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EFFECT OF PARTIAL SUBSTITUTION OF DRIED PLANTAIN FLOUR ON THE SENSORY AND FUNCTIONAL PROPERTIES OF MAIZE FLOUR BASED SNACK (*KOKORO*)

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ABSTRACT

The study is focused on the effect of partial substitution of dried plantain flour on the sensory and functional properties of maize flour based snack (kokoro).Snacks are food substances usually consumed in between meals and usually have low nutritional values . Kokoro is a maize based snack widely consumed in the south western part of Nigeria. Due to the need to encourage regular consumption of snacks such as Kokoro, nutritional improvement of snacks should be embarked upon. In this case, improving the nutritional value and crunchiness of kokoro snack was studied by blending it with plantain (sun dried and oven dried) flour in the ratio (90:10, 80:20, 70:30) respectively, while Kokoro made from 100% maize serves as(control). The bulk density, water absorption capacity, oil absorption capacity, solubility and swelling index of the blends were: (0.60% to 0.65%), (2.13 to 2.47), (1.96 to 2.08), (2.81 to 7.65), and (212.30 to 333.25) respectively, while the control had 0.64, 2.53, 2.37, 4.57, and 324.60. Kokoro made from pure maize (100% maize flour) was found to be the most acceptable overall which could likely be due to its familiarity to the consumers. Blend of 90:10 maize flour to sundried plantain flour (sample B) was the next acceptable. The least accepted were 90:10 and 70:30 oven dried samples. It is concluded that plantain flour can be successfully blended with maize flour for the production of good kokoro product. Recommendation is made for the large scale production of fortified kokoro.
Keywords: Kokoro, crunchiness, fortification, plantain flour, maize, drying.
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INTRODUCTION

Food production and processing entails conversion of unstable food raw materials to a more stable form. Food products can be deficient in a particular nutrient or the other which might be vital to the body when consumed, or could be too hard for some people to chew (Adeleke, 1981). Snacks are meals or foods that are usually eaten in a hurry. In advanced countries, snacks are not eaten as main meals but are taken as a stop gap measure to briefly check hunger; provide energy for the body and for enjoyment of the taste. Common snacks are produced by the local women for livelihood without the cognizance of their nutritional values which may ordinarily be lacking or would have been lost during processing. Snacks are usually used to entertain guests, but the time of eating snacks between meals may be different and the type of snacks consumed may also vary from one part of the country to another (Maliki, 1999; Oke *et al*., 1995).

Nigerians are snacks loving people, and this singular fact makes it important for food scientists to develop new snacks and modify existing snack products to achieve a variety of healthy snacks for consumption. Snacks consumed in Nigeria are made from different raw materials with wheat flour being the most common source for pastries. However, some problems associated with local production of snacks include non-standardization of equipment, process and raw materials; inadequate hygiene during and after production; and little or no packaging, which could lead to poor preservation techniques and high levels of contaminations in the food resulting in food borne illnesses (Ingbian and Akpapunam, 2005).

Locally, many indigenous snacks have been produced and consumed in various parts of Nigeria (Ingbian and Akpapunam, 2005). Most Nigerian children especially in the urban areas receive snacks items such as biscuits, meat pies, chin-chin, dough nuts, and potato chips, while children in the rural areas make do with fried melon seed cake, *robo*, and fried maize paste, *Kokoro* with a very low nutritional value (Adelakun *et al., 2005*).

Kokoro is a local finger-like shaped snacks made from maize which is mostly produced and consumed in the Western part of Nigeria especially in Oyo and Ogun State. It is widely acceptable and consumed by adult and school children. The principal constituent of *kokoro* is maize, which is high in carbohydrate (Ihekoronye and Ngoddy, 1985), low in protein, but a good source of iron and B-complexes vitamins.

Kokoro is a popular local snack made from thick coarse corn paste maize flour for adult and children (Uzor-Peters *et al.,*2008). It is therefore a predominantly carbohydrate food lacking in some essential nutrients. The technology of *kokoro* production is largely traditional, involving mixing maize flour with boiled water to form a paste and seasoning with salt and sugar. The dough is kneaded and cut into shapes. The pieces are then deep-fried in vegetable oil for 5 minutes to produce a golden-yellow, hard textured, low-moisture product (Adelakun *et al,* 2005).

