



# Can Flaxseed Lower Cholesterol Levels?

*Young Ju, Associate Professor, Human Nutrition, Foods, and Exercise, Virginia Tech*

Flaxseed has been used as food and medicine in both traditional Indian and Chinese medicines for thousands of years (Patwardhan, Vaidya, and Chorghade 2004). Flaxseed has become popular as an important functional food ingredient because of its rich content of alpha-linolenic acid (omega-3 fatty acid), lignans (phytoestrogens), and lignin (fiber) that are known to promote cardiovascular health. In this article, we talk about the potential cholesterol-lowering effect of flaxseed and its components.

## Cardiovascular Disease

Cardiovascular disease (CVD) is a multifactorial disorder of the heart and blood vessels. CVD is the leading cause of death worldwide, accounting for approximately 30 percent of all deaths. More than 81 million Americans have cardiovascular disease, which means that 1 in 3 American adults suffer from some form of CVD, and nearly 610,000 Americans die of CVD each year (CDC 2015b). High blood pressure and high cholesterol are two main causes of heart disease and stroke (CDC 2011). Table 1 shows desirable cholesterol levels (CDC 2015a); table 2 shows blood pressure levels (CDC 2016).

**Table 1. Desirable cholesterol levels.**

Blood fats	Readings (mg/dL)
Total cholesterol	<200
LDL (bad) cholesterol	<100
HDL (good) cholesterol	≥ 60
Triglycerides	<150

**Table 2. Blood pressure levels.**

Blood pressure categories	Readings (mm Hg)
Normal	Systolic: <120 Diastolic: <80
At risk (prehypertension)	Systolic: 120-130 Diastolic: 80-89
High	Systolic: ≥140 Diastolic: ≥90

## Cardiovascular Protective Components in Flaxseed

Flax (*Linum usitatissimum*) has been cultivated since the beginning of civilization (Laux 2013) and is currently cultivated in more than 50 countries (predominantly in the Northern Hemisphere), with Canada being the world's largest producer and exporter of flaxseed. In recent years as people have become more concerned about their health, the demand for flaxseed in food and beverages has increased dramatically.

Various edible forms of flax are available in the food market: whole seed, ground whole seed, flaxseed oil, partially or fully defatted flaxseed meal, flaxseed mucilage extracts, flaxseed hulls, and flaxseed alcohol extracts (Shim et al. 2014). As a functional food ingredient, flaxseed or flaxseed oil has been incorporated into food products, including baked goods, beverages, dairy products, dry pasta products, salad dressings, and egg substitutes. Among many nutritional components in flaxseed, alpha-linolenic acid (20 percent of dry weight), lignan secoisolariciresinol diglucoside (1 percent of dry weight), and soluble fiber (6 percent of dry weight) are associated with improved cardiovascular health (Pan et al. 2012).

## Alpha-Linolenic Acid

Flaxseed is one of the richest plant sources of alpha-linolenic acid (omega-3 fatty acid; Shim et al. 2014). One tablespoon of flaxseed oil contains approximately 7.3 grams of alpha-linolenic acid, and 1 tablespoon of flaxseed contains approximately 1.6 grams of alpha-linolenic acid (Singh et al. 2011). Alpha-linolenic acid can be further metabolized in the body into docosahexaenoic acid and eicosapentaenoic acid. The health benefits of these omega-3 fatty acids (alpha-linolenic acid, docosahexaenoic acid, and eicosapentaenoic acid) have been demonstrated for several conditions, including cardiovascular disease, hypertension, and atherosclerosis (Blondeau et al. 2015).

## Lignans

Flaxseed is one of the richest sources of phytoestrogens (lignans). Secoisolariciresinol diglucoside (SDG) is the major lignan found in flaxseed (Sicilia et al. 2003). Flaxseed has 75-800 times more active lignans than vegetables, fruits, legumes, cereals, or seeds (77-209 milligrams SDG per tablespoon; Adolphe et al. 2010; Kajla, Sharma, and Sood 2015; Mazur et al. 2000; Murphy and Hendrich 2002). Dietary supplements containing lignans derived from flaxseed are also available, with lignan contents ranging from 5 to 300 milligrams in those supplements. When we eat flaxseed, SDGs are converted to enterolignans, enterodiols, and enterolactone by bacteria that live in the human gut. Enterodiols and enterolactone have weak estrogenic activity (female hormone-like activity). Flaxseed SDGs also have antioxidant properties that can help reduce oxidative stress and protect against CVD (Adolphe et al. 2010). Diets rich in foods containing lignans from flax and other plants have consistently been associated with reductions in the risk of CVD (Prasad and Jadhav 2016).

