*IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*
*e-ISSN: 2319-2402, p- ISSN: 2319-2399.Volume 18, Issue 10 Ser. 2 (October 2024), PP 23-28*
*www.iosrjournals.org*

# Production And Quality Evaluation Of Kokoro (A Maize Based Snack) From Sprouted Maize Suipplemented With African Yam Bean

Makanjuola, John Olanrewaju And Makanjuola, Olakinle Moses
*Department Of Science Laboratory Technology, Federal Polytechnic, P.M.B. 50, Ilaro, Ogun State, Nigeria*
*Department Of Food Science And Technology, Federal Polytechnic, P.M.B. 50, Ilaro, Ogun State, Nigeria.*

***Abstract***
*"Kokoro", a maize-based snack characterized by low protein was evaluated for nutrients composition by supplementation with African yam bean (AYBF)flour using standard analytical procedures. The maize-based snack (Kokoro) produced from this research work was a blend of unsprouted maize and sprouted maize supplemented with AYBF at different substitutional levels. The proximate content revealed that moisture content, crude protein, fat, ash and fibre as well as carbohydrate contents ranged from 9.23-1054%, 7.82-13.13%, 20.82-31.73%, 1.52—1.96%, 2.16-2.74% and 41.21-57.14% respectively. Increase in the levels of protein, fat, ash and fibre as the level of substitution increases was observed. Functional properties revealed AYBF can be useful in food application, most especially with cereal based crops. The pasting characteristics although revealed significant variation (P<0.05) among samples, also revealed its uses in food systems. The sensory qualities showed that sample supplemented with 30% AYBF came closely to the reference kokoro, indicating consumers' preference for supplemented kokoro that an favourably supply needed nutrients when consumed.*
***Keywords:*** *Production, Quality evaluation, kokoro, Supplementation, Maize, African yam bean*

---

Date of Submission: 16-10-2024 Date of Acceptance: 26-10-2024

---

## I. Introduction

Kokoro snack is an indigenous maize based product from 100% whole white maize that undergoes a 3-day intensive traditional process with several unit operations such as drying, cleaning, boiling, fermentation, milling, mixing, dough formation, kneading, rolling and cutting, deep frying, draining, second deep-frying, for the development of colour and aroma, cooling and packaging (Akinbola et al., 2020). Kokoro is a popular traditional maize snack of Nigeria, but characterized by low protein (Idowu, 2015).

Maize (zea may) is an indispensable food crop consumed by African in various processed forms such as kokoro. Maize (zea mays) is the third most important cereal in the world after rice and wheat and ranks fourth after millet, sorghum and rice in Nigeria *FAO, 2009). It is a good source of carbohydrate, vitamins and mineral and it can be processed into a wide range of food items and snacks. Some of the maize-based snacks in Nigeria include aadun (maize pudding), kokoro (maize cake) and donkwa (maize-peanut ball) (Idowu, 2022).

African yam bean is an underutilized crop with high nutritional value which has attracted research interest in recent times (Akinsola, et al., 2020). Plant foods still maintain the greatest possible fountain head of basic nutrients for major population globally. Plant foods are more advantageous over other sources of food due to the fact that they are readily available cheap, affordable and generally acceptable (Gbenga-Fabusiwa, 2021). African yam beans contains 2 to 3 times protein of cereal grains (Ngwu et al., 2014), Pamplona-Roga, 2006). Indeed, no other plant food is as rich in protein as legumes in their natural state. Its amino acid profile is comparable to those for most edible pulses (Ngwu et al. 2014; Pamplona-Roga, 2006; Eno-Obong & Carnovate, 1992). A lot of research works have been carried out on the production of kokoro. Nutritional composition, anti-oxidant and sensory properties of a maize-based snack (kokoro) enriched with defatted sesame and moringa seed flour was undertaken by Oluwamukomi et al., (2021) while Nutrient composition and sensory properties of kokoro (a Nigerian Snack) made from maize and African yam bean flour blends was reported by Idowu (2015). Akinsola et al. (2020) researched on the evaluation of quality and acceptability of snack (kokoro) produced from synthetic provitamin A maize (zea mays) genotypes and Okolie et al. (2022) reported the physiochemical and quality evaluation of kokoro (a maize-based snack) from blend of yellow maize, fermented African yam-bean and rice bran flours. Kokoro is low for its low protein content while the amino acid values in African yam bean seeds spectrum indicates the levels most of the essential (amino-acids especially lysine, methionine, histidine and isoleucine. Therefore, this study aims to evaluate the nutrient composition as well as consumer's acceptability of kokoro snack produced from sprouted maize supplemented with African yam bean blends, thereby promoting the utilization of African yam bean as well as increasing the nutritional content of kokoro.

