Ground
Flaxseed
Protein

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Ground Flaxseed Protein

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- The use of plant-based protein is a significant trend in the healthy food sector.
- Flaxseed is a rich source of protein and contains no gluten.
- Protein in flaxseed has several health benefits including assisting in the reduction of heart disease, hypertension and diabetes.

The use of plant-based protein is a significant trend in the healthy food sector. Protein rich foods are important to consumers who perceive health benefits relevant to all family members.[1] In the Shopping for Health 2014 survey, 33 percent of U.S. shoppers indicated that protein content is an essential criterion when purchasing foods.[2] When making decisions about buying packaged food or beverages, 57 percent of Americans surveyed by the International Food Information Council (IFIC) stated that consuming more protein was an important characteristic in food choice.[3] The primary reasons included: "protein is an important component for a balanced diet" (76%); "to gain energy" (62%), "to build or maintain muscle strength" (56%), and "for satiety" (51%).

As a result of consumer demands, there has been a shift in the food industry away from animal-based proteins toward the use plant-derived sources that offer similar or superior functional properties. Some of the possible reasons for this shift are:

- Health benefits associated with eating plant-based diets[4]
- Concerns about animal welfare in food production systems[5]

The Importance of Protein

Protein is an essential nutrient required in the diet for growth and development, and for the maintenance of cellular structures, organs and muscle mass. Proteins are large organic compounds made of one or more chains of amino acids (AA). The AA sequence of a protein determines its three-dimensional structure. Proteins are essential components of all living organisms and are intimately involved in most cellular functions.

There are nine essential amino acids: isoleucine, leucine, lysine, threonine, tryptophan, methionine, histidine, valine and phenylalanine. Non-essential amino acids are those that the body can manufacture and include: glutamic acid, alanine, aspartic acid, asparagine, glutamine, arginine, proline, serine, tyrosine, cysteine, and glycine.[6]

Proteins can be synthesized when there are sufficient quantities of all necessary AA available. If essential amino acids (EAA) are lacking, the body will be unable to make proteins and will have to break down muscle proteins to meet requirements.

Proteins from animal sources such as meat, poultry, fish, eggs, milk, cheese and yogurt, provide all nine EAA and are referred to as "complete" or "high quality" proteins. Plant proteins (from cereals, pulses, nuts, seeds, and vegetables) are low in one or more specific EAA and are therefore considered to be "incomplete" proteins. By combining various plant proteins from different sources it is possible to improve the overall EAA profile thereby achieving "complete" or "high quality" protein. EAA requirements can be met exclusively by plant proteins if a variety of plant sources are consumed to meet energy needs.[7]

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Protein Requirements

The Recommended Dietary Allowance (RDA) of high quality protein (i.e., complete and/or complementary proteins) for both men and women is 0.80 g per kg body weight per day.[6] The Acceptable Macronutrient Distribution Range (AMDR) is "the range of intake for a particular energy source that is associated with reduced risk of chronic disease while providing intakes of essential nutrients". For protein, the AMDR is 10-35%.[6]

Emerging research suggests that protein requirements may be somewhat higher than the levels established by the Institute of Medicine,[8] although this evidence has not yet prompted a revision of the recommendations.

A dietary plan that includes 25–30g of high quality protein per meal may help to maximize muscle protein synthesis. Dividing protein intake evenly throughout the day may be a particularly important consideration for elderly populations who are at increased risk for sarcopenia, the degenerative loss of skeletal muscle mass that occurs with aging.[9]

Flaxseed as a Dietary Protein Source

Flaxseed (*Linum usitatissimum*) is a rich source of protein, fat, and dietary fibre to support a healthy lifestyle. On average, Canadian flaxseed contains 41% fat and 28% total dietary fibre. The protein content of flaxseed varies from 20 to 30 %[10] constituting approximately 80% globulins and 20 % glutelin.[11] Flaxseed contains no gluten.

