Himalayan Popular Lecture

Ladakh Series-3rd

MEDICINAL PLANTS BIODIVERSITY OF COLD ARID LADAKH HIMALAYA

By

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10th September 2022

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(An autonomous Institute of Ministry of Environment, Forest & Climate Change, Govt. of India)

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Dr Om Prakash Chaurasia has taken over as Director, Defence Institute of High-Altitude Research (DIHAR), Leh – Ladakh from 15th February 2017. Dr O. P. Chaurasia obtained his PhD in Botany from Magadh University, Bodh Gaya, Bihar. He joined DIHAR (DRDO) as Research Associate in 1993 & selected as Scientist 'C' in 1998 at DIHAR and is presently serving as Director. As an ethnobotanist par excellence, he has extensively surveyed flora of both coastal regions like Andaman & Nicobar Island as well as Tran-Himalayan regions of Ladakh and Lahaul-Spiti with emphasis on medicinal plants of Defence importance. He has pioneered research on cold arid agro technologies and protected cultivation that has largely contributed towards food security of troops in strategic Ladakh sector. He has also developed several herbal products viz., Seabuckthorn beverages, Seabuckthorn herbal tea, Seapricot beverages, Seabuckthorn soft gel capsules, Herbal Antioxidant Suppliment, Herbal Adaptogenic Appetizer, Herbal Adaptogenic Performance Enhancer, Joint Care Gel, Anti Blemishes Cream atc., from indigenous trans-Himalayan medicinal plants, especially Seabuckthorn, with targeted health benefits for troops deployed in high altitude regions. He has 11 patents for which technology has been commercialized and

has published more than 150 research papers in various national & international journals and authored books on Cold Desert Plants in 05 volumes and Ethnobotany & Plants of Trans-Himalaya. Dr O.P. Chaurasia has several awards to his credit, recently also has been awarded with First State (Ladakh UT) Public Service (Gazetted Category) Award-2021 by Administration of Ladakh UT on the Republic Day-21.

MEDICINAL PLANTS BIODIVERSITY OF COLD ARID LADAKH HIMALAYA

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Cold deserts are found in the interior of Asia and the intermountain zone of North America. Sixteen percent of areas of total landmass are under cold deserts. The Indian cold desert comes under the trans-Himalayan zone. They are confined to Ladakh in Jammu & Kashmir (J&K) and Lahul & Spiti in Himachal Pradesh (HP). In J&K cold desert lies between 320 15'-360 N and 750 15' -800 15' E. It covers approximately 68,321 sq. km besides 27, 555 sq. km. the area which is under illegal occupation of Pakistan and China. In H.P. the area lies between 310 44' 57" -320 59' 57" N and 760 46' 29" -780 41' 34" E and covers approximately 6,488 sp. km. Daunting heights and landscapes determine the climate and temperature which during winter months reaches to -30^{0}C (Leh) and -56^{0}C (Drass) for about 3-4 months in a year. Physiographically the whole Indian cold arid zones can be divided into six valleys viz Leh, Nubra, Changthang, Suru, Zanskar, and Lahul - Spiti.

Plant species of cold desert zones of India trans-Himalaya are mostly xerophytes followed by mesophytes. The flora is dominated by annual and perennial herbs followed by a few dwarf bushes or shrubs. The vegetative growth starts with the onset of summer. The melting snow provides abundant moisture to the plants to run their full course of development with great rapidity. The mountain slopes, alpine meadows, moraines, and pasture lands give a spectacular display of varieties of flowers in otherwise Barren Mountain during July and August. The remarkable feature of this zone is continuous and successive changes in the floristic pattern during the growth period. After melting of snow and onset of summer the cruciferous plants such and *Draba, Christolea, Choriospora, Mathiola, Arabis* are the first to bloom followed by species of *Corydalis, Gentiana, Primula, Saxifraga* and many others. The late summer (Aug – Sept) of this zone is dominated by Asteraceous taxa viz. Saussurea, Anaphalis, *Leontopodium, Jurinea, Waldheima, Nepeta* and others.

Cold Arid Medicinal Plants:

Since the dawn of history, man has been in search of ways to find cure and relief from mental and physical

illnesses. The history of medical botany dates back to the origin of civilization. The Sumerian ideograms depicting various medicines of plant origin date back approximately to 2000 B.C. The Assyrians and Mesopotamian pharmacopeias had approximately 250 herbal plant species listed in them. These included poppy, belladonna, hemp, saffron, thyme, garlic, onion, cassia and asafoetida.

The earliest written records of herbal plants are preserved in scrolls of Papyrus, a precursor of paper made from the pith of paper Nile of bulrush. The most famous scroll, the ebers of paper Nile of bulrush. The most famous scroll, the Ebers papyrus, which is a compilation of earlier works, contains 877 prescriptions and recipes of Cannabis, Opium, Aloe, Juniper and Henna dating back to the sixteen century B.C. It is believed that about one third of all pharmaceuticals are of plant origin.

