Nutrients Composition of Acha base complementary food supplemented with Soybean and Sweet Potato Flour

Abstract

Poor complementary food and feeding had been shown to increase the morbidity and mortality among under-five children in developing countries in which Nigeria is not exempted. This study aimed at evaluating the Nutrients Composition of Acha -Based complementary food supplemented with soybean and sweet potato flour. Raw materials used for the formulated of the complementary were purchased from Erekesan market in Akure Local Government Area of Ondo State. Five (5) samples were formulated in different ratios of Acha (100:70:60:50:40), Soyabean (20:25:30:35) and Orange flesh sweet potato (10:15:20:25). Samples were subjected to chemical and instrumental analysis in line with standard method. The data obtained were statistically analyzed using ANOVA to test for the significant difference among means ($P<0.05$) using Statistical Package for Social Science (SPSS version 22). Finding shows that Moisture, crude fibre, and carbohydrate was significantly ($p<0.05$) higher in sample Awhile, Sample E was significantly ($p<0.05$) higher protein (18.42%) and fat (12.40%) compared to other formulated samples. The Moisture, crude fibre, and CHO was significantly ($p<0.05$) decreases with decreased in the quantity of Acha use in the formulation of the CFs while crude fat, Ash and protein increases with increase in the quantity of soybean incorporated in the formulations. Sample E is significantly ($P<0.05$) higher in vitamin B_1, B3 and B_9 compared with sample A. vitamin B_1, B3 and B_9 increases with increase in the quantity of soybean and OFSP. All the samples have appreciable amount of sodium, calcium, phosphorus, magnesium and potassium but, zinc and iron was low in the entire sample. Sample E was exceptional in all the minerals but significantly ($p<0.05$) lower in Zinc and iron. The mean sensory scores revealed that sample C was different in after taste, flavour, mouth feel, colour and overall acceptability. The mean scores increase with increase in the proportion of soybean and potato in the formulated complementary food samples in terms of all the sensory attributes tested. The scores showed that sample C had the highest acceptability by the panelists. The complementary foods had improved nutrients that can support optimal nutrition of undernourished children and other older people.

Keywords: Complementary food, Orange flesh sweet potato, soybean, Acha, malnutrition

Introduction

An estimated 51 million children under-five suffer from acute malnutrition (wasting) globally (United Nation Children fund, 2014), while an estimated 12 million children below the age of 5 (five) years die annually with more than 50% of all these cases attributed to malnutrition (Food and Agricultural Organization (FAO) (2014).“Under nutrition is the leading cause and effect of poverty, ill-health and permanent impairment of the physical and mental growth of those children who survive”(Algur, Yadavannavar & Patil, 2012; Park, 2013).“Infants and children under five years are the most vulnerable tomalnutrition and is most severe atthe complementary

feeding stage, because their nutrients (macro and micro-nutrient) requirements might not be sufficiently provided forin the complementary foods"(FAO, 2014; Onofiok, 2012).

Recent statistics in Nigeriashows that about 23% of children under-5 years are underweight in Nigeria and the prevalence among children aged 6–23 months is 24%; wasting among under-five children is 13% and 17% among children aged 6–23 months. Likewise a total of 41% of children under-5 years of age are stunted, with an increase from 27% at age 6 months to 50% at 23 months (NNHS, 2018),which is the period when complementary feeding intensifies (Sudik et al., 2019; Okoronkwo et al., 2023).

"Complementary foods are foods and liquids apart from breast milk or infant formulas needed during the second part of the first year of life for both nutritional and developmental reasons and also to enable transition from milk feeding to family foods" (Koletzko*et al.*, 2008). "After 6 months of age, breast milk is not enough to meet the macro- and micronutrient requirements of infants" (Ijarotimi&Keshinro, 2013; Koletzko*et al.*, 2008).

