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Advances, Challenges and Future Prospects in the Bioprocessing of Practical Components from Oil-Rich Seeds

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Introduction

All around the world, common flax is a valuable agricultural commodity. Flaxseed is a "superfood" with a high concentration 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. The health-preventive and bioactive characteristics of these flaxseed components have been widely explored [1]. Because to its lipids, lignans, and fiber, flaxseed has been demonstrated to have hypolipidemic, antiatherogenic, postprandial glycemic and insulinemic responses, anticholesterolemic, and anti-inflammatory characteristics. Furthermore, other flaxseed components, such as proteins and peptides, have been proven in humans to generate favourable physiologically active qualities such as antioxidant, anti-inflammatory, antihypertensive, immunological suppression/enhancement, glucose absorption regulation, and so on.

Description

Not only does the diversity of biomolecules in flaxseed give a high nutritional profile for this plant crop, but particular flaxseed components have also been explored as food additives due to certain functional capabilities they exhibit. Functional qualities are characteristics that define how the biochemical components of a food affect its sensory features during and after processing. For example, flaxseed mucilage has a high water-binding capacity and is used to improve the consistency, stability, and viscosity of beverages. Furthermore, this mucilage contains prebiotic potential and adds volume to stools, which aids in the management of constipation, irritable bowel syndrome, and body weight.

Despite its culinary and health applications, flaxseed has high quantities of phytotoxic chemicals, which might result in poorly accessible nutrients and/or health issues when ingested. The principal antinutritive chemicals identified in flaxseed include linatine, phytic acids, protease inhibitors, and cyanogenic glycosides. Mineral absorption is inhibited by phytic acid, whereas cyanogenic glycosides produce hydrogen cyanide, a respiratory inhibitor that is converted to thiocyanates upon hydrolysis. Thiocyanates limit thyroid gland iodine uptake, and long-term exposure exacerbate iodine-deficiency illnesses such goitre and cretinism [2,3]. All antinutritive components must be eliminated or inactivated to physiologically undetectable levels before flaxseed can be consumed. While flaxseed is one of the oldest oil crops used in food, knowledge on how its beneficial components are processed differs. Furthermore, many of the processing techniques established for other oil crops are typically incompatible with flaxseed. This article discusses the functional/bioactive compounds obtained from flaxseed, as well as the processing procedures utilised to extract or isolate these chemicals. The possible obstacles of extracting flaxseed-derived beneficial compounds are examined, as solutions for more efficient, greener extraction. This paper also highlights and analyses flaxseed detoxification strategies.

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].

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

Solid-liquid extraction, which includes the mass transfer of solutes from a solid matrix into a solvent, is the most basic approach for isolating bioactive carbohydrates. The major solvent in carbohydrate extraction is water. Mucilage is extracted by soaking whole seeds or partially defatted seed cake in hot water [6]. Following freeze drying, the viscous crude extract is precipitated using organic solvents or ultrafiltration. Methods for selective carbohydrate removal from crude fractions have been employed, but these approaches are time demanding because many washing processes are sometimes necessary. Furthermore, residue removal may be required depending on the solvents employed. The advantage of solid-liquid extraction is that it produces respectable yields while needing little capital [7].

Conclusion

Many fractionation procedures have been tried throughout the years to separate seed protein, including flaxseed. Albumin, globulin, and glutelin are

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the three forms of flaxseed proteins. To increase digestibility, improve techno-functional qualities, taste and color, and lower levels of antinutritive chemicals, protein must be extracted from seeds prior to use as a food component. For the manufacture of flaxseed protein isolates, several protein extraction procedures have been developed. Traditional approaches as well as novel processing technologies are included. Traditional isolation procedures include alkaline/isoelectric precipitation, acid pre-treatment with ultrafiltration, and micellization. In addition, several innovative protein extraction strategies have been discovered. These technologies boost protein yield, functionality, and the sustainability of production.

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Conflict of Interest

There is no conflict of interest by author.

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