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**Sasmita Pati**  
Lecturer in Botany  
Stewart Science College,  
Cuttack, Odisha, India

## Flaxseed the wonder of nature

**Sasmita Pati**

### Abstract

Now-a-days people are more conscious about the nutrition as well as health. Functional food has an important role in food industry due to their increasing popularity among the conscious people. Flaxseed is cultivated in parts of the world for food, fiber, and oil and medicine purpose. In this review the nutritional value, anti-nutrients, health benefits, side effect upon health, measure components of flaxseed and medicinal and industrial application of flaxseed are discussed.

**Keywords:** Flaxseeds, functional properties, nutritional value, alpha linolenic acid, dietary fiber, health benefits, side effects, industrial application, anti-nutrients

### Introduction

Flaxseed is one of the first plants domesticated by human beings about 8000-10,000 years ago. Flaxseed a small brown or golden seed produced from the blue flower of linseed crop commonly known as "Alsi", has scientific name *Linum Usitatissimum* belonging to the family linaceae. Flaxseed is used to describe flax when consumed by humans while linseed denotes when it is used specifically for industrial application. Flaxseed is cultivated for fiber, oil, nutritional products and medicinal purposes. Flaxseed possesses crispy texture and nutty taste. Flaxseed is the best plant source of three important omega-3 fatty acids which are alpha-linolenic acid (ALA), Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA). Also it is a good source of dietary fiber, lignans, fat protein and vitamins. The major flaxseed growing countries are USA, Canada, Argentina, Pakistan, Australia and India. Canada is the world's largest producer and exporter of flaxseed while India ranks first among the leading flaxseed producing countries in terms of acreage accounting 23.8% of the total and third in production contributing to 10.2% of the world's production. Flaxseed is now considered as a "functional food". Functional food can be defined as the food or food ingredients that may provide physiological benefits and help in preventing and/or curing of diseases. Flaxseed can be used as whole flaxseed, ground meal or extracted oil. Flaxseed has good nutritional value with specific health benefits exhibiting anti-inflammatory anti-thrombotic and anti-arrhythmic properties which make the flaxseed as the "Wonder of Nature".

### Composition

The composition of flaxseed averages 41% fat, 28% dietary fiber, 20% protein 7.7% moisture, 3.5% ash and 1% simple sugar. The proximate composition for common measure of whole and ground flaxseed and flaxseed oil is given in the table (DH Morris, M Vaisery-Genser).

Flaxseed is characterized as being made up of about 45% oil and 55% meal on a dry basis. The lipids present include Acylglycerols, fatty acids, Sterol esters, glycolipids and phospholipids. In fatty acid ALA is of 50% while other is palmitic, steric, oleic and linoleic acids. Flaxseeds contain a group of vitamin E compounds including both tocopherol and one tocotrienol. The major tocopherol in flaxseed is gamma-tocopherol which is better than alpha-tocopherol in preventing fat oxidation. Flaxseeds contain major amount of stigmaterol, campesterol and delta-savenasterol. The important pigments found are lutein and violaxanthin. The protein found in flaxseed is 20% of albumin and 80% of legumin like protein. Carbohydrate present as dietary fiber is of both soluble and insoluble type that accounts for about 28% of the dry seed weight. Flaxseeds also contain minerals like potassium, phosphorus, iron, zinc and manganese with vitamin B and C and significant amount of phenol compounds as flavonoids and lignans. The lignin components present in flaxseed are isolariciresinol, diglucoside (SDG), isolariciresinol, pinoresinol and matiresinol.

**Correspondence**  
**Sasmita Pati**  
Lecturer in Botany  
Stewart Science College,  
Cuttack, Odisha, India

**Table 1:** Proximate composition of flaxseed based on common measures<sup>3</sup>

Form of flaxseed	Weight G	Common measure		Energy kcal kJ	Total fat g	Ala g	Protein g	Total carbohydrate <sup>b</sup>	Total dietary fiber <sup>c</sup> gg
Whole seed	100			450	1890	41	23	29	28
	180	1 cup		810	3402	74	41	52	50
	11	1 tbsp		50	210	4.5	2.5	3	3
Ground seed	4	1 tsp		18	76	1.6	0.9	1.2	1.1
	130	1 cup		585	2457	53	30	38	36
	8g	1 tbsp		36	151	3.3	1.8	2.3	2.2
Flaxseed oil	2.7	1 tsp		12	50	1.1	0.6	0.8	0.8
	100			884	3712	100	57		
	14	1 tbsp		124	520	14	8.0		
	5	1 tsp		44	185	5	2.8		

<sup>a</sup> Used with permission of the Flax Council of Canada. Based on a proximate analysis conducted by the Canadian Grain Commission, May 2001. The fat content was determined using the American Oil Chemists' Society (AOCS) Official Method Am 2-93. The moisture content was 7.7%. <sup>b</sup> Total carbohydrate includes available carbohydrate (1 g) and total dietary fiber (28g) per 100g of flaxseed. <sup>c</sup> Total dietary fiber includes insoluble fiber (19 g) and soluble fiber (9 g) per 100 g of flaxseed.

