Ethno-botanical Studies and Survey of Rare and Endangered Medicinal Plants of Chang-La (17,688 ft) and Taglang-La (17,582 ft) Region of Union Territory of Ladakh

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ABSTRACT
The paper deals with the ethno-botanical studies and survey of rare and endangered medicinal plants of Chang-La and Taglang-La and surrounding villages (Meru, Lato, Gya, Sasoma and Rumtse). Although the region looks barren and lifeless, it actually represents a treasure house of diversity of plants with high medicinal, aromatic value and also fulfills other useful purposes (such as food, fodder, fuel and ritual requirements). Predominant species of these areas are: Geranium wallichianum, Carum carvi, Aconogonom tortuosum, Cremanthodium elisii, Corydalis stricta, Oxytropis microphylla, Cicer microphyllum, Rosa webbiana, Caragana versicolor, Artemisia macrocephala, Dracocephalum heterophyllum, Hippophae rhamnoides, Astragalus tibetanus, Thalictrum foliolosum, Delphinium brunonianum. The medicinal plants surveyed during tour was widely used in Sowa- rigpa system of Indian medicine for curing various diseases and ailments as it has no side-effects compared to allopathic medicines. The present paper documents ethno-botanical information of sowa-rigpa traditional medicinal usage by the local people. Around 54 medicinal plants species botanical name, sowa-rigpa name, medicinal use, family, habitat and part uses are enumerated in this paper.

Keywords: Ethnobotany; sowa-rigpa; medicinal plants; Chang-La; Taglang-La; Ladakh.

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1. INTRODUCTION

The vegetation of Ladakh generally comes under sub-alpine, alpine, and high alpine zones and is dominated by annual and perennial herbs, followed by a few stunted shrubs and bushes; which differ remarkably from the rest of the Himalayas due to its existing unique, topographic, physiographic and climatic conditions. The climate of Ladakh is predominantly aridly characterized by low annual precipitation (50-300 mm), and cold due to high elevation and glacier-capped mountains. The annual average temperature of Ladakh is less than 10°C. The temperature may exceed at a lower elevation in summer. There are great diurnal variations in daily atmospheric temperature during the summer season ranging from 0°C to 35°C.

Ladakh is a newly formed Union Territory (on 5th August 2019), earlier being a part of erstwhile state of Jammu & Kashmir. It consists of two districts viz. Leh and Kargil which covers an area of more than 78,000 Km² which lies between 32°15`50 – 35°38’11 N latitudes and 75°36`73-78° 31’11 E longitudes at an elevation of 2700-7560m. The earliest records of the flora of Ladakh and western Tibet have been compiled by Stewart in 1916-17 (831 species in 66 families). Later, a total of 611 plant species from Ladakh (540 are dicotyledons, 65 monocotyledons, and 2 gymnosperms). According to the latest floristic, more than 1180 vascular plant taxa have been reported from the cold desert of Ladakh [1].

The Indian Himalayan region is endowed with rich faunal and floral diversity. Most of the floral diversity of the region is high in valuable medicinal properties and forms a basis of traditional knowledge. Since, the ancient times people are well endowed with the information of curative properties of plants and have started using them for health care and these practices are a part of cultural folk tradition [2].

Sowa-rigpa derived from Mongolian word “Am-raj” means superior of all, commonly known as Amchi or Tibetan system of medicine and the practitioner of it is called Amchi. Amchi system of medicine is also very well known in Tibet, Mongolia, Bhutan, China, Nepal, Bhurit Republic of Russia and Himalaya region of Himachal Pradesh and Sikkim in India. It was the only healing method during early times prior to the introduction of modern allopathic medicine [2-5]. In the early days, every village had a healer locally known as Amchi [6]. This knowledge and skill set was passed down from the father to the son in a family known as “Lharjaj” in most of the larger villages. Unlike today, anybody can pursue this discipline of traditional medicine. Amchis never charged for their services directly, patients offered them gifts in the form of wheat, barley and offered labour work during the time of harvesting the crops, etc [7]. Rgyud-bzi, a fundamental text book of sowa-rigpa is believed to be taught by Buddha outlines a vast knowledge of medicine, basic principle of health and disease, method of diagnose disease and therapeutic approaches. The basic theory of sowa-rigpa is based on the principles of Jung-wa-Ina (English- five elements, Sanskrit-Panchmahabhuta) and Nespa gsum (English-three humours, Sanskrit-Tri-dosh) [8]. In Ladakh, 80% of older peoples from the age of above 35 years still depend on the traditional system of medicine.

