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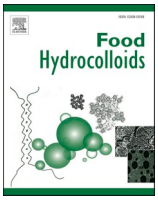

Effect of controlled enzymatic treatment on the physicochemical, structural and functional properties of high-intensity ultrasound treated album (*Chenopodium album*) protein

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ABSTRACT

The present study was carried out to examine the effect of enzymatic treatment on high-intensity ultrasound modified album proteins. The results showed that enzymatic treatment induced structural changes which in turn improved physiochemical and functional characteristics of album proteins. Trypsin treated album proteins showed highest degree of hydrolysis values of 18.99%. Enzymatic treatment decreased particle size, polydispersibility index, zeta-potential, turbidity, total SH content and SS-bonds, however, DPPH radical scavenging activity, total phenolic content, solubility, surface hydrophobicity, free SH groups increased significantly ($p \leq 0.05$). Smallest particle size reduction of 400 nm was observed in the case of pepsin treated album proteins. FTIR resulted showed major peak shifting in the wavelength ranging from 1600 to 1700 cm^{-1} in enzymatically treated album proteins indicating structural and conformational changes. Enzymatic treatment decreased molecular weight of album proteins as indicated by SDS-PAGE results. X-ray diffraction analysis showed decline in crystallinity of all the enzymatically treated album proteins and highest decline was observed in protease treated album proteins. FE-SEM results showed the appearance of cracks and porous type surfaces in all the enzymatically treated album proteins, however, the control samples showed somewhat smooth surface morphologies. Thermal characteristics, particularly denaturation temperature showed significant increase in enzymatic treated album proteins. These structural and conformational changes reduced particle size, improved color characteristics, flow properties, antioxidant activity and total phenolic content of enzymatic treated album proteins. For instance, trypsin treated album proteins showed highest antioxidant activity and highest total phenolic content values of 66.75% and 8.61 (mg GAE/g), respectively. Pepsin treated album proteins showed lowest turbidity values of 0.73 and trypsin treated album proteins showed highest solubility values of 99.73%. Loose bulk density, packed bulk density and true density of enzymatic treated album proteins was found significantly higher than those of control album proteins, whereas, Hausner's ratio, Carr's index and Tan θ was found significantly higher in trypsin treated album proteins. Enzymatic treatment coupled with HIUS modification favorably impacted the structural, physiochemical and functional properties of album proteins.

1. Introduction

A growing global population with deteriorating natural resources and increased urbanization means more people to feed with less water, farmland and rural labor. Shifting to more sustainable production and consumption practices is necessary to meet the anticipated increases in water, energy and food needs. By 2050, it is predicted that there will be 9.7 billion people on the planet which will ultimately increase the demand for food (Umesha, Manukumar, & Chandrasekhar, 2018). According to a recent study, plant-based proteins require 69–92% fewer carbon emissions, 53–95% fewer water resources and 38–91% fewer lands than their meat-based counterparts. Album (*Chenopodium album*) belongs to pseudocereals and is famous for its high nutritional profile particularly the presence of high quality essential amino acids like tryptophan, histidine, methionine and lysine etc. (Mir, Riar, & Singh, 2019a). Apart from the presence of high quality essential amino acids, it also contains other bioactive compounds with number of health benefits (Mir, Riar, & Singh, 2018). In our previous studies, the proteins obtained

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