In India, the history of medicinal plants can be traced back to the Vedic period (4500 B.C. to 1500 B.C.). The identity of serval plants like Semal, Pithuan and Pipal referred to in the suktas of Rig Veda can be fixed with reasonable certainty. Atharveda contains detailed information on approximately 2000 medicinal plants

and their uses. After the Vedic era, the works of Charak and Susruta namely Charak Samhita and Susruta Samhita deal with 700 drugs of daily and specific uses. The period of the 16th and 17th century witnessed a spurt in the development of medical botany and most of the world-famous medical drugs came into light during this period. For this reason, the period is called "The Age of Herbal Medicines".

It has been estimated that out of about 2000 drugs that have been used extensively in India, only 200 each are of animal and mineral origins while the rest are of plant origin. According to the WHO report, over 3/4th of the five billion world population cannot afford the products of modern medicines and must rely upon the use of traditional medicines of plant origin. WHO currently encourages, recommends, and promotes the inclusion of plant-derived drugs in national health care programme because of low cost and within the reach of a common man and as such are time-tested and considered to be much safer.

The people of Ladakh and Lahul-Spiti has its own medical system called "Amchi system of medicine" (Sowa-Rigpa) and the practitioners are called Amchis (Superior of all). Amchi medicine is based on

principally on a skillful use of plants, minerals, and animal products. The origin of Amchi medicine is traced back to India, where more than 2500 years ago Lord Buddha delivered a medical practice called Bzi (Chatus tantre) which was translated in the Tibetan language during 8th century AD by Acharya Chandrananda and Varochana. In order to popularize these texts in Tibet, the senior Yusthog Youthan Gonbo had made some changes in it to make it harmonious with the culture and environment of Tibet. Since then this system is very popular in Tibet and the entire Himalayan belt. This system was introduced in cold arid zones during the 10th/11th century AD approximately.

The Sowa-Rigpa system of medicine has been in vogue in Ladakh for the past many centuries. Amchis are looking after 60% of public health. Amchis have not only theoretical texts, but also practical experience handed over from generation to generation. They have also a reputation of having a high ethical standard in the social system of Ladakh. Generally, single herbal preparation and combinations of two or more herbs are prescribed and administered. Keeping in view the rich ethno-medicinal wealth of cold arid zones of Himalaya Defence Institute of High Altitude

Research, an establishment of Defence Research and Development Organisation has carried out a detailed extensive survey of all the six valleys viz. Indus, Nubra, Changthang, Suru, Zanskar and Lahaul-Spiti valleys, covering far-flung and higher passes since 1993 and collected valuable ethno-medicinal information with the help of tribals, shepherds, senior citizens and Amchis. Approximately 1100 plant species of various uses based on ethno-botanical information have been collected, out of them, approximately 500 species are of medicinal values. The widely used medicinal plants from high altitude regions of Ladakh and Lahaul-Spiti are *Aconitum heterophllum* (Aconite), *Bergenia stracheiy* (Pashanbheda), *Capparis spinosa* (Caper bush), *Dactylorhiza hatagirea* (Spotted Heart Orchid), *Ephedra gerardiana* (Somlata), *Gentiana aligida*, *Hippophae rhamnoides* (Seabuckthorn), *Inula racemosa* (Pushkarmool), *Lycium ruthenicum* (Russian box berry / Goji berry), *Meconopsis aculeaa* (Himalayan Blue Poppy), *Origanum vulgare* (Origano), *Podophyllum hexandrum* (Himalayan Mayapple), *Rheum webbianum* (Himalayan Rhubarb), *Rhodiola imbricata* (Golden Arctic Root), *Saussurea lappa* (Costus), *Thymus serpyllum* (Wild thyme), etc.

The widely used medicinal plants of Indian cold arid region have been described in brief along with family, common/local name, brief botany, parts used and their respective therapeutic uses.

1. ***Achillea millefolium*** **Linn.**

Family: Asteraceae

Name: Gandana (H), Milfoil / Yarrow (E), Chuang (L)

Distribution: Widely distributed from Kashmir to Sikkim, temperate Eurasia.

Habitat: Along roadsides & dry places, Zanskar, Suru, and Lahaul valleys around 3,680 m.

Plant Characters: A perennial herb. Stem branched, furrowed reaching up to 50 cm tall, pubescent, glabrous. Leaves narrowly oblong-lanceolate. Flower heads terminal, corymbose, white short pedicel. Involucral bracts are obtuse. Achenes small, 1-2 mm long.

Uses: The extract of leaves is useful in urinary problems, toothache and gum inflammation. The leaves are used for stomach complaints. Flowers are used in tonic. The whole herb is credited with astringent, stimulant, tonic, diaphoretic, cold, colic, heartburn, hysteria, epilepsy and rheumatism The herb contains alkaloids and quartenary bases like achilleine, achilletin, betaine, betonicin and choline.

Major sterols and triterpinoids are stgmasterol, campesterol and B-amyrin. It is one of the constituents of Liv-52.

2. *Aconitum heterophyllum* Wall ex. Royle

Family: Ranunculaceae

Name: Attees (H), Aconite (E), Bona-karpo (L)

Distribution: Pakistan, Central Nepal to Kashmir.

