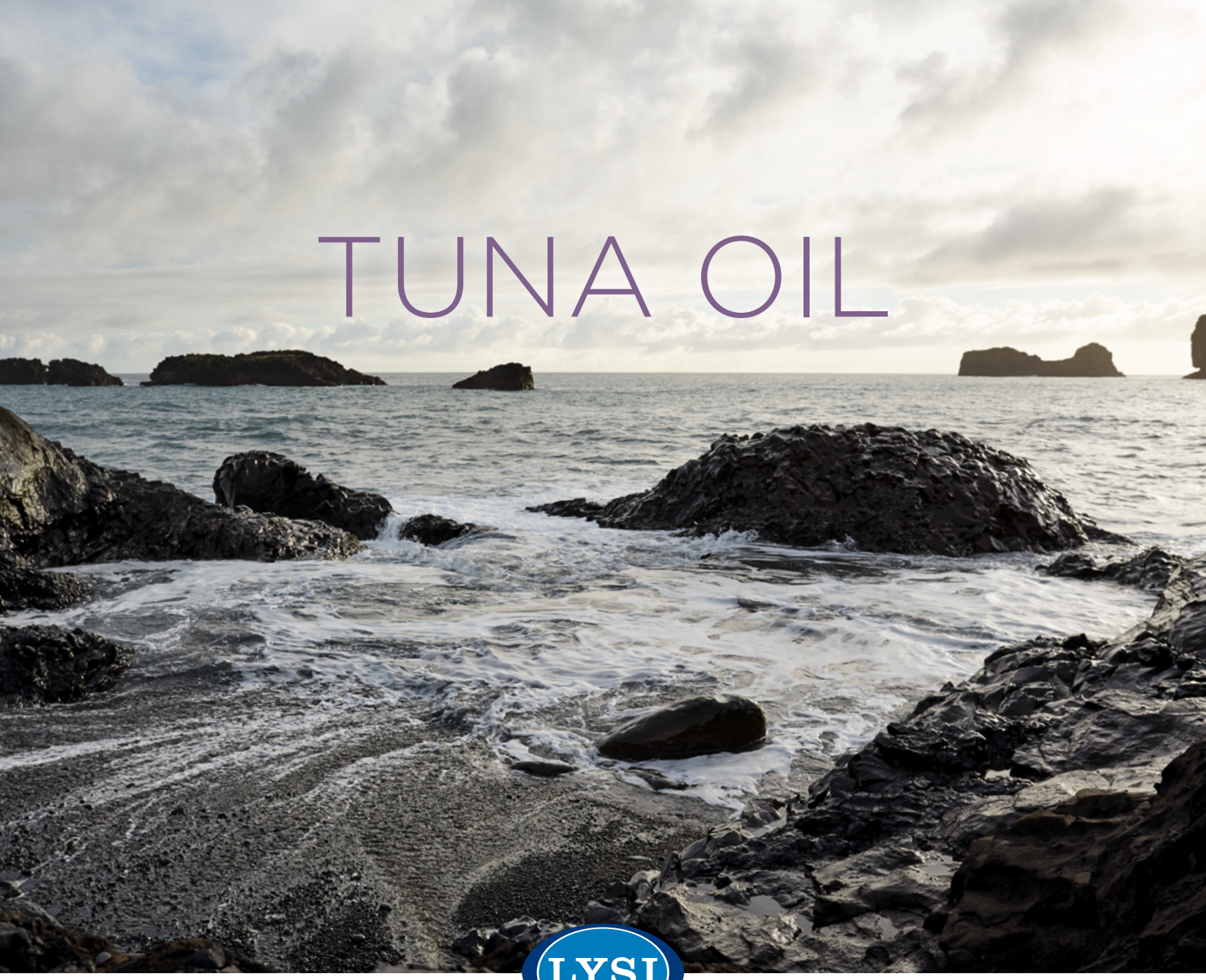


TUNA OIL

SINCE 1938

Tuna oil products supplied by LYSI hf are categorised as food supplements.

Tuna oil is natural fish oil. It is a complex mixture of triacylglycerols (also called triglycerides), which is characterised with an exceptionally high level of the omega-3 fatty acid DHA.

Tuna oil is extracted by physical means from fresh fish of the family Scombridae (the genera Thunnus and Sarda). The principal species are skipjack tuna *(Katsuwonus pelamis)*, yellowfin tuna *(Thunnus albacares)*, albacore *(Thunnus alalunga)*, bigeye tuna *(Thunnus obesus)* and longtail tuna *(Thunnus tonggol)*.

LYSI imports crude oil mainly from producers in the Seychelles and Ecuador for processing in the company's refinery in Reykjavik, Iceland.

The fishing stocks are under control to ensure sustainability. There are also in place measures to ensure that dolphins are not endangered during the tuna catching.

LYSI is a major producer of refined tuna oil.

The Refining Process

Crude tuna oil is not suited for direct consumption and must be refined before use. The refining process removes unwanted components such as free fatty acids, pigments, contaminants and various other substances that can impart fishy flavour or off-flavour to the oil.

