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Medicinal and Aromatic Plants of Tons Watershed in Uttarakhand Himalaya

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Abstract The rich plant diversity of Uttarakhand hills has provided an initial advantage to the local people for scrutinizing various plant species for the purpose of food, medicine, perfumes and spices. Over the years, they have accumulated a great deal of knowledge on the use of plant species. The present study aims to document such information, especially the use of plants for curing diseases and as perfumes. Field surveys carried out in the villages of Tons watershed have resulted in the documentation of 84 medicinal, aromatic and spice plant species. These species were distributed over various life forms, of which 19 were tree species, 12 were shrub and 53 were herbaceous species. For curing various ailments, the use of aboveground plant parts was relatively higher (57%) than the belowground plant parts. Different belowground plant forms such as root, tuber, rhizome and bulb were used for preparing herbal medicine for curing ailments. About 17% of these species, which include *Picrorhiza kurrooa* Benth, *Dactylorhiza hatagirea* (D.Don) Soo, *Arnebia benthamii* (D. Don) Johnston, *Podophyllum hexandrum* Royle, *Polygonatum verticillatum* (L.) All., *Rheum australe* D. Don and *Angelica glauca* Edgew. have become threatened due to several natural and anthropogenic pressures. Sustainable utilization of these valuable plant species is an urgent need of hour.

Keywords: *medicinal and aromatic plants, tons watershed; traditional uses, documentation, threatened species, sustainable development*

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1. Introduction

Historically, the Himalaya is well known for its rich biodiversity, including medicinal, aromatic and spice plant species [1,2,3,4]. Uttarakhand state of India being located in the Himalaya harbors a rich diversity of unique medicinal and aromatic plants [5]. The varied altitudinal zones of Uttarakhand – alpine, subalpine, temperate and subtropical – provide a remarkable range of habitats and micro-habitats for variety of useful plants to flourish. Since time immemorial, the natives of Uttarakhand hills have been thriving on these natural resources, which form an integral component of their livelihood [5,6,7].

The rich plant diversity has provided an initial advantage to the inhabitants of Uttarakhand for scrutinizing various plant species for the purpose of food, medicine, perfumes and spices. Over the years of trial and errors, they have developed a great deal of knowledge on the use of various plant species [8,9]. However, at present, the traditional knowledge on the use of plant resources is dwindling due to several reasons, including shift in attitude towards a more western lifestyle and declining interest of younger generations to carry forward the tradition [10,11]. Therefore, a need is felt to document such valuable information on the use of plant species before it vanishes completely.

There are areas in the remote hills where people still practice traditional way of life and hence use nearby plant species for curing diseases and other purposes. Tons watershed being tugged deep into the hills the inhabitants of this area are relatively less influenced by the modern forces. In this background, the present study aims to document the plant species used by inhabitants of Tons watershed, especially for curing diseases and use as perfumes.

2. Methods

2.1. Study Area

The present study was conducted in the villages of Tons watershed (Figure 1), which is located in the Uttarkashi district of Uttarakhand state in India between 30°55' - 31°28' N and 77°22' - 78°38' E. Tons watershed spans over a large altitudinal range from 1400 m to 6323 m above mean sea level [12]. The river Tons originates from the Bandarpuch mountain range (6,316 m ASL) of the Himalaya. Tons watershed harbors a rich biodiversity and diverse vegetation types due to wide altitudinal range, diverse terrain, and history of anthropogenic pressures. The major forest types in the Tons watershed are Himalayan chir pine (*Pinus roxburghaii* Sarg.; Figure 2), Banj oak (*Quercus leucotrichophora* A. Camus ex

Bahadur), Moru oak (*Quercus dilatata* Royle), deodar (*Cedrus deodara* Roxb. ex D.Don) G.Don), blue pine (Pinus wallichiana A.B.Jacks.) and Kharsu oak (*Quercus semecarpifolia* Sm), apart from the bamboo brakes, alder, birch-fir, birch-rhododendron, juniper scrub and alpine meadows [13,14]. Agriculture and animal husbandry are the major livelihood activities of villagers [6]. At present, river rafting has become one of the income generation activities to some villagers. The study area still possesses some unique cultures being tugged deep into the mountains.

