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Effect of natural fermentation on protein fractions and in vitro protein digestibility of rice

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Abstract. Changes in pH, titratable acidity, total soluble solids and protein of rice during natural fermentation at 37 °C 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 content fluctuated during the first 24 h of fermentation but started to increase thereafter. Non-protein nitrogen was unchanged during the first 12 h of fermentation but increased sharply with progressive fermentation. The in vitro protein digestibility markedly increased as a result of fermentation. The increase in the globulin + albumin fractions constituted the most remarkable increase and were the major proteins in the 36 h fermented rice; the increase was up to 2.7 fold. The prolamin fraction, which was the minor fraction, the G_1-glutelin and G_2-glutelin fractions increased with progressive fermentation time. The G_3-glutelin, which was the major protein fraction of unfermented rice, markedly decreased as a result of fermentation, while insoluble protein fluctuated during the fermentation process.

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

Introduction

Rice (*Oryza sativa*), is one of the most important crops in the world, in addition to wheat and maize. More than 500 million tons of paddy rice are produced worldwide per year [1]. Approximately 90% of the world rice is produced in Asia, but only 4–5% enters the global market [2].

The rice crop is grown in the tropics where sunshine is abundant. Although typically a cereal of the swamps, rice can be grown either on dry land or under water. There are varieties of rice adapted to a wide range of environmental conditions. This wide adaptability of the rice plant is the basis for its importance as a food crop [3]. Total world consumption of rice is projected to increase from 356 million metric tons in 1994 to 403 million metric tons by 2005 [4].

Rice is mainly for human nutrition and has historically been perceived as hypoallergenic [5]. In addition to the specific nutritional benefits of rice and

its fractions, it is particularly valuable for use in medical and functional foods [5].

Milled rice grains contain about 7–8% protein, which are about 80% glutelins, 10% globulins, 5% albumins and less than 5% prolamins [6]. Rice, like other cereals, is deficient in lysine. Hamad & Fields [7] reported a significant increase in available lysine in fermented rice. In view of the world shortage of high quality protein, any procedure which improves the nutritional value of the food supply would be of value. Thus, the objective of the present investigation was to study changes occurring in rice proteins during natural fermentation of rice.

Materials and methods

Materials

Five kg of a popular commercial variety of rice were purchased from Khartoum North local market. The sample was carefully cleaned and freed from foreign material; the grains were ground to pass a 0.4 mm screen using a Tecator, CYCLOTEC 1093 Sample Mill (Sweden). The rice flour was stored in polyethylene bags at 4 °C. Natural rice fermentation was carried out by mixing rice flour with distilled water (1:2 w/v). Two hundred and fifty gram samples of rice flour were mixed with 500 ml distilled water in a 600 ml beaker and incubated (Gallenkamp, England) at 37 °C for periods of 0, 4, 8, 12, 16, 20, 24, 28, 32 and 36 h. After incubation, 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 (Heraus TT 5042, Germany) at 70 °C for 3–4 h. Dried samples were ground using a Braun grinder (England) to pass a 0.4 mm screen and stored in polyethylene bags at 4 °C for subsequent analyses. All samples were analyzed for titratable acidity, total soluble solids, crude protein, non-protein nitrogen and protein solubility fractions and in vitro protein digestibility.

Determination of pH and titratable acidity

The pH of the fermented dough was monitored initially and every 4 h using a glass electrode pH meter (PUSL München 2, Karl Kolb, Germany). Titratable acidity, expressed as lactic acid, was determined according to the established AOAC method [8].