## II. Materials And Methods

High quality maize variety (BR-9928-DMR-SY) was obtained from International Institute of Tropical Agriculture (IITA) Ibadan, Oyo State, Nigeria while African yam bean seeds were obtained from the Botanical Garden of the Department of Science Laboratory Technology of the Federal Polytechnic, Ilaro, Ogun State, Nigeria. High grade onion, salt (Dangote), vegetable oil (Akon) polyethylene bags (high density) were purchased from a reputable store in Ilaro metropolis. 20kg of dry maize grains were sorted, cleaned and divided into two (2) portions. The first portion was soaked in clean potable water for 24 hours after which it was spread on stainless trays lined with cloth and kept wet by frequent spray of water at every morning for 3 days for sprouting to occur. The sprouted maize grains were then oven dried (cabinet dryer) at 60ºC to constant weight, cooled and milled into flour with hammer mill. The second portion was processed into flour with hammer mill. The second portion was processed into flour without sprouting to serve as the control. The African yam bean (ABY) seeds were sorted, weighed, washed, de-hulled manually by soaking in water at ratio 1.5 w/v for 4 hours at room temperature (29±2ºC) and dried at 60±2ºC in air-dried oven (cabinet dryer). The seeds were then milled using hammer mill and sieved with 500µm mesh sieve to obtain yam bean flour.

Sprouted maize flour (SMF) were substituted with 10, 20, 30 and 40% African yam bean flour (AYBF) by weights. Each blend was separately mixed in a blender for 3 minutes at high speed. The various blends and 100% unsprouted maize flour were packed separately in air tight plastic containers.

**Table 1: Unsprouted and Sprouted Mazie Flour and African Yam Bean Flour Blends**

| SAMPLE CODE | UNSPROUTED AND SPROUTED MAIZE FLOUR (g) | AFRICAN YAM BEAN (g) | SALT | ONION |
|---|---|---|---|---|
| A | 100 | 0 | 5 | 10 |
| B | 90 | 10 | 5 | 10 |
| C | 80 | 20 | 5 | 10 |
| D | 70 | 30 | 5 | 10 |
| E | 60 | 40 | 5 | 10 |

Otunola et al; 2012

Unsprouted/Sprouted maize flour and African yam bean flours

Boiling

Mixing

Cooling

Kneading

Rolling into round shapes

Frying (deep frying) @ 170ºC for 5 minutes

Draining

Cooling

Kokoro

Packaging

**Flow chart for the production of Kokoro**

The Kokoro snack samples were prepared as described by Idowu (2015) and Uzo-Peters et al., (2008). Analysis of proximate composition was carried out using standard method of AOAC (2010), bulk density using AOAC (2006), Water absorption capacity (AOAC, 2006), Swelling power by Adeboye and Singh (2008). Solubility index by Mandge et al. (2011) and dispersibility by Kulkani (1991). Colour determination was determined by the method of Feili et al. (2013), and pasting properties with the use of Rapid Viscos Analyser (RVA).

