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## Medicinal plants of Ladakh

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#### Abstract

This review paper indicates the findings on the traditional medicines of cold desert Ladakh which has a very huge potential to treat various ailments among the tribal communities and its possible uses all over the continent. Ladakh is a dry and hilly region so it harbours the optimum environment required by these medicinal plants to thrive. In Ladakh they can be grown in summer season in open field condition while in winter it can be grown under protected structures because in winter, the temperature falls below zero. In earlier days, healthcare was mainly dependent in the traditional system of medicine which is popularly known as amchi system of medicine. These plants have a wide range of essential uses including therapeutic value with minimum side effects. Till now, these essential herbs were only found in the remote mountains but these days, with the collaboration of various institutes, they are being commercially cultivated. These include *Rhodiola rosea*, *Lavendula angustifolia*, *Inula racemosa*, *Achillea millefolium*, *Delphinium brunonianum*. The market for medicinal plants in India is growing exponentially each year and it is expected to be of a great value by the year 2026. In the near future, it is expected that the export of these commodities will not only benefit the local people but to the people all around the world.

**Keywords:** Ladakh, larkspur, lavender, medicinal plant, pushkarmool, solo, yarrow

#### Introduction

Ladakh is a union territory situated in North India consisting of two districts, Leh and Kargil, incorporating parts of the Himalayan and Karakoram mountain and upper Indus river valley. The current area of Ladakh is nearly 59,146km square with an elevation ranging between 2700 to 4200m, much of it being 3000m. Ladakh lies in the western Himalayan region which has a temperate climate. The temperature in summer ranges from 10 to 30 degrees Celsius while in winter it can reach up to -30 degree Celsius. The region is dry and arid, so the vegetation is less, but the area is suitable for growing many medicinal plant species which thrives in these conditions. Majority of the soil in Leh and Kargil are sandy to loam in texture and medium to medium high in organic matter with poor water holding capacity. The pH ranges from 5.65 to 10.12 in Leh while in Kargil it ranges from 6.57 to 9.47 (Acharya *et al.*, 2001) <sup>[1]</sup>. Majority of the soil in Ladakh is alkaline in nature. Ethnobotanical surveys and sample collections from two district, Leh and Kargil covering five main valleys *viz.*, Indus, Nubra, Changthang, Suru and Zaskar were undertaken by the authors since 2000 during different seasons and occasions (Jain and Rao, 1997). The medicinal plants are mostly seen growing in wild areas away from the main cities like in villages and mountain hills but now due to their exceptional values, people have started growing it commercially especially defence institute of high altitude research (DIHAR) has laid out trails for many of these plants and have successfully achieved it while they are conducting more research in coming days.

The vegetation here is less compared to other parts of India but the place is rich in medicinal plants Like *Ephedra gerardiana*, *Chinopodium botrys*, *Rhodiola tibetica*, *Angelica glauca*, *Caragana brevifolia*, *Salsola collina*, *Lavender*, *Chamomile*, *Dracocephalum*, *Rhodiola*.

Defence institute of high-altitude research (DIHAR) also carried extensive surveys of various region of Ladakh and collected 425 plant species used by Amchis. Sowa rigpa commonly known as Amchi system of medicine is one of the oldest, living and well documented medical tradition of the world. It has been popularly practiced in Tibet, Mongolia, Bhutan, some parts of China, Nepal and Himalayan regions of India (Ballabh and Chaurasia, 2009) <sup>[3]</sup>.

Ladakh has a huge scope in medicinal plants because of its climate and topography. Gurmet and Stobgais, 2016 <sup>[7]</sup> compiled nearly 162 plant species of Ladakh, which are used in sowarigpa system of Tibet as medicine: the prominent once being *Artemisia annua*, *Thermopsis barbara*, *Rheum emodi*, *Clematis tibetan*, *Juniperus indica*, *Rhodiola tibetica* and *Angelica gluaca* (Gurmet P and Stobgais, 2016) <sup>[7]</sup>.

