


17. Food Standards Agency. Survey of mercury in fish oil supplements. October 2003. The FDA ruled in 1997 that intakes of up to 3 grams per day of EPA+DHA are recommended to consume about one gram of EPA+DHA per week. In 2002, the FDA has tested over 3400 cans of tuna as well as 227 samples of various fish. Large carnivorous fish that are high in the food chain were found to have the highest levels of mercury. Swordfish may have 1 gram of mercury per gram (1 ug/gm). Tuna was found to have an average of 0.5 micrograms per gram (0.5 mg/gm). The maximum safe daily intake of mercury is 3.5 ug per day in the United States. Because of concerns of mercury contamination in the food supply, women of childbearing age are recommended by the FDA to eat no more than one or two portions of oily fish per week (about 0.4-0.8 g/day of omega-3 fats).9

In addition, omega-3 fatty acids can regulate the activation of transcription factors including NF-kappa B. NF-kappa B induces many of the genes in response to inflammatory stimulation.

Inflammation plays a key role in coronary artery disease and other manifestations of atherosclerosis. Immune cells dominate the early atherosclerotic lesions and their effector molecules accelerate the progression of atherosclerosis. The infiltration of inflammation and retention of LDL in the arterial intima initiate an inflammatory response in the artery wall. The balance between inflammatory and anti-inflammatory responses determines the progression of atherosclerosis. Omega-3 FA as modulators of the inflammatory process are natural agents that have also been reported to be beneficial in the treatment of inflammatory diseases.

Maroon9 treated 250 patients who had been seen by a neurosurgeon and were found to have nonsurgical neck or back pain with 1,200 mg per day of omega-3 FA. After taking the omega-3 FA for 4 weeks, 70% of patients discontinued pain medication due to their improvement. 88% stated they would continue to take the omega-3 FA supplement. Maroon noted that “the literature reviewing rheumatoid arthritis, both chronic inflammatory conditions, consistently reports improvements in joint pain and function using omega-3 EFA.”

The modern western diet which contains corn oil, sunflower oil and safflower oils supplies large amounts of linoleic acid (LA), omega-6 fatty acid, which competes with omega-3 fatty acids in particular, LA and arachidonic acid (AA) (C 20:4n-6) should be reduced or eliminated from the diet to the extent possible. LA increases inflammation by several mechanisms, one of which is the activation of NF-kappa B. The increased omega-6/omega-3 ratio most likely contributes to an increased incidence of cardiovascular disease and inflammatory disorders.

The earlier hunter-gather diet provided an omega-3 to omega-6 ratio of between 1.5:1 and 2:1. These ratios were maintained until the industrial revolution and are now estimated at between 16:1 and 20:1. In order to obtain a dietary fat intake that more closely resembles what our genomic code is based upon, a reduction of omega-6 fats and increase of omega-3 fats is necessary in the human diet. These dietary suggestions do not take into consideration the effects of trans fats, oxidized fats, and saturated fats that have occurred with industrial food supplies.

To obtain one gram of omega-3 FA per day from fish an individual would have to consume 2-3 ounces of salmon, sardines or mackerel per day or consume dietary supplements containing fish oil. It appears that the fact that some omega-3 fish may be contain relatively high amounts of heavy metals, such as mercury and/or organics pollutants such as polychlorinated biphenyls (PCBs). In 2002, the FDA has tested over 3400 cans of tuna as well as 227 samples of various fish. Large carnivorous fish that are high in the food chain were found to have the highest levels of mercury. Swordfish may have 1 gram of mercury per gram (1 ug/gm). Tuna was found to have an average of 0.5 micrograms per gram (0.5 mg/gm). The maximum safe daily intake of mercury is 3.5 ug per day in the United States. Because of concerns of mercury contamination in the food supply, women of childbearing age are recommended by the FDA to eat no more than one or two portions of oily fish per week (about 0.4-0.8 g/day of omega-3 fats).9

In 1997, the US EPA recommended the value of 0.1 ug/kg body weight per day as a lifetime safe daily intake of mercury (methyl

New Findings on Essential Fatty Acids and Cardiovascular Health

by Mark Houston MD, FACP FAHA and William Sparks BS
mercury. For a 60 kg woman the EPA maximum safe dose of mercury per day would be 6 micrograms. This dose would have made the consumption of 7 ounces of canned tuna per week as equaling or possibly excelling the level of mercury the FDA has reviewed the data on mercury and proposed a reference dose of 0.5 ug/kg of body weight per day (NRC, 1990).

To provide a diet of one gram omega-3 FA per day, supplementation with omega-3 fatty acid capsules (LA) (C18:2n6) is 4.4 grams per day. The western industrialized countries rely on corn, safflower and soybean oils as sources of omega-6 FA. There is an overwhelming evidence that high dietary omega-6 FA consumption can consumes more than 15 grams of LA per day. To be fully utilized by the body, LA must be metabolized to a range of metabolites. The ratio of omega-6/3 FA is such as high as 10:1. When the omega-6/3 FA ratio is proportional it reduces the enzyme delta-6-desaturase and produces gamma linolenic acid (GLA). This enzymatic step is slow and rated limited, especially in humans.

