International Journal of Research and Publication
Issue 5:Vol. 2 (May, 2023)

QUALITY EVALUATION OF BISCUITS PRODUCED FROM BLENDS OF YAM, ORANGE FLESHED SWEET POTATO AND BEETROOT FLOURS

ECHEM FRANKLYN NDUKA

Email: echemfranklyn@gmail.com

Phone No: 08035651982

*Food Science and Technology, Federal Polytechnic Oko, Orumba North, Anambra State

Abstract

This study was carried out to investigate the characteristics of biscuits produced from blends of yam, orange fleshed sweet potato and beetroot flours. Yam, orange fleshed sweet potato and beetroot were separately processed into fine flours. Composite flours were formulated by blending yam, orange fleshed sweet potato and beetroot flours in the ratios of 100:0:0, 80:10:10, 70:20:10 and 60:30:10 and were labeled as YP1, YP2, YP3 and YP4 respectively. The flours were used to produce biscuits and 9 point hedonic scale was used to ascertain the acceptability of the product. The results showed that sample YP3 was the most preferred in overall acceptability with a score of 7.00. The sample was further analyzed for proximate, mineral and vitamin compositions using standard analytical methods. The results showed that the biscuit had 6.46 % moisture, 2.88 % ash, 1.87 % crude fibre, 15.33 % crude fat, 6.67 % crude protein and 66.79 % carbohydrates. The calcium, potassium, magnesium, phosphorus and iron content of the biscuits were 82.25 mg/100g, 325.660 mg/100g, 44.26 mg/100g, 168.30 mg/100g and 3.40 mg/100g respectively. Values of 0.36 UI/100g, 0.06 mg/100g, 0.08 mg/100g and 0.49 mg/100g were recorded for vitamins A, B1, B2 and B3 respectively. The findings of the study have shown that biscuits of acceptable sensory and nutritional qualities can be produced from the composite flours of yam, orange fleshed sweet potato and beetroot.

Keywords: biscuit, beetroot, proximate, yam, sensory evaluation.

1.0 INTRODUCTION

Biscuits may be regarded as a form of confectionery dried to a very low moisture content which is made from unleavened dough (Obi and Nwakalor, 2015). They are ready-to-eat, convenient and inexpensive food products, containing digestive and dietary principles of vital importance. The major ingredients for production of biscuits are flour, fat, sugar, salt and water, which are mixed together with other minor ingredients, such as baking powder, skimmed milk, emulsifier and sodium meta-bisulphite to form dough containing a gluten network (Oyedele *et al*., 2017). According to Nwakalor (2014), the dough is rested for a period and passed between rollers to make a sheet. These sheets are however, transformed into appetizing product through the application of heat in the oven. Alebiosu *et al.* (2020) noted that biscuits constitute valuable amount of iron, calcium, protein, calorie, fibre and some of the B-vitamins and they are classified based

on the ingredient composition and processing techniques.

Yams (*Dioscorea spp.*) are staple tuber of West African origin which belongs to the *Dioscoreaceae* family. According to Nwokorie (2017), Nigeria is by far the world's largest producer of yams, accounting for over 70–76% of the world production. Several species of yam exists and their nutritional composition varies. Achy *et al.* (2017) noted that fresh yams contain high moisture (50 to 78%) and carbohydrate (15 to 40.61%); however, their protein, fat and fibre content are generally low. Some yam species are also rich in essential minerals (potassium, phosphorus, calcium, sodium and magnesium) and bioactive compounds (phenolic compounds, alkaloids and diosgenin) which have been implicated to possess some health promoting properties such as anti-cancer and anti-inflammatory properties (Obidiegwu *et al.*, 2020). Traditionally, yam tubers are consumed in different ways as cooked, roasted and pounded yam while industrially it is processed into products like starch, livestock feed, flours and instant pounded yam flour (Olumurewa *et al.*, 2019).

Orange fleshed sweet potato (*Ipomea batatas*) is a biofortified staple crop that has recently gained much attention because of its high content of beta-carotene, a major precursor of vitamin A (Kolawole *et al.*, 2020). Aside its significant amounts of β-carotene, orange-fleshed sweet potato is also rich in starch, dietary fiber, minerals, vitamins (especially vitamins C, B6 and folate), as well as antioxidants, such as phenolic acids, anthocyanins, and tocopherol (Tiruneh *et al.*, 2021). Orange fleshed sweet potato has been suggested to have great potentials to be used in food based programs to address vitamin A deficiency (Babatunde *et al.*, 2019). It has been reported to be highly promising for the production of bakery foods, snack foods, confectionery products and may be processed into flour for longer shelf life (Ubbor *et al.*, 2022; Malavi *et al.*, 2022).

Beetroot (*Beta vulgaris* L.) on the other hand, is a root crop belonging to the family *Chenopodieacea* and it is an excellent source of red and yellow pigments (Abiodun *et al.*, 2020). Red beetroot is a rich source of minerals (manganese, sodium, potassium, magnesium, iron, copper), vitamins (A, C, B), phenolic compounds and betalain, which have antioxidant properties that help to protect against heart disease and certain type of cancers (Kavalcova *et al.*, 2015). Beetroot could be consumed fresh as salad, boiled, roasted, made into fresh juice and could be used as colourant (Otegbayo *et al.*, 2020). Dried beetroots can be consumed directly in the form of chips as a substitute to traditional snacks or after easy preparation as a component of instant food (Ingle *et al.*, 2017).

