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An Evaluation of Two Multimixes as Weaning Foods in Nigerian Children

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Summary

Olusanya JO, Ketiku AO, Omotade OO. An Evaluation of Two Multimixes as Weaning Foods in Nigerian Children. *Nigerian Journal of Paediatrics* **2000; 27: 33.** Two locally prepared multimixes [one containing rice, beans and carrots (RBC) and the other containing rice, fish and carrots (RFC)] were evaluated in the feeding of young children in a small village. The first multimix (RBC) was fed to five children and the second (RFC) to four children, aged between nine and 13 months, for a period of six weeks. Weights and lengths were monitored weekly over the period, while the haemoglobin and haematocrit values were determined at the beginning and at the end of the study. Both multimixes produced a significant increase in weight, RBC producing a weight gain of 1.96 ± 0.55kg ($t = 7.897$, $p = 0.001$) and RFC 1.90 ± 0.52 kg ($t = 7.359$, $p = 0.005$). The growth velocity of all the children increased during the trial and their standardised weights crossed percentile lines by 15 to 26 percentiles. There were however, no significant increases in length, and haemoglobin levels. The two multimixes met the protein, energy and vitamin requirements of the infants but were short in their daily iron requirements. The results indicate that both multimixes were adequate in feeding young children and in improving their weight gain. It is however, recommended that such locally prepared multimixes be further evaluated in larger numbers of infants, before their widespread adoption.

Key words: Infant feeding, multimix, weight gain, anthropometry

Introduction

CHILDREN in developing countries of sub-Saharan Africa, including Nigeria, have a high incidence of low birth weight.[1] This disadvantaged position is often worsened by continuing relative poor nutrition associated with breastfeeding that is not exclusive. Those who introduce cow-milk substitutes and low energy cereal gruels within a few weeks of birth, often fail to use the right proportions of milk powder in order to maximize the period of use.[2] Furthermore, some children are totally weaned on to cereal gruels that are often highly deficient in nutrients. The net result of such a scenario as described above is malnutrition which is highly prevalent in many parts of Nigeria.[3] In order to prevent such malnutrition in infants, the use of home prepared weaning foods has been emphasized by health workers.[4-7]

Although programmes such as the Integrated Management of Childhood Illnesses (IMCI) and Baby Friendly Hospital Initiative (BFHI) targeted at promoting exclusive breastfeeding in the first six months of life exist, there are gaps in the execution of these programmes particularly the way they are coordinated. For example, the vigour with which the campaign for exclusive breastfeeding is executed does not find an equally vigorous continuation in the way children are weaned and the directions for children's feeding after the period of exclusive breastfeeding. The highly successful campaign against marketing of breast milk substitutes shifted the attention of producers from baby milk substitutes to production and marketing of complementary (weaning) mixtures in the belief that in so do-

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ing, they are not breaking any marketing code restriction. However, the same problems associated with the use of breast milk substitutes are still applicable to the use of these mixtures. Towards solving these problems, Olusanya[8] formulated, prepared and chemically evaluated thirty home-prepared multimixes for use as weaning food in Nigeria. In order to evaluate the usefulness and acceptability of the multimixes, two of them as prepared by one of us,[8] were evaluated in a study carried out in a village in Osun State.

Materials and Methods

The feeding experiment was carried out in Osegere village, about 24 kilometres from Ibadan, where the department of Human Nutrition, University of Ibadan, runs a nutrition and health clinic. The subjects consisted of nine children whose nursing mothers agreed to take part in the study. The children whose ages ranged from nine months to 13 months, were medically examined and certified to be well for the purpose of the study. They were divided into two groups and assigned to two multimixes. Since the diets were designed to complement breast milk, the babies continued breastfeeding and their normal feeding habits during the study. Anthropometric measurements were carried out weekly Lengths were measured supine with an infantometer (Harpenden Infantometer) while the weights were determined with an infant weighing scale (WeighMaster) as described by Owen.[9] The packed cell volume (PCV) and the haemoglobin concentrations were also determined at the beginning and at

