



## **CETO3® Omega-11, a true innovation in the omega space.**

CETO3® fish oil which contains high levels of Cetoleic acid, also known as Omega-11, is derived from north Atlantic Pelagic fish, harvest and produced in Norway. Immediate processing, from fresh fish to oil in 30 minutes at our production plant, secures a fresh CETO3® oil with high levels of Omega-11, Omega-9 & Omega-3 and with a unique sensory quality with no fishy smell, taste and no fishy reflux.

CETO3® Omega-11, combined with another long-chain omega-9 monounsaturated fatty acid, Gondoic acid, and Omega-3 fatty acids EPA and DHA can be used in liquid applications or in capsules.

**CETO3® Omega 11 has surprising properties, which set it apart from conventional fish oils.**

**Long chain Monosaturated fatty acids, like Omega-11 supplementation, performs better than olive oil against atherosclerosis.**

Atherosclerosis is a chronic disease that affects the arteries, which are the blood vessels that carry oxygen-rich blood from the heart to the body's organs and tissues. This condition is characterized by the gradual accumulation of deposits of fat, cholesterol, calcium, immune cells, and other substances on the inner lining of the arteries. These deposits form atherosclerotic plaques.

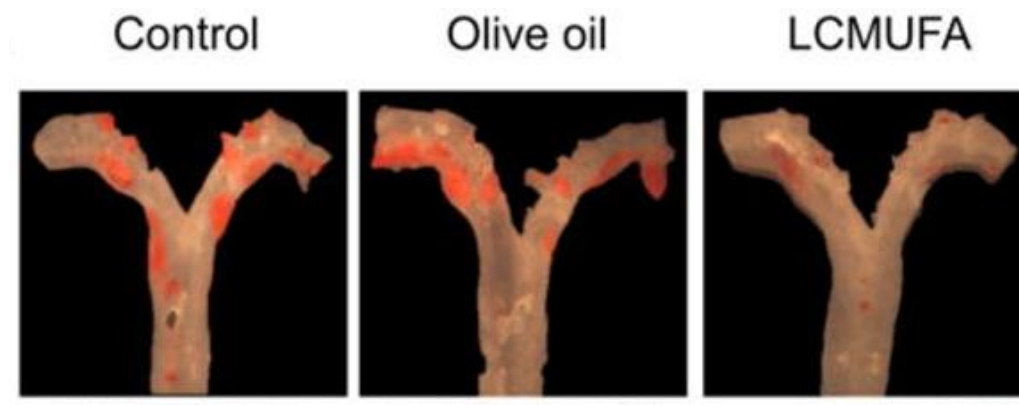
Animal studies have shown that the long-chain monounsaturated fatty acids C20:1 ( Gadoleic acid )) and C22:1 n-11 (Cetoleic acid) from fish oil suppress the development of atherosclerosis<sup>1</sup>.

It is important to understand that these fatty acids are different from those found in olive oil. The latter does contain omega-9, but with 18 carbons, oleic acid C18:1 n-9. The length of the carbon chain of a fatty acid can change its properties. A study has investigated this.

Mice were fed a Western-style diet alone (control group) or supplemented with 2% long-chain monounsaturated fatty acid (LC-MUFA) or olive oil, for 12 weeks<sup>2</sup>.



Omega-11 & 20:1 LCMUFA, but not olive oil, significantly suppressed the development of atherosclerotic lesions and several levels of inflammatory cytokines in the blood.

