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(RESEARCH ARTICLE)

Nutrients composition, physical, microbial and sensory properties of functional cake enriched with plantain-velvet bean flours

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Abstract

Functional foods can be considered to be those whole food, fortified, enriched or enhanced foods that provide health benefits beyond the provision of essential nutrients (e.g., vitamins and minerals), when they are consumed at efficacious levels as part of a varied diet on a regular basis. Wheat flour is a finely ground powder prepared from wheat grain. Flour can be produced from other starchy plant foods and used in baking. Although flour can be made from a wide variety of plants, the vast majority is made from wheat. Plantain is a crop plant with green leaves and herbaceous stem. Its fruits are cherished by many people. More than 60 plantain varieties have been identified. Velvet bean belongs to the Fabaceae family. It is among the various underutilized wild legumes and is wide spread in tropical and sub-tropical regions of the world. It is considered a viable source of dietary proteins. This study therefore investigated assessment of nutritional, physical, microbial and sensory properties of functional cake produced from wheat, plantain and velvet bean flours blends. The procured velvet bean and plantain were thoroughly washed, peeled, dried and converted into flours. Wheat, plantain and Velvet flours composite were prepared in the ratio 240:37.5:22.5, 210:60:30 and 150:105:45 respectively and 100% wheat flour was used as the control. The samples were evaluated for their nutritional quality; gross and metabolizable energy, total starch, total sugar; physical properties; weight, volume and specific volume, Microbial; total plate counts, fungi and coliform tests and sensory properties; taste, colour, appearance, aroma, texture and overall acceptability. Nutritional quality revealed that gross, metabolisable energy, total starch, and total sugar ranged from 21.08 – 26.39 kCal/g, 8.89 – 11.65 kCal/g, 16.64 – 21.13% and 0.11 – 0.38% ; weight, volume and specific volume ranged from 33.35-36.95, 819.80-944.35, 23.67-26.02; ; total plate counts, fungi and coliform ranged from 2.44×10^5 to 5.61×10^5 cfu /g, 1.73×10^3 to 2.41×10^3 cfu /g and 1.1×10^1 to 1.21×10^2 cfu/g and sensory properties; taste, colour, appearance, aroma, texture and overall acceptability ranged from 7.2 – 8.6, 7.9 – 6.0, 6.0 -8.3, 7.4 to 8.1, 7.5 – 7.9 and 7.5 – 8.7. Addition of plantain and velvet beans flour blend significantly ($p < .05$) enhanced the nutritional quality, physical properties and sensory properties of the functional cake produced. Storability test is imperative.

Keywords: Velvet Bean; Plantain; Cake; Wheat Flour; Functional Food

1. Introduction

Functional foods are category of foods that are associated with several powerful health benefits. They can not only prevent nutrient deficiencies but also protect against disease and promote proper growth and development.

Wheat flour is a finely ground powder prepared from grain or other starchy plant foods and used in baking. Although flour can be made from a wide variety of plants, the vast majority is made from wheat. It is nutritious, easy to store and transport and can be processed into various types of food. Wheat is considered a good source of protein, minerals, B-group vitamins and dietary fiber (Ikpeme et al., 2012) although the environmental conditions can affect nutritional composition of wheat grains with its essential coating of bran, vitamins and minerals; it is an excellent health- building

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food. Dough made from wheat flour is particularly well suited to baking cake, bread, biscuit, chin-chin, etc. because it contains a large amount of gluten, a substance composed of strong, elastic proteins. Wheat flour as the major ingredient for bakery products has dominated other potential sources of flour for bakery products. However, the high cost of wheat flour has led to a rise in the cost of bakery products in Nigeria and indeed other countries in Sub-Sahara Africa (Ikpeme *et al*., 2012).