Table I

Chemical Composition and Protein Quality of RBC and RFC

	RBC	RFC	p
Moisture (%)	64 ± 1.3	62.1± 1.6	0.71
Protein (%)	12.8 ± 0.6	13.9 ± 2.1	0.24
Energy (Kcal/100g)	287.01 ± 1.7	308.2 ± 2.3	0.0003
Minerals (mg/kg)			
Calcium (Ca)	38.4 ± 2.6	15.7± 2.1	0.0003
Iron (Fe)	2.0 ± 0.3	1.9 ± 0.5	0.07
Vitamins (mg/100g)			
Niacin	10.0 ± 1.1	13.9 ± 2.6	0.001
Thiamine	8.8 ± 0.3	0.7 ± 0.2	0.0001
Riboflavin	1.0 ± 0.2	0.8 ± 0.4	0.5
Protein Energy Ratio	2.2	2.4	0.2
Net Protein Ratio	3.1 ± 0.3	3.6 ± 0.5	0.1
Net Protein Utilisation	66.2 ± 2.6	70.1 ± 3 9	0.006

Source: Olusanya JO.[10]

Table II

Average Weekly Food Consumption (gram/day) on wet weight basis

Diet	Subjects	Age (mo)	Week 1	2	3	4	5	6	Average Daily Food (gm) Consumption
	M.O	9	117.5 ± 14.6	122.6 ± 20.1	132.1 ± 18.3	147.1 ± 14.3	161.7 ± 20.3	186.1 ± 18.7	144.5 ± 26.0
	T.S	10	118.4 ± 16.4	131.2 ± 14.8	150.4 ± 18.4	163.7 ± 16.4	184.8 ± 15.7	201.4 ± 21.3	158.3 ± 26.0
RBC	R.A	11	120.1 ± 15.6	130.4 ± 18.4	153.1 ± 17.5	169.4 ± 18.7	187.2 ± 21.6	216.8 ± 22.8	162.8 ± 36.1
	I.A	12	140.7 ± 20.1	148.6 ± 17.6	174.7 ± 18.9	196.3 ± 14.5	215.0 ± 21.1	226.4 ± 22.5	183.7 ± 35.1
	S.D	13	135.4 ± 18.3	139.5 ± 15.8	168.9 ± 17.7	190.6 ± 15.5	209.3 ± 19.8	215.7 ± 20.6	176.6 ± 30.3
	B.S	9	118.8 ± 16.3	131.7 ± 18.7	150.3 ± 14.7	168.4 ± 17.4	187.4 ± 15.6	206.4 ± 20.1	160.0 ± 20.0
RFC	S.L	11	138.7 ± 12.8	149.6 ± 16.5	163.4 ± 18.2	181.8 ± 21.4	195.6 ± 20.6	212.8 ± 22.3	173.7 ± 28.2
	AL.	12	128.1 ± 16.7	140.1 ± 18.2	162.0 ± 15.7	187.7 ± 16.1	195.4 ± 20.1	213.6 ± 32.4	171.2 ± 33.3
	L.R	13	141.2 ± 13.6	163.5 ± 19.2	170.0 ± 16.6	170.0 ± 16.6	197.6 ± 22.6	218.4 ± 22.6	180.0 ± 27.4

Table III

Daily Nutrient Contribution of Multimixes

Diets	*Subjects*	*Protein (g)*	*Energy (Kcal.)*	*Calcium (mg)*	*Iron (mg)*	*Niacin (mg)*	*Thiamine (mg)*	*Riboflavin (mg)*
	M.O	26.9	644.4	86.2	4.5	22.5	1.8	2.2
	T.S	31.5	705.5	94.4	4.9	24.9	2.0	2.5
RBC	R.A	32.2	725.5	97.1	5.1	25.3	2.0	2.5
	I.A	36.5	818.7	109.5	5.7	28.5	2.3	2.9
	S.D	36.2	812.4	108.7	5.7	25.3	2.3	2.8
	B.S	35.8	796.1	40.5	4.8	35.8	1.8	2.1
RFC	S.L	38.9	858.6	43.9	5.3	38.9	2.0	2.2
	A.L	38.2	849.7	43.3	5.2	38.3	1.9	2.2
	I.R	40.2	893.3	45.5	5.2	40.3	2.0	2.3

the end of the study.

