

Sea buckthorn (*Hippophae rhamnoides*)

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Plant Profiler

Synonyms / Common Names / Related Terms

5-formyltetrahydrofolate, 5-hydroxytryptamine, 5-methyltetrahydrofolate, acetic acid, aekol, alkaloids, almindelig havtorn (Danish), alpha-linolenic acid, amino acid, Amritscherl (German), anthocyanin, arabinose, argasse, argasse (French), argouse (French), argousier (French), artificial sea-buckthorn oil, ascorbic acid, ash, Audorn (German), baie d'argousier (French), baie d'hippophaé (French), beta-sitosterol, beta-carotene, buckthorn, caffeic acid, campherol, carbohydrates, carotene, carotenoid, carotenoids, catechin, cinnamic acid, citric acid, common sea-buckthorn, dehydroascorbic acid, dhar-bu (Lao (Sino-Tibetan)), dhurchuk (Hindi), duindoorn (Dutch), Dünendorn (German), Elaeagnaceae (family), *Elaeagnus rhamnoides* (L.) A. Nelson, espinheiro-marítimo (Brazilian Portuguese), espino amarillo (Spanish), espino falso (Spanish), Fasanbeere (German), fat, ferulic acid, fiber, finbar (Swedish), finnbär (Swedish), flavo-glycoside, flavones, flavonoid, flavonoids, flavonol aglycones, flavonols, folate vitamers, fruit acid, galactose, gallic acid, Gemeiner Sanddorn (German), Gewöhnlicher Sanddorn (German), glucose, grisset, Haffdorn (German), hafþyrnir (Icelandic), harmalol, harmol, havtidse (Danish), havtorn (Swedish), havtorn (Danish), *Hippophae angustifolia* Lodd., *Hippophae littoralis* Salisb., *Hippophae rhamnoides* cv. Indian Summar, *Hippophae rhamnoides* oil, *Hippophae rhamnoides*, *Hippophae rhamnoideum* Saint-Lager, Lodd., *Hippophae stourdziana* Osyris *rhamnoides* Scop., paeonin, palmitic acid, palmitoleic acid, p-coumaric acid, pectin, pentamethylquercetin, phenolic acids, phosphatides, p-hydroxybenzoic acid, phylloquinone, physalien, Prielbrusie, proteins, protocatechuic acid, pulp oil, purging thorn, quercetin, quinic acid, rakytník řešetlákovitý (Czech), *Rhamnoides hippophae* Moench, rhamnose, rokitnik, rokitnik zwyczajny (Polish), Rote Schlehen (German), saccharose, salicylic acid, sallow thorn, Sandbeere (German), Sanddorn (German), sandthorn, sandtidse (Danish), sandtidsel (Danish), sandtorn (Danish), sceitbezien, seabuckthorn, sea-buckthorn, seabuckthorn oil, sea-buckthorn oil, seabuckthorn powder, seed oil, seed residues of *Hippophae rhamnoides* L, Seedorn (German), serotonin, sha ji (Chinese), shaji (Chinese), silverbuske (Swedish), star-bu (Lao (Sino-Tibetan)), stearic acid, sterols, støggved (Norwegian), Stranddorn (German), succinic acid, sugar, syringetin, tænnved (Norwegian), tannic acid, tanning agents, terpenoids, tetrahydrofolate, tindved (Danish), tindved (Norwegian), tinnan (Norwegian), tinne (Norwegian), tinnved (Norwegian), tocopherol, tocopherols, tocotrienols, tørn (Norwegian), tornan (Norwegian), tørri (Norwegian), total flavones of *Hippophae rhamnoides* L (TFH), trans-reservatrol, tyrni (Finnish), unsaturated fatty acids, vanillic acid, vitamin B, vitamin B12, vitamin C, vitamin E, water, Weidendorn (German), Weisseldorn (German), xanthophylls, yellow spine, zeaxanthin.



Note: Sea buckthorn (*Hippophae rhamnoides*) should not be confused with alder buckthorn (*Rhamnus frangula*), common buckthorn (*Rhamnus cathartica*), or cascara/California buckthorn (*Rhamnus purshiana*), although these plants have similar common names.

