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SUPPLEMENTATION OF WHEAT FLOUR WITH DETOXIFIED COTTON SEED FLOUR

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A biological trial was conducted on 20 albino rats to see the effect of different levels of cotton seed protein supplementations on the nutritive value of cereal based (wheat) diet. Five isonitrogenous and iso-caloric diets containing 10 per cent protein were prepared. The experimental control and basal diets supplied 10 per cent protein purely from casein and wheat, respectively. While othe diets furnished 10, 15 and 20 per cent protein purely from detoxified cotton seed flour. The rats fed diet containing 10, 15 and 20 per cent protein from cotton seed flour gained more weight than those fed on basal diet. Protein efficiency ratio and feed consumption followed a pattern similar to the growth. The rats fed on different levels of cotton seed protein showed better biological value than the casein diet. The rats fed diets, furnishing 10 per cent protein from cotton seed flour and the control showed higher NPU than all other diets.

INTRODUCTION

Cotton seed oil meal is produced in huge quantities every year because cotton crop is vital to the economy of Pakistan. Pakistan is the third highest producer of cotton seeds in the area (Altschul, 1966). Cotton seeds are pressed to extract oil which is later made into vegetable ghee and cotton seed oil meal is mainly used in cattle feed and to a lesser degree in poultry feed. It has food potentials as human food provided that the toxic principal "gossypol" is detoxified (Altschul *et al*; 1958). Such products are in wide practical use all over the world. Guatemala is commercially producing such food (Incapariria) containing cotton seed flour, 1,20,000 thousand pounds per month (USDA, 1955).

Detoxification of cotton seed flour has been attempted in PCSIR Lab. (Nazeer *et al*; 1963 and Aslam *et al*; 1970). The study under report was

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conducted to test whether this product was free of any toxic principal and also to assess its nutritive value as a vegetable protein supplement to cereal-based diet.

MATERIALS AND METHODS

Twenty weanling albino rats of uniform age were used in this experiment. The rats were fed stock diet (20 per cent protein) for a period of one week and then randomly divided into five groups of four rats each. The rats were housed in individual metabolic cages in the experimental room where the temperature was maintained between 75—80° F. The experimental diets containing 2, 3 and 4 per cent detoxified cotton seed flour were prepared, supplying 10, 15 and 20 per cent of the total protein in the diets. A diet containing casein served as control. The basal diet furnished protein purely from wheat (Table 1).

Table 1. *Per cent composition of Experimental Diets*

Ingredients	Diets				
	A	B	C	D	E
Casein	10.0	—	—	—	—
Detoxified CSF	—	-	2.00	3.00	4.00
Wheat flour	-	81.70	73.44	69.36	65.28
Corn starch	59.68	—	5.25	7.87	10.70
Corn oil	6.50	5.00	5.00	5.00	5.00
Glucose	4.50	4.50	4.50	4.50	4.50
Mineral*&Vitamins***	10.00	8.80	9.81	10.27	10.52
Crude fibre	1.75	—	—	—	—
Water	7.56	—	—	—	—
Total:	100.00	100.00	100.00	100.00	100.00
Crude protein %	10.00	10.00	10.00	10.00	10.00
Cal./lb	355.22	353.08	352.49	352.24	352.12
Wheat flour protein: DCSF protein	—	100.00	90.10	85.15	80.20

* Hawk-Oser Salt Mixture (Oser, 1965)

** Glaxo Multivitamin Syrup.

The experimental diets were randomly assigned to each group and were fed adlibitum for a period of 28 days. Fresh and clean water was provided all the time. The body weights of individual rats were recorded at the start of the experiment and on alternate days, thereafter. The urine and faeces were collected during the last week of the experiment. The digestibility coefficients, biological values and net protein utilization values of different diets were calculated according to the formulae of Platt *et al*; 1961. The protein efficiency ratio (PER) of the proteins of the different diets were determined by the rat growth method of Osborne *et al*; 1919. The data were subjected to statistical analysis using variance technique and a further comparison of the mean differences was made by Duncan's multiple range test.