Plantain (Musa paradisiaca) is an important starchy staple and commercial crop in the West and Central Africa where fifty percent of the world's plantain crop is produced (Adeniji *et al*., 2007). It constitutes a significant source of carbohydrate, low in protein and fat but rich in starch and mineral elements, especially potassium. It is widely cultivated in most of the eastern and southern parts of Nigeria.

Velvet beans (Mucuna pruriens), one of the several species of Mucuna in the Leguminosae family, is an underutilized tropical legume found majorly in Africa and parts of America and Asia (Duru, *et al.,* 2020). It is a legume that can grow in arid and infertile terrain, has a high nutritional content, is relatively cheap, and is widely cultivated in Nigeria (Duru*, et al., 2020*). It is nutritionally comparable to other legumes such as soybeans because of their similar contents of protein, fibre and carbohydrate content (Duru, *et al., 2020*). Mucuna pruriens is a good source of crude protein (24–31.44%), crude carbohydrate (42.79–64.88%), crude lipid (4.1–14.39%), crude fibre (5.3–11.5%) and ash (2.9–5.5%) (Natarajan, *et al*., 2012). The bean is rich in minerals like iron, calcium, and zinc, as well as lysine, an essential amino acid that is deficient in cereals (Duru*, et al., 2020*).

2. Materials and Methods

Plantain, velvet bean and wheat flour were purchased from Owode market, Offa, Kwara State, Nigeria. The equipment used was made available from the department of Food Technology, Federal Polytechnic Offa, Nigeria. All chemicals that were used are of food standard and analytical grade.

2.1. Methods

2.1.1. Sample preparation

Preparation of plantain flour

Plantain flour was prepared following the processing steps described by Kure *et al.,* (2012). Plantain fingers were separated from the bunches, washed, peeled manually and sliced to (2 mm thickness) using a stainless-steel kitchen slicer. The sliced chips were blanched at 70 °C for 5 min, and dried in a cabinet drier at 50 °C for 48 h. The dried slices were milled, sieved and packaged in a low density polyethylene bag; and stored at ambient conditions for subsequent use. See figure 1

Preparation of boiled-velvet beans into flour

Velvet beans were processed into flour as described by Balogun and Olatidoye (2010). About 1000 g of matured velvet beans seed were sorted cleaned to remove extraneous materials like stones and defective seeds. The seeds were introduced into already boiling distilled water (1000:4000 g/ml) and boiled for 30 min. The seeds were dehulled manually and washed thoroughly under running water and drained. The seed was oven-dried at 50 °C for 24 hrs and milled into flour (300 μm). See figure 2.

Plantain
↓
Washing
↓
Peeling
↓
Slicing (2 mm)
↓
Blanching (70 °C for 5 min)
↓
Draining
↓
Drying (50 °C for 48 h)
↓
Milling
↓
Sieving
↓
Plantain flour

Figure 1 Flow chart for the production of plantain flour

Source: (Kule *et al.*, 2021)

Velvet bean
↓
Sorting
↓
Cleaning
↓
Boiling (boiled 1000 g: 4000 ml water for 30 min)
↓
Dehulling (manually under running tap water)
↓
Draining
↓
Drying (50 °C for 24 hrs)
↓
Milling
↓
Velvet flour

Figure 2 Flow chart for the production of Soaked-velvet bean flour

Source: (Balogun and Olatidoye, 2010)

2.2. Composite Flour Preparation

Boiled-velvet bean flour and plantain flour composite flours were prepared by blending them with wheat flour. The composite flour of wheat-plantain-velvet beans (240:37.5:22.5, 210:60:30 and 150:105:45 respectively and 100% wheat flour was used as the control.