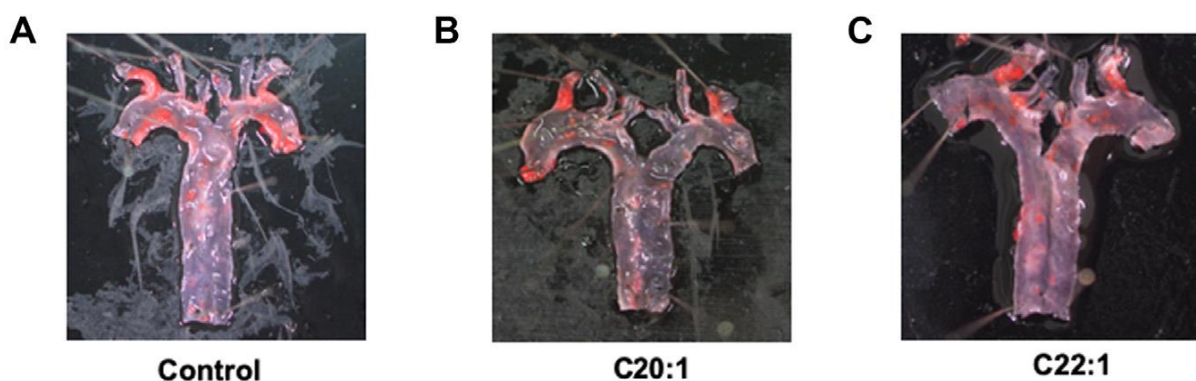


*Staining of atherosclerosis lesions in the aorta*

#### Cetoleic acid (Omega-11) effects inflammation related to atherosclerosis

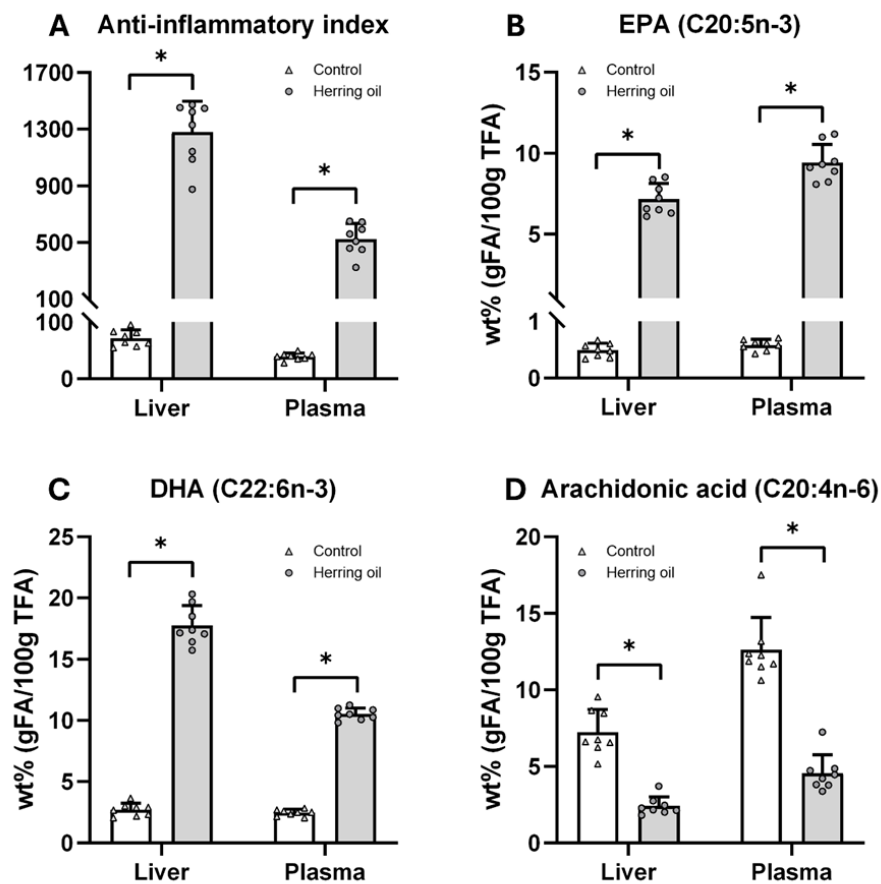
Another study pin-point Omega-11 (Cetoleic acids) preventive effect on atherosclerosis showed on ApoE<sup>-/-</sup> mice, genetically exposed to atherosclerosis, fed Western style diet with addition of (A) 3% butter, (B) 3% LC-MUFA C20:1 or (C) 3% Cetoleic acid C22:1n-11<sup>5</sup>. The biomarkers of inflammation supported the evidence of the reduction beside the reduction of lesions in the aorta by the LC-MUFA and especially Cetoleic acid,

Inflammation is strongly correlated with atherosclerosis. In a CETO3<sup>®</sup> animal study with healthy rats fed Western style diet added CETO3<sup>®</sup> or soy oil (Control), showed the anti-inflammatory Index in the CETO3<sup>®</sup>-group were strongly increased by altering the mobilization and changes in omega-3 and omega-6 fatty acids in the liver and plasma<sup>6</sup>, support that CETO3<sup>®</sup> might have a beneficial effect, reducing inflammation leading to atherosclerosis.



