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NUTRIENT AND ORGANOLEPTIC ASSESSMENT OF SNACKS PRODUCED FROM WHEAT AND AFRICAN BREADFRUIT (*Treculia africana*)

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ABSTRACT

African breadfruit snacks were produced from wheat and African breadfruit composite flour blends in the ratio of 100:0, 95:5, 90:10, 85:15 and 80:20 respectively. Breadfruit seed was coated with the respective wheat-African breadfruit composite flour blends and then baked to produce the snacks. Coating made with 100% wheat served as the control. Proximate composition and functional properties of the flour blends, proximate, mineral content and sensory analysis of the snacks were all determined using standard methods. Proximate composition ranged as follows: protein (10.77-14.32%), fat (1.61-3.20%), fiber (1.20-1.40%), ash (2.04-3.33%), moisture (8.16 -10.00%) and carbohydrate content (70.33 - 75.48%) respectively. The result showed increase in protein, ash, fat, fiber as well as phosphorus (139-159mg/100), magnesium (2.05 – 2.94mg/100), calcium (169 – 190mg/100), and potassium (240 – 255.01mg/100) due to the addition of African breadfruit. The functional properties revealed potential suitability of wheat-breadfruit composite flour in snack production and the snack produced from 15% inclusion of African breadfruit flour was most preferred in terms of general acceptability.

Keywords: Composite flour, breadfruit snack, proximate composition, general acceptability, functional properties.

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INTRODUCTION

Snack foods are eaten between meals; sometimes for pleasure and during relaxation. These include peanut burger, biscuits, chin-chin, deep fried plantain chips, sausages, doughnuts, toasted African breadfruits seeds (Nwabueze *et al*., 2008). African breadfruit (*Treculia africana, Decne*) a member of the family, Moracea, is widely grown in Southern part of Nigeria for its seeds. It is also grown in forest zone, particularly the coastal swamp zone (Agbogidi and Onomeregbor, 2008) and flowers between October and February. The seeds are known by various tribal names like; "*Ukwa*" (Igbo), "*Afon*" (Yoruba), "*Barafuta*" (Hausa), "*Ize*" (Benin), "*Eyo*" (Igala), "*Edikang*" (Efik), (Onweluzo & Odume,2008). This fruit is usually hard and also spongy in texture when ripe and contains numerous seeds embedded in the fleshy pulp (Enibe, 2001). A mature seed consists of an outer covering (seed coat) and an inner edible endosperm. The seeds are prepared by cooking them to porridge or mixed with other food stuff (Onweluzo & Nnamuchi, 2009) or even roasted and sold with palm kernel or coconut as a snack. It is potential as an immense nutrient contributor to diet of Nigerians has been reported by Iwe and Ngoddy (2001). They are very nutritious and a cheaper source of vitamins, minerals, proteins, carbohydrates and fat (Osuji and Owei (2010). Proximate analysis shows that the seeds contain 17-23% crude protein, 11% crude fat and other essential vitamins and minerals (Akubor *et al.,* 2000). It sustains the population during planting seasons when the major staples (yam, rice, corn and cassava) are under cultivation. The seeds are used in rural homes as complimentary food for babies (weaning food) and substitute to more expensive food product. Onyekwelu & Fayose (2007) stated that the seeds from African breadfruits are used in the preparation of pudding and as a thickener during weaning for children.

African breadfruit seeds are domestically consumed boiled or toasted. The toasted seeds are seldom hawked by peasant farmers. The food material has very little or no industrial application. African breadfruit is yet to be commercially incorporated in the production of many nationally or internationally distributed food products. This therefore implies that the nutritious food is underutilized hence the need to develop a product that would be commercially or widely distributed. Also incorporation of African breadfruit could led to enrichment of food products in terms of protein, minerals and vitamins needed for growth and nourishment of the teeming population of young children, even adults. The success of this work will create alternative product through which African breadfruit could be commercially marketed and consumed. It would compete with the already existing peanut burger in the market. Generally, the economic importance of African breadfruit will be obviously improved. This study therefore entails the use of wheat and African breadfruit to produce snacks with the aim of providing nutritious snack and thereby increase industrial application of African breadfruit.

