Bioavailability comparison of triglycerides, phospholipid and ethyl ester fish oils

Ensuring optimal absorption of an EPA supplement is vital for therapeutic outcomes and numerous studies have assessed the absorption and bioavailability of ethyl-ester fish oils in comparison to triglyceride forms, with some reporting similar absorption rates for the two types of oil. [1, 2]

Fatty acid structure and bioavailability

The bioavailability of fatty acids is determined by their structure and whilst it is accepted that triglyceride fish oils are generally better absorbed in comparison to ethyl-ester, the absorption of fatty acid ethyl esters is significantly improved when other sources of fat are present.[3] Since the introduction of krill oil to the ‘fish oil’ market, more data has arisen comparing krill with triglyceride and ethyl-ester, with the phospholipid delivery of EPA and DHA regarded as superior over the other two forms of delivery. As such, the marketing of krill oil has focused on this potentially superior uptake, with consumers led to believe that they can derive similar health benefits from taking less product compared with standard fish oil with a lower bioavailability. Given that many health conditions require high doses of EPA for successful therapeutic outcomes, such marketing may be highly misleading.

A 2011 paper compared the bioavailability of different forms of omega-3 from fish oil were randomized to receive 1680 mg EPA+DHA given either re-esterified triacylglycerides [rTAG], ethyl-esters [EE] or krill oil, and fatty acid levels in plasma phospholipids (as a proxy for bioavailability) analysed pre-dose and 2, 4, 6, 8, 24, 48, and 72 h after the capsules were ingested. Given the differences in fatty acid structure and the effects on bioavailability, it would be expected that krill oil would deliver the highest levels of EPA and DHA level followed by rTAG and then EE.
Whilst the highest incorporation of EPA into plasma phospholipids was indeed achieved by krill followed by fish oil as rTAG and finally by EE, there were, however, no statistically significant differences in uptake between the three treatments (Figure 1). [4]

![Figure 1. Increase in EPA fatty acid concentrations in plasma phospholipid after the ingestion of different supplement forms.](image)

Given that ethyl-ester oils can deliver high doses of omega-3 as super concentrates and that both standard fish oil and krill oil contain only around 18% EPA, the volume of these latter oils required to deliver 1g pure EPA, is substantially more. The volume of krill oil required to match the EPA content, for example, was twice that of both the ethyl-ester and triglyceride fish oils (7g vs 3.4g). Thus the concept of marketing krill oil as ‘less is more’ does not, in reality, hold up.
Maximising ethyl-EPA bioavailability

One of the causative factors for the potentially lower bioavailability of ethyl-EPA fish oil is the greater resistance to digestive enzymes. EPA is more easily hydrolysed from triglyceride than from an ethyl-ester and whilst it is possible to re-esterify EPA back to triglyceride, the process is costly, resulting in a more expensive end product.

As the EPA content of natural triglyceride oil is only 18%, the use of ethyl-ester is common in both clinical trials and in pharmaceutical omega-3 products because they offer the concentrations required for therapeutic outcomes.

Igennus recommend the following guidelines to optimise the bioavailability of ethyl-EPA

- Smaller capsules
  Unlike our competitors, we keep our capsules small, making them not only easier to swallow but to encourage and highlight the importance of split dosing.

- Split-dosing
  High doses of EPA should be distributed throughout the day. Not only does this help with digestion and uptake of the fatty acids within the oil, but it also ensures that blood levels are sustained throughout the day.

- Taking the supplements with food
  Capsules should never be taken on an empty stomach. Taking E-EPA with food (and ideally in the presence of other dietary oil/fat) will increase the body’s natural ability to digest and absorb the fatty acids.

- Inclusion of vitamin E
  We add vitamin E to all of our EPA products to protect the free fatty acids from oxidation both pre and post digestion.
References


2. Krokan HE, Bjerve KS, Mork E: The enteral bioavailability of eicosapentaenoic acid and docosahexaenoic acid is as good from ethyl esters as from glyceryl esters in spite of lower hydrolytic rates by pancreatic lipase in vitro. *Biochimica et biophysica acta* 1993, **1168**:59-67.

3. Lawson LD, Hughes BG: Absorption of eicosapentaenoic acid and docosahexaenoic acid from fish oil triacylglycerols or fish oil ethyl esters co-ingested with a high-fat meal. *Biochemical and biophysical research communications* 1988, **156**:960-963.