

An assessment of ethnomedicinal plant diversity in Haat Kali Sacred Grove in Kumaun Himalaya, Uttarakhand, India

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Abstract

Sacred grove is a traditional practice managed by local people on the basis of their religious beliefs. They conserve and utilize its forest products to cure various ailments. Therefore, an ethno-medicinal investigation was conducted in Haat Kali sacred grove, dedicated to local deity 'Maa Kalika' from Kumaun region of Indian Himalaya. A study based on the local community was conducted with the help of questionnaire and 38 species of medicinal importance belonging to 35 genera and 22 families were identified. It was observed that the local communities used roots and rhizomes maximum represented by 14 species followed by whole plant (12 species), fruit (7 species), leaves (5 species) and flower, stem bark, gum or resin, seeds, with 1 species each. Plant families like Asteraceae (5 species) and Rosaceae (5 species) were used maximum followed by Rubiaceae (2 species), Violaceae (2 species), Moraceae (2 species), Urticaceae (2 species) and Oxalidaceae (2 species). For quantitative analysis, fidelity level and informant's consensus factor were performed. *Malaxis acuminata* and *Hedychium spicatum* were cited as high fidelity level medicinal plants for the treatment of respiratory problems while highest Informant's consensus factor was examined for respiratory disorder (0.87) and least for dermatological disorders (0.18). Anthropogenic pressures like tourism, fodder collection, poaching of medicinal plants, etc. are the main threats to the existence of sacred grove. Thus, special attention is needed towards its conservation by using specific management's tools and methodology.

Key words: Kumaun Himalaya, Haat Kali sacred grove, ethno-medicinal plants, conservation

INTRODUCTION

Indian Himalayan region exhibits remarkable plant diversity derived from steep gradients of both elevation and precipitation and has traditionally been an important source of medicinal plants. This precious region has a rich flora of medicinal and aromatic plants and so far 1,748 species have been reported as medicinally important (Samant *et al.* 1998). Documentation of traditional knowledge on ethnomedicinal uses of plants has been considered as a high priority task to support the discoveries of drugs benefiting mankind (Pieroni 2000; Dutta & Dutta 2005; Pradhan & Badola 2008). Kumaon Himalaya occupies the central sector of Indian Himalaya with varied topography and climatic conditions that enhance its rich vegetation. People of this part are closely connected with nature and they protect important

medicinal plants through many traditional practices. Such traditional practices conserve not only the regional flora but also cultures and religions of the area. One such practice of sustainable and conservation of biodiversity is 'sacred grove' which is a practice of conserving the forests by dedicating it to the local deity or ancestor. In Kumauni cultures, the practice of dedicating forests to a deity is a common occurrence seen and the period for which the forests are dedicated varies from a minimum of 8 to 20 years, depending upon the size and pressure on the forest. These groves are popularly known as '*Devta Than*' or simply '*Than*'. These groves are the treasure-house of rare, endangered plants and have higher richness and regeneration of medicinal plants than reserve forests (Boraiah *et al.* 2003; Gadgil & Vartak 1975, 1976).

Many ethnobotanical studies are undertaken in Kumaun Himalaya by different workers (Shah & Joshi 1971; Kalakoti & Pangety 1988; Pande *et al.* 1998, 2006). Several sacred groves are documented from Kumaun Himalayas by Singh *et al.* (2011, 2013 & 2014) for their importance in conservation of ethnomedicinal plants. High rate of exploitation and anthropogenic pressures on these sacred groves from Kumaon Himalaya could cause serious depletion of biodiversity. Thus, realising the importance of sacred groves in preserving the traditional knowledge and ethno-medicinal plants, the study was undertaken in Haat Kali sacred grove in Central Himalaya.