These practitioners detect and cure number of diseases through their own traditional knowledge [9]. The health care system of 80% populace of the developing world is still dependent on their surrounding vegetation/ forests and pastures. They rely on medicinal plants because of their effectiveness and cultural preferences in addition to absence of modern healthcare alternatives [10].

The increase in demand for medicinal plant has led to over exploitative collection of such plants from its natural habitat. causing threat to many valuable medicinal herbs which are already rare in nature [11]. Further, we are witnessing a sharp decrease in the biological diversity across the globe and our study area is no exception to the above trend. Medicinal and aromatic plants (MAPs) are regarded as vital constituent for maintaining human health since the dawn of civilization. The therapeutic values of some of these plants are mentioned in the old Indian scriptures [12,13].

At present, there is a growing demand for plant-based medicines, health products, pharmaceuticals, food supplements, cosmetic, etc. in the national and international markets [14], resulting in serious threats to many medicinal and aromatic plant. Recently, International Union for Conservation of Nature (IUCN) designed Conservation Assessment and Management Prioritization for the Medicinal Plants (CAMP) methodology revealed that about 112 species in Southern India, 74 species in Northern and
Central India and 42 species in high altitude areas of Himalaya are threatened in the wild [14].

In the Indian Himalayan region, the reservoir of enormous natural resources of medicinal wealth and traditional knowledge has been explored for its multiple benefits [15]. The traditional medicinal practice is inclusive of local practitioners and the use of herbal medicine by the tribal communities is influenced by various socio-culture practices, beliefs and benefits, support of traditional authority since their ancestral times. The tribal people have close relationship with their environment they are entirely dependent on it for their primary healthcare due to their remoteness.

The uncontrolled and illegal exploitation of Himalayan medicinal species is an appalling problem in the conservation practice [16]. Bio-industries are causing a serious damage to the wealth due to its over exploitative tendencies to the brink of complete depletion. It is anticipated that more than 90% of the entire herbal raw material is from the wild [17]. Therefore, sustainable use of the natural resources to ensure their availability for future generations is a challenge at present. The present rates of habitat loss, landscape alteration; extinction of the species, community and even loss of ecosystem, have prompted conservation biologists to devise methods and tools for species protection and preservation. The main aim of this survey is to develop and publish a resource database on the presence of certain ethno-medicinal plants diversity in Chang-La and Taglang-La and adjoining villages.

2. METHODOLOGY

2.1 Collection of Data

A three day ethno-botanical studies and survey of rare and endangered medicinal plants has been carried out during the year 2021 in the month of September for the collection of specimen, their traditional usage in Amchi system of medicine, raw drug collection, herbarium specimen and vegetative propagules for trans-Himalayan herbal garden of NISR-Leh from various locations of Chang-La and surrounding villages of Taglang-La like Meru, Lato, Gya, Sasoma and Rumtse. The specimens were collected from different location with varying altitudes were photographed, collected, dried and documented in field survey book. The medicinal specimens collected for herbarium were thoroughly cleaned and pressed under the old newspaper between the two wooden blocks and tightly tied them with ropes. Herbarium is a conservatory of material and data. The specimens in the herbarium carry valuable data on their labels. The material in the herbarium remains a permanent record of flora of these regions and in certain cases, where catastrophes or other factors have totally destroyed the vegetation the collections in the herbarium provide evidence of what once existed there. The information regarding traditional amchi knowledge related to plant resources, socio-economic and ethno-botanical information was recorded by interviewing the local amchi practitioners, villagers and especially old aged persons. The information on usage of medicinal plants specimens their local names were recorded through discussions with the renowned amchi practitioners and knowledgeable persons of the locality. The vegetative propagules collected from survey locations like *Rhodiola* sps., *Waldhemia tomentosa*, *Thylacospermum ceasitosum* were planted in seedbed of trans-himalayan herbal garden of the Institute (NISR-Leh). The details have been highlighted in Table form in the discussion part giving the scientific names, family, habitat, life form, parts used and their traditional usage.

