

Medicinal Plant Growing under Sub-optimal Conditions in trans-Himalaya Region at High Altitude

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ABSTRACT

Supporting people's culture, income and healthcare, medicinal plants are of a great importance in Himalayas. Trading these herbal formulations worldwide is earning billions. But since the demand of such splendid plant and plant products has tremendously hiked in past two decades, and because of the unstable environmental changes due to global warming and industrialisation, these significant species are in threat of extinction. To preserve these treasures, several technical steps have been adopted by the government. A successful establishment of plants sector will raise rural empowerment, boost international commerce and contribute to health of millions worldwide. Alongside highlighting the major medicinal plant species and their uses, this review also foregrounds traditional medicinal practitioners, regions of trans-Himalayas rich in medicinal plants, major threats to these plants, significant biomolecules and detection techniques, threats to these plants, and government bodies and their responsibilities for their conservation.

Keywords: Amchi; Bio-diverse; Agronomist; Enthobotanist; Horticulturist; Plant pathologist; Taxonomist

1. INTRODUCTION

Medicinal plants have acquired immense popularity worldwide, resulting in a tremendous hike in consumption of herbal medicines. India, particularly the trans-Himalayan region, a habitat to thousands of useful medicinal plant species, has been a major part of India's rich medicinal plant heritage. Physical features of these high altitude cold deserts include coarse and porous sandy soil prone to wind and water erosion; dense influx of ultraviolet and infrared radiations; lower oxygen levels; low atmospheric carbon dioxide; short cultivation seasons; prolonged freezing winters; temperature variations from 40 °C to - 40 °C; low relative humidity and negligible rainfall. Therefore, only those plant species which have adopted to adjust in such harsh climatic conditions can grow in these areas. Sikkim is reported to inherit nearly 424 species of medicinal plants, used in Ayurveda, Homeopathy, Siddha, Amchi, Unani and other folk medicines. With about 4,000 species and around 40,000 herbal formulations, 12 per cent of world's medicinal plant requirement is supplied by India, 90 per cent of which are found in forest habitats¹. With growing demand for plant based medicines, health products, pharmaceuticals, food supplements, cosmetics etc. in the national and international markets². The urge to alternate artificial antioxidants like butyl hydroxyl toluene, butyl hydroxyl anisole, gallic acid, etc. with naturally occurring antioxidants has increased because of the several negative

health consequences³. Treeline ecotones are the transition zones between adjacent subalpine forest and open alpine tundra⁴. Shrestha⁵, *et al.*, investigated the treeline dynamics of two environmentally contrasting areas of Himalayas in Nepal and discovered that in spite of varying climate, environment, tree species and seasonal climate changes, the treeline dynamics were similar. A team of experts including agronomists (improved cultivation technology), conservation campaigners (sway public for conservation), ecologist (plant growth ecosystem), enthobotanist (identification of plant), health policy-maker (includes conservation and utilisation of plants in policy and planning), horticulturist (cultivation of medicinal plant), legal experts (effective legal mechanism to ensure collection sustainable medicinal plants), park manager (conservation of plants within park and reserve vicinity), park planner (maintaining maximum diversity of medicinal plants in the park and reserve), pharmacogenosist (application of medicinal plants), plant breeder (breed improved strains of medicinal plants), plant genetic resource specialist (assessing and mapping of genetic variation in medicinal plants and maintenance of seed banks), plant pathologist (protection of cultivated medicinal plants from pests and diseases), religious leader (promotion of respect for nature), resource economist (evaluation of patterns of used and economic value of medicinal plants), seed biologist (germination and storage requirement of seeds), taxonomist (accurate identification of plant) and traditional health practitioner (informs about the use and availability of medicinal plants)^{6,7}.

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2. TRADITIONAL MEDICINE PRACTITIONERS

Indians have traditional knowledge of these plants and the local denizens use various herbal remedies for treatment of a vast variety of diseases. Since physicians are not easily approachable for populations of remote and village areas, they prefer to visit the traditional health practitioners who use herbal preparations for ailments and to conserve these beneficial species, local inhabitants cultivate these plants. 'Amchis' in Tibet are skilled traditional medicine practitioners with good knowledge of biology, ecology and herbal formulations. Amchi medicines have 80 per cent of plant origin substances. These are based on Jung-wa-Lna (five elements) and Nespasum (three humours) theories⁸. 'Amchis' in Tibetan language means 'superior to all'. They have developed three methods for examining the patients: inspection, palpitation (by examining the pulse-rate) and interrogation. The treatment techniques include 'moxibustion and puncturing the veins' (generally for skin and blood disorders); 'cold and hot water bath' (generally for backache and sciatica). Amchis have their own specific 'medical formulations', generally made with combination of plant parts from several species. The end product is generally in form of powder, paste, tablet, decoction or ointment. 'Minerals' and stones, in combination with animal and plant parts are used for ailments. Rock extract 'Shilajit' is used individually. Other minerals used are sulphur, borax, sodium sulphate, antimony sulphate, sodium bicarbonate, antimony sulphate, sodium bicarbonate, yellow arsenic, serpentine, quartz. Amchi associations like the Traditional Medico-Cultural Association and the Yuthog Foundation deal with the preservation and promotion of Tibetan medicines. There is a Tibetan Medical Centre in Darjeeling, Higher Tibetan Studies in Sarnath, TMAI in Dharamshala (established by His Holiness, the 14th Dalai Lama in exile)⁹.

