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ENGROSSING DIETETIC RÉGIME OF PROPHYLACTIC FLAXSEEDS (*LINUM USITATISSIMUM* L.)

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Abstract
Preventing the occurrence of CVD with nutritional interventions is a therapeutic strategy that may warrant greater research attention. The increased use of omega ω-3 fatty acids is a powerful example of one such nutritional strategy that may produce significant cardiovascular benefits. Marine food products have provided the traditional dietary sources of ω-3 fatty acids. Flaxseed is an alternative to marine products. It is one of the richest sources of the plant-based ω-3 fatty acid, ALA. Based on the results of clinical trials, epidemiological investigations and experimental studies, ingestion of ALA has been suggested to have a positive impact on CVD. Because of its high ALA content, the use of flaxseed has been advocated to combat CVD. Amongst its other incredible nutrition facts, flax seeds are also packed with antioxidants. Lignans are unique fiber-related polyphenols that provide us with antioxidant benefits for anti-aging, hormone balance and cellular health. The purpose of the present review was to identify chemical constituents of flaxseeds and their exemplary therapeutic usage with special reference to ALA and, just as importantly, what is presently unknown.

Keywords
ALA, ω-3 fatty acid, Lignans, CVD, Phytoesterogens.

INTRODUCTION

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 means “very useful”, and it has two basic varieties: brown and yellow or golden (also known as golden linseeds). The flax plant is a small, single-stemmed annual that grows to about 2 ft (0.6 m) tall and has grayish green leaves and sky-blue flowers. Historically, flax has been cultivated for thousands of years. Linen made from flax has been found in the tombs of Egyptian pharaohs and is referred to in the Bible and in Homer's Odyssey. The Roman naturalist Pliny wrote about the laxative and therapeutic powers of flax in the first century AD, and many authorities believe it has been used as a folk remedy since ancient times. Flax is believed to be native to Egypt, but its origins are questionable since it has been used widely around the world. It is cultivated in many places, including Europe, South America, Asia, and parts of the United States 1-3 Flaxseed is one of the most important oilseed crops for industrial as well as food, feed, and fiber purposes. [1-3] 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 lignans, and fiber. Lignans appear to be anti-carcinogenic compounds. [4-5]The omega-3s and lignan phytoestrogens of flaxseed are in

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focus for their benefits for a wide range of health conditions and may possess chemo-protective properties in animals and humans.

Flax seeds come from flax which is a fiber crop that dates back to ancient Egypt. Flax seeds are thus, high in fiber. In addition to their fiber content they are a rich source of antioxidants as well as healthy fats. There are two kinds of flax seeds, golden and brown, that have very similar nutritional make ups. Flax seeds contain high concentrations of two essential polyunsaturated fatty acids— linoleic acid (x-6) and a-linolenic acid (x-3), which cannot be produced by the human body. Their oxidation occurs rapidly in the air. [3-6]

Fig. 1: Flaxseed plants.

Types of seeds

There are two main types of flaxseed: golden flaxseed and brown flaxseed. Their nutritional profiles are very similar and both contain the same number of short-chain omega-3 fatty acids. The ANA (American Nutrition Association) highlighted the importance of this "neglected food," stating that flaxseed is not only "an excellent source of two fatty acids that are essential for human health - linoleic acid and alpha-linolenic acid," but also, "an excellent source of fiber and a good source of minerals and vitamins.

Fig. 2: Golden flaxseed and brown flaxseed.

Flaxseed Nutrition Facts

One of the most extraordinary benefits of flax seeds is that they contain high levels of mucilage gum content. Mucilage is a gel-forming fiber that is water soluble and has incredible benefits on the intestinal tract. The mucilage can keep food in the stomach from emptying too quickly into the small intestine which can increase ient absorption. Also, flax is extremely high in both soluble and insoluble fiber which can support colon detoxification, fat loss and reduce sugar cravings. The ALA fats in flax seeds benefits the skin and hair by providing essential fats as well as b-vitamins which can help reduce dryness and flakiness. It can also improve symptoms of acne, rosacea, and eczema. This also applies to eye health as flax can reduce dry eye syndrome. The soluble fiber content of flax seeds trap fat and cholesterol in the digestive system so that it unable to be absorbed. [7-9]

Fig. 3: Various uses of flaxseeds in daily nutrition.

