



## Stabalizing Flax for Food Applications



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Flaxseed provides a rich source of the omega-3 short chain polyunsaturated fatty acid (PUFA), alpha-linolenic acid (ALA), soluble and insoluble fibers, phytoestrogenic lignans, protein, and an array of antioxidants. Fish oils contain long chain omega-3 PUFAs, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). ALA can be converted in the body into EPA and, to a limited extent, DHA. ALA has its own unique benefits in addition to being converted to EPA. Recent clinical investigations have focused upon the role of omega-3s in reducing and even treating numerous clinical conditions including cardiovascular disease, inflammation, diabetes, cancer,

and improving overall mental and immune system health.

It is well accepted that while foods prepared with omega-3 fatty acids are healthier, they also have an increased vulnerability to rancidity, which is caused by oxidation, the chemical reaction of lipids with oxygen. In particular, EPA and DHA are particularly vulnerable to oxidative breakdown leading to the development of food deterioration affecting flavor, aroma, color, texture, and nutritional value (10).

Stability problems have limited the use of these omega-3 fatty acids in many foods, especially toasted or extruded longer shelf life products such as cereals and some prepared foods. To date, these PUFAs have been most successfully incorporated into chilled food applications with short shelf lives such as milk, juice, yogurt, margarine, and spreads.

Additionally, it has been challenging to enrich foods with enough EPA and DHA to ensure that a daily requirement for a defined health benefit can be met. This presents a major challenge on several fronts, including the price of final products, market positioning, and, importantly, the taste and flavor of the food product. However, due to a complex and effective antioxidant profile, food manufacturers using flaxseed as a source of omega-3 are much less likely to face these challenges. In addition, processing advances are extending the use of milled flaxseed to capitalize on its natural antioxidants to stabilize not only flax ALA but also fish oil EPA and DHA as well as algae-sourced DHA.

### Flax—A Favorite in Bakery Applications

Flax has been valued for decades by the bakery sector for its appearance and versatility and the nutty flavor it imparts in food products. More recently, the numerous health benefits being attributed to flax has increased its popularity. Flax contains approximately 40% fat, 28% dietary fiber, 21% protein, 4% ash,

and 6% carbohydrates such as sugars, phenolic acids, lignans, and hemicellulose (3).

### A Rich Source of Healthful Fats

Flax has a unique and healthy fatty acid profile with very low saturated fat (approximately 9%) and moderate amounts of monounsaturated fat (approximately 18%). Of the nutritionally beneficial polyunsaturated fats, about 16% belong to the omega-6 family as linoleic acid (LA) and 57% are the omega-3 fatty acid ALA.

Both LA and ALA are essential fatty acids, meaning they are “essential to life” and cannot be produced by the body and therefore must be obtained from the diet. The omega-6 and the omega-3 fatty acid families are precursors for different series of hormone-like substances known as eicosanoids. Omega-6 derived eicosanoids stimulate pro-inflammatory, pro-thrombotic, and hypertensive events. Eicosanoids synthesized from omega-3 fatty acids have opposite effects. For optimal health, Health Canada, for example, recommends an omega-6:omega-3 fatty acid dietary ratio of 4:1 to 10:1 (11).

It is speculated that Western diets may have ratios of omega-6:omega-3 fatty acids as high as 20–30:1 (19). Flaxseed contains an omega-6 to omega-3 ratio of 0.3:1.

Health Canada has established a recommended nutrient intake for ALA, specifying the minimum daily intake should be 0.5% of total energy (11). In the United States, the National Academy of Sciences’ Institute of Medicine (IOM) recommends 1.6 g/day of ALA for men and 1.1 g/day for women (12).

### Dietary Fiber

Total fiber accounts for about 28% of the weight of full-fat flax seeds and is found in both soluble and insoluble forms. Water-soluble fibers such as mucilage found in flax will delay transit through the stomach and small intestine. Because of their hydration characteristics, mucilage gums “trap” lipids and aid in excretion, thus helping to lower serum cholesterol levels (2), an effect that ultimately benefits cardiovascular health.

Fibers that are predominantly water insoluble promote laxation and are fermented either slowly or not at all (21). Diets high in insoluble fiber result in good colon health, which may have protective effects against colon cancer (14).

Daily recommended intakes target amounts of 25 g for women and 38 g for men (12). However, in the North American population, usual intakes average only 14–15 g/day (1). One tablespoon of whole flax or milled flax contains 0.60–1.2 g and 440–880 mg of insoluble fiber and 1.8–2.4 g and 1.3–1.8 g of soluble fiber, respectively.

