

Flax vs. Fish: The Alpha and the Omega

The need for increased omega 3 intake through diet and /or supplementation has become increasingly clear. What health professionals and the patients want to know is, “what is the best way to do this in each particular case?”

What Are the Major Omega-3 Fats?

Alpha-linolenic acid (ALA) is a plant source omega-3 essential fatty acid (EFA); "essential", as our bodies cannot make it. Two other omega-3 fats are eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). EPA and DHA, which is best provided by fatty fish in the diet several times a week, are both vital for health. EPA is not technically “essential” because our bodies make them from ALA, though conversion is not efficient and rates vary based on many factors. 1 However, DHA conversion from ALA is so poor in many persons that some authorities think it should be classified as "conditionally essential". 2

ALA is found mainly in flax seeds and walnuts and in plant oils like flax, canola and soybean oils. Flax seeds and flax oil are the richest sources of ALA in the North American diet. 3 EPA and DHA are found mainly in fatty fish like herring, salmon, mackerel and bluefin tuna and the fish oil supplements made from them. Marine algae, the base of the oceanic food chain, are rich sources of DHA, but contain little EPA.

Do All Omega-3 Fats Have the Same Health Benefits?

Omega-3 fats are alike in some ways and different in others. ALA, EPA and DHA all support in keeping cell membranes flexible and elastic and block the actions of some compounds that cause inflammation and clotting. 4 Chronic diseases like heart disease, diabetes, cancer and arthritis are marked by inflammation. Therefore, all omega-3 fats help reduce chronic disease risk by blocking inflammation. In a clinical study involving adults with moderate high blood cholesterol, eating a diet rich in ALA from walnuts, walnut oil and flax oil reduced the blood level of one marker of inflammation by 75%. 5 In the Nurses’ Health Study, the greater the ALA intake, the lower the concentration of the inflammatory markers in the blood.6

Still it is generally recognized that EPA/DHA intake is more powerful in relation to cardio-vascular disease and inflammatory joint disease. 7, 8, 9 DHA is unique in its health effects. Because it helps the eye, brain and nervous systems develop properly infants have a special need for DHA.10, 11. Of note, supplementing the new born with EPA displaces arachidonic acid, interfering with growth, so only DHA, not direct EPA supplementation is used in infant formulas. 12,13,14 Aging adults may need DHA, too. A study of 815 elderly people living in Chicago found that those with the highest DHA intake had the most protection against Alzheimer Disease.15

Flax Facts

Flax seeds provide much more than the richest source of ALA. Flaxseed is approximately 38% oil which is comprised mainly of alpha linolenic acid, with lesser amounts of the linolenic acid (LA, an essential omega-6 fatty acid) and oleic acid (an omega-9 fatty acid as in olive oil); 28% fiber of which 2/3's or so is insoluble; 20% protein with an amino acid profile similar to soy beans; 7% carbohydrates (simple sugars, lignans, phenolic acids and hemicellulose) with less than 3% net digestible carbs; 4% ash, 2% minerals, especially magnesium, but also potassium, calcium, iron, phosphorous, sodium, copper, zinc, manganese, selenium; .32% vitamins A, B1, B2, D, E, and niacin; .15% lecithin, .1% flavonoids, and .1% phytic acid.

Besides their omega 3 content flax's most beneficial compounds are likely its lignans and fiber. Lignans are phytoestrogens – plant compounds that can have estrogen-like actions. Through the actions of the lignans and ALA, flax blocks tumor growth in animals and may help reduce cancer risk in humans, likely by competing with toxic endogenous and xenogenous estrogens. 16, 17 The major lignan in flax is secoisolariciresinol glucoside (SDG), a phytochemical polysaccharide that is a powerful phytoestrogen chemically similar to the breast cancer drug tamoxifen. Postmenopausal women consuming 5 or 10 grams of milled flax over seven weeks showed significant reductions in blood concentrations of the most potent estrogen, estradiol, and its less potent sister, estrone. This may be desirable for postmenopausal women who have a high risk of breast cancer. 18

The SDG lignan also has anti-viral, anti-bacterial, anti-fungal and immune enhancing properties and is a potent antioxidant, 500% more powerful than vitamin E. 19 SDG lignans have shown such extraordinary potential that they have been studied by the National Cancer Institute for their cancer preventative properties. A controlled study by the Queen Elizabeth II Medical Centre, Perth, Australia concluded that "there is a substantial reduction in breast cancer risk among women with high intake (as measured in excretion) of phytoestrogens, particularly the isoflavonic phytoestrogen equol and the lignan enterolactone (a metabolite of SDG)". 20