3. REGIONS OF TRANS-HIMALAYAS RICH IN MEDICINAL PLANTS

3.1 Ladakh, Kashmir

The highest geographical region in the trans-Himalayan region of India, Ladakh, the land of high rising passes, is located in the state of Jammu and Kashmir (32°15' - 36°N; 75°15'80°15'E). Ladakh is popularly known for its rich vegetation, medicinal flora and endemic diversity. Consumption of medicinal plants has increased worldwide, so the medicinal plants of Ladakh open approaches of economic growth in the aggressing world market. Some important species from Ladakh region are *Saussurea lappa*, *Inula racemosa*, *Oxytropis chiliophylla*, *Picrorhiza kurrooa*, *Rubia cordifolia*, *Aconitum violaceum*, *Hippophae rhamnoides*, *Hypocoum leptocarpum*, *Rheum spiciforme*, *Rhododendron* sp., *Carum curvi* and *Hyoscyamus niger*. Several conservation techniques are being employed for the conservation and cultivation of these marvellous species. Vegetative propagation through root divisions, tubers, division of bulbs, rhizome cuttings, tuber division, root cuttings, rootstocks, sucker cutting, stem cutting etc. is adopted for improved results². Few other important plant species like *Desideria pumila*, *Ladakiella klimesii*, *Stellaria decumbens* and *Waldheimia tridactylites* are also capable of surviving in extreme climate and environment of

Ladakh. Exploiting these species, Dvorsky⁹, *et al.*, were able to conclude that vascular plants in these regions are able to maintain elevation limits, and are capable of continuing under adverse conditions and propagation limitations. Also known as 'Rhubabr', *Rheum webbianum* Royale, is also an important medicinal plant containing ample amounts of free anthraquinones, stilbene glycosides, tannins, sennosides, catechins, gallic acid, cinnamic acid etc. These compounds make the plant an expert cure of health problems like indigestion, abdominal diseases, boils, wounds, flatulence, gastritis and cancer¹².

3.2 Spiti, Kashmir

Arnebia euchroma found in Spiti cold deserts in western Himalayas is an important medicinal plant species. It cures body aches, has antimicrobial activities and possesses anti-HIV properties¹³. Damianakos¹⁴, *et al.*, isolated nine isohexenylnaphthazarins from the n-hexane extracts from callus and suspension culture of *Arnebia euchroma*. These were deoxylkannin, alkannin, acetylalkannin, isobutyrylalkannin, β -hydroxyisovalerylalkannin, 2''-(S)- α -methylbutyrylalkannin, propionylalkannin, teracrylalkannin and acetylshikonin; and their structures were determined by MS and NMR spectroscopy.

3.3 Mustang, Nepal

Mustang district, located in the trans-Himalayan Arid Zone, covers 3,639 sq. Km, has vegetation of mixed forest and grasslands. Around 90 per cent of Nepal's population reside in rural areas with deficient health care facilities, one physician/6500 people. So the residents rely on traditional, herbal formulation medicines. Traditional practitioners in Nepal have vast knowledge of medicinal plants and people preserve these plants in home gardens. The major medicinal plant species are *Alliaceae*, *Amarnathaceae*, *Apiaceae*, *Araceae*, *Asparagaceae*, *Asteraceae*, *Berberidaceae*, *Betulaceae*, *Bignoniaceae*, *Boraginaceae*, *Cannabaceae*, *Caprifoliaceae*, *Chenopodiaceae*, *Convolvulaceae*, *Crassulaceae*, *Cupressaceae*, *Elegnaceae*, *Ephedraceae*, *Ericaceae*, *Fabaceae*, *Gentianaceae*, *Juglandaceae*, *Lamiaceae* and *Liliaceae*. With more than 80 per cent people relying on herbal medicines in developing countries, the thousands of medicinal plant species in Upper Mustang, Himalayas, add to its treasures in health sector. Pandey¹⁷, has enlisted a wide range of plant species from Tibet and Nepal regions, which serve wonderfully to cure health problems like wound healing, cough, cold, fever, gastritis, skin problems, bone diseases, menstrual disorders, as antiseptics, eye problems, tooth decay, body aches, tumors, hypertension, kidney problems, food poisoning, anaemia, liver problems, asthma, sinusitis, oral diseases, blood pressure, dysentery, indigestion, diarrhea, rheumatism etc. Major medicinal plant families from Mustang are *Amaryllidaceae*, *Araceae*, *Berberidaceae*, *Betulaceae*, *Bignoniaceae*, *Boraginaceae*, *Caprifoliaceae*, *Chenopodiaceae*, *Compositae*, *Cupressaceae*, *Dipsacaceae*, *Elaeagnaceae*, *Ephedraceae*, *Ericaceae*, *Gentianaceae*, *Geraniaceae*, *Hypocreaceae*, *Labiatae*, *Leguminosae*, *Liliaceae*, *Malvaceae*, *Orchidaceae*, *Papaveraceae*, *Plantagiaceae*, *Polygonaceae*, *Primulaceae*,