*Staining of atherosclerosis lesions in the aorta*

CETO3<sup>®</sup>

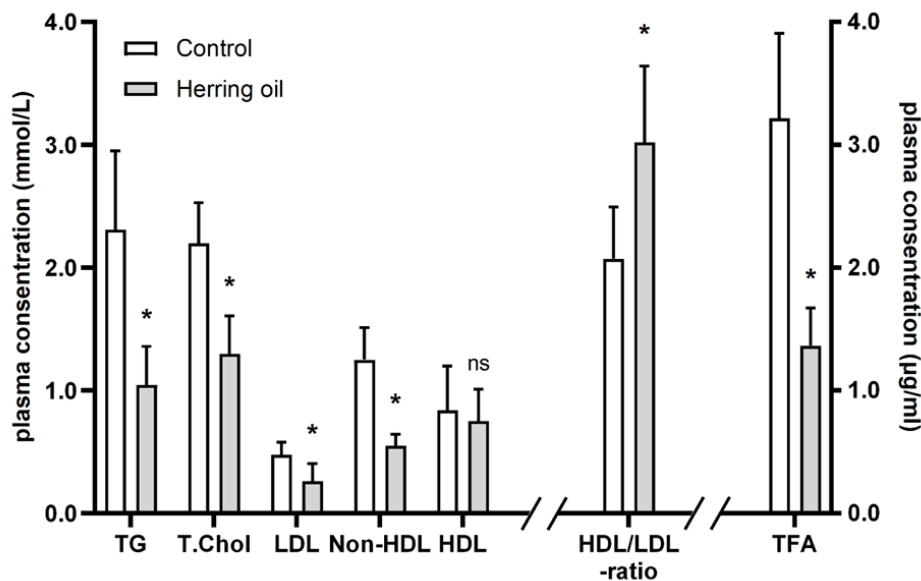


**CETO3® effect on anti-inflammatory fatty acid indices after herring oil supplement in rat liver and plasma, compared to Control (soy oil).** Anti-inflammatory index (A), and relative proportion (wt%) of eicosapentaenoic acid (EPA) (B), docosahexaenoic acid (DHA) (C), and arachidonic acid (D) in rat liver and plasma. The control group (n=8) is represented by white bars, while the herring oil group (n=8) is represented by grey bars. Values are shown as means with standard deviation (SD). Statistical significance was determined using an unpaired t-test (\*p<0.05, ns = not significant).

## Omega-11 oil performs better on cholesterol reduction than standard fish oil

Omega-3 Fish oil supplementation is known to effectively lower plasma triglyceride levels (which are a cardiovascular risk factor), but it is not as effective on cholesterol.

A CETO3® 12-weeks intervention study on healthy rats<sup>6</sup>, with 5% CETO3® omega-11 fish oil added in Western style diet compared to Control-group, added 5% soy oil, significantly reduced LDL cholesterol (-45%), total cholesterol (-41%) and triglycerides (-55%) in plasma as well as improving the ratio HDL/LDL (+46%). The effect on circulatory total fatty acids (TFA) are also strongly reduced by CETO3®.



**Figure 3: Impact of herring oil (CETO3®) supplementation on plasma lipid profile in rats.** Plasma concentrations (mmol/L) of triglycerides (TG), total cholesterol (T. Chol), LDL cholesterol (LDL), non-HDL cholesterol (non-HDL), and HDL cholesterol (HDL), as well as HDL/LDL ratio and plasma concentration (µg/ml) of total fatty acids (TFA). The control group (n=8) is represented by white bars, and the herring oil group (n=8) by grey bars. Values are presented as means with standard deviation (SD). Statistical significance was determined using an unpaired t-test (\*p<0.05, ns = not significant).

In one other study, rats with type 2 diabetes were fed for 5 weeks, either with omega-11-rich herring oil, or with omega-11-low anchovy oil, or with soybean oil for the control group<sup>3</sup>. The content of EPA and DHA was comparable in the two fish oils (herring oil being rich in omega-11).

