Essential Fatty Acid Tidbits

Health Benefits of Omega-3 Fatty Acids:

- Improve heart health
- Reduce hypertension
- Improve autoimmune diseases
- Reduce inflammation
- Reduce depression
- Cancer prevention and support
- Vision
- Reduce risk of osteoporosis

Plant sources of dietary omega-3 fats are in the form of alpha-linolenic acid (ALA; also sometimes written as α-LNA). Fish contains eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Conversion from ALA to EPA/DHA is estimated to be from 2% to a high of 8% average, with average being 3.8%. A few isolated cases have reported up to 36% conversion of the ALA to EPA/DHA.

Factors Affecting Conversion:

- Gender, smoking, and diet
- Oxidation
- Amount of saturated fatty acids, trans fatty acids, oleic acid, the amount of LA, the ratio of saturated to polyunsaturated fats
- Delta-6-desaturase
- High LA yields a greater net conversion of LA to arachidonic acid (AA), diminishing the net conversion of ALA to EPA and DHA

Recommended Daily Intakes:

According to the Scientific Advisory Commission on Nutrition, a minimum of 0.45 g long-chain fatty acids per day, or 3 g a week, will help keep your heart in good shape.

The conversion from ALA to EPA/DHA is dependent on an enzyme called delta-6-desaturase. Many common lifestyle and dietary habits interfere with the actions of delta-6-desaturase.

Delta-6 desaturase (D6D) inhibitors:

- Trans fatty acids: margarine, shortening, and hydrogenated fats
- Excess omega-6 fatty acids
- Excess of oleic acid
- Sugar
- Caffeine
- Alcohol
- Protein deficiency
- Deficiencies of biotin, magnesium, zinc, vitamin E, B12, B3,and B6
- Diabetes
- Poor pituitary function
- Low thyroid function
- Cancer

Note: ALA to EPA/DHA conversion and the activity of delta-6-desaturase is less efficient in babies and the elderly.

Nutrients that improve delta 6 desaturase:

- Certain saturated fats - lauric acid** found in mother's milk and coconut oil
- Biotin
- Vitamin E
- Vitamin C
- B Vitamins: B12 , B3, and B6
- Zinc
- Magnesium

Note: **When lauric acid is present in the diet, the long chain omega-6 fatty acids accumulate in the tissues where they belong, even when consumption of essential fatty acids is low.

An Omega-6 Fatty Acid that is Often Deficient is Gamma Linoleic Acid (GLA)

GLA sources

- Hemp: 2-4%
- Evening primrose oil: 7%
- Black currant seed oil: 15%
- Borage oil: 23%

References

Myristic acid increases delta6-desaturase activity in cultured rat hepatocytes.

Jan S, Guillou H, D'Andrea S, Daval S, Bouriel M, Rioux V, Legrand P.

Source

Laboratoire de Biochimie, INRA-ENSA, 65 rue de Saint-Brieuc, CS84215, 35042 Rennes, France.

Abstract

In order to study the effects of saturated fatty acids on delta-6-desaturase activity, rat hepatocytes in primary culture were incubated with lauric (C12:0), myristic (C14:0) or palmitic (C16:0) acids. After optimization, the standard in vitro conditions for the measurement of delta-6-desaturase activity were as follows: 60 micromol x L(-1) alpha-linolenic acid (C18:3n-3), reaction time of 20 min and protein content of 0.4 mg. Data showed that cell treatment with 0.5 mmol x L(-1) myristic acid during 43 h specifically increased delta-6-desaturase activity. This improvement, reproducible for three substrates of delta-6-desaturase, i.e., oleic acid (C18:1n-9), linoleic acid (C18:2n-6), and alpha-linoleic acid (C18:3n-3), was dose-dependent in the range 0.1-0.5 mmol x L(-1) myristic acid concentration.

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Liver conversion of docosahexaenoic and arachidonic acids from their 18-carbon precursors in rats on a DHA-free but α-LNA-containing n-3 PUFA adequate diet.

Gao F, Kim HW, Igarashi M, Kiesewetter D, Chang L, Ma K, Rapoport SI.

Source

National Institute on Aging, National Institutes of Health, Bethesda, MD 20892, USA.
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Abstract

The long-chain polyunsaturated fatty acids (PUFAs), eicosapentaenoic acid (EPA, 20:5n-3), docosahexaenoic acid (DHA, 22:6n-3), and arachidonic acid (AA, 20:4n-6), are critical for health. These PUFAs can be synthesized in liver from their plant-derived precursors, α-linolenic acid (α-LNA, 18:3n-3) and linoleic acid (LA, 18:2n-6). Vegetarians and vegans may have suboptimal long-chain n-3 PUFA status, and the extent of the conversion of α-LNA to EPA and DHA by the liver is debatable. We quantified liver conversion of DHA and other n-3 PUFAs from α-LNA in rats fed a DHA-free but α-LNA (n-3 PUFA) adequate diet, and compared results to conversion of LA to AA. [U-(13)C]LA or [U-(13)C]α-LNA was infused intravenously for 2h at a constant rate into unanesthetized rats fed a DHA-free α-LNA adequate diet, and published equations were used to calculate kinetic parameters. The conversion coefficient k(□) of DHA from α-LNA was much higher than for AA from LA (97.2×10(-3) vs. 10.6×10(-3)min(-1)), suggesting that liver elongation-desaturation is more selective for n-3 PUFA biosynthesis on a per molecule basis. The net daily secretion rate of DHA, 20.3μmol/day, exceeded the reported brain DHA consumption rate by 50-fold, suggesting that the liver can maintain brain DHA metabolism with an adequate dietary supply solely of α-LNA. This infusion method could be used in vegetarians or vegans to determine minimal daily requirements of EPA and DHA in humans.
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Miscellaneous Research about Converting Food Form of Fats to Anti-Inflammatory EPA and DHA