RESULTS AND DISCUSSION

The data regarding weight gain, protein efficiency ratio, digestibility coefficient of crude protein, biological value and net protein utilization are given in table 2.

Table 2. *Average values for weight gain, protein efficiency ratio, crude protein digestibility, biological value and net protein utilization of various experimental diets.*

Description	DIETS				
	A	B	C	D	E
Number of rats	4	4	4	4	4
Days on experiment	28	28	28	28	28
Average initial weight (gm.)	30.0	32.0	34.0	33.2	30.5
Average final weight (gm.)	80.0	65.25	109.5	78.98	68.0
Average gain in weight (gm.)	51.0	33.25	75.5	45.67	37.5
Protein efficiency ratio (PER)	1.96	1.34	2.22	1.50	1.49
Crude protein digestibility (%)	92.75	78.0	89.50	83.5	70.75
Biological value (%)	75.67	52.25	81.21	69.25	56.86
Net protein utilization (%)	70.03	40.65	71.13	57.13	39.60

Weight gain: The average gain in weight of rats fed on diet A, B, C, D and E were 51.0, 33.25, 75.5, 45.6 and 37.5 gms, respectively. Supplementation of wheat flour with all levels of detoxified cotton seed flour increased the body weights. Maximum weight was gained with diet C supplying 10 per cent of

the total protein from cotton seed flour and it was significantly ($P<0.01$) better than all other diets. A decline in growth was indicated with higher levels of cotton seed flour.

Protein efficiency ratio (*PER*): Protein efficiency ratio was determined as the gain in weight per gram of protein consumed. The average PER values of the diets are given in Table-2. There was significant ($P<0.01$) difference among the PER values of different diets. The PER of different diets ranked in the following order, diet C (2.22), diet A (1.96), diet D (1.50), diet E (1.49) and diet B (1.34). Supplementation improved significantly the PER values of diets. There was no significant difference between PER values of diets C and A. It is evident that diet C had the best PER presumably having better protein quality due to better assortment of essential amino acids and was comparable with the diet containing casein. The finding is in line with those of Bressani and Marenco (1964), Daniels *et el*; 1970 and Tarquin and Bressani, 1966 who reported that addition of 8 to 10 per cent protein from cotton seed flour improved the PER in growing rats.

Digestibility of crude protein: The data on average crude protein digestibility of rats fed on different diets are summarised in Table 2. The digestibility of casein based diet was the highest (92.75%) being significantly ($P<0.05$) greater than that of all other diets. The digestibility of crude protein at 10 per cent level from cotton seed flour is as good as casein. A depressing trend in digestibility of crude protein was observed with the increasing levels of cotton seed flour.

Net protein utilization (*NPU*): The average NPU value of wheat based diet was 40.65 and it improved to 71.13 when 10 per cent of the wheat protein was replaced by DCSF (diet C). A similar value was obtained with casein based diet. The analysis of variance indicated a significant ($P<0.01$) difference among the diets. The rats fed on diet C had significantly higher NPU than those fed on diets, supplemented with or without DCSF. Diet D differed significantly from the diet B and E. Maximum increase in NPU was observed with diet C and NPU values were decreased with the increasing levels of DCSF. The results are in accordance to the findings of Alison *et al*; 1960 and Demaeyer and H. Vamderborght, 1968 who reported that 10 per cent protein from cotton seed flour gave 50 and 54 per cent NPU.

Biological value (BV): The average biological values of the diets A, B, C, D and E were 75.67, 52.25, 81.21, 69.75 and 56.85, respectively. Supplementation of DCSF improved the quality of wheat protein and the highest value was obtained with diet C. There was no significant difference between diet C and A and diet C was significantly better than all other experimental diets. It may be concluded on the basis of the findings of this investigation that the nutritive value of wheat flour could be improved with the supplemetation of DCSF and the best response could be obtained when 10 per cent of wheat protein was replaced by DCSR.

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