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SEA BUCKTHORN: THE NATURE'S WONDER

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ABSTRACT
The sea buckthorn (SBT; *Hippophae rhamnoides*) in the family Elaeagnaceae is a deciduous shrub with a vast area of natural growth in temperate regions of the world, mainly in Mongolia, China, Tibet, Russia, Canada, India, Pakistan, and Nepal. The ancient Greeks noticed that horses fed with the leaves and new branches of SBT exhibited shiny hair and skin and a significant visible gain in weight. This resulted in the naming of the genus Hippophae (from hippo [horse] and phaos [shine]). The most common species of the genus Hippophae is rhamnoides, which is known by various names, such as Siberian pineapple, sand thorn, sea berry, and sallow thorn. In the cold deserts of Ladakh (State of Jammu and Kashmir) and in Lahaul and Spiti (HP), where it is known by many local names, such as Sastalulu, Shangti, Dhurchuk, Chumma, Tarwaa, Sirmaa, Chhurmak, and Leh berry. On September 23, 2015, a renowned Indian yoga guru, Baba Ram Deo of Patanjali Yogpeeth, Haridwar, Uttarakhand, named the plant Brahmaphal, in a transfer of technology function at the Defence Institute of High-Altitude Research (DIHAR), Leh (Jammu and Kashmir). Hence, the Hindi name for SBT is also given as Brahmaphal. It is growing at low temperature, wild in other Indian Himalayan states such as Uttarakhand, Sikkim, West Bengal (Darjeeling hills), and Arunachal Pradesh. It mostly grows wild along river beds or wherever there are small water streams and even irrigation channels. Sea buckthorn is one of the future crops. The leaves, flowers, seeds, and fruits are used to make medicine. Sea buckthorn is used for heart health, skin conditions, swelling (inflammation), and other conditions, but there is no good scientific evidence to support any of these uses. In foods, sea buckthorn berries are used to make jellies, juices, purees, and sauces. In manufacturing, sea buckthorn is used in cosmetics and anti- aging products. The shrub has a remarkable lifespan of more than 100–150 years, and it has a number of eco-environmental and commercial benefits.

KEYWORDS: Introduction, Taxonomy, distribution, mycorrhiza, chemical composition, vitamin C, vitamin K, flavonoids, anti-oxidant, anti-cancer action, soil enhancer, land regeneration, seabuckthorn oil, seabuckthorn tea.

INTRODUCTION
Sea buckthorn, found in the icy heights of the Himalaya, is a deciduous, thorny willow-like plant species native to Europe and Asia. It is a pioneer species and prefers to grow in low humid, alluvial gravel, wet landslips and riverside with brown rusty-scaly shoots. It is also a multipurpose fast-growing species which is serving as a measure of biodiversity conservation, soil conservation, medicines, food, fodder and fuel wood. It has an extraordinary capacity to grow and survive under adverse conditions (-40 to 40º C) and has extensive subterranean rooting system with strong soil binding ability useful for soil stabilization, river bank control and water retention. Sea buckthorn berry is a very rich source of vitamins and is called treasure of bio-activity substance because of its over 190 bio-activity substances possessing unique medicinal properties. For these reasons, it is also called a wonderful plant. Sea-buckthorn is a spinescent, deciduous and anemophilous shrub or a small tree (Fig. 1). Mature plants are extremely variable in height, from less than 50 cm to 20 m tall. Their usual height is ranging between 2 to 10 m. The bark is rough brown, the young branches are grey and usually spiny and the buds are alternate and golden-brown. The leaves are linear or linear-lanceolate, 2–6 cm long, with short petioles and entire margin, covered on both sides with silvery scales, often glabrescent above at maturity. The flowers are very small, yellowish, without petals and appear before the leaves. The fruit (Figure: 1) is subglobose to ovoid, 6–8 mm long, orange-yellow.[1-3]

Figure-1: Sea-buckthorn fruit & tree.

For the farmers living in the mountains, sea buckthorn offers the opportunity to maintain a sustainable livelihood – providing healthy foods, variety of medicines and protecting their land from soil erosion. The use of sea buckthorn illustrates how low input costs and careful planning can lead to quite substantial benefits; a good example of mountain perspective-oriented sustainable development. It thus qualifies as a unique option for the simultaneous management of several problems emanating from the fragility, marginality, inaccessibility and diversity characterizing mountain areas.[4-6]

Taxonomy: Hippophae is a small genus of Elaeagnaceae having a terminal taxon with seven species and eleven subspecies (Fig: 3), which was also given in Species Records of Hippophae, Germplasm Resource Information Network (GRIN, 2007).