MATERIALS AND METHODS

Wheat flour and African breadfruit seeds were purchased from Eke-Ukwu Owerri Market. The breadfruit seeds were divided into two batches. First batch was processed into flour while the second batch was toasted before being used in the snacks production.

Sample preparation

African Breadfruit flour (ABF) preparation

The raw seeds were parboiled (100 ^{0}C for 15 minutes) to facilitate dehulling. The dehulled seeds were oven dried till equilibrium, milled with a locally fabricated attrition mill and sieved with a 40 µm mesh sieve to obtain African breadfruit seeds flour. The flour was stored in an airtight plastic container at room temperature until when needed.

Formulation of flour blends

Five blends were prepared by mixing wheat flour with African breadfruit flour in the proportions of 100:0, 95:5, 90:10, 85:15 and 80:20 respectively. Snack produced with hundred per cent wheat (100:0) flour blend served as the control.

Preparation of breadfruit snacks

The ingredients used includes: flour, vegetable oil, egg sugar, baking powder, nutmeg vanilla, salt, sugar and vanilla (Table 1). The eggs were whisked in a bowl together with salt, vanilla, and sugar before being poured into a clean bowl containing wheat flour, baking powder and nutmeg powder. The mixture was properly kneaded to the desired thickness, cut into rectangular shapes and finally used to coat the breadfruit seeds (35g per snack). The coated breadfruit seeds were baked in a local oven for 10min at a temperature of 160^{o}C.

Quality evaluation of samples

Proximate and mineral compositions were determined according to AOAC (2015) while the functional properties were determined following the methods described by Onwuka (2015). The sensory attributes were evaluated by a panel of thirty semi-trained members (students and staff of Imo State University, Owerri). They were provided with the packaged wheat-breadfruit snack samples. The samples were rated based on taste, mouthfeel, aroma, appearance and general acceptability using the hedonic scale which ranges from 1(dislike extremely), 2(dislike very much), 3(dislike moderately), 4(dislike slightly), 5(neither like nor dislike), 6(like slightly), 7(like moderately), 8(like very much) to 9(like extremely) as described by Ihekoronye and Ngoddy (1985).

Statistical analysis

The data obtained from this study were subjected to analysis of variance (ANOVA). The means were compared to determine the effects to the treatment. The least significant difference was calculated at 95% level of significance (Ihekoronye & Ngoddy, 1985).

RESULTS AND DISCUSSION

Proximate composition of the flour blend samples were presented in Table 2 below. The result for protein of the flour samples ranged from 10.77-12.73%. There were significant ($p<0.05$) increase in the crude protein content of the flour blends even at 5% level of substitution of flour with breadfruit flour. Sample A (100% wheat flour) had the least protein content (10.76%) compared to the composite flour blends. Sample B had a protein content of 11.00% while samples C, D and E had protein content of 11.40%, 12.31% and 12.72% respectively. Sample E had the highest protein content due to its high level of breadfruit flour. This indicates that blending of wheat flour with breadfruit flour improves the protein content of the flour for baking (Ubbor & Akobundu, 2009). There was significant ($p< 0.05$) difference in the fat contents of the flour samples which ranged from 1.61% to 3.20%. The fat content was highest in sample E (3.20%) while the lowest value (1.61%) was observed in samples A and B. The result shows that wheat flour is low in fat and the incorporation of breadfruit flour increased the fat content of the flour blends. But the low fat contents of the wheat flour implies that it may be less prone to rancidity compared to flours with higher oil content, under the same conditions of storage, handling, etc. because high oil content could increase the risk of rancidity (Hossein *et al.,* 2013). The fiber content of the flour samples ranged from 1.20% to 1.36%. The fiber content of sample A (1.26%) was highest but not significantly ($p>0.05$) higher than the other samples; B (1.25%), C (1.23%), D (1.20%) and E (1.20%). This could be because wheat is higher in starch than breadfruit. Therefore, samples B, C, D and E had lower fiber content corresponding to their respective breadfruit contents. The ash content of the flour samples ranged from 1.49% to 2.63%.