METHODOLOGY

Study area

Haat Kali Sacred Grove which is a tribute to goddess *Maa Kali* is situated near Rawalgoan in Gangolihat tehsil, about 77 Kilometres from Pithoragarh district at an altitude of 1668 m (N 29° 39.459' N and 080° 02.808' E). It is rich in folk culture, music and religious traditions and had been chosen by *Sankaracharya* for the installation of *Mahakali Shaktipith*. The whole grove is covered by dense forest of *Cedrus deodara* trees (considered as a sacred tree in Kumaon Himalaya). Several bells are found hanging all around the tree and the outer boundary of the grove. This grove is inhabited by 'Rawal' communities while the *Poojari* (i.e. the priest) is of Bhatt community of Rawal village visits the temple.

Sampling informant

The interview and field observations were carried out in Haat Kali Sacred Grove during 2009 to 2011. A total of 30 informants were selected at random during house to house surveys represented largely by villagers (25 males and 5 women) who had traditional knowledge on the medicinal use of different plants and had a tradition of healing in their families. Age class and educational background of the informants were also taken into consideration; 5 belonged to the 20 to 40 years age group, 15 belonged to the 40 – 60 years. However, 10 of them were from 60 to 80 years age group.

Plant collection and Identification

Present study is based on extensive and intensive field surveys made during 2009 – 2011. The neighbouring villages were visited for the identification of medicinal plant species collected during the survey. The collected information was re-examined by consulting important works pertaining to medicinal plants and their scientific identification with the help of available literatures (Singh *et al.* 2010; Nair & Mohanan 1998; Kanjilal 1998) and local experts. All the specimens were deposited in LWG Herbarium (CSIR-NBRI), Lucknow. The medicinal plants collected are listed with their botanical names followed by family name, local names if any and the parts used for medicinal purpose in the (Table 1).

Data analysis

The uses of medicinal plants were classified into categories following the standard developed by Heinrich *et al.* (1998). To test the homogeneity of knowledge on the use of plants in the illness categories between the populations, we used the informant consensus factor (Heinrich *et al.* 1998): $ICF = \frac{N_{ur} - N_l}{N_{ur} - 1}$, where N_{ur} refers to the number of use reports for a particular use category and N_l refers to the number of taxa used for a particular use category by all informants. We used fidelity level (FL) of Friedman *et al.* (1986) to determine the most preferred species used in the treatment of particular ailment as many plant species could be possibly used in the same use category: $FL (\%) = \frac{N_p}{N} \times 100$ where N_p is the number of use-reports cited for a given species for a particular ailment and N is the number of informants that used the plants as a medicine to treat any given disease.

RESULTS AND DISCUSSION

Haat Kali Sacred Grove is covered with *Cedrus deodara* along with the rich ground flora. Total 38 species belonging to 35 genera from 22 families were reported from the grove, having 23 herbs (62.16 %), 7 shrubs (18.91 %), 5 trees (13.51 %) and 3 climbers (8.10 %) (Figure1). Rhizomes and roots of *Malaxis acuminata*, *Berberis asiatica*, *Valeriana jatamansi*, *Thalictrum foliolosum*, *Smilax aspera*, *Hedychium spicatum*, *Viola serpens*, *Rubus ellipticus*, *Bergenia ciliata*, *Rubia manjith*, and *Cynodon dactylon*, and flowers and stem bark of *Rhododendron arboreum* are used by the local community for the treatment of various diseases. For the treatments, the local communities used roots and rhizomes maximum represented by 14 species followed by whole plant (12 species), fruits (7 species), leaves (5 species) and flowers, stem bark, gum or resin, seeds, with 1 species each (Figure

Table 1. Ethnobotanical plants of Haat Kali Sacred Grove used by the local community