Habitat: Moist & damp places, Zanskar, Suru and Lahaul valleys around 2,865 m.

Plant Characters: An erect, perennial herb. Roots tuberous. Stem branched, 30-100 cm. Leaves ovate-heart-shaped to rounded blades, the upper clasping the stem; lower leaves deeply lobed, long-stalked. Flowers large, greenish purple usually in lax spike-like clusters. Hood rounded, broader than long. Seeds small and black.

Uses: A very important plant of Amchi system and other traditional systems of Indian medicine. The roots are used against toothache, high fever, stomach complaint, gastric trouble, and headache. The roots are collected at the time of maturity in October and dried properly in shade. These are made into a powder and used in different medicines. The roots are a source of alkaloids heterophyllisine heterophylline, atidine, hetisine, atisine. The roots are considered as

astringent, anti-pyretic, anti-diabetic and for dyspepsia, abdominal pains, vomiting and cough.

3. *Arnebia euchroma* (Royle.) John. I. M Johnston.

Family: Boraginaceae

Name: Ratanjot (H); Demok (Dre-mog) (L)

Distribution: From Kashmir to Kumaun & Afganistan.

Habitat: On dry rocky slopes, Leh, Nubra, Suru, Zanskar, Changthang and Spiti valleys between 4,650-4,790 m.

Plant Characters: A tufted very bristly haired perennial with the stout rootstock. Stem many, arising from the rootstock, 25-40 cm. Leaves linear to narrow lanceolate, bristly haired. Flowers many in rounded cluster, pale pink-purple turning blackish-purple.

Uses: In Amchi system of medicine the root is used as blood purifier, blood disease, cold, cough, lung and pulmonary problems. The roots are also used as hair tonic by the locals. The roots contain Ac-Shikonin and four related compounds – alkamin-B, B-di-Me-acrylate. It has been reported to be an antipyretic, anti-microbial and anti-inflammatory.

4. *Bergenia stracheyi* (Hk. f. & T.) Engl.

Family: Saxifragaceae

Name: Pashanbhed (H); Tiang or Gaotlis or Gatikpa (L)

Distribution: From Afganistan to Uttranchal, Western Himalaya and Kashmir to Himachal Pradesh.

Habitat: Open slopes, Zanskar and Lahaul valleys around 3,610 m.

Plant Characters: A perennial herb. Rootstocks very stout, creeping. Stem simple. Leaves with ovate or rounded, blade, 20 cm, glabrous with crenate margins. Flowers many, pink or white or lilac, in a drooping cluster. Calyx is hairy with marginal bristles. Fruits ovate-lanceolate.

Uses: In Zanskar areas, roots are used against stomach complaints. The roots are also used as a febrifuge, anti-inflammatory, against contagious diseases, influenza, inflammation of lungs and nerve, swelling of limbs etc. The rhizome contains gallic acid, tannic acid, mucilage, glucoside, albumens, starch and mineral salts. The rhizomes and roots are bitter, astringent, diuretic, tonic properties. The roots are reported to be used in menorrhagia and in urinary diseases.

5. *Codonopsis clematidea* (Schrenk) Clarke.

Family: Campanulaceae

Name: Burkutang or Mokhting (L)

Distribution: From Afganistan to Kashmir.

Habitat: Cultivated fields & alpine slopes, Suru and Spiti valleys around 3,020 m.

Plant Characters: A strong smelling, perennial herbs. Stem slender, branched from the base, 30-70 cm high. Leaves alternate, hairy, ovate, and acute at apex, margins irregularly crenate, base cuneate or rounded. Flowers white, solitary, axillary and terminal peduncles. Capsule cylindric, often curved.

Uses: The roots are considered useful in mild stomachache, digestion and stimulant. The whole plant is used against pain, swelling of joints due to gout, arthritis, rheumatism, stiffening of ligaments, nerves, paralysis and leprosy. The plant contains flavonoids, Vit A and C.

6. *Colchicum luteum* Baker.

Family: Liliaceae

Name: Hirantutiya (H), Tukapa (L)

Distribution: Western temperate Himalayas & Pakistan, Turkistan to Himachal Pradesh.

Habitat: Open snow cleared slopes, Suru valley around 3,325 m.

Plant Characters: A bulbous, small perennial herb. Corm cylindrical, brownish in color, almost conical in

shape with narrow-oblong, blunt, increasing in size as the plant approaches fruiting stage. Flowers solitary or 2, large, with golden-yellow petals. Leaves narrow-oblong blunt. Fruits 2.5-4 cm with curved beaks.

Uses: The bulbs are used against gout. Corms and seeds are the source of drug, Colchicine' which is useful in pains and inflammation of gout.

7. *Dactylorhiza hatagirea* (D. Don.) Soo.; O. latifolia Linn.

Family: Orchidaceae

Name: Salampanja (H), Spotted Heart Orchid (E), Ambolakpa (L)

Distribution: From Pakistan to Southeast Tibet.

Habitat: On damp & moist places, Nubra, Suru and Lahaul valleys around 3,280 m.

