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Rheological, structural and thermal characteristics of protein isolates obtained from album (*Chenopodium album*) and quinoa (*Chenopodium quinoa*) seeds

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ABSTRACT

This study was carried out to examine the structural, rheological and thermal characteristics of protein isolates extracted from album and quinoa seeds. The results showed that surface hydrophobicity, free and total sulfhydryl groups were found significantly ($p \leq 0.05$) higher in quinoa protein isolates. Rheological parameters showed that both G' (storage modulus) and G" (loss modulus) were higher in quinoa protein isolates than album protein isolates. Enthalpy of denaturation (ΔH) was found significantly ($p \leq 0.05$) higher in quinoa protein isolates, however, denaturation temperature (T_d) was found higher in album protein isolates. Thermal gravimetric analysis showed that album protein isolates were degraded much faster than quinoa protein isolates with increasing temperature. Both quinoa and album protein isolates had two diffraction peaks at $2\theta=10^\circ$ and $2\theta=20^\circ$ respectively, but the peaks were more intense in album protein isolates. Circular dichroism showed α-helical structure and a more dominant negative peak in album protein isolates. FTIR showed characteristic peaks at 1200, 1500, 1700 and 3100-3300 cm^{-1} for both album and quinoa seed proteins respectively. SDS-PAGE results confirmed the presence of globulins in quinoa and album protein isolates.

1. Introduction

Proteins obtained from natural vegetable plants are not always promising sources of essential amino acids which in turn leads to the deficiency of several essential amino acids in the diet. To overcome this problem, proteins obtained from *pseudo-cereal* seed crops can be alternative and complementary to many protein sources with the potential of being used as food ingredients due to their high quantity of essential amino acids (Abugoch, 2009). In the findings of our recent study Mir, Riar & Singh (2019a), it was observed that protein isolates obtained from quinoa and album seeds were having a higher nutritional profile in terms of essential amino acid index, biological value, protein efficiency ratio, nutritional index and amino acid score than conventional seed crops. Proteins isolated from natural *pseudo cereals* sources are also considered efficient food ingredients due to their safeness, low cost and high biocompatibility (Mir, Riar & Singh, 2018). In addition to this, their use in mixed systems can improve or modify the functional behavior of many food systems (Rocha, Souza, Magalhaes, Andrade & Gonçalves, 2014).

Quinoa (*Chenopodium quinoa*) is an *Amaranathacean* stress-tolerant plant cultivated along the Andean region for the last 7000 years due to its excellent versatility to different environmental conditions. Its grains possess higher nutritive value than traditional cereals and it is also considered as a promising worldwide cultivar for human consumption and nutrition (Vega-Galvez et al., 2010). Album (*Chenopodium album*) is native to Western Asia and distributed worldwide containing almost 250 species. It naturally grows as a weed in the fields of wheat, barley, mustard, gram and other crops. The whole plant has got herbal and medicinal properties. In India, it is known by various vernacular names like Bathua sag (Hindi), Chandan betu (Bengali), Parupukkirai (Tamil), Pappukura (Telgu) and Katu ayamoddakam (Malyalam) (Poonia & Upadhayay, 2015). It is a promising *pseudo-cereal* crop with high-quality protein and a good balance of essential amino acids particularly lysine and methionine (Jan, Saxena & Singh, 2018). Regardless of their higher nutritional profile, it is necessary to evaluate structural, thermal, rheological and molecular characteristics because the ultimate success of protein isolates before employing them in any food system primarily depends upon the structure-functional relationships. Moreover, most of the foods are usually processed at higher temperatures and proteins should resist the changes in temperature, pH or any other processing parameter. The structure-functional relationships are special attributes of food proteins that depend upon their molecular size, charge distribution and three-dimensional networks. They also determine their interactions with themselves and other ingredients in a complex food system. These important properties are having a profound impact on other characteris-

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