The result shows that the ash content of the flour samples increased significantly ($p<0.05$) on addition of higher quantity of breadfruit as observed in samples C, D and E which have ash contents of 2.14%, 2.37% and 2..64% respectively. Sample E had the highest ash content (2.64%). This means that addition of breadfruit can improve the mineral content of a food material. The moisture content of the flour samples which ranged from 9.77% to 10.00% did not statistically show any significant ($p<0.05$) difference. The moisture content of the blends decreased with incorporation of African breadfruit flour. Samples B, C, D and E have moisture contents of 9.79%, 9.78%, 9.78% and 9.77% respectively. This could be due to the low water absorption capacity of breadfruit flour. High moisture content in flours can cause short shelf life of the flour because it can encourage microbial growth and consequent spoilage of the flour. The carbohydrate content of the flour samples ranged from 70.46% to 74.32%. Sample A was found to have the highest carbohydrate content (74.32%) while sample E had the lowest carbohydrate content (70.46%). Addition of breadfruit flour in increasing proportion resulted in a corresponding decrease in the carbohydrate content of the flour blends. This is due to the lower carbohydrate content of the breadfruit flour than that of wheat flour, thus reducing the overall carbohydrate content of the blended flours (Olu *et al*., 2011).

Functional properties of flour blends

Functional properties of the flour blend samples are presented in Table 3 below. Bulk density of the flour samples ranged from 0.68-0.92g/cm^3. Sample A had the highest value while sample E had the least value. There was significant decrease in the bulk density of the flour due to increase in the level of incorporation of breadfruit flour. Bulk density is a measure of the heaviness of a flour sample (Oladele & Aina, 2009). The bulk density is affected by the size and density of the flour used which is important in determining packaging requirements, material handling and wet processing in food industry (Adegunwa *et al.,* 2014). Water absorption capacity values of the flour samples ranged from 5.55-5.99g/g. There was significant variation in the water absorption capacity among the flour samples. The highest value was observed in sample A which had water absorption capacity of 5.99g/g and the lowest value was observed in sample E which had water absorption capacity of 5.55g/g. Water absorption capacity is an important processing parameter as it ensures consistency of product in baking application (Niba *et al*., 2001). Oil absorption capacity (OAC) of the flour samples ranged from 15.5 - 17.72g/g. Sample E had the highest value (17.72g/g) while sample A had the lowest value (15.5g/g). The high oil absorption capacity shows that the lipophilic character of the flour components (Ubbor & Akobundu, 2009). Swelling capacity of the flour samples ranged from 2.58 – 3.47 % with the highest value (3.47%) found from sample A. There was significant ($p<0.05$) difference in swelling capacity of the flour blends. Nwokocha *et al.* (2008) observed that the difference in swelling capacity is due to the differences in bonding forces within the granules of the flour. Suresh *et al.* (2015) added that swelling capacity of flours depends on size of particles, types of variety and types of processing methods or unit operations. The foaming capacity of the flour samples ranged from 9.40 - 10.63%. The result revealed significant ($p<0.05$) difference among the samples. The highest foam capacity (10.633%) was observed in sample E followed by sample D (10.07%) while the lowest foam capacity (9.40%) was found in sample A. Foaming capacity is a function of the amount of interfacial area that can be created by the protein in the flour (Fennema, 1996).