2.2.1. Determination of the nutritional quality of the composite flour blends

The following nutritional quality of composite flour blend of (wheat, plantain and velvet beans) gross energy, metabolizable energy total starch and total sugar using approved methods

2.2.2. Gross energy

The AOAC method (2000) was used to determine the energy value of the flour sample using Gallenkamp Ballistic Bomb Calorimeter, USA. The determinations were carried out in triplicate for each sample. About 0.25 g samples were weighed into the steel capsule; 10 mm cotton threads were attached to the thermocouple to touch the capsule. The bomb calorimeter was closed, charged in with oxygen up to 30 atm and switch on to burn the samples in excess oxygen. The maximum temperature rise in the bomb was measured with the thermocouple and galvanometer system; the temperature rises were compared with values obtained for 0.25 g of benzoic acid (C_6H_5COOH) which is the standard solution.

The values of each sample were determined as follows:

Calorific value of sample = $\frac{(T3\ xT1)\ x\ y\ kcal}{g}$ / 0.25

2.2.3. Metabolizable energy

The method of Rebecca *et al.,* 2016 was used to determine the metabolizable energy. This was calculated from fat, protein and carbohydrate using the following formula: Metabolizable energy (ME (Kcal/100 g) = [(3.5 x CP) + (8.5 x CF) + (3.5 x NFE) where ME = metabolizable energy CP =% crude protein, CF=% crude fat, NFE =% Nitrogen free extract)].

2.2.4. Determination of total starch and sugar

The method described by Akinsola *et al*., 2017 was used to determine the total starch and sugar of the composite flour. Approximately 0.2 g of the samples was weighed into centrifuge tube and 1 ml of ethanol was added to make it wet. About 2 ml of deionized water and 10 ml of hot ethanol was added and vortexed using Sorvall centrifuge (New town Connecticult USA, Model GLC-1) at 2000 rpm for 10 mins. The supernatant was collected and used for free sugar while the residue was used for starch analysis. About 7.5 ml of perchloric acid was added to the residue and allowed to hydrolyze for 1 hr. The hydrolyzed solution were diluted with 25 ml deionized water and filtered through Whatman No2. About 0.05 ml of the filtrate was made up to 1 ml with deionized water and the mixture was vortexed and allowed for colour development. The remaining supernatant was made up to 25 ml with deionized water and about 0.2 ml of aliquot was taken and added to 0.5 ml of 5% phenol and 2.5 ml concentrated sulphuric acid. Allow the mixture to cool and the absorbance was read at 490 nm wavelength using spectrophotometer (Model spectronic 601). The optical values of the samples were compared to the standard and the graph given by the machine manual and expressed as percentage (%) of starch and % sugar.

% Sugar = $\frac{\text{Absorbance} - \text{Intercept x dilution factor x volume}}{\text{weight of sample x slope}}$ x 10,000

Abs = absorbance, dilution factor = 5, volume 25; slope = 0.0055; and intercept = 0.0044

% Starch = $\frac{\text{Absorbance x Intercept x dilution factor x volume}}{\text{weight of sample x slope}}$ x 10,000

Abs = absorbance, dilution factor = 5, volume 25; slope = 0.0055; and intercept = 0.0044

2.3. Determination of Physical Parameters

The weight, volume and specific volume of the functional cake were determined by the method described by Giami and Barber, (2004). The cakes volume were calculated using the cone equation volume of cake (Cm^2) = h (d^2 + db +b^2).

2.4. Microbial Evaluation of Cake Samples

Total mesophilic (total viable bacterial counts) and fungi counts (yeast and mould counts) were carried out on the bread samples to determine the microbial load of the samples as described by American Public Health Association (APHA, 2021). Cakes samples were prepared by mashing and mixing in peptone water. Subsamples were diluted decimally and 0.1 mL aliquots were spread plated on nutrient agar (NA), MacConkey agar (MCA), and potato dextrose agar (PDA) for the enumeration of aerobic viable bacteria, coliforms, and fungi, respectively. The NA and MCA plates were incubated at 37°C for 24–48 hours while PDA plates were incubated at room temperature (°C) for 3–5 days. The colonies were then counted and expressed as colony forming units per gram (cfu/g) of samples. All counts were done in duplicate using the Stuart scientific colony counter. Observed colonies were subcultured repeatedly on media used for primary isolation to obtain pure cultures.

