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NUTRITIVE VALUE OF WHEAT FLOUR AS AFFECTED BY SUPPLEMENTATION WITH DIFFERENT LEVELS OF MAIZE GLUTEN MEAL

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The supplementary effect of maize gluten meal (MGM) on the protein quality of wheat at 10% dietary protein level in weanling rats was studied. In the supplemented diets wheat supplied 75, 50, 25 and 0% protein, while the rest was provided by MGM protein. The PER, BV and NPU of the experimental diets varied between 0.99 to 1.86 and 49.93 to 78.64% and 40.29 to 62.26%, respectively. The highest protein quality was obtained when 25% of the protein from MGM and 75% of the protein was derived from wheat. This mixture had a BV of 76.44% and was higher than wheat and MGM when each was fed alone.

INTRODUCTION

The quality of protein in the diet is as important for the prevention of deficiency as the quantity. The pattern of amino acid contents varies according to the food consumed. Certain foods such as meat, fish eggs and milk products have amino acid patterns which most closely approximate human requirements. On the other hand, protein from a vegetable source while itself incomplete, may complement, protein from a second plant source to provide good protection from dificiency (Miller and Payne, 1961).

Cereals do not supply adequate amount of essential amino acids necessary for growth and maintenance of the body. Among vegetable crops, legumes contain the highest amounts of protein and are considered to be a good source of lysine. Supplementary relationship has been observed between the protein of Bengal gram and wheat (Khan *et al.*, 1976), between defatted soyabeans and wheat (Khan *et al.*, 1977), among defatted groundnut and wheat (Nuzhat, 1979) and between soyabean and wheat (Naheed and Chaudhry, 1979) in Pakistan. But no attempts have been made to supplement cereals with a by-product of cereal with high protein content.

The removal of starch and maize syrup from the grain leaves the remaining product much richer in protein than the original maize grain; corn gluten meal, a product of cereal origin containing 60% protein is a valuable, inexpensive vegetable protein source available abundantly in Pakistan. It has been reported to be the rich source of vitamin A, leucine, isoleucine, methionine, phenylalanine and threonine, but some essential amino acids like tryptophan and lysine are lacking in it (Fanguaf *et al.*, 1959). Animal protein supplements and locally grown legumes are comparatively expensive as compared to corn gluten meal. Thus, it may be possible to replace such costly protein supplements with a cheaper ingredient like corn gluten meal supplemented with limiting amino acids.

In this study maize gluten meal (MGM), has therefore, been chosen to be added to wheat flour and study its supplementary value.

MATERIALS AND METHODS

Wheat flour, MGM (60%), corn starch, skimmed milk powder, corn oil, vitamins and minerals were purchased from local market for the preparation of experimental diets. The samples of wheat flour, MGM (69%), corn starch, and skimmed milk powder were analysed for protein contents. The percentage distribution of protein in the experimental diets is shown in Table 1. In order to measure metabolic faecal nitrogen a protein free diet (G) was also incorporated.

Forty-eigt weanling Albino rats, aged 23 days, were used for the biological evaluation of experimental diets. The rats were fed stock diet for seven days and then randomly divided into six groups of four rats each. The experimental diets (A, B, C, D, E and F) were randomly assigned to these groups and fed *adlibitum* for a period of ten days. The temperature of the room was maintained between 24-27°C. A sheet of filter paper was placed in each cage for the collection of faeces. Fresh and clean drinking water was provided all the time to each group. During experimental period the data on feed consumed, and weight gains were collected, which were then used to calculate the PER, TD, NPU and BV of the test diets.

RESULTS AND DISCUSSION

The data on average weight gain, protein efficiency ratio, true digestibility

Table 1. *Percentage Composition of Experimental Diets.*

Ingredients	Diets						
	A	B	C	D	E	F	G
Wheat	—	89.00	65.80	43.80	21.90	—	—
L-Lysine	—	—	0.34	0.34	0.34	0.34	—
L-Tryptophan	—	—	0.35	0.35	0.35	0.35	—
Maize gluten meal 60%	—	—	4.20	8.40	12.60	16.80	—
Corn starch	61.20	—	18.31	36.11	53.81	71.51	89.00
Skimmed milk powder	27.80	—	—	—	—	—	—
Corn oil	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Vitaman mivture	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Mineral mixture	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Protein in the diet%	10.12	10.12	10.12	10.12	10.12	10.12	10.12
Protein distribution of the diet							
a) Wheat	control	100	75	50	25	0	Non-protein
b) Corn gluten meal (60%)	control	0	25	50	75	100	Non-protein

Table 2. *Average weight gain*, feed consumed, protein efficiency ratio, net protein utilization and biological values of various experimental diets,*

Description	Diets						
	A	B	C	D	E	F	G
Number of rats in each group	4	4	4	4	4	4	4
Days on experiment	10	10	10	10	10	10	10
Initial weight per group(gm)	168	168.5	170	167	169.50	167	—
Final weight per group (gm)	220	213.5	227.50	223	207.50	197.50	—
Weight gain per group (gm)	52	45.0	57.50	56.00	38.00	30.50	—
Feed consumed per grouh(gm)	412.70	447.5	406.50	299.20	318.30	305.90	—
Protein efficiency ratio	1.26	1.01	1.42	1.86	1.29	0.99	—
Net protein utilization(%)	57.76	40.29	62.26	49.89	60.85	53.68	—
True Digestibility(%)	74.07	80.90	78.49	83.86	81.33	88.09	—
Biological value(%)	78.64	49.93	76.54	59.30	74.05	60.79	—

* An average of two trials.

net protein utilization and biological value of the experimental diets are persented in Table 2.

