Print ISSN: 2958-3675 | Online ISSN: 2958-3683
International Journal of Medical and Pharmaceutical Research
Available Online at https://ijmpr.in/
ORCiD ID: 0000-0002-3849-6959
Volume 3, Issue 2; Jul-Dec 2022; Page No. 15-22
Original Article
Open Access

A Review On Application And Benefits Of Flax Seed (*Linum Usitatissimmum L.*)

Vikash Chandra[1]; Ruchi Mishra[2]; Ravindra Singh[3]; Navneet Kumar Verma[4*]
[1]Faculty of Pharmacy, Uttar Pradesh University of Medical Sciences Saifai Etawah UP. 206130
[2]Assistant Professor, B.P.S. Educational Institution of Pharmacy, Etah, U.P, India
[3]Assistant Professor, Buddha Institute of Pharmacy, GIDA, Gorakhpur, UP, India-273209
[4]Associate Professor, Buddha Institute of Pharmacy, GIDA, Gorakhpur, UP, India-273209

ABSTRACT
The review is supported by earlier research that shows how much influence climatic factors have on plant development and quality. Geographical studies of plant molecular diversity can provide significant information about plant growth and improve plant germplasm, medical benefits, and uses, but such studies are lacking for cultivated flax (*Linum usitatissimum L.*). Flax is one of the five most important oil crops on the planet and the third-largest naturally harvested source of fibre. Because of its small size and characteristics that promote self-fertilization, flax is frequently used as a model plant for the best plants. The climate and soil types had a huge impact on flaxseed yields, however the next generation of yields showed little effect from plant thickness. Cultivated flax exhibits a greater diversity of generative plant parts, whereas pale flax fluctuates exhibit a greater number of vegetative plant parts. In particular, the effects of domestication are taken into consideration when considering the range of variation, hereditarily based variety, heritability, and connectivity of a few traits. The effectiveness of agriculture, farm revenue, and food security may be affected by higher developing season temperatures in various areas. Planting was delayed, which caused the natural temperature to rise during the conceptual development of harvest, resulting in lower seed quality. The results showed that planting climate has an impact on the features of development, yield, and its segment as well as oil yield. These results are significant for comprehending the domestication of flax and are also useful for classifying intra specific cultivars of flax, establishing a core subset of the flax assortment, and looking into new sources of characteristics for flax enhancement.

Keywords: *Linum usitatissimum; growth performance; cultivators; seed and oil yields; genetic diversity*

***Corresponding Author**
Navneet Kumar Verma
Associate Professor, Buddha Institute of Pharmacy, GIDA, Gorakhpur, UP, India-273209

INTRODUCTION

Linseed (*Linum usitatissimmum*) and flax seed (*Linum usitatissimmum*) are two words that are frequently used interchangeably. It is commonly referred to as Alsi, Jawas, and Akse bija in Indian languages[1]. The Latin name of the flaxseed is Linum usitatissimum, which means "extremely useful"[2]. Flaxseed was first brought to the United States by colonists, largely to manufacture fibre for garments. In the past, flaxseed was used to make cloth and paper, and now, animal feed is made with flaxseed oil and its byproducts [3]. Flaxseeds come from an annual herb with blue flowers in the Linaceae family. The height of a flax plant ranges from 12 to 40 inches[4]. It has a thin, fibrous stem, and its bright blue blossoms can reach a diameter of 3 cm [5]. The flowers have five petals and are arranged into a five-celled ball that can hold up to 10 seeds. Till plant growth stops, flowers will continue to bloom. The five compartments in the spherical fruit capsules hold two seeds apiece. The whole flaxseed is flat and oval with pointed tips and contains a seed coat or true hull (also known as testa), a thin endosperm, two embryos, and an embryo axis. Fiber flax types are tall, unbranched plants that are grown at extremely high densities to enhance fibre output. It has a glossy, smooth surface. Flaxseed comes in a variety of colours, ranging from dark brown to yellow[6,7]. It has a crisp, chewy texture and a pleasant, nutty flavor[8]. Different varieties, including Sheela, Sweta, Garima, Sharda, Rashmi, Shikha, Padmini, Shekhar, Neelam, LC-2063 and LC-2023, have been developed for oilseed and fibre flax [9]. Oilseed flax varieties typically have short In terms of area, India ranks first among the top flaxseed producers, accounting for 23.8% of the total, and third in production, contributing to 10.2% of global production[10,11]. Flaxseed is mostly grown in Madhya Pradesh, Maharashtra, Chhattisgarh, and Bihar in India. Almost every component of the linseed plant is used in some way. Flaxseed and flaxseed oil are thought to have potential health benefits due to the presence of various biologically active compounds and elements, including linolenic acid, linoleic acid, lignans, cyclic peptides, polysaccharides, alkaloids, cyanogenic

