

# A comprehensive review on Flaxseeds: Nutritional profile, food uses and health benefits

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## ABSTRACT

Flaxseed is a crop used for fiber. It includes lignans, which are phytoestrogens that resemble the hormone estrogen. Alpha linolenic acid (ALA), a soluble fiber, and lignans satisfy it. It is used to treat lupus patients' renal edema, diabetes, high cholesterol, constipation, and obesity. Many individuals have been taking it for a very long time because of its nutritional worth and therapeutic uses. In addition to enhancing skin health and preventing several types of cancer, it may also improve brain development and heart health. The objective of flaxseeds' nutritional composition, health advantages, value-added goods, and toxicity. Lignans, which resemble the hormone estrogen, are another kind of phytoestrogen found in flaxseeds. It appears to reduce appetite when taken before meals. Additionally, it may help reduce the amount of cholesterol that the body takes in from diet. Flax seeds have several nutritional advantages and are a promising seed. It has the advantages of lignans and omega-3 fatty acids. It comes in a variety of forms, including as whole or flour. The flour has nutritional and health advantages and is utilized in baked goods. Because of its high PUFA, phytosterol, and low saturated fat content, this oil seed may help decrease LDL cholesterol. When flax seeds are processed, their nutrients become accessible. The nutritional makeup and health advantages of flaxseed have been covered in this review.

**Keyword:** Flaxseeds, Nutritional Value, Fiber, Lignan, Diabetes, Estrogen

## 1. Introduction:

Flaxseed is a dietary supplement with potential health benefits. Small edible flax plant seeds have been discovered. Linseeds are another name for it. Flaxseed's Latin name, *linum usitatissimum*, translates to "very useful." It was initially brought to the United States by colonists. Additionally, it was utilized to fabricate clothing and papers, and linseed oil and its derivatives were employed in animal formulation. Known as *Alsi*, or *Jaws* in India, flaxseed is a member of the *Linaceae* family. It is grown around the world, including in South America, India, the United States, Canada, England, Greece, Italy, and Spain. The *linaceae* family includes flax plants, which are derived from blue-flowering herbs. It ranges in color from reddish brown to golden yellow. Its height ranges from 12 to 40 inches. Its stem is fibrous. Flaxseed has a crunchy, crisp texture and a nice, nutty flavor. With five petals, the flaxseed flower forms a five-celled ball that may hold up to ten seeds. Until plant growth ends, the flowering will continue. It has been grown for both medicinal and fiber purposes. About 55% ALA, 28–30% protein, and 35% fiber are found in flaxseeds. Food was made from the seeds. Flaxseeds are utilized to treat cardiovascular illness, as well as anti-inflammatory, antithrombotic, and anti-arrhythmic conditions. There is proof that it can lower your risk of diabetes, cancer, heart disease, and stroke.

### 1.1 Pharmacognosy:

- **Synonym:** Flax seed, *Alsi*, *Jawas*

- **Biological Source:** Linseed is the dried ripe seed of *linum usitatissimum* linn. Through linseed expression, linseed oil is produced. It is made from dried, ripe *Linum usitatissimum* seeds.
- **Family:** Linaceae
- **Geographical Source:** It is cultivated in many countries such as United State, Canada, England, Italy, Spain, India and Russia.

### 1.2 Physical Characteristics:

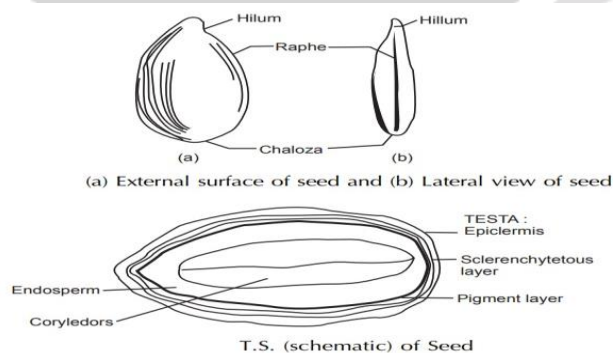
- Colour: Reddish Brown
- Odour: Characteristics odour
- Shape: Oval and Strongly Flattened
- Size: Length – 4 – 6 mm Width - 2 – 3 mm

There are two types brown and golden. It produces an oil called as linseed oil. It is an edible oil obtained by expeller pressing followed by extraction process.