The recent development and urbanization in African countries is changing the food habit and preferences of the population towards convenience foods. Consumption of biscuits and similar foods made from wheat has become so popular in Nigeria that its total elimination from the dietary pattern could have nutritional and socio economic implications (Eke-Ejiofor, 2013). Biscuits are made from refined wheat flour which is highly deficient in most essential nutrients. Therefore partial or complete substitution of wheat flour with flours from tropical crops such as roots and tubers like yam, orange fleshed sweet potato and beet root could tremendously improve the nutritional quality of the product and as well reduce the huge foreign exchange spent on importation of wheat. This study sought to evaluate the proximate composition and sensory acceptability of biscuits from blends of yam, orange fleshed sweet potato and beetroot flours.

2.0 MATERIALS AND METHODS

2.1 Source of Material

Tubers of white yam, beetroots and other baking materials were purchased from Eke Ekwuluobia Market while orange flesh sweet potato was purchased from Eke Awka Market both in Anambra State. All the materials were packaged in a clean polyethylene bag and taken to the Food Processing Laboratory of Department of Food Technology, Federal Polytechnic Oko, Anambra State; for further processing and analysis.

2.2 Sample Preparation

2.2.1 Processing of Yam Flour

Yam tubers were processed into flour following the method of described in the study of Orafa *et al.* (2021). The yam tubers were washed to remove sand, dirt and other adhering materials. The yam tubers were peeled manually with sharp stainless kitchen knife, sliced directly into water containing 0.2 % sodium metabisulphite of for 5 min (in order to prevent browning reaction). The sliced yam were removed and placed in a sieve to remove excess water. The yam slices were dried in a cabinet dryer at 60˚C for 10 h and milled using hammer mill. The resulting flour sieved and packaged in polythene bags prior to use.

2.2.2 Processing of Orange Fleshed Sweet Potato Flour

Orange fleshed sweet potato flour was produced following the method described by Kure *et al.* (2021) with slight modification. Orange fleshed sweet potatoes were properly washed and peeled manually with knives while keeping them in water to prevent enzymatic browning. The tubers were trimmed and sliced thinly (manually) and dried using a cabinet dryer at 60°C for 9 h. The dried chips were milled and then sieved to obtain flour of uniform size. The resulting flour was packaged in polythene bags prior to use.

2.2.3 Processing of Beetroot Flour

Beetroot flour was made from fresh beetroot following the method described in the study of Aulia and Sunarharum (2020) with slight modification. Beetroots were washed and blanched at 85˚C for 3 min before peeling and slicing using kitchen knife. Beetroot slices were dried using a cabinet dryer at 60°C for 12 h. The dried beetroot chips were grinded and sieved to obtain fine flour. The resulting flour was packaged in an airtight container prior to further use.

2.3 Formulation of Composite Flours

Composite flours were formulated by blending yam, orange fleshed sweet potato and beetroot flours in the ratios of 100:0:0, 80:10:10, 70:20:10 and 60:30:10 respectively.

2.4 Production of Biscuits

The biscuits were made following a commercial recipe and baking procedures reported in the study of Kindeya *et al.* (2022). Ingredients required to make biscuits were added in the same amount to the different treatments in the experiment [composite flour (100 g), baking powder (1.12 g), margarine (28 g), sugar (5 g), salt (1 g), and 48 ml of water] and mixed thoroughly. The biscuit dough was made manually for 20-minutes. After the dough was prepared, it was manually sheeted to a thickness of 5 mm. The dough was cut to equal diameter before being placed on a lightly greased baking tray. In a baking oven, the dough were baked for 12-minutes at a temperature of 200°C. The resulting biscuits were allowed to cool and then packaged in well labeled airtight containers until needed for analyses.

2.5 Sensory Evaluation

A semi-trained panel of 10 judges made up of male and female students of the Department of Food Technology, Federal Polytechnic, Oko was used. The panelists

were educated on the respective descriptive terms of the sensory scales and requested to evaluate the various biscuit samples for taste, colour, texture, flavour and overall acceptability using a 9-point Hedonic scale, where 9 was equivalent to like extremely and 1 meant dislike extremely. Presentation of coded samples was done randomly and portable water was provided for rinsing of mouth in between the respective evaluations (Iwe, 2014).

2.6 Nutritional Analysis

The proximate (moisture, ash, crude protein, crude fibre, crude fat and carbohydrate), mineral (calcium, potassium, magnesium, phosphorus and iron) and vitamin (vitamins A, B1, B2 and B3) composition of the most accepted biscuit sample were determined using the standard methods of AOAC (2012).

2.7 Statistical Analysis

Data generated from the respective analyses were compiled appropriately and subjected to Analysis of Variance. All other data had the means separated using the Duncan Multiple Range test (Statistical Package for Social Science, version 25.0).

