

Potential health benefits of Sea buckthorn oil- A review

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ABSTRACT

Hippophae rhamnoides, also known as sea buckthorn is an ancient plant with modern virtues, due to its nutritional and medicinal value. Sea buckthorn berry is rich in oil. Seeds (seed oil) and fruit pulp (pulp oil) are used for oil extraction. The oil content of Sea buckthorn pulp and seeds are in range of 18.2-43.5% and 7.03 -12.86% respectively. While linoleic (18:2n-6) and α -linolenic (18:3n-3) acids are the major fatty acids in the seed oil, the high level of palmitoleic acid (16:1n-7, up to 50%) differentiates sea buckthorn pulp oil from most other oils of plant origin. Oil from sea buckthorn contains several bioactive components such as vitamin E, vitamin K, carotenoids and phytosterols. Sea buckthorn oil has shown great healing effect in treating damaged mucous membranes of the gastrointestinal tract, wound, burn, dry eye, dermatitis and sunburn. The oil from pulp and the seeds of sea buckthorn have been shown to possess anti-diabetic, anti-atherogenic, hypocholesteromic, hypotensive, anti-hypoxic, antioxidant and anti-inflammatory properties. Sea buckthorn oils are used as a source for ingredients in several commercially available cosmetic products and nutritional supplements like jelly, plant capsules, or oral fluids.

Key words: Anti-atherogenic, Mucous membrane, Phytosterol, Pulp, Sea buckthorn oil.

Sea buckthorn (*Hippophae rhamnoides* L., family: Elaeagnaceae) is a thorny, deciduous shrub that grows widely at high altitudes of 7,000–15,000 foot of the northwest Himalayan region, native to Eurasia. The most recognized product of sea buckthorn (SBT) is comprised of seed oil and pulp oil. Sea buckthorn seed oil is considered to be of particular nutritional interest because it is the only oil that naturally provides a 1:1 ratio of omega-3: omega-6 (linolenic and linoleic acid respectively). The oil content of Sea buckthorn pulp and seeds are in range of 18.2-43.5% and 7.03 -12.86% respectively (Shah *et al.*, 2007). Oil from sea buckthorn contains several bioactive components such as vitamin E, vitamin K, carotenoids and phytosterols (Zeb, 2004a; Kallio *et al.*, 2002). Total phytosterol content is 4–20 times higher than in soybean oil. Major constituent of phytosterols in the SBT oil was identified as β -Sitosterol (Moersel *et al.*, 2005; Sajfirtova *et al.*, 2010). The essential fatty acid content in the sea buckthorn oil extract is 80 - 95%. Sea buckthorn berry oil is especially rich in an n-7 (palmitoleic acid) and n-9 (Oleic acid). Linoleic acid and α -linolenic acid are the major fatty acids in seed oil (Yang and Kallio, 2001). Triacylglycerols form the main lipid class in the seed and the soft part oils, and comprise approximately 80% of the oil from whole berries of ssp. *Mongolica* and ssp. *Sinensis* (Kallio *et al.*, 2002).

The pulp of sea buckthorn contains high quality oil, which is regarded to be very important for its medicinal value (Lebeda, 2004). Oils from sea buckthorn seeds and

berries have traditionally been used in the treatment of disorders of skin and mucosa in China. Oil extracted from SBT fruit pulp and seeds absorb ultraviolet light and promote healthy skin and act as raw material for the pharmaceutical and cosmetic industries. Sea buckthorn oils are used as a source for ingredients in several commercially available cosmetic products and nutritional supplements (Dharmananda, 2004). Oil from sea buckthorn has shown effectiveness in skin therapy for sunburns, chemical burns, radiation burns and eczema (Goel *et al.*, 2002; Seven *et al.*, 2009; Yang *et al.*, 2000; Zeb, 2004b). Furthermore, sea buckthorn oil has shown positive results in treating health problems related to damaged mucous membranes of the gastrointestinal tract including mouth ulcers, gastric ulcers and stress ulcers (Suleyman *et al.*, 2001a, 2001b; Xu *et al.*, 2007). Of particular interest, the oil from pulp and the seeds of sea buckthorn have been shown to possess anti-atherogenic, hypocholesteromic, hypotensive and anti-inflammatory properties (Eccleston *et al.*, 2002; Ganju *et al.*, 2005). The oil absorbs ultraviolet light and promotes healthy skin. The 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 believed to be a skin softener. Triacylglycerol is a major constituent of sea buckthorn seed oil and is being used in a variety of cosmetic formulations.

