

Flaxseed- Nutritional Composition and its Health Benefits

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Flaxseeds are the finest source of omega-3 fatty acids for those who do not consume seafood, which belongs to the family Linaceae. In India, it is mainly cultivated in Madhya Pradesh, Maharashtra, Chhattisgarh, and Bihar. The top producer and exporter of flaxseeds is Canada, followed by the United States, China, India, and Ethiopia are major producers of flaxseed. India is third in production, accounting for 10.2% of global output. One serving of flaxseed provides protein, fiber, omega-3 fatty acids, and essential vitamins and minerals. Flaxseed may help lower the risk of some cancers, maintain a moderate weight, and reduce cholesterol and blood pressure.



Introduction

Flax (*Linum usitatissimum*), which belongs to the family Linaceae, is a blue-flowering annual herb that produces small, flat seeds ranging in color from golden yellow to reddish brown. It is commonly known as Alsi, Jawas, and Akse Bija in various Indian languages. The Latin name, *Linum usitatissimum*, means “very useful,” and linseed is another term for flaxseed, often used when flax is primarily for industrial purposes. The flax plant grows from 12 to 40 inches tall and has a slender, fibrous stem. Its bright blue flowers are up to 3 cm in diameter and have a crispy texture and a nutty flavor. Each flower has five petals and forms a five-celled ball that can contain up to 10 seeds. Flowering continues until the plant's growth stops. The spherical fruit capsules hold two seeds in each of five compartments. Fiber flax varieties are tall, unbranched plants grown at high density to maximize fiber yield. In India, it is mainly cultivated in Madhya Pradesh, Maharashtra, Chhattisgarh, and Bihar. Canada is the top producer and exporter of flaxseeds, followed by the United States, China, India, and Ethiopia. India ranks third in production, accounting for 10.2% of global output. In India, flaxseed is used for both culinary and medicinal purposes. Flaxseeds are an excellent source of omega-3 fatty acids for those who do not eat seafood. Flaxseed products are recommended as nutritious supplements in various foods, including meat extenders, bread, muffins, fiber bars, salad toppings, ready-to-eat cereals, baked goods, and spaghetti. Almost all parts of the linseed plant are used for different purposes. The seed contains oil, which, after refining, is used for edible purposes. It has been used in various forms such as flour, oil, and raw seed. The oil in the seeds is used for food. Flaxseed has been consumed for a very long time due to its nutritional value and medicinal benefits. The seeds contain 35%–45% oil, 20%–30% protein, and 28% dietary fiber. Due to its potential health benefits, flaxseed has gained

increasing attention from nutritionists and medical experts. It can be considered a functional food because of its health benefits and nutritional profile.



Flaxseed Plant



Mature Plant of Flaxseed

Nutritionists worldwide recommend incorporating omega-3 fatty acid sources into the diet. Flaxseed is a great source of omega-3 fatty acids for non-fish eaters. Edible flaxseed products include the whole flaxseed, ground meal, and extracted oil or mucilage. These products are intended for use as nutritional additives in the preparation of a range of dietary items, including baked cereal products, ready-to-eat cereals, fiber bars, salad toppings, meat extenders, bread, muffins, and spaghetti.

Forms of Flaxseed Consumption

Whole flaxseed, ground flaxseed, and flaxseed oil are the three most common forms of flaxseed consumed. The form of flaxseed consumed affects its stability and the bioactive components it contains. Whole flaxseed's ALA can withstand temperatures up to 35 °C without losing its oxidative stability. However, when flaxseed is ground, the seed coat barrier is broken, making it more susceptible to oxidation. Therefore, whole flaxseed should be stored in airtight containers at room temperature for four to twenty months to preserve its health benefits. Flaxseed oil is most prone to oxidation. It is best to choose unrefined flaxseed oil, which has a longer shelf life due to antioxidants like tocopherols and phenolic compounds. Flaxseed oil should be kept refrigerated in an opaque glass container, extending its shelf life up to six months. At room temperature, flaxseed oil can oxidize within a week, making it unsuitable for consumption. As a functional food ingredient, fatty acids or lignans can be protected from oxidation by adding flaxseed to baked goods such as muffins or bagels. However, due to its short shelf life and instability under poor storage conditions, the recommended form of flaxseed intake is ground seeds containing similar ALA levels. Ground flaxseed should be used soon after grinding and stored briefly, as it is more vulnerable to oxidation than whole flaxseed. Consuming whole flaxseed provides the least amount of ALA and SDG because of its hard, impermeable seed coats. The intake of flaxseed oil and ground flaxseed results in significantly higher plasma ALA levels compared to whole flaxseed.



Whole Flaxseed



Ground Flaxseed



Flaxseed Oil

Nutritional composition

Flaxseed has become a promising functional food choice because it contains phenolic compounds, lignans, high-quality protein, soluble fiber, and alpha-linolenic acid. The composition of flaxseed is shown in the table. Its chemical profile is influenced by processing methods, genetics, and the growing environment. The lipid content ranges from 37 to 45 grams per 100 grams of the seed. Seventy percent of the seed oil is stored in the cotyledons, which are the main oil storage tissues. The primary components of flaxseed oil include phospholipids, 0.1% free fatty acids, and 98% triacylglycerols. It contains an average of 21% protein, mostly located in the cotyledons. The two main protein fractions are albumin (20–42%) and globulin (26–58%). The nutritional value and amino acid profile of flaxseeds are comparable to those of soy proteins. Flaxseed protein is rich in arginine, aspartic acid, and glutamic acid, but limited in lysine. High levels of cysteine and methionine boost antioxidant properties, which may help lower cancer risk. The protein content varies with processing factors such as dehulling and defatting; defatted and dehulled meals tend to be higher in protein. Flaxseed proteins also have antifungal effects against *Aspergillus flavus*, *Candida albicans*, and *Alternaria solani*. The most abundant source of phytoestrogens, known as lignans, is flaxseed. It is rich in phenolic compounds, which are recognized for their antioxidant and anticancer effects. The main phenolic compounds include phenolic acids, flavonoids, and lignans. Additionally, flaxseed contains the highest amount of potassium among various foods. Higher potassium intake is linked to reduced blood platelet aggregation, lower free radical levels in the blood, and a decreased risk of stroke. Flaxseed also contains small amounts of water-soluble and fat-soluble vitamins.