University of Wales College of Medicine researchers in the UK determined the concentrations of lignans in prostate fluid and concluded high levels of lignans and related plant estrogens may, in part, be responsible for lower incidences of prostate cancer in men from Mediterranean and Asian countries. 21

Flax has been shown to lower blood cholesterol levels and helps reduce the risk of heart attacks and stroke, likely related to fiber content, but partly through the actions of ALA. 22 ALA may be especially important to vegetarians and people with low intakes of fatty fish. In a cohort of more than 45,000 US men followed for 14 years, each 1-g/day increase in dietary ALA intake was associated with a 16% reduction in the risk of CHD. Moreover, in those who ate little or no seafood, each 1-g/day increase in dietary ALA intake was associated with a 47% reduction in the risk of CHD. 23 In a cohort of more than 76,000 US women followed for 10 years, those with the highest ALA intakes (~1.4 g/day) had a risk of fatal CHD that was 45% lower than women with the lowest intakes (~0.7 g/day) 24. Findings from the Health Professionals Follow-up Study of 45,722 men

indicated that each one gram of ALA in the daily diet was associated with a 47% lower risk of heart disease among men with low intakes of EPA and DHA (< 100 mg per day). Flax's insoluble dietary fiber promotes laxation while the soluble fibers promote intestinal health and glycemic control. 25 Fortunately flax has a nutty, cereal like taste that makes incorporation into the diet pleasant.

Why Eat Fish?

Fish is valued for its high-quality protein and nutrient content, especially vitamins D and B-12. But only fatty fish is prized for its high EPA/DHA content. Populations with high fish intakes, like the Japanese and Inuit, have low rates of many of the common diseases of aging such as heart disease. Multiple clinical studies have shown the oils of fatty fish, EPA and DHA, to be of benefit to the cardiovascular system, brain and visual function, immune function, skin health, inflammatory modulation and joint health .26,27 As ALA conversion to EPA is poor to moderate, depending on many variables, and conversion to DHA is minimal, it is generally thought that regular twice weekly fatty fish oil consumption, or fish oil supplementation, are the best ways to enhance EPA/DHA status 28

Several factors inhibit conversion (via elongation enzymes) of short chain ALA to its long-chain metabolites EPA and DHA:

- A diet high in omega-6 EFAs, saturated fats and trans fats, all common in US, can compete with the enzymes needed to convert ALA to EPA
- High alcohol intake
- A deficiency of vitamins B3, B6, C, and zinc or magnesium, which are required by elongase and delta-6 desaturase conversion enzymes.
- Loss of Delta-6 desaturase activity that occurs during normal aging
- Certain health conditions such as diabetes, RA, viral infections and drugs/medications
- Certain populations, such as North American natives, Inuit, Orientals, Norwegians, and Welsh-Irish may not effectively convert ALA to EPA in the body as they come from a genetic history of high fatty fish intake. (Conversely, those with genes from largely vegetarian societies convert ALA to EPA/DHA more efficiently.)

Is It Safe to Eat Fish?

The AHA warns that "some species of fish may contain significant levels of methylmercury, polychlorinated biphenyls (PCBs), dioxins, and other environmental contaminants. These substances are present at low levels in fresh waters and oceans, and they bio-concentrate in the aquatic food chain such that levels are generally highest in older, larger, predatory fish and marine mammals." 29 The U.S. Environmental Protection Agency actually posts an advisory of fish consumption! 30 Nonetheless, federal health agencies in Canada and the United States conclude that the benefits of eating fish outweigh concerns about traces of mercury and PCB and dioxins in fish.

However, both countries advise pregnant and nursing women, women who may become pregnant and young children to avoid eating certain fish. 31,32

What about Fish Oil Supplements?

