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Proceeding Paper

Effect of Quinoa Germination on Its Nutritional Properties †

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Abstract: The aim of this study was the evaluation of the effect of desaponification, soaking, germination and refrigerated storage on the phytase activity, phytic acid content, and nutritional properties of three varieties of quinoa: white, red and black. Desaponification and soaking reduced the amount of minerals and the nutritional content. Germination of the seeds was carried out in desaponified samples. Quinoa nutritional values, phytase activity and phytic acid content were measured during the first 7 days of germination, plus 7 days on refrigerated storage. Germination increased fibre and protein content as well as mineral contents. Germination significantly increased the phytase activity of all varieties and reduced the phytic acid content. The phytic acid content decreased during germination to between 32 and 74%. Refrigerated storage had no significant effect on most of the factors studied. Germination boosted nutritional content and phytase activity while decreasing phytic acid content. Germination can be a simple method to reduce phytic acid in quinoa and may also improve the nutritional quality of this pseudo-cereal, with potential for use in functional foods and vegetarian diets.

Keywords: *Chenopodium quinoa*; germination; phytic acid; phytase activity; nutritional value

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1. Introduction

Pseudocereal flours can be included in bakery products as a strategy to improve their nutritional profile without needing to use whole products completely [1]. The increasing interest in quinoa in Europe has generated a large number of studies with this seed as a partial substitute for refined wheat flour in bakery products as a strategy to improve their nutritional value. However, the wide genetic diversity of this seed offers very different compositions in different varieties [2]. However, quinoa, and other pseudocereals, has some anti-nutritional factors, especially saponins and phytic acid (phytates). Phytic acid can bind di- and trivalent minerals, making them unavailable for monogastric animals and humans. Phytate-degrading enzyme catalyses the hydrolysis of phytate, releasing the inorganic phosphate from the seeds. During the seed germination, the activity of several enzymes increase, including phytases [3].

The aim of this study was to evaluate the effect of germination on phytase activity on the proximate composition, mineral content and phytic acid residual of three quinoa varieties from Ecuador.

2. Materials and Methods

2.1. Materials

White, red and black quinoa harvested in Ecuador were the raw materials of this investigation. The samples were stored at room temperature and in a dark environment to prevent light exposure. Quinoa seeds were desaponified and disinfected prior to the germination process.

2.2. Germination Process

The soaking and sprouting processes were carried out according to the methodology described by D'ambrosio et al. [3].

2.3. Chemical Composition

The total lipid, fibre, ash and moisture contents of the samples were determined according to AOAC official methods: 945.16, 985.29, 923.03, and 925.10, respectively [4]. The protein content was analysed according to the Dumas method, whereas the carbohydrates were calculated based on the other measurements by difference. The determination of Ca, Fe and Zn was carried out by an atomic absorption spectrophotometer following the methodology described by Tazrart et al. [5]. Phytic acid content was measured according to the methodology described by Reason et al. [6], whereas the phytase-degrading enzyme activity as by Garcia-Mantrana et al. [7], expressed in U/g of quinoa. One phytase unit (U) was defined as 1.0 µg of inorganic phosphate liberated per minute at 50 °C and pH: 5.5.

The results were expressed as mean value ± standard deviation (SD). One-way ANOVA was performed to evaluate the statistical significance of differences.

3. Results

The protein content of the three studied quinoa seeds ranged between 16 and 19 %, which was in accordance with reported values in the bibliography [8]. The ash content of the quinoa samples ranged from 2.3 to 4.3 %, and lipids were between 7.0 and 7.9, in concordance with other researchers [9]. The mineral content values (Figure 1) obtained in this study were also similar to those described in the literature [10]. However, there was an initial reduction of ash content during soaking (data not shown) that could be explained by the mineral lixiviation during this step [9]. Later, during germination, the ash content significantly increased (data not shown), probably due to the conversion of carbohydrates to carbon dioxide during respiration as was observed previously by other researchers [11].