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Pulp oil: The pulp contains 4–13% of oil, and dry pulp contains about 20–25% of oil (Zeb 2006; Valíček and Havelka, 2008). The pulp oil contains 180–240 mg of carotenoids in 100 g, of them 40–100 mg in form of carotene, 110–330 mg of vitamin E and unsaturated fatty acids, mainly linoleic and linolenic acids. The pulp oil contains the highest concentration of palmitoleic acid (16:1, n-7), up to 43% (Fatima *et al.*, 2012). The highest content of oil in pulp was 18.75% in *Hyppophae neurocarpa* and the lowest one is 2.46% in *spp. yunaanesis*.

Seed oil: Sea buckthorn seeds contain 8–20% oil (Kumar *et al.*, 2011). Seed oil mainly includes unsaturated fatty acids – 90% (linoleic 47 mg, linolenic 18 mg, oleic 16 mg) and saturated palmitic acid (Valíček and Havelka, 2008). Oil pressed from sea buckthorn seeds is mainly rich in essential fatty acids such as linoleic acid (18:2, n-6), making up to 42% of the total fatty acid, and α -linolenic acid (18:3, n-3), up to nearly 39% of the total fatty acid content. The total carotenoids seed oils of berries cultivated in Canada varied between 24 - 28 mg/ 100 g (George and Cenkowski, 2007). The highest content of seed oil is 17.85% in *Hyppophae rhamnoides* sub *spp. Tibetana* and lowest one is 7.80% in *Hyppophae neurocarpa* (Lebeda, 2004).

Potential Health Effects:

Woundhealing: SBT seed oil has been observed to possess mitogenic potential and is involved in fibroblasts and keratinocytes proliferation at the wound site. Seed oil treatment showed an increase in endogenous antioxidant and decrease in free radical production in burn wounds. Palmitoleic acid contained in sea buckthorn is a component of skin fat and thus represents a valuable component of topical treatment of cellular tissue and wounds (Bal *et al.*, 2011; Kumar *et al.*, 2011). Burnt sheep were administered sea buckthorn seed oil and in 6, 14 and 21 days after the injury, the wound blood flow and epithelization were determined. After 14 days the percentage of epithelization in the areas treated with sea buckthorn was higher than in the untreated

areas. The epithelization time was significantly shorter compared to the untreated areas (Ito *et al.*, 2014). SBT seed oil treatment upregulated the expression of matrix metalloproteinases (MMP-2 and 9), collagen type-III and vascular endothelial growth factor in granulation tissue (Upadhyay *et al.*, 2009).

Antiulcer: Administration of the CO₂-extracted sea buckthorn seed and pulp oils significantly reduced the index of pylorus ligation-induced gastric ulcer and speed up the healing process of acetic acid-induced gastric ulcer (Xing *et al.*, 2002). It is concluded that Sea buckthorn oil was the best therapeutic agent for dexamethasone-induced GUE in dogs followed by famotidine, lansoprazole, misoprostol, and sucralfate (Dogra *et al.*, 2013). The antiulcer action of sea buckthorn oils related to an increased in the hydrophobicity of the mucosal surface, retarded the gastric emptying (Xing *et al.*, 2002), inhibited lipid peroxidation in gastric mucosa, accelerated the mucosal repair (Xu *et al.*, 2007), inhibited proteolytic activity in gastric liquid, promoted the wound repair processes of mucosa and prevent mucosa damage (Halis *et al.*, 2001).