Figure 1. The landscape of Tons watershed in Uttarakhand state of India. - Photo by Chandra Prakash Kala

Figure 2. Chir pine forest in the Tons watershed. - Photo by Chandra Prakash Kala

2.2. Survey Methods

Field survey was undertaken during May and June 2014 among the villagers of Tons watershed in order to gather information on various indigenous uses of plant species, especially for curing ailments and their use as spice and perfumes. During the survey period, information was also gathered using semi-structured questionnaires from the traditional herbal healers and elderly men and women on the types of ailments cured by plant species and plant parts used in curing ailments. Cross-checking of data was made with the help of group discussions, which include the members from both the genders of the society. The participant observation method was also employed to understand the methods and techniques adopted by the healers and other local people for curing diseases. The nearby forest and agricultural lands were surveyed with the help of local people and practitioners of herbal medicine for identification of medicinal plant species and understanding their indigenous uses.

Figure 3. The fruits and plants of Rubes ellipticus – a medicinal and wild edible plant in the study area. - Photo by Chandra Prakash Kala

Table 1. Plants used as medicines, perfumes and spices by local people in Tons watershed of Uttarkashi district in Uttarakhand state of India

S. N.	Latin Name	Vernacular Name	Altitude	Life form	Parts used	Uses
1	Aconitum balfourii Stapf.	Vatsanabh / Mitha vish	3000 m	Herb	Root	Sciatica
2	Aconitum heterophyllum Wall.	Atis	>3000 m	Herb	Root	Cough, fever, diarrhea, constipation
3	Acorus calamus L.	Bach / ghurwach	1800 - 3000 m	Herb	Root	Snake bite, backache, fever, epilepsy, menstrual disorder, jaundice, headache, bronchitis
4	Adhatoda vasica Nees	Adoosa, Vashinga	1300 m	Shrub	Leaf	Asthma, bronchitis
5	Adiantum venustum D. Don	Hansraj	900 – 2500 m	Herb	Leaf	Bronchitis, skin disease, fever
6	Aesculus indica (Wall. ex Jacquem.) Hook.f.	Pangar	1500 – 2500 m	Tree	Fruit, seed, root	Sciatica, skin disease
7	Allium stracheyi Baker	Jambu	>3000 m	Herb	Leaf, flower	Spice
8	Anemone rivularis Buch.-Ham ex DC.	Dhaipha	3000 m	Herb	Root, leaf	Fever, headache
9	Angelica glauca Edgew.	Gandhrayan / Chora	2800 – 3700 m	Herb	Root	Spice, dysentery, vomiting, bronchitis
10	Arisaema jacquemontii Blume	Bankh	1200-3500	Herb	Tuber	Skin disease, snake bite
11	Arnebia benthamaii (D. Don) Johnston	Ratanjot / Laljari	3000- 4000 m.	Herb	Root, bark	Internal injuries, hair care
12	Artimisia nilagirica (Cl.) Pamp.	Panti	1600 to 3000 mtr.	Shrub	Leaf, root	Respiratory and psychological disorders
13	Asparagus racemosus Willd.	Satwar/ Keroova	1200 m	Herb	Root	Tonic
14	Astragalus candolleanus Royle ex Benth.	Rudravanti	4000 m	Herb	Root	Respiratory disorder
15	Berberis asiatica Roxb. ex DC.	Kilmora	1000 – 2300 m	Shrub	Root, bark	Cut and injury, malaria, skin disease, diarrhea, fever, eye disease
16	Berberis chitria Edwards	Daruhaldi	1800-2700 m	Shrub	Whole plant, root, bark	Malaria, jaundice, eye disease, skin disease
17	Berginia ciliata Sternb.	Pashanbhed / Silphoda	1200- 3000 m	Herb	Root	Kidney stone, gastric problem, diarrhea, tonic
18	Berginia stracheyi (Hook. f. Th.) Engler	Pashanbhed / Silphoda	3500-4800 m	Herb	Root	Kidney stone, tonic, cut-wounds
19	Betula utilis D. Don	Bhojpatra	2800-4000 m	Tree	Bark	Psychological disorder, cut-wounds, jaundice, cough-cold
20	Cannabis sativa L.	Bhang	1000-2200 m	Herb	Leaf	Pain killer
21	Centella asiatica (L.) Urban	Bramhi	<2500 m	Herb	Whole plant	Increasing brain power
22	Cedrus deodara (Roxb. ex D. Don) G. Don	Deodar	2000-3000 m	Tree	Stem, bark	Skin disease, itching, ulcer