**Sensory Evaluation**

Sensory properties were determined by using 9-point hedonic scale, where 9 represent the highest score and 1, the lowest score to evaluate Kokoro for aroma, colour, taste, texture, flavor and overall acceptability. A total of forty (40) semi-trained panelists drawn from the Federal Polytechnic community who were familiar with the product served as panelists.

Data obtained were subjected to statistical analysis using analysis of variance (ANOVA) to determine differences in sample means. Duncan's Multiple Range Test (DMRT) was used to separate the means P≤0.05, using SPSS version 21.0.

## III. Results And Discussion

**Results**

**Table 2: Functional Properties of Unsprouted and Sprouted maize and African Yam Bean Flour Blends**

| Samples | BD (g/ml | WAC (%) | SP (g/g) | Solubility (%) | Dispersibility (%) |
|---|---|---|---|---|---|
| A | 0.577±0.00$^{b}$ | 170.7±1.15$^{a}$ | 4.25±0.02$^{a}$ | 4.37±0.02$^{a}$ | 50.53±0.03$^{a}$ |
| B | 0.886±0.00$^{e}$ | 174.0±2.00$^{a}$ | 4.48±0.02$^{b}$ | 4.63±0.03$^{b}$ | 68.63±0.03$^{b}$ |
| C | 0.705±0.00$^{c}$ | 195.0±2.00$^{b}$ | 5.54±0.02$^{c}$ | 4.86±0.02$^{c}$ | 70.46±0.01$^{c}$ |
| D | 0.717±0.00$^{d}$ | 197.0±2.00$^{b}$ | 6.73±0.03$^{d}$ | 5.04±0.02$^{d}$ | 72.02±0.03$^{d}$ |
| E | 0.556±0.00$^{a}$ | 253.0±2.00$^{c}$ | 6.83±0.04$^{e}$ | 5.15±0.02$^{e}$ | 75.53±0.04$^{e}$ |

Values are mean ± Standard Deviation. Means in the sane column with different superscript letters are significantly (*p*<0.05) different.

Key: BD: Bulk Density, WAC: Water Absorption Capacity, SP: Swelling Power, AYBF= African yam bean flour

A – 100% Un-sprouted maize flour; B- 90% Sprouted maize flour + 10% AYBF; C- 80% Sprouted maize flour + 20% AYBF; D- 70% Sprouted maize flour + 30% AYBF; E- 60% Sprouted maize flour + 40% AYBF

**Table 3: Pasting Properties of Unsprouted and Sprouted Maize and African Yam Bean Flour Blends**

| Samples | PV (RVU) | TV (RVU) | BV (RVU) | FV (RVU) | SV (RVU) | PT (Mins) | PT ($^{0}$C) |
|---|---|---|---|---|---|---|---|
| A | 323.0±1.41$^{d}$ | 316.5±0.71$^{e}$ | 8.00±0.00$^{b}$ | 2226.5±0.71$^{e}$ | 1911.5±0.71$^{e}$ | 6.20±0.00$^{a}$ | 89.56±0.01$^{c}$ |
| B | 213.0±1.41$^{b}$ | 211.0±1.41$^{c}$ | 2.00±0.00$^{a}$ | 2053.5±0.71$^{d}$ | 1841.5±0.71$^{d}$ | 6.20±0.00$^{a}$ | 88.03±0.04$^{b}$ |
| C | 211.5±0.71$^{b}$ | 187.5±0.71$^{b}$ | 24.50±0.71$^{c}$ | 1929.0±1.41$^{c}$ | 1741.5±0.71$^{c}$ | 7.00±0.01$^{b}$ | 86.44±0.01$^{a}$ |
| D | 70.5±0.71$^{a}$ | 31.50±0.71$^{a}$ | 40.50±0.71$^{d}$ | 1543.5±0.71$^{a}$ | 1512.5±0.71$^{b}$ | 7.01±0.01$^{b}$ | 87.95±0.07$^{b}$ |
| E | 288.5±0.71$^{c}$ | 244.5±0.70$^{d}$ | 40.50±0.71$^{d}$ | 1723.5±0.71$^{b}$ | 1478.5±0.71$^{a}$ | 7.00±0.01$^{b}$ | 87.98±0.04$^{b}$ |

Values are mean ± Standard Deviation. Means in the sane column with different superscript letters are significantly (*p*<0.05) different.

