Quality Characteristics of Cake Made from Blends of Soy-Bean and Unripe Plantain Flour

Oledimma, N.U., Ibeogu, I.H.* and Umeojiego O.P

Department of Food Science and Technology, Ebonyi State University, Abakaliki, Nigeria
**Corresponding author*

Abstract: **This study was undertaken to assess the quality characteristics of cake made from composite flour (soy-bean and unripe plantain flour) enriched with carrot. The soy bean and unripe plantain were prepared and then blended into the following ratios: soy bean/unripe plantain (80:20), soy bean/unripe plantain (40:60), soy bean/unripe plantain (20:80), soy bean/unripe plantain (60:40), soy bean/unripe plantain (50:50), control (100% wheat flour). Functional analysis were carried out on the flour samples while the cakes produced from the flours were subjected to proximate analysis and sensory evaluation on a 9-point hedonic scale using 25-member trained and semi trained panelists. The results showed that swelling index ranged from 1.20-2.05, WAC 1.55-2.95ml/g, OAC 0.86-1.04ml/g, bulk density 0.24-0.29g/ml, wettability 16.9-29.3 sec and sinkability 24.9-38.2 sec. unripe plantain significantly improved the functional properties of the flour blends. The proximate composition were 16.1-23.2% protein, 9.0-16.1% fat, 21.8-42.7% moisture, 1.3-4.3% ash, 1.8-4.5% fibre and 22.5-44.7% carbohydrate. The proximate composition of the cakes produced from these flour blends compared very well with the 100% wheat flour cake and was in most cases superior. The sensory attributes of all the composite cakes (except the soy bean/unripe plantain (60:40) cake) compared well with the control and were all acceptable. The result of this study shows that various formulations of soy bean-unripe plantain flours can totally replace wheat flour in production of nutritious cakes of acceptable sensory quality.**

***Keyword*: Cake, soy-bean, unripe plantain, carrot, quality**

I. INTRODUCTION

Cake is a bakery product in form of a sweet desert that is typically baked. Cake preparation can be simple or elaborate. Typical cake ingredient are flour, sugar, eggs, butter, baking soda, baking powder, common additional ingredients and flavoring include dried or fresh fruit, carrot, nut, extract such as vanilla, banana etc. Cake can be coated with icing sugar, with butter cream or other icing and decorated with colorings and candied fruits. (Modestus, 2011 and Akubor, 2011).

Plantain (*musa para. Disiaca*) is the common name for herbaceous plants of the genus musa. It is an important staple food in Central and West Africa. It is a basic food crop and cheap source of energy in Nigeria (faturoti *et al.,* 2007; Adeniye *et al.,* 2006). Several food consumption survey in Nigeria identified plantain among the major starchy staples (Odenigbo 2012, Okeke *et al.,* 2001: Ogealu *et al.,* 2007). Plantain is widely grown in the southern states of Nigeria and it is used both in Nigeria and many African countries as a cheap source of calories, excellent for weight control, slow in the release of energy after consumption with a low glycermic index (Mendosa 2008), high in potassium and good for diabetic patients (Akubor, 2003). According to FAO (2005) over 2.11 million metric tons of plantains are produced in Nigeria annually. Olorunda and Adelusola (1997) reported that about 35-60 % post harvest losses usually occur in this food material and this could be attributed to lack of storage facilities and inappropriate technologies for food processing. An average plantain has about 220 calories and is a good source of potassium and dietary fiber, irons, vitamins and minerals (Ogazi, 1988). The nutritious food is deal for diabetics, children and pregnant women (Ogazi, 1988). Plantain contains small amount of genetonin which has the ability to dilate the arteries and improves blood circulation.

The soybean (*Glyeine max*) is a legume species native to East Asia, widely grown for its edible bean which has numerous uses. It is now grown commercially in many parts of the world and soybeans are a globally important crop providing oil and protein. Soybean is now the world's fourth most important crop, only surpassed by wheat maize and rice. Soy bean flour is made from roasted soy beans that have been ground into fine powder. Soy flour is rich in protein and it is also a good source of calcium and vitamin B. Unripe plantain flour is made from dried unripe plantain finely ground into powder. Unripe plantain is rich in carbohydrate and dietary fiber which aids digestion. Plantain flour is low in fat and is also gluten free. (Brinan, 2017).