Plant Characters: A tuberous, perennial herb. Roots palmately divided into 2 to 5 finger-like processes. Stem tall up to 70cm. leaves several, oblong-lanceolate up to 25 cm. Flowers pink or purple in dense flowering spikes. Sepals and petals nearly are equal. Lower bracts longer than the flowers.

Uses: Local Amchis use the tuber roots for a health tonic. An extract of roots is also used against urine and kidney problems. The tubers are considered energetic, and health improving, which are

recommended for weak people also. Tubers are astringent, expectorant, used as a nervine tonic, aphrodisiac, useful in diarrhea, bone fracture and chronic fevers. The tuberous roots contain starch, mucilage, sugar, albumen and ash of potassium.

8. *Delphinium brunonianum* Royle.

Family: Ranunculaceae

Name: Himalayan Larkspur (E), Lunde-kaown (L)

Distribution: Pakistan to Eastern Nepal, Southeast Tibet & Kashmir.

Habitat: Moist stony places, Changthang, Leh and Spiti valleys between 4,760-5,130 m.

Plant Characters: An erect, glabrous, long, perennial herb. Stem 15-20 cm long, leafy below. Leaves lobed, cuneate-ovate, obovate, long-petioled. Flowers large, royle blue to pale blue, mostly in terminal corymbs or sometimes in compound corymbs. Seeds winged or angled. Follicle 5-6, hairy.

Uses: The flower juice and infusion of the whole plant are used for colic in Ladakh. The seeds and vegetative parts of the plant contain an alkaloid "Delphinine" which is used as an insecticide.

9. *Ephedra gerardiana* Wall. ex Stapf.

Family: Ephedraceae

Name: Asmania / Somlata (H), Ephedra (E), Chhapat (L)

Distribution: From Afganistan to Bhutan.

Habitat: Stony dry areas, Leh, Nubra, Zanskar and Spiti valleys around 3,960 m.

Plant Characters: A low growing tufted shrub. Stem tall 30-60 cm, erect, green, branched, Branches scaly on joints, Male cones ovate, solitary. Female cones usually solitary, Fruits ovoid, red, fleshy bracts. Seeds 2, black.

Uses: The roots, stems and branches are used as a tonic, against fever, stop bleeding, blood purification, snuffing, hepatic diseases, rheumatism, toothbrush and bronchial asthma. It is also used against hemorrhage, hot disorders of gall bladder, liver, spleen, fever due to bile, fevers, inflammation of spleen, wounds, dissolve tumors. It is also used as an important fuel and fodder during winters. The fruit and dried stem constitute a valuable drug "Ephedrine" which is used to cure Asthma. It is a very effective cardiac stimulant, asthma, heart failure and rheumatism. The stems and branches are used as a tonic, against fever, stop bleeding and bronchial asthma. Stops bleeding, febrifuge and tonic.

10. *Hippophae rhamnoides* Linn. spp. turkestanica Rousi.

Family: Elaeagnaceae

Name: Seabuckthorn (E), Tsermang or Sastalulu (L)

Distribution: From Pakistan to Himachal Pradesh, Central Asia & Northwest Himalayan regions.

Habitat: River belts & wastelands, Leh, Nubra, Zanskar, Suru, Changthang and Lahaul valleys between 2,600-4,000 m.

Plant Characters: A dwarf, very thorny, perennial shrub or small tree. Stem woody, erect, long up to 10-15 ft with silvery-waxy covering on the old shoots. Leaves variable, oblong blunt to green above and silvery scaly on both sides. Flowers very small greenish or yellowish. Male in clusters Female dull yellow, short stalked. Fruits subglobose, succulent, orange, or red.

Uses: The whole plant has got enormous medicinal properties. The fruits, leaves and seeds are considered as an anti-aging, anti-cold, restore memory and energetic. The fruits are antitussive, blood purifier, heals peptic ulcer, oral mucocitosis rectal mucocitosis, lungs disorders, cuts and wounds. Used against pulmonary disorders, inflammation of pulmonary tract expelling phlegm, healing peptic ulcer, clotting of blood, improve digestion, useful for

spleen disorders, lungs, inflammation in blood and pain to blood disorders. Seabuckthorn is considered as a storehouse of various vitamins viz. C, B, E, K, Carotenoids which indicates its strong antioxidant property. The berries are useful in gum bleeding, regeneration of tissues, to help in repair of mucus membrane and other organs. In addition, seeds and fruits contain valuable fatty oil which is the rich source of beta-carotene, Vitamin E, rare fatty acids and phytosterols having great demand in pharmaceutical industries. It has been reported that Chinese developed over 200 medicinal products and drugs from roots, leaves, fruits, seeds and bark. Seabuckthorn has got a valuable importance in Ladakh and other parts of trans Himalayan regions after its utilization on commercial scale during the year 2001, when DRDO has first ever developed, patented and commercialized multi-vitamin herbal beverage, Jam and Herbal tea from Seabuckthorn.

11. ***Hippophae salicifolia*** **D. Don.**

Family: Elaeagnaceae

Name: Seabuckthorn (E), Chharma (L)

Distribution: Pakistan to Himachal Pradesh, Uttranchal & Asia.

