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Development and Nutritional Assessment of a Weaning Food from Sorghum and Oil - Seeds

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Abstract: The study investigated the use of locally sourced flours of germinated Sorghum, Sesame oil seed, Groundnut and Soyabeans which were combined in the ratio of 3 ½ : 1:1:1 (w/w), to produce weaning diet rich in energy and protein. The results showed significant differences ($P<0.05$) between the experimental diet and a commercial weaning diet - "Nutrend" (Nestle, Nigeria) in terms of protein content, minerals and energy content . The experimental diet showed higher values when compared with the commercial diet. Also, the physico - chemical characteristics of the experimental diet were improved upon in terms of bulk - density, swelling capacity, viscosity and water - holding capacity. The animal feeding experiment further showed higher values of PER (Protein Efficiency Ratio) , FER (Food Efficiency Ratio) and Total tissue Nitrogen for the experimental diet. It was thus concluded that the experimental diet was capable of ameliorating Protein - Energy Malnutrition (PEM) in infants especially during the weaning period.

Key words: Protein - energy malnutrition (PEM), food efficiency ratio (FER), protein efficiency ratio (PER)

Introduction

Prevalence of PEM (Protein Energy Malnutrition) in infants after six months old is high in Africa (Plahar and Hoyle, 1991; Ojofeitimi, 1982). This is because infants at this stage of development required higher energy and proteins in their diet so as to meet increasing demand for metabolism.

Literature showed that most of the weaning foods consumed in communities of developing nations are deficient in essential nutrients (FAO/WHO, 1970). Several strategies have been used to improve the nutritive value of weaning foods (Gopaldas *et al*., 1988).The traditional West - African weaning foods could be improved upon by combining locally available foods that complement each other in such away that new pattern of amino - acids created by this combination is similar to that recommended for infants (Fashakin and Ogunsola, 1982). Cereals are deficient in lysine but have sufficient sulphur - containing amino - acids which are the limiting factors in legumes (Tsai *et al*., 1975).

In this research work, efforts were made to develop a weaning food from oil seeds of Soyabeans, Groundnut and Sesame oil- seed (they served as sources of energy and proteins), together with flour of germinated Sorghum (source of energy) blended together in the ratio of 1:1:1:3 ½ (w/w).Thus a weaning food rich enough in energy and proteins to ameliorate PEM in infants was obtained.

Materials and Methods

Sorghum, Soyabean, Groundnut and Sesame- oil seeds were obtained from local market in Ile - Ife, Osun state, Nigeria. Also, 12 albino rats were obtained from the Animal House, Faculty of Pharmacy, Obafemi Awolowo University, Ile - Ife, Nigeria. The weaning diet used as standard was "Nutrend" (Nestle, Nigeria) obtained commercially.

Table 1: Proximate analysis of the formulated diet

Nutrients	Composition (g/100g)	
	Experimental	Nutrend
Protein	19.972	16.0
Fat	9.87	9.0
Moisture	1.18	4.0
Ash	2.39	2.3
Crude fiber	4.87	5.0
Total Carbohydrate	71.45	68.7
Digestible Carbohydrate	66.58	63.7
Total Energy	1846.7kJ	1670kJ

Flours of the cereal and oil-seeds where prepared according to the flow - charts shown in Fig. 1, 2, 3 and 4 (Fashakin and Ogunsola, 1982). Modification of the procedure for germinating Sorghum was used which entails inoculating it with LAB (Lactic - Acid Bacterial) before the commencement of germination. The lactic acid produced will discourage the fungi growth(Ramesh *et al*., 2002) . These flours were blended in the ratios 3 ½ :1:1:1 (w/w) for Sorghum, Soyabean, Groundnut, and Sesame seed flours respectively. Also, the basal diet was prepared according to the procedure of Mbuba, (1992).

Nutritional assessment was done via feeding 12 albino rats with various diets prepared. They were divided into four groups of 3 albino rats per group. Three groups were fed respectively with Basal, "Nutrend", and Experimental diets while the fourth group served as Control ,where the rats were sacrificed at the beginning of the feeding experiment.

Table 2: Physico - chemical characteristics of the diets

Dietary Samples	Bulk Density (g/ml)	Swelling Capacity (ml/g)	Water Holding Capacity (ml/g)
Experimental Diet	0.657±0.02	4.871±0.10	0. 44±0.14
Nutrend	0.605±0.16	3.64±0.18	0.414 ± 0.10

Table 3: Mineral composition of formulated diet (mg /100 g)

Minerals	Experimental Diet	Nutrend
Calcium	93.4	39
Iron	28.5	1.0
Phosphorus	22.8	26
Sodium	40.0	22

Table 4: Tissue nitrogen of various organs (mean ± sem)

Dietary Sample	Kidney (mgN/g)	Liver (mg N/g)
Basal	3.21±0.07	2.97±0.07
Nutrend	10.34±0.90	5.75±0.27
Experimental Diet	7.23±0.02	6.13±0.79
Control	6.10±1.25	4.45±0.14

Table 5: Utilization of diets by the albino rats

Dietary Samples	PER	FER
Experimental Diet	3.16±0.61	2.22±0.17
Nutrend	0.63±0.12	0.44±0.03

Results and Discussion

Table 1 and 2 shows the results of the proximate analysis and physico - chemical characteristics of the experimental weaning diets as compared to "Nutrend" (commercial weaning diet). The values for experimental weaning diet showed improvement over the values obtained for "Nutrend" ($P<0.05$).