Fish oil capsules are the most concentrated form of omega-3 fats, and though few contain mercury, some may contain polychlorinated biphenyls (PCBs). PCBs are chemicals used in industrial processes and may cause cancer in humans. Consumers who follow the label recommendation on some fish oil supplements can take in up to 43% of the daily upper limit of PCBs. Consumers who take fish oil capsules and eat PCB contaminated fish may increase their risk of PCB toxicity.³³

The biggest problem with deterioration in the quality of fish oil is rancidity. The main cause of rancidity is oxidation. The most common analytical assessments of oxidation are provided in terms of Peroxide Value (PV), Anisidine Value (AV), and Totox Value. However, perhaps the best, and certainly the easiest test is the "taste test". If the oil tastes or smells bad, it probably is bad, regardless of what the tests say. ³⁴ Because of the lipid peroxidation, it is generally recommended to take physiological doses of vitamin E when supplementing with fish oils. ^{35,36} Therapeutic dosages of over 3 gm a day (900 mg EPA/DHA), as may be recommended in heart disease or R.A, may increase a tendency to hemorrhage and interfere with immune function. The AHA therefore recommends physician guidance at such levels. ³⁷

Besides safety concerns, the main factors to consider, mostly related to compliance, are taste and texture with fish oils, and difficulty swallowing, fishy aftertaste and "fish burps" experienced with some fish oil capsules.³⁸ We should not forget that fish is the major dietary source of Vit D and is absent from most fish oils. Cod liver oil has vitamin D, but usually relatively too much vitamin A. ³⁹ As recent studies suggest that consuming more vitamin D3 may lower the risk of death from any common disease of aging, especially colon and breast cancer, this is not an unimportant omission. ^{40,41}

Vegan DHA

DHA produced from algae is a vegetarian source of DHA. Algae is the only vegetarian source that provides a meaningful amount of DHA. DHA is the only omega-3 shown to provide brain, eye and heart health benefits. Today DHA can be produced with excellent sensory characteristics in a controlled environment, is environmentally sustainable as relates to our over fished oceans and eliminates the risk of oceanic contamination such as PCBs and dioxins. Along with flax, marine DHA is being used more and more to fortify breads, cereals, juices, eggs, dairy products and functional foods.

Omega 6-3 Ratio

Omega-6 fatty acids, specifically linoleic acid (LA) and arachidonic acid (AA) are also essential. However, in many ways they act opposite to omega 3 fatty acids. Specifically, they tend to promote inflammation and clotting. They also compete with enzymes that

help ALA be converted to EPA and DHA. It has been estimated that the ratio of omega-6 to omega-3 fatty acids in the diet of early humans was perhaps as low as 1:1. 40 Today the ratio in the typical Western diet is now 10:1 or even higher due to increased use of vegetable oils rich in LA, full fat dairy and grain feed meats high in AA, and declining fish consumption. 43

Functional Food Solution

In view of the widespread reluctance of the public to consume sufficient amounts of fish, and to a lesser extent fish oil supplements, functional foods containing flax, EPA and/or DHA are becoming increasingly important sources of these nutrients that support optimal brain/visual performance, cardio-vascular function, joint and skin health for young and old alike. Presuming good taste, texture and ease of mixing, an interesting functional food supplement would be a combination of stabilized flax seed, marine DHA, with synergistic vitamins D3, E, and the B complex.⁴⁴ New technologies now make it possible to combine specially stabilized crushed flaxseeds with EPA and/or DHA, the natural rich antioxidants in the flax, like gamma tocopherol and SGD lignan, stabilizing the fish oils. Functional foods combining flax with vegetarian DHA and synergistic vitamins, together with an effort to lower the intake of omega 6 fats from LA vegetables oils (corn, safflower, sunflower), AA rich full fat dairy and grain fed animal fats, and ‘bad fats’ like trans fats and rancid deep fried fats, with moderation in alcohol, may be part of the answer to returning our omega 3 / omega 6 dietary ratios closer to those of our ancestors in a scientifically efficacious, highly compliant, vegetarian, safe and environmentally sustainable way.

References

1. In one study, for instance, the blood level of EPA increased 60% when 56 African-American adults with chronic illness consumed 3 grams of ALA daily for 12 weeks. The source of ALA in this study was flax oil capsules. Harper CR, Edwards MJ, DeFilipis AP, Jacobson TA. Flaxseed oil increases the plasma concentrations of cardioprotective (n-3) fatty acids in humans. *J Nutr* 2006;136:83-87.
2. <http://dhaomega3.org/index.php?category=overview&title=Conversion-of-ALA-to-DHA>
3. Health Canada. Novel food information on: Omega-3 enhanced pork and products derived therefrom. Available at www.hc-sc.gc.ca/fn-an/gmf-agm/appro/dd109_v3_e.html.
4. Caughey GE, Mantzioris E, Gibson RA, et al. The effect on human tumor necrosis factor ??and interleukin 1??production of diets enriched in n-3 fatty acids from vegetable oil or fish oil. *Am J Clin Nutr* 1996;63:116-122.

