Food Hydrocolloids 103 (2020) 105708

Contents lists available at ScienceDirect

Food Hydrocolloids

journal homepage: http://www.elsevier.com/locate/foodhyd

Structural modification in album (*Chenopodium album*) protein isolates due to controlled thermal modification and its relationship with protein digestibility and functionality

Nisar A. Mir, Charanjit S. Riar *, Sukhcharn Singh

Department of Food Engineering & Technology, Sant Longowal Institute of Engineering & Technology, Longowal, Punjab, 148106, India

ARTICLE INFO

Keywords:
Heat treatment
Album protein isolates
Denaturation
Dynamic rheology
Digestibility
Conformation

ABSTRACT

Native *pseudo*-cereals protein has low gelling characteristics even though they are rich in essential amino acids. It is therefore desirable to find the suitable modification approach which can manipulate their structure with an overall improvement in the functional characteristics. Accordingly, the impact of controlled heat treatment of album protein isolates (93% protein, db), on its structural and conformational changes have been investigated in order to study their impact on physicochemical, rheological, and thermal properties. Fluorescence intensity of native and heat-treated APIs occurred at 350 nm and the highest peak were obtained for the APIs heated at 100 °C for 30 min, depicting conformational changes due to thermal modification. FTIR results showed absorption peaks in amide-I, amide-II, and amide-III zones for the heat-treated APIs which confirms the presence of structural modifications. Molecular weight of heat-treated APIs was reduced to 31 kDa indicated splitting of bands. Surface hydrophobicity of heat-treated APIs was higher indicating maximum unfolding of protein structure, whereas, the available lysine content of APIs decreased due to heating effect. Heat treatment resulted in an improvement in the thermal stability of APIs such as lower weight loss which is evident from the results of denaturation temperature, enthalpy and improvement in gelling characteristics (highest values of loss modulus and storage modulus at higher thermal temperatures). *In vitro* digestibility increased up to 87.55% when API was heated at 100 °C for 30 min. L^*, b^*, and chroma values of heat-treated APIs were found higher than native APIs. The results suggest that the heat treatment induced conformational and structural changes showing positive impacts on the physicochemical, nutritional, and gelling characteristics of the APIs which are important for the processing and application of proteins.

1. Introduction

Pseudo cereals for instance album (*Chenopodium album*) and quinoa (*Chenopodium quinoa*) can play a major role in the development and diversification of agricultural products and foods (Mir, Riar, & Singh, 2018). Album is commonly known as 'Bathua' in India and grows as an annual weed in the fields of rice, wheat, and maize. In India, mainly its leaves are utilized for culinary purposes and very scarce information is available regarding the potential application of high-quality proteins present in the seeds. The seeds of *Chenopodium album* contains around 13.12% protein and has a perfect amino acid balance with a high spectrum of lysine (59 g/kg) and methionine (21 g/kg) (Mir, Riar, & Singh, 2019a). The results from our previous study also depicted that the nutritional profile like essential amino acid index (EAAI), nutritional index, amino acid score, protein efficiency ratio (PER), biological value (BV) of APIs was far better than the proteins from traditional cereals like rice, wheat, and maize. The study also revealed that lysine to arginine ration of APIs (0.67) was also lower than soy protein isolates (0.71) and whey protein isolates (5.38) (Kaushik et al., 2016). The lysine to arginine ratio is used to measure the cholesterolomic and atherogenic effects of proteins. A protein with a lower ratio of lysine to arginine has lesser lipidemic and atherogenic effects. So, APIs can be used in food formulations in order to combat the problems of cardiac health. Nature has blessed this crop with some extraordinary features like excellent resistance to salinity, drought, and phenotypic flexibility thus making it a potential candidate for national food security (Jan, Saxena, & Singh, 2018). Besides being rich in essential amino acids, this crop is also odorless and has been extensively used in traditional medicinal systems

* Corresponding author.
E-mail address: charanjitriar@yahoo.com (C.S. Riar).

https://doi.org/10.1016/j.foodhyd.2020.105708
Received 26 September 2019; Received in revised form 21 January 2020; Accepted 22 January 2020
Available online 24 January 2020