

Diversity, Distribution, Indigenous Uses and Conservation of the Medicinal Plants of Indian Himalayan Region Used in Cancer

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ABSTRACT Indian Himalayan Region is very well known for the medicinal plant wealth. The representative, natural and unique medicinal plants are used for curing various diseases/ailments including cancer and income generation. In view of high value of the medicinal plants of IHR, an attempt has been made to; (i) assess and review the medicinal plants with anti-cancerous properties; (ii) document indigenous uses and practices; (iii) analyze for nativity, endemism and rarity; (iv) review the species for chemical composition/active ingredients; and (v) suggest strategy for the conservation and management of these species. Total 36 species representing trees (18 spp.), shrubs (07 spp.), herbs (08 spp.) and ferns (01 spp.) were recorded. Different parts of these species, such as whole plants, roots (including rhizomes and tubers), leaves, flowers, fruits, seeds, stems, barks, etc. were used by the inhabitants for curing the cancer. Four (04) species were natives and 31 species non-natives to the Himalayan region. Two species i.e., *Berberis aristata* and *Taxus baccata* subsp. *wallichiana* were near endemic. Chemical composition of the part(s) used, if available, has been given. Due to over exploitation, habitat degradation and changing environmental conditions, the populations of many species are depleting fast. Therefore, studies on habitat ecology, development of conventional and in-vitro propagation protocols; development of agro techniques/plantation techniques and introduction in the akin habitats; and education and awareness programs for the inhabitants are suggested.

INTRODUCTION

Nature has been a source of medicinal treatments for thousands of years, and plant-based system continues to play an essential role in primary health care of 80% of world's population (Gupta 2001). Among the various diseases, cancer is one of the most dangerous diseases and can be depicted as a disease in cell proliferation and differentiation becomes uncoupled and damage to numerous regulatory genes ultimately results in the development of invasive and metastatic cancer, which is the culmination of the chronic disease process, carcinogenesis (Hong and Sporn 1997). Natural products have long been a fertile source of cure for cancer, which is projected to become the major causes of death in this century. However, there is a continuing need for development of new anticancer drugs, drug combinations and chemotherapy strategies, by methodical and scientific exploration of enormous pool of synthetic, biological and natural products (Mukherjee et al. 2001). The Indian Himalayan Region (IHR) is bestowed with varied landscape features that provide multitude of habitats for the biodiversity elements including medicinal plants. It extends

from Jammu and Kashmir to Arunachal Pradesh with latitudes 27°-38°N and longitudes 72°-89° E and spread over in an area of 236,000 km² (Valdiya 1980) and includes parts of Jammu and Kashmir, Himachal Pradesh, Garhwal, Kumaun, Sikkim, Darjeeling District of West Bengal and other North Eastern states (Rodgers and Panwar 1988). The entire region is endowed with a wide range of physiography, climate, soil and biological wealth. The region is one of the richest reservoirs of biological diversity in the world and is considered as a store house of the valuable medicinal plant species (Samant et al. 1998, 2007).

The vegetation comprises of tropical, subtropical, temperate, sub-alpine and alpine types. It supports about 18,440 species of plants (25.3% endemic) (Singh and Hajra 1996; Samant et al. 1998), 1,748 medicinal plants (Samant et al. 1998) and 675 wild edibles (Samant and Dhar 1997). It is known for its representative, natural, unique, biodiversity (Samant et al. 1998). This biodiversity is being utilized by the inhabitants of the IHR in various forms, i.e. medicine, food, fuel, fodder, timber, making agricultural tools, fiber, religious and various other purposes (Samant and Dhar 1997; Samant et al. 1998). Plants with medicinal properties enjoyed the highest reputation in the indigenous systems of medicine all over the world, and still

