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Nutrient Composition of Multimixes for Use as Weaning Foods in Nigeria

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ABSTRACT

Eight different multimixes prepared from rice, meat and carrot (RMC); maize, meat and carrot (MMC); banana, meat and amaranth (BMA); maize, fish and tomato (MFT); rice, beans and carrots (RBC); maize, beans and amaranth (MBA); banana, beans and amaranth (BBA) and potato, beans and tomato (PBT) were analysed for their nutrient content. The protein content (N × 6·25) ranged from 10·6 g/100 g in PBT to 13·4 g/100 g in MFT. The values for carbohydrates ranged from 72·8 g/100 g in MFT to 82·1 g/100 g in RBC. All the food mixtures were low in fat content, ranging from 0·6 g/100 g in MMC to 4·6 g/100 g in MFT. The gross energy values of the multimixes ranged from 209 kcal/100 g in PBT to 291 kcal/100 g in MMC. Calcium content ranged from 9·2 mg/100 g in RMC to 48·5 mg/100 g in MBA. The multimixes were found to be low in iron (1·2 mg/100 g in PBT to 3·6 mg/100 g in RMC). Values for phosphorus ranged from 50·7 mg/100 g in BMA to 300·7 mg/100 g in MBA. All the food mixtures contained negligible amounts of ascorbic acid and riboflavin but nutritionally appreciable amounts of thiamin and niacin. The multimixes were found to be adequate in most of the essential amino acids required by infants.

INTRODUCTION

It is commonly accepted that breast milk is the best food for human infants and that it should be their sole food up to 4–6 months of age (Jelliffe & Jelliffe, 1971), if produced in sufficient quantity. However, it ceases to meet their nutritional requirements after this age. Hence, there is a need to supplement the breast milk or replace it with more nutritious foods.

A common traditional food supplement to breast milk, or its sole replacer, in Nigeria, is corn 'ogi', especially among the low-income groups. This 'ogi' by itself, does not support growth in laboratory animals (Akinrele, 1966). Attempts to improve the nutritional quality of the Nigerian corn 'ogi' have yielded good results. Soy 'ogi', a blend of corn and soybean, developed and processed by the Federal Institute of Industrial Research, Oshodi, Nigeria, was observed to be comparable, nutritionally, with other available commercial weaning foods (Akinrele & Edwards, 1971).

However, this product is not readily available; it is costly and, consequently, has not successfully reached the poorer mothers who need it most. There is, therefore, a need to develop multimixes that can be easily prepared at home.

This paper reports the formulation of eight such mixtures and their nutrient compositions. Data are also presented on their essential amino acids profile.

MATERIALS AND METHODS

The food mixtures were prepared from the following foodstuffs: rice, maize, potato, banana, fish (frozen mackerel), white beans, lean meat, pawpaw, carrot, tomatoes and amaranth. The starchy staples are necessary to supply energy and nutrients, the animal-derived foods and legumes to provide protein and the fruits and vegetables to supply minerals and vitamins.

Preparation of the multimixes

The three foodstuffs constituting a multimix were cooked in an aluminium pot over a gas fire. Where the mixture contained maize, the maize was first well cooked alone before the remaining two foodstuffs were added and the mixture cooked together until it became very soft. No salt or any condiment was added. Cooking was carried out in the presence of excess water which was used in blending the food mixture to obtain a homogeneous purée. Dehulled bean (Cowpea, *Vigna unguiculata*) and boneless fish were used. Tomatoes, carrots and amaranth were usually added when the other components, in their respective mixtures, were almost cooked. In effect, they were cooked to soften the tissues without loss of nutrients. Sweet banana and ripe and peeled pawpaw were not cooked and were added to their respective mixtures before blending. The purée was obtained by blending each multimix in a Kenwood blender.

Chemical analysis

Portions were taken for the estimation of moisture content and the remainder dried at 60°C, milled and used for subsequent chemical analysis. Vitamin C was determined on the fresh material.