Scientific Name [Family]; Exsiccatae	Local Name	Part Used	Uses & Mode of preparation	Fidelity level
<i>Ainsliaea latifolia</i> (D. Don) Schultz-Bipontinus [Asteraceae]; LWG-215225	<i>Kauru/ Karu-buti</i>	Root	Decoction of crushed roots cure colic and cholera	Colic (25%); cholera (25%)
<i>Ajuga bracteosa</i> Wallich ex Bentham [Acanthaceae]; LWG- 215244	<i>Ratpatti</i>	Root	Root decoction in water used in jaundice	Jaundice (100%)
<i>Agrimonia pilosa</i> Ledebour [Asteraceae]; LWG-262881	<i>Lesukuria</i>	Whole plant	Decoction of powder plant used in cough	Cough (25%)
<i>Berberis asiatica</i> Roxburgh ex de Candolle [Berberidaceae]; LWG- 215294	<i>Kilmora</i>	Root	Decoction of shade dried roots boiled in water, concentrated at low temperature and finally dried, produce " <i>Rasaunt</i> " and is used in eye infection; extract of fresh root cures jaundice	Eye diseases (100%); jaundice (33.34%)
<i>Bergenia ciliata</i> (Haworth) Sternberg [Saxifragraceae]; LWG- 262329	<i>Patarcatha/ Silpara</i>	Rhizome	Watery decoction of rhizome powder used against kidney stone	Kidney stone (100%)
<i>Bidens pilosa</i> Linnaeus [Asteraceae]; LWG-249885	<i>Arakajhar</i>	Whole plant	Seeds of <i>Zanthoxylum armatum</i> mixed with plant powder used as tooth powder	Toothache (100%)
<i>Boeninnghausiana albiflora</i> (Hooker) Reichenbach ex Meisner [Rutaceae]; LWG-215212	<i>Pissu mar</i>	Whole plant and leaves	Paste of crushed fresh leaves directly applied on cuts	Cut (25%)
<i>Cynodon dactylon</i> (Linnaeus) Persoon [Poaceae]; LWG-	<i>Doob</i>	Whole plant	plant powder mixed in taken during jaundice	Vomiting (100%)

Scientific Name [Family]; Exsiccatae	Local Name	Part Used	Uses & Mode of preparation	Fidelity level
<i>Desmodium heterocarpon</i> (Linnaeus) de Candolle [Fabaceae]; LWG- 262377	Sarivan	Leaves	1 table-spoon of powder of leaves used as a tonic.	Tonic (50%)
<i>Duchesnea indica</i> (Andrews) Teschemacher [Rosaceae]; LWG-262325	Bhuikaphal	Fruit	Dry powder of fruit used in digestion related problem; fresh leaves paste applied on cuts.	Stomach-ache (71.42%); cuts (28.57%)
<i>Eclipta prostrata</i> (Linnaeus) Linnaeus [Asteraceae]; LWG-249881	Bhringra	Whole plant	2 table spoons of dried plant powder with water applied directly on head	Hair tonic (100%)
<i>Ficus palmata</i> Forsskål [Moraceae]; LWG-261618	Bedu	Fruit	Fresh ripe fruits used in digestion problem	Digestion (100%); dysentery (33.34%)
<i>Ficus auriculata</i> Loureiro [Moraceae]; LWG-249900	Timul	Fruit	Fruits used in stomachache and dysentery	Stomach-ache (66.66%); dysentery (33.34%)