Soluble fiber also traps bile, which is made from cholesterol in the gallbladder. The bile is then excreted through the digestive system, forcing the body to make more, using up excess cholesterol in the blood and lowering cholesterol overall. Using flax is a great way to naturally replace gluten-containing grains which are inflammatory where flax is anti-inflammatory. [9-11] So, flax seeds are great for those who have Celiac disease or have a gluten-sensitivity. They may also be a good alternative to omega-3 fats in fish for people with a seafood allergy. Amongst its other incredible Nutrition facts, flax seeds are also packed with antioxidants. Lignans (- among all commonly eaten foods, researchers now rank flaxseeds as the no.1 source of lignans in human diets, containing about 7x as many lignans as the closest runner-up food (sesame seeds). They contain about 338x as many

lignans as sunflower seeds, 475x as many as cashew nuts, and 3,200x as many lignans as peanuts.) are unique fiber-related polyphenols that provide us with antioxidant benefits for anti-aging, hormone balance and cellular health24-26. Polyphenols support the growth of probiotics in the gut and may also help eliminate yeast and candida in the body. Lignans are also known for their anti-viral and antibacterial properties, therefore consuming flax regularly may help reduce the number or severity of colds and flus. Maybe the biggest flax seed benefits come from its ability to promote digestive health. The ALA in flax can help protect the lining of the digestive tract and maintain GI health. It has been shown to be beneficial for people suffering from Crohn's disease or other digestive ailments, as it can help reduce gut inflammation. Flax is also very high in soluble and insoluble fiber which can also improve digestive health and is one of the highest magnesium foodsin the world. Flax seed benefits have been proven time and time again and even including fighting breast, prostate, ovarian and colon cancer. [12-15] The three lignans found in flaxseeds can be converted by intestinal bacteria into enterolactone and enterodiol which naturally balance hormones which may be the reason flax seeds reduce the risk of breast cancer. The lignans in the flax have been shown to have benefits for menopausal women. It can be used as an alternative to hormone replacement therapy because lignans do have estrogenic properties. These properties may also help reduce the risk of osteoporosis. It can even help menstruating women by helping maintain cycle regularity. A study published in Nutrition Reviews has shown that approximately 20% of ALA can be converted into EPA, but only .5% of ALA is converted into DHA. Also, surprisingly gender may play a big role in conversion where young women had a 2.5-fold greater rate than men. Regardless of conversion, ALA is still considered a healthy fat and should be included in a balanced diet. [16-18] Flaxseeds or Alsi are not commonly included in our daily diet, but those tiny, brown seeds pack a lot of health benefits that you might not know about. Containing Omega-3 fatty acids (also known as 'good fat'), lignans (rich in antioxidants and estrogen content) and fiber, flaxseeds are great for your health, here's why.

