Supplementation of Wheat Flour with Leaf Protein Concentrate (LPC)

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Abstract : *A study was undertaken to see the effect of different levels of leaf protein concentrate (LPC) supplementation on the nutritive value of wheat flour. The experimental diets supplied 25, 50 and 75 per cent of the total protein from LPC and were fed to weanling rats for 10 days. Supplementation improved weight gain, net protein utilization, biological value and protein efficiency ratio. It was concluded that the nutritive value of wheat flour could be improved by supplementation with LPC and the diet with 25 per cent of the total protetin from LPC was the best and the results were comparable to casein based diet.*

1. INTRODUCTION

Among the various problems emerging out as a consequence of rapid population explosion, the problem of food particularly of good quality protein is reaching critical proportion, affecting most adversely the health and vitality of the nation. Wheat being the staple food is the main source of calories and protein in this country and does not supply adequate amount of essential amino acids necessary for growth and maintenance. On the other hand animal proteins are costly, difficult to produce and are in short supply to meet the needs of the expanding population. Keeping in view the present interest in unconventional protein sources, leaf protein have attracted the attention of nutritionists. Studies on leaf proteins have shown their potential for providing good quality protein, minerals and some vitamins (Morrison & Pirie[6]). The leaf protein may be useful for supplementing and extending over other food proteins especially those with low contents of lysine, threonine, isoleucine and valine (Waterlow[10]). The biological value of leaf protein has been reported to be higher than that of beef, casein, soy and yeast (Akeson and Stahamann[1]).

Sur[9] supplemented rice diet with lucerne leaf protein. The diets were fed to adult and growing rats at 6 per cent protein level.. The biological value was found to be 88 per cent. He further noted that supplementary effect was greater for young than for adults rats which have a lower lysine requirement.

Devadas *et al.*[4] conducted growth studies over 3 weeks in weanling rats. The supplementation of a cereal based diet with lucerne leaf protein concentrate brought about significant increase in body weight, feed efficiency ratio and liver nitrogen contents as compared to control group.

The present experiment was aimed to study the supplementary effects of different levels of leaf protein concentrate on the protein quality of wheat flour.

2. MATERIAL AND METHODS

Twenty four weanling Albino rats, 23 days old were used in this experiment. The rats were fed stock diet for a period of one week and then randomly divided into six groups of four rats each. The rats were kept in metabolic cages in the experimental room maintained at 80°F. The experimental diets containing 4, 8 and 12 per cent alfalfa leaf protein concentrate (LPC) were prepared, supplying 25, 50 and 75 per cent of the total protein in the diets. A diet containing casein served as control. A protein free diet was included in the test to measure metabolic fecal nitrogen (Table 1).

The experimental diets containing 10 per cent protein were randomly allotted to each group and were fed ad-libitum for a period of 10 days. Fresh and clean water was provided all the times.

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At the end of the experimental period, the rats were killed and net protein utilization (NPU) was determined according to the method of Miller and Bender[5]. The data were subjected to statistical analysis, using analysis of variance technique.

3. RESULTS AND DISCUSSION

The data regarding average weight gain, protein efficiency ratio true digestibility, biological value and net protein utilization are given in Table 2.

3.1 Weight gain : The average gain in weight of groups of rats fed on diets, A, B, C, D and E were 84.0, 60.5, 92.3, 77.0 and 69.0 gms respectively. Supplementation of wheat flour with all levels of LPC increased the body weights. Maximum weight was gained with diet C supplying 25 per cent of the total protein from LPC and it was significantly ($P < 0.1$ and $P < .05$) better than diets B and E reespectively. A decline in growth was noticed with higher levels of LPC which could be due to the presence of some glucoside in LPC (Suba Rao and Singh[8]).

3.2 Protein efficiency (PER) and net protein retention (NPR) : PER 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 ($P < .01$) difference among the PER values of different diets. The PER of different diets ranked in the following order, diet C (2.65), Diet A (2.53), Deit D (2.09), diet E (1.86) and diet B (1.3). Supplementation improved significantly the PER values cf diets. There was no significant difference between PER values of diets C and A.

In order to overcome the drawbacks of PER and to get the results independent of food intake, net protein retention was determined according to the method of (Bender and Doel[2]). The trends of NPR values of the diets were found similar to PER values.

It is evident that diet C had the best PER and NPR presumably having better protein quality due to better assortment of essential amino acids and was comparable with the diet containing casein.

