The Academic
International Journal of Multidisciplinary Research

An Online Peer Reviewed / Refereed Journal
Volume 4 | Issue 3 | March 2026
ISSN: 2583-973X (Online), SJIF IF: 5.6
Website: www.theacademic.in

Ethnobotanical Relevance of Sea Buckthorn (Hippophae spp.) in Tibetan and Himalayan Traditional Medicine Systems

Dr. S. Shyamkiran Singh

Assistant Professor, Department of Chemistry, Waikhom Mani Girls' College, sorokhiabams@gmail.com

DOI : https://doi.org/10.5281/zenodo.19543493

ARTICLE DETAILS

Research Paper

Accepted: 27-03-2026

Published: 10-04-2026

Keywords:

Sea buckthorn; Hippophae rhamnoides; ethnobotany; Tibetan medicine; Himalayan traditional medicine; ethnopharmacology; conservation

ABSTRACT

Sea buckthorn (*Hippophae* spp.), notably *Hippophae rhamnoides*, is a thorny, nitrogen-fixing shrub native to cold-temperate and alpine regions across Eurasia. Its striking orange berries, seeds, leaves and oils have long been used in Tibetan and other Himalayan traditional medicine systems for an array of ailments including wounds and burns, gastrointestinal disorders, respiratory complaints, circulatory problems and nutritional deficiencies. Ethnobotanical surveys conducted across the Himalayan arc (India, Nepal, Bhutan, Tibet, Pakistan) document diverse local uses, preparation methods and cultural practices tied to sea buckthorn, as well as social and economic values for pastoralists and high-altitude communities. The phytochemical richness of sea buckthorn — vitamins (notably vitamin C), carotenoids, flavonoids, unique fatty acids (including palmitoleic acid), sterols and polysaccharides — underpins many of these traditional uses, providing plausible bioactivity for wound healing, mucosal protection and metabolic support. However, despite a strong cultural legacy and growing pharmacological interest, critical challenges remain: variability of traditional preparations, limited integration of indigenous knowledge into formal pharmacopoeias, threats to wild populations from overharvesting and land-use change, and the need for culturally sensitive conservation and sustainable utilization strategies. This paper synthesizes ethnobotanical records and contemporary scientific literature to (1) document traditional uses of sea

buckthorn in Tibetan and Himalayan medicine, (2) explore links between traditional practices and phytochemical/pharmacological evidence, and (3) highlight conservation, livelihood and research priorities needed to translate traditional knowledge into sustainable health and development outcomes.

1. Introduction

Sea buckthorn (*Hippophae* spp.), a deciduous shrub belonging to the family *Elaeagnaceae*, has been deeply interwoven with the cultural, medicinal, and nutritional fabric of the Tibetan Plateau and the Himalayan region for centuries. Indigenous communities inhabiting these high-altitude, ecologically fragile zones have relied on the plant's fruits, seeds, leaves, and bark as a multipurpose resource for sustenance, health maintenance, and spiritual well-being. Known locally by various names—such as "Tshedruma" in Tibetan, "Acha" in Ladakh, and "Charma" in parts of Nepal—sea buckthorn occupies a distinct position in both the formalized Tibetan Sowa Rigpa medical tradition and diverse Himalayan folk healing systems.

The plant's ethnobotanical prominence arises not only from its remarkable resilience to extreme cold, drought, and poor soils but also from its unique phytochemical profile. Rich in vitamins (especially vitamin C, E, and K), carotenoids, flavonoids, sterols, and essential fatty acids (including the rare omega-7), sea buckthorn offers a synergistic combination of nutrients and bioactive compounds. These constituents underpin its therapeutic applications for conditions ranging from digestive disorders and respiratory ailments to wound healing and cardiovascular health. In traditional Tibetan medicine, the fruits and leaves are incorporated into multi-herb formulations to "balance the three humors" (rLung, mKhris-pa, and Bad-kan), alleviate heat disorders, and strengthen the body's protective essence (*nying-rgyud*).