2.2 Study Area

The present investigation has been carried out in two locations namely Taglang-La and surrounding villages of Taglang-La (Meru, Lato, Gya, Sasoma and Rumtse) and Chang-La in year 2021 during the month of September. The Taglang-La pass is situated on a elevation 5328 metres (17,480 ft) with coordinates 33°30'28"N 77°46'12"E is gateway to Leh-Manali highway heading south from Upshi to Taglang La is paved, with the exception of a very short (approximately 500 m) unpaved section just north of the pass.

The survey second location Chang-La is a high mountain pass in Ladakh at an elevation of 5,360 metres (17,585 ft) with coordinates 34°02'49"N 77°55'50"E in the Ladakh range between Leh and Shyok River valley which is 75 km away from Leh town. The data were obtained from native informants who were amchi, village elders and local people who have the knowledge of the therapeutic value of the plants. (Need a colorful map for showing location aslo with...
highlighted areas showing availability of medicinal plants).

3. RESULTS AND DISCUSSION

Ethno-botany is a multidisciplinary science that deals with direct relationship between man and plants [18] which records the history and status of human kind even while foretelling the future [19]. In every ethnic group there exists a traditional healthcare system, which is culturally patterned. In rural communities healthcare seems to be first and foremost line of defense. The WHO has already recognized the contribution of traditional health care in tribal communities. In India there exists more than one million community based traditional workers and about 600,000 licensed medical practitioners of traditional systems like Ayurveda, Siddha, Unani and Sowa-Rigpa.

During the survey authors have collected 54 medicinal plant species from different locations. The collected specimens were used for treat different ailments in sowa-rigpa system of medicine by the rural households which constitute the majority of the survey area. The collected specimens were incorporated in table form (Table 1) with their sowa-rigpa uses, habitat, type, botanical name and their family. The survey data shows majority of plants species belongs to Asteraceae (12) family followed by Lamiaceae (7), Fabaceae (5), 3 each from Boraginaceae, Ranunculaceae, 2 each from Rosaceae, Polygonaceae, Geraniaceae, Crassulaceae and 1 each from Plumbaginaceae, Apiaceae, Ephedraceae, Onagraceae, Orobancheae, Solanaceae, Elaeagnaceae, Tamaricaceae, Zygophyllaceae, Plantaginaceae, Primulaceae, Saxifragaceae, Urticaceae. The medicinal plant species are mainly used to treat fever, inflammation and dermatological disorder. The roots followed by leaves, flower and whole plants are used as a raw material to prepare Sowa-rigpa medicine.

Regarding the life form, majority of medicinal plant species belongs to perennial herbs (39), followed by Sub-shrubs (6), shrubs (6), annual (2) and biennial (1). The data were obtained from native informants who were amchi, village elders and local people who have the knowledge of the therapeutic value of the plants.

![Fig. 1. a, b, c. Location map of study area](image-url)
Fig. 2. Collection of herbarium specimen and raw drug from different location

*Lancea tibetica*  
*Pedicularis longiflora*
Waldhemia tomentosa

Silene gonosperma

Rhodiola imbricate

Thylocospermum ceasptosum

Urtica hyperborean

Tanecetum fruticulosum
Fig. 3. Pictures of some important medicinal plants of Chang-La and Taglang-La

