

SHARK LIVER OIL



SINCE 1938

Shark liver oil products supplied by LYSI are categorised as food supplements.

Shark liver oil is a complex mixture of triacylglycerols (also called triglycerides), and alkylglycerols (also called ether lipids). Fully refined shark liver oil contains high levels (min. 20%) of the alkylglycerols.

The shark liver oil is extracted by physical means from fresh liver of various sharks of the families Squalidae (e.g. *Squalus blainville*) and Centrophoridae (e.g. *Centrophorus zeehaani*) caught in the Atlantic and Indian Oceans. None of the species used are on the IUCN list of endangered species.

LYSI imports semi-refined oil for processing in the company's refinery in Reykjavik, Iceland.

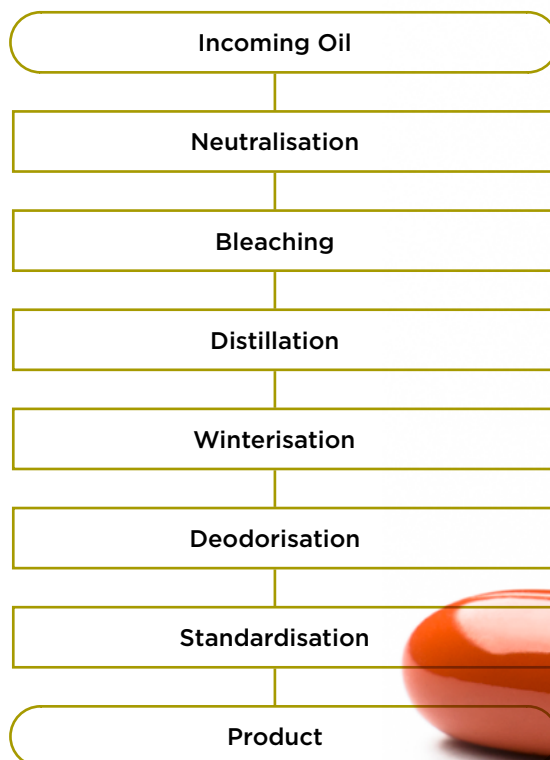
The Refining Process

Crude shark liver oil is extremely rich in squalene. Normally this is removed from the crude shark liver oil before delivery to LYSI where the oil is further refined. 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 shark liver 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 80 years.

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



Technical Aspects

Typical quality and composition parameters for shark liver oil are shown below:

These are based on LYSI specifications for shark liver oil. This oil is not defined in pharmacopoeias.

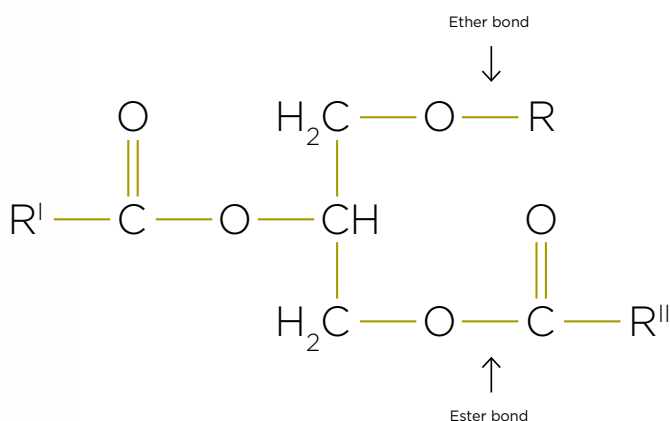
Every batch of shark liver oil produced at LYSI is analysed per specification. A certificate of analysis is issued for every batch.

Parameters:	LYSI Specification	Typical LYSI values
Acid value (mg KOH/g)	max. 0.4	less than 0.2
Iodine value	max. 130	90 - 100
Alkylglycerols (%)	min. 20.0	20 - 24
Refractive index	1.471 - 1.474	1.472 - 1.474
Peroxide value (meq. O ₂ /kg)	max. 3.0 - 10.0	less than 2

Properties of Shark Liver Oil

Shark liver oil is natural fish oil that has not been subjected to any chemical alterations, only refining. The oil is normally taken in capsule form. Shark liver oil differs from many other common fish oils regarding the content of the omega-3 fatty acids which is very low for shark liver oil.

Of particular interest is the high content of alkylglycerols. Alkylglycerols differ from triacylglycerols by the fact that one position on the glycerol molecule has an alcohol (ether) and only two positions have fatty acids (esters) (see below). The ether bond remains intact in the body which gives alkylglycerols their special properties.



Shark liver oil, in particular the alkylglycerols, have been implemented in research on cancer and the immune system. However, limited clinical data are available.

Swedish doctors used shark liver oil as a part of cancer therapy in the 1960s (Brohult, et al., 1970). Later research has also suggested that it may possess anti-tumor activities (Reynolds, et al., 2000) (Krotkiewski, et al., 2003) (Pédrono, et al. 2004) (Iagher, et al., 2013).

Research indicates that alkylglycerols may have beneficial immunomodulatory effects (Pugliese, et al., 1998) (Qian, et al. 2014) (Palmieri, et al., 2014).

Products

Fully refined shark liver oil is produced to specifications that can be generic or 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. Flavours include lemon, orange, lemon-mint, and tutti-frutti.

Ingredients/additives should be non-GMO, non-irradiated and Halal-certified.

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



References

- Brohult, A., Brohult, J. & Brohult, S. (1970). Biochemical effects of alkoxyglycerols and their use in cancer therapy. *Acta Chem. Scand.*, 24, 730-732.
- Iagher, F., de Brito Belo, S.R., Souza, W.M, Nunes, J.R., Naliwaiko, K., Sasaki, G.L., Bonatto, S.J.R., de Oliveira, H.H.P., Brito, G.A.P., de Lima, C., Kryczyk, M., de Sousa, C.F., Steffani, J.A., Nunes, E.A. & Fernandes, L.C. (2013). Antitumor and anti-cachectic effects of shark liver oil and fish oil: comparison between independent or associative chronic supplementation in Walker 256 tumor-bearing rats. *Lipids in Health and Disease*, 12, 146.
- Krotkiewski, M., Przybyszewska, M. & Janik, P. (2003). Cytostatic and cytotoxic effects of alkylglycerols (Ecomer). *Medical Science Monitor*, 9(11), P1131-P1135.
- Palmieri, B., Penelli, A. & Di Cerbo, A. (2014). Jurassic surgery and immunity enhancement by alkylglycerols of shark liver oil. *Lipids in Health and Disease*, 13, 178.
- Pédrono, F., Martin, B., Leduc, C., Le Lan, J., Saïag, B., Legrand, P., Moulinoux, J.P., & Legrand, A.B. (2004). Natural alkylglycerols restrain growth and metastasis of grafted tumors in mice. *Nutrition and Cancer*, 48(1), 64-69.
- Pugliese, P.T., Jordan, K., Cederberg, H. & Brohult, J. (1998). Some biological actions of alkylglycerols from shark liver oil. *The Journal of Alternative and Complimentary Medicine*, 4(1), 87-99.
- Qian, L., Zhang, M., Wu, S., Zhong, Y., Van Tol, E. & Cai, W. (2014). Alkylglycerols modulate the proliferation and differentiation of non-specific agonist and specific antigen-stimulated splenic lymphocytes. *PLOS ONE*, 9(4).
- Reynolds, S., Cederberg, H. & Chakrabarty, S. (2000). Inhibitory effect of 1-O (2 methoxy) hexadecyl glycerol and phenylbutyrate on the malignant properties of human prostate cancer cells. *Clinical & Experimental Metastasis*, 18, 309-312.



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