



Sea buckthorn: A potential dietary supplement with multifaceted therapeutic activities

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ABSTRACT

Sea buckthorn (*Hippophae rhamnoides* L.) is a plant with various nutritional and medicinal properties. It contains vitamins, carotenoids, polyphenols, fatty acids, and phytosterols, which have antioxidant, anticancer, anti-hyperlipidemic, anti-obesity, anti-inflammatory, antimicrobial, antiviral, dermatological, neuroprotective, and hepatoprotective effects. Sea buckthorn can be used as a functional food or a dietary supplement for the prevention and treatment of chronic diseases. This review summarizes the phytochemistry, health benefits, and food applications of sea buckthorn, and highlights the potential and challenges for its further development and utilization. Sea buckthorn not only has great medicinal and therapeutic potential, but also is a promising economic plant. The potential of seabuckthorn in the human food industry has attracted the research interest of researchers and producers. The present review mainly summarizes the phytochemistry, nutrients, health benefits, and food applications of sea buckthorn. Overall, sea buckthorn is a dietary source of bioactive ingredients with the potential to be developed into functional foods or dietary supplements for the prevention and treatment of certain chronic diseases, which deserves further research.

1. Introduction

Sea buckthorn (*Hippophae rhamnoides*) stands out as a promising dietary supplement, showcasing a myriad of potential therapeutic activities. Its nutrient-rich berries, loaded with vitamins (C, A, E, and K), minerals, and essential fatty acids, form the foundation of its health benefits. The plant's remarkable antioxidant properties, attributed to high levels of vitamin C and flavonoids, equip it to combat oxidative stress and protect cells from free radical damage.¹

This multifaceted botanical ally extends its support to various aspects of health. Sea buckthorn is known to boost the immune system, thanks to its rich vitamin content, contributing to overall well-being. Its omega fatty acids, notably omega-7 and omega-3, hold promise for cardiovascular health by reducing inflammation and lowering cholesterol levels. The oil derived from sea buckthorn finds application in skincare products, promoting hydration, reducing inflammation, and aiding in wound

healing.²

Beyond skin-deep benefits, sea buckthorn is under scrutiny for potential advantages in gastrointestinal health, displaying anti-inflammatory effects on the digestive tract. Preliminary studies hint at anti-cancer properties, with antioxidants and bioactive compounds potentially inhibiting the growth of certain cancer cells.³ Fig. 1, the plant's role in diabetes management is also being explored, with indications of potential blood sugar regulation and improved insulin sensitivity.

In the realm of inflammation-related conditions, sea buckthorn's anti-inflammatory properties may offer relief, extending to conditions like arthritis.⁴ The rich array of bioactive compounds, including quercetin, catechins, and beta-carotene, contributes to its diverse therapeutic potential. However, it's crucial to approach sea buckthorn supplementation with caution, acknowledging the need for further research to fully understand its effects and potential side effects.⁵ Consulting with a

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Fig. 1. Plant and Berries of the Sea buckthorn (*Hippophae rhamnoides*).

healthcare professional before incorporating it into one's routine is advisable, particularly for those with underlying health conditions or taking medications.⁶ Sea buckthorn has been shown to have various health benefits, such as:

- a. **Antioxidant:** Sea buckthorn can protect the cells from oxidative stress and free radical damage.
- b. **Anti-inflammatory:** Sea buckthorn can modulate the immune system and reduce inflammation.
- c. **Anti-cancer:** Sea buckthorn can inhibit the growth and spread of cancer cells.
- d. **Hepatoprotective:** Sea buckthorn can prevent liver damage and improve liver function.
- e. **Cardiovascular:** Sea buckthorn can lower blood pressure, cholesterol, and triglycerides, and prevent atherosclerosis.
- f. **Neuroprotective:** Sea buckthorn can improve cognitive function and memory, and protect the brain from neurodegeneration.
- g. **Dermatological:** Sea buckthorn can improve skin health and appearance, and treat skin disorders such as eczema.
- h. **Ophthalmological:** Sea buckthorn can protect the eyes from dryness, irritation, and infection.
- i. **Gastrointestinal:** Sea buckthorn can heal ulcers and gastritis, and regulate bowel movements.

