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Original article

A superior approach for production of protein isolates from de-oiled soy meal and its comparison with conventional method

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Summary Protein isolates were prepared from de-oiled soy meal by a superior approach, *i.e.* biological precipitation using two lactic acid bacterial strains and a conventional acid precipitation method. The isolates were characterised for physico-chemical, functional, anti-nutritional and structural properties and compared with isolates prepared using the conventional method. The purity, yield, lightness, whiteness index and degree of hydrolysis were higher ($P \leq 0.05$) for biologically precipitated soy protein isolates (BPSPIs). The functional properties of BPSPI samples were also superior. BPSPIs showed 1.85 mg g^{-1} and 1.44 TIU mL^{-1}, whereas acid-precipitated soy protein isolates (APSPIs) showed 3.65 mg g^{-1} and 3.16 TIU mL^{-1} of phytic acid and trypsin inhibition activity respectively. A sharp bend in the wavelength ranges from 3700 to 3900 cm^{-1} was observed in BPSPI samples, which depicts structural changes owing to fermentation by lactic acid bacteria. Two characteristic peaks at 2 = 20° and 2 = 15° were observed in both the samples; however, intensity and crystallinity were higher in BPSPIs. Hexagonal-shaped particles of different sizes were displayed by field emission scanning electron microscopy images. The results thus confirm that the soy protein samples prepared through the biological precipitation process had better properties over conventionally prepared soy protein samples, which can be further used as novel ingredients in protein-based functional products.

Keywords Anti-nutritional factors, lactic acid bacteria, precipitation, probiotics, soy protein isolate, structural properties.

Introduction

Conventional, alkali solubilisation followed by acid precipitation is an established method for the extraction of proteins from various plant sources and is well-adopted technique at the commercial level (Kamal *et al.*, 2021). Safety, nutritional and functional properties of proteins are main concerns of the conventional process. Acidic conditions (by hydrochloric acid) used for precipitation of proteins can impair the digestibility as well as can lead to racemisation, thus destroy some amino acids in protein isolates (PIs) (Kumar *et al.*, 2021). Decline in nutritional and functional properties, generation of brown substances and severe protein denaturation were also reported by Wang *et al.* (1999) in protein isolates prepared through conventional process. Use of strong acids like HCl degrades the nutritional and functional quality of the final product and can pose serious environmental problems (Kumar *et al.*, 2021).

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In order to address the prevailing limitations associated with the conventional process, many innovative technologies such as air classifications, membrane filtration and wet extraction with different solvents etc. have been researched for the extraction of protein from plant sources (Hadnađev *et al.*, 2017). To enhance extraction of proteins by means of hydrolysis or to increase the solubility of the proteins by disrupting the cell structure, the main focus of researchers at present and also many techniques have been explored at the laboratory scale (Kamal *et al.*, 2021). These include enzyme-assisted extraction (Rommi *et al.*, 2015), subcritical water extraction using hot water under high pressure (Lu *et al.*, 2016), reverse micelles extraction using nano-sized aggregates of surfactant molecules (Zhao *et al.*, 2018) and with bis (2-ethylehexyl) sodium sulfosuccinate salt (Biswal *et al.*, 2020, 2021), aqueous two-phase systems (Zeng *et al.*, 2013). Sari *et al.* (2013) observed 10% higher extraction yield of soy protein in comparison to the conventional method using enzyme-assisted extraction with serine, endo- and exoprotease. Novel cell disruption techniques such as microwave-assisted extraction

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