Carrot on the other hand is grown on a large scale in the northern Nigeria and is widely consumed in all part of the country. (Asagbara and Oyewole, 2010). The consumption of carrot in Nigeria has increased in recent years because of the increase awareness of it benefits. Carrot is good source of carotene which is the precursor of vitamin A, which is an essential nutrient for maintaining vision and good health. (Heiman, 2010). Carrot also contains oxycarotenoids such as leutin which has been shown to be protective against colon cancer in men and women (Jonas, 2011). Appreciable amount of vitamins and minerals are found in carrot. Ronard (2012) reported that carrot is one of the important root vegetables rich in bioactive compounds like carotenoids and dietary fibers with appreciable levels of several other functional components having significant health promoting properties. s. The consumption of carrot and its products is increasing steadily due to its recognition as an important source of

natural antioxidants having anticancer activity (Ronard, 2012). Thus, the objective of this study was to produce an acceptable nutritious cake from blends of soy bean and unripe plantain flour enriched with carrot.

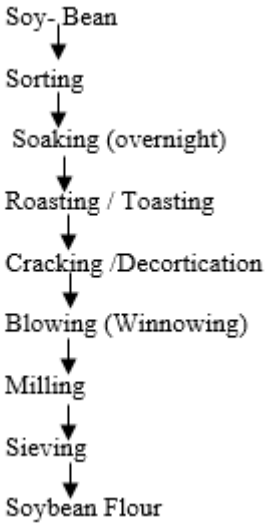
II. MATERIALS AND METHOD

The materials used for this study (unripe plantain, soy bean, carrot) and other baking ingredients sugar, egg, salt etc were purchased from local retailers at the Abakaliki Meat Market in Ebonyi State, Nigeria.

Sample Preparation

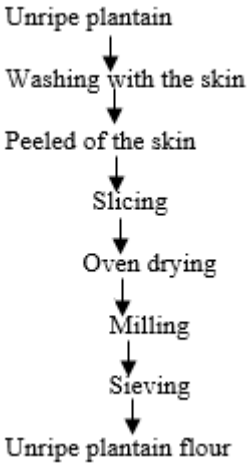
Preparation of Soy Bean

The soy bean used was sorted in order to remove unwanted materials like stones and foreign seeds. The clean soy-bean was soaked, roasted/ toasted, cracked, blown, milled and sieved.



Preparation of Unripe Plantain

The unripe plantain used was washed with the skin, peeled, Sliced,Oven Dried, Milled and Sieve.



Carrot Preparation

Table 1: Recipe for Carrot Cake Production

Ingredients	Quantity
Flour	200g or 2 Cups
Sugar	1½ Cups
Oil or melt magarine	1¼ cups
Grated carrot (fresh)	3 cups
Mixed fruit (optional)	¼ cups
Eggs	4 sizable eggs
Baking soda	2tsps
Cinnamon	2tsp
Ginger	1tsp
Nutmeg	½ tsp
Salt	1 tsp
Flavour	2tsp
Groundnut	¼ cup

Flour Blending

The soy-bean and unripe plantain flour were mixed at different respective ratios. The blends were thoroughly mixed and kept in plastic contains until needed.

Table 2: Ratio for flour blends

	Soybean	unripe plantain
A	80%	20%
B	40%	60%
C	20%	80%
D	60%	40%
E	50%	50%
F	100%	Wheat flour (control)

Mixing and Baking Process

All dried ingredients were properly mixed together and kept, sugar and oil was whisked in a bowl until well blended. The eggs were added one at a time to the sugar and oil blend. The already mixed dried ingredients were gradually added to the mixture ensuring that it was well mixed. Finally the freshly grated carrot and mixed fruit and groundnut were added and mixed together for about 3 minutes and then poured into an already greased baking pan and placed in the pre-heated oven.

