

QUALITY EVALUATION OF AGIDI (MAIZE PUDDING) ENRICHED WITH FLOUR BLENDS OF SOYBEANS AND CARROT

ANOSIKE A., SOGUNLE, K.A AND AGOMUO, J.K

Department of Food Science & Technology, Federal University, Dutsinma, Katsina State.

Corresponding Author: mailify2k@gmail.com

DOI Link: <https://doi.org/10.70382/bejhmns.v7i3.007>

Abstract

Agidi (maize pudding) is a gel-like traditional fermented starchy food mainly made from maize. Maize used in the production of agidi is limiting in some essential nutrients. The study aims to assess the quality properties agidi produced from maize, soybean and carrot composite flour. Agidi was produced from the blends of maize, soybean and carrots at ratio; 100 maize flour for sample A (control), 85:10:5 sample B, 80:15:5 sample C, 75:20:5 sample D, and 70:25:5 sample E. The agidi samples were analyzed for proximate composition and minerals using standard methods. Moisture, fiber, protein, ash, fat, carbohydrate and energy content ranged from 22.4 - 31.5%, 0.08 - 1.04%, 8.7-19.7%, 0.08-0.64%, 4.7-8.2%, 48.0-54.9 %, 223.0 - 275.5 kcal/100g respectively. Iron, zinc, calcium and potassium content ranged from

Introduction

Agidi a “maize based pudding is a gel like traditional fermented starchy food mainly made from maize (Adegbehingbe *et al.*, 2018). It is a very popular food, widely recognized and enjoyed by different ethnic groups in Nigeria, For instance, the Yoruba refer to it as eko, the Igbos call it *Agidi*, and the Beninians called it akasan while the Hausas refer to it as kafa, (Ogiehore *et al.*, 2005 Kolawole *et al.*, 2020). Agidi Production is laborious, tedious and time taking.

0.947-2.997 mg/100g, 0.121-0.551mg/100g, 23.179-58.694mg/100g, and 5.575-10.201mg/100g respectively. The addition of soybeans and carrots to agidi significantly changed its proximate composition. These findings highlight the potential of this enrichment strategy to enhance the nutritional value of staple foods and promote better health outcomes.

Keyword: Agidi, Composite flour, Maize, Pudding.

Currently, its production varies from one locality to another resulting in a non-uniform product (Ogiehor *et al.*, 2005). In western part of Nigeria it is prepared by stirring of ogi paste in hot water over fire and stirring until a gel is formed. The cold gel is there after wrapped in leaves such as ewe eran (Abiodun *et al.*, 2018). Generally, *Agidi* is wet milled sieved and cooked until a gel paste is formed (Ikya *et al.*, 2013). It is typically eaten with stew, vegetables, bean cake, or bean pudding. According to Akusu *et al.*, (2020) consumption of *Agidi* (maize pudding) has increased significantly as its consumption cuts across all economic classes of people, sex and age groups. However, it is commonly consumed by the vulnerable group, including the elderly and as a weaning food for children (Zakari *et al.*, 2010).

Maize (*Zea mays L.*) is an important annual cereal crop of the world belonging to family Poaceae. It is the third most popular cereal crop after rice and wheat in the world and fourth in Nigeria after millet, sorghum and rice (FAO, 2009). Due to its highest yield potential among the cereals it is known globally as queen of the cereals. Maize is an important cereal which can be fermented to give various products important to the diet of many countries in Africa. Fermentation improves the products quality producing lactic acid which causes souring and improvement in its taste flavour and texture (Mohiedeen *et al.*, 2001). Maize is generally processed and utilized in food preparations including breakfast cereal, weaning foods, and other snacks since it contains a lot of carbohydrates (70–87%), provides 365 Kcal of energy, 6–13% protein, 4% fat, 2–6% oil, and 1–3% sugar (FAO, 2009).

According to Oguche *et al.*, (2017) puddings made from maize contain higher proportion of carbohydrate (74.06%) but low in terms of fibre 1.92% and protein (8.92%). This led to emergence and incorporation of plant based nutrient source to enrich the final product.