The refining process of tuna oil is comprised of 6 steps, as outlined below.

It is imperative that the products we consume are clean and that they meet the most stringent international demands issued by health authorities. This is secured through elaborate and comprehensive production processes in the LYSI refinery. The equipment used for refining is custom-made, built on the extensive knowledge of fish oil refining obtained over the last 85 years. The key processes have been validated and approved.

The company is **FSSC 22000** and **GMP** certified. FSSC 22000 is a food safety scheme that is fully recognised by the Global Food Safety Initiative (GFSI) and GMP is a pharmaceutical standard.

Crude Oil

Neutralisation

Bleaching

Winterisation

Distillation

Deodorisation

Standardisation

Product

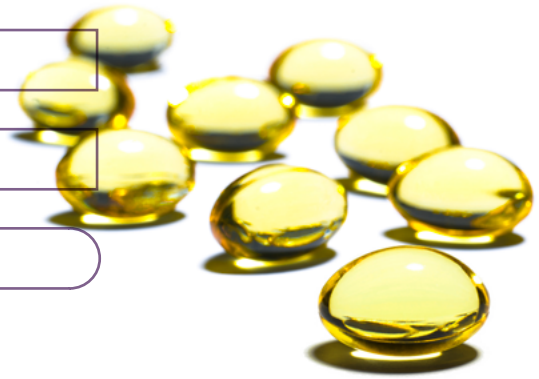
Technical Aspects

The fatty acid composition of tuna oil is defined in the European Pharmacopoeia.

LYSI can provide tuna oil that meets the requirements of the European pharmacopoeia. Vitamins, flavourings and antioxidants can be added in accordance with the needs of the individual customer.

Every batch of tuna oil produced at LYSI is analysed per specification. A certificate of analysis is issued for every batch.

Our standard specification for omega-3 fish oil is shown in the table on the opposite page.



Properties of Tuna Oil

Tuna oil is an excellent source of the omega-3 fatty acid DHA. It is natural fish oil that has not been subjected to any chemical alterations, only refining. The oil may be taken orally as a liquid or in capsule form. Tuna oil is frequently used in infant formulas as a source of DHA.

EPA and DHA acids are often considered essential due to their low conversion efficiency from alpha-linolenic acid. They have been extensively studied for the last three decades and their different effects on the body have been described.

Initial studies on the physiological effects of long-chain omega-3 fatty acids focused on the relationship between EPA and DHA and cardiovascular disease. The findings showed that both the acids reduced the risk of cardiovascular disease (Casula, et al., 2013) (de Oliviera Otto, et al., 2013) (Zock, et al. , 2016).

A deficiency of omega-3 fatty acids has been implicated as a risk factor in mental disorders such as depression, schizophrenia and ADHD (McNamara, 2016) (Parletta, et al., 2016) (Königs & Kiliaan, 2016).

Parameters	**Specification**
EPA (area %)	min. 5,0
EPA (mg/g as TG)	min. 45
DHA (area %)	min. 25,0
DHA (mg/g as TG)	min. 215
Total omega-3 (area %)	min. 35,0
Total omega-3 (mg/g as TG)	min. 310
Acid value (mg KOH/g)	max. 0,50
Unsaponifiable matter (%)	max. 1,5
Cold test; remains clear at 0°C (hours)	min. 3
Peroxide value (meq. O_2/kg)	max. 5,0
Anisidine value	max. 20,0
Refractive Index at 20°C	1,481 – 1,485

Of particular interest are the effects of DHA on the development and function of the brain. The consumption of DHA leads to many positive physiological and behavioral effects, including those on cognition (Weiser, et al., 2016), brain development and function (Lauritzen et al., 2016) and possibly on postpartum depression (Markhus et al., 2013). The European food safety authority (EFSA) has authorised the use of certain health claims relating to the consumption of DHA, when the level of DHA is above a minimum level.

Omega-3 polyunsaturated fatty acids have been shown to contain anti-inflammatory properties. These acids play a role in arthritis and possibly other conditions associated with inflammation (Yates, et al., 2014) (Calder, 2015) (Khatib, et al., 2016).

A number of recommended daily intakes of EPA and DHA have been published. Health claims authorised by the EU give daily intakes from 250 mg to 3 g EPA+DHA, depending on the claim. For example, the beneficial effect to normal heart function is obtained with 250 mg of EPA and DHA, but the beneficial effect to maintenance of normal blood pressure is obtained with 3 g of EPA and DHA. In comparison LYSI tuna oil normally contains 270 mg EPA+DHA/g.

Product Groups

Fully refined tuna oil is produced to fulfil LYSI many different specifications. The specifications can be generic or they can be determined in agreement with customers in terms of individual requirements.

Other ingredients can be added, such as vitamins, antioxidants and flavourings. Mixed tocopherols are used as antioxidants.

All ingredients/additives must be non-GMO, non-irradiated and preferably, Halal-certified.

On customers request LYSI can also offer various fish oil blends containing tuna oil.

The products are packed into steel drums, IBCs, tankcontainers or flexicontainers, all according to customer requirements.

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