**Fig 1** Flaxseed (*linum usitatissimum* linn)

The seeds are oval, flattened, 4 – 6 mm long and 2 – 3 mm wide. Testa is glossy. Seeds are rounded and pointed on another side. Raphe is present along edge. Endosperm is narrow. It has two thick flattened radical. The seeds are odourless and oil as well as mucilaginous taste.



**Fig 2 :** Transverse Section of Flaxseed

### 1.3 Microscopical Characteristics:

After observing the flaxseeds under the microscope, the testa shows a mucilage containing outer epidermis. The round cell and a single layer of sclerenchyma is present. The hyaline layer composed in ripe seed of parenchymatous cells. The outer epidermis composed of cells rectangular or five sided in surface view. It contains numerous globules of fixed oil. It shows epidermis, pigment layer, cotyledon consist of protein mass with aleurone grains and abundant globule of fixed oil.

#### A. Testa:

Epidermis: It is polyglobular tubular cells with thin walls filled with stratified mucilage

Hypodermis: 1-2 layers of collenchyma.

#### B. Tegmen:

Sclereid layer: Have layer of lignified elongated sclerids.

Hyaline layer: outer cells are elongated and perpendicular to sclerids cells

Pigment layer: Polygonal flatend cells.

#### C. Endosperm: It is composed of thick-walled cellulosic parenchyma. The cells contain fixed oil and aleurone grains.

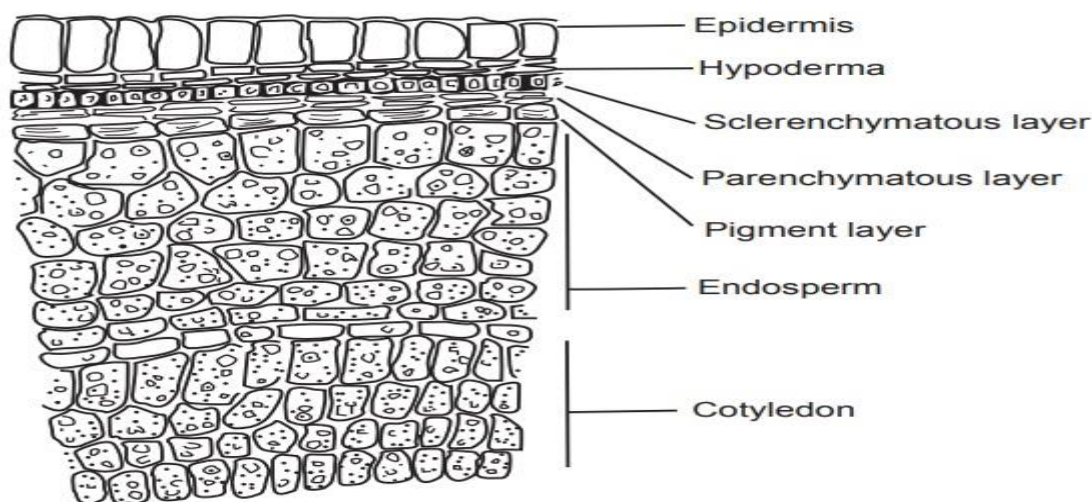
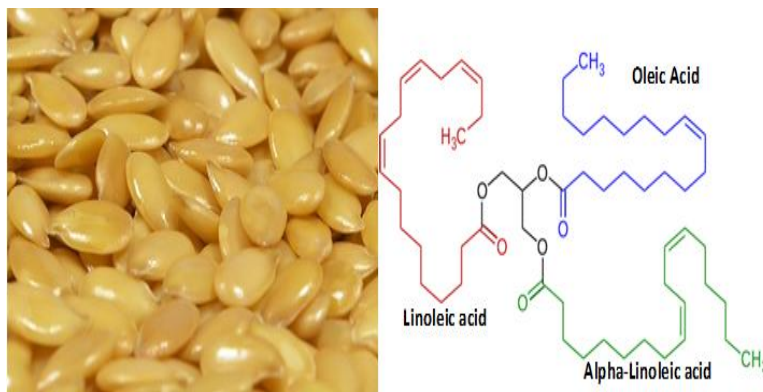


