

Some High Value Medicinal Plants of Khumbu Region Nepal

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Abstract

Visualizing the present biodiversity status of Nepal, an integrated approach comprising of biodiversity documentation, bio-prospecting, sustainable utilization and conservation has become an urgent need. Realizing the importance of medicinal plants altogether 45 plants were collected from Khumbu region with the altitudinal variation of 2582m to 4470m. Among the collected plant species 12 have been characterized as highly valuable. The important biochemical constituents and morphology of these plants have been described in this paper.

Key words: Himalayan region, Khumbu, medicinal plants, morphological characters.

Introduction

Medicinal plants are second most valuable bio-resources of Nepal after water resources. Many highly demanded and globally important medicinal plants such as *Swertia* spp., *Neo-picrorhiza scrophulariiflora*, *Podophyllum hexandrum*, *Taxus wallichiana*, *Podocarpus* sp. etc. are harbored in various geoclimatic region of Nepal (Polunin & Stainton 1984, Press *et al.* 2000). The total number of medicinal and aromatic plants reported in Nepal varies according to various authors (DPR 1970, 1984; Malla & Shakya 1999, Baral & Kurmi, 2006). The compilation of Medicinal and Aromatic plant database of Nepal was published in 2000 (Shrestha *et al.* 2000), which listed 1624 species of medicinal plants. Most recently, Ghimire (2008) reported 1950 species of medicinal plants in Nepal.

According to recent estimates by the World Health Organization, more than 3.5 billion people in the developing world rely on plants as components of their primary health care (www.fao.org). High value medicinal plants have been the basis for modern allopathic drug development while the use of indigenous drugs from plant origin form major part of complementary and

alternative medicines in the form of herbal drugs and Ayurvedic medicines. Many such high value medicinal plants have been equally used in other forms of alternative medicines such as Chinese, Tibetan and Homoeopathic medicine (Li *et al.* 1997, Dhama & Dhama 1996). Therefore, the production, consumption and international trade in medicinal plants and phyto-medicines are growing and expected to grow quite significantly in future.

Himalayan region of Nepal is one of the major store houses of various high value medicinal plant species. Most of such valuable plants grow in wild conditions as natural components of vegetation of particular region. The necessary plant material (roots, leaves, bark, etc) are collected and sold by the local people to the traders, industries and exporters purchase them from traders. Since there is no scientific system of collecting and regenerating these plants, several such high value plants have either been completely lost or have become endangered. In this scenario, handling of Nepalese medicinal biodiversity should involve

an integrated approach comprising of well documentation, their sustainable utilization and conservation.

Conventionally, macroscopic (morphological) and microscopic characters including anatomy, cytology and chemical profiling techniques such as thin layer chromatography (TLC) and high performance thin layer chromatography (HPTLC), gas chromatography (GC), high performance liquid chromatography (HPLC), etc are being used for characterizing genotypes and chemotypes (Joshi *et al.* 2004). Such studies can produce deep level insights for conservation and sustainable utilization of high value medicinal plant biodiversity of Nepal.

Present study on high value medicinal plants of Khumbu region was formulated for the exploration, documentation and characterization of high value medicinal plants of Khumbu region in order to devise prospects of such plants for long-term sustainable utilization and conservation.

Materials and Methods

Field survey was carried out during May, 2007 at Khumbu region of Nepal, for the ecological, anatomical study and for the collection of herbaria for the morphological studies as well as collection of anatomical and DNA samples. Altitude, longitude and latitude readings of the plant collection sites were taken by using geographical positioning system (GPS). The collected plants were properly dried and mounted for further identification.

Herbarium specimens were prepared for the collected high value medicinal plants. Morphological identification of the specimens was carried out consulting taxonomic experts and using various taxonomic literatures (Polunin & Stainton, 1984, Press *et al.* 2000). Again, the specimens were compared with previously identified herbaria in National Herbarium and Plant Research Laboratory,

Godawari and Plant specialists from Natural History Museum, Swoyambhu.