Since *kokoro* is an accepted snack in Nigeria, especially among children and adult in south western part of Nigeria, the main objective of this research work, is to produce *kokoro* from blend of maize and plantain flour, with a view to enriching the *kokoro* in order to improve the nutritional quality and standard of the product. Specific objectives of the research work are to i) determine the functional properties of the fortified flour blends and ii) investigate consumers' acceptability of the product (sensory quality).

Material and Methods

Source of samples

Dried maize grains and stage 1 unripe plantain used for the research were obtained from *Ipata* market in Ilorin, Nigeria. Spices (onions, salt, and pepper) were equally purchased from *Ipata* market in Ilorin metropolis.

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Production of Flour from Maize and Sundried and Oven Dried Plantain

The maize grains and the unripe plantain were milled into flour after drying. The maize grains were milled into flour using the method described by Uzor-Peters *et al.,* (2008) and likewise, the dried plantain was milled into flour using the method of Ojure *et al.,* (2012).

Blending of Maize and Plantain Flours

Sundried and oven dried plantain flour were blended with the maize flour in different ratios for the production of *kokoro* as shown in Table 1.

FLOUR BLENDS

↓

MIXING OF DRY INGREDIENTS

↓

BOILING (100°C for 10-15 minutes)

↓

COOLING

↓

KNEADING

↓

ROLLING(Roundish or longish in shape as desired)

↓

FRYING

↓

KOKORO

Fig 1: Flow Chart for the Production of *Kokoro* from Flour Blends
Source: Uzor-Peters *et al.,* (2008)

Determination of the Functional Properties of the Various Blends

i) Water Absorption Capacity (WAC)

The water absorption capacity of the various blends was determined by the method of Abbey and Ibeh (1988), described below:

A gram of flour sample was weighed and transferred into a clean centrifuge tube of known weight. Distilled water was mixed with the flour to make up to 10ml dispersion. The dispersion was centrifuged at 3500rpm for 15minutes. The supernatant was decanted and the tube with its content reweighed. The gain in mass is the water absorption capacity of the flour.

ii) Oil Absorption Capacity

This oil absorption capacity of the various blends was determined by the method used by Abbey and Ibeh (1988) briefly described below:

A gram of flour sample was weighed and placed in a clean centrifuge tube of known weight. Groundnut oil was mixed with the flour to make up to 10ml dispersion. The tubes were centrifuged at 3500rpm for 15minutes. The supernatant was discarded and the tube was reweighed. The gain in mass is recorded as the oil absorption capacity.

iii) Bulk Density

This was determined by the AOAC (2000) method briefly described below:

20 grams of flour was weighed into a 100ml graduated measuring cylinder, the bottom of the cylinder was tapped against the palm, the cylinder was placed on a table and final volume was read, the final volume is used to calculate bulk density as g/ml.

$$B.D = \frac{\text{Mass of material}}{\text{Volume of materials after tapping}}$$

iv) Swelling Index

This was determined by the method described by Ukpabi and Ndimele (1990).

3 grams of flour sample was weighed into a 50ml graduated measuring cylinder and leveled. The volume was recorded. 30ml of distilled water was added, swirled and allowed to stand for 1 hour. The volume change (swelling) was recorded every 15minutes. The swelling power of the flour was calculated as a multiple of the original volume.

v) Solubility

This was determined by the method described by Udensi and Onuora (1992), as described below:

A gram of flour was weighed and made up to 10ml in a graduated measuring cylinder. The dispersion was allowed to stand for 60 minutes while being stirred every 10 minutes and subsequently allowed to settle for 15minutes after which 2ml of supernatant was transferred to an already weighed petri dish using a pipette. The supernatant was evaporated to dryness and reweighed. The total soluble solids were calculated as:

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$TSS (\%) = (V_s/2M_s)(M_e - M_d) \times 100$

Where V_s= Total supernatant/filtrate

M_d= Mass of empty, dry petri dish

M_e = Mass of petri dish plus residual solids after evaporation to dryness

M_s = Mass of sample used for dispersion

Sensory Evaluation (Consumer Acceptability)

The sensory attributes, including colour, crunchiness, taste, flavour and general acceptability, were evaluated by a semi trained 20-member panel, using a 9-point Hedonic scale with 1 representing the least score (dislike extremely) and 9 the highest score (like extremely). Analysis of variance (ANOVA) was performed on the data gathered to determine differences, while the least significant test was used to detect significant differences among the means (Iwe, 2002).