Sample Analysis

Sensory evaluation was carried using 20 semi-trained panelists comprising of staff and students randomly selected from the Department of Food Science and Technology, Ebonyi State University, Abakaliki. Properties of the cake evaluated includes, taste, texture, appearances, crispness, mouth feel, general acceptability of the cake. A 9 point Hedonic scale was used with 9 = extremely like, 8 = like very much, 7 =like moderately, 6 = like slightly, 5 = like nor dis

like, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much, 1 = dislike extremely. Samples were presented in a random sequence to the panelist; water was presented to rinse their mouth before and after each sample.

Proximate Analysis

Moisture, protein, fibre, ash, fat and carbohydrate content of the samples were determine using the method of AOAC, (2010)

Functional Properties

Bulk Density Determination, Wettability Determination, Oil and Water Absorption Capacities and Swelling Capacity were evaluated using the method of AOAC (2005).

Statistical Analysis

All data obtained from the analysis were subjected to analysis of variance (ANOVA) using SPSS software package. Means were separated using Duncan Multiple Range test to determine the significant difference at 5 % probability.

III. RESULTS AND DISCUSSION

Functional properties of the flour blends

Functional properties relate to those characteristics that govern the behaviour of nutrients in food during processing, storage, and preparation as they affect food quality and acceptability (Matil, 1971). The functional properties of the flour blends used in the production of the cakes are shown in Table 3.

Table 3: Functional properties of the flour blends

Functional properties	A	B	C	D	E	F
Swelling Capacity	1.20^{b}±0.28	1.75^{a}±0.07	1.80^{a}±0.28	2.05^{a}±0.07	1.95^{a}±0.07	0.60^{c}±0.00
WAC(ml/g)	1.90^{b}±14	2.75^{a}±0.07	2.95^{a}±0.07	1.55^{c}±0.07	2.95^{a}±0.07	0.95^{d}±0.07
OAC(ml/g)	0.86^{c}±0.06	1.04^{b}±0.06	0.86^{c}±0.06	0.86^{c}±0.06	1.04^{b}±0.06	1.94^{a}±0.06
Bulk density(g/ml)	0.24^{d}±0.01	0.28^{ab}±0.00	0.29^{a}±0.01	0.27^{bc}±0.01	0.26^{c}±0.00	0.29^{a}±0.00
Wettability(sec)	24.6^{bc}±0.1	29.3^{b}±0.1	21.4^{cd}±0.1	19.8^{cd}±0.1	16.9^{d}±0.0	113.9^{a}±5.0
Sinkability(sec)	33.9^{c}±0.1	38.2^{b}±0.1	27.3^{d}±0.1	34.2^{c}±0.1	24.9^{e}±0.1	119.7^{a}±0.5

Values are means ± standard deviation of duplicate measurements. Means with the same superscript in the same rows are not significantly different at 0.05 levels. A= soy bean/unripe plantain (80:20); B = soy bean/unripe plantain (40:60); C= soy bean/unripe plantain (20:80); D= soy bean/unripe plantain (60:40); E= soy bean/unripe plantain (50:50); F= control (100% wheat flour).

The swelling Capacity increased from 0.60 for the control to 2.05 for the soy bean/unripe plantain (60:40) blend. The swelling capacity of the flour blends were significantly ($p<0.05$) higher than that of the control. There was no significant difference among the flour blends except the soy bean/unripe plantain (80:20) blend which was significantly lower than the others. The high swelling index observed in the flour blends are indication of higher starch content and will have both economic and culinary benefits especially in production of pastries and baked products such as cake (Onwuka and Onwuka, 2005). However, the results are lower than those reported by Abioye *et al.* (2011) for soy-plantain flour blends.

The water absorption capacity (WAC) increased from 0.95ml/g for the control to 2.95ml/g for both the soy bean/unripe plantain (20:80) blend and the soy bean/unripe plantain (50:50) blend. There was significant difference ($p<0.05$) among the flour blends and the WAC of the flour blends were significantly higher than that of the control. The results revealed that increase in unripe plantain flour increased the WAC of the blends. This might be due to higher starch content of the unripe plantain flour which will bind more water to its molecule during hydrolysis (Onwuka and Onwuka, 2005). High WAC is important in production of pastries and bakery products. The results are in agreement with those reported for unripe plantain flour (Onwuka and Onwuka, 2005; Inyang *et al.,* 2017; Ibeanu *et al.,* 2015) but higher than those reported for soy-plantain flour blends (Abioye *et al.,* 2011).