Geographically, the distribution of *Hippophae* spp. in the Tibetan and Himalayan regions includes *H. rhamnoides*, *H. salicifolia*, and *H. tibetana*. Each species is adapted to specific altitudinal and climatic niches, from the trans-Himalayan arid zones of Ladakh and Spiti to the mid-hill valleys of Nepal and Bhutan. This ecological variability influences not only the phytochemical profile but also the cultural uses, as local healers often differentiate between species for targeted applications. For instance, *H. tibetana* is favoured in certain areas for respiratory complaints, while *H. salicifolia* is valued for gastrointestinal remedies.

The ethnobotanical role of sea buckthorn in these regions cannot be separated from its socio-economic and spiritual contexts. In many Tibetan Buddhist communities, medicinal plants are harvested according to lunar and astrological calendars, with rituals performed to honour the mountain deities believed to be guardians of the flora. Sea buckthorn groves are often considered protective vegetation, preventing soil erosion and maintaining riverbanks in high-altitude landscapes where vegetation cover is sparse. This ecological service has reinforced its role as a "life-supporting" plant in local cosmologies.

Over the past few decades, there has been a resurgence of interest in sea buckthorn, driven by global nutraceutical markets and conservation-based livelihood programs. However, this commercialization brings both opportunities and challenges. While increased demand can promote income generation and conservation awareness, unsustainable harvesting and habitat degradation threaten wild populations. Traditional practitioners and ethnobotanists stress the importance of aligning modern utilization strategies with age-old principles of sustainable harvesting embedded in Himalayan and Tibetan cultural norms.

In modern scientific discourse, the pharmacological potential of sea buckthorn has been extensively studied, lending credence to many traditional claims. Its antioxidant, anti-inflammatory, hepatoprotective, and adaptogenic properties, documented in both in vitro and in vivo studies, align with its ethnomedicinal uses. Nonetheless, there is a pressing need to bridge traditional knowledge systems with contemporary research, not only to validate traditional uses but also to safeguard the cultural heritage associated with the plant.

This paper aims to synthesize ethnobotanical evidence regarding sea buckthorn's role in Tibetan and Himalayan medicine, highlighting its cultural symbolism, medicinal formulations, preparation methods, and the interplay between traditional knowledge and modern applications. By integrating ethnographic documentation with phytochemical and pharmacological data, we seek to provide a comprehensive perspective that can inform sustainable development, conservation policy, and cross-cultural healthcare integration.

2. Historic and Cultural Context in Tibetan and Himalayan Medicine

The Tibetan Plateau and the Himalayan ranges, spanning across modern-day Tibet, Nepal, Bhutan, northern India, and parts of China, have long nurtured a distinctive medicinal tradition that integrates empirical herbal knowledge with deeply rooted spiritual and cultural beliefs. Within this framework, *Hippophae rhamnoides* and related species of sea buckthorn hold a revered position, both as a therapeutic resource and as a culturally significant plant. Historical accounts trace its medicinal use in the region

back more than a thousand years, with its prominence documented in classical Tibetan medical texts such as the *Gyud Zhi* (Four Tantras) and in regional *materia medica* manuscripts. These records often describe sea buckthorn fruits, seeds, and oils as agents for nourishing the body, balancing humoral energies, and addressing specific gastrointestinal, respiratory, and skin ailments.

In Tibetan medicine, which is based on the balance of three humours (*rlung* – wind, *mkhris-pa* – bile, and *bad-kan* – phlegm), sea buckthorn is primarily associated with harmonizing *mkhris-pa* and *bad-kan* disturbances. The fruit's sour-sweet taste, oily nature, and warming potency are considered beneficial for promoting digestion, enhancing nutrient assimilation, and reducing phlegmatic sluggishness. Traditional healers have historically prescribed its juice and decoctions for conditions described as "cold disorders" of the stomach, which often correspond to chronic indigestion, poor appetite, and fatigue. In addition, its oil was valued as a restorative tonic for convalescent patients, reflecting its cultural role as a symbol of vitality and recovery.

