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Health Benefits and Nutritional Value of Flaxseed- a Review

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ABSTRACT *Flaxseed, or linseed (Linum usitatissimum L.), comes from the flax plant, which is an annual herb. The ancient Egyptians used flaxseed as both food and medicine. The Latin name of flaxseed (Linum usitatissimum L.) means "very useful", and it has two basic varieties: brown and yellow or golden (also known as golden linseeds). This review highlights the potential of 'flax seed' as a 'neutraceutical' and its role as a protective and therapeutic medicinal food.*

Introduction
Flaxseed is one of the most important oilseed crops for industrial as well as food, feed, and fiber purposes. Almost every part of the flaxseed plant is utilized commercially, either directly or after processing. The stem yields good quality fiber having high strength and durability. The seed provides oil rich in omega-3, digestible proteins, and lignans. In addition to being one of the richest sources of α-linolenic acid oil and lignans, flaxseed is an essential source of high quality protein and soluble fiber and has considerable potential as a source of phenolic compounds. Flaxseed is emerging as an important functional food ingredient because of its rich contents of α-linolenic acid (ALA), lignans, and fiber. Lignans appear to be anti-carcinogenic compounds. The omega-3s and lignan phytoestrogens of flaxseed are in focus for their benefits for a wide range of health conditions and may possess chemo-protective properties in animals and humans.

Materials and methods
The data presented in the review paper were collected using all scientific data come from articles, journals and websites such as Google scholar, Scopus and Puvmed.

Cullnary Uses of Flax seed
Flaxseed meal is gluten free and has a pleasant nutty flavour. The protein content, combined with the gelling/binding properties of the soluble fiber found in flaxseed meal, make it ideal for incorporating into gluten free baked goods, or as a gluten free thickening agent.

One tablespoon of flaxseed meal combined with three tablespoons of water and allowed to gel can even be used as a substitute for an egg in baked goods. The flake is quite good combined with hot or cold breakfast cereals in the morning and is a good source of fiber.

Applications as a dietary supplement
- Isolated encapsulated lignan supplements.
- Fiber supplementation (bulk laxative with a demulcent action).
- As a component of protein powder blends.

Applications as a food ingredient
- Breads and other baked goods such as cookies and muffins including gluten free products. The incorporation into bread results in an improved texture and crumb structure.
- Healthy functional snack foods such as high protein energy bars.

Nutrient in Flaxseed
Table 1. -Nutritional value of Flaxseed

	Quantity Per Serving(5 gm)	Quantity Per Serving(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

Typical chemical analysis of flaxseed fibre. Data averaged from analyses undertaken by an independent NZ laboratory.

Omega-3 fatty acids
There is an optimal ratio of omega-6 to omega-3 in the human diet. Oils such as flaxseed, walnut, and canola help to maintain this balance. Whilst it is true that very little ALA converts to the long chain polyunsaturated omega-3 found in marine oils, it does have

beneficial effects itself. The benefits of ALA are seen at intakes as low as 1g/day and 2g/day is recommended for a cardio protective effect.

Researchers are investigating whether omega-3 fatty acids contained in flaxseed may help protect against certain infections and in treating conditions including ulcers, migraine headaches, attention deficit/hyperactivity disorder,

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eating disorders, preterm labor, emphysema, psoriasis, glaucoma, Lyme disease, lupus, and panic attacks

Proteins

The amino acid pattern of flax protein is similar to that of soybean protein, which is viewed as one of the most nutritious of the plant proteins. Like all vegetables, flaxseed proteins have techno-functional properties that affect their behaviour in a food system through interaction with other ingredients.

These properties are mainly dependent on their hydration mechanisms for solubility and water/oil retention capacity. The amino acid pattern of flax protein is similar to that of soybean protein, which is viewed as one of the most nutritious of the plant proteins. Flaxseed grain and flaxseed paste contain about 21% and 34% protein respectively and may varies with the genetic and environmental factors. Cool climates usually result in high oil and low protein content in the seeds. Flaxseed has two major storage proteins, a predominant salt soluble fraction with high molecular weight (11-12S; globulin; 18.6 % nitrogen) and a water soluble basic component with low molecular weight (1.6- 2S; albumin; 17.7 % nitrogen) .

Dietary fiber

Flaxseed meal is high in fibre, a significant amount of which is soluble (20%), in the form of gums and mucilages. In addition to accounting for the laxative effect of flaxmeal, soluble fibre is known to have potent cholesterol lowering qualities, therefore reducing a major risk factor for cardiovascular disease. In Canada, where a great deal of research has been carried out, there is now an approved health claim for the use of ground flaxseed to lower cholesterol. Insoluble dietary fibre reduces insulin resistance, is useful in treating constipation and helps maintain overall bowel health. Increased stool bulk, normalised bowel transit time, healthy gut flora, and production of short-chain fatty acids such as butyrate are all positive effects on the bowel of a high fibre diet. Low fibre diets are associated with many chronic diseases including inflammatory bowel disease, heart disease, obesity, diabetes and colorectal cancer. The fibre content of flaxmeal makes it an ideal addition to a balanced diet aimed at reducing the risk of these chronic diseases.