The protein, ash, fat, carbohydrate and crude fibre were determined using the methods of the Association of Official Analytical Chemists (AOAC, 1975).

Riboflavin was determined by the method of Hodson & Norris (1939), niacin by the method of Melnick & Field (1940), vitamin C by the 2, 6-dichlorophenol indophenol dye method (AOVC, 1966) and thiamin by the thiochrome method (AOVC, 1966).

Calcium and iron were estimated using an atomic absorption spectrophotometer after wet oxidation of the sample; phosphorus was determined using the vanado-molybdate colorimetric method of Kitson & Mellon (1944).

Energy content was determined using a ballistic bomb calorimeter (Miller & Payne, 1959) and a benzoic acid standard.

RESULTS AND DISCUSSION

The mixtures are shown in Table 1. The chemical composition is presented in Table 2A. The moisture content of the multimixes ranged from 64·4 g/100 g in RBC to 83·9 g/100 g in MFT. The moisture contents were comparable with those of current traditional weaning foods such as maize and millet paps, 77·9 and 84·8 g/100 g, respectively (Eka, 1978). The

TABLE 1
Food Components of the Multimixes

Multimix	*Starchy staple* (%)		*Protein source* (%)		*Vegetable* (%)	
RMC	Rice	64·5	Meat	32·3	Carrot	3·2
MMC	Maize	64·5	Meat	32·3	Carrot	3·2
BMA	Banana	82·0	Meat	16·4	Amaranth	1·6
MFT	Maize	64·5	Fish	32·3	Tomato	3·2
RBC	Rice	64·5	Beans	32·3	Carrot	3·2
MBA	Maize	64·5	Beans	32·3	Amaranth	3·2
BBA	Banana	64·5	Beans	32·3	Amaranth	3·2
PBT	Potato	87·9	Beans	11·0	Tomato	1·1

moisture content will vary with the desired consistency of the mixture. The protein content (N × 6·25) ranged from 10·6 g/100 g in PBT to 13·4 g/100 g in MFT. These protein values were higher than those published for millet and maize paps, millet, guinea corn and maize porridges (Eka, 1978) but comparable with that of Cerelac, 10·5 g/100 g (Table 2B), a commercial infant food, and the infant foods developed by Dutra De Oliveira *et al* (1967) in Brazil and Dutra De Oliveira & Carneiro (1970) with protein contents of 12·5 % and 14·2 %, respectively, but lower than that reported for soy 'ogi', 20·3 g/100 g (Akinrele & Edwards, 1971).

The carbohydrate fraction (carbohydrate by difference) ranged from 72·8 g/100 g in MFT to 82·1 g/100 g in RBC and was similar to values reported for millet pap supplemented with soya bean flour and Cerelac (Table 2B). The fat content ranged from 0·6 g/100 g in MMC and BBA to 4·6 g/100 g in MFT. The crude fibre figures for the multimixes ranged from 0·8 g/100 g in RBC and MBA to 2·8 g/100 g in BMA. Dutra De Oliveira *et al.* (1967) reported a crude fibre content of 0·6 % in infant food they prepared while Ekpenyong (1979) also reported a value of 1·1 % for Belona, another processed weaning food. The low fibre content may be an advantage in an infant food.

The gross energy values of the multimixes are shown in Table 2A. They varied from 209 kcal/100 g in PBT to 291 kcal/100 g in MMC. These figures are lower than that reported for soy 'ogi', 400 kcal/100 g (Akinrele & Edwards, 1971), due to the low fat content. However, the energy values of the mixtures were higher than that reported for corn 'ogi' (maize pap), 29 kcal/100 g (Naismith, 1973), a common traditional weaning food in