23	Celtis australis L.	Khadik	2000 m	Tree	Stem, bark	Sprains, joint pain, leprosy
24	Chenopodium album L.	Bathuwa	1800 m	Herb	Leaf	Constipation, skin diseases
25	Cinnamomum tamala Nees	Dalchini / Tejpaat	<1800 m	Tree	Bark, leaf	Spice, throat problem
26	Citrullus colocynthis (L.) Schrader	Indrayan	<1800 m	Herb	Root	Jaundice
27	Coleus forskohlii Briq.	Koliyas	1000 – 2000 m	Herb	Root	Glaucoma, blood pressure
28	Cynodon dactylon (L.) Pers.	Doob	<1800 m	Grass	Whole plant	Cut-wounds, snake bite, blood purification
29	Dactylorhiza hatagirea (D.Don) Soo	Hathajari/ salampanja	> 3000	Herb	Tuber	Cut and injury, cough, tonic
30	Datura stramonium L.	Dhatura	<2700 m	Shrub	Leaf, seed, fruit, flower	Skin disease, locoderma, joint pain
31	Delphinium denudatum Wall.	Nirvishi	2500-4000 m	Herb	Root	Tonic, toothache
32	Dioscorea bulbifera L.	Genthi	2500 – 3000 m	Herb	Tuber	Tonic, wounds
33	Dioscorea deltoidea Wall.	Kathtarood	1500 – 2500 m	Herb	Rhizome	Dysentery, abdominal pain
34	Diploknema butyracea (Roxb.) Lam.	Chura	<1500 m	Tree	Fruit, seed oil	Rheumatism, wounds
35	Ephedra gerardiana Wall.	Som / Somalta	3500 m	Shrub	Shoot	Asthma, reproductive disorder
36	Eulophia dabia (D. Don) Hochr.	Salab	3500 m	Herb	Tuber	Cough, cold, tonic
37	Fagopyrum esculentum (L.) Moench	Ogal	2000-3600 m	Herb	Whole plant	Fever, headache, tonic, urinary disorder
38	Fritillaria roylei Hook.	Kakoli	>3300 m	Herb	Bulb	Asthma, tonic
39	Geranium wallichianum D.Don ex Sweet	Ratanjot	3400 m	Herb	Root	Eye disease
40	Gerardinia diversifolia (Link) Friis	Marsu kandali	<2500 m	Herb	Root, leaf	Bronchitis, asthma
41	Habenaria intermedia D. Don	Riddhi – Siddhi	3000 m	Herb	Tuber	Tonic
42	Hedychium spicatum Ham. ex Smith	Kapoor Kachri	1500 – 2100 m	Herb	Root	Diarrhea, liver complaints
43	Hippophae salicifolia D.Don	Amesh	2500 m	Shrub	Fruit	Indigestion, lung disorder
44	Indigofera pulchella Roxb.	Sakina	1500 m	Shrub	Root	Cough, chest pain
45	Juglans regia L.	Akhrot	800 - 2000 m	Tree	Bark, leaf, fruit	toothache
46	Juniperus communis L.	Poorcha	> 4000 m	Shrub	Leaf	Aromatic, incense stick
47	Jurinea macrocephala (Royle) Aswal & Goel	Dhoop	3500 m	Herb	Root	Fever
48	Lilium polyphyllum D. Don	Shir kakoli	1500-3300 m	Herb	Bulb	Tonic
49	Lyonia ovalifolia (Wall.) Drude	Aynar	1000-3000 m	Tree	Seed, leaf	Skin diseases
50	Malaxis muscifera (Lindley) Kuntze	Lahsooniya	3000 m	Herb	Bulb	Tonic
51	Mallotus Philippensis (Lam.) Muell.-Arg.	Rohni/ Kamela	< 1400 m	Tree	Fruit	Blood purification
52	Melia azedarach L.	Daikan	<1300 m	Tree	Fruit, bark, leaf	Rheumatism, antiseptic, skin diseases
53	Mentha longifolia (L.) Hudson	Podina	1200 – 2700 m	Herb	Leaf, flower	Aromatic, indigestion
54	Myrica esculenta Buch.-Ham ex D Don	Kafal	750-2300 m	Tree	Bark, fruit	Asthma, cough