Sea buckthorn is a potential dietary supplement that can be consumed as oil, juice, powder, or capsule.^{7,8} It can also be used as an ingredient in various food products, such as jams, pies, drinks, and cosmetics. However, more clinical trials are needed to confirm the safety and efficacy of sea buckthorn for human health. Some possible side effects of sea buckthorn include allergic reactions, bleeding disorders, low blood sugar, and interactions with some medications. Therefore, it is advisable to consult a doctor before taking sea buckthorn supplements. Sea buckthorn is a genus of thorny shrubs that produce orange-yellow berries.⁹ There are several species and subspecies of sea buckthorn, each with different characteristics and distributions. Here are some examples:

- a. ***Hippophae rhamnoides*:** This is the most common and widely distributed species of sea buckthorn. It has silvery-green leaves and grows in dry and cold regions of Asia and Europe¹. It has nine subspecies, such as *H. rhamnoides* ssp. *sinensis*, which is native to China.
- b. ***Hippophae salicifolia*:** This species is restricted to the Himalayas, where it grows at high altitudes in dry valleys. It has broader and greener leaves than *H. rhamnoides*, and yellow berries.
- c. ***Hippophae goniocarpa*:** This species grows in mountainous regions of Nepal and China, between 2650 and 3700 m. It has two subspecies, *H. goniocarpa* ssp. *litangensis* and *H. goniocarpa* ssp. *goniocarpa*, which differ in the shape and color of their leaves.

- d. ***Hippophae neurocarpa*:** This species is endemic to Xizang, where it grows on rocky slopes and river banks. It has small and narrow leaves, and orange-red berries.

There are also some varieties of sea buckthorn that have been cultivated¹⁰ for their fruit quality and yield, such as:

- a. **Russian Orange:** This variety has fewer thorns and yields large, top-quality fruits that are sweet and juicy.
- b. **Sirola:** This variety is strong and vigorous, with fewer thorns than some others. The berries are sweet and enjoyable.
- c. **Pollmix:** These are male varieties that are used for pollination of female plants. They have different flowering times and thorniness levels.

Sea buckthorn is a nutritious fruit that contains many bioactive compounds, such as vitamins, minerals, antioxidants, fatty acids, and phytosterols.¹¹ According to one source, 100 g of dried sea buckthorn berries have the following nutritional values in Table 1.

Sea buckthorn also provides significant amounts of vitamin C, vitamin E, beta-carotene, lycopene, iron, and calcium. Sea buckthorn oil, which is extracted from the seeds or pulp of the berries, is rich in omega-7 fatty acid (palmitoleic acid), which has anti-inflammatory and skin-protective properties. Sea buckthorn can be consumed as oil, juice, powder, or capsule, or used as an ingredient in various food products and cosmetics.¹² However, before taking sea buckthorn supplements, you should consult your doctor for the appropriate dosage and possible side effects¹. Sea buckthorn may interact with some medications, such as blood thinners, blood sugar-lowering drugs, and cyclosporine. It may also cause allergic reactions in some people.

2. Traditional and modern day uses

Sea buckthorn is a plant that has many uses and benefits for health, beauty, and food. Sea buckthorn has been used in herbal medicine for centuries, especially in China, Mongolia, and Russia. It is believed to have

Table 1
Nutrients value of the Sea buckthorn (*Hippophae rhamnoides*).

Nutrient	Amount
Calories	275 kcal
Carbohydrates	55.4 g
Fiber	14.1 g
Sugar	5.4 g
Fat	7.1 g
Protein	3.7 g

anti-inflammatory, antioxidant, anti-microbial,¹³ anti-cancer, and immune-boosting properties. Some of the conditions that sea buckthorn may help treat include eczema, wound healing, blood sugar, high blood pressure, high cholesterol, liver disease, gastric ulcers, and radiation damage.¹⁴

Sea buckthorn oil is extracted from the seeds and pulp of the berries and is widely used in cosmetics and skin care products. Sea buckthorn oil is rich in essential fatty acids, vitamins, and antioxidants that can nourish, moisturize, protect, and heal the skin. Sea buckthorn oil may help with acne, rosacea, sunburns, scars, wrinkles, dryness, and skin infections. Sea buckthorn berries are edible and have a sour and tangy taste.¹⁵ They are high in vitamin C, vitamin E, carotenoids, flavonoids, and other phytochemicals that can benefit health. Various uses are shown in Fig. 2. The berries can be eaten fresh or processed into juices, jams, syrups, wines, teas, candies, and other products.¹⁶ The berries can also be used in both sweet and savory dishes as a flavoring agent or a garnish.

