

New Insights towards Implications of Sea Buckthorn Oil in Human Health: A Review

Tyagi N, Singh A, Kohli K*

Department of Pharmaceutics, Faculty of Pharmacy, Jamia Hamdard University, India

***Corresponding author:** Kanchan Kohli, Department of Pharmaceutics, Faculty of Pharmacy, Jamia Hamdard University, India, Email: kanchankohli50@gmail.com

Review Article

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Abstract

Background: The use of Sea Buckthorn oil is being promoted for a large variety of ailments and the clinical studies being carried on the use of Sea Buckthorn oil. Hypothesis / Purpose: This review article aims at compilation of the latest research on the process of extraction, use of Sea Buckthorn oil and various marketed preparation used in the various disorders.

Methods: The various databases like PubMed and Science Direct were used to identify, analyse and summarise the research literature on this topic. Most of the studies were at preclinical stage. Applicability of the findings and date of the publication were high priority factors for the studies to be included in the review.

Results: Sea Buckthorn oil has its indication in various diseases like cancer, skin problems, cardiovascular disorders, gastric ulcer. It is a powerful antioxidant, anti-bacterial and anti-viral agent. It is used as immunomodulator and has nutritional value.

Conclusion: Sea Buckthorn oil has immense medicinal and therapeutic potential. However, several knowledge gaps give the way for new academic and research and development activities in the field of herbal medicines and nutraceuticals.

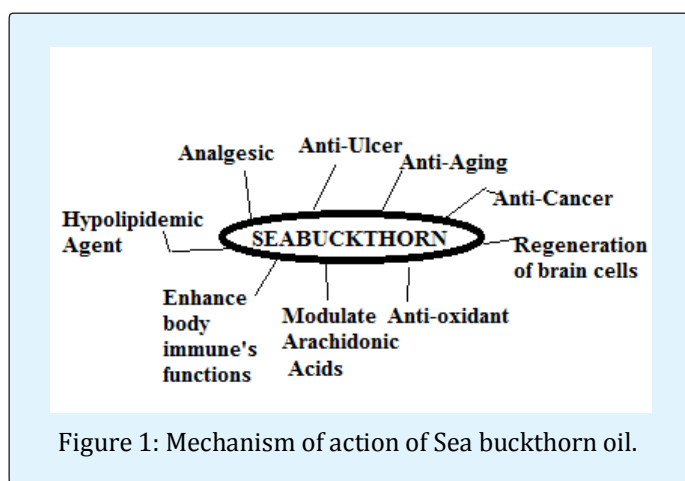
Keywords: Sea buckthorn oil; Clinical studies; Extraction; Side effects

Introduction

Sea buckthorn is an herb which has medicinal value and used to heal various disorders ever since 12 centuries in China, Asia and Europe. Sea buckthorn belongs to the genus Hippophae, the most commonly used of which is Hippophae rhamnoides, belonging to Elaeagnaceae/oleaster family [1]. The lipids are accumulated in the mesocarp (fleshy part of the fruits) and oil can be extracted from either seed or pulp of the fruit by Simple

extraction or Supercritical Carbon Dioxide extraction [2]. The preferred method for extraction is Supercritical Carbon Dioxide extraction, where Carbon Dioxide is forced into a liquid state. This method of extraction provides refined oil with no plant solid material. The Carbon Dioxide extracts the oil from the seed and berries with their magical omega fatty acids and useful nutrients. The oil content found in mature seed, dried fruit pulp and berries residue after juice extraction are 8-20%, 20-25% and 15-20% respectively. The fruit oil is dark red or

reddish orange and thicker than seed oil which is yellow or pale orange and has musky odour. Sea buckthorn oil has its application in treatment of asthma, heart disorders, arthritis, skin disorders and Cancer. The mechanism of action of sea buckthorn oil is depicted in Figure 1. The oil extract of Sea Buckthorn has been used in cosmetic cream for its anti-ageing effect [3]. The ointment containing Sea Buckthorn oil (0.5-1%) has its implication in suppressing caragenin-induced edemas and passive cutaneous anaphylaxis in patient with inflammation and allergic skin damages [4]. Sea Buckthorn oil has its application in treatment of burns and fractured injuries. Sea Buckthorn oil cream has been shown to be anti-allergic, anti-inflammatory and help in cell regeneration. The extract of Sea Buckthorn is used in cancer therapy [5]. The composition containing Sea Buckthorn oil is used to cure eczema and burn symptoms and has moisturizing effects [6].