Description of major vegetation

The vegetation pattern from Lukla (2800) to Jorsalle (2400) to Namche (3400) comprises the canopy vegetation of Abies spectabilis D. Don, Pinus roxburgii Sarg., Rhododendron arboretum Smith, Tsuga demosa D. Don, Pinus wallichiana A.B. Jacks etc. In case of the shrubby vegetation plants like Rhododendron triflorum Hook.f, Juniperus indica Bertol, Juniperus recurva Buch. Ham. ex D. Don, Berberis aristata Hook. F. & Thomson, Berberis erythroclada Ahrendt, Zanthoxylum nepalense DC, Cotoneaster microphyllus Wallich.ex Lindley, Rubus ellepticus Smith, Utrica dioica L were quite common. The ground vegetation consisted mostly of plants like Euphorbia wallichii Hook.f, Artemisia sps., Viola sp., Plantago ersoa Wall, Primula sp.

Above Namche along Syangboche and Khunde Khumjung trail (around 3400- 4000). The common vegetation comprised of *Juniperus* sp., *Rhododendron anthopogan* D.Don, *Rhododendron wightii* Hook..f as well as different species of *Berberis*. Around 4000m, *Juniperus indica* Bertol were present and above 4,000m, where conditions are drier, along with dwarf rhododendrons and *Cotoneasters*, *Ephedra girardiana* Wall ex Stapf, shrubby *Potentilla* sp, willow *Salix* sp were found.

The shrub layer diminishes as conditions become cooler and above 5000m, other dwarf shrubs in the dry valley upland, include horsetail *Ephedra gerardiana* Wall ex Stapf, *Juniperous indica* Bertol and *Potentilla* sp. Above this and up to the permanent snow line at about 5,750m, plant life is restricted to lichens, mosses and dwarf grasses.

Results

Altogether, 45 medicinal plants were collected from the research site. Of them, 12 have been short listed as being high value species for further detail study (Table 1). The selection has been based on IUCN category, CITES list, DPR list, IDRC list and other relevant literature.

Table 1. List of high value medicinal plants collected from the Khumbu Region with geographical positioning

S.N.	Scientific name	Family	Nepali Name	Altitude (m)	Longitude/Latitude
1	<i>Artemisia</i> sp.	Compositaeae		3500	N-27°48.132' E-86°42.589'
2	<i>Berberis erythroclada</i> Ahrendt	Berberidaceae		3522	N – 27° 48.229' E – 086° 42.908'
3	<i>Berberis aristata</i> . var. <i>micrantha</i> Hook. F. & Thomson	Berberidaceae	Chutro/Kirmundo	3522	N – 27° 48.229' E – 86° 42. 908'
4	<i>Ephedra gerardiana</i> Wall ex Stapf	Ephedraceae		4470	N- 27° 54.21' E- 86° 42.132'
5	<i>Mecanopsis grandis</i> Prain	Papaveraceae		3596	N – 27° 48.405' E – 86° 42. 214'
6	<i>Meconopsis peniculata</i> Prain	Papaveraceae	Mulapate	3596	N – 27° 48.405' E – 86 °42. 214'
7	<i>Neopicrorhiza scrophulariiflora</i> (Pennenn)Hong	Scrophulariaceae	Kutki		3634N-27° 48.594' E- 86°42.163'
8	<i>Paris polyphylla</i> Smith	Liliaceae	Satuwa	2584	N-27°45.145' E-86°43.008'
9	<i>Podophyllum hexandrum</i> Royle	Berberidaceae	Laghu patra	3984	N- 27° 49.124' E- 086 42.711'
10	<i>Potentilla peduncularis</i> D. Don	Rosaceae		3845	N-2748.920' E-86°42.845'
11	<i>Taxus wallichiana</i> Zucc.	Taxaceae		2783	N-27° 41.87' E- 86° 43.40'
12	<i>Zanthoxylum nepalense</i> DC.	Rutaceae	Timur	2717	N- 27° 45.595' E – 86° 42.044'

Morphological description and important chemical constituents

***Abies spectabilis* (D. Don) Mirb**

Tall evergreen, coniferous tree about 50m in height. Leaves sessile, linear, flattened, leathery, dark green above and whitish beneath with incurved margins, notched at the apex. Flowers unisexual, female cones solitary, situated a little below the tips of shoots, dark purple when young and brown at maturity with broad fan shaped scales, erect cylindrical, 10-20 cm long and 4-7.5 cm broad. Male cones usually clustered, yellowish and ellipsoid, 5cm long. Cones: April- May. (Plate 1)



Plate 1 - *Abies spectabilis*

Leaves produce essential oil which contains mainly α and β - pinene, camphene, lemonene, bornyl acetate (DPR 2007).