Results and Discussion

Functional Properties of the Flour Blends

The functional properties of the flours are as shown in Table 2. Bulk density values are useful information for packaging and storage requirements of food products. Except for sample B (90%maize flour, 10% sundried plantain flour *kokoro)*, the bulk density was highest for the control and this predicts a higher moisture absorption during storage for the control than for the blended samples. The reduction in the bulk density implies that more will be consumed to increase bulk.

The water absorption capacity increased with increase in plantain flour concentration. This is due to the fact that the more the starch content, the more the water holding ability. From Table 2, the control sample, which was purely maize, had the highest value, and as substitution increased and quantity of maize decreased, water absorption ability decreased slightly. This can be attributed to breakdown in the structural network of the food system resulting in less retention of moisture. It was equally noticed that *kokoro* samples made from blends of maize and sun dried flour e.g. sample B (90%maize flour, 10% sundried plantain flour) had higher water holding capacity than samples blended with oven dried flours. This can equally be attributed to distortion of the cell arrangement and reduction in pore holes..

The oil absorption capacity of sample A (control) was the highest (2.37); while sample F had the lowest oil absorption capacity (1.96). The oil absorption capacity of flour is important as it improves mouth feel and retains the flavour of the product. Eke and Akobundu (1993), had associated oil absorption capacity to ability of protein fractions to bind fats. It can be observed that the values of the oil absorption capacity of the various blends (blends with sundry and oven dry plantain flour) followed the same trend, as the values were between 1.96 and 2.17.

On solubility of flours, sample D was found to have the highest solubility (8.44), while sample F had the lowest with value of 2.81. Swelling and solubility patterns provide information on the nature of the associative bonding within the starch granule (Beleia *et al*, 1980; Leach *et al*, 1959).

Sample C had the highest swelling index value of 333.25, while the lowest was sample B with 212.30. The ratio of these fractions in the starch granule and the manner in which they are arranged inside the granule affect the swelling and solubility of the starch (Beleia *et al*., 1980). Sundried and oven dried flour blended with the maize flour could have been disrupted in the cell structure during drying, which could have had influence in the swelling capacity of the blends.

Consumer Acceptability of *kokoro* (Sensory Evaluation)

The result of the sensory evaluation carried out on the samples is as shown in Table 3. There were significant differences at ($p< 0.05$) in all the parameters measured. Though, the control sample was the most preferred, the blended samples were comparable to the control and showed that it can be produced in large quantity. This is shown by the rating, as most of the blends fell between "like slightly" and "like very much". For taste, control sample (100% maize flour) had the highest value of 7.90, while sample with 90% maize flour and 10% oven-dried plantain flour had the least preference with 6.50.

The acceptance or preference for the control sample can be attributed to the fact that consumers are familiar or used to *kokoro* made from pure maize flour, but not that familiar or acquainted with *kokoro* made from other flour sources, thus slightly difficult for the consumers to accept *kokoro* with different taste.

On the aroma of the samples, same scenario as with taste was observed, but there was no significant difference between Samples A (control) and C (80% maize flour and 20% sundried plantain flour) at ($p< 0.05$), as they were both rated highest. The range of hedonic scale for all the samples was between 6.20 and 7.20. This implies that all the samples including the control were liked, that is, within "like slightly" and "like very much".

For colour, there was a significant difference at ($p< 0.05$) between the samples, with the control sample rated highest. All the samples including the control were between 6.40 and 7.60, which were between "like slightly" and "like very much". This can be attributed to the composite nature of the other blends, which had a deeper brown colour which was less attractive to consumers.

In terms of the crunchiness of the *kokoro, s*ample A (control) was the most preferred, followed by sample B. Sample A had overall highest rating of 8.50, which corresponds with "like very much" on the 9-point Hedonic scale. However, it was observed that the blended samples were more easily chewable and breakable for children, because they were slightly softer than the control sample.

For overall acceptability, though the control sample was the most preferred with a rating of 8.0 corresponding to "like very much", however, other samples were equally accepted, as the rating were close to each other with the least being samples E and G with a rating of 6.50, which is slightly above "like slightly" with a rating of 6.0.

In all, it was noticed that as the substitution level increased, changes were noticed in the parameters measured. This was similar to the findings of Olaoye *et al*, (2006), where bread was produced from composite flour of wheat, soy and plantain.

Looking at the various blends and their ratings, it can be deduced from the results that apart from the control samples made from pure maize flour and most accepted samples blends with sundried flour were next in quality to the control.

