J. Nutr. Dietet. (1964), **I**, 95

SUPPLEMENTARY VALUE OF A PROCESSED PROTEIN FOOD BASED ON A BLEND OF COCONUT MEAL, GROUNDNUT FLOUR AND BENGAL GRAM FLOUR TO POOR INDIAN DIETS BASED ON DIFFERENT CEREALS AND MILLETS

P. K. TASKER, M. NARAYANA RAO AND M. SWAMINATHAN

Central Food Technological Research Institute, Mysore

(Received 20 Oct 1963)

The diets consumed by a majority of the population in India are mainly based on cereals like rice and wheat or millets like ragi *(Eleucine coracana)*, jowar *(Sorghum vulgare)* or maize *(Zea mays)* and contain only small quantities of pulses, vegetables and fat and negligible amounts of milk and other animal foods.[1] Such diets are deficient in vitamin A, riboflavin, calcium and proteins and do not promote optimum growth in children[2]. The possibilities of using protein-rich foods of plant origin for the preparation of processed protein foods which can be used as effective supplements to the poor diets based on cereals or millets have received the attention of a number of workers.[3-5] Krishnamurthy *et al.*,[6] prepared a composite protein food based on a blend of coconut meal, groundnut flour and Bengal gram flour and fortified with certain essential vitamins and minerals. The food was shown to possess a significant supplementary value to poor rice diet[7]. The results of studies on the supplementary value of the food to diets based on wheat, jowar, maize and ragi are reported in this paper.

Experimental

Materials : Protein food : The protein food based on a 1:1:2 blend of coconut meal (screw pressed), Bengal gram flour and groundnut flour and adequately fortified with calcium, vitamins A and D, thiamine and riboflavin was prepared according to Krishnamurthy *et al.*[6]

Cereals and millets : Samples of wheat, maize (yellow), jowar and ragi obtained from the local market were cleaned free from impurities and were powdered in a flour mill to pass through 50 mesh sieve. The flours were used for the preparation of the diets.

Animal experiments : The supplementary value of the protein food to diets based on the different cereals and millets was studied by the rat growth method. The studies were carried out in two series. The supplementary value of the food to wheat and maize diets was studied in the first series and to ragi and jowar diets in the second series. Groups of freshly weaned albino rats weighing about 45g, allotted according to a randomized block design were fed *ad lib* on the poor cereal or millet diets or the same supplemented with the protein food at 12.5% level. The composition of the cereal or millet diet was the same as the basal rice diet suggested by the Vanaspathi Research Advisory Committee[8], except that rice was replaced by the cereal or millet under study. The experimental diets were prepared by replacing 12.5 parts of rice by the protein food. The methods adopted for the preparation of the diets and the feeding of the experimental animals were the same as those of Kuppuswamy *et al.*[9] The duration of the experimental period was 8 weeks in the first series and 4 weeks in the second series.

Results and Discussion

Data ragarding the average food intake and the weekly increase in body weight of animals are given in Tables I and II. The poor Indian diets based on wheat, maize, jowar and ragi promoted a low growth (5.6-10.2g/week) in albino rats. Supple-

Table I. *Gain in body weight of rats on a wheat or maize diet supplemented with the protein food*[1] (Duration of experiment 8 weeks; mean values for 5 male and 5 female rats in each group)

Diets	Protein content of diet[2]	Initial body weight (g)	Daily food intake[2] (g)	Weekly gain in body weight (g)	
Wheat diet	11.3	49.3	9.8	10.2	±0.56 (40 d.f.)
,, + protein food	16.2	49.4	10.4	15.9	
Maize diet	9.5	49.4	9 4	8.8	
,, + protein food	14.5	49.4	10 6	14.2	
Critical difference at 5% level				1.60	
,, ,, 1% ,,				2.14	
,, ,, 0.1% ,,				2.81	

[1] Based on a 1:1:2 blend of coconut meal, Bengal gram flour and groundnut flour
[2] Expressed on moisture-free basis

Table II. *Gain in body weight of rats on ragi or jowar diet supplemented with the protein food*[1] (Duration of experiment 4 weeks; mean values for 8 female rats in each group)

