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A Review

Flaxseed: Herbal king of present era

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ABSTRACT : Flaxseed is one of the oldest known medicinal plants gifted by nature, often called miracle plant. The flaxseed is an herbaceous plant. The flax stem is cylindrical straight and narrow, pointy leaves. The flowers of this medicinal plant growing in the end of the branches, have five petals, light blue and the fruit is a capsule nearly round finished in the top edge. Flaxseeds are used both as food and medicine. Flaxseed a minor oilseed, is highly valued for its neutraceutical properties. Flaxseeds are rich in alpha-linolenic acid (ALA). It is important to maintain a good balance of omega-3 and omega-6 another essential fatty acid in your diet, as these two substances work together to promote health. Flaxseed also contains a group of chemicals called lignans that may help protect the body from cancer. Lignans are phytoestrogens plant compounds that act like the hormone estrogen. Crushed flaxseeds are an excellent natural source of fibre. Some of the health benefits of flaxseed are- helping to protect against cancer, heart disease, cataracts and gallstones, reduces inflammation associated with gout, promotes healthy skin, hair and nails, impotence, menstrual cramps, helps to treat nerve disorders, relieves constipation, gallstones and diverticular disorders. Thus, regular intake of flaxseed in diet is perfect supplement for good health.

KEY WORDS : Flaxseed, Health benefits, Alpha-linolenic acid, Dietary fibre

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Flax or linseed is among the oldest crop plants cultivated for the purpose of oil and fibre. It belongs to the genus *Linum* and family Linaceae. Its botanical name is *Linum usitatissimum* L. It is an annual herbaceous plant with shallow root system.The common names flax and linseed are used in North America and Asia, respectively, for L. *usitatissimum*. Oilseed varieties and fibre varieties are specialized development of this species (Millam *et al.,* 2005).The cultivars grown primarily for seed/oil purposes are relatively short in height and possess more secondary branches and seed bolls (seed capsule). The cultivars grown for fibre purpose are tall growing with straight culms and have fewer secondary branches. Flaxseed (*Linum usitatissimum*), a minor oilseed is highly valued for its neutraceutical properties such as omega-3 fatty acids which are the substrates for the synthesis of longer chain unsaturated fatty acids which confer important biophysical properties on cell membranes and are required for cell function. Flaxseed is claimed to exhibit protective effects against cardio-vascular diseases. It is also a good source of macronutrients. Flaxseed is a functional food which helps to improve the ratio of essential fatty acid in diet.

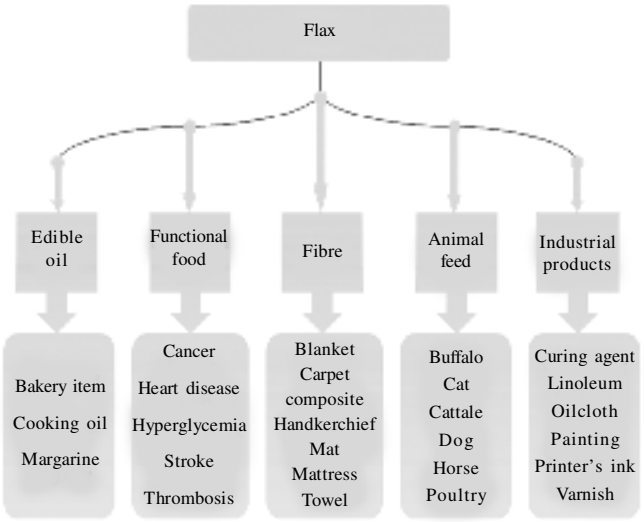
Flaxseed has recently gained attention in the area of cardio-vascular disease primarily because it is the richest known source of alpha-linolenic acid (ALA) and the phytoestrogen, lignans, as well as being a good source of soluble fibre. Human studies have shown that flaxseed can modestly reduce serum 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. More research is needed to define the role of this functional food in reducing the cardiovascular risk.

Flaxseed helps to reduce cardio-vascular diseases by altering the ω-3 fatty acid content of cell membranes by improving blood lipids and endothelial function and also by exerting antioxidant effects (Bloedon and Szapary, 2004).

The recommended amount of daily dietary fibre of >25g is, according to many studies, useful in the treatment of constipation, irritable bowel syndrome and diverticular disease. Ground flaxseed consists of 40 per cent of dietary fibre, 2/3 of which is insoluble (cellulose, hemicellulose and lignin) and 1/3 is soluble fibre. Insoluble fibre binds water and thus increases the bulk in colon. Soluble fibre from flaxseed mucilage has similar effects than guar gum or delay in gastric emptying, improvement in glycemic control and alleviation of constipation. The mean dietary fibre intake in western countries is approximately 20 g/day. Flaxseed supplement of 10-20 g/day would increase the intake to the recommended level of 25-30 g/day.