### Flax Lignans

Lignans are phytoestrogens—estrogen-like compounds found in plants (phyto). Flax produces 75–800 times higher levels of active lignans than other vegetables, fruits, legumes, cereals, or

seeds. Lignans show promise in reducing growth of cancerous tumors, especially hormone sensitive ones such as those of the breast, endometrium, and prostate (20).

Flax lignans play an important role in reducing the risk of diabetes. In volunteers who consumed 50 g of carbohydrates from bread containing flaxseed, significant improvements in glucose absorption (8) were observed. The consumption of 40 g of ground flaxseed for a 2-month period also reduced postprandial blood glucose, insulin, and serum lipid levels (7).

The powerful antioxidant properties of lignans as well as phenolic acids and flavanoids found in flax can reduce the activity of cell-damaging free radicals that are generated through oxidation in the body (17) and are strongly associated with aging.

The antioxidants in flax are so effective in fact that synergistically they can even stabilize fish oils.

### Flax Nutrients and Cardiovascular Disease

Intervention studies have shown beneficial effects of ALA on cardiac health. In the Health Professionals Follow-up Study (4), a 1% increase in ALA intake (as percent of energy) has been associated with a 40% reduction in the risk of nonfatal coronary heart disease. Another major study, the Lyon Diet Heart Study, included participants who had previously survived a myocardial infarction. The experimental group who consumed a typical Mediterranean-style diet rich in ALA had a 75% reduction in nonfatal myocardial infarctions and a 70% reduction in total death compared to the control group (18).

Recent research is focusing upon the role that ALA can play in lowering inflammatory biomarkers. A diet high in ALA dramatically decreased C reactive protein in men and women with high cholesterol levels (5).

Flax nutrients such as fiber, lignans, and other antioxidants also offer protection against cardiovascular disease. Milled flax levels of 3–6 tbsps (30–50 g) for as little as 4 weeks reduced blood total and LDL cholesterol significantly in clinical trials. Blood total cholesterol decreased 6–13% and LDL cholesterol decreased 9–18% in studies of healthy young adults (8), men and women with moderately high levels of blood cholesterol (6), postmenopausal women (13), and men with prostate cancer (9).

### Regulatory Status

In the United States, the Food and Drug Administration (FDA) and the IOM define food or supplement products as “high in” omega-3 when they contain at least 130 mg per serving of EPA/DHA or 260 g or more of ALA. Additional guidelines are in place for products labeled a “good source” and “more.” Additionally, products containing flax qualify for structure/function claims that describe the effect that a food product has on the normal structure or function of the body. These need not be pre-approved by the FDA, but they must be true and not misleading to the consumer. An increasing number of food products are using packaging claims such as “Now with Omega-3 ALA To Help Support A Healthy Heart!”

In Canada, food manufacturers may declare the omega-3 fatty acid content of their food products. For example, the label of a food containing flax can state the amount of ALA (e.g., 0.5 g of ALA) per serving. Flax based products containing at least 300 mg of ALA per serving can also use nutrient content claims, which allow “source of omega 3 fatty acids” to appear on the label.

### New Developments in Stabilization

It has been demonstrated that the lipid in full fat milled flaxseed is very stable when the seed has been carefully selected to

remove discolored and immature parts (15). This is due to a very active antioxidant system present in flaxseed, which includes lignans, phenolic acids, anthocyanin pigments, several flavonols and flavones, and phytic acid.

Specially processed milled flaxseed also provides oxidative protection to fish oil containing 18% EPA and 12% DHA in a flax/fish oil blend as shown by accelerated and real time conditions (16). The protective environment of flaxseed was effective in maintaining lipid stability of the blend for at least one year under ambient storage conditions in standard poly-lined paper packaging.

The result of these experiments led to the development of Pizzezy Nutritional’s MeadowPure Omega-3 Ultra, a milled flaxseed and fish oil ingredient that uses the milled flaxseed to encapsulate the fish oil. The process creates a shelf stable ingredient that has no taste or smell and is easily incorporated into dry formulations. The subject of a recent patent application (16), this unique ingredient provides the beneficial nutrients found in flaxseed as well as the long chain omega-3 PUFAs from fish oil, in particular, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).

New innovations such as flax-based MeadowPure Omega-3 Ultra offer food manufacturers unique ingredients that combine the evidence-based health and nutrition attributes of flaxseed and fish oil while taking advantage of the natural antioxidant components present in flaxseed for oxidative stability.

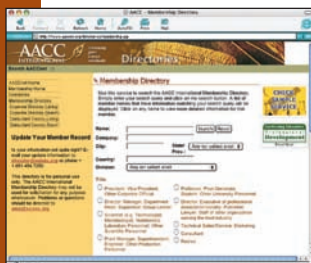
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