GLA is present only in small amounts in the oils commonly used in the Western diet but is found in high amounts in the plant oils borage seed (23%), blackcurrant seed (18%) and evening primrose rose (9%). GLA is rapidly converted by the enzyme elongase to dihomo-gamma-linolenic acid (DGLA) (C16:3n6). Increased dietary intakes of GLA or DGLA have been shown to increase prostaglandin E1 (PGE1) which suppresses PGE2 production. PGE2, produced from arachidonic acid (AA), is pro-inflammatory and suppresses T cell function. Both GLA and AA compete for the same cyclooxygenase enzyme. GLA down regulates the production of proinflammatory cytokines by competing with AA.

PGE1 increases intracellular cyclic AMP and it is this increase in polymonuclear leukocyte cyclic AMP that reduces the release of inflammatory enzymes, reduces polymorphonuclear leukocyte chemotaxis, and reduces the margination and adherence of leukocytes to the blood vessels.20 By a similar fashion, PGE1 inhibits the release of interleukin 1, a mediator of angiogenic chemotaxis, and reduces the margination and adherence of polymorphonuclear leukocytes to the blood vessels. As a result, AA causes a marked increase in blood pressure, and atherosclerosis. This balance is thought to be regulated by the complex interaction between DGLA, AA and EPA.

The administration of GLA, which rapidly converts to DGLA, has been shown to reduce joint swelling and tenderness in patients with rheumatoid arthritis (RA). The dosage of GLA effective in RA was not well established. Studies using less than 500mg/day of GLA for periods of less than 6 months typically fail to show benefit in a randomized treatment of RA. In a randomized placebo controlled study 4 grams of EPA+DHA were supplied to thirty one healthy women who were assigned to one of four groups. The group that received four grams of EPA+DHA had two grams of GLA,2 two grams of EPA and four grams of DGLA for daily 28 days. The group that received four grams of EPA+DHA and two grams of GLA had the largest mean reduction in normal LDL cholesterol concentrations (14.4%). The DGLA increased only when the ratio of EPA to DHA to GLA was 4:2:4. The one gram, two gram and four gram GLA groups had decreases in LDL cholesterol and improved LDL:LDL ratios. Overall, the mixture of 4 grams EPA+DHA and 2 grams GLA (2:1 ratio) provided the greatest reduction in LDL cholesterol. 43%, in the 10 year myocardial infarction risk as measured by the PROCAM program (which takes into account LDL, HDL, and triglyceride concentrations). The one gram EPA and two gram DHA group had a 34% reduction in risk and the four gram GLA group had a 24% reduction in risk.

Vitamin E Required with EFA Supplementation
PUFA supplementation increases the daily requirement for vitamin E. Concentrations of alpha tocopherol in plasma decrease significantly with increased PUFA intake. Kramer21 observed a reduction of plasma alpha tocopherol of 20% in patients supplemented with 7.5 grams EPA+DHA. In healthy elderly patients vitamin E supplementation was found to increase plasma tocopherol responses such as lymphocyte proliferation.22 The immuno-enhancing effect of vitamin E in the elderly has been shown to be dampened by high doses of PUFA. In subjects consuming 2.5 grams of EPA+DHA, 200 mg of vitamin E as dl-alpha tocopherol was able to increase plasma vitamin E levels by 25% which is the greatest increase we have observed in three times that of synthetic dl-alpha tocopherol acetate.23 An optimal dose of natural alpha tocopherol would be 67 units per 2.5 grams of EPA+DHA.

Vitamin E as a lipid soluble antioxidant inhibits the proliferation of smooth muscle cells, reduces platelet adhesion and aggregation and prevents monocyte-endothelial interactions. All of these actions are increased in the development of the atherosclerotic process. Clinical trials have demonstrated a linear decrease in oxidative stress markers in patients supplemented with vitamin E.24 Plants produce eight different molecules with vitamin E activity (alpha, beta, delta and gamma tocopherols and the four corresponding tocotrienols). Alpha tocopherol is the major form of vitamin E found in human tissue. Gamma tocopherol is the major form found in the US diet. Gamma tocopherol has been demonstrated to be a more powerful in trapping many reactive oxidative species and displays a broader anti-inflammatory profile than alpha tocopherol. Compared to alpha tocopherol, gamma tocopherol is a more potent inhibitor of COX activity, and is more effective for the inhibition of key mediators such as TNF-alpha, nitric oxide an inflammatory eicosanoid production. Clinical evaluation of individuals suffering from coronary heart disease has shown decreased levels of gamma-tocopherol, but not to alpha-tocopherol.

Omega-3, Omega-6 and Vitamin E
To obtain the optimal omega-3 index, supplementation with omega-3 FA is necessary. To obtain the optimal PUFA supplementation the addition of omega-3 FA to omega-3 FA is necessary. The 2:1 mixture of omega-3 to omega-6 has been shown to provide the greatest supplemental benefit to patients. The addition a high gamma tocopherol vitamin E to a 2:1 omega-3 FA is necessary to insure healthy antioxidant status. Natural mixed tocopherols as found in many whole foods provide 20% alpha tocopherol, 60% gamma tocopherol and 24% delta tocopherol. The optimal dose is dependent on the ratio of the tocopherols with 10 mg of alpha tocopherol would contain 215 mg gamma, 86 mg delta and 50 IU of alpha tocopherol. All this factors must considered when choosing a supplement that contains omega-3 , GLA and or vitamin E.

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