1) *H. goniocarpa*
2) *H. gyantsensis*
3) *H. litangensis*
4) *H. neurocarpa*
i. *Subsp. neurocarpa*
ii. *Subsp. stellatopilosa*
5) *H. salicifolia*
6) *H. tibetana*
7) *Hippophae rhamnoides*
i. *Subsp. carpatica*
ii. *Subsp. caucasica*
iii. *Subsp. fluviatilis*
iv. *Subsp. mongolica*
v. *Subsp. rhamnoides*
vi. *Subsp. sinensis*
vii. *Subsp. turkestanica*
viii. *Subsp. Wolongensis*
ix. *Subsp. yunnanensis*

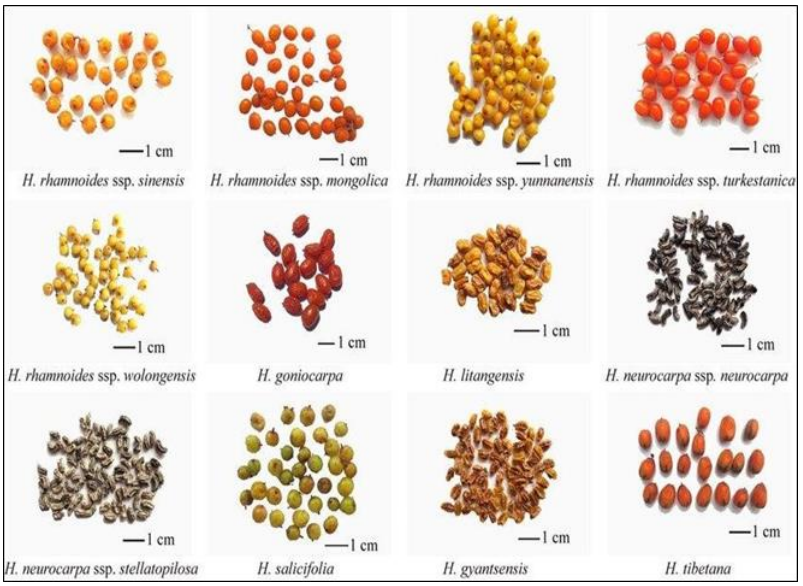

Figure-2: Seven species and subspecies of Sea Buckthorn.

Distribution

1) *H. goniocarpa*: This type of species grows in mountainous region in Nepal and China on mountain slopes, river bank, flood land and valley terraces. The species is decided into two distinct subspecies H. goniocarpa Subsp. litangensis and H. goniocarpa Subsp. Goniocarpa.

2) *H. gyantsensis*: This type of species grown in Tibet of China.

3) *H. litangensis*: This type of species found in Sichuan, Qinghai of China.

4) *H. neurocarpa*: This species is found in Sichuan, Qinghai, Gansu of China.

5) *H. salicifolia*: This is restricted to the south Himalayan area.

6) *H. tibetana*: This species is found in Sichuan, Qinghai, Gansu, Tibet of China, Nepal, India.

7) *Hippophae rhamnoides:*

i. *H. rhamnoides.* Subsp. *rhamnoides* are found in the area of Scandinavian countries, Baltic Sea countries, Germany, Belgium, Netherlands, Ireland, Poland, U.K., France, Russia.
ii. *H. rhamnoides.* Subsp. *carpatica* are found in The Capathinan Mountains, Transsylvanian Alps, the valley and the mouths of the Danube and its tributary.
iii. *H. rhamnoides*. Subsp. *caucasica* are found in the Caucasus Mountains, Georgia, Azerbaijan, Armenia, Ukraine, Romania, Turkey, Bulgaria, Iran, Russia.
iv. *H. rhamnoides*. Subsp. *fluviatilis* are distributed around Alps Mountains: Germany, France, Switzerland, Austria, Czech, Slovakia, Italy.
v. *H. rhamnoides*. Subsp. *mongolica* are distributed in the Siberia of Russia, Mongolia, Xinjiang of China.
vi. *H. rhamnoides.* Subsp. *sinensis* are found in the North, Northwest, Southwest of China.
vii. *H. rhamnoides.* Subsp. *turkestanica* are distributed in the area of India, Pakistan, Afghanistan, Turkmenistan, Kyrgyzstan, Uzbekistan, Kazakhstan, Iran, Turkey, Xinjiang, Tibet of China.
viii. *H. rhamnoides.* Subsp. *yunnanensis* are found in Sichuan, Yunnan, Tibet of China.

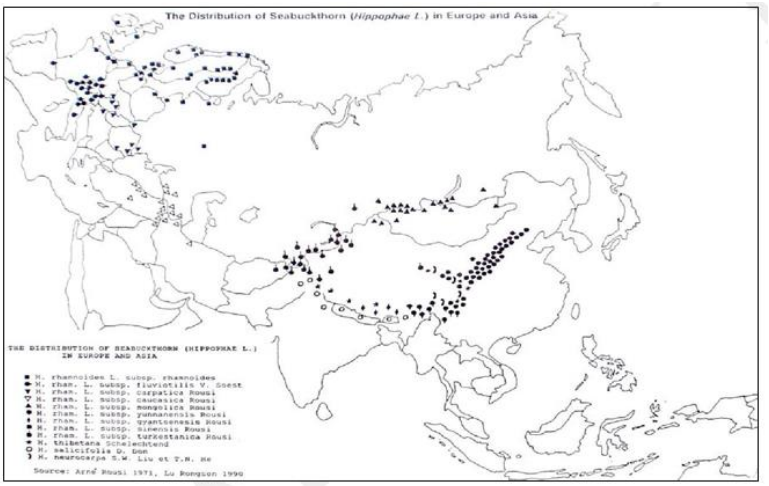

Figure-3: distribution of sea buckthorn in Asia and Europe.