3.3 True Digestibility (T.D.): The true digestibility of casein based diet was the highest (93%) being significantly ($P < 0.1$) greater than that of all other diets. The differences among the true digestibility of wheat protein with or without supplementation with LPC were not statistically significant. The results indicated that supplementation did not improve the digestibility of wheat protein.

3.4 Net protein utilization (NPU) : The average NPU value of wheat based diet was 49.5 and it improved to7 2.5 when 25% of the wheat protein was replaced by LPC (diet C). A similar value was obtained with casein based diet. The analysis of variance indicated a significant ($P < .01$) differences among the diets.

The rats fed on diet C had significantly ($P < .01$) higher NPU than those fed on diets, supplemented with or without LPC. Diet D differed significantly ($P < .01$) from the diet B. It was evident from the results that the NPU of wheat flour was enhanced when it was supplemented with different levels of LPC. Maximum increase in NPU was observed with diet C and NPU values were decreased with the increasing levels of LPC. The low nitrogen retention in rats fed higher levels of LPC may be due to the presence of higher contents of nitrogen bases (Bickoff **et al.**[3]).

3.5 Biological Value (BV): The biological value was calculated by dividing the NPU value by true digestibility. The average biological values of the diets A, B, C, D and E were 77.0, 54.9, 86.3, 73.6 and 66.6% respectively. Supplementation improved the quality of wheat protein and the highest value was obtained with diet C. There was no significant difference between diets C and A and the diet C was significantly better than all the other supplemented 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 supplementation of leaf protein concentrate and the best response could be obtained when 25 per cent of wheat protein was replaced by LPC.

Table 1

Composition of Experimental Diets

Ingredients %	Diets					
	A	B	C	D	E	F
Casein	10.7	—	—	—	—	—
Wheat flour	—	80.0	60.0	40.0	20.0	—
Leaf Protein concentrate	—	—	4.0	8.0	12.0	—
Corn starch	69.3	—	16.0	32.0	48.0	80.0
Glucose	5.0	5.0	5.0	5.0	5.0	5.0
Vitamin mixture	5.0	5.0	5.0	5.0	5.0	5.0
Mineral mixture	5.0	5.0	5.0	5.0	5.0	5.0
Corn oil	5.0	5.0	5.0	5.0	5.0	5.0
Total ..	100.0	100.0	100.0	100.0	100.0	100.0

Table 2

Average values for weight gain, Protein Efficiency Ratio, True Digestibility, Net Proetin Utilization and Biological Value of various Experimental Diets

Description	Diets				
	A	B	C	D	E
Number of rats in each group	4	4	4	4	4
Days on experiment	10	10	10	10	10
Initial weight, per group (gm)	231.0	227.5	231.0	227.5	229.0
Final weight, per group (gms)	315.0	228.0	323.3	304.5	298.0
Gain in weight, per group (gms)	84.0	60.5	92.3	77.0	69.0
Protein efficiency ratio	2.53	1.30	2.65	2.09	1.86
Net protein retention	3.59	2.05	3.69	2.99	2.90
True digestibility (%)	93.00	86.57	84.57	85.69	84.00
Biological value (%)	77.0	54.9	86.3	73.6	66.61
Net protein utilization (%)	72.0	49.5	72.5	63.1	50.5

4. REFERENCES

1. Akeson, W.R., and Stahaman, M.A., *J. Sci. Fd. Agric.* **13**. 139 (1965).
2. Bender, A.E. and Doel, B.H., *Brit. J. Nutr.*, **11**. 140 (1957).
3. Bickoff, E.M., Spencer, R. P., and Stark, J.B., *J. Food Chem.*, **16**. 246 (1969).
4. Devadas, R.P., Mathew, L., and Radharakmani, A., Indian *J. Nutr. Dietetics*, **5.** 234 (1970).
5. Miller, D.S., and Bender, A.E., *Brit. J. Nutr.*, **9**: 382 (1955).
6. Morrison, J.E., and Pirie, N.W., *J. Sci. Fd. Agric*, **12.** 1 (1961).
7. Snedecor, G.W., *Statistical Methods*, The Iowa State Uni. Press. Ames. Towa, U.S.A. (1967).
8. Suba Rao, B.H., and Singh, N., *J. Sci. Fd. Agric.*, **22**. 365 (1971).
9. Sur, B.K., *Brit. J. Nutr.*, **15.** 419 (1961).
10. Waterlow, J.C., *Brit. J. Nutr.*, **16.** 531 (1963).