Sea buckthorn leaves are also edible and can be used fresh or dried to make herbal teas or tisanes. The leaves contain various bioactive compounds that may have anti-inflammatory, antioxidant, anti-diabetic, anti-obesity, and neuroprotective effects.¹⁷ The leaves can also be used as animal fodder or as a source of natural dyes. Sea buckthorn is also an environmentally friendly plant that can grow in harsh conditions and improve soil quality. It can prevent soil erosion, increase soil fertility, fix nitrogen, and provide habitat for wildlife. Sea buckthorn is also a renewable source of biomass that can be used for biofuel production.¹⁸

As you can see, sea buckthorn is a versatile plant that has many traditional and modern day uses. However, before using sea buckthorn for any purpose, you should consult your doctor or pharmacist for advice on dosage, safety, interactions, and possible side effects. Sea buckthorn is a plant that has many uses and benefits for health, beauty, and food.¹⁹ However, like any other natural product, it may also have some side effects for some people. Sea buckthorn may cause allergic reactions in people who are sensitive to the plant or its components. Symptoms may include rash, itching, swelling, hives, difficulty breathing, or anaphylaxis. If you experience any of these symptoms after using sea buckthorn, stop using it and seek medical attention immediately. Sea buckthorn may interfere with blood clotting and increase the risk of bleeding or bruising. This may be a problem for people who have bleeding disorders, are taking blood thinners, or are undergoing surgery.²⁰ If you are in any of these situations, consult your doctor before using sea buckthorn and avoid using it at least two weeks before or after surgery.

Sea buckthorn may lower blood pressure and cause symptoms such as swelling, headache, dizziness, and palpitations in some people who have high blood pressure. If you have high blood pressure or are taking medication for it, monitor your blood pressure closely and talk to your doctor before using sea buckthorn. Sea buckthorn may interact with

other medications or supplements that have similar effects or are metabolized by the same enzymes. Some examples include cyclosporine, warfarin, aspirin, ibuprofen, clopidogrel, statins, and antidiabetic drugs. If you are taking any of these or other medications or supplements, check with your doctor or pharmacist before using sea buckthorn.²¹ Sea buckthorn may cause gastrointestinal upset such as nausea, vomiting, diarrhea, or stomach pain in some people. This may be due to the high acidity or oil content of the berries or the supplements. To reduce this risk, take sea buckthorn with food and water and start with a low dose. Sea buckthorn may change the color of urine to a dark yellow or orange hue. This is not harmful and is due to the presence of carotenoids in the berries or the supplements. However, if you notice any other changes in your urine such as blood, pain, or difficulty urinating, contact your doctor as soon as possible.²² These are some of the potential side effects of sea buckthorn. However, this is not a complete list and there may be other side effects that are not yet known or reported. Therefore, it is important to use sea buckthorn with caution and under the guidance of a qualified health professional.

3. Pharmacological and therapeutic action

3.1. Anti-depressant

Sea buckthorn is a plant that has many uses and benefits for health, beauty, and food. However, there is not much evidence to support its anti-depressant activities. According to the web search results, sea buckthorn may have some effects on the nervous system, such as neuroprotection, anti-inflammatory, and antioxidant properties. However, these effects do not necessarily translate into anti-depressant effects, which depend on the modulation of neurotransmitters, hormones, and brain regions involved in mood regulation.^{2,23}

There are some studies that suggest sea buckthorn may have some positive effects on mood and cognition in healthy subjects or patients with mild cognitive impairment. For example, one study found that sea buckthorn juice improved mood and mental performance in healthy young adults. Another study found that sea buckthorn oil improved memory and attention in elderly patients with mild cognitive impairment. However, these studies are limited by small sample sizes, short duration, and lack of placebo control. Therefore, more rigorous and long-term studies are needed to confirm the potential anti-depressant effects of sea buckthorn. Sea buckthorn is a plant that has many health benefits, but its anti-depressant activities are not well established. There is some evidence that sea buckthorn may have some positive effects on mood and cognition, but more research is needed to verify this claim. If you are suffering from depression or any other mental health condition, you should consult your doctor before using sea buckthorn or any other natural product.

Sea buckthorn is a plant that has many uses and benefits for health, beauty, and food. However, it may also have some interactions with certain medications, including anti-depressants. Therefore, you should be careful when using sea buckthorn with your anti-depressant medication and consult your doctor or pharmacist before doing so. Sea buckthorn may interfere with the metabolism of some anti-depressants, such as sertraline (Zoloft), by affecting the enzymes that break them down in the liver. This may increase the levels of the anti-depressant in your blood and cause side effects or toxicity.²⁴ Sea buckthorn may also lower blood pressure and increase the risk of bleeding, which may be problematic for people who take anti-depressants that have similar effects.

