

# Sea buckthorn oil can offer help for dry eyes

➤ Dry eye syndrome, or dry eye, is a common condition that can occur along with ageing and certain external factors, such as low humidity and the use of contact lenses. Women suffer from dry eye more frequently than men do. In studies, even more than 30% of people over 50 years of age have stated that they suffer from dry eye symptoms, such as soreness, burning, redness, and itching of the eyes.

Dry eye can be caused by two, different mechanisms: there can be disturbances in lacrimal secretion (aqueous deficient dry eye), or the composition of the tear film protecting the ocular surface can be abnormal, leading to excessive evaporation of the aqueous tear film (evaporative dry eye). In both cases, the osmolarity (solute concentration) of the tear film, is increased. Inflammation reactions are also activated. Symptoms of dry eye are usually treated with humidifying eye drops that do not, however, eliminate the underlying inflammation.

## A clinical study at the University of Turku: sea buckthorn oil has an effect on osmolarity and symptoms

The effects of sea buckthorn oil on dry eye were investigated in a placebo-controlled, randomised, double-blind study at the Department of Biochemistry and Food Chemistry at the University of Turku.

A hundred men and women between the ages of 20 and 75 experiencing symptoms of dry eye participated in the study. Half of the subjects were contact-lens users. For three months, half of the participants took a daily oral dose of 2 grams of SBA24®, a carbon dioxide-extracted sea buckthorn oil manufactured by Aromtech Ltd, and half took a placebo oil. The placebo oil contained triacylglycerols of medium-chain fatty acids that were fractionated from coconut and palm oils. The test oils were ingested via capsules in the morning and evening.

During the study, the dry eye of the participants was evaluated with the aid of clinical dry eye tests, symptom queries, and a symptom logbook kept by the participants. In addition, samples were gathered from the participants, for determination of the fatty acid composition of the tear film.

During the observation period, the osmolarity of the tear film increased in both the sea buckthorn group and the placebo group. The increase from the beginning of the observation period to the end, however, was significantly milder in the sea buckthorn group than in the control group (sea buckthorn: +8 mOsm/L, placebo: +12 mOsm/L;  $P = 0.04$ ). The observation period in the study started in the autumn and ended in the winter. Over this time, the average temperature in Turku decreased by more than 10 °C. During the cold season, the humidity of the air is low both outside and indoors, which increases the evaporation of tears and dry eye symptoms. It also explains the general increase observed in osmolarity.



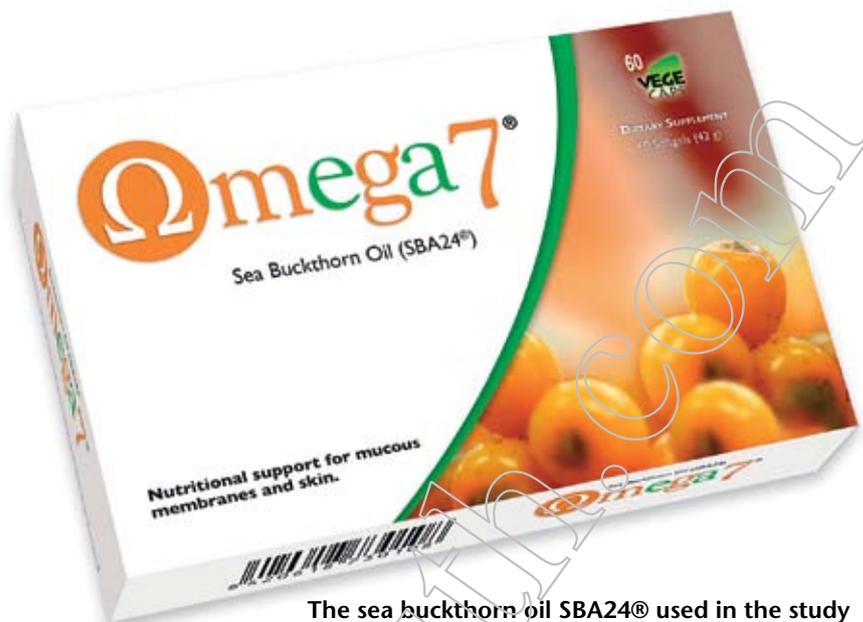
Review of the symptom logbooks revealed that the redness and burning sensations of the eyes experienced were milder in the sea buckthorn group when compared to the control group. Studies have reported differences especially in the fatty acid composition of the tear film in individuals suffering from evaporative dry eye as compared to the tears of healthy individuals. In this study, wherein the test subjects had different dry eye types, there was no difference observed in the tear-film fatty acid profiles between the sea buckthorn and placebo group.

### The combined effect of the oils in the soft portion of the berry and in the seeds

The sea buckthorn oil used in the study, SBA24®, contained both sea buckthorn berry oil and seed oil, which were extracted by means of supercritical carbon dioxide extraction.