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constitute one of the major sources of drugs in modern as well as traditional systems of medicine in spite of tremendous development in the field of synthetic drugs and antibiotics (Aswal 2001). In the remote areas of IHR where primary health centers are not available, inhabitants mostly rely on plants for the treatments of various ailments/diseases, that is, cancer, kidney disorders, asthma, skin diseases, piles, etc. Amongst them cancer is the most hazardous and needs to be controlled in the initial stages. Cancer is a class of diseases characterized by out-of-control cell growth. It is ultimately the result of cells that uncontrollably multiply and do not die. The IHR harbors the medicinal plants which are used for curing cancer. As such focused studies are not available on this aspect. Keeping in view the potential of Himalayan medicinal plants with anti-cancerous property, the present attempt has been made to; (1) assess and review the medicinal plants with anti-cancerous properties; (2) document indigenous uses and practices; (3) analyze for nativity, endemism and rarity; (4) review the species for chemical composition/active ingredients; and (5) suggest strategy for the conservation and management of these species.

METHODOLOGY

The present study is based on the extensive surveys on the representative parts of Trans, North Western and Western Himalaya and scrupulous review of the information available on medicinal plants in the IHR. While conducting the surveys on biodiversity including medicinal plants of the above regions, information was also gathered from local inhabitants about the anti-cancerous properties of the medicinal plants. For this local knowledgeable persons were interviewed on indigenous uses and anti-cancerous properties the medicinal plants. The additional information includes local names, part(s) used, altitudinal distribution, habitat, etc. According to the inhabitants, for the internal use the useful part of the medicinal plant is crushed and made into paste. This paste is mixed with water, and this decoction is given to the patient 2 or 3 times in a day. For the external use, the useful part of the medicinal plant is crushed and converted into paste. The paste is mixed with a few drops of water and applied on the affected part. Also, information on indigenous uses and

biological activities was collected from the available literature (Jain 1980; Aswal 2001). Collection of fresh samples was done and identified with the help of local flora (Collett 1902; Osmaston 1927; Choudhary and Wadhwa 1984; Samant 1987; Aswal and Mehrotra 1994; Dhaliwal and Sharma 1999). Anonymous (1883-1970) and Samant et al. (1998) were followed for finding the nomenclature and nativity. Endemism of the species was based on the distribution of species. The species restricted to the IHR were identified as endemic, while those with extended distribution to the neighboring countries were identified as near-endemic (Dhar and Samant 1993; Samant et al. 1998). Rarity of the species is based on Samant et al. (1998, 2007) and Ved et al. (2003, 2005). Chemical composition of the species is based on secondary information (Chopra et al. 1986a and b; Asolkar et al. 1992; Anonymous 1997; Samant and Palni 2001).

RESULTS

Diversity and Distribution

Total of 36 species of medicinal plants belonging to 32 genera in 28 families were found with anti-cancerous property. These species represent trees (18 spp.), shrubs (07 spp.), herbs (08 spp.) and fern (01 sp.). Twenty one (21) families were monotypic, indicating a poor genetic base and family Anacardiaceae (03 spp.) and Acanthaceae, Asclepiadaceae, Asteraceae, Mimoseae, Moraceae and Rutaceae (02 spp., each) represent the maximum species associated with the treatment of cancer.

Along an altitudinal gradient, the maximum species (32 spp.) were found in the tropical and sub-tropical zones that is, (< 1800 m), followed by the temperate (1801–2800 m) (04 spp.), sub-alpine (2801–3800 m) (03 spp.) and alpine (> 3800 m) (01 sp.) zones (Fig. 1; Table 1). Overlapping of the species within the zones has been observed.