Soybeans (*Glycine max*) is grown for its edible pulse, it contains significant amount of protein that may vary from 33 to 50 % depending on the varieties. Soybeans also contain all the essential amino acids except methionine and cysteine which must be supplied in the diet as the body cannot synthesize it (Moses *et al.*, 2019). It also contains essential minerals like calcium, iron and zinc and vitamins A, B and C (Silvina, 2011). Soybean grains can be used in multiple ways, through processing into snacks, paste and milk like product for infant. It has potential for preparation into flour, roasted and eaten as peanut-like (Martin *et al.*, 2010). Processing of soybean will not only help in making nutrients more accessible and palatability, it will also help in removing undesirable constituent (Agume *et al.*, 2017).

Carrot is a root vegetable that belongs to the Apiaceae family (Ascot *et al.*, 2010). It is a popular vegetable worldwide and is known for its bright orange color, crunchy texture and sweet taste. Carrots are widely consumed both raw and cooked and are commonly used in salads, soups, stews, and various other dishes. Carrots storage root is a good source of carotenoids vitamin and dietary fiber and is also rich in minerals and antioxidants (Ascot *et al.*, 2010). Due to increase in health awareness, carrots are becoming more popular due to their abundant nutrient and health benefit. (Nicolle *et al.*, 2004). The aim of this research is to evaluate the quality of agidi enriched with four blends of soybeans and carrot.

MATERIALS AND METHODS

Sources of Materials

Maize (*Zea mays* L.), soybean (*Glycine max* L.) and carrot (*Daucus carota* L.) were obtained from a local market in Dutsin ma Katsina State, Nigeria.

All the chemical used were analytical grade

Sample preparation

Fermented maize flour production

Fermented maize flour was produced according to method describe by Ojo *et al.*, (2016). The maize was cleaned and soaked for 48 hours at room temperature. Thereafter the steeped water was decanted and the maize grain obtained was washed with portable water. The grains were subjected to wet milling using attrition mill after which the slurry was then sieved using 500 um aperture sieve. The slurry was allowed to settle for 12 hours and the supernatant decanted. The semi dried slurry was then dried in oven at 65 °C for 5 hours and milled, sieved before packing in an air tight nylon for further use.

Soybean flour production

One kilogram (1kg) of soybean was processed according to method as describe by Adesokan *et al.*, (2011). The soybean is cleaned, sorted, and blanched at 90 °C for 3 minutes to inactivate the enzymes. The soybean was manually dehulled and oven-dried at 60 °C for 4 hours. The dried beans were milled using an attrition machine and filtered through a 1 mm mesh sieve.

Carrot flour production

The method as described by Obidiapo *et al.*, (2017) with slight modification was used in the preparation of carrots powder. The carrots were sorted, brushed using knife then washed with portable water. They were grated using a grater and then oven-dried at 55 °C for 24 hours. After drying, the carrots were milled using an electric blender and sieved through a 0.5mm mesh sieve. Finally, the carrot powder was packed in an airtight container.

Table 1: Formulation of maize, soybean and carrot in *agidi* (maize pudding)

Samples	Maize (%)	Soybean (%)	Carrot (%)
A	100	0	0
B	85	10	5
C	80	15	5
D	75	20	5
E	70	25	5

Enriched *agidi* production

Agidi was prepared using the method described by Kolawole *et al.*, (2020) as shown in Table 1 with slight modifications. Fermented maize powder was mixed with soybean flour and carrot flour according to the specified percentages for each sample. 300ml of water was added to the mixture and was stirred thoroughly to avoid formation of lumps in the final product. This was then added into 1000 mL capacity pot, it was allowed to boil with continuous stirring for about 10 minutes until a gel-like semi-solid was formed. Each sample was dispensed into a well labelled aseptic disposable plastic package and sealed.