<i>Galium rotundifolium</i> Linnaeus; [Rubiaceae]; LWG-262882	Kutub	Whole plant	Fresh plant paste is used in cuts and wounds	Wounds (100%)
<i>Geranium ocellatum</i> Cambessèdes [Geraniaceae]; LWG-262316	Bheel Jadhi/Bhanda	Whole plant	1 table spoon of dried plant powder with warm water taken for fever and urinary problems	Fever (25%); diuretic (25%)
<i>Girardiana diversifolia</i> (Link) Friis [Urticaceae]; LWG- 249899	Kandeli-marsu/ Kali-sisun	Root	Decoction of root powder used in urinary disorders	Urinary disorder (25%)
<i>Hedera nepalensis</i> Koch [Araliaceae]; LWG-215228	Arambal/ Mithiai	Leaves and fruits	Fresh leaves are directly applied on ulcers	Ulcer (100%)
<i>Hedychium spicatum</i> Buchanan-Hamilton ex Smith [Zingiberaceae]; LWG- 262907	Van Haldu	Rhizome	Decoction of dried plant used in bronchitis and asthma and juice of fresh root used as a tonic.	Tonic (100%); bronchitis (50%); asthma (100%)
<i>Hypericum oblongifolium</i> Choisy [Hypericaceae]; LWG- 215220	Peniuli	Flowers and Leaves	Paste of flowers and leaves used directly applied on wounds and boils	Wounds (100%); boils (100%)
<i>Lindenbergia grandiflora</i> (Buchanan-Hamilton ex D. Don) Benthham [Scrophulariaceae]; LWG-249893	Vasant	Leaves	Paste of fresh leaves directly applied on skin disease	Skin (50%)
<i>Malaxis acuminata</i> D. Don [Orchidaceae]; LWG- 97336	Hari-musali/ Jhatbha-k	Rhizome	½ table spoon of dried powder of rhizome with warm water taken in bronchitis.	Bronchitis (100%)
<i>Oxalis corniculata</i> Linnaeus [Oxalidaceae]; LWG- 262321	Chilmora	Whole plant	Paste of fresh plant is directly applied on cuts and wounds. Juice of the plant is generally taken during scurvy.	Cuts (50%); wounds (25%); scurvy (50%)
<i>Oxalis latifolia</i> Kunth [Oxalidaceae]; LWG- 262320	-	Whole plant	Paste of plant is applied on cuts	Cuts (25%)
<i>Prinsepia utilis</i> Royle [Rosaceae]; LWG- 262305	Bhekal	Seeds	Paste of seed powder is applied on wounds. Decoction of seed powder is also used in stomach related problems	Wounds (100%); stomach problem (100%)
<i>Prunus cerasoides</i> D. Don [Rosaceae]; LWG- 262351	Pyia	Stem bark	Decoction of stem bark powder used in fever	Fever (25%)
<i>Pyracantha crenulata</i> (D. Don) M. Roemer [Rosaceae]; LWG- 262304	Ghingaru	Fruit	Fruits used in constipation.	Constipation (100%)
<i>Quercus leucotrichophora</i> Aimée A. Camus ex Bahadur [Fagaceae]; LWG- 262862	Banj	Gum/resin	Dried gum powder used with milk during weakness in body	Energetic (50%); stomachache

