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Seabuckthorn - A Secret Wonder Species: Review

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Abstract

Hippophae L. is a multipurpose wonder plant found in the Himalayan region which is beneficial both ecologically and economically. The genus *Hippophae* has seven species which are distributed mainly in the Himalayan region. It contains different kinds of nutrients and bioactive substances such as vitamins, carotenoids, flavonoids, polyunsaturated fatty acids, free amino acids and elemental components which have been proved to be very effective for the treatment of various diseases and skin related problems. Not only is it rich in nutrients but it also effectively mitigates many soil related tribulations. It shows multiple pharmacological and therapeutic activities such as antioxidant, immunomodulatory, anti-inflammatory, anti-atherogenic, anti-stress, cardio protective and wound healing. Seabuckthorn has attracted attention world over due to its nutritional and medicinal values.

Not only is it valuable nutritionally and medicinally but in a place like Sikkim it can be usedto control soil erosion since it has long and extensive rooting system which can bind the soil effectively and its association with *Frankia* makes it a nitrogen fixer as well.This review highlights the importance of *Hippophae* both ecologically and economically, also encourages the upcoming researchers to work on wonder species.

Keywords: *Seabuckthorn, Hippophae, Elaeagnaceae, Medicine, Sikkim.*

Introduction

Seabuckthorn (*Hippophae.),* 2n=24 (Li and Schroeder, 1996) is mainly used for economic and ecological purposes. It is a spinscent, dioecious, nitrogen fixing, actinorhizal, wind-pollinated plant (Jeppsson et al,1999; Arne Rousi, 1971), deciduous, thorny willow-like pioneering, shrubby or with luxuriant foliage and strong root system; it can retain the soil from erosion. The genus has been reported to grow in low humid (15%), alluvial gravel, wet landslips, various soil conditions, hills, gully tops and riverside with brown rusty-scaly shoots (Rongsen, 1992; Banjade, 1999; Basistha et al., 2001). *Hippophae* species are fast growing, (Rongsen, 1992), hardy woody plant often used in prairie conservation programmes (Schroeder, 1988), which is able to grow and survive well with low precipitations (300 mm), in soils with pH of 9.5 and 1.1% salts (Rongsen, 1990). Hence, it can be planted even in marginal soils (Rongsen, 1992). The whole plant (fruits, roots, leaves and stem) are economically important (Rongsen, 1992).

Seabuckthorn the general English term given to genus *Hippophae* was classified in 1753 in *"Speciae Plantarum"* by Karl von Linné at the position 1023 (Rajchal, 2009). The genus belongs to the family Elaegnaceae, Order: Elaeagnales, Super order: Celastraneae, Subclass: Rosidae, Class: Magnoliopsida and Division: Magnoliophyta (Rajchal, 2009). It is a small family with seven species, *viz. Hippophae salicifolia* D. Don, *Hippophae rhamnoides* Linn, *Hippophae tibetana* Schlecht, and *Hippophae neurocarpa* S.W. Liu et T.N. He, *Hippophae gyantsensis* Lian, *Hippophae goniocarpa* Y.S. Lian & al. ex Swenson and Bartish and *Hippophae litagenesis* Y.S. Lian& al. ex Swenson and Bartish(Rousi, 1971). Among these, *H. rhamnoides* has further been sub-divided into eight sub-species (Rongsen, 1992; Schroeder and Yao, 1999) .Other genera of Elaeagnaceae are *Elaeagnus* L. with 40 species

and *Shepherdia* L. with only 3 species (Rongsen, 1992). It is called Oblepikha in Russia, Sanddorn in Germany, Argousier in France, Espino Armarillo in Spain, Finbar in Sweden, Tindved in Denmark, Rokitnik in Poland, Yashildoo Chatsargana in Mongolia and Sebu in China. About 14 million hectare or more of natural sea buckthorn orchards are distributed widely over the world (Rongsen, 1992) distributed between 27º–69º N latitude and 7º W to 122º E longitude (Rousi, 1971; Pan et al., 1989) over 3500 km from east to west (Rongsen, 1990). Generally the global distribution pattern of sea buckthorn shows that the plant is concentrated mostly in the cold temperate regions of Hindukhush Himalayas (Rongsen, 1990, Subedi, 2007), parts of Europe and former USSR as well as Scandinavian region (42 countries).

