PROTEIN QUALITY OF "IDLI", A FERMENTED STEAMED FOOD PREPARED FROM BEANS (PHASEOLUS VULGARIS) AND RICE

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INTRODUCTION

"Idli" is a common breakfast item in India, particularly popular in South India and to some extent in parts of Sri Lanka (1). It is a naturally fermented steamed food prepared from rice and Indian black gram cotyledons in various proportions. "Idli" is used as a weaning food in many families and as a main dish in soft diets in South Indian Hospitals because of its soft texture. Legumes such as soy beans, white beans and dehulled black beans (**Phaseolus vulgaris**) can be substituted for Indian black gram in the preparation of "idli". An attempt was made in this experiment to determine the protein quality of "idli" prepared with whole black, whole white, dehulled black and dehulled white beans in combination with rice.

METHODS AND MATERIALS

Black Ebony, a black cultivar and Aurora, a white bean cultivar (**Phaseolus vulgaris**) grown in Washington state were purchased from Cenex (Othello, WA). Enriched rice was purchased locally (Pullmam, WA). Beans were dehulled at the laboratories of the National Research Council of Canada, Saskatoon, Saskatchewan with an Abrasive-Type Intermediate-Sized Batch Dehuller (2). Casein served as the protein source in the control diet. A protein free diet was formulated for the determination of endogenous loss of nitrogen in rats. Experimental diets were divided into two sets, fermented and unfermented, each set contained four diets of bean and rice combinations. The diets were whole black bean, whole white bean, dehulled black bean, dehulled white bean in combination with rice. Diets were formulated to supply 10 percent protein and 400 Kilocalories per 100 grams of diet. For experimental diets, rice and beans for each diet was soaked separately in water for five hours. Soaked beans and rice were ground separately in a blender to a semi-thick batter consistency. The batter of rice and bean was mixed with other ingredients in a Hobart dough mixture for 15 minutes. For fermented diets, a day old fermented culture was used. The culture was prepared from rice and Indian black gram cotyledons which were soaked, ground and fermented for 12 hours at 30°C. The fermented batter was dished into an "idli" pan containing 24 perforated cups. These cups were 3 inches in diameter and 1 inch in depth. These pans were loaded in an autoclave and steamed for 7 minutes at 100°C. "Idli" was cooled on the pan, removed individually, packaged in plastic bags and stored at -40°C.

Growth and nitrogen balance experiments were conducted in rats. Weanling male Sprague Dawley white rats, nine rats per diet were housed individually in stainless steel cages with wire bottoms. Frozen "idli" diets were thawed in the refrigerator, brought to room temperature and fed to the rats daily. Water and food were available ad libitum. Rats were weighed twice weekly and food records of each rat was maintained. Growth experiment was terminated on day 28. Prom protein consumption and weight gain of rats Protein Efficiency Ratio (PER), relative PER (rPER) and Feed Efficiency Ratio (FER) were calculated. Rats were transferred to metabolism cages for a nitrogen balance study soon after the completion of growth study for a period of nine days, and feeding was continued. Feces and urine of each rat were collected during the last five days after an initial adjustment of four days. From nitrogen intake and nitrogen output values, true Digestibility Coefficient (DC), Biological Value (BV) and Net Protein Utilization were calculated. Rats were euthanized with carbon dioxide soon after the nitrogen balance study. Carcass length and weight

of rats were measured. Blood was drawn via cardiac puncture and serum was analyzed for total protein concentration. ANOVA determined the statistical differences among the diets and Duncan's Multiple Range Test compared the diets within a set of diet..

RESULTS AND DISCUSSION

An increase in most of the amino acids was found in the fermented "idli" diets and the increase was greater for methionine than other essential amino acids. Weight gain of rats fed fermented "idli" diets was significantly lower ($P < 0.05$) than the weight gain of rats fed unfermented "idli" diets. Weight gain of rats fed the whole Black bean and rice combination "idli" diet was significantly lower ($P < 0.05$) than the weight gain of rats fed the whole white or dehulled black or dehulled white bean with rice, both fermented and unfermented "idli" diets. Protein Efficiency Ratio, rPER and FER of fermented "idli" diets were significantly lower ($P < 0.05$) than the PER, rPER and FER of unfermented "idli" diets. Reduced food intake and weight by rats fed the fermented diets suggest that physiochemical changes occured during the fermentation process which depressed food consumption and therefore reduced growth rate and weight gain of rats. Digestibility Coefficient and NPU of fermented "idli" diets were significantly lower ($P < 0.05$) than the DC and NPU of unfermented "idli" diets. Digestibility Coefficient and NPU of "idli" diet prepared from the whole black bean and rice were significantly lower ($P < 0.05$) than the DC and NPU of "idli" diets prepared from whole white, dehulled black and dehulled white beans in combination with rice. Biological value of fermented and unfermented "idli" diets was statistically similar to the BV of casein, the control diet. Carcass length and weight, and total serum protein concentration of rat fed fermented "idli" diets were significantly lower ($P < 0.05$) than the carcass weight and length and total serum protein concentration of rats fed the unfermented "idli" diets of similar combinations. Reduced digestibility, BV and NPU of whole black bean and rice combination "idli" diet appear to suggest the possibility of increased endogenous nitrogen loss through the intestine of rats which may be due to tannins in the seed coat (3,4). In conclusion, the fermentation process did not show any additional benefits in improving the quality of proteins in "idli".

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