### Antinutrients

Flaxseeds contain some anti-nutrients, like phytic acid, cyanogenic glucoside and linatin. reviewed that flaxseed antinutrients have lesser impact on human health as compared to soybean and canolaseeds, trypsin inhibitors found in flaxseed is insignificant as compound to soybean and canolaseeds.

### Nutritional value of flaxseed

Flaxseed is one of the most important oil seed crops for industrial as well as food, feed, fiber and medicinal purpose. Flaxseed is emerging as an important functional food because of rich contents of alpha-linolenic acid (ALA), lignans and fiber.

### Nutrients of Flaxseeds

**Table 2:** Nutritional value of Flaxseed

	Quantity Per Serving (5 gm)	Quantity Per Serv- ing (100 gm)
Energy	82kj	1635 kj
Protein	1.6g	32g
Total Fat	0.5g	10g
Saturated	0.02g	0.4g
Monounsaturated	0.08g	1.5g
Polyunsaturated	0.35g	7g
Omega 3(ALA)	0.25g	5g
Total Carbohydrate	2.18g	43.6g
Sugar	0.07g	1.4g
Dietary fibre	1.95g	39g
Soluble fibre	0.4g	8g
Insoluble fibre	1.55g	31g
Lignans	25-50mg.	500-1000mg

### Alpha-Linolenic Acid

Alpha-linolenic acid is one of the most important component of flaxseed that serves as main source of omega -3 fatty acid in vegetarian diet. Flaxseed oil is rich in polyunsaturated fatty acid (PUFA) and monounsaturated fatty acid (MUFA) and low amount of saturated fat. Flaxseed contains both essential fatty acids-alpha linolenic acid (ALA) and linolenic acid (LA). ALA serves as the precursor for the synthesis of polyunsaturated fatty acids - EPA (Eicosapentaenoic acid) and DHA (Docosahexanoic acid). The conversion of ALA to EPA and DHA is not very efficient in human being due to competition between both the fatty acid for the same enzyme. So human beings should consume a diet that contains a balanced ratio of omega-3 and omega-6 essential fatty acid which complete with each other for placement within cell membranes. A higher proportion of one type of fatty acid results adverse effects by affecting cellular functions and health of cell.

Now a days the ratio of omega-6 to omega-3 fatty acid is 20-30: 1 in western diets and 38-50 : 1 is Indian diets which reveals that high value of omega 6 fatty acids are incorporated in the cell membrane for which cellular function more of the pro-inflammatory process than anti-

inflammatory process. The recommended ratio of omega-6 to omega-3 fatty acid should be within the range of 4:1 to 10:1.

### Lignans

Lignans are present in almost all plants Lignans are phenolic compounds formed by the union at two cinnamic acid residues and act as both antioxidants and phytoestrogens. Flaxseeds contain up to 800 times more lignans than other plant food. Lignan content in flaxseed is composed of secoisolariciresinol diglucoside (SDG). The SDG is converted by bacteria in the gut to the lignans enterodiol and enterolactone which can provide health benefits due to their weak estrogenic or antiestrogenic as well as antioxidant effects.

### Dietary Fiber

Flaxseeds serve as a good source of both soluble and insoluble dietary fiber. Insoluble fiber consists of cellulose, hemicelluloses and lignin. The soluble fiber of flaxseed appears to be the mucilage of seed coat which contains mainly of water soluble polysaccharides. The water binding capacity of flaxseed mucilage is about 1600-3000 gm of

water/100gm of solids due to the presence of polysaccharides in the seed coat. Flaxseed mucilage associated with hull of flaxseed is a gum like material composed of acidic and neutral polysaccharides. The acidic fraction of flaxseed is composed mainly of rhamnose and galactose while the neutral fraction of flaxseed contains xylose. Soluble fiber and other components present in the flaxseed control the insulin secretion and maintain the plasma glucose homeostasis of the body. The dietary fiber reaches to the large intestine and is fermented by colonic microflora with production of short chain fatty acids (SCFA), hydrogen, carbon dioxide, methane and biomass and exhibit laxative effect.

### Health Benefits

Brown and Golden flaxseed are the two basic varieties with similar nutritional composition. Most of the health benefits reported from flaxseed are due to the three important components found as Alpha-linolenic acid (ALA), lignans and dietary fiber. Flaxseeds are cholesterol free and good for heart as well as help in digestion and prevent constipation due to the source of fiber. Flaxseeds have significant health benefits which are described in detail.