Ranunculaceae, *Rosaceae*, *Salicaceae*, *Scrophulariaceae*, *Solanaceae*, *Thymalaeaceae*, *Umbrelliferae*, *Valerianaceae* and *Violaceae*¹⁵. Rich in biodiversity, Mustang is very well known for timber plantation. This trans-Himalayan region is a unique ethno-ecological area of Nepal, and is enriched with non-timber plantations also, including food, spices, medicines etc. raising popularity of natural resins, dyes, handicrafts, food etc. and providing raw material for such industries, these non-timber forest products (NTFPs) have drawn attention of various multinational companies. Important medicinal plants like *Cordyceps sinensis*, *Arnebia benthamii*, *Thymus linearis*, *Polygonatum cirrhifolium* and *Allium fasciculatum* have drawn attention of national and multinational pharmacists¹⁶. But such NTFPs have to tackle other situations also. With highly distinguishing and unsure affects of global changes, small-scale farmers in the diverse Himalayan region depend on flexibility to adapt agricultural production to uncertain production conditions. The rising temperature and changing patterns of precipitation, combined with high and volatile food prices in international markets, these small scale farmers get bound to adapt new practices. Defining this 'flexibility' as 'uncommitted potential for change', Homelin & Aase¹⁶, have argues that farming system flexibility may be analysed in terms of the three aspects: flexibility of scope, flexibility of type and temporal flexibility.

4. BIOMOLECULES AND THEIR DETECTION

Significant pharmaceutical compounds from the plants are morphine (first pure medicinal substance from plants), diosgenin, aspirin (now mostly prepared synthetically), alkaloids, polyphenols, glycosides, terpenes⁷. Good sources of natural antioxidants are stems, leaves, barks and/or other parts of the plants *Saussaria lappa*, *Rheum webbanium*, *Arnebia euchroma*, *Inula racemosa*. With major content constunolide dehydrocostus, *Saussaria lappa* is used as an anti-ulcer and anti-carcinogenesis agent. Ample sources of drugs rhein, emodin and rutin are present in the roots of *Rheum webbanium*, serve as laxative, tonic and purgative. *Arnebia euchroma* have anti-inflammatory, antimicrobial and anti-tumor activities. *Inula racemosa* plant parts are utilised for severe health problems like hyperglycaemia, hypercholesterolemia, cough, dyspnea, asthma, pleurisy, tuberculosis and cordial pain. Tiga³, *et al.* employed techniques like DPPH assay, ABTS diammonium salt assay, FRAP (ferric reducing antioxidant power), TPC (total phenol content) to show ample amounts of phenol, flavonoids, flavonols and proanthocyanidin contents and exhibit antioxidant activities. Dhar¹⁸, *et al.* has estimated the nutritive values, vitamin content, amino acid composition, fatty acid content and mineral profile of three plants *Hippophae rhamnoides* (seabuckthorn), *Prunus aemniaca* (apricot) and *Rhodiola imbicata* (roseroot). They used all the latest techniques. RRLC-MS/MS (rapid resolution liquid chromatography/tandem mass spectrometry) for analysis of free vitamin forms; RP-HPLC (reversed phased high performance liquid chromatography) with pre-column derivatisation for identification and quantification of amino acids; GC-FID (as chromatography coupled with a flame ionisation detector) with fatty acid methyl esters derivatisation, to quantify fatty

acids; ICP-OES (Inductively coupled plasma optical emission spectrometer) for mineral profiling.

5. THREATS

But unfortunately, these treasures are facing various threats. A major decline in the population and availability of medicinal and aromatic plants has been noted, which may be because of the climatic changes, high demand but low production, fast pace of tourism in high altitude areas damaging this bio-diverse ecological system²⁰. Banerji and Basu²⁰, have highlighted some major threats to the endangered species. There are habitat degradation and impacts of climate change; high demand levels and unsustainable extraction for herb trade; endangerment of species; impacts on host communities; lack of R&D and policy neglect; lack of protection and conservation.

