NOTE

Germinated Quinoa Flour to Reduce the Viscosity of Starchy Foods

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ABSTRACT

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Quinoa (*Chenopodium quinoa* Willd.) from northern Bolivian highlands was germinated under laboratory conditions. Shoots were apparent after 6 hr; α-amylase activity rose about fourfold after 12 hr. Whole flour from quinoa germinated for 12 hr lowered amylograph peak viscosity of hard red spring flour suspensions. Time-dependent data collected on protein and fat are also reported.

Quinoa (*Chenopodium quinoa* Willd.) is a crop grown in the mountainous regions of South America. Protein quality of the grain was examined by Mahoney et al (1975), and quinoa starch has been characterized by Wolf et al (1950) and Atwell et al (1983). The qualities of the germinated grain, however, are relatively unexplored.

The grain is underexploited with respect to its use as a food source, especially in the region around Lake Titicaca in northern Bolivia, even though it grows well in the arid environment and is considered a "strong food" by the Aymara people. One of the issues affecting the Aymarans is the high mortality rate of weaning children. Children are generally weaned and fed starchy foods (primarily potatoes) that form the staple of the Aymaran diet. Germinated sorghum and maize, investigated as supplements to starchy foods consumed at weaning in other areas, have beneficial effects on the nutrient density of the diet (Mosha and Svanberg 1983). Consequently, germinated quinoa might be included in Aymaran foods at weaning to increase their nutritional qualities, caloric density, and palatability.

A long-term goal of a collaborative project between the Freedom from Hunger Foundation (Davis, CA) and The Pillsbury Company (Minneapolis, MN) is to improve the nutritional qualities of the foods used at weaning in this region. The specific objective of the present study is to evaluate the effect of germinated quinoa flour on the viscosity and the nutrient density of a starchy system.

MATERIALS AND METHODS

Saponin-free quinoa of unspecified variety was obtained from Bolivia through the Freedom from Hunger Foundation. It was

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TABLE I
Moisture, Protein, Fat, and α-Amylase of Quinoa Germinated up to 36 hr

Germination Time (hr)	Moisture (%, wb)	Protein (%, db)	Fat (%, db)	α-Amylase (meq/g, db)
0	10.19	15.23	5.39	1.45
12	52.35	15.03	5.48	6.93
24	60.65	14.87	4.88	5.08
36	62.68	14.79	5.23	6.70

TABLE II
Amylograph Viscosities of Hard Red Spring (HRS) Wheat Flour Supplemented with up to 10% Germinated Quinoa Flour

HRS Wheat Flour (%)	Germinated[a] Quinoa Flour (%)	Peak Viscosity (BU)[b]
100	0	245
99	1	240
95	5	200
90	10	185

[a] 12-hr germination.
[b] Brabender units.

germinated by placing quinoa on paper towels in trays and adding water until the quinoa was well soaked but not submerged. Bed depths were approximately one half inch. The trays were placed in closely fitting plastic bags to prevent drying out and were germinated at 22± 2° C. Samples were removed at 12, 24, and 36 hr and analyzed for fat, moisture, protein, and α-amylase activity. A single bed of quinoa was used after 12 hr for the amylograph evaluation.

Germination was stopped prior to analysis by quickly freezing the grain. To determine the effects of germinated quinoa on amylograph viscosity, the germinated grain was dried at 43° C and ground with a Waring Blendor.

The amylograph procedure (method 22-10, AACC 1983) was run using various blends of the germinated quinoa whole grain flour and a commercial hard spring wheat flour. The wheat flour was supplemented with 0, 1, 5, and 10% germinated quinoa flour. Reproducibility for this test in our laboratories is ±10 Brabender units (BU).

Moisture of the dry, germinated, whole quinoa flour was determined using a 130° C, 1-hr air oven method (sections 10.119 and 14.004, AOAC 1984). Reproducibility for the method was ±3.0% of the value reported. Moisture of the wet quinoa grain was determined using a 105° C, 2-hr air oven method (method 44-15a, AACC 1983). Reproducibility for this procedure was ±0.1% moisture. Milder drying conditions were chosen for the wet grain due to the instability of enzymes in high-moisture systems.

Crude protein (N × 5.7) was determined with a Kjeltec Auto 1030 Analyzer. Reproducibility was ±1.5% of the value obtained. Fat was determined by acid hydrolysis (section 14.019, AOAC 1970), and reproducibility was ±3.0% of the value reported. α-Amylase was estimated using the Phadebas method of Barnes and Blakeney (1974). Reproducibility was ±3.3% of the reported value.

RESULTS AND DISCUSSION

Sprouts of the germinating quinoa grain were noticeable after only 6 hr and were about one-half inch long after 36 hr. The germination time and the complexity of the germination process are much less for quinoa than for maize and sorghum (Mosha and Svanberg 1983). Germination conditions in the study of Mosha and Svanberg (1983) were very similar to the conditions used in this study. However, the germination time reported for maize and sorghum was 48 hr. In addition, the grain was steeped for 12–20 hr. The simplicity and rapidity of quinoa germination make it a workable process for the Aymara people.

Results of moisture, protein, fat, and α-amylase are reported in Table I. The values for protein, fat, and α-amylase are reported on a dry basis. There is apparently little change in the fat or protein during germination. The values for α-amylase increased from 3.5- to 4.5-fold and remained constant after the first 12 hr.

Table II includes data on the effect of adding germinated quinoa on amylograph peak viscosity of a hard wheat flour; peak viscosity was reduced by the supplementaion. The amylograph procedure (method 22-10, AACC 1983) presents a temperature-moisture environment similar to cooking, gelatinization, and liquefaction of a starchy food such as a gruel.

Reduction in viscosity of starchy foods used at weaning increases the palatability and the effective caloric density of the food for weaning children (Mosha and Svanberg 1983). Hence, germinated quinoa flour supplementation of the starchy foods consumed by the Aymara people at weaning may be of significant nutritional benefit.

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