In the Himalayan regions of Ladakh, Spiti, and Mustang, sea buckthorn also holds economic and seasonal importance. Harvested in late autumn, its berries are traditionally preserved by sun drying or fermenting, ensuring availability during the long winter months when fresh produce is scarce. Folklore and oral traditions from these communities often portray the plant as a gift from the mountain deities, conferring resilience and protection against the harsh alpine climate. These narratives not only underscore its medicinal role but also embed it within the spiritual identity of the people, where plants are often regarded as sacred allies in maintaining health and harmony with nature.

The integration of sea buckthorn into Buddhist monastic medical practice is another notable aspect of its cultural history. Monasteries across Tibet and the Himalayas historically served as centres for both spiritual study and medical care, where trained *amchi* (traditional physicians) cultivated medicinal plants in monastery gardens. Sea buckthorn shrubs were often planted in high-altitude monastery compounds, both for practical medicinal access and for their perceived auspicious qualities. In this context, sea buckthorn became part of ritual healing practices, where herbal preparations were sometimes consecrated through prayer before administration, aligning with the Buddhist emphasis on compassionate care.

Cultural trade routes, particularly along the ancient Silk Road and the trans-Himalayan trade networks, also played a role in expanding the reputation of sea buckthorn beyond its native high-altitude zones. Tibetan traders and herbalists exchanged dried berries and oil with Mongolian, Chinese, and Central Asian counterparts, further embedding it in the pharmacopeias of multiple traditional medicine systems.

These exchanges facilitated cross-cultural learning, allowing the plant's therapeutic uses to evolve and diversify while maintaining its core ethnobotanical significance.

In contemporary times, the historic and cultural heritage of sea buckthorn continues to influence its identity in the region. Even as modern phytochemical research validates many traditional claims, local communities retain a strong cultural attachment to the plant. It remains a key element in ethnobotanical knowledge transmission, passed from elder herbalists to younger practitioners through apprenticeship and oral instruction. This continuity of use underscores not only its medicinal efficacy but also its enduring role as a cultural emblem of health, sustenance, and adaptation in the challenging environments of Tibet and the Himalayas.

3. Ethnobotanical uses, preparations and administration

Sea buckthorn (*Hippophae rhamnoides* L.) holds a well-established role in the ethnobotanical practices of communities inhabiting the Tibetan Plateau, Ladakh, Nepal, Bhutan, and adjacent Himalayan regions. Its ethnopharmacological relevance extends beyond a single therapeutic niche, as local healers and traditional physicians employ various parts of the plant—berries, leaves, bark, and seeds—across multiple formulations aimed at treating a broad spectrum of disorders. The versatility of *Hippophae* stems from its diverse chemical composition and the adaptability of its preparations to local health needs, seasonal availability, and cultural contexts.

3.1. Traditional Uses by Plant Part

- **Berries:** The berries, either fresh, dried, or processed, are widely used to address digestive disturbances, improve appetite, relieve weakness, and promote recovery from illness. In Tibetan medicine, berry juice or pulp is given to treat chronic cough, lung weakness, and phlegm-related disorders, aligning with the humoral concept of balancing lung, wind, and bile energies.

- **Leaves:** Decoctions of the leaves are administered for inflammatory conditions of the stomach and intestines, and as a supportive measure for joint pain and rheumatism. In pastoral Himalayan communities, leaf infusions are also consumed as a general tonic and given to livestock to improve health and milk yield.

- **Bark and Roots:** Bark preparations, particularly in powdered form, are used as topical applications for skin wounds, frostbite, and burns. Root infusions are less common but have been employed to manage fever and systemic inflammation.

