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# Sea buckthorn : A Treasure of Cold desert

**Bushra Bashir[1], Md.Aamir Khan[2],Shafia Rehman[3] , Monica Reshi [4], Hilal Makroo [5], Urba Shafiq [6]**

*[1]Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology, Shalimar, 190025*
*[2] CEO and Founder at Waste to Wealth-an agrifood tech and agri-food waste R&D enterprise*
*[3] Healthcare Educator, Government Higher Secondary School, Devsar, Kulgam, 192231*
*[4] Assistant Professor, Division of Post Harvest Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu,*
*[5]180009Assistant Professor, Department of Food Technology, Islamic University of Science and Technology, Awantipora, Pulwama, 192122*
*[6] Department of Food Technology, Islamic University of Science and Technology, Awantipora, Pulwama, 192122*

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**Abstract -** *Sea buckthorn (Hippophae L.) is a useful, versatile plant that is widely farmed in Asia, Europe, and Canada. It is a trans-Himalayan Ladakh plant species that is both environmentally and economically valuable. Sea buckthorn (SBT), once regarded as a vexing problem, is now seen as a viable option for the trans Himalayan region's long-term development. Sea buckthorn produces yellow or orange-red berries, and the ripe fruits are high in vitamins with antioxidant and anti-stress qualities, as well as a variety of bioactive chemicals. The juice or pulp could be used in a variety of cuisines and beverages. Foods, beverages, medications, cosmetics, healthcare items, chemicals, and industrial materials are all products of SBT. The presence of a variety of different medicinal components suggests that developing new pharmaceuticals based on extracts from the plant could help treat a wide range of ailments. Sea buckthorn can endure temperatures ranging from -40 to +40 degrees Celsius. Moreover, sea buckthorn is recognized for its potential in addressing tumors, stomach ulcers, skin ailments, and arsenic poisoning. The Himalayas conceal this invaluable resource, presenting abundant prospects to positively impact the lives of high-altitude communities by harnessing this hidden gem.*

***Key Words***: **Sea buckthorn, ladakh, sustainable, bioactive compounds, foods, medicine**

## 1. INTRODUCTION

During the last few decades, sea buckthorn (SBT) has grown in importance. It is commonly referred to as the Golden Bush of the Himalayas, Ladakh Gold, and Wonder Plant, owing to its multifaceted applications [1]. The sea buckthorn (genus Hippophae L., family Eleagnaceae) is a highly valued shrub that is currently being domesticated and cultivated in orchards throughout the world, particularly in Europe, Canada, and the United States [2]. For centuries, it has been employed in Europe and Asia for both culinary and pharmaceutical uses. [4]. It thrives in impoverished soils and exhibits resilience to extreme temperatures, withstanding ranges from -40 °C to +40 °C [3]. In Ladakh, it is known as "Tsermang" and its fruits are known as "Tsestalullu." Sea buckthorn is found in greater abundance in Ladakh's Leh and Nubra valleys [6, 7]. Its name is derived from its tendency to thrive in coastal areas and the abundance of spines or thorns resembling those of certain buckthorn species (of the genus Rhamnus). The leaves of seabuckthorn are small, featuring a thicker cuticle, a well-defined crib structure, and a densely scaled and star-hair-covered underside to conceal the stomata. The shrub develops an extensive root system capable of nitrogen fixation from the air [5].

Sea buckthorn can be found in India's frigid deserts and other Himalayan regions, including Himachal Pradesh, Ladakh in Jammu and Kashmir, Sikkim, and Arunachal Pradesh [4]. In India, sea buckthorn has garnered growing interest, particularly after the Defence Institute of High Altitude Research (DIHAR), formerly known as the Field Research Laboratory (FRL), a constituent institute of the Defence Research and Development Organisation (DRDO), successfully developed technology for creating a beverage from its highly acidic fruit. Every component of the plant, including the fruit, leaf, twig, root, and thorn, has been traditionally utilized for medicinal purposes, nutritional supplementation, fuel, and fencing. As a result, sea buckthorn is commonly referred to as the 'Wonder Plant,' 'Ladakh Gold,' 'Golden Bush,' or 'Gold Mine''[5].