6. GOVERNMENT INITIATIVES FOR PRESERVATION OF MEDICINAL PLANTS

Along with providing natural healing these plants also provide employment to the populations of these remote areas. Therefore state government also has introduced the several programmes for medicinal plants¹:

- The 'State Medicinal Plants Board' established in June 2002, creates herbal gardens, and registers medicinal plants' farmers, collectors, traders and manufacturers.
- The 'Forest Development Agency' looks after the plantation of medicinal plants.
- The 'Integrated Watershed Development Project' encourages employment propagation in the rural areas.

The STNM hospital, Gangtok, The Sikkim Manipal Institute of Medical Sciences and Central Referral Hospital, Department of health, Department of Horticulture and Department of Science and Technology are among the major bodies which have played significant roles in research initiatives in the medicinal plant sector, in these areas. Along with the latest research programmes on these herbal treasures, these institutes also avail the former traditional health practitioners for the local populations¹. Research collaborations of areas rich in these useful medicinal species with government research bodies like CSIR, DBT etc. has proved beneficial for in-situ preservation and propagation of these species through optimised protocols. Also, the certification, preservation and knowledge of these useful plant species are crucial. The National Gene Bank is primarily responsible for the conservation of unique accession on long-term basis, as base collections for posterity, predominantly in the form of seed¹⁵. The Ministry of Environment, Forests and Climate Change, Govt. of India has ongoing projects for collection of oil crops, pulse and medicinal plant material for enrichment of Botanical Gallery; Micropropagation, phytochemical screening of medicinal plants and molecular characterisation of selected species; inventory of ethno-medicinally important plant at West Kameng; Medicinal and edible mushroom cultivation for income generation in rural areas of Uttarakhand; Studies on diseases of economically important medicinal plants of Assam through organic approach; Survey and mapping of Ashtavarga group of medicinal plants in HP; 'National Medicinal Plants Board' funded projects in Shimla; A training programme titled 'Cultivation of High

Valued Temperate Medicinal Plants and related Issues' in Himalayan Forest Research Institute, Shimla; Development of Agro-techniques for organic cultivation of *Tribulus terrestris* L. and *Cissus quadrangularis* L. medicinal plants²². Defence Institute of Higher Altitude Research (DIHAR), Leh has an herbal garden where they have standardised the methods seed germination trials and root cutting for the propagation of *Rheum webbianum* Royale¹². By providing training and support in cultivation of medicinal plants, The Mountain Institute (TMI), Nepal, increased the income of over 12,500 farmers. TMI established nurseries to plant millions of seed of native tree and fodder species over 500 hectares forestland and meadows, which resulted in a hike in population of medicinal plants by upto 80 per cent, and these wild species have also been preserved²³. A collaborated set of three projects in India, and on each in Nepal, China and Pakistan, were launched under 'Plant Conservation and Livelihoods Programme', with initial emphasis on medicinal plants, funded for 'Plantlife' from the 'Allachy Trust'. Objectives of the project were to collect and consider the information on medicinal plants, their habitat and threats; Conservation of the existing plant species in Himalayan regions; Identification and maintenance of important plant areas; and Future progress and initiative technologies for conservation of the species and important plant areas. Another part of the project was to overcome some common threat problems faced in Himalayas, viz., habitat loss by extremely harsh climatic conditions, climate change, deforestation, habitat fragmentation, burning, overgrazing and unsustainable harvesting. Below mentioned organisations have also been in a regular action for the conservation of the important medicinal plant species in Himalayas²⁴:

- ANSAB: The Asia Network for Sustainable Agriculture and Bioresources is active since 1922 and has followed an enterprise oriented approach for conservation of medicinal plants.
- Dabur, Nepal: A part of an international company, Dabur conducts domestication of medicinal plants for commercial cultivation by maintaining a large nursery in Kathmandu.
- ESON, Rasuwa: Funded by an Allachy Award from Plantlife International, it is a community-based conservation project on medicinal plants, near Langtang National Park.
- HNCC/DPR, Nepal: The Herbal and NTFP Coordination Committee, Development or Plant Resources, is responsible for conservation of medicinal plants and other non-timber forest products in Nepal.
- ICIMOD, Kathmandu: The International Centre for Integrated Mountain Development conserves the Himalayas and hosts Medicinal and Aromatic Plants Programme in Asia.
- IAAS, Chitwan: The Institute of Agriculture and Animal Sciences runs 3 courses on medicinal plants and has several related research and development activities.
- Tribhuvan University: In collaboration with ESON, they compile database on medicinal plants.
- The World Conservation Unit (IUCN): It works with several communities in Nepal to elicit the conservation

awareness and sustainable use of NTFPs, including medicinal plants.