Proximate composition of the African breadfruit snacks sample

Significant ($p<0.05$) increase was observed in the protein content of the samples as shown in Table 4 below. The protein content of the samples ranged from 11.69-14.32%. Sample A (100% wheat flour) had lowest protein content (11.69%) compared to the other samples. Sample B had a protein content of 12.02% while sample C, D and E had protein contents of 12.74%, 13.29% and 14.32% respectively. Sample E had the highest protein content due to its high ratio of African breadfruit flour. This indicates that incorporation of breadfruit flour could enhance the protein content of wheat based products in line with the work of Agu *et al.* (2007). The result shows that sample A was low in fat and the addition of African breadfruit flour increased the fat content of the other samples. The fat content of the samples ranged from 1.62% to 2.46% and they were statistically significant ($p< 0.05$). The fat content was highest in sample E (2.46%) while the lowest value (1.62%) was observed from sample A. Fiber content of the samples ranged from 1.37% to 1.40%. The fibre contents of the products showed no significant ($p>0.05$) difference. This could be because the quantity of fiber in breadfruit is lower than fiber in wheat. So, increase in the incorporation of breadfruit flour led to lower fibre content of the snack samples. Hence, samples A, B and C had lower fibre content corresponding to their respective contents of breadfruit. The ash content of the samples ranged from 1.6% to 3.33%. With the incorporation of higher proportion of African breadfruit flour as observed in samples C, D and E which have ash contents of 1.74%, 2.29% and 3.33% respectively, the ash content of the samples increased significantly ($p<0.05$). The result agrees with the observation of Olaoye and Onilude (2008) and Ishera *et al*. (2021). Sample E had the highest ash content (3.33%) which implies that when consumed, it may supply minerals to the body more than other products. The moisture content of the samples ranged from 8.16% to 8.24% and were statistically significant ($p<0.05$). The moisture content of the samples reduced with increased addition of breadfruit flour. Sample A has the highest moisture content of 8.24%. Moisture in foods aids the solubility of ingredients but high moisture content can make the product more prone to microbial attack or spoilage. Addition of breadfruit in increasing proportion resulted in a corresponding decrease in the carbohydrate content of the products. The carbohydrate content of the breadfruit snack samples ranged from 70.33% to 75.48%. Sample A was found to have the highest carbohydrate content (75.48%) while sample E had the lowest carbohydrate content (70.33%). The decrease observed could be attributed to the lower carbohydrate content of the African breadfruit flour than that of wheat flour as claimed by Ejidike and Ajileye (2007).

Mineral content of the burger sample

The phosphorus content of the African breadfruit snack samples ranged from 145-151mg/100g as shown in Table 5 below. The result showed that incorporation of breadfruit flour led to increase in phosphorus content of the products. African breadfruit has been known to be rich in phosphorus. This may account for the increase in phosphorus content with increase in substitution of wheat flour with breadfruit flour. The magnesium content of the burger samples ranged from 2.05-2.92mg/100g. It was observed that addition of breadfruit flour led to increase in magnesium content of the samples. This observation justifies the assertion of Osabor et al. (2009) that African breadfruit is rich in magnesium. Magnesium is necessary in the system for prevention of various reproductive complications like infertility, pregnancy wastage, congenital anomalies, pregnancy-induced hypertension, placental abruption, premature rupture of membranes, still births and low birth weight (Pathak & Kapil, 2004). The calcium content of the burger samples ranged from 178-199mg/100g. The result revealed that inclusion of breadfruit flour resulted increase in calcium content of the product. Breadfruit has been known as a rich source of calcium. This may account for the increase in calcium content with increase in substitution of wheat flour with breadfruit flour. The African breadfruit snack samples contained iron in the range of 2.48-2.65mg/100g. The result indicated that addition of breadfruit flour improved the iron content of the samples. The sodium content of the burger samples fell within 1.02-1.08mg/100g. The result showed a decrease in sodium content of the samples as incorporation of breadfruit flour increases. African breadfruit is known as poor source of sodium. This may account for the decrease in sodium content with increase in substitution of wheat flour with breadfruit flour. Low sodium is necessary in the system due to its support to cell functionality without promoting heart-beat or high blood pressure (Guenther *et al*., 2013). The potassium content of the burger samples ranged from 238.00-254.00mg/100g. The result showed that incorporation of breadfruit flour led to increase in potassium content of the samples. African breadfruit has been known as a rich source of potassium. This may account for the increase in potassium content with increase in substitution of wheat flour with breadfruit flour. Potassium is necessary in the system due to its role in enhancing absorption of protein and other minerals like calcium (Niba *et al*., 2009)