Habitat: On slopes, Lahaul valley, 4,390 m.

Plant Characters: An erect shrub or small tree. Leaves 5-10 cm long, linear-lanceolate, softly white-pubescent, above when young, densely white-tomentose or stellately hairy beneath, margins recurved. Fruits ovoid, yellow in axillary clusters.

Uses: This species is also used in traditional system of medicine. All the parts have got medicinal value. Like H. rhamnoides this plant is also rich in various vitamins and carotenoids.

12. *Hippophae tibetana* Schlecht.

Family: Elaeagnaceae

Name: Seabuckthorn (E), Tsermang or Sastalulu

Distribution: Pakistan to Himachal Pradesh, Uttranchal & Northwest China.

Habitat: Along river belts & wastelands, Zanskar and Spiti valleys around 4,230 m.

Plant Characters: A small, dwarf, less thorny, perennial shrub. Leaves variable, oblong blunt to green. Flowers very small greenish or yellowish. Fruits subglobose, succulent, orange or yellow. Seeds light black to brown.

Uses: It is a good source of vitamins and carotenoids.

13. *Inula racemosa* Hk. f.

Family: Asteraceae

Name: Puskarmool (H), Manu (L)

Distribution: Afganistan to Central Nepal, Kashmir, Kumaun & temperate regions.

Habitat: Cultivated in Leh, Kargil and Lahaul valleys around 3,870 m.

Plant Characters: An erect, robust, hairy, perennial herb. Leaves leathery, rough above, densely hairy beneath, toothed; radical leaves long-stalked, elliptic-lanceolate, cauline leaves ovate-oblong, semiamplexicaul. Flower-heads yellow, many in racemes, borne on spike like clusters. Achenes glabrous.

Uses: The plant is having great demand in traditional systems of medicines. Roots are considered to be useful in bronchial asthma when mixed half of the amount with Kuth. Used for blanching rLung (wind disease) and thak (blood), inflammation due to pad kan (phlegm) fever and pain in upper body region. The roots are used in gastrointestinal problems and rheumatism. It has been used as anthelmintic for children and antiseptic, expectorant and diuretic.

14. *Lycium ruthenicum* Murray ex Dunal.

Family: Solanaceae

Name: Umila (L)

Distribution: From Himachal Pradesh to Nepal, China and Kashmir.

Habitat: On dry places, Zanskar & Nubra valleys 3,180-3,970 m.

Plant Characters: A spinous, glabrous perennial herb. Stem many from the base. Leaves linear, often fascicled at the nodes. Flowers small, few. Calyx campanulate. Corolla funnel shaped. Berries small, globose.

Uses: The plant is used as an ointment to treat blindness in camels. The fruits are very rich source of vitamins and minerals, especially in vitamins A, C and E, flavonoids, and other bio-active compounds. It is also a fairly good source of essential fatty acids, which is fairly unusual for a fruit. It is being investigated as a food that can reduce the incidence of cancer and as a means of halting or reversing the growth of cancers.

15. *Peganum harmala* Linn.

Family: Zygophyllaceae

Name: Wild Rue (E), Sepan (L)

Distribution: From Afghanistan to Kashmir, Asia, Europe & North Africa.

Habitat: Wastelands dry places, Leh valley around 3,430 m.

Plant Characters: A perennial much branched bushy herb. Stem branched from the base, branches flattened and spreading. Leaves pinnately cut into long linear lobes. Flowers greenish white, solitary, terminal. Corolla 4-5 ovate-oblong. Stamens many (15) with many antherless filaments. Fruits globular, seeds dark brown.

Uses: The seeds are narcotic and used as fever, stomach complaint, anthelmintic, antiseptic, disinfections', eye disorders, narcotic, measles, incense, asthma, rheumatism, diuretic, tonic, appetizer and joint pains, aphrodisiac, urino-genital complaints, lactation, menstrual complaints. The plant is aphrodisiac, abortifacient, amoebicidal, anodyne, diuretic. The seeds are narcotic and contain harmaline, harmidine and harmalol.

16. *Picrorhiza kurrooa* Royle ex Benth.

Family: Scrophulariaceae

Name: Kutki or Kour (H) & Hanglang (L)

Distribution: Alpine Himalayas from Kashmir to Sikkim & Southwest China.

Habitat: Rare on moist slopes & alpine grasslands, Lahaul valley around 4,150 m.

Plant Characters: A low, hairy perennial herb. Rootstock thick as the little finger, 6-10 inches long,

clothed. Leaves radical, spathulate sharply serrate. Flowers white or pale blue purple in raceme. Corolla a short stamened. Capsule long, ovoid.

Uses: The roots are best source of bitter tonic, which is useful in stomachache, fever, laxative, dysentery, liver diseases cold, cough and heart problems by the local Amchis. The plant is cooling, cardio tonic, antipyretic, anthelmintic, anaemia, promote appetite, secretion of bile, useful in 'kapha', fever, urinary discharge, asthma, blood trouble, influenza, jaundice, menstrual disorders, joints pain, piles, nose problem, liver protectant, good for gums and teeth and snake bites: A brown resinous glucoside Picrorhizin, its aglycone picrorhizetin, Kutkin, B-sitosterol have been reported from the rhizomes.