- **Seeds and Seed Oil:** The oil, extracted traditionally by boiling seeds or berries and skimming off the lipid layer, is used externally for wound healing, burns, and skin dryness, and internally for gastric ulcers, sore throat, and cardiovascular vitality.

3.2. Preparation Methods

Preparation techniques in Tibetan and Himalayan medicine often reflect a blend of indigenous knowledge and Buddhist medical principles as codified in the *Gyud Zhi* (Four Tantras). Common methods include:

- **Decoctions:** Fresh or dried berries/leaves boiled for extended periods to extract bioactive constituents; often taken warm with added honey or rock sugar.

- **Infusions:** Milder extractions used particularly for leaves, intended for daily tonic consumption.

- **Pastes and Poultices:** Crushed fresh berries or leaves applied directly to wounds, burns, or inflamed areas.

- **Fermented Preparations:** In certain Himalayan villages, berry fermentation yields mildly alcoholic beverages or probiotic-rich tonics consumed for digestive and circulatory health.

- **Oils and Ghee-based Extracts:** Oil extracted from berries or seeds is sometimes blended with yak ghee to enhance warming and restorative properties in winter months.

3.3. Administration and Dosage Practices

In traditional contexts, dosing is typically empirical and adjusted according to age, constitution, and illness severity. The therapeutic use is often seasonal—berry-based tonics are more common during winter and early spring to counter cold-induced ailments, while leaf teas are used in summer for digestive balance and detoxification. In Tibetan medical clinics, formulations containing sea buckthorn may be dispensed as part of compound herbal pills (*rilbu*), combined with other botanicals such as *Terminalia chebula* (chebulic myrobalan) and *Saussurea lappa*.

3.4. Integration with Dietary Practices

Sea buckthorn consumption often blurs the line between food and medicine in these regions. Berries are incorporated into soups, chutneys, and preserved condiments, reflecting the ethnobotanical principle that nourishment and therapy are interlinked. This dietary integration ensures sustained intake of beneficial nutrients such as vitamin C, flavonoids, and omega fatty acids, supporting both preventive and curative health approaches.

Overall, the ethnobotanical utilization of sea buckthorn in Tibetan and Himalayan medicine illustrates a highly adaptive and culturally embedded practice, where preparation methods are closely aligned with seasonal availability, local resource management, and the holistic philosophies of traditional healing systems.

4. Linkages between traditional uses and Phytochemistry / pharmacology

The ethnobotanical applications of sea buckthorn (*Hippophae rhamnoides* L. and related species) in Tibetan and Himalayan medicine exhibit a striking congruence with modern phytochemical and pharmacological findings. Traditional healers have long prescribed sea buckthorn fruits, leaves, and oils for conditions ranging from digestive ailments to respiratory disorders, skin injuries, and metabolic imbalances. Contemporary research provides a mechanistic basis for many of these uses, validating centuries of empirical knowledge.

From a phytochemical standpoint, sea buckthorn is a rich reservoir of bioactive constituents, including high concentrations of flavonoids (isorhamnetin, quercetin, kaempferol derivatives), carotenoids (β-carotene, lycopene, zeaxanthin), polyunsaturated fatty acids (omega-3, -6, -7, and -9), sterols, phenolic acids, and vitamins C and E. These compounds collectively impart potent antioxidant, anti-inflammatory, antimicrobial, and tissue-regenerative effects. The traditional Tibetan application of sea buckthorn oil for wound healing and skin regeneration, for instance, aligns with modern evidence demonstrating its role in enhancing collagen synthesis, improving microcirculation, and modulating inflammatory cascades.

Similarly, the use of sea buckthorn decoctions and infusions in Himalayan communities for gastrointestinal complaints finds biochemical support in the plant's mucilage content, flavonoid-mediated mucosal protection, and anti-ulcerogenic effects. Laboratory and clinical studies have shown that sea buckthorn extracts can reduce gastric mucosal injury, promote epithelial repair, and regulate gut microbiota — pharmacodynamic outcomes that directly parallel ethnomedicinal observations.