**Key**: PV= Peak Viscosity, TV= Trough Viscosity, BV: Breakdown Viscosity, FV= Final Viscosity, SV= Setback Viscosity, PT=Peak Time, PT=Pasting Temperature, AYBF= African yam bean flour

A – 100% Un-sprouted maize flour; B- 90% Sprouted maize flour + 10% AYBF; C- 80% Sprouted maize flour + 20% AYBF; D- 70% Sprouted maize flour + 30% AYBF; E- 60% Sprouted maize flour + 40% AYBF

**Table 4: Proximate Composition of Kokoro Produced from Unsprouted and Sprouted African Yam Bean Flour Blend.**

| Sample | Moisture Content (%) | Protein Content (%) | Crude Fat (%) | Total Ash (%) | Crude Fibre (%) | Carbohydrate (%) |
|---|---|---|---|---|---|---|
| A | 10.54±0.02$^{e}$ | 7.82±0.02$^{a}$ | 20.82±0.03$^{a}$ | 1.52±0.03$^{b}$ | 2.16±0.02$^{a}$ | 57.14±0.06$^{f}$ |
| B | 10.42±0.03$^{d}$ | 10.05±0.02$^{c}$ | 23.03±0.02$^{c}$ | 1.63±0.03$^{c}$ | 2.35±0.03$^{b}$ | 52.53±0.02$^{d}$ |
| C | 10.15±0.03$^{c}$ | 10.54±0.02$^{d}$ | 27.04±0.02$^{d}$ | 1.76±0.01$^{d}$ | 2.45±0.01$^{c}$ | 48.07±0.05$^{c}$ |
| D | 9.71±0.01$^{b}$ | 11.48±0.02$^{e}$ | 29.85±0.02$^{e}$ | 1.84±0.02$^{e}$ | 2.66±0.03$^{d}$ | 44.47±0.06$^{b}$ |
| E | 9.23±0.02$^{a}$ | 13.13±0.03$^{f}$ | 31.73±0.03$^{f}$ | 1.96±0.02$^{f}$ | 2.74±0.02$^{e}$ | 41.21±0.02$^{a}$ |

Values are mean ± Standard Deviation. Means in the sane column with different superscript letters are significantly (*p*<0.05) different.

**Key**: AYBF= African yam bean flour

A – 100% Un-sprouted maize flour; B- 90% Sprouted maize flour + 10% AYBF; C- 80% Sprouted maize flour + 20% AYBF; D- 70% Sprouted maize flour + 30% AYBF; E- 60% Sprouted maize flour + 40% AYBF

**Table 5: Colour of Kokoro Produced from Unsprouted and Sprouted Maize and African Yam Bean Flour Blends.**

| Samples | L* | a* | b* |
|---|---|---|---|
| A | 60.37±0.02[d] | 2.49±0.02[b] | 13.99±0.02[d] |
| B | 49.07±1.15[a] | 2.95±0.02[c] | 13.63±0.02[c] |
| C | 52.59±0.02[b] | 3.37±0.02[d] | 14.05±0.02[e] |
| D | 56.21±0.02[c] | 3.37±0.02[d] | 11.46±0.02[b] |
| E | 56.71±0.02[c] | 5.34±0.02[e] | 17.38±0.02[f] |

Values are mean ± Standard Deviation. Means on the sane column with different superscript letters are significantly (*p*<0.05) different.