Sea buckthorn has gained international attention as a potential new crop [8,10]. It is thought to have enormous commercial potential, and some predict that it will become the next big health food craze. Seabuckthorn stands as a valuable resource for researchers across diverse fields, including biotechnology, nutraceuticals, pharmaceuticals, cosmetics, and environmental science, among others, owing to its distinctive and advantageous properties. It serves as an exemplar illustrating how a lesser-known shrub, thriving in the Himalayas, can contribute to modern society through

rigorous scientific exploration [9,10]. The berries of Sea buckthorn rank among the most nutritious and vitamin-rich fruits within the plant kingdom, earning them the designation of "Super Healthy Fruits" [11,12]. The nutritional value of the berries determines the plant's importance. The berries boast a rich concentration of vitamins A, B1, B2, B6, C, and E. Additionally, they contain essential components such as carotene, fatty acids like palmitin and palmitolein, and β-sitosterol, all of which have found application in therapeutic contexts. Impressive levels of vitamin C and E are present, reaching up to 360 mg/100 g of fruit weight and 160 mg/100 g of fruit weight, respectively. Sea buckthorn is abundant in flavonoids, carotenoids, as well as water and fat-soluble vitamins. [14].

In recent years, the plant has been extensively utilized for addressing issues such as sluggish digestion, stomach malfunction, neoplasia, thrombosis, hepatic injuries, as well as tendon and ligament injuries [5]. Traditional uses of sea buckthorn in treating stomach ulcers have been supported by laboratory investigations, highlighting the efficacy of its seed oil in this application. It appears to play a role in regulating stomach acid secretion and minimizing inflammation by modulating pro-inflammatory mediators. Moreover, clinical trials have demonstrated that sea buckthorn extracts contribute to normalizing liver enzymes, serum bile acids, and immune system markers associated with liver inflammation and degeneration [16].

## 2. Origin and Distribution

In India, three distinct species of Hippophae L. (namely H. rhamnoides L., H. salicifolia D. Don, and H. tibetana Schultz) are naturally found in high-altitude regions of Himachal Pradesh (Lahul Spiti, parts of Chamba, Kinnaur, Kullu, Shimla, and Kangra), Jammu and Kashmir (Leh and Ladakh), and certain areas of Uttar Pradesh and Sikkim. Within the Sikkim Himalayas, the plant thrives along riversides, landslide-prone areas, and torrential slides, predominantly on the South-East aspects in Lachen and Lachung valleys of North Sikkim. Specifically, H. salicifolia D. Don in Sikkim typically grows at altitudes ranging from 2377–3093 m, and no other species have been observed in this region except for H. salicifolia [13].

Around 11,500 hectares of pure seabuckthorn have been observed in the Ladakh region of Jammu and Kashmir [5]. Seabuckthorn is found in abundance in India's Ladakh region, followed by Uttrakhand, Himachal Pradesh, and the North East. In Ladakh, there are 11,500 hectares of pure Seabuckthorn vegetation and 30,000 hectares of mixed forest [9] cultivation/cover with Willow (Salix), Populus, and other species [11]. The Geographical Indication Registry, operating under the Ministry of Commerce & Industry, Government of India, has officially granted the GI tag to the Department of Industries & Commerce, Ladakh and approved it as the Registered Proprietor for ‘Ladakh Sea Buckthorn’ in Class 31.

## 3. Fruit Harvesting

The harvest of sea buckthorn fruit commences shortly after reaching ripeness. Fruit harvesting proves to be the most time-consuming phase of sea buckthorn production. Several factors contribute to the complexity of this process, including the small size of the fruit, the short pedicel, the force required to detach each fruit from the branch, the dense arrangement of fruit on the branches, and the presence of thorns on the plant. Harvesting is notably more manageable during the early morning hours. Various methods, both direct and indirect, can be employed for fruit collection. [5,10,15].