Table 1. List of medicinal plant species available in Chang-La and Tag-Lang-La region of UT-Ladakh

| S.No. | Scientific name | Family | Sorig/local name | Habitat | Life form | Parts used and uses |
|-------|-----------------|--------|------------------|---------|-----------|---------------------|
| 1.    | *Acantholimon lycopodiodes* (Longze) | Plumbaginaceae | Longze | Dry stable slopes | Subshrubs | Plant ashes used to treat cardiac arrest |
| 2.    | *Aconogonon tortuosum* | Polygonaceae | Snya-lo | Sandy slopes, screes | Perennial herbs | Roots to treat dysentery, diarrhea with bleeding |
| 3.    | *Arnebia euchroma* | Boraginaceae | Demok | Screes, stabilized slopes | Perennial herbs | Roots to treat pulmonary diseases, blood vomiting |
| 4.    | *Arnebia guttata* | Boraginaceae | Demok | Sandy deserts | Biennial or perennial herbs | Roots to treat hair loss, pulmonary diseases |
| 5.    | *Artemisia santolinifolia* | Asteraceae | Khampa-nagpo | Stony steppes | Subshrubs | Upper parts to treat swelling, epidemic fever, blisters |
| 6.    | *Aster* | Asteraceae | Lug-mig | Moist alpine | Perennial | Flowers to treat |
| S.No. | Scientific name            | Family          | Sorig/local name | Habitat                  | Life form | Parts used and uses                                      |
|-------|---------------------------|-----------------|------------------|---------------------------|-----------|---------------------------------------------------------|
| 7.    | Astragalus densiflorus    | Fabaceae        | Sad-rigs         | Alpine meadows, grasslands | Perennial | Upper parts used as decoction for skin diseases         |
| 8.    | Astragalus oplites        | Fabaceae        | Zomo-shing       | Stabilized slopes          | Subshrubs | Aerial parts used for dermatological disorders          |
| 9.    | Caragana versicolor       | Fabaceae        | Dama             | Dry slopes, dry watersheds | Shrubs    | Root and stem cortex to treat inflammation of nerves, nerve disorders [20] Seeds are used to treat cardiac disorders, increase appetite Powdered flower used to control high fever Aerial portion used as fodder for livestock Aerial parts used as anti-vomiting agent |
| 10.   | Carum carvi               | Apiaceae        | Kosnyot          | Disturbed soil, field borders | Biennial | Herb                                                    |
| 11.   | Chrysanthemum arassanicum| Asteraceae      | Serpan           | Dry stony stabilized slopes | Perennial | Perennial herbs                                          |
| 12.   | Cicer microphyllum        | Fabaceae        | Sari             | Stabilized slopes, stony screes sediments | Perennial | Aerial portion to treat pulmonary and liver diseases Floral parts used for pulmonary and liver diseases |
| 13.   | Circium arvense           | Asteraceae      | Chang-tser       | Sandy river sediments     | Perennial | Aerial parts used as anti-vomiting agent                |
| 14.   | Clematis tangutica        | Ranunculaceae   | Emong            | Stony walls in settlements | Semi-erect shrubs | Upper parts to treat pulmonary diseases, lymph fluid |
| 15.   | Cremanthodium ellisii     | Asteraceae      | Ming-chan-nagpo  | Snow beds, alpine meadows | Perennial | Upper parts to treat larynx disorders, evil spirits Flowers used in gynecological disorders Upper parts to treat dermatological, cold cough Whole plant to treat oral diseases, liver diseases |
| 16.   | Dasiphora dryadanthoides  | Rosaceae        | Span-chung       | Stony places, dry subalpine zones | Shrubs    | Flowers used in gynecological disorders Upper parts to treat dermatological, cold cough Whole plant to treat oral diseases, liver diseases |
| 17.   | Delphinium brunonianum    | Ranunculaceae   | Chagot spos      | Stony and gravel slopes   | Perennial | Flowers used in gynecological disorders Upper parts to treat dermatological, cold cough Whole plant to treat oral diseases, liver diseases |
| 18.   | Dracocephalum heterophyllum, | Lamiaceae      | Gypsy-karpo      | Sandy plains, stabilized slopes | Perennial | Whole plant to treat pulmonary and liver diseases Aerial parts used for pulmonary and liver diseases |
| 19.   | Ephedra geradiana         | Ephedraceae     | Tse-pat          | Stony and rocky habitats  | Subshrubs | Aerial parts used for pulmonary and liver diseases Aerial parts used for pulmonary and liver diseases |
| 20.   | Epilobium angustifolium   | Onagraceae      | Moist places     | Perennial                 | Herb      | Whole plant to treat pulmonary and liver diseases Aerial parts used for pulmonary and liver diseases Aerial parts used for pulmonary and liver diseases |