Fig 3: Pharmacognosy and T.S of flaxseed

## 2. Phytochemistry:

### 2.1 Chemical Constituents:

Flaxseed contains fixed oil (30 – 40 %), mucilage (6-10%), protein (25%), small amount of lipase. They also include sucrose, raffinose, cellulose and mucilage. Mucilage swells with water and forms red colour with ruthenium red linnamarin or hydrolysis yield acetone, hydrocyanic acid and glucose. On hydrolysis linseed oil produces unsaturated acids like linoleic acid (30-50%), Linoleic acid (23-24%), oleic acid (10-18%) together with saturated acids stearic and palmitic (5-11%). The other constituent is phytin, lecithin, wax, resin, pigments, mallic acid, cyanogenic glycosides, linustatin and phenylpropanoid glucoside linsitamarin. On hydrolysis linseed oil produces unsaturated acid like linolic acid (30-50%), linoleic acid (23-24%), oleic acid (10-18%) together with saturated acid myristic, steric and palmitic (5-11%). Unripe seeds contain starch which is converted to mucilage on ripening the seeds. The mucilage can be fractionated into a neutral fraction a remifide arabinoxylan composed of D-xylose, L-arabinos, D-glucose and D-galactose and an acidic fraction mainly composed of L-rhamnose and D-galactose.



**Fig 4:** Structure of Flaxseeds

## 2.2 Chemical Composition of Flaxseeds:

Flaxseed contains biological activity and functional properties: Polyunsaturated fatty omega -3 family, lignans, proteins and carbohydrates. Flaxseed averaged 41% fat, 20 % protein, 28% total dietary fiber, 77% moisture and 3,4% ash which is the mineral rich residue left after samples are burned.

**Table -1:** Chemical composition of Flaxseed

Contents	Percentage
Fat	41%
Protein	20%
Dietary fibre	28%
Moisture	7.7%
Ash	3.4%

- **Protein:** Globulins are the main proteins in flaxseed up to 18.6% of total protein. Arginine is a rich protein it also includes lysine, methionine and cysteine.
- **Polysaccharides:** Mucilage is an important component of flaxseed which is present in outer layer of seed. It constitutes 8-10% of whole seed weight. The hot water extraction method was found to be treatment for obtaining gum, that yields polysaccharides with consistency, functional abilities.
- **Carotenoids:** It has numerous health advantages. They are dividing into two types of phenolic acid and lignans. The phenolic acid range is between 790-1030mg/100g. Lignans have low molecular weight. They are present in coat seed mostly lignans used as antioxidant. The lignans obtained 50% ethanol, 1:60 solid to liquid ratio 30 min shaking 200rpm speed. Carotenoids contain 40 carbon atoms and gives red, orange and yellow colours as precursor of vitamin A.
- **Fibre:** Flaxseeds are divides into two types soluble and Insoluble. Insoluble fibre composed of substance such as cellulose, hemicellulose and lignin. Soluble fibres form a gel in presence of water, and this includes gums, pectins and sugars which forms mucilage. It contains polysaccharides which due to their anti-hypercholesterolemic and glucose metabolism controlling effect may reduce metabolism controlling effect may reduce the risk disease.

