Nutritional and Sensory Attributes of Puff-Puff Produced From Composite Flour of Yellow Cassava, Orange flesh Sweet Potato and Sesame seed

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ABSTRACT

Background: *Protein and micronutrient deficiencies is still a threat to our development. Improving the nutrient content of our common snacks is a strategy to reduce malnutrition prevalence in Nigeria*

Objective: *The study investigated the nutritional and sensory attributes of puff-puff produced from the partial replacement of wheat flour with yellow cassava, orange flesh potato flour and sesame seed.*

Materials and method: *Orange flesh sweet potato, yellow cassava and sesame seed were processed into flour, and the flours were combined in different proportions to obtain composite flours: (60% yellow cassava, 20% orange flesh sweet potato, 10% sesame seed, 10% wheat flour), (50% yellow cassava, 30% orange potato, 10% sesame seed, 10% wheat flour), (40% yellow cassava, 40% orange potato, 10% sesame seed, 10% wheat flour) for puff-puff production, commercial wheat flour was used as control. Samples were subjected to chemical, instrumental, and sensory analysis. Statistical Package for Social Science (SPSS) version 23 was performed. Significance was accepted at $P<0.05$.*

Result: *The puff-puff made from the control sample was significantly ($p<0.05$) low in protein (10.12%), ash (1.94%), fibre (3.24%) and moisture (13.61%) content. Puff-puff from composite flours had a Significant ($p<0.05$) higher value for all micronutrient compared to the control. The puff-puff from composite flours compared well to the control, but the sensory scores of the control was significantly ($p<0.05$) higher in all parameters.*

Conclusion: *The study had shown that a nutritious and acceptable puff-puff could be produced with partial replacement of wheat flour with yellow cassava and orange flesh sweet potato flours*

Keywords: puff-puff, Yellow cassava, Orange flesh sweet potato, Sesame seed

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INTRODUCTION

Puff-puff is one of Nigeria's most popular snacks sold and consumed. It is a nutritive food obtained from single or composite dough that has been transformed into digestible and more appetizing products through heat via deep frying with hot fat (1). They are regarded as confectioner food with low moisture content (2). They are made of dough containing flour, yeast, sugar, salt, water, and deep fried in vegetable oil to a golden-brown color. Puff pastry is a bakery product containing a high-fat content (3).

Because of the rising demand for functional food,

snack manufacturers are attempting to improve the nutritional value and functionality of their products by altering their formulations. This entails the use of non-wheat flour in an attempt to boost the protein content and quality of the puff-puff while also addressing the high cost of wheat flour in Nigeria and other countries (2). Due to these constraints, researchers are looking for available or underutilized crops with useful properties that can be used as composite flours in baked and fried dough products (4).

Yellow cassava (*Manihot esculenta*) is a new yellow-fleshed cultivar of cassava grown in Nigeria for its high beta carotene content, a precursor to vitamin A. Vitamin A deficiency is a major nutritional issue among children under the age of five (5). Yellow cassava has the potential to prevent vitamin deficiency in Nigeria and Africa because it is a key staple. Cassava is a good source of carbohydrates, with starches accounting for 80 percent of the total 100g of edible portion (6), and is a staple in many people's diets. Using cassava bio-fortified flour to make puff-puff would be a great way to eliminate the need for wheat flour while also improving the nutritional value of the puff-puff. In Nigeria, attempts have been undertaken to make bread using cassava flour as a partial replacement for wheat flour (7).

Orange flesh sweet potato (*Ipomoea batatas*) (OFSP) is another of the world's most significant food crops and a staple in Nigeria and other African countries (8). It's a low-input crop that can be used as a vegetable, a dessert, a starch source, or animal feed (8). Sweet potato is commonly consumed in Nigeria as a snack (dundun), fried, boiled, and as a sweetener in beverage preparation. Despite its nutritional richness and ability to promote food security, improve health, battle malnutrition, and improve economic activity, the orange flesh sweet potato is underutilized in Nigeria when compared to other root and tuber crops consumed (8).

Sesame seeds (Sesamum indicum) have a nutty flavor and are small, flat oval seeds. Many ethnic groups in Nigeria eat sesame seed, and it is grown throughout most of the country's central belt as well as certain Nigerian states in the north (9). Oil (44-52.5%), protein (18-23.5%), and carbohydrate (13%) are all important components of sesame (10, 11). The inclusion of sesame flour as one of the composite flours will increase the protein intake of puff-puff, reducing malnutrition and enhancing consumer nutritional status. Sesame seeds that have been processed are utilized in baked goods such as cakes, hamburgers, buns, cookies, confectionary, and a variety of snack items (12).

In baking and pastry industry, the use of composite flours made from crops have been reported (13,14,15). Sweet potato and yellow cassava flour won't be left behind in creating an appealing pastry if properly processed thus play a key role in promoting awareness and utilization of the crop's potential.