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### Trade in medicinal plants

The Himalayan region covers approximately 10% of India's total land surface and nurtures 18,440 species of flora (Singh and Hajra 1996) [17] out of which 1750 species have medicinal importance (Samant *et al.*, 1998) [16]. The market for medical plants in India stood at Rs. 4.2 billion (US\$ 56.6 million) in 2019 and is expected to increase at a CAGR 38.5% to Rs. 14 billion (US\$ 188.6 million) by 2026. The total world herbal trade is currently assessed at US\$ 120 billion. (IBEF, 2020) [8]. India is among the paramount countries in Asia in terms of wealth of traditional knowledge system related to herbal medicine and utilizes a large number of plant species include Ayurveda (2000), Siddha (1121), Unani (751) and Tibetan (337) (Kumar *et al.*, 2001) [10].

The traditional Ladakh healthcare, the Amchi system fosters about 60% of public health of Ladakh (Chaurasia and Singh, 1996; Kala, 2005) [5]. Medicinal plants offer auxiliary remedies with enormous opportunities to create revenue in the form of income, employment and foreign exchange (Rawat

and Uniyal, 2004). Goraya and Vedin 2017 have mentioned around 36 medicinal plants from the Himalayas including Ladakh being in high annual trade which include 15 Red listed species, out of these, 8 are found in Ladakh. Extract from these plants have good herbal properties and can be used to produce medicine out of it which can cure various diseases. With proper research and technology, it can be converted into a huge industry which can be used for export purposes.

Rigzin *et al.*, 2019 [14] studies on some medicinal plants of Suru Valley of Ladakh used in Sowa Rigpa system of medicine. There finding has been listed in Table 1. "Sowa-Rigpa" is one of the oldest, living and well documented medical tradition popular in the world. It is an ancient Indian medical system which was enriched in the entire Trans-Himalayan region. At present Sowa-Rigpa is more popular in Himalayan societies especially in J & K region', Ladakh, Himachal Pradesh (Lahaul & Spiti), West Bengal (Darjeeling), Sikkim and Arunachal Pradesh and other parts of India.

**Table 1:** Some medicinal plants of Suru valley of Ladakh used in Sowa rigpa system of medicine

S. No.	Botanical name	Sowa rigpa uses
1	<i>Aconitum heterophyllum</i>	It treats arthritis, gout, swelling, pain and inflammation.
2	<i>Articulmappa</i>	It treats kidney diseases, urinary bladder cysts, tumours, nerve disorder
3	<i>Artemisia brevifolia</i>	Leaf extract against stomach disorders, digestion
4	<i>Clematis vernayi</i>	treats indigestion, tumours and pus related problems
5	<i>Carum carvi</i>	Fruits and seeds are used as febrifuge, improve eye vision and digestion.
6	<i>Delphinium cashmirianum</i>	It treats dysentery, diarrhoea and inflammation
7	<i>Durata stramonium</i>	It treats pathogenic diseases like sinusitis, tooth, head and other diseases associated with microorganisms.
8	<i>Lancea tibetica</i>	It treats lung diseases like pulmonary diseases, diphtheria, lung inflammation.
9	<i>Silene tinuis</i>	Treats nasal problems and hearing defects
10	<i>Verbascum thapsus</i>	Leaves and seeds are used for asthma and chest pain