glycosides, and cadmium. It enjoys a good status among oilseeds because of its versatility[12,13]. Seed contains oil that after refining is used for Due to its extraordinarily high levels of alpha-linolenic acid (ALA), dietary fibre, high-quality protein, and phytoestrogens, it has become a compelling nutritional meal. Due to the potential health benefits linked to some of its biologically active components—ALA, lignan-Secoisolariciresinol diglycoside (SDG), and dietary fiber—flaxseed has been attracting the attention of nutritionists and researchers in the field of diet and disease research over the past 20 years [14]. The roots of L. Usitatissimum contain detectable levels of lignans and isoflavones[4]. Flaxseed is becoming more and more popular due to its potential for lowering the risk of cardiovascular disease, cancer risk, especially that of the mammary and prostate glands, anti-inflammatory activity, laxative effect, and relief of menopausal symptoms and osteoporosis [15]. Flaxseed has new prospects as a functional food at the moment due to consumers' growing interest in food with. Because of its excellent nutritional profile and potential health benefits, flaxseed has gained popularity as an ingredient in diets designed specifically for specific health benefits [16]. Flaxseed is well-known for its content of chemical compounds with specific biological activity and functional properties like solubility, thermal stability, emulsifying properties, electrostatic charge density, water holding and fat absorption capacities. The protein content of the seed decreases as the oil content increases [17]. The nutritional content of brown and yellow flaxseed is essentially the same [18]. The amount of pigment present determines the colour of the seed coat, a characteristic that may be altered using standard plant breeding techniques. Omega 3 fatty acid sources are advised to be included in the diet by nutritionists all over the world. The finest supply of omega 3 fatty acids for people who don't eat seafood is flaxseed. Whole flaxseed, pulverised flour, and extracted oil or mucilage are all examples of edible flaxseed products. These products are designed to be used as dietary supplements when preparing a variety of foods, including bread, muffins, spaghetti, fibre bars, salad toppings, ready-to-eat cereals, baked cereal goods, and meat extenders[10,11].

Nutrient composition

The protein content in flaxseed has been reported to between 10.5% and 31%.12 Khategaon cultivars grown in India had a protein content of 21.9%[19]. Differences in protein can be attributed to both genetics and environment. The proximate protein content of dehulled and defatted flaxseed varied considerably depending upon cultivar growth location and seed processing. However, the dehusked and defatted meals have high protein content[20]. The major proteins in flax is albumin and globulin. Globulin fraction makes up to 73.4% and the albumin constitutes about 26.6% of total protein. Flaxseed proteins are relatively high in arginine, aspartic acid and glutamic acid, while lysine is limiting[10,11,21]. High cysteine and methionine contents improve the antioxidant levels, thus helps in reducing risk of cancer.12 Total amino acid content of the flaxseed after 8 days of germination increased by 15 times with greatest increase (i.e. 200 times) being observed in glutamine and leucine compared to the original seed The total nitrogen content is 3.25 g/100 g of seed[22]. Flaxseed proteins exhibit antifungal properties against Alternaria solani, Candida albicans and Aspergillus flavus[23,24]. Flaxseed is the richest plant source of w-3 fatty acid i.e. a-linolenic acid (ALA), low in saturated fatty acids (9%), moderate in monounsaturated fatty acids (18%), and rich in polyunsaturated fatty acid (73%). Moreover it is considered to be a source of a-Linolenic Acid (ALA), ALA has greater bioavailability in oil than in milled seed, and has greater bioavailability in oil and milled seed than in whole seed[25]. Omega-3 and omega-6 fatty acids are the two groups of omega fats. There are three types of omega-3 fatty acids which are of nutrition importance namely, Linolenic acid, eicosapentaenoic acid (EPA) and docosahexanoic acid (DHA). All three fatty acids have been shown to reduce the risk of cardiovascular disease[2]. Flax contains a mixture of fatty acids. It is rich in polyunsaturated fatty acids, particularly a-Linolenic Acid, the essential omega-3 fatty acid, and linoleic acid (LA), the essential omega-6 fatty acid. These two polyunsaturated fatty acids are essential for humans – that is, the body needs them. ALA and Linoleic acid constitutes 57% and 16.0 % of total fatty acids respectively in flax making the richest source of ALA. ALA, being the essential fatty acid, requirement can be fulfilled by intake of flaxseed products[18]. It also constitutes about 28% of dietary fiber. Diets rich in dietary fibre may help reduce the risk of heart disease, diabetes, colorectal cancer, obesity and inflammation[18]. The proportion of soluble to insoluble fiber varies between 20:80 and 40:60.3 However, flax is low in carbohydrates (sugars and starches), providing only 1 g / 100 g. For the reason that flax contributes little to total carbohydrate intake, it's recommended for the individual with specific diseases. Flaxseed polysaccharide is composed of two major fractions: a neutral arabinoxylan (75%) and an acidic rhamnogalacturonan (25%)[26]. It serves as a good source of minerals especially, phosphorous (650 mg/100 g), magnesium (350–431 mg/100 g), calcium (236–250 mg/100 g) and has very low amount of sodium (27 mg/100g)[1]. It contains highest amount of potassium 5600–9200 mg/kg among various foods and high potassium intake is inversely related to blood platelet aggregation, free radicals in blood and stroke incidence.8 Flaxseed contains small amounts of water-soluble and fat-soluble vitamins. Vitamin E is present as gtocopherol, amounting to 39.5 mg/100 g. g-tocopherol is an antioxidant providing protection to cell proteins and fat from oxidation; promotes sodium excretion in urine, which may help in lowering of blood pressure and heart disease risks and Alzheimer disease[1]. Besides it contain a good amount of phenolic compounds. These phenolic compounds are well known for anticancer andanti-oxidative properties. Basically, flaxseeds have three different types of phenolic compounds–phenolic acids, flavonoids and lignans. Major phenolic acids present in defatted flaxseed are ferulic acid (10.9 mg/g), chlorogenic acid (7.5 mg/g), gallic acid (2.8 mg/g). Other phenolic acids include p-coumaric acid glucosides, hydroxycinnamic acid glucosides and 4-hydroxybenzoic acid that are present in low quantities [27,28]. Flavone C- and Flavone O-glycosides are the major flavonoids found in flaxseeds [27]. Flaxseed is the richest source of phytoestrogens (lignans). The amount