"Complementary foods should be of the right nutritional quality and energy to balance the nutrients obtained from breast milk for infants and family foods for younger children. By combining locally available plant based foods that complement each other in such a way that new patterns of amino acids are created, in such way traditional complementary foods could be enhanced. Enrichment of cereal-based food with other protein source such as legumes, oilseeds etc, have gained more attention since investigations have revealed that cereals are deficient in lysine and tryptophan but have sufficient sulphur containing amino acids which are limiting in legumes" (Abiose*et al.*, 2015). "In view of these nutritional challenges, some studies have investigated ways of formulating quality complementary foods through a combination of available plant based foods to meet the nutritional demands of infants of weaning age" (Ikujenlola, 2014).

"Sweet potato as a complementary food has been known as a viable product both for supplementing the nutritional needs of babies in developing countries while improving the usage of the crop. A number of studies have, thus been conducted in this wise"(Sanoussi*et al.*, 2013; Haque*et al.*, 2013). Some varieties have high portion of β-carotene which is a precursor of vitamin A (Burri*et al.*, 2011), hence, could help minimize vitamin A deficiency amongst children. Notwithstanding the increase energy content of sweet potato and other micronutrients

such as vitamin A, C, potassium, iron and zinc, it is low in protein and fat contents; hence, the need to complement it with legumes and/or cereals when being used in weaning foods.

"*Acha*is a tropical millet native to West Africa, one of the most nutritious of all grains rich in methionine and cystine, amino acids important to man's health and lacking in today's major and has the advantage to be minimally processed which limited the loss of the native nutritional value during milling"(Olapade and Aworh, 2012). "The use of Achais mainly limited to traditional foods such as thick and thin porridges, steam cooked products (e.g. Couscous), and alcoholic and nonalcoholic beverages. *Acha* can be used for weaning foods of low dietary bulk and high calorie density; such complementary preparations with good acceptability and tolerance by children have been investigated" (Olapade and Aworh, 2012).

"Soyabean is a legume widely grown for its edible bean which has numerous uses. Soybean contains 40% food quantity protein, 20% fat, 23% of carbohydrate and reasonable amount of minerals vitamins and is an excellent healthy food. Be a complete protein, it can also be used to fortified food that has limiting amino acid" (Purcel*et al.*, 2000). Malnutrition affects mostly children because of their high demand for nutrients to meet rapid growth rates. Low quantity and quality of complementary foods, poor child-feeding practices, inadequate Ready to use therapeutic food and high rates of infections, contribute to poor health and growth among this group. Attention of nutrition scientists need to be refocused on the local available grains that are beneficial to the survival of children such as taking note of the vitamins and minerals, the quantity and the quality of complementary food for reduction in childhood mortality by two-thirds and a reduction in the number of infants who suffer from malnutrition. Based on the notion the Nutrients Composition of Acha -Based Complementary Food Supplemented with Soybean and Sweet Potato Flour was investigated

Materials and Methods

Procurement of raw materials

The raw materials used in this study are "Acha" (*Digitariaexilis*), Soybean (*Glycine max*) and Sweet potato (*Ipomoea batatas*). The Acha was purchased from Jos, Plateau State while Soybean and Sweet Potato were purchased from Oja Oba market in Owo, Ondo State.

Preparation of Acha flour

Acha grains were manually cleaned and sorted by hand picking of the chaff. Dust and sands were removed by washing severally in tap water using plastic bowls. The washed grains was oven dry

at 50^0C for 6 h, after which the dried grains were finely milled into flour with an attrition mill and sieved to remove coarse and fibrous materials. The resulting flour was store in air tight polyethylene bags at room temperature 25^{o}C until needed,

Preparation of Soybean Flour

This was produced according to the methods of (Oluwamukomi *et al*., 2005). Soybean was cleaned and sorted, washed and boiled in water at 100^{o}C for 30 min. It was dehulled manually, oven dried at 70^{o}C for 15hrs and was milled into flour using attrition mill and was sieved to remove coarse material. The resultant fine flour was packaged in polythene bags and stored in air-tight container for further use.

Preparation of Sweet Potato Flour

"The flow chart for the production of sweet potato flour was adopted and modified. This method was described" by Adeleke and Odedeji (2010).Selection of fresh tubers of Sweet potato roots weighing 20kg, were washed thoroughly in water and were peeled with a stainless steel knife, immersed in water to prevent discolouration and rewashed. The peeled roots are grated into chips using an ordinary grater. The chips are then spread thinly in a drying tray and oven dried at 50^0C for 72 hours. The dried chip was milled into flour using an electric mill. It was sieved with a fine sieve and packed into a air tight polythene bag at room temperature and stored for further use.