Plant morphology

1) Flower: Seabuckthorn floral buds (Fig: 4) are mostly mixed with vegetative buds and are rarely pure. Floral buds appear mainly in the summer or the autumn and usually open in the following spring. The male floral bud consists of four to six flowers; the female floral bud consists of one flower and rarely two or three. The sex of the seabuckthorn cannot be judged until the first flower bud appears. In the precocious plants this may be in the third year, whereas in slow plants it may happen in the fifth or the sixth year. In Mustang, *H. salicifolia* was found to be fruiting at the age of five. The female flower depends almost entirely on the wind for pollination because both the male and the female flowers have no nectar and they rarely attract bees or other insects.[5-7]

2) Fruit: Seabuckthorn bears a special fruit, which is different from other common fruits or berries. Morphologically it develops from an ovary and a calyx tube which is closely connected to the ovary. Actually, the fruit is a combination of an unsplit, fleshy, expanded calyx tube and an ovary. In other words, the expanded, juicy calyx tube is the important part with economic value.

Figure-4: Sea buckthorn flower & fruits.

The time taken from flowering to fruit maturation is 12 to 15 weeks. Young fruits are hard and greenish, but turn soft and orange or orange-red as they mature. Unlike the majority of fruits that fall away from the maternal plant at maturity, the seabuckthorn berries remain on the branch for several months. This gives ample time to harvest them. In natural seabuckthorn forest, fruits can remain on the branches until the following spring. During this period, usually cold winter, the fruits gradually shrink but do not fall. Therefore, they become

the favourite food of animals, especially birds.

Figure-5: Sea buckthorn seed.

3) Seed: Sea buckthorn is a single seeded fruit. The seed is ovate-oblong with a length of 4 to 7 mm, a breadth of 2.5 to 3.5 mm and a thickness of 1.6 to 2.2 mm. The skin of the seed is greyish-brown or dark brown, leathery and lustrous. The seed is surrounded by a parchment-like ovarian wall. *H. salicifolia* seed is globose and seem fissured on one side with length 3 to 4.5 mm long, a breadth of 2.5 to 3 mm wide and 1.5 to 2 mm thick. It tastes sour. Sea buckthorn belongs to the group of thermophilic plants. Ideal temperature for germination of seed is 24º to 26º C (Fig: 5).

Figure-6: Sea buckthorn leaf.

4) Leaves: The leaves are small (usually 3 to 8 cm long and 0.4 to 1 cm wide), alternate, linear, lanceolate and covered on the backside with silvery stellate scales that reflect sunshine and reduce moisture loss (Fig: 6).

5) Roots: Sea buckthorn has a mighty and well-developed tap root system (Fig: 7), having primary, secondary and tertiary roots covered with root hairs, found more prominently in the apical portion. Some 80% of its feeding roots are in the topsoil (0.2 to 0.8 m) helping to prevent erosion. Often young plants have twice the height of the plant and root widths three times wider than the crown of the plant above the ground. The sea buckthorn root system is so extensive that its roots can branch many times in a growing season and form a complex network of roots. Horizontal roots also have root turions (underground buds) which sprout and give rise to another plant. In this way, seabuckthorn bushes play an important role in protecting riverbanks, preventing floods and clogging mud, which would otherwise be washed away in floodwaters symbiotic mycorrhizal fungus, which is identified as *Flankia* (Actinomycetes), has been found on seabuckthorn roots.[8-10]

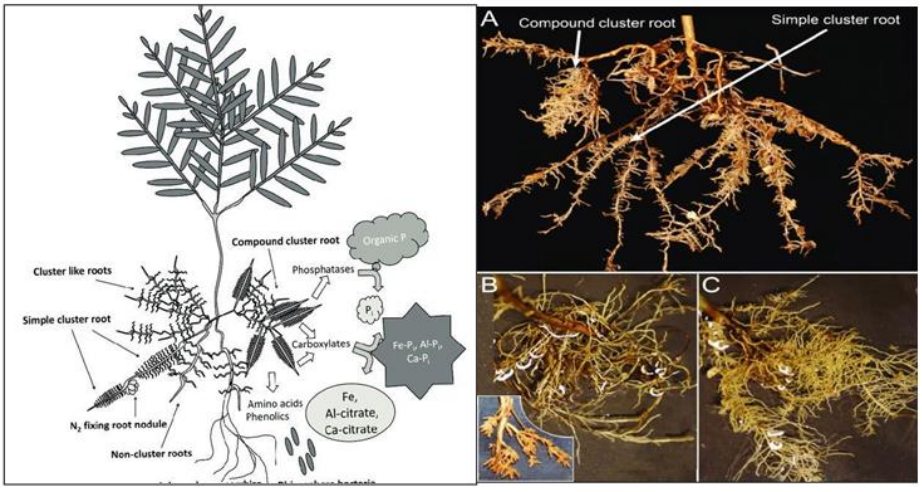

Figure-7: Sea buckthorn root and possible rhizosphere interaction.

