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PEANUT
an underrated nutrient heap

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Introduction

Plant-based proteins offer economic and environmental advantages over animal proteins. Research indicates that producing 1 kg of animal protein requires 4.9 kg of plant proteins as feed, and animal-based food production generates higher greenhouse gas emissions compared to plant-based alternatives. However, human nutrition necessitates a balanced amino acid profile for optimal protein synthesis. Plant proteins often lack sufficient quantities of essential amino acids like methionine, lysine, tryptophan, and threonine. They also contain antinutritional factors that can impede nutrient absorption.

Despite these challenges, the demand for plant-based protein sources has grown rapidly since 2010, while global animal protein demand is projected to double by 2050. This shift has led to increased demand for oilseed meals, surpassing that for oils. However, consumer preferences still favor animal-based products in terms of flavor, color, and texture.

India leads global oilseed production, generating over 25 million tons of oilseed cakes annually. Historically, oilseed cakes have been utilized as animal feed and soil compost due to their cost-effectiveness and nutritional value. These by-products are rich in protein, energy, carbohydrates, and minerals, making them a valuable resource in various applications. Soybean and canola seed cakes are the most abundant by-products worldwide. Peanuts, both an oilseed and legume, boast high protein content (26-29%) and an excellent amino acid profile, making them valuable as a food ingredient. Despite these benefits, peanut protein isolates are not yet available as a commodity, though this form would be desirable for its ease of incorporation into food formulations and higher market value compared to other oilseed-derived products

Nutritional profile of peanut

Peanuts, ranking third globally in vegetable oil production with an annual yield of 31 million tonnes, play a significant role in both Western and Eastern cuisines. The majority of the more than 5 million tonnes of defatted peanut meal (protein content greater than 55%) produced annually worldwide is utilised as animal feed, resulting in resource loss (Wang, 2018). The dazzling white colour, high digestibility (~90%), lack of flatulence factor, and bean flavour of peanut protein powder, which mostly contains glycinin and β-conglycinin, may assist to compensate for the shortcomings of soybean protein. The fatty acid composition and location inside the triacylglycerol molecule of fats and oils mostly dictate their chemical and physical characteristics. Due to its high oleic content, peanut oil has good frying and oxidative stabilities. Peanut oil solidifies between 0 and 3° C and is a non-drying oil that does not solidify when exposed to air. Three main fatty acids are found in peanut oils as acylglycerols, which are esters made of glycerol and fatty acids. These acids include linoleic (C18:2), palmitic (C16:0), and oleic (C18:1). Their versatility extends to various culinary applications, including pastries, sandwiches, egg rolls, chili, syrups, flours, sauces, and confectioneries.

The nutritional profile of peanut seeds is impressive, containing 25-29% protein, 20-23% carbohydrates, and 40-50% oil. After oil extraction, the protein content in the residual cake can increase to 45-60%, accompanied by 22-30% carbohydrates, 3.8-7.5% crude fiber, and 4-6% minerals. This protein rich byproduct has numerous potential applications, such as low-fat concentrates, composite flours, bakery products, breakfast cereals, snack foods, nutritional supplements, infant formulas, and extruded foods. Peanuts are a rich source of vegetable protein, have a high oleic acid content, and have a low saturated fatty acid content. In addition, it contains a lot of bioactive substances (including phytosterols and polyphenols) and a high concentration of potassium and magnesium, which are linked to a lower risk of a number of illnesses. In a healthy young population, regular ingestion of peanuts may improve stress response and cognitive performance. Consuming peanut polyphenols appears to be linked to these effects, as are elevated faecal SCFA and, surprisingly, VLCSFA levels. Dietary fibre content in peanut shells ranges from 38.8 to 42.8% (Muñoz-Arrieta et al., 2021). Prebiotic fibre and polyphenols, which are nutritional ingredients that support the gut bacteria, are abundant in nuts.