3.0 RESULTS AND DISCUSSION

3.1 Sensory Qualities of Biscuits Produced from Blends of Yam, Orange Fleshed Sweet Potato and Beetroot Flours

The mean scores for the sensory evaluation of biscuits produced from composite flours of yam, orange fleshed sweet potato and beetroots are presented in Table 1. The mean scores for the colour of the biscuits ranged between 7.30 and 8.00 indicating that the colours of the biscuits were liked very much according 9 point hedonic scale. There was no significant difference ($p > 0.05$) in the colour of the biscuit samples. The colour of sample YP3 was the most accepted closely followed by that of the sample YP1. The high acceptability recorded for the colour of the biscuit samples could be due to the resultant effect of Millard reaction as Ubbor *et al.* (2022) stated that this type of reaction imparts a brown colour on biscuits during baking. The scores recorded for the colour of biscuits tarried with the findings of Orafa *et al.* (2021) who reported mean scores ranging from 7.15 – 8.15 for biscuits made from yam and carrot composite flours. Colour according to Ogundele *et al.* (2015) is an important parameter in assessing quality of food materials. It is one of the first attribute considered in making food choice. The high acceptability of the colour of the biscuits in this study implies that the product will be appreciated when commercialized.

Samples	Colour	Taste	Texture	Flavour	Overall Acceptability
YP1	$7.60^{a}\pm1.83$	$5.60^{b}\pm1.51$	$6.30^{a}\pm2.21$	$6.00^{ab}\pm1.56$	$5.94^{b}\pm1.48$
YP2	$7.30^{a}\pm0.94$	$6.70^{a}\pm1.57$	$6.50^{a}\pm1.27$	$5.70^{b}\pm2.31$	$6.28^{ab}\pm1.14$
YP3	$8.00^{a}\pm0.67$	$7.00^{a}\pm0.67$	$6.80^{a}\pm1.69$	$6.70^{ab}\pm1.25$	$7.00^{a}\pm0.77$
YP4	$7.30^{a}\pm1.70$	$6.10^{ab}\pm0.88$	$7.00^{a}\pm1.41$	$7.10^{a}\pm1.44$	$6.68^{a}\pm1.09$

Table 1: Sensory qualities of biscuits produced from blends yam, orange fleshed sweet potato and beetroot flours

*Values are means ± standard deviations of sensory evaluation. Means with the different superscripts in the same column are significantly different ($p <$

0.05). **Keys**: **YP1**: 100:0:0 yam-orange fleshed sweet potato-beetroot blends; **YP2**: 80:10:10 yam-orange fleshed sweet potato-beetroot blends; **YP3**: 70:20:10 yam-orange fleshed sweet potato-beetroot blends; **YP4**: 50:40:10 yam-orange fleshed sweet potato-beetroot blends.

In terms of taste, the result ranged from 5.60 in sample YP1 to 7.00 in sample YP3. The results showed that some significant difference ($p < 0.05$) existed in the taste of the samples. It was observed that the taste of sample YP3 was most preferred while that of sample YP1 was the least preferred. However, the values for taste obtained in this study were lower than values obtained in wheat based cookies (7.44 - 8.36) substituted with acha and orange fleshed sweet potato flour (Ubbor *et al.*, 2022). The variation in these results could be due to the differences in the raw materials used. Taste is the sensation of flavor perceived in the mouth and throat on contact with a substance and it is one of the most important attributes watched out for in a food product. Taste could be affected by the types and quality of ingredients and could also depend on the formulation of the food material (Olurin *et al.*, 2021).

The scores recorded for texture ranged from 6.30 to 7.00 with sample YP1 having the least score and sample YP4 having the highest score although the biscuit samples did not display any significant difference ($p > 0.05$). The texture scores obtained in this study is lower than the scores (7.60 to 8.15) obtained in biscuits produced from wheat, yam and carrot composite flours (Orafa *et al.*, 2021) but falls within the range of values (6.17 to 8.00) obtained by Temesgen *et al.* (2015) for cookies produced from composite flours of wheat and orange fleshed sweet potato. Texture is one of the most important quality characteristics of dry snack foods, indicating freshness and high quality. A crisp product should, in general, be strong and snap easily when bent, emitting a crunchy sound. The moderate scores recorded for the texture of the biscuit samples could be due to moisture content as Kindeya *et al.* (2022) stated that a biscuit's structure will not be crisp if it has higher moisture levels.

The scores for the flavour of the biscuit samples ranged from 5.70 in sample YP2 to 7.10 in sample YP4. Some significant differences ($p < 0.05$) existed amongst the samples. The results obtained for the flavour of the biscuits connotes 'like slightly' to 'like moderately' according to 9 point Hedonic scale (Iwe, 2014). The flavour scores obtained in this study are lower compared to 7.20 – 8.12 reported by Ubbor *et al.* (2022) for cookies produced from wheat-acha-orange fleshed sweet potato composite flours but similar to 5.60 – 7.20 reported by Kure *et al.* (2021) for cookies produced from wheat-orange fleshed sweet potato composite flours.

Biscuits produced from 70% yam, 20% orange fleshed sweet potato and 10% beetroot flours (YP3) was the most preferred in terms of overall acceptability with mean score of 7.00; closely followed by the sample produced from 50% yam, 40% orange fleshed sweet potato and 10% beetroot (YP4) with mean score of 6.68. However, the sample produced from 100% yam flour (YP1) was the least accepted with mean score of 5.94. There was no significant difference ($p > 0.05$) between samples YP3 and YP4 but they differed significantly from those of samples YP1 and YP2. The lower overall acceptability score recorded for 100% yam flour biscuits in this study did not concur with the observation of Orafa *et al.* (2021) who noted that biscuits produced from 100% yam flour had higher score of 8.15. This variation could probably be due to differences in product formulation as well as species of yam used. Colour, taste and texture have distinct and influential effects on food acceptability (Piqueras-Fiszman, and Spence, 2015). The higher acceptability of sample YP3 was due to higher scores of

these attributes. It was based on the high preference of sample YP3 that it was selected for nutritional analyses.