This symbiosis between the fungus and seabuckthorn results in root nodule formation that can fix the maximum amount of atmospheric nitrogen. Besides fixing nitrogen, the perennial root nodule has the function of transforming difficult to dissolve organic and mineral matter into an absorbable state.

Chemical composition of sea buckthorn: Fruit of sea buckthorn is very rich in variety of vitamins and other chemical compounds (Fig: 8) with nutritional and medicinal properties.

1) Proteins and Amino Acids: Total protein level in fresh fruits of sea buckthorn is in the range of 2.1-3.4%. In seeds, it may be between 18-33%. Protein content in the pulp varies from 0.79-1.64%, that is why pulp or juice seems cloudy or opalescent product, which provides a stable turbidity to the juice. The majority of sea buckthorn proteins are well-ingested albumins and globulins. As studied in Russian forms, globulins (53.7-56.0%) and albumins (33.1-38.4%) are important proteins, which contain a large number of free amino acids, among them aspartic acid is quantitatively most important.

2) Pectin: Pectin content of the sea buckthorn fruits is low. Pectin value was estimated in Siberian sea buckthorn ranging from 0.2 to 1.2%.

3) Sugars: Although, sea buckthorn berries are not considered rich in sugars, however, sugar is an important ingredient of this fruit, as it plays a useful role in determining the sweetness of its juice and in fact the sugar: acid ratio has been reported to constitute the major promoter of taste of sea buckthorn fruit juice. The average content of sugar in fruits is 2.00-3.26 percent and in the sweetest Russian forms, it can go up to 7.0 percent. The sugar is composed of glucose (1.3-1.8%), fructose (0.7-2.3%), and saccharose (0.07-0.30%). There are minor amounts of xylose, mannitol, sorbitol and xylitol.[11-13]

4) Organic Acids: Organic acids and sugars are the major portion of the soluble solid fraction of the fruit pulp of sea buckthorn fruit. Fruit juice of sea buckthorn is quite rich in organic acid, pH of juice being near to 2.7. About 90 percent of the total acidity is represented by malic and quinic acids in Chinese, Russian and Finnish berries, malic acid being a major constituent. Presence of vitamin C organic acid and tannic acid in the fruit of sea buckthorn make it an ideal source for the production of several beverages particularly health protection juices.

5) Vitamin C: Sea buckthorn is famous for very high content of vitamin C (100-2750 mg/100g), which are 4-100 times higher than any vegetable and fruit. Generally, Chinese sea buckthorn (ssp. *Sinensis*) 360-2500mg and *H. salicifolia* (2750 mg) in Indian Himalayas are richest in vitamin C, whereas Russian and European forms are low to medium. It is anti-oxidant, scavenger of free radicals, inhibits the formation of potentially carcinogenic N-nitroso compounds and thus offers protection against stomach cancer. Ascorbic acid also plays a critical role in wound repair and healing/regeneration process.

6) Oil: Oil of sea buckthorn berries is the most valuable product of this plant, as it possesses anti-oxidant, wound healing, anti-ulcer, anti-tumour and curing cardiovascular etc. properties. Generally, the oil content of sea buckthorn fruit is low (about 4%), whereas as ssp. *Turkestanica* in western Pamirs, Tajikistan is quite rich in oil of fresh fruits (6.8-13.7%). Russian and central Asian forms are known to be rich in oil, where the oil content on the average does not fall below 6.0-6.6 percent. In Lahaul valley, Indian Himalayas, total oil in fresh fruits varied from 2.9-4.6 percent in *H. rhamnoides* ssp. *turkestanica* and much lower of 2 percent in *H. salicifolia*. The total oil content varies from 2-4 % in pulp to 8-16% in seed.

7) Fatty Acids: Unsaturated fatty acids make about 85 percent of total oil. The human body absolutely requires the polyunsaturated EFAs α-linoleic acid (omega-6 fats) and alpha-linolenic acid (omega-3 fats). Both fatty acids repair the cell membrane after oxidation due to attack of free radicals. Sea buckthorn seed oil is very high in two essential fatty acids, Linoleic acid (30-40%) and α-linoleic acid (20-35%). The dominating fatty acids in the soft parts of the fruit are palmitoleic acid (16-54 percent). Generally, less than 14 percent of Linoleic acid and less than 3 percent of α-linoleic acid are usually found in pulp oil.

8) Vitamin E: Important antioxidant function of vitamin E, also known as tocopherols, appears to be the inhibition of lipid peroxidation, scavenging free radicals. Low intakes of vitamin E and other anti-oxidants results into certain types of cancer and atherosclerosis. Both pulp and seed oils of sea buckthorn are rich in vitamin E, much higher than other nutrient oils.

9) Vitamin K: Vitamin K promotes normal coagulation of blood during the injuries of blood vessels, and its content varies from 0.65-1.3mg/100gm of fresh fruit, 59-64mg/100g in pulp oil to 110-230mg/100g in seed oil, which is more than many horticulture crops.