Sensory evaluation of the snack samples

The sensory characteristics of the wheat-African breadfruit snack samples were assessed by 30 panelists with the use of a hedonic scale. The mean scores of the attributes for each samples is shown in Table (6) below. The sensory scores for appearance of the snack samples ranged from 6.43 to 7.53. The statistical analysis revealed that there was no significant ($p>0.05$) difference between samples A, B, C and D. Sample A had the highest score (7.53) while sample E had the lowest score (6.43). The panelist showed preference for the appearance of sample A which had slight degree of discoloration/browning. The score for aroma of the breadfruit snack samples ranged from 6.23 to 7.33. The trend of the result showed that aroma of the sample increased with increase in the quantity of African breadfruit flour. This agrees with the assertion of Osturk *et al*. (2002) that breadfruit flour improves aroma of baked products. Samples E had the highest score (7.33) followed by sample D, C, and sample B. The aroma of sample A was least preferred among the samples. Aroma is one of the sensory attributes that make a product to be liked or disliked even before it is being consumed (Wenting *et al*., 2017). In other words, it is a strong force that attracts consumers to the food. The mouth feel of the samples had mean scores which varied from 5.2 to 7.77. Sample A which was given the highest score (7.77) was the most preferred sample in terms of mouth feel followed by sample B (7.17). The higher the quantity of breadfruit flour, the lower the score for mouth feel of the products. Sample C was scored 6.03 while samples D and E were respectively scored 5.5 and 5.2. Taste is the primary factor which to a great extent influences the acceptability and probably market value of a food product. The taste of the breadfruit snack samples was given scores which ranged from 5.1 to 7.70. Sample C was most preferred among all the samples as it was given the highest score (7.70) while the least preferred sample was sample E (5.1) which showed that the panelists neither liked nor disliked it. It was observed that the taste of the samples improved as the incorporation of African breadfruit flour as coating material increased up to 15%. This increase in taste might be due to the caramelization of free sugar in breadfruit flour during baking (Ishera *et al*., 2021). The scores for the overall acceptability of the breadfruit snack samples varied from 5.8 to 7.63. Significant ($p<0.05$) difference was observed among the samples. Sample C had the best overall acceptability followed by samples D, C A and then E. Overall acceptability is a reflective of the consumer's acceptance of the product after evaluating all its attributes (Ihemeje *et al.,* 2021). The result of this assessment proved that moderate (10-15%) incorporation of breadfruit as coating material is most preferred to the panelists.

CONCLUSION

The result of this work proved the possibility of wheat-breadfruit snack production. The nutrient composition of the product revealed that inclusion of African breadfruit (coating) significantly ($p<0.05$) increased most of the nutrients (protein, ash and fat) which points that the product can be a cheap and fair source protein and minerals. The functional properties of the composite flour indicate its potential suitability in food formulations, especially in flour-based products. Therefore, the composite flour blends can be adopted or used to prevent protein energy malnutrition in the society. Organoleptic analysis of the products further revealed that the product would be highly appreciated by consumers. Snacks produced from 15% inclusion of breadfruit as coating material was most preferred in terms of general acceptability. The production and consumption of wheat-breadfruit snacks is therefore recommended because of its nutrient composition and good organoleptic attributes. Also the inclusion of African breadfruit in food formulations especially where product enrichment or fortification is needed should be encouraged. Attempt should be made to use wheat-breadfruit composite flour in the production of other foods like bread, biscuits, cakes, etc. which will definitely increase the use or economic importance of African breadfruit.