Proximate composition of *agidi* enriched with soybeans and carrot

Proximate composition include moisture, fat, ash, protein, and carbohydrate calculated by difference using AOAC (2012)

Determination of moisture content

Two grams (2.0g) of the prepared sample was weighed in duplicates into petri dishes of a known weight and covered immediately, these was transferred into the oven and heated at 105 °C for 4 hours, the samples was then transferred into the desiccator and allowed to cool for 15 minutes before weighing. This was repeated until a constant weight was gotten.

$$\text{Moisture content} = \frac{\text{weight loss}}{\text{weight of sample}} \times 100 \dots\dots\dots (i)$$

Determination of crude fat content

Two gram (2.0g) of the prepared samples was weighed into the extraction thimbles and fixed into an extraction flasks of a known weight. Extraction was carried out using diethyl ether on electro thermal. At the completion of the extraction, the diethyl ether was removed by evaporation on electrical bath and the remaining fat was dried at a temperature of 60 °C for 30 minutes in

the oven and then cooled for 15 minutes. The fat content (%) was calculated as follows

$$\text{Fat content} = \frac{\text{weight loss of fat}}{\text{weight of sample}} \times 100, \dots\dots\dots (ii)$$

Determination of crude protein content

Two grams of the prepared sample was digested in the kjedahl digestion system under a fume chamber. The digested sample was allowed to cool and then distilled into boric acid containing mixed indicator (Methyl red and methylene blue) after being diluted first with distilled water and later with sodium thiosulphate and sodium hydroxide solution. The sample was then titrated against 0.1N Hydrochloric acid (HCl) solution. A blank titration was similarly carried out and the percentage (%) protein content was estimated as % Nitrogen *6.25 (1ml of 0.1N HCl=0.0014gN)

$$\text{Nitrogen} = \frac{\text{Titre value} - \text{blank} * 0.0014 \text{gN} * \text{N HCl loss of fat}}{\text{weight of sample}} \times 100 \dots\dots\dots (iii)$$

$$\text{Protein} = \% \text{ Nitrogen} * 6.25 \text{ (general factor)} \quad (4)$$

Determination of fibre content

Two gram (2.0g) of the samples was transfer into 1000ml conical flask. Then 200ml of 0,2N of sulphuric acid was added into the flask. The filled flask was transferred to a cold finger condenser and heated for 30minutes. Then the flask contents were filtered using Buchner funnel with washing using a wash bottle filled with hot distilled water. After that, the washed sample was transferred to a conical flask filled with 200ml 0.2N of sodium hydroxide (NaOH), then back to the finger condenser and heated for 30minutes, and was washed as mentioned previously. The sample was transferred to an air oven drier, and left for 24hrs at 65°C, cooled in desiccator and then reweighed. After that, the samples were placed in a muffle furnace, for 3hrs at 550°C and

re weighed after cooling. Crude fiber content was expressed as a percentage and calculated as follows:

$$\text{Crude fibre} = \frac{\text{oven dried weight} - \text{weight after ashing}}{\text{weight of sample}} \times 100 \dots\dots\dots (iv)$$

Two grams (2.0g) of the samples was used for the analysis. $\times = \frac{\text{oven dried weight} - \text{weight after ashing}}{\text{weight of sample}} \times 100$ led and reweighed. The percentage crude fibre was calculated as follows:

Determination of ash content

Five grams (5 g) of the samples was weighed in triplicate into pre weighed dishes. The dishes were placed into a muffle furnace and ignited at 550 °C for 5 hours. The resulting sample was cooled and calculated as follows.

$$\text{Ash content} = \frac{\text{weight loss after ashing}}{\text{weight of sample}} \times 100 \dots\dots\dots (v)$$

Determination of Carbohydrate

Carbohydrate content was determined by difference. Carbohydrate content = $100(\% \text{ moisture} + \% \text{ protein} + \% \text{ fat} + \% \text{ fibre} + \% \text{ ash})$. The energy values was calculated using Atwater factors (protein-4kcal/g Carbohydrate-4kcal/g and fat -9kcal/g) using equation as shown below

$$E. V = (9 \times \text{Crude fat}\%) + 4 \times \text{crude protein}\% + 4 \times \text{carbohydrate}\%$$

