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Flaxseed: A Nutritional Smash for Superior Health

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***Abstract*—** Flaxseed is mainly considered as oilseed crop. Moreover, the other nutritional parameters than its oil content, make it more favorable choice for food technologist to develop functional foods. Several studies reveal that these components work well for nutritional benefit in human being. Scientific evidence supports flaxseed consumption; however, a large sector of the population is still unaware of the benefits associated to its consumption and its possible applications as functional food ingredient in foodstuffs. Flaxseed is mainly known by its high alpha-linolenic acid content, but it is also a lignan source, soluble fibre and protein, compounds which are biologically active in the prevention of some non-transmissible chronic diseases. Flaxseed dietary fiber exhibits positive effect to reduce constipation, to keep better bowel movement and as hypocholestermic agent. As compared to soyabean and canola, flaxseed antinutrient effect on human health is very less. Researchers reported that flaxseed incorporated food products can have good consumer acceptability along with its nutritional benefits.

***Keywords*—** Flaxseed; oil; protein; lignan.

I. INTRODUCTION

Nutrition is an environmental factor of major importance. Flaxseeds are scientifically known as *Linumusitatissimum*L and in Latin *usitatissimum*means 'most useful'. Flaxseed is also known as Linseed. Plant products have gained the well deserved attention. *Linumusitatissimum* cultivated commercially as a field crop is generally considered as a non- edible oilseed [1]. Flax plant has small, narrow leaves that are less than an inch long. Stems are branched near the base of plant. The height of plant varies from 30 to 36 inches [2]. Flax seeds are flat and oval with pointed tip and their color varies from darkbrown to yellow [3].Flaxseed is a multi-farious crop [4].Flaxseeds have been classified as functional food because it provides numerous health benefits in addition to serving as a source of nutrients. Functional attributes of many traditional foods are being discovered. Flaxseed continues to surge forward in its recognition as a functional.Flaxseed is grown either for the production of oil or fiber [5-7].

Flaxseed is the richest source of the mammalian lignin. Flaxseed are rich in alphalinolenate, soluble fiber mucilage and mammalian ligan precursors. Flaxseed rich in the essential omega-3 fatty acid and many phytochemicals. Flaxseeds combined with an abundance of omega-3 fatty acids makes them an increasingly popular addition to the diets of many a health conscious consumer.Flaxseed also provides dietary fiber and proteinan was singled out as one of six neutraceuticals [8]. Flaxseed is thought to be one of the oldest cultivated crops [9]. Flax seeds have been consumed as food for around 6,000 years and may have very well been the world first cultivated superfood.

II. FUNCTIONAL FOOD

Belief in the medicinal power of foods is not a recent event but has been a widely accepted philosophy for generations [10]. Although Hippocrates may not have started the functional foods movement, he stated almost 2,500 years ago, ''Let food be thy medicine and medicine be thy food.'' Today, consumers' beliefs in the health benefits of selected foods and their components appear to be increasing at an unprecedented pace [10].

The main role of diet is to provide nutrients to meet host physiological requirements. As research behind diet and health has evolved, so has the concept of 'functional foods' become popular. Foods which are touted as being 'functional' are thought to exert certain positive properties over and above their normal nutritional value [11]. The range of functional foods that have potential benefits for health has grown tremendously. Examples include baby foods, bakery and cereals, confectionery, dairy food, ready meals, snacks, soft drinks such as energy and sport drinks, meat products and spreads [11, 12]. These functional foods are associated with various types of benefit, looking particularly at vitamin and mineral fortification, cholesterol reduction, antioxidants, phytochemicals, dietary fibre, herbs and botanicals, and probiotics, prebiotics and synbiotics, organic and inorganic micronutrients, vitamins, some proteins (e.g. lactoferrin), certain bioactive peptides and polyunsaturated fatty acids [11, 12].

The demand for flax in food and beverages, functional foods and dietary supplements hasrisendramatically [9]. Flaxseed is considered to be a complete functional food due to the presence of α-linolenic acid [13].

III. NUTRITIONAL COMPOSITION OF FLAXSEED

The major nutritional components of flaxseed include oil, lignin rich fibres, protein and minerals.Flaxseed has become known as a functional food due to its nutritional composition. Positive effects on disease prevention providing health-beneficial components [13]. Flaxseed is high in most of the vitamins, magnesium and manganese [14] and is low in saturatedfatty acids. Flaxseed is a source of good-quality protein and albumins and globulins are the storage proteins of flaxseed with globulins forming the highest portion [15].

IV. CHEMICAL COMPOSITION OF FLAXSEED

The seed contains approximately 40% lipids, 30% dietary fibre and 20 % protein. The chemical composition varies considerably among varieties and also depends on the

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environmental conditions in which the plant is grown. Cotyledons contain 75% of the lipids, and 76% of protein is found in the seed. The endosperm contains only 23% of the lipids and 16% of protein [16, 17]. Table I shows the chemical flaxseed composition.

TABLE I. Chemical composition of flaxseed.