In India, three different species of *Hippophae* L. (viz. *H. rhamnoides* L., *H. salicifolia* D. Don and *H. tibetana* Schultz) are naturally distributed in high altitude areas of Himachal Pradesh, (Lahul Spiti, parts of Chamba, Kinnaur, Kullu, Shimla and Kangra), Jammu and Kashmir (Leh and Ladhak) and parts of Uttar Pradesh (Singh et al., 1995; Singh and Awasthi, 1995) and Sikkim (Basistha, 2001). In Sikkim Himalayas, the plant grows on the riverside, land slide areas, torrential slides and mostly South–East aspect in Lachen and Lachung valleys of North Sikkim. *H. salicifolia* D. Don, in Sikkim, grows generally at altitudes ranging from 2377–3093 m**.**here, other than *H. salicifolia* no other species have been observed (Basistha et. al., 2009).

The seabuckthornplant is indigenous to the region and widely distributed (2500-4300 m) above sea level (asl) Fruit of this plant is quite rich in vitamin C (300-2400 mg/100g), vitamin A, E and K, protein, organic acid, carotenoids, flavonoids and steroids, which have been used in countries like Russia, CIS states, Mongolia and China for the production of several medicines, cosmetics and food products (Rongsen 1992). The concentration of vitamin C in sea buckthorn fruit, ranged from 100–300mg/100g fruit, which is higher than strawberry, kiwi, orange, tomato, carrot, and hawthorn (Bernath and Foldesi, 1992; Lu et al., 1992). Since 1954, seabuckthorn has also been widely planted to control soil erosion on fragile mountainous lands in China (Rongsen, 1992), which has climatic and geographical similarities to cold desert areas of Indian Himalayas. Therefore, seabuckthorn makes a suitable choice for the afforestation programmes of cold deserts of Himalayas in India.

Sea buckthorn also grows in areas with compressed soils, and has symbiotic relationships with nitrogen fixing actiniomycetes known as *Frankia* in its root nodules (Rousi, 1971).

The name *Hippophae* (Latin words *Hippo* means horse and *Phaos* means to shine) reflects its uses in ancient Greece where the horses gained weight and attained shiny coat after people used *Hippophae* as fodder (Subedi and Adhikari, 2001). The bioactive compounds are in great demand due to its extensive biological properties and providing source of discovery of many type effective herbal formulation based drugs which are safe having negligible or no side effect in comparison to the synthetic drug. Natural bioactive compounds from seabuckthorn have been found to possess significant anti-microbial, anti-oxidative, anti-inflammatory, immunomodulatory, radio-protective, adaptogenic and tissue regenerative properties (Chauhan et.al, 2007, Ganju et.al, 2005; Geetha et. al, 2005). Entire plant are considered to possess a large number of bioactive compounds like flavonoids (isorhamnetin, quercetin, myricetin, kaempferol and their glycoside compounds), carotenoids (β and δ-carotene, lycopene), vitamins (C, E, K), tannins, triterpenes, glycerides of palmitic, stearic and oleic acids, tocopherols and some essential amino acids and many more (Xiao Z, 1980; Andersson, 2009; Suryakumar and Gupta, 2011; Pradhan et al., 2012). Seabuckthorn have been clinically used for past more than 50 years in around 300 medical preparations which have been used to treat various diseases (Lu, 1992; Patro, et.al 2001).

Globally, the ethnic knowledge of wild medicinal plants is declining gradually (Pandey et. al.,1997), efforts are made to educate the upcoming generation about the importance of bio resource of nation; otherwise it may be lost inthe near future. *Hippophae salicifolia* is one of the most valuable plants of Sikkim state which has been neglected since time immemorial despite of its rich medicinal and ecological importance. Sea buckthorn has attracted attention world over due to its nutritional and medicinal values. (Xu et al., 1994; Beveridge et al.,1999). The objective of this paper is to popularize the plant species as this is in the list of neglected plant in Sikkim Himalaya and only very few people know its importance. The present review paper is an endeavor to acknowledge the importance, conservation and richness of this plant.

Pharmalogical Properties of Seabuckthorn

Seabuckthorn against antimicrobial (antiviral, antibacterial, antifungal) activity:

Phytochemical compound “Hiporamin” extracted from seabuckthorn leaves have shown to be

effective against the antiviral and antimicrobial activities (Kripkova et. al., 2008). Hiporamin is a purified fraction of polyphenols fraction, containing monomeric hydrolysable gallo-ellagi-tannins (preferably strictinin, isostrictinin, casuarinin, casuarictin pedunculagin, stachyurin according to the NMR spectra (Suryakumar and Gupta, 2011). Shipulina et. al, (2005) recorded potent inhibitory antiviral activity against Influenza and Herpes viruses from seabuckthorn fruit extracts. It also showed inhibitory effect in a HIV infection in the cell culture and antimicrobial activity (Suryakumar and Gupta, 2011). Similarly, leaf extract also found a significant anti-dengue activity (Jain et al., 2008). The aqueous extract ofseabuckthorn seeds was found to possess antibacterial activity (Chauhan et al., 2007). Similar studies found that leaf and seed extracts was effective against gram positive bacteria and seed oil extract against fungus (Mucor and Tilletia) (Gupta et. al., 2011). Similar studies found that, aqueous and hydroalcoholic leaf extracts of Seabuckthorn showed growth inhibiting result against *Bacillus cereus*, *Pseudomonas aeruginosa*, *Staphylococcus aureus and Enterococcus faecalis* (Upadhyay et al., 2010)**.**