Determination of Mineral

Determination of iron contents

The method of AOAC (2012) was used in determining the iron content of samples. Standard solution containing 100mg/ml of Fe^{3+} ions was prepared from 1g pure iron wire. The wire was dissolved in 20 ml concentrated HNO_3 , boiled in water bath and diluted to 1000ml with distilled water. Standard solutions with concentrations 0, 0.5, 1.0, 2.0 and 4.0ppm were prepared. Two

milliliter of sample aliquot was diluted to 100ml and was used to determine the absorbance of the sample using an AGILENT (Model 5805, Agilent Spec England) atomic absorption spectrophotometer at 510 nm. The standard and samples absorbance was noted and concentration of iron in the sample was determined from the standard curve.

Determination of zinc contents

Zinc was determined by atomic absorption spectrophotometer as described by AOAC (2012). One gram of the sample was digested with 20ml of acid mixture (650ml conc HNO₃; 80ml perchloric acid (PCA); 20 ml conc H₂SO₄. The concentration of the test mineral in the sample was calculated with reference to the graph (standard curve) which was obtained as follows:

$$Zn (mg/100g) = 100 \times X \times V_f \times D \dots\dots\dots(vi)$$

W x 100 x Va

W = Weight of the sample analyzed

X = Concentration of Ca obtained from the standard curve

Vf = Total volume of extract

Va = Volume of extract used

D =Dilution factor

Determination of calcium content

Calcium was determined using the atomic absorption spectrophotometer described by AOAC (2012). Calcium carbonate (2.495g) was dissolve and diluted to 100ml with de-ionized water. This solution which contain 1000mg Ca²⁺ ions and from this stock solution, calcium standard of the following concentration levels 0.0, 3.0, 6.0, 9.0 was prepared. The absorbance of both the sample and the standard working aliquot was determined in the AGILENT (Model 5805, Agilent Spec England) atomic absorption spectrophotometer at 239.9nm.

The concentration of the test mineral in the sample was calculated with reference to the graph (standard curve) and obtained as follows:

$$Ca (mg/100g) = 100 \times X \times Vf \times D \dots\dots\dots (vii)$$

$$W \times 100 \times Va$$

W = Weight of the sample analyzed

X = Concentration of Ca obtained from the standard curve

Vf = Total volume of extract

Va = Volume of extract used

D = Dilution fact

Determination of potassium contents

The method of AOAC (2012) was used in determining the potassium content of samples. One gram of the sample was dissolved in 20ml of acid mixture (650 ml of concentrated HNO₃; 80ml PCA; 20ml conc H₂SO₄) and aliquots of the diluted clear digest were taken for photometry using Flame analyser

Statistical analysis

Triplicate samples of data were prepared and analyzed using one-way analysis of variance (ANOVA). Means were compared using the Fisher Least Significant Difference (LSD) test ($p \leq 0.05$) with the Statistical Package for the Social Sciences (SPSS) Version 16.0 for Windows (SPSS Inc., Chicago).

RESULTS AND DISCUSSION.

Table 2: Proximate composition of *Agidi* (maize pudding) enriched with soybean and carrot flour

Samples	Moisture	Fibre	Protein	Ash	Fat	CHO	Energy (Kcal)
A	31.5±0.48 ^a	0.08±0.01 ^a	8.7±0.12 ^a	0.08±0.01 ^a	4.7±0.2 ^a	54.9±0.51 ^a	249.1±0.8 ^a
B	26.4±0.78 ^b	0.63±0.02 ^b	14.5±0.17 ^b	0.45±0.02 ^b	7.8±0.05 ^b	50.2±0.65 ^b	229.0±0.6 ^b
C	25.8±0.46 ^b	0.65±0.02 ^b	15.6±0.22 ^c	0.44±0.04 ^b	7.9±0.03 ^{b,c}	49.6±0.6 ^{b,c}	227.9±0.3 ^b
D	23.7±0.61 ^c	0.84±0.01 ^c	17.4±0.25 ^d	0.58±0.01 ^c	8.1±0.03 ^c	49.5±0.85 ^{b,c}	275.5±0.8 ^c
E	22.4±0.66 ^c	1.04±0.02 ^d	19.7±0.05 ^e	0.64±0.03 ^c	8.2±0.03 ^{c,d}	48.0±0.66 ^c	223.0±1.7 ^d