Humidity %	Protein %	Lipids %	Fibre %	Ash %	Reference
7.4	23.4	45.2	-	3.5	(18)
4 – 8	20 – 25	30 – 40	20 – 25	3 – 4	(19)

V. FLAXSEED LIGAN

Flaxseed is the richest source of lignin, which contains tens to hundreds times more than most other edible plants .After consuming flax seeds, plant based lignans are converted into mammalianlignans– enterodiol and enterolactone [20]. Lignans are found in most fiber-rich plants, including grains such as wheat, barley, and oats; legumes such as beans, lentils,and soybeans; and vegetables such as garlic, asparagus, broccoli, and carrots [21, 22]. Flax is a particularly rich source of a lignan called secoisolariciresinoldiglycoside (SDG). SDG is a plant lignan that is converted by bacteria in the colon of humans to mammalian lignans known as enterodiol (ED) and enterolactone (EL). Lignans arediphenolic compounds of higher plants formed by the coupling of two coniferyl alcohol residues that are present in the plant cell wall [24, 24]. SECO is portion of SDG. [2,3-di(methoxy- 4-hydroxybenzyl) butane-1,4-diol]. SECO is the major lignan present in flaxseed, which is found as the conjugate diglycoside SDG [25]. Whole seed and ground flax typically contain between 0.7%and 1.9% SDG [26].

VI. FLAXSEED FIBER

Fibre, the component which gives volume and form to the majority of foodstuff. There are two types of fibre, soluble and insoluble. Insoluble fibre is composed of substances such as cellulose, hemicellulose and lignin. Whole-grain cereals present the greatest quantity of this type of fibre. Soluble fibre forms a gel in the presence of water. Flax contains polysaccharides which, due to their anti-hypercholesterolemic, anti-carcinogenic and glucose metabolism controlling effects, may prevent or reduce the risk of various important diseases, such as diabetes, lupus nephritis, arteriosclerosis and hormone-dependent types of cancer [27, 28].

VII. FLAXSEED PROTEIN

Flax protein is relatively rich in arginine, aspartic acid. The limitingaminoacids are lysine, methionine and cysteine [29]. 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.

VIII. FLAXSEED FATTY ACIDS

Flaxseed provides a unique mix of fatty acids. Flaxseed is rich in the essential omega-3 fatty acid, alpha linolenic acid. The omega-3 fattyacids have biologic effects that make them useful in preventing andmanaging chronic conditions such as type 2 diabetes, kidney disease,rheumatoid arthritis, high blood pressure, coronary heart disease,stroke, Alzheimer disease, alcoholism and certain types of cancers [30]. The high alpha linolenic acid content of flaxseed oil. Observed protective effects of omega-3 fatty acids on cancer haveled to the hypothesis. The fatty acid composition of flaxseed may render it protective against cancer [31].

IX. HEALTH BENEFITS

The various health benefits associated with the consumption of flaxseeds are given as below:

Maintains the health of heart

Flaxseed confers its health benefits on heart due to the presence of α-linolenic acid and omega -3 fatty acid [32, 33]. Fatty acids regulate gene transcription and expression. Then altering enzymesynthesis and modify several risk factors for coronary heart diseases. Heart diseases including reducing serum triglycerides and blood pressure.Flaxseed and its components improve cardiovascular health. Flaxseeds are a rich source of lignans, they may prove to be beneficial for reducing the cardiovascular diseases (CVDs). Dietary flaxseed supplementation prevent hypercholesterolemia-related heart attack and strokes [34].

Reduction of inflammation

Flaxseed possess anti-inflammatory activity [35, 36]. Lignans and ALA in flax help to preventinflammation that affects the body's immune system [37]. Dietary fatty acids present in flaxseed gets converted into prostaglandins which are also important for regulating inflammation.

Anti-cancerous properties

Flaxseeds is in present the secoisolariciresinol (SDG). That gets converted into active mammalian lignans - enterodiolaandentero-lactone, which have the potential to reduce the growth of cancerous tumors [38, 39]. Lignans have an antioxidant activity and contributed to the anti-cancerous activity of flaxseed [40-43]. Lignan, enterodiol and enterolactone are believed to be responsible for inhibiting the growth of human prostate cancerous cells [44]. Flaxseed and flaxseed meal (FLM) decrease the risk of cancer [45].

Anti–diabetic function

Blood glucose values were improved by ingestion of flaxseed fibre. Daily lignan supplementation resulted significant improvements in glycemic control in type 2 diabetic patients [46]. Flaxseed lignin, SDG reduced high-fat diet. They improved hyperlipidaemia, hypercholesterolemia, hyperinsulinaemia and hyperleptinaemia. These effects may prevent obesity and may reduce cardiovascular risk associated with lifestyle diseases, such as diabetes, atherosclerosis and hypertension. Dietary fiber are a promising food to help decrease the risk of lifestyle related diseases such as a diabetic [47]. World Health Organization researchers published an open-label the effect of flax seed powder supplementation in the management of diabetes.

X. CONCLUSION

Globally, Flaxseed is grown as either oil crop or a fiber crop with fiber linen derived from the stem of fiber varieties

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and oil from the seed of linseed varieties [48, 49]. The plant is native to west Asia and the Mediterranean. As the source of linen fiber flax has been cultivated since at least 5000 BC, today it is mainly grown for its oil [50]. Although flaxseed has been well known since ancient times, at present it is not massively used in the formulation of foodstuffs; however its popularity has increased thanks to recent studies. Flaxseed contains important quantities of compounds with functional and bioactive properties, such as alpha-linolenic acid, lignans, soluble fibre and protein, whose effects on the prevention of certain non-transmissible chronic diseases have been tested. These characteristics make flaxseed an attractive source of functional ingredients for the preparation of foodstuffs.

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