



Effect of fermentation on sorghum protein fractions and in vitro protein digestibility

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Abstract. Changes in pH, titratable acidity, total soluble solids and proteins of Dabar sorghum (*Sorghum bicolor* (Linn) Moench.) during natural fermentation at 37 °C for up to 36 h were monitored. The pH of the fermenting material decreased sharply with a concomitant increase in the titratable acidity. Total soluble solids increased with progressive fermentation time. The crude protein and non-protein nitrogen slightly increased during the last stages of fermentation. The in vitro protein digestibility markedly increased as a result of fermentation. The globulin plus albumin fractions increased significantly ($p \leq 0.05$) during the first 8 h of fermentation. Kaffirin fraction decreased during the first 8 h of fermentation but increased sharply as fermentation progressed. Cross-linked kaffirins fluctuated during the fermentation process. Glutelin like protein, which was the minor fraction, true glutelins, the second most abundant fraction, together with non-extractable proteins fluctuated during the fermentation process.

Key words: Fermentation, In vitro protein digestibility, Protein fraction, Solubility, Sorghum

Introduction

Sorghum (*Sorghum bicolor* (Linn) Moench.) is the fifth most important cereal in world production, being exceeded only by wheat, rice, maize and barley in that order [1]. The leading sorghum producing countries are the USA, China, India, Nigeria, Mexico, Argentina, Sudan and Egypt [2]. It is a major source of protein and calories in the diets of a large segment of the populations of Africa and Asia. It is the most important cereal crop in Sudan. Various methods have been used to improve the nutritional quality of grain sorghum. Hamad & Field [3] found an increase in percent relative nutritive value (RNV) by natural lactic acid fermentation of wheat, barley, rice, millet and maize when they were fermented at 22 °C for six days. Taur et al. [4] found a significant improvement in reducing sugars, free amino acids and ascorbic acid by natural lactic acid fermentation of sorghum at 25 °C for 24 h. Kazanas & Fields [5] reported that the nutritional value of sorghum could be increased by fermentation, which increases the content of lysine and methionine. The

effect of fermentation on protein solubility fractions using the Landry and Moureaux technique [6] has not been studied previously. The objective of the present investigation was to study changes occurring in sorghum proteins and the in vitro protein digestibility of the grain during natural fermentation of sorghum.

Materials and methods

Material. Sorghum flour from the Dabar cultivar was obtained from the Food Research Center, Khartoum North, Sudan. The flour was stored in polyethylene bags at 4 °C. Natural sorghum fermentation was carried out by mixing sorghum flour with distilled water (1:2 wt/vol). Two hundred and fifty grams of each sample were mixed with 500 ml distilled water in a 600 ml beaker and then incubated (Gallenkamp, England) at 37 °C for periods of 0, 4, 8, 12, 16, 20, 24, 28, 32 and 36 h. After the incubation period, the samples were mixed with a glass rod and transferred to three aluminum dishes (30 cm diameter each), and dried in a hot air oven (Heraeus UT 5042, Germany) at 70 °C for 3–4 hours. Dried samples were ground using a Braun grinder (England) to pass 0.4 mm screen and stored in polyethylene bags at 4 °C for analysis. All samples were analyzed for titratable acidity, total soluble solids, crude protein, non-protein nitrogen, in vitro protein digestibility and protein solubility fractions.

Determination of pH and titratable acidity. The pH of the fermenting dough was monitored initially and every 4 h for 36 h by using a glass electrode pH meter (PUSL Munchen 2, KARL KOLB, Germany). Titratable acidity, expressed as lactic acid, was determined by titration with 0.1 NaOH to pH 8.1 [7].

Determination of crude protein, non-protein nitrogen and in vitro protein digestibility. Crude protein was determined by the microKjeldahl method (2.036) of the AOAC [8]. Non-protein nitrogen was determined according to the Gheyasuddin [9] method. In vitro protein digestibility was determined according to Saunders et al. [10].

Determination of total soluble solids. Total soluble solids were determined at 20 °C using an Abbe refractometer (Bellingham & Stanley LTD, London) [11].

Protein fractionation. Nitrogen from defatted, cold extraction 1:2 sorghum flour to hexane ratio for up to 16 hours, meal was extracted stepwise by