Flaxseed and Sports Nutrition

Flax oil and seed is used by sports enthusiasts, and professional and amateur athletes, and most of what we know about its properties related to muscle building and exercise endurance is anecdotal. Hollywood recognized the importance of flax oil in sports nutrition when its principal character for an Oscar-winning performance, Hilary Swank (in the 2005 film "Million Dollar Baby"), was challenged to transform her 110-lbs., 5'7-1/2" frame into one representative of a Women's World Boxing Champion. Swank did put in many hours at the gym and in the boxing ring to get the desired result; but there was another key component to her success — flax oil. On a post-Oscar appearance on "The Tonight Show with Jay Leno," Swank acknowledged that flax oil was responsible for a significant part of her success in achieving the look she did for her role in the film. Flax oil is a high-quality source of essential fatty acids (EFAs) required for optimum cellular metabolism and growth.

The two EFAs found in flax are linoleic acid (C18:2, LA), which is an omega-6 fatty acid, and the omega-3 fatty acid alpha-linolenic, ALA (18:3, n-3). Omega refers to different chemical characteristics of the fatty acids. LA and ALA are components of cellular membranes that act to increase membrane fluidity. These fatty acids are necessary for cell membrane function, as well as for proper functioning of the brain and nervous system.[1,2] Flaxseed is the richest dietary source of ALA. Oil constitutes 32-45 percent of the composition of flaxseed, of which 51-57 percent is ALA.

ALA plays an important role in growth and development, reproduction and vision; maintaining healthy skin and cell structure; metabolism of cholesterol; and gene regulation. ALA has also been linked to the prevention and/or amelioration of several chronic conditions, including cardiovascular disease, certain cancers, rheumatoid arthritis and autoimmune disorders.[3] ALA is the most commonly consumed omega-3 fatty acid in the typical Western diet.[4]

The EFAs serve as the starting point for the production of a number of important, very active, hormone-like compounds called "eicosanoids." The omega-6 fatty acid LA and the omega-3 fatty acid ALA form different eicosanoids with different activities. LA and ALA also compete with one another for the enzymes responsible for the synthesis of various eicosanoids. Thus, an excess of one family of fatty acids can interfere with the metabolism of the other, reducing its incorporation into tissue lipids and altering their biological effects.[2] A proper balance of EFAs in the diet is important for maintaining good health and optimum sports performance.

ALA is converted to the long-chain omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), the fatty acids also found in fish oil. LA is converted by the same enzymes to the long-chain omega-6 fatty acid arachidonic acid (AA), the precursor of eicosanoids, several of which promote the clumping (aggregation) of blood platelets, the clotting of blood within blood vessels (thrombosis) and inflammatory reactions. When diets are high in omega-6 fatty acids, AA and its potent eicosanoids are produced in abundance, resulting in an over-active immune system. The activity of the eicosanoids impacts proper cell function and the growth of tissues such as muscle as well as inflammation, which is a concern in exercise and athletic training.

The Importance of an Optimal Omega-6 to Omega-3 Ratio

For optimal health, Health Canada recommends an omega-6:omega-3 fatty acid dietary ratio of 4:1 to 10:1.[2] The U.S. Food and Drug Administration has yet to set an official recommendation in this area.

It is speculated that in today's Western society the ratio of omega-6:omega-3 fatty acids may be as high as 20—30:1.[3] Today's elevated dietary omega-6:omega-3 ratio is largely attributed to the plethora of vegetable oils currently available and consumed that are high in the omega-6 fatty acid LA. Technological developments, such as food processing, have also depleted much of the ALA and omega-3 content from foods, which further contributes to an imbalanced omega-6:omega-3 ratio.

Overall, we are consuming too much LA and not enough ALA. Studies indicate that a high intake of LA shifts the physiologic state to one that is prothrombotic and proaggregatory, characterized by increases in blood viscosity, vasospasm, and vasoconstriction. High intake of LA also decreases in bleeding time and, of significance to exercise physiology – an inflammatory state.[1] ALA, however, has anti-inflammatory, antithrombotic, antiarrhythmic, hypolipidemic, and vasodilatory properties. Excessive free radical formation that occurs with cellular oxidation and trauma during high-intensity exercise both lead to an inflammatory state that is made worse by the increased amount of omega-6 fatty acids in Western diets.[5] This can be counteracted by the omega-3 fatty acids, in particular ALA and EPA. For the majority of athletes, including those at the leisure level, ALA from flax is a crucial component for enhanced performance and general good health.

ALA and Sports Nutrition

In "Million Dollar Baby," flax oil allowed Hilary Swank not only to reach her physical goals, but far surpass them. Her diet during training consisted of mostly proteins (egg whites, fish, etc.), almost no carbohydrates (except for some fibrous vegetables and controlled high-glycemic carb snacks), and flax oil (for its EFAs). The bulk of her caloric intake came from protein (for muscle and repair of muscle tissue after workouts) and flax oil (for continued growth). Flax oil provided her with nearly 1,000 calories a day, a quarter of her daily intake. Without an abundance of carbohydrates, her body began accessing stored fat to use as energy. For athletes and in sports nutrition, one of the most important benefits of ALA, in this regard, is the role that it plays in optimizing energy reserves in the body.[6]

ALA improves the metabolism of fats which is especially helpful with endurance sports, such as marathons. When a runner "hits the wall" and their glycogen stores are used up, the body begins burning fats.[7] In this case, efficient burning of fats makes a difference in performance.

