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PREPARATION OF POST DIARRHOEAL FOOD FOR INFANTS AND ITS BIOLOGICAL AND CLINICAL EVALUATION

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A post-diarrhoeal food formulation based on a blend of rice, soymilk and moong pulse and fortified with essential vitamins and potassium salt has been prepared. Chemical and biological evaluation showed that it is of high nutritive value. It is a good source of proteins (19.5 %). The nutritional quality of recipe was measured by feeding trials on albino rats. Net protein utilization (NPU), protein efficiency ratio (PER), Net dietry protein calorie per cent (NDP cal %) and digestibility (D) were 57, 2.4, 11.6 and 92 % respectively Clinical evaluation showed that it is a satisfactory food product for feeding babies during and after diarrhoeal period. All babies fed on the formulation showed great improvement and recovered from diarrhoea within a few days of being fed upon it.

Key words: Post diarrhoeal food; Infant food;Nutrition evaluation.

INTRODUCTION

In countries like India, Bangladesh and Pakistan the incidences of diarrhoea are very common among the malnourished infants and children. This is evidenced by high mortality rate of infants suffering from diarrhoea as compared with that of developed countries. Many factors such as poor hygiene, malnutrition, uncleanliness and contamination of food and water are responsible for diarrhoea. In most of the cases, diarrhoea is due to pathogens which gains access to the gastrointestinal tract mostly through ingestion of contaminanted food. Repeated incidences of diarrhoea also make infants intolerant to lactose and so they react badly to milk diets. In the result, mothers stop feeding their infants and children during the diarrhoeal period which the malnourished infants were vulnerable to infection rather than effecting any improvement in their health. It is advisable, therefore, not to stop feeding but to give suitable food to children as that their daily requirements of nutrients are fulfilled and food is easily digestible, providing the excess of water and salt to make up for the losses due to the frequency of stools.

With a view to ameliorating this unhappy situation in the country, investigations are in progress in PCSIR Laboratories Lahore, to develop foods for postdiarrhoeal feeding. In earlier reports [1,2,3] the preparation and nutiritional evaluation of weaning foods both from conventional and non-conventional sources named as PROTOFEX, PROTOLAC and SOYLAC were described. These infant foods or other imported baby foods are not suitable during diarrhoeal period. Consequently attempts were made to prepare a food which may be used as a special diet during the diarrhoeal and post-diaorrhoeal periods. The present paper deals with the preparation of post-diarrhoeal food and its biological and clinical evaluation.

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MATERIAL AND METHODS

A mixture of rice, moong and soymilk was used in our preparation. Soybean seeds were obtained from the Seed Division of Pakistan Ghee Corporation. Soymilk free from trypsin inhibitor was prepared as described earlier [4]. Broken rice and dehulled moong pulse were purchased from the local market. They were thoroughly cleaned, made into flour and stored separately. The mixture of rice flour, moong pulse flour, soymilk and potasium chloride was cooked for 20 min. in a steam-jacketed pan. The cooked slurry was dried in thin flakes on a twin cylinder roller dryer at 40 lb. psi. The flakes were milled and mixed with vitamins to meet the quality requirements of FAO/WHO/UNICEF for the infants [5]. The process rights of the recipe may be leased out, and hence a detailed description of the process is omitted.

Chemical analysis. Post diarrhoeal food (PDF) was analysed for moisture, protein, fat, crude fibre, ash, and vitamin C according to the AOAC Methods [6]. Vitamin A, thiamin and riboflavin were assayed according to vitamin assays methods [7]. Total bacterial count and coliforms were determined according to the method given in the "Hand Book of Practical Bacteriology" [8]. The results are giving in Table 1.

