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Review Article

**THE ROLE OF FLAXSEED IN IMPROVING HUMAN  
HEALTH**<sup>1</sup>Yash Ravindra jichkar , <sup>2</sup>Shruti A. Wankhade<sup>1</sup>Student vardhaman College Of Pharmacy, Koli , Karanja (Lad), Washim<sup>2</sup>Assistant Professor , Department of Pharmaceutical Chemistry

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**Abstract:**

*Ayurveda, regarded as one of the world's oldest continuous health traditions, remains deeply rooted in India and has gained recognition across many countries for its strong philosophical foundation and practical applications. Ayurvedic texts describe numerous plants, minerals, and natural fats that support overall well-being and help manage various serious illnesses. Among the foods recommended for promoting health is flaxseed. Flaxseed also known as linseed or Alsi is rich in dietary fibre, manganese, B-complex vitamins, and alpha- linolenic acid (ALA), an essential omega-3 fatty acid. It is also a valuable source of several important minerals. The seeds are obtained from the flax plant, one of the oldest fibre crops, historically cultivated in ancient Egypt and China. In Ayurveda, flax is used internally as a soothing demulcent for conditions such as gastritis and enteritis. It is also prescribed for chronic constipation, colon dysfunction caused by excessive laxative use, and irritable bowel tendencies. The flowers are described as cardiotoxic, while the oil functions as a natural purgative. Externally, powdered seeds or press cakes are applied to reduce inflammation and soften tissues, making them useful in poultices for boils, carbuncles, and other skin problems. Its oil is applied in abhyanga (therapeutic massage) for balancing vata dosha.*

**Keywords:** Flaxseed, Lignans, Omega-3 Fatty Acids, Dietary Fibre.**Corresponding author:****Yash Ravindra jichkar,**

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## • INTRODUCTION:

A substantial and continually expanding body of research now supports the use of dietary flaxseed for a wide range of health concerns. In contrast to the late 20th century when both the health benefits of flaxseed and effective methods of consuming it were poorly understood current scientific knowledge has advanced considerably. Modern studies have shed light on the diseases flaxseed may help prevent or manage, the physiological effects it produces, the specific bioactive compounds responsible for these benefits, and the forms of flaxseed needed for optimal absorption of these components.[1]

Although much of the early evidence came from animal studies, a growing number of human clinical trials many conducted with rigorous scientific controls have begun to confirm these findings. Such high-quality data have increased public confidence in flaxseed's therapeutic potential, especially for individuals with existing health challenges. The food industry has responded to this evidence by developing a wider range of flaxseed-based products, giving consumers more convenient ways to add flaxseed to their daily diet. As awareness of its health-promoting properties increases, flaxseed is expected to gain further economic importance for farmers, manufacturers, and retailers. It is now well recognized that lifestyle and environmental factors, particularly diet, play a crucial role in sustaining health and influencing the development of disease. Likewise, managing illness involves not only medication but also well-designed nutritional strategies. This review aims to present an overview of the key research findings that have elevated flaxseed to a position of growing relevance in nutrition and medicine.[2]

Flaxseed has earned the reputation of a "superfood" due to its rich profile of beneficial components, including lignans, dietary fibre, essential vitamins, minerals, and omega-3 fatty acids. This naturally nutrient-dense food contains multiple bioactive substances that contribute to a variety of health-enhancing effects. Consistent consumption of flaxseed may therefore offer significant support in maintaining overall wellness.

Flaxseed plays an important part in preventing various illnesses, including those linked to unhealthy dietary habits. Flaxseed oil is the richest plant-based source of alpha-linolenic acid (ALA), containing about 53%, along with approximately 19% oleic acid. Its high ALA content results in a favourable n-6 to n-3 fatty acid ratio of around 0.3:1. ALA contributes to cancer prevention due to its anti-inflammatory and antiproliferative properties, which help suppress tumour

development and the spread of malignant cells. In

addition, ALA from flaxseed has been shown to improve blood lipid profiles by significantly lowering total plasma cholesterol, LDL, and VLDL levels.