Indigenous Uses

Leaves (15 spp.), roots (13 spp.), bark (10 spp.), fruits (09 spp.), seeds (08 spp.), whole plants (05 spp.), flowers (03 spp.), stems (03 spp.), latex (02 spp.), rhizome (01 sp.) of the medicinal plants were used by native communities for the treatment of tumor/cancer (Fig. 2)

Table 1: Diversity, distribution, nativity, chemical composition and indigenous uses of plants used in Cancer in the Indian Himalayan Region

Family/Taxa	Local name	Altitude	Life form	Part(s) used	Nativity	Active compounds	Uses
Acanthaceae		200-600	H	St, Lf, Rt	Ind Or	Spasmol, hypoten, flcontain, apigenin, and glucuronide	Rheumatism, inflammation, jaundice, hepatic obstruction, body pain, dropsy
<i>Hygrophila auriculata</i> (Sechum.) Heine	Gormidi	200-600	H	St, Lf, Rt	Ind Or	Spasmol, hypoten, flcontain, apigenin, and glucuronide	Aphrodisiac, renal tonic
<i>H. spinosa</i> Anders.	Kikirigach						
Anacardiaceae		Up to 1200	T	Wp	Ind Or Burma	Amino acid, tannin	The roots are acrid, astringent, cooling, depurative and constipating, and are useful in treatment of diarrhea. Leaves are used in the treatment of skin diseases. Fruits are used in treating cough and asthma.
<i>Buchanania lanzan</i> Spr.	Char						
		Up to 1200	T	Wp	Ind Or Burma	Amino acid, tannin	-
<i>B. latifolia</i> Roxb.	Pial	Up to 1200	T	Lf, Fl	Ind Or Malaya	Ethyl glate, Vitamins A, B, C, and D	Fruits are used in curing diarrhea. Bark cures jaundice, stomachache and anti fertility. Also, cures cholera, fever, dysentery, toothache and scabies.
<i>Mangifera indica</i> L.	Am						
Annonaceae		500-1400	T	Rt, Sd, Lf	Ind Occ	Hydrocyanic acid, anonaine, Vitamin-C	A bark decoction is used to stop diarrhea, while the root is used in the treatment of dysentery.
<i>Annona squamosa</i> L.	Sitaphal						
Apocynaceae		150-1500	Sh	Wp	Cosmop Trop	Ursolic acid, leanolic acid, vincarine, vinervine, tombozine, leurosine, vindoline, catharanthine, lochnerine, and tetrahydroalrtonine	Whole plant is used in curing diabetes, while the leaves are used during body swelling.
<i>Catharanthus roseus</i> (L.) Don	Nayatara						
Araceae		200-800	H	Wp	Ind Or Burma	Sterol, sciandapsin A and B	Whole plant is used in curing bone fracture, while roots are used in the treatment of cough, stomachache and tuberculosis.
<i>Scindapsus officinalis</i> (Roxb.) Schott.	Harjora, Gajapipauli						
Aristolochiaceae		1200-1800	H	Lf, Rt	Ind Or	Isoaristolochic, Oil contains: Carbonyl compounds and isovanillin	The roots are used in the treatment of diarrhea, dropsy, hypertension, menstrual complaints, scabies and skin diseases.
<i>Aristolochia indica</i> L.	Kalesar, Panairi						
Asclepiadaceae		Up to 1200	Sh	La, Lf, Sd, Rt	Ind or	Caloptrin, akundarin, uscharin, calotoxin, calactin, α -calotropeol, α -calotropeol, β -amyryn, and calcium oxalate	Asthma, bodyache, boil, burns, dropsy, dysentery, leprosy, ringworm and other skin diseases.
<i>Calotropis gigantea</i> (L.) Br.	Amadar					Cardiac steroid, glycd. With some aglycone, calatropagenine, uscharin, calotoxin, and calactin	Asthma, boils, cholera, cold, cough, rheumatism, ringworm, small pox, stomach disorders, toothache and swelling.
<i>C. procera</i> Br.	Aak, Madar	Up to 800	Sh	La, Rt, Lf	Peruv Afr Trop Ind Or		

Table 1: Contd.....

