



Structural modification of quinoa seed protein isolates (QPIs) by variable time sonification for improving its physicochemical and functional characteristics

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

High intensity ultrasound treatment (HIUS) by probe method is a novel technique to impart desirable physical, structural and functional characteristics to the native proteins structures. In this concern, effect of HIUS treatment at variable intervals from 5 to 35 min on quinoa seed protein isolates (QPIs) characteristics was analyzed. A typical dynamic rheological characteristic curve of QPIs had been obtained as a result of HIUS treatments at variable time intervals. Higher sonication resulted in the formation of large protein aggregates with higher particle size which increased QPIs turbidity. Temperature and frequency sweep tests had shown dominance of storage modulus over loss modulus, thus described strong gelling behavior of treated QPIs. HIUS treatment reduced particle size of QPIs with improved its flow properties. No splitting of bands had occurred due to sonication, whereas, more intensity of bands of treated QPIs depicted its greater water solubility. HIUS treatment decreased fluorescence intensity of QPIs whereas, no significant changes in Amide-II & III regions of QPIs occurred except decrease in wave number. The effects of HIUS on QPIs isolates had shown completely different response than those of results of quinoa protein extracts. Moreover, the studies conducted on quinoa protein extracts provided detailed information about the effect of HIUS on structural changes and its impact on physicochemical, functional and rheological characteristics.

1. Introduction

Quinoa (*Chenopodium quinoa*) belongs to the family *Chenopodiaceae* and is a highly valuable *pseudo*-cereal seed crop because of its excellent nutritional profile [1]. Quinoa comprises approximately 250 species and has been domesticated in the Andean regions of Peru and Bolivia. In Peru, Argentina, Ecuador and Bolivia it is commonly known as quinoa. In the recent years, production of quinoa has increased remarkably because of its gluten free nature, high quality protein (particularly good content of essential amino acids), excellent fatty acid profile, dietary fiber and presence of vitamins and minerals [2]. Moreover, the quality of protein in terms of nutritional characteristics like amino acid score, protein efficiency ratio, essential amino acid index, biological value, and nutritional index is also far better than the traditional cereal crops like wheat, maize, rice and barley [3]. Studies conducted on peptides released by quinoa protein under simulated gastrointestinal digestion have shown promising results against

oxidative stress related diseases like cancer [2]. In India, little information available about the nutritional and health benefits of proteins extracted from quinoa seed crop grown. Since majority of Indian population rely upon traditional cereal crops like wheat, maize, barley etc. therefore, protein isolates extracted from quinoa seeds can be used to enrich different kinds of foods like beverages, bakery products and breakfast cereals in order to increase their nutritional value.

HIUS treatment, particularly by probe method is a novel approach to impart desirable structural characteristics to the native structure of proteins which are otherwise usually lacking in these protein sources. HIUS is defined as a clean and green technology which has been used from laboratory to industrial scale in a wide range of food products to improve their physicochemical properties from the technological point of view [4]. HIUS is characterized either by low frequency (16–100 kHz, power 10–1000 Wcm⁻²) to high frequency (100 kHz–1 MHz, power < 1 Wcm⁻²) [5]. Low intensity or high frequency ultrasound is also a non-destructive type of technique which is

Abbreviations: WBC, Water binding capacity; OBC, Oil binding capacity; HIUS, High intensity ultrasound treatment; QPIs, Quinoa protein isolates; SDS-PAGE, Sodium dodecyl sulphate polyacrylamide gel electrophoresis; FTIR, Fourier transform infra-red spectroscopy; SEM, Scanning electron microscope

* Corresponding author.

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

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