



## Health Benefits of $\alpha$ -Linolenic acid from Flaxseed

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Flaxseed oil contains over 50% of its fatty acids as  $\alpha$ -linolenic acid, making it the richest plant source of this essential omega-3 fatty acid.

Current intakes of  $\alpha$ -linolenic acid in North America are below recommendations for a large portion of the population, making flaxseed enrichment of common foods a solution to this dietary inadequacy.

$\alpha$ -linolenic acid is a healthy fatty acid with anti-inflammatory properties and is associated with decreased risk of cardiovascular disease, diabetes and cancer.

Table 1. Average content of  $\alpha$ -linolenic acid in select food sources<sup>2,4</sup>

Food item	Average content (%)
Flaxseed oil	53
Flaxseed	23
Chia seed	18
Hempseed	17
Walnuts, English	9
Canola oil	9
Soybean oil	7
Corn oil	1
Olive oil	1
Sunflower oil	1
Kale	0.2
Spinach	0.1

Flaxseed provides a unique mix of fatty acids. It is low in saturates (less than 9% of total fatty acids) and contains the essential polyunsaturated fatty acids omega-3  $\alpha$ -linolenic acid (ALA; 18:3n-3) and omega-6 linoleic acid (LA; 18:2n-6). Essential fatty acids are required in the diet as they cannot be made by humans. Most notably, ALA comprises on average 53 to 57% of the fatty acids in flaxseed oil, making it the richest plant source (Table 1).<sup>1</sup>

### $\alpha$ -linolenic intake is below recommendations

The Institute of Medicine recommended dietary intake of ALA is 1.6 g/day for men and 1.1 g/day for women, or 0.6-1.2% of energy intake, with a dietary omega-6 to omega-3 ratio of 5:1 to 10:1.<sup>5</sup> However, the consumption of omega 3 fatty acids is very inadequate in North America. Data from the 2003-2008 National Health and Nutrition Examination Survey (NHANES) in the U.S. showed that over 40 % of adults aged  $\geq 19$  years were not meeting the recommended dietary intake for ALA.<sup>6</sup>

In the past, dietary intake of omega-6 and omega-3 fatty acids were approximately equal, but modern diets have significantly changed resulting in very high omega-6 to omega-3 ratios (16:1 or higher).<sup>7</sup> Not only are people eating less omega-3, the overall availability of omega-6 LA in the food supply has increased from about 2.79% to 7.21% of energy from 1909 to 1999. The level of ALA in the food supply has only increased from 0.39% to 0.72% of energy due mostly to modifications in food processing. These changes resulted in the ratio of LA to ALA increasing from 6.4:1 in 1909 to 10.0:1 in 1999.<sup>8</sup> Consumption of soybean oil, which is comprised of approximately 54% LA, has increased from 0.009 kg per capita per year in 1909 to 11.64 kg per capita per year in 1999, an increase of 1163-fold.<sup>8</sup>

Dietary flaxseed can help to improve LA to ALA ratios since it contains more than three times as much omega-3 as omega-6 fatty acids. Flaxseed enrichment in common foods will provide healthier fatty acid profiles overall.

### Metabolism of $\alpha$ -linolenic acid

ALA and LA are components of cellular membranes and act to increase membrane fluidity. ALA is converted to the long-chain omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosapentaenoic acid (DPA), and to some extent to docosahexaenoic acid (DHA), fatty acids that naturally occur in fish and fish oil. Similarly, LA is converted to long-chain omega-6 fatty acids, in particular arachidonic acid, by the same series of desaturation and elongation enzymes that metabolize ALA (Figure 1).