A direct harvester involves physical contact with the fruit, while an indirect harvester removes the fruit without direct physical contact. Direct harvesters, exemplified by vacuum suction harvesters, prove to be highly efficient in fruit removal. In the harvesting process, the vacuum pump, powered by the tractor through the universal shaft, generates a flow within the designated picking head, suctioning the sea buckthorn fruit into the harvester's container. Once the container is full, the fruit is transferred to fruit boxes. Indirect harvesting often involves shaking a section of the plant, causing the fruit to detach from the stem when forces are applied to the plant's trunk or branches. Examples of indirect harvesting methods include vibration harvesting and cutting harvesting [32].

## 4. Composition

Table 1 displays the moisture, ash, protein, carbohydrate, fat, sugars and vitamin C expressed from sea buckthorn berries of ladakh [2,17].

**Table -1:** Chemical composition of sea buckthorn berries of Ladakh

| | |
|---|---|
| Moisture (%) | 75.42 ± 80.11 |
| Ash (%) | 2.21 ± 2.70 |
| Crude protein (%) | 5.09 ± 5.99 |
| Crude fiber (%) | 4.22 ± 4.74 |
| Total carbohydrates (%) | 22.04 ± 25.65 |
| Fat (%) | 1.72 ± 2.21 |
| Total sugar (%) | 1.0 ± 1.3 |
| Vitamin C (mg/100 g) | 454.2 ± 470.31 |

The average composition of sea buckthorn berries is presented in Table 1. Moisture content ranges from 75.42% to 80.11%, although these values require careful consideration. Sea buckthorn juice is known to be highly deliquescent, and measuring moisture can pose challenges in some samples. This is particularly true when the base dry weight is high in both moisture and oil determinations, especially when determined through freeze-drying [14]. The juice extracted from the berries is high in suspended solids and very high in vitamin C [18].

## 5. Traditional Uses

Sea buckthorn fruits, in the form of concoctions, have been integral to the Tibetan system of medicine for over a millennium [17]. The inhabitants of the trans-Himalayan region have acquired expertise in the prudent utilization of SBT resources [6]. In the cold deserts of Ladakh, people have adeptly harnessed the benefits of seabuckthorn, utilizing it judiciously due to resource scarcity. Traditionally, every part of the plant, including the fruit, leaf, twig, root, and thorns, serves a multitude of purposes such as medicine, nutritional supplementation, firewood, fencing, tree guards, windbreaks, building construction, religious rites, and agricultural implements, as outlined in Table 2. [5,6]. In the region, agricultural fields hold utmost importance owing to the limited availability of cultivable land [20]. The cultivation of timber trees, particularly willow and poplar, is a significant undertaking in the cold desert of Ladakh [21]. As per tradition, the dense and thorny shrub is strategically planted around agricultural fields and plantation sites to provide protection against stray animals and pedestrian movement [5]. In the Nubra Valley, it is a common practice to enhance the fertility of low-fertile fields by incorporating soil from areas densely populated with sea buckthorn (SBT). However, in specific villages within Leh district, including Matho, Shey, and Skurbuchan, sea buckthorn is considered sacred, and any form of cutting from this plant is strictly prohibited. In various locations across Nubra under Leh district, as well as in Kargil and Zanskar under Kargil district, the sea buckthorn plants exhibit larger and sturdier bodies. The robust stems of these plants are utilized for construction purposes, crafting farm implements, wooden ladders, and other applications. [11].

**Table 2** Traditional uses of sea buckthorn in cold desert of Ladakh [21]

| Plant Parts | Traditional uses |
|---|---|
| Leaf | Fodder, tea |
| Berry | Treatment of common ailments, nutritional supplements, oil for household lightening |
| Twig and branches | Biological fencing, firewood, religious rituals, tree guard |
| Stem | Firewood, charcoal, handle for agricultural implements |

## 6. SEA BUCKTHORN BASED PRODUCTS

The nutritional and bioactive substances present in seabuckthorn berries and leaves have captured the attention of researchers, leading to the development of products for both preventive and curative purposes. Seabuckthorn has become a versatile source for various products, including those intended for nutraceutical, cosmetic, and medicinal applications.

