

Fatty Acid Facts

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Polyunsaturated fatty acids (PUFA's) are showing up everywhere – in foods, supplements, and even joint cream.ⁱ At least one prescription dog food contains more omega-3 content than even nutraceuticals provide. Navigating successfully among the many supplementation options requires understanding the unique attributes of each fatty acid and deciphering the alphabet soup of acronyms.

Specific Fatty Acids and Where to Find Them

Naturally occurring fats fall into three categories – saturated, monounsaturated, and polyunsaturated. (“Trans” fats occupy a separate category of hydrogenated fats created by food processors.) Saturated fats include beef and dairy fat while monounsaturated fats arise from plants such as olive and canola. Polyunsaturated fats (PUFA's) include omega-3 and omega-6 fatty acids. Fish, walnuts, flaxseed, and hemp seed contain omega-3's whereas safflower oil, corn oil, peanuts, and soybean oil have omega-6's.

PUFA's produce bioactive molecules known as eicosanoids. Leukotrienes, prostaglandins, and thromboxanes derived from omega-3's predominantly afford anti-inflammatory and platelet inhibiting effects, whereas omega-6's do the opposite. The ideal ratio of omega-3 to omega-6 fatty acids in carnivore diets remains unclear. Given that the “typical Western diet” exhibits an unhealthy high omega-6 and low omega-3 ratio, augmentation of omega-3's seems advisable. Further, food grown today contains less omega-3 and more omega-6 fatty acids than in the past.ⁱⁱ Shifting the diet to weight omega-3's more heavily may counter the development of a range of inflammation-based illnesses, including arthritisⁱⁱⁱ, heart disease, and cancer^{iv}.

Omega-3:

Alpha linolenic acid (ALA) occurs from leafy vegetables, nuts, and oils. Major sources include hemp, canola, soybean, and flaxseed oil, and English walnuts. Plant-derived PUFA's require desaturation to form EPA and DHA. Several factors such as species, sex, competition for the desaturase enzyme by linolenic acid, and negative feedback inhibition of desaturase by pre-existing EPA and DHA, influence the rates of ALA conversion.^v One source estimates that less than 10% of ALA becomes EPA and DHA.^{vi}

Fish oils already contain eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) and as such require no conversion. Yet, the disadvantageously fishy odor of the oils, as well as the patient, can limit their acceptability as a supplement.

EPA and DHA appear in recommendations for cancer, cardiovascular health maintenance, and nutritional support for repair of brain tissue after traumatic brain injury.^{vii} The gray matter of the brain, the retina, and the heart all utilize DHA as a major structural component. Thus, DHA specifically plays an important role in eye and brain development.

Omega-6:

Following desaturation, gamma-linoleic acid (GLA) produces arachidonic acid (ARA), though levels of the required enzyme delta-6-desaturase may vary across species.^{viii} GLA has received research scrutiny for treatment of atopic eczema, rheumatoid arthritis, multiple sclerosis, schizophrenia, and pre-menstrual syndrome in humans. A limited number of plants contain abundant GLA concentrations, with evening primrose and borage being the most notable.

Arachidonic acid (ARA) – ARA supplies the most abundant source of PUFA in the body, providing membrane phospholipids and, as such, precursors to a panoply of molecules such as prostaglandins and leukotrienes that participate in lipoprotein metabolism, platelet activation, leukocyte properties, and blood rheology.^{ix} ARA works with DHA in brain development, making it less surprising that breast milk contains rich quantities of both PUFAs. Egg yolks, mammal meat, and liver offer abundant amounts of ARA.

What They Do

Research has confirmed that fatty acids improve health in many ways, including providing flexibility, fluidity, and selective permeability properties to cell membranes.^x A common mechanism by which they do pertains to its anti-inflammatory effects. Lipid mediators derived from omega-3 polyunsaturated fatty acids (PUFA) participate in the reduction and active resolution of inflammation.^{xi}

Adverse Effects

Some dogs consuming large quantities of fish oils will exude a fishy odor. Other than that, no adverse effects from fish oil supplementation has been reported in veterinary patients. Humans consuming 1-3 g of fish-derived omega-3 fatty acids complained of gastrointestinal upset, fishy aftertaste, elevated blood glucose in patients with diabetes and impaired glucose tolerance, and elevated LDL-C levels in patients with hypertriglyceridemia.^{xii}