TABLE 2A
Chemical Composition of the Multimixes (g/100 g) on a Dry Matter Basis

Multimix	*Moisture*	*Protein* ($N \times 6{\cdot}25$)	*Ash*	*Fat*	*Crude fibre*	*Carbohydrate*	*Gross energy* (*kcal/100 g*)	*Protein energy* (%)
RMC	78·5 ± 1·6	12·7 ± 1·3	1·2 ± 0·1	0·8 ± 0·2	1·0 ± 0·3	80·2 ± 0·3	263·3 ± 3·6	19·3
MMC	77·8 ± 0·6	13·3 ± 0·7	2·9 ± 0·1	0·6 ± 0·1	1·2 ± 0·2	76·9 ± 1·0	291·1 ± 4·4	18·3
BMA	77·3 ± 1·3	12·4 ± 0·4	3·5 ± 0·2	3·2 ± 0·4	2·8 ± 0·3	74·1 ± 0·7	249·0 ± 2·4	19·9
MFT	83·9 ± 1·1	13·4 ± 0·3	3·2 ± 0·3	4·6 ± 0·2	1·4 ± 0·5	72·8 ± 0·7	287·5 ± 2·6	18·6
RBC	64·4 ± 1·3	12·8 ± 0·6	1·7 ± 0·2	0·9 ± 0·2	0·8 ± 0·3	82·1 ± 1·5	287·0 ± 1·7	14·6
MBA	73·1 ± 1·2	12·4 ± 0·3	3·6 ± 0·3	1·9 ± 0·1	0·8 ± 0·3	75·8 ± 1·6	279·3 ± 1·4	17·8
BBA	64·6 ± 1·3	10·8 ± 0·2	4·1 ± 0·1	0·6 ± 0·1	1·2 ± 0·2	77·8 ± 0·9	228·5 ± 6·1	18·0
PBT	68·3 ± 1·2	10·6 ± 0·3	4·5 ± 0·2	1·2 ± 0·1	1·0 ± 0·2	77·8 ± 1·3	209·2 ± 1·9	19·7

TABLE 2B
Chemical Composition of Some Nigerian Traditional Weaning Foods (g/100 g on a Dry Matter Basis)[a]

	Moisture content	*Crude protein*	*Ash*	*Fat*	*Nitrogen-free extract*
Guinea corn pap	78·3	4·2	0·4	3·4	91·8
Maize pap	77·9	5·5	0·2	3·6	90·6
Millet pap	84·8	6·9	0·5	4·2	88·4
Millet pap supplemented with soya-flour	72·4	15·8	1·1	5·2	78·7
Cerelac[b]	71·0	10·5	2·0	4·7	81·6
Guinea pap porridge	86·5	5·1	0·9	3·1	90·8
Maize porridge	85·7	7·2	1·5	4·1	87·2
Millet porridge	86·3	8·0	1·1	3·4	87·4

[a] Adapted from Eka (1978).
[b] A commercially produced baby food.

Nigeria. Vegetable oil could be added to the multimixes to increase the energy density. Also shown in Table 2A are the protein energy per cent (PE%) values of the multimixes. A PE % of 12·0 to 15·0% is recommended for infant foods (Goan-Hong *et al.*, 1976). All the multimixes met this criterion.

Table 3 shows the mineral composition. Calcium values ranged from 9·2 mg/100 g in RMC to 48·5 mg/100 g in MBA, while iron ranged from 1·2 mg/100 g in PBT to 3·6 mg/100 g in RMC. These multimixes are

TABLE 3
Mineral Composition of the Food Mixtures (mg/100g)

Multimix	*Calcium*	*Phosphorus*	*Iron*
RMC	9·2	126	3·6
MMC	10·6	173	3·5
BMA	12·1	50·7	2·3
MFT	23·8	190	2·6
RBC	38·4	249	2·0
MBA	48·5	301	3·4
BBA	45·6	190	2·0
PBT	21·2	98·7	1·2

considered to be fair sources of calcium and phosphorus but poor sources of iron. They can, however, supplement breast milk minerals. The phosphorus content of the multimixes was fairly high, being 50·7 mg/100 g in BMA and 301 mg/100 g in MBA.