## Soluble Fibers

Flaxseed is a good source of fiber (35-45 percent); two-thirds is insoluble and one-third is soluble (Oomah and Mazza 1993; Kajla, Sharma, and Sood 2015). Most of the soluble fibers are mucilage gums. It has been reported that increased consumption of soluble fiber can reduce the risk of CVD by reducing LDL ("bad") cholesterol (Anderson et al. 2009). Soluble fiber binds bile acids in the intestine, thereby

increasing fecal excretion. The body must replenish bile acids and since cholesterol is a precursor for bile acids, increased excretion causes more cholesterol to be used for bile acid production and decreased circulating cholesterol levels (Anderson et al. 2009).

## Research Findings

The health benefits of flaxseed are attributed to its alpha-linolenic acid, secoisolariciresinol diglucoside, and fiber content. These active constituents may have combinational or synergistic actions that account for flax being referred to as a functional food. The cardiovascular protective effects of flaxseed, flax lignans, flax fibers, and flaxseed oil consumption ? improved lipid profile and reduced inflammatory markers ? have been studied extensively in both animals and humans.

## Flaxseeds (Whole and Ground)

Some human clinical trials found that consumption of 30-50 grams of flaxseed per day for four to 12 weeks resulted in an 8-14 percent decrease in LDL cholesterol levels (Cunnane et al. 1995; Arjmandi et al. 1998; Patade et al. 2008), while other trials did not observe significant reductions in LDL cholesterol after adding 30-40 grams of flaxseed per day to the diet (Lemay et al. 2002; Lucas et al. 2002; Stuglin and Prasad 2005). A double-blind randomized controlled trial that fed participants 30 grams of ground flaxseed daily for six months found increased plasma levels of alpha-linolenic acid and enterolignans (Rodriguez-Leyva et al. 2013).

## Flax Lignans

Animal and human studies have suggested that secoisolariciresinol diglucoside, the major lignan in flax, and its metabolites lower total cholesterol, triglycerides, and LDL cholesterol levels, and they increase HDL cholesterol levels (Zanwar et al. 2014; Zhang et al. 2008; Prasad 1999). Flax lignans have been shown to reduce the progression of atherosclerosis and improve blood pressure (Adolphe et al. 2010). Additionally, a human study reported that a flax SDG supplement of 100 milligrams per day reduced bad cholesterol, increased good cholesterol, and reduced liver disease risk in participants with moderately high cholesterol (Fukumitsu et al. 2010).

## Flax Fibers

Flaxseed mucilage intake may be helpful in the prevention of CVD by lowering cholesterol (Jenkins et al. 1987; Cunnane et al. 1995). Flaxseed gum intake of 5 grams per day decreased bad cholesterol in participants with Type 2 diabetes (Thakur et al. 2009). A prospective cohort study with European participants who were free of CVD for approximately six and a half years reported that flax-fiber-enriched drinks lowered cholesterol (Du et al. 2010). Another study showed that flaxseed dietary fiber reduced triglyceride levels and increased satiety (Kristensen et al. 2013).

## Flaxseed Oil

A human study where participants were fed 6 grams of flaxseed oil per day for eight weeks showed a decrease in triglyceride levels, but patients on hemodialysis showed no changes in total, bad, or good cholesterol levels (Mirfatahi et al. 2016). A study with rats reported a cholesterol-lowering effect of flaxseed oil (Vijaimohan et al. 2006). However, in an animal study that compared flaxseed and flaxseed oil (Lucas et al. 2011), hamsters fed flaxseed showed a cholesterol-lowering effect, but hamsters fed flax oil did not.

## A Health Claim for Flaxseed in the U.S.

Although it has been found that the health-promoting components in flaxseed are associated with improved heart health, and flaxseed is becoming a widely used food ingredient, the U.S. Food and Drug Administration has not evaluated or approved any health claim for flaxseed products distributed and sold in the U.S.