Scientific Name [Family]; Exsiccatae	Local Name	Part Used	Uses & Mode of preparation	Fidelity level
<i>Rhododendron arboreum</i> Smith [Ericaceae]; LWG- 215202	<i>Burans</i>	Flowers, Stem bark	Flower juice extract used as blood purifier and in dysentery	Blood purifier (100%); stomach problem (66.66%)
<i>Rubia manjith</i> Roxburgh ex Fleming [Rubiaceae]; LWG- 249873	<i>Manjeeth</i>	Root	Decoction of root used in fever. Leaves Paste used to treat skin diseases	Fever (75%); Skin (50%)
<i>Rubus ellipticus</i> Smith [Rosaceae]; LWG- 215221	<i>Hisalu</i>	Fruits and root	Decoction of fresh and crushed roots is used in diarrhoea. Fruits are used in dysentery.	Diarrhoea (100%); dysentery (50%)
<i>Rumex hastatus</i> D. Don [Polygonaceae]; LWG- 249897	<i>Chalmori</i>	Whole plant	Crushed fresh leaves directly applied on the cuts	Cuts (66.66%)
<i>Smilax aspera</i> Linneaus [Smilacaceae]; LWG- 97360	<i>Kukurdara</i>	Root	Paste of leaves is used on wounds	Wound (100%)
<i>Taraxacum officinale</i> Webber [Asteraceae]; LWG- 249888	<i>Kanphul</i>	Root	1 table spoon of root powder is mixed with milk and used in liver disorder. Decoction of root powder used in urinary disorder.	Liver (66.66%); urinary disorder (100%)
<i>Thalictrum foliolosum</i> de Candolle [Ranunculaceae]; LWG- 97363	<i>Mamiri/ Pilihari</i>	Root	Decoction of fresh roots used in fever. Dry powder of root is also used in toothache.	Fever (100%); toothache (50%)
<i>Urtica dioica</i> Linneaus [Urticaceae]; LWG- 262345	<i>Bhicchughas/ Shin</i>	Whole plant	Plant is directly applied on leg swelling	Swelling (50%)
<i>Valeriana jatamansi</i> (De Candolle) Jones [Valeriacae]; LWG- 249879	<i>Shameo/ Banbansi</i>	Root & rhizome	Decoction of root and rhizome powder used in stomach related problem	Stomachache (50%)
<i>Viola canescans</i> Wallich [Violaceae]; LWG- 262313	<i>Banfsa</i>	Root	2 gm of dried root powder with honey is used in cold and fever. Decoction of root powder is used in cold.	Cold (66.66%); fever (66.66%)
<i>Viola pilosa</i> Blume [Violaceae]; LWG- 262314	<i>Banfsa/ Gulva-nsha</i>	Whole plant	Similarly as in the case of <i>Viola canescans</i>	Cold (66.66%); fever (66.66%)