Biological evaluation

Net protein utilization operative (NPU op) was determined according to the method of Platt *et al.* [8] using male albino rats weighing 40-45 g. NPU standardized (NPU st.) was calculated using the formula [9]:

$$\text{NP U st} = \frac{\text{NPU x 54}}{\text{54- p}} - 8 \text{ where p is protein cals. (\%)}$$

Net dietary protein calories % (NDP cal %) were calculated by the formula:

NDP cals % = NP U op x protein calories %

Protein efficiency ratio and digestibility. Protein efficiency ratio (PER) was determined at 10 % protein level according to the method of Campbell [9] using albino rats. In addition to the test group a reference standard group of rats on casein diet at 10 % protein level was also maintained. Feeding was continued for a period of 4 weeks and a record of weight gain and food intake was maintained. PER was calculated by dividing the weight gain with protein intake during the experimental period and is shown in Table 2. The faeces collected during NPU experiment were dried at 105° for 48 hr. from the dry weight of faeces and food intake digestibility was calculated by using the formula:

$$\text{Digestibility} = \frac{\text{Wt. of food intake} - \text{wt. of faeces}}{\text{wt. of food intake}} \text{x } 100$$

Clinical evaluation. The PDF was given to infants ranging in the age from 6 to 18 months. Studies were made with 8 children who were admitted to the Nutrition Unit of the Department of Child Health, Mayo Hospital, Lahore. All of them were found suffering from protein calorie malnutrition (marasmus). The number of stools was in the range of 10 to 12 per day when these children were brought to the hospital. All of them were in acute illness and their actual body weights were less than the expected average weights. The children were housed as comfortably as possible. Visitors were not allowed except for mothers, who fed the children under the supervision of trained nurses and doctors. In many cases, mothers took their children back to their home as soon as their babies recover-

Table 1. Composition of post-diarrhoeal food compared with FAO/WHO/UNICEF Protein Advisory Group Specifications for infant foods and daily recommended allowances

	PDF	PAG specification	Daily recommended allowances FAO/WHO
1. Moisture (%)	4.5	Max 5-10	–
2. Protein (%)	19.5	Min 20.0	1.2-2.3 gm/kg
3. Fat (%)	2.7	Max 10.0	–
4. Ash (%)	3.8	Max 5.0	–
5. Fibre (%)	0.7	Max 5.0	–
6. Carbohydrates (%)	68.8	–	–
7. Vitamin A(IU/100g)	1500	1400	1100
8. Vitamin D (IU/100g)	480	400	–
9. Thiamine (mg/100g)	1.2	0.3	0.4
10. Riboflavin (mg/100g)	1.3	0.4	0.6
11. Niacin (mg/100g)	6.0	5.0	4.0
12. Vitamin C(mg/100g)	28.0	20.0	30.0
13. Calories	377	–	100/kg
14. Total bacterial count/g	5000	Max 50000	–
15. Coliform count/g	Nil	Max 10	–

Table 2. Protein values of PDF

Diet	Protein calories %	NPU operative %	NPU st %	NDP cals %	Digestibility %	PER
PDF (post-diarrhoeal food)	20.3	57	82	11.6	92	2.4
Skim milk	10.2	75.5	84.7	7.7	92	2.9

Table 3. Experiment period: 4 weeks for 8 infants.

	At the start of first week	At the end of fourth week	Increas in value
Average food intake in g./day	123	212	
Average calorie intake per kg body weight	113	150	
Average protein intake in g. per kg	5.8	7.6	
Average serum protein in g. 100 ml	5.8	7.1	1.3
Average haemoglobin %	9.6	10.2	0.6
Average weight of infants in kg	3.8	5.0	1.2
Average height of infants in cm	59.6	62.0	2.4
Reference protein g./kg body weight	–	–	–
NPU at x protein intake g/kg body weight 100	4.7	6.2	

