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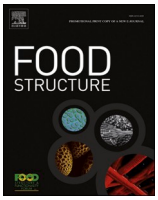

Improvement in the functional properties of quinoa (*Chenopodium quinoa*) protein isolates after the application of controlled heat-treatment: Effect on structural properties

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

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

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ABSTRACT

Quinoa protein isolates (QPIs) were subjected to controlled heat-treatment (80−100 °C) at variable time (15−30 min). Results showed that heat-treatment induced structural changes in QPIs. Circular dichroism showed loss of secondary structure of QPIs, particularly α-helix and β-sheet. Total and exposed SH groups were significantly ($p \leq 0.05$) lower in heat-treated QPIs. SDS-PAGE profile showed formation of soluble protein aggregates with smaller particle size. Particle size decreased when QPIs were heated at 80 °C for 30 min. Solubility and turbidity of heat-treated QPIs improved significantly. Decline in crystallinity was due to denaturation of protein molecules by heat-treatment. Water binding capacity, oil binding capacity, emulsifying activities and stabilities were found lower in QPIs heat-treated at higher thermal temperatures for longer time. This might be due to decline in total and exposed SH contents, accelerated conversion of SH groups into disulfide bonds and formation of large molecular weight polymers or protein aggregates due to polymerization reactions. Higher foaming capacity (89.99 %) and foaming stability values of 167.80 % (10 min) and 124.15 % (20 min) were found in QPIs heated at 80 °C for 30 min. The results thus suggests that heat-treatment carried out at lower heating temperatures had improved the functional properties of QPIs.

1. Introduction

Quinoa (*Chenopodium quinoa*) is a *pseudo*-cereal crop and belongs to the family *Chenopodiaceae*. It is a dicotyledonous plant as opposed to many cereal grains like wheat, barley, and maize which are monocotyledonous (Mir, Riar, & Singh, 2018). It is commonly known as quinoa in Argentina, Ecuador, and Bolivia and has been considered as the domesticated crop in the Andean regions (Mir, Riar, & Singh, 2019). Nowadays, quinoa is gaining tremendous attention due to its excellent nutritional profile. Among all the essential ingredients present in quinoa, proteins mainly have been in demand for the last few years (Mir, Riar, & Singh, 2019). This important and nutrient-dense *pseudo*-cereal crop generally grows as a weed in rice, wheat, and maize fields. Despite rich in essential amino acids, the proteins of this important pseudo-cereal crop is however low in functional properties like solubility, water binding capacity, foaming, and emulsification properties.

Thermal treatment is the most common conventional method used to alter the physicochemical and functional characteristics of protein isolates obtained from different sources (Raikos, 2010). In this method, the native structure of protein isolates is subjected to varying levels of time and temperature exposures which can lead to an overall improvement in the functional and physicochemical characteristics. In our recent study (Mir, Riar, & Singh, 2020) album protein isolates (APIs) were subjected to controlled heat-treatment and the results indicated that heat-treatment had improved the physicochemical, gelling, thermal, and *in-vitro* digestibility of APIs by alteration in structural and conformational properties. Peyrano, Speroni, and Avanza (2016) have conducted studies on the effect of temperature on physicochemical and functional characteristics of cowpea protein isolates and have observed an improvement in the functional properties like solubility, surface hydrophobicity, and least gelation concentration. Sui, Roginski, Williams, Versteeg, and Wan (2011) carried out comparative studies on the effects of thermal and pulsed electric field treatments on the physicochemical and functional properties of whey protein isolates. Interestingly, pulsed electric field treatment did not show any alteration in the physicochemical and functional characteristics of whey protein isolates; however, only gelling characteristics were improved. In comparison with pulsed electric field treatment, the thermal treatment showed amazing

* Corresponding author.
E-mail address: nisarmir89@gmail.com (N.A. Mir).

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