17. *Podophyllum hexandrum* Royle

Family: Berberidaceae

Name: Himalayan Mayapple (E), Vankakri or Vanvaigan (H) Demokusu, Papra, Ol-mose (L)

Distribution: From Kashmir to Sikkim & Afganistan to South West China.

Habitat: Rare on forest areas & cultivated fields, Zanskar valley around 3, 755 m.

Plant Characters: A perennial scapigerous herb. Stem modified into underground rhizomes. Leaves 2, blade

rounded in outline, 10-25 cm, deeply cut into 3 ovate toothed lobes, sometimes further lobed. Flowers solitary, terminal white or pink, cup-shaped. Sepals 3, soon falling; stamens 6. Fruit large, scarlet or reddish berry, pulpy, orange or red seeds.

Uses: The entire plant is used for gynecological diseases like menstrual irregularity, diseases of the uterus and improves Lung and blood circulation, helps the delivery of the baby and placenta. The roots are used against skin problems, hardening of the skin and skin diseases by local Amchis. The young and ripe fruits are edible and are useful against high altitude mountain sickness. The rhizomes and roots of the plant, which constitute the drug "podophyllin" as podophyllotoxin, is considered a cholagogue, purgative, emetic, and a bitter tonic. Podophyllin is also used in veterinary medicine as a cathartic for dogs and cats. Roots have potential chemical, which is effective in skin cancer and radiation.

18. ***Rheum webbianum* Royle.**

Family: Polygonaceae

Name: Himalayan Rhubarb (E), Revanchini (H), Lachhu

Distribution: From Pakistan to Western Nepal.

Habitat: On open slopes & shrubberies, Leh & Zanskar valley

between 3,105-3,920 m.

Plant Characters: A stout, erect, perennial herb. Roots thick. Stem variable, 30-150 cm. Lower leaves long-petioled, orbicular-cordate 15-60 cm across. Panicles axillary and terminal. Flowers pale yellow small in the cluster. Fruits broadly oblong notched at both ends.

Uses: The roots, stems, leaves and leafstalks are purgative and are beneficial in treating indigestion, abdominal diseases, astringent, boils, purgative, wounds and flatulence. The roots are diuretic, purgative, febrifuge; used against indigestion, wounds, and gastritis etc. The roots are an excellent source of anthraquinones, useful as a laxative.

19. *Rhodiola imbricata* Edgew.; Sedum roseum (Linn.) Scop.

Family: Crassulaceae

Name: Rose root or Stone crop (E), Shrolo (L)

Distribution: Pakistan to Central Nepal.

Habitat: Rocky slopes, wet places & higher passes, Leh, Changthang and Spiti valleys around 5,420 m.

Plant Characters: A succulent, perennial herb 10-35 cm with rose scented massive rootstock. Leaves 1.3-3 cm long, oblong to narrow, elliptic, nearly entire. Flowers pale yellow in congested clusters, surrounded by an involucre of leaves. Fruits of 4-5, many seeded.

Uses: The roots are used in medicine against lung problems, cold, cough, fever, loss of energy and pulmonary complaints. It is also used in the preparation of health tonic, and it restores memory. It is also used for inflammation of lungs, due to contagious diseases.

20. ***Saussurea lappa*** **(Decne.) Sch.-Bip.; S. costus (Falc.) Lipsch.**

Family: Asteraceae

Name: Costus (E), Kuth (H), Rustha (L)

Distribution: Endemic to Kashmir and cultivated in Kashmir, Himachal Pradesh & other Himalayan regions.

Habitat: Being cultivated in Lahaul valley and introduced in Leh upto 3,850 m.

Plant Characters: An erect, robust perennial herb. Root possessing a characteristic penetrating odour; radical leaves with long lobately winged; flowers dark blue-purple in axillary and terminal clusters; achene curved, compressed.

Uses: The roots are used in bronchitis along with Manu in equal quantity by the Amchis. The roots are being used in asthma, dysentery, rheumatism, ulcer, incense and this use of the drug has received ample confirmation by several scientific investigations. The

roots are hot, bitter, pungent, fattening, aphrodisiac, carminative, analgesic, anthelmintic, emmenagogue, alternative, cures leucoderma, erysipelas, itching, ringworm, 'tridosa' bronchitis, vomiting, scabies, vata, headache, hysteria, and epilepsy, stimulant to brain, cures liver, kidney diseases, chest pain and joint pains paralysis, asthma, cough, inflammations, ophthalmia, old fever. The root contains an alkaloid Saussurine and tannins.

21. ***Tribulus terrestris*** **Linn.**

Family: Zygophyllaceae

Name: Gokhroo (H), Land caltrop or Puncture vine (E), gZe-ma, Rasha, Kokulla (L).

Distribution: Afganistan to Southwest China & Burma.

Habitat: Cultivated fields & wastelands, Leh, Nubra and Lahaul valleys 3,490 m.

