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Nutritional Qualities and Acceptability of Kokoro (Local Snack) Enriched with Malted Sorghum (*Sorghum Bicolor* [L] Moench) and African Yam Bean (*Sphenostylis Stenocarpa*) Flour

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Abstract

Kokoro is a local snack and popularly eaten by people in South Western part of Nigeria. Maize, Malted sorghum and African yam bean. were processed into flour separately. The flour samples were mixed in ratio of 100:0:0 (BK1), 90:5:5 (BK2), 80:5:15 (BK3), 70:10:20 (BK4) and 60:15:25 (BK5) for Maize, Malted Sorghum, and African yam bean, respectively. The proximate compositions, mineral elements and sensory properties of the blends were determined. The proximate composition of the sample ranged from 7.21-11.01 % for moisture, protein content 9.62-19.34 %, crude fat 8.94-13.91 %, ash 2.02-3.31 %, crude fibre 2.31-3.61 %, and carbohydrate 49.21-70.35 %. Mineral contents were sodium 9.11-20.52 mg/100g, potassium 18.63-27.30 mg/100g, magnesium 19.41-26.16 mg/100g, calcium 20.34-31.52 mg/100g, iron 1.11-3.89 mg/100g and zinc 0.09-2.95 mg/100g. All formulated samples were accepted in term of overall acceptability as compared with the control. This study showed improvement in the nutrient composition of samples (kokoro) as a result of African yam bean inclusion.

Keywords: Kokoro (Local Snack), Maize, Malted Sorghum, African Yam Bean, Proximate Composition.

Introduction

Kokoro is well acceptable local snack produced from maize flour and is a favourite food of the people in south Western Part of Nigeria. The major ingredient for the production of kokoro is maize which is rich in carbohydrate but relatively poor in protein, therefore this demand the addition or blend of local snack from indigeneous crop from malted sorghum and African yam bean so as to achieved nutritionally balanced diet that would played an important role in human nutrition especially in the aspect of food security and micronutrient deficiencies (Borokini *et al.*, 2019).

Maize (*Zea mays*) also known as corn, belongs to the family gramineae it is the third most important crop in the world after rice and wheat and ranks fourth after millet, sorghum and rice in Nigeria (FAO, 2009). Maize is rich source of energy (excellent source carbohydrate, fat and fibre) for people in Tropics but low in protein. Sorghum (*Sorghum bicolor* [L] Moench) belongs to the family Gramineae, it is the fifth important crop among the cereals in the world following rice, wheat, maize, and barley in production (Afify *et al.*, 2012). Sorghum is a good source of

energy, proteins, carbohydrates, oils, polyunsaturated fatty acid (PUFA), vitamins and minerals.

Malted sorghum involves soaking the beans, allows germinating and finally subjected to drying. In the process of malting stage the enzyme present responsible for the conversion of starch into more digestible maltose and increase the rate of absorption of vitamin during digestion and also enhance the availability of mineral by reduction of anti-nutritional factors in grains such as tannin, phytic acid, flavonoid compounds (Chinma and Gernah, 2007).

African yam bean (*Sphenostylis stenocarpa*) is a nutrient dense, but highly underutilized legume that is predominantly cultivated in Nigeria. African yam bean seed contains 21-29% protein; it is a good source of fibre, carbohydrates and rich in minerals (Yusuf, *et al.* 2005). The research is aimed to investigate the production and evaluation of local snack (kokoro) produced from the blend of maize, malted sorgthum enriched with african yam bean to enhanced the nutritive value of locally produced snack.

Materials and Methods

Sources of Material

Maize and sorghum (white variety) were purchased from Owode market Sango Saki, Oyo state. African yam bean were purchase from Temileke market Saki, Oyo State. Sugar, salt and vegetable oil were purchased from Owode market Sango Saki. Equipment, and other facilities used in the research work was obtained from the laboratory of Food Science and Technology, of The Oke-Ogun Polythenic Saki.

Methods

Preparation of Maize

Maize grain was processed in to flour using the method described by (Oti and Akobundu, 2007). The grains were cleaned and washed. The cleaned grains were boiled in water at 100 °C for 10 minutes and drained for 10 minutes. The grains were dried in an oven at 70 °C for 1 hr and the dried grains were dehulled, winnowed and milled in milling machine in to flour. Sieved (500 µm) mesh sieve. The maize flour was packaged in moisture proof polyethylene film and kept at ambient conditions (28±2 °C) for further use. and packaged till needed.