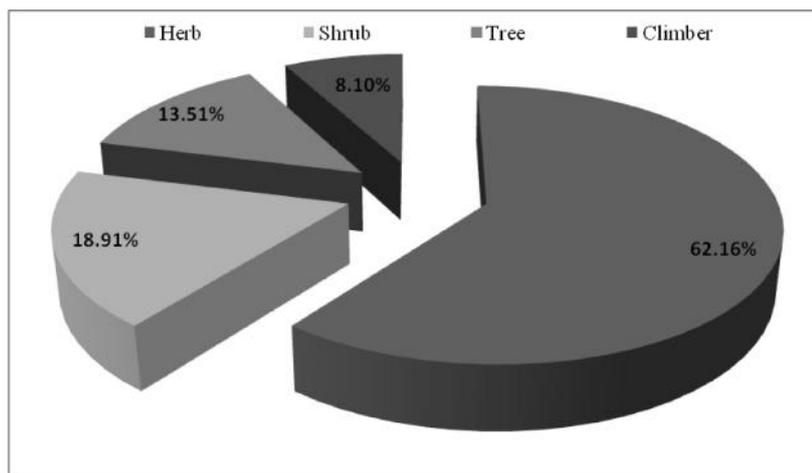


Figure 1. Habit of Ethnomedicinally important plants

Table 2. Category of ailments and their informant consensus factor (ICF)

Category (disease and disorder)	Plant species	Uses reports	Informant Consensus factor (ICF)	Plant used
Fever	5	8	0.42	<i>Rubia cordifolia</i> , <i>Thalictrum foliolosum</i> , <i>Viola canescens</i> , <i>Viola pilosa</i> , <i>Prunus cerasoides</i>
Jaundice	3	4	0.33	<i>Ajuga bracteosa</i> , <i>Berberis asiatica</i> , <i>Cynodon dactylon</i>
Gastro-intestinal disorder (Colic, Chlorea, Digestion, Dysentery, stomachache, constipation, vomiting)	10	23	0.59	<i>Ainsliaea latifolia</i> , <i>Duchesnia indica</i> , <i>Ficus palmata</i> , <i>Ficus roxbughii</i> , <i>Prinsepia utilis</i> , <i>Prunus cerasoides</i> , <i>Quercus leucotrichophora</i> , <i>Rhododendron arboreum</i> , <i>Valeriana jatamansi</i> , <i>Pyracantha crenulata</i>
General health (tonic, blood purification, Ulcer, scurvy, energetic)	4	10	0.66	<i>Desmodium heterocarpum</i> , <i>Eclipta prostata</i> , <i>Hedera nepalensis</i> , <i>Hedychium spicatum</i> , <i>Oxalis corniculata</i> , <i>Quercus leucotrichophora</i> , <i>Rhododendron arboreum</i>
Respiratory (Bronchitis, cold, cough, Asthma)	2	9	0.87	<i>Agrimonia pilosa</i> , <i>Hedychium spicatum</i> , <i>Malaxis acuminata</i>
Dermatological disorder (cuts, wounds, boils)	10	12	0.18	<i>Boeninghausiana albiflora</i> , <i>Gallium rotundifolium</i> , <i>Hypericum oblongifolium</i> , <i>Oxalis corniculata</i> , <i>Prinsepia utilis</i> , <i>Rubia cordifolia</i> , <i>Smilax apera</i> , <i>Lindenbergia grandiflora</i> , <i>Rumex hastatus</i> , <i>Oxalis latifolia</i>
Body pains (Toothache, ear, eye diseases)	2	7	0.85	<i>Bidens pilosa</i> , <i>Thalictrum foliolosum</i>
Urological problem (Kidney stone, diuretic, urinary problm)	3	4	0.33	<i>Bergenia ciliata</i> , <i>Girardinia diversifolia</i> , <i>Quercus leucotrichophora</i> , <i>Taraxacum officinale</i>
Liver problem	1	3	-	<i>Taraxacum officinalae</i>