7. FUTURE ASPECTS

Such research organisations, when coupled with few more specialised modes can bring out even better results. These can be proper maintenance of gene banks, seed banks, proper documentation; extensive network system in every state for effective dissemination and documentation of information; organised central pool of information by corroborating several medicinal plant conservation activities and their consequences; micropropagation parks employing local people. Rising demands, creating heavy pressure on some selected high-value medicinal plants, increasing rarity, relatively low cultivation, bio-piracy add to the challenges faced by medicinal plants sector²⁵.

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Appendix-A**Medicinal plants in trans-Himalayan regions used by traditional health practitioners^{1,8}**

Medicinal Plant Species	Used in	Medicinal Plant Species	Used in
<i>Acantholimon lycopodioides</i>	Cardiac disorders	<i>Astragalus multiceps</i>	Colic problems
<i>Achillea millefolium</i>	Cough and cold, toothache	<i>Astragalus rhizanthus</i>	Skin disease
<i>Aconitum heterophyllum</i>	Rheumatism fever, body pain, antipyretic	<i>Astragalus strictus</i>	Diuretic
<i>Aconitum violaceum</i>	Antipyretic, fever	<i>Astragalus tribulifolius</i>	Diuretic
<i>Aconogonum tortuosum</i>	Abdominal pain	<i>Berberis ulicina</i>	Tonic
<i>Actinocarya tibetica</i>	Fever	<i>Bergenia ciliata</i>	Oral inflammation, infection, diarrhea
<i>Allium carolinianum</i>	Indigestion	<i>Bergenia stracheyi</i>	Tonic, kidney problems
<i>Aesculus indica</i>	Mumps	<i>Biebersteinia odora</i>	Antiseptic, skin sores
<i>Alstonia scholaris</i>	Diabetes	<i>Capparis spinosa</i>	Rheumatism, liver problems
<i>Anaphalis busua</i>	Cold and cough	<i>Capsella bursa-pastoris</i>	Stomach problems, lung problems
<i>Anaphalis cuneifolia</i>	Skin disease	<i>Carum carvi var. gracile</i>	Carminative, digestive, febrifuge
<i>Anaphalis triplinervis var. monocephala</i>	Chronic diseases	<i>Centaurea depressa</i>	Fever
<i>Anaphalis triplinervis var. intermedia</i>	Skin disease, genital problems	<i>Cerastium cerastioides</i>	Headache
<i>Androsace rotundifolia</i>	Tonic	<i>Chaerophyllum refraxum</i>	Stomach problems
<i>Androsace villosa</i>	Tonic	<i>Chenopodium botrys</i>	Laxative, stomach problems
<i>Anemone rivularis</i>	Indigestion	<i>Chrysanthemum griffithii</i>	Menses regulation
<i>Anemone rupicola</i>	Stomach problems	<i>Chrysanthemum purethoides</i>	Fever, rheumatics
<i>Aquilegia fragrans</i>	Anti-scorbutic, diuretic and diaphoretic	<i>Chrysanthemum tibeticum</i>	Antiseptic
<i>Arabidopsis multiflorum</i>	Diarrhoea	<i>Cicer microphyllum</i>	Adaptogenic
<i>Arabis glandulosa</i>	Abdominal pain	<i>Cirsium wallichii</i>	Stomach problems
<i>Arctium lappa</i>	Diuretic, depurgative and lung diseases	<i>Citrus sp.</i>	Worms in children
<i>Arenaria bryophylla</i>	Kidney problems	<i>Clematis tibetana</i>	Indigestion
<i>Arenaria griffithii</i>	Menstrual problems	<i>Codonopsis clematidea</i>	Rheumatism, stimulant
<i>Arnebia euchroma</i>	Hair tonic and blood purification	<i>Codonopsis ovata</i>	Rheumatism, stimulant
<i>Arnebia guttata</i>	Hair tonic and blood purification	<i>Colchicum luteum</i>	Colchicines and gout
<i>Artemisia annua</i>	Anti-malaria	<i>Corispermum hyssopifolium</i>	Kidney problems
<i>Artemisia biennis</i>	Obesity, stomach problems	<i>Corydalis cashmeriana</i>	Anti-periodic, diuretic
<i>Artemisia brevifolia</i>	Anti-worm, stomach problems	<i>Corydalis crassissima</i>	Lung problems
<i>Artemisia desertorum</i>	Intestinal problems	<i>Corydalis flabellata</i>	Skin disease
<i>Artemisia dracuncululus</i>	Diuretic, toothache	<i>Corydalis govaniana</i>	Anti-pyretic, diuretic
<i>Artemisia gmelinii</i>	Cold and cough	<i>Corydalis meifolia</i>	Diuretic
<i>Artemisia laciniata</i>	Toothache	<i>Corydalis thyrsoiflora</i>	Skin disease
<i>Artemisia salsoloides</i>	Intestinal complaints	<i>Cousinia falconeri</i>	Diuretic
<i>Artemisia scoparia</i>	Intestinal problems	<i>Cousinia thomsoni</i>	Diuretic
<i>Artemisia sieversiana</i>	Antimicrobial, intestinal worms	<i>Cremanthodium ellisii</i>	Contagious disease, fever
<i>Artemisia starcheyi</i>	Toothache	<i>Cremanthodium reniforme</i>	Contagious disease, fever
<i>Artemisia tournefortiana</i>	Intestinal worms	<i>Crepis flexuosa</i>	Muscle pain
<i>Asperugo procumbens</i>	Stomach problems	<i>Cuscuta approximata</i>	Sin disease
<i>Asperula oppositifolia</i>	Tonic	<i>Cuscuta capitata</i>	Kidney problems
<i>Aster flaccidus</i>	Cough and cold	<i>Cuscuta europaea</i>	Kidney problems
		<i>Cuscuta gigantea</i>	Antiseptic
		<i>Cuscuta reflexa</i>	Purgative, warts
		<i>Curcuma zedoaria</i>	Jaundice