Preparation of sorghum flour

Malted sorghum grain was processed using the method of (Iwe, 2003) The sorghum grain was sorted, cleaned, washed and soaked overnight in a stainless steel bucket containing clean tap water, and was drained the following day, spread on a clean jute bag and covered to screen from direct sun light. Water containing 1% sodium hypochlorite was sprinkled twice a day on the sorghum at the intervals of nine (9) hrs to discourage the growth of microorganisms (Iwe, 2003) the grain was allowed to germinate for 96 hrs. at room temperature and dried in hot air oven at the temperature of 70 °C for 1 hr. The dried grain were milled to fine particles using hammer mill, sieved with 400 µm mesh and packaged in polyethylene bags until further used.

Preparation of African Yam Bean (AYB) Flour

AYB flour was prepared following the method described by Yusufu, *et al.* (2005) AYB seeds were cleaned of dirt, parboiled (100 °C for 20 min) in an aluminum pot with lid. The parboiled seeds were drained for 5 minutes, dehulled manually and washed with clean water. The seeds were oven dried at 150 °C for 1 hr. The dried

seeds were milled in a hammer mill and sieved through a 500µm mesh. The flour was packaged in an air tight container.

Formulation of Composite Flour

The composite flours used for the kokoro (local snack) production were obtained by mixing the flour blend of maize, malted sorghum and African yam bean together in different proportion (90:5:5; 80:15:5, 70:20:10, 60:25:15, respectively while 100 % maize flour was used as control using a Kenwood blender (Model HM400). packed in polyethene container.

Preparation of Kokoro (Local Snack)

The composite flour was mixed thoroughly based on the proportion of composite flour with salt, sugar and water to form dough in each case. The dough was kneaded and cut into pieces and rolled into shape on chopping board. The rolled out pieces was fried in hot vegetable oil using deep fat fryer. The fried pieces was drained and allowed to cool in a lined basket. It was packed in polyethylene bags and sealed for further analysis.

Chemical Analyses

Proximate Composition

The proximate composition of the samples (The crude proteins, ash, crude fiber, crude fat, moisture and carbohydrates contents) were analyzed using AOAC (2012) methods.

Calculation for energy

Energy value /caloric content the standard AOAC method (2010) was applied in the calculation Of caloric content as shown:

$$\text{Calorie (kcal /100 g)} = (4 \times \% \text{ carbohydrate}) + (4 \times \% \text{ protein}) + (9 \times \% \text{ fat})$$

Mineral Analysis

The sample (5 g) was ashed, and the selected minerals, including sodium, calcium, magnesium, iron and zinc were determined by atomic absorption spectrophotometer (AOAC, 2005).

Sensory Evaluation

The local; snack were subjected to sensory evaluation for consumer's acceptance using 50 untrained panelists. The sensory attributes of cookies samples were rated on a 9-

point hedonic scale (1= dislike extremely, 5= neither like nor dislike, and 9= like extremely) to evaluate the coded samples for colour, taste, aroma, texture, crispiness and overall acceptability.

Statistical Analysis

All data were subjected to statistical analysis of variance (ANOVA). Means was separated using the Duncan's Multiple Range Test to detect significant difference ($p < 0.05$) among the sample.

Results and Discussion

Proximate Composition of Kokoro

The results of proximate composition of kokoro produced from the blend of maize, malted sorghum and African yam bean flour is presented in Table 1. The moisture content of the sample ranged from 7.21- 11.01 % with kokoro produced from 100 % maize flour had the least value (7.21 %.) while sample BK5 (60 % MF + 15% MS + 25% AYB) flour having the highest value (11.01 %). Since moisture content determined the shelf life stability of the product, the lower the moisture content, the lesser the microbial deterioration and chemical reactions that could enhances the quality deterioration of the quality of food. The value obtained (7.21- 11.01 %) for moisture content is less than the good recommended storage stability (14%) for moisture content (Adeleke and Odedeji, 2010, Ogunlakin *et al.*, 2012). There were significant differences ($p \geq 0.05$) among the samples. The protein content varied from 9.62-19.34 %. Sample BK5 had highest protein content (19.34 %) while control (100 % maize) had the least value of 9.62 %. There were no significant deference among the sample except sample BK4 and BK5. Also from the table the crude fat content varied from 8.94-13.91 % with sample BK1 (100 % maize flour) having the lowest value (8.94 %) while sample with 60 % MF + 15% MS + 25% AYB flour had the least. There were no significant differences among the sample except sample BK4 and BK5.