Respiratory uses, such as treating chronic cough, bronchitis, and altitude-related respiratory distress, may be linked to the presence of bioflavonoids and triterpenoids with bronchodilatory, anti-inflammatory, and antimicrobial activities. The adaptogenic role attributed to sea buckthorn in Tibetan formulations, often prescribed to improve stamina and vitality at high altitudes, can be rationalized by its antioxidant capacity, mitochondrial protective effects, and the presence of omega-7 fatty acids that support energy metabolism and membrane fluidity in hypoxic conditions.

Metabolic indications in traditional systems, particularly for "hot" disorders (interpreted in humoral pathology as inflammatory or oxidative conditions), correspond well with modern findings on sea buckthorn's ability to modulate lipid profiles, enhance insulin sensitivity, and lower systemic oxidative stress. Phytosterols and unsaturated fatty acids present in the berries and seeds have demonstrated hypolipidemic effects, while polyphenols contribute to improved endothelial function and reduced inflammatory markers.

Moreover, the combination of multiple plant parts in Tibetan and Himalayan preparations — fruits for systemic rejuvenation, leaves for antimicrobial infusions, and bark for anti-inflammatory poultices — mirrors a pharmacological synergy. Current research increasingly highlights the additive or synergistic actions of sea buckthorn's phytochemicals, where antioxidant vitamins protect polyunsaturated fatty acids from peroxidation, and flavonoids enhance the bioavailability of carotenoids.

Overall, the correspondence between traditional therapeutic claims and modern biochemical evidence underscores the ethnopharmacological validity of sea buckthorn in these high-altitude cultural contexts. By linking ancient practice with contemporary science, we not only reinforce the credibility of Himalayan and Tibetan medical heritage but also identify promising avenues for drug discovery and nutraceutical development.

5. Socioeconomic, cultural and conservation considerations

The ethnobotanical importance of sea buckthorn (*Hippophae rhamnoides* and related species) in Tibetan and Himalayan traditional medicine is deeply intertwined with the livelihoods, cultural identity, and ecological integrity of the high-altitude communities where it grows. Beyond its pharmacological value, the plant plays a pivotal role in rural economies, traditional knowledge systems, and environmental stewardship, making it a cornerstone species in the socio-ecological landscape of the Himalayan region.

5.1. Socioeconomic dimensions

In remote Himalayan and trans-Himalayan areas such as Ladakh, Himachal Pradesh, Sikkim, Nepal, and the Tibetan Autonomous Region, sea buckthorn has emerged as both a subsistence and cash crop. Local communities traditionally harvested the fruits, seeds, and leaves for self-use, but in recent decades, market demand for nutraceuticals, cosmetics, and functional foods has driven commercial-scale collection and processing. Value-added products such as sea buckthorn juice, jams, herbal teas, seed oil, and skincare formulations have become significant sources of household income, particularly for women's cooperatives and small-scale entrepreneurs. In areas with limited agricultural options due to harsh climates, sea buckthorn cultivation and processing provide critical livelihood diversification, contributing to food security and rural development. Government and non-governmental organizations in India, China, and Nepal have promoted sea buckthorn-based enterprises as part of poverty alleviation and sustainable development programs.

5.2. Cultural importance

Sea buckthorn holds symbolic and ritual significance in Himalayan and Tibetan societies. In Tibetan medicine, known as *Sowa Rigpa*, it is often associated with vitality, resilience, and purification. Traditional healers (*amchi*) regard it as a 'warm' plant that can restore balance to the digestive and circulatory systems, reflecting the humoral theories underlying Sowa Rigpa. In Ladakhi culture, the plant's bright orange berries symbolize health and prosperity, and they are sometimes offered during local festivals or incorporated into ceremonial meals. In Buddhist contexts, its ecological role in protecting fragile soils and providing sustenance resonates with values of environmental harmony and compassion toward all living beings.