The diverse range of potential products underscores the plant's significance in multiple industries, showcasing its potential contributions to health, beauty, and wellness [10,23]. Ripe seabuckthorn fruits are utilized in the production of various products. The mature fruits are typically pressed or pulped, and the resulting mixture is separated into juice and seeds plus skin/fiber components. The oil-less juice obtained can then undergo further processing to create products such as fruit juice, mixed beverages, or pure seabuckthorn (SBT) juice. This processing method allows for the extraction of both nutritional and flavorful elements from the ripe fruits [17]. The Defence Institute of High Altitude Research (DIHAR) has been actively involved in seabuckthorn research since the early nineties and has successfully developed a range of seabuckthorn-based products. Notably, products like seabuckthorn beverage and herbal tea have gained popularity in the Indian market. The institute's efforts in exploring the potential of seabuckthorn and creating marketable products highlight the significance of this plant in various applications, from nutrition to herbal teas, contributing to both health and market appeal [24]. The residual part of the fruit, known as pomace, which includes the seed, skin, and other solids, is subjected to sun drying to facilitate the separation of seeds. The resulting solids and skin can be utilized directly in animal feed. Alternatively, the pigments and carotenoids can be extracted before incorporating the pomace into animal feed, offering a versatile approach to maximize the utilization of seabuckthorn by-products. This process underscores the potential for sustainable practices in making use of various components of the seabuckthorn plant [17]. Sea buckthorn seed oil is used in phytomedicines and in the manufacture of health products [25]. The non-oil solids or seed cake are used to make biscuits or snacks or animal feed [26].

### 6.1 Extraction of Sea-buckthorn Seed Oil

The extraction of common sea-buckthorn oil involves two key components of the plant .Figure 1 illustrates an exemplary and patented method for processing fresh sea buckthorn berries to obtain seed oil, pulp oil, and juice.Primarily, sea-buckthorn oil can be derived through the mechanical cold pressing of seeds, which contain approximately 12.5 wt.% of oil. Alternatively, the oil is extracted through cold pressing or solvent extraction of fruit pulp, containing 8–12 wt.% oil. The resulting fractions undergo filtration.Notably, the appearance and properties of the two oil types differ significantly. Sea-buckthorn fruit oil, for instance, boasts the highest palmitooleic acid (omega-7) content among vegetable oils, ranging from 30 to 35 wt.%, a level not reached by sea-buckthorn seed oil.The oil from juicy berries manifests as a thick, dark orange or red-orange liquid with a distinct smell and taste (sourish when pressed from fruit pulp).Although sea-buckthorn seed oil and fruit oil exhibit differences in active ingredient content, both oils feature a rich array of essential unsaturated fatty acids (UFA), particularly the esteemed palmitooleic acid (C16:1) highly valued in cosmetology. Additionally, both oils are abundant in tocopherols, tocotrienols, and plant sterols.Notably, pulp sea-buckthorn oil is rich in carotenoids compared to seed oil.In regions such as Mongolia, Russia, and China, pulp oil finds application topically for the treatment of skin burns and has been embraced by cosmetic companies for use in anti-aging skincare and oral care products.[33]

Figure 1: A schematic diagram depicting the patented method for processing sea buckthorn berries for seed oil, pulp oil, and juice. [33]