10) Carotenoids: Various colours of ripe berries of sea buckthorn, ranging from yellow to bright red are related to occurrence of carotenoids. Total carotenoid content in sea buckthorn fresh fruit varies generally from 1mg to 120mg/100g, whereas content of β-carotene varies from 0.2 to 17mg/100g. Red and orange-red fruits are richer in carotenoids as compared with the less intensely coloured fruits like yellow and orange-yellow. Different growth conditions influence the carotenoid content in the soft parts of the berries. Carotenoid content has been found increasing with the maturation of fruit. Soft part (pulp)

oil of ssp. *sinensis* had a maximum carotenoid level of 2140mg/100g and a minimum value of 2.1mg/100g in north Caucasus. It is established that carotenoids of sea buckthorn fruits consist of α-carotene, β- carotene, lycopene and zeaxanthin. Many studies have found s-carotene to be a major carotenoid, making 15-55% of total carotenoids, depending on the place.[14-16]

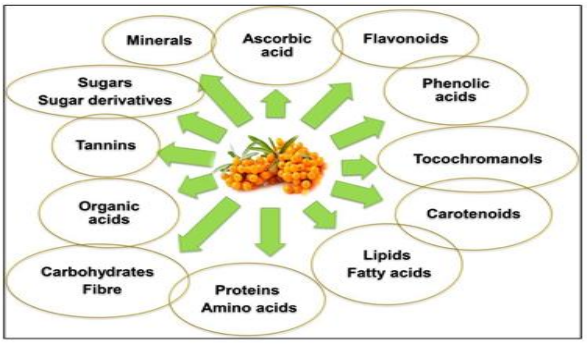

Figure-8: Chemical compounds present in Sea Buckthorn.

11) Flavonoids: Sea buckthorn fruit and leaves are very rich source of flavonoids. Flavonoids are found in all parts of sea buckthorn, i.e. leaves (3.8-4.0%), fruits, juice and seeds. Sea buckthorn growing in west Pamirs had flavonoids 310-1238mg/100g dry weight in leaves and 168-859mg/100g in crude fruits. Studies found that the juice and dried fruit residue contained flavonoid of 0.2% and 0.55%. The main flavonoids identified in sea buckthorn are leucocyanidin, catechin, flavanol and trace flavanone. From flavanol, the isorhamnetin, quassin and camellin could be isolated. They have been found to possess very strong anti-oxidant activity. It has found that flavonoids improve the immunity of the body, lower the osmosis of the capillary wall and prevent oxidation of vitamin C. Flavonoids have been found in controlling arteriosclerosis, reducing cholesterol level, turning hyperthyroidism into euthyroidism and eliminating inflammation. They have also been found effective against tumour and radiation damage.

12) Sterols: Sterols constitute the main portion of unsaponifiable matters. All sterols in sea buckthorn oil belongs the following 4 series, i.e., ergosterols, stigmasterol, lanosterols and amyrins. Due to their structural similarity to cholesterol, plant sterols are well studied for their cholesterol absorption inhibition properties. In addition to their cholesterol lowering property, plant sterols may possess anti-cancer, anti-atherosclerosis, anti-inflammation and anti-oxidation activities. The amount of sterols, in the fruit pulp of studies forms ranged between 0.16 and 0.76%, but in the seeds, it ranged from 0.19 to 0.96%. it was found that content of sterol in sea buckthorn oil is about 10 times higher than other oils. Total sterol content in the pulp oil (soft part) of sea buckthorn fruit ranged from 1-3%. Juice oil, processed by centrifugation of pressed juice of subsp. *sinensis*, had 720 mg/100g sterols.

13) Folate: Folate is a water-soluble vitamin B known to have several benefits to human health, such as prevention of neural tube defect in babies, an action against cardiovascular diseases caused by elevated plasma homocysteine and certain forms of cancer. Sea buckthorn fruits have been found to be a rich source of folate (29µg/100g fresh weight).

14) Betaine: Sea buckthorn accumulates betaine an anti-ulcer compound in high amount. It varied from 19.9 to 190 mg/100g in sea buckthorn cultivars growing at Urals Curative Plants Garden, Russian. Betaine quantity in sea buckthorn fruits varied from 512 to 897 mg% in Altay cultivars and from 728 to 1389 mg% in East Sayan forms.[17-19]

15) 5-hydroxytryptamine (5-HT): Of the chemical neurotransmitter substances, serotonin is perhaps the implicated in the etiology or treatment of various disorders, particularly those of the central nervous system, including anxiety, depression, obsessive-compulsive disorder, schizophrenia, stroke, obesity, pain, hypertension, vascular disorders, migraine and nausea. The peel of stem and fruit of sea buckthorn contains serotonin. In Russian forms, experts estimated 1.1-2.6 mg/100g serotonin in sea buckthorn fruit. 5-hydroxytryptamine (5-HT) isolated from sea buckthorn bark inhibited tumour growth.