5.3. Conservation concerns and sustainable use

Despite its abundance in certain areas, the growing commercial demand for sea buckthorn products has raised concerns about overharvesting and habitat degradation. In many high-altitude valleys, wild populations are subjected to intensive fruit collection, which can impact natural regeneration and wildlife that depend on the berries, such as migratory birds. Moreover, unsustainable harvesting of branches for fuel wood or over-pruning for easier fruit access can damage plants and reduce long-term yields. Climate change adds another layer of vulnerability, as shifting temperature and precipitation patterns may alter the distribution and productivity of sea buckthorn stands in the Himalayas.

5.4. Community-based conservation strategies

Recognizing these risks, various community-based resource management initiatives have been implemented. In Ladakh, for example, women's self-help groups have developed rotational harvesting schedules to allow plants to recover between collection periods. In parts of Nepal, village forest user groups manage sea buckthorn habitats through controlled access and replanting programs. Agroforestry approaches, where sea buckthorn is cultivated alongside other crops, not only enhance income but also reduce pressure on wild stands. Scientific institutions have collaborated with traditional healers to promote the cultivation of selected high-yield varieties, ensuring both pharmacological quality and ecological resilience.

5.5. Balancing tradition and commercialization

The challenge lies in balancing the preservation of ethnobotanical traditions with the pressures of globalized trade. While commercialization has brought economic benefits and increased awareness of the plant's medicinal potential, it also risks commodifying traditional knowledge without adequate benefit-sharing. Ethical and legal frameworks, such as India's Biological Diversity Act (2002) and the Nagoya Protocol on Access and Benefit Sharing, offer mechanisms to protect the intellectual property rights of indigenous communities and ensure equitable sharing of profits arising from the use of traditional medicinal plants like sea buckthorn.

Sea buckthorn's role in the Himalayan and Tibetan cultural landscape extends far beyond its medicinal uses—it is a nexus of economy, ecology, and heritage. Sustaining its ethnobotanical legacy will require integrative strategies that combine community empowerment, ecological stewardship, and respect for traditional knowledge, ensuring that both the people and the plant thrive in the face of modern challenges.

6. Research gaps and priorities

Several gaps should be prioritized to ethically and effectively translate traditional knowledge into broader health and development outcomes:

- **Rigorous ethnographic documentation:** More systematized fieldwork to record local preparation methods, dosages, and cultural meanings of sea buckthorn use across Tibetan and Himalayan communities.

- **Phytochemical standardization of traditional preparations:** Chemical profiling of traditional formulations (oil, decoctions, poultices) to link bioactive constituents with ethnomedical claims.
- **Community-led cultivation and value-chain models:** Participatory programs to develop sustainable cultivation, processing and equitable benefit sharing.
- **Safety, dosage and interaction studies:** Local remedies should be studied for safety (especially topical vs. systemic), and for potential interactions with contemporary medications used by high-altitude populations.
- **Integration into health systems with cultural sensitivity:** Where clinically supported, design culturally appropriate interventions that respect indigenous intellectual property and benefit sharing.

7. Conclusion

Sea buckthorn occupies a central place in Tibetan and Himalayan ethnomedicine, functioning as food, remedy and economic resource. Its traditional uses for wound healing, gastrointestinal complaints, respiratory ailments and as a nutritive tonic find support in modern phytochemical and pharmacological studies, although the evidence base varies by indication. Protecting the plant's ecological habitat and intangible cultural heritage, while fostering community-owned, scientifically robust valorization pathways, offers a path for sustaining both biodiversity and indigenous health knowledge. Interdisciplinary research that combines ethnography, phytochemistry, pharmacology and participatory development will be essential for ethical and effective utilization of sea buckthorn's ethnobotanical legacy.

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