### Medicinal plants being cultivated commercially in Ladakh

#### *Rhodiola rosea* (Solo)

*Rhodiola rosea* is a perennial flowering plant in the family crassulaceae. It is native to colder region of northern hemisphere. In mountain areas, it grows close to the snow line and it is propagated as ground cover. *Rhodiola* will thrive under cultivation in deep moderately rich and well drained sandy-loam soil which is neutral to slightly acidic (pH5-7). It can be propagated by seeds, crown or by root division. Plants reproduced by vegetative propagation establish more rapidly and are more vigorous than those grown from seedlings. For large scale cultivation in fields, transplanting seedlings is the most efficient method (Cuerrier *et al.*, 2014) [6]. An experiment with organic fertilizer was carried out from 1997-2000 in Finland (Galombosi *et al.*, 2003). One-year old seedling were transplanted into plastic mulch at a density of 6 plants/m<sup>2</sup> in sandy soil. Before transplanting, three doses of compost (5-10 and 20 t/ha) were incorporated in the soil. The increase compost treatment increased shoot growth and fresh weight of roots, but decreased fresh root dry matter content. The variation in fresh root weights was quite high, dry root yield were similar and the result were not significant. According to German experiences, it needs 500-600 mm precipitation for 2-3 t/h (Plescher *et al.*, 2010). The plants can tolerate drought condition but cannot tolerate high summer temperature and require regular water in spring. High humidity is important for its growth. Since the plant will be growing for an average of five years at the same site, the soil must be well-prepared, free of weeds and other competition. Solo is the local name of the herb *Rhodiola rosea*. The leafy parts of the plant are used as vegetables by the locals in a dish called tangthur. *Rhodiola* is grown as a perennial, but the

roots are harvested once at the end of four or five years. The root yield continues to increase throughout the five-year period. To ensure continuous supply by the buyers, growers must establish a new plantation every year. Defence institute of high-altitude research (DIHAR) based in Lehhas been studying the plant for over a decade to explore the therapeutic values of this wonder plant. They have successfully cultivated this plant in an area of 2 acres in the institute of DIHAR.

*Rhodiola* is unique as it has secondary metabolites phyto-active compounds which help in enhancing the immune system. The plant has adaptogenic properties that can help soldiers adjust to low pressure and low oxygen environments. The plant has been used in traditional Chinese medicine to combat high altitude sickness, while in Mongolia, physicians prescribed it for tuberculosis and cancer. Other benefits include improving brain function, anti-depressants, fatigue and reduce stress (Gavin Van De Walle, 2018). The plant also has radio protecting ability. It has been found that the plant has anti-depressant and appetizer properties.

OP Chaurasia ethnobotanist with Dihar for nearly two decades, told INAS that they have successfully established a gene bank and *Rhodiola* plantation of nearly two acres in the premise of the laboratory.

#### *Lavendula angustifolia* (Lavender)

Lavender is generally an herb which is a bushy, strong scented perennial plant from the Mediterranean region. In warmer region, it's grey to green foliage stays evergreen throughout the year and the herb thrives in some of the toughest conditions. Prized for its fragrance, medicinal properties and bluish colour, *Lavendula angustifolia* is valued across the world. The plant is not picky and will survive in a

wide range of soil, even poor soil. The flower and the oil of lavender are used to make medicine. The oil is extracted by distillation of flower spikes of certain lavender.

Propagation of lavender through seed is tough so can either purchase it from the nursery or wean take cutting from a mature plant. We can take softwood cutting of several inches in spring or later in the year when stems are more matured. Intercultural operations are necessary such as irrigation, pruning and proper maintenance.

The medicinal benefits include treatment of hair growth, asthma symptoms, blood pressure and heart rate (Valencia Higuera, 2019). The oil has antiseptic and anti-inflammatory properties which can help to treat minor burns and bug bites. Consuming lavender as a tea can help digestive issues such as vomiting, nausea intestinal gas, stomach upset and abdominal problems. In addition to helping in digestive problems lavender is used to help relieve pain from headaches, sprains, toothache and body sores. (Valencia Higuera, 2019). A study found that lavender oil could be effective in combating anti-fungal resistant infections. As the Ladakh region is deprived of natural irrigation facilities and is suitable for the cultivation of high value medical and aromatic crops such as dracocephalum, lavender, saffron, so CSIR IHBHT recognized this area for the cultivation of these crops.