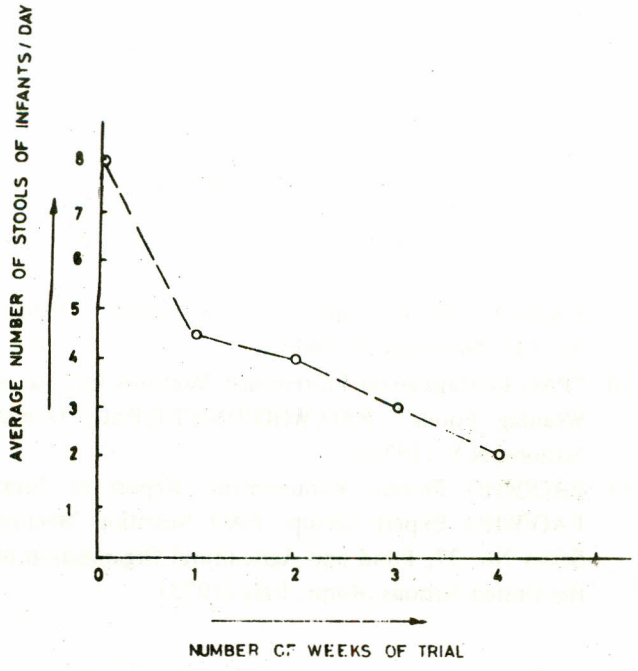

Fig. 1

ed from illness. It was very difficult to keep the babies in the hospital even for four weeks. However, a few mothers agreed to keep their children under treatment for four weeks. At first the babies were given emergent relief and no other food or milk was given to them except post diarrhoeal food during these four weeks. The food was prepared by adding 30 g. of PDF to 160 ml of boiled lukewarm water and a teaspoonful of sugar (5 g) was also added to each food dose. The food was given to the infants at four hourly intervals and each baby was given 5 feeds a day.

The unused portions of the feed were collected together and its weight was deducted from the total food given in a day. Changes in body weight, length, haemoglobin, serum protein and the number of stools of each infant, shown in Table 3, were determined weekly. The number of stools of each infant was noted daily but for reporting purposes weekly records were kept. Decrease in the number of stools of 8 infants was from 10 to 2 per day.

RESULTS AND DISCUSSION

Chemical and bacteriological analyses of post-diarrhoeal food as shown in Table 1 are compared with specifications for infant food and the recommended daily allowances by the FAO/WHO Protein Advisory Group [10] for infants. It was observed that PDF conforms to PAG specification and only 100 g of post diarrhoeal food are required to meet the vitamin and mineral requirements of one-year old children. In fact, vitamins are in higher amounts than the daily recommended allowances keeping in view the prevalence of malnutrition among babies. Bacteriological analysis of post diarrhoeal food showed that it is free from coliforms and the total count/g is 6000 which is much less than the minimum permissible in baby food. Hence this food is completely safe for feeding infants.

Biological evaluation. As shown in Table 2 NPU operative of post-diarrhoeal food was found to be 57 whereas NPU(st) was 82.0 which eliminates the effect of protein concentration. It has also been observed that there is no significant difference between NPUst of milk (84.7) and post-diarrhoeal food (82.0). According to an FAO/WHO report [11] and Platt *et al.* [9], food combinations having NDP cals % less than 8 are incapable of meeting the protein requirement of infants. The NDP cals % of post-diarrhoeal food was found to be 11.6 as shown in Table 2. The PER of the food was 2.4 and the digestibility 92 %. All these results showed that the protein quality of post-diarrhoeal food is satisfactory for infant feeding.

It was observed that at the time of the admission of the babies in the hospital the average number of stools per day was 6. During the treatment when PDF was given as the only food, it was observed that there was rapid decrease in the number of stools in the first week. Almost all the babies recovered from diarrhoea during the second week of their feeding and began to show increases in length, haemoglobin content and serum protein. The average weight gain of the group fed on the PDF was 1.2 kg in 4 weeks. These were higher than the average weight gain of 0.8 kg of children of similar age and body weights fed on other mixed diets in the children welfare centres. It can be observed from Table 3 that the initial calorie intake and protein intake/kg body weight were low because of malnutrition or having been adapted to low intake. Calorie intakes of infants exceeded that calculated according to their body weight from the start of first week and at the end of the 4th week of trial, ranged from 113 to 150. It may be due to increase in growth rate and to make up the losses during diarrhoea, which increased their energy requirement. Similar was the case with protein intakes. At the start of the trial, average protein intake was 5.8g/kg body weight and at the end of the fourth week it was 7.6 g/kg body weight. From Table 3 it can be also observed that reference protein intake was 4.7 to 6.2 g/kg which was 3 to 4 times the bodily needs of the infants. According to an FAO report [11], safe level of the intake of egg or milk protein (NPU = 100) for infants is 1.7 g/kg body weight which indicates that the infants fed on PDF receive fully daily calorie and protein requirements.

On the basis of the above results it can be concluded that PDF is a complete food for infants and can be used as

post-diarrhoeal food.

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