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COMPARATIVE EVALUATION OF ENERGY, AMINO ACIDS AND MINERALS AVAILABILITY OF MAIZE BASED AND MAIZE-ACHA-BASED COMPLEMENTARY INFANT WEANING FOODS

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ABSTRACT

The higher prices of fortified nutritious proprietary complementary foods are beyond the purchasing power of the less privilege who forms the bulk the population in most developing countries. Therefore, it becomes necessary to source for alternative. The objective of this paper was to determine comparative evaluation of energy, amino acids and minerals availability of maize-based and maize-acha-based complementary infant weaning foods. Tow foods designated as T1 and T2 were formulated by replacing the content of maize by 0% and 50%. The results showed that T1 had higher proportion of energy due to carbohydrate than T2 while T2 had higher proportion of energy due to protein, proportion of energy due to fat and utilizable energy due to protein than T1. Majority of amino acids were higher in T2 than in T1 and in most cases they were higher than the recommended daily allowances while only serine was higher in T1 than T2. All the minerals studied were higher T2 than T1 except iron and the values of calcium, phosphorus, potassium, sodium, iron, zinc and copper were higher in both treatments than in RDA while magnesium and manganese were lower in both treatments than RDA. It can be concluded that mixed ingredients foods contain higher nutrient profile and are recommended infants.

Keywords: Energy, amino acids, minerals, maize, acha, infant foods

INTRODUCTION

Poverty and poor education are key factors militating against meeting the nutrient requirements of infants in most rural communities in developing countries. According to the report of NNN (2000), poor feeding and short fall of food in infant nutrition are the direct factors responsible for malnutrition and illness in most Nigeria families. Due to poverty most nursing mothers cannot afford high cost fortified nutritious proprietary complementary foods (Sudik *et al*., 2019) and due to illiteracy they may be unaware of the need to supplement locally cereal porridge usually made from maize, millet and sorghum with more nutrient dense ingredients to give better foods (Bruyeron *et al*. 201). In most cases they assumed whatever that are given support growth and health of the children. Even among the literates there is the assumption that every formulated food is right for children which may not be all that true. It has been documented that local complementary foods can be improved by mixing several cereals and legumes (Achidi *et al*. 2016). Maize has been the commonness energy source and others cereals that equally supply energy has not been given attention. On of such cereals is acha (fonio). Acha (*Digitaria exilis*) is also known as fundi, hungry rice. It is one of the older crops of Africa, but to date is also one of the underutilized cereals. It belongs to Poaceae family, sub-family of Panicoideae, tribe of Paniceae (NRC, 1996; Vietmeyer *et al*., 1996). It is mainly consumed as a whole grain, porridge and couscous (Jideani, 1999; 2012). This study therefore was designed to compare energy and protein availability of maize based and maize-acha-based complementary infant weaning foods.

MATERIALS AND METHODS

Proximate composition of the home-made infant weaning foods was determined in triplicate according to the method of the AOAC (2012). The gross energy of the samples was determined

against thermocouple grade benzoic acid a Gallenkamp Adiabatic bomb calorimeter (Model CBB-330-01041) United Kingdom. 0.5 gram of the sample was weighed into the bomb. The caloric values of the samples were estimated (in MJ/kg) by using the bomb calorimeter. The energy values as contributed by protein, fat and carbohydrate and the Utilizable Energy due to Protein (UEDP) were calculated as described by Adeyeye (2013) and Sudik (2016). The amino acid profile was determined following the procedures described by and the minerals were determined using AOAC (2012) procedures.

Calculations

Carbohydrate was determined by difference: = 100 - (%moisture, %ash, %fat and %protein)
Gross energy = (%protein x 4+%fat x 9 and %carbohydrate x 4)
Dry matter = 100- moisture
Organic matter = 100-moisture-ash
Proportion of energy due to protein [%] = %protein x 4 x 100/energy
Proportion of energy due to fat [%] = %fat x 9 x 100/energy
Proportion of energy due to carbohydrate [%] = %carbohydrate x 4 x 100/energy
Utilizable energy due to protein = %protein x 0.60

Infant weaning food preparation

Two infant weaning foods (designated as T1 and T2) were formulated by replacing maize with acha at 0% and 50% respectively (Table 1). These formulations were done following the specifications for 12 to 24 months old infant by Codex Alimentarius Standards (FAO/WHO 1994).
Standard deviation of each parameters was determined to ascertain the difference in mean.