The nutritional value and chemical composition of peanuts and other oilseeds are influenced by various factors. These include genetic traits, geographical location, soil characteristics, farming practices, weather conditions, and processing methods. Environmental stressors like water scarcity and plant diseases can impede seed development. Notably, nitrogen fertilization plays a crucial role in determining protein content, as it is essential for amino acid and protein synthesis. Processing vegetable oil produces waste effluent with high quantities of organic elements that must be eliminated before release. It was discovered that defatted peanut meal extracted with salt solution was useful in lowering the turbidity, chemical oxygen demand, and total suspended particles of the effluent from facilities that produce palm oil. Peanuts can be regarded as a superior source for comparable applications, such wood adhesives, because their protein content is larger than that of soy. Proteins in defatted peanut meal were denatured using surfactants, and their water resistance was increased by modifying them with ethylene glycol diglycidyl.

Methods of oil extraction

Oil extraction from oilseeds traditionally employs two primary methods: screw pressing and solvent extraction. The resulting co-product is referred to as "cake" when obtained directly from the expeller, while "meal" denotes the product that has undergone additional de-oiling, typically using organic solvents. An alternative approach, aqueous extraction, often incorporates isoelectric precipitation followed by membrane filtration for purification. This method offers the added benefit of reducing antinutrient content. Peanut protein products with fiberous textures are made via extrusion processes. Preserving such texture has been the main goal of approach optimisation. One disadvantage of peanut protein has been its low tensile strength when extruded and utilised to make meat substitutes. To get over this inadequacy, peanut protein has been combined with either wheat gluten or soy protein isolates. Protein enrichment processes aim to balance several factors like maximizing protein yield, minimizing purification steps to control costs, preserving protein functionality and nutritional value while eliminating antinutrients and minimizing environmental and health impacts

Common vegetable protein extraction techniques include salt precipitation, solvent precipitation, and alkaline extraction. The latter is considered the most efficient in terms of protein yield. However, when applied to defatted peanut flour, these methods may be less effective compared to their use with unprocessed or unheated proteins.

To enhance peanut protein extractability, researchers have explored various strategies, including physical treatments (such as milling and solvent selection) and enzymatic approaches. These methods, while promising, come with drawbacks like high energy consumption, potential damage to the carbohydrate-protein matrix, time inefficiency, extensive solvent use, and the need for precise pH and temperature control.

Ultrasound technology has gained popularity in food processing due to its simplicity, speed, and eco-friendly nature. It enhances extraction efficiency through cavitation, where rapidly forming and collapsing bubbles create mechanical effects that rupture plant cell walls, facilitating the release of intracellular components into the solvent.

Varietal roles of peanut proteins

Since peanuts are technically classified as a legume, its nutritional value, particularly their protein content is more comparable to that of chickpeas and soybeans than it is to that of almonds, walnuts, and other oil seeds. Nonetheless, peanuts are composed of 32 distinct protein components, 18 of which have the potential to cause allergic reactions. Furthermore, heat, chemical denaturation, and proteolytic enzymes cannot break down these allergenic proteins.

Reports on the characterisation of peanut proteins frequently concentrate on the protein found in the peanut flour matrix. A more effective method of examining the proteins' functioning was to isolate the peanut's pure proteins and protein fractions. The flour was more effectively hydrolysed by a protease (Flavorzyme) than the isolate when defatted peanut flour and peanut isolate were compared. This was ascribed to peptide aggregation brought on by hydrogen bonds and hydrophobic interactions. Anion exchange chromatography can be used to isolate the proteins. The stability of foams made with isolated peanut proteins and their emulsifying qualities were explained.

Transglutaminase has been utilised to create a microgel from peanut protein. At a high pH of 9.0, the particles were controlled to create monolayers that retained water and oil, producing a finished product that could be used as vegetable spreads.

Protein isolates from peanuts (PPI) work well as emulsifiers. Peanut protein isolates' emulsifying capacity was enhanced by heat treatment at temperatures higher than 80°C, which also increased the size of the proteins in the isolates and their hydrophobicity and other physical properties. PPI loses its sulfhydryl concentration and surface hydrophobicity when it is frozen and thawed repeatedly. Because of the smaller particle size and more homogeneous microstructure, the PPI's emulsification impact was enhanced.