Carbohydrates

Flax is low in carbohydrates (sugars and starches), providing only 1 gram (g) per 100 g. For this reason, flax contributes little to total carbohydrate intake; it's recommended for people with specific deseases. Flaxseed polysaccharide is composed of two major fractions: a neutral arabinoxylan (75%) and an acidic rhamnogalacturonan (25%). The arabinoxylan is composed mainly of xylose, arabinose, and galactose and the rhamnogalacturonan consists of L-rhamnose, D-galactose, D-galacturonic and L-fucose acid. Considerable and significant variations exist in monosaccharide composition, carbohydrate yield and quality among accessions from the world collection of flaxseed .

Health benefits

Flaxseed is well-known for the content of chemical compounds with specific biological activity and functional properties: polyunsaturated fatty acids (PUFA) omega-3 family, soluble dietary fibers, lignans, proteins and carbohydrates. However, it is constituted by few levels of adverse health compounds such as Cadmium, protease inhibitors and cyanogenic compounds

Flaxseed and Cancer

Ground flax seeds have been studied for its effect on cancer, including several excellent studies by Lilian Thompson's research group at the University of Toronto. In one study the flax seed, its lignan fraction, or the oil were added to the diet of mice who had previously been administered a chemical carcinogen to induce cancer. All three treatments reduced the established tumor load; the lignan fraction containing secoisolariciresinol diglycoside (SDG) and the flax seed also reduced metastasis. In another study the flax lignan SDG was fed to mice starting 1 week after treatment with the carcinogen dimethylbenzanthracene. The number of tumors per rat was reduced by 46% compared to the control in this study. Flax or its lignan (SDG) were tested to see if they would prevent melanoma metastasis. The flax or lignan fraction were fed to mice two weeks before and after injection of melanoma cells. The flax treatment (at 2.5, 5, or 10% of diet intake) resulted in a 32, 54, and 63 percent reduction in the number of tumors, compared to the control. The SDG, fed at amounts equivalent to the amount in 2.5, 5, or 10% flax seed, also reduced the tumor number, from a median number of 62 in the control group to 38, 36, and 29 tumors per mouse in the SDG groups, respectively.

Flaxseed and Heart Disease

Flaxseed has recently gained attention in the area of cardiovascular disease primarily because it is the richest known source of both alpha-linolenic acid (ALA) and the phytoestrogen, lignans, as well as being a good source of soluble fiber. Human studies have shown that flaxseed can modestly reduce serum total and low-density lipoprotein cholesterol concentrations, reduce postprandial glucose absorption, decrease some markers of inflammation, and raise serum levels of the omega-3 fatty acids, ALA and eicosapentaenoic acid. Data on the antiplatelet, antioxidant, and hypotensive effects of flaxseed, however, are inconclusive.

Partially defatted flaxseed reduced total cholesterol (4.6 ± 1.2%; $P = 0.001$), LDL cholesterol (7.6 ± *1.8%;* $P < 0.001$), apolipoprotein B (5.4 ± 1.4%; $P = 0.001$) and apolipoprotein A-I (5.8 ± *1.9%;* $P = 0.005$), but had no effect on serum lipoprotein ratios. There were no significant effects on serum HDL cholesterol, serum protein carbonyl content, or ex vivo androgen or progestin activity. Unexpectedly, serum proteinthiol groups were significantly lower (10.8 ± 3.6%; $P = 0.007$) suggesting increased oxidation. Dietary flaxseed has been shown to have potent antiatherogenic effects in rabbits. When LDL receptor deficient mice (LDLrKO) were administered a 10% flaxseed-supplemented diet for 24w, a reduction of circulating cholesterol levels was observed indicating the anti-atherogenic effect of flax seeds.

Flaxseed and Menopause

Competition of lignans with estrogen for receptor sites causes dual effects. Considering that lignan possesses a weak hormonal action, during phases of life when there is a large production of estrogen, the chronic ingestion of flaxseed may exert an antiestrogenic action because it competes with estrogen for the same receptors. By means of this mechanism, flaxseed may protect women with risk of cancer by decreasing hormonal signalization involved in the beginning of tumor development Consuming lignans may lower the risk of endometrial cancer in post-menopausal women, and it might also help reduce the severity of osteoporosis. Dew et al. 2013 sistematic review controlled flax interventions on menopausal symptoms and

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bone health in premenopausal and postmenopausal women. The majority of studies considered suggested that flax consumption alters circulating sex hormones and increased the urinary 2α-hydroxyestrone/16α-hydroxyestrone ratio associated with a lower risk of breast cancer. However, few studies considered bone mineral density or markers of bone turnover; more investigation needed to confirm influence of flax lignan intake on postmenopausal bone mineral density.

Conclusion

Flaxseed has many health benefits as well as rich of nutrients. In fact the content Fiber, proteins, Amino acids, vitamin E and lignans present in flaxseed satisfy basic needs in the human diet. Flaxseed also has healthy properties that prevent from cardiovascular disease, problems related to menopausal and many more disease

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