5. Zhao G, Etherton TD, Martin KR, et al. Dietary α -linolenic acid reduces inflammatory and lipid cardiovascular risk factors in hypercholesterolemic men and women. *J Nutr* 2004;134:2991-2997.
6. Lopez-Garcia E, Schulze MB, Manson JAE, et al. Consumption of (n-3) fatty acids is related to plasma biomarkers of inflammation and endothelial activation in women.
7. Kris-Etherton, P.M., et al. Omega-3 fatty acids and cardiovascular disease: New recommendations from the American Heart Association. *Arterioscler. Thromb. Vasc. Biol.* 23: 151-152, 2003.
8. van der Tempel H, Tulleken JE, Limburg PC, et al. Effects of fish oil supplementation in rheumatoid arthritis. *Ann Rheum Dis* 1990;49:76-80.
9. Lau CS, Morley KD, Belch JJ. Effects of fish oil supplementation on non-steroidal anti-inflammatory drug requirement in patients with mild rheumatoid arthritis- a double-blind, placebo-controlled study. *Br J Rheumatol* 1993;32:982-9.
10. Malcolm, CA, et al; Scotopic Electroretinogram in Term Infants Born of Mothers Supplemented with Docosahexaenoic Acid during Pregnancy. *Investigative Ophthalmology and Visual Science.* 2003;44:3685-3691.
11. Susan Carlson, Ph.D., Overview of dha in maternal and infant/child nutrition, Midwest Dairy Council Professor of Nutrition, Departments of Dietetics and Nutrition and Pediatrics
University of Kansas Medical Center,
http://www.ot.kumc.edu/jradel/workshops/ClinNutr_DHA_2005/01_Carlson_talk.pdf
12. Simmer K. Longchain polyunsaturated fatty acid supplementation in infants born at term. *Cochrane Database Syst Rev.* 2001(4):CD000376. (PubMed)
13. Simmer K, Patole S. Longchain polyunsaturated fatty acid supplementation in preterm infants. *Cochrane Database Syst Rev.* 2004(1):CD000375. (PubMed)
14. Uauy R, Hoffman DR, Mena P, Llanos A, Birch EE. Term infant studies of DHA and ARA supplementation on neurodevelopment: results of randomized controlled trials. *J Pediatr.* 2003;143(4 Suppl):S17-25. (PubMed)
- 15 Morris MC, Evans DA, Bienias JL, et al. Consumption of fish and n-3 fatty acids and risk of incident Alzheimer disease. *Arch Neurol* 2003;60:940-946.
16. Flax Council of Canada. Flax—A Health and Nutrition Primer. Winnipeg, MB, 2003. www.flaxcouncil.ca.