**Table -2:** Chemical composition of flaxseed and flax meal

Humidity %	Protein %	Lipid %	Fiber %
7-4	23.4	45.2	-
4-8	20-25	30-40	20-25

### 3. Health Benefits of Flaxseeds

- 3.1 Loaded with nutrients** Flaxseed is among the world's oldest crops. They provide a healthy amount of omega-3 fatty acids, fiber, and protein, as well as a few important minerals.
- 3.2 Act as anti-cancer agents:** The lignan is abundant. It combats cancer. According to studies done on animals and in lab settings, flaxseed also offers protection against colorectal, skin, blood, and lung cancer. This seed has 75–800 times more lignans than other plant foods.
- 3.3 Preventive constipation:** Flaxseed is a good source of insoluble fiber, which does not dissolve in water, instead remaining in the digestive tract. It absorbs water and adds bulk which may help promote regularity. It helps in preventing constipation
- 3.4 Low cholesterol:** Flax seed in your diet can reduce cholesterol level. Flaxseed help in trapping the fat and cholesterol in digestive system. Soluble fiber also traps bile which made from cholesterol in gall bladder
- 3.5 Healthy Skin and hair:** For healthy skin, nails and hairs flaxseeds are used. Add 2 tbsp of flax seeds or 1 tbsps of flax seed oil in your daily routine. Essential fat and vitamin which help to reduce dryness. It can improve symptoms of acne, eczema. This also applies to eye to reduce dry eye syndrome.

**Fig 5:** Benefits of Flaxseeds

### 4. Pharmacological Activity:

- 1. Anti-diabetic:** Flax seeds are rich in Omega-3 fatty acids. They are believed to inhibit progression of diabetes by maintaining insulin sensitivity in phospholipid membrane. Cinnamic acid SDG. Metabolites are antioxidant and also possess a hypoglycemic effect. The moderate amount of flaxseed consumption had favorable result in lowering blood glucose, whereas lower high dosage of flaxseed had no effect on glycemic control.

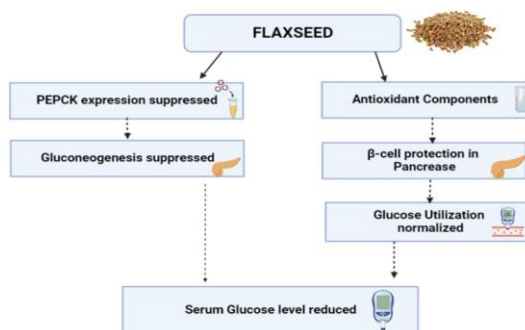


Fig 6 : Anti-diabetic action of flaxseeds

- Hepatoprotective effect:** Liver plays a key role in our body it performs a number of vital functions. It stores glucose and control body fuel regulations. It provides vitamins and minerals to human body. Due to its diverse function, the liver is susceptible to attack by toxins, disease and viruses. To prevent this nutritional modification that provide hepatoprotective effect on preferable to supplement and medication that can cause adverse effect.
- Anti- neoplastic:** It potential to destroy cancerous cell and inhibit their proliferation Omega-3 fatty acid in flax seed able to inhibit progression of another breast cancer cell line without affecting non-cancerous cell. Enterolactone can selectively target malignant and abnormal cell. Breast cancer modeling effect of phytoestrogen and depend both on background diet, genetic makeup and on timing exposure in life.

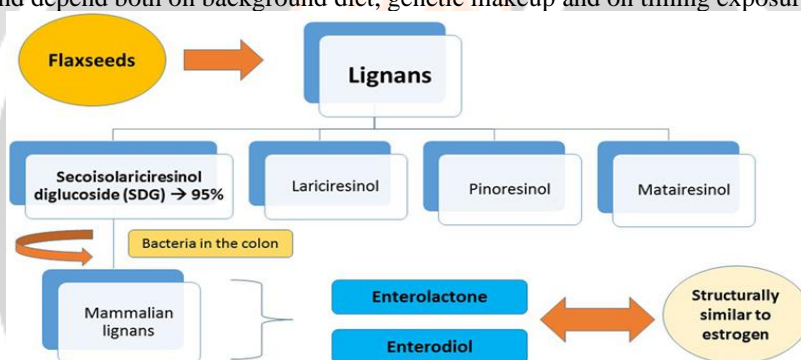
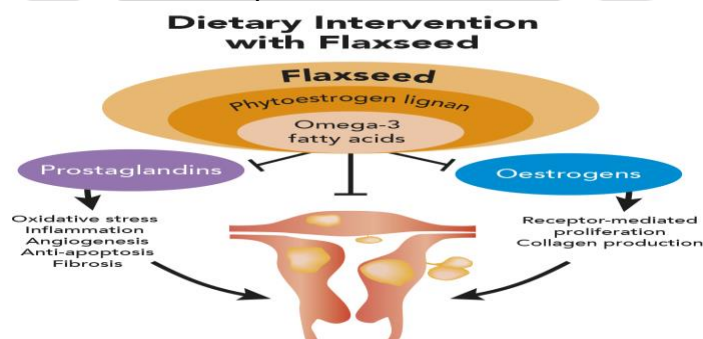