Antimicrobial: Oil obtained by pressing is a very effective inhibitor of bacterial growth, especially of *Escherichia coli* (Christaki, 2012). Kaushal and Sharma (2011) confirmed that sea buckthorn seed oil showed good antimicrobial properties (growth inhibition zone diam. 4.0 mm) against *Escherichia coli*. The phenolic compounds of sea buckthorn oil represent the main group of phytochemicals, which exhibit antibacterial and antiviral effects. These compounds suppress gram-negative bacteria (Khan *et al.*, 2010) and reduce gram-positive bacteria (Kumar and Sagar, 2007).

Antidiabetic: Sea buckthorn fruit oil (SBFO) is rich in palmitoleic acid, which has been reported to play roles in many metabolic processes. Gao *et al.*, (2017) conducted *in-vivo* and *in-vitro* experiments to explore anti-diabetic mechanism of SBFO. The results revealed that the SBFO extract effectively increased the glucose uptake from 12.23 \pm 1.09 to 14.90 \pm 1.48 mmol/L in insulin resistance (IR) HepG2 cells, lowered blood glucose (the reductions rates of blood glucose in groups treated with SBFO extract at 200 and 300 mg/kg/day were 10.47% and 13.79%, respectively) and improved insulin indices from “6.11 \pm 0.10 to “5.45 \pm 0.31 after 4 weeks treatment with SBFO extract at 300 mg/kg/day in rats induced type2 diabetes. Thus, the SBFO extract played a positive role in alleviating T2DM through the PI3K (phosphatidylinositol-3-kinase) signaling pathway in HepG2 cells and diabetic rats.

Eye health: Oil from seeds and fruits are used in the treatment of keratitis, trachoma, injuries or burns of eyelid, and conjunctivitis (Guliyev *et al.*, 2004). It is shown that SBT oil reduces an increase in tear film osmolarity during the cold season and positively affects the dry eye symptoms

Table 1: Chemical Composition of Sea Buckthorn Seed – and Pulp Oils

	Seed oil	Pulp oil
Fatty acids (%)		
Palmitic 16:0	6 – 10	15 – 40
Palmitoleic 16:1 n-7	<0.5	15 – 50
Oleic 18:1 n-9	15 – 20	10 – 20
Linoleic 18:2 n-6	35 – 40	5 – 15
α -Linolenic 18:3 n-3	20 – 35	5 – 10
Vitamins (mg / 100 g)		
K	110 - 230	54 – 59
Tocopherols & tocotrienols	100 - 200	100 – 400
Carotenoids	10 – 50	100 – 400
Plant sterols (%)	1 – 2	2 – 3

Represents the chemical composition of the sea buckthorn oils (Zeb, 2006).

(Larmo *et al.*, 2010). Carotenoids and tocopherols in the sea buckthorn oil or eicosanoids produced from the fatty acids of the oil may have a positive effect on inflammation and differentiation of the meibomian gland cells in dry eye (Jarvinen *et al.*, 2011). Oral intake of sea buckthorn pulp oil has a potency to preserve tear secretion capacity in the dry eye state and palmitoleate, its main constituent fatty acid, is an active component of the oil (Nakamura *et al.*, 2017).

Antioxidant and anti-inflammatory: The seed oil and pulp oil from sea buckthorn berries contain all the natural isomers of tocopherols and tocotrienols. α -Tocopherol is the major isomer in the pulp oil, whereas the seed oil contains almost equal levels of α - and γ -tocopherols. Sea buckthorn seed oil and pulp oil are also rich in natural carotenoids, a group of antioxidants working synergistically with tocopherols and tocotrienols by quenching oxygen and scavenging oxygen containing free radicals. Both pro- and non-vitamin A carotenoids present in sea buckthorn oil have proven effects on inflammation *in vitro*. The oil is rich in phytosterols, associated with potential antioxidant and anti-inflammatory activity. 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). 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).

Antiatherogenic: Because sea buckthorn seed oil is a rich source of unsaturated fatty acids, phytosterols, carotenoids and flavonoids, the anti-atherogenic activity of sea buckthorn seed oil in rabbits have been evaluated (Basu *et al.*, 2007). Feeding sea buckthorn seed oil to normal rabbits for 18 days caused a significant decline in plasma cholesterol, LDL, atherogenic index and LDL/HDL ratio. Significant increase in HDL was observed in sea buckthorn seed oil treated hypercholesterolemic rabbits. Atherogenic index (AI) was significantly reduced and acetylcholine-induced vasorelaxation was markedly impaired which could be restored to control values in SBT seed oil treated normally and hypercholesterolemic animals (Basu *et al.*, 2007).