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APPENDICES

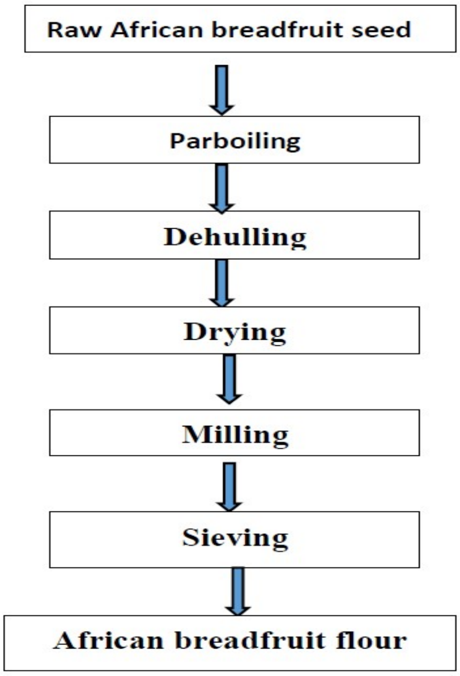

Fig. 1: Production of African breadfruit flour

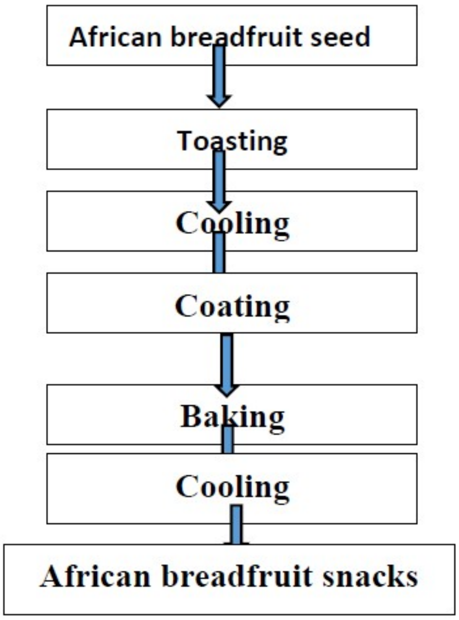

Fig. 2: Production of African breadfruit snacks

Table 1: Ingredients for preparation of coating material

Ingredient	Quantity
Flour	500g
Vegetable oil	75g
Egg	50g
Baking powder	30g
Nutmeg	20g
Salt	15g
Sugar	15g
Vanilla	10g

Table 2: Proximate composition of flour samples

Sample	Moisture (%)	Protein (%)	Fat (%)	Fibre (%)	Ash (%)	CHO (%)
A	$10.00^{a}\pm0.21$	$10.77^{c}\pm0.30$	$1.61^{c}\pm0.20$	$1.26^{a}\pm0.09$	$2.04^{c}\pm0.18$	$74.32^{a}\pm0.32$
B	$9.79^{a}\pm0.21$	$11.00^{b}\pm0.41$	$1.61^{c}\pm0.18$	$1.25^{a}\pm0.28$	$2.08^{bc}\pm0.10$	$74.27^{a}\pm0.32$
C	$9.78^{a}\pm0.16$	$11.39^{b}\pm0.39$	$1.63^{c}\pm0.19$	$1.23^{a}\pm0.10$	$2.14^{bc}\pm0.28$	$73.83^{b}\pm0.38$
D	$9.78^{a}\pm0.42$	$12.32^{a}\pm0.11$	$2.60^{b}\pm0.22$	$1.20^{a}\pm0.31$	$2.37^{ab}\pm0.12$	$71.73^{c}\pm0.18$
E	$9.77^{a}\pm0.11$	$12.73^{a}\pm0.30$	$3.20^{a}\pm0.12$	$1.20^{a}\pm0.22$	$2.64^{a}\pm0.19$	$70.46^{d}\pm0.29$

Values are means of triplicate analysis and standard deviation. Means on the same column with the same superscript are not significantly ($p>0.05$) different.

A = 100% wheat flour

B = 95% wheat flour + 5% African breadfruit flour

C = 90% wheat flour + 10% African breadfruit flour

D = 85% wheat flour + 15% African breadfruit flour

E = 80% wheat flour + 20% African breadfruit flour

Table 3: Functional properties of flour samples

Sample	Bulk Density (g/ml)	WAC (g/g)	OAC (g/g)	Swelling capacity (%)	Foaming capacity (%)
A	0.92^{a}±0.31	5.99^{a}±0.10	15.50^{c}±0.22	3.47^{a}±0.41	9.40^{c}±0.33
B	0.91^{a}±0.16	5.97^{a}±0.29	16.06^{bc}±0.51	2.94^{b}±0.18	9.49^{c}±0.04
C	0.77^{a}±0.12	5.86^{a}±0.07	16.9^{abc}±0.26	2.80^{b}±0.42	9.90^{bc}±0.00
D	0.71^{a}±0.20	5.76^{a}±0.11	17.10^{ab}±0.50	2.73^{b}±0.10	10.07^{b}±0.19
E	0.68^{a}±0.08	5.55^{a}±0.39	17.72^{a}±1.02	2.58^{b}±0.21	10.63^{a}±0.23

Values are means of triplicate analysis and standard deviation. Means on the same column with the same superscript are not significantly ($p>0.05$) different.