Family/Taxa	Local name	Altitude	Life form	Part(s) used	Nativity	Active compounds	Uses
Asteraceae							
<i>Ageratum conyzoides</i> L.	Ajgandha	200-1200	H	Lf	Reg Trop	Phenols, (eugenols), ethyl eugenol, caryophyllene, γ -cadinene, agerotochromene and OMe its derivatives, Stigmaestrol, β -sitosterol, ditriacontene	The seeds are used in the treatment of diarrhea while, leaves cure boils, cuts, headache, leprosy, piles, scabies and other skin diseases.
<i>Elephantopus scaber</i> L.	Bis-hari	200-1500	H	Rt	Cosmop Trop	Germacranolide, elephantopin	Roots and leaves are used as emollient for diarrhoea, dysentery, swellings and stomach pain. Leaves are used for eczema.
Berberidaceae							
<i>Berberis aristata</i> DC.*	Kilmora	1500-3000	Sh	Rt	Reg Himal	Berberine	It is used in the treatment of malaria, eye complaints, skin diseases, diarrhoea and jaundice.
Caesalpiniaceae							
<i>Cassia fistula</i> L.	Amaltas	Up to 1500	T	Lf, Fr, Sd	As Trop	Anthraquinone, tannin, fistucacidin, sennosides A and B	The pulp of the seed pod is used as a mild laxative. Fruits are used in curing asthma, chest infection, constipation, cough, diarrhea and dysentery.
Cochlospermaceae							
<i>Cochlospermum religiosum</i> (L.) Alston	Gong, Gongal	Up to 1000	T	Br, Fl, Fr	Afr Trop	Saponins, tannins and terpenoides	The bark is used in curing jaundice, while roots in the treatment of urinary diseases.
Combretaceae							
<i>Anogeissus latifolia</i> Bedd.	Bakla, Dhavada	-	-	Br, Rt	Ind Or	-	The bark is used in the treatment of colic, cough, diarrhea, dysentery, liver complaints and stomach disorders.
Convolvulaceae							
<i>Cuscuta chinensis</i> Lam.	-	-	-	-	-	Dulcitol, D-mannitol, leutolin, cuscutalin and cuscutin	Bone fracture, dropsy, labour complaints.
Dicranopteridaceae							
<i>Dicranopteris linearis</i> (Burm.f.) Underw.	-	1200-2000	Fn	Wp	-	β -sitosterol, flavon	Asthma, epilepsy, fits.
Euphorbiaceae							
<i>Tragia involucrata</i> L.	Bishati, Sengalsingh	Up to 500	T	Fr, Lf, Rt	As Trop	-	The fruits are used in curing baldness and skin diseases. The leaves cure dysentery and swelling in hands and feet.
Fabaceae							
<i>Mucuna pruriens</i> (L.) DC.	Konch, kavach	Up to 1200	Sh	Fr, Sd	Amphing Trop	Mucquadine, mucuadinine, mucuadinine and pruriendine and small amount of nicotine, etc	It maintains healthy cholesterol and blood sugar levels. The roots are used in curing cough and dysentery, while seeds cure scorpion bite, snake bite and urinary complaints.

Table 1: Contd.....