When protein isolates from peanuts were extracted using ultrasonic, the arachin and conarachin peanut proteins changed. Peanut protein isolates can also be utilized to formulate plant protein isolate blends along with some cereal protein isolate in order to achieve a complete protein with all the essential aminoacids.

Limitations

Peanuts' rich nutritional makeup makes them vulnerable to contamination by toxic fungus, which may eventually cause the production of mycotoxins, or fungal metabolites, especially aflatoxins. The International Agency for Research on Cancer has classified aflatoxin as a Group-1 human carcinogen. *Aspergillus flavus* and *A. parasiticus,* which are found in soil, generate it. Processing has an impact on peanuts' bioactive components and polyphenol profiles. Based on sensory analysis and bioactive concentration, the best processing parameters were determined to be pressure cooking for 15 minutes, frying at 170°C for 2 minutes, and roasting at 150°C for 10 minutes. Therefore, the health advantages linked to processing may be changed by the treatment procedure (Salve et al., 2021).

Conclusion

The functional components, resveratrol, tocopherols, phytosterols, and other bioactive compounds in peanuts have been shown in epidemiological and clinical trials to have protective benefits against cancer, heart disease, and other chronic illnesses when consumed regularly. Peanuts are a good and inexpensive snack choice, especially for teenagers and the elderly who suffer from protein-energy malnutrition, because of its low cost, high energy value, and micronutrients including vitamin B and vitamin E as well as functional components. A decreased risk of noncommunicable illnesses was associated with eating more nuts and less red and/or processed meats. Many experts advocate for a worldwide reduction in the consumption of animal-based foods and an increase in the consumption of nuts and/or seeds due to the urgent need for a changing global food system to preserve health and ecological sustainability. If can better harness the potential of these nutrients in peanut products within the food sector if we have a better grasp of the nutritional chemistry of peanuts. Furthermore, a better knowledge of the nutritional chemistry of peanuts may make it easier to determine how best to employ peanuts and/or peanut-derived ingredients in the agricultural feed sector to enhance the performance, growth, and general health of producing animals. While a more thorough understanding of the nutritional chemistry of peanuts allows us to better address global hunger and nutrition challenges, an understanding of the functional components contained in peanuts may also help consumers' health and wellness. As a result, the range of recently developed study on peanut nutrition keeps growing significantly.

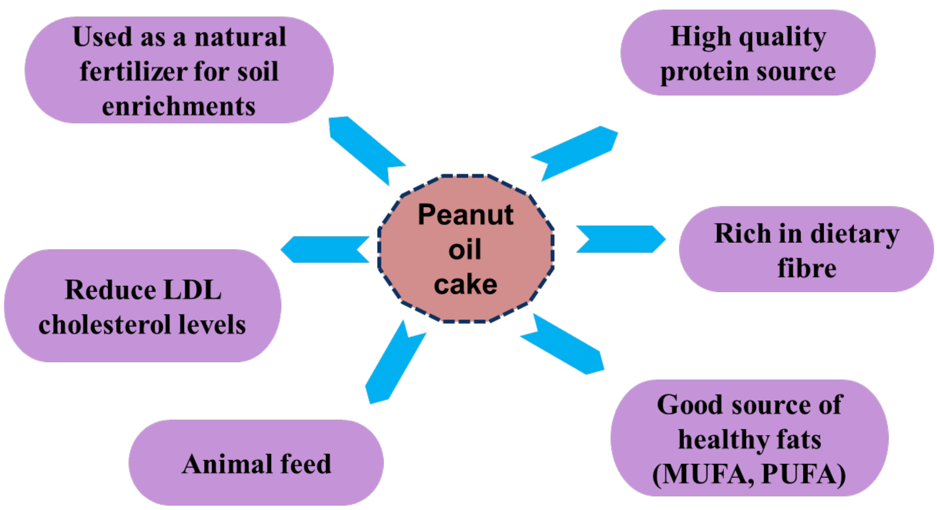

Fig: Nutritional benefits of Peanut

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