Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 02, Issue: 02 (MAR-APR, 2022)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Nutritional Importance and Potential Health Benefits of Flax Seeds (*Linum usitatissimum*)

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Flax is one of the oldest crops grown for fiber and oil purpose. it is also called as linseed and is popularly known as Alsi, Jawas, Akse bija in Indian languages. It belongs to family Linaceae. It is an annual herbaceous plant with shallow root system. The cultivars grown primarily for seed/oil purpose are relatively short in height and possess more secondary branches and seed bolls (seed capsule). The cultivars grown for fiber purpose are tall growing with straight culms and have fewer secondary branches. Flaxseed was used for many purposes like used in the fabrication of cloths and papers, while flaxseed oil and its sub-products are used in animal feed formulation (Jhala and Hall, 2010).

Morphological Characteristics

Flax is an annual herb grows up to 12-14inches with slender and fibrous stem. It has bright blue flowers are up to 3 cm in diameter. The flowers have five petals and form a five-celled ball that can contain up to 10 seeds. Flowering continues until plant growth stops. It has a spherical fruit with five compartments and each compartment has two seeds. The shape of the seed is flat and oval with pointed tips. It has seat coat with glossy surface and has brown to yellow colour. The seeds texture was crip and chewy with pleasant nutty taste.

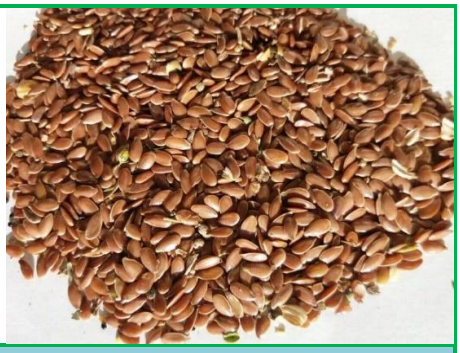
For both fiber and flax, different varieties namely Sheela, Sweta, Garima, Sharda, Rashmi, Shikha, Padmini, Shekhar, Neelam, LC-2063 and LC-2023 are cultivated in India. In India, it is mainly cultivated in Madhya Pradesh, Maharashtra, Chhattisgarh and Bihar. Almost all parts of linseed plant are utilized for various purposes. Seed is used as oil and other purposes as flour, oil and seed (Naik et al., 2020).

Cultivation

Flax species do best on well-drained soils. They have excellent cold winter and drought tolerance. They will tolerate weakly saline to weakly acidic sites. The ideal seeding depth is 1/8 inch. Growth of flax begins in early spring and flowers appear in mid may through early July depending on species. Disease problems are minimal with flax. However, fungus problems occur. Seed yields of 600 to 700 pounds per acre of blue flax under irrigated conditions and 200 to 300 pounds per acre under dryland conditions can be expected (Ogle et al., 2009).

Flaxseed is a multicomponent system with bio-active plant substances such as oil, protein, dietary fiber, soluble polysaccharides, lignans, phenolic compounds, vitamins A, C, F and E and mineral P, Mg, K, Na, Fe, Cu, Mn and Zn.





Flaxseed crops | **Flaxseeds**

Nutritional composition

Nutrient			Quantity/100g		
Energy	534 Kcal	Lutein zeaxanthin	651 mcg	Manganese	2.48mg
Carbohydrates	28.8 g	Calcium	255 mg	Zinc	4.34 mg
Protein	18.3 g	Copper	1.12 mg	Vitamin E	19.95 mg
Total Fat	42.16 g	Iron	5.73 mg	Vitamin K	4.3 mcg
Dietary Fibre	27.3 g	Magnesium	392 mg	Folates	87 mcg
Protein	32g	Omega 3(ALA)	5g	Soluble fibre	8g
Saturated	0.4g	Total Carbohydrate	43.6g	Lignans	500-1000mg
Monounsaturated	1.5g	Sugar	1.4g	Polyunsaturated	7g

(Mantri *et al.*, 2012; Sadia and Monika, 2016)

Lipids: It is a richest plant source of the ω-3 fatty acids: α-linolenic acid (ALA), low in saturated fatty acids (9 %), moderate in MUFA (18 %), and rich in PUFA (73%). Flaxseed oil is naturally high in anti-oxidant like tocopherols and beta-carotene.

Proteins: The protein content of flaxseed varies from 20 to 30 %, constituting approximately 80 % globulins (linin and conlinin) and 20 % glutelin. Flaxseed protein is not a complete protein, but the amino acid profile is comparable soybean and contains no gluten. Whole flaxseed, flaxseed meals and isolated proteins are rich sources of glutamic acid/glutamine, arginine, branched-chain amino acids and aromatic amino acid.

Dietary Fibers

Flax fibers include both soluble and insoluble dietary fibers (in the ratio of 20:80 and 40:60). The major insoluble fiber fraction consists of cellulose and lignin whereas the soluble fiber fractions are the mucilage gums. Only 10 g of flaxseed in the daily diet increases the daily fiber intake by 1 g of soluble fiber and by 3 g of insoluble fiber. High insoluble fiber increases the fecal whereas soluble fiber maintains blood glucose levels and lowering the blood cholesterol levels.

Lignans

Plant lignans are phenolic compounds and act as both antioxidants and phytoestrogens. Phytoestrogens can have weak estrogen activity in animals and humans. Flax contains up to 800 times more lignans than other plant foods. Besides lignans, other compounds like p-coumaric acid and ferulic acid are present. Flax lignans showed promising effects in reducing growth of cancerous tumors, especially hormone-sensitive ones such as those of the breast, endometrium and prostate.