Seabuckthorn as an antioxidant, immunomodulatory and anti-cancer agent

The widespread use of Seabuckthorn in many oriental and traditional medicines for treatment of many inflammatory disorders and immunomodulatory activities has scientifically proven its use. It has properties of anti-aging, anti-inflammatory, immunomodulatory activity and specifically activates the cell-mediated immune response (Geetha et al., 2005; Mishra et al., 2011). It provides protection against chromium induced oxidative injury (Suryakumar, and Gupta, 2011). Triterpenoids bioactive compounds from seabuckthorn extract showed significant inhibitory effect on nitric oxide production and enhanced radical-scavenging activities (Yang et al., 2007). Leaf extract of also has the capability to protect the glial cells against hypoxia induced oxidative damage (Narayanan et al., 2005). Ting et al., (2011) studied antioxidant activity of seed oil found significant radical-scavenging activities. Similarly alcoholic fruit extract found significant cytoprotection against sodium nitroprusside induced oxidative stress in the lymphocytes (Geetha et al., 2002). Animal studies documented that Seabuckthorn extracts also attenuated the nicotine induced oxidative stress in rat liver and heart (Gumustekin et al., 2010). Similar studies of seed oil showed strong inhibition of oxidative damage induced by CCl4 on mice, increased the activities of antioxidant enzymes and decreased the lipid peroxidation in liver (Padwad et al., 2006).

Medicinal properties and bioactive compounds of different parts of Seabuckthorn

Leaf

The leaves possess anti-inflammatory properties (Ganju et al., 2005; Padwad et al., 2006). Leaf extract is also used in ointments for treating burns, skin cracks, scabies, impetigo, keratosis and cures xeroderma (Rongsen, 1992). The young leaves contain high nutrient, carotenes and flavonoids. Generally, vitamin C in leaves is higher than the fruit. It is also used as one of the most important raw materials for the extraction of vitamins and flavonoids. Seabuckthorn leaves also controls the growth of cancer cells in liver (Zhao et al., 1987). Shipulina et al. (2005) reported presence of strictinin, isostrictinin, casuarinin, casuarictin from tannin fraction of leaf extracts. Similarly, kaempferol and isorhamnetin were isolated in aqueous and hydro alcoholic leaf extract (Upadhyay et al., 2010) and polyphenolic compounds such as flavonols, leucoanthocyanidins, (−) epicatechin, (+) gallocatechin, (−) epigallocatechin and gallic acid are isolated from leaf extracts (Suryakumar and Gupta, 2011). The leaves are an equally rich source of important antioxidants including, vitamin E, catechins, elagic acid, ferulic acid, folic acid and significant values of calcium, magnesium and potassium are present (Suryakumar G. and Gupta A., 2011). It is also used as one of the most important raw materials for the extraction of vitamins and flavonoids. Seabuckthorn leaves also controls the growth of cancer cells in liver (Zhao et al., 1994). Leaf extracts showed potential obesity properties in mice (Pichiah et al., 2012). Aqueous and hydro alcoholic leaf extracts of Seabuckthorn also showed antioxidant, cytoprotective and anti-bacterial effects (Upadhyay et al.,2010).

Oil

The seabuckthorn berry seed oil effective in various skin conditions including eczema, burns, and bad healing wounds, skin damaging effects of sun, therapeutic laser treatment and cosmetic laser surgery, wrinkles, dryness and other symptoms of malnourished or prematurely aging skin and is utilized in anti-aging skin cream and lotions (Parimelazhagan et al., 2004). It is traditionally used in the treatment of gastric ulcers (Zhou, 1998; Xing, 2002). It is believed to be a skin softener. Triacylglycerol is a major constituent of seabuckthorn seed oil and is being used in a variety of cosmetic formulations. Due to its inimitable botanical and nutritional properties, and there being no reported evidence of seabuckthorn oil causing undesirable reactions or negative effects, the oil is used as a natural