**Key**: AYBF= African yam bean flour

A – 100% Un-sprouted maize flour; B- 90% Sprouted maize flour + 10% AYBF; C- 80% Sprouted maize flour + 20% AYBF; D- 70% Sprouted maize flour + 30% AYBF; E- 60% Sprouted maize flour + 40% AYBF

**Table 6: Sensory Qualities of kokoro Produced from Unsprouted and Sprouted Maize and African Yam Bean Flour Blends.**

| Samples | Aroma | Colour | Taste | Texture | Flavour | Overall acceptability |
|---|---|---|---|---|---|---|
| A | 8.47±0.52[c] | 8.73±0.46[b] | 8.80±0.41[b] | 8.73±0.46[b] | 8.73±0.46[b] | 8.60±0.51[b] |
| B | 6.73±0.80[a] | 6.33±0.82[a] | 6.47±1.13[a] | 6.60±1.24[a] | 7.00±1.07[a] | 6.73±0.96[a] |
| C | 7.33±1.06[ab] | 6.57±1.08[a] | 6.29±2.10[a] | 6.24±1.89[a] | 6.71±1.06[a] | 6.90±1.72[a] |
| D | 7.86±1.46[bc] | 8.14±1.57[b] | 7.14±2.73[a] | 7.14±3.07[a] | 7.57±2.30[a] | 7.57±2.14[ab] |
| E | 6.93±0.96[a] | 7.00±1.36[a] | 6.60±1.64[a] | 6.40±1.84[a] | 6.80±1.42[a] | 6.93±1.98[a] |

Values are mean ± Standard Deviation. Means in the sane column with different superscript letters are significantly (*p*<0.05) different.

**Key**: AYBF= African yam bean flour

A – 100% Un-sprouted maize flour; B- 90% Sprouted maize flour + 10% AYBF; C- 80% Sprouted maize flour + 20% AYBF; D- 70% Sprouted maize flour + 30% AYBF; E- 60% Sprouted maize flour + 40% AYBF

**Discussion**

Table 2 displays the functional properties of African Yam Bean Flour (AYBF) and unsprouted and sprouted maize flour. Food characteristics that dictate a food's application and final use are known as its functional features. Bulk density (BD), water absorption capacity (WAC), swelling power (SP), solubility, and dispensability are the functional attributes that have been identified. The bulk densities of the AYBF and both sprouted and unsprouted maize ranged from 0.577g/ml to 0.886g/ml, showing that the sprouted maize flour supplemented with 10% AYBF had the highest value of 0.886mg/ml, while the unsprouted maize recorded the least value of 0.577mg/ml (control). Karauna et al. (1996) reported that BD is influenced by particle size and the density of the flour, which is significant in determining the packaging requirement and material handling. The low densities found in this study suggest that all of the flour samples could be utilized to enhance foods and be employed in food formulation without raising any red flags about retrogradation. A flour product's ability to bind with water in a situation when water is scarce is measured by its WAC (Omueti et al., 2009). The water absorption capacities of formulation A, B, C, D, and E were 170.7%, 174.0%, 195.0%, 197.0%, and 253.0%, respectively. The literature (Omueti et al., 2009) attributes the high WAC to the starch polymers' loose structure, however the low absorption capacity found in this work may also be helpful in food systems, such as baked goods which require hydration to improve handling characteristics. However, results of this study for WAC were higher than those of Ayinde et al. (2012). Since the determination of SP is a weight measure of swelled starch granules and their included water, SP is a measure of hydration capacity. It was shown that when the amount of AYBF included rose, solubility and SP also increased. There were notable variations (P<0.05) between the samples in the SP and solubility of the flour blends, ranging from 4.25 to 6.83g/g and 4.37 to 5.15, respectively. The water absorption index of the starch-based flour during heating is likewise correlated with SP (Loss et al., 1981), and the indication of how sample it is to reconstitute flour samples in water is called dispersability.

The flour samples differed significantly (P<0.05), as indicated by the percentage dispersibility. The results showed rising values with an increase in AYBF inclusion, ranging from 50.53 to 75.53%. Table 3 displays the pasting properties of the blended African yam and maize beans, both sprouted and unsprouted (control). Peak viscosity (PV) has been defined as a measure of a food's capacity to swell unrestrictedly prior to physical breakdown. The peak viscosities of the flour samples under examination ranged from 70.5 to 323 RVU, with significant variations (P<0.05) observed. PV also reveals the flour samples' ability to bind water, which is crucial for the user to obtain a usable starch.