In Nigeria, the partial replacement of wheat flour with other types of flour in puff-puff manufacture is economically crucial because wheat is imported and the country's wheat production cannot meet the demand of over 200 million Nigerians. Due to economic, social, and health considerations, there is a growing interest in employing composite flour for snacks. However, substituting cassava and potato flour for wheat flour in the production of puff-puff may effectively lower the cost of wheat flour importation while increasing the yield income from cassava and potato crops. However, there is a dearth of information on the use of Composite flour made from cassava, potato, and sesame seed flour for puff-puff manufacture. Therefore, this study aimed to investigate the nutrients and sensory attributes of puff-puff produce from partial replacement of wheat flour with composite flour of yellow cassava, orange flesh potato, and sesame seed.

MATERIALS AND METHODS

Procurement of Raw Materials

Commercial wheat flour, salt, sugar, and dry baker's yeast were purchased at Oba market in Owo. Orange fleshed sweet potatoes and yellow cassava was purchased at Mr. Mukaila farm in Ikire, local government area of Osun State because we could get root and tubers in Ondo state as at the time it was needed. Sesame seed was purchased at Shasha market in Akure, Ondo state.

Preparation of Orange Fleshed Sweet Potato Flour

The sweet potato flour was produced using the method (1). The orange-fleshed sweet potato tubers were peeled and cut into thin pieces manually. The potato slices were then first immersed in a 1% NaCl solution and in a solution containing potassium metabisulphite (1%) and citric acid (0.5%) for 30 min to prevent browning reactions and enhance the colour of the flour. Drying of sweet potato slices was done on perforated trays and was air dry. The dried sweet potato chips were milled into flour using the laboratory attrition milling machine passed through a 250 μm mesh sieve, packed in airtight containers

Preparation of yellow cassava Flour

The yellow cassava was produced using the method (1). The yellow cassava roots were peeled and cut into thin pieces manually. The cassava slices were then spread on perforated trays and were air dry. The dried yellow cassava chips were milled into flour using the laboratory attrition milling machine passed through a 250 μm mesh sieve, packed in airtight containers

Preparation of puff-puff

A thorough mixture of little hot water with 45g of sugar and 30gram of yeast with the addition of 5g of salt was stirred to mix well and allowed to activate for 5-10minutes. The mixture was poured into the measured composite and thoroughly mixed, covered with a bowl for 45minutes to rise. After which, the batter was deep fried to golden brown coloration in hot vegetable oil. Samples of the puff-puff from each composite flour were sent for laboratory analysis and while the other ones were kept for sensory evaluation.

Proximate Analysis

The standard method of AOAC (17) was used to determine the proximate content of the samples. The hot air oven method was used to determine the moisture content; Protein was determined using the Kjeldahl method of protein analysis. Fat was determined by the Soxhlet method of fat extraction, while ash was obtained by weighing 5g of the sample into a tarred porcelain crucible. The crucible and its content were then transferred into a muffle furnace set at 550^{0}C for 6hours until ash content was obtained. The crude fibre was determined, weighing 2.0g of each sample was weighed into separate beakers while total carbohydrate content was obtained by difference (17).

Determination of vitamin and mineral analysis.

Water soluble vitamins such as thiamin, riboflavin, niacin, pantothenic acid, pyridoxine and folic acid were determined using the AOAC method of analysis (17). Each analysis was carried out in duplicates on all the samples, while vitamin A was determined using the method described by IVACG (1992). Minerals determination was carried out in a dilute solution of the ashed samples according to the method outlined in AOAC (17) by Atomic Absorption Spectrophotometer (Buck Scientific, Model 210) for Calcium, Iron, iodine, Magnesium, Sodium and Manganese, copper and Zinc while potassium was by flame photometry (18), and phosphorus was determined by colorimetric method (17) at the central laboratory of the College of sciences of Afe Babalola University

Sensory evaluation of the food samples

A structured questionnaire was used to collect information from 15 untrained panelists on the sensory characteristics of the puff-puff. The Puff-puff samples were coded as $WYOSF_{1,}$ $WYOSF_{2,}$ $WYOSF_3$and WHTF and presented to the panelists who were students recruited from Rufus Giwa Polytechnic, Owo. The panelists were seated comfortably at the sensory unit of the Nutrition and Dietetics department, and each panelist was served with a separate plate containing two balls of samples served at the same temperature (30°C) in line with method described by (19).

Statistical Analysis

The results were expressed as mean ± standard deviation, and the test for statistical significance was carried out using a one-way analysis of variance (ANOVA). The Statistical Package for

Social Sciences (SPSS, Version 20) software determined significant differences. Significant means were separated using Duncan's New Multiple Range Test (DNMRT), and differences were considered significant at $p<0.05$

RESULTS

Table 1 result shows that sample $WYOSF_3$ significantly ($p<0.05$) had the highest value of moisture (15.21%) while sample WHTF (13.61%) had the least value. The value (2.52%) obtained for ash in $WYOSF_1$ was significantly ($p<0.05$) different other samples including the control.

The ash content decreases with a reduction in the quantity of yellow cassava flour used to produce the puff-puff. In the same vein, the fibre content of the samples shows that $WYOSF_1$, $WYOSF_2$, $WYOSF_3$ and WHTF had 6.67%, 5.58%, 3.73% and 3.24%, respectively. In the same way; fibre content reduces with a decrease in the amount of yellow cassava used. Sample $WYOSF_1$ was significantly ($p<0.05$) higher in protein (14.25%), and was significantly ($p<0.05$) lower carbohydrate (49.05%) than the control sample while $WYOSF_3$ had the highest value (15.15%) of fat.

