## Omega-3 Fatty Acids in Human Health

# Heart Health: The Role of Alpha-Linolenic, Eicosapentaenoic & Docosahexaenoic Acids

Summary: The body of evidence supporting the cardiovascular and other health benefits of the long chain omega-3 fatty acids, Eicosapentaenoic Acid (EPA), and Docosahexaenoic Acid (DHA) is very significant and has lead to government recommendations and recommended levels of intake for populations in many countries.

A recent comprehensive review by the Agency for Healthcare Research and Quality (AHRQ) a division of the U.S. Department of Health and Human Services culminated in the issuing of five evidence based reports. The reports were in response to a request from the National Institutes of Health Office of Dietary Supplements (ODS). The conclusions were that: "*the evidence supports the hypothesis that consumption of omega-3 fatty acids (EPA, DHA, or ALA) from fish or supplements of fish oil reduces all-cause mortality and various CVD events, and the evidence is strongest for fish and fish oil supplements*" (as opposed to other sources of omega-3 fatty acids). The report further states, there was also strong evidence that fish oil lowers levels of circulating triglycerides (TG) in blood – high TGs are considered a serious risk factor for cardiovascular disease.

Thousands of clinical studies have clearly demonstrated the importance of Omega-3 long chain polyunsaturated fatty acids in helping to achieve optimum health. Alpha-Linolenic Acid (ALA), Eicosapentaenoic Acid (EPA), and Docosahexaenoic Acid (DHA) are essential to sound human nutrition, and research has demonstrated their beneficial effect in cardiovascular and neurological health. Despite increased academic and public interest, there remains some confusion about the role of Omega-3 fatty acids, specifically in relation to heart health, daily nutritional requirements, and the value of food sources versus dietary supplements.

**Differences between the long chain fatty acids ALA, EPA and DHA**

| Omega-3 Fatty Acid | Present Throughout All Body Cells | Considered Physiologically Essential | FDA Qualified Heart Claim |
|---|---|---|---|
| **ALA** | **No** | **Yes** | **No** |
| **EPA** | **No** | **Yes** | **Yes** |
| **DHA** | **Yes** | **Yes** | **Yes** |

Figure 1 B. Holub.

Clinically, there is a complex biological and physiological relationship between ALA, EPA and DHA: they each deliver important health benefits and the byproducts of their metabolism create important anti-inflammatory, immune and other beneficial factors. The metabolism of ALA and Linoleic Acid (LA) to long chain fatty acids is through a complex series of desaturation and elongation steps with enzymes (Figure 2). These enzymes are active for both omega-6 and omega-3 polyunsaturated fatty acids, but since our western diets contain an abundance of the omega-6 fatty acids the enzymes are less efficient in converting ALA to the longer chain EPA and DHA. In addition, the high level of LA leads to increased production of arachidonic acid, and these n-6 fatty acids compete with n-3 fatty acids for incorporation into complex lipids.

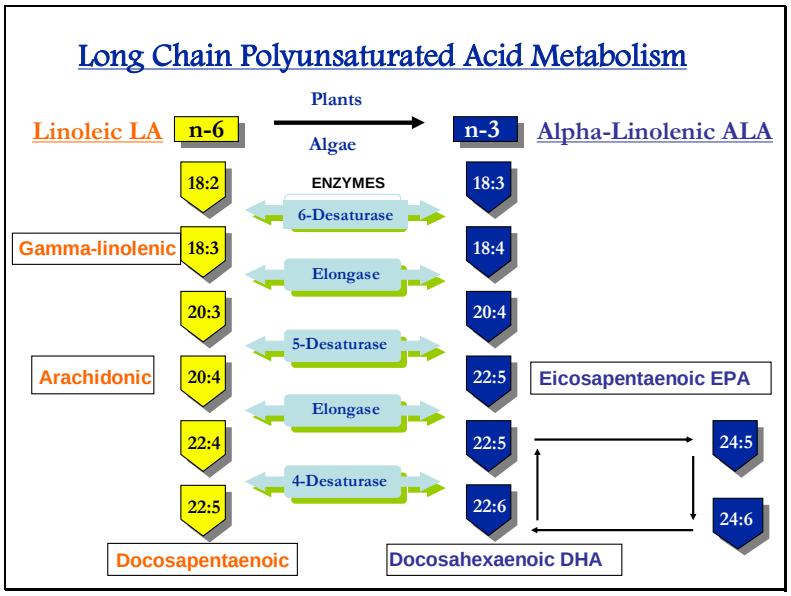


Figure 2.

The metabolism of Alpha Linolenic Acid (ALA) to the longer chain fatty acids, Eicosapentaenoic Acid (EPA) and Docosahexaenoic Acid (DHA).