Flaxseed is also rich in dietary fibre, consisting of roughly 40% fibre overall about 25% soluble and 75% insoluble. The soluble fraction, which includes gums, pectin, and beta-glucan, plays a vital role in controlling blood glucose and reducing the absorption of cholesterol and triglycerides. These actions are essential for lowering the risk of cardiovascular disease and diabetes. Soluble fibre also supports a healthy gut microbiome and is fermented into short-chain fatty acids that positively influence human health.[3]

The insoluble fibre components cellulose, hemicellulose, and lignin promote digestive regularity by increasing stool bulk and reducing constipation. Flaxseed is additionally a good source of niacin and vitamin E, particularly in the form of tocopherols, which function as potent antioxidants. The amount of tocopherol present typically ranges from 39.5 to 50 mg per 100 g of seed. Adequate vitamin E intake is associated with a reduced risk of cardiovascular disease, Alzheimer's disease, and certain forms of cancer.

## • Flaxseed Nutritional Profile:

Golden and brown flaxseeds are the two main types commonly available, and both offer nearly identical nutritional benefits, including the same amount of short-chain omega-3 fatty acids. According to the American Nutrition Association, flaxseed provides not only essential fatty acids such as alpha-linolenic acid that support human health, but also serves as an excellent source of dietary fiber, vitamins, and minerals. Once considered an overlooked ingredient, it has recently gained recognition for its nutritional value. Flaxseed is also naturally low in sodium and contains negligible cholesterol.

### 1. Synonyms:

Flax seed, semen lini, Bizr El kettan, the seed and the flax-woven cloth have been found in ancient Egyptian Plant.

### 2. Source:

Dried ripe seeds of *Linum Usitatissimum*. Scientific Classification

Family: Linaceae. Kingdom: Plantae.

Genus: *Linum*.

Species: *Linum usitatissimum*.

BotanicalName: *Linum usitatissimum*.



**Fig.No.1 Flaxseed**

### 3. Geographical source:

Linseed is cultivated in many sub tropical countries such as a South America, India, United State, Canada, England, Russia, Greece ,Italy, Spain and Algeria.

### 4. Medicinal Uses:

- Improving nerve and brain health.
- Regulate the blood sugar level.
- Support weight loss and heart health.
- Promote the hair growth.
- It help to treat digestive condition.

### 5. Important Flax Compound

Alpha-Lineolenic acid (ALA) Enterolactone (ENL)  
 Docosapentaenoic acid (DPA) Linustatin  
 Lineolenic acid (LA) Enterodiol (END)  
 Docosahexaenoic acid (DHA)  
 Secoisolariciresinol(SDG) Eicosapentaenoic acid  
 (EPA) Linamarin.

#### ● Flaxseed Are Abundant In:

##### 1) Lignans

Lignans are one of the major categories of phytoestrogens plant compounds that are structurally similar to oestrogen and possess antioxidant effects. Flaxseed is considered one of the richest dietary sources, containing about 0.3 g per 100 g. A review published in Clinical Laboratory Science Critical Reviews reported that diets high in lignans may offer long-term health benefits, especially when consumed consistently throughout life.

##### 2) Fibre

Flaxseed provides both soluble and insoluble fibre. The Mayo Clinic explains that soluble fibre dissolves in water to form a gel-like material that can help lower cholesterol levels and regulate blood sugar. Insoluble fibre, in contrast, absorbs water and increases the bulk of stool, supporting healthy digestion and promoting regular bowel movements.

### 3) Omega-3 Fatty Acids

Flaxseed is also a notable source of omega-3 fatty acids, often referred to as “good fats” for their heart-protective qualities. Since the body cannot produce these essential fats on its own, they must be obtained through food. Additionally, flaxseeds supply valuable nutrients such as vitamin B6, iron, potassium, copper, and zinc.

#### ● Flaxseed Chemical Composition:

Flaxseed typically contains around 20% protein, 30% dietary fiber, and 40% fat, although these proportions can vary significantly depending on the plant’s growing conditions and variety. Most of the seed’s protein (about 76%) and lipids (around 75%) are concentrated in the cotyledons, while the endosperm holds only about 16% of the protein and 23% of the lipids.

Flaxseed is especially valued for its fatty acid profile. It is rich in omega-3 fatty acids particularly alpha-linolenic acid (ALA) which can account for as much as 52% of its total fatty acid content. In addition to its oil, flaxseed provides lignans, mucilaginous gum, and high-quality protein, making it an important source of various phenolic compounds. These components, found in different structural parts of the seed, often interact during oil extraction and processing. Despite its nutritional benefits, the seed itself is difficult to digest unless properly processed.