agent for treating the diseases of mucous membranes (Xu Mingyu, 1991) including aphthous ulcers, esophagitis, acid reflux and peptic ulcers, dermatological diseases and skin conditions (Thompson, 2010) and for the treatment of oral mucositis, rectum mucositis, vaginal mucositis, cervical erosion, radiation damage, burns, scalds, duodenal ulcers, gastric ulcers, chilblains, skin ulcers caused by malnutrition, and other skin damage(Akulinin et al., 1958; Zhang et al., 1988). Seabuckthorn oil has a restorative action due to its high content of essential fatty acids, carotenoids (alfa- and beta-carotenes, lycopene, cryptoxanthin, zeaxanthin, taraxanthin and phytofluin), tocopherols (represented by vitamin E and gamma-tocopherol), rare fatty acids and phytosterols (beta-sitosterol, beta-amirol and erithrodiol) (Chen et. al.,1990) giving it synergistic power to protect cell membranes, enhance cell regeneration and helps in the maintainance of a healthy skin. The essential fatty acid content in the seabuckthorn oil extract is 80 - 95%. Major essential fatty acids are oleic (C18:1) and linoleic(C18:2).Others are pentadecenoic (C15:1), palmitoleic (C16:1), heptadecenoic (C17:1), linolenic (C18:3), eicosenoic (C20:1), eicosadienoic (C20:2), erucic (C22:1) and nervonic (C24:1) (Internet). Seabuckthorn berry oil is especially rich in an Omega-7 series fatty acid (palmitoleic acid),which is a key component can act as a replacement for other fatty acids in cell membranes and can make up around 30% of the total oil. Linoleic acid and α-linolenic acid are the major fatty acids in seed oil (Yang B and Kallio, 2001) high levels of carotenoids (Beveridge,et.al.,1999). Both the seed and pulp oils are rich in tocopherols, tocotrienols and plant sterols (Kallio et al., 2002).

Fruit

The bioactive components of berries vary with maturity, fruit size, species, geographic locations, climate and methods of extraction (Leskinen et al., 2010). In Indian, Chinese and Tibetan medicines seabuckthorn fruit observed as medication in pulmonary, gastrointestinal, gum bleeding, cardiac, blood or metabolic disorders. Berries are edible and nutritious, although they are astringent and oily and unpleasant to eat raw, unless 'bletted' (frosted to reduce the astringency) and/or mixed as a drink with sweeter substances such as apple or grape juice. Saturated and polyunsaturated fatty acids of fruit are used in preparation of cosmetic (skin creams), syrup products (Seglina et al., 2006). Seabuckthorn has been shown to have potent antioxidant activity, mainly attributed to its flavonoids (Li and Schroeder, 1996), vitamins E and C (Varshney and Tyagi, 2004). In the former USSR it was discovered

that the fruits of seabuckthorn contained more than 190 kinds of bio-active substances, and the oil contained 106 kinds of such substances. Of these, there were 6 kinds of fat-soluble vitamins, 22 kinds of fatty acids, 42 kinds of lipids and 36 kinds of flavonoids and phenols (Xu, et al., 1994)

The seabuckthorn juice is yellow in colour due to high levels of carotene and primarily valued for its golden-orange fruits, which are very rich in vitamins A, B1, B12, C, E (including α, β, γ - VE), K and P, flavonoids(isorhamnetin, quercetin, isorhamnetin-3-betad-glucoside; isorhamnetin-3-beta-d-glucosaminide; kaempferol, metc.); carotenoids (carotene, lycopene, lutein and zeaxanthin); organic acids, macro and micro nutrients; dietary minerals (Yang and Kallilo 2001, Rosch et al., 2003], polyphenols and oil rich in essential fatty acids. Many bioactive compounds such as cerebroside, oleanolic acid, ursolic acid, 19-alpha-hydroxyursolic acid, dulcioic acid, 5-hydroxymethyl-2-furancarbox-aldehyde, cirsiumaldehyde, octacosanoic acid, palmitic acid and 1-Ohexadecanolenin (Zheng et al., 2009) have been extracted from the berries of seabuckthorn. Isorhamnetin isolated from seabuckthorn, showed significant antioxidant activity in several antioxidant assays (Pengfei et al., 2009). Zeaxanthin and betacryptoxanthin esters in seabuckthorn berries can be used as food additives, cosmetic ingredients or nutraceuticals (Pintea et al., 2005; Andersson et al., 2009). There are many mineral elements present in berries and juice of sea buckthorn. Fruits also contain flavoxanthin, progestin, cryptoxanthin, violaxanthin and neoxanthin The most recognized product of seabuckthorn is comprised of seed oil that is enriched in essential fatty acids (omega-3 and 6) and pulp oil that contains high levels of omega-7 (Yang and Kallio, 2005).