***Berberis aristata* DC**

Spiny shrub about 3 m high. Leaves sub-sessile, clustered, 2-7 cm long, 0.5 – 2 cm wide, ovate with trifid spines, entire or spinuous dentate, smooth, base tapering. Flower stalked, yellow, in dropping racemes. Fruit ovoid, blue black when ripe. Flowering: March – June. Fruit: July – November. (Plate 2)

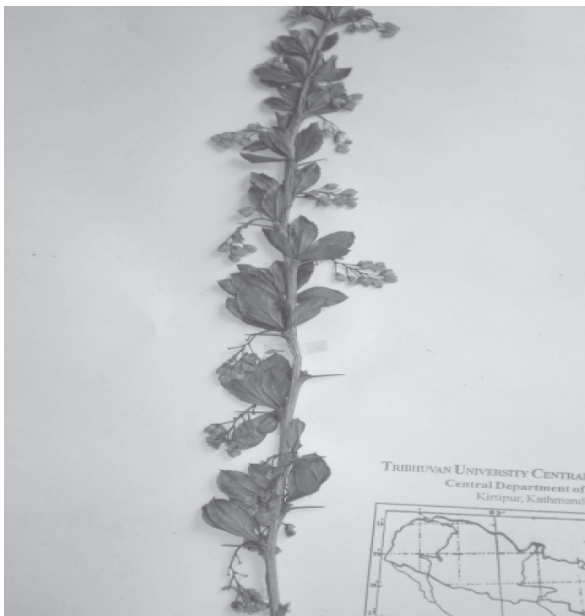


Plate 2- *Berberis aristata* DC

Root's bark contain berberis aristatin, berberine, berbamine (DPR 2007).

***Berberis erythroclada* Ahrendt**

Much branched spiny shrub, about 1m high, branches grooved, shiny dark red. Leaf stalks, 1-2cm long ovate, margin dentate. Flowers yellow, solitary, on a slender stalk. Fruit red. Flowering: June – July. (Plate 3)



Plate 3- *Berberis erythroclada*

Root bark contains berberis aristatin, berberine, berbamine (DPR 2007).

***Ephedra gerardiana* Wall. ex Stapf**

A rigid tufted gymnospermous shrub about 1m high. Stem much branched whorled spreading. Leaves reduced to 2 toothed sheaths. Branches smooth, slender, green and jointed. Plants are dioecious, male flower ovate, 6-8 mm long with 4-8 flowers. Female cones usually solitary and yellowish, ovules ovoid, 7-10 mm surrounded by fleshy red succulent persistent bracts enclosing two seeds. (Plate 4)



Plate 4- *Ephedra gerardiana*

Aerial parts contain ephedrine, ephedroxine, ephedrine and pseudoephedrine. (Husain *et al.* 1992).

***Meconopsis grandis* Prain**

Polycarpic herb up to 1m high. Tap root narrowly dauciform or root system fibrous. Stems leafy, basal part covered with appressed bristly, membranous persistent leaf sheaths, clothed with reflexed, deflexed, 3-7mm long yellow bristle. Leaf elliptic oblanceolate, long petioles, apex acute, base cuneate or shortly attenuate, margins entire or with several broad teeth. Flowers blue, solitary on axils of upper most leaves. Seed reniform. Flowering: June to July. Fruiting: August – September. (Plate 5)



Plate 5- *Meconopsis grandis*

Phytochemical constituents are cyanidin 3-malonylsambubioside 7-glucoside as the anthocyanin. They also contain large amounts of kaempferol 3-gentiobioside and very small amounts of kaempferol 3-xylosylgentiobioside. The ratio of flavonol to anthocyanin was found to be 5.6:1, suggesting that the flavonol plays a role as a co-pigment in the blueing of *Meconopsis* flowers, rhoeadine alkaloid in traces (Kosaku *et al.* 1996).

***Meconopsis peniculata* Prain**

Monocarpic herb 1.8m tall, tap root dauciform or narrowly elongated. Stems moderately bristly covered with golden yellow soft hairs. Leaves linear-oblong on outline, deeply pinnatifid or pinnatisect at the base densely clothed with same type of hairs like in stems, segments ovate-oblong, base spatulate, apex acute to obtuse margin coarsely serrate. Flowers solitary terminal or axillary, numerous pendulous, borne singly in upper part in 2-6 flowered lateral cymes in lower part. Ovary sub globose, ellipsoid or ovoid densely covered with hairs. Flowering :June – August, Fruiting time : September- October. (Plate 6)



Plate 6- *Meconopsis peniculata*

Phytochemical constituents are alkaline phosphatases, glucose 6-phosphate dehydrogenase and malate dehydrogenase (Irshad *et al.* 1993) Papaverubins A, B, C, D E, rhoeadine alkaloid in traces (Arnold *et al.* 1986).