Area and production of flax :

Flax was grown in 47 countries in 2004 with the seed production of 1.903 million metric tonnes (Smith and Jimmerson, 2005). Canada has the highest area and production of flax in the world followed by China, U.S.A., India and E.U. In 2006, Canada produced 1.014 million tonnes of flax seed from an area of about 800 thousand hectares (Statistics Canada, 2006).



Heath benefits of flaxseed :

***Constipation and dietary fibre* :**

Constipation, a major health problem mostly due to refined diet. It is well known that a sufficient amount of dietary fibre is a cornerstone in the prevention and treatment of constipation. Commonly recommended dietary fibre intakes should be 30 g or more per day. This amount is expected to increase stool weight and frequency and normalize stool consistency (Devroede, 1988). The metabolism of flaxseed fibre can be stated as with any dietary fibre. The effect of soluble fibre is believed to be more or less local: it increases the viscosity of the small intestinal contents and delay the digestion and absorption of carbohydrates (Blackburn *et al.*, 1984; Holt *et al.*, 1979). Although soluble fibre reduces intestinal mixing, the effects of these viscous polysaccharides on enzyme activity in the gut lumen may be offset by a compensatory increase in pancreatic enzyme secretion or a reduction in the luminal degradation of enzymes (Schwartz and Levine, 1980; Scarpello *et al.*, 1982). Perfusion of loops of small intestine *in vivo* with glucose solutions has shown that viscous polysaccharides reduce glucose absorption in proportion to the viscosity of the solutions (Isaksson *et al.*, 1983; Johnson and Gee, 1981). In general, the addition of soluble fibre to liquid meals delays mouth-tocecum transit time of the head of a meal. This effect is only partly explained by the delay in gastric emptying; there is evidence for an additional delay in small bowel transit (Spiller, 1994). Ground flaxseed with a particle size of 2-4 mm shows good water-binding capacity in the colon compared to finely ground flaxseed meal or whole flaxseed (Report of analysis. Technical Research Center of Finland, Biotechnology, 1995). Other components of fibre are susceptible to bacterial degradation; their availability to the fecal flora is thought to represent a major source of carbon for bacterial growth. In these instances, fecal bulk is largely accounted for by an increase in the excretion of bacteria. By whatever mechanism, and whether taken as dietary supplements or proprietary bulking agents, fibre increases stool bulk, and eases evacuation (Devroede, 1988). Although traditional medicine has used flaxseed for centuries to treat constipation, the controlled trials of flaxseed as a laxative are rare. Cunnane *et al.* (1995) studied the influence of consuming 50 g flaxseed per day for 4 weeks on several indexes of nutrition in 10 young healthy adults. Bowel movements per week increased by 30 per cent ($p<0.05$) while flaxseed was consumed. During flaxseed consumption, α-linolenic acid was increased significantly in adipose tissue, and n-3 polyunsaturates were increased in plasma lipids. Plasma LDL-cholesterol was also reduced by up to 8 per cent and total urinary lignan excretion was increased more than five-fold ($p<0.05$).To conclude, the traditional flaxseed has modest beneficial effect on several indexes of nutritional status without compromising antioxidant status.

Blood glucose and fibre :

High-fat, low-fibre, low-nutrient diets combined with genetic susceptibility and low-level exercise may lead to symptoms associated with metabolic syndrome. These are insulin resistance, hyperlipidemia and hypertension. When progressing, metabolic syndrome may result in type 2 diabetes and coronary heart disease. Nutritional treatment, which means a change of diet and unhealthy life habits, gives longterm results and improvement of health. The consensus of today claims the importance of lower postprandial plasma

glucose and lower blood lipids through low-fat, high fibre diet. The latest recommendation for diabetic individuals and persons at risk (Andersson *et al.*, 2004) is to maintain desirable body weight and to have a diet containing 55 per cent or more of carbohydrate, 12-15 per cent of protein, less than 30 per cent of fat including 12-15 per cent of monounsaturated fat. The diet provides 25-50 g/day of dietary fibre. The metabolic prevalence was significantly lower among those in the highest quintile of cereal fibre intakes. Investigators conclude that whole-grain intake may reduce the risk of developing the metabolic syndrome.

Cunnane *et al.* (1993) carried out a study where muffins containing 25 g flaxseed each, two consumed daily for 4 weeks, resulted in 27 per cent lower postprandial glucose values than control muffins. Addition of 25 g of flaxseed mucilage to a 400 ml solution with 50 g glucose reduced the area under the blood glucose response curve by 27 per cent compared to oral glucose alone. The effect of flaxseed protein on blood glucose has not been studied but may be comparable with other dietary plant proteins, *i.e.* suppression of postprandial blood glucose levels as seen after wheat albumin ingestion (Kodama *et al.*, 2005).