ALA is considered an essential fatty acid because it is available only through the diet, from certain plant sources and some commonly used vegetable oils, e.g., soy, flax. The human body cannot naturally produce ALA, and its role in heart health is attributed primarily to its *conversion* to EPA and DHA in the human body. While the human body has the ability to synthesize EPA and DHA from ALA, the process is inefficient (Figure 3). As an example, ALA from flaxseed, rapeseed or soybean oil – which are lacking in EPA and DHA – does not have a protective effect comparable to the Omega-3 long chain polyunsaturated fatty acids found in fish oils.

While flaxseed is the richest source of ALA, very high amounts would need to be consumed to achieve newly established recommended daily intakes for EPA; however, an increase in DHA content may not be achievable in this way. To provide 500 mg of EPA/DHA, using conversion rates of 3-10% (our estimates are way below this, maybe 0.1% or less, Pawlosky ref), it is estimated that a person would need to consume between 16-52 grams of flaxseed oil, the richest source of ALA. This amounts to a daily intake of 140-470 calories and, as such, is not a practical dietary solution. Canola oil, a very poor source of ALA (~10% ALA), would require approximately three times these amounts.

The AHRQ reports also studied the potential health benefits of ALA but found that the quality of studies was considered poor, and thus the potential effect of ALA is unknown. This is due to the limited number of data sets. Moreover, dietary intervention trials such as DART, the Lyon Heart Study and the Indian Experiment of Infarct Survival are limited by multiple and complex dietary changes in the trials that do not allow differentiation and comparison, or to determine which components or combinations are most beneficial.

Current intakes of EPA and DHA in North America (130-150 mg/day) are well below the levels recognized to achieve optimal health. The scientific literature, health professionals, and health promotion and regulatory agencies support *significantly* higher intakes of the long chain Omega-3s. The recommendations are often for 500 mg/day, more than three times current consumption. This is for example the American Heart Association's recommendation. To bridge this "nutritional gap" for EPA and DHA would require increasing intakes of EPA and DHA by eating, for example, 2 to 3 servings of fatty fish a week or by taking 3 to 4 grams of fish oil in the form of capsules or fortified foods.

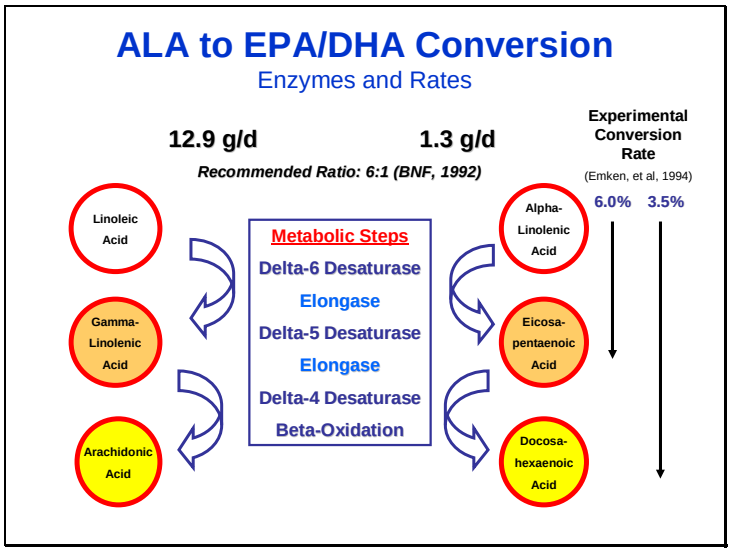


Figure 3.

The relative inefficiency of the conversion of ALA to EPA and DHA (modeled after Emken, I believe that Emken has overstated the n-3 conversion rates due to incorrect methods for their calculation).

In relation to heart health, research has demonstrated that EPA and DHA help normalize plasma lipid levels (i.e., reduce triglycerides), and reduce blood pressure and thrombosis tendency. As a consequence, the U.S. Federal Drug Administration has approved certain heart health claims for the Long Chain Omega-3's EPA and DHA, in both food products and dietary supplements (Figure 1).

EPA and DHA, and their metabolic byproducts, are chemical regulators that modify important processes, such as inflammation, heart arrhythmias, lipid lowering (blood triglceride lowering), and blood clotting. DHA is also a physiologically essential nutrient in the brain for normal functioning of neural tissue (including for cognitive performance, learning ability, memory, etc), and in the retina of the eye for visual acuity and optimal rhodopsin function. The addition of DHA to infant formula has been found to improve the infant mental development index. A recent review of nine observational studies, analyzed by meta-analysis, suggests that ALA is associated with an increase risk of prostate cancer (I tyhink I would delete that sentence re risk of prostate cancer. Intakes of EPA and DHA, however, appear to have a protective effect and reduce total prostate cancer risk.

A list of references is available on request.

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