of secoisolariciresinol diglycoside (SDG) varies from 77 to 209 mg SDG/tbsp. of whole flaxseed[1,14]. Flaxseed contains very low level of carbohydrates (1 g/100 g) and thus contributing very little to total carbohydrates intake [1].

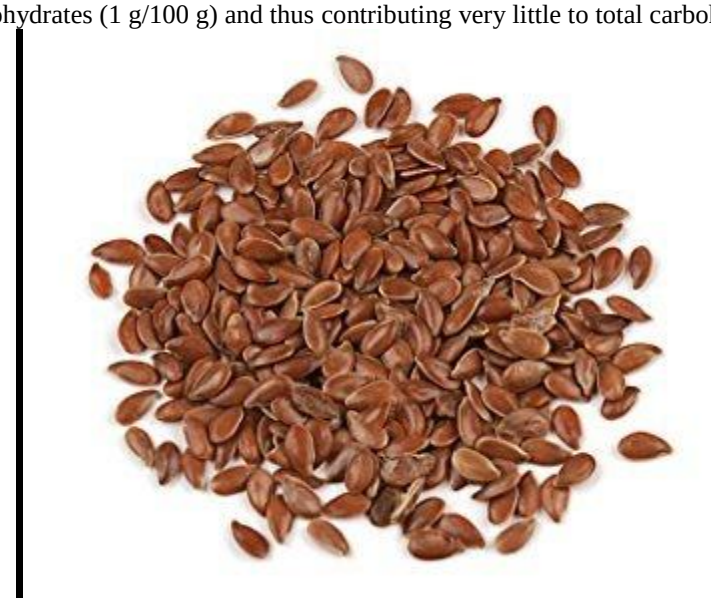

Figure.1; Flaxseed (taken from google.com)

Health benefits

Flaxseed has been grown since the beginnings of civilization, and in the world arena, people have celebrated its usefulness throughout the ages. Flaxseed has nutritional and functional properties. The presence of bioactive constituents of flaxseeds have the potentiality to reduce the various diseases such as cardiovascular ailments, strokes, diabetes, cancer etc.,[29] is evident from various clinical and epidemiological studies. However, flaxseed contains low quantities of adverse healthy compounds such as cadmium, cyanogenic glycosides, inhibitors of trypsin that are commonly removed through thermal and mechanical processes, including cooking in microwaves, autoclaving and boiling[26]. Flaxseed oil is believed to initiate mental and physical endurance by fighting fatigue and controlling aging process. Flaxseed is also mentioned in Ayurveda as atasi having properties like Madhura (balances the skin pH), Picchaila (lubricous) Balya (improves tensile strength or elasticity of the skin), Grahi (improves moisture holding capacity of skin), Tvagdoshahrit (removes skin blemishes), Vranahrit (wound healing) and useful in Vata (skin) disorders including dryness, undernourishment, lack of lustre / glow[3].

Prevention From Memory Loss

Loss of spatial memory is strongly correlated with lipid peroxide buildup in the hippocampus. Higher concentrations of the nutritional and non-nutritional properties of flaxseed, such as antioxidants in the form of N-3 fatty acids, also known as -3 fatty acids, i.e. In addition to lowering body mass, ALA, DHA, and dietary fibres such lignans also help to lower levels of lipid peroxide in the hippocampus. Studies on flax feed dams indicate that an increase in the ALA and DHA concentration in the hippocampus leads to a decrease in the inhibitors of spatial memory, which improves the learning capacity of the flaxseed feed dams [30] and prevents constipation. The recommended amount of daily dietary fiber of >25g is, according to many studies, useful in the treatment of constipation. Ground flaxseed consists of 40 % of dietary fiber, 2/3 of which is insoluble (cellulose, hemicellulose and lignin) and 1/3 is soluble fiber. Insoluble fiber binds water and thus increases the bulk in colon. Soluble fiber from flaxseed mucilage has similar effects than guar gum or ispaghula, e.g. delay in gastric emptying, improvement in glycemic control and alleviation of constipation. The mean dietary fiber intake in western countries is approximately 20 g/day. Flaxseed supplement of 10-20 g/d would increase the intake to the recommended level of 25-30 g/day. However, the use of flaxseed has to be long term as the full effects are only observed after two months. Roughly ground flaxseed seems to have better water-binding capacity than the finely ground flaxseed meal. Presence of antinutrients in flaxseed Flaxseed has several compounds that may negatively influence health and well-being. In some cases, the negative impact might simply be an assumption based on literature reports of similar compounds from other foods. The 2 components that have been questioned most frequently are the cyanogenic glycosides, cadmium, phytic acid and trypsin inhibitor. Cyanogenic glycosides Cyanogenic glycosides are not exclusive to flaxseed. These compounds can be found in a number of plants including brassica vegetables and especially cassava. Many of the health concerns regarding cyanogenic glycosides stem from studies showing that cassava was toxic to animals and humans[31]. At the recommend daily intake of about 1 to 2 tablespoons, approximately 5 to 10 mg of hydrogen cyanide is released from flaxseed, which is well below the estimated acute toxic dose for an adult of 50 to 60 mg inorganic cyanide and below the 30 to 100 mg/d humans can routinely detoxify[32]. Cadmium Flaxseeds accumulate cadmium from soil, especially from artificially fertilized soil. The cadmium content of a flaxseed product investigated was analyzed to be 0.84 mg/kg[33]. Cadmium accumulates in the liver and kidneys, where the proteins called metallothioneins bind it. The amount of these proteins increases after cadmium exposure. In the kidney, the