KEY: Values are mean ± standard deviation of triplicate determined. Values with same superscript are not significantly different at $p (<0.05)$

A=100% maize, 0% soybean, 0% carrot, B= 85% maize, 10% soybean, 5% carrot, C= 80% maize, 15% soybean, 5% carrot, D= 75% maize, 20% soybean, 5% carrot, E= 70% maize, 25% soybean, 5% carrot

Moisture content is a critical factor in food stability, as it represents the amount of water present in a sample and directly impacts its storage and shelf life. The highest moisture content in sample A could be attributed to the low protein content in maize, as it consists of 100% maize. On the other hand, sample E, which is rich in soybeans with a constant proportion of carrots, had the lowest moisture content at 22.4%. The high moisture content observed in this study contrasts with the findings of Oguche (2017), who reported a moisture content range of 8.65% to 9.26% in *agidi* fortified with soybean. However, it aligns more closely with the results of Kolawole *et al.*, (2020), who recorded a moisture content range of 35.44% to 36.97% in *agidi* fortified with soybean and orange-fleshed sweet potatoes.

This high moisture content suggests that the product will have a short shelf life, requiring immediate consumption or refrigeration to prevent spoilage.

The protein content is one of the important key factors in quality food, to support health for preventing malnutrition and body functions. The protein in this study varied highly within the sample ranges, 8.7% for sample A to 19.7% for sample E; respectively. Sample E, produced with 70% maize and 25% soybeans with the addition of carrots at 5%, was high in its protein content due to its high proportion of-protein- in soybeans grains. In contrast, sample A, which contained 100% maize, had the lowest amount of protein because maize naturally has lower protein.

These results align with those of Ikya *et al.*, (2013) and Kola *et al.*, (2020). They demonstrated that protein content of *agidi* increases with increase proportion of soybean added into it. The protein in cereal-based food is greatly increased by adding legumes, especially soybeans. Legumes typically contain higher proportions of protein compared to cereals; they are incorporated into the processing of cereals to enhance the nutritional content of cereals (Stadimayr *et al.*, 2012).

Regarding the appropriateness of all ages, samples E with high protein contents are most ideal for children, adolescents, and any other groups requiring a higher content of protein. On the other hand, *agidi* produced with 100% maize is not that appropriate since it contains low content of protein and will be inappropriate for people requiring more balanced diets. Although higher levels of protein enhance nutritional value of food product, but it can also impact the stability of food product.

The enrichment of *agidi* with soybean and carrot increased its fat content, with Sample E having the highest fat content, whereas Sample A had the lowest because it contained 100% maize. Such an increase corroborates the findings by Nwanagba *et al.*, (2021), where a blend of 30% soybean and 70% maize exhibited a fat value of 9.65%, and Ujoh *et al.* (2023) observed fat values of between 7 to 9% in mixtures containing 20% non-defatted almond seed.

The high fat in Sample E could have been contributed by soybean, which is known to contain rich healthy monounsaturated and polyunsaturated fats (Stadimayr *et al.*, 2012). These fats are important for the provision of energy, absorption of nutrients, and flavor retention, thus improving the nutrient and acceptability of *agidi*.

The fiber is important in the digestive system; it enhances digestion and offering a feeling of fullness. Highest value of fiber values found in Sample E could be attributed to high proportion of soybeans and a constant level of carrots added to it, while Sample A having the lowest level of fiber could be non-inclusion of soybean to it. The increase level of fiber observed in sample E could be advantageous as it helps in the treatment and prevention of many diseases including obesity, colon cancer and diabetes. This is significant in regard to the addition of soybean and carrot in the *agidi*. This finding is in agreement with Oguche *et al.*, (2017) that reported increase in fibre content of *agidi* samples as soybean proportion increases.