The oil in the soft portions of the sea buckthorn berry is rich in carotenoids, and its primary fatty acids are palmitoleic, palmitic and

oleic acids. The seed oil in particular contains plenty of linoleic (n-6) and alpha-linolenic (n-3) acids. Both oils contain vitamin E and plant sterols.



The sea buckthorn oil SBA24® used in the study is marketed globally under various trademarks, such as Omega7® and Membrasin®.

# Consumption of sea buckthorn has an effect on inflammation

➤ The berries and leaves of sea buckthorn, a bush in the *Hippophaë* genus, have been used for centuries in Asian medicine. In the Chinese Pharmacopoeia, sea buckthorn is recommended for benefits such as treating cough, and for improving digestion and the circulation. In Nepal, in areas where few people have the opportunity to rely on modern medicine, sea buckthorn, as judged by its indications for use, is one of the most versatile plants in local folk medicine. Today, sea buckthorn is cultivated for food use in several European countries, Russia, and the United States.

In the Department of Biochemistry and Food Chemistry at the University of Turku, two clinical placebo-controlled, randomised double-blind studies were carried out between 2005 and 2010 as part of research for a doctoral dissertation aimed at determining the health effects of the sea buckthorn.

The main focus of the first study was on determining the effect of whole sea buckthorn berries on the common cold and other infections, and inflammation. The second study investigated the effects of sea buckthorn oil on dry eye.

### The bioactive compounds of sea buckthorn

Sea buckthorn is rich in flavonoids, which are among the phenolic compounds: secondary metabolites of plants that the plant uses to protect against UV radiation, insects, and pathogens. *In vitro*, flavonoids have presented antioxidant, antimicrobial and inflammation-regulating effects. In epidemiological studies, the consumption of flavonoids has been associated with lower incidence of cardiovascular diseases.

The sea buckthorn berry is an excellent source of vitamin C. As with other

berries and fruits, the vitamin C content varies according to genetic background, growth conditions, and degree of ripeness. In particular, the Chinese sea buckthorn subspecies *H. rhamnoides* ssp. *sinensis* commonly contains vitamin C concentrations of up to 10 g/L juice.

Unlike most other berries, the soft inner portions of the sea buckthorn berries contain ample amounts of oil (approximately 2–3%). The oil content of sea buckthorn seeds is roughly 7–13%. Sea buckthorn's seed oil is especially rich in essential linoleic acid (18:2n-6) and alpha-linolenic acid (18:3n-3). The n-6/n-3 ratio in the sea buckthorn berry and seed oils is low, at <2:1, in comparison to most other oils. This can be seen as positive, as the intake of n-6 fatty acids in proportion to n-3 fatty acids is generally considered to be too high in the Western countries.

The positive effects of sea buckthorn oil are most likely related to the alleviation of inflammation, which tends to maintain and increase the dryness of the eyes. In humans, linoleic and alpha-linolenic fatty acids can be converted to longer-chain n-6 and n-3-fatty acids that are precursors of eicosanoids exerting control over inflammation. Previous studies have shown that n-3 fatty acids have beneficial effects on dry eye. Also the combination of linoleic acid and gamma-linolenic acid (n-6) has been found to alleviate dryness of the eyes and to increase the amount of prostaglandin E1 eicosanoid in the tears. This eicosanoid increases tear secretion and alleviates inflammation. Vitamin E and carotenoids have also been reported as having anti-inflammatory effects.

The lipids in tear film are produced mainly in the meibomian glands, located at the margins of the eyelids. They secrete lipid-containing meibum in tears. In addition to differences report-

ed between the fatty acid composition of tears in dry-eyed and healthy persons, some studies suggest that the phospholipid composition of the tear film is abnormal in dry eyes, and individuals suffering from dry eyes have a thinner tear lipid layer than healthy persons do. Also, in a Raman spectroscopy study, the amount of carotenoids in the meibum of dry-eye sufferers has been noted to be smaller than that for others. It has been presented that the n-3 and n-6 fatty acids may have an effect on the differentiation of the meibomian gland cells, and hence possibly also affect the quantity of lipids being formed.

### Conclusions

According to the study, the intake of sea buckthorn oil can positively affect the tear film osmolarity and dry eye symptoms. The mechanism of action is most likely related to alleviation of the inflammation that maintains and

fortifies dry eye. The inflammation is affected by the bioactive compounds contained in oils from both the sea buckthorn seeds and the soft portions of the berry.

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# xthorn

The oil in the flesh of the sea buckthorn berry contains plenty of carotenoids, which give the berry its orange colour. Sea buckthorn contains both carotenoids that are a precursor to vitamin A, such as  $\beta$ -carotene, and carotenoids that have been found to feature other potential mechanisms than vitamin A activity. Carotenoids are efficient antioxidants. They have shown inflammation-regulating effects *in vitro* and in epidemiological studies.

