, *Bombax ceiba*, *Rumex hastus* growing well in the study area and increasing the diversity of the area. So in case of food scarcity or unavailability of food, they can also collect the edible fruits, leaves and fleshy twigs of the wild plants. The indigenous groups identify a particular wild edible plant quickly on the basis of some characters and given them a name. Various plant like *Amaranthus spinosus*, *A. paniculatus*, *Fagopyrum esculantum*, *Bidens pilosa*, *Chenopodium album* are used in making mouth-watering dishes by the people of study area. The information of all of the edible plants may help adding variety to monotonous diet so the requirement of vitamins and minerals can easily have met to the locals, tribal and the indigenous groups (Pangtey, 1980). The food habits of the indigenous groups of the forest areas are generally developed according to the adaptability of their nutritional value so the supplying of food is totally depending on their own collection in the forest. Sometime starvation occurs due to food scarcity. The role of traditional medicines is increasing continuously with their status and contributing to both safety and efficacy (Nanjan, 2010). The rich floristic diversity of the present study area is utilized by the indigenous groups not only for food security but at the same time these all different forms of wild plants also helps in curing various

ailments. Plants are also used in different forms like raw, powder, water suspension, infusion and through crushing for various ailments. *Fagopyrum esculantum*, *Amaranthus spinosus*, *A. paniculatus* *Chenopodium album* is used as vegetable purpose but at the same time these plants species are also used by the indigenous groups for various ailments. Further *Ocimum santum*, *Celosia argentea*, *Achyranthus aspera*, *Terminalia chebula*, *T. bellirica* *Phyllanthus emblica*, *Syzygium cumini*, *Brassica campestris* which are the common plants in the study area for their daily sustainability are also used by these groups in serious disease like Diarrhoea and dysentery, muscular pain and swelling, asthma, cut and wound.

Conclusion

The present study has revealed that the indigenous groups are utilizing the wild and edible plants due to their nutritive property and medicinal value. Due to the backwardness and poor financial condition of the people wild and cultivated edible plants in Rajaji tiger reserve are the primary source of their livelihood and sustainability. Attention need to pay in the sustainable collection and conservation of these wild and cultivated edible medicinal plants. As many of the activities in the tiger reserve are restricted so the official and government should have to focussed on the status of these indigenous groups. Further the additional studies of the status of these indigenous groups and plants in terms of their nutritive value will help to reduce the future extinction of these plants.

