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Bioprocessing of Practical Components from Oil-Rich Seed

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Abstract

Flaxseeds are nutritious oilseeds rich in lignans, lipids, proteins, fibre, carbohydrates, and micronutrients. Flaxseeds have an established reputation as a dietary source of high value functional ingredients due to their established high nutritional profile. These essential constituents in flaxseeds can be made bioavailable for various applications such as nutraceuticals, cosmetics, and the food industry by using various bioprocessing techniques. Nonetheless, flaxseeds contain high levels of phytotoxic compounds such as linatine, phytic acids, protease inhibitors, and cyanogenic glycosides, despite their food and health applications. According to epidemiological studies, consuming these compounds can result in poor bioavailability of essential nutrients and/or health complications. As a result, these components must be removed or rendered inactive to physiologically undetectable levels.

Keywords: Flaxseed • Lignans • Micronutrients • Phytotoxic

Introduction

The common flax is a valuable agricultural commodity all over the world. For the composition of flaxseed, it is considered a "superfood" and a generally recognised as safe (GRAS) source of vitamins, minerals, proteins and peptides (including bioactive cyclic peptides), lipids (including omega-3 and omega-6 polyunsaturated fatty acids), carbohydrates, lignans, and dietary fibre. These flaxseed components' health-preventive and bioactive properties have been extensively researched. Flaxseed, for example, has been shown to have hypolipidemic, antiatherogenic, postprandial glycemic and insulinemic responses, anticholesterolemic, and anti-inflammatory properties due to its lipids, lignans, and fibre. Furthermore, other flaxseed components, such as proteins and peptides, have been shown to induce desirable biologically active properties in humans, such as antioxidant, anti-inflammatory, antihypertensive, immune suppression/enhancement, glucose absorption control, and so on [1].

Not only does the diversity of biomolecules in flaxseed provide this plant crop with a high nutritional profile, but some flaxseed components have also been investigated as food additives due to certain functional properties they exhibit. Functional properties are traits that describe how a food's biochemical component affects its sensorial properties during and after processing. Flaxseed mucilage, for example, has a high water-binding capacity, which is used to improve the consistency, stability, and viscosity of beverages. Furthermore, these mucilage have prebiotic potential and provide a bulking effect to stools, which helps to control constipation, irritable bowel syndrome, and body weight [2].

Despite its food and health applications, flaxseed contains high levels of phytotoxic compounds, which when consumed can result in poorly bioavailable nutrients and/or health complications. Linatine, phytic acids, protease inhibitors, and cyanogenic glycosides are the main antinutritive compounds found in flaxseed. Phytic acid inhibits mineral absorption such as calcium, zinc, magnesium, copper, and iron, whereas cyanogenic glycosides release hydrogen cyanide, a respiratory inhibitor that is converted to thiocyanates upon hydrolysis. Thiocyanates inhibit iodine uptake by the thyroid gland, and long-term exposure worsens iodine-deficiency disorders like goitre and cretinism. To make flaxseed safe for consumption, all antinutritive components must be removed or inactivated to physiologically undetectable levels [3].

While flaxseed is one of the oldest oil crops used in food, information on how its functional ingredients are processed varies. Furthermore, many of the processing techniques developed for other oil crops are frequently incompatible with flaxseed. This review describes the functional/bioactive ingredients derived from flaxseed, as well as the processing techniques used to extract or isolate these ingredients. The potential challenges to the extraction of flaxseed-derived functional ingredients are discussed, as are ideas for more efficient, greener extraction. This review also highlights and discusses flaxseed detoxification strategies.

Literature Review

Flaxseed is mostly made up of proteins, which are mostly concentrated in the cotyledons. Flaxseed protein is high in amino acids like glutamic acid, methionine, arginine, cysteine, and aspartic acid, but low in lysine, threonine, and tyrosine. The final protein content of flaxseed products is affected by a number of processing conditions. Also, while flaxseed is not a complete source of dietary protein (due to a lack of certain essential amino acids such as lysine), the contributions of these beneficial proteins and bioactive compounds (primarily peptides), as well as their potential nutraceutical/nutritional applications, have received considerable attention in the literature. The digestibility of flaxseed proteins is determined by whether the protein is isolated in pure form or exists in conjunction with other nutritional components [4].

Flaxseed proteins have been linked to antifungal properties , and specific amino acids found in flaxseeds, such as cysteine and methionine, have been shown to have antioxidant properties. Furthermore, flaxseed protein hydrolysates have been shown to have anti-neurodegenerative properties by inhibiting nitric oxide synthesis, anti-hypertensive properties by inhibiting the transformation of angiotensin I to angiotensin, plasma glucose lowering abilities, and many other benefits.Flaxseed is also a source of cyclic peptides known as cyclolinopeptides, with over 25 different types of these peptides identified in flaxseed to date [5].

Discussion

Flaxseed contains a significant amount of dietary fibres and phenolic compounds (phenolic acids, flavonoids, and lignans). A detailed discussion

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of the metabolism, composition, and health properties of these components can be found elsewhere (as well as references). Soluble flax mucilage is commonly used as a food constituent, either as a stabiliser for vegetable and fruit juices or as an ingredient to prevent syneresis and improve the texture of dairy products. Flaxseeds, on the other hand, have 75 to 800 times the amount of lignans as other cereal grains. Secoisolariciresinol diglycoside is the most abundant lignin in flaxseed. These phytoestrogens have been linked to a variety of health-promoting properties, including protection against cardiac and hepatic diseases, osteoporosis and carcinogens, and plasma cholesterol reduction.

The simplest technique for isolating bioactive carbohydrates is solid-liquid extraction, which involves the mass transfer of solutes from a solid matrix into a solvent. Water is the primary solvent used in carbohydrate extraction. Mucilage is extracted using hot water by soaking whole seeds or partially defatted seed cake. The viscous crude extract is then precipitated with organic solvents or ultrafiltration, followed by freeze drying. Methods for selective removal of carbohydrates from crude fractions have been used, but these techniques are time consuming because several washing steps are often required. Furthermore, depending on the solvents used, residue removal may be required. Solid-liquid extraction has the advantage of producing reasonable yields while requiring little capital [6, 7].

Conclusion

Over several decades, many fractionation techniques have been used to separate seed protein, including flaxseed. Flaxseed proteins are classified into three types: albumin, globulin, and glutelin. Protein must be extracted from seeds prior to use as a food component to improve digestibility, improve techno-functional properties, taste and colour, and reduce levels of antinutritive compounds. Several protein extraction techniques have been proposed for the preparation of flaxseed protein isolates. These include both traditional methods and novel processing technologies. Alkaline/isoelectric precipitation, acid pre-treatment with ultrafiltration, and micellization are all traditional isolation methods. Several novel protein extraction technologies have also been discovered. These methods increase protein yield, functionality, and production sustainability.

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Conflict of Interest

There is no conflict of interest by author.

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