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Full Length Research Article

QUALITY ASSESSMENT OF BABY FOOD PRODUCED FROM CEREALS ENRICHED WITH DATE PALM

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ABSTRACT

The objectives of the study were to formulate a composite blend (weaning food) based on locally available cereals and legumes, to chemically evaluate their nutrient values, and compare with those of a proprietary formula. The study is part of the effort to provide home-based complementary (weaning) foods that can be more cost-effective to the low-income families. Composite blends were formulated based on protein basis of the food commodities used: millet, guinea corn, yellow corn, soybean, groundnut and date palm. Standard procedures of the Association of Official Analytical Chemists were used to determine the proximate chemical composition. Atomic absorption spectrophotometer and ion chromatographic analyzer were used to determine the mineral elements composition. The overall results indicated that crude protein, lipid, fibre, ash, moisture, energy and carbohydrate contents of the composite blend were either comparable or higher than values in the proprietary formula. The researchers believe that complementary foods formulated from locally available food commodities have great potential in providing nutritious foods that are practical, food-based approaches, aimed at combating the problem of malnutrition among infants and children in Nigeria in particular, and developing countries in general.

Keywords: Composite blend, Cereals, Date palm, Atomic Absorption Spectrophotometer, Ion chromatographic analyzer.

INTRODUCTION

Scientifically, it has been proven that breast milk is the perfect food for the infant during the first six months of life. It contains all the nutrients and immunological factors an infant requires to maintain optimal health and growth (Amira *et al*., 2018). Furthermore, breast milk also protects infants against the two leading causes of infant mortality; upper respiratory infections and diarrhoea (Brown & Dewey, 1998; Bartick *et al*., 2017). However, at the age of six months and above when the child's birth weight is expected to have doubled, breast milk is no longer sufficient to meet the nutritional needs of the growing infant. Nutritious complementary foods are therefore introduced - also known as weaning foods - which typically covers the period from six to twenty-four months of age in most developing countries (Abbey & Nkanga, 1988). On the other hand, nowadays, due to the reduced consumption of breast milk, important nutrients such as proteins, zinc, iron and B-vitamins are likely to be deficient in the contemporary diet of most infants (Pelto *et al*., 2003.). If this development is not well handled during this crucial growth period, it can then lead to under-nutrition. Infant formula is needed to supplement the child's nutritional needs after 6 months of age.

As in most other developing countries, the high cost of fortified nutritious proprietary complementary foods is always, if not prohibitive, beyond the reach of most Nigerian families. Such families often depend on inadequately processed traditional foods consisting mainly of un-supplemented cereal porridges made from maize, sorghum and millet (Nnam, 2002). In view of this, appropriate processing and blending of locally available food commodities have been carried out and researched by Badamosi and VJ*,* (1995). Such blends have been found to improve nutrient density of the complementary food with improved nutrient intake, resulting in the prevention of malnutrition problems. This approach would require knowledge about the nutritive values of a variety of local food commodities indigenous to the affected communities. (Temple & Badamosi*,* 1996).

A number of cereals and legumes that are readily available in Nigeria have been found to have nutrient potentials that could complement one another if properly processed and blended (Abbey & Nkanga, 1988). Therefore, it is imperative that efforts to formulate composite blends and scientific studies carried out to ascertain the nutritive adequacy of these locally available blends (cereal and legumes) for possible use as complementary foods, especially by the rural and poor urban mothers during the weaning period. Local indigenous cereals and legumes are good sources of cheap, high-quality macro and micro-nutrients. The aim of this study therefore, is to assess the quality (suitability) of baby food (nutritional dry meal) by comparing its physiochemical constituent with that of the control.

MATERIALS AND METHODS

Sample collection

Samples of millet, guinea corn, yellow corn, soya beans, groundnut, date palm, crayfish and the Nestle Cerelac baby food were purchased from Sabongari market, Sabongari Local Government Area, Zaria, Kaduna State, Nigeria.

Sample Preparation

The cereals – guinea corn, millet, yellow maize - were separately washed with tap water and air-dried for 72 hours. The Soya beans were washed, air-dried and fried until the colour turned brown. The groundnut was also fried, and the back peeled off. The crayfish was sorted and cleaned. The date palm fruits were crushed to remove the seed, washed with clean tap water and air-dried for 72 hours. The fried groundnut and soya beans, dried millet, guinea corn, yellow corn, date palm and crayfish were milled into a smooth homogenous powder and stored in airtight containers until the time for analysis.