References

- Akash, Navneet and B.S. Bhandari (2018a). Phytosociological studies, biodiversity conservation in a sub tropical moist deciduous forest of Rajaji tiger reserve; Uttarakhand, India. *Int. J. of Res. Ana. Rev.*, **5(3)**: 39-51.
- Akash, Navneet and B.S. Bhandari (2018b). Phytosociological investigation, Biodiversity conservation and Life form pattern in a *Holeptelea integrifolia* community under Rajaji tiger Reserve, Uttarakhand, India. *Inter. Res. J. of Bio. Sci.*, **7(7)**: 1-8.
- Akash, Navneet and B.S. Bhandari (2018c). Tree diversity, stand structure and community composition in tropical forest of Rajaji tiger reserve, Northern India. *J. of App. and Nat. Sci.*, **10(3)**: 945-953.
- Akash, Navneet and B.S. Bhandari (2019). A community analysis of woody species in a tropical forest of Rajaji tiger reserve. *Env. and Eco.*, **37(1)**: 48-55.
- Akash and Navneet (2018). 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, 103-120.
- Akash, Navneet and B.S. Bhandari (2020). Ethnomedicinal Plant Use and Practice in Traditional Medicine. IGI Global, USA, 1-300.
- Anonymous (1997a). Without a trace. *Down to Earth.*, **6**: 22-23.
- Anonymous (2011b). Cuisine of Uttarakhand (Uttarakhand Food). Uttarakhand World Wide, Kumaon Garhwal Global Community. www.uttrakhandorg.uk.
- Badoni, A.K. (1990). An ethnobotanical study of Pinswari community: A preliminary survey. *Bull. Bot. Surv. India.*, **32**: 103-115.
- Dhar, U. (2002). Conservation implications of plant endemism in high-altitude Himalaya. *Curr. Sci.*, 141-148.
- Dhyani, P.P. and C.P. Kala (2005). Current research on medicinal plants: five lesser known but valuable aspects. *Curr. Sci.*, **88**: 335-340.
- Duthie, J.F. (1906). Catalogue of plants of Kumaun and of the adjacent portions of Garhwal and Tibet based on the collections of Strachey and Winter bottom during the year 1846-1849, on the catalogue originally prepared in 1852 by Sir Richrad Strachey, Lovell Reeve & Co., Limited, London.
- Gangwar, K.K., Deepali and R.S. Gangwar (2010). Ethnomedicinal plant diversity in Kumaon Himalaya of Uttarakhand, *India. Nat. Sci.*, **8(5)**: 66-78.
- Gaur, R.D. and J. Sharma (2011). Indigenous knowledge on the utilization of medicinal plant diversity in the Siwalik region of Garhwal Himalaya, Uttarakhand. *J. of for. and Env. sci.*, **27(1)**: 23-31.
- Gaur, R.D. (1999). Flora of the District Garhwal, North West Himalaya. Transmedia publication, Srinagar, Garhwal, Uttarakhand. 1-670.
- Kadel, C. and A.K. Jain (2008). Folklore claims on snakebite among some tribal communities of Central India. *Ind. J. of Trad. Know.*, **7(2)**: 296-299.
- Kala, C.P. (2007). Prioritization of cultivated and wild edibles by local people in the Uttaranchal hills of Indian Himalayas. *Ind. J. Tradit. Knowl.*, **6**: 239-243.
- Kala, C.P. (2005). Ethnomedicinal botany of the Apatani in the Eastern Himalayan region of India. *J. of Ethnobot. and Ethnomed.*, **1(1)**: 11-15.
- Kanjilal, U. (1928). Forest for a of the Chakrata, Dehradun and Saharanpur forest divisions, United provinces. Manager of Publications, Delhi.
- Jablonski, D. (2004). Extinction: Past and Present. *Nat.*, **427**: 589.
- Naithani, B.D. (1984). Flora of Chamoli, Vol.- I&II, Botanical Survey of India, Howrah.
- Nanjan, M.J. (2010). Quality control and standardisation of traditional medicine/herbal drugs." In Proceedings of an International Conference on Challenging and Emerging Dimensions in Medicinal/Herbal Plants and their Products. A Global Perspective Chennai Trade Centre, Chennai, 26-28 November, India.
- Nautiyal, S., K.S. Rajan and R. Shibasaki (2004). Environmental conservation vs compensation: explorations from the Uttaranchal Himalaya. *Env. Infor. Arch.*, **2(1)**: 24-35.
- Nautiyal, S., R.K. Maikhuri and K.S. Rao (2001). Medicinal plant resources in Nanda Devi Biosphere Reserve in the Central Himalaya, India. *J. of Her. Spic. and Med. Plan.*, **8**: 47-64.
- Negi, K.S. and R.D. Gaur (1994). Principal wild food plants of Western Himalaya, Uttar Pradesh, India. *High Pl. Ind. Subcont.*, **3**: 1-147.
- Negi, K.S. and R.D. Gaur (1991). A contribution to the edible wild fruits of Uttar Pradesh hills. *Bull. Bot. Surv. India.*, **33**: 233-266.
- Negi, V.M and N.S. Chauhan (2009). Medicinal and aromatic plants wealth of a tribal district Kinnaur in Himachal Himalayas. *Ind. For.*, **135(6)**: 838-52.
- Pant, S., S.S. Samant and S.C. Arya (2009). Diversity and indigenous household remedies of the inhabitants surrounding Mornaula reserve forest in West Himalaya. *Ind. J. of Trad. Know.*, **8(4)**: 606-610.
- Pangtey, Y.P.S. (1980). *Some Wild Edible Fruit Plants of Kumaun Hills in Science and Rural Development in Mountains*, Gyanodaya Publication Nainital.
- Ros-Tonen, M.A. (2000). The role of non-timber forest products in sustainable tropical forest management. *Hol. als. Werk.*, **58(3)**: 196-201.
- Saxena, K.G., K.S. Rao and K.K. Sen (2001). Integrated natural resources management: approaches and lessons from the Himalaya. *Conser Eco.*, **5**: 1-14.
- Samant, S.S., U.U. Dhar and L.M.S. Palni (1998). Medicinal Plants of Indian Himalaya. Gyanodaya Prakashan. 1-105.
- Semwal, D.P., P.P. Saradhi, C.P. Kala and B.S. Sajwan (2010). Medicinal plants used by local Vaidyas in Ukhimath block, Uttarakhand. *Ind. J. of Trad. Know.*, **9(3)**: 480-485.
- Singh, P.K., V. Kumar, R.K. Tiwari, A. Sharma, C.V. Rao and R.H. Singh (2010). Medico-ethnobotany of 'chatara' block of district sonbhadra, Uttar Pradesh, India. *Adv. in Biol. Res.*, **4(1)**: 65-80.
- Sen, S.K. and L.M. Behera (2008). Ethnomedicinal plants used by the tribals of Bargarh district to cure diarrhea and dysentery. *Ind. J. of Trad. Know.*, **7(3)**: 425-428.
- Singh, G. and G.S. Rawat (2011). Ethnomedicinal survey of Kedarnath wildlife sanctuary in Western Himalaya, India. *Ind. J. of Fun. and App. Lif. Sci.*, **1(1)**: 35-46.
- Tiwari, J.K., R. Ballabha and P. Tiwari (2010). Diversity and present status of medicinal plants in and around Srinagar hydroelectric power project in Garhwal Himalaya, India: needs for conservation. *Res.*, **2(2)**: 50-60.
- Uniyal, B.P., J.R. Sharma, U. Choudhary and D.K. Singh (2007). Flowering Plants of Uttarakhand (A Checklist), Bishen Singh Mahendra Pal Singh, Dehradun.