55	Nardostachyus jatamansi (D. Don) DC.	Jatamansi	1800-2700 m	Herb	Root	Antiseptic, tonic, epilepsy
56	Origanum vulgare L.	Ban tulsi	1500-4000 m	Herb	Whole plant	Fever, cold, bronchitis, epilepsy, rheumatism
57	Oxalis corniculata L.	Bilmoru	<1800 m	Herb	Whole plant	Indigestion, fever, cataract
58	Paris polyphylla Smith	Satuwa	3300 m	Herb	Rhizome	Tonic
59	Phyllanthus emblica L.	Aounla	<1400 m	Tree	Fruit	Cough, constipation, blood purification
60	Picrorhiza kurrooa Benth	Kutki / Kadu	> 3000 m	Herb	Root	Fever, cough, headache, scorpion bite
61	Pinus roxburghii Sarg.	Cheer	> 1400 m	Tree	Resin	Aromatic, cut and wounds
62	Podophyllum hexandrum Royle	Van kakri	3000 m	Herb	Root	Liver disorder
63	Polygonatum cirrhifolium (Wall.) Royle	Mahameda	3000 m	Herb	Root	Tonic, blood purification
64	Polygonatum verticillatum (L.) All.	Meda	3000 m	Herb	Root	Tonic, aphrodisiac
65	Potentilla fulgens Wall. ex Hook.	Bajradanti	3000 m	Herb	Root	Toothache
66	Prunus cerasoides Buch.-Ham. ex D. Don	Padam, Payyain	<2000 m	Tree	Bark, fruit	Cut, wounds, muscular pain
67	Rheum australe D. Don	Dolu	3000-4000 m	Herb	Leaf, fruit	Indigestion, piles
68	Rhododendron arboreum Smith	Burans	1200-2500 m	Tree	Fruit	Heart problems, headache, rheumatism
69	Rubia cordifolia L.	Majistha/ maj	1500 m	Herb	Root	Skin diseases, burn, scald
70	Rubus ellipticus Smith	Hinsalu	1200 m	Shrub	Root, fruit	Stomachache, dysentery
71	Rumex nepalensis Spr.	Khunkhuiyan	3000 m	Herb	Leaf	Colic
72	Selinum vaginatum (Edgew) Cl.	Bhootkeshi	3000-36000 m	Herb	Root	Incense, hysteria
73	Skimmia laureola (DC.) Zucc.	Neirpatti / Kastura Patti	2200 – 3500 m	Herb	Leaf	Aromatic plant, incense, scabies
74	Stephania glabra (Roxb.) Miers	Ginjadoo, Gindaroo	1800 m	Herb	Root	Inflammation, blood pressure
75	Swertia chiraiyta (Roxb. ex Fleming) Karsten	Chiraita	1500 – 3000 m	Herb	Whole plant	Fever, blood purification
76	Symplocos racemosa Roxb.	Lodh, Lodhra	2300 m	Tree	Bark	Blood purification
77	Syzygium cuminii (L.) Skeels	Jamun	<1400 m	Tree	Bark, fruit, seed	Respiratory disorder, asthma, cut and wounds
78	Taxus baccata L.	Thuner	1800 – 3600 m	Tree	Leaf, bark	Asthma, respiratory disorder, epilepsy, aromatic
79	Thailictrum foliolosum DC	Mamiri	2500-3200 m	Herb	Root	Fever, eye disease
80	Thymus linearis Benth.	Van aajwain	2000 – 3500 m	Herb	Whole plant	Eye disease, toothache, stomachache, aromatic
81	Vibernum cotinifolium D. Don	Guieyan/ Dhenu	1800- 3000 m	Tree	Bark	Digestive disorder
82	Viola bioflora L.	Vanfsa	2000 – 2500 m	Herb	Root, fruit	Fever, lungs diseases
83	Woodfordia fruticosa (L.) Kurz.	Dhak-Dhai/ Dhoula	1400 m	Shrub	Fruit	Tonic
84	Zanthoxylum armatum DC.	Timroo	< 1800 m	Shrub	Bark, fruit	Toothache