Lignans present in flaxseed, are known to improve the blood sugar levels in type 2 diabetics. having flaxseed on a daily basis can help maintain your blood sugar levels over an extended period of time. Flaxseeds are great for your heart health. Not only do they help prevent the formation of plaque within your arteries, but they also prevent atherosclerosis (when the arteries become stiff and less elastic), reduce blood pressure, heart rate and beat oxidative stress (due to its antioxidant properties). Apart from that flaxseeds can help lower the levels of bad cholesterol (or LDL cholesterol) in check, protecting your heart. The high content of antioxidants and Omega 3 fatty acids protect against breast cancer, prostate cancer and colon cancer. The lignin content in flaxseed especially protects against tumours that are hormone sensitive eg. estrogen-sensitive breast tumours. [19-21] The omega 3 fatty acids, lignans and ALA (alpha-linolenic acid) present in flaxseeds are known to block the release of inflammatory agents and are especially beneficial for patients who suffer from diseases such as arthritis, and 'Parkinsons disease. Hot flashes is a problem that is commonly associated with menopausal women. If you suffer from this condition then flaxseeds can help. The antioxidant properties of flaxseeds help regularise the hormonal imbalnce responsible for hot flashes and a study found that women who had a spoon of flaxseeds regularly experienced a 57% drop in the intensity of hot flashes they experienced. [22-25] Flaxseed may also help to lower cholesterol, control high blood pressure, protect against heart disease, control constipation, heal haemorrhoids, prevent painful gallstones and dissolving existing ones, it promotes healthy hair and nails, treats acne, eczema, reduces cancer risk, treats menopausal symptoms, infertility and male impotence! Make sure to include any form of flax in your daily diet, it is a must for the gout sufferer. Flaxseed's oil is very high in Omega -3 fatty acids and levels vary from the types and colors of the flax seed, usually in a yellow or brownish color. Just one teaspoon contains about 2.5 grams, the equivalent of more than twice the amount most people get through their diets! Flaxseeds also provide you with calcium, magnesium and potassium, all of which are needed in any gout diet. Flaxseeds also have omega-6 fatty acids in the form of linoleic acid. Flaxseed oil only contains alpha-linolenic acid (Omega 3 oils), and not the fiber or lignan components. Flaxseed is also good for gout sufferers that can't eat any fish which is on the higher end in the purines scale since it may trigger gout attacks for them. [26-27] Fish oil or flax seed oil supplements are into existence for obtaining health benefits from omega 3 fatty acids. Omega 3 fatty acids are essential fatty acids as these cannot be synthesized in our body and must be obtained from food or supplements. Three types of omega-3 fatty acids are ALA (alpha- linolenic acid), EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid). Omega-3 supplements in the form of EPA and DHA are what offers many of the evidence based benefits when used in the body and can be supplemented with fish oil. Flax seed oil contains omega-3 in the form of ALA from which the body can make EPA and EPA is finally converted to DHA. But the ratio of conversion is not efficient. [28-30]

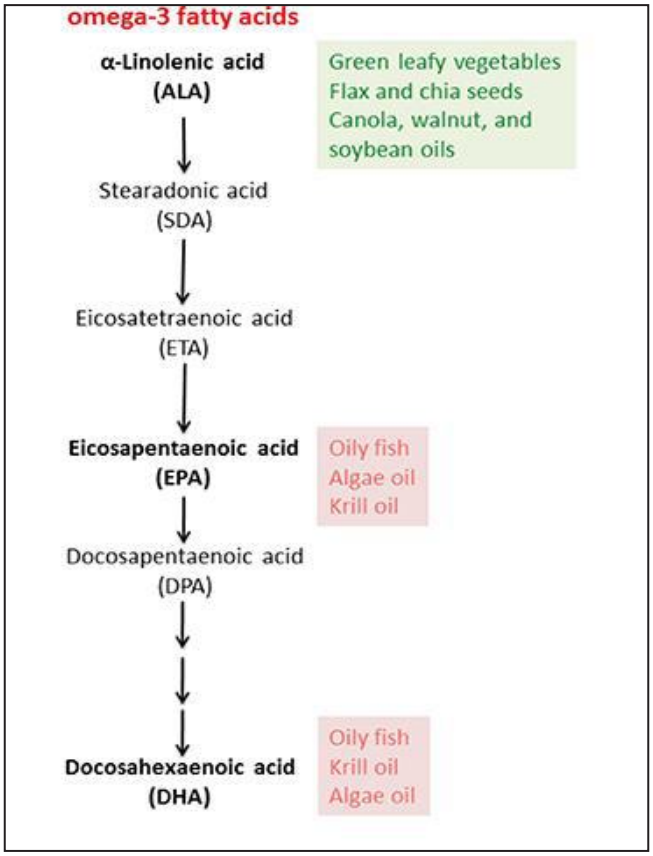
Fig. 4: Flaxseed oil.