2). Five species each belonging to Asteraceae and Rosaceae were mostly used followed by Rubiaceae (2 species), Violaceae (2 species), Moraceae (2 species), Urticaceae (2 species) and Oxalidaceae (2 species), while many other families such as Araliaceae, Hypericaceae, Berberidaceae, Saxifragaceae, Ericaceae, Urticaceae, Scrophulariaceae, Zingiberaceae, Fabaceae, Poaceae, Rutaceae, Acanthaceae, Smilacaceae, Polygonaceae, Valerianaceae, Fagaceae, Solanaceae and Geraniaceae contributed only 1 species each (Figure 3). The local people believe that the deity resides in this sacred grove and any harm to the local flora and fauna might cause serious destruction. The local communities use local name(s) for particular plant species such as *Kilmora* for *Berberis asiatica*, *Hisalu* for *Rubus ellipticus*, *Patarchur* for *Bergenia ciliata*, *Bhuikaphal* for *Duchesnia indica*, etc.

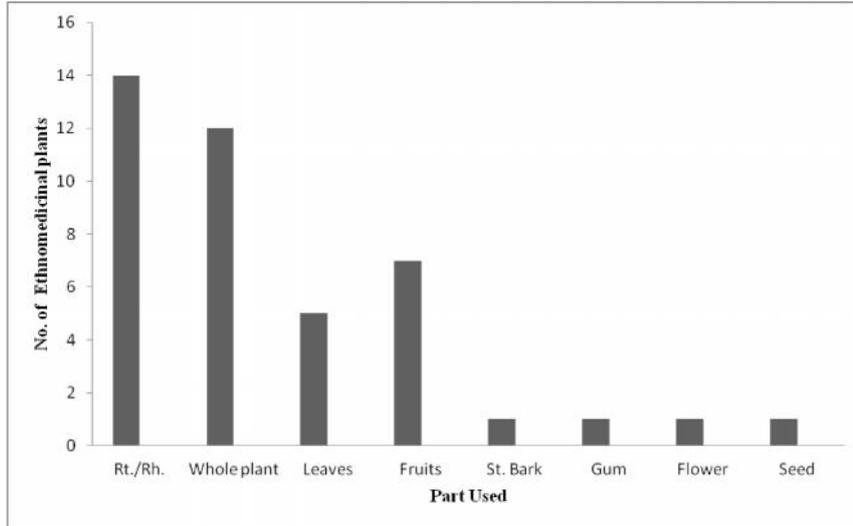


Figure 2. Plant parts used as ethnomedicines

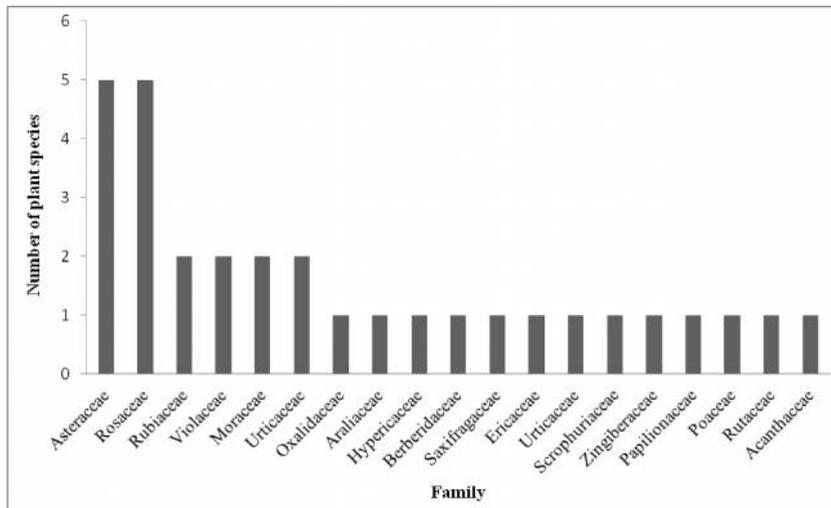


Figure3. Dominant families used by the local people used as ethno-medicines

Highest fidelity level (FL) (100 %) was noticed for 18 plants used against various diseases. *Rubus ellipticus* was used for treating Diarrhoea, *Smilax aspera*, *Prinsepia utilis*, *Hypericum oblongifolium*, *Gallium rotundifolium* was used for wound, *Thalictrum foliolosum* for fever, *Taraxacum officinalae* for urinary disorder, *Rhododendron arborum* as a blood purifier, *Pyracantha crenulata* for constipation, *Malaxis acuminata* for bronchitis, *Hedera nepalensis* for ulcer, *Ficus palmata* for digestion, *Cynodon dactylon* for vomiting, *Bidens biternata* for toothache, *Bergenia ciliata* for kidney stone, *Berberis asiatica* for eye disease, and *Ajuga bracteosa* for jaundice. High fidelity level of given plant species indicates its widespread acceptance among the informants in the treatment of any given disease whereas low FL of a given plant indicates its use for other purposes (Table 1). The medicinal plants were used for treating 27 different ailments and grouped into 8 categories. The highest informant’s consensus factor value (0.87) was for respiratory, body pains (0.85)

and minimum dermatological disorder (0.18), etc. *Malaxis acuminata* and *Hedychium spicatum* were the highly cited medicinal plant to treat respiratory disorder and as a result had a high fidelity level (Table 2).

Malaxis acuminata, *Hedychium spicatum*, *Bergenia ciliata* and *Valeriana jatamansi* are threatened plant species present in the grove (Friedman *et al.* 1986; Joshi *et al.* 1993; Arya & Agarwal 2006). The rate of exploitation of these species is high due to their potential value in the commercial market. Hence, conservation of these taxa in the long run can be done by incorporating traditional knowledge with the modern techniques. Sustainable utilization and equal sharing of benefit is important part of Convention on Biological Diversity (CBD 1993), which encourage local people towards conservation of important sacred groves. There is an urgent need to set forth strong guidelines to safeguard the sacred groves and promote traditional knowledge on conservation.

Sacred groves are generally rich in ethnomedicinal plants and provide excellent habitat for their survival and perpetuation. Each community has their own process of utilisation of medicinal plants. There is little documentation about the community under present study that has exposed its ethnomedicinal richness potential for conservation and sustainable exploitation. The traditional uses of medicinal plants in healthcare practices provide clues to new areas of research for new biological compounds and discovery of new drugs. It is important to identify the medicinal plants of this region and their documentation.