3.2 Proximate Composition of Biscuits Produced from Blends of Yam, Orange Fleshed Sweet Potato and Beetroot Flours

The results of the proximate composition of biscuits produced from composite flours of yam, orange fleshed sweet potato and beetroots are presented in Table 2. Moisture content is an essential quality attribute that largely contributes to the physical, sensory, and microbial properties of any food product (Malavi *et al.*, 2022). The moisture content of the biscuit sample was 6.46 %. This value is lower compared to the range of values (6.99 – 10.96 %) reported by Kindeya *et al.* (2022) for biscuits produced from blends of wheat, orange fleshed sweet potato and haricot bean blends. Ingle *et al.* (2017) reported lower moisture content ranging from 2.57 – 5.26 % for cookies produced from wheat and beetroot flour blends. The variations in these results could be due to differences in the raw materials used. Ndulaka and Obasi (2018) noted that baked products such as biscuits are generally low moisture foods. Baked products including biscuits with moisture content less than 13% are stable from moisture-dependent deterioration (Ayo-Omogie and Odekunle, 2015). The moisture content of the biscuit sample produced was below this specified moisture content indicating that it can be stored at room temperature and be less prone to fungal and microorganism infections.

Ash content of food gives an idea of the total quantity of the mineral elements in the food (Iwe *et al.*, 2016). The value recorded for the ash content of the formulated biscuit was 2.88 %. This value is higher than range of values (0.82 – 1.64 %) recorded for cookies produced from cookies produced from composite flours of wheat and orange fleshed sweet potato (Temesgen *et al.*, 2015). The ash content obtained in this study fell within the range of 1.99- 3.33 % reported by Kindeya *et al.* (2022) for biscuits produced from blends wheat, orange fleshed sweet potato and haricot bean flours. The higher ash content obtained in this study is indicative that it would be rich in mineral elements.

The crude fibre content of the formulated biscuit sample was 1.87 %. Ubbor *et al.* (2022) reported similar fibre values ranging from 1.54 – 2.01 % for cookies produced from wheat, acha and orange fleshed sweet potato composite flours. However the value obtained in this study is higher than 0.11 – 0.57 % reported for cookies produced from blends of wheat and orange fleshed sweet potato flour (Temesgen *et al.*, 2015). The variation in this study could be due to the differences in the product formulation. The presence of fibre in food products is essential owing to their ability to facilitate bowel movement (peristalsis), bulk addition to food and prevention of many gastrointestinal diseases in man (Kure *et al.*, 2021).

Table 2: Proximate Composition of biscuits produced from blends of 70% yam, 20% orange fleshed sweet potato and 10% beetroot flours

Parameters	Values (%)
Moisture	6.46±0.03
Ash	2.88±0.00
Crude Fibre	1.87±0.01
Crude Fat	15.33±0.01
Crude Protein	6.67±0.02
Carbohydrate	66.79±0.20

*Values are means ± standard deviations of duplicate determinations.

The crude fat present in the formulated biscuit was 15.33 %. This is higher than 1.71 – 2.49 % reported for wheat-orange fleshed sweet potato-haricot bean biscuits (Kindeya *et al.*, 2022) but lower than 21.08 – 23.42 % for wheat-beetroot cookies (Ingle *et al.*, 2017). The varied results could be due to differences in the raw materials used. According to Orafa *et al.* (2021) fat plays a significant role in the shelf life of food products and as such relatively high fat content could be undesirable in baked food products. This is because fat can promote rancidity in foods, leading to development of unpleasant and odorous compounds.

The crude protein content of the biscuit sample was 6.67 %. The crude protein value obtained in biscuit produced in this study was higher than values (5.39 - 6.32%) reported for wheat based cookies substituted with OFSP flour (Temesgen *et al*., 2015), but lower than values (12.61 - 15.03%) obtained in cookies from wheat, *Acha* and pigeon pea flour blends (Adeyanju *et al*., 2018). This could be attributed to the low protein content of the raw materials used in this study. Orange fleshed sweet potato contain protein content ranging from 1.91 – 5.83 % (Mohammed *et al*., 2016) while beetroot contains protein content of 1.89 % (Ceclu and Nistor, 2020). This explains why biscuit sample produced from 70% yam flour, 20% orange fleshed sweet potato and 10% beetroot flours had low protein content.

The carbohydrate content of the biscuit sample was 66.79 %. This value fell with the range of 57.45 – 67.60 % reported by Ubbor *et al.* (2022) for cookies produced from blends of wheat, acha and orange fleshed sweet potato composite flours. Temesgen *et al.* (2015) and Kure *et al.* (2021) reported lower carbohydrate content ranging from 62.56 – 63.79 % and 53.61 – 57.11 respectively for cookies made from blends of wheat and orange fleshed sweet potato. Variations on the raw materials as well as differences in product formulation could be the possible reason for the varied results. Also all the flour samples used were starchy food crop; thus the high carbohydrate content obtained in this study.