Estimates of the rate of conversion range from 5% to 25%. Several factors further reduce the ability to convert ALA to EPA. For example with growing age this rate of conversion is diminished. ALA also competes metabolically with the other essential fatty acid omega-6. Too much of omega-6 in the diet leading to unbalanced fatty acid ratios also negatively affects the conversion. Looking at typical Indian diet excess of omega-6 through grains, cereals and cooking oil like sunflower oil is undeniable. Other factors like gender (conversion of ALA to EPA is limited in men and further transformation to DHA is very low.), medications, alcohol consumption, deficiency of certain micronutrients etc also affect the conversion rate. Thus, omega-3 fatty acid from flax seed cannot be considered substitute for omega-3 fatty acids from fish oil. [31-32] The best option for those who cannot have fish oil can be DHA rich algae oil. Fish consume algae and therefore are rich in DHA and EPA. Algae are the primary producers of DHA and EPA in the ecosystem, and several refined algal oils are rich sources of DHA. DHA is retroconverted to EPA following supplementation. Due to nontrivial retroconversion efficiency between omnivores and vegetarians, DHA supplementation represents an alternative to fish oil to increase blood and tissue levels of EPA, and DHA20-22.

Table 1: Nutritional value of flaxseed per 20 g (2 tbsp).

Energy - 54.7 kcal (DV = 3%)	Carbohydrates - 3.0 g (DV = 1%)
Sugars - 0.2 g	Dietary fiber - 2.8 g (DV = 11%)
Fat - 4.3 g (DV = 7%)	Saturated fat - 0.4 g (DV = 2%)
Monounsaturated fat - 0.8 g	Polyunsaturated fat - 2.9 g
Protein - 1.9 g (DV = 4%)	Thiamine (vit B1) - 0.2mg (DV = 11%)
Riboflavin 0.0mg	Niacin (vit. B3) - 0.3mg (DV = 2%)
Pantothenic acid (B5) - 0.1mg (DV = 1%)	Vitamin B6 - 0.0 mg
Folate - 8.9 mcg (DV = 2%)	Vitamin C - 0.1 mg (DV = 0%)
Calcium - 26.1mg (DV = 3%)	Iron - 0.6mg (DV = 3%)
Magnesium - 40.2 mg (DV = 10%)	Phosphorus - 65.8mg (DV = 7%)
Potassium - 83.3 mg (DV = 2%)	Zinc - 0.4mg (DV = 3%)

Source: USDA Database



Therapeutic Importance of Flaxseed Oil

Flaxseed oil is used medicinally. Linseed oil is the term usually used for the oil found in polishes, varnishes, and paints. Flaxseed oil is derived from the flax plant's crushed seeds, which resemble common sesame seeds but are darker. The amber oil is very rich in a type of fat called alpha-linolenic acid (ALA), an omega-3 fatty acid that is good for the heart and found in certain plants. High amounts of omega-3 fatty acids are found in fish and smaller amounts are found in green leafy vegetables, soy-derived foods, and nuts. Studies suggest that they can lower triglyceride levels and reduce blood pressure. Omega-3 fatty acids may also decrease the risk of heart attacks and strokes by preventing the formation of dangerous blood clots within arteries. In high dosages, the fatty acids may help to alleviate arthritis, though flaxseed products have not yet been shown to be effective for this purpose. In addition to omega-3 fatty acids, flaxseed products also contain potentially therapeutic chemicals called lignans. Lignans are believed to have antioxidant properties and may also act as phytoestrogens, very weak forms of estrogen found in fruits, vegetables, whole grains, and beans. Unlike human estrogen, phytoestrogens have dual properties: they can mimic the effects of the hormone in some parts of the body while blocking its effects in others. Many herbalists believe that phytoestrogens can be useful in the prevention or treatment of