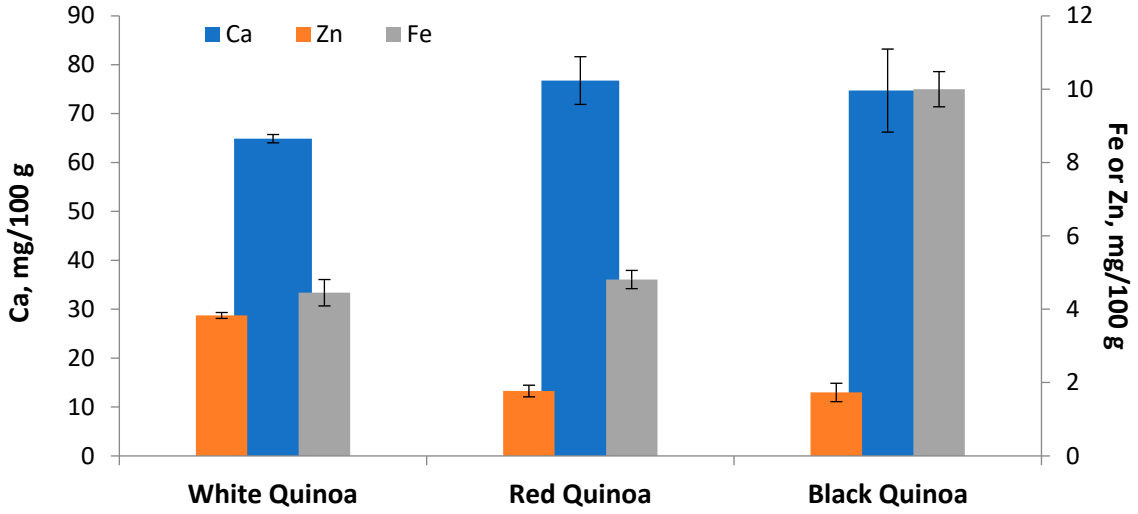

Figure 1. Mineral content in white, red and black quinoa from Ecuador.

The effects of germination on phytic acid content and phytase activity of the three quinoa varieties are presented in Figure 2. After one week of germinations, a significant reduction of phytic acid was observed in the three samples. In addition, phytase activity was increased in the first week of germination, with the exception of the black quinoa; however, the degradation of phytic acid was with the same efficiency as the other samples (Figure 2).

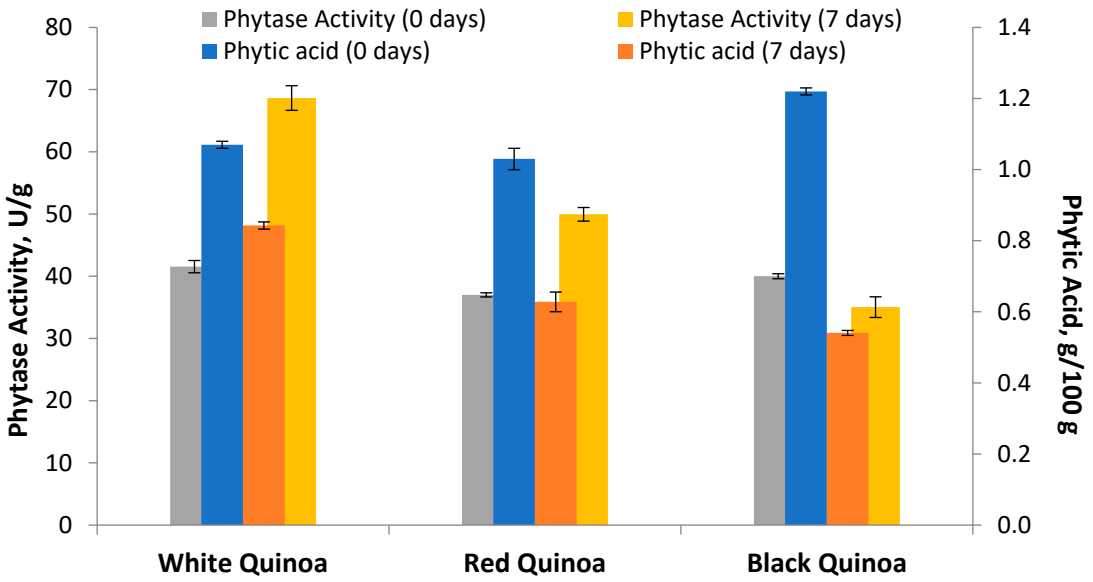

Figure 2. Phytic acid content and phytase activity in quinoa seeds before and after 7 days of germination.

4. Conclusions

The germination process has the potential to be an easy method to increase the mineral availability by phytate hydrolysis in the food production, mainly in vegetarian diets.

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