The oil absorption capacity (OAC) increased from 0.86 to 1.95ml/g with the highest value corresponding to the control. The OAC of all the flour blends were significantly ($p<0.05$) lower than the control. High OAC are very beneficial in bakery products requiring emulsion and creaming properties, such as cake production (Onwuka and Onwuka, 2005). Again, fats are reported to improve flavour and mouth feel of foods (Eke and Akobundu, 1993). Thus, the soy bean/unripe plantain (40:60) and the soy bean/unripe plantain (50:50) blends are expected to give better cake quality.

The bulk density increased from 0.24g/ml for the soy bean/unripe plantain (80:20) blend to 0.29g/ml for the control and the soy bean/unripe plantain (20:80) blend. There was significant difference ($p<0.05$) among the flour blends including the control although there was no significant difference ($p>0.05$) between the control and the soy bean/unripe plantain (20:80) and the soy bean/unripe plantain

(40:60) blends. The bulk density of the flour blends increased with increase in unripe plantain. Similar result was reported by Abioye *et al.* (2011) for soy-plantain flour blends.

The low bulk density of these samples indicate that they can be useful in formulation of infant foods where low bulk density and high nutrients are required (Olapade and Adeyemo, 2014).

The wettability and sinkability ranged from 16.9 to 113.9 sec and 24.9 to 119.7 sec respectively. The lowest wettability and sinkability were observed in the soy bean/unripe plantain (50:50) blend while the highest wettability and sinkability were observed in the control. Among the flour blends, the highest wettability and sinkability were observed in the soy bean/unripe plantain (40:60). There was significant difference ($p<0.05$) among the flour blends including the control.

Proximate Composition of the Cakes

The proximate composition of the cakes produced from the flour blends are presented in Table 4.

Table 4: Proximate composition of the cake samples

Composition (%)	A	B	C	D	E	F
Protein	23.2^{a}±0.14	16.4^{c}±0.14	16.1^{d}±0.07	17.1^{b}±0.14	16.6^{c}±0.07	15.2^{e}±0.07
Fat	16.1^{a}±0.14	9.7^{bc}±0.14	12.5^{ab}±0.14	11.3^{bc}±0.14	9.0^{bc}±3.96	7.4^{c}±1.41
Moisture	21.8^{d}±1.06	42.7^{a}±7.99	30.8^{bc}±0.35	34.8^{ab}±0.35	25.3^{cd}±0.35	28.8^{bcd}±0.35
Ash	2.3^{b}±0.1.06	4.3^{a}±0.35	2.3^{b}±0.35	1.3^{b}±0.35	1.3^{b}±0.35	1.3^{b}±0.35
Fibre	1.8^{d}±0.35	4.5^{ab}±0.71	2.8^{cd}±0.35	3.8^{bc}±0.35	3.3^{c}±0.35	5.0^{a}±0.71
Carbohydrate	35.0^{bc}±0.35	22.5^{d}±6.93	35.7^{bc}±0.28	31.9^{c}±0.35	44.7^{a}±3.68	42.5^{ab}±0.64

Values are means ± standard deviation of duplicate measurements. Means with the same superscript in the same rows are not significantly different at 0.05. . A= soy bean/unripe plantain (80:20); B = soy bean/unripe plantain (40:60); C= soy bean/unripe plantain (20:80); D= soy bean/unripe plantain (60:40); E= soy bean/unripe plantain (50:50); F= control (100% wheat flour).

The moisture content of the cakes ranged from 21.8 to 42.7%. The lowest value was observed in the soy bean/unripe plantain (80:20) cake while the highest was observed in the soy bean/unripe plantain (40:60) cake. There was significant difference in the moisture content of the cake samples ($p<0.05$). The moisture content of the control was statistically equal ($p>0.05$) to those of the composite cakes except the soy bean/unripe plantain (40:60) cake. The high moisture content of the cakes could be attributed to the high WAC of the flour blends (table 3) and is an indication that the cakes will not be shelf stable. The results are higher than those reported for Wheat-Unripe Plantain-Bambara Groundnut Protein Concentrate cake (Kiin-Kabari and Banigo, 2015), jackfruit seed flour and wheat flour cake (Khan *et al.*, 2016), and plantain-wheat flour cake (Ibeanu *et al.*, 2016).