| 21.   | Gentiana nubigena         | Gentianaceae    | Spangyan-snonpo  | Snow bed and moss rich springs | Perennial | Flowers to treat epidemic fever, pharyngitis, cold cough Roots to reduce swelling in limbs, inflammation Roots to treat epidemic fever |
| 22.   | Geranium himalayense      | Geraniaceae     | Ligadur          | Mesic to wet river banks  | Perennial | Roots to reduce swelling in limbs, inflammation Roots to treat epidemic fever |
| 23.   | Geranium regelii          | Geraniaceae     | Gadur            | Alpine meadows            | Perennial | Roots to reduce swelling in limbs, inflammation Roots to treat epidemic fever |
| S.No. | Scientific name          | Family        | Sorig/local name | Habitat                        | Life form | Parts used and uses                                                                 |
|-------|--------------------------|---------------|------------------|--------------------------------|-----------|-------------------------------------------------------------------------------------|
| 24.   | Hippophae rhamnoides    | Elaeagnaceae  | Star-bu          | River gravel deposits          | Shrubs    | Fruits to treat pulmonary diseases, high altitude diseases                            |
| 25.   | Lactuca tartarica       | Asteraceae    | Khala            | Saline and sandy soils         | Perennial | Tender leaves used as vegetables by local people                                     |
| 26.   | Leontopodium ochroleucum| Asteraceae    | Targot           | Dry slopes and dry meadows     | Perennial | Whole plant used as septic wounds                                                  |
| 27.   | Lindelofia stylosa      | Boraginaceae  | Nadma-jar        | Dry loamy and stony slopes     | Perennial | Whole plant used against bone fracture                                              |
| 28.   | Menitskia tibetica      | Lamiaceae     | Yakzas           | Stony habitats                 | Perennial | Dried whole plants used as roofing agent                                              |
| 29.   | Mentha royleana         | Lamiaceae     | Phowa-res        | Wet places along streams       | Perennial | Leaves used for stomach pain and appetite                                           |
| 30.   | Myricaria elegans       | Tamaricaceae  | Umbo             | River banks, stream sides      | Shrubs    | Leaves and flowers to treat arthritis, headache                                     |
| 31.   | Nepeta discolor         | Lamiaceae     | Shamalolo        | Sandy sediments, exposed rocky slopes | Perennial | Leaves decoction used against cold cough                                             |
| 32.   | Nepeta flocose          | Lamiaceae     | Shangku-kuram    | Sandy slopes, deserts          | Perennial | Leaves decoction against malaria                                                   |
| 33.   | Nepeta longibracteata   | Lamiaceae     | Tiangku          | Stony and gravel slopes        | Perennial | Leaves used to treat fever of stomach and fever                                     |
| 34.   | Oxytropis microphylla   | Fabaceae      | Stag-shakarlo    | Semi-deserts, sandy plains     | Perennial | Leaves to subsides swelling and infectious fever                                    |
| 35.   | Pedicularis bicornuta   | Orobanchaceae | Kyang-shog-pa    | Alpine meadows, loamy soils    | Perennial | Upper parts of plant used for vomiting, heal wounds, urine obstruction               |
| 36.   | Peganum harmala         | Zygophyllaceae| Balti-shukpa     | Disturbed habitats, desert areas | Perennial | Seeds used against asthma, rheumatism                                               |
| 37.   | Perovksia abrotanoides  | Lamiaceae     | Iskiling         | Dry river beds, between large stones | Subshrubs | Leaves and flowers used as a aromatic plant                                         |
| 38.   | Physocelaina praetita   | Solanaceae    | Thang-phrom-nagpo| Stony deserts, loamy slopes    | Perennial | Roots and fruits to treat bacterial diseases, diphtheria, inflammation               |
| 39.   | Plantago depressa       | Plantaginaceae| Tharam           | Field margins, eutrophicated soils | Annuals or short lived perennials | Upper parts to treat dysentery, lymph fluid                                         |
| 40.   | Primula macrophylla     | Primulaceae   | Shang-dril-snonpo| Snowbeds, wet spring areas     | Perennial | Flowers to treat fever of lungs, nerve disorders, dysentery of child                 |
| S.No. | Scientific name                | Family              | Sorig/local name | Habitat               | Life form | Parts used and uses                                                                 |