Conclusion

It was noticed that *Kokoro* can be produced from blends of maize flour and that of dried plantain flour, though kokoro made from purely 100% maize flour was better accepted. However, kokoro made from the blends of maize flour and that of dried plantain flour equally received attention and gave better flavor. It can be argued that large quantities of wastage normally witnessed during postharvest of plantain can be reduced by channeling it to the production of kokoro; addition of plantain flour can reduce the hardness normally observed in *kokoro* made from pure maize (i.e plantain flour substitution) leading to the production of varieties. *Kokoro* snack can be made from blends of maize flour with plantain flour.

Recommendation

Blending of plantain flour with that of maize flour produces good quality *kokoro,* it is therefore recommended it should be produced on a large scale, as it helps to reduce the hardness of the *Kokoro* and equally creates varieties in *kokoro* production from the composite flour of maize and plantain.

REFERENCES

Abbey, B.W. & Ibeh, G.O. (1988). Functional properties of raw and heat processed Cowpea (*Vigna Unguiculata*,Walp) lour. *Journal of Food Science*, Volume 53: Pp 1775 – 1777.

Adeleke, R.O. (1981). *Basic principle of food processing and preservation* Word-Ward Publishers, Nigeria.

Adelekun, O.E., Adejuyitan, J. A., Olajide, J. O. &Alabi, B.K. (2005).Effect of soybean substitution on some physical compositional and sensory properties of *Kokoro* (A Local Maize Snack).*European Food Research and Technology*220 :79-82.

AOAC (2000).*Official methods of analysis* 17th Edition Association of Official Analytical Chemists International, Washington DC, USA

Beleia, A., Varriano-Marston, E., & Hoseney, R. C. (1980).Characterization of starch from pearl millets.*Cereal Chemistry*, 54(6), 1096–1107.

Eke, O.S.,&Akobundu, E.N.T. (1993). Functional properties of African yam bean (Sphenostylis stenocarpa) seed flour as affected by processing. *Food Chemistry*, 48:337 – 340.

Ihekoronye A.I., & Ngoddy, P.O. (1985).*Integrated food science and technology for the tropics.*1st Edition.McMillan Publishers.

Ingbian, E.K., & Akpapunam, M.A. (2005). Appraisal of traditional technologies in the processing and utilization of Mumu, a cereal based local food product. *African Journal of Food, Agriculture, Nutrition and Development.* Vol. 5 (2) 11-15.

Iwe, M.O.(2002). *Handbook of sensory methods and analysis*. Rojoint Communication Service Limited. Enugu, Nigeria. Pp. 71-72.

Leach, H. W., McCowen, L. D., & Schoch, T. J. (1959). Structure of the starch granule: Swelling power and solubility patterns of different starches. *Cereal Chemistry*, 36, 534–544.

Maliki, K. (1999). Investigation of storage stability of "Kokoro".*Nigerian Food Journal*,22: 58.

Ojure, M.A.,& Quadri, J.A. (2012). Quality evaluation of noodles produced from unripe plantain flour using Xanthan Gum. *International Journal of Research and Reviews In Applied Sciences.* 13 (3) Pp:740 – 752.

Oke, O.V.,Oluwole, O.B.,Adeyoju, O.A.,Ajayi, T.O.,Ozumba, A.U., & Solomon, H.M. (1995). Effects of packaging on moisture content and organoleptic qualities of coconut snack during storage. *Nigerian Food Journal*

Olaoye, O.A., Onilude, A.A & Idowu, O.A (2006). Quality characteristics of bread produced from composite flours of wheat, plantain and soybeans. *African Journal of Biotechnology*. Vol. 5 (11), pp. 1102-1106, Available online at www.Academicjournals.org,AJB ISSN 1684-5315

Udensi, F.A., & Onuora, J.O. (1992).“Chemical and functional properties of some soya bean flour in the Nigerian market”.Proceedings of the 16th Annual Conference of Nigeria Institute of Food Science and Technology, October 26 – 30, 1992, Enugu, Nigeria.

Ukpabi, U.J., & Ndimele, C. (1990). Evaluation of the quality of gari produced in Imo State. *Nigerian Journal of Food Science* Volume 8: 105 – 110.