Chemical Constituents

The Sea buckthorn is a valuable plant with therapeutic value as its various parts including seed, pulp, fruit and pomace is enriched with essential oil but the content of oil distinctly varies from variety to variety, species, parts of the plant used, extraction method and stage of harvesting. The oil content from various sources differ in physico-chemical and bio-chemical properties as mature seeds contain 8-20% oil while 20-25% oil is present in dried fruit pulp and 15-20% oil is derived from the residue left after juice extraction.

Sea buckthorn oil is enriched with saturated fatty acids like palmitic acid (30–33 w/w %) and stearic acid (<1 w/w %) and essential unsaturated fatty acids, mainly PUFA (polyunsaturated fatty acids) comprising α -linolenic acid (omega-3) (30 w/w%), γ -linolenic acid (omega-6) (35.5 w/w%), linoleic acid (omega-6)(5–7 w/w%), oleic acid

(omega-9 (14–18 w/w%) and eicosanoic acid (omega-9)(2 w/w%) [7-8].The γ -linolenic acid present in high amount contributes to its effect on the nutrient transport. Omega-3 (linolenic acid) and Omega-6 (linoleic acid) are the essential fatty acids required by human body for the transport of fat soluble vitamins like Vitamin A, D, E and K. It also enhances the cognitive function and bone health. Seabuckthorn seed oil is the only seed oil in which Omega-3 and Omega-6 are present in the ratio of 1:1. Thus, Seabuckthorn seed oil can be considered as invaluable part of balanced diet as it contains 32% Omega-3 (linolenic acid). Seabuckthorn seed oil has known to have blood cholesterol lowering effect due to the presence of beneficial fatty acids like Oleic acid.

Sea buckthorn seed oil contains 1 to 2% of the sterol in the seed oil and 1 to 3% in the soft parts of the fruit as sitosterol, isofucoesterol, campsterol, stigmastanol, citrostadienol, avenasterol, cycloartenol, 24-methylenecycloartenol and obtusifoliol. The β -sitosterol is 57-83% in Sea Buckthorn oil. The method of extraction has an effect on the content of β -sitosterol in seed oil like solvent extraction (746.3 mg/100 g oil), SCFE CO₂ (667.8 to 748.1 mg/100 g oil) and screw pressing (635.0 mg/100 g oil). The carotenoids give the distinctive colour to pulp oil. Seabuckthorn pulp oil has maximum quantity of Carotenoids (527.4 mg/100 g). The main carotenoid present is β -carotene, zeaxanthin and lycopene. The chemical constituents are enlisted in Table 1.

Fatty acid (% weight)	Seed oil	Pulp oil
Palmitic acid 16:0	5-Oct	15-40
Palmitoleic acid 16:1n-7	<0.5	15-50
Stearic acid 18:0	2-Apr	1-Feb
Oleic acid 18:1n-9	15-20	20-Oct
Vaccenic acid 18:1n-7	2-Apr	5-Oct
Linoleic acid 18:2n-6	35-40	20-35
α -Linolenic acid 18:3n-3	20-35	5-Oct
Folic acid	Up to 80 mcg	Up to 60 mcg
Total sterols	1094	721
Carotenoids (mg/100 g)	Oct-50	100-400
Tocopherols and tocotrienols (mg/100g)	100-200	100-400
Vitamin K	110-230	54-59
Vitamin E	207	171
Vitamin C	600-1200	200-600

Table 1: Chemical composition of oils from seed and pulp of Sea Buckthorn berry.