Table 2. Plant parts used by people of Tons watershed for curing diseases and other purposes

Plant parts used			
Above ground		Below ground	
Plant part	Number of species	Plant part	Number of species
Fruit	17	Root	33
Leaf	17	Tuber	4
Bark	14	Bulb	3
Seed	5	Rhizome	2
Flower	2		
Shoot	1		
Resin	1		
Whole plant	8		

Table 3. Major ailments as cured by the use of plant species

Serial No	Diseases	Number of plants used
1	Tonic	12
2	Skin diseases	11
3	Fever	10
4	Cut and wounds	9
5	Cough & cold	7
6	Diarrhea and dysentery	7
7	Digestion and constipation	6
8	Bronchitis	6
9	Headache	5
10	Jaundice	4
11	Epilepsy	4
12	Asthma	4
13	Respiratory disorder	4
14	Rheumatism	4
15	Eye diseases	4
16	Snake bite	3
17	Sciatica	2
18	Malaria	2
19	Psychological disorder	2
20	Kidney stone	2
21	Joint pain	2
22	Throat pain	2
23	Menstrual disorder	1
24	Toothache	1
25	Backache	1
26	Scorpion bite	1
27	Glaucoma	1
28	Hair care	1
29	Brain power	1
30	Hysteria	1
31	Pain killer	1
32	Ulcer	1
33	Cataract	1
34	Itching	1
35	Sprains	1
36	Liver complaints	1
37	Muscular pain	1
38	Scabies	1
39	Leprosy	1
40	Urinary disorder	1
41	Blood pressure	1
42	Leucoderma	1
43	Lung problem	1
44	Gastric problem	1

3. Result and Discussion

The present investigation has resulted in the documentation of 84 plant species, which were used in curing various ailments, of these 3 species were used as spice and 4 species as perfumes (Table 1). These species were distributed over various life forms; 19 were tree species, 12 were shrub, and 53 were herbaceous species**.** Different plant parts were used as medicine by the local people of Tons watershed (Figure 3). For curing ailments, the use of aboveground plant parts was relatively higher (57%) than the belowground plant parts. Of the aboveground plant parts, fruit and leaf were used in the majority of cases (17 species), followed by bark of woody species (14 species). Different belowground plant forms such as root, tuber, rhizome and bulb were used as a medicine for the treatment of various ailments (Table 2). The whole plant of 8 species was used as medicine. About 44 types of ailments were treated by using these 84 plant species, of which the highest numbers of plant species (12 species) were used as general healthcare tonic. About 11 medicinal plant species were used in curing various skin diseases, 10 species for fever, 9 for cut and wounds and 7 each for cough-cold and diarrhea-dysentery (Table 3).

Previous studies carried out in the study area report the use of 23 plant species as medicine [15]. In the adjacent valley called as Rawain valley, 63 plant species are reported for curing diseases by the local people [16]. The use of various plant species remained intact in the study area for centuries being a remote hilly region. With due course of time, the advent of commercial interests has overexploited many important plant species. The loss of native biodiversity due to natural and anthropogenic pressures and changes in traditional land-use practices altered the natural vegetation composition [12]. The decline in diversity of useful plant species may ultimately affect the traditional system of plant use for medicine, perfumery and spice. There are reports suggest the decline in number of traditional herbal healers due to decline in number of youths coming forward to learn this tradition in the state of Uttarakhand [17,18]. Migration of youths from hills to towns and cities is also held responsible for decline in the traditional system of therapy [16].

Table 4. Threatened species recorded in the study area

Serial No.	Species	IUCN Red List Status
1	Aconitum balfourii Stapf.	Vulnerable
2	Angelica glauca Edgew.	Endangered
3	Arnebia benthamaii (D. Don) Johnston	Endangered
4	Dactylorhiza hatagirea (D. Don) Soo	Endangered
5	Ephedra gerardiana Wall.	Endangered
6	Fritillaria roylei Hook.	Endangered
7	Jurinea macrocephala (Royle) Aswal & Goel	Endangered
8	Malaxis muscifera (Lindley) Kuntze	Endangered
9	Nardostachyus jatamansi (D. Don) DC.	Critically Endangered
10	Picrorhiza kurrooa Benth.	Critically Endangered
11	Podophyllum hexandrum Royle	Endangered
12	Polygonatum verticillatum (L.) All.	Vulnerable
13	Rheum australe D. Don	Endangered
14	Taxus baccata L.	Endangered

The present investigations reveal that 17% of the documented plant species in the study area are threatened. Of the 14 threatened plant species (Table 4), 10 are endangered, 2 vulnerable and 2 other species are critically endangered as per the IUCN threat assessment [2,19,20]. The critically endangered species are *Nardostachyus jatamansi* (Don) DC. and *Picrorhiza kurrooa* Benth. The less availability of these rare species in the study area affects the traditional system of therapy. Conservation of these valuable plant species is the need of hour. Attempts should be made to document the indigenous uses of plant species at a larger scale in order to safeguard the valuable knowledge practiced over centuries for the welfare of the

society. There is a need to rejuvenate the traditional system of plant use for therapy and perfumery as it provides a time-tested goods and services.

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