CEDTECH International Journal of Bioscience and Biotechnology
Volume 1, Number 2, September 2020
http://www.cedtechjournals.org
ISSN: 2756-4568

NUTRIENT COMPOSITION OF BISCUITS FROM BAMBARANUT, SOYBEAN AND CARROT FLOUR BLENDS

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ABSTRACT

Biscuit composite flour was formulated from the blends of Bambaranut, soybean and carrot flours in the ratios of 80:20:0, 70:20:10, 60:20:20 and 50:20:30 coded as A, B, C and D samples respectively. The proximate composition, mineral elements, functional properties and sensory evaluation of the biscuits were also analysed. The crude protein content of the biscuit samples ranged from (13.04 to 18.53%), moisture content(1.80 to 2.75 %) fat (21.39 to 22.57 %), crude ash (3.45 to 4.23 %) and crude fiber from (1.41 to 1.82 %). The energy values of the biscuit samples ranged from 465.95 to 477.08 Kcal/mg. The bulk density of the biscuit samples ranged from 0.72 to 1.71 g/ml, swelling capacity from 5.00 to 9.00 ml/g and water absorption capacity from 1.50 to 2.10 %. Calcium ranged from (393.30 to 433.50 ppm), Iron (30.27 to 39.22 ppm), Potassium (88.15 to 95.40 ppm), Magnesium (80.20 to 90.30 ppm). The K/Ca ratio ranged from 0.22 to 0.23, and Fe/Mg ratio ranged from 0.38 to 0.45. Appearance ranged from 7.30to 8.70, aroma (7.00 to 8.50), taste (6.70 to 8.30), texture (7.10 to 8.30) and overall acceptability ranged from 7.30 to 8.80.

Keywords: *Bambaranut, Soybeans, Carrot Flours and Biscuits*

INTRODUCTION

Biscuits are one of the confectionary food products consumed as snacks by all ages. They are ready to eat, convenient, and inexpensive food products (Omoba and Omogbemile 2013). They are snacks produced from dough that is transformed into appetizing product through the application of heat in the oven (Kure *et al*., 1998). It is flat crisp and may be sweetened according to preference, it can be made from hard dough, hard sweet dough, or soft dough and biscuit has been reported to be rich in fat and carbohydrate. It is regarded as very low moisture content food product.

Sometimes, bakery products are used as vehicles for the incorporation of different nutritionally rich ingredients (Sudha *et al*., 2011). Soy is a complete protein. It is an important source of protein for many people, According to (USDA, 2017), 100 grams (g) of cooked green soybeans without salt contains 141 kilocalories, 12.35 g of protein, 6.4 g of fat, 11.05 g of carbohydrate, 4.2 g of fiber. Soybeans is low in saturated fat and high in protein, vitamin C, and folate. It is also a good source of calcium, iron, magnesium, phosphorus, potassium, thiamin. The nutrients content of other soy products may vary based on how manufacturers have processed them and which ingredients they have added.

The antioxidant properties of the fatty acids in the Bambaranuts can suppress the production of carcinogenic substances in the stomach, hence, it prevents damages to the mucus lining of the stomach, and therefore lowers the risk of stomach cancer (Ezengige, 2015). The Bambaranut flour is very high in protein which can be used to treat and cure protein energy malnutrition PEM and also as therapeutic diet. Carrots contains beta carotene as vitamin A precursor in biscuits, carrot possesses strong antiseptic qualities, can be used as a laxative, vermicides (worm expelling agents) poultice and for the treatment of liver conditions. Ethnomedically, the roots are used as an emmenagogue (to increase blood flow in the pelvic area and uterus), a carminative (to reduce flatulence), to treat digestive problems, intestinal parasites and constipation. The aim of this research is to expand the utilization of carrot powder, soy flour and bambaranut flour to avoid wastage and to produce nutritious biscuits, since the consumption of biscuit in Nigeria and the world at large by both children and adult is rapidly increasing.

MATERIALS AND METHODS

SOURCES OF RAW MATERIALS

The raw materials include carrot, Soybeans and bambaranut, which were purchased from Anyigba market in Kogi State, Nigeria.