Family/Taxa	Local name	Altitude	Life form	Part(s) used	Nativity	Active compounds	Uses
Liliaceae <i>Drimys indica</i> (Roxb.) Jessop.	Ban-piaj, Ramkanda	1200-2400	H	Bb	Ind Or Burma	Hentriantanol, octanosanoic acid, sitisterol, 12 -types of cytotypes e.g. di, tri, tetra, hexalpoids, proscillaridin A, scillophenoside, and anhydro-scilli phaosidin and sterols, etc.	Cardiac stimulant, fever, rheumatism, wounds and skin diseases.
Lythraceae <i>Woodfordia fruticosa</i> (L.) Korz.	Dhai, Daul, Jaji	200-1800	Sh	Fl	As et Afr Trop	Astrin	It is used for dysentery, diarrhea, cough, injuries, nausea and sprain.
Malvaceae <i>Gossypium herbaceum</i> L.	-	Up to 1200	Sh	Rt, Bb, Sd	As Trop	Gossypol	The paste is applied on wounds for curbing the infection. Also, powder is used for rectifying digestive disorders.
Meliaceae <i>Azadirachta indica</i> Juss.	Neem	Upto 1000	T	Bk, Lf, Fr	Ind Or	Margosic acid, nimbin, nimbinin and nimbidin, bakaganin	The leaves are used in blood purification, boils, cold, diarrhea, dysentery, malaria, scabies, tuberculosis, while bark is used in curing liver complaints, jaundice and skin diseases.
Mimosaceae <i>Acacia catechu</i> (L.f.) Willd.	Khatta, Khair	200-1400	T	Br, Rt	Ind Or	D-glucose, L-arbinose, D-ramnose, L-gluconic acid	The bark is used in the treatment of diarrhea, menstrual complaints and haemoptysis, while the roots cure rheumatism and toothache.
<i>Entada pursaetha</i> DC.	Gila-phal	300-1600	T	Lf, Sd	Amer Trop	Oleanolic acid, entagenic acid, sapogenin, prosapogenin A, lupeol, echinocytic acid, Mercaptan, cyrosine glucy-soides, $\hat{\alpha}$ -sitosterol, $\hat{\alpha}$ -amyrin, gallic acid	The leaves are used in the treatment of cuts and wounds, while seeds in curing eye diseases and liver complaints.
Moraceae <i>Ficus racemosa</i> L.; <i>F. glomerata</i> Roxb.	Gular	Up to 1200	T	Bk	Ind Or Burma	Ceryl behenate, lupeol, $\hat{\alpha}$ -amyrin, $\hat{\alpha}$ -sitosterol, stigmasterol	The leaves are used in the treatment of blisters, boils, diarrhea, dysentery, piles and urinary complaints, while fruits are used in curing diabetes, leprosy and stomach disorders.
<i>Streblus asper</i> Lour.	Khaksa	Up to 1600	T	Lf, Bk, St	As Trop	Myocardmium, comparable to adrenaline, α -glycosode	The bark is used in curing stomachache and urinary troubles.
Myrtaceae <i>Syzygium cuminii</i> (L.) Skeels	Jamun	300-1500	T	Lf, Bk, Fr, Sd	As et Austr Trop	Jambolin, ellagic acid, tannins, gallic acid, lactic acid, proteins, amino acids, etc	The fruits are used in the treatment of digestive troubles, stomachache; bark cures piles; and seeds heal pimples.

Table 1: Contd.....

Family/Taxa	Local name	Altitude	Life form	Part(s) used	Nativity	Active compounds	Uses
Oleaceae							
<i>Nyctanthes arbortristis</i> L.	Parijat, harsingar	200-1200	T	Lf, Bk	Ind Or	Mannitol, β -amyrin, β -sitosterol, hentriacontane, benzoic acid, free glucose, fructose, etc	The leaves are used in the treatment of cough, fever, hiccups, malaria and rheumatism; bark is used for healing internal injuries and bone fracture.
Podophyllaceae							
<i>Podophyllum hexandrum</i> Royle	Bankakri	2800-4500	H	Rh	Reg Himal	Podophyllin, podophyllotoxin and podophyllol resin	The rhizomes are used in curing diarrhea, cuts, wounds, fever and skin diseases.
Rutaceae							
<i>Glycosmis arborea</i> (Roxb.) DC.	Panal, Bannimbu	200-1000	T	Fr, Rt, Bk	As Trop Austr	Glycozolidine, carbazole derivatives, γ -tagarine, dictamine, arborinine, triterp, arborinone, skimmianine	It has wound-healing properties. The fruits are used in the treatment of dysentery and roots in curing fever, snake bite and labour pain.
<i>G. mauritiana</i> (Lamk.) Tanaka	Ban-nimbu	200-1000	T	Fr	As Trop Austr	Skimmiamine, γ -tagarine, and dictamine, $\hat{\alpha}$ -sitosterol, glycozoline, glycozolidine, arborinine, friedelin, vitexin, hentriacontanol	The roots cure cold, cough, fever and wounds.
Simaroubaceae							
<i>Brucea mollis</i> Wall. ex. Kurz	Koinine	1000-1600	T	Fr, Sd	Reg Himal	-	The fruits are used in the treatment of malaria, while seeds in curing stomachache.
Taxaceae							
<i>Taxus baccata</i> L. subsp. <i>wallichiana</i> (Zucc.) Pilger*	Rakhal	2500-3300	T	Br, Lf	Reg Himal	Taxol	Swelling, contraceptive and aromatic