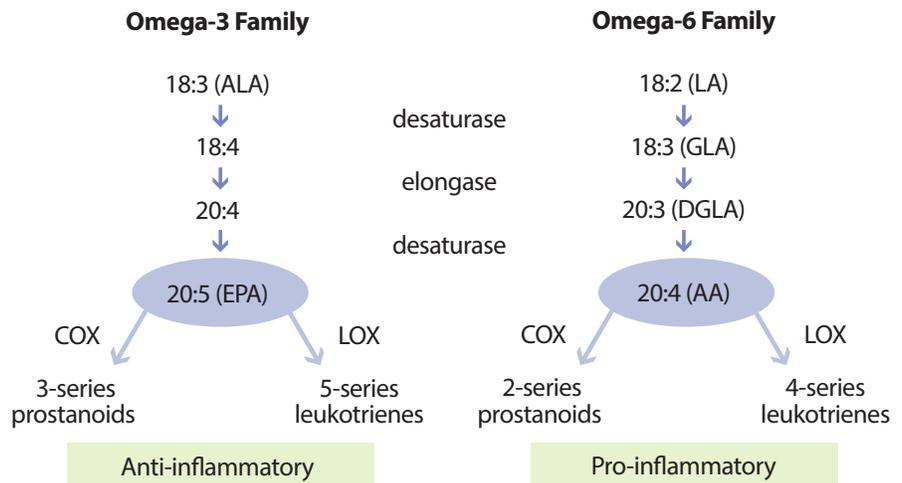
Flaxseed Oatmeal Porridge recipe at HealthyFlax.org



The metabolism of omega-3 fatty acids depends on other nutrients, particularly omega-6 fatty acids due to the competition between the two families for the same enzymes.<sup>9</sup> High levels of omega-6 fatty acids reduce the amount of omega-3 fatty acids incorporated into lipids that comprise human tissues as well as the conversion of ALA to the longer chain omega-3 fatty acids.<sup>9</sup> Higher amounts of dietary ALA as well as decreased LA increase the conversion of ALA to EPA and DHA.<sup>9,10</sup> The rate of conversion is fairly limited in humans, but increasing research supports health benefits of ALA which are independent of its conversion to the longer chain omega-3 fatty acids.<sup>2,11</sup> A gender difference also appears to exist, with estrogen increasing conversion in women compared to men.<sup>12</sup>

Eicosanoids, such as prostanoids and leukotrienes, are hormone-like substances that affect inflammation. They are produced from both ALA (less inflammatory) and LA (mostly pro-inflammatory; Figure 1). Arachidonic acid, derived from LA, is the starting point of the eicosanoid inflammatory cascade that affects a wide array of body functions.<sup>13</sup> Chronic inflammation is linked with age-related diseases such as heart disease, obesity, diabetes and cancer. Diets that are high in LA and low in ALA skew eicosanoid production towards a more inflammatory profile. Increasing dietary ALA intake from flaxseed can help to guard against inflammation.<sup>14</sup>

Figure 1. Overview of pathways for conversion of  $\alpha$ -linolenic acid and linoleic acid to eicosanoids<sup>11-15</sup>



YELLOW FLAXSEED



YELLOW GROUND FLAXSEED



BROWN FLAXSEED



BROWN GROUND FLAXSEED



### ALA and cardiovascular disease

Cardiovascular disease (CVD) includes all diseases of the heart and vasculature and has been the worldwide leading cause of mortality during the past decade.<sup>16</sup> Dietary strategies are an important way to reduce the risk of CVD. The American Heart Association recommends eating sources of ALA, including flaxseed and its oil, due to large epidemiologic studies suggesting that people at risk for coronary heart disease benefit from consuming both plant and marine sources of omega-3 fatty acids.<sup>17</sup>

EPA and DHA are well recognized for being cardioprotective, but current evidence suggests that ALA provides comparable benefits.<sup>11</sup> A number of large population studies demonstrate an inverse relationship between ALA levels and cardiovascular events.<sup>18</sup> A meta-analysis reported that each 1 g/day increment of ALA intake was associated with a 10% lower risk of death from coronary heart disease.<sup>19</sup> Risk of non-fatal myocardial infarction was shown to decrease by 57% with a median ALA intake of 1.79 g/day (0.65% energy) compared to 1.11 g/day (0.42% energy).<sup>20</sup> Individuals with low initial ALA intakes may experience the greatest cardiovascular benefits with increased intakes.<sup>20</sup> This evidence has led to the recommendation that ALA intake be increased to 2–3 g/d to reduce the risk of CVD.<sup>11</sup>

The mechanisms by which ALA reduces CVD risk remain under investigation. However, research to date suggests that ALA may:

- **Lower risk of mortality from heart disease.** ALA can reduce the chance of abnormal heart rhythms and the development of fatal blood clots, two major causes of heart disease deaths.<sup>21</sup> ALA may also help to reduce atherosclerotic plaques and lower total- and LDL-cholesterol.<sup>3,22</sup>
- **Improve heart rhythms.** ALA may help maintain stable heart rhythms by affecting the electrical activity of the heart, making it more difficult for arrhythmias to develop.<sup>23</sup>
- **Lessen the chance of having a heart attack or stroke.** Consuming a small amount of flaxseed oil per day (approximately 1-2 ml) may be enough to significantly reduce the risk of non-fatal myocardial infarction, particularly for people whose baseline ALA intake is low.<sup>20</sup>
- **Reduce blood clotting.** Some blood clotting is essential for life, but an excessive tendency towards clotting increases the risk of blocked arteries. ALA reduces the tendency for blood to clot, enhances blood flow, and improves the flexibility of red blood cells so they pass through narrow blood vessels more easily.<sup>21</sup>

### ALA and diabetes

Diabetes is characterized by hyperglycemia due to defects in insulin metabolism that results in organ damage, particularly to the eyes, kidneys, heart and vasculature.<sup>24</sup> Dietary intake of ALA is associated with a modest reduction in diabetes risk.<sup>3</sup> In a meta-analysis of prospective studies examining the relationship between omega-3 fatty acid intake and diabetes, both dietary ALA intake and circulating ALA biomarkers were associated with a trend towards lower risk.<sup>25</sup> One of the mechanisms by which ALA may act to counter the disease is by increasing the cells sensitivity to insulin.<sup>3</sup>

### ALA and cancer

Studies suggest that omega-3 fatty acids reduce the risk of cancer whereas omega-6 fatty acids promote its development. ALA may protect against cancer via its anti-inflammatory properties. ALA has been found to suppress the growth, size and proliferation, and increase the death of, breast cancer cells in an animal model.<sup>26</sup> Additional protective mechanisms of ALA include modulating the expression and function of numerous receptors, transcription factors and signaling molecules involved in reducing tumorigenesis.<sup>7</sup>

### ALA: A plant-sourced omega-3

ALA from flaxseed provides numerous health benefits as well as some unique advantages over marine omega-3 fatty acid sources, the latter of which include limited global availability, high cost, allergenicity, and toxins that have been reported with some seafood products.<sup>18</sup> For consumers trying to eat healthier, sustainable, plant-based diets, flaxseed and its oil are beneficial additions.

## A Health Claim for Flaxseed

In 2014, Health Canada approved a health claim linking ground whole flaxseed to blood cholesterol lowering, a major risk factor for CVD.<sup>27</sup> The claim – only one of eleven approved in Canada – was based on seven clinical research trials of normal and hypercholesterolemic males and females aged 8 to 75 years who consumed 30 to 50 g/day of ground flaxseed. The primary endpoints in these studies were total cholesterol and low density lipoprotein (LDL) cholesterol, recognized risk factors for CVD. The pooled results from these studies found that compared to baseline, total cholesterol levels decreased by 0.21 mmol/L (-0.56 to -9.01 percent) and LDL decreased by 0.22 mmol/L (-3.42 to -14.94 percent).<sup>27</sup> A reduction of 1 percent in total cholesterol levels is related to a 2 percent reduction in risk of CVD. Therefore, according to these studies, flaxseed intake may decrease the risk of CVD between 1 and 18 percent.

*The “daily amount” referred to in the claim is 40 g (5 tablespoons) of ground whole flaxseed to be consumed over three eating occasions in the day.*

An example of the permitted claim for ground flaxseed is: “16 g (2 tablespoons) of ground flaxseed supplies 40% of the daily amount shown to help lower cholesterol”. In addition to this primary statement, the following additional statements may be used:

- Ground (whole) flaxseed helps reduce/lower cholesterol
- High cholesterol is a risk factor for heart disease
- Ground (whole) flaxseed helps reduce/lower cholesterol, (which is) a risk factor for heart disease

Flaxseed has been consumed for centuries due to its desirable flavor and nutritional properties. In recent years, as people have become more concerned about health, demand for flaxseed in food and beverages has risen dramatically. Scientific research and now regulatory approval supports the heart health benefits of flaxseed, particularly due to ALA, fibre and lignan contents.

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HealthyFlax.org is the source of information on the health benefits and uses of whole flaxseed, ground flaxseed and flaxseed oil. Our website includes recipes, nutritional evidence, facts and news about flaxseed in all its forms. HealthyFlax.org is supported by Canada's flax growers, processors, food manufacturers and governments. For more information, email us at [info@healthyflax.org](mailto:info@healthyflax.org)



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