Table: Gross composition of maize-based and maize-acha-based infant foods

Ingredients	T1	T2
Maize	72	36
Acha	0	36
Soybean meal	8.65	8.65
Soy oil	6	6
Powder milk	10	10
Dicalcium phosphate	3	3
Premix*	0.25	0.25
Salt	0.1	0.1
Total	**100**	**100**
Nutrients		
Moisture	2.13	2.11
Ash	1.58	2.33
Protein	14.44	15.36
Fat	27.35	27.30
Carbohydrate	54.50	52.90
Gross energy (kcal/kg)	521.91	518.74

Results

Table 1 shows the energy values of maize and maize-acha based infant weaning foods. The proportion of energy due to carbohydrate were higher in T1 and lower in T2 while proportion of energy due to protein, proportion of energy due to fat and utilizable energy due to protein were higher in T2 and lower in T1.
Table 2 shows Amino acid profiles (g/16 g N) of the home-made infant weaning foods and recommended daily allowance (RDA). All the amino acid studied were higher in T2 and lower in T1. Except serine that was higher in T1 and lower in T2. Comparison to RDA the arginine, histidine, leucine and phenylalanine values in both treatments were high the RDA; while isoleucine, lysine,

methionine, threonine and valine values in T2 were higher than in RDA and in T1 were lower than RDA.

Table 3 shows the minerals (mg/100g) of home-made infant weaning foods and recommended values (RV). All the minerals were higher in T2 than T1 except iron. The values of calcium, phosphorus, potassium, sodium, iron, zinc and copper were higher in both treatments than in RDA while magnesium and manganese were lower in both treatments than RDA.

Table 1: Comparative proximate and energy values of maize-based and maize-acha-based infant weaning foods

Parameters	T1	T2	±Standard deviation
Gross energy (kcal/kg)	521.91	518.74	2.24
Proportion of energy due to protein [%]	11.07	11.84	0.54
Proportion of energy due to fat [%]	47.16	47.36	0.14
Proportion of energy due to carbohydrate [%]	41.77	40.79	0.69
Utilizable energy due to protein	8.66	9.22	0.39

Values are mean ± standard deviation of 3 samples

Table 2: Amino acid profiles (g/16 g N) of maize-based and maize-acha-based infant weaning foods and recommended daily allowance (RDA)

Amino acids	T1	T2	±Standard deviation	*RDA
Alanine	3.31	3.39	0.06	-
Aspartic acid	4.75	4.98	0.16	-
Glutamic acid	11.94	12.93	0.70	-
Serine	2.50	2.66	0.11	-
Arginine	5.11	5.96	0.60	2.00
Cystine	0.90	1.04	0.10	-
Glycine	3.28	3.53	0.18	-
Proline	2.55	2.78	0.16	-
Tyrosine	2.38	3.44	0.75	-
Histidine	2.16	2.29	0.09	1.90
Isoleucine	2.27	3.14	0.62	2.80
Leucine	7.10	8.93	1.29	6.60
Lysine	5.50	6.08	0.41	5.80
Methionine	1.50	2.23	0.52	2.20
Phenylalanine	3.06	3.15	0.06	2.80
Threonine	3.21	3.64	0.30	3.40
Valine	3.38	4.22	0.59	3.50

- Source: FAO and WHO (2013)

Table 3: Minerals (mg/100g) of home-made infant weaning foods and recommended values (RV)

Nutrients	Maize-based	Acha-based	±Standard deviation	*RV
Calcium [Ca]	761.00	769.11	5.73	500.00
Phosphorus [P]	459.94	457.67	1.61	456.00
Potassium [K]	511.91	516.45	3.21	516.00
Sodium [Na]	300.01	322.44	15.86	296.00
Magnesium [Mg]	71.17	71.22	0.04	76.00
Iron [Fe]	21.12	21.66	0.38	16.00
Zinc [Zn]	6.17	6.11	0.04	3.20
Manganese [Mn]	28.12	30.16	1.44	32.00
Copper [Cu]	200.16	202.15	1.41	160.00

- Source: FAO (2013)

DISCUSSION

The higher proportion of energy due to protein, proportion of energy due to fat and utilizable energy due to protein were higher in the T2 than T1 depicts that energy is yielded in mix energy sources than a single energy source. This supports the report of Bruyeron *et al*. (2010) that supplementation of food better yields the nutrient requirements. The lower proportion of energy due to carbohydrate demonstrated that acha has lower carbohydrate than maize. This supports that report of Jideani (1999) and Balde *et al*. (2008) that the low carbohydrate content of acha has made it to be a complement in diabetes diets

The higher amino acids in the maize-acha-based food further demonstrates the complementary role of mixing ingredients. It was reported that acha contains higher protein which is evident by its food of choice to diabetic patients (Jideani, 1999) and it's usually prescribed to nursing mothers (Balde *et al*., 2008). Some others (Temple and Bassa, 1991) asserted that the methionine level in acha is twice that of egg protein.

CONCLUSION

It was observed in this study that maize-acha-based food supplied more proportion of energy due to protein, proportion of energy due to fat and utilizable energy due to protein were higher. Again, it had higher amino acid profile and essential minerals. Therefore, mixed ingredients foods are suggested for weaning infants.

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