Mechanism of Action

Pharmacology:

- Constituents:** Sea buckthorn (*Hippophae rhamnoides* L.) contains vitamin E³³, beta-carotene, chrysin, sterols, polyunsaturated fatty acids, free amino acids, flavonols (especially pentamethylquercetin, syringetin, isorhamnetin, quercetin, kaempferol, and myricetin), tocopherols, tocotrienols, phenolic acids (including gallic acid, protocatechuic acid, p-hydroxybenzoic acid, vanillic acid, salicylic acid, p-coumaric acid, cinnamic acid, caffeic acid, and ferulic acid), phylloquinone, *trans*-resveratrol, catechin, vitamin C^{16,7,11,29,5,34,35,36,37,38,39,33}, and elemental components⁹. One *in vitro* study has shown a potential intra-herb pharmacokinetic interaction between quercetin and isohamentin (two flavonols found in sea buckthorn).⁴⁰ The major fatty acids in the seed oil are linoleic (34%), fishoil (25%), and oleic (19%) acids, whereas the major fatty acids in the pulp oil are palmitic (33%), oleic (26%), and palmitoleic (25%) acids.^{1,5} Sea buckthorn contains folate vitamers, and during processing of sea buckthorn berries to concentrate some were degraded (tetrahydrofolate and 5-formyltetrahydrofolate) while others remained intact (5-methyltetrahydrofolate).⁴¹ According to secondary sources, sea buckthorn also contains vitamin C (1,500mg/100g), 20 micro elements, and 200 bioactive substances, including 5-hydroxytryptamine, acetic acid, alkaloids, amino acid, anthocyanin, arabinose, ascorbic acid, ash, beta-sitosterol, beta-carotene, campherol, carbohydrates, carotene, citric acid, dehydroascorbic acid, fat, fiber, flavo-glycoside, flavones, flavonoids, galactose, glucose, harmalol, harmol, isolinoleic acid, isorhamnetin, leucocyanidin, leucodelphinidin, linoleic acid, linolenic acid, lycopene, malic acid, mannitol, minerals, oil, oleic acid, paeonin, palmitic acid, pectin, phosphatides, physaligenin, proteins, quinic acid, rhamnose, saccharose, serotonin, stearic acid, succinic acid, sugar, tannic acid, terpenoids, unsaturated fatty acids, vitamin B, vitamin B12, water, xanthophylls, and zeaxanthin.
- In a survey of juices from seven sea buckthorn (*Hippophae rhamnoides* L.) varieties, total sugar (fructose and glucose) varied from 1.9 to 7.1g/100mL, total acid (malic and quinic acids) from 3.1 to 5.1g/100mL, vitamin C from 29 to 176mg/100mL, and pulp oil from 0.7 to 3.6%.⁴² The soluble solids were between 7.4 and 12.6, the pH between 2.7 and 2.9, and the titrable acidity between 2.0 and 3.7.
- Antibacterial activity:** In an *in vitro* study using five clinical strains of *Helicobacter pylori*, the ethanol extract of sea buckthorn inhibited all test strains (MIC close to 60.0mcg/mL).³
- Anticancer activity:** In *in vitro* studies, extracts of sea buckthorn have shown dose- and time-dependent anticancer effects.^{7,10,11,8,43} This may be achieved through co-regulating of intracellular and extracellular signal transduction pathways, ultimately inducing apoptosis.^{10,11,8} Sea buckthorn berries have also shown antiproliferative activity *in vitro* in some studies⁶ but not in others⁴⁴.
- Antioxidant activity:** Available information on the antioxidant activity of sea buckthorn is contradictory. In several laboratory assays and animal studies, sea buckthorn has shown antioxidant activity^{6,29,30,14,31,32,20,18,45,46}, and in other *in vitro* studies, a lack of such an effect has been observed⁴⁷. However, when human subjects ingested a combination of oatmeal porridge and sea buckthorn flavonols, there was no statistically significant effect on plasma antioxidant potential, nor was there a significant effect on the levels of oxidized low-density lipoprotein.¹⁶ In another placebo controlled trial of 20 healthy men, ingestion of sea buckthorn juice for eight weeks moderately decreased the susceptibility of LDL to oxidation.⁴