Processing of Bambaranut into flour

5 kg Bambaranuts were sorted to remove extraneous matters and damaged seeds, winnowed and milled using laboratory hammer mill machine (grain mill, china, model 9fc 35) fitted with a 150 μm opening screen to produce relatively fine whole flour, which was packed in plastic bags and sealed to prevent moisture absorption, contamination, alteration and aeration and store at 4 °C prior to usage.

Processing of Soybeans into flour

3 kg of Soybeans were prepared by the methods described (Raji, 2015). They were sorted to remove dirt, defective seeds and stones before cleaning, and thoroughly washed in clean water. The seeds were boiled for 30mins, drained, dehulled and dried in a hot air oven at 70°C for 10 hours. The dried soybeans seeds were then milled (grain mill, china, model 9fc 35) and sieved through a standard sieve.

Processing of Carrot into Powder

1 kg of fresh carrots was washed, scraped, and ends trimmed to remove dirts. It was grated using a grating machine and dried inside cabinet dryer at 60°C. The dried carrots then milled using laboratory hammer mill fitted with a 150 μm opening screen to produce relatively fine whole flour, packaged and stored in a heat seal polythene bag prior to usage.

PROCEDURE FOR BISCUITS PRODUCTION

All the ingredients were weighed and labelled separately, butter and the sweetener (sucrose) creamed using a method described (clement, 2011). Other powdered ingredients folded in and refrigerated at 10°C for 12hours. It was then sized out using various biscuit cutters unto pre-determined size and weight, picked and placed on an ungreased baking pan, then baked at a high constant temperature of 180°C for 20 minutes to prevent spreading. Then it was cooled on coolling rack, packed, sealed and stored prior to laboratory analysis.

Table 1: Biscuit Blend Formulations

Samples	Bambaranut flour (%)	Soybean flour (%)	Carrot flour (%)
AAA	80	20	0
BBB	70	20	10
CCC	60	20	20
DDD	50	20	30

Chemical Analysis

Determination of proximate composition

The moisture, protein, fat, ash, and crude fiber contents of the biscuit samples were carried out according to the methods of AOAC (2010), the carbohydrate was calculated by differences, while the energy value were calculated using Atwater factor.

Determination of mineral composition

The calcium, iron, magnesium, potassium content of the biscuit samples were carried out according to the method of Taffouo et al., (2013).

Determination of Functional Properties

The bulk density, Water absorption capacity and Swelling Capacity/ Index was determined by the method of Fayemi *et al.* (2010).

SENSORY EVALUATION

20 untrained panelists were recruited to assessed the appearance, taste, aroma, texture and overall acceptability. The sensory evaluation as was done using 9 point Hedonic scale, 9 as very extremely liked, 8 very much liked, 7 much liked, 6 slightly liked, 5 neither liked nor disliked, 4 slightly disliked, 3 much disliked, 2 very much disliked, 1 extremely disliked. Statistical analysis were carried out in triplicates and experimental data were subjected to one-way analysis of variance (ANOVA). Means were separated using New Duncan Multiple Range Tests (NDMRT).

RESULTS AND DISCUSSIONS

Table 2: PROXIMATE ANALYSIS OF FOUR DIFFERENT BISCUIT SAMPLES.

Samples	Moisture content (%)	Crude Protein (%)	Crude Fat (%)	Crude Ash (%)	Crude Fibre (%)	Carbohydrate content (%)	Energy value (Kcal)
A	$2.07^{c}\pm0.07$	$17.22^{c}\pm0.07$	$22.08^{b}\pm0.02$	$3.45^{b}\pm0.05$	$1.41^{d}\pm0.01$	$53.78^{b}\pm0.08$	477.78
B	$1.80^{d}\pm0.00$	$18.09^{b}\pm0.02$	$21.65^{c}\pm0.05$	$3.53^{b}\pm0.03$	$1.44^{c}\pm0.00$	$53.50^{b}\pm0.05$	475.45
C	$2.28^{b}\pm0.02$	$18.53^{a}\pm0.07$	$22.57^{a}\pm0.03$	$4.23^{a}\pm0.03$	$1.82^{a}\pm0.02$	$50.58^{c}\pm0.01$	472.29
D	$2.75^{a}\pm0.05$	$13.04^{d}\pm0.02$	$21.39^{d}\pm0.09$	$4.13^{a}\pm0.03$	$1.69^{b}\pm0.01$	$57.01^{a}\pm0.12$	465.95