16) Tannins: Sea buckthorn leaves have been found to contain high content of polyphenols, including tannin (10- 12%). Therefore, sea buckthorn plant leaves have been proposed as the prospective source of dyeing and tanning substances. Fruits, pulp and juice were found to be poor in tannins (0.02, 0.02 and 0.004%, correspondingly). Sea buckthorn tannins are important source of anti-viral drugs.

17) Metallothionein: Metallothionein acts as detoxing agency for heavy metals and as free radical scavenger for most toxic radical, hydroxyl radical (HO). Metallothionein inhibits the erythrocyte haemolysis, and stress induced ulcer and diabetes. In view of the high anti-oxidant activity, which is 7-8 times higher than human serum, it can be commercially utilized in sufficient quantity from sea buckthorn.

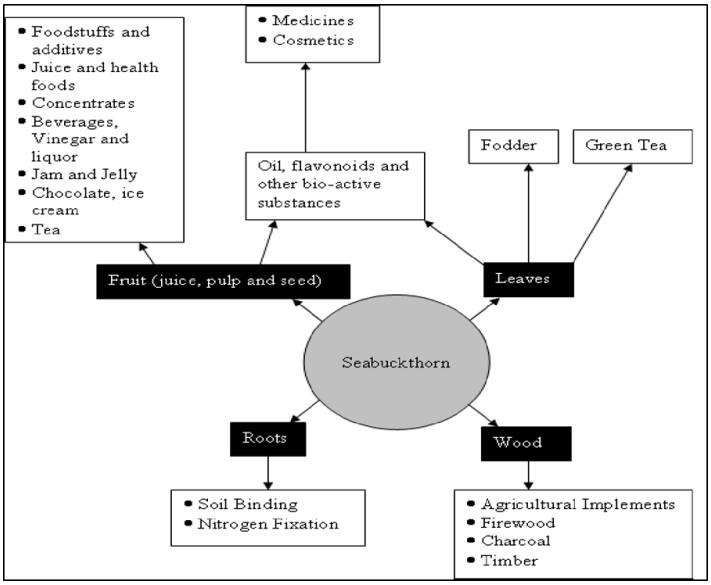

Figure-9: Sea buckthorn in vast activities.

Activity of sea buckthorn in health: The leaves, flowers, seeds, and fruits of sea buckthorn are used to make medicine. Sea buckthorn is used for heart health, skin conditions, swelling (inflammation), and other conditions, but there is no good scientific evidence to support any of these uses. In foods, sea buckthorn berries are used to make jellies, juices, purees, and sauces. In manufacturing, sea buckthorn is used in cosmetics and anti-aging products.[20]

- **Anticancer Activity:** Sea buckthorn possesses a wide range of biological and pharmacological activities, including anticancer properties. The antitumor activity of sea buckthorn can be attributed to antioxidant compounds, particularly phenolic compounds such as flavonoids, including kaempferol, quercetin, and isorhamnetin; these protect cells from oxidative damage that can lead to genetic mutation and to cancer**.**
- **Antioxidant activity:** Sea buckthorn berries have high contents of natural, potent antioxidants including: Ascorbic Acid (Vitamin C), Tocopherols (Vitamin E), Carotenoids, Flavonoids - isorhamnetin, quercetin and kaempferol, Catechins, Proanthocyanidins and Chlorogenic Acids.
- **Cardiovascular activity:** There is increasing evidence to support the hypothesis that free radical-mediated oxidative processes contribute to atherogenesis. Research (in vitro) has shown that antioxidant nutrients have the ability to affect cell response and gene expression. Sea buckthorn is a rich source of Antioxidants both aqueous and lipophilic, as well as polyunsaturated fatty acids, which may provide cardiovascular benefits.
- **Activity on High levels of cholesterol or other fats (lipids) in the blood (hyperlipidaemia).** Consuming sea buckthorn berries or extracts might lower "bad" cholesterol and increase "good" cholesterol in people with high cholesterol or fatty liver disease not caused by alcohol use. But it's not clear what dose or formulation of sea buckthorn works best.
- **Activity on High blood pressure.** Early research suggests that taking sea buckthorn by mouth for up to 8 months might reduce high blood pressure similarly to certain blood pressure-lowering drugs.
- **Activity on Dry eye:** Taking a specific sea buckthorn product by mouth decreases feelings of eye redness and burning. Using an eyelid spray containing sea buckthorn helps to reduce feelings of dryness in the eye.
- **Activity on Immune System:** Sea buckthorn contains several nutrients that may help to strengthen the immune system, by building immunity at the cellular level.
- **Activity on Skin:** Sea buckthorn seed oil contains a high content of two essential fatty acids, linoleic acid and -linolenic acid, which are precursors of other polyunsaturated fatty acids such as arachidonic and eicosapentaenoic acids. The oil from the pulp/peel of sea buckthorn berries is rich in palmitoleic acid and oleic acid helpful for treating burns and healing wounds. This fatty acid can also nourish the skin when taken orally in adequate quantities of sea buckthorn or its oil are consumed; this is a useful method for treating systemic skin diseases, such as atopic dermatitis. Sea buckthorn oil is already widely used alone or in various preparations topically applied for burns, scalds, ulcerations and infections.
- **Others:** Sea buckthorn has been shown to have additional health benefits for the liver, including treating liver fibrosis and providing a protective effect for liver injury. Research has shown benefits for gastric ulcer, treatment of chronic hepatitis, healthy mucus membranes and neurotoxicity protection.