Medicinal Plant Species	Used in	Medicinal Plant Species	Used in
<i>Cynoglossum wallichii</i>	Vomiting	<i>Halerpestis tricuspis</i>	Stomach ache
<i>Dactylorhiza hatagirea</i>	Energetic, health tonic, nervine tonic	<i>Heracleum lanatum</i>	Leucoderma, menses regulation
<i>Delphinium brunonianum</i>	Colic, insecticidal	<i>Heracleum pinnatum</i>	Leucoderma, menses regulation
<i>Delphinium cashmerianum</i>	Colic, insecticidal	<i>Herminium monorchis</i>	Health tonic
<i>Dianthus anatolicus</i>	Stomach problems	<i>Hippophae rhamnoides ssp. turkestaica</i>	Source of multi-vitamins, carotenoids, anti-oxidants
<i>Dianthus deltooides</i>	Stomach problems	<i>Hippophae tibetana</i>	Source of multi-vitamins, carotenoids, anti-oxidants
<i>Dianthus Jacquemontii</i>	Stomach problems	<i>Hippuris vulgaris</i>	Antiseptic, febrifuge
<i>Draba tibetica</i>	Tonic	<i>Humulus lupulus</i>	Nervine tonic, sedative effect
<i>Dracocephalum heretophyllum</i>	Cold and cough	<i>Hyoscyamus niger</i>	Asthma, toothache
<i>Dracocephalum moldavicum</i>	Intestinal problems	<i>Hyoscyamus pusillus</i>	Asthma, toothache
<i>Dracocephalum stamineum</i>	Cold and cough	<i>Hypecoum leptocarpum</i>	Septic wounds
<i>Dipazium polypodioides</i>	Dysentery	<i>Hypericum perforatum</i>	Sciatic neuralgia
<i>Echinops cornigerus</i>	Septic wounds	<i>Inula falconeri</i>	Sprains
<i>Ephedra gerardiana</i>	Asthma, hepatic disease	<i>Inula obtusifolia</i>	Internal wounds
<i>Ephedra intermedia</i>	Asthma	<i>Inula racemosa</i>	Anthelmintic, bronchial asthma, expectorant
<i>Epipactis helleborine</i>	Blood purification	<i>Inula rhizocephala var. rhizophaloides</i>	Cough, chest pains
<i>Erigeron alpinus</i>	Cold and cough	<i>Inula royleana</i>	Dermatitis
<i>Ermania albiflora</i>	Fever	<i>Juniperus communis</i>	Purgative, anti-inflammatory
<i>Ermania lanuginosa</i>	Diuretic, purgative	<i>Juniperus macropoda</i>	Purgative, anti-inflammatory
<i>Euphorbia hispida</i>	Skin eruption	<i>Juniperus recurva</i>	Purgative, anti-inflammatory
<i>Euphorbia stracheyi</i>	Boils	<i>Jurinea ceratocarpa</i>	Bronchitis
<i>Euphrasia laxa</i>	Eye complaints	<i>Jurinea macrocephala</i>	Stimulant, fever
<i>Euphrasia officinalis</i>	Eye complaints	<i>Lactuca lessertiana</i>	Skin diseases
<i>Euphrasia vulgaris</i>	Eye complaints	<i>Lancea tibetica</i>	Tonic, wound healing
<i>Ferula jaeschkeana</i>	Rheumatics, septic wounds	<i>Leontopodium leontopodium</i>	Septic wounds
<i>Galium aparine</i>	Urinary complains	<i>Leontopodium nanum</i>	Septic wounds
<i>Galium pauciflorum</i>	Intestinal problems	<i>Linum perenne</i>	Emollient, expectorant
<i>Galium serpylloides</i>	Diuretic, purgative	<i>Lloydia serotina</i>	Blood purification
<i>Gentiana algida</i>	Analgesic, bronchitis	<i>Lomatogonium rotatum</i>	Fever
<i>Gentiana aquatica</i>	Health tonic	<i>Lonicera spinosa</i>	Asthma, headache
<i>Gentiana carinata</i>	Stomach complains	<i>Lychnis himalayensis</i>	Cold and cough
<i>Gentiana humilis</i>	Fever	<i>Lychnis nutans</i>	Dysentery
<i>Gentiana squarrosa</i>	Diuretic	<i>Lycopsis arvensis</i>	Tonic
<i>Gentiana starcheyi</i>	Tonic	<i>Malva verticillata</i>	Liver tonic
<i>Gentianella moorcroftiana</i>	Febrifuge	<i>Mattiastrum thomsonii</i>	Diuretic
<i>Gentianella paludosa</i>	Febrifuge, tonic	<i>Meconopsis aculeate</i>	Ulcer, liver, lung problems
<i>Geranium collinum</i>	Stomach problems	<i>Medicago lupulina</i>	Cough, lung disorders
<i>Geranium pratense</i>	Analgesic	<i>Mentha longifolia</i>	Headache, stomach ache
<i>Geranium sibiricum</i>	Dysentery	<i>Mesua ferrea</i>	Inflammation and septic condition
<i>Geranium tuberaria</i>	Kidney problems	<i>Microula tibetica</i>	Pulmonary disorders
<i>Geum eletum</i>	Health tonic	<i>Minuartia kashmirica</i>	Liver tonic
<i>Gnaphalium stewartii</i>	Skin disease	<i>Morina longifolia</i>	Worm infection
<i>Goodyera repens</i>	Health tonic	<i>Myricaria squamosa</i>	Febrifuge, poison
<i>Gypsophyla cerastioides</i>	Cold and cough	<i>Nardostachys jatamansi</i>	Anticonvulsant, cholera, palpitation
<i>Hackelia uncinata</i>	Cough and cold		
<i>Halenia elliptica</i>	Stomach problems		