#### ● Benefits of Flaxseed :

##### 1) Hair and Skin Health

Regular consumption of flaxseed such as two tablespoons of whole seeds or one tablespoon of flaxseed oil can support the health of your skin, hair, and nails [6,7]. The high levels of ALA (alpha-linoleic acid) and B vitamins help prevent dryness, flakiness, and irritation. These nutrients may also reduce symptoms associated with eczema, rosacea, and skin inflammation, and they are known to benefit individuals experiencing dry eye syndrome [6].

Flaxseed oil contains an even greater concentration of beneficial fats. Taking one to two tablespoons daily can promote internal hydration, while mixing it with essential oils creates a natural topical moisturizer [7].

##### 2) Digestive Health and Laxation Activity

Flaxseed supports digestive function whether eaten whole, ground, or baked into foods. Studies show that consuming around 15 g of flax fiber daily for two weeks can improve bowel regularity and reduce constipation [3,4]. For additional relief during constipation, 3–5 tablespoons of flaxseed oil mixed into carrot juice may be helpful [5].

Flaxseed’s ALA helps maintain gastrointestinal health and supports beneficial gut microbes. Its anti-inflammatory properties make it useful for

individuals with digestive issues such as Crohn's disease [6].

Flaxseed is also rich in soluble and insoluble fiber, as well as magnesium. Approximately 5 g of fiber about one-quarter of the recommended daily intake can be obtained from two tablespoons of flaxseeds [7]. This fiber promotes healthy gut flora and aids efficient waste elimination.

### 3) Flaxseeds and Cancer Prevention

Flaxseeds are a major source of lignans, compounds that may help slow cancer progression by preventing angiogenesis, encouraging healthy cellular activity, and modifying molecular signalling pathways involved in tumour development [8]. These lignans may help inhibit the spread of several cancers, with research suggesting benefits in breast, prostate, ovarian, and colon cancers [8,9].

Some studies also indicate that regular intake of flaxseed may lower the risk of breast cancer by influencing early cellular changes and reducing factors that contribute to tumour growth [9].

According to research reported in the Journal of Clinical Cancer Research, the three primary lignans in flaxseeds are metabolized into enterolactone and enterodiols, compounds that help regulate hormones and support gut microbiota. This activity may contribute to the observed association between flaxseed consumption and a reduced risk of breast cancer [10,11].

#### ● Antioxidant Activities :

Flaxseed is known for its antioxidant properties, which help reduce cholesterol levels and inhibit platelet aggregation. Studies have shown that mammalian lignans, such as enterodiols (ED) and enterolactone (EL), along with flaxseed lignan secoisolariciresinol diglucoside (SDG), act as effective antioxidants, protecting against DNA damage and lipid peroxidation [12,13,14]. Investigations of SDG, EL, and ED at supra-physiological concentrations demonstrated a reduction in activated cell chemiluminescence. The antioxidant activity of these lignans is attributed to the 3-methoxy-4-hydroxy functional groups present in SDG and SECO. Moreover, SDG has been found to delay or prevent the onset of type 1 and type 2 diabetes, with its hypoglycaemic effect in type 2 diabetes potentially mediated through antioxidant mechanisms. The inhibition of phosphoenolpyruvate carboxykinase, a key enzyme in gluconeogenesis, may explain SDG's effect on glucose regulation. In rat studies treated with azoxymethane, flaxseed preparations reduced lipid peroxidation (TBARS) and decreased  $\gamma$ -glutamyl transpeptidase activity, further demonstrating antioxidant capabilities [12,13,14].