The Nestle Cerelac served as the control for assessing the nutrient levels of the composite blends against amounts of nutrients present in 65g (dry weight estimate of the daily intake of local weaning food of a 6-month old infant).

Proximate Analysis
Moisture content, crude fibre, carbohydrate content and ash were determined according to AOAC (1990); crude protein by the Kjeldahl method; fat content by solvent extraction and calcium and sodium were determined by flame photometry AOAC (1990).

Determination of Total Aflatoxin
From the sample, 5 g was weighed into the reagent bottle and 25 cm^3 of 70/30 (v/v) methanol-water extraction solvent was added. Extraction is always done in the ratio of 1:5 (w/w) of sample extraction solvent respectively. The sample was then vigorously shaken using an orbital shaker at 250 rpm for 3 mins. The sample was allowed to settle and then filtered using Whatman's filter paper and the filtrate collected into a test tube.
200 µl of the conjugate was drowned using a 200 µl pipette and dispensed into each of the mixing wells**,** 100 µl of standard (0, 1, 2, 4, 10 and 20 ppb) and the sample was pipetted using a 100 µl pipette and added to the mixing wells. Each well was mixed carefully by pipetting up and down 3 times and immediately 100 µl of contents was transferred from each dilution well into a corresponding antibody coated microwell**.**
It was then incubated at room temperature for 15 minutes**.** Each of the content of the microwell strips was emptied into waste container and washed by filling with distilled water and then dumping the water from the microwell strips. This was repeated 4 times and the microwell strips were dried by hitting it against an absorbent (tissue) paper. 100 µl of the substrate was pipetted using a 100 µl pipette into each microwell strip and incubated at room temperature for 5 minutes after which a blue color developed**,** 100 µl of stop solution was measured using a 100 µl pipette and dispensed into each micro well strip. On adding the stop solution, the colour changed from blue to yellow, the microwell strips were then read using ELISA machine.

Vitamin Determination

Standard Sample Preparation: 10mg of the standard salt (Vitamin B2) was weighed into a 25cm^3 volumetric flask, dissolved, and made up to the mark with the buffer solution then labelled as stock. 4$cm^3$of the standard stock was transferred into a 25cm^3 amber volumetric flask, made up to the mark with the buffer solution, vortexed and labelled as intermediate mixed stock. The intermediate mixed stock solution was used to carry out serial dilutions by pipetting 1cm^3, 2cm^3, 3cm^3, 4cm^3 and 5cm^3 of the intermediate into 5 different 10cm^3 volumetric flasks and made up to the mark with the buffer solution, vortexed and labelled "mixed working standards" serially. The mixed working standards were transferred into vials with a syringe and a microfilter for each mixed working standard.
The working standards and the sample were taken to the HPLC for analysis. The above analyses were performed on both the formulated baby food sample and the control (Nestle Cerelac).

RESULTS
Table 1, 2 and 3 show the results of the proximate, minerals and vitamins analysis respectively. The results from Table 1-3 revealed a higher nutritional content in the composite blend compared to the control.

Table 1: Comparison of the physiochemical result of the control, sample and expected value

TEST PERFORMED	CONTROL	SAMPLE (Composite blend)	EXPECTED (based on NAFDAC/FAO)
Appearance	Off White Cereal	Brown Cereal	
Moisture (%)	1.77	4.96	15.0 max
Fat (%)	14.55	18.74	10
Ash (%)	2.57	3.59	2.5 stated
Crude Fibre (%)	2.46	3.69	2.5
Protein (%)	16.68	25.78	20
Total Carbohydrates (%)	64.43	46.93	68.0 stated
Energy (Kcal/100g)	455.39	459.50	422.0 stated
Total Aflatoxin (ppb)	0.00	3.76	4.0 max

Table 2: Mineral Determination

TEST PERFORMED	CONTROL	SAMPLE (Composite blend)	EXPECTED (based on NAFDAC/FAO)
Calcium (mg/100g)	448.0	328.44	450.0 stated
Sodium (mg/100g)	142.0	193.20	135.0 stated

Table 3: Results of Vitamins Determination

TEST PERFORMED	CONTROL	SAMPLE (Composite blend)	EXPECTED (based on NAFDAC/FAO)
Vitamin B1 (mg/100g)	0.00	0.00	0.6 stated
Vitamin B2 (mg/100g)	4.50	3.88	0.6 stated
Vitamin B3 (mg/g)	0.00	0.00	0.3 stated
Vitamin B6 (mg/100g)	1.88	0.00	
Vitamin B12 (mg/g)	0.10	0.01	1.0 stated