- 1. Control Cholesterol:** Eating flaxseed daily can reduce the cholesterol level due to the presence of omega-3 fatty acids, fiber and lignin which work together to reduce cholesterol.
- 2. Controls Diabetics:** Daily intake of lignin rich foods stabilizes blood sugar level by insulin sensitivity.
- 3. Prevents Cancer:** The antioxidants in flaxseed provide protection from breast, prostate and colon cancer. The lignans present in the flaxseeds have antigenic properties which prevent the tumors from forming new blood cells. The seeds contain ALA and omega-3 fatty acids which inhibits tumor incidence interferes with the growth and speed of cancer.
- 4. Improves Digestive Health:** Flaxseeds contain both soluble and insoluble fiber that improves the movement of food through the intestines. The mucilage of flaxseed helps in intestinal absorption of nutrients. The soluble fiber dissolved in water forming a gel like substance keeping the stomach full for long time.
- 5. Prevents Cardiovascular Disease:** The amino and omega-3 fatty acids can significantly lower high blood pressure and prevent hardening of the arteries which controls the deposition of plaques in the arteries keeping white blood cells (WBC) from sticking to the blood vessels inner lining. Lignan in flaxseed reduces the atherosclerotic plaque build-up and useful in treating irregular heartbeat. The ALA in flaxseeds protects blood vessels from inflammatory damage.
- 6. Promotes Fertility:** The lignans present in flaxseed can balance female hormones, promotes fertility and reduce pre-menopausal symptoms.
- 7. Improves Immunity:** A rich source of omega-3 and omega-6 fatty acid which protects the body from bacteria and virus by improving system's immunity are mentioned.
- 8. Fight Inflammation:** The presence of omega-3 acids, ALA and lignin may reduce inflammation by blocking the release of pro-inflammatory agents and increase the production of two another omega-3 fatty acids namely eicosapentaenoic acid (EPA) and docosapentaenoic acid (DPA) which provide further inflammatory protection.
- 9. Good for Skin:** Omega-3 fatty acids present in flaxseed helps in wounds heal and minimize the skin irritation, rashes, inflammation and redness. It also controls the production of sebum by the skin gland which prevents the onset of acne. Flaxseeds prevent dermatitis psoriasis eczema and reduce the skin damage after sun exposure preventing skin cancer.
- 10. Good for Hair:** Flaxseeds are packed with nutrients like protein, calcium, zinc, magnesium, iron and omega-3 fatty acids which needs for the growth of the hair. It prevents hair breakage and endows with strong hair. The anti-inflammatory property reduces dandruff and other scalp problems, prevents alopecia a permanent hair loss conditions. The ALA and linolenic acid are used as natural remedies to treat male baldness.
- 11. Good for Eye Health:** Due to the presence of B vitamins flaxseeds are good for eye health by reducing dry eye syndrome.
- 12. Accelerates Weight Loss:** The insoluble fiber present in flaxseed can suppress hunger by helping to delay the emptying of food from the stomach and helps to feel fuller longer that helps in weight loss. The fat present in the flaxseed reduces inflammation in the body.
- 13. Helps those with a gluten allergy:** Flaxseeds are gluten free and helps those are suffering from gluten sensitivity or celiac disease and also good for those who have an allergy from omega-3 fatty acids in fish.
- 14. Full of Antioxidants, Vitamins and Minerals:** Flaxseeds are loaded with antioxidants which help in regeneration and repair of body cell. Flaxseeds are also full of vitamins and minerals like vitamin B1, Vitamin-E, Copper, Manganese, Zinc, and Molybdenum which are essential for normal function of our body.

### Side Effect of Flaxseeds

Adding flaxseeds to the diet might increase the number of bowel movements each day. It may cause gastrointestinal (GI) side effects like bloating, gas, abdominal pain, diarrhea, stomachache and nausea. It also delays clotting time of blood. Flaxseed imitates the functioning of the women hormone "estrogen" for which it affect the menstrual cycles as well as leading to infertility.

### Other Application of Flaxseed

Flaxseed otherwise referred to as linseed which has the primary industrial use obtaining linseed oil and linseed meal. Flax is also grown for fiber produced from the stem. The following few industrial application of flaxseed is described briefly.

- 1. Linseed Oil:** Linseed oil is used as a drying oil vehicle in paints, varnish, lacquers, enamels, oil cloth, linoleum, tarpaulins and tenting, patent leather, textiles, printing inks, soap, shoe polish etc.
- 2. Linseed Meal:** Linseed meal is a byproduct of flaxseed after it is crushed for linseed oil which is used as high protein animal and poultry feed.
- 3. Flax Fiber:** Flax fiber is produced to make the finest paper and linen products and other used as mulches for horticultural use.

### Conclusion

Flaxseeds have high nutritional value, potential health benefits and good industrial applications. However many people are still unaware about flaxseeds and their application. Daily intake of flaxseed is 1-2 table spoon

(ground) or 1 table spoon of flaxseed oil is recommended. Flaxseed is considered as one of the nutritive and functional food. Flaxseeds have many essential ingredients, good nutritional value and lots of medicinal and industrial application make it as “The wonder of Nature”.

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