Serum lipids and fibre :

Hyperlipidemia is closely linked with impaired glycemic response. The early studies of fibre effects on hyperlipidemia or blood lipids in general mostly failed to show any lipid lowering effect because the fibre under investigations was insoluble wheat bran. Studies with soluble dietary fibre such as pectin, guar gum, oat bran and psyllium started to emerge during 1960's showing a clear reduction in blood lipids (Miettinen and Tarpila, 1989). Flaxseed, which is a good source of soluble dietary fibre, has shown similar results in clinical studies. Cunnane *et al.*(1993) carried out a study where 50 g of ground raw flaxseed ingested daily by nine healthy volunteers for 4 weeks. They showed that total serum cholesterol reduced by 9 per cent and LDL cholesterol by 18 per cent. When flaxseed was baked in muffins both plasma total cholesterol levels and the ratio of LDL/HDL cholesterol had fallen by 6 per cent (Cunnane *et al.*, 1995). In the study with 55 IBS patients receiving either ground flaxseed or psyllium 6-24 g/day for 3 months flaxseed reduced the serum total cholesterol by 10 per cent and LDL cholesterol by 12 per cent (Tarpila *et al.*, 2004). Several explanations have been suggested, such as enhanced gastric emptying, altered transit time, interference in bulk phase diffusion and sequestration of micellar components, including bile acids as well as the increased excretion of cholesterol into faeces.

Cardio- vascular diseases and fibre :

Dietary fibres may protect against coronary heart disease by lowering blood cholesterol, attenuating blood triglyceride levels, decreasing hypertension and normalizing postprandial blood glucose levels. A pooled analysis of dietary fibre and its subtypes and risk of coronary heart disease has been conducted by Pereira *et al.* (2004).The effect of dietary fibre on hypertension has been investigated in two studies recently, unfortunately neither with flaxseed. In a randomized controlled study with 41 hypertensive patients (36 completed), subjects were normalized on low protein, low-fibre diet for a period of four weeks (Burke *et al.*, 2004). After that they were randomized to 4 groups either to (1) continue the low-protein, low-fibre diet or (2) a diet supplemented with soy protein, increasing the total protein intake to 25 per cent (3) a diet supplemented with additional 12g of soluble fibre, or (4) supplemented with both protein and fibre. The 24-hour ambulatory blood pressure was compared from the end of the baseline period to the end of intervention of eight weeks. Relative to control subjects, the net reduction in 24-hour systolic blood pressure was 5.9 mm Hg with fibre and with protein. In another recent study, 110 participants with elevated, untreated or stage 1 hypertension were randomized to receive 8 g/day of water-soluble fibre from oat bran or a placebo intervention.

Flaxseed oil and cancer :

It is generally considered that the high content of ALA in flaxseed oil plays a protective role in carcinogenesis. The effect of supplementation of flaxseed, flaxseed lignan secoisolaricirecinol-diglycoside (SD) or flaxseed oil on established rodent mammary tumors and appearance of new tumors has been studied by Thompson *et al.* (1996). The role of ALA in the etiology of prostate cancer has been studied in Uruguay with 217 men with advanced prostate cancer (De Stefani *et al.*, 2000). ALA was found to be associated with a significantly increased risk of prostate cancer after controlling for total energy intake and for other types of fat. ALA from both animal and vegetable sources displayed increased risks of prostate cancer. In this study, the main source of ALA was animal fat (red meat). The daily intake of ALA in all groups was below the recommended daily intake of 2 g.

Breast cancer :

A study performed at the University of Toronto and Princess Margaret Hospitals in Toronto found that women with breast cancer benefited from flaxseed. The study followed 9 women with newly diagnosed breast cancer tumors. One group of women were eating 25 grams of ground flax in a muffin each day and the other half were given a control muffin that was whole-wheat flour. The study lasted for approximately five and a half weeks and the women that ate the flax muffins showed significant reductions in breast cancer cell proliferation and the tumor growth was smaller compared with the women eating the whole-wheat flour muffins.

Flax and kidney disease :

Researchers at the University of Toronto found that ground flax reduced the inflammation of the kidneys and

improves the function of patients with chronic, inflammatory autoimmune disease with major health consequences, including renal failure, arthritis, thrombosis, and seizures. Patients with these conditions were given 15-45 grams of flax on a daily basis for a total of four weeks and they showed improved kidney function and reduced inflammation.

Flax and immune system :

Studies from the University of Toronto regarding the effects of flaxseed on the immune system have favourably shown that the body's ability to defend itself against bacteria and viruses is increased with the use of flaxseed.

Flax and ADHD :

The Department of Foods and Nutrition at Purdue University has found that boys who have been diagnosed with ADHD had significantly lower concentrations of certain EFAS in their blood. The use of flaxseed to increase this EFA level is a safe and beneficial treatment.

Flax and diabetes :

The University of Manitoba is currently studying the effects of ground flax and flax oil on blood glucose and insulin levels in people with type 2 diabetes. In the study so far flax consumption lowers the blood glucose level in healthy young adults. One study had six healthy volunteers fast overnight and in the morning they consumed a test meal containing 50 grams of bread with either ground flax or white flour. The blood glucose response was 28 per cent lower after eating the flax bread compared with the white flour bread.

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