- **Antiplatelet activity:** Various extracts of sea buckthorn may affect platelet aggregation differently. In a placebo controlled trial of 20 healthy men, ingestion of sea buckthorn juice for eight weeks did not change platelet aggregation or plasma intercellular cell adhesion molecule 1 (ICAM-1) levels when the treatment groups were compared.⁴ However, in a randomized crossover study in 12 normolipidemic men, ingestion of sea buckthorn berry oil 5g daily for four weeks decreased the rate of adenosine-5'-diphosphate-induced platelet aggregation and maximum aggregation when compared with the fractionated coconut oil control.⁵ In a mouse thrombosis model and *in vitro* studies, sea buckthorn flavones prevented *in vivo* thrombogenesis and reduced whole blood platelet aggregation.²²
- **Antiulcer activity:** In an animal study, sea buckthorn seed and fruit oil reduced ulcer formation in rats.²⁷ Animal study has shown that the procyanidins in sea buckthorn may help heal gastric ulcers.⁴⁸ In rats, sea buckthorn pulp oil can inhibit gastric acid and pepsin secretion.²⁸
- **Antiviral activity:** When compared to the traditional dengue fever treatment (the commercially available anti-viral drug Ribavirin®), sea buckthorn showed similar anti-dengue activity as evidenced by its ability to maintain the cell viability of infected cells along with decreases in TNF-alpha and increases in IFN-gamma.¹²
- **Cardiovascular effects:** In *in vitro* study, the total flavones of *Hippophae rhamnoides* had inhibitory effects on angiotensin-converting enzyme (ACE) activity and on angiotensin II formation in rabbit aortic smooth muscle cells.² Total flavones extracted from seed residues of sea buckthorn have shown antihypertensive effects that may be modulated at least in part by improving insulin sensitivity and blocking the angiotensin signaling pathway.⁴⁹ In animal study, flavonoids from sea buckthorn have been found to significantly reduced serum cholesterol and serum triglyceride levels.^{17,11} However, in human study, sea buckthorn has been reported to elevate high-density lipoprotein (HDL) levels^{16,1}, but no effect was noted on paraoxonase activity¹⁶. Low-density lipoprotein (LDL) levels have not been altered in clinical study.^{16,4} Ingestion of sea buckthorn berry oil 5g daily for four weeks did not affect phospholipid fatty acids or plasma lipids when compared with the fractionated coconut oil control in randomized controlled study in normolipidemic men.⁵
- *Hippophae rhamnoides* L. has not been found to alter sympathetic activity in the treatment of hypertension based on human study.²⁶ Its inhibitory effects were noted, however, after supine isometric exercise.²⁶ Animal studies have shown that sea buckthorn improved the metabolic processes accompanied by reduction of hypertensive stress on the ventricular microvessels in hypertensive/stroke-prone rats⁵⁰.
- *In vivo* studies have demonstrated that sea buckthorn extract may help to protect the myocardium from ischemia through the regulation of various proteins.⁵¹ Another study in rats showed that sea buckthorn significantly improved hypoxic tolerance, as evidenced by increased hypoxic gasping time and survival time, and decreased plasma catecholamine levels, as compared to hypoxic animals.⁵²
- In a clinical trial, a reductive effect on CRP, a marker of inflammation and a risk factor for cardiovascular diseases, was detected in response to treatment with sea buckthorn berries.¹³
- **Cold stress reduction effects:** In a preliminary study in cold-sensitive humans, oral administration of 500mg of sea buckthorn alcoholic extract daily for three months reduced the cardiovascular reactivity to cold stress.¹⁹ Studies in animals have shown that sea buckthorn extract may allow for a shift in anaerobic metabolism to aerobic during cold-hypoxia-restraint exposure by affecting several key metabolic enzymes.⁵³

- **Endocrine effects:** In a randomized crossover study in 12 normolipidemic men, ingestion of sea buckthorn berry oil 5g daily for four weeks did not affect plasma glucose when compared with the fractionated coconut oil control.⁵ However, in healthy mice, flavonoids from sea buckthorn significantly reduced serum glucose levels.¹⁷ The mechanism by which sea buckthorn lowers glucose is not well understood.
- **Hematological effects:** In patient with acute blood stasis, one study found that sea buckthorn was able to recover to control levels; the authors suggest that significant changes in some metabolites such as cholic acid, phenylalanine, and kynurenic acid may be possible mechanisms for this effect.⁵⁴
- **Hepatoprotective activity:** In human study, sea buckthorn has been shown to reduce serum levels of laminin, hyaluronic acid, collagen types III and IV, and total bile acid compared to the control group.²⁵ In addition, the sea buckthorn treatment notably shortened the duration for normalization of aminotransferases. In *in vitro* study using tissue and serum from rats with induced toxic lesions of the liver, sea buckthorn increased the proportion of tissular and serumal proteins and protected cytochrome P450 enzymes from damage.¹⁴ An *in vivo* animal study supports this result.¹⁵
- **Immunomodulation activity:** In an *in vitro* study, sea buckthorn alcoholic leaf and fruit extracts showed immunomodulation activity.^{18,24} In animal study, mice administered an alcoholic extract of sea buckthorn and exposed to lethal whole body Co-60-gamma irradiation had enhanced viable counts of macrophages, compared to those that did not receive the sea buckthorn.²³ Mice that received the sea buckthorn and no radiation also had higher macrophage counts than nonirradiated mice without sea buckthorn.
- **Physical performance:** Studies in rats have shown that sea buckthorn may be effective in enhancing physical performance activity during avoidance learning; however, it had no effect on cognitive function.⁵⁵ The mechanism for these effects is not well understood.
- **Vulnerary activity:** In animal study, sea buckthorn increased wound healing.^{21,56}

Pharmacodynamics/Kinetics:

Absorption: In a clinical trial, sea buckthorn flavonols were rapidly absorbed when administered with oatmeal porridge, and a small amount of sea buckthorn oil seemed to increase the bioavailability of additional sea buckthorn flavonols.¹⁶

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