Significance of Sea Buckthorn Oil for Human Health

Combats cancer

The Plants have the immense potential to provide various novel, naturally occurring agents to combat cancer. Sea buckthorn oil has bioactive components having anticancer properties. The Hippophae rhamnoides extract inhibits the growth of pre-existing tumor by enhancing the immune system, antioxidant activity, arresting the cells proliferation in certain steps of cell cycle and anti-mutagenic effects against cancer causing agents [5]. Sea buckthorn juice not only retard the growth of the lymphatic leukemia (L1200) human gastric carcinoma (SGC7901) but kills both S180 and P388 cancer cells [9]. SEA BUCKTHORN juice lessens the effect of cisplatin on somatic and germ cell of mice [10]. SEA BUCKTHORN antimutagenic activity can be deduced from antioxidative mechanism [11]. Sea buckthorn juice can inhibit the formation of N-nitroso compounds endogenously more efficiently than ascorbic acid resulting in prevention of tumor [12]. The ethyl acetate extract has inhibitory action against CaCo-2 cells and augment apoptosis while the ethanolic extract has high content of phenolic and proanthocyanidin which has inhibitory effect on HepG₂ cells [13]. It abates the side effect of chemotherapy and radiotherapy and enhances tissue regeneration. It was demonstrated that the cellotoxic effects of Sea Buckthorn oil on extrinsic cell strains of Human Leukemia (K 562) [14].

Platelet Aggregation

The total flavonoids present in the *H. rhamnoides* L. (TFH) inhibits the activity of tyrosine kinase activity resulting in suppression of platelet aggregation caused by collagen. It has been found out that phosphorylation of Syk (Spleen tyrosine kinase) or Src (proto-oncogene of tyrosine kinase) by the collagen receptor stimulation followed by phospholipase C-gamma 2 activation. The augmentation of intracellular calcium is carried out by the activation of Tyrosine kinase which activates phospholipids A₂ (PLA₂), followed by synthesis of arachidonic acid from phospholipids in plasma membrane [15]. The rate of aggregation reaction (% aggregation/min) was diminished by Sea Buckthorn oil supplementation [16].

Minimises or Prevents Skin Problems

Sea buckthorn oil reduces sunburn, radiation damage, acne, dermatitis, dry skin, eczema, skin ulcers, protecting mucus membrane. It also helps in healing wounds- bed sores, burns and cuts by augmenting wound contraction,

hydroxyproline, hexosamine, DNA and total protein contents [17]. Sea Buckthorn oil has effects in atopic skin diseases as it increases the plasma fatty acids in plasma of atopic subjects. Yang et al. 1999 conducted the study on 30 female subjects of 61 yr by giving them 4 SBA24 capsule (2g oil) for 3 months and it was observed that there was increase in hydration and elasticity of skin and it was concluded that the oil has anti-wrinkle effect [18]. The liposoluble extract of Sea Buckthorn increase viability of regenerating cells as well as provide nutrients to epidermal cells in skin ulcers and wound healing. It has restorative effects with protective effects against dehydration, and antiseptic effects [19].

Battles Cardiovascular System Disorders

Sea Buckthorn oil escalate the left ventricles internal pressure and maximum rate of change (dp/dt) respectively, the time from the left ventricle starting a contraction to the occurrence of a dp/dt was reduced, the left ventricular pressure of the isovolumetric relaxation phase and the diastolic pressure of the left ventricle shortened and results in augmentation of cardiac output, cardiac index, heart stroke index, and left ventricular power index of the myocardium [20].

It regulates blood lipids and help in prevention of coronary heart diseases. It has pivotal role in treatment of angina. It decreases cholesterol level and has cardioprotective and anti-atherogenic activity. It was found out that the Sea Buckthorn oil is useful in anti-myocardial ischemia, decreases triglyceride, cholesterol and β -Lipoprotein and stabilise hyperlipemia induced in white rats by experimental high fat diet [21].

Treatment of Gastric Ulcer

The Sea buckthorn oil's anti-ulcer action is related to an enhanced hydrophobicity of the mucosal surface delaying the gastric emptying [22], inhibited peroxidation of lipid in gastric mucosa, accelerated of the mucosal repair [23], inhibited proteolytic enzyme activity in gastric liquid, fostered the wound healing processes of mucosa and inhibit mucosal damage [24].

In comparison with negative control, carbon dioxide extracted seed and pulp oil in the dose of 7.0 ml/kg/day showed the decrease in ulcer in water immersion ($P < 0.05$) and reserpine induced ($P < 0.01$) in rats. Sea buckthorn oil has both preventive and curative effects against gastric ulcer. It decreases the index of pylorus ligation induced gastric ulcer ($P < 0.05$) and healing process was expedited in acetic acid induced ulcer ($P < 0.01$) [25]. It smoothens and strengthens the mucous membrane of stomach, esophagus and intestine and helps in better

functioning of digestive glands. Thus, this oil aids in preventing or reversing GERD and gastric ulcers.