The weight gains of the experimental animals on different diets were 52.0, 15,0, 57.5, 56.0, 58.0, and 30.5 gm, respectively. The analysis of variance of the weigqt gains showed a significant difference ($P<0.01$) between the means of weight gains of various groups fed different diets. The maximum gain in weight was measured in rats fed diet C.

Duncan's Multiple Range test revealed that rats on diets C and D gained significantly more weight than rats fed basal diet B, but a non-significant difference between weight gain was observed in diets A, C and D, The group of rats fed diets E and F showed significantly less weight gain than supplemented diets and also from basal diet B. These results were in line with Fanguaf *et al.* (1959) and Sprauge (1971). The PER for diets A, B, C, D, E and F was 1.26, 1.01, 1,42, 1.86, 1.29, and 0.99, respectively, which imporved significantly ($P<0.01$) and the highest value of 1.86 was obtained for diet D. The PER values of all the experimental diets were significantly ($P<0.01$) better than the basal diet B and diet D (containing 100% protein from MGM). It appeared that rats did not like wheat flour when compared to the combination of wheat and MGM.

The highest digestibility (88.09%) was found in rats fed diet F and the lowest (74.07%) in rats fed diet A. The analysis of varionce showed a non-significant ($P<0.01$) difference in the TD obtained on various diets i. e., 71.07, 80.90, 78.49, 83.86, 81.33 and 88,09, respectively.

Duncan's Multiple Range test revealed that ture digestibility value for diet F was significantly ($P<0,01$) better than that of A, but these were significantly different from those of diets C, B and E. It was further noted that diets E and D were significantly better than diet A.

The NPU value for diets A, B, C, D, E and F were 57.76, 40.29, 62.26, 49.89, 60.85, and 53.68% respectively. The maximum NPU value (62.26) was found in rats fed diet C, whereas minimum value (40.29) was observed in rats fed diet B. The NPU values of supplemented diets C, D, E and F were 62.26, 49.89, 60.85 and 53.68%, respectively. The analysis of varionce showd a significant ($P<0,01$) difference in various NPU values. Duncan's Maltiple Range test showed that the rats fed diets A, C, D, E and F retained significanty

($P<0.01$) more nitrogen than rats fed on basal diet B. The results indicated that NPU values at all levels of MGM supplemented diets were significantly higher than in case of basal diet B. The analysis of data on BV revealed highly significant ($P<0.01$) difference among various experimental diets. It was found that all supplemented diets had significantly ($P<0.01$) higher biological value compared to basal diet B. Thus it could be concluded that BV for diets A, B, C, D, E and F (57.76, 40.29, 62.26, 49.89, 60.85 and 53.68) improved with increasing level of MGM in the diets as compared to basal diet (Table 2). These results were similar to those obtained by Rosenberg and Eckert (1961) Barn s *et al.* (1961) and Daniel *et al.* (1968) who also observed that the nutritive value of wheat flour was improved by the addition of L-lysine.

REFERENCES

Barness, L. A., R. Kaye and A. Valyaseni, 1961. Lysine and potassium supplementation of wheat protein. Am. J. Clin. Nutr. 9 : 331.

Duncan, D. B. 1955. Multiple range test and multiple F. Test. Biometrics, 11:1,

Daniel, V. A., T. R. Doraiswamy, S. Venket Rao, M. Swaminathan and H.A.B. Parpia. 1968. Effect of supplementing a poor wheat diet with L-Lysine and DL-threonine on the digestibility co-efficient, biological value and net utilization of protein and nitrogen retention in children. J. Nutr. Dietet. 5 : 134.

Fanguaf, R., H. Vogt and G. V. Barlowen. 1959. By-products of manufacture of maize starch as chick feed. Arch. Ceflugelk; 23 : 192-202 (Nutr. Abst. Rev., 30 : 13, 1381 (1960).

Khan, M. A., K. Almas, A. R. Abid and M. Yaqoob. 1976. The effect of gram flour on the quality of wheat protein. Pak. J. Agri. Sci. 13 (2) : 167-172.

Khan, M. A., Riaz-ul Haq, A. R. Abid and M. Yaqoob. 1977. Nutritive value of Maxi-Pak. wheat flour supplemented with defatted soyflour. Pak. J. Agri. Sci. 14 (1) : 69-71.

Miller, D. S. and P. R. Payne. 1961. Problems in the prediction of protein values of diets. J. Nutr. 57 (2) : 225-228.

Nuzhat P. 1979. Supplementation of wheat flour with various levels of defatted groundnut flour. M. Sc. Thesis, Univ. of Agri., Faisalabad.

Naheed and H. M. Chaudhry. 1979. Soyabean and human nutrition a review. J. Ani. Sci. Pak. 1 (1-2) : 73-84.

Rosenberg, H. R. and Eckert, R. E. 1961. Meeting protein needs of infants and children. Pub. No. 843. pp. 451. Natl. Acad. Sci., Natl. Res. Council, Washington D. C., USA.

Sprague, G. F. 1971. "Corn Breeding" in improving the nutrition quality of cereals. A report of workshop on Breeding and Fortification. Agency for International Development, Washington D. C., USA.