Abbreviations used: H = Herb; Sh = Shrub; T = Tree; Fn = Fern; Wp = Whole plant; Rt = Root; St = Stem; Fl = Flower; Lf = Leaf; Bk = Bark; Fr = Fruit; La = Latex; Sd = Seed; Rh = Rhizome; Reg Himal = Himalayan Region; Ind Or = Indian Oriental; et = And; As = Asia; Afr = Africa; Trop = Tropical; Amphig = Amphigaea; Austr = Australia; Am = America; Cosmop = Cosmopolitan; Occ = Occidentalis; Peruv = Peruvian and * = Near Endemic

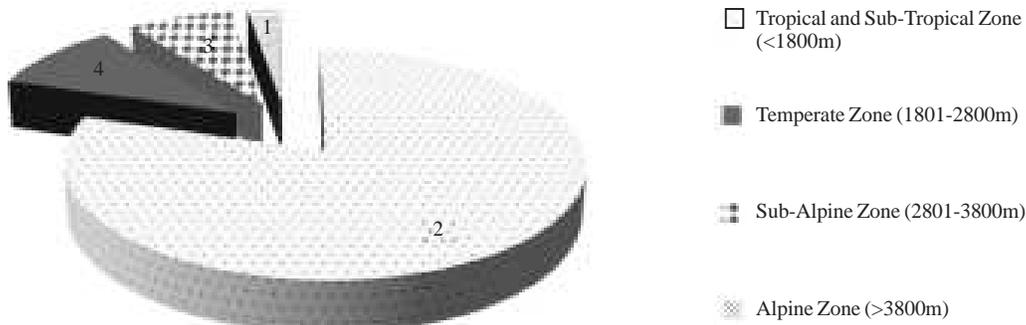


Fig. 1. Altitudinal distribution of the medicinal plants with anti-cancerous properties

and various other ailments/diseases. The indigenous uses of the medicinal plants are presented in Table 1.

Nativity, Endemism and Rarity

Four (04) species i.e., *Berberis aristata*, *Podophyllum hexandrum*, *Taxus baccata* subsp. *wallichiana* and *Brucea mollis* were native to the Himalayan region, while 31 species were non-natives, representing Africa, Australia, Oriental India, Tropical Asia, America and other parts of the globe (Table 1). Only 02 species i.e., *Berberis aristata* and *Taxus baccata* subsp. *wallichiana* were identified as near-endemic. Among the species, *Podophyllum hexandrum* and *Taxus baccata* subsp. *wallichiana* fall under Endangered category (Ved et al., 2003). *Dicranopteris linearis* and

Berberis aristata under Vulnerable category. The remaining species fall under Least Concerned category.