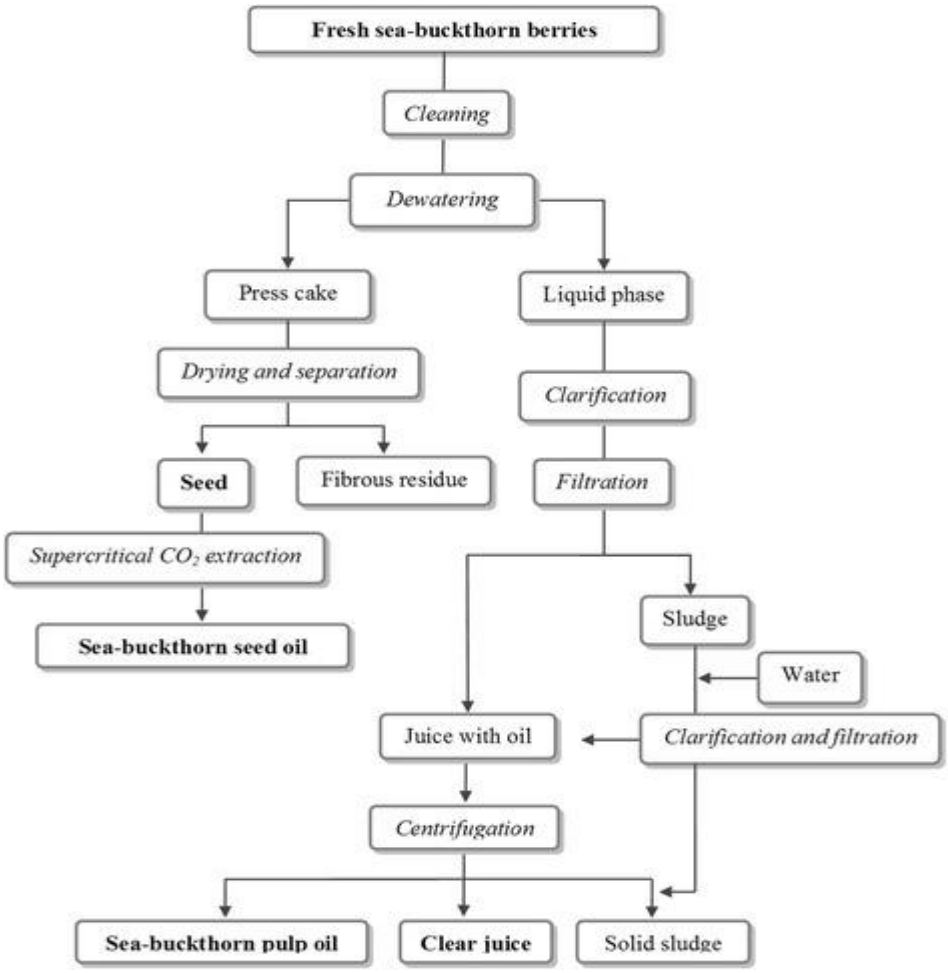


Figure 1: Schematic Diagram

### 6.2 Sea-buckthorn Oil in Cosmetic Formulations

Sea-buckthorn oil serves as a valuable ingredient in the cosmetic industry, particularly in formulations designed for mature skin. Commonly featured in anti-aging and anti-wrinkle products, it stands out as an excellent antioxidant .Furthermore, it contributes to firming and toning sagging skin, effectively smoothing out wrinkles .The oil is also beneficial in caring for dry, irritated (e.g., post-sunbathing), rough, flaking, and itchy skin and serves as an auxiliary product in treating frostbites and skin damage caused by exposure to UV radiation, x-rays, and chemical compounds. Sea-buckthorn oil promotes wound healing, stimulating the regeneration and formation of a new, healthy epidermis, along with collagen synthesis .Its efficacy extends to reducing bedsores, treating eczema, minimizing spots, acne, and alleviating allergic and inflammatory skin conditions .The oil is employed as a soothing agent post-cosmetic procedures such as peelings, baths, masks, and hair removal. Due to its high content of unsaturated fatty acids. and the associated rapid rancidity, it is advisable to use sea-buckthorn oil in the form of capsules for cosmetic products. Additionally, the vivid color of sea-buckthorn oil enhances skin tone upon direct application, providing a fresh and healthy appearance.[33]