Ash content represents the mineral composition left after complete combustion and reflects the mineral density of the sample. Higher

proportions of soybeans and carrots resulted in higher ash content. Values from this study were compared to those of Nwanagba *et al.*, (2020) that reported 2.08% ash content in 30%, 70% soy and maize. As studies has shown that ash is discovered to be in abundant in soy-supplemented cereal foods (Alabi and Anuonye, 2007)

Carbohydrates are the body's main source of energy. The carbohydrate content of the samples decreased significantly ($p \leq 0.05$) with addition of soybean flour at constant carrot level with Sample produced from 100% maize had the highest carbohydrate content while agidi produced with 70% maize 25 soybean and 5% carrot had lowest carbohydrate content. The result gotten is in agreement with kolawole *et al.*, 2020 who reported the range of 48% to 58% of carbohydrate in *agidi* enriched with soybean and orange flash potato but varied from the result of Zakari *et al.*, 2010 who reported the range of 67% to 84% of carbohydrate in *agidi* produced from maize and soybean. This could also be due to variety of maize and soybean used for the production. Enriching *agidi* with soybeans and carrots balances carbohydrate intake, as also observed in similar studies of (Kolawole *et al.*, 2020 and Ohwesiri *et al.*, 2023)

Energy content reflects the caloric value of a sample, which is affected by the presence of protein, fat, carbohydrates and other nutrients. Sample E had the highest energy content, which is attributed to its higher protein and fat content. These findings are consistent with the work of Ikya *et al.*, (2013) that highlighted the energy-enhancing effects of soy-rich *agidi*

Table 3: Mineral Composition of *agidi* enriched with soybean and carrot flour

Samples	Iron (mg/100g)	Zinc (mg/100g)	Calcium (mg/100g)	Potassium (mg/100g)
A	1.584±0.08 ^a	0.121±0.03 ^a	23.179±0.16 ^a	5.575±0.14 ^a
B	0.947±0.03 ^b	0.183±0.02 ^b	30.865±0.23 ^b	6.291±0.15 ^b
C	1.527±0.15 ^c	0.203±0.03 ^c	44.994±0.37 ^c	8.201±0.33 ^c
D	2.399±0.032 ^d	0.302±0.02 ^d	58.694±0.24 ^d	9.160±0.42 ^d
E	2.997±0.53 ^e	0.551±0.04 ^e	53.150±0.34 ^e	10.201±0.31 ^e

KEY: Values are mean $\pm$ standard deviation of triplicate determined. Values with same superscript are not significantly different at p (<0.05)

A=100% maize, 0% soybean, 0% carrot, B= 85% maize, 10% soybean, 5% carrot, C= 80% maize, 15% soybean, 5% carrot, D= 75% maize, 20% soybean, 5% carrot, E= 70% maize, 25% soybean, 5% carrot

Mineral content of agidi

Significant differences were observed in the mineral composition of the samples, particularly in iron, zinc, calcium and potassium levels.

Iron is essential for transporting oxygen in the blood. The iron content in the *Agidi* varied from sample A to sample E, indicating the various proportion of soybean and carrot added into the samples. This is consistent with the findings of Kolawole *et al.*, (2020) that reported an increase in iron content as the enrichment increases and recorded the range of 3.15mg/100 to 5.10mg/100 of iron in *Agidi* fortified with soy and orange flash sweet potato at varying proportion. However, the generally low iron content obtained in this research suggests that *Agidi* rich in soybeans and carrots may not be a high iron source due to the limited amounts of these nutrients.

