Short communication

Protein and energy utilization of rice milling fractions by rats

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Abstract. Brown rice (variety IR32), bran, and polish had higher protein content and lysine content in protein than milled rice. Nitrogen balance in growing rats showed that brown rice had lower true digestibility, but similar biological value and NPU as milled rice. Undermilled rice had similar true digestibility, but higher biological value and NPU than milled rice. Bran and polish had lower true digestibility, but higher biological value than brown and milled rice, but polish had higher NPU than bran and the three other milling fractions. The percentage of digestible energy in the rats was lowest for bran.

Introduction

Chemical analysis suggests that brown rice has a higher content of B vitamins and is more nutritious than milled rice [11, 16]. Brown rice has more protein, minerals, and lipid, and its protein has higher lysine content than milled rice [16]. However, it has higher fiber and phytin P content than milled rice [16].

Comparative protein utilization of all the milling fractions of rice grain in rats has been done by Kik [13] using PER, based on weight gain per amount of protein eaten. He reported PER values of 1.80–1.87 for brown rice and 1.74–1.84 for milled rice at 5%–7% dietary protein level, and 1.92 for rice bran and 1.84 for rice polish at 9% dietary protein level. Eggum and Juliano [6] found a NPU value of 64.2% for IR480-5-9 brown and milled rices, but lower true digestibility and higher biological value for brown-rice protein than for milled-rice protein. Betschart [2] recently reported that brown rice has better protein quality in rats than milled rice. Because of the current interest in high-fiber diets [10], and the inappropriateness of the PER method in measuring utilisable protein [15], the milling fractions of IR32 brown rice were subjected to nitrogen and energy balance studies. These brown, undermilled, and milled rices are also being compared in nitrogen-balance studies in...
preschool children at the Nutritional Evaluation Laboratory, Food and Nutrition Research Institute, Manila, The Philippines.

Materials and Methods

IR32 rough rice was taken from the 1976 crop of the IRRI farm that had been stored at 20°-25° C. Rough rice was dehulled in a Satake SB-2B one-pass pearler and brown rice was sized through a Satake RG-C6A tropics rice grader. Whole brown rice was then undermilled to about 5% weight removal with the SB-2B pearler to obtain bran. Broken grains were removed from one-half of the resulting undermilled rice with the rice grader, and the whole-grain fraction was remilled with the SB-2B pearler for 4% weight removal to obtain polish and milled rice. Contaminant broken milled rice of the bran and polish fractions was removed by sieving successively through 12-, 20-, and 30-mesh sieves.

Representative samples of the five milling fractions were ground for analysis with a UD cyclone mill with a 40-mesh sieve and analyzed for moisture by loss of weight at 130° C for 1 h [1], micro-Kjeldahl protein (N x 6.25) [1], crude fiber [1], neutral detergent or dietary fiber [8], pet. ether extractable crude fat [1], crude ash [1], P [16] and phytin P [9]. Total carbohydrates were assayed by dispersing a 25 mg sample with 6.83 g 26N (72%) H2SO4 for 3 h at 25° C, diluted to 2N H~SO4 with water and heated for 2.5 h at 100° C [17], and the filtered hydrolyzate treated with phenol-H2SO4 reagent [3].

Duplicate samples were defatted with refluxing pet. ether for 48 h and hydrolyzed with 6 N HCl for 23 h at 110° C in sealed tubes under N2 and analyzed for amino acids in a Beckman Spinco Model 120C Amino Acid Analyzer with a AA-15 and PA-35 resins [6, 7].

Samples equivalent to 7.5 g N were sent to the National Institute of Animal Science for nitrogen balance by the Thomas–Mitchell method in five Wistar (Wistar-møll) male, growing rats each weighing 65–68 g as described by Eggum [5]. The trial lasted nine days — four days for introductory feeding and a five-day balance period in which pooled feces and pooled urine were analyzed for N. The rats’ daily diet had a constant amount of dry matter (10 g) and N (150 mg). Autoclaved potato starch was used to reduce the N content of high-protein samples. Metabolic N and endogeneous N were determined by adding ether-extracted, freeze-dried egg equivalent to 4% protein to the N-free diet of autoclaved potato starch, sucrose, cellulose powder, soybean oil, minerals, and vitamins [5]. Egg protein at this level was completely utilized by rats. Energy value of food and feces was estimated by IKA adiabatic calorimeter. Digestible energy of the diets was calculated by measuring the difference of energy in food and feces according to Miller and Payne [18]. Rat data were subjected to analysis of variance followed by Duncan’s [4] multiple range test.