Sample $WYOSF_1$

Sample $WYOSF_2$

Sample $WYOSF_3$

Sample WHTF

Formulation of composite flour and other ingredients for puff-puff production

Four different puff-puff samples were produced and coded as $WYOSF_1$, $WYOSF_2$, $WYOSF_3$ and WHTF. Sample WHTF served as the control and contained 100% wheat. Samples $WYOSF_1$, $WYOSF_2$ and $WYOSF_3$ consisted of wheat/cassava /potato /sesame seed flours, and the other ingredients for Puff-puff production are presented in table 1.

Table 1: Recipe formulation for puff- puff production

Ingredient	$WYOSF_1$	$WYOSF_2$	$WYOSF_3$	WHTF
Wheat flour(g)	10%	10%	10%	100%
Yellow cassava flour (g)	60	50	40	-
OFSP flour (g)	20	30	40	-
Sesame seed	10%	10%	10%	-
Yeast (g)	30	30	30	30
Salt (g)	5	5	5	5
Sugar (g)	45	45	45	45
Water (ml)	200	200	200	200

Values are mean ± standard deviation of duplicate analyses. Values with the same superscript in the same columns are statistically insignificant at ($P<0.05$). Key: $WYOSF_1$= 60% Yellow cassava flour, 20% orange flesh sweet potato, 10% sesame seed, 10% wheat flour, $WYOSF_2$= 50% Yellow cassava flour, 30% orange flesh sweet potato, 10% sesame seed, 10% wheat flour, $WYOSF_3$= 40% Yellow cassava flour, 40% orange flesh sweet potato, 10% sesame seed, 10% wheat flour, WHTF = 100% Wheat flour