The bacterial isolates were characterized using Gram reaction and biochemical tests and were identified by comparing their characteristics with those of known taxa as outlined in Bergey's Manual of Systematic Bacteriology (Krieg and Holt,1994). The fungal isolates were characterized based on macroscopic and microscopic examination and identified using the scheme of (Alexopoulus and Mims, 1979).

2.5. Determination of Sensory Evaluation

The four sample cakes were prepared and presented to twenty-one (21) semi-trained students and staff of the department of Food Technology, Federal Polytechnic, Offa. The samples were coded, and evaluated for preference as described by Iwe (2002). They were asked to score the functional cake samples for colour, flavour, taste, texture, and overall acceptability. Each panelist sat in an enclosed cubicle designed for sensory evaluation and water was provided to rinse their mouth before and after tasting each of the samples. The panelists were given a score sheet that contains 9-point hedonic scale where 1 is dislike extremely and 9 liked extremely

2.6. Statistical Analysis

Data generated from this study were analyzed using Analysis of Variance (ANOVA). Values were expressed as mean ± standard error of mean (SEM) from three determinations. Differences in mean were compared using Duncan multiple test range. P<0.05 was considered significant (Iwe, 2002).

3. Results and Discussion

Table 1 Result for the nutritional quality of composite flours from wheat, plantain and velvet bean blends

Parameters	CSA	CSB	CSC	CSD	Mean
Gross energy (kCal/g/g)	26.39±0.62^{b}	21.08±0.76^{a}	21.45±0.11^{a}	25.21±0.27^{b}	23.53
Metabolizable energy (kCal/g/g)	8.89±0.05^{a}	10.03±0.19^{b}	11.06±0.04^{c}	11.65±0.11^{d}	10.41
Total starch (%)	20.67±0.61^{b}	16.64±0.13^{a}	17.39±0.23^{a}	21.13±0.08^{b}	18.96
Total sugar (%)	0.11±0.00^{a}	0.16±0.03^{a}	0.24±0.02^{b}	0.38±0.02^{c}	0.22

Values are mean ± standard deviation. Data with different superscripts in the same row are significantly different at p < .05

Key:

CSA = 300 g wheat flour
CSB = 240 g wheat flour, 37.5 g plantain flour and 22.5 g velvet bean flour
CSC = 210 g wheat flour, 60 g plantain flour and 30 g velvet bean flour
CSD = 150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour

Table 1 presents the results for the nutritional quality of composite flours from wheat, plantain and velvet bean blends. The gross energy contents of the composite flours varied between (21.08 – 26.39 kCal/g) with CSA (300 g wheat flour) having the highest gross energy (26.39 kCal/g) while the least value (21.08 kCal/g) was observed in CSC (210 g wheat flour, 60 g plantain flour and 30 g velvet bean flour). There are significant differences at (p < .01) between the gross energy contents of the composite flours. Although not significant (p > .05), inclusion of plantain and velvet bean flours to wheat flour at different levels of supplementation slightly reduced the gross energy contents of the composites. This could be due to the energy reduction capability of velvet beans and other legumes (Moses and Adebola, 2017; Abioye *et al.*, 2011; Adekunle and Mayowa, 2018). The gross energy contents of the composites flours in this study are lower than the reports of Lofty *et al.* (2019) for rice-legumes blends (344.3 – 368 kCal/g) and the findings of Famakin *et al.* (2016) for plantain-based functional dough meals (1528.18 – 1658 kCal/g).