Zinc plays an important role in the immune system and cellular metabolism. Sample E had the highest value of zinc while sample A had the least value of zinc. This could also be due to various proportion of soybean and constant value of carrot added to the samples. The study is aligned with the study by Kolawole *et al.*, (2020), that recorded an increase in zinc content of *agidi* as the proportion of soybean and orange flash potatoes increases, and the value ranged from 2.40 mg/100g to 5.00 mg/100g, indicating an increase in soybean content and orange potatoes used to enriched *agidi*. Though the values gotten were lower when compared to that of Kolawole *et al.*, (2020) and this could be due to the different raw material used. This high zinc content in enriched samples may be beneficial for health, especially in treating childhood diarrhea and preventing developmental delay.

Calcium is important for bone and tooth health, muscle function, and nerve signaling. The calcium content varied greatly among the samples. The higher calcium content of sample D indicates the optimal amount of soy and carrot to increase the calcium content of *agidi*. The increased calcium content of enriched samples may contribute positively to bone health and development. Potassium is important for heart function, muscle contraction and fluid balance. The potassium content ranged from 5.575 mg/100g in sample A to 10.201 mg/100g in sample E, showing a significant increase in soybean and carrot content (Kolawole *et al*, 2020). The high potassium content in enriched samples suggests benefits for lowering blood pressure and supporting cardiovascular health.

CONCLUSION

There were significant differences in the proximate composition and mineral composition of the *agidi* enriched with varying proportions of soybean and carrot flours. The use of soybean at various proportion and carrot improve the quality of the *agidi* produced such as higher protein, fat and fiber. It also increased the quality of minerals like Iron, zinc and potassium. However nutritional improvement through the addition of soybean and carrot suggest that enriched *agidi* could be used for dietary purpose.

REFERENCES

- Abiodun, S. O., Ogunlade, A. O. and Idowu-Mogaji, G. O. (2018). Proximate, mineral, and sensory analysis of maize-soybeans composite flour biscuit enriched with edible insect "Kanni." *Food Science & Nutrition Research*, 6(2), 1-4.
- Adegbehingbe, K. T., Adeleke, B. S., and Adejoro, D. (2018). Microbiological assessment, physico-chemical, and functional properties of *Agidi* produced in Akoko area of Ondo State. *Fuoye Journal of Pure and Applied science*, 2(1), 31-38.
- Adesokan I. A.1, Fawole A. O., Ekanola Y. A., Odej ayi D. O. and Olanipekun O. K. (2011) Nutritional and sensory properties of soybean fortified composite. *African Journal of Microbiology research*, 5(20) 3144-3149
- Akusu, O. M., Emelike, N. J. T., and Chibor, B. S. (2020). Physiochemical, functional, and sensory properties of *Agidi* produced from maize, millet, and sorghum starch blends. *Delta Agriculturist*, 11(2/3), 50-59.