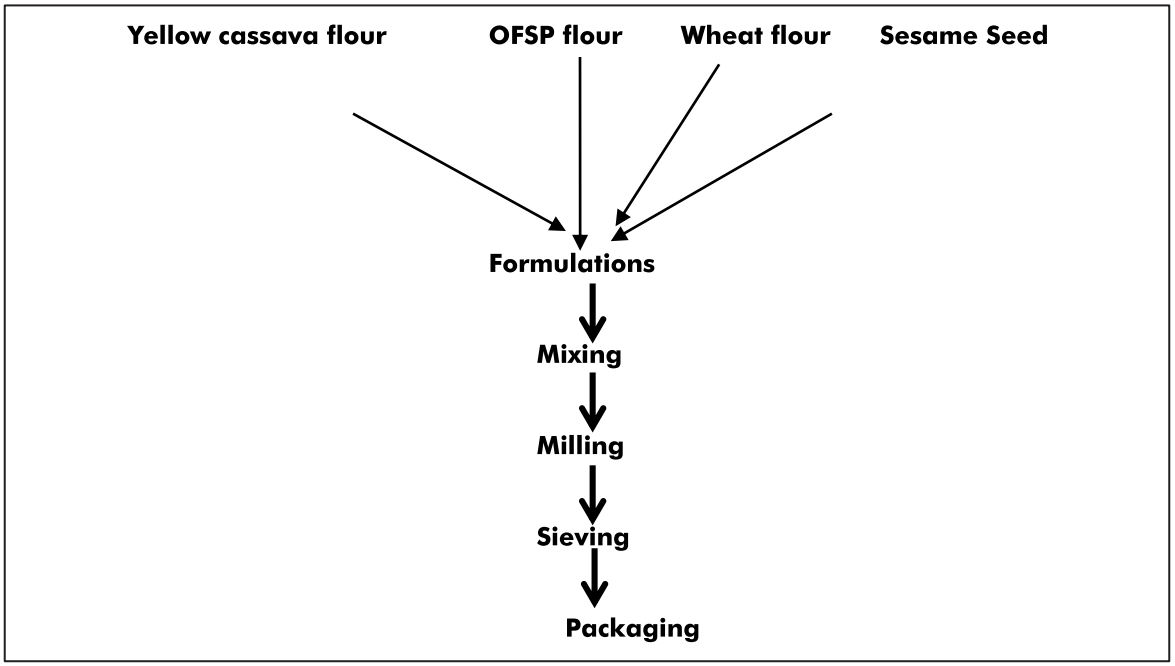

Figure 1: Flow chart for the production of composite flour

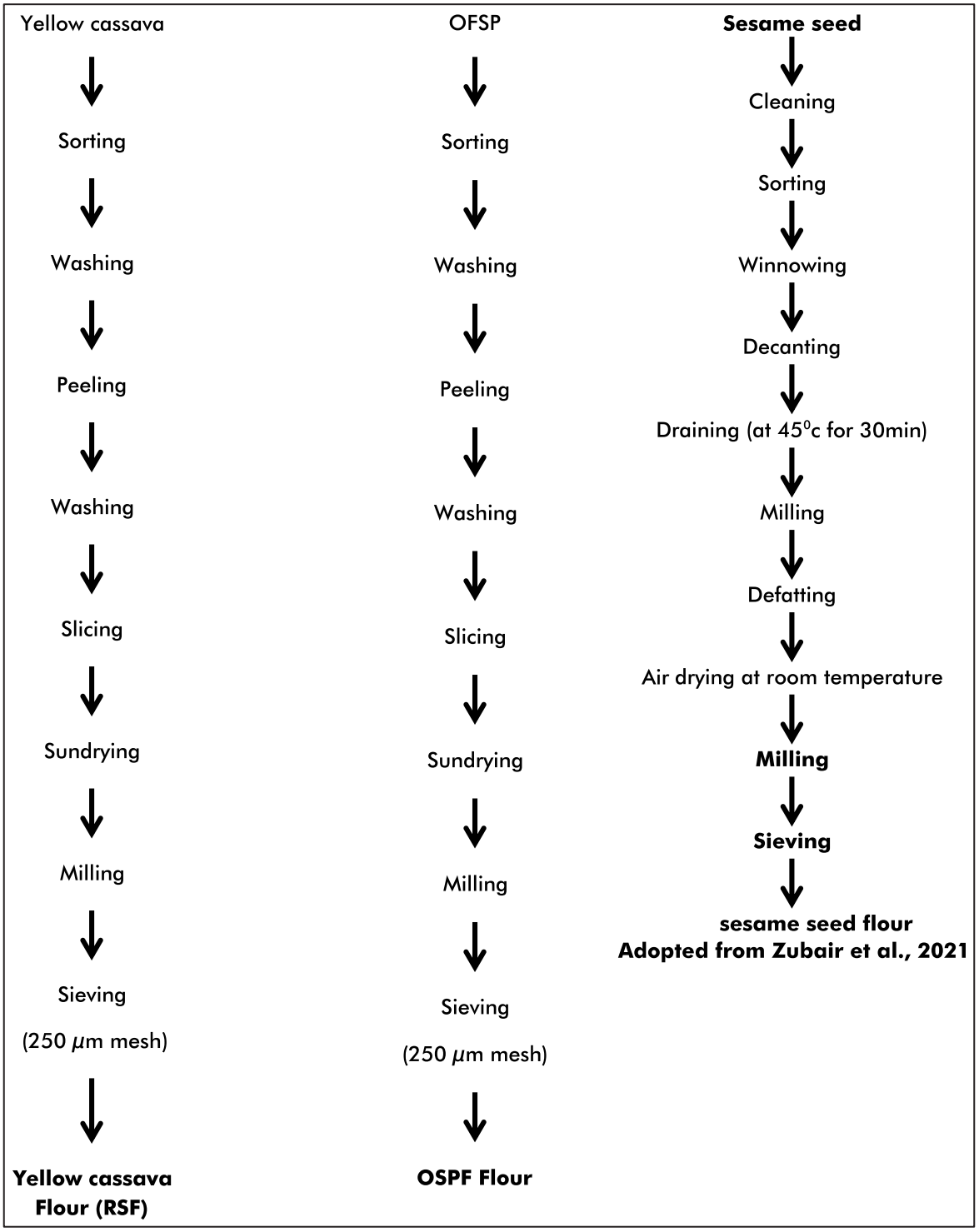

Figure 2: Flow chart for the production of grains flour

Table 1: Proximate composition of puff-puff produced

Parameters	$WYOSF_1$	$WYOSF_2$	$WYOSF_3$	WHTF
Moisture (%)	14.660.007^{b}	14.52±0.012^{b}	15.21±0.016^{a}	13.61±0.016^{d}
Ash (%)	2.52±0.006^{a}	2.19±0.009^{c}	2.23±0.002^{b}	1.94±0.012^{d}
Fat (%)	12.89±0.021^{b}	12.85±0.16^{bc}	12.32±0.021^{d}	15.15±0.000^{a}
Fibre (%)	6.67±0.001^{a}	5.58±0.006^{b}	3.72±0.002^{c}	3.24±0.007^{cd}
Protein (%)	14.25±0.014^{a}	13.18±0.021^{b}	11.37±0.026^{c}	10.12±0.009^{d}
CHO (%)	49.05±0.047	51.75±0.023	55.16±0.036	55.90±0.003

Values are mean ± standard deviation of duplicate analyses. Values with the same superscript in the same columns are statistically insignificant at ($P<0.05$). Key: $WYOSF_1$= 60% Yellow cassava flour, 20% orange flesh sweet potato, 10% sesame seed, 10% wheat flour, $WYOSF_2$= 50% Yellow cassava flour, 30% orange flesh sweet potato, 10% sesame seed, 10% wheat flour, $WYOSF_3$= 40% Yellow cassava flour, 40% orange flesh sweet potato, 10% sesame seed, 10% wheat flour, WHTF = 100% Wheat flour