Metabolizable Energy (ME) is the net energy remaining after fecal and urinary energy loss, and represents the energy available for growth or reproduction and for supporting metabolic processes such as work (locomotion) and respiration (thermoregulation, maintenance metabolism, HIF) (Costal and Williams, 2015). The metabolizable energy of the composite flours ranged between (8.89 – 11.65 kCal/g). The highest metabolizable energy was observed in CSD (150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour) while the least metabolizable energy was observed in CSA (300 g wheat flour). The result showed significant (p < .05) improvement in the metabolizable energy of the composites with increase in level of plantain and velvet bean flours inclusion. Our findings are lower than the reports (290.86 – 331.19 kCal/g/100g) of Rebecca *et al.* (2016) for cupcakes from oat, corm, green gram, peanut and soya blends and the value (3,000 kCal/kg) obtained for basal diet formulated from corn-soybean by da Silva *et al.* (2012). This study established that due to the low metabolizable energy of the composites in this study, minimal energy will be available for growth or reproduction and for other physiological functions including movement / work and respiration (Costal and Williams, 2015).

The mean results for the total starch contents of the composite flours ranged from 16.64 – 21.13% with CSD (150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour) having the highest total starch (21.13%) while the least value (16.64%) was observed in CSB (240 g wheat flour, 37.5 g plantain flour and 22.5 g velvet bean flour). Although there was slight increase in the total starch content of CSD which could be due to its formulation, no significant differences ($p > .05$) were observed between CSB and CSC respectively. The total starch contents of the composites in this study are not in consonance with the reports (55.77 – 63.67 g/100 g) of Falade and Oyeyinka (2013) for selected banana and plantain varieties. The total sugar contents of the composite flours ranged between (0.11 – 0.38%) with CSD significantly ($p < .05$) having the highest total sugar content (0.38%) while the least value (0.11%) was observed in CSA (300 g wheat flour). There were increases in total sugar contents of the blends with increase in level of plantain flour substitution. This justifies the claim of Falade and Oyeyinka (2013) who reported plantain to be of high sugar contents (1.94 – 25.32%). The study of Singh *et al.* (2018) for different germinated brown rice flour (1.64 – 5.98%) and those of Malomo *et al.* (2021) for maize-acha-sorghum *ogi* fermented at 0, 12, 24, 36 and 48 hours (30.33 – 39.34%), (32.54 – 40.02%), (33.19 – 39.09%), (32.19 – 40.09) and (34.37 – 38.76%) respectively are higher than the total sugar contents of composites in this study. Variation in values could be due to the breakdown of complex carbohydrate of maize-acha-sorghum cereals into simple sugar by fermenting microorganism and utilization of these sugars as carbon source could be responsible for high total sugar content of their samples (Oyarekua and Adeyeye 2009; Adepoju *et al.*, 2016).

Table 2 Physical properties of cake produced

Sample (cm)	**CSA**	**CSB**	**CSC**	**CSD**
Weight (g)	33.35±4.55^{a}	34.82±2.45^{b}	36.79±5.35^{ab}	36.95±3.17^{b}
Volume (cm^{3})	944.35±109.9^{b}	819.80±121.68^{a}	939.64±145.49^{b}	829.82±97.30^{a}
Specific volume (cm^{3})	26.02±2.74^{b}	25.78±2.63^{b}	23.89±2.63^{a}	23.67±2.25.^{a}

Values are means ± standard deviation of measurements. Different letter in the same column indicate significant different ($p<0.05$).

Key:

CSA = 300 g wheat flour
CSB = 240 g wheat flour, 37.5 g plantain flour and 22.5 g velvet bean flour
CSC = 210 g wheat flour, 60 g plantain flour and 30 g velvet bean flour
CSD = 150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour

The results of physical properties of the cake were presented in Table 2 above.

One of the main quality characteristics of a cake is the porous structure that is formed through air bulb expansion and volume development during baking. The physical properties, including weight (g), volume (cm^{3}) and specific volume (cm^{3}/g) were determined, for control and different samples of cakes substituted with plantain and velvet bean flour powder.