Formulation of composite flour

The flour (Acha), Soybean and potato) were formulated into various blends using the following ratios shown in Table 1 below.

Table 1: Formulation of Acha, Soybean and Sweet potato composite flour

Samples	Acha (g)	Soybean (g)	Potato (g)
A	100	0	0
B	70	20	10
C	60	25	15
D	50	30	20
E	40	35	25

Key: A = Acha 100%, (control), **B** = 70% Acha; 20% Soybean; 10% Potato, **C** = 60% Acha; 25% Soybean; 15% Potato, **D** = 50% Acha; 30% Soybean; 20% Potato, **E** = 40% Acha; 35% Soybean; 25% Potato

Preparation of samples for laboratory analysis

"The prepared flour from each of the raw materials was homogenized based on the percentage as shown in table 1 using the laboratory homogenizer. Each of the composite flour was then packaged in an air tight container and stored in the refrigerator for nutrients analysis". [46]

Proximate Analysis

The proximate analysis was carried out according to AOAC methods (2012), to determine moisture, crude fats, ash, crude protein, crude fibre and total carbohydrate.

Determination of Pro-vitamin A (Beta Carotene), vitamin K and B-complex

The Pro-vitamin A (Beta Carotene), vitamin K and vitamin B-complex analysis was carried out for each of the complementary food sample in according to the AOAC methods (2012).

Mineral elements in the complementary foods

"Two grams of each sample was ashes in muffle furnace at 550^{o}C for 6 to 8 hours. The ash was dissolved with HCl. The analysis of sodium, calcium, potassium, iron, magnesium, copper and zinc was carried out with a Buck Model 210 VGP atomic absorption spectrometer, USA. For each element, the instrument was auto zeroed using the blank (de-ionized water) after which the standard was aspirated into the flame starting from the lowest concentration. The corresponding absorbance value was obtained and the graph of absorbance against concentration was plotted by the instrument. The digested samples were analyzed in duplicates with the average concentration of the metal present being displayed in part per million (ppm) by the instrument after extrapolation from the standard curve" [46].

Statistical Analysis

"The results were expressed as mean ± standard deviation and the test for statistical significance was carried out using one-way analysis of variance (ANOVA). The Statistical Package for Social Sciences (SPSS, Version 20) software was used to determine significant differences. Significant means was separated using Duncan's New Multiple Range Test (DNMRT) and differences was considered significant at $p<0.05$". [46]

Results

The proximate content of the sample is shown in table 2. Control Sample (A) had the highest value of moisture (6.99%) and was exceptionally higher in crude fibre (4.07%) content. Sample E was significantly ($p<0.05$) higher protein (18.42%) and fat (12.40%) compared to other formulated samples. The Moisture, crude fibre, and CHO was significantly ($p<0.05$) decreases with decreased in the quantity of Acha use in the formulation of the CFs while crude fat, Ash and protein increases with increase in the quantity of soybean incorporated in the formulations. There was no significant difference ($p>0.05$) between the Ash content of sample C, D, and E of the

complementary foods and likewise the moisture content of sample B,C,D and E except for the control sample

Table 2: Proximate composition of Acha based complementary food

Samples	Moisture	Ash	Crude fibre	Fat	Protein	CHO
A	6.99 ± 0.14^{a}	1.20 ± 0.01^{d}	4.07 ± 2.13^{a}	2.42 ± 0.02^{e}	7.21 ± 0.24^{e}	76.58 ± 0.00^{a}
B	5.15 ± 0.00^{b}	1.33 ± 0.01^{c}	2.64 ± 0.49^{ab}	8.18 ± 0.06^{d}	12.11 ± 0.00^{d}	70.56 ± 0.40^{b}
C	5.55 ± 0.53^{b}	2.09 ± 0.12^{b}	1.06 ± 0.45^{b}	10.22 ± 0.01^{c}	14.16 ± 0.09^{c}	67.27 ± 0.65^{c}
D	5.08 ± 0.10^{b}	2.14 ± 0.65^{b}	1.01 ± 0.00^{b}	11.00 ± 0.03^{b}	15.96 ± 0.10^{b}	64.77 ± 0.22^{d}
E	5.02 ± 0.10^{b}	2.52 ± 0.04^{a}	1.00 ± 0.12^{b}	12.40 ± 0.00^{a}	18.42 ± 0.25^{a}	60.61 ± 0.74^{e}