There is not much evidence to support the anti-depressant effects of sea buckthorn itself, so you should not rely on it as a substitute for your prescribed medication. Sea buckthorn may have some positive effects on mood and cognition, but more research is needed to verify this claim. Sea buckthorn is a plant that has many health benefits, but its interaction with anti-depressants is not well established.²⁵ There is some evidence that sea buckthorn may interfere with the metabolism, blood pressure, and bleeding of some anti-depressants, which could be harmful for your

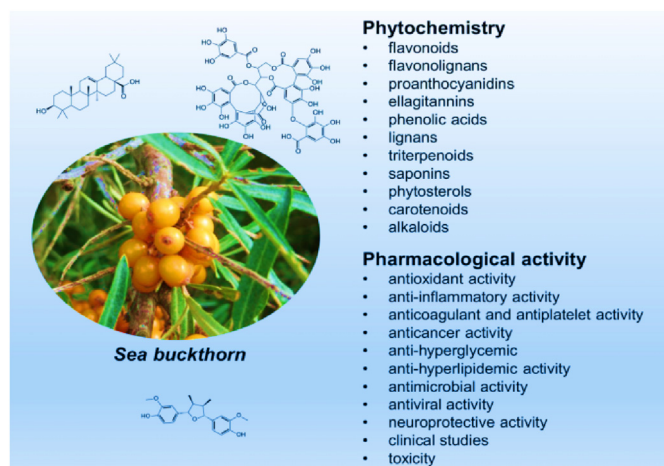


Fig. 2. Various uses of the plant Sea buckthorn (*Hippophae rhamnoides*).

health. Therefore, you should use sea buckthorn with caution and under the guidance of a qualified health professional if you are taking any anti-depressant medication.

3.2. Anti-asthmatic

Sea buckthorn is a plant that has many uses and benefits for health, beauty, and food. According to the web search results, sea buckthorn may also have some anti-asthmatic activities, which means that it can help prevent or treat asthma, a chronic respiratory condition that causes inflammation and narrowing of the airways. Sea buckthorn oil, extracted from the seeds or pulp of the berries, is used as an expectorant for loosening phlegm and clearing the lungs. This can help reduce coughing and wheezing, which are common symptoms of asthma. Sea buckthorn oil also has anti-inflammatory and antioxidant properties that can protect the cells and tissues of the respiratory system from damage caused by oxidative stress and inflammation. This can help prevent or reduce the severity of asthma attacks, which are triggered by various factors such as allergens, infections, or irritants.

Sea buckthorn oil may also modulate the immune system and reduce the production of histamines, which are chemicals that cause allergic reactions and inflammation in the body. This can help prevent or treat allergic asthma, which is caused by an overreaction of the immune system to certain substances such as pollen, dust mites, or animal dander.²⁶ Sea buckthorn berries and leaves are also edible and can be consumed as food or supplements. They contain various bioactive compounds such as phenolic acids, flavonoids, carotenoids, vitamins, and fatty acids that may have beneficial effects on the respiratory system.³¹⁵ For example, some studies suggest that sea buckthorn berries and leaves may have neuroprotective, anti-diabetic, anti-obesity, and anti-lipoxygenase effects that may improve mood, blood sugar, body weight, and inflammation levels, which are all factors that can affect asthma.

These are some of the potential anti-asthmatic activities of sea buckthorn. However, this is not a complete list and there may be other mechanisms or benefits that are not yet known or reported. Therefore, it is important to use sea buckthorn with caution and under the guidance of a qualified health professional.^{2,5,9} Sea buckthorn may have some side effects or interactions with other medications or supplements that could affect your health or asthma condition. It may cause allergic reactions in some people who are sensitive to the plant or its components. Symptoms may include rash, itching, swelling, hives, difficulty breathing, or anaphylaxis. If you experience any of these symptoms after using sea buckthorn, stop using it and seek medical attention immediately.²⁷ It may interfere with blood clotting and increase the risk of bleeding or bruising. This may be a problem for people who have bleeding disorders, are taking blood thinners, or are undergoing surgery.