Diet	Protein content of diet[2]	Initial body weight (g)	Daily food intake[2] (g)	*Weekly gain* in body weight (g)	
Jowar diet	9.6	46.6	7.1	7.6	±0.52[3] (14 d.f.)
,, + protein food	14.4	46.8	8 3	14.6	
Critical difference at 0 1% level				3.07	
Ragi diet	7.6	46.5	7.0	5.6	±0.72[3] (14 d.f.)
,, + protein food	12.5	46.6	8 5	14.7	
Critical difference at 0.1% level				4.24	

[1] Based on a 1:1:2 blend of coconut meal, Bengal gram flour and groundnut flour
[2] *On moisture-free basis*
[3] Standard error and degrees of freedom are for *3 groups of rats; the values for one group* have not been included in the table

mentation of the different diets with the protein food based on a blend of coconut meal, groundnut flour and Bengal gram flour resulted in a highly significant ($P<0.001$) increase in the growth rate of rats. Aykroyd and Krishnan [10,11] found that the primary deficiencies in poor Indian diets based on cereals or millets (except ragi) were calcium, vitamin A, riboflavin and protein. The protein food used in the present study was a rich source of protein, vitamin A, riboflavin and calcium and hence supplemented to a highly significant extent the diets consisting predominantly of cereals and millets. The results obtained in the present investigation have demonstrated that in areas where milk and other protein-rich foods of animal origin are not available in adequate quantities, large scale production and consumption of low-cost fortified foods based on blends of coconut meal, groundnut flour and Bengal gram flour will help to a considerable extent in making up the deficiencies in poor Indian diets and preventing malnutrition.

Summary

1. The supplementary value of a processed protein food based on a 1:1:2 blend of coconut meal, Bengal gram flour and groundnut flour and adequately fortified with vitamins and minerals to poor diets based on wheat, maize, jowar or ragi was determined at 12.5% level by the rat growth method. The diets based on wheat maize, jowar or ragi promoted a low growth (5.6–10.2g/week) in albino rats. Supplementation of the different diets with the protein food resulted in a highly significant increase in the growth rate of rats (14.2-15.9g/week).

Acknowledgement

Our thanks are due to Mr. A. N. Sankaran for the statistical analysis of the results and to Dr. V. Subrahmanyan, Director of the Institute for his keen interest in the investigation.

REFERENCES

1. Aykroyd, W. R. (1948), *Note on the results of diet surveys*, Spec. Rep. No. 16, Indian Research Fund Association, Delhi.
2. Patwardhan, V. N. (1952), *Nutrition in India*, published by Indian Journal of Medical Sciences, Bombay, India.
3. Narayana Rao, M. and Swaminathan, M. (1960), *Ann. Rev. Fd. Technol.*, published by Association of Food Technologists, India, **1**, 73.

4. Scrimshaw, N. S. and Bressani, R. (1961), *Fed. Proc.*, **20**, (Supple7), 80.
5. Subrahmanyan, V., Joseph, K., Doraiswamy, T. R., Narayana Rao, M., Sankaran, A. N. and Swaminathan, M. (1957), *Brit. J. Nutr.*, **11**, 382.
6. Krishnamurthy, K., Tasker, P.K., Indira, K., Rajagopalan, R., Swaminathan, M. and Subrahmanyan, V. (1958), *Ann. Biochem. Expt. Med.*, **18**, 175.
7. Tasker, P. K., Krishnamurthy, K., Rajagopalan, R., Swaminathan, M. and Subrahmanyan, V. (1960), *Food Science*, **9**, 84.
8. Council of Scientific and Industrial Research. (1952), *Investigations on the composition and nutritive value of vanaspathi, C.S.I.R., New Delhi.*
9. Kuppuswamy, S., Joseph, K., Narayana Rao, M., Rama Rao, G., Sankaran, A. N., Swaminathan, M. and Subrahmanyan, V. (1957), *Food Science*, **6**, 86.
10. Aykroyd, W. R. and Krishnan, B. G. (1937), *Indian J. Med. Res.*, **25**, 1.
11. Aykroyd, W. R. and Krishnan, B. G. (1937), *Indian J. Med. Res.*, **25**, 367.