The protein content ranged from 15.2% for the control to 23.2% for the soy bean/unripe plantain (80:20). There was significant difference among the cake samples ($p<0.05$) and the protein content of the composite cakes were significantly higher than that of the control. As expected, the cake sample with the highest soy bean content had the highest protein content showing the ability of soy bean to improve the nutritional quality of cake. Similar increase in protein content of cake with addition of legumes has been reported (Kiin-Kabari and Banigo, 2015).

The fat content ranged from 7.4 to 16.1%. The control had the lowest value while the soy bean/unripe plantain (80:20) cake had the highest value. There was significant difference among the cake samples ($p<0.05$). The high fat content observed in the cakes could be due to the high OAC of the flour blends. The results are comparable to those reported by Kiin-Kabari and Banigo, (2015) for cake produced from wheat and unripe plantain flour blends enriched with Bambara groundnut protein concentrate.

The ash content of the cakes ranged from 1.3 to 4.3%. There was no significant difference between the ash content of the control and the composite cakes except the soy bean/unripe plantain (40:60) cake which was significantly ($p<0.05$) higher than the rest. Low ash content is an indication of low mineral content (Adeyeye and Ajewole, 1992). The results are similar to those reported by Kiin-Kabari and Banigo (2015) for cake produced from wheat and unripe plantain flour blends enriched with Bambara groundnut protein concentrate.

The fibre content ranged from 1.8% for the soy bean/unripe plantain (80:20) to 5.0% for the control. There was significant difference among the cake samples including the control ($p<0$

.05). The results are similar to those reported by Kiin-Kabari and Banigo (2015) for cake produced from wheat and unripe plantain flour blends enriched with Bambara groundnut protein concentrate but higher than those reported by Khan *et al.* (2016) for jackfruit seed flour and wheat flour cake.

The carbohydrate content ranged from 22.5% for the soy bean/unripe plantain (40:60) cake to 44.5% for the soy

bean/unripe plantain (50:50) cake. There was significant difference among the cake samples ($p<0.05$). The results showed that the composite cakes are good sources of energy. The results are comparable to those reported for plantain-wheat blend cakes (Ibeanu *et al*., 2016).

Sensory Characteristics of the Cakes

The sensory attributes of the cake samples evaluated by 25 judges are presented in table 5.

Table 5: Sensory characteristics of the cake samples

Sensory Parameter	A	B	C	D	E	F
Appearance	$7.24^{b}\pm1.09$	$7.12^{b}\pm1.05$	$6.88^{ab}\pm1.67$	$6.72^{ab}\pm1.49$	$7.04^{ab}\pm1.54$	$7.84^{a}\pm1.57$
Sweetness	$7.32^{a}\pm1.15$	$7.08^{ab}\pm1.38$	$6.80^{ab}\pm1.47$	$6.32^{b}\pm1.35$	$6.56^{ab}\pm1.69$	$6.96^{ab}\pm1.93$
Salty	$4.72^{a}\pm2.61$	$4.72^{a}\pm2.75$	$4.64^{a}\pm2.87$	$4.56^{a}\pm4.49$	$4.64^{a}\pm2.46$	$4.80^{a}\pm2.57$
Colour	$7.16^{ab}\pm1.07$	$7.04^{abc}\pm0.79$	$6.60^{bc}\pm1.56$	$6.36^{c}\pm1.60$	$6.44^{bc}\pm1.53$	$7.48^{a}\pm1.76$
Crumb colour	$6.96^{b}\pm1.31$	$6.48^{bc}\pm1.26$	$6.52^{bc}\pm1.30$	$6.12^{c}\pm1.83$	$6.16^{bc}\pm1.49$	$7.84^{a}\pm7.41$
Crust colour	$7.04^{ab}\pm1.06$	$6.84^{abc}\pm1.14$	$6.44^{bc}\pm1.29$	$6.08^{c}\pm1.50$	$6.16^{c}\pm1.49$	$7.32^{a}\pm1.87$
Flavour	$6.80^{bc}\pm1.56$	$6.60^{bc}\pm1.29$	$6.92^{ab}\pm1.19$	$6.00^{c}\pm1.78$	$6.36^{bc}\pm1.47$	$7.68^{a}\pm1.87$
Texture	$6.72^{ab}\pm1.57$	$6.80^{ab}\pm1.26$	$6.00^{bc}\pm1.83$	$5.64^{c}\pm1.80$	$6.12^{bc}\pm1.39$	$7.20^{a}\pm2.08$
Mouthfeel	$6.80^{ab}\pm1.47$	$6.32^{abc}\pm1.49$	$5.92^{bc}\pm1.71$	$5.80^{c}\pm1.29$	$5.80^{c}\pm1.16$	$7.04^{a}\pm2.23$
After taste	$7.00^{ab}\pm1.63$	$6.64^{abc}\pm1.35$	$6.44^{abc}\pm1.98$	$6.04^{c}\pm1.67$	$6.12^{bc}\pm1.20$	$7.12^{a}\pm1.99$
General acceptability	$7.56^{a}\pm1.23$	$7.24^{abc}\pm1.17$	$7.16^{abc}\pm1.46$	$6.60^{bc}\pm1.32$	$6.40^{c}\pm1.41$	$7.44^{ab}\pm2.29$