3.3. Anti-diabetic

Sea buckthorn is a plant that has been used in traditional medicine for various health benefits, including diabetes. According to some recent studies, sea buckthorn may have anti-diabetic effects by influencing glucose metabolism and insulin secretion. Sea buckthorn pulp oil, which is rich in palmitoleic acid (POA), a rare fatty acid in plants, may enhance glucose-induced insulin secretion in human islet cells by activating G protein-coupled receptors. Sea buckthorn seed protein (SSP) may improve oral glucose tolerance and insulin sensitivity, reduce insulin resistance, and modulate liver glucose metabolism genes and the AMPK/SIRT1 pathway in diabetic mice. Sea buckthorn fruit extracts may inhibit the activity of α -amylase and α -glucosidase, two enzymes that break down polysaccharides to glucose, and thus lower postprandial blood glucose levels. Sea buckthorn fruit puree may slightly decrease fasting blood sugar in people with impaired glucose regulation (IGR) or pre-diabetes.²⁸

3.4. Anti-cancer

Sea buckthorn is a plant that has been used in traditional medicine for various health benefits, including cancer prevention and treatment. According to some recent studies, sea buckthorn may have anti-cancer effects by influencing cell proliferation, apoptosis, and immune system. Sea buckthorn pulp oil, which is rich in palmitoleic acid, a rare fatty acid in plants, may inhibit the growth of human leukemia cells and induce their apoptosis by activating caspase-3 and caspase-9 pathways. Sea buckthorn seed oil, which contains omega-3, omega-6, omega-7, and omega-9 fatty acids, may suppress the growth of human breast cancer cells and enhance the cytotoxicity of doxorubicin, a chemotherapy drug, by modulating the expression of Bcl-2, Bax, and p53 genes.²¹ Sea buckthorn fruit extracts, which are rich in phenolic compounds such as flavonoids, may prevent the formation of colon cancer in rats by reducing the levels of fecal bile acids and increasing the activity of detoxifying enzymes. Sea buckthorn leaves, which contain flavonoids, triterpenes, and ursolic acid, may exhibit anti-angiogenic and anti-metastatic effects in mouse models of melanoma and lung cancer by inhibiting the expression of vascular endothelial growth factor (VEGF) and matrix metalloproteinases (MMPs).

3.5. In sepsis

Sea buckthorn is a plant that has been used in traditional medicine for various health benefits, including sepsis. Sepsis is a life-threatening condition that occurs when the body's response to an infection causes damage to its own tissues and organs. According to some recent studies, sea buckthorn may have anti-septic effects by influencing inflammation, oxidative stress, and immune system.^{5,7} Sea buckthorn pulp oil, which is rich in palmitoleic acid, a rare fatty acid in plants, may protect against sepsis-induced acute lung injury in mice by reducing inflammatory cytokines, neutrophil infiltration, and oxidative stress in the lung tissue. Sea buckthorn seed oil, which contains omega-3, omega-6, omega-7, and omega-9 fatty acids, may attenuate sepsis-induced liver injury in rats by modulating the expression of toll-like receptor 4 (TLR4), nuclear factor kappa B (NF- κ B), and inducible nitric oxide synthase (iNOS) genes, and enhancing the activity of antioxidant enzymes. Sea buckthorn fruit extracts, which are rich in phenolic compounds such as flavonoids, may improve survival and organ function in septic rats by inhibiting the activity of nuclear factor of activated T cells (NFAT), a transcription factor that regulates the expression of pro-inflammatory genes. Sea buckthorn leaves, which contain flavonoids, triterpenes, and ursolic acid, may prevent sepsis-induced intestinal barrier dysfunction in mice by enhancing the expression of tight junction proteins and reducing the levels of endotoxin and inflammatory cytokines.²⁹

3.6. Renal protection

Sea buckthorn is a plant that has been used for centuries in various parts of the world for its nutritional and medicinal benefits. Sea buckthorn berries, seeds, and leaves contain many bioactive compounds, including polyphenols, flavonoids, carotenoids, fatty acids, vitamins, and phytosterols. Some of these compounds have been shown to have renal protective effects, meaning they can help prevent or reduce kidney damage caused by various factors.²² According to a review article, sea buckthorn has anti-inflammatory and immunomodulatory effects, which can help reduce the inflammation and immune system dysfunction that often accompany kidney diseases. Sea buckthorn also has antioxidant properties, which can help scavenge the reactive oxygen species (ROS) that can damage the kidney cells and tissues.³⁰ Sea buckthorn oil, in particular, can enhance the level of non-enzymatic antioxidants such as glutathione, thioredoxin, and vitamins E and A, as well as stimulate the activity of Nrf, a transcription factor that regulates the expression of antioxidant enzymes.