Mean ± standard deviation of three replicate; mean values with the same superscript letter within the same column do not differ significantly (p> 0.05)

KEYS: A *= Bambaranut 80%, Soybean 20%, Carrot 0%,* ***B*** *= Bambaranut 70%, Soybean 20%, Carrot 10%,* ***C*** *= Bambaranut 60%, Soybean 20%, Carrot 20%,* ***D*** *= Bambaranut 50%, Soybean 20%, Carrot 30%*

PROXIMATE COMPOSITION OF BISCUIT SAMPLES

The Proximate composition of the biscuit samples are presented in table 2. The moisture content of the biscuit samples ranged from 1.80 to 2.75%. Sample B had the lowest value (1.80%), while Sample D had the highest value (2.75%).The moisture content of the biscuit samples were significantly ($P\leq0.05$) different. High moisture content (2.75%) although, within acceptable limit in terms of food storage as recommended by USDA (2017), which states 1-15% safe moisture contents as optimal range for storage of food and cereal grains. Low moisture content of biscuit samples indicates longer keeping storage with proper packaging.

Protein content of the biscuit samples ranged from 13.04 to 18.53%. Sample C had the highest value (18.53%) while Sample D had the lowest value (13.04%). The protein content of the biscuit samples were significantly ($P\leq0.05$) different. Protein also plays a part in the organoleptic properties of foods in addition to being a source of amino acid. High crude protein value found in the sample is as a result of increase in bambara nut and soybean flour proportion which is in line with previous finding of Boateng *et al* (2013).

The values obtained for crude fat in the sample ranged from 21.39 to 22.57%. Sample D had the lowest value (21.39%), while Sample C had the highest (22.57%). The analysis showed significant (P≤0.05) difference among all samples. High values of crude fat content agree with the findings of Agu *et al*. (2014). High fat content in biscuit can lead to rancidity which can constitute storage problem.

Ash content of the different biscuit samples ranged from 3.45 to 4.23%. Sample A had the lowest value (3.45%) while Sample C had the highest value (4.23%). The ash content of the biscuit samples were significantly (P≤0.05) different. High ash content is an indication of high minerals which invariably increases the mineral content of biscuit that contribute to nutrition of consumer such as calcium for strong bones development as reported by Agu *et al*. (2014).

The crude fibre of the biscuit samples ranged from 1.41 to 1.82%. Sample C had the highest value (1.82%) while Sample A had the lowest value (1.41%) The crude fibre of the biscuit samples were significantly (P≤0.05) different. High value of fibre contents would improve digestion and aid waste elimination in the body and prevent anthracites (Ayo *et al,* 2013).

The carbohydrate ranged from 50.58 - 57.01%. Sample C had the lowest mean value (50.58%) while Sample D had the highest value (57.01%). The analysis showed that there were significant (P≤0.05) differences among all samples. Low value of carbohydrate content is as a result of low contents in bambaranut and carrot flour which actually increased significantly in the final biscuit product. (Yao *et al*., 2015). The energy value ranged from 465.95 to 477.08Kcal/100g biscuit. Sample D had the lowest energy value (465.95)Kcal while sample A had the highest energy value (477.08Kcal). This is in agreement with the RDA for energy intake in infants ranging from 108-478Kcal/day (WHO, 2014)

Mineral Elements Composition of Biscuit Samples

Table 3: Minerals Composition of Four Different Biscuit Samples

Sample (%)	Calcium (Ca) (ppm)	Iron (Fe) (ppm)	Potassium (K) (ppm)	Magnesium Mg (ppm)	K/Ca Ratio	Fe/Mg ratio
A	$393.30^{d}\pm0.10$	$30.27^{d}\pm0.10$	$88.15^{c}\pm0.05$	$80.20^{d}\pm0.10$	0.22	0.38
B	$407.35^{c}\pm0.25$	$35.34^{c}\pm0.65$	$93.25^{c}\pm0.15$	$84.35^{c}\pm0.15$	0.23	0.42
C	$433.50^{a}\pm0.10$	$39.22^{a}\pm0.11$	$95.40^{a}\pm0.10$	$87.40^{b}\pm0.20$	0.22	0.45
D	$408.60^{b}\pm0.20$	$38.25^{b}\pm0.08$	$94.05^{b}\pm0.05$	$90.30^{a}\pm0.10$	0.23	0.42