- Alabi, E.O. and Anuonye, G.O., (2007). Carotenoid profile and functional properties of flour blends from biofortified maize and improved soybean varieties for product developments. *Cogent Food and Agriculture*, 7(1), 1868665: 1-16.
- Ascot, P. I., Onogwu, C. O., Okereke, G. O., And Amak Damak, A. M. (2010). Production and quality evaluation of gluten-free biscuit from maize and soybean blend. *Journal of European*, 80-150
- FAO. (2009). *The future of food and agriculture: Trends and challenges*. Rome: FAO.
- Ikya, J. K., Gernah, D. L., and Sengeev, I. A. (2013). Enhancing the nutritional value of *Agidi* (maize pudding) through protein enrichment. *African Journal of Food Science*, 8(6), 112-118.
- Kolawole, F., Oyeyinka, S., Balogun, M., and Oluwabiyi, F. (2020). Chemical composition and consumer acceptability of *Agidi* (maize gel) enriched with orange-fleshed sweet potato and soybean. *Ceylon Journal of Science*, 49(4), 463-471. <https://doi.org/10.4038/cjs.v49i4.7826>
- Martins, H., Zhang, M., Peng, Z., and Deng, Y. (2010). Current status and future trends of smart packaging technologies for food safety and quality control. *Trends in Food Science & Technology*, 111, 151-160.
- Mohiedeen, C. A., Eze, A. N., and Okeke, M. N. (2001). Ukpo oka: A traditional *Agidi* (maize pudding) in Southeast Nigeria. *Journal of Food Science and Technology*, 57(9), 3187-3193.
- Moses, F., Zhang, J., and Chen, J. (2019). Effect of starch properties on paste viscosity of corn starch. *Journal of Food Science*, 85(5), 1478- 1486.
- Ndife, J., Abdulraheem, L.O. and Zakari, U.M. (2011). Evaluation of the Nutritional and Sensory Quality of Functional Breads Produced from Whole Wheat and Soyabean Flour Blends. *African Journal of Food Science*, (5): 466-472.
- Nicolle, S. A., and Terwase A.D, Ibe, D. I. (2004). Effects of storage conditions on the Microbial and sensory properties of maize-soy flour blend of *Agidi* (maize pudding). *Journal of Food Processing and Preservation*, 42(3), 15-28.
- Nwanabga, N., Obetta, A., Iseac, U., and Nwachukwu, A. (2020). Evaluation of the chemical composition and sensory properties of soy *Agidi* fortified with *Alternanthera brasiliensis* powder. *Nigerian Agricultural Journal*, 52(2), 400-407.
- Obidiapo, P. C., Barber, L., and Enyi, C. (2017). Proximate composition and sensory properties of complementary food formulated from malted pre-gelatinized maize, soybean, and carrot flours. *Journal of Food Research*, 5(2), 59-63. <https://doi.org/10.5539/jfr.v5n2p59>
- Ogiehor, I., Ekundayo, A., and Okwu, G. (2005). Shelf stability of *Agidi* produced from maize (*Zea mays*) and the effects of sodium benzoate treatment in combination with low temperature storage. *African Journal of Biotechnology*, 4(7), 738-743. <https://doi.org/10.5897/AJB2005.000-3134>
- Oguche, G. H. E., Okudu, H. O., & Ikani, I. T. (2017). Energy, proximate, and sensory attributes of soy-fortified "*Agidi*". *Direct Research Journal of Agriculture and Food Science*, 5(6), 161-164.
- Ohwesiri, E. R., Abiodun, A. A., Micheal, A. I., Olajide, P. S., Adeniyi, T. A., Raphael, O. I., Simeon, O. A., Tolulope, O. O. and Ayorinde, F. (2016). Nutrient Composition, Functional, and Pasting Properties

of Unripe Cooking Banana, Pigeon Pea, and Sweet Potato Flour Blends. *Journal of Food Science and Nutrition*, (5):750-762.

Ojo, M. A. (2016). Tannins in foods: Nutritional implications and processing effects of hydrothermal techniques on underutilized hard-to-cook legume seeds—a review. *Preventive Nutrition and Food Science*, 27(1), 14–19. <https://doi.org/10.3746/pnf.2022.27.1.14>

Silvina, R. L. (2011). Trypsin inhibitors of raw and heat-treated soybean meals (Anhydrotrypsin, Affinity Chromatography). *Dissertation Abstracts International*, 47(01), 0173A.

Stadimayr, N.A., Eze, C.M., Leonard, O. C.; Ugwuona, F.U. and Obeta, U. R. (2012) Quality Evaluation And Sensory Properties Of *Agidi* Produced From Blends Of Maize (*Zea Mays*) And Pigeon Pea (*Cajanus Cajan*) *Carpathian Journal Of Food Science And Technology*

Ujoh, A., Yusuf M. and Ahure D. (2023). Antioxidant properties, Antioxidant minerals and vitamins composition of sorghum-carrots *agidi* enriched with *Terminalia catappia* L. seed Flour. *Africana Journal of Scientia* /21(3), 83-96.

Zakari, U., Hassan, A., and Abbo, E. (2010). Physicochemical and sensory properties of “*Agidi*” from pearl millet (*Pennisetum glaucum*) and bambara groundnut (*Vigna subterranea*) flour blends. *African Journal of Food Science*, 4(12), 662-667. <https://doi.org/10.5897/AJFS9000224>