Skin health: The unique combination of multiple natural antioxidants of SBT oil provides the skin with a synergistic protection against oxidation induced by UV and ageing. β -Carotene in sea buckthorn oil is a precursor for vitamin A, known to be essential for skin well-being. Sea buckthorn berry oil is similar to natural skin sebum lipids, and provide important healing and anti-aging benefits to skin. Sea buckthorn seed oil treatment increased the level of α -linolenic, linoleic and eicosapentaenoic acids, whereas pulp

oil supplementation increases level of β -Sitosterol and β -carotene which have effect on the symptoms of atopic dermatitis (Yang *et al.*, 2000). The oil has also been used for protection against solar radiation (Li and Beveridge 2003). SBT seed oil absorbs strongly in the UV-B range (290–320 nm) and may be used as a natural sunscreen absorber.

Antihypoxic: Sea buckthorn seed oil significantly attenuated hypoxia-induced oxidative stress, maintained blood-brain barrier membrane integrity, restricted the rise in plasma catecholamine, and significantly enhanced the hypoxic tolerance in experimental animals (Purushothaman *et al.*, 2008). SBT seed oil also decrease the level of stress hormones and enhances hypoxic tolerance in animals exposed to hypoxia indicating its anti-stress and adaptogenic activity against hypoxia (Varshney, 2008).

Other effects: The hepatoprotective activity of sea buckthorn seed oil was evaluated using carbon tetrachloride (CCl₄) induced hepatic damage in animals (Geetha *et al.*, 2009; Hsu *et al.*, 2009). Other studies suggest that sea buckthorn oil alleviates haematological damage caused by chemotherapy, such as part of treatment of leukaemia (Yang and Kallio, 2002). Therapeutic effects are ascribed to substances such as catechin, gallic acid, and epigallocatechin (Khan *et al.*, 2010). Sea buckthorn berry oil is reported to play a potential role in treating atopic dermatitis and thrombosis (Cheng *et al.*, 2003; Yang *et al.*, 2000). Oils from the seeds and pulp may be used as ingredients in food supplements such as jelly, plant capsules, or oral fluids (Yang and Kalilo, 2002). They are also used in cosmetic products such as shampoo (Bal *et al.*, 2011).

Sea buckthorn oil (2 g/day for 3 months) was found to attenuate the increase of tear film osmolarity taking place during the cold season when the air is dry indoors and outdoors. The positive indications of sea buckthorn oils on the skin and mucosa have been observed in humans. Clinical study observations on the prevention of platelet aggregation and the elevation of blood HDL cholesterol due to sea buckthorn oils have been published. The anti-inflammatory and anti-ulcer properties of β -sitosterol, β -D-glucosides, usrolic acid and betaine promote ulcer healing, prevent spread and inhibit erosion. Vitamin-E, β -carotene, unsaturated fatty acids of sea buckthorn oil stimulate cell metabolism at site and repair injuries. It also reduces liver damage by alcohol, paracetamol and carbon tetrachloride and prevent fatty liver. Sea buckthorn oil extract played a positive role in alleviating type2 diabetes mellitus. Sea buckthorn seed oil showed good antimicrobial properties (growth inhibition zone diam. 4.0 mm) against *Escherichia coli*. Sea buckthorn oil has good adaptogenic activity against hypoxia.

CONCLUSION

Currently, *Hippophae rhamnoides* or sea buckthorn has gained the statue of one of the world's most promising functional food, due to the valuable bioactive compounds it contains. The oil has strong antioxidant activity, which

increases our life interval by combating free radicals produced in our body. Sea buckthorn oil has multidimensional functions. Various chronic diseases may be cured by sea buckthorn oil. Nevertheless, more research is needed in order to confirm all its positive effects.

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