metallothioneins seem to protect the tissue as long as the tissue concentration is below 200 µg. Above this concentration damage to the kidney tubuli occurs resulting in proteinuria. Cadmium has a half-life of 10-40 years and is eliminated probably via the kidneys or bile. The daily amount of cadmium, which can cause accumulation in body, is considered to be 200-300 µg[34]. Trypsin inhibitors and phytic acid Trypsin inhibitor and phytic acid are other antinutrients contained in flaxseed. But compared to soyabean and canola seeds, activity of them are low[35]. In a study it was reported that the laboratory-prepared flaxseed meals containing 42–51 units of TIA (Trypsin inhibitor activity)[36], which was slightly higher than 10–30 units [37] and commercially obtained flaxseed meal (14–37 units). The antipyridoxine factor linatine was also identified[38]. Although linatine is a problem in chicks, flaxseed has not been associated with a vitamin B6 deficiency in humans.

Lignans in flaxseed and health benefits

Lignans, flavonoids, and phenolic acids are among the phenolic compound family's other beneficial components found in flaxseed [39, 40]. The richest dietary source of lignan precursors is flaxseed, specifically. The bacteria that ordinarily inhabit the human intestines transform the lignan precursors, enterodiol and enterolactone, when they are consumed. Secoisolariciresinol Diglucoside is the main lignan precursor present in flaxseed [41]. Ferulic acid (10.9 mg/g), chlorogenic acid (7.5 mg/g), gallic acid (2.8 mg/g), and traces of 4-hydroxybenzoic acid are four phenolic acids found in defatted flaxseed powder (Figure 4). Flavone C- and O- glycosides are the main flavonoids found in flax [42]. Lignan-rich foods are part of a healthful dietary pattern; the role of lignans is important in the prevention of hormone-associated cancers, osteoporosis, and cardiovascular diseases. The flaxseed lignan secoisolariciresinol (SECO) and its diglucoside Secoisolariciresinol Diglucoside (SDG) are reported to have a number of health benefits associated with their consumption that have in part been attributed to their antioxidant properties. After ingestion, SDG is converted to enterolignans (enterodiol and enterolactone) by the intestinalmicroflora; then these metabolites (phytoestrogens) are absorbed and can provide health benefits. Prasad 2013 investigated if SDG from flaxseed could be an alternative to Angiotensin-Converting Enzyme (ACE) in the treatment of hypertension. In particular the study focused on SDG-induced hypotension through inhibition of ACE. After feeding rats with specific doses of flaxseed, SDG decreased the systolic, diastolic and mean arterial pressure. Data suggested that SDG reduced the angiotensin I-induced rise in the arterial pressures and hence SDG was a potent ACE inhibitor [43]. Adolphe et al. 2010, summarized results from scientific paper about health effects of the flax lignan secoisolariciresinol diglucoside. Animal studies using rat, mice and rabbit models suggested that SDG supplementation protects against the development of chronic diseases, cancer and diabetes. Several of the human studies that have included SDG were performed, but, more randomised controlled trials are needed before to elucidate whether SDG supplementation protects against disease in human [44]. Utilization of flaxseed for glycemic control may also be associated to the decrease in risk of obesity and dyslipidemia, since these are risk factors for the development of diabetes and resistance to insulin. Sonali and Charu 2013, evaluated the therapeutic potential of flaxseeds in dyslipidemia. In the experimental group flaxseed supplementation resulted in a improvement in anthropometric measurements, blood pressure, and lipid profile. Body weight and Body Mass Index (BMI) of the experimental group were significantly reduced as well as systolic and diastolic blood pressure. At the same time, a highly significant reduction in total cholesterol, triglycerides, low density lipoprotein-cholesterol (LDL-C) and low density lipoproteincholesterol (VLDL-C) levels were observed [45]. Lignans may protect against certain cancers, particularly hormone-sensitive cancers such as those of the breast, endometrium and prostate, by interfering with sex hormone metabolism. Most of the research regarding flaxseed and breast cancer focuses on the lignin content in flaxseeds, and their potential for weak estrogenic or anti-estrogenic effects in a woman's body. Experimental evidence in animals has shown anticarcinogenic effects of flaxseed or pure lignans in many types of cancer: flaxseed oil can inhibit the growth and development of tumors in the breast of laboratory animals [46]. Mason et al [47], researched the influence of flaxseed lignans and oil components in reducing breast cancer risk and tumour growth. In vitro, animal, observational, and clinical studies on FS and its lignan and oil components were reviewed. Results showed that flaxseed intake reduces tumour growth in breast cancer patients. Mechanisms included decreased cell proliferation and angiogenesis and increased apoptosis through modulation of estrogen metabolism and estrogen receptor and growth factor receptor signalling pathways. More clinical trials are needed to indicate that flaxseed components are effective in the risk reduction and treatment of breast cancer [47]. The systematic review by Flower et al. [48] considered lignans and other flaxseed compounds (ALA and fiber content) to check the efficacy in improving menopausal symptoms in women living with breast cancer and for potential impact on risk of breast cancer incidence or recurrence. Making a comparison among all studies examined, authors concluded that flax may be associated with decreased risk of breast cancer. Furthermore, flax demonstrated anti-proliferative effects in breast tissue of women at risk of breast cancer. Mortality risk may also be reduced among those living with breast cancer [48]. Despite acting as an inhibitor to the development of cancer, recent evidence has shown that lignan and flaxseed oil reduced the growth of tamoxifen treated tumors by mechanisms involving signaling pathways, suggesting their potential use to aid in chemotherapy of some cancer types. Saggar et al. [49], analyzed the effect of dietary flaxseed lignan or oil combined with tamoxifen (TAM) treatment on tumor growth. All treatments reduced the growth of TAM-treated tumors by reducing cell proliferation, expression of genes, and proteins involved in the growth factor mediated signaling pathways with flaxseed oil having the greatest effect in increasing apoptosis compared with TAM treatment alone. SDG and