The ash content increased from 2.02-3.31 % with sample BK5 (60 % MF + 15% MS + 25% AYB) had the highest value. The consistent increase in the ash content connotes that samples happened to be a viable source of minerals. Ash content indicates the level of mineral. There were no significant difference among the sample except samples BK3 and BK4

The crude fibre of the samples ranges between 2.31-3.61 %, kokoro (local snack) produced from 70 % MF + 10% MS + 20% AYB flour had the highest values (3.61 %). All the samples differed significantly. The carbohydrate content of the samples ranged between 49.21-70.35 %. The lowest value was recorded for the kokoro (local snack) produced from 60 % MF + 15% MS + 25% AYB flour, while control samples (100 % maize flour had the highest value (70.35 %). All the samples differed significantly. The energy content of the samples ranged from 391.51-399.39 kcal with sample BK4 having lowest value (391.51 kcal) while highest value of 399.39 kcal was recorded for sample BK5. All the samples differed significantly except samples BK3 and BK4.

Table 1: Proximate Composition of Kokoro (Local Snack) prepared from Maize, Malted Sorghum and African Yam Bean Flour

Samples	Moisture (%)	Protein (%)	Crude fat (%)	Crude ash (%)	Crude fibre (%)	Carbohydrate (%)	Energy (Kcal)
BK1	7.21 ^b ±0.11	9.62 ^e ±0.12	8.94 ^b ±0.11	2.02 ^b ±0.01	2.31 ^a ±0.02	70.35 ^a ±0.1	396.26 ^a ±0.2
BK2	8.31 ^d ±0.13	10.85 ^a ±0.11	9.31 ^b ±0.11	2.13 ^c ±0.11	2.46 ^c ±0.21	66.96 ^d ±0.1	395.03 ^a ±0.1
BK3	8.94 ^c ±0.21	13.71 ^b ±0.11	10.61 ^b ±0.04	3.11 ^d ±0.04	2.89 ^e ±0.21	60.54 ^a ±0.1	392.49 ^a ±0.13
BK4	10.64 ^a ±0.1	15.86 ^d ±0.13	12.31 ^a ±0.21	3.26 ^d ±0.13	3.61 ^d ±0.02	54.32 ^b ±0.21	391.51 ^c ±0.21
BK5	11.01 ^b ±0.11	19.34 ^c ±0.01	13.91 ^c ±0.13	3.31 ^a ±0.01	3.42 ^b ±0.01	49.21 ^c ±0.13	399.39 ^b ±0.11

Mean with the same superscript along the same column are not significantly different ($p>0.05$)

Key:

BK1- 100 % Maize Flour; BK2- 90 % MF + 5% MS + 5% AYB

BK3- 80 % MF + 5% MS + 15% AYB

BK4- 70 % MF + 10% MS + 20% AYB

BK5- 60 % MF + 15% MS + 25% AYB

Mineral Composition of Kokoro

The results of minerals composition of the kokoro (Local Snack) samples is shown in Table 2. The sodium, potassium, calcium, iron and zinc values ranged from 9.11-20.85, 18.63-27.36, 19.41-26.16, 20.34-31.52, 1.11-3.89 and 0.09-2.95 mg/100g, respectively. It was observed from the table that all the mineral parameters analyzed for the samples increased significantly as the propotion of the composite flour

increased. The results also indicated that the mineral composition of samples is high, this corroborated with the finding of Ijarotimi *et al.* (2006). Highest values of calcium were obtained from samples, this will play very important role in the formation of strong bones, teeth and for growth also for, heart function and cell metabolism (Abbaspour *et al.*, 2014). Also from the results the values obtained for iron and zinc are appreciable. Iron is an essential element for almost all living organisms because it participates in a wide range of metabolic processes, including oxygen transport, synthesis of deoxyribonucleic acid (DNA) and electron transport. This metal also plays important roles during inflammation and the immune response to infection. However, as this mineral can form free radicals, its concentration in the body must be carefully regulated, since its excess can cause tissue damage (Abbaspour *et al.*, 2014; Barragán-Ibañez *et al.*, 2016). Iron is the most abundant in human serum, followed by zinc and copper. Zinc performs a wide variety of functions in the human body, such as maintenance of physiological processes, metabolism, signaling, transduction, cell growth and differentiation. There were significant differences in all the parameters analyzed for minerals content of the samples except potassium which was differed significantly.