Medicinal Plant Species	Used in	Medicinal Plant Species	Used in
<i>Nepeta coeruleascens</i>	Dysentery	<i>Rheum spiciforme</i>	Laxative, purgative, source of anthraquinone
<i>Nepeta discolor</i>	Cold and cough	<i>Rheum webbianum</i>	Laxative, purgative, source of anthraquinone
<i>Nepeta erecta</i>	Dysentery	<i>Rhodiola crenulata</i>	Anti-stress, restores memory, health tonic
<i>Nepeta eriostachya</i>	Eye problems	<i>Rhodiola heterodonta</i>	Anti-stress, restores memory, health tonic
<i>Nepeta floccosa</i>	Cough and cold	<i>Rhodiola imbricata</i>	Anti-stress, restores memory, health tonic
<i>Nepeta glutinosa</i>	Diarrhea	<i>Rhodiola tibetica</i>	Anti-stress, restores memory, health tonic
<i>Nepeta laevigata</i>	Pneumonia	<i>Rosa webbiana</i>	Vitamin C, hepatitis
<i>Nepeta leucolaena</i>	Skin disease	<i>Rubia cordifolia</i>	Anthelmintic, blood purification, leucoderma
<i>Nepeta longibracteata</i>	Stomach ache	<i>Rumex acetosa</i>	Laxative
<i>Onosma hispidum</i>	Cardiac tonic, stimulant	<i>Rumex patientia ssp tibeticus</i>	Purgative, vermifuge
<i>Orchis latifolia</i>	Body-ache, cuts and bruises	<i>Saussurea bracteata</i>	Boils
<i>Orobanche hansii</i>	Boils	<i>Saussurea glaciales</i>	Intestinal problems
<i>Oxyria digyna</i>	Digestive, purgative	<i>Saussurea gnaphaloides</i>	Kidney problems
<i>Oxytropis lapponica</i>	Antiseptic	<i>Saussurea jacea</i>	Diuretic
<i>Oxytropis macrophylla</i>	Antiseptic, fever	<i>Saussurea lappa</i>	Asthma, anthelmintic, carminative
<i>Papaver nudicaule</i>	Pains	<i>Saxifraga cernua</i>	Tonic
<i>Parnassia laxmanni</i>	Diuretic	<i>Saxifraga jacquemontiana</i>	Liver tonic
<i>Pedicularis brevifolia</i>	Sedative	<i>Saxifraga pulvinaria</i>	Liver tonic
<i>Pedicularis cheilanthifolia</i>	Stomach complaints	<i>Saxifraga stenophylla</i>	Blood purification
<i>Pedicularis longiflora ssp. tubiformis</i>	Diuretic	<i>Scorzonera virgata</i>	Intestinal problems
<i>Pedicularis mollis</i>	Antiseptic, febrifuge	<i>Scrophularia dentata</i>	Appetizer
<i>Peganum harmala</i>	Asthma, diuretic, rheumatic	<i>Scrophularia koelzii</i>	Joint pain
<i>Perovskia abrotanoides</i>	Laxative	<i>Scutellaria prostata</i>	Jaundice
<i>Pimpinella tenera</i>	Carminative, diuretic	<i>Sedum ewersii</i>	Dysentery
<i>Plantago depressa</i>	Anti-diarrhoeal, anthelmintic, stimulant	<i>Senecio chrysanthemoides</i>	Rheumatism
<i>Plantago major</i>	Anti-diarrhoeal, anthelmintic, stimulant	<i>Senecio tibeticus</i>	Diuretic
<i>Physalis alkekengi</i>	Gout, rheumatic, vermifuge	<i>Silene vulgaris</i>	Skin disease
<i>Physochlaina praealta</i>	Narcotic, vermifuge, source of atropine drug	<i>Solanum nigrum</i>	Appetizer, diuretic, laxative
<i>Picrorhiza kurrooa</i>	Dyspepsia, appetizer, malaria fever	<i>Sophora moorcroftiana</i>	Blood purifier
<i>Podophyllum hexandrum</i>	Vermifuge, emetic, blood purifier	<i>Statice macrorrhabdos</i>	Stomach problems
<i>Potentilla ambigua</i>	Tonic	<i>Swertia chirata</i>	Fever, acidity
<i>Potentilla anserina</i>	Astringent, diarrhoea, leucoderma	<i>Swertia cordata</i>	Fever
<i>Potentilla atrosanguinea</i>	Fever	<i>Swertia petiolata</i>	Fever, tonic
<i>Potentilla fruticosa</i>	Fever	<i>Swertia thomsonii</i>	Fever, febrifuge
<i>Potentilla multifida</i>	Insomnia	<i>Tanacetum dolichophyllum</i>	Intestinal worms
<i>Prangos pabularia</i>	Carminative, diuretic, stomach complaints	<i>Tanacetum fruticosum</i>	Stomach ache
<i>Primula microphylla</i>	Cough	<i>Tanacetum gracile</i>	Intestinal worms
<i>Primula rosea</i>	Muscular pains	<i>Tanacetum nanum</i>	Intestinal worms
<i>Ranunculus brotherusii</i>	Digestive, ulcer	<i>Tanacetum tibeticum</i>	Khamchu
<i>Ranunculus laetus</i>	Stimulant	<i>Taraxacum officinale</i>	Analgesic, diuretic, liver disorders, tonic
<i>Ranunculus lobatus</i>	Gum inflammation, toothache		
<i>Ranunculus trichophyllus</i>	Diarrhea		
<i>Ranunculus tricuspis</i>	Eye inflammation		
<i>Rheum nobile</i>	Blood clot, swelling		