Uzor-Peters P. I., Arisa, N. U., Lawrence, C. O.,Osondu N. S., & Adelaja, A. (2008). Effect of partially defatted soybeans or groundnut cake flours on proximate and sensory characteristics of Kokoro. *African Journal of Food Science* Volume (2) Pp. 098-101

APPENDIX

Table 1: Flour Blends made from Maize and Plantain Flours:

SAMPLES	MAIZE FLOUR (%)	SPF (%)	OPF (%)
A	100	-	-
B	90	10	-
C	80	20	-
D	70	30	-
E	90	-	10
F	80	-	20
G	70	-	30

Legend:

SPF: sun-dried plantain flour

OPF: oven-dried plantain flour

Source: Field report

Table 2: Functional Properties for flours Produced

SAMPLE	**B. D (g/ml)**	**WAC**	**OAC**	**SOLUBILITY**	**S.I (%)**
A	0.64 ± 0.007^{ab}	2.53 ± 0.002^{a}	2.37 ± 0.010^{a}	4.57 ± 0.021^{cd}	324.60 ± 28.84^{ab}
B	0.67 ± 0.008^{a}	2.47 ± 0.000^{ab}	1.99 ± 0.084^{bc}	7.12 ± 2.029^{ab}	212.30 ± 2927^{c}
C	0.61 ± 0.013^{cd}	2.35 ± 0.040^{bc}	2.08 ± 0.035^{bc}	3.83 ± 0.177^{d}	333.25 ± 0.071^{a}
D	0.60 ± 0.02^{d}	2.13 ± 0.002^{c}	2.02 ± 0.163^{bc}	8.44 ± 0.509^{a}	324.95 ± 0.071^{ab}
E	0.65 ± 0.030^{ab}	2.30 ± 0.223^{bc}	2.17 ± 0.023^{b}	7.65 ± 0.071^{ab}	301.00 ± 1.414^{ab}
F	0.61 ± 0.020^{cd}	2.14 ± 0.028^{c}	1.96 ± 0.051^{c}	2.81 ± 0.247^{d}	304.40 ± 0.283^{ab}
G	0.62 ± 0.007^{bc}	2.26 ± 0.007^{bc}	2.07 ± 0.021^{bc}	6.34 ± 0.141^{bc}	291.65 ± 0.071^{b}

Values are duplicate determination. Means with different letters of alphabet differed significantly (P<0.05).

Legend as in Table 1

Source: Field report

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Table 3: Result of the Sensory Evaluation of the *Kokoro* Product

SAMPLE	TASTE	AROMA	COLOUR	CRUNCHINESS	ACCEPTABILITY
A	7.90 ± 0.994^{a}	7.20 ± 1.033^{a}	7.60 ± 0.699^{a}	$8.50\pm o.527^{a}$	8.00 ± 0.943^{a}
B	6.90 ± 0.876^{b}	7.10 ± 1.197^{ab}	7.00 ± 0.816^{b}	6.80 ± 1.989^{b}	7.60 ± 0.966^{ab}
C	6.80 ± 0.789^{bc}	7.20 ± 1.033^{a}	7.00 ± 0.816^{b}	5.80 ± 1.229^{c}	7.40 ± 1.174^{b}
D	7.40 ± 0.516^{ab}	6.90 ± 0.738^{b}	7.10 ± 0.738^{b}	6.10 ± 1.524^{c}	7.10 ± 0.568^{b}
E	6.50 ± 1.509^{c}	6.20 ± 1.059^{c}	6.70 ± 0.972^{c}	5.80 ± 1.229^{c}	6.50 ± 1.650^{c}
F	7.40 ± 0.516^{ab}	6.40 ± 0.699^{c}	6.50 ± 0.738^{c}	5.20 ± 1.398^{d}	7.30 ± 1.059^{b}
G	7.00 ± 0.816^{b}	6.20 ± 1.059^{c}	6.40 ± 1.033^{c}	5.10 ± 1.197^{d}	6.50 ± 1.650^{c}

In each of the column, the samples whose means are not followed by the same superscripts are significantly different at ($P< 0.05$)

Legend as in Table 1.
A :100% maize flour *kokoro*
B: 90%maize flour, 10% sundried plantain flour *kokoro*
C: 80% maize flour, 20% sundried plantain flour *kokoro*
D: 70% maize flour, 30% sundried plantain flour *kokoro*
E: 90% maize flour, 10% oven dried plantain flour *kokoro*
F: 80% maize flour, 20% oven dried plantain flour *kokoro*
G: 70% maize flour, 30% oven dried plantain flour *kokoro*
Source: Field report