flaxseed oil reduced the growth of TAM-treated tumors [49]. Sturgeon et al 2008, studied the effects of flaxseed lignans on serum sex hormones implicated in the development of breast cancer. Result suggested that dietary flaxseed may modestly lower serum levels of sex steroid hormones, especially in overweight/obese women [50]. Lignans have been shown, for example, to suppress the differentiation and growth of cultured human leukemic cells, possibly by interfering with DNA, RNA and/or protein synthesis [51]. Moreover, lignan cytotoxicity on normal immune cells appears to be low. Lignans may also exert fungistatic, cytotoxic, antiviral activities and a hormonal modulation, causing a decrease in hot flashes which are characteristic of menopause [52]. Simbalista et al. 2010 tested the effects of daily intake of bread produced with defatted ground flaxseed on the climacteric symptoms and endometrial thickness of postmenopausal women. Authors concluded that flaxseed consumption at certain levels l (46 mg lignans/day) was effective as well as placebo for reducing hot flashes [53]. Lignans may reduce the level of free circulating testosterone and when bonded together are excreted in the bile, potentially reducing the risk of polycystic ovary syndrome in susceptible women, since this syndrome is associated to high levels of androgens. Nowak et al. 2007, described the clinical case study based on the impact of flaxseed supplementation (30 g/day) on hormonal levels in a 31-year old woman with polycystic ovary syndrome. The clinically and significant decrease in androgen levels and the concomitant reduction in hirsutism viewed in patients demonstrated a need for further research of flaxseed supplementation on hormonal levels and clinical symptoms of polycystic ovary syndrome [54]. 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 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 [55].

Anti-nutritive compounds in flaxseed and adverse health properties

Toxic substances, phytoestrogens with negative health effects, and inhibitors of trypsin including myo inositol phosphate, cadmium, and cyanogenic glycosides [56,57] are all present in flaxseed, and this must be emphasised. In actuality, flaxseed contains 264–354 mg of cyanogenic chemicals per 100 g of seed, of which 10–11.8 mg per 100 g are linamarin, 136–162 mg per 100 g are linustatin, and 105–183 mg per 100 g are neolinustatin. It is thought that 100 mg of these substances, which are hazardous to humans, might be fatal to adults if consumed. The nitrogenous secondary plant metabolites known as cyanogenic glucosides are produced from amino acids. Their causes chronic effects, manifested in the nervous system and are observed in populations that ingest high quantities of cyanate in foods [58]. However, these compounds present instability when subjected to thermal and mechanical processes, including cooking in microwaves, autoclaving, and boiling [58,59]. Cadmium is potentially toxic to the human organism. When accumulated in the kidney, this metal can cause renal dysfunction, as well as pulmonary emphysema, aminoaciduria, glycosuria, phosphaturia and even compromise mineral reabsorption, making organisms susceptible to osteomalacia. Trypsin inhibitors present in the diet have been known for decades to diminish growth in animals, since they decrease the digestion and consequent absorption of proteins by the inhibition of proteases [60]. In comparison to soybean and canola seeds, flaxseed had low trypsin inhibitor activity (TIA). Flaxseed meals made in a lab were shown to contain 42 to 51 units of TIA [61] according to Bhatty (1993). It is advised to consume these compounds in the form of flour (after thermal treatment), as the concentrations of compounds that have negative effects are eliminated or reduced. In addition, the trituration of the seed increases the bioavailability of the bioactive compounds, despite the fact that these compounds present instability when subjected to thermal and mechanical processes, such as cooking in microwaves, autoclaving, and boiling [62].