Table 2: Mineral composition of puff-puff produced

Mineral	$WYOSF_1$	$WYOSF_2$	$WYOSF_3$	WHTF
Na (mg/100g)	306.10±0.141^{a}	278.40±0.212^{b}	259.70±0.212^{c}	248.50±0.141^{d}
Ca (mg/100g)	191.40±0.000^{c}	204.70±0.212^{a}	178.70±0.707^{d}	212.40±0.141^{b}
K (mg/100g)	610.70±0.141^{b}	585.30±0.424^{d}	591.70±0.141^{c}	660.10±0.212^{a}
Zinc (mg/100g)	1.37±0.006^{a}	1.23±0.004^{b}	0.83±0.022^{c}	0.62±0.005^{d}
Mg (mg/100g)	46.12±0.035^{a}	33.97±0.009^{b}	27.19±0.014^{d}	30.26±0.001^{c}
Se (mg/100g)	0.17±0.003^{c}	0.21±0.004^{a}	0.20±0.002^{ab}	0.14±0.004^{d}
Fe (mg/100g)	0.22±0.002^{a}	0.19±0.004^{b}	0.16±0.002^{c}	0.14 ±0.006^{d}
Cu (mg/100g)	0.11±0.004^{d}	0.21±0.004^{c}	0.26±0.004^{b}	0.30±0.001^{a}
P (mg/100g)	59.13±0.002^{a}	56.76±0.018^{b}	45.43±0.001^{c}	37.27±0.002^{d}
Iodine (μg/100g)	7.14±0.004^{a}	5.22±0.006^{c}	6.19±0.004^{b}	5.05±0.038^{cd}

Table 3: Vitamin composition of puff-puff produced

	Samples code			
Vitamin composition	**$WYOSF_1$**	**$WYOSF_2$**	**$WYOSF_3$**	**WHTF**
Beta carotene (mcg)	15.55±0.20^{a}	13.45±0.34^{b}	11.89±0.21^{c}	8.67±0.67^{d}
B1 (mg/100g)	28.65± 0.005^{a}	25.41±0.003^{b}	21.96±0.014^{c}	15.60±0.002^{d}
B_2 (mg/100g)	0.52±0.049^{a}	0.47±0.005^{b}	0.45 ±0.002^{c}	0.03 ±0.002^{d}
B_3 (mg/100g)	1.73±0.004^{a}	1.62±0.002^{b}	1.37±0.007^{c}	1.15±0.011^{d}
B_5 (mg/100g)	0.17±0.004^{a}	0.13± 0.002^{b}	0.12±0.001^{c}	0.11±0.001^{d}
B_6 (mg/100g)	0.31±0.002^{a}	0.28±0.003^{b}	0.24±0.004^{c}	0.19±0.004^{d}
B_9 (mcg/100g)	95.65± 0.212^{a}	82.85± 0.212^{b}	80.26 ±0.212^{c}	71.25±0.02^{d}

Table 4: Sensory Evaluation of the Puff-puff

Sensory attributes	$WYOSF_1$	$WYOSF_2$	$WYOSF_3$	WHTF
Flavour	6.07 ± 0.632^{d}	6.47 ± 2.799^{b}	6.20 ± 1.494^{c}	8.33 ± 1.174^{a}
Aroma	6.40 ± 0.632^{b}	5.60 ± 1.430^{d}	6.13 ± 1.853^{c}	8.33 ± 1.989^{a}
Mouth feel	5.60 ± 0.699^{d}	5.30 ± 1.636^{c}	6.20 ± 1.838^{b}	8.27 ± 2.201^{a}
Taste	5.87 ± 0.949^{d}	6.00 ± 1.494^{bc}	6.07 ± 2.163^{b}	8.27 ± 1.080^{a}
Colour	4.93 ± 1.687^{b}	4.67 ± 2.058^{bc}	4.60 ± 2.541^{cd}	8.25 ± 2.506^{a}
Overall acceptability	5.80 ± 1.370^{c}	5.40 ± 1.252^{d}	6.07 ± 1.160^{b}	8.47 ± 1.059^{a}

Table 2 result shows that sample $WYOSF_1$ significantly ($p<0.05$) had the highest value of sodium (306.mg/100g)), followed by sample $WYOSF_2$ (278mg/100g), while sample WHTF (248mg/100g) revealed the least value for the sodium content of the puff-puff. The control sample had the highest value of calcium (212mg/100g). K, Mg, and Z decreases with decrease in the quantity of yellow cassava flour and significant ($p<0.05$) difference was recorded in their values. The result also showed that selenium was significantly ($p<0.05$) higher in sample $WYOSF_2$ (0.21mg/100g), while WHTF had the least value (0.14mg/100g). Sample $WYOSF_1$ had the highest value for phosphorus content (59.13mg/100g), while control sample had the least value (37mg/100g). Sample $WYOSF_1$ significantly ($p<0.05$) contained the highest value of iodine (μg/100g).

The vitamins content of the samples is shown in table 3. Vitamin B_1 (28.65mg/100g), Vitamin B_2 (0.52mg/100g), Vitamin B_3 (1.61mg/100g), and vitamin B_9 (95.65mg/100g was significantly ($p<0.05$) higher in sample $WYOSF_1$. In the same vein, sample WHTF had the least among of folic acid (71mcg/100g and other vitamins. All the vitamins were significantly ($p<0.05$) decreases with reduction in the percentage proportion of yellow cassava flour used in the production of the puff-puff. Beta-carotene content of the puff-puff was significantly ($p<0.05$) higher in the composite puff-puff than the control sample.

The result of the mean sensory scores is presented in Table 4. The scores for overall acceptability and colour varied from 5.80-8.47 and 4.93-8.25 respectively. The result revealed that the flavour and aroma of the puff-puff varied significantly ($P<0.05$) between the (control) sample WHTF which is 100% wheat flour and the other samples $WYOSF_1$ to $WYOSF_3$ incorporated with yellow cassava and orange flesh sweet potato flours. In general, all the puff- puff samples compared well with the control sample, and were well accepted.