A = 100% wheat flour

B = 95% wheat flour + 5% African breadfruit flour

C = 90% wheat flour + 10% African breadfruit flour

D = 85% wheat flour + 15% African breadfruit flour

E = 80% wheat flour + 20% African breadfruit flour

Table 4: Proximate composition of snack samples

Sample	Moisture (%)	Protein (%)	Fat (%)	Fibre (%)	Ash (%)	CHO (%)
A	8.24^{b}±0.11	11.69^{d}±0.30	1.62^{b}±0.09	1.37^{a}±0.21	1.60^{c}±0.18	75.48^{a}±0.20
B	8.18^{b}±0.21	12.02^{d}±0.08	1.63^{b}±0.18	1.37^{a}±0.28	1.66^{c}±0.30	75.14^{a}±0.42
C	8.17^{a}±0.12	12.74^{c}±0.39	1.68^{b}±0.29	1.38^{a}±0.10	1.74^{c}±0.38	74.29^{b}±0.45
D	8.17^{a}±0.19	13.29^{b}±0.19	1.74^{b}±0.38	1.40^{a}±0.21	2.29^{b}±0.20	73.11^{c}±0.18
E	8.16^{ab}±0.11	14.32^{a}±0.30	2.46^{a}±0.12	1.40^{a}±0.09	3.33^{a}±0.31	70.33^{d}±0.37

Values are means of triplicate analysis and standard deviation. Means on the same column with the same superscript are not significantly ($p>0.05$) different.

A = Snack coated with 100% wheat flour

B = Snack coated with 95% wheat flour + 5% African breadfruit flour

C = Snack coated with 90% wheat flour + 10% African breadfruit flour

D = Snack coated with 85% wheat flour + 15% African breadfruit flour

E = Snack 80% wheat flour + 20% African breadfruit flour

Table 5: Mineral composition (mg/100g) of wheat-African breadfruit snacks

Sample	Phosphorus	Magnesium	Calcium	Iron	Sodium	Potassium
A	139±0.31	2.05±0.09	169±3.00	2.50±0.17	1.09±0.01	240.00±2.04
B	145±1.12	2.30±0.06	174±1.58	2.50±0.19	1.08±0.21	243.18±1.72
C	149±2.00	2.52±0.16	178±1.24	2.55±0.36	1.05±0.12	247.26±3.11
D	154±1.45	2.62±0.77	182±0.84	3.01±0.19	1.06±0.13	250.00±3.07
E	159±1.95	2.94±0.18	190±1.66	3.44±0.31	1.06±0.10	255.01±1.39

Values are means of triplicate analysis and standard deviation.

A = Snack coated with 100% wheat flour

B = Snack coated with 95% wheat flour + 5% African breadfruit flour

C = Snack coated with 90% wheat flour + 10% African breadfruit flour

D = Breadfruit snack coated with 85% wheat flour + 15% African breadfruit flour

E = Snack coated with 80% wheat flour + 20% African breadfruit flour

Table 6: Sensory attributes of the snack samples

Sample	Appearance	Aroma	Mouthfeel	Taste	General Acceptability
A	7.53^{a}	6.23^{c}	7.77^{a}	5.83^{c}	6.07^{b}
B	7.27^{a}	6.80^{b}	7.17^{a}	6.53^{b}	7.63^{a}
C	7.13^{ab}	7.00^{b}	6.03^{b}	7.70^{a}	7.33^{a}
D	6.97^{b}	7.33^{a}	5.50^{bc}	7.30^{a}	7.33^{a}
E	6.43^{c}	7.57a	5.20^{c}	5.10^{d}	5.80^{c}

Means in the same column with the same superscript are not significantly (P>0.05) different.

A = Snack coated with 100% wheat flour

B = Snack coated with 95% wheat flour + 5% African breadfruit flour

C = Snack coated with 90% wheat flour + 10% African breadfruit flour

D = Snack coated with 85% wheat flour + 15% African breadfruit flour

E = Snack coated with 80% wheat flour + 20% African breadfruit flour