Weight result ranged 33.35-36.95. Weight of substituted cake is increased with increasing substitution level of plantain and velvet bean flour. These results may be related to higher water holding capacity of such additional flour compared to wheat flour; as a result, the composite ability of these flours to absorb and retain water than wheat flour. These results were in agreement with that reported by Akubor and Eze (2012).

Volume of cakes with control sample had the highest volume score (944.35 cm^{3}) while sample CSA had the least volume score (819.80 cm^{3}). As the replacement level was increased, the volume decreased. The specific volume of a cake can be used as an indicator of volume development and consequently of the porous structure of the product.

Specific volume of substituted cake decreases with increasing substitution level of plantain flour and velvet bean flour. These results may be related to higher fiber composition of the substituted products. These results agreed with Wongsagonsup *et al.*, (2015) who found that bread volume and specific volume significantly decreased with increase in level of pumpkin flour. As substitution increased, cakes yielded less volume upon baking, which means that the product is less aerated and denser. These results agree with that mentioned by Varastegani *et al*., (2015), who referred the decrease in the height and volume of substituted cakes to the high dietary fiber of plantain flour and velvet bean flour.

Table 3 Microbial loads of cake produced

Sample (cfu/g)	CSA	CSB	CSC	CSD
TPC	2.44×10^5	2.59×10^5	3.81×10^5	5.61×10^5
Fungi	1.73×10^3	2.41×10^3	2.04×10^4	2.13×10^4
Coliform	Nil	1.1×10^1	1.21×10^2	1.21×10^2

Values are means ± standard deviation of measurements. Different letter in the same column indicate significant different ($p<0.05$).

Key

Sample CSA - 300 g wheat flour
Sample CSB - 240 g wheat flour + 37.5 g Plantain flour + 22.5 g velvet bean
Sample CSC - 210 g wheat flour + 60 g Plantain flour + 30 g velvet bean
Sample CSD - 150 g wheat flour + 105 g Plantain flour + 45 g velvet bean

The result of the microbial load of the functional cake is presented in Table 3

Because of the ingredients used in the production of cakes, they are suitable environment for the growth and proliferation of microorganisms and microbial agents that can transmit infection or cause food poisoning to consumers. Personal hygiene and good manufacturing practices (GMP) are two important and effective factors in microbial contamination of foods. The microbiological count considered as a suitable monitor for the shelf life of cake production. The result of total plate count ranged from (2.44×10^5 to 5.61×10^5 cfu / g). The result showed that sample CSD had the highest value of total plate count. The results indicated that bacterial growth for cakes were minimal with the predominant microbial culture and increases shelf life as a result of the reduced availability of water for the microbial growth.

Table 4 Sensory evaluation of cake produced

Sample (%)	CSA	CSB	CSC	CSD
Taste	8.6^b	7.2^a	7.6^a	7.8^{ab}
Colour	7.9^b	7.4^b	6.8^a	6.0^a
Appearance	8.3^b	7.6^b	6.3^a	6.0^a
Aroma	8.1^b	7.4^a	7.5^a	7.6^a
Texture	7.9^b	7.6^a	7.8^b	7.5^a
Overall acceptability	8.7^b	8.1^b	7.8^a	7.5^a

Values are means ± standard deviation of measurements. Different letter in the same column indicate significant different ($p<0.05$).

Key:

CSA = 300 g wheat flour
CSB = 240 g wheat flour, 37.5 g plantain flour and 22.5 g velvet bean flour
CSC = 210 g wheat flour, 60 g plantain flour and 30 g velvet bean flour
CSD = 150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour

Fungi result ranged from 1.73×10^3 to 2.41×10^3 cfu / g The fungi counts were higher in cake made from CSB (240 g wheat flour + 37.5 g plantain flour + 22.5 g velvet bean flour) than all other samples probably because of raw materials, processing, handling, and storage. The organism could have been introduced at the different stages of cake production. This finding is lower to the findings of Udeme *et al*., (2014) who identified 8.0×10^1 organism in bread. The organism could be responsible for the spoilage of cake.