DISCUSSION

The moisture level of all the formulated samples was higher than the control, but lower than the 24.56 percent and 20.65 percent obtained by (20) in puff-puff sold in Lagos State's Ojuelegba motor park. It is possible that the variation stems from the preparation procedure. Moisture content is used as a quality indicator in the industrial world, and moisture content of less than 10% is considered excellent for the prevention of microbial growth, reduce deterioration and prolong its Shelf life (21), however in the case of a snack like puff-puff, the moisture content from this finding is acceptable since it is not anticipated to be kept for more than 7 days. Moisture is crucial in human nutrition because, in addition to providing satiety, it also helps the body maintain homeostasis (22). The introduction of sesame seed increased the protein content of the puff-puff from the WYOSF1, WYOSF2, and WYOSF3. Sesame seeds are a good source of protein proving up to 18-23.5% (10,11). Sample

WYOSF1 had the highest protein value, which was more than the 7.22 percent of puff-puff sold in Abule-Egba (20). Protein consumption is good for a variety of nutritional health outcomes, including muscle preservation, decreasing kwashiorkor, and lowering the risk of heart disease (23). Individual diets should include fat because it supplies needed fatty acids, aids in fat-soluble vitamin absorption, and improves dietary energy density and sensory characteristics (24). Fat is an important constituent of tissues and good source of fat-soluble vitamins. The fat content of the puff-puff samples was comparable with that 12.55% reported by (20). The fibre content of the puff-puff ranged from 3.24-6.67%. This value was higher than the crude fibre reported by (20). The fibre content of the puff-puff decreases with decrease in the quantity of yellow cassava used for the composite flour. Sample Fibre is a non-nutritive, non-starch polysaccharide needed to provide bulk to the diet and helps to satisfy the appetite and stimulate peristalsis (22). The high fibre content of the puff-puff provides several health benefits, as it aids digestion, ensure glycemic control and prevent constipation associated with the consumption of low fibre diet (22, 25). The carbohydrate content of the puff-puff samples was generally low compared with the 58.20% reported in the puff-puff obtained from the sold puff-puff at Mushin motor park in Lagos (20). But higher than the value 48.27 and 47.10% obtained in Oshodi and Iyana-paja (20). The low content of carbohydrate in composite puff-puff samples compared to the control sample may be attributed to the addition of protein source (sesame seed).

The samples had high appreciable amount of sodium but, sodium content was significantly ($p<0.05$) higher in the puff-puff made with composite flour than the control sample. The addition of salt in the preparation of the puff-puff. Sodium the principal extracellular fluid in the body and essential nutrient necessary for maintenance of plasma volume, acid-balance, transmission of nerve impulse and normal cell function (26). The calcium contents ranged from 178.7 mg/100g to 212.4 mg/100g. The highest content of calcium in this study was found in the control sample. The value was higher than the reported 137.4mg/100g value for chocolate buns sold in Malaysia (27).

This may be related to the high content of calcium in wheat flour. Calcium is an effective pressure lowering agents apart from ossification of bone (28). As for potassium contents, the highest value was found (660mg/100g) in the control sample. The value obtained in this study was higher than the value 141.75mg/100g obtained by (27). Potassium is a cofactor for many enzymes and it is also required for protein synthesis, creatine phosphorylation and carbohydrate metabolism (29). Eating food high in potassium has been linked to reducing blood pressure, improving bone health, decreasing the risk of stroke, and reducing the risk of renal calculi (30). In this study, all the puff-puff had the high appreciable potassium contents and therefore it could contribute more potassium in dietary intake of the consumers. The highest magnesium content was found in puff-puff from composite flour, higher than the value obtain in chocolate buns (24.30 mg/100 g) in Malaysia (27). Zinc and Phosphorus in food are nutritionally essential for all organisms for several reasons, for immune building, insulin secretion, the release of vitamin A from liver stores and strong bone_formation respectively (31). In this study Zinc and Phosphorus was significantly ($p<0.05$) higher in the puff-puff made from composite flour than the control sample. This could be as a result of the incorporation of sesame seed which had been found to be high in zinc (12). The range of iodine found was 5.05–7.14 μg/100g which was very low, the reason could not be far fetch to the fact that most the ingredient for the preparation of the puff-puff were natural deficient in iodine except for the addition of iodine salt which was the only sources of iodine. Most dietary iodine is provided by Saltwater seafood, seaweed, iodized salt, molasses, and dairy products are the best sources of iodine. Iron, copper and selenium were very low in all the samples including the control sample. Iron and Copper is also an essential trace element that is required in the cellular processes of electron transfer in human (32).

The high content of beta-carotene in composite

puff-puff may be due to the addition of yellow cassava and orange flesh sweet potato which contains 13.11 (μg/g) as reported by Stinco *et al*. (33). Beta-carotene is a provitamin A, it's essential for normal vision and also helps the lungs, kidney, heart and other organs to function properly (22). The content of the water-soluble vitamins in the study revealed that the puff-puff from the composite had higher value compared to the control sample. The vitamins decrease with decreased in the quantity of yellow cassava flour used in the production of the puff-puff. The puff-puff samples are good sources of vitamins providing more than the daily adult requirement for (1.5mg/day) of thiamine, 5% of daily adult (20mg/day) prescription of nicotinic acid intake and 20% of daily adult (400mcg/day) recommendation of folate intake (34).