Antibacterial and Anti-Viral Agent

Sea buckthorn oil has Antimicrobial activity against E.coli and helps in combating various bacterial and viral diseases. Sea Buckthorn soothes irritation by calming nerve-endings. CO₂ extracted Sea Buckthorn seed oil helps in wound contractions and increase the level of hydroxyproline, hexosamine, DNA and total protein contents augmenting the wound healing processes with no significant side effects or toxicity in comparison to control and reference control treatment with silver sulfadiazine [26].

Antioxidant

Sea buckthorn oil has high content of antioxidants which help in preventing infection and enhance immunity. The Department of Drug technology and Pharmaceutical management at Kaunas University of Medicine in Lithuania conducted the study to evaluate the potency of antioxidants of pure extracted oil which found out to be 2.4 times more than other oils. It has high content of linoleic and linolenic acid and high phytochemical content including carotenoids, flavonoids and phytosterols which corresponds to its antioxidant property [27]. It restored the intracellular antioxidants such as reduced glutathione (GSH) and Glutathione peroxidase (GPx) and exhibited inhibition of ROS/free radical production [28,29]. It showed maintenance of mitochondrial and nuclear integrity as well as restoring the phagocytosis by macrophages [30].

Immunomodulatory Action

It ameliorates immune response in the broilers. Sea Buckthorn oils antagonise effects of immune suppressants. Baoru Yang and Risto Erkkola showed that in normal and cyclophosphamide (immunosuppressant) treated mice, the Sea Buckthorn oil increases the phagocytocytivity of abdominal macrophages and spleen NK cell activity as well as SRBC primed Ab production.

Dry Eye

The meibomian gland dysfunction and abnormalities of the tear film lipids causes dry eye. SEA BUCKTHORN oil contains antioxidants, Omega -7 acids, linoleic acid, tocopherols and carotenoids which have beneficial effect in dry eyes as they reduce inflammation, redness and itching in eye [31].

Anti-Atherogenic and Hypoglycemic Activity

Atherogenic index (AI) was lessened and vasorelaxation induced by acetylcholine was reduced to an extent which could be restored to control values in SEA BUCKTHORN oil treated normally and hypercholesterolemic animals [32]. Sea Buckthorn diminishes blood glucose and lipid in normal mice, and effect of Sea Buckthorn on glycometabolism may be related to the control of gluconeogenesis [33].

Nutritional Applications

Sea buckthorn oil has high content of Omega-7s and various Omega acids. Omega-7 also known as Palmitoleic acid, is a rare fatty acid. It is present in all body tissues, especially in skin and fat tissue and has nourishing effect on cell membrane. It is all purpose tissue healing oil.

Pharmacological Effects of Sea Buckthorn yet to Be Explored in Relation with Other Diseases

Sea Buckthorn is a long established herbal medicine which is indelibly used in many conditions like alleviating cough, diarrhea, aiding digestion, revitalizing blood circulation reducing pain, investigating because of antioxidant activity. The fruit's juice, syrup and oil have implications in disantharia, osteoporosis, hemorrhage, cataract, urinary stone, acne, psoriasis, sterility, polyneuritis, cheilosis, glossitis, baldness, analgesic, benign prostatic hypertrophy, antiobesity, gout, and chronic prostatitis a metabolism regulator in classical medicine [34].

Consumption Precautions &side effects of Sea Buckthorn oil Pregnancy and breast-feeding

There is not enough scientific evidence about the risks of taking sea buckthorn during pregnancy or breast-feeding process Therefore it is advised to avoid the use of Sea buckthorn oil and stay on the safe side.

Bleeding disorder

Sea buckthorn oil consumption has proven to slow blood clotting. Therefore, should be a concern that it might increase the risk of bleeding and bruising in people having bleeding disorders.

Low blood pressure

When taken as a medicine, Sea buckthorn oil might lower blood pressure. In theory, consumption of sea buckthorn may cause blood pressure to dip too low in people with low blood pressure.

Surgery

Sea buckthorn might cause extra bleeding during and after surgery as it slows down blood clotting when taken as a medicine. Therefore, it is recommended to stop using sea buckthorn about 2 weeks before any scheduled surgery.