#### ● Antidiabetic Properties:

Daily lignan supplementation from flaxseed has been shown to modestly improve glycaemic control in type 2 diabetes patients, although effects on fasting glucose, lipid profiles, or insulin sensitivity are limited. Flaxseed fiber intake also reduced postprandial blood glucose levels in healthy individuals. Following oil extraction, the residual flaxseed cake containing antioxidants can be used as a supplement for diabetics in rural areas. In animal models, SDG delayed the onset of diabetes in female Zucker rats. Both lignans and SDG lowered hyperlipidemia, hypercholesterolemia, hyperinsulinemia, hyperleptinemia, and decreased visceral and hepatic fat accumulation caused by high-fat diets. These effects could reduce the risk of cardiovascular disease linked to lifestyle disorders such as diabetes, atherosclerosis, hypertension, and obesity. Additionally, the combination of polyunsaturated fatty acids (PUFAs) and dietary fiber in flaxseed enhances its potential as a functional food for preventing lifestyle-related diseases [12,13,14].

#### ● Nephrology Uses of Flaxseed:

Experimental studies in animal models have demonstrated that flaxseed derivatives, such as flaxseed oil and lignans, can modulate the progression of kidney injury [15,16]. For instance, overweight male SHR/N-cp rats were fed diets containing 20% casein, 20% soy protein isolate, or 20% flaxseed meal. All diets were balanced for protein, minerals, vitamins, carbohydrates, and fat, and administered for six months [17].

All groups showed similar weight gain and food intake, as well as fasting hyperinsulinemia and hyperglycemia [18]. However, rats receiving flaxseed meal exhibited significantly lower plasma insulin concentrations compared to casein- or soy-fed rats, while plasma glucose levels remained comparable [18,19]. Renal function markers, including plasma creatinine, creatinine clearance, and urine urea excretion, did not show significant differences among groups [20]. Importantly, flaxseed-fed rats had significantly lower proteinuria ( $P < 0.01$ ), and histological analysis revealed reduced glomerular and tubulointerstitial lesions, suggesting a renal-protective effect [21,22]. The precise components of flaxseed responsible for these effects remain uncertain [23].

#### 1) Flaxseed and Bone Health

Flaxseed is rich in alpha-linolenic acid (ALA), an omega-3 fatty acid, which helps maintain bone health by reducing excessive bone turnover [24]. Diets high in omega-3 fats may also improve blood pressure and optimize the omega-6:omega-3 ratio [24].

## 2) Flaxseed and Menopausal Symptoms

In clinical studies, postmenopausal women who consumed two teaspoons of ground flaxseed twice daily for six weeks experienced a reduction in hot flash frequency by approximately 50% and intensity by 57% [25]. Mild side effects included moderate diarrhea and stomach bloating in some participants [25].

## 3) Flaxseed and Lipid Metabolism

Flaxseed consumption has also been associated with cholesterol-lowering effects, which may contribute to overall cardiovascular health [15,25]. Flaxseeds can naturally help reduce cholesterol levels. This is primarily due to their soluble fiber, which binds to dietary fat and cholesterol in the digestive system, limiting their absorption. The fiber also binds to bile, which the gallbladder produces from cholesterol. Consequently, the body produces more bile, using up circulating cholesterol and promoting its excretion through the digestive tract [15].

Flaxseeds also demonstrate anti-inflammatory effects. In a study involving diabetic participants with mild hypercholesterolemia, supplementation with 360 mg/day of lignan capsules for 12 weeks significantly reduced C-reactive protein levels [16]. Intestinal microorganisms convert flaxseed lignans into bioactive compounds such as enterolactone and enterodiol. The bioavailability of these enterolignans depends on the form of flaxseed consumed: whole flaxseeds yield approximately 28%, whereas crushed or ground flaxseeds provide around 43%, indicating that milling significantly enhances lignan absorption [17].

Supplementation with flaxseeds has been associated with increased serum concentrations of enterolactone, eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and alpha-linolenic acid (ALA), sometimes doubling their levels [18]. Lignans and flaxseed consumption have been linked to reduced cardiovascular risk [19]. Moreover, flaxseeds and secoisolariciresinol diglucoside (SDG) have shown beneficial effects in models of polycystic kidney disease and lupus, and they exhibit hepatoprotective properties [20,21]. These effects may result from mechanisms including modulation of hormone availability, antioxidation, inhibition of angiogenesis, and regulation of gene expression [22-25].