Side effect of sea buckthorn

1) **Pregnancy and breast-feeding**: There aren't enough reliable information to know if sea buckthorn is safe to use when pregnant or breast-feeding. Stay on the safe side and avoid use.
2) **Children**: Sea buckthorn is possibly safe when used orally for up to 6 weeks in children 1-7 years of age.
3) **Bleeding disorder**: Sea buckthorn might slow blood clotting when taken as a medicine. There is some concern that it might increase the risk of bruising and bleeding in people with bleeding disorders.
4) **Low blood pressure**: Sea buckthorn might lower blood pressure when taken as a medicine. In theory, taking sea buckthorn might make blood pressure become too low in people with low blood pressure.
5) **Surgery**: Sea buckthorn might slow blood clotting when taken as a medicine. There is some concern that it might cause extra bleeding during and after surgery. Stop using sea buckthorn at least 2 weeks before a scheduled surgery.

The appropriate dose of sea buckthorn depends on several factors such as the user's age, health, and several other conditions. At this time there is not enough scientific information to determine an appropriate range of doses for sea buckthorn. Keep in mind that natural products are not always necessarily safe and dosages can be important. Be sure to follow relevant directions on product labels and consult your pharmacist or physician or other healthcare professional before using.[21,22]

Uses of sea buckthorn in cosmetic industry: Many kinds of sea buckthorn cosmetics have been developed and tested in hospitals. It is proved that sea buckthorn beauty cream has positive therapeutic effects on melanosis, skin wrinkles, keratoderma, keratosis, senile plaque, xeroderma, facial acne, recurrent dermatitis, chemical corrosion as well as freckles. Other sea buckthorn extracts can improve metabolism and retard skin maturation.

Figure-10: Sea buckthorn cream.

Uses of sea buckthorn in food industry: At present, many factories are producing sea buckthorn food, beverages and other products such as jam, jelly, juices and syrup. Along with traditional foods, some new ones, such as condensed juice, mixed juice, sea buckthorn carrot jam, candied fruit, sea buckthorn cheese, sea buckthorn butter, tea and health protection drinks are also being produced. The pigments of sea buckthorn are widely used as a food additive. Sea buckthorn yellow consists of flavours, carotene and vitamin E. Its physio-chemical properties, such as appearance, solubility, colour value, heat and light stability and effect of pH and metabolic ions make it a very useful food additive.

Ecological uses of sea buckthorn

As Soil Enhancer: Sea buckthorn is useful in reclaiming and conserving soil, especially on fragile slopes, due to its extensive root system. Because it is resistant to drought and tolerates soil salinity and low temperatures, it is suitable for many situations that are simply too demanding for most plants. Riverbanks, lakeshores, steep slopes and other susceptible terrain can benefit from the establishment of sea buckthorn. Windbreaks made up of seabuckthorn are effective at preventing wind erosion in open areas. The spiny shrub has even proven to be beneficial in acting as a barrier to pedestrian traffic, preventing sensitive vegetation from being trampled. Not only does seabuckthorn prevent the loss of soil, but it also improves degraded soils due to its nitrogen-fixing capabilities. Thus, there is reduced need to add fertilizers, which results in less input costs as well as fewer ecological problems.

As Pollution Reducer: Seabuckthorn is useful in lessening pollution resulting from erosion of contaminated mine waste, since it can be used to re-vegetate a variety of mine spoils. Because seabuckthorn is naturally resistant to pests, it has limited need of pesticides that are potentially damaging to the environment. In parts of North America, it has been planted as cover along highways where de-icing salt prevents growth of many other woody plants. Thus, seabuckthorn helps to prevent erosion and release of pollutants from roadsides.

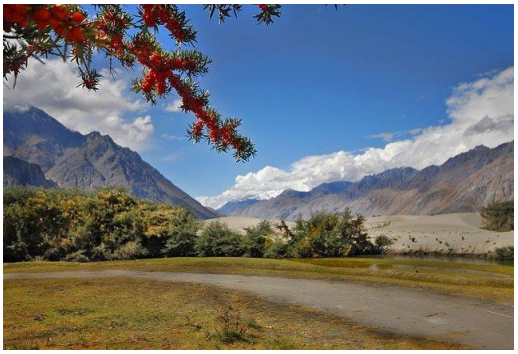

Figure-11: Sea buckthorn transform Ladakh economy.