Mean ± standard deviation of three replicate; mean values with the same superscript letter within the same column do not differ significantly (p> 0.05)

KEYSA *= Bambaranut 80%, Soybean 20%, Carrot 0%,* ***B*** *= Bambaranut 70%, Soybean 20%, Carrot 10%,* ***C*** *= Bambaranut 60%, Soybean 20%, Carrot 20% ,* ***D*** *= Bambaranut 50%, Soybean 20%, Carrot 30%*

The calcium content ranged from 393.30 to 433.50ppm. Sample C had the highest mean value of 433.50ppm while Sample A of 393.30ppm is the lowest mean value. The calcium content of the different biscuit samples was significantly ($P\leq0.05$) different. The calcium content of the biscuits increased with increase in level of bambaranut-soy-carrot flour addition, which means that the Bambaranut-soy-carrot has high content of calcium, as previously reported by (Islamiyat *et al*, 2016).

The iron content ranged from 30.27 to 39.22ppm. Sample A had the lowest value (30.27ppm) while Sample C had the highest value (39.22ppm). The iron content of the different biscuit samples were significantly ($P\leq0.05$) different. Iron is a major component of haemoglobin that carries oxygen to all parts of the body. Iron also has a critical role within cells assisting in oxygen utilization, enzymatic systems, especially for neural development, and overall cell function, (Islamiyat *et al*, 2016). Therefore, all biscuit samples would furnish iron to improve nutrition of the consumers.

The potassium content ranged from 88.15 to 95.40ppm. Sample C had the highest mean values of 95.40ppm, while Sample A has the lowest significant mean value of 88.15ppm. The potassium content of the different biscuit samples are significantly (P≤0.05) different. This is good because it is required to maintain osmotic balance of the body fluids, the pH of the body, to regulate muscle and nerve irritability, control glucose absorption, and enhance normal retention of protein during growth, (Arinathan *et al*, 2013).

TABLE 4: Functional Properties of the Biscuit Samples

Sample (%)	Water Absorption Capacity (ml/g)	Bulk Density (g/ml)	Swelling Capacity (%)
A	1.50^{c}±0.00	1.70^{d}±0.00	5.00±0.00
B	1.80^{b}±0.00	1.71^{c}±0.00	8.00±0.00
C	2.05^{a}±0.05	0.72^{b}±0.00	9.00±0.00
D	2.10^{a}±0.10	0.73^{a}±0.00	8.00±0.00

Mean ± standard deviation of three replicate; mean values with the same superscript letter within the same column do not differ significantly (p> 0.05)

KEYS*: **A** = Bambaranut 80%, Soybean 20%, Carrot 0%, **B** = Bambaranut 70%, Soybean 20%, Carrot 10%, **C** = Bambaranut 60%, Soybean 20%, Carrot 20%, **D** = Bambaranut 50%, Soybean 20%, Carrot 30%.*

Table 4 above shows the Functional Properties of Biscuit Samples

The water absorption capacity ranged from 1.50 to 2.10 ml/g biscuit. Sample D had the highest mean value of 2.10 ml/g, while Sample C of 1.50 ml/g had the lowest mean value. The water absorption capacity result shown for the different biscuit samples are significantly (P≤0.05) different. Water absorption capacity is a desirable character in foods such as custards, sausages and dough because these are supposed to imbibe water without dissolution of protein thereby attending body thickening and viscosity, (Seena and Sridhair, 2015).