DISCUSSION

The Indian Himalayan Region is very well known for the medicinal plants wealth as it supports 1,748 medicinal plants (Samant et al. 1998). These medicinal plants are used for curing various diseases/ailments by the inhabitants of remote areas (Samant et al. 1998, 2007). The present study provides detailed information on the diversity, distribution pattern and indigenous uses for the treatment of cancer. In view of the potential of medicinal plants for curing dangerous diseases like cancer, present study was focused on the medicinal plants with anti-cancerous properties, and recorded 36 species,

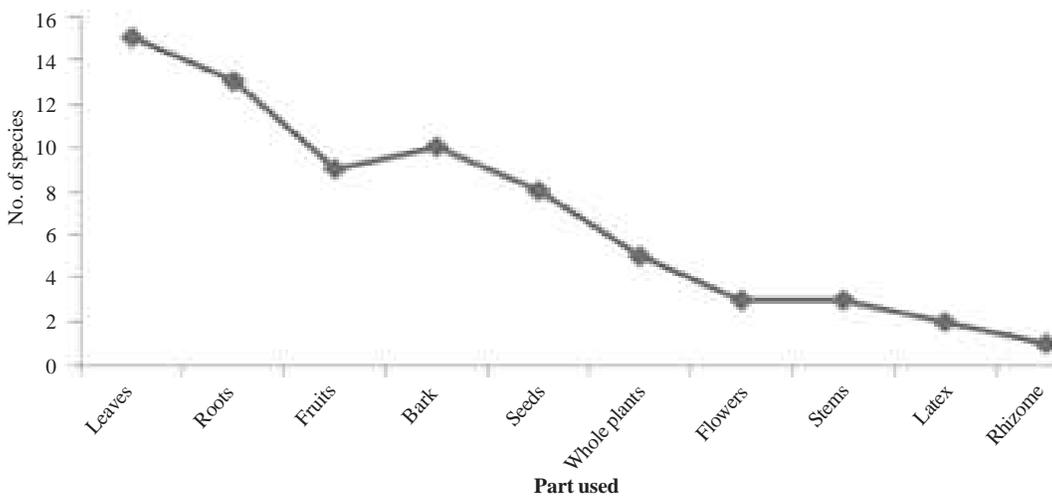


Fig. 2. Parts used of the medicinal plants for curing cancer

maximum species (32) in the altitudinal zone < 1800 m which identifies this zone as high potential for the medicinal plants with anti-cancerous properties. The rich diversity may be due to the favorable environmental conditions for these species (Samant and Dhar 1997; Samant et al. 1998). Exploitation of leaves (15 spp.), roots (13 spp.), bark (10 spp.), fruits (09 spp.), seeds (08 spp.), whole plants (05 spp.), flowers (03 spp.) and rhizome (01 sp.) of anti-cancerous medicinal plants indicated a high degree of threat to these species. Continued exploitation of these species may lead to rapid depletion of their populations from their natural habitats. This is the fact that continued over exploitation of roots of *Podophyllum hexandrum* and bark and leaves of *Taxus baccata* subsp. *wallichiana* has placed these species under the Endangered category, and rhizome of *Dicranopteris linearis* and root bark of *Berberis aristata* under Vulnerable category. Such species merit priority attention for conservation.

CONCLUSION

Cancer is one of the most dangerous diseases and has projected to become the major causes of death in this century. The medicinal plants with anti-cancerous properties were studied and it was found that exploitation of these species had lead to depletion of their population to a great extent from their natural habitats. If the over-exploitation of these species continues, their population will be wiped out from the natural habitats within a few years. Apart from the cancerous diseases, these species were also used medicinally to cure diarrhea, rheumatism, inflammation, jaundice, hepatic obstruction, pain, cold, cough, etc. indicating their high value for the native communities. Looking to the tremendous importance of these plants in curing ample of diseases, conservation by the local inhabitants, NGOs, Central and State Government organizations is essentially required. The indigenous knowledge may be lost in the coming future. So, proper methods of conservation and preservation are suggested.

RECOMMENDATIONS

In view of above, for the long-term conservation management of these species, studies on habitat ecology, development of conventional and in-vitro propagation protocols; development

of agro techniques/plantation techniques and introduction in the akin habitats; and education and awareness programs for the inhabitants are recommended.

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