Fish Protein Concentrates in the Treatment of Kwashiorkor

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Skim milk has been used extensively in the treatment of kwashiorkor and found satisfactory. Diets based upon vegetable sources of protein have also initiated satisfactory clinical cure although they have been found inferior in their ability to regenerate serum albumin.[1–3] On the other hand, blends of vegetable protein and milk have been reported to compare favorably with milk alone, from both a clinical and biochemical standpoint.[4] Fish offers an inexpensive source of large amounts of protein. The long coast line and the numerous inland rivers in India offer considerable possibilities for the production and utilization of fish as a major source of protein in the prevention and control of protein malnutrition. Recently several processes have been developed to produce deodorized, defatted fish protein concentrates. Although some studies on experimental animals have shown that the nutritive value of fish flours may vary widely, depending upon the species of fish used and the processing procedure employed, it is possible to obtain samples high in protein.[5]

In this study, a diet based on fish protein concentrate as the main source of protein was used in the treatment of children suffering from kwashiorkor. The results obtained were compared with those obtained with a diet based upon skim milk protein.

MATERIALS AND METHODS

Fifty-seven children suffering from kwashiorkor and admitted as inpatients to hospital wards were studied. These children were grossly underweight; they had varying degrees of edema, hypoalbuminemia and generally conformed to the type of cases reported earlier.[6] Thirty-three children were given a diet which provided 80 per cent of the total protein in the form of deodorized, defatted fish protein concentrate (FPC, VioBin);‡ the remaining twenty-four children were given a diet in which 80 per cent of total protein was derived from dry skim milk. In both diets, the remaining 20 per cent of protein came from wheat flour in the form of bread. Both diets provided 6 gm. of protein and 200 kilocalories per kg. body weight. Earlier studies with dry skim milk protein had suggested that these amounts induced optimal responses.[7] The composition of the diets employed in this study is shown in Table 1.

Preparation of Diets

The defatted, deodorized VioBin fish flour used was a light, buff-colored, fine, dry powder which still retained some odor. Chemical analysis showed that it contained 82 per cent protein (N × 6.25) 3.1 per cent moisture and 14.9 per cent ash. (Manufacturer's figures: 79.5, 3.6 and 16.8 per cent, respectively).

The fish flour, sugar and sago were mixed with water and cooked over a low flame for about 15 to 20 minutes; the mixture was stirred constantly until the sago granules became soft and a thin gruel was formed. This was cooled and fed in four or five servings. Bread, bananas and butter were fed separately.

Dry skim milk was reconstituted with water in the ratio of 1:6, sugar was added and the mixture was slightly warmed before feeding in four or five servings. Bread, bananas and butter were fed separately.

Blood samples were obtained at the time of admission and on the tenth and thirtieth days after initiation of the diets in order to determine the serum total proteins and albumin levels. A daily record of body

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‡ Manufactured in the U. S. by the VioBin Corp., Monticello, Illinois.

weights was maintained and clinical improvement assessed. Serum proteins were determined by the microKjeldahl procedure. Sodium sulphite, 28 per cent, was used to fractionate albumin.

RESULTS

Acceptability

Acceptability of the FPC diet was poor. The skim milk diet was readily accepted by all children, whereas the FPC diet was rejected by ten of the thirty-three children to whom it was given. Five other children given this diet vomited on more than one occasion every day. Acceptability was not improved by either changing the consistency or the taste of the meal by the addition of salt and spices in small amounts. The odor of the cooked gruel was distinctly more fishy than the uncooked flour and appeared to be primarily responsible for nonacceptance. Of the eighteen children who consumed the diet, nearly a third had to be coaxed and persuaded to do so during the first four or five days. Few children relished the FPC diet. The mothers of several of the children were also offered the meal; they disliked the taste and smell of the FPC diet. The fifteen children whose intake of the FPC diet was unsatisfactory are not included in the analysis of data.

Clinical and Biochemical Response

The results are presented in Table II. Judged by clinical criteria, i.e., the time in which (1) the edema disappeared, (2) the minimum body weight was reached and (3) the mental status of the child improved, the FPC diet was comparable to the skim milk diet. The gain in body weight following the elimination of edema, however, was distinctly lower with the FPC diet than with the skim milk diet. Although only two of the twenty-four children receiving the skim milk diet had insignificant increases in body weight, five of the eighteen children receiving the FPC diet had stationary body weights over three weeks, nine had marginal increases and only four had significant increases. The difference in mean weight gains on the tenth and twentieth days after disappearance of edema between children receiving the FPC diet and the skim milk diet was significant.