The oil in both the soft part of the sea buckthorn berry and the seeds contains vitamin E, which has the important task in the body of protecting lipids from oxidising. In addition to the best known and most frequently studied form of vitamin E,  $\alpha$ -tocopherol, the other tocopherols and tocotrienols contained in sea buckthorn oil have been reported to have specific effects in, e.g., regulation of inflammation.



Sea buckthorn is a hardy plant that can survive the arctic conditions. This photograph of frosty berries is taken in Tepasto, Kittilä, in Finnish Lapland.

## Previous research evidence concerning the health effects of sea buckthorn berries

The majority of the research publications on the physiological effects of sea buckthorn are available only in Chinese or Russian and therefore are not accessible to most Western researchers. The sea buckthorn components most often studied in English-language scientific literature are the sea buckthorn oils and flavonoids, and the alcohol extracts that contain phenolic compounds, sugars, and vitamin C.

Alcohol-soluble fractions of sea buckthorn have shown protective effects against oxidative stress and regulate inflammation *in vitro*. These mechanisms are most likely behind the beneficial effects observed in animal studies. In the animal models, the flavonoids and alcohol-soluble fractions of sea buckthorn have provided protection against risk factors for cardiovascular disease and against toxic compounds. So far, only a few clinical studies of the effects of consuming sea buckthorn flavonoids have been published.

Animal studies indicate that also the sea buckthorn oils have antioxidant and inflammation suppression effects. Carefully implemented animal studies suggest sea buckthorn oil may protect against ulcers and liver damage, and promote wound healing. There is also clinical evidence of sea buckthorn oil having positive effects on the skin, especially in orally taken combination of sea buckthorn seed oil and berry oil.

## Decreased concentration of C-reactive protein in the circulation

The aim of clinical testing of whole sea buckthorn berries carried out at the University of Turku was to find out whether the consumption of sea buckthorn berries has an effect on the risk of common cold or other infections, or on inflammation. In total, 250 healthy women and men between the ages of 19 and 50 years participated in the study. Half of them were randomly assigned to the sea buckthorn group and the other half to the control group. For three months, the participants ate a small daily dose (28 g) of sea buckthorn

puree or a placebo puree. For the duration of the intervention, they kept a symptom logbook of their symptoms of common cold and other infections. Blood samples for analysis of infection markers were drawn from them at the beginning and end of the study.

During the study period, concentrations of the serum's C-reactive protein (CRP, as measured by the high sensitivity method) in the participants of the sea buckthorn group showed a statistically significant ( $P < 0.05$ ) decrease in comparison to the placebo group. The change was slight (approx.  $-0.1$  mg/L), but consistent with the findings of epidemiological studies that have shown an inverse relationship between the consumption of fruit and vegetables and concentrations of the serum's inflammation markers. The effect was observed despite the fact that, according to the background surveys, the participants already ate fruits, vegetables, and berries regularly as part of their normal diet. CRP is an acute-phase protein that, even in slightly elevated concentrations, has been associated with the risk of cardiovascular diseases. It has also been posited that CRP is not just a risk indicator; it might also be involved in the development of cardiovascular diseases.

The symptom logbook monitoring indicated that sea buckthorn did not affect the risk or duration of common colds or gastrointestinal tract infections in this study. The incidence of urinary tract infections was so low during the study that no decisive conclusions

on the effectiveness of sea buckthorn could be drawn. The participants in the study were healthy adults with healthy lifestyles and dietary habits. In previous studies, the effects of vitamins C and E on the common cold have been shown in the elderly and in persons under great physical stress.

The sea buckthorn preparation used in the study was a sweetened and frozen sea buckthorn puree. In order for the body to be able to utilise the seed compounds, also the berries' seeds were part of the preparation, in ground-up form. The results of the study cannot be generalised as applying to all sea buckthorn products, because the plants' genetic background, growth conditions, and the ripeness of the berries significantly affect the amounts of bioactive compounds, as does the processing of the berries.

## Conclusions

Regardless of their traditional use in folk medicine, sea buckthorn berries are considered to be food, not medicine. In comparison to medicines, any effects of a food substance on a person's health are usually slower to appear, milder, and caused (in most cases) by a joint effect of several compounds rather than a single compound. Mild chronic inflammation is associated with many illnesses, and current knowledge indicates that it is a critical factor in, e.g., cardiovascular diseases. As part of a healthy way of life, the right kind of diet can be an important non-medication method of affecting inflammation. The decrease in CRP in the sea buckthorn group indicates that there are possible mechanisms regulating inflammation. These mechanisms are most likely induced by the joint effect of the berry's bioactive compounds.

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