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LITERATURE CITED

- Arya, K.R. & Agarwal S.C. 2006. Conservation of threatened medicinal and folklore plants through cultivation in Uttaranchal state, *Ethnobotany* 18: 77 – 86.
- Boraiah, K.T.; Vaudeve, R.; Bhagwat, S.A. & Kushalappa, C.G. 2003. Do informally managed sacred groves have higher richness and regeneration of medicinal plants than state-managed reserve forests. *Curr. Sci.* 84: 804 – 808.
- Dutta, B.K. & Dutta, P.K. 2005. Potential of ethnobotanical studies in North East India: an overview. *Indian J. Trad. Knowl.* 4(1): 7 – 14.
- Friedman, J.; Yaniv, Z.; Dafni, A. & Palewitch, D. 1986. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev desert, Israel. *J. Ethnopharm.* 16: 275 – 287.
- Gadgil, M. & Vartak, V.D. 1975. Sacred groves of India: a plea for continued conservation. *J. Bom. Nat. Hist. Soc.* 72: 314 – 320.
- Gadgil, M. & Vartak, V.D. 1976. Sacred Groves of Western Ghats of India. *Econ. Bot.* 30: 152 – 160.
- Heinrich, M.; Ankil, A.; Frei, B.; Wiemann, C. & Stricher, V. 1998. Medicinal plants in Mexico: healers consensus and cultural importance. *Soc. Sci. Med.* 47: 1859 – 1871.
- Joshi, G.C.; Pande, N.K. & Uniyal, M.R. 1993. Inventory of disappearing angiosperms of Kumaun and Garhwal Himalaya-causes and suggestions. *J. Econ. Tax. Bot.* 17(2): 421 – 432.

- Kalakoti, B.S. & Pangety, Y.P.S. 1988. Ethnomedicine of Bhotiya tribe of Kumaun Himalaya, Uttaranchal. *Bull. Med. Ethnobot. Res.* 9:11-20.
- Kanjilal, U.N. 1998 (reprint). *Forest flora of the Chakrata, Dehraduna and Saharanpur forest division*. Natraj Publisher, Dehradun.
- Nair, C.K.N. & Mohanan, N. 1998. In: *Medicinal plants of India*. Nag Publishers, Delhi.
- Pande, P.C.; Joshi, P. & Joshi, G.C. 1998. Ethnobiology of Kumaun Himalaya II. In: P.C. Pande, R.K. Pande & Rajnish Pande (eds.), *Himalayan Environment Issues and Challenges*. Durga Publishing House, New Delhi: Pp. 148 – 158.
- Pande, P.C.; Tiwari, L. & Pande, H.C. 2006. *Folk-Medicine and Aromatic Plants of Uttaranchal*, Bishen Singh Mahendra Pal Singh, Dehradun, Pp. 21 – 163.
- Pieroni, A. 2000. Medicinal plants and food medicines in the folk traditions of the upper Lucca Province, Italy. *J. Ethnopharm.* 70: 235 – 273.
- Pradhan, B.K. & Badola, H.K. 2008. Ethnomedicinal plant use by Lepcha tribe of Dzongu valley, bordering Khangchendzonga Biosphere Reserve, in North Sikkim, India. *J. Ethnobot. Ethnomed.* 4: 22.
- Samant, S.S.; Dhar, U. & Palni, L.M.S. 1998. *Medicinal plants of Indian Himalaya: diversity, distribution potential values*, Gyanodaya Prakashan, Nainital, India,
- Shah, N.C. & Joshi, M.C. 1971. An ethnobotanical study of Kumaun region of India. *Econ. Bot.* 25: 414 – 422.
- Singh, H.; Agnihotri, P.; Pande, P.C. & Husain, T. 2011. Biodiversity conservation through a traditional beliefs system in Indian Himalaya: A case study from Nakuleshwar sacred grove. *Environmentalist* 31: 246 – 253.
- Singh, H.; Agnihotri, P.; Pande, P.C. & Husain, T. 2013. Role of traditional knowledge in conserving biodiversity: a case study from Patal Bhuvneshwar sacred grove, Kumaon Himalaya, India. *J. Biodiv. Manage. Forest.* 2: 1 – 5.
- Singh, H.; Agnihotri, P.; Pande, P.C.; Husain, T. & Khatoon, S. 2014. An Ethnobotanical survey of medicinal plants in sacred groves of Indian Himalayan region of Uttarakhand. *J. Ethnopharm.* 154: 98 – 108.
- Singh, H.; Husain, T. & Butt, F.A. 2010. Ethno-medicinal plants and their conservation through sacred groves in Pithoragarh district of Central Himalaya, Uttarakhand. *Geobios* 37: 53 – 56.