### 7. Medicinal uses

The utilization of medicinal plants for human well-being has been a practice dating back to ancient times. In the Ladakh region, this tradition persists, and even today, local traditional healers known as Amchies commonly recommend remedies derived from seabuckthorn to address various everyday health issues. These may encompass conditions such as indigestion, throat infections, gynecological problems, ulcers, gastritis, bronchitis, acidity, diarrhea, hypertension, blood disorders, fever, tumors, gallstones, coughs, colds, and food poisoning, showcasing the enduring significance of seabuckthorn in traditional healing practices [5]. Seabuckthorn oil finds application in treating conditions such as oral mucositis, vaginal mucositis, cervical erosion, duodenal ulcers, gastric cancers, and skin ulcers. [27]. SBT seed, pomace and leaf extracts possess antimicrobial property. Researchers studied the extracts against 6 Gram-positive and 11 Gram-

negative food borne and food spoilage pathogens. Seabuckthorn (SBT) is recognized for its potent antioxidant properties, exhibiting anti-stress and anti-aging effects. It plays a role in slowing down the aging process of the skin and contributes to the promotion of wound healing (17). The antioxidant activity of sea buckthorn is notably potent, primarily attributed to its content of flavonoids, along with vitamins E and C [13,28]. Administration of sea buckthorn seed oil to individuals and animals with hyperlipidemia has demonstrated efficacy in reducing total cholesterol and triacylglycerol levels in the plasma. Additionally, it has been observed to elevate the levels of high-density lipoprotein (HDL) [30]. Sea buckthorn oil possess anti-tumour activities, since the seed oil is known to retard tumour growth by 30-50% [14]. The extensive utilization of sea buckthorn oil is prevalent in fostering the healing of diverse skin conditions. These include eczema, burns, poorly healing wounds, sun damage to the skin, the effects of therapeutic radiation treatment, and cosmetic laser surgery [31].

## CONCLUSIONS

Sea buckthorn stands out as a distinctive and valuable crop, particularly well-suited for cold arid regions. It is gaining prominence as an emerging yet crucial horticulture crop in India and several other nations. The plant holds the potential to significantly contribute to the sustainable development of fragile, cold arid areas. The combination of its traditional uses, commercial value, and ongoing scientific research presents substantial benefits to modern society, unveiling the potential of this lesser-known Himalayan shrub.

In-depth research is imperative for understanding and optimizing sea buckthorn's production, processing, and utilization. It is equally crucial to develop suitable technologies to harness its potential for enhancing human health, wellness, and eco-environmental conservation. Sea buckthorn emerges as a promising plant, particularly for health benefits, owing to its antioxidant properties and high nutraceutical and pharmaceutical value. The medicinal and cosmetic applications of sea buckthorn products, especially its oil, are increasingly sought after.

Investing in sea buckthorn plantation not only holds the promise of high profitability but also serves as a means for the sustainable development of the Ladakh region. With over 300 bioactive agents present, sea buckthorn has become a vital subject for research and development. Undoubtedly, the future looks promising for sea buckthorn, positioning it as a valuable resource with multifaceted benefits.

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## BIOGRAPHIES

Bushra Bashir
Research Scholar,
Department of Food Technology
Islamic University of Science and Technology,
Awantipora

Shafia Rehman;
MSc Public Health,
Healthcare Educator at Govt Hr Sec
School Devsar Kulgam

Mohd. Aamir Khan
Mechanical Engineer,Masters in Social Work,Post graduate diploma in Intellectual Property Rights,Clinton University Graduate Fellow for Waste Management,Researcher, Sustainable Development Goals Advocate and Global Ambassador, CEO and Founder at Waste to Wealth

Monica Reshi
Assistant Professor ,
Department of Post Harvest Management;
Sher e Kashmir University of Science and Technology,Jammu

Dr. Hilal Ahmad Makroo
Assistant Professor, Department of Food
Technology, IUSTAwantipora
Technical Manager, NABL Accredited Food Testing
Lboratory, IUST Awantipora

Urba Shafiq
Research Scholar,
Department of Food Technology
Islamic University of Science and
Technology, Awantipora