3.3 Mineral Composition of Biscuits Produced from Blends of Yam, Orange Fleshed Sweet Potato and Beetroot Flours

Table 3 depicts the results of mineral composition of biscuits produced from composite flours of yam, orange fleshed sweet potato and beetroot. The calcium content of the formulated biscuit was 82.25 mg/100g. The value for calcium obtained in this study is significantly higher than 26.20 – 28.10 mg/100g and 26.94 – 36.41

mg/100g reported by Onabanjo and Ighere (2014) and Kure *et al.* (2021) for wheat-sweet potato and wheat-orange fleshed sweet potato composite cookies respectively. Kolawole *et al.* (2018) reported higher calcium content ranging from 227.15 – 345.64 mg/100g for cookies made from wheat, orange fleshed sweet potato and mushroom composite flours. The varied results could be due to the differences in the raw materials used for the biscuit formulation. Adequate calcium intake is essential for normal development and maintenance of bones and teeth, clotting of blood, normal functioning of the heart and muscle, nerve irritability, and enzyme activation (Ufot *et al*., 2018). Rickets, retarded growth, tetany and osteoporosis in older people surviving from diabetes have been linked to calcium deficiency (Igbabul *et al*., 2018).

Table 3: Mineral Composition of biscuits produced from blends of 70% yam, 20% orange fleshed sweet potato and 10% beetroot flours

Parameters	Values (mg/100g)
Calcium	82.25±0.00
Potassium	325.60±0.11
Magnesium	44.26±0.06
Phosphorus	168.30±0.10
Iron	3.40±0.00

*Values are means ± standard deviations of duplicate determinations.

Potassium is the most predominant mineral element in the biscuit. The formulated biscuits had potassium content of 325.60 mg/100g. The value is within the range of 300.00 – 398.80 mg/100g reported by Kure *et al.* (2021) for wheat-orange fleshed sweet potato cookies. Lower potassium content ranging from 105.40 mg/100g to 128.72 mg/100g was reported by Ufot *et al.* (2018) for biscuits produced from blends of wheat, acha and African yam bean flours. According to USDA (2010), 4700 mg/day daily intake of Potassium from food is recommended for adults. This is for reduction of blood pressure and risk of cardiovascular disease, stroke and coronary heart disease. Although the potassium values of the biscuits do not meet the USDA recommendations, the moderate potassium contents of the biscuits make them suitable for consumption by hypertensive individuals. Potassium in the diet affects the metabolism of calcium, and other minerals such as sodium. It is important for bone health; is needed as a cofactor for numerous reactions in the body and is also essential for nerve and muscle conductivity (Chidinma *et al.*, 2010).

The magnesium content of the biscuit as shown in Table 3 is 44.26 mg/100g. Lower magnesium content ranging from 7.30 to 9.60 mg/100g was reported by Onabanjo and Ighere (2014) for wheat-sweet potato composite cookies while higher magnesium content ranging from 47.58 – 65.29 mg/100g was reported by Kolawole *et al.* (2018) for cookies formulated from composite flours of wheat, orange fleshed sweet potato and mushroom composite flours. This could be due to the differences in formulation and varieties of sweet potato used. Magnesium is needed for healthy muscles and nerves metabolism. Magnesium deficiency in our diet will lead to mental, emotional and muscle disorders.

Magnesium in the diet affects the metabolism of calcium, potassium and sodium. It is important for bone health and it is also needed as a cofactor for numerous reactions in the body (Okereke *et al*., 2022).

Phosphorus content of the biscuit sample was 168.30 mg/100g. Functions of phosphorus in our body include normal development and maintenance of bones and teeth, metabolism of carbohydrate and fats, normal cell and muscle activities, and maintenance of normal acid-base balance of the blood. People with phosphorus deficiency, could suffer retarded growth, poor tooth and bone formation, rickets, weakness, anorexia and pain in bones (Okereke *et al.,* 2022). The phosphorus content obtained in this study fell within the range (151.20 – 262.70 mg/100g) reported for wheat-orange fleshed sweet potato cookies.

Iron content of the biscuit sample was 3.40 mg/100g. The iron content value of the present study is not in agreement with the reported values (9.14 - 22.14 mg/100 g) reported by Temesgen *et al.* (2015) for wheat orange fleshed sweet potato cookies. Iron is an important element in the diet to prevent anemia and other related diseases (Oluyemi *et al*., 2006). According to Wardlaw and Kessel (2005), the daily recommended intake of iron for pregnant/lactating women and children (6-59 months) were 27 and 5.8 mg/100 g, respectively. Iron is needed for the formation of hemoglobin, the component of blood cell that carries oxygen in the blood stream throughout the body (Short and Domagalski, 2013).

3.4 Vitamins Composition of Biscuits Produced from Blends of Yam, Orange Fleshed Sweet Potato and Beetroot Flours

Table 4 depicts the results of vitamin composition of biscuits produced from composite flours of yam, orange fleshed sweet potato and beetroot. The vitamin A composition of the formulated biscuit was 0.34 µI/100g. This value is lower compared to the ones reported by other researchers. Kure *et al.* (2021) reported a very high vitamin A content ranging from 131.00 – 12496.00 µg/100g for cookies produced from blends of wheat and orange fleshed sweet potato. Temesgen *et al.* (2015) also reported slightly higher value of 0.55 µg/100g and 2.35 µg/100g for wheat-based cookies substituted with 10 % and 20 % orange fleshed sweet potato flour. Wheat bread substituted with orange fleshed sweet potato puree also recorded higher vitamin A content ranging from 1.90 – 5.40 µg/100g. Another study by Okereke *et al.* (2022) showed that inclusion of orange fleshed sweet potato and moringa seed flours in bread formulation significantly improved its vitamin A content (1.84 – 3.98 µg/100g). Previous study by Mohanray and Sivasankar (2014) showed that orange fleshed sweet potato contain enough carotenoid to meet over 90 % of vitamin A needs around the world. The variations in these results could be due to differences in the processing method, specie of orange fleshed sweet potato used, level of substitution of wheat flour as well as topographical differences. The recommended dietary allowance (RDA) of vitamin A for pregnant/lactating women and children (6-59 months) according to WHO (2005) was 800 and 400 µg/100g respectively. The biscuit sample in the present study may not be able to suffice the recommended dietary allowance (RDA) of vitamin A for these categories of people; thus, other sources of vitamin A such as fruit juices should be used as an accompaniment when consuming the biscuit in order to meet the required needs. Vitamin A is essential for good vision, growth and repair of body tissues, integrity of white and red blood cells, maintenance of the stability of cell membranes, and immunity of the body (Donaldben *et al*., 2019). It also promotes healthy skin, hair,