CONCLUSION

After seeing the numerous prevailing trends to be employed in the various disorders, flaxseed is now thought to be the most valuable food. Flaxseed has the ability to fight off diseases like cancer, menopausal symptoms, skin conditions, gastrointestinal problems, and brain damage. The flaxseed exhibits a striking shift in the pattern of its distribution, with the seeds acquired from the cool climate region displaying greater potency than those from the hot region. Flax grows quickly after being planted in the spring because of the favourable stickiness and warmth present at that time. The request has a 100-day development cycle. The development cycle is accelerated by a rise in temperature and dry conditions, but the size of the plant. The majority of the harvest is produced north of latitude 50° N, which accounts for the somewhat high levels of iodine and oil content. The use of different bio fertilizers can also improve the quality of flaxseed, but the key determinants of quality are the days of seeding and harvesting as well as the technique used to carry them out. Based on the available literature, it was discovered that flaxseed from the Canadian region has better quality. Nearly 25% of the world's flaxseed production was collected. Flaxseed offers beneficial nutritional and practical qualities. In reality, flaxseed is a source to meet fundamental needs due to its composition, which includes polyunsaturated fatty acids,

essential amino acids, vitamin E, lignans, and dietary fibres health maintenance. The lowering of cholesterol, the reduction of cardiovascular disease, and the prevention of diabetes are all related to healthy qualities, which also include anti-inflammatory, anti-oxidant, and anti-carcinogenic activities. However, flaxseed has low levels of unhealthy components that are typically eliminated using heat and mechanical methods, such as boiling, autoclaving, and frying in microwaves. These include cadmium, cyanogenic glycosides, and trypsin inhibitors.

REFERENCES

1. Morris, D. H. (2007). Flax: A health and nutrition primer. Flax Council of Canada.
2. Ganorkar, P. M., & Jain, R. K. (2013). Flaxseed--a nutritional punch. International Food Research Journal, 20(2).
3. Goyal, A., Sharma, V., Upadhyay, N., Gill, S., & Sihag, M. (2014). Flax and flaxseed oil: an ancient medicine & modern functional food. Journal of food science and technology, 51(9), 1633-1653.
4. Halligudi, N. (2012). Pharmacological properties of flax seeds: a Review. Hygeia. JD Med, 4(2), 70-77.
5. Rubilar, M., Gutiérrez, C., Verdugo, M., Shene, C., & Sineiro, J. (2010). Flaxseed as a source of functional ingredients. Journal of soil science and plant nutrition, 10(3), 373-377.
6. Vaisey-Genser, M., & Morris, D. H. (2003). Introduction: history of the cultivation and uses of flaxseed. In Flax (pp. 13-33). CRC Press.
7. Freeman T(1995). Structure of flaxseed. Champaign Illinois: AOCS Press. p. 11–21.
8. Carter, J. F. (1993). Potential of flaxseed and flaxseed oil in baked goods and other products in human nutrition. Cereal foods world (USA).
9. Singh, K. K., Barnwal, P., & Rehal, J. (2013). Selected engineering and biochemical properties of 11 flaxseed varieties. Food and Bioprocess Technology, 6(2), 598-605.
10. Singh KK, Jhamb SA, Kumar R. 2011.
11. Singh, K. K., Mridula, D., Rehal, J., & Barnwal, P. (2011). Flaxseed: a potential source of food, feed and fiber. Critical reviews in food science and nutrition, 51(3), 210-222.
12. Oomah, B. D. (2001). Flaxseed as a functional food source. Journal of the Science of Food and Agriculture, 81(9), 889-894.
13. Shim, Y. Y., Gui, B., Arnison, P. G., Wang, Y., & Reaney, M. J. (2014). Flaxseed (Linum usitatissimum L.) bioactive compounds and peptide nomenclature: A review. Trends in food science & technology, 38(1), 5-20.
14. Touré, A., & Xueming, X. (2010). Flaxseed lignans: source, biosynthesis, metabolism, antioxidant activity, bio-active components, and health benefits. Comprehensive reviews in food science and food safety, 9(3), 261-269.
15. Neil DW(2004). Flax seed lignan in disease prevention and health promotion. Kluwer Academic Publishers.
16. Kaushik, P., Dowling, K., McKnight, S., Barrow, C. J., Wang, B., & Adhikari, B. (2016). Preparation, characterization and functional properties of flax seed protein isolate. Food Chemistry, 197, 212-220.
17. Malcolmson, L. J., Przybylski, R., & Daun, J. K. (2000). Storage stability of milled flaxseed. Journal of the American Oil Chemists' Society, 77(3), 235-238.
18. Morris, D. H. (2003). Flax—a health and nutrition primer Flax Council of Canada Winnipeg.
19. Madhusudhan, K. T., & Singh, N. (1983). Studies on linseed proteins. Journal of Agricultural and Food Chemistry, 31(5), 959-963.
20. Oomah, B. D., & Mazza, G. (1997). Effect of dehulling on chemical composition and physical properties of flaxseed. LWT-Food Science and Technology, 30(2), 135-140.
21. Chung, M. W. Y., Lei, B., & Li-Chan, E. C. Y. (2005). Isolation and structural characterization of the major protein fraction from NorMan flaxseed (Linum usitatissimum L.). Food chemistry, 90(1-2), 271-279.
22. Gopalan, C., Rama Sastri, B. V., & Balasubramanian, S. C. (1971). Nutritive value of Indian foods.
23. Xu, Y., Hall Iii, C., & Wolf-Hall, C. (2008). Antifungal activity stability of flaxseed protein extract using response surface methodology. Journal of Food Science, 73(1), M9-M14.
24. Pellizzon, M. A., Billheimer, J. T., Bloedon, L. T., Szapary, P. O., & Rader, D. J. (2007). Flaxseed reduces plasma cholesterol levels in hypercholesterolemic mouse models. Journal of the American College of Nutrition, 26(1), 66-75.
25. Bernacchia, R., Preti, R., & Vinci, G. (2014). Chemical composition and health benefits of flaxseed. Austin J Nutri Food Sci, 2(8), 1045.
26. Mazza, G. (2008, August). Production, processing and uses of Canadian flax. In First CGNA International Workshop, Temuco, Chile, August (pp. 3-6).
27. Beejmohun, V., Fliniaux, O., Grand, É., Lamblin, F., Bensaddek, L., Christen, P., ... & Mesnard, F. (2007). Microwave-assisted extraction of the main phenolic compounds in flaxseed. Phytochemical Analysis: An International Journal of Plant Chemical and Biochemical Techniques, 18(4), 275-282.
28. Mishra, S., & Verma, P. (2013). Flaxseed-Bioactive compounds and health significance. J. Humanit. Soc. Sci, 17, 46-50.
29. Fernandes FS, de Souza AS, do Carmo MDT and Boaventura GT (2011). Maternal intake of flaxseedbased diet (Linum usitatissimum) on hippocampus fatty acid profile: Implications for growth, locomotor activity and spatial memory. Nutr., 10: 1040- 1047.