Values are mean ± standard deviation of triplicate analyses. Values with the same superscript in the same columns are statistically not significant at (P<0.05). **Key: A** = Acha 100%, (control), **B** = 70% Acha; 20% Soybean; 10% Potato, **C** = 60% Acha; 25% Soybean; 15% Potato, **D** = 50% Acha; 30% Soybean; 20% Potato, **E** = 40% Acha; 35% Soybean; 25% Potato

Table 3 shows the vitamin composition of Acha based complementary food. Sample E had the highest value for vitamin B_1 (0.84mg/g), while control sample had the least value (0.33mg/g). Sample E had the highest value for vitamin B_2 (0.68mg/g), while sample A, B, C and D had the value of 0.23mg/g, 0.42mg/g, 0.53mg/g and 0.63mg/g. There was no significant difference ($p<0.05$) in the values obtained for Vitamin B_3 inSample D (2.55mg/g) and sample E. Sample E contained the highest value of vitamin B_3 (2.64mg/g) while sample B and C had 1.36mg/g and 2.22mg/g respectively, however there was no significant difference ($P<0.05$) between sample A (1.37mg/g) and B (1.36mg/g). Vitamin B_5 was significantly ($p<0.05$) higher in the sample E with the value of 0.70mg/g. Sample E had the highest value for vitamin B_6 (0.39mg/g), while sample D had the value of 0.33mg/g. The result also showed that sample E (344.02mg/g) is significantly higher in vitamin B_9.

Table 3: Vitamin composition of Acha based complementary food.

Samples(mg/g)	Vitamin B_1	Vitamin B_2	Vitamin B_3	Vitamin B_5	Vitamin B_6	Vitamin B_9
A	0.33 ± 0.01^{e}	0.23 ± 0.00^{e}	1.37 ± 0.17^{c}	0.34 ± 0.00^{e}	0.11 ± 001^{d}	100.61 ± 0.57^{e}
B	0.51 ± 0.01^{d}	0.42 ± 0.00^{d}	1.36 ± 0.01^{c}	0.54 ± 0.00^{d}	0.21 ± 0.01^{c}	120.21 ± 0.32^{d}
C	0.63 ± 0.01^{c}	0.53 ± 0.01^{c}	2.22 ± 0.001^{b}	0.60 ± 0.00^{c}	0.30 ± 0.00^{b}	180.61 ± 0.41^{c}
D	0.71 ± 0.02^{b}	0.63 ± 0.01^{b}	2.55 ± 0.03^{a}	0.67 ± 0.00^{b}	0.33 ± 0.04^{b}	225.68 ± 0.48^{b}
E	0.84 ± 0.01^{a}	0.68 ± 0.01^{a}	2.64 ± 0.03^{a}	0.70 ± 0.01^{a}	0.39 ± 0.01^{a}	344.02 ± 2.09^{a}

Values are mean ± standard deviation of triplicate analyses. Values with the same superscript in the same columns are statistically not significant at (P<0.05). **Key: A** = Acha 100%, (control), **B** = 70% Acha; 20% Soybean; 10% Potato, **C** = 60% Acha; 25% Soybean; 15% Potato, **D** = 50% Acha; 30% Soybean; 20% Potato, **E** = 40% Acha; 35% Soybean; 25% Potato