nails, gums, glands, bones and teeth; and may help prevent lung cancer. Vitamin A deficiency is the cause of some of the major public health concerns ravaging developing countries like Nigeria. Functional disorders of the eye (night blindness), increased susceptibility to infections, changes in skin and membranes are symptoms of Vitamin A deficiency (Okereke *et al.*, 2022).

Table 4: Vitamin Composition of biscuits produced from blends of 70% yam, 20% orange fleshed sweet potato and 10% beetroot flours

Parameters	Values
Vitamin A µI/100g	0.36±0.01
Vitamin B1 (mg/100g)	0.06±0.04
Vitamin B2 (mg/100g)	0.08±0.01
Vitamin B3 (mg/100g)	0.49±0.02

*Values are means ± standard deviations of duplicate determinations.

The B vitamins content of the biscuit were 0.06 mg/100g, 0.08 mg/100g and 0.49 mg/100g for vitamins B1 , B2 and B3 respectively. The results showed that the formulated biscuit sample is generally low in B vitamins. These results are similar to the findings of Okereke *et al.* (2022) who reported values ranging from 0.036 – 0.67 mg/100g, 0.065 – 0.096 mg/100g and 0.170 – 0.400 mg/100g for vitamins B1, B2 and B3 respectively of bread produced from wheat, orange fleshed sweet potato and moringa seed flour blends. Kure *et al.* (2021) also reported similar values for cookies produced from wheat-orange fleshed sweet potato composite flours. Vitamin B1 is a water-soluble vitamin that plays vital role in metabolizing carbohydrates, formation of coenzyme, digestion, maintaining normal appetite and nervous system functions. Loss of appetite, irritability, less resistance to fatigue and constipation are linked to deficiency of vitamin B1. Vitamin B2 is essential for healthy eyes and mouth tissue; and in formation of coenzyme needed in metabolism of carbohydrate, fat, and protein. Deficiency symptoms of vitamin B2 include cheilosis, blurred vision and light intolerance. Vitamin B3 has been identified to be important in formation of coenzyme used in energy metabolism, supporting health of skin, nervous system and digestive system. Intake of high (pharmacological) doses of vitamin B3 can help lower cholesterol in the body (Ukom and Obi, 2018; Ndife *et al.*, 2019; Okereke *et al.*, 2022).

4.0 CONCLUSION

The study was attempted to investigate the possibility of producing acceptable biscuit from composite flours of yam, orange fleshed sweet potato and beetroot. The findings showed that the biscuits produced from blends of 70 % yam flour, 20 % orange fleshed sweet potato flour and 10 % beetroot flour was the most accepted; thus, the reason it was analyzed for proximate, mineral and vitamin composition. The biscuit sample recorded appreciable levels of fat, ash, protein, carbohydrate, calcium, potassium, phosphorus and magnesium. The biscuit sample was however, very low in vitamins. In view of the results of the present study, the use of yam, orange fleshed sweet potato and beetroot flour blend in biscuit formulation appeared to be promising from nutritional quality, acceptability and economical point of view.

5.0 REFERENCES

Abiodun, O. A., Ojo, A., Abdulganiu, O. S. and Olosunde, O. O. (2020). Effect of beetroots substitution and storage on the chemical and sensory properties of wheat noodles. *Agrosearch*, 20(1): 1-12.

Achy, J. Y., Ekissi, G. S. E., Koffi, P. K. B., Koné, F. M. T. and Kouamé, L. P. (2017). Effect of boiling and baking times on the functional properties of aerial yam (Dioscorea bulbifera) flours cv Dugu-won harvested in Côte d'Ivoire. *International Journal of Agronomy and Agricultural Research (IJAAR).* 10(2): 1-12

Adeyanju, J. A., Babarinde, G. O., Adekunle, A. A., Olajire, A. S. and Adegboye, A. A. (2018). Quality Characteristics of Cookies Produced from Wheat, *Acha* and Pigeon Pea Flour Blends. *Annals. Food Science and Technology*, 19(4): 691-698.

Alebiosu, M. O., Akinbode, B. A., Oni, I. S. and Oladele, J. O. (2020). Quality Evaluation of Cookies Produced from Wheat, Sorghum and Defatted Coconut Flour Blends. *Asian Food Science Journal*, 17(3): 11-21.

AOAC, (2012). Official methods of Analysis. 19th edition. Association of official Analytical chemists. Washington, D.C., U.S.A; 2012.