α-LNA is converted to the long-chain Omega-3 fatty acids, particularly EPA and docosapentaenoic acid DPA7.

Efficiency of Conversion of α-LNA: Conversion of α-LNA to EPA in humans reportedly ranges from a low of 02% to a high of 8% (7,10). The 40-fold difference in these conversion rates may be due to differences in study they admit.

The fact that α-LNA conversion to EPA, DPA, and DHA is affected by gender, smoking, and diet suggests that people differ in their metabolic capacity for α-LNA conversion. Clearly, α-LNA conversion is more complex than was originally thought. Studies are needed to determine the diet and lifestyle patterns that enhance α-LNA conversion to the long-chain Omega-3 fatty acids.

Of the studies conducted; ALA conversion to EPA was on average 3.8%, and the conversion to DHA was a mere 1% - refer to table 1 for details.

Petra et al. 2005; Burdge, et al. 2003; Fokkema et al, 2000; Burdge, et al 2002; Burdge , Jones & Wooton, 2002; Pawlosky, et al. 2001; Harper, et al. 2006; Goyens et.al, 2006, Hussein, et al. 2005; Tarpila, et al. 2002; Emken et al, 1994; Petra et al, 2005.
The human body is inefficient at converting ALA into EPA and DHA, and what is converted, is highly variable and inconsistent due to several bioconversion factors. ALA is affected by a diverse array of metabolic factors such as carbon recycling, oxidation, and desaturation, Delany, et al. 2000; Vermunt, et al.

It is also greatly affected by dietary factors such as the amount of saturated fatty acids, the amount of LA, the ratio of saturated to polyunsaturated fats, Layne et al, 1996, and the amount of cholesterol, Garg, et al, 1988.

Additionally, a significant amount of ALA is either found distributed throughout several major tissue lipid pools, such as adipose, carcass, and skin, or as mentioned is destined for b-oxidation, rendering it useless for conversion, Burdge et al, 2005.

Perhaps the most significant factor in ALA metabolism is the competitive inhibitor linolenic acid (LA), the omega-6 long-chain polyunsaturated fatty acid precursor. LA and ALA both require delta-6-desaturase activity to form their longer chain derivatives, and because LA is found extensively in the human diet, a greater net conversion of LA to its longer chain fatty acid, arachidonic acid (AA), occurs, diminishing the net conversion of ALA to EPA and DHA, Chan et al, 1993.

One small study showed that the women involved were able to convert an average of 36% of the ALA they were given into long chain derivatives, 21% EPA, 6% DPA, and 9% DHA. Another small study with men, showed that they converted an average of 16% of the ALA they received into long-chain derivatives, 8% EPA and 8% DPA, but no DHA, although another study did show that men do convert ALA to DHA just as well.

Research has also proven that as quantities of dietary DHA increased, synthesis of DHA from ALA decreased but was not totally suppressed, even when the DHA levels are increased to very high concentrations. This means that the natural ability to convert ALA to DHA diminishes as more supplemental DHA is taken in, but does not stop entirely. Studies conducted in Japan confirmed these findings. Ten months of feeding ALA to elderly volunteers, ages 67-91, showed serum increases of DHA. This surprised researchers, since the regular intake of long-chain omega-3s from fish had been very high. The conclusion was that DHA synthesis from ALA is a continuing process and the body adjusts to fulfill essential brain functions.

Eating a minimum of .045g (450mg) of long-chain fatty acids a day, or 3g (3,000mg) a week, as part of a healthy, balanced diet, will help keep your heart in good shape, according to the Scientific Advisory Committee on Nutrition SACN and Committee on Toxicity COT.

Vegan Sources of EPA and DHA

Search on Amazon: (Some are not vegan; they contain fish oil.)

- http://www.drritamarie.com/go/AmazonVeganEPASearch
- http://www.drritamarie.com/go/AmazonVeganDHASearch

Recommended:

- NuTru's O-Mega-Zen + EPA supplement
  http://www.drritamarie.com/go/NuTruOMegaZen
- Opti-3 Omega-3 EPA & DHA Supplement
  http://www.drritamarie.com/go/Opti3
- DEVA Omega-3 EPA & DHA
  http://www.drritamarie.com/go/DEVAOmega3
- Biotiva Green Omega-3
  http://www.drritamarie.com/go/BiotivaGreenOmega3
- Amerifit Nutrition Ovega-3
  http://www.drritamarie.com/go/AmerifitOmega3
- Pure Encapsulations EPA/DHA Vegetarian
  http://www.drritamarie.com/go/PEOmega3