Coliform count ranged from (1.1 x 10^1) to (1.21 x 10^2) cfu/g in composite flour. It was observed that cake produced from 100% wheat flour has no coliform count. However, cakes from composite flours have from (1.1 x 10^1) to (1.21 x 10^2) cfu/g with the highest in sample with highest substitution. This could be as a result of raw materials used, environmental factors during harvesting, type of water used for processing, handling and storage effect.

3.1. Result of the Sensory Evaluation of the Functional Cake

The results for the sensory evaluation of functional cakes are as presented in table 4. The mean results for taste ranged between (7.2 – 8.6) with whole wheat flour cake (CSA) significantly ($p <.05$) having the highest rating (8.6) while the least value (7.2) was observed in (CSB) 240 g wheat flour + 37.5 g Plantain flour + 22.5 g velvet bean composite cake.

The mean results for color showed a range of value between (7.9 – 6.0) with cake from CSA (300 g wheat flour) significantly ($p < .05$) having the highest value (7.9) while the least value (6) was observed in CSD (150 g wheat flour + 105 g Plantain flour + 45 g velvet bean) composite cake there is significant difference between the cakes in terms of colour. The plantain and velvet bean flour impact bluish-black coloration on the cakes. However the cakes were still acceptable.

In terms of appearance of cakes, the values ranged from (6.0 -8.3). Cakes from CSA (300 g wheat flour) was rated the best, followed by CSB (240 g wheat flour, 37.5 g plantain flour and 22.5 g velvet bean flour) and CSC (210 g wheat flour, 60 g plantain flour and 30 g velvet bean flour) and CSD had the lowest rating of 63 and 60 respectively. The low acceptability in these two samples may be due to the level of velvet beans in the cake sample. The higher the level of velvet beans in the sample the darker the cake; which affects the appearance. The aroma of the cakes ranged from (7.4 to 8.1) in favour of 100% wheat cake. There was no significant difference among the cakes with different levels of substitution. However, sample CSC (210 g wheat flour + 60 g Plantain flour + 30 g velvet bean) was rated least.

Evaluation of texture is based on hand feeling, appearance and consistency of a food product (Ogundele *et al.*, 2014). These are important discriminative attribute of food product as it affects the mouth feel and appearance of a product. The texture of the cake samples were evaluated to be (7.5 – 7.9) which showed that supplementation of plantain-velvet bean flour to the wheat flour at different levels for the cake production had no significant ($p > .05$) improvement on the texture of the respective cake samples.

In respect aroma, the values ranged from 7.4 to 8.1 in favour of CSA (300 g wheat flour) having the highest value (8.1) while the least value (7.4) CSB (240 g wheat flour + 37.5 g, plantain flour + 22.5 g velvet bean). There was no significant difference (P. 05) among the plantain – velvet beans composite blend.

In respect to the overall acceptability of samples, the mean results ranged between (7.5 – 8.7) with CSA (300 g wheat flour) significantly ($p < .05$) having the highest rating (8.7) followed by (8.1) sample CSB (240 g wheat flour + 37.5 g Plantain flour + 22.5 g velvet bean) while there was no significant difference among the remaining two composite flour blends of CSC and CSD with 7.8 and 7.5 respectively. However, acceptable cakes were produced from the composite flour wheat, plantain and velvet beans flour.

4. Conclusion

The results of this study show that addition of plantain and velvet beans flours significantly improved the nutritional quality (Gross, metabolisable energy, total starch, and total sugar) and physical properties (weight, volume and specific volume) of cake flour blends with increasing in addition of plantain-velvet beans flours blends. Sensory properties of the flour blends showed that safe and acceptable cakes can be produced from the composite flours. The study therefore recommends the utilization of plantain-velvet flour blends as a supplement in functional cake and similar foods with low nutrients. Storability test of this product is recommended.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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