Other Uses

Apart from the above listed medicinal values, Seabuckthorn holds great ecological importance as its extensive root system are ideal for afforestation, soil conservation, waste land reclamation (Zhao,1990) especially on fragile slopes, transforms insoluble organic matter in the soil in its more soluble state (Rongsen,1992; Singh,1998) and helps to mitigate soil erosion (Rongsen, 1990). Seabuckthorn trees have potential applications in reclaiming and conditioning soil. Produce timber and pulp and acting as nurse, windbreak, ornamental and fuel wood plants, branches are used by florist for designing ornaments. It is an active ingredient in many medical skin care products, dietary supplement and health foods because

of its nourishing, revitalizing and restorative action. Scientists of the former Soviet Union have many medicinal preparations, including health products for astronauts and pilots. Seabuckthorn is also used as an anti-cardiovascular medicine (Chai et.al., 1989; Yang et, al., 2002). Seabuckthorn extracts have also seen to help normalize liver enzymes, serum bile acids, liver inflammation and degeneration (Gao, et al., 2003). Researchers found that seabuckthorn flavonoids help in reducing cholesterol level and improved cardiac function. More recently, sea buckthorn (*H. rhamnoides*) has been planted as orchards for commercial purposes and for greening of hilly regions in countries such as Russia and Germany (Rongsen, 1992). China is an old-established leader in commercial exploitation of this crop (Liu and He, 1978). Sea buckthorn oil could decrease cholesterol, triglyceride and ß-lipoprotein (LP), and counteract hyperlipemis induced by the experimental high fat diet. The fruits of seabuckthorn (*H.rhamnoides* L.) have been used as a drug by traditional Tibetan and Mongolian medicine system since ancient times. It has pharmacological effects on the lungs, the stomach, the spleen, the blood circulation, which were recorded in some medicinal classics, such as SibuYidian from the Tang Dynasty and Jing Zhu Ben Cao from the Qing Dynasty (Li et al., 1983).

In Sikkim, the juice extracted from the fruits have been used traditionally in preparing dyes, pickles and jam and in the remediation of some common ailments like cough and cold. The fruit pulps are also used to treat fever, diarrhoea, scabies, constipation and other intestinal disorder. The matured sticks/branches of the trees are used for fencing work and making hedges around the apple orchards and vegetable gardens. The plants are also used as fodder and firewood.

Commercial products from sea-buckthorn

Seabuckthorn fruit has been used to make pies, jams, lotions, fruit wines and liquors. The juice or pulp has other potential applications in foods or beverages. In Mongolia, it is made into a juice drink. In Finland, it is used as a nutritional ingredient in baby food.

Fruit drinks were among the earliest seabuckthorn products developed in China. Seabuckthorn based juice is popular in Germany and Scandinavian countries. It provides a nutritious beverage, rich in vitamin C and carotenes. For its troops confronting extremely low temperatures, India's Defence Research Development Organization established a factory in Leh to manufacture a multi-vitamin herbal beverage based on seabuckthorn juice. The seed

and pulp oils have nutritional properties that vary under different processing methods. Seabuckthorn oils are used as a source for ingredients in several commercially available cosmetic products and nutritional supplements. Extracts from seabuckthorn have also been used in the preparation of herbal oil in traditional herbal medicine. Till date more than 10 different drugs have been isolated from seabuckthorn in Asia and Europe and are available in different forms such as liquids, powders, plasters, films, pastes, pills, liniments, suppositories and aerosols (Lu,et.al.,1992). In Europe sea-buckthorn juice, jellies, liquors, candy, vitamin C tablets and ice-cream are readily available (Bernath and Foldesi, 1992)

Conclusion

Seabuckthorn seems to be a promising plant having potential beneficiary role in improving human health. In India studies to explore the potential of this plant are going on especially in Himachal Pradesh, Leh and Ladakh and Sikkim.The paper presented above is an effort to highlight the uses of *Hippophae* an ecologically, economically and medicinally important plant which is also found in abundance in Sikkim region. *H. salicifolia* has a large population in Sikkim but despite of this fact its true potential is still under explored. The paper presented above is an effort to highlight *Hippophae* as an ecologically, economically and medicinally important plant which is also found in abundance in Sikkim region but has failed to gain importance. Moreover people living in the area which shows a huge population of *Hippophae* are unaware of the importance of this plant. Due to the lack of a proper scientific systematic study this plant remains underutilized and only few people know the importance of this plant. This review may also help for upcoming researchers to work on this wonder species.

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