- **As a Landscape Management Tool:** One of the most promising tools to control land degradation is re-vegetation and sea buckthorn is one of the species successfully used on a large scale. It can help to control desertification, conserve land and water resources and integrate economic exploitation with ecological rehabilitation. A living windbreak is a linear arrangement of plants, primarily trees and shrubs, established to reduce harmful effects of strong winds, such as soil erosion. It also helps protect crops, manage snow accumulation and create wildlife habitat. Plants that serve as windbreaks must be resistant to the drying effects and physical injuries caused by wind and sea buckthorn is well suited to this task.
- **As Maintaining Ecological Balance:** It has been observed that a number of wildlife species depend on sea buckthorn stems, leaves, flowers, roots, fruit and seed. In the Loess Plateau of China, 51 bird species are entirely dependent and 80 bird species are relatively dependent on sea buckthorn for their food. In winter, the importance of sea buckthorn increases as it is almost the only food available for birds. Sea buckthorn provides long-term benefits in terms of maintaining the ecological equilibrium and improving the environment.

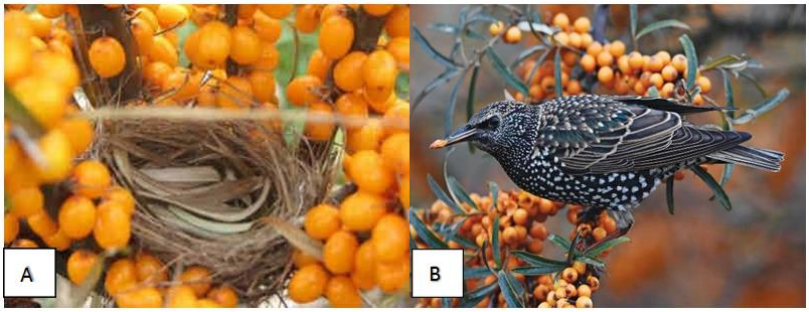

Figure-12: A) Bird Nest in Sea buckthorn tree B) Bird is eating sea buckthorn fruit.

Merchandise forms of sea buckthorn

Figure-13: Sea buckthorn oil, tea, squash, jam.

- **Oil:** Sea buckthorn oil has been used for thousands of years as a natural remedy against various ailments. It is extracted from the berries, leaves and seeds of the sea buckthorn plant (*Hippophae rhamnoides*), which is a small shrub that grows at high altitudes in the northwest Himalayan region. Sometimes referred to as the holy fruit of the Himalayas, sea buckthorn can be applied to the skin or ingested. A popular remedy in Ayurvedic and traditional Chinese medicines, it may provide health benefits ranging from supporting your heart to protecting against diabetes, stomach ulcers and skin damage.[23]
- **Tea:** Tea can be prepared from fruits and leaves. From leaves, the collected leaves can be quickly washed to sure the removal of dust particles. It should be fried for a while and twist it. Frying should be continued by stirring the leaves. It should be moistened after this frying. Second stir-frying should be continued and flutter it. It makes the

leaves into dust particles and ready. Now it can be packaged and sterilize to store for long duration. This tea can be used as commercial tea by mixing in hot water and serves with sugar if necessary. From the fruit, the juice of fruit can be used just as making lemon tea because the juice is very sour and nutritious.

- **Squash:** The squash can be formulated with 25 % crude juice, 40 – 45 % sugar and remaining water. Sugar mixed with water is boiled and then juice is mixed. It is again boiled for a moment and squash is prepared. About 0.5 gm of potassium meta-disulphide can be used for one litre of squash if it has to be stored for several months. It needs dilution with three parts of water before serving. The squash does not need any extra artificial flavours and colours as the juice contain its natural yellow and orange red colour and orange flavours.
- **Wine:** The juice contained less amount of sugar and excessive amount of acid to make the wine, so addition of water and sugar is essential. The wine made with 10 kg sugar, 2 gm ammonium sulphate, 1.35 kg fruit juice and 38 litres of water should be mixed and heated to 60º C for about five minutes and then cooled. About 10 % of activated wine yeast should be added in the heated mesh and allowed to ferment for 3 – 4 weeks. Within that period, the fermented mesh produces a fine taste and flavour of wine. However, maturation for 6 – 8 months enhance fine aroma and clarity in the winter.
- **Jam:** Best quality jam can be prepared out of the fruit extract. The jam is prepared with 0.75 % pectin, 10 % juice, 70 % sugar, 1.14 % acid and remaining water. These are boiled till paste is prepared and then cooled.

CONCLUSION

Sea buckthorn is a unique and valuable plant species currently being domesticated in various parts of the world. The invasive behaviour of sea-buckthorn, its extensive use in several areas and the intensive efforts to reclaim and ameliorate different types of terrains affected especially by water or wind erosion with this species in many regions worldwide, have led to its spread and naturalization on large areas. According to the review, *H. rhamnoides* should be regarded more as a very useful multi-purpose shrub species with a high potential for forest land reclamation, rather than a dangerous invasive one. Nevertheless, the presence of this species should be carefully monitored around fragile landscapes in nutrient-poor and dry locations, as it has potential to do great harm. The experience acquired in land reclamation with sea-buckthorn is very important from the perspective of global warming. It is expected that the importance of this species will increase in the future due to its high ecological amplitude and biological characteristics that make it suitable even for arid lands. As a final conclusion, sea-buckthorn represents a wonder plant, which provides several benefits to humanity.

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