Health benefits:

In the recent times, falx seeds gained much importance due to their wide range of health functions. The seeds have high antioxidant, anti-inflammatory, anticancer, antidiabetic, antibacterial and antiviral activity.

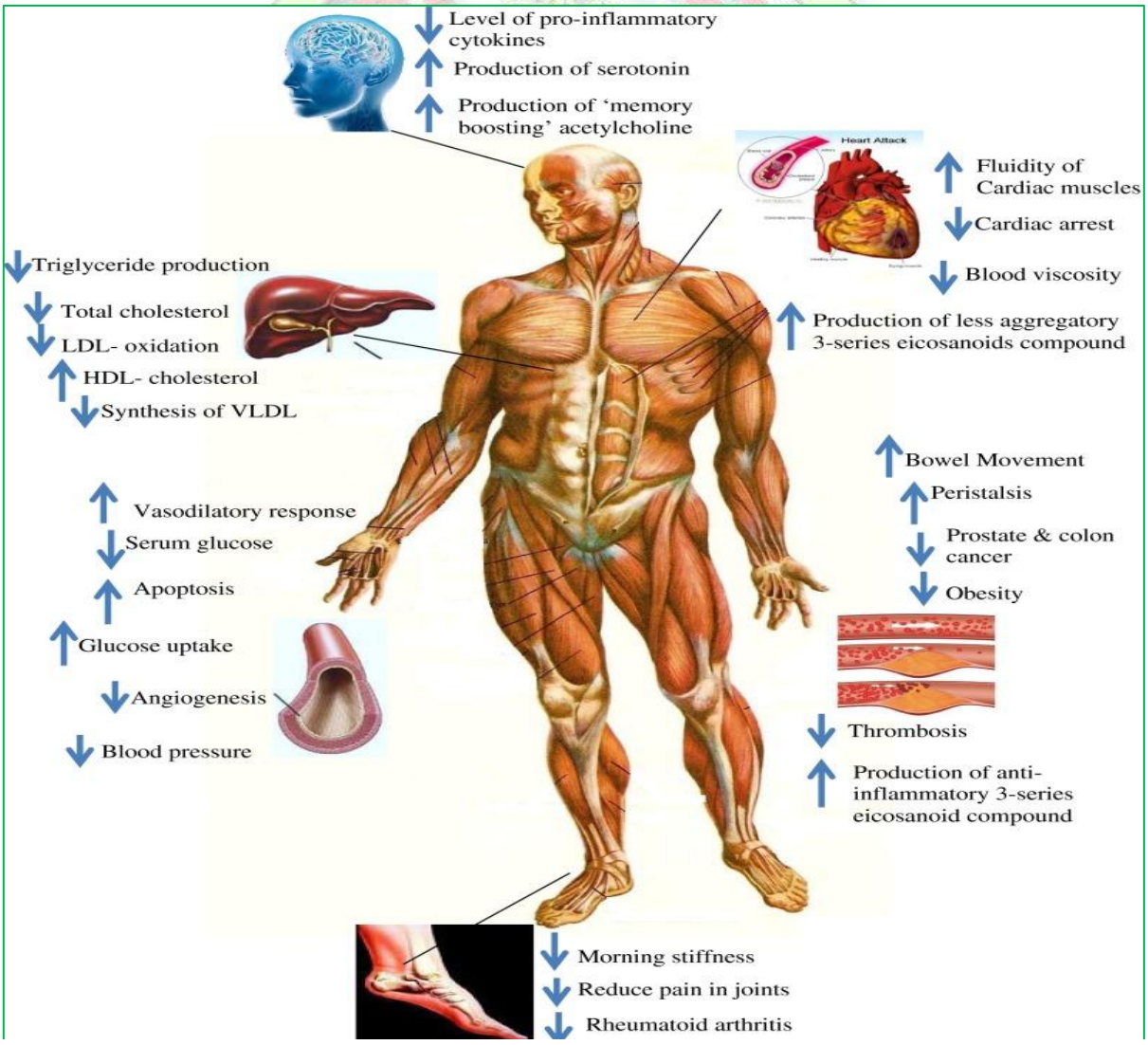
Flax seeds and health: Flax has been showed to protect against cardiovascular disease (CVD) through various mechanisms such as by reducing the reducing serum cholesterol, reducing platelet aggregation, reducing inflammatory markers and improving glucose tolerance.

Hypotensive Effects: ALA is a precursor of EPA and DHA, it may have independent effects on blood pressure and blood lipids.

Cancer: Lignans have a very similar chemical structure to some of the therapies available for breast cancer, and recent research has focused on using lignans for cancer treatment and their role in cancer prevention.

Excessive consumption and Safety: Excessive intake of flax seeds with inadequate water intake leads to bowel obstruction.

Flaxseed possesses antioxidant and hepatoprotective properties. EPA and DHA play a major role in reducing depression symptoms. Lignans in flaxseed plays an important role in preventing various types of hormone sensitive cancers. In postmenopausal women, lignans act as weak estrogens, while at normal estrogen levels, lignans act as estrogen antagonists. Flaxseed has been shown to inhibit colon and skin cancers in cell cultures and in animal studies.



Health benefits of flaxseeds

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