In addition, sea buckthorn has been reported to have hepatoprotective, cardiovascular-protective, neuroprotective, radioprotective, skin protective, and gastrointestinal protective effects, which can also indirectly benefit the kidney health by preventing or alleviating the complications of kidney diseases. In a pilot study on 28 people with kidney disease (idiopathic nephrotic syndrome), an herbal preparation with sea buckthorn (as an add-on to conventional therapy) improved symptoms of swelling, lack of appetite, and low urination, as well as reducing inflammatory cytokines in the blood and proteins in the urine after 3 months. This suggests that sea buckthorn may have a therapeutic potential for kidney disease patients.

However, more clinical trials are needed to confirm the safety and efficacy of sea buckthorn for renal protection, as well as to determine the optimal dosage and formulation. Sea buckthorn may also have some side effects, such as allergic reactions, bleeding, low blood pressure, and interactions with some medications. Therefore, it is advisable to consult a doctor before using sea buckthorn for any health purpose.³¹

3.7. Antioxidant

Sea buckthorn is a plant that has many health benefits, especially for its antioxidant activity. Antioxidants are substances that protect the cells from damage caused by free radicals, which are unstable molecules that can cause diseases such as cancer, stroke, and cardiovascular diseases. Sea buckthorn contains various antioxidants, such as phenolic compounds, flavonoids, carotenoids, tocopherols, tocotrienols, and vitamin C. These antioxidants can help prevent or reduce oxidative stress, inflammation, and DNA damage in the cells.

Some studies have shown that sea buckthorn oil, which is extracted from the seeds or the pulp of the berries, has antioxidant activity in different models. For example, sea buckthorn oil can partially prevent UV-induced reactive oxygen species (ROS) generation and enhance the level of non-enzymatic antioxidants such as glutathione, thioredoxin, and vitamins E and A in human skin cells.³² Sea buckthorn oil can also stimulate the activity of Nrf2, a transcription factor that regulates the expression of antioxidant enzymes such as catalase, superoxide dismutase, and glutathione peroxidase.¹⁹ Moreover, sea buckthorn oil can inhibit the growth of various cancer cells by inducing apoptosis, cell cycle arrest, and autophagy, which are mechanisms that eliminate abnormal or damaged cells.

Sea buckthorn berries can also be consumed as fresh fruits, juices, jams, or supplements. They have a high content of sugars, organic acids, pectins, and vitamin C, which contribute to their sour and sweet taste. The antioxidant activity of sea buckthorn berries can be measured by different methods, such as ABTS, FRAP, ORAC, and iron chelating assays. The results may vary depending on the cultivar, the extraction method, and the solvent used.³³ However, generally, sea buckthorn berries have a high antioxidant potential compared to other fruits and vegetables.

Sea buckthorn is a valuable source of antioxidants that can help protect the cells from oxidative damage and prevent or treat various diseases. Sea buckthorn can be used as a raw material for the development of functional foods and nutraceutical products that can improve human health and well-being. Sea buckthorn oil is a natural remedy that may benefit your skin in various ways. You can use it topically or orally, depending on your preference and needs.

For dry or mature skin, you can apply sea buckthorn oil directly to your face and neck after cleansing and toning.³⁴ You can also mix it with your favorite moisturizer or serum for extra hydration and nourishment. Sea buckthorn oil can help improve your skin's elasticity, firmness, and moisture level. For oily skin and acne, you can use sea buckthorn oil as a spot treatment for your blemishes. You can also add a few drops of it to your cleanser or mask to help regulate your sebum production and reduce inflammation. Sea buckthorn oil can help balance your skin's oiliness and prevent acne breakouts.

For sunburn or wound healing, you can apply sea buckthorn oil to the affected area to soothe the pain and speed up the recovery process. You

can also take sea buckthorn oil capsules orally to boost your immune system and antioxidant defense. Sea buckthorn oil can help protect your skin from UV damage and promote cell regeneration. Sea buckthorn oil is generally safe and well-tolerated, but you should always do a patch test before using it on your skin. You should also consult your doctor before taking it orally, especially if you have any medical conditions or allergies. Sea buckthorn oil may interact with some medications, such as blood thinners or blood pressure drugs.³⁵