***Neopicrorhiza scrophulariiflora* (Pennell) Hong**

A prostrate herb about 10cm high with perennial woody rhizome covered with old leaves at the base. Leaves subsessile aggregated at the base, each leaf 2-6cm long and 0.5-1.2 cm wide, acuminate, serrate, stalked

and winged, oblanceolate. Flowers dark blue purple, flowering: July – August in a dense terminal spikes arising from a rosette of conspicuously toothed leaves, spikes 5-10cm long, Fruits capsule; October – November 6-10mm, Rhizome is bitter.(Plate 7)



Plate 7- *Neopicrorhiza scrophulariflora*

Phytochemical constituents contain Kutkin (glucosidal), kurrin (a non bitter product), kutkiol(alcohol), kutkisterol.(Watanabe *et al.* 2005), Rhizomes and roots contain picoside I, picoside II, kutkoside, minecoside, phenol glycoside (picein and androsin) and 4 hydroxyacetophenone.(Anonymous 2002) Kutkiol (an alcohol), pocrorhizin, pocrorhizitin, picoside, picroliv, kuthoside, androsine, aucubin, catalpol, valinic acid and kutkisterol (Kunwar 2006).

***Paris polyphylla* Sm**

The herb is about 60 cm high. Leaves stalked, in a whorl at the top of the stem, 5-16 cm long, 1.5-4 cm wide, lanceolate, long-pointed, dark green. Flowers solitary, Flowering time: April-May. (Plate 8)



Plate 8- *Paris polyphylla*

Rhizome contains pariphyllin A, pariphyllin B, parsterone, pollyphylin D, and trillin (Buckingham 1994).

***Podophyllum hexandrum* Royle**

An erect perennial herb about 15-40cm tall. Leaves usually two, deeply three lobed. Long stalked, orbiculate to cordate. Lobes obovate, acuminate, serrate. Flowering time May - June, cup shaped, 2-4 cm across, large white or pale pink. Fruiting time: July - September, ovoid, 2.5-5cm long, scarlet when ripe.(Plate 9)



Plate 9- *Podophyllum hexandrum*

Podophyllotoxin, 4'-dimethyldesoxy podophyllotoxin, α and β pellatin, deoxypodophyllo toxin,

podophlotoxone, isopropodophyllone, 4'-demethyldeoxy podophyllotoxin, 4'-demethyldeoxypodophyllotoxin are the biochemical chemical constituents of this plant (Husain *et al.* 1992).

Potentilla peduncularis D. Don

Perennial, herbaceous plant about 30cm in height, rootstock stout, covered with old leaf bases. Leaves uniformly pinnate about 20cm long mostly basal covered with silvery hairs appear white at beneath. Flowers yellow, corymbs, flowering and fruiting time July - November. (Plate 10)



Plate 10- *Potentilla peduncularis*

Most of the pharmacological effects can be explained by the high amount of tannins and to a lesser extent by triterpenes, present in all plant parts. Polyphenols and flavonoids are also present in this plant (Micha³ *et al.* 2009).

Taxus wallichiana Zucc

Evergreen much branched coniferous tree nearly 30m tall. Bark reddish brown, rough, exfoliating in irregular papery scales. Leaves linear, short- stalked, flat, acute, distichous, shiny dark green above, rusty beneath and narrowed towards the base, 2-3.5 cm long and 3mm broad. Flowers unisexual, male flowers in short stalk, globose catkins in axils of leaves; female flowers solitary, axillary, green. Cones yellowish, axillary. Fruits or seed cones are red fleshy, 8mm in diameter. Seeds are olive green. (Plate 11)



Plate 11- *Taxus wallichiana*

Biochemical constituents contain taxine alkaloids and taxol (Joshi & Joshi 2001).

Zanthoxylum nepalense Babu

Shrub with corky bark and numerous straight spines. Leaves stalked pinnatifid, rachis winged, leaflet short stalked 1-3 cm long, ovate, dentate, gland dotted, flower yellowish, fruit a capsule, globose red and wrinkled. Flowering time: May -June. (Plate 12)



Plate 12 - *Zanthoxylum nepalense*

Tannic acid, gallic acid, starch, mineral salts and mucilage from the rhizome contain (Anonymous, 1994) biochemical constituents.