#### ***Inula racemosa* (Pushkarmool)**

Manu (*Inula Racemosa*) is a stout herbaceous plant, 1.5 m tall with very large basal leaves (40 × 12 cm) and terminally borne with yellow flower head. It is propagated through root cuttings or via seeds but the viability of seed is less compared to cuttings. The root cuttings are planted, either in late autumn (October) or early spring (May), in small deep pits incorporation with FYM or droppings of sheep and goats. The roots sprout in about 6 weeks. Availability of moisture due to melting of snow helps in growth initiation, and the plant attains maximum height in the second year. The plant grows over 1 m in height in the third year and the roots are dug by September-October, when the flower starts drying. The fresh roots are later cleaned, cut into small pieces and sun dried (Arora *et al.*, 1980) [2].

The plants grow in temperate region of western Himalayas in India at an elevation of 1300 to 4500 meters. Inula is locally called Manu in Ladakh. It is used for the treatment of respiratory tract disorders, ulcers and as an antiseptic. It can also be used in treatment of heart diseases. Manu-pata which is endemic to North West Himalaya and its neighbouring areas, predominantly in Jammu-Kashmir and Himachal Pradesh, is critically endangered plant.

The plant is easily propagated through cutting of roots and also via seeds. Seeds remain dormant state during winters season. To overcome dormancy, chilling treatment is essential. Seeds sown in polyhouse in the month of November which starts germination in month of March. Through rootstock it is easy to propagate and get ready to harvest after 2-2.5 years. The 2 years old rootstock provide around 20-30 terminal buds. For the preparation of land, application of sand, fym and manure from goat and poultry are used to increase the yield. Fym of around 6-8t/acre is required. At the time of seedlings transplantation and plantation through vegetative means, the crop requires watering twice per week during April-May. After proper establishment of plants, the crop requires watering once in a week. In open field condition, the plant is ready for harvest within 2 to 2.5 years if the plant is propagated through root cutting or it takes 4 to 5

years if done through seedling (Rinchen *et al*, 2019) [15]. It has been estimated that the marketable production of roots is approximately 580 kgs/kanal in 2 years. The plants are used to treat a large spectrum of disorders, mainly respiratory, digestive, inflammatory, dermatological, cancer and microbial diseases. The roots of the plant has been widely employed to treat conditions such as inflammation, boils, ear pain, cough, asthma and as an expectorant (Kirtikar and Basu, 1994). In the preliminary pharmacological screening, alcoholic extract obtained from the roots of *Inula racemosa* showed potent anti-spasmodic activity in various experimental preparations (Singh *et al*, 1976).

#### ***Achillea millefolium* (Yarrow)**

*Achillea millefolium* belongs to the family compositae (Asteraceae). It is commonly known as common yarrow, chuang and chabu in Ladakh. The plant is found at an elevation of 1800-3600 meters in temperate and dry barren regions. The species is mainly confined to the Western and Central Indian Himalayas from Jammu and Kashmir to Uttarakhand. The species is found naturally growing in, Thatch (3800 m), Chherna Devi Bardhar (2300-2700 m), Swarhkothi slopes (2500 m), Pattan Valley (Lahaul), Sangla Valley (Kinnaur), Rohthang and Churdhur slopes, Koksar region in Himachal Pradesh and Changthang region in Ladakh. It is a leafy perennial plant which grows upto a height of 50 cm consisting roots and stolons. The flowers are small, white and numerous, borne in compound corymbose inflorescences. The leaves have a pungent aroma, especially when grown in a hot and sunny position. The flowering takes place in July while the fruits are produced in August-September. The plant has diuretic, stimulant and haemostatic properties. It helps in treating various kidney diseases. It also prevents baldness, helps relieve fever and promote appetite. Yarrow has a high reputation and is widely employed in herbal medicine, administered both internally and externally. It is used in the treatment of a very wide range of disorders but is particularly valuable for treating wounds, stopping the flow of blood, treating colds, fevers, kidney diseases and menstrual pain. The growing plant repels beetles, ants and ward off mosquitoes. (Moerman, 1998) [11].