The bulk density ranged from 0.70 to 0.73g/ml. Sample D had the highest mean value of 0.73g/ml and Sample A of 0.70 g/ml had the lowest mean value. The bulk density result shown for the different biscuit samples are significantly (P≤0.05) different. Bulk density is a measure of heaviness of flour and is generally affected by the particle size. The low value of bulk density observed in this study is important in transportation, packaging requirement, material handling and cost-efficient of bakery products, (Ajanaku *et al*, 2012).

The swelling capacity ranged from 5.00 to 9.00%. Sample A had the lowest value (5.00%) while Sample C had the highest value (9.00%). Samples B and D had the same values (8.00%) therefore making the foam capacity of Samples B and D significantly (P>0.05) similar. The foam capacity of the different biscuit samples are significantly (P>0.05) different. The result of this study is related to the work of Chandra *et al*., (2015) that reported an increasing foaming capacity as the level of bambaranut flour decreases.

Table 5: SENSORY ANALYSIS RESULTS OF FOUR DIFFERENT BISCUIT SAMPLES.

Sample (%)	Appearance	Aroma	Taste	Texture	Overall acceptability
A	$8.70^{a}\pm0.15$	$7.80^{ab}\pm0.33$	$8.50^{a}\pm0.17$	8.30 ± 0.30	$8.80^{a}\pm0.13$
B	$8.00^{ab}\pm0.26$	$8.50^{a}\pm0.27$	$8.10^{a}\pm0.28$	7.40 ± 0.45	$8.50^{a}\pm0.22$
C	$8.10^{ab}\pm0.23$	$7.80^{ab}\pm0.33$	$8.00^{a}\pm0.26$	7.70 ± 0.34	$8.20^{a}\pm0.20$
D	$7.30^{b}\pm0.52$	$7.00^{b}\pm0.47$	$6.70^{b}\pm0.50$	7.10 ± 0.46	$7.30^{b}\pm0.52$

Mean ± standard deviation of three replicate; mean values with the same superscript letter within the same column do not differ significantly (p> 0.05)

KEYS
A = *Bambaranut 80%, Soybean 20%, Carrot 0%*
B = *Bambaranut 70%, Soybean 20%, Carrot 10%*
C = *Bambaranut 60%, Soybean 20%, Carrot 20%*
D=*Bambaranut 50%, Soybean 20%, Carrot 30%*

Sensory Evaluation of the Biscuit Samples

Sensory quality characteristics of the Banbaranut-soybean-carrot biscuit samples were presented in table 5. It shows that they are significantly (P≤0.05) different in their appearance, aroma, taste and overall acceptability. The appearance ranged from 7.30 to 8.70%. Sample A had the highest value (8.70%) while Sample D had the lowest value (7.30%). The low value in Sample D could also be due to enzymatic browning, which might have given an impression of the products been over baked to the panellist hence the less liking effect. These results are comparable to the result of Mouni *et al* (2017).

The aroma ranged from 7.00 to 8.50%. Sample B had the highest with 8.50 while Sample D of 7.00 had the lowest. The taste ranged from 6.70 to 8.50% Sample A had the highest (8.50%) while Sample D of 6.70% had the lowest value. The addition of bambaranut and carrot flour decreased the value of the taste and aroma .This could be due to increase in the sugar, fat and some other compounds in the bambaranut and carrot flour, (Akoja and coker, 2018)The texture ranged from 7.10 to 8.30%. sample A had the highest (8.30 %) value, while sample D had the least (7.10 %). This Similar trend was observed by Akoja and Coker (2018). The overall acceptability ranged from 7.30 to 8.80%. Sample A had the highest (8.80) value while Sample D had the least (7.30) value. Similar trend was observed by Akoja and Coker (2018).

CONCLUSION

Based on the results obtained from this study, biscuit produced from 60%, bambaranut, 20%, soybean and 20% carrot flour improved the nutrients content as well as the organoleptic attributes of biscuit without causing any adverse effect. Sample C (Bambaranut 60%, Soybean 20%, Carrot 20%) had higher values of protein, fat and oil, ash and fibre contents. Sample D (Bambaranut 50%, Soybean 20%, Carrot 30%) had higher Carbohydrate content and moisture. Sample A (Bambaranut 80%, Soybean 20%, Carrot 0%) was most accepted in all the sensorial attributes.

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