The mixtures were prepared from locally available foodstuffs namely, rice, fish beans (Vigna unguiculata) and carrot. Each multimix was prepared from three foodstuffs in the following proportions: a 64.5 percent starchy staple (rice), 32 percent protein source [boneless fish in form of frozen mackerel (RFC), or dehulled beans(RBC)] and 3.2 percent vegetable (in the form of carrot). The three foodstuffs without added salt or condiment, were mixed and made into a paste, using a Kenwood blender. The puree was then cooked until it became very soft. Cooking was carried out with the excess water that was used in blending the mixture, to obtain a homogeneous paste. The assessment of the nutrient contents of these multimixes has been published earlier.[10, 11]

Food preparation and feeding were carried out under hygienic conditions in the clinic. The (wet) weight of the food consumed at each meal was measured on a daily basis throughout the six-week duration of the study. Based on suggestions by the parents and the clinic staff, the children were brought to the clinic and fed twice daily between 8.00 – 9.00 a.m. and 1.00 – 2.00 p.m. The home visits also provided the opportunity of measuring the babies over the week-end and to determine if there were untoward reactions such as diarrhoea, to the food, and to institute immediate assessment and management should the need arise..

In order to determine the effects of the diets on the babies, the initial and final anthropometric and haematological profiles were compared statistically.

Results

Composition of the multimixes

The chemical and mineral compositions, as well as the protein and vitamin contents of the two multimixes are presented in Table I. Although the moisture, protein, iron, riboflavin and niacin contents of the two multimixes were similar, RFC had significantly (p = 0.0003) more energy than the RBC while the calcium content of the RBC was more than twice that of the RFC (38.4 and 15.7 mg/100mg, respectively). The thiamine content of RFC was less than ten percent of that of RBC.

The average weekly and total food consumption throughout the study period is presented in Table II. The weekly food consumption increased from week one to week six for all the subjects. No significant differences were observed in the average daily and weekly intakes among the subjects fed RBC (p>0.05). Similarly, the differences in the weekly intakes among those fed RFC were also not significant (p>0.05). The daily nutrient contribution of the multimixes to the children's diet is presented in Table III. The daily nutrient intakes were compared with the recommended daily allowances as recommended by Cameron and Hofvander.[5] Both diets provided more than 100 percent of the protein requirements of the children. RBC provided between 65.8 percent and 81.2 percent and RFC provided between 85 percent and 89.3 percent of the daily energy requirements, respectively. Both diets provided more than the daily requirements of niacin, thiamine,

Table IV

Effects of Diets on Anthropometric Parameters

Diets	*Subjects*	*Age (mo)*	*Body Weight (kg)*		*Length (cm)*		*Relative Body Wt (%) to W/A WHO Standard*		*Mean initial Wt.*	*Mean Final Wt.*	*t.*	*p*
			Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*				
	M.O	9	4.3	5.7	60.0	61.0	48.3	64.0				
	T.S	10	6.3	7.7	73.0	73.0	68.5	83.6	5.54	7.50	7.8971	0.0014
RBC	R.A	11	6.1	8.1	69.0	69.1	63.5	83.3	(0.81)	(1.03)		
	I.A	12	5.8	8.2	67.3	67.5		59.2	83.6			
	S.D	13	5.2	7.8	65.5	65..6	51.5	77.2				
	B.S	9	5.0	7.1	68.0	68.0	56.2	79.8				
RFC	S.L.	11	6.8	8.1	72.5	72.6	70.8	84.8	6.2	8.1	7.3587	0.0052
	/A.L	12	7.7	8.4	73.0	73.0	68.4	85.7	(0.83)	(0.73)		
	I.R	13	6.3	8.8	73.0	73.0	62.4	87.1				

Checking for differences between initial and final weights

Initial RBC = 5.54, Initial RFC = 6.2 ($t = -1.2005, p = 0.2720$)

Final RBC = 7.5, Final RFC = 8.1 ($t = -1.0205, p = 0.3397$)

Table V

Effects of Diets on Haemoglobin Concentration and Packed Cell Volume

Diets	*Subjects*	*Haemoglobin Final Initial*	*Final*	*Packed Cell Volume (PCV %) Initial*	*Final*
	M.O	9.6 ± 0.7	9.8 ± 0.7	30.3 ± 1.2	30.3 ± 1.2
	T.S	8.3 ± 0.3	8.4 ± 0.4	29.3 ± 1.5	30.3 ± 1.2
RBC	R.A	6.6 ± 0.9	7.1 ± 0.2	28.7 ± 2.1	30.1 ± 1.0
	I.A	6.2 ± 0.3	6.4 ± 0.2	29.3 ± 1.2	29.3 ± 0.6
	S.D	6.4 ± 0.6	6.7 ± 0.3	28.3 ± 1.5	29.6 ± 1.6
	B.S	5.8 ± 0.3	5.9 ± 0.5	29.0 ± 2.0	30.3v 0.7
RFC	S.L	6.0 ± 0.6	6.2 ± 0.2	27.7 ± 0.7	30.0 ± 1.0
	A.L	7.7 ± 0.1	7.7 ± 0.3	30.6 ± 1.5	30.7v 1.2
	L.R	6.0 ± 0.6	6.1 ± 0.2	30.3 ± 0.6	30.7v 0.7

