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Food Chemistry



Effect of pH and holding time on the characteristics of protein isolates from *Chenopodium* seeds and study of their amino acid profile and scoring

valine as the limiting amino acids.



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ARTICLE INFO	A B S T R A C T
Keywords:	Alkali extraction and acid precipitation methods were adopted to isolate protein from quinoa and album seeds of
Protein purity	variety Chenopodium. Different pH dispersions (3-11) of isolated proteins were prepared and effects of pH and
Particle size	holding time on protein characteristics were evaluated. The pH-10 of extraction medium was found suitable for
Functional properties Isoelectric pH Protein quality Nutritional profile	protein extraction on the basis of yield, purity, solubility and colour having isoelectric pH of 4.5. Yield and purity of protein isolates (PI) of <i>quinoa</i> and <i>album</i> varied from 8.12 to 12.22%; 74.19 to 85.07% and 7.71 to 10.98%; 77.16 to 86.12%, respectively. Overall, pH and time had significant effect on functional properties of PI of both
	seeds. Quinoa PI had higher emulsifying activity, emulsion stability, water binding capacity and dispersibility, whereas, foaming capacity and stability were higher for album PI. Nutritional indices were 64.20 and 64.58 for guinoa and album PI. respectively, whereas, amino acid scoring (FAO, 2013) indicated, isoleucine, leucine and

1. Introduction

The ever-increasing gap between human population and food supplies may threaten the survival of humanity. According to the report "The State of Food Insecurity and Nutrition in the World 2017", released by FAO, the number of undernourished people in the world increased from 777 million in 2015 to 815 million in 2016, which comprises 779 million in the developing countries, 25 million the countries in transition and 11 million in the industrialized countries (FAO/WHO, 2017). Human beings are always in search of exploring and utilization of unusual plants materials in order to tackle problems related to the scarcity of food and nutrition. Pseudo-cereals are gaining increasing attention and are considered as the stable alternatives to commonly consumed cereals in the world. Pseudo-cereals are relatively abundant, easily digestible, contain adequate quantity of essential amino acids and shows promising results against number of diseases (Krajcovicova-Kudlackova, Babinska, and Valachovicova, 2005). Proteins isolated from pseudo-cereals can be used in processed foods in place of meat and dairy proteins and are able to impart desirable physicochemical and sensory characteristics such as structure, texture, flavor, and colour to the formulated foods.

Chenopodium quinoa and *Chenopodium album* called as *pseudo-cereals* are commonly known as bathua (Hindi) or pigweed in English and belong to the family *Chenopodiaceae*. They were considered as the major

crops for centuries by the pre-Colombian cultures in Latin America. As a consequence of the invasion and conquest by the Spanish, cultivation and consumption of these crops was subsequently declined and thereafter cultivated on a minor scale (Mota et al., 2016). Since quinoa plants are tolerant to salinity and drought stress, they can grow well in marginal regions. It has been selected by FAO as one of the crops destined to offer food security in the 21st century (Jacobsen, Mujica, & Jensen, 2003). This new plant species can play a potential role for the development and diversification of agricultural sector and food production (Mir, Riar, & Singh, 2018).

The protein content of *pseudo-cereals* varies from 13.8 to 16.5% on dry basis with an average of 15% and is highest amongst most of the major cereal crops (USDA, 2015). Majority of the stored proteins in *pseudo-cereals* consists of albumins (35%), globulins (37%) and low concentrations of prolamins. These values are close to those specified by the Food and Agriculture Organization (FAO) (Abugoch et al., 2008). Owing to high lysine, glutamic acid and arginine contents of pseudo-cereals, the food of these plants is often considered closer to the ideal balanced protein equal to that of milk. With perfect amino acid balance and rich contents of sulphur containing amino acids, quinoa and album are one of the few plants that provide all the essential amino acids necessary for human life contrary to major cereal grain proteins (Filho et al., 2015). *Pseudo-cereals* contain high amounts of non-protein tryptophan which is easily absorbed by the intestine and its usability in

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