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THE EFFECT OF GRAM FLOUR ON THE QUALITY OF WHEAT PROTEIN

M. Akmal Khan*, K. Almas, A. R. Abid and M. Yaqoob**

In this investigation the protein quality of wheat, gram and wheat supplemented by gram protein was studied by means of biological methods. In the supplemented diets wheat provided 75, 50 and 25 per cent of the protein while the rest was supplied by gram protein. The PER, NPU and BV of supplemented diets varied between 2.13-2.8, 62-68 per cent and 71.5-80.00 per cent, respectively, compared to 1.25, 48 per cent and 56.5 per cent of unsupplemented wheat, and 1.95, 55 per cent and 68.25 per cent of gram protein, respectively. Supplementation of wheat protein with gram protein improved the quality of wheat protein and best results in terms of weight gain, PER, NPU and BV were obtained with a diet contributing 25 and 75 per cent protein by wheat and gram, respectively. It was concluded that such vegetable protein mixtures could be suitable for the prevention and treatment of protein-calorie malnutrition.

INTRODUCTION

Cereals constitute the bulk of an average diet in Pakistan. Seventy two per cent of calories and 76 per cent protein consumption are derived from cereals and their derivative. Cereals do not supply adequate amount of essential amino acids necessary for the growth and maintenance of the body. Wheat is the main staple and forms 88 per cent of the total cereal intake. Wheat may have protein which is adequate in quantity but poor in quality, lysine being the limiting amino acid in wheat protein.

In order to improve the protein quality of cereal staples enrichment with amino acids or with protein concentrates containing missing amino acid may be an attractive solution. The protein-rich sources to be used for the improvement of wheat flour must be locally available and should be within the reach of the common man. For this purpose, legumes, the poor man's meat, have been tried. Gram contains 18 to 28 per cen protein

*Department of Nutrition, University of Agriculture, Lyallpur.

**Department of Chemistry, University of Agriculture, Lyallpur.

and is a fairly good source of lysine. A sole source of gram protein might produce toxic symptoms, cicerism, attributed to cicerine, the gram protein (kuppuswamy et. at. 1958). Mclaren *et. al.* (1966) evaluated a vegetable protein mixture, containing chickpea flour and parboiled wheat in the ratio of 1:2. The results of the metabolic studies established that the mixture was capable of producing high positive nitrogen balance in normal and malnourished children. Shehata (1971) studied the protein quality of wheat bread supplemented with 5, 10, 15 or 20 per cent chickpea flour. The addition of chickpea flour did not affect the physical properties of dough and caused increases in PER of 18, 29, 19 and 45 per cent, respectively.

An experiment was planned to study the supplementary effect of gram protein on the protein quality of wheat.

MATERIALS AND METHODS

Forty eight weanling albino rats, 23 days old, were used in this study. In the first experiment, twenty four rats were fed on stock diet for seven days and then randomly divided into six groups of four rats each. Each group was weighed and housed in a wire screen mesh bottomed cage. The experimental diets (Table 1) were randomly assigned to these groups and were fed ad-libitum for a period of ten days. The temperature of the room was maintained at 80°F

TABLE 1. *Composition of experimental diets.*

Ingredients	Diets					
	A	B	C	D	E	F
Wheat flour	89.0	63.8	43.8	21.9	—	—
Gram flour	—	11.4	22.8	34.2	45.6	—
Corn starch	—	11.8	22.4	32.9	43.4	89.0
Corn oil	5.0	5.0	5.0	5.0	5.0	5.0
Vitamin mixture	2.0	2.0	2.0	2.0	2.0	2.0
Mineral mixture	4.0	4.0	4.0	4.0	4.0	4.0
Total :	100.0	100.0	100.0	100.0	100.0	100.0
Protein per cent distribution						
Wheat flour	100	75	50	25	0	
Gram flour	0	25	50	75	100	

The body weight and feed consumption of each group were recorded. Faeces were collected for the determination of true digestibility. At the end of experimental period, the rats were killed and net protein utilization was estimated according to the method of Miller and Bender (1955). Biological value was caculated from true digestibility and NPU values.

The experiment was repeated under similar laboratory conditions and the data, thus collected in both assays were subjected to statistical analysis, using analysis of variance technique (Snedecor, 1967).