In the U.S., a food additive approved as a “generally recognized as safe” (GRAS) substance by the FDA can be added to foods. Under current regulations, a food additive petition has not been submitted to the FDA for flaxseed, nor has a formal review of the GRAS status of whole or milled flax been conducted. Basically, the GRAS status of flax was declared by food manufacturers, and the FDA has indicated that it does not object to its use in foods up to 12 percent flax. There is no set dose of flaxseed determined to effect health benefits. In research studies of subjects with high cholesterol, 40-50 grams of flaxseed per day has been used.

A recent study reviewed flaxseed patent applications for the reduction of cholesterol levels (Ribas et al. 2016) and identified 307 patent documents; 184 of these claimed flaxseed or flax parts in the product formulation for lipid-lowering effects in humans. China and the U.S. are the leading countries of flax-related patent applications.

Unlike the U.S., Health Canada (2014) approved a health claim linking ground whole flaxseed to blood cholesterol lowering. The claim is only one of 11 approved in Canada; an example of the permitted claim for ground flaxseed is “16 grams (2 tablespoons) of ground flaxseed supplies 40 percent of the daily amount shown to help lower cholesterol.” The “daily amount” referred to in the claim is 40 grams (5 tablespoons) of ground whole flaxseed to be consumed over three eating occasions in a day.

## Potential Adverse Effects of Flaxseed

Even though flaxseed is usually well-tolerated with few allergic reactions, there are several concerns related to adverse effects. Flaxseed naturally contains compounds called “cyanogenic glycosides” (Shim et al. 2016; Abraham, Buhrke, and Lampen 2016) that can be converted to thiocyanates in the body. Excessive amounts of thiocyanates can impair thyroid gland function, but moderate portions are unlikely to cause any adverse effects in healthy individuals. However, anyone with thyroid problems should consider avoiding consumption of large amounts of flaxseed.

Another side effect might be digestive in nature. Flaxseed, and especially raw flaxseed, contains high amounts of globulins (storage proteins) and albumins (anti-nutritional factors such as digestive enzyme inhibitors), and these proteins in animal and human diets reduce digestibility and absorption (Anaya et al. 2015). Anyone consuming large amounts of flaxseed may experience mild digestive problems, including bloating, gas, abdominal pain, and nausea. It is best to start with small doses and work up to 1-2 tablespoons per day. Adding flaxseed to the diet can also increase bowel movement frequency because flaxseed is a natural laxative because of its high fiber content.

Although limited human studies are available, many health professionals might not recommend the

consumption of flaxseed during pregnancy due to lignans (a phytoestrogen), which can act similar to the female hormone estrogen. Animal studies have shown that flaxseed and flaxseed lignans might alter birth weight, the development of the offspring's reproductive system, milk production, and fatty acid compositions in milk (Gandra et al. 2016). It is unlikely that smaller doses of flaxseed will have an adverse effect. However, during pregnancy and lactation, limiting the intake of flaxseed and other dietary sources of phytoestrogens is recommended.

## How To Use Flaxseeds

The use of flax in food products is growing rapidly in North America and includes breads, cereals, crackers, energy bars, meals, oils, pastas, snacks, waffles, and even pet foods. Whole flaxseed, ground (or milled) flaxseed, and flax oil are available in stores. Light can damage sensitive nutrients in flaxseed and cause its oils to go rancid, so flaxseed and flax oil should have opaque packaging. Whole flaxseed, ground flaxseed, and flax oil last longer with refrigeration. Whole flaxseed can keep at room temperature in a cool, dry place for up to a year.

The nutrients in ground flaxseed may be better absorbed by the body than whole flaxseed. Ground flaxseed can be added to muffin, pancake, or waffle batter, bread dough, and smoothies and juices, or it can be used to top hot or cold cereal. Also, ground flaxseed can be used as an egg substitute (1 egg = 1 teaspoon of ground flaxseed + 3 teaspoons of water).

## Summary

High blood pressure and cholesterol levels are the major causes of heart disease and stroke. Research findings indicate that flaxseed might lower blood pressure, total cholesterol, and LDL cholesterol levels. These findings support that flaxseed and flaxseed components can help lower cholesterol, which could reduce the risk of heart disease.

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