Mineral composition of Acha based complementary food

Table 4 shows the mineral composition of Acha based complementary food. Sample E significantly ($p<0.05$) higher in calcium, magnesium, phosphorus, potassium and sodium while sample A was significantly ($p<0.05$) higher in zinc and iron. Calcium, Magnesium, Phosphorus, Potassium increases in the entire sample with increase in quantity of soybean and orange flesh sweet potato while iron, zinc decreases with decrease in the quantity of Acha. Sample E significantly ($p<0.05$) contained the highest value of calcium (50.20mg/g) while sample A, B, C and D contained 39.52mg/g, 39.27mg/g, 44.99mg/g and .48.59g/g respectively. In the values obtained for iron content, sample A significantly ($p<0.05$) contained 3.50mg/g of iron while sample B, C D and E had 2.92mg/g, 2.06mg/g, 1.10mg/g and 1.24mg/g respectively while the control sample (A) had the least value (73.06mg/g). There was no significant difference ($p<0.05$) between sample C (1.45mg/g) and D (1.46mg/g) for the zinc content. Sample E had the highest value for potassium content (364.59mg/g), while sample A had the least value (288.50mg/g).

Table 4: Mineral composition of Acha based complementary Food

Samples	Calcium	Iron	Mg	Phosphorus	Sodium	Zinc	Potassium
A	39.52 ± 0.71^{d}	3.50 ± 0.00^{a}	73.55 ± 0.77^{e}	254.51 ± 6.36^{d}	73.06 ± 0.10^{e}	1.85 ± 0.04^{a}	288.50 ± 6.79^{d}
B	39.27 ± 0.00^{d}	2.92 ± 0.57^{b}	98.62 ± 0.58^{d}	261.13 ± 7.06^{d}	82.18 ± 0.8^{c}	1.62 ± 0.01^{b}	301.11 ± 1.40^{cd}
C	44.99 ± 0.01^{c}	2.06 ± 0.52^{c}	104.46 ± 1.25^{c}	275.93 ± 0.08^{c}	79.84 ± 0.55^{d}	1.45 ± 0.64^{c}	305.00 ± 7.23^{c}
D	48.59 ± 0.52^{b}	1.10 ± 0.00^{d}	125.86 ± 0.25^{b}	300.61 ± 0.70^{b}	85.07 ± 0.20^{b}	1.46 ± 0.07^{c}	321.67 ± 3.49^{b}
E	50.20 ± 0.07^{a}	1.24 ± 0.03^{e}	136.00 ± 0.01^{a}	324.72 ± 0.72^{a}	86.21 ± 0.03^{a}	1.30 ± 0.71^{d}	364.59 ± 3.54^{a}

Values are mean ± standard deviation of triplicate analyses. Values with the same superscript in the same columns are statistically not significant at ($P<0.05$). **Key: A** = Acha 100%, (control), **B** = 70% Acha; 20% Soybean; 10% Potato, **C** = 60% Acha; 25% Soybean; 15% Potato, **D** = 50% Acha; 30% Soybean; 20% Potato, **E** = 40% Acha; 35% Soybean; 25% Potato

Sensory evaluation of Acha based complementary food

The mean sensory scores of the Acha based complementary food as presented in table (5) were different in after taste, flavour, mouth feel, colour and overall acceptability. The mean scores increase with increase in the proportion of soybean and potato in the formulated complementary food samples in terms of all the sensory attributes tested. The scores showed that sample C had the highest acceptability by the panelists.

Table 5: Sensory evaluation of Acha based complementary food

Samples	Flavour	Aroma	Mouth feel	After taste	Colour	Acceptability
A	6.40 ± 1.24^{b}	6.07 ± 1.22^{b}	6.93 ± 0.88^{a}	5.93 ± 1.62^{e}	7.47 ± 0.83^{a}	6.93±1.28c

B	6.80±0.94^{a}	5.73±1.22^{d}	6.20±1.37^{c}	6.13±0.83^{d}	7.00±0.76^{de}	6.20±1.52^{d}
C	6.40±1.24^{b}	6.73±1.22^{a}	6.60±1.45^{b}	7.27±0.30^{a}	7.07±1.16^{d}	7.55±0.52^{a}
D	6.20±1.47^{cd}	6.53±1.19^{c}	6.13±0.64^{d}	6.13±1.19^{b}	7.13±0.74^{c}	7.13±0.74^{b}
E	6.27±1.10^{c}	5.60±1.12^{e}	5.93±1.71^{e}	6.40±1.30^{c}	7.20±0.78^{ab}	7.07±1.03^{b}