The range of the trough viscosity was 31.50 to 316.5 RVU. A paste's ability to resist breaking down during cooling is shown by its high TV; the larger the TV, the better the paste's ability to withstand breaking down during cooling: The capacity of the flours to create a viscosity paste or gel after boiling and cooling is indicated by breakdown viscosity. The greater the viscosity rating, the more resistant the starches are to breaking down. The breakdown viscosity of the sample blends varied significantly, ranging from 2.00 to 40.50 RVU. The lowest value (2.00 RVU) was obtained when 10% of the sprouted maize flour was replaced with AYBF; the highest values (40.50 RVU) were obtained when 30% and 40% of the sprouted maize flour was replaced with African yam bean flour.

The capacity of the substance to become a viscous paste or gel after heating and cooling, as well as the paste's resistance to shear force when stirring, are indicators of its final viscosity. The final viscosities of the five flour samples (A, B, C, D, and E) were 2226.5, 2053.5, 1929.0, 1543.5, and 1723.5 RVU, respectively. The cooked starch's propensity to solidify upon cooling as a result of amylose retrogradation is known as setback viscosity. It also revealed a significant difference ($P \leq 0.05$) across the flour samples, ranging from 1478.5 to 1911.5 RVU. In freeze-thaw cycles, whipping or syneresis is also linked to higher setback viscosity. Peak time (PT), which ranged from 6.20 to 7.01 minutes and represents longer processing time, is a measure of cooking time as the AYBF inclusion increases.

An indicator of the processing time required for gelatinization is provided by the pasting temperature. It is the temperature at which viscosity increases for the first time that can be detected. The range of pasting temperatures was 89.56% to 86.44. The maximum pasting temperature was recorded by the 100% (unsprouted mazie flour), indicating the presence of starch that is extremely resistant to swelling during cooking.

The approximate composition of kokoro made from sprouted and unsprouted maize flour combined with mixes of AYBF was displayed in Table 4. The kokoro made from the flour samples had a moisture percentage ranging from 9.23 to 10.54%. Significant differences ($P<0.05$) were seen in all samples that had their moisture contents assessed. The kokoro made with unsprouted maize flour (control) had the maximum moisture content at 10.54%, while the kokoro made with sprouted maize flour supplemented with 40% AYBF had the lowest moisture level at 9.23%. The trend indicated that the moisture content decreased with an increase in the incorporation of AFYB. The values found in this investigation fell within the range that has been shown to have no negative impact on the product's quality attribute (Mepha et al., 2007). Reduced moisture content will stop germs from growing, extending the product's shelf life. The range of the protein contents was 7.82 to 13.13%. The high level of protein contents found in African yam bean flours may be the cause of the protein's progressive increase as the amount of flour is added. Literature suggests that it is crucial to enhance the nutritional quality of kokoro by supplementing it with plant-based protein sources such AYBF and fortifying it (Okolie et al., 2022).

Samples A, B, C, D, and E had fat contents of 20.82%, 23.03%, 27.04%, 29.85%, and 31.73%, respectively. This indicates a progressive increase in fat content as the substitution of AYBF increases; therefore, there were significant differences ($P<0.05$) in the treated samples. Products with high fat contents are known to have high energy values and to encourage lipid oxidation. Food materials' ash contents provide a ballpark assessment of the product's mineral composition. There was a significant difference ($P<0.05$) in the ash content of every sprouting African yam bean and maize kokoro. Ash levels ranged from 1.52 to 1.96%. The sprouted maize-African yam bean kokoro will have a high mineral content, as indicated by the increase in ash content.