The blood concentration of total cholesterol was 14% lower in the omega-11 group compared to the other two groups.

The omega-11-rich herring oil group had higher fecal excretion of bile acids, but cholesterol production in the liver, hepatic secretion of VLDL, and the liver's ability to absorb cholesterol were similar to those in the control group.

This shows that omega-11 Cetoleic acid lowers cholesterol mainly by facilitating its elimination.



## Omega-11 facilitates the conversion of omega-3 precursors into the active form

The omega-3 index corresponds to the sum of the EPA and DHA contents measured in the membranes of red blood cells during a blood test. The omega-3 index is expressed as a percentage of the total red cell fatty acids:

- Below 4%, the omega-3 index is associated with an increased risk of cardiovascular disease.
- Between 4 and 8%, it represents an intermediate status in omega-3.
- Above 8%, it is associated with better cardiovascular health, reduced inflammation, and cognitive benefits.

Another benefit of Cetoleic acid is its action on the metabolism of omega-3s.

A pilot, placebo-controlled study showed that supplementation with CETO3® Omega-11-rich oil increases the omega-3 index more than would be expected from the levels of EPA and DHA contained in the oil itself<sup>4</sup>. In concrete terms, this means that this CETO3® oil provides less omega-3 than conventional fish oil, but that it facilitates the conversion of another omega-3 in the body, alpha-linolenic acid. If you consume plant-based sources of omega-3s such as flax, walnuts, and rapeseed, the alpha-linolenic acid they contain converts very little to EPA and especially DHA. Omega-11 facilitates this conversion, resulting in higher levels of EPA and DHA, and an increase in the omega-3 index measured by blood tests.

In summary, the benefits of CETO3® omega-11 (Cetoleic acid) include:

### 1. Reduction of atherosclerosis:

- Long-chain monounsaturated fatty acids like omega-11 suppress the development of atherosclerosis, unlike olive oil.
- These fatty acids significantly reduce the levels of inflammatory cytokines in the blood.
- Anti-inflammatory Index of fatty acids in liver and plasma significant increase.

### 2. LDL- and total cholesterol reduction:

- CETO3® Omega-11 reduces LDL cholesterol (-43%) and total cholesterol (-45%) as well as triglycerides (-55%) in plasma
- Ratio of HDL/LDL is significantly improved (+46%)



- Omega-11 facilitates the elimination of cholesterol by increasing the excretion of bile acids, while maintaining normal liver production.
- 3. **Improved omega-3 index:**
  - Omega-11 promotes the conversion of alpha-linolenic acid (found in plant-based sources of omega-3) to EPA, a bioactive omega-3.
  - This action increases the omega-3 index, an indicator of cardiovascular health.
- 4. **Synergistic effect in CETO3® omega-11-9-3 blends:**
  - Omega-11 combinations with other fatty acids (such as omega-3 EPA/DHA and long-chain omega-9) provide better cardiovascular performance than conventional fish oils.

These properties highlight omega-11 as a promising dietary supplement for cardiovascular and metabolic health. In other words, CETO3® omega-11 fish oil, which is ultimately a mix of omega-11-9-3, provides a real plus for cardiovascular health compared to standard fish oil.

CETO3® Omega-11 can be used in liquid applications or in capsules, combined with another long-chain omega-9 monounsaturated fatty acid, Gondoic acid, and of course the fatty acids EPA and DHA.

#### **Immediate processing when producing CETO3® Omega-11 fish oil.**

CETO3® Omega-11-9-3 have unique sensory qualities and no reflux due to its immediate processing. Immediate processed fresh fish (herring) are turned into oil as fast as 30 minutes which enables us to make CETO3® with natural high levels Omega-11. This enables to use CETO3® in a different application.

CETO3® is produced by Grøntvedt Biotech which is a part of Grøntvedt group which have been working with north Atlantic pelagic fish since 1830.

#### **Sustainability**

CETO3® is derived from a friend of the sea fishery where the main product for human consumption. 100% of the fish is utilized in a low carbon footprint operation. Made in Norway.

**Sources:**

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