Medicinal Plant Species	Used in
<i>Taraxacum sikkimensis</i>	Febrifuge, Analgesic
<i>Terminalia bellerica</i>	Cough
<i>Terminalia chebula</i>	Cough
<i>Thalictrum alpinum</i>	Fever
<i>Thalictrum foetidum</i>	Diuretic, fever
<i>Thermopsis barbata</i>	Pains
<i>Thlaspi alpestre</i>	Digestive problems, fever
<i>Thlaspi arvense</i>	Digestive problems, fever
<i>Thymus serpyllum</i>	Carminative, expectorant, stimulant
<i>Tragopogon gracilis</i>	Wound healing
<i>Tragopogon pratensis</i>	Wound healing

Medicinal Plant Species	Used in
<i>Tribulus terrestris</i>	Diuretic, sexual weakness, tonic
<i>Ulmus wallichiana</i>	Wounds, hair tonic
<i>Urtica hyperborea</i>	Rheumatism
<i>Verbascum Thapsus</i>	Asthma, frost bite
<i>Vincetoxicum hirundinaria</i>	Dysentery
<i>Viola biflora</i>	Tonic
<i>Viscum album</i>	Bone fracture
<i>Waldheimia glabra</i>	Septic wounds
<i>Waldheimia stoliczkai</i>	Septic wounds
<i>Waldheimia tomentosa</i>	Septic wounds
<i>Youngia glauca</i>	Health tonic
<i>Youngia tenuifolia</i>	Health tonic