- 17 Joanne L. Slavin, PhD, RD, Mechanisms for the Impact of Whole Grain Foods on Cancer Risk, *Journal of the American College of Nutrition*, Vol. 19, No. 90003, 300S-307S (2000)
18. Joanne L. Slavin, PhD, RD, Mechanisms for the Impact of Whole Grain Foods on Cancer Risk, *Journal of the American College of Nutrition*, Vol. 19, No. 90003, 300S-307S (2000)
19. Prasad, K. "Antioxidant Activity of Secoisolariciresinol D diglycoside derived Metabolites, Secoisolariciresinol, Enterodiol, and Enterolactone" *Int. Journal of Angiology*, 2000 Oct. 9(4): 220-225
20. David Ingram, Katherine Sanders, Marlene Kolybaba. Derrick Lopez, Case Control Study of Phyto-oestrogens and Reduction in breast-cancer risk, University Department of Surgery, Queen Elizabeth II Medical Centre, Perth, Western Australia, <http://www.blossom-s.com/phytoe.cc.pdf>
21. *Baillieres Clin Endocrinol Metab.* 1998 Dec;12(4):625-47. Phytoestrogens and diseases of the prostate gland. Griffiths K, Denis L, Turkes A, Morton MS. Tenovus Cancer Research Centre, University of Wales College of Medicine, Cardiff, UK.
- 22 Mozaffarian D, Ascherio A, Hu FB, et al. Interplay between different polyunsaturated fatty acids and risk of coronary heart disease in men. *Circulation* 2005;111:157-164.
- 23 Mozaffarian D. Does alpha-linolenic acid intake reduce the risk of coronary heart disease? A review of the evidence. *Alt Ther* 2005;11:24-30.
24. Hu FB, Stampfer MJ, Manson JE, et al. Dietary intake of alpha-linolenic acid and risk of fatal ischemic heart disease among women. *Am J Clin Nutr.* 1999;69(5):890-897. (PubMed)
25. Wendy J. Dahl, Erin A. Lockert, Allison L. Cammer, Susan J. Whiting. Effects of Flax Fiber on Laxation and Glycemic Response in Healthy Volunteers, *Journal of Medicinal Food.* 2005, 8(4): 508-511. doi:10.1089/jmf. 2005.8.508.
- 26 12. Kris-Etherton PM, Harris WS, Appel LJ, for the Nutrition Committee. Fish consumption, fish oil, omega-3 fatty acids, and cardiovascular disease. *Circulation* 2002;106:
- 27 For a complete list of references related to clinical trials of EPA/DHA see <http://www.truthaboutomega3.com/benefit.html?pg=g01-001-1000D&abc=4&gid=118798605113011>

28. It has been suggested that only about 15 percent of ALA converts to EPA and 5 percent to DHA. (H. Gerster. Conversion of ALA and DHA. *Internat. J Vit. Nutr. Res* 68 (1998)-Cunnane , 1995, Nutrition Advisory Panel, 1995).
29. Penny M. Kris-Etherton, PhD, RD; William S. Harris, PhD; Lawrence J. Appel, MD, MPH, Fish Consumption, Fish Oil, Omega-3 Fatty Acids, and Cardiovascular Disease, AHA Scientific Statement, *Circulation*. 2002; 106:2747.)
30. Fish Advisories <http://www.epa.gov/waterscience/fish/>
31. Health Canada. Advisory: Information on mercury levels in fish (May 2002). Available at www.hc-sc.gc.ca.
32. Food and Drug Administration. What you need to know about mercury in fish and shellfish (March 2004). Available at www.cfsan.fda.gov.
33. Shim SM, Santerre CR, Burgess JR, Deardorff DC. Omega-3 fatty acids and total polychlorinated biphenyls in 26 dietary supplements. *J Food Sci* 2003;68:2436-2440.
34. http://www.marine-ingredients.com/research/rancidity_vs_purity_of_fo.pdf
35. Allard JP, Kurian R, Aghdassi E, Muggli R, et al. Lipid peroxidation during n-3 fatty acid and vitamin E supplementation in humans. *Lipids* 1997;32:535-41.
36. Cho SH, Im JG, Choi YS, Son YS, Chung MH., Lipid peroxidation and 8-hydroxydeoxyguanosine formation in rats fed fish oil with different levels of vitamin E, *J Nutr Sci Vitaminol (Tokyo)*. 1995 Feb;41(1):61-72.
37. Penny M. Kris-Etherton, PhD, RD; William S. Harris, PhD; Lawrence J. Appel, MD, MPH, Fish Consumption, Fish Oil, Omega-3 Fatty Acids, and Cardiovascular Disease, AHA Scientific Statement, *Circulation*. 2002;106:2747.)
38. Ibid, 37
- 39 <http://ods.od.nih.gov/factsheets/vitamind.asp>
40. Sept. 10 issue of *Archives of Internal Medicine* (2007;167(16):1730-37).
41. Garland, Cedric F. et al. "What is the dose-response relationship between vitamin D and cancer risk?" *Nutrition Reviews* 65;8 (Suppl):91-95.
42. Simopoulos AP, Leaf A, Salem N, Jr. Workshop statement on the essentiality of and recommended dietary intakes for Omega-6 and Omega-3 fatty acids. *Prostaglandins Leukot Essent Fatty Acids*. 2000;63(3):119-121.

43. Kris-Etherton PM, Harris WS, Appel LJ. Fish consumption, fish oil, omega-3 fatty acids, and cardiovascular disease. *Circulation*. 2002;106(21):2747-2757

44. Flax seed, being high in PUFA, also needs to be specially selected and processed to prevent oxidation and rancidity.