Serum albumin levels increased by 0.61 and 0.67 gm. per 100 ml. on the tenth day and by 1.37 and 1.27 gm. per 100 ml. on the thirtieth day, with the skim milk and FPC diets, respectively. The differences between the diets in this respect were not significant.

TABLE I
Composition of Diets

Ingredient	Skim Milk Diet (gm./kg. body weight)	FPC Diet (gm./kg. body weight)
Dry skim milk	15	...
Fish flour	...	6
Sugar	1	6
Butter fat	6	6
Bread	15	15
Sago	...	9
Bananas, peeled ripe	20	20

NOTE: Both diets provided 6 gm. of protein and 200 kilocalories per kg.

TABLE II
Summary of Results of Treatment

Data	Skim Milk Diet (gm./kg. body weight)	FPC Diet (gm./kg. body weight)
No. of subjects	24	18*
No. of days in which edema disappeared	9	10
No. of days taken for minimum body weight to be reached	8	9
Increase in serum albumin (gm./100 ml.)		
Initial	1.62 ± 0.130	1.71 ± 0.090
10th day	0.61 ± 0.072	0.67 ± 0.090
30th day	1.37 ± 0.162	1.27 ± 0.150
Gain in body weight (kg.)		
10th day	0.64 ± 0.06	0.47 ± 0.071
20th day	1.19 ± 0.170	0.57 ± 0.080

* This figure does not include the fifteen children who did not accept this diet satisfactorily. Values given are means with standard error.

COMMENTS

The results of this study indicate that in children who accept fish flour diets, fish protein concentrate is as satisfactory as skim milk in its ability to reverse the acute manifestations of kwashiorkor. Although no differences were observed between milk and fish proteins insofar as the clinical improvement and the rise in serum albumin levels were concerned, body weight gains were much lower in those receiving the fish protein. This finding is puzzling and requires an explanation. In preparing these two diets, the FPC diet was subjected to heating, a process which, in the presence of sugar, is known to alter the amounts of available lysine, whereas the skim milk diets were just warmed. Analysis of the cooked diets for the amounts of lysine available by the method of Carpenter[8] showed that in the skim milk diets the available lysine was 6 per cent and in the FPC diet only 4.2 per cent. The intakes of absolute amounts of lysine in those receiving the milk diet would, therefore, be 360 mg. per kg., whereas in those receiving the FPC diet, it would be only 252 mg. per kg. The possibility that this difference in the amounts of lysine available was responsible for the differences in body weight gain was considered even though the level of 4.2 per cent in the FPC diet is well above the 2.7 per cent suggested as the limiting level of available lysine.[9] Four children receiving the FPC diet, whose body weights had remained stationary, were therefore given daily supplements of 500 mg. of L-lysine for a period of ten days to see if their body weights would increase. In only one of the four was there a significant rise. This observation, coupled with the fact that the increase in serum albumin both on the tenth and thirtieth days of therapy with the FPC diets was as good as that obtained with the skim milk diets, argues against the theory that lower intakes of available lysine are responsible for the lower gains in body weight. In addition, protein efficiency ratio studies carried out on rats, using the same batch of fish protein concentrate, gave values which were similar to those obtained with skim milk (2.8 and 2.9, respectively). However, it is possible even though the PER of fish flour protein in normal animals is similar to that of skim milk, in protein-depleted animals differences may be observed. The reason for the lower gain in body weights in the children studied, however, still needs elucidation.

SUMMARY

Fifty-seven children suffering from kwashiorkor were hospitalized and given diets in which the major source of protein was from either fish protein concentrate (FPC) or skim milk. Diets containing fish protein concentrates were not well accepted by a large proportion of the children. In those who did consume it, both the clinical and biochemical responses compared favorably with those obtained in children receiving the diets containing skim milk, except for the increase in body weight after the disappearance of edema. Analysis of the cooked diets showed that the amounts of available lysine were lower in the FPC diets than in the skim milk diets. However, supplementation studies, using pure L-lysine, suggested that the lower gain in body weight could not be ascribed to this factor.

Fish flour does not appear to be a satisfactory substitute for skim milk in the treatment of kwashiorkor, not only because of its nonacceptance by a large number of children but also because of its inability to promote body weight gains.

ACKNOWLEDGMENT

We wish to thank the VioBin Corp., Monticello, Illinois, for their generous gift of the deodorized, defatted fish flour used in this investigation. We wish to acknowledge the assistance of Dr. Kumudini Mohanram in this study.

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