The viscosity values at 15%, 25%, 35% and 40% concentrations of the experimental diet at 30°C, using Cannon Viscometer is shown in Fig. 5. The recommended viscosity of "Nutrend" by its manufacturer corresponded to 20% concentration. This value corresponded to the viscosity of the experimental gruel at 40% concentration. Further increase in the concentration makes the gruel to become viscous. The implication of this is that more of the experimental diet will be dissolved in order to achieve the same constitution as "Nutrend". This will make more nutrients and energy available for the infants fed on experimental diet than those fed on "Nutrend", thereby further increasing the ability of the experimental diet to ameliorate PEM in infants. This phenomenon could be adduced to effect of germination on Sorghum. Germination of cereals have been shown to reduce bulkiness in gruels (Mosha and Svanberg, 1990). Besides, due to small stomach size of the infants, the gruel has to be compact in respect of calorie/energy and

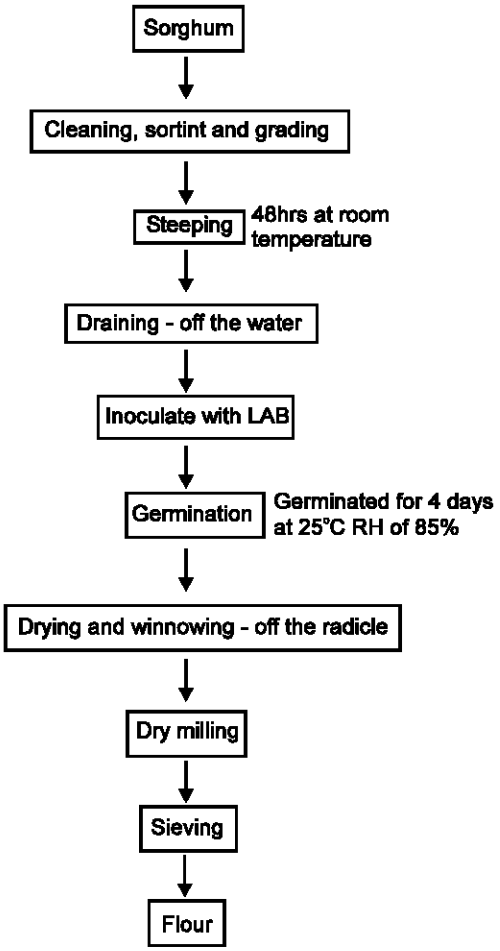

Fig. 1: Flowchart illustrating preparation of Sorghum flour

nutrents. It has been shown that 280 - 450 kcal is required from complementary diet for 6 - 12 months old infants (USAID, 2002).

Table 3 shows the four minerals of importance to the infants namely Fe, Na, P and Ca, present in the diets. Their values are well above the recommended daily allowance for infants (Ihekoronye and Ngoddy, 1985).

The nutritional assessment of the formulated diet via bioassay showed a favourable comparation with "Nutrend". Fig. 6 shows the weight gained by the experimental animals when fed over a period of 28 days. The Protein Efficiency Ratio (PER) and Food Efficiency Ratio (FER) are shown in Table 4. Also, the tissue nitrogen of livers and kidneys of the four groups are shown in Table 5. The distribution pattern of amino - acids as reflected by the tissue nitrogen in basal,