Values are mean ± standard deviation of triplicate analyses. Values with the same superscript in the same columns are statistically not significant at (P<0.05). **Key: A** = Acha 100%, (control), **B** = 70% Acha; 20% Soybean; 10% Potato, **C** = 60% Acha; 25% Soybean; 15% Potato, **D** = 50% Acha; 30% Soybean; 20% Potato, **E** = 40% Acha; 35% Soybean; 25% Potato

Discussion

Proximate composition of the samples

Moisture contents of the samples ranged from 5.02% to 6.99%. These values were lower than 8.80%-10.57% reported by Yusufu*et al.* (2013) for complementary food formulated from sorghum, African yam bean and mango mesocarp flour blends. "The low moisture content of the product (gruel) could be attributed to the fact that the product is in fluidly forming" (Nnam, 2002). "This will also have an adverse effect on its keeping quality though the product is not usually kept too long before consumption. Moisture has an implication in terms of the consistency/texture and microbiological quality of food" (Makinde&Ladipo, 2012). Olaoye *et al*., (2006) "reported that lower moisture content in food have an implication to prevent from microbial contaminations".

FAO/WHO/UNICEF (2011) "reported that the ash content of a complementary food should be less than 5%. The samples, therefore, met this standard as they were below 5%. The fat content of the samples ranges between 2.42% to 12.46%". These values are higher when compared to 0.31% to 8.08% obtained by Akinola *et al*., (2014) on Formulation of local ingredient-based complementary food in South-west Nigeria. The fat content of the blended flour is relatively higher than the Acha flour (control), This could be attributed to supplementation of soy bean which tends to increase the concentration of the fat content. This are in agreement with the findings of Abraham *et al*., (2013) who also ascertained in their study increase in fat content of soybean. The crude fibre content of the complementary food samples ranged from 1.00% to 4.07%. These values were higher to 0.06% and 1.86% obtained by Chukwu*et al*., 2014 on chemical composition of locally made complementary food standard recipes in Nigeria. There was no significant differences (P<0.05) among sample C, D and E, however sample A has the highest crude fibre while sample E has the lowest crude fibre, Fibre increases as the inclusion of Acha flour increases.

The protein contents of the samples ranged from 7.21% to 18.42%. These values were within the limit of estimated daily amount of protein needed from complementary foods by breastfed infants aged 6-24 months ranged from 0 to 9g (WHO/UNICEF, 2008). The protein is relatively lower than what was reported by Nwosu*et al.*, (2014) in his complementary food prepared from maize flour, soybean flour and Moringa oleifera leaf powder. This may be due to the level of soybean in his formulation.

"The carbohydrate contents ranges from 60.61% to 76.58%. Sample A (76.58%) was significantly ($p<0.05$) while sample E had the least value of 60.61%. The high carbohydrate contents of the samples observed in this study are nutritionally desirable as children require energy to carry out their rigorous physical and physiological activities as growth continues" (Ibironke*et al.*, 2004).

Micronutrients composition of samples

The calcium content of the formulations varied significantly ($p<0.05$) among the samples. The increase in calcium content of the sample E could be as a result of increase of supplementation (Lutter and Rivera, 2003). According to the Codex Alimentarius standards, Ca concentrations in complementary foods should not be less than 45.51mg/g of the dry food. On the basis of this standard, the samples except for sample D and E did not exceeded the minimum amount (45.51gm/g) specified in the Codex Alimentarius Standards (FAO/WHO, 2003). The iron content of sample A and sample B were significantly higher ($p<0.05$) than sample D (1.10mg/100g). The increase of iron in sample A could be attributed to fortification of Acha flour which tends to increase the concentration of the iron.

The zinc contents of the samples ranged from 1.45 to 1.85mg/100g. These results corroborated with the findings of Egbujie and Okoye, (2019). Zinc supports normal growth and development during pregnancy, childhood and adolescence. Zinc is very useful in protein synthesis, cellular differentiation and replication, immunity and sexual functions (Sobukola*et al.*, 2007).