Risks^{xiii}

Ingesting certain fish or shellfish may lead to higher tissue levels of omega-3 fatty acids,^{xiv} but it comes at a price. Fish often contains contaminants, depending on species and source. In

addition to mercury, toxins range from polychlorinated dibenzo-p-dioxins, furans, polychlorinated biphenyls, polychlorinated naphthalenes, and hexachlorobenzenes to arsenic and more.^{xv} Microbial sources of PUFA's are considered non-pathogenic and non-toxic.^{xvi}

Concern has been expressed that fish oils may lead to heightened risk of bleeding by inhibiting platelet activation and lowering plasma levels of coagulation factors.^{xvii} Human reports tie prolonged coagulation times to combining omega-3 fatty acids with warfarin.^{xviii} However, an expert opinion assessing the evidential support on this issue dismissed these concerns as insignificant.^{xix}

Finally, omega-3 fatty acids may influence the bioavailability of lipophilic medications such as cyclosporine, causing levels to rise.^{xx}

ⁱ Kraemer WJ, Ratamess NA, Anderson MJ, et al. Effect of a cetylated fatty acid topical cream on functional mobility and quality of life of patients with osteoarthritis. *J Rheumatol.* 2004;31:767-774.

ⁱⁱ DeFilippis AP and Sperling LS. Understanding omega-3's. *Am Heart J.* 2006;151:564-570.

ⁱⁱⁱ Roush JK. University Clinical Trials. Omega-3 fatty acid effects on force plate analysis and clinical signs. *NAVC Clinician's Brief.* 2005;3(4 Suppl):9.

^{iv} Davenport DJ and Roudebush P. The use of nutraceuticals in cancer therapy. *NAVC Proceedings. Small Animal – Oncology.* 2006:777-780.

^v DeFilippis AP and Sperling LS. Understanding omega-3's. *Am Heart J.* 2006;151:564-570.

^{vi} Moyad MA. An introduction to dietary/supplemental omega-3 fatty acids for general health and prevention: Part I. *Urologic Oncology: Seminars and Original Investigations.* 2005;23:28-35.

^{vii} Wu A, Ying Z, and Gomez-Pinilla F. Omega-3 fatty acids supplementation restores mechanisms that maintain brain homeostasis in traumatic brain injury. *Journal of Neurotrauma.* 2007;24:1587-1595.

^{viii} Ward OP and Singh A. Omega 3/6 fatty acids: alternative sources of production. *Process Biochemistry.* 2005;40:3627-3652.

^{ix} Ward OP and Singh A. Omega 3/6 fatty acids: alternative sources of production. *Process Biochemistry.* 2005;40:3627-3652.

^x Ward OP and Singh A. Omega 3/6 fatty acids: alternative sources of production. *Process Biochemistry.* 2005;40:3627-3652.

^{xi} Serhan CN. Novel ω -3-derived local mediators in anti-inflammation and resolution. *Pharmacology & Therapeutics.* 2005;105:7-21.

^{xii} Ward OP and Singh A. Omega 3/6 fatty acids: alternative sources of production. *Process Biochemistry.* 2005;40:3627-3652.

^{xiii} US Department of Health and Human Services AfHRaQ. Effects of omega-3 fatty acids on cardiovascular disease. *Evid Rep Technol Assess.* (Summ). 2004;1-8. Cited in: DeFilippis AP and Sperling LS. Understanding omega-3's. *Am Heart J.* 2006;151:564-570.

^{xiv} Elvevoll EO, Barstad H, Breimo ES, et al. Enhanced incorporation of n-3 fatty acids from fish compared with fish oils. *Lipids.* 2006;41(12):1109-1114.

^{xv} Mahaffey KR, Clickner RP, and Jeffries RA. Methylmercury and omega-3 fatty acids: Co-occurrence of dietary sources with emphasis on fish and shellfish. *Environmental Research.* In press.

^{xvi} Ward OP and Singh A. Omega 3/6 fatty acids: alternative sources of production. *Process Biochemistry.* 2005;40:3627-3652.

^{xvii} Goodman L and Trepanier L. Potential drug interactions with dietary supplements. *Compendium.* October 2005: 780-789.

^{xviii} Goodman L and Trepanier L. Potential drug interactions with dietary supplements. *Compendium*. October 2005: 780-789.

^{xix} Harris WS. Expert opinion: omega-3 fatty acids and bleeding – cause for concern? *Am J Cardiol*. 2007;99[Suppl]:44C-46C.

^{xx} Goodman L and Trepanier L. Potential drug interactions with dietary supplements. *Compendium*. October 2005: 780-789.