## Benefits of Flaxseed



Fig . No. 2 Benefits of Flaxseed

### ● Dietary Flaxseed and Skin Health:

A 12-week, randomized, double-blind study involving healthy female volunteers with sensitive skin found that flaxseed oil supplementation improved several skin parameters. Participants showed reduced skin sensitivity, decreased transepidermal water loss, and less skin roughness and scaling, along with enhanced hydration and smoothness. Alpha-linolenic acid (ALA) was identified as the primary bioactive compound responsible for these beneficial effects on skin aging [26–31]. Older individuals tend to have higher levels of pro-inflammatory oxylipins, such as 5- HETE, 9,10,13-TriHOME, and 9,12,13-TriHOME, which may contribute to increased inflammation. Dietary flaxseed supplementation has been shown to help balance pro- and anti-inflammatory oxylipins, potentially promoting healthier aging.

### ● Dietary Flaxseed and Gastrointestinal Health :

The gut microbiome plays a critical role in both human and animal health, yet the effects of flaxseed on gut microbiota remain incompletely understood. Flaxseed is rich in lignans, which require metabolism by intestinal bacteria to become bioavailable in humans. Milled flaxseed and defatted flaxseed meal are particularly effective for producing enterolignans, such as enterodiol and enterolactone, from secoisolariciresinol diglucoside (SDG). Specific bacteria, including *Ruminococcus bromii*, *Ruminococcus lactaris*, *Lactobacillus casei*, and *Lactobacillus acidophilus*, contribute to this conversion [26–31].

Animal studies indicate that flaxseed supplementation can alter intestinal bacterial populations. For example, in mice, flaxseed in the diet influenced Enterobacteriaceae diversity in feces and cecum. One study reported a 20-fold increase in *Prevotella* spp. and a 30-fold decrease in *Akkermansia muciniphila* following flaxseed supplementation. A diet combining flaxseed with fish oil and high fat increased *Bifidobacterium* abundance, while flax oil alone could reduce Proteobacteria and Porphyromonadaceae, potentially benefiting conditions like alcoholic liver disease. Defatted flaxseed meal was also shown to reduce aberrant crypt foci in mice, linked to higher *Bifidobacterium* expression. Flaxseed mucilage altered 33 gut microbial species in women, including eight *Faecalibacterium* species, affecting insulin sensitivity. However, some studies reported minimal changes in dominant gut microbiota species with flaxseed supplementation and questioned its disease-modifying effects [26–31].

Concerns have been raised regarding potential toxic compounds in flaxseed. Cyanogenic glycosides, such as linustatin and neolinustatin, can generate hydrogen cyanide through enzymatic reactions. Yet, typical dietary intake (1–2 tablespoons) produces far below toxic levels, and cooking further reduces cyanide risk. Linatine, a vitamin B6 antagonist observed in chicks, has not been shown to induce B6 deficiency in humans. Similarly, phytic acid and trypsin inhibitors have not been associated with negative impacts on mineral or protein digestion in clinical studies. Overall, current evidence does not support the notion of flaxseed toxicity at typical dietary levels [26–31].

#### ● CONCLUSION:

Flax seeds are widely recognized as a rich source of bioactive compounds, particularly alpha-linolenic acid (ALA), lignans, and, to a lesser extent, soluble polysaccharides (gum). Much of the research on flax seeds has focused on the biological activities associated with these components. Various flax seed-based products have demonstrated beneficial effects in the market. To harness flax seeds as a natural antioxidant, effective methods for extracting, modifying, and isolating their phytochemicals need to be developed. Additionally, flax seed peptides exhibit significant immunosuppressive and antimalarial properties, lignans provide antioxidant and phytoestrogenic benefits, and ALA contributes anti-allergic and anti-inflammatory effects.

#### ● REFERENCES:

1. Brown, L.; Caligiuri, S.P.B.; Brown, D.; Pierce, G.N. Clinical trials using functional foods provide unique challenges. *J. Funct.*

*Foods* 2018, 45, 233–238. [CrossRef]