Aulia, F. and Sunarharum, W. B. (2020). Beetroot (*Beta vulgaris* L. var. *rubra* L.) flour proportion and oven temperature affect the physicochemical characteristics of beetroot cookies. *International Conference on Green Agro-industry and Bioeconomy*, 475: 1-7.

Ayo-Omogie, H. N. and Odekunle, O. Y. (2015). Substituting Wheat Flour with Banana Flour: Effects on the Quality Attributes of Doughnut and Cookies. *Applied Tropical Agriculture*, 1: 134-137.

Babatunde, R. O., Adeyemi, O. and Adegbanke, E. A. (2019). Orange fleshed sweet potato (OFSP) and productivity: the case study of smallholders in Kwara State, Nigeria. *Agricultura Tropica et Subtropica;* 52(3-4). 105-111.

Ceclu, L. and Nistor, O. (2020). Red Beetroot: Composition and Health Effects - A Review. *J Nutri Med Diet Care* 6:043. 1-9

Chidinma W. A., Jiddari, W. U. and Hassan, S. C. (2010). A student handbook on food and nutrition. 1st edition, Kaduna, De-New creation printsltd publishers. Pp. 222.

Donaldben, N.S, Ibrahim, S. and Lindaqueen, A. (2019). Effect of Substituting Wheat Flour with Sweet Potato and Sprouted Soybeans Flour on Bread Quality. *International Journal of Science and Research* 8(4): 1-10.

Eke-Ejiofor, J. (2013). Proximate and Sensory Properties of African Breadfruit and Sweet Potato-Wheat Composite Flour in Cakes and Biscuits. *International Journal of Nutrition and Food Sciences* 2(5): 232-236.

Igbabul, B., Ogunrinde, M. D. and Amove, J. (2018). Proximate, Micronutrient Composition, Physical and Sensory properties of Cookies Produced from Wheat, Sweet Detar and *Moringa* Leaf Flour Blends. *Current Research in Nutrition and Food Science*, 06(3): 690-699.

Ingle, M., Thorat, S. S., Kotecha, P. M. and Nimbalkar, C. A. (2017). Nutritional assessment of beetroot (*Beta vulgaris* L.) powder cookies. *Asian J. Dairy & Food Res*, 36(3): 222-228.

Iwe, M. O. (2014). Current trends in sensory evaluation of foods. Revised Edition. Rojoint Communication Services Ltd. Uwani Enugu, Nigeria, 144-145.

Iwe, M. O., Onyeukwu, U. and Agiriga, A. N. (2016). Proximate, Functional and Pasting Properties of Faro 44 Rice, African Yam Bean and Brown Cowpea Seeds Composite Flour. *Cogent Food and Agriculture*, 2: 1-10.

Kavalcova, P., Bystricka, J., Tomas, J., Karovicova, J., Kovarovic, J. and Lenkova, M. (2015). The content of total polyphenols and antioxidant activity in red beetroot. *Potravinarstvo*, 9(1): 77-83.

Kindeya, F., Hailu, W., Dessalegn, T. and Kibr, G. (2022). Effect of blending ratio of wheat, orange fleshed sweet potato and haricot bean flour on proximate compositions, β-carotene, physicochemical properties and sensory acceptability of biscuits. *F1000Research*, 10:506

Kolawole, F. L., Akinwande, B. A. and Ade-Omowaye, B. I. O. (2020). Physicochemical properties of novel cookies produced from orange-fleshed sweet potato cookies enriched with sclerotium of edible mushroom (*Pleurotus tuberregium*). *Journal of the Saudi Society of Agricultural Sciences* 19 (1): 174–178.

Kure, O. A., Ariahu, C. C. and Eke, M. O. (2021). Effect of Incorporating Orange Flesh Sweet Potato Flour, Starch and Non-starch Residue Flour to Wheat on the Quality Characteristics of Cookies. *American Scientific Research Journal for Engineering, Technology, and Sciences* 77(1): 200-220.

Malavi, D.; Mbogo, D.; Moyo,M.;Mwaura, L.; Low, J. and Muzhingi, T. (2022). Effect of Orange-Fleshed Sweet Potato Purée and Wheat Flour Blends on _-Carotene, Selected Physicochemical and Microbiological Properties of Bread. *Foods*, 11, 1051.

Mohanraj, R., and Sivasankar, S. (2014). Sweet potato (*Ipomoea batatas* [L.]) – A valuable medicinal food: A review. *Journal of Medicinal Food*, *17*(7), 733–741.

Ndife, J., Elija, I. Onwuzuruike, A., Ubbor, S. and Ojinnaka, M. C (2019). Impact of Blanching Pretreatment on the Quality Characteristics of Three Varieties of Oven Dried Eggplant. *International Journal of Agriculture and Biological Sciences*, 31: 15-26.

Ndulaka, J. C. and Obasi, N. E. (2018). Effects of Storage on the Proximate and Beta Carotene Contents of Cookie-Like Products Formulated From Blends of Wheat Flour and Garri from Biofortified Cassava Varieties. IOSR *Journal of Environmental Science, Toxicology and Food Technology*, 12(6): 2319-2399.

Nwakalor, C. N. (2014). Sensory Evaluation of Cookies Produced from Different Blends of Wheat and *moringa Oleifera* Leaf Flour. *International Journal of Nutrition and Food Sciences*, 3(40): 307-310.

Nwokorie, E. C. (2017). Acceptability Of Roast *Dioscorea Rotundata* With Fortified *Gongronema Latifolium* Sauce For Consumption In Nigeria Restaurants. *International Journal of Innovative Research and Advanced Studie;* 4(1): 27-33.