Plant Characters: An annual, prostrate herb. Stem branched, slender, decumbent, hairy. Leaves pinnate compound, leaflets 4-12 ovate to obviate. Flowers solitary, yellow in a long raceme. Calyx is ovate to linear. Stamens 10. Fruits of 5 stiff achenes fused together; each achene triangular.

Uses: Fruits are considered useful in liver complaints, leucoderma, impotency, cold, cough, urinary disorders and weakness, infusion useful in gout.

Promotes urination. Cooling, aphrodisiac, and diuretic. The seeds are used to activates kidney function, diuretic, dries pus. The fruits are credited with diuretic and tonic properties. It forms a constituent of the well-known Ayurvedic medicine Dashamoola-rishtha and Amritha Prasa Ghritha, prescribed for several diseases. Fruits are useful in urinary disorders and sexual weakness, infusion useful in gout. The plant contains carboline alkaloids, steroidal sapogenins, saponins, flavonoids.

Herbal Products Development:

DIHAR has formulated and patented various gerbil products using high altitude medicinal plants viz. Seabuckthorn beverage, Seapricot beverage, Seabuckthorn based tea, Seabuckthorn oil capsules, etc. These herbal products have been commercialized through companies and local entrepreneurs.

Rare, Endangered & Threatened Medicinal & Aromatic Plants:

Rarity is a two-fold concept associated with the biology of the species and ecology of the area. Threat is more difficult to characterize since it may be a

natural consequence of biological or geological processes or be the result of past or present human activities directly or indirectly influencing the plant populations or their environment. The plant populations keep changing size and density over a period of time and such changes may make plant species rare, endangered and threatened, eventually leading in the extinction.

The cold desert plants have been used for various purposes by the valley people since for a long time. There are over exploitation, grazing, uprooting for fuel, increasing tourism and road construction have made some of the important medicinal plant species endangered and threatened. According to one report over 90 percent of herbal materials come from wild resources. Due to these activities cold desert ecosystems are destroying day by day.

Propagation & Cultivation:

Propagation and Cultivation of medicinal plants are one of the important aspects for their conservation and sustainable utilization. Defence Institute of High Altitude Research has established an alpine herbal garden (Field gene bank) within the premises of

DIHAR at an altitude of 11,500 ft with a view to standardize the cultivation practices of medicinal plants growing at different altitudes and localities. In this direction, efforts have been made to collect the germplasm from natural localities and at present germplasm (seeds) of 70 medicinal and aromatic plants are maintained at DIHAR. At present approximately 40 medicinal plants viz. *Achillea millefolium, Aconitum heterophyllum, Allium carollianum, Dracocephallum heterophyllum, Ephedra gerardiana, Inula racemosa, Mentha longofolia, Origanum vulgare, Rheum webbianum, Rhodiola imbricata, Saussurea lappa* are being under different stages of cultivation study in Alpine herbal garden.

CONCLUSION

The recent development activities and increased population have exposed Trans Himalayan floristic diversity especially herbal wealth and brought new commercial interest. Therefore, it is very important to develop a mechanism for sustainable and coordinated exploitation of these wild plants which will provide ecologically sustainable, socially acceptable, and economically equitable production and utilization system. This will require appropriate participation and

action from major stakeholders like traditional medical practitioners, foresters, local community, Government and non-Government organization, Researchers, and Industries etc.

Conservation of biodiversity of high-altitude medicinal plants will play a vital role to protect the existing genetic diversity and will be helpful in sustainable exploitation of these valuable resources of cold arid zones for overall economic development.

G.B. Pant National Institute of Himalayan Environment

(An autonomous Institute of Ministry of Environment, Forest & Climate Change, Govt. of India)

Ladakh Regional Centre, Leh, Ladakh UT

Himalayan Popular Lecture: *Ladakh Series*

1st Lecture - **Sh. C. Phunsog** (*Vice Chancellor, University of Ladakh*), ***Impact of climate change on India's trans-Himalayan region***

2nd Lecture – **Prof. S.K Mehta** (*Vice Chancellor, University of Ladakh*), ***Water: Pollution and Remediation***