2. Caligiuri, S.P.B.; Pierce, G.N. A review of the relative efficacy of dietary, nutritional supplements, lifestyle and drug therapies in the management of hypertension. *Crit. Rev. Food Sci. Nutr.* 2017, 57, 3508–3527. [CrossRef] [PubMed]
3. Wioletta Nowak and Małgorzata Jeziorek, The Role of Flaxseed in Improving Human Health. *Healthcare* 2023, 11, 395[MDPI].
4. Dr. Monika Gupta and Dr. Sharuti Sarin, a review over the benefits of flax seeds- a magical medicine. *world journal of Pharmaceutical and Life Sciences WJPLS*, 2017, Vol. 3, Issue 8, 37-39.
5. Mr. Shaikh Akbar, Mr. Mirza Nazish Baig, Miss. Desahmane Amruta, Flaxseeds: AReview. *INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY*, Volume 8 Issue
6. Md Sadique Hussain, Gurleen Kaur, Chandan Mohapatra, Nutritional composition and functions of flaxseed (*Linum usitatissimum* linn). *Food Therapy and Health Care* 2021;3(4): 88–91.
7. Mihir Parikh, Thomas Netticadan, and Grant N. Pierce, Flaxseed: its bioactive components and their cardiovascular benefits. *American journal of physiology.* 314: H146–H159, 2018.
8. Dobrowolska, K.; Regulska-Ilow, B. The legitimacy of using dietary supplement diglycoside secoisolariciresinol (SDG) from flaxseed in cancer. *Rocz. Panstw. Zakl. Hig.* 2021, 72, 9–20.
9. Di, Y.; De Silva, F.; Krol, E.S.; Alcorn, J. Flaxseed Lignans Enhance the Cytotoxicity of Chemotherapeutic Agents against Breast Cancer Cell Lines MDA-MB-231 and SKBR3. *Nutr. Cancer* 2018, 70, 306–315.
10. Neukam, K.; De Spirt, S.; Stahl, W.; Bejot, M.; Maurette, J.M.; Tronnier, H.; Heinrich, U. Supplementation of flaxseed oil diminishes skin sensitivity and improves skin barrier function and condition. *Skin Pharmacol. Physiol.* 2011, 24, 67–74. [CrossRef]
11. Caligiuri, S.P.B.; Aukema, H.M.; Ravandi, A.; Pierce, G.N. Elevated levels of pro-inflammatory oxylipins in older subjects are normalized by flaxseed consumption. *Exp. Gerontol.* 2014, 59, 51–57. [CrossRef]
12. Ettinger, G.; MacDonald, K.; Reid, G.; Burton, J.P. The influence of the human microbiome and probiotics on cardiovascular health. *Gut Microbes* 2014, 5, 719– 728. [CrossRef]
13. Thompson, L.U.; Robb, P.; Serraino, M.; Cheung, F. Mammalian lignan production from various foods. *Nutr. Cancer* 1991, 16, 43–52. [CrossRef]
14. Wang, C.Z.; Ma, X.Q.; Yang, D.H.; Guo,