Fig 7. Anti-neoplastic action of flaxseed

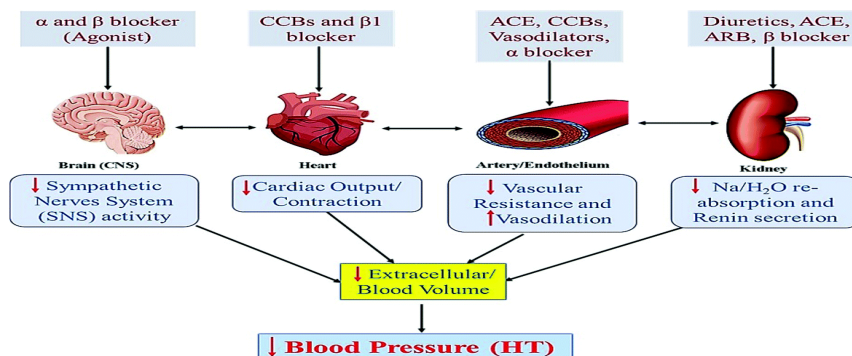
- Hormonal effect:** Lignans are often referred to as phytoestrogen and may possess estrogen receptor agonist or antagonist properties with unclear effect on hormone sensitive cancer such as prostate cancer. Enterolactone and Enter diol may decrease cell proliferation and inhibit aromatase,17 beta -hydroxysteroid dehydrogenase activity which may reduce risk of breast and prostate cancer.



Hypothesis: Lignan and omega-3 work synergistically to combat fibroids

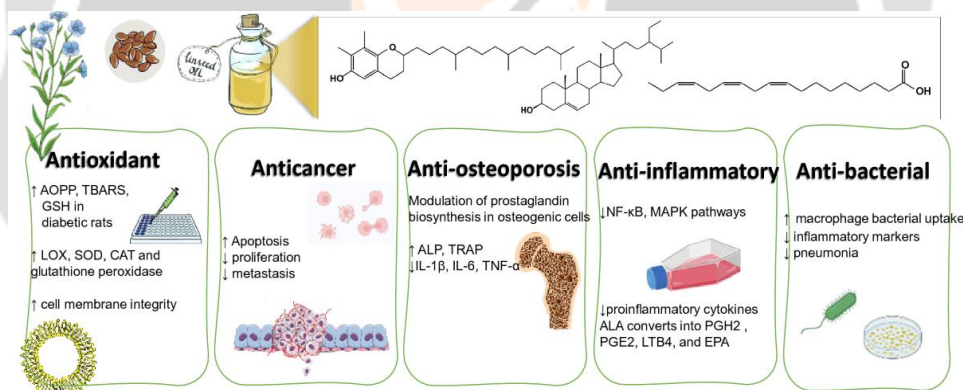
Fig 8. Hormonal effect of flaxseeds

- 5. Anti-arrhythmic effect:** ALA and Omega-3 fatty acid shows anti-arrhythmic effect. Anti-arrhythmic effect shows increase in DHANEPA, but not ALA higher intake of linoleic acid might be associated with reduce risk of abnormally prolong repolarization male and women.
- 6. Anti-hypertensive effect:** Higher level of linoic acid in human adipose tissue corelate with lower blood pressure. However, it is not clear if their major adipose tissue levels of linoleic are causative.



**Fig 9. Anti-hypertensive effect of flaxseed**

- 7. Inflammation:** Flaxseed and flaxseed oil possess, anti-inflammatory properties due to presence of ALA. Here ALA converted to EPA and DHA inhibit neutrophil inflammatory response in human.
- 8. Weight Loss:** There is limited research on obesity of the patient. Ingestion pf alpha linoleic acid in combination with arginine and yeast RNA was associated with weight gain in HIV patient.