Table 1. Protein and amino acid content of select oilseeds[12]

	Flaxseed g/100 g	Soybean g/100 g	Chia g/100 g	Corn, yellow g/100 g
Protein	19.290	16.640	16.540	9.420
Tryptophan*	0.297	0.242	0.436	0.067
Threonine*	0.766	0.723	0.709	0.354
Isoleucine*	0.896	0.807	0.801	0.337
Leucine*	1.235	1.355	1.371	1.155
Lysine*	0.862	1.108	0.970	0.265
Methionine*	0.370	0.224	0.588	0.197
Cysteine	0.340	0.268	0.407	0.170
Phenylalanine*	0.957	0.869	1.016	0.463
Tyrosine	0.493	0.630	0.563	0.383
Valine*	1.072	0.831	0.950	0.477
Arginine	1.925	1.291	2.143	0.470
Histidine*	0.472	0.449	0.531	0.287
Alanine	0.925	0.784	1.044	0.705
Aspartic acid	2.046	2.093	1.689	0.655
Glutamic acid	4.039	3.224	3.50	1.768
Glycine	1.248	0.770	0.943	0.386
Proline	0.806	0.974	0.776	0.822
Serine	0.970	0.965	1.049	0.447

**Essential amino acids*

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The amino acid profile of flaxseed is similar to that of other oilseeds (*Table 1*) and especially to that of soybeans.[12] Whole and milled flaxseed, oil-extracted flaxseed meals, and isolated flaxseed proteins have high levels of glutamic acid/glutamine, arginine, and branched-chain amino acids (valine and leucine) and are low in aromatic amino acids (tyrosine and phenylalanine).[10] Flaxseed protein is not considered to be a complete protein due to the limiting EAA, lysine.[13]

The protein in flaxseed can make an important contribution to overall protein intake, particularly for vegetarians or people trying to consume less animal products. In a world that is striving to feed a rapidly expanding population, choosing more plant-based foods is becoming an increasingly popular strategy among health- and environmentally-conscious consumers seeking more sustainable diets.

The Health Benefits of Plant-based Proteins

The Academy of Nutrition and Dietetics states that "appropriately planned vegetarian diets, including total vegetarian or vegan diets, are healthful, nutritionally adequate, and may provide health benefits in the prevention and treatment of certain diseases. Well-planned vegetarian diets are appropriate for individuals during all stages of the lifecycle, including pregnancy, lactation, infancy, childhood, and adolescence, and for athletes."[7] Vegetarian diets tend to be lower in saturated fat and cholesterol, and higher in dietary fibre, magnesium, potassium, vitamin C, vitamin E, folate, carotenoids, flavonoids, and other phytochemicals.[7] Nutrients that are at greater risk of being inadequate in vegetarian diets include vitamin B12, calcium, vitamin D, zinc, and long chain omega-3 fatty acids.[7]

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Cardiovascular Disease

Cardiovascular disease (CVD) has been the number one killer worldwide during the past decade.[14] Vegetarian diets are associated with a number of cardiovascular benefits, including lower blood cholesterol and blood pressure as well as decreased risk of type 2 diabetes.[7] The Academy of Nutrition and Dietetics reported that vegetarian diets are linked to a lower risk of death from ischemic heart disease.[7]

Research over the past five decades has demonstrated that plant proteins produce cholesterol-lowering effects in comparison to animal proteins, which in general, can be more cholesterolemic and atherogenic. Plant protein intake appears to be inversely associated with CVD mortality.[15] Several factors have been suggested to explain these results. The ratio of amino acids in plant versus animal protein may be one reason.[16] Animal protein may also exert hypercholesterolemic effect through an increased absorption and decreased turnover of cholesterol.[16]

Flaxseed protein has been shown to be more effective in lowering plasma cholesterol and triglycerides compared to soy protein and casein protein.[17] Studies with flaxseed protein suggest that its lower ratio of lysine to arginine may be related to hypocholesterolemic effects.[18] Arginine is the substrate of nitric oxide synthase (NOS) which generates nitric oxide (NO), a vasodilator and an inhibitor of platelet aggregation. The higher arginine levels in flaxseed protein may be in part responsible for anti-atherogenic and antithrombotic effects.[17]

Flaxseed and Cardiovascular Disease

In 2014, Health Canada approved a health claim for flaxseed based on evidence that linked ground (milled) whole flaxseed with reductions in blood cholesterol.[19] The research supporting the claim demonstrated that flaxseed decreased total cholesterol and LDL cholesterol levels by 0.21 mmol/L and 0.22 mmol/L, respectively.[19] This has clinically relevant implications since every 0.0259 mmol/L reduction in LDL-C is estimated to reduce total mortality by 1%.[20] The health claim for flaxseed does not attribute the cholesterol lowering characteristics to any one individual nutrient, but suggests that a combination of the ALA, lignans, fibre and protein may all contribute to the positive effects on cholesterol lowering reported with flaxseed consumption.