3.8. Cardio protective

Sea buckthorn is a plant that has many health benefits, especially for its cardioprotective activity. Cardioprotective means that it can help protect the heart and blood vessels from damage or disease. Sea buckthorn contains various bioactive compounds, such as fatty acids, flavonoids, vitamins, and phytosterols, that can improve the cardiovascular system in different ways. It can lower the levels of cholesterol and triglycerides in the blood, which are risk factors for atherosclerosis and heart attack.³⁵ It can inhibit the aggregation of platelets, which are blood cells that form clots and can block the blood flow to the heart or brain. It can reduce the blood pressure and the heart rate, which are indicators of the workload and stress on the heart. It can scavenge the free radicals and prevent the oxidative stress, which are harmful processes that can damage the cells and tissues of the heart and blood vessels.³⁶

Sea buckthorn can be consumed as fresh fruits, juices, jams, oils, or supplements. It has a sour and sweet taste and a pleasant aroma. It is also safe and well-tolerated by most people. However, you should always consult your doctor before using sea buckthorn, especially if you have any medical conditions or allergies, or if you are taking any medications. Sea buckthorn may interact with some drugs, such as blood thinners or blood pressure drugs.³⁷

3.9. Hepatoprotective

Hepatoprotective activity means the ability to protect the liver from damage or disease. Sea buckthorn is a plant that has many health benefits, including hepatoprotective activity. Sea buckthorn contains various bioactive compounds, such as fatty acids, flavonoids, vitamins, and phytosterols, that can improve the liver function in different ways. It can reduce the levels of liver enzymes, such as alanine aminotransferase (ALT) and aspartate aminotransferase (AST), which are indicators of liver injury. It can prevent or reverse the liver fibrosis, which is the scarring of the liver tissue due to chronic inflammation or injury.³⁸ It can inhibit the oxidative stress and inflammation, which are harmful processes that can damage the liver cells and tissues.

It can modulate the immune system and enhance the liver's ability to fight against infections and toxins. Sea buckthorn can be consumed as fresh fruits, juices, jams, oils, or supplements. It has a sour and sweet taste and a pleasant aroma. It is also safe and well-tolerated by most people. However, you should always consult your doctor before using sea buckthorn, especially if you have any medical conditions or allergies, or if you are taking any medications. Sea buckthorn may interact with some drugs, such as blood thinners or blood pressure drugs.

3.10. Neuroprotective

Sea buckthorn is a plant that has many health benefits, including neuroprotective activity. Neuroprotective activity means the ability to protect the brain and nervous system from damage or disease.⁷ Sea buckthorn contains various bioactive compounds, such as flavonoids, phenolic acids, carotenoids, vitamins, and fatty acids, that can improve the brain function in different ways.³⁹ It can scavenge the free radicals and prevent the oxidative stress, which are harmful processes that can damage the brain cells and tissues.

It can inhibit the activity of acetylcholinesterase (AChE) and monoamine oxidase A (MAO-A), which are enzymes that degrade the

neurotransmitters acetylcholine and serotonin, respectively. These neurotransmitters are important for memory, learning, mood, and cognition. It can modulate the expression of neurotrophic factors, such as brain-derived neurotrophic factor (BDNF) and nerve growth factor (NGF), which are proteins that support the survival, growth, and differentiation of neurons.⁴⁰ It can regulate the activity of nuclear factor erythroid 2-related factor 2 (Nrf2), which is a transcription factor that controls the expression of antioxidant enzymes, such as catalase, superoxide dismutase, and glutathione peroxidase. These enzymes can protect the brain from oxidative damage.

Sea buckthorn can be consumed as fresh fruits, juices, jams, oils, or supplements. It has a sour and sweet taste and a pleasant aroma. It is also safe and well-tolerated by most people. However, you should always consult your doctor before using sea buckthorn, especially if you have any medical conditions or allergies, or if you are taking any medications. Sea buckthorn may interact with some drugs, such as blood thinners or blood pressure drugs.

3.11. Anti-viral

Sea buckthorn (*Hippophae rhamnoides*) is a plant that has been used in traditional medicine and cosmetics for its various health benefits.⁴¹ Sea buckthorn contains many nutrients and bioactive compounds, such as vitamins, carotenoids, polyphenols, fatty acids, and phytosterols. Some of these compounds have been shown to have antiviral activity against different types of viruses, such as influenza, herpes, and coronavirus. One of the antiviral compounds found in sea buckthorn is isorhamnetin, a flavonoid that can inhibit the activation of purine, which is an energy source required by the virus for its mutation. Isorhamnetin may have potential to be developed into an antiviral drug against SARS-CoV-2, the virus that causes COVID-19. However, more research is needed to confirm its efficacy and safety in humans. Sea buckthorn oil, extracted from the fruits or seeds of the plant, has also been used to treat skin disorders, such as eczema, burns, and wounds.⁵ Sea buckthorn oil may help improve skin hydration, elasticity, and inflammation, as well as promote wound healing and prevent infections. Sea buckthorn oil can be applied topically or taken orally as a supplement. Sea buckthorn is a dietary source of bioactive ingredients that may have antiviral and other health benefits.⁴² However, it is not a substitute for medical advice or treatment. If you have any health concerns or questions, you should consult your doctor before using sea buckthorn or any other supplement.