**5. Nutritional Profile of Flaxseeds:**

There are different types of flaxseeds. Golden flaxseed and brown flaxseed are one of them. They both contain similar nutritional profile of short chain Omega-3 fatty acids. The flaxseed is not only an excellent source of fatty acid that are essential for human health. Linoleic acids and alpha-linoelic acid. Flaxseed is very low in cholesterol and sodium.

**Table -4:** Nutritional composition of flaxseeds

Components	Value
Energy	54.7 kcal
Sugars	0.2g
Fat	4.3 (DV-7%)
Monosaturated fat	0.8g

Protein	1.9g
Riboflavin	0.0mg
Panthenic acid	0.1mg
Calcium	26.1mg (DV=3%)
Magnesium	40.2mg (DV=10%)
Potassium	83mg (DV=2%)
Carbohydrate	3.0g (DV=1%)
Dietary fibre	2.8g (DV=11%)
Saturated fat	0.4g(DV=2%)
Polyunsaturated fat	2.9g
Iron	0.6mg(DV=3%)

#### 6. Side Effects:

Flax seed is safe for the adults but consuming higher amount might increase the number of bowel movement each day and cause GI side effect such as gas, abdominal pain, constipation etc. Consuming large amount of flaxseed could block intestine due to bulk forming laxative effect of flaxseed.

- a. Diarrhea or constipation
- b. Estrogen balance
- c. Allergic Reaction
- d. Increased risk of premature birth
- e. Reaction with other medication

#### 7. Interactions with medications:

1. Flaxseed may block the normal absorption of medicines. Always take medicines at least one hour before or two hours after using flaxseed.
2. If you currently being treated with any of the following medications, you should not use flaxseed without first talking to your health care provider:
  - a. **Blood thinning medications:** Omega-3 fatty acids may increase the risk of bleeding especially if you also take blood thinner such as warfarin or aspirin.
  - b. **Medications for diabetes:** Flaxseed may lower blood sugar levels. If you are taking medicines for diabetes, including insulin, you should use flaxseed (ALA) only under your doctor's supervision.
  - c. **Birth control pills or hormonal replacement therapy:** Flaxseed may affect hormonal levels and effects on oral contraceptives.
  - d. **Antibiotic drugs:** Bacteria in the intestine convert some of the chemicals in flaxseed into lignans, which are thought to be responsible for many of the possible benefits of flaxseed. However, because antibiotics kill these bacteria, lignans are not formed as usual.

#### 8. Precautions:

1. Do not eat raw or unripe flaxseeds – They may be poisonous.
2. People with bowel obstruction, inflamed bowl or narrowed oesophagus should not take flaxseeds.
3. It should be taken with plenty of water.
4. It may cause GI side effects such as bloating, gas, abdominal pain and nausea.
5. Avoid eating flax seed whole.
6. The Omega-3 fatty acids in flaxseeds aren't taken up as well by the human body as the omega 3 in fish oil.



## 9. Contraindications:

- a. **Low blood pressure:** Taking flaxseed cause blood pressure to become too low in individual with low blood pressure.
- b. **Pregnancy:** Taking flaxseed during pregnancy is harmful. It can act like hormone estrogen. It may affect on fetus.
- c. **GI Obstruction:** People with narrow or inflamed oesophagus or intestine should avoid flaxseed. It can cause Obstruction.
- d. **Hypertriglyceridemia:** It increases the triglyceride level. So, it is harmful to take if you have high Triglyceride level.
- e. **High Blood Pressure:** Flaxseed might lower diastolic blood pressure. Taking flaxseed might cause Blood pressure to become too low in individual with high blood pressure who are taking blood pressure.

## 10. Conclusion

Flaxseed have good nutritional profile. It is use as an ingredient making it available in many forms with specific available in many forms with specific nutritional benefits. Consumption of flaxseed has many benefits which include, boost pre and postal brain development, improve memory and reduces the cholesterol and used in treatment of various disease. It contains alpha lineic acid, lignans, soluble fibres and protein effects on prevention of chronic diseases. These characteristics make flaxseed more attractive source of functional ingredients for preparation of food stuff. ALA, Omega -3 fatty acids, dietary fibers and lignan content attracts food technologist to explore its abilities at fullest extent in commercial food processing sectors.

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