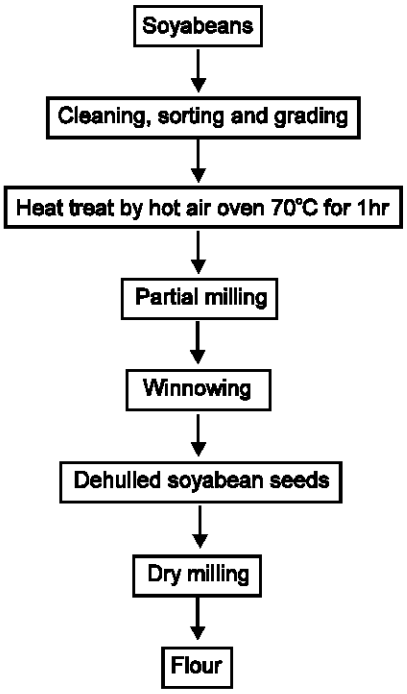

Fig. 2: Flowchart showing soyabean flour preparation

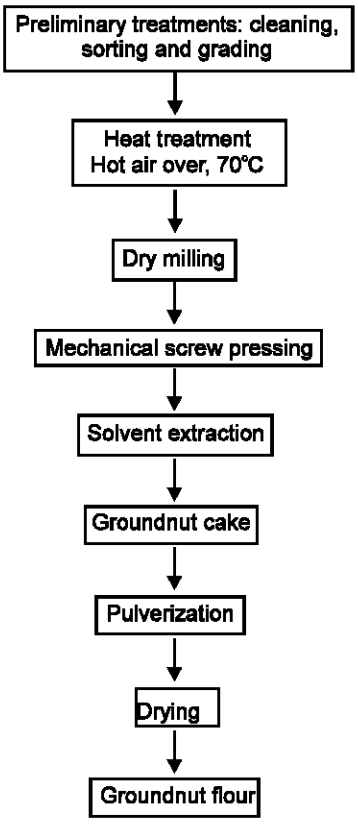

Fig. 3: Flowchart showing groundnut flour preparation

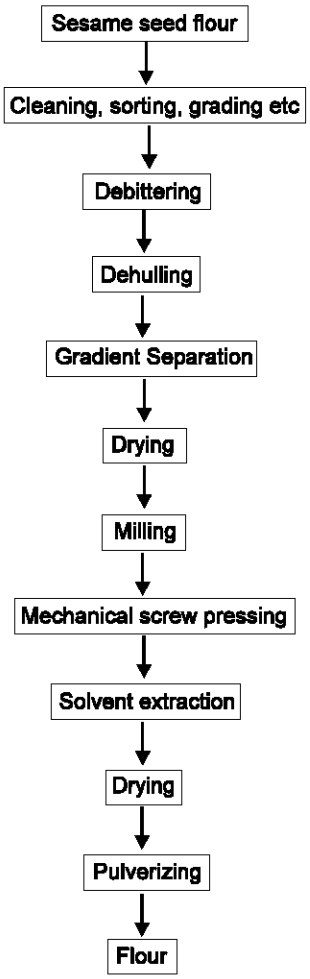

Fig. 4: Flowchart showing sesame seed flour preparation

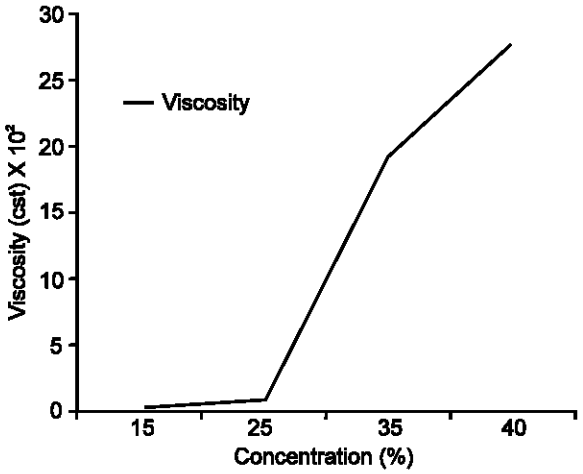

Fig. 5: Graph showing the relationship between viscosity and concentration of formulated diet

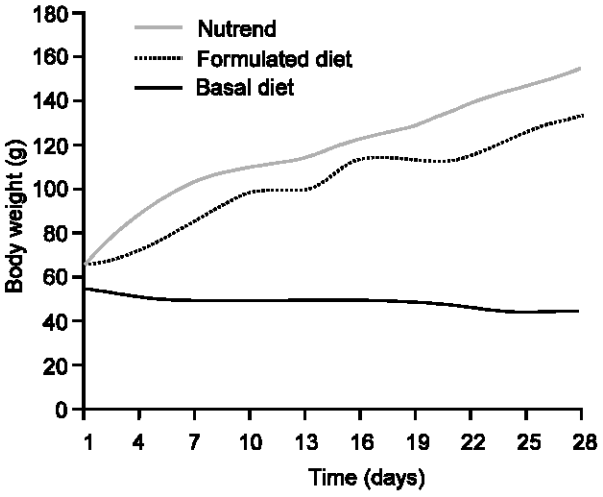

Fig. 6: Graph showing rate of changes in the weight of albino rats

formulated diet and control groups is similar, with the kidney having higher tissue nitrogen than the liver. Nephron cells may require more nitrogen in their development. However, the pattern shown by the group fed with "Nutrend" differs. The tissue nitrogen in the kidney almost doubles that of the liver.

Conclusion: Attempts were made in this study to design and evaluate weaning food that can alleviate PEM in infants of six months and above. The nutritional assessment of the formulated diet in terms of PER, FER, Tissue nitrogen and proximate analysis showed improvement over what is obtained commercially. It also possessed good physico - chemical qualities.

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