4. Current status of use of sea buckthorn

Sea buckthorn is a plant that has many uses and benefits for humans, animals, and the environment. It grows in cold and dry regions, such as the Himalayas and Central Asia. Sea buckthorn berries, leaves, and oil are rich in vitamins, antioxidants, and omega fatty acids. They have been used to treat various health conditions, such as eczema, inflammation, ulcers, and cardiovascular diseases. Sea buckthorn supplements are available in capsules, tablets, powders, and juices.^{16,34} Sea buckthorn oil has moisturizing, anti-aging, and healing properties for the skin. It can also protect the skin from sun damage and infections. Sea buckthorn oil is used as an ingredient in creams, lotions, serums, and masks.

Sea buckthorn berries have a sour and tangy taste that can be used to make jams, pies, sauces, and drinks. They can also be eaten fresh or dried as snacks. Sea buckthorn tea is made from the leaves and has a mild flavor. Sea buckthorn is a hardy and drought-resistant plant that can grow in poor and degraded soils. It has a deep root system that can fix nitrogen and prevent soil erosion and desertification.⁴³ Sea buckthorn also provides habitat and food for many birds and animals in the cold deserts. Sea buckthorn plantation is being promoted as a way to improve the livelihoods and ecology of the high-altitude regions. Sea buckthorn is a versatile and valuable plant that has many current and potential uses. It

is also known as the “wonder berry” or the “Ladakh gold” for its amazing benefits.

Sea buckthorn is a hardy and drought-resistant plant that can grow in poor and degraded soils. It has a deep root system that can fix nitrogen and prevent soil erosion. It also produces nutritious and tasty berries that can be used for food and medicine.⁴⁴ To grow sea buckthorn at home, you will need to consider the following factors:

- Sunlight:** Sea buckthorn plants prefer a sunny location for optimal growth and fruit production. They cannot tolerate shade at any stage of growth.
- Soil:** Sea buckthorn plants can grow in a variety of soils, including saline, sandy, and rocky ones. However, they need good drainage and do not thrive in boggy conditions.
- Water:** Sea buckthorn plants are drought-tolerant and do not need much water once established. However, they need regular watering during the first year of planting and during dry spells.
- Fertilizer:** Sea buckthorn plants are nitrogen-fixing and do not need much fertilizer. However, they may benefit from some organic matter or compost added to the soil before planting.
- Pollination:** Sea buckthorn plants are dioecious, which means they have separate male and female plants.⁴⁵ Only the female plants produce berries, and they need a male plant nearby for pollination. It is recommended to plant one male plant for every six female plants.
- Propagation:** Sea buckthorn plants can be propagated from seeds or cuttings. Seeds can be scarified and sown outdoors in the fall or early spring, or indoors after cold stratification. Cuttings can be taken from dormant plants and soaked in water until roots form, then potted and transplanted outdoors.
- Pruning:** Sea buckthorn plants can grow up to 20 feet tall and have thorny branches. Pruning is not necessary, but it can help shape the plants and improve fruit quality. Pruning can be done in late winter or early spring, before the new growth starts.

5. Conclusion

Sea buckthorn is a plant that has many uses and benefits for humans, animals, and the environment. It contains various essential fatty acids, antioxidants, vitamins, and other bioactive compounds that have been shown to have antioxidant, anti-inflammatory, immunomodulatory, anti-cancer, hepatoprotective, neuroprotective, and skin-protective effects. Sea buckthorn is also a potential source of functional foods, dietary supplements, and cosmeceuticals that can help prevent and treat various chronic diseases. Sea buckthorn is a promising plant that deserves further research and development.

Data availability

All the data was collected from the various articles.

CRediT authorship contribution statement

Roshan Kumar Dubey: Writing – review & editing. **Satyam Shukla:** Visualization, Investigation. **Vaishnavi Shukla:** Data curation. **Sumit Singh:** Data curation.

Declaration of competing interest

Not any declaration of the interest.

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