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Flaxseed and Hypertension

Hypertension, known as the "silent killer", represents a global health crisis contributing to 9.4 million deaths per year and affecting more than 40% of adults aged 25 years and older. If left uncontrolled, hypertension can lead to heart attacks, strokes, kidney failure, blindness, dementia, and peripheral arterial disease (PAD, which is a serious plaque build-up in the arteries of arms and legs).[21]

A double blind randomized controlled trial found that in PAD patients who received ground flaxseed, systolic blood pressure decreased by 10 mm Hg and diastolic blood pressure decreased by 7 mm Hg compared to placebo.[22] This is one of the most potent antihypertensive effects observed as the result of a dietary intervention and is even more significant than some common drugs used to treat the disease.[22]

In adults with metabolic syndrome, 30 g/d of whole ground flaxseed combined with lifestyle counseling lowered blood pressure by 8.8/5.0 mmHg in 12 weeks.[23] The consumption of 40 g/d of whole ground flaxseed reduced blood pressure by 5.0/4.1 mmHg in healthy post-menopausal women after one year compared to baseline.[24]

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Bioactive Peptides in Flaxseed Protein

Hydrolysate peptides (short amino acid sequences) isolated from flaxseed show potent blood pressure lowering properties.[25] Blood pressure is controlled through a series of enzyme reactions known as the renin-angiotensin cascade, the most important of which is the Angiotensin Converting Enzyme (ACE). ACE converts Angiotensin I to Angiotensin II which increases blood pressure by causing constriction of the arteries and stimulating the release of aldosterone in the adrenal cortex, which enhances salt retention and water by the kidneys. Angiotensin II can also degrade bradykinin, a vasodilator. The ultimate result of these actions is an increase in blood volume and hence pressure.[26] Flaxseed protein hydrolysates have been shown to inhibit ACE activity and reduce the production of Angiotensin II[27] thereby lowering blood pressure.[28]

As noted, flaxseed is also relatively rich in arginine, the precursor of NO, the underproduction of which can cause vasoconstriction and an increase in blood pressure. In contrast, an overproduction of NO can cause oxidative damage and an inflammatory response.[29] Activity of NOS is dependent upon the protein, calmodulin. Flaxseed hydrolysate fractions have been reported to reduce NOS activity by modifying the structure of calmodulin,[29] thus re-balancing NO levels and reducing the onset of oxidative stress and inflammation. Additionally, peptide sequences derived from flaxseed in particular, hydrolysates rich in the amino acids, lysine and leucine, show antioxidant properties, the ability to 'quench' damaging free radicals and provide protection against lipid peroxidation.[30]

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Diabetes

The number of adults with diabetes worldwide has more than doubled over three decades and is now estimated to be 8.3%, or 371 million people.[31] Studies indicate that nutrition therapy aimed at improved glycemic control can significantly lower hemoglobin A1C by approximately 1% in type 1 diabetes and 1-2% in type 2 diabetes within 3-6 months.[32] Glycated hemoglobin occurs when glucose molecules attach to the hemoglobin in red blood cells. A hemoglobin A1C value of ≥6.5% is a criterion for the diagnosis of diabetes.[33]

In a randomized cross-over study, overweight or obese men and women with pre-diabetes who consumed 13 g of ground flaxseed for 12 weeks showed improved fasting insulin and glucose as well as insulin sensitivity compared to controls.[34] Following one month on a 10 g/day supplement of ground flaxseed, fasting blood glucose and hemoglobin A1C were found to be significantly reduced in type 2 diabetics.[35] Flaxseed peptides may play a role in alleviating diabetic hyperglycemia through improving glucose intake as demonstrated in an in vitro study.[28]

Emerging research is suggesting that specific peptide sequences of flaxseed protein may have therapeutic benefits for cardiovascular disease, including lowering blood cholesterol and blood pressure as well as improving antioxidant defenses and decreasing the risk of type 2 diabetes.

HealthyFlax.org is the source of information on the health benefits and uses of whole flaxseed, ground flaxseed and flaxseed oil. Our website includes recipes, nutritional evidence, facts and news about flaxseed in all its forms. HealthyFlax.org is supported by Canada's flax growers, processors, food manufacturers and governments. For more information, email us at info@healthyflax.org

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