ALA improves response time. Electrical impulses move from the brain to muscles across cell membranes which, as indicated earlier, are rich in ALA when consumed in the diet. Omega-3 fatty acids, such as ALA, are the most efficient fatty acids in allowing these electrical impulses to move from cell to cell. Thus, response time is improved.

ALA aids in muscle repair at the cellular level. Omega-3 fatty acids present on the cell membrane significantly affect the speed and quality of tissue repair.

ALA and Inflammation

ALA is particularly helpful with inflammation and the swelling that often accompanies serious training. ALA interferes with the conversion of LA to AA and blocks the conversion of AA to its pro-inflammatory eicosanoids, including thromboxane A_2 (TXA_2) and leukotriene B_4 (LTB_4). TXA_2 is one of the most potent promoters of platelet aggregation known. LTB_4 increases the release of reactive oxygen species and cytokines like tumor necrosis factor α (TNF-α), interleukin 1β (IL-1β), IL-6 and IL-8.

Population-based support for an anti-inflammatory effect of ALA comes from a community-based study in two small towns in Tuscany, Italy.[8] The researchers examined the relationship between the concentration of fatty acids in plasma and the level of inflammatory markers in 1,123 persons aged 20 to 98 years. A low plasma ALA concentration was associated with a higher level interleukin 1 receptor antagonist (IL-1ra). IL-1ra is considered an acute-phase protein and a reliable measure of the pro-inflammatory state. Thus, ALA-rich diets containing flax oil have substantial effects on systemic markers of inflammation.

Early research identified ALA as the regulator of LA and AA metabolism. ALA acts to competitively inhibit the conversion of LA to AA resulting in decreased amounts of substrate available for the production of proinflammatory eicosanoids.[9] In a clinical study of healthy men who consumed 1¾ tbsp of flax oil daily for 4 weeks, the TXB_2 concentration in immune cells decreased 30 percent.[10] (TXB_2 is an inactive metabolite of TXA_2.) A study of 64 patients with chronic obstructive pulmonary disease (COPD) found that levels of LTB_4 in serum decreased 32 percent and in sputum 41 percent in patients who received an ALA-rich nutritional support (1.4 percent ALA) daily for 24 months compared with those who received a low-ALA nutritional support (0.18 percent ALA) during the same period.[11] Diets rich in ALA have also been shown to decrease significantly the concentration of AA in neutrophils, and in serum.[13,14]

ALA effects cytokines which are proteins liberated from immune cells in response to injury, infection or exposure to foreign substances. The cytokines that contribute to inflammation are tumor necrosis factor-α (TNF-α), interleukin-1β (IL-1β) and interleukin-6 and -8 (IL-6 and IL-8). Serum levels of IL-6 decreased 25 percent in men who consumed 1 tbsp of flax oil daily for 12 weeks,[12] whereas the concentrations of TNF–α and IL-1β in immune

cells decreased 26 percent and 28 percent, respectively, when healthy men consumed flax oil for 4 weeks.[10] The serum level of TNF-α decreased by 43 percent and the production by immune cells of TNF-α and two other cytokines, IL-6 and IL-1β, decreased between 18 percent and 22 percent when adults with hypercholesterolemia consumed a diet rich in ALA compared with the average American diet.[14]

The anti-inflammatory properties of ALA can reduce the incidence of exercise-induced bronchoconstriction (EIB) which is a condition characterized by transient airway narrowing during or after exercise, resulting in decrements in post-exercise pulmonary function. A high prevalence of EIB and asthma-like symptoms, such as wheezing, chest tightness, abnormal breathlessness, cough, and/or sputum production have been reported in elites athletes and increasingly in "weekend warriors" — individuals who exercise strenuously on an irregular basis.[17] EIB appears to involve multiple mechanisms. It has been suggested that transient dehydration of the airways activates the release of inflammatory mediators, such as AA metabolites (leukotrienes [LTs] and prostaglandins [PGs]), from airway cells, resulting in bronchial smooth muscle contraction. Omega-3 fatty acids have been reported to improve pulmonary function and reduce several proinflammatory markers in athletes with EIB.[16]

Flaxseed Oil as the Best Choice for Omega-3s From Plants

Flax oil contains more than three times as much omega-3 fatty acids than omega-6 fatty acids, with an omega-6 to omega-3 ratio of 0.3:1. When comparing to other common plant-based oils, corn oil has an omega-6:omega-3 ratio of 58:1, soybean oil 7:1, and canola oil 2:1. Due to the current high intake of the omega-6 fatty acid LA, coupled with the deficiency of omega-3 fatty acids in today's typical North American diet, flax oil clearly provides the best overall dietary fatty acid ratio. Supplementing the diet with flax provides a good source of the plant-based omega-3 fatty acid ALA and a healthy and optimal omega-6:omega-3 ratio.

Flaxseed as an Excellent Source of Protein

The protein found in flaxseed is very similar to that of soybean protein, which is considered one of the most nutritious plant proteins. This is attributed to the type of amino acids present, which are the building blocks of protein. Flaxseed contains numerous "essential amino acids," which the body cannot produce and therefore must obtain from the diet. This is of significance to vegetarians relying on plant sources to meet their daily protein requirements. It is also critical for body builders and athletes.

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