- Z.R.; Liu, G.R.; Zhao, G.X.; Tang, J.; Zhang, Y.N.; Ma, M.; Cai, S.Q.; et al. Production of enterodiols from defatted flaxseeds through biotransformation by human intestinal bacteria. *BMC Microbiol.* 2010, 10, 115. [CrossRef]
15. Lagkouvardos, I.; Kläring, K.; Heinzmann, S.S.; Platz, S.; Scholz, B.; Engel, K.H.; Schmitt-Kopplin, P.; Haller, D.; Rohn, S.; Skurk, T. Gut metabolites and bacterial community networks during a pilot intervention study with flaxseeds in healthy adult men. *Mol. Nutr. Food Res.* 2015, 59, 1614–1628. [CrossRef]
  16. Munoz, O.; Fuentealba, C.; Ampuero, D.; Figuerola, F.; Estévez, A.M. The effect of *Lactobacillus acidophilus* and *Lactobacillus casei* on the in vitro bioaccessibility of flaxseed lignans (*Linum usitatissimum* L.). *Food Funct.* 2018, 9, 2426–2432. [CrossRef]
  17. Pulkrabek, M.; Rhee, T.; Gibbs, P.; Hall, C. Flaxseed- and Buckwheat- supplemented diets altered enterobacteriaceae diversity and prevalence in the cecum and feces of obese mice. *J. Diet. Suppl.* 2017, 14, 667–678. [CrossRef]
  18. Power, K.A.; Lepp, D.; Zarepoor, L.; Monk, J.M.; Wu, W.; Tsao, R.; Liu, R. Dietary flaxseed modulates the colonic microenvironment in healthy C57BL/6 male mice which may alter susceptibility to gut-associated diseases. *J. Nutr. Biochem.* 2016, 28, 61–69. [CrossRef]
  19. Patterson, E.; O'Doherty, R.M.; Murphy, E.F.; Wall, R.; O'Sullivan, O.; Nilaweera, K.; Fitzgerald, G.F.; Cotter, P.D.; Ross, R.P.; Stanton, C. Impact of dietary fatty acids on metabolic activity and host intestinal microbiota composition on C57BL/6J mice. *Br. J. Nutr.* 2014, 111, 1905–1917. [CrossRef]
  20. Zhang, X.; Wang, H.; Yin, P.; Fan, H.; Sun, L.; Liu, Y. Flaxseed oil ameliorates alcoholic liver disease via anti-inflammation and modulating gut microbiota in mice. *Lipids Health Dis.* 2017, 16, 44. [CrossRef]
  21. Gomides, A.F.; Concalves, R.V.; de Paula, S.O.; Ferreira, C.L.; Comastri, D.S.; Peluzio Mdo, C. Defatted flaxseed meal prevents the appearance of aberrant crypt foci in the colon of mice increasing the gene expression of p53. *Nutr. Hosp.* 2015, 31, 1675–1681.
  22. Brahe, L.K.; Le Chatelier, E.; Prifti, E.; Pons, N.; Kennedy, S.; Blaedel, T.; Håkansson, J.; Dalsgaard, T.K.; Hansen, T.; Pedersen, O.; et al. Dietary modulation of the gut microbiota—A randomized controlled trial in obese postmenopausal women. *Br. J. Nutr.* 2015, 114, 406–417. [CrossRef]
  23. an Kranen, H.J.; Mortensen, A.; Sørensen, I.K.; van den Berg-Wijnands, J.; Beems, R.; Nurmi, T.; Adlercreutz, H.; van Kreijl, C.F. Lignan precursors from flaxseed or rye bran do not protect against the development of intestinal neoplasia in ApcMin mice. *Nutr. Cancer* 2003, 45, 203–210. [CrossRef]
  24. Määttänen, P.; Lurz, E.; Botts, S.R.; Wu, R.Y.; Yeung, C.W.; Li, B.; Abiff, S.; Johnson-Henry, K.C.; Lepp, D.; Power, K.A.; et al. Ground flaxseed reverses protection of a reduced-fat diet against *Citrobacter rodentium*-induced colitis. *Am. J. Physiol. Gastrointest. Liver Physiol.* 2018, 315, G788–G798. [CrossRef]
  25. Soltanian, N.; Janghorbani, M. Effect of flaxseed or psyllium vs. placebo on management of constipation, weight, glycemia, and lipids: A randomized trial in constipated patients with type 2 diabetes. *Clin. Nutr. ESPEN* 2019, 29, 41–48. [CrossRef]
  26. Cockerell, K.M.; Watkins, A.S.; Reeves, L.B.; Goddard, L.; Lomer, M.C. Effects of linseeds on the symptoms of irritable bowel syndrome: A pilot randomized controlled trial. *J. Hum. Nutr. Diet.* 2012, 5, 435–443. [CrossRef]
  27. Hanif, P.A.; Gilani, A.H. Dual effectiveness of flaxseed in constipation and diarrhea: possible mechanism. *J. Ethnopharmacol.* 2015, 169, 60–68. [CrossRef]
  28. Bolarinwa, I.F.; Orfila, C.; Morgan, M.R. Determination of amygdalin in apple seeds, fresh apples and processed apple juices. *Food Chem.* 2015, 170, 437–442. [CrossRef]
  29. Touré, A.; Xueming, X. Flaxseed lignans: Source, biosynthesis, metabolism, antioxidant activity, bio-active components, and health benefits. *Comp. Rev. Food Sci. Food Saf.* 2010, 9, 261–269.
  30. Cressey, P.; Reeve, J. Metabolism of cyanogenic glycosides: A review. *Food Chem. Toxicol.* 2019, 125, 225–232. [CrossRef]
  31. Kajla, P.; Sharma, A.; Sood, D.R. Flaxseed—a potential functional food source. *J. Food Sci. Technol.* 2015, 52, 1857–1871. [CrossRef]