RESULTS AND DISCUSSION

The average weight gain, protein efficiency ratio, true digestibility, net protein utilization and biological value of experimental diets are presented in Table 2 and are shown in Fig. 1.

TABLE 2. *Average weight gain, protein efficiency ratio (PER), true digestibility (TD), net protein utilization (NPU), and biolagical values (BV) of various experimental diets.*

Description	Diets					
	A	B	C	D	E	F
Number of rats in each group	4	4	4	4	4	4
Days on experiment	10	10	10	10	10	10
Initial weight per group (gm)	239.0	241.0	240.0	242.0	243.0	238.0
Final weight per group (gm)	301.5	337.5	365.0	376.0	351.0	185.0
Gain in weight per group (gm)	62.5	96.5	125.0	134.0	108.0	—
Protein Efficiency ratio	1.25	2.13	2.68	2.8	1.95	—
True digestibility (%)	85.0	86.0	87.0	84.5	80.0	—
Net protein utilization (%)	48.0	62.0	66.0	68.0	55.0	—
Biological value (%)	56.5	71.5	76.0	80.0	68.25	—

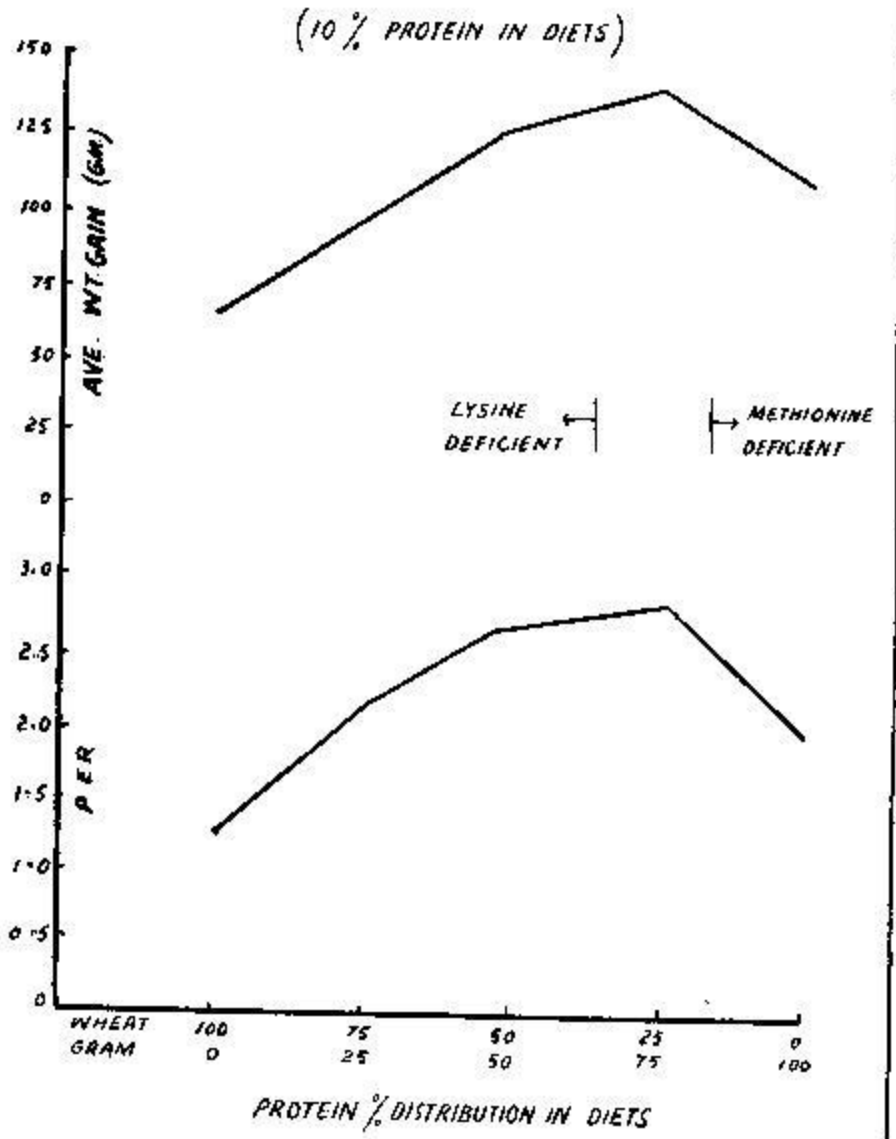

FIG. 1: NUTRITIVE VALUE OF VARIOUS COMBINATIONS OF WHEAT AND GRAM:

Body weights : The body weight increased by 26.1, 40.0, 52.0, 55.4 and 44.4 per cent on diets A, B, C, D and E, respectively. The rats fed supplemented diets B, C and D gained significantly ($P<0.01$) more weight than rats fed on diet A based on wheat flour. Diets C and D produced significantly ($P<0.01$) better growth than diet B, there was a non-significant difference between the weight gain of rats fed diets C and D. Similarly, diets C and D were significantly ($P<0.05$) better than diet E, based on gram flour in promoting growth of the rats. It was further observed that rats on diet E gained significantly ($P<0.01$) more weight than the group fed on diet A. Supplementation of wheat flour with gram flour, a good source of lysine, improved the growth rates of the rats and it increased with the increasing levels of gram flour in the diet.

Protein Efficiency Ratio: The average PER values of diets A, B, C, D and E were 1.25, 2.13, 2.68, 2.8 and 1.95 respectively. Supplementation improved the PER values and the increases were 70.4, 114.4 and 124 per cent on diets B, C and D, respectively. Supplemented diets had significantly ($P<0.01$) better PER than basal diet A. The PER values of diets C and D were significantly higher than diet B. Non-significant difference between the PER values of diets C and D was observed. When supplemented diets were compared with diet E, based on gram flour, it was noticed that PER values of diets C and D were significantly ($P<0.01$) better than diet E. The PER of wheat protein was significantly ($P<0.01$) less than gram proteins. The results indicated that PER of wheat protein was improved when 25, 50 and 75 per cent of wheat protein was replaced by gram protein and PER of gram protein was better than wheat protein which could be explained on the basis of better assortment of amino acids in gram protein.

True Digestibility: The highest digestibility (87 per cent) was found in case of diet C, containing equal part of wheat and gram protein whereas the lowest value (80 per cent) was obtained in rats fed diets E based on gram flour. Supplementation of wheat flour with gram flour did not improve the digestibility and there was no significant difference between the diets supplemented with or without gram flour. However, the digestibility of diet E was significantly ($P<0.05$) lower than diets A and C.

Net Protein Utilization: Supplementation of wheat flour with different levels of gram flour caused an increase in NPU by 29.1, 37.3 and 41.6 per cent respectively. Supplemented diets B, C and D had significantly ($P<0.01$) higher NPU values than basal diet A. There was non-significant difference between diets B and C and between C and D. However, NPU of diet D was

significantly ($P<0.05$) better than diet B. Similarly when supplemented diets were compared with diet E, it was observed that rats fed diets B, C and D utilized protein significantly better than diet E. The net utilization of protein of diet E based on gram flour was significantly ($P<0.05$) higher than protein utilization of diet A, based on wheat flour. It is clear from the results that NPU values improved with the increasing levels of gram flour in the basal diet. The improving effect of supplemented diets may be due to correction of lysine deficiency in wheat protein.

Biological Value : The percentage of absorbed nitrogen retained in the bodies of rats fed experimental diets showed trends similar to the NPU values. The results of the present experiment indicated that the biological values of wheat and gram proteins were 56.5 and 68.25 per cent respectively, when both proteins were combined in porportion of 75 : 25, 50 : 50 and 25 : 75, the biological value increased to 71.5, 76 and 80 per cent respectively, exceeding those of wheat or gram protein alone.

The biological value of a protein depends on its capacity to supply the essential amino acids in the proportion the body requires. Since proteins are not essential nutrients as such but as a source of amino acids, they may be combined to give a balanced aminogram, although individually they may infact be unbalanced. Vegetable mixtures of satisfactory nutritive value can be prepared by mutual supplementation of wheat flour with gram flour and the best results in terms of weight gain, PER, NPU and BV were obtained with a diet deriving 25 and 75 per cent protein from wheat and gram, respectively.

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