It is currently acknowledged, according to Slavin (2005), that fiber is important in preventing a number of pathological disorders, including diverticulosis, constipation, irritable colon syndrome, diabetes, cancer, and cardiovascular illnesses. The crude fibre ranged from 2.16 to 2.74%, revealing that kokoro produced from the blends increases as the substitution with AYBF increases, except the reference (control) kokoro samples. The range of carbohydrate levels for all samples, including the control (unsprouted maize flour), was 41.21 to 57.14%. Significant variations ($P<0.05$) were observed between the samples, and it was shown that the amount of carbs decreased with a rise in AYBF inclusion.

The colour characteristics of the kokoro produced from flour blends of maize and AYBF are shown in Table 5. Significant differences ($P<0.05$) existed in the lightness ($L^*$), redness ($a^*$) and yellowness ($b^*$). Lightness ranged from 49.07 to 60.73 while redness varied from 2.49 to 5.34. Also, yellowness varied from 11.46 to 17.38 for the kokoro samples: The redness ($a^*$) increased as the substitution of African yam bean increases, showing more red.

Table 6 displays the findings of the sensory attributes tests performed on the kokoro samples. Food acceptability is thought to be significantly influenced by sensory evaluation since consumers seek out foods with particular sensory qualities. It is a well-known truth that a food's acceptance depends on how effectively it meets the needs and satisfaction of its customers. A substantial variation ($P<0.05$) exists in almost every attribute that has been assessed. Overall acceptance typically indicates how panelists or consumers feel about the products being considered. Nonetheless, it was found that, based on of all the assessed features, the control kokoro was the most favored.

## IV. Conclusion

The use of sprouted maize supplemented with AYBF for the production of kokoro has the dual advantage of increasing the nutrients such as protein, ash and crude fibre of the product while also promoting the utilization of a lesser utilized legume such as African yam bean in combating malnutrition.

## V. Acknowledgement

The Authors wish to express their gratitude to the Research and Development Centre (RESDEC), the Management of the Federal Polytechnic, Ilaro and Tertiary Education Trust Fund (TETFUND) for providing the fund used in undertaking this study. Also, worth of mentioning is the technical assistance provided by Olorunoje, Sadiq Olatunji.

## References

[1] Akinsola, O. T., Alamu, E. O., Otegbayo, B. O., Menkir, A. And Maziaya-Dixon, B. Evaluation Of Quality And Acceptability Of Snack (Kokoro) Produced From Synthetic Provitamin A Maize (Zea Mays) Genotypes. Front Sustain Food. 2020, System.4https//Doi.Org/10.3389/Sufs.576217.

[2] Idowu, A. O., Nutrient Composition And Sensory Properties Of Kokoro (A Nigerian Snack) Made From Maize And African Yam Bean Flour Blends; International Food Research Journal 2015, 22(2). 739-744.

[3] F.A.O. Food And Agriculture Organization, Maize, Rize And Wheat: Area Harvested, Production Quality, Yield, 2009, Food And Agriculture Organization Of The United Nations, Rome, Italy.

[4] Gbenga Fabusiwa, F. J., African Yam Beans (Sphenostylis Stenocarpa): A Review Of A Novel Tropical Food Plant For Human Nutrition, Health And Food Security, African Journal Of Food Science, 2021, 15(2): 33-47.

[5] Ugwu, E. K., Aburime, L. C. And Ani, P. N., Effect Of Processing Methods On The Proximate Composition Of African Yam Bean (Sphenostylis Stenocarpa) Flours And Sensory Characteristics Of Their Gruels, International Journal Of Basic And Applied Sciences, 2014, 3(3): 285-290.

[6] Pamplona-Roger, G. D., Encyclopedia Of Food And Health Power, Education And Health Library, 2006.

[7] Eno-Obong, H. N. And Carnovale, E. A., Comparison Of The Proximate And Mineral And Amino Acid Composition Of Some Lesser Known Legumes In Nigeria, Journal Of Food Chemistry, 1992, 43: 169-175.