|-------|--------------------------------|---------------------|------------------|-----------------------|-----------|--------------------------------------------------------------------------------------|
| 41    | Ranunculus natans              | Ranunculaceae       | Churug-sbal-lak  | Rivers, streams       | Perennial | Upper parts used to treat ligament and tendon disorders                                |
| 42    | Rheum spiciforme               | Polygonaceae        | Lachu            | Gentle stabilized areas | Perennial | Roots are used to treat dermatological disorder, indigestion                          |
| 43    | Rhodiola imbricate             | Crassulaceae        | Rholomarpo       | Mesic stony slopes    | Perennial | Roots to treat lung disorder, high altitude diseases                                   |
| 44    | Rhodiola pamiroalaica          | Crassulaceae        | Rholomarpo       | Screes and stony slopes | Perennial | Roots used as tonic and infectious cough                                              |
| 45    | Rosa webbiana                  | Rosaceae            | Sia              | Dry stony slopes, rock crevices | Shrub     | Fruits and petals used as exorcizing evil spirits                                      |
| 46    | Saussurea bracteata            | Asteraceae          | Jarbag           | Stony slopes, gravel areas | Perennial | Leaves used against wounds                                                           |
| 47    | Saussurea ceratocarpa (Jurinea ceratocarpa) | Asteraceae | Charok-nyungma | Wet to mesic meadows | Perennial | Upper part used for stomach cancer                                                    |
| 48    | Saxifraga flagellaris          | Saxifragaceae       | di-ta-sa-zin     | Wet rock crevices     | Perennial | Whole plants used to treat inflammation of nerve                                       |
| 49    | Senecio krascheninnikovia      | Asteraceae          | Serpo-gudrus     | Disturbed sites, gravel slopes | Annuals   | Flowers to treat wounds and eczema                                                    |
| 50    | Silene gonosperma              | Caryophyllaceae     | Luk-suk          | Moraines, scree       | Perennial | Roots to treat nasal problem and hearing defects                                       |
| 51    | Tanacetum fruticulosum (Ajania fruticulosa), | Asteraceae | Khanser          | Rock crevices         | Subshrubs | Whole plant to treat swelling and inflammation of lymphs                               |
| 52    | Thylocospermum ceaspitosum     | Caryophyllaceae     | Tagara-can       | Stony river sediments, rock crevices | Perennial | Whole plant used as fuel wood during winter season                                      |
| 53    | Urtica hyperborean             | Urticaceae          | Za-tshod         | Eutrophicated and disturbed sites | Perennial | Leaves used in cold diseases, blood diseases                                           |
| 54    | Waldheimia tomentosa           | Asteraceae          | Palu             | Stabilized slopes, rock crevices | Perennial | Both leaves and flower used to treat nerve disorder                                     |

4. CONCLUSION

The ethno-botanical study and survey of the location revealed that the people of the area have good knowledge of medicinal plants and their traditional usage in amchi system but due to the over exploitation of these species has not only degraded the local vegetation and the disappearing of natural beauty but also endangered certain species, and one has to travel miles to find them. Harsh climate and high altitude conditions and inaccessibility are the
factors which force the people to depend on wild flora for healthcare. Therefore, there is dire need for the protection of this wealth of nature before it disappears from this planet.

Therefore, all efforts made to conserve the threatened herbal species and promote its cultivation by developing different agro-techniques either in-situ or ex-situ by the coordinated efforts of the research and development organizations would go a long way in improving the socio-economic status of and in preserving the traditional knowledge and resources of this region.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

NOTE

The study highlights the efficacy of "herbal" which is an ancient tradition, used in some parts of India. This ancient concept should be carefully evaluated in the light of modern medical science and can be utilized partially if found suitable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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