Obi, C. and Nwakalor, C. (2015). Production and Sensory Evaluation of Biscuits Using the Composite Flours of African Yam Bean and Wheat Flour. *Journal of*

Environmental Science, Toxicology and Food Technology, 9(11): 83-84.

Obidiegwu, J. E., Lyons, J. B. and Chilaka, C. A. (2020). The *Dioscorea* Genus (Yam)—An Appraisal of Nutritional and Therapeutic Potentials. *Foods*, 9(1304): 1-45.

Ogundele G. F., Ojubanire B. A. and Bamidele O. P. (2015). Determination of the pasting and functional properties of cowpea (*Vigna unguiculata*) and soybean (*Glycine max*) blends. *Britain Journal of Applied Science and Technology*, 6 (3), 304-309.

Okereke, G. O., Igbabul, B. D. and Ikya, J. K. (2022). Evaluation of breads made from wheat flour, modified white yam/trifoliate yam/sweet potato starches and *Moringa Oleifera* seed flour blends. *International Journal of Food Science and Nutrition* 6(2): 107-119

Olumurewa, J. A. V., Ibidapo, P. O. and Adebileje, J. F. (2019). Evaluation of functional and pasting properties of instant pounded yam/plantain flour. *Adv Obes Weight Manag Control*; 9(1): 1–6.

Olurin, T.O., Abbo, E.S. and Oladiboye, O.F. (2021). Production and evaluation of breakfast meal using blends of sorghum, bambara nut and date palm fruit flour. *Journal of Tropical Agriculture, Food, Environment and Extension* 20(3): 30-36.

Oluyemi, E. A., Akilua, A. A., Adenuya, A. A. and Adebayo, M. B. (2006). Mineral contents of some commonly consumed Nigerian foods. *Journal of Science*, 11: 153 - 157.

Onabanjo, O. O and Ighere, D. A. (2014). Nutritional, functional and sensory properties of biscuit produced from wheat-sweet potato composite. *Journal of Food Technology Research*, 1(2): 111-121.

Orafa, N. P., Samuel, O. B. and Daagema, A. A. (2021). Quality Evaluation of Yam (*Dioscorea rotundata*) and carrot (*Daucus carota* L.) Flour Blends for Production of Stiff Dough and Biscuits. *Asian Food Science Journal* 20(3): 18-29.

Otegbayo, B. O.; Oguniyan, D. J.; Olunlade, B. A.; Oroniran, O. O. and Atobatele, O. E. (2018). Characterizing genotypic variation in biochemical composition, anti-nutritional and mineral bioavailability of some Nigerian yam (*Dioscorea spp*.) land races. *J. Food Sci. Technol*., 55: 205–216.

Oyedele, D. S., Oluwafemi, G. I., Adepeju, A. B., Otutu, O. L. and Oluwasola, P. O. (2017). Development and quality evaluation of cookies produced from flour blends of wheat, almond nuts and some natural plant materials. *FUTA Journal of Research in Sciences*, 13(3): 502-516.

Piqueras-Fiszman, B. and Spence, C. (2015). Sensory Expectations Based on Product-Extrinsic Food Cues: An Interdisciplinary Review of The Empirical Evidence and Theoretical Accounts. *Food Quality and Preference*, 40:165-179.

Short, M. W. and Domagalski, J. E. (2013). Iron deficiency anemia: Evaluation and management. *Amer. Fam. Physician*. 87(2):98- 104.

Temesgen, L., Abebe, H. and Tigist, F. (2015). Production and Quality Evaluation of Cookies Enriched with B-Carotene by Blending Orange-Fleshed Sweet Potato and Wheat Flours for Alleviation of Nutritional Insecurity. *International Journal of Food Science and Nutrition Engineering*, 5(5): 209-217.

Tiruneh, Y., Urga, K., Bekerie, A. and Weledesemayat, G. T. (2021). Effect of treatment on beta carotene

retention of orange fleshed sweet potato grown in Hawassa, Ethiopia. *Journal of Nutrition and Food Science;* 11(799): 1-4.

Ubbor, S. C., Ekeh, J. I., Agwo, O. E., Iguh, B. N. and Egwu, S.N. (2022). Physicochemical and Sensory Properties of Cookies produced from Composite Flour of Wheat, *Acha* and Whole Orange Fleshed Sweet Potato. *Nigerian Agricultural Journal* 53(1): 248-259.

Ufot, E. I., Effiong, C. F. and Edima-Nyah, A. P. (2018). Physical Properties, Nutritional Composition and Sensory Evaluation of Cookies Prepared from Rice, Unripe Banana and Sprouted Soybean Flour Blends. *International Journal of Food Science and Biotechnology*. 3(2): 70-76.

Ukom, A. N. and Obi, J. A. (2018). Comparative Evaluation of the Nutrient Composition and Phytochemical Content of Selected Vegetables Consumed in Nigeria. *International Letters of Natural Sciences Submitted* 71: 43-50.

USDA. (2010). United states Department of Agriculture, National nutrient database for standard reference, Agricultural Research Service SR23; 2010. Available:http://www.ars.usda.gov/services/docs.htm% 29/08/2014.

Wardlaw, G. M. and Kessel, M. (2005). Perspectives in nutrition (13th Edition) New York: McGraw Hill Higher Education publisher.