Table: Nutritional composition of flaxseed (Morries, 2007)

Nutrients	Amount per 100 g of edible flaxseed
Moisture	6.5
Protein (N×6.25) (g)	20.3
Fat (g)	37.1
Minerals (g)	2.4
Crude fiber (g)	4.8
Total dietaryfiber (g)	24.5
Carbohydrates (g)	28.9
Energy (kcal)	530.0
Potassium	750.0
Calcium (mg)	170.0
Phosphorus (mg)	370.0
Iron (mg)	2.7
Vitamin A	30.0
Vitamin E (mg)	0.6
Thiamine (B1) (mg)	0.23
Riboflavin (mg)	0.07
Niacin (mg)	1.0
Pyridoxine (mg)	0.61
Pantothenic	0.57
Biotin	0.6
Folic acid	112.0

Health Benefits and Medicinal Value of Flaxseeds

Flaxseed, cultivated since ancient times, is highly valued for its rich nutritional and medicinal properties. Its bioactive compounds help reduce the risk of cancer, diabetes, heart disease, and stroke. Although it contains trace amounts of antinutritional factors such as cyanogenic glycosides and cadmium, these are typically removed through heat treatments like boiling or autoclaving. Flaxseed oil is known to boost stamina, slow aging, and promote heart and bone

health. It also shows anti-inflammatory, laxative, and hormone-balancing effects. In Ayurveda, flaxseed, called Atasi, is recognized for improving skin health, healing wounds, and treating dryness and other issues. Some key health benefits are listed below:

Reducing the risk of cancer: Flaxseed contains omega-3 fatty acids, which may help prevent different types of cancer cells from growing, also reduce blood pressure, and the chances of heart attack and stroke. Flaxseed also contains lignans, which are antioxidants that may slow tumor growth by preventing it from forming new blood vessels. Lignans are a type of phytoestrogen, which is a plant-based nutrient that acts in a similar way to estrogen.

Improving cholesterol, blood sugar, and heart health: Flaxseed could serve as an alternative to marine sources of omega-3. This might make it a valuable resource for people who follow a plant-based diet. Lignans may also help prevent cardiovascular disease. Flaxseed contains phytosterols, which have a structure similar to cholesterol but help prevent its absorption in the intestines. Consuming phytosterols could thus help lower levels of low-density lipoprotein (LDL), or “bad” cholesterol in the body. Some scientists have also associated omega-3 oils, commonly found in oily fish, with reductions in cardiovascular risk. Lignans and other phytoestrogens may contribute to lowering the risk of chronic conditions such as diabetes.

Preventing constipation: Flaxseed is a good source of insoluble fiber, which does not dissolve in water but remains in the digestive tract after eating. There, it absorbs water and adds bulk, potentially helping to promote regularity. Dietary fiber delays gastric emptying, regulates postprandial blood glucose levels, and is useful in preventing constipation.

Reducing hot flashes: Flaxseed may help lessen the frequency or intensity of hot flashes in women not on estrogen therapy during menopause.

Easing the symptoms of arthritis: Flaxseed may help decrease joint pain and stiffness. Some people use it for rheumatoid arthritis, lupus, and Raynaud’s phenomenon. Flaxseed may reduce inflammation. People can take it as ground, as an oil, or in capsule form.

Future Prospects

Because of its biocompatibility, non-toxicity, and inherent healing properties, flax-based materials are being explored for use in the medical field in applications such as drug delivery systems, implants, and wound dressings. Flaxseed extracts are promising options for creating alternative antibiotics and medicinal formulations to treat various diseases because they possess antibacterial, anti-inflammatory, anti-tumour, and anti-atherosclerotic qualities. The natural antioxidants and fatty acids in flaxseed oil make it an excellent component for skincare and haircare products. In the future, flaxseed-based cosmetics and organic beauty products are expected to attract increased market interest.

Conclusion

Flaxseeds are the richest source of α -linolenic acid and lignans. Additionally, they offer significant potential for providing antioxidants, soluble fiber, and high-quality protein. For many people, their long journey from ancient medicine to a nutritious food source in the twenty-first century has opened new doors. Using flaxseeds, oil, and cakes promotes the creation of innovative, branded, healthful, and functional foods. These herbal remedies, abundant in lignans, alpha-linolenic acid, and fiber, are employed. They also possess a higher potential for preventing diseases such as rheumatoid arthritis, cancer, osteoporosis, and cardiovascular disease. Flaxseed lowers serum and LDL cholesterol levels because it is a rich source of alpha-linolenic acid. To determine the health benefits of flaxseed ingredients, the minimum amount needed to explore its therapeutic potential across all demographic groups, including pregnant and lactating women, and to assess the risks of overdose requires more in vivo studies. Recently, flaxseed has been added to the recipes of baking and pasta companies. Without a doubt, switching to a diet high in fiber and omega-3 fatty acids would be beneficial. Therefore, using flaxseed as a dietary supplement in whole or ground form can be recommended. For the development of flaxseed-derived nutraceuticals, quick, repeatable, and cost-effective methods must be developed.

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