#### ***Delphinium brunonianum* (Musk larkspur)**

*Delphinium brunonianum* belongs to the family Ranunculaceae. It is a perennial herb which can grow up to 20 cm tall and has a musky smell. The flowers look inflated and rather papery, woolly haired, and sometimes prominently veined. Flowers are borne in small dense cluster. Musk Larkspur is a high-altitude plant found at an elevation of 4300-5500 m. The plant flowers in July-September. Propagation is mainly done by seeds which is sown in March-April. The seed germinates in 2 to 9 weeks at 15 degree Celsius. The plant grows to a height of 40 cm. A parasiticide is obtained from the leaves. It is quite toxic and so is for external use only. In the Himalayas it is only used to destroy ticks on animals (Polunin *et al*, 1984) [12].

Other uses include; for treatment of enlarged liver, stomach and intestinal trouble, urinary system, and venereal diseases. Decoction of delphinium can be used for inflammation of the lungs, pleurisy, headaches, tapeworm, female sickness, chronic coughs and toothaches. It is used externally to eliminate skin parasites. Leaves juice are effective for bleeding piles (Khare, 2007) [9].

### Future prospects of herbal medicine

- The area of Ladakh may emerge as a hot spot for medicinal and aromatic plants cultivation. As much of the research is not yet conducted, so in the future with the proper resources and technology we might be able to exploit the resources to full extent and can also develop a good market in Ladakh itself which will also provide jobs and livelihood to many local people.
- With increasing use and fast-growing market of herbal medicines and other herbal healthcare products, in both developing and developed countries of the world, policy-makers, health professionals and the public are increasingly expressing concerns about the safety, efficacy, quality, availability, preservation, and further development problems of these herbal products.
- Public demand has also grown for evidence on the safety, efficacy and quality of herbal products and traditional medicine/complementary and Alternative Medicine practices.
- In order to allay these concerns and to meet public demands, extensive research on herbal medicines is needed to be undertaken not only for their great healthcare value but also for the commercial benefits.
- Fortunately, quite extensive phytochemical and pharmacological researches on medicinal plants and herbal medicines are already in place throughout the world and efforts are being made to isolate and identify their active chemical constituents and to substantiate the claims of their efficacy and safety. In most cases, it has been established that herbal medicines are not totally without scientific basis as most of them contain the relevant chemical compounds and exert the claimed activity.
- In the present situation, it is apparent that whatever important the concerns and demands of the policy makers, health professionals and public may be, they do not, in any way, stop the increasing trend of using herbal medicines. As a result, herbal medicine-based Traditional Medicine (TM) practices remain widespread in developing countries and that of Complementary and Alternative Medicine (CAM) is increasing rapidly in developed countries.
- This trend of growing and widespread use of herbal medicines is likely to increase even further throughout the world in the coming years with more and more scientific evidence of their quality, efficacy and safety coming from the researchers.
- However, in order to ensure quality and safety of herbal medicines, their production, sale and use should be officially and legally controlled, as done with allopathic medicines, by established rules and regulations. Therefore, herbal medicines should be brought under legal control in all countries where they are used for medical and therapeutic purposes and efforts should be made to raise public awareness about the risks and benefits of using herbal medicines.
- Proper use of herbal medicinal products of 'assured quality' is sure to produce beneficial therapeutic effects on the users and reduce the risks associated with them. At the same time, it should be noted that, similarly to allopathic drugs, herbs, and herbal products are not free from side-effects. They are also likely to cause adverse effects. Therefore, rules and regulations of GMP should be strictly followed in the production of herbal

medicines.

- With this cautionary note, it may be concluded safely that herbal medicines hold good future prospects and they may, one day emerge as good substitutes or better alternatives for synthetic chemicals-based allopathic drugs or may even replace them.

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