a variety of diseases, including cancer , CVD, and osteoporosis . The estrogen-blocking effects of phytoestrogens may be particularly effective at combating certain cancers that depend on hormones, such as cancers of the breast or uterus. Women who consume large amounts of lignans appear to have lower rates of breast cancer . The fact that heart disease and certain cancers occur less frequently in Asian countries is sometimes attributed to a diet rich in plant foods containing phytoestrogens. [32-34]Flaxseed is sometimes referred to as a nutraceutical, a recently coined term that includes any food or food ingredient thought to confer health benefits, including preventing and treating disease. Several studies, some conducted in people, suggest that flaxseed products (or agents contained in them) may help to keep the heart and cardiovascular system healthy. Flaxseed products may lower cholesterollevels, help control blood pressure, and may reduce the buildup of plaque in arteries. Test tube and rat studies suggest that chemicals in flaxseed may help to prevent or shrink cancerous tumors. Due to its estrogen-like effects, some women use flaxseed oil to ease breast tenderness, alleviate symptoms of PMS (premenstrual syndrome), and help control menopausal symptoms. Flaxseed oil has also been recommended to treat skin conditions, inflammation, and arthritis. It is usually taken internally for all the purposes mentioned above. The oil may be used externally to help the healing of scalds and burns. More recently, flaxseed has been shown to be beneficial for people suffering from digestive disorders. It is now recommended as an "effective herbal agent" for treating IBS. [30-34]

Fig. 5: Flaxseeds and Flaxseeds Oil

Culinary asset

Finding creative ways to add flaxseeds to your meals can be a challenge. One popular technique is to incorporate ground flaxseeds into your muffin, cookie, or bread recipes. Recent research studies have shown that ground flax can be added to baked foods without sacrificing large amounts of alpha-linolenic acid (ALA), their showcase omega-3 fatty acid that accounts for over half of their total fat content. Oven temperatures of 300o F (150oC) - even over several hours of baking time - do not appear to substantially reduce the amount of ALA in baked products. This outcome has been demonstrated for breads, muffins and cookies. Even when flaxseeds are ground prior to incorporatation into breads and pastas, these preparation methods - involving grinding prior to heating - only appear to lower ALA levels by about 4-8%. Interestingly, bread enriched with ground flaxseed has also been shown to have a greater antioxidant capacity and a much lower GI(glycemic index) value (of ~ 51) than the same bread without the ground flaxseed addition. These research findings are great news for anyone who wants to include flaxseeds in baked dishes, in either whole or ground form. You could start off by having one tablespoon of ground flaxseed powder every morning on an empty stomach with a glass of warm water. Alternatively, you can even add it to your energy drink or fresh juice or include it in your meals by sprinkle one tablespoon of flaxseed powder on the dish you cook. Remember to not put the powder directly into hot oil, as the excess heat tends to deactivate the beneficial properties of flaxseed and may add a bitter taste to your food. Also do not have more than 2 tablespoons per day, as it can be detrimental to your health.

CONCLUSION

Flaxseeds are extremely good for one's health. They are a prime source of ω-3 fatty acids which makes them a must-have in one's diet especially if you are a vegetarian. Flax seeds also rich in Fe, Zn, Ca, Ca, K, Mg, protein, , folate, soluble fiber and even B. They are high in antioxidants which prevent free-radical damage by protecting healthy cells from getting damaged. Flax may be beneficial in suppressing the growth of breast and prostate cancers because when consumed, tumor cell proliferation goes down, cancer cell death increases, and c-erbB2 score is reduced. Combining flaxseed with dietary fat restriction may have an even greater effect on prostate cancer. Eating only 1 tbs of ground flaxseed a day may help prevent and reverse diabetes. Eating flaxseeds may also diminish skin sensitivity and improve skin barrier function and condition. Because lignans are activated by our gut bacteria, taking antibiotics may impair the production of the lignans. They also contain dietary fibre which is essential for regulating proper bowel movements. Fibre prevents constipation and also keeps you fuller for a longer time. So

people who are on a weight loss diet should eat flaxseeds regularly. When flaxseeds are compared with other commonly eaten foods in terms of their total polyphenol content (polyphenols are one very important group of antioxidants), flaxseeds rank 9th among 100 commonly eaten foods. Flaxseeds turn out to be significantly higher in polyphenol antioxidants than fruits like blueberries or vegetables like olives. The antioxidant benefits of flaxseeds have long been associated with prevention of cardiovascular diseases and have recently also been tied to decreased insulin resistance. Flaxseeds also help keep lifestyle diseases like diabetes, high BP, heart disease at bay.

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