Discussion

Several collected plants were found to have different medicinal uses in different alternative medicines such as Tibetan medicines, herbal drugs have been homoeopathy (Alam *et al.* 2008, Dhama & Dhama, 1996), many others have been mentioned in ethnomedicinal literatures (Ghimire 1999, Rajbhandari, 2001, Joshi & Joshi, 2001, Bhattarai *et al.*, 2006, Rajbhandari *et al.* 2007, Bhattarai *et al.* 2008, Ghimire 2008).

P. hexandrum, Himalayan May apple, is recognized for its anticancer properties (Alam *et al.* 2008) and has been employed in the treatment of cancer (Prakash *et al.* 2005). It has been extensively exploited in traditional Ayurvedic system of medicine for treatment of a number of ailments like *Condyloma acuminata*, *Taenia capitis*, monocytoid leukemia, Hodgkins disease, non-Hodgkin's lymphoma, cancer of brain, lung, bladder and venereal warts. Utility of *P. hexandrum* has also been reported against constipation, cold, biliary fever, septic wound, burning sensation, erysipelas insect bite, mental disorders, rheumatism, plague and to provide symptomatic relief in some of the allergic and inflammatory conditions of skin. The radio-protective effect of hydroalcoholic extracted material from the rhizome of *P. hexandrum* was studied in mice exposed to lethal γ radiation (10 Gy). The extract was found to restore the hemoglobin content (14.73 \pm 0.33) and total leukocyte count (TLC) (4166.66 \pm 0.02) in lethally (10 Gy) γ -irradiated mice on the 15th day in comparison to the radiation control mice (Arora *et al.* 2007).

Similarly, various species of *Berberis* are reported to have various medicinal properties. *Berberis aristata* has been reported to have wound healing properties (Biswas & Mukharjee 2003). It produces a bitter tonic, which is anti periodic and diaphoretic. The chief constituents are those of berberis bark, the principle being the alkaloid Berberine (Internet visit 2007; www.botanical.com). Aqueous extract of *B. vulgaris* has antihistaminic and anticholinergic activity in guinea pig ileum (Shamsa *et al.* 1999). Berbamine, an ingredient of *Berberis* is widely utilized in Chinese Folk Medicine as a source of leukogenics, anti-arrhythmic and anti-hypertensive. In recent years, the immunosuppressive effect of berbamine has been demonstrated (Luo *et al.* 1998). Therefore, bioprospecting of important biomolecules in Nepalese

Berberis species can be a prospective research area in future.

N. scrophulariflora (Kutki) is in high demand in and outside of Nepal for its valuable rootstocks. It furnishes the drug, picrorhizin, obtained as dried rhizomes and roots; which is used as an adulterant of or as a substitute for Indian gentian (*Gentiana kurroo*). The rhizomes of this Himalayan perennial herb are used in several traditional medicine systems to treat a wide variety of ailments. Kutki is widely distributed in the Himalayas (3000-5000 m), occurring in Pakistan, India, Nepal, Bhutan and Southern China (Traffic international 1999, Press *et al.* 2000).

Although little is known about biochemical specificities of Himalayan medicinal plants, some evidences suggest that such plants offer great potential for discovery of novel molecules and new sources of active compounds, mainly because of environmental stress to which they are subjected (Ghimire 2008). In mountains, plant secondary compounds exhibit patterns of variation in relation to stress associated with elevation, which relates to plant competition for resources, defense strategies against herbivores and pathogens and harsh climate (Iwashina *et al.* 2004). Concentration of active phytochemical constituents of some Himalayan medicinal plant species have been reported to be high in populations growing at higher altitude as compared to populations growing at the lower altitude (Mikage *et al.* 1987).

Regarding the conservation and sustainable utilization of high value medicinal plant species of Nepal in the changing scenario of environmental changes, an integrated approach needs to be followed. For rational and sustainable utilization of valuable medicinal plant species, conventional plant breeding techniques as well as biotechnological techniques need to be integrated to increase productivity and long term conservation. Considering the present scenario on advancement in biotechnology, in addition to conventional techniques of biodiversity characterization, detail molecular characterization also should be incorporated. So that the technique will further help during intellectual property rights (IPR) protection, devise authentication technique, in revealing taxonomic and evolutionary relationships for bioprospecting.

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