DISCUSSION
The moisture content value of the sample was found to be 4.96 % which is higher than the moisture content of the control found to be 1.77 %. The value of the result is in compliance with the NAFDAC limit with a maximum of 15.0 %. This implies that the shelf life of the sample will be less compared to the control since the higher the moisture content, the more susceptible to microbial attack during storage (Isengard, 2001).
The fat content was found to be 18.74 % in the composite blend. The fat content of the composite blend was higher than that of control which was 14.55 %. The fat values obtained are higher

than the 10% recommended by (FAO, 1996) for weaning food formulation. This high content implies that the storage life of the flour blends may decrease due to their high-fat content resulting in high susceptibility to oxidative rancidity (Ihekoronye & Ngoddy, 1985). Dietary fats function in the increase of palatability of food by absorbing and retaining flavours (Antia *et al.,* 2006). Also, diet providing 1-2% of its caloric of energy as fat is said to be sufficient to human beings.

The ash content gives an indication of the mineral composition preserved in the food materials (Omotoso, 2005; Nnamani *et al.,* 2009). The ash content was found to be 3.59 % in the sample. Higher ash content indicates a higher mineral content. The ash content was higher when compared with the control which implies that infant feeding on the flour blend will not suffer mineral deficiency.

The fibre content was found to be 3.69 % in the local diet which is higher than the fibre content of the control found as 2.46 %. Geddes and Stewart (1973), reported that the fibre content of infant cereals should be between the ranges of 0.3 % to 2.5 %. The fibre content of the composite blend and the control were found to be higher than the recommended limit.

The protein content of the local diet was found to be 25.78 % which was higher than the control which has a value of 16.68 %. The crude protein of the composite blend compared favourably with the value recommended by FAO (1998) that a protein of 20 % is designated for any weaning food. The percentage protein is equally high enough to prevent protein-energy malnutrition in an adult who depends on it as its protein source. The composite blend may be another cheap source of plant protein for the marginal resource communities of Nigeria. Effionge *et al*., (2009) stated that any plant food that provides about 12 % of the caloric value from protein are considered good sources of protein. Therefore, the blended food meets this requirement.

Carbohydrate content contributes to the bulk of the energy of the formulation. The carbohydrate content in the composite blend was found to be 46.93 %. The high carbohydrate yield of this food blend makes them ideal for babies since they require energy for their rapid growth. The carbohydrate content was not comparable to that of the control.

Aflatoxin was found in the local diet to be 3.76 ppb but for the control, no aflatoxin was found. The aflatoxin found in the composite blend is in compliance with the NAFDAC limit with a threshold value of 4.0 ppb maximum. These aflatoxins are secondary metabolites of fungi, they are classified as contaminants and are naturally occurring, therefore the complete elimination of mycotoxins from foods would be an impossible task but it is important to ensure that the levels do not threaten health. When present in high enough levels in the composite blend, it may cause chronic adverse health effect in animals and humans. They affect the target organs such as kidney, liver, the nervous system, endocrine system, and immune system (IARC, 1993).

From Table 2, the composite blend shows a high level of sodium which was found to be 193.20 (mg/100 g) higher than that of control which was 142.0 (mg/100 g) and low level of calcium 328.44 (mg/100 g) in the local diet compared to that of control 448.0 (mg/100 g). The values are within the required daily intake (RDI) for an infant as reported by the dietary guidelines of the Food and Nutrition Board of the Institute of Medicine National Academy of Science (1997 – 2001). Minerals are vital for the overall mental and physical well-being and are important constituents of bones, teeth, tissues, muscles, blood and nerves cells (Soetan *et al.,* 2010). They generally help in the maintenance of acid-base balance, the response of nerves to physiological stimulation and blood clotting (Hanif *et al.,* 2006).

The results from Table 3 revealed that Vitamin B1 and B3 were absent in both the composite blend and the control. Vitamin B2 was found to be lower in the composite blend 3.88 (mg/100 g) compared to that of the control which was found to be 4.50 (mg/100 g). Vitamin B6 was absent in the composite blend and found to be 1.88 (mg/100 g) in the control. Vitamin B12 was also lower in the composite blend 0.01 (mg/g) and high in the control 0.10 (mg/g). Vitamin B6 is involved in homocysteine metabolism (Stuart *et al*., 2004).

Conclusion

This study revealed that the composite blend formulated from locally available food commodities meets the recommended micronutrient (minerals) requirements of infants and children, and is highly nutritious compared to the control. Thus, the composite blend is considered safe as the anti-nutrients were destroyed during processing and values are within recommendation by FAO and WHO 2004. The procedure for its processing is equally easy and energy saving

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