The result shown that people are more likely to consumed the control sample WHTF than other composite puff-puff, the addition of sesame seed flour might have affected the degree of likeness as seen in the score for the colour and taste (table 4) as against the normal taste and colour puff-puff. This could be responsible for the wide variation in the in their general acceptability $WYOSF_3$ was comparable to the control sample in all the sensory attributes especially mouth feel, taste and general acceptability while $WYOSF_2$ and $WYOSF_1$ was comparable to the control sample in term of colour and aroma respectively. Colour is one of the determinant factors in product selection and acceptability (16, 36). The addition of orange flesh sweet potato and sesame seed flour resulted to dark colour of the composite puff-puff this might have been responsible for the low rating in colour and aroma which invariably alter the acceptability of the composite puff-puff, this could be as result of the poor functional properties of the composite flour thereby reducing the utilization and quality of product from them.

CONCLUSION

The study has shown that $WYOSF_1$ could be used as wheat substitute to produce puff-puff that would be accepted by consumed in terms of nutritional composition. The puff-puff produced from 60% Yellow cassava flour, 20% orange flesh sweet potato, 10% sesame seed, 10% wheat flour had increased nutrients of carbohydrate, fibre, fat, and ash, including vitamins and mineral content. The sample with 100% wheat flour had the lowest amount of protein and score highest for all the sensory properties evaluated followed by sample $WYOSF_3$ thus, the puff-puff would enhance the health, growth and wellbeing of the consumers. The use of yellow cassava and orange flesh sweet potato in puff-puff production would promote production, value addition and diversification of utilization of the crops in Nigeria and environs.

REFERENCES

1. Singh, S., Ria, C.S and Saxena, D.C. (2008). Effect of incorporating sweet potato flour to wheat flour on the quality characteristics of cookies. African Journal Food science, 2: 65-7.
2. Akusu O.M. (2019). Effects of Processing Methods on the Nutrient Composition and Sensory attributes of Cookies Produced from Wheat and Sesame Seed Flour Blends. International Journal of Nutritional Science & Food Technology. 5:5, 34-40.
3. Mashayekh M, Mahmoodi M.R and Enterazzi M.H (2008). Effect of fortification of defatted soy flour on sensory and rheological properties of wheat bread. International Journal of Food Science and Technology, 43: 1693-1698.
4. Chinma, C.E, James S, Imam, H, Ocheme, O.B, Anuonye, J.C, Yakubu C. M. (2011). Physicochemical and sensory properties and In-Vitro Digestibility of Biscuits made from blends of tigernut and pigeon pea. Nigerian Journal of Nutritional Science, 32: 52-62
5. Oparinde, Adewale, Abhijit Banerji, Ekin Birol, and Paul Ilona (2014). Information and consumer willingness to pay for biofortified yellow cassava: evidence from experimental auctions in Nigeria. International Food Policy Research, 13: 245-354
6. Bokanga, M. (2000). Cassava: Post-harvest operations. Information Network on Post-Harvest Operations. 1-26.
7. Bolajoko, O.O., [2]Holdbrooke, J.A and

Olanrewaju, O.I (2021). Evaluation of Nutrients, Antioxidants and Sensory Attributes of Bread Produce from Wheat, Orange Flesh Sweet Potato and Bio-fortified Cassava Flour. Proceedings of the Institute for Dietetics in Nigeria, 2021 pp 68-70

