

## Food Chemistry



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# Combined effect of pH treatment and the extraction pH on the physicochemical, functional and rheological characteristics of amaranth (Amaranthus hypochondriacus) seed protein isolates



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#### ABSTRACT

Results for the effect of extraction pH and pH treatment on the functional, physicochemical, rheological and thermal characteristics of amaranth protein isolates (APIs) are reported in this study. Four amaranth protein isolates (P1, P2, P3 and P4) were prepared by varying the extraction pH (9-11). These four protein isolate samples were further treated at pH values from 3 to 9. The total protein content and purity of protein isolates were found to be higher for P1 than P2, P3 and P4 samples. The particle size of P1 was significantly ( $p \le 0.05$ ) higher (299.68 µm) than other samples. Solubility, emulsifying capacity and stability, foaming properties, water and oil binding capacities were higher for the P1 sample treated at pH 9. Gelation characteristics like storage modulus (G') and loss modulus (G'') were higher for P1 samples. APIs obtained at extraction pH 9 (P1) also exhibited better thermal properties in comparison with other three samples.

### 1. Introduction

Plant-based proteins are getting increasingly popular as they can be a good alternative to meat proteins for the development of different food products. They can also provide high nutritional and medicinal benefits at a reasonable cost (Mir, Riar, & Singh, 2019a, 2019b). Now-a-days, pseudo-cereal proteins have gained a lot of attention because of their exceptional nutritive value due to the presence of essential amino acids which can cope up with daily requirements (Ventureira, Martinez, & Añon, 2012; Mir, Riar & Singh, 2018). Amaranth grain is a highly nutritious pseudo-cereal and has agronomical importance throughout the world. This crop is resistant against severe environmental conditions and can be cultivated on high altitude and unfruitful soil conditions (Gorinstein et al., 2007). In Asia, it is mainly cultivated in the Himalayan region as a vegetable plant. Conformational characteristics of amaranth seed differ significantly from other grains for example wheat, rice and corn. Diameter of this grain varies from 0.9 to 1.7 mm and weight of 1 g constitute around 1000 seeds. The shape of the grain is mostly lenticular and color varies from brown, gold, white, and pink to black (Grobelnik,

Turinek, Jakop, Bavec, & Bavec, 2009). Importance of amaranth grain is mainly associated with its protein content. Its protein quality is superior due to the presence of all the essential amino acids as compared to other cereals such as rice, wheat and maize. Among all the essential amino acids, methionine and lysine (15.8 and 55.8 mg/g of total protein) are present in higher amounts. Amaranth also possesses many medicinal benefits because it contains various bioactive peptides which are distributed in different fraction of protein. Different clinical and preclinical studies have revealed that protein isolates from amaranth seeds can alleviate chronical disorders like cancer, coronary heart disease and hyperlipidemia etc.

The utilization of amaranth seeds protein isolates has increased significantly in food processing industries due to the presence of higher quantity of essential amino acids and moreover it also possess limiting amount of anti-nutritional factors (Vega-Galvez, Miranda, Vergara, Uribe, Puente, & Martinez, 2010). The functional characteristics of protein isolates like solubility, emulsion capacity, foam forming capacity, gelling characteristic, oil and water binding capacity etc. are greatly influenced by the extraction pH. These properties change according to

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