Results not significantly different

and riboflavin while neither diet met the acceptable daily requirements for calcium (8.1 percent – 21.9 percent); they also provided about 60 percent of the daily requirement for iron.

The growth promoting effect of both diets is presented in Table IV. The changes in the individual's weight and height during the study period are also shown in the table. Before the commencement of the feeding, all the babies had varying degrees of malnutrition. With respect to subjects fed RBC, their initial (pre-feeding) percentage of body weight for age (W/A) compared to the WHO standards varied from 48.3 percent to 68.5 percent, while for subjects fed RFC, it varied from 56.2 percent to 70.8 percent. There were no significant differences in the starting and final mean weights between the children in both groups ($t = -1.2005$; $p = 0.2720$, $t = -1.0205$; $p = 0.3397$, respectively). However, generally higher weight increases were observed in subjects fed RFC than those fed RBC. Thus, at the end of the feeding period, the relative body weight to the WHO standards for the subjects increased to between 64 percent and 83.6 percent for the subjects fed RBC. Corresponding figures for subjects fed RFC were 79.8 percent and 87.1 percent (Table IV). Thus, both diets produced significantly increased mean weights at the end of the feeding (RBC, $t = 7.8971$; $p = 0.0014$, RFC, $t = 7.3587$; $p = 0.0052$) (Table IV).

The effects of the diets on the haemoglobin and packed cell volume (PCV) of the subjects are presented in Table V. No significant changes were noted in both parameters before and after feeding on both diets.

There were no reports of gastrointestinal disturbances or changes in the consistency of the stools during the study period.

Discussion

We have experimented with two multimixes out of the very many possible preparations that could be used for feeding children. Carrot featured prominently in the two preparations because the study was carried out during the 'carrot season'. Ordinarily, carrot does not form part of the daily diet of the people of Osegere where the study was carried out. However, the vegetable was chosen in a deliberate attempt at encouraging the mothers to include carrot in the children's diet. There are other sources of vitamin A rich food such as red palm oil and green leafy vegetables like spinach in the community that may be used as alternatives to carrot by those who prefer them.

The higher energy contribution by RFC in this study may be due to the fat supplied by the mackerel fish, an animal protein that is richer in essential amino acids than the plant protein contained in RBC. Furthermore, the RFC multimix contained mackerel oil that may have an energy sparing effect on the protein, consequently leading to a higher weight gain. In fact, the protein efficiency ratio (PER), net protein ratio (NPR), and the net protein utilization (NPU) values for RFC are higher than for the RBC confirming the former to be of a higher protein quality than the latter. Cost considerations may not be a problem with respect to the mackerel fish as this is about the commonest and cheapest source of animal protein found even in the remotest of villages in this country. Ordinarily, mothers in this part of the country use gruels made from cereals usually alone or in combination with milk, to wean their children. The energy density of such preparations is about a tenth of what the children require for daily growth.[10] For the children to consume enough to provide the daily recommended allowance for nutrients, they may have to consume about 10 litres of such preparations daily. Addition of mackerel fish and its oil to these preparations would increase their energy density. When such a preparation is fed in combination with continuing breast milk and for longer periods (two years as recommended), such diets are likely to prevent protein-energy malnutrition.

It was demonstrated that the children grew while taking the multimixes and breast milk, and from the regular home visits conducted during the feeding period, none of the mothers reported any adverse changes in the consistency of the stools of the infants. Furthermore, no incidence of gastrointestinal disturbances were reported. The diets could therefore, be said to be well tolerated by the babies.

The small sample size of the babies involved in the present feeding experiment may limit the applicability but does not detract from the usefulness of the study in sensitizing others to carry out larger studies to either confirm, modify or refute the claims made in respect of the present study.

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