[8] Oluwamukomi, M. O. Awolu, O. O. And Olapade, K. T. Nutritional Composition, Antioxidant And Sensory Properties Of A Maize-Based Snack (Kokoro) Enriched With Defatted Sesame And Moringa Seed Flour, Asian Food Science Journal, 2021, 20(10): 100-113.

[9] Okolie, P. I.Coker, M T., Okolie, E. C. And Oke, K. E., Physiochemical And Quality Evaluation Of Kokoro (A Maize-Based Snack) From Blend Of Yellow Maize, Fermented AYB And Rice Bran Flours. Applied Food Research, 2022, 2(5): 100-104.

[10] Otunola, E. T. Sunny-Roberts, E. O., Adejuyitan, J. A. And Famakinwa, A. O., Effects Of Addition Of Partially Deffated Groundnut Paste On Some Properties Of Kokoro" (A Popular Snack Made From Maize Paste), Agriculture And Biology Journal Of North America, 2012, 3(7): 280-286.

[11] Uzo-Peters, P. I., Arisa, N. U., Lawrence, C. O., Osondu, N. S. And Adelaja, A.; Effect Of Partially Defatted Soybeans Or Groundnut Cake Flours In Proximate And Sensory Characteristics Of Kokoro, African Journal Of Food Science, 2008, 2: 98-101.

[12] AOAC, Association Of Official Analytical Chemist, Official Methods Of Analysis, 2010, 17th Edition, Washington, D. C.

[13] AOAC, Association Of Official Analytical Chemist, Official Methods Of Analysis, 2006, 18th Edition, Washington, D. C.

[14] Adeboye, O. C. And Singh, V, Physicochemical Properties Of The Flour And Starches Of Two Cowpea Varieties, (Vigna Unguiculanta L Walp), Innovation In Food Science And Emerging Technology, 2008, 9: 92-100.

[15] Mange, H. M. Sharma, S And Dar, N. B., Instant Multigram Porridge; Effect Of Cooking Treatment On Physiochemical And Functional Properties. Journal Of Food Science And Technology, 2011, Doi.10.1007/S/13197-01100461-6.

[16] Kulkarni, K. D., Kulkarni, D. N. And Ingler, U. M., Sorghum Malt-Based Weaning Food Formulations , Preparations, Functional Properties And Nutrition Value, Food And Nutrition Bulletin, 199, 13(4): 322-327.

[17] Feili, R., Zaman, W., Abdullah, W. N. And Yang, T. A., Physical And Sensory Analysis Of High Fiber Bread Incorporated With Jackfruit Rind Flour, Food Science And Technology, 2013, 1(2): 30-36

[18] Karuna, D., Noel, G And Dilip, K., Food And Nutrition Bulletin, 1`996, 17:2, United Nations.

[19] Omuet, O., Otegbayo, B., Jaiyeola, O. And Afolabi, O., Functional Properties Of Complementary Diets Developed From Soybean (Glycine Max), Groundnut (Arachis Hypogeal) And Crayfish (Macrobrachium Spp), Journal Of Environmental, Agricultural And Food Chemistry, 2009, 8(8): 563-573.

[20] Ayinde, F. A., Bolaji, O. T., Abdul-Salami, R. B., And Osidipe, O., Functional Properties And Quality Evaluation Of Kokoro Blended With Beni-Seed Cake (Sesame Indicum), African Journal Of Food Science, 2012, 6(5): 117-123.

[21] Loss, P. J., Hood, L. F. And Graham, A. J., Isolation And Characterization Of Starch From Bread Fruit, Cerakl Chemistry, 1981, 58: 282-286

[22] Mepba, H. D., Adninwhu, S. N. And Aso, S. N., Microbiological Quality Of Selected Street Foods In Port Harcourt, Nigeria, Journal Of Food Safety, 2007, 27: 208-212.

[23] Slavin, J. L., Dietary Fibre And Body Weight, Journal Of Nutrition, 2005 21: 411-418.