30. Fukumitsu, S., Aida, K., Shimizu, H., & Toyoda, K. (2010). Flaxseed lignan lowers blood cholesterol and decreases liver disease risk factors in moderately hypercholesterolemic men. Nutrition Research, 30(7), 441-446.
31. McMahon, J. M., White, W. L., & Sayre, R. T. (1995). Cyanogenesis in cassava (Manihot esculenta Crantz). Journal of Experimental botany, 46(7), 731-741.
32. Roseling, H. (1994). Measuring effects in humans of dietary cyanide exposure to sublethal cyanogens from Cassava in Africa. Acta Hortic, 375, 271-283.
33. Tarpila, S., Tarpila, A., Grohn, P., Silvennoinen, T., & Lindberg, L. (2004). Efficacy of ground flaxseed on constipation in patients with irritable bowel syndrome. Current Topics in Nutraceutical Research, 2, 119-125.
34. Meberg, A., Sande, H., Foss, O. P., & Stenwig, J. T. (1979). Smoking during pregnancy—Effects on the fetus and on thiocyanate levels in mother and baby. Acta Paediatrica, 68(5), 547-552.
35. Hall, C. and Shultz, K. (2001). Phenolic antioxidant interactions. In Abstracts of the 92nd American Oil Chemists Society Annual Meeting and Expo. p. S88 Minneapolis, Minnesota: AOCS
36. Bhatty, R. S. (1993). Further compositional analyses of flax: mucilage, trypsin inhibitors and hydrocyanic acid. Journal of the American Oil Chemists' Society, 70(9), 899-904.
37. Madhusudhan, K. T., & Singh, N. (1983). Studies on linseed proteins. Journal of Agricultural and Food Chemistry, 31(5), 959-963.
38. Klosterman, H. J., Lamoureux, G. L., & Parsons, J. L. (1967). Isolation, characterization, and synthesis of linatine. A vitamin B6 antagonist from flaxseed (Linum usitatissimum). Biochemistry, 6(1), 170-177.
39. Madhusudhan, B. (2009). Potential benefits of flaxseed in health and disease-A perspective. Agriculturae Conspectus Scientificus, 74(2), 67-72.
40. Lowcock, E. C., Cotterchio, M., & Boucher, B. A. (2013). Consumption of flaxseed, a rich source of lignans, is associated with reduced breast cancer risk. Cancer Causes & Control, 24(4), 813-816.
41. Adlercreutz, H. (2007). Lignans and human health. Critical reviews in clinical laboratory sciences, 44(5-6), 483-525.
42. Siger, A., Nogala-kalucka, M., & Lampart-Szczapa, E. (2008). The content and antioxidant activity of phenolic compounds in cold-pressed plant oils. Journal of food lipids, 15(2), 137-149.
43. Prasad, K., Mantha, S. V., Muir, A. D., & Westcott, N. D. (1998). Reduction of hypercholesterolemic atherosclerosis by CDC-flaxseed with very low alpha-linolenic acid. Atherosclerosis, 136(2), 367-375.
44. Adolphe, J. L., Whiting, S. J., Juurlink, B. H., Thorpe, L. U., & Alcorn, J. (2010). Health effects with consumption of the flax lignan secoisolariciresinol diglucoside. British Journal of Nutrition, 103(7), 929-938.
45. Saxena, S., & Katare, C. (2014). Evaluation of flaxseed formulation as a potential therapeutic agent in mitigation of dyslipidemia. Biomedical journal, 37(6).
46. Lamblin, F., Hano, C., Fliniaux, O., Mesnard, F., Fliniaux, M. A., & Lainé, É. (2008). Intérêt des lignanes dans la prévention et le traitement de cancers. médecine/sciences, 24(5), 511-520.
47. Mason, J. K., & Thompson, L. U. (2014). Flaxseed and its lignan and oil components: can they play a role in reducing the risk of and improving the treatment of breast cancer?. Applied Physiology, Nutrition, and Metabolism, 39(6), 663-678.
48. Flower, G., Fritz, H., Balneaves, L. G., Verma, S., Skidmore, B., Fernandes, R., ... & Seely, D. (2014). Flax and breast cancer: a systematic review. Integrative cancer therapies, 13(3), 181-192.
49. Saggar, J. K., Chen, J., Corey, P., & Thompson, L. U. (2010). Dietary flaxseed lignan or oil combined with tamoxifen treatment affects MCF-7 tumor growth through estrogen receptor-and growth factor-signaling pathways. Molecular nutrition & food research, 54(3), 415-425.
50. Sturgeon, S. R., Heersink, J. L., Volpe, S. L., Bertone-Johnson, E. R., Puleo, E., Stanczyk, F. Z., ... & Bigelow, C. (2008). Effect of dietary flaxseed on serum levels of estrogens and androgens in postmenopausal women. Nutrition and cancer, 60(5), 612-618.
51. Cardoso Carraro, J. C., Dantas, M. I. D. S., Espeschit, A. C. R., Martino, H. S. D., & Ribeiro, S. M. R. (2012). Flaxseed and human health: reviewing benefits and adverse effects. Food Reviews International, 28(2), 203-230.
52. Xu, Y., Hall III, C., Wolf-Hall, C., & Manthey, F. (2008). Fungistatic activity of flaxseed in potato dextrose agar and a fresh noodle system. International Journal of Food Microbiology, 121(3), 262-267.
53. Simbalista, R. L., Sauerbronn, A. V., Aldrighi, J. M., & Arêas, J. A. (2010). Consumption of a flaxseed-rich food is not more effective than a placebo in alleviating the climacteric symptoms of postmenopausal women. The Journal of nutrition, 140(2), 293-297.
54. Nowak, D. A., Snyder, D. C., Brown, A. J., & Demark-Wahnefried, W. (2007). The effect of flaxseed supplementation on hormonal levels associated with polycystic ovarian syndrome: a case study. Current topics in nutraceutical research, 5(4), 177.
55. Dew, T. P., & Williamson, G. (2013). Controlled flax interventions for the improvement of menopausal symptoms and postmenopausal bone health: a systematic review. Menopause, 20(11), 1207-1215.
56. Lei, B., Li-Chan, E. C., Oomah, B. D., & Mazza, G. (2003). Distribution of cadmium-binding components in flax (Linum usitatissimum L.) seed. Journal of Agricultural and Food Chemistry, 51(3), 814-821.
57. Haque, M. R., & Bradbury, J. H. (2002). Total cyanide determination of plants and foods using the picrate and acid hydrolysis methods. Food chemistry, 77(1), 107-114.