The levels of vitamins in the multimixes are shown in Table 4. None contained significant amounts of ascorbic acid. The values ranged from 0·1 mg/100 g in RMC to 6·8 mg/100 g in mixture PBT. The low vitamin C content may be due to the original drying, washing and cooking to which they were subjected during the preparation of the multimixes. The niacin,

TABLE 4
Vitamin Composition of the Food Mixtures

Multimix	*Ascorbic acid*	*mg vitamin/1000 kcal energy*		
		Niacin	*Thiamin*	*Riboflavin*
RMC	0·1 ± 0·04	15·7 ± 0·27	0·2 ± 0·15	0·2 ± 0·08
MMC	0·2 ± 0·02	6·3 ± 0·83	0·2 ± 0·14	0·1 ± 0·03
BMA	1·6 ± 0·07	2·3 ± 0·08	0·1 ± 0·04	0·2 ± 0·04
MFT	1·3 ± 0·17	12·3 ± 0·66	0·5 ± 0·03	0·2 ± 0·03
RBC	0·2 ± 0·01	10·0 ± 1·04	0·8 ± 0·07	0·1 ± 0·03
MBA	1·6 ± 0·27	6·0 ± 0·61	1·0 ± 0·14	0·2 ± 0·04
BBA	1·5 ± 0·15	2·7 ± 0·09	0·6 ± 0·09	0·2 ± 0·04
PBT	6·8 ± 0·17	4·6 ± 0·29	0·6 ± 0·05	0·2 ± 0·04

thiamin and riboflavin values are expressed in relation to the energy value of the food mixtures. Niacin concentration ranged from 2·3 mg/1000 kcal energy in BMA to 12·3 mg/1000 kcal energy in MFT. Thiamin figures ranged from 0·1 mg/1000 kcal in BMA to 1·0 mg/1000 kcal in MBA, while riboflavin content ranged from 0·1 mg/1000 kcal in MMC to 0·24 mg/1000 kcal in BMA, MFT and PBT. The requirements of thiamin, riboflavin and niacin are 0·4 mg/1000 kcal, 0·55 mg/1000 kcal and 6·6 mg/1000 kcal, respectively (FAO/WHO, 1967). Multimixes PBT, BMA and BBA are deficient in niacin while RMC and MFT are rich sources of niacin. Only three multimixes, RMC, MMC and BMA, are adequate in thiamin. All the mixes are deficient in riboflavin.

The calculated essential amino acids composition of the multimixes was compared with the provisional amino acids scoring pattern

TABLE 5
Amino Acids Scores of the Multimixes

Multimix	*Isoleucine*	*Leucine*	*Lysine*	*Valine*	*Tryptophan*	*Threonine*	*Total S amino acids (Met. + Cyc.)*	*Histidine*	*Total aromatic amino acids (Phen. + Tyr.)*
RMC	77·3	104	123	129	102	105	143	226	99·5
MMC	140	148	122	118	72·0	104	150	234	150
BMA	98·4	70·1	116	81·1	88·8	76·8	95·4	197	96·8
MFT	134	140	146	75·7	323	47·7	113	479	112
RBC	143	113	95·1	138	83·6	109	157	232	157
MBA	159	164	141	153	75·4	24·0	183	277	183
BBA	105	79·5	117	89·5	80·5	81·3	66·3	203	111
PBT	106	81·2	116	89·0	116	81·8	60·1	155	109

(FAO/WHO, 1973) in order to establish the limiting amino acids (Table 5). All the multimixes contained adequate amounts of methionine and histidine: only RBC was slightly deficient in lysine. Several mixtures were found to be limiting in threonine and tryptophan. Multimix MMC was adequate in the essential amino acids, except tryptophan, while RBC was deficient in isoleucine.

Some (RBC, RMC and MBA) of the multimixes which have been found to possess good nutritional qualities are being investigated further, both biologically and clinically.

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