The levels of potassium in the blends varied significantly at ($p<0.05$) among the samples. These values were lower than potassium content of 293.11mg/100g to 306.20mg/100g obtained on complementary foods produced from sorghum, African yam bean and crayfish flours (Egbujie and Okoye, 2019).

The sodium content of the complementary food samples ranged from 73.06mg/100g to 86.21mg/100g. These values are lower to 132.60mg/100g to 140.13mg/100g obtained by Amal

et al., (2014) on Nutritional and sensory evaluation of a complementary food formulated from rice, faba beans, sweet potato flour, and peanut oil. “Sodium is needed in the body in a small amount to help maintain normal blood pressure and normal function of muscles and nerves. Sodium regulates homeostasis in the body and helps in the effective functioning of muscles and nerves” (Payne, 2012).

“The Vitamin B_1 (thiamine), Vitamin B_2 (riboflavin), vitamin B_3 (niacin), vitamin B_5, Vitamin B_6 and vitamin B_9 contents of the samples increased with increased substitution with soy bean and sweet potato flours. The increase in the vitamin content of the formulations confirms the beneficial effect of supplementation” (Okaka*et al*., 2006). “The thiamine content was consistent (0.15-0.62mg/100g) with the results of previous investigations” by Gautier *et al*., (2008). The results for vitamin B_2 (riboflavin) ranged from 0.23-0.68mg/g. These values were similar to 0.10-0.79mg/100g obtained by Santosh *et al.,* (2012), similar increase in riboflavin content with increase in substitution with soybean and crayfish flours has been reported by Oti and Akobundu (2008) for complementary food made from cocoyam, soybean and crayfish flour blends. Riboflavin is necessary for growth and development in infants and young children. Vitamin B_2 content of sample C, D and E will meet up the requirements.

Vitamin B_3 (Niacin) contents of the samples ranged from 1.36mg/g to 2.64mg/g. The increase in niacin content observed in the samples could be due to the inclusion of soybean and potato flours in the blends. The niacin content of the complementary food formulated in this study was lower than the niacin content (3.17-8.72 mg/100g) of complementary food prepared from malted millet, plantain and soybean blends reported by Bolarinwa *et al*., (2016). Niacin helps in the reduction of the level of blood cholesterol in humans.

Vitamin B_6 (Pyridoxine) contents of the samples ranged from 0.11mg/g to 0.39mg/g. The result shows that sample E, had the highest values of 0.39mg/100g. This finding is in agreement with the report of Oti and Akobundu (2008), who revealed that soybean contains high amount of Vitamin B6. The B complex vitamins function as precursors for enzyme co-factors (Bernhardt and Schlich, 2006). Apart from their role in assisting enzyme -substrate reactions, their other functions are equally important. These findings are consistent with the results of previous investigations by (Bureau *et al*., 2015). The Vitamin B_9 content of the formulations varied significantly at ($p<0.05$) among the samples. The increase in Vitamin B_9 content of the sample E, substituted with 40% Acha; 35% soybean and 25% potato (344.02mg/100g) could be as a result

of increase of supplementation (Okaka *et al*., 2006).On acceptability level,the mean sensory scores of the Acha based complementary food were different in after taste, flavour, mouth feel, colour and overall acceptability. The mean scores increase with increase in the proportion of soybean and potato in the formulated complementary food samples in terms of all the sensory attributes tested. The scores for sensory evaluation showed that sample C had the highest acceptability by the panelists.

Conclusion

The complementary foods formulated showed nutritional superiority over the control in terms of calcium, magnesium, potassium, sodium and vitamins. The blend especially sample E met the recommended micronutrient (minerals and vitamins) requirements of infants and children. Hence their use should be encouraged as a means of promoting dietary diversity and reducing prevalence of under-five malnutrition in Nigeria. In conclusion, Supplementation of cereal-based foods with soybean and sweet potato for the production of complementary foods improved the Calcium, Magnesium, Potassium, sodium and potassium for minerals and also improved the all the vitamin contents.

Ethical approval

Ethical approval reference number RUGIPO/NUD/2020/106 was obtained for the study from the Ethic committee of the department of Nutrition and Dietetics Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria

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