Interactions

Sea buckthorn oil cannot be co-administered with anti-coagulant or anti-platelet drugs as they decrease blood

clotting. It has antagonistic effect with Aspirin, Clopidogrel, Diclofenac (Voltarex), Ibuprofen (Advil, Motrin), Dalteparin (Fragmin), Naproxen (Anaprox, Naprosyn), Enoxaprin (Lovenox), Warfarin (Coumadin), Heparin.

Dosage

Doses of sea buckthorn oil are dependent on an individual's age, health status, nutrition and several other conditions. No scientific information is there for determination of appropriate range of doses of sea buckthorn oil.

Sea Buckthorn Market Products Table 2

S.No.	Product Name	Manufacturer's Name
1.	Inlife Sea Buckthorn oil capsule	Inlife Pharma Pvt. Ltd. (India)
2.	Sea Buckthorn Berry oil	Natures natural (India)
3.	Sea Buckthorn cosmetic oil	MNC (India)
4.	Sibu Sea Buckthorn berry oil	Sibu, Sea berry therapy co.,ltd. (North America)
5.	Sea Buckthorn seed oil capsule	Wutai mountain sea buckthorn co.,ltd.(China)
6.	Natural Sea Buckthorn oil	Siboos, Grow Up Trading Company (India)
7.	Sea Buckthorn effervescent tablets	Nanjing union biotech co.,ltd.(China)
8.	Menova heyeqianzi slimming herbs capsule	Panda international trade co., ltd.(China)
9.	Sea Buckthorn Herbal Capsules	Mart Fitcare (India)
10.	Seabuck wonders	Weleda (Germany)
11.	Sea Buckthorn galic softgel (psg)	Perfect co., ltd.(China)
12.	Sea Buckthorn oil softgel	Fraken biochem co., ltd.(China)
13.	Spirulina	Dechen nutrachem co.,ltd.(China)
14.	Deve herbes pure Sea Buckthorn oil	Deve Herbes (India)
15.	Sibu Sea Buckthorn fruit oil	Sibu, Sea berry therapy (North America)

Table 2: List of available Sea buckthorn market preparation

Patents on Sea buckthorn and its variety

Table 3 illustrates an updated report on therapeutic application of sea buckthorn.

Patent No.	Title	Publication date	Ref.
US20060222724A1	Reproductive cell system	2000	[3]
US20050214394	Hippophae Rhamnoides compositions for cancer therapy	2005	[4]
US20070178061A1	Therapeutic blended oil composition and method	2007	[6]
US6524561	Composition including sea buckthorn oil extract and antioxidant and/or a UV filter	2003	[35]
US20050031718	Sea buckthorn compositions and associated methods.	2004	[36]
WO2004091368 A2			
US 6576269 B1	Treating open skin lesions using extracts	2003	[37]
US 20150079011 A1	Dermatological Product	2015	[38]
US 20160184375 A1	Sea buckthorn compositions and associated methods	2016	[39]
US 20140147522 A1	Gastric health supplement and methods thereof	2014	[40]

Table 3: Updated list on Patents of Sea Buckthorn.

Summary

Sea Buckthorn oil has a medicinal and therapeutic value. Sea Buckthorn oil extracted with the technique Supercritical CO₂ extraction gives the high yields due to its high solvating power and effective penetration through raw material as compared to cold pressure which give low yield and disadvantage of solvent residue. It has high content of PUFAs, tocopherols, polyphenols, Fatty acids which help in the prevention and treatment of various disorders. It is an antioxidant property which help in prevention of Cancer and used as supplementing agent in treatment of Cancer. The various clinical trials are carried to study the effect in various ailments. The fatty acids help in resorting skin elasticity, skin hydration, thus finding its implication as anti-wrinkle and in various other skin diseases. Sea Buckthorn oil has calming effect on nerve ending soothes the irritation. It has high content of Omega-7 acids which help in tissue regeneration and tissue healing. It decreases Triglycerides and cholesterol level and acts as anti hyperlipidemic agent. It decreases blood clotting antagonise the effect of anti-coagulant and anti-platelet drugs. The various products are available used for gastric ulcer treatment and skin diseases. The numerous patents on Sea Buckthorn oil composition, preparation of formulation and uses are granted in the recent years.

Conclusion

Sea buckthorn oil has extensive medicinal and therapeutic potential. However, it is needful to extract pure Sea Buckthorn oil. The various knowledge gaps give the way for new academic and research and development activities in the field of herbal medicines and nutraceuticals.

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