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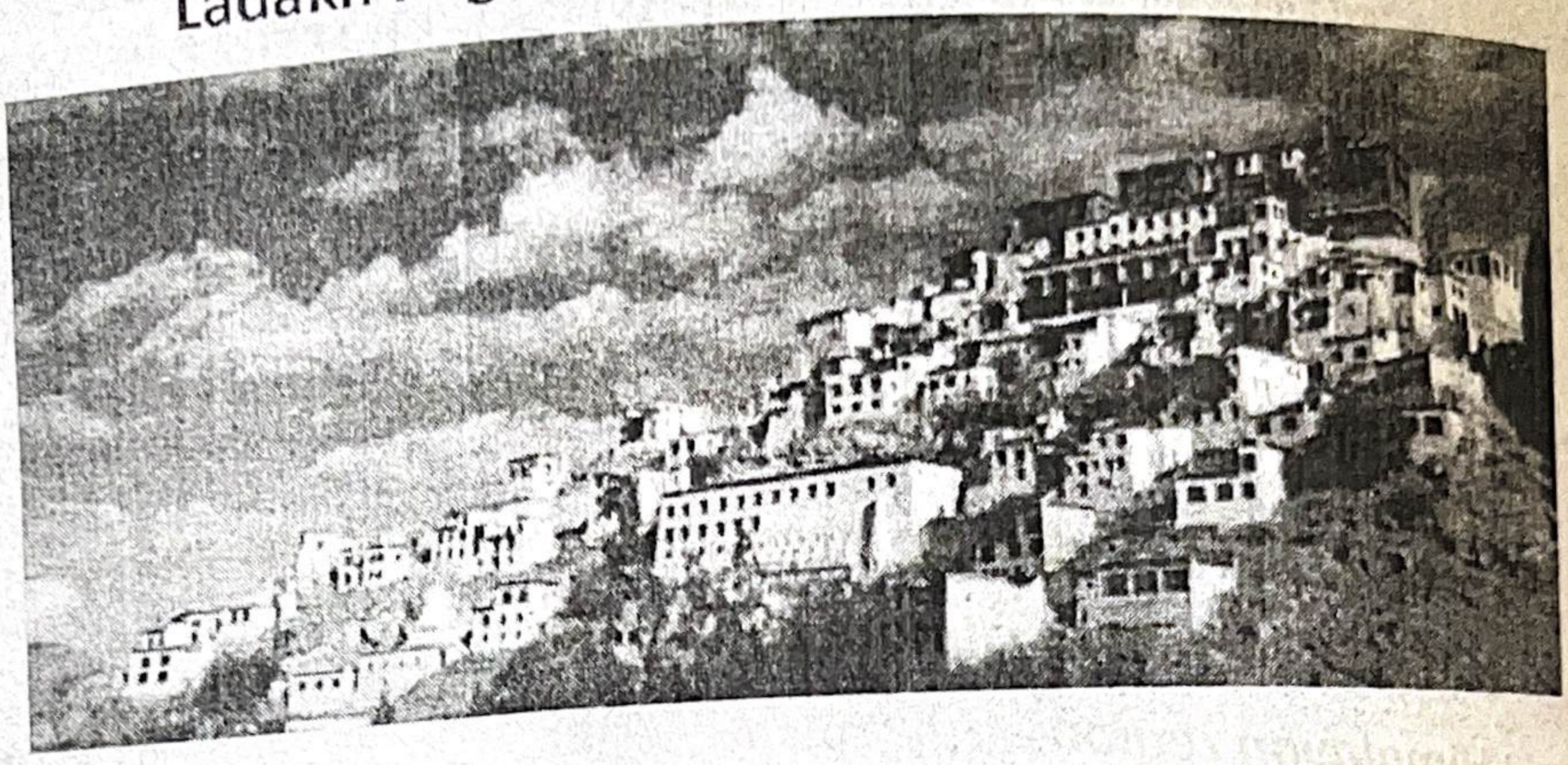
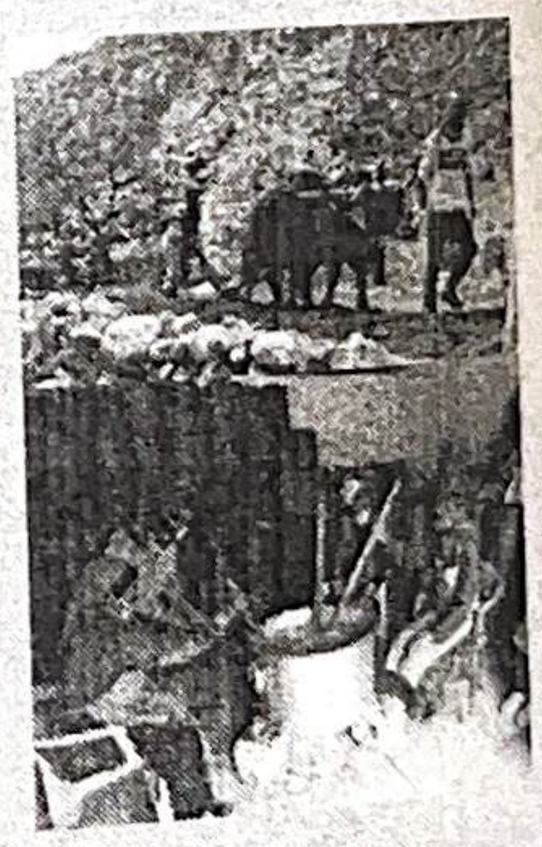


Objectives

- To promote alternative livelihoods for climate change vulnerable cold-desert communities.
- To facilitate conservation of critical/important cold desert habitats and biodiversity.
- To strengthen and establish approaches for addressing issues of water scarcity.
- To foster climate smart communities in the trans-Himalayan landscape.



Our Mission

- Science for society,
- Networks and collaborations,
- Promotion of successful models,
- Private sector engagement,
- Harness energies of local young
- Promoting use of sustainable technology.

Wildlife Warden Building, Near Council Secretariat, Leh