58. Tarpila, A., Wennberg, T., & Tarpila, S. (2005). Flaxseed as a functional food. Current Topics in Nutraceutical Research.
59. Guerrero-Beltrán, J. A., Estrada-Girón, Y., Swanson, B. G., & Barbosa-Cánovas, G. V. (2009). Pressure and temperature combination for inactivation of soymilk trypsin inhibitors. Food Chemistry, 116(3), 676-679.
60. Puvača, N., Stanaćev, V., Milić, D., Kokić, B., & Čabarkapa, I. (2012). Limitation of flaxseed usage in animal nutrition. In XV International Feed Technology Symposium. COST-" Feed for Health" joint Workshop, Proceedings. Novi Sad, Serbia, 3-5 October, 2012 (pp. 58-63). Institute of Food Technology.
61. Bhatty, R. S. (1993). Further compositional analyses of flax: mucilage, trypsin inhibitors and hydrocyanic acid. Journal of the American Oil Chemists' Society, 70(9), 899-904.
62. Austria, J. A., Richard, M. N., Chahine, M. N., Edel, A. L., Malcolmson, L. J., Dupasquier, C. M., & Pierce, G. N. (2008). Bioavailability of alpha-linolenic acid in subjects after ingestion of three different forms of flaxseed. Journal of the American College of Nutrition, 27(2), 214-221.