Table 2: Mineral Composition of Kokoro (Local Snack) prepared from Maize, Malted Sorghum and African Yam Bean Flour

Samples	Sodium (mg/100g)	Potassium (mg/100g)	Magnesium (mg/100g)	Calcium (mg/100g)	Iron (mg/100g)	Zinc (mg/100g)
BK1	9.11 ^b ±0.01	18.63 ^b ±0.13	19.41 ^c ±0.01	20.34 ^a ±0.02	1.11 ^e ±0.12	0.09 ^a ±0.01
BK2	15.74 ^c ±0.01	19.21 ^b ±0.11	20.46 ^a ±0.01	25.12 ^d ±0.04	1.65 ^d ±0.01	0.12 ^d ±0.03
BK3	18.22 ^a ±0.03	23.45 ^b ±0.01	24.57 ^e ±0.01	28.12 ^c ±0.01	1.94 ^c ±0.01	0.17 ^b ±0.05
BK4	18.91 ^d ±0.11	25.22 ^{bc} ±0.01	25.32 ^d ±0.05	29.35 ^b ±0.01	2.34 ^b ±0.01	1.98 ^a ±0.11
BK5	20.52 ^e ±0.01	27.36 ^b ±0.01	26.16 ^b ±0.11	31.52 ^a ±0.01	3.89 ^a ±0.02	2.95 ^c ±0.01

Mean with the same superscript along the same column are not significantly different ($p>0.05$)

Key:

BK1- 100 % Maize Flour

BK2- 90 % MF + 5% MS + 5% AYB

BK3- 80 % MF + 5% MS + 15% AYB

BK4- 70 % MF + 10% MS + 20% AYB

BK5- 60 % MF + 15% MS + 25% AYB

Sensory Attributes of Kokoro

The results of sensory evaluation of kokoro produced from the blend of maize, malted sorghum and African yam bean flour is presented in Table 3. The attributes evaluated for sensory are appearance, flavor, taste, texture, crispness and overall acceptability. Sample BK1 was most acceptable in terms of appearance, texture, crispness and overall acceptability, while in terms of flavour and taste sample BK2 were rated highest by the panelist. The sensory results revealed that acceptable kokoro (Local Snack) that were similar to the control (100 %) maize flour for most of sensory attributes were produced from proportion of samples BK3, BK4 and BK5.

Table 3: Sensory Evaluation of Kokoro (Local Snack) prepared from Maize, Malted Sorghum and African Yam Bean Flour

Samples	Appearance	Flavour	Taste	Texture	Crispness	Overall Acceptability
BK1	7.86 ^a ±0.04	5.33 ^d ±0.05	7.52 ^a ±0.01	6.87 ^c ±0.11	6.95 ^b ±0.02	6.75 ^b ±0.13
BK2	7.77 ^b ±0.01	6.92 ^b ±0.14	7.54 ^a ±0.04	6.61 ^c ±0.14	6.90 ^a ±0.01	6.68 ^b ±0.05
BK3	7.69 ^c ±0.01	6.87 ^c ±0.12	7.46 ^a ±0.02	6.55 ^c ±0.05	6.46 ^d ±0.01	6.71 ^a ±0.12
BK4	7.64 ^c ±0.01	6.21 ^a ±0.01	7.10 ^{ab} ±0.01	6.43 ^a ±0.04	6.41 ^c ±0.12	6.73 ^a ±0.04
BK5	7.42 ^d ±0.03	6.12 ^a ±0.02	6.82 ^b ±0.11	6.11 ^b ±0.04	6.28 ^e ±0.01	6.70 ^c ±0.02

Mean with the same superscript along the same column are not significantly different ($p>0.05$)

Key:

BK1- 100 % Maize Flour

BK2- 90 % MF + 5% MS + 5% AYB

BK3- 80 % MF + 5% MS + 15% AYB

BK4- 70 % MF + 10% MS + 20% AYB

BK5- 60 % MF + 15% MS + 25% AYB

Conclusion

The results obtained from the study has shown that enrichment of maize flour used in the production of kokoro with malted sorghum and African yam bean resulted to increase in protein ash, fat and crude fiber contents of the flour- mixes. Mineral

composition also increased consistently for all the samples. The results also indicated that all the composite samples were acceptable as compared to the control sample (100 % maize flour) by the consumers. It thus recommended that further research should be carried out on anti-nutritional composition of both composite flour and the products.

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