8. Makinde, F.M.1., Adetutu, A.O. and Olorunyomi, G.O. (2016). Influence of Roasting Techniques on Chemical Composition and Physico-chemical Properties of Sesame (Sesamum indicum) Seed Flour and Oil. Applied Tropical Agriculture, 21 (2): 25-31
9. Olanyanju T.M.A, Akinoso R, Oresanya M.O. (2006). Effect of wormshaft speed, moisture content and variety on the recovery from expelled beniseed. Agricultural Engineering International, 8:1-7
10. Kahyaoglu, T and Kaya, S 2006). Modelling of moisture, colour and texture changes in sesame seeds during the conventional roasting. Journal of Food Engineering. 75: 167–177
11. Bamigboye AY, Okafor, A.C, Adepoju O.T. (2010). Nutritional composition of sesame seed. African Journal of Food Science and Technology, 2010, 1 (3):71-5.
12. Nagaraj G (2009). Oilseeds – properties, processing, products and procedures. New India Publishing Agency, New Delhi, p 601.
13. Nagendra, P.M.N, Sanjay K. R, Prasad D.S, Vijay N, Kothari R, Nanjunda, S. S. (2012). A review on nutritional and nutraceutical properties of sesame. Journal of Nutrition and Food Science, 2(127) : 2-9
14. Aliyu H.N, Sani U. (2009). Production of biscuit from composite flour as a substitute for wheat. Bioscience Research Communications, 21(3):129-32
15. Hassan E. E. (2011). Effect of Heat Treatments on Certain Antinutrients and in vitro Protein Digestibility of Peanut and Sesame Seeds. Food Science Technology Review, 17 (1), 31–38.
16. Zubair, A.B., Femi, F.A., Azeez, S.O., Maxwell, Y.M.O., Isah, L.R., Jiya, M.J., and Owheruo, J.O. (2021). Proximate, Mineral and Sensory Evaluation of cake baked from Wheat and Sesame Seed Flour Blends. Nigerian Journal of Nutritional Sciences, 42 (2) :124-129 ISBN: 028054008
17. AOAC. Official Methods of Analysis,19th ed. Association of Official Analysis Chemist, Washington, 2012
18. Onwuka, G.I. Food Analysis and Instrumentation theory and practices. 1st Ed. Napthali Prints, Surulere, Lagos, Nigeria pp. 140-160
19. Ihekoronye, R.I and Ngoddy, P.O. (1985). Integrated food science and technology for the tropics. Macmillan Publishers, London, pp 259-262 ISBN: 0333388836
20. Pikuda, O.O and Ilelaboye, N.O.A (2009). Proximate Composition of Snacks Purchased from a Selected Motor Parks in Lagos. Pakistan Journal of Nutrition, 8(10): 1657-1660
21. Okudu, H.O., Ojinnaka, M.C. & Kalu, M.O. (2017). Chemical and sensory properties of complementary food produced from sorghum (sorghum bicolor), Pigeon pea (Cajanuscajan) and carrot (Daucuscarrota) blends. African Journal of Food Science and Technology, 8(4): 50-55
22. Anne, W., Allison, G (2006). Anatomy and Physiology in Health and Illness. Ross snd Wilson 10th Ed. Food Analysis and Instrumentation theory and practices. 1st Ed. Churchill Livingstone Elsevier Prints, Spain, pp. 270-280
23. Rodrigues, N. R., Barbosa, J. L., & Barbosa, M. I. M. J. (2016). Determination of physico-chemical composition, nutritional facts and technological quality of organic orange and purple-fleshed sweet potatoes and its flours. International Food Research Journal, 23(5): 1–11
24. kavanagh k (2007). Trans fat diet induces abdominal obesity and changes in insulin sensitivity in monkeys. Journal of Obesity, 15: 1675-1680
25. Bolajoko O.O, Olanrewaju O.I, Akingboye O.O (2018). Evaluation of Dietary Adherence and Body mass index of Diabetes Patient Attending Medical Outpatient Clinic of Federal Medical Centre, Idi Aba,

Abeokuta, Ogun State Nigerian journal of nutritional sciences, 39 (1): 59-67
26. World Health Organization (WHO) (2014). Noncommunicable diseases country profiles 2014. World Health Organization, p: 210.
27. Norizan, N.A, Noh, M.F.M, Khalid N.M, Selamat R, Rashed A.A. (2018). Nutritional Composition of Commercial Sweet Buns in Malaysian Market. Journal of Nutrition, Food Science 9: 746-751
28. Osborne, C.G, McTyre R.B, Dudek, J, Roche, K.E, Scheuplein R. (1996). Evidence for the relationship of calcium to blood pressure. Nutrition Revolution, 54: 365-381.
29. Perez V, Chang E.T. Sodium-to-potassium ratio and blood pressure, hypertension, and related factors. Advance Nutrition, 2014, 5: 712-741.
30. Yang Q, Liu T, Kuklina E.V, Flanders W.D, Hong Y. (2011). Sodium and potassium intake and mortality among US adults: prospective data from the Third National Health and Nutrition Examination Survey. Arch International Medical, 171: 1183-1191
31. King J.C, Cousins R. (2014) Zinc. In: Ross A.C, Caballero B, Cousins RJ, Tucker KL, Ziegler TR (2014). Modern nutrition in health and disease (11th Edn). Lippincott Williams & Wilkins, Philadelphia; 189-205.
32. Sunde, R.A (2012). Selenium. In: Modern Nutrition In Health And Disease (Ross AC, Caballero B, Cousins RJ, Tucker KL, Ziegler TR Edn). Lippincott Williams & Wilkins, Philadelphia, USA, Pp: 225-237.
33. Stinco, C. M., Benítez-González, A. M., Hernanz, D., Vicario, I. M., & Meléndez-Martínez, A. J. (2014). Development and validation of a rapid resolution liquid chromatography method for the screening of dietary plant isoprenoids: Carotenoids, tocopherols and chlorophylls. Journal of Chromatography A, 1370, 162–170.
34. Food and Nutrition Board, Institute of Medicine (2000). Dietary Reference Intakes for vitamin C, vitamin E, selenium and carotenoids. Washington, DC: National Academy Press; 2000.
35. Combs G. Vitamins (2004). In: Mahan L, Escott-Stump S (11th ed). Krause's food, nutrition, and diet therapy. Philadelphia: WB Saunders pp. 245
36. Ani, P.N., Madukwe, E.U. Ugwuanyi, U.F (2021). Functional, Nutritional and Sensory Characteristics of Biscuits Improved with Plantain, Breadfruit and Termite Flour. Nigerian Journal of Nutritional Sciences. 42 (2) :1-9
37.