Values are means ± standard deviation of hedonic scores of sensory attributes of the cakes rated by 20 panelists. Means with the same superscript in the same row are not significantly different at 0.05. A= soy bean/unripe plantain (80:20); B = soy bean/unripe plantain (40:60); C= soy bean/unripe plantain (20:80), D= soy bean/unripe plantain (60:40); E= soy bean/unripe plantain (50:50); F= control (100% wheat flour).

There was significant difference in the mean appearance of the cake samples including the control ($p<0.05$). The control was rated highest in appearance (7.88) although this was not significantly different from the mean score of many of the composite cakes ($p>0.05$). The appearances of the composite cakes were at least moderately liked (6.72).

The judges at least slightly liked (6.32) the sweetness of the cakes. The soy bean/unripe plantain (80:20) cake received the best rating although there was no significant difference in the sweetness of the cakes including the control except the soy bean/unripe plantain (60:40) cake whose score was significantly ($p<0.05$) lower than most of the cake samples.

In terms of saltiness, none of the cake samples including the control was liked by the judges. The highest rating (4.8) was given to the control although there was no significant difference ($p>0.05$) in the saltiness attribute. The low scores could be attributed to the recipe used in production of the cakes.

The mean score ranged from 6.36 to 7.48, 6.12 to 7.84 and 6.08 to 7.32 for overall colour, crumb colour and crust colour respectively. The soy bean/unripe plantain (60:40) cake received the worst colour rating while the control received the best colour rating. There was significant difference in these three colour attributes ($p<0.05$). The colour attributes of all the cake samples including the control were at least slightly liked.

The flavour attribute of the cake samples including the control was at least slightly liked with the soy bean/unripe plantain (60:40) cake having the worst rating while the control had the best rating. There was significant difference among the cake samples ($p<0.05$). The addition of unripe plantain flour seemed to improve the flavour of the composite cake samples. This could be attributed to high OAC of the unripe plantain flour.

The mean score for texture ranged from 5.64 for the soy bean/unripe plantain (60:40) cake to 7.20 for the control. There was significant difference in the mean score of texture ($p<0.05$). The judges at least slightly liked the texture of the cake samples.

The mouth feel of the cake samples were all acceptable to the judges with the soy bean/unripe plantain (60:40) cake and the soy bean/unripe plantain (50:50) cake having the least score (5.80) while the control had the best score (7.04). There was significant difference in the texture of the cake samples ($p<0.05$).

The after taste of the cake samples including the control was acceptable to the judges. The soy bean/unripe plantain (60:40) cake had the least score (6.04) while the control had the best score (7.12). There was significant difference in the after taste of the cake samples ($p<0.05$).

For general acceptability of the cake samples, the scores ranged from 6.40 for the soy bean/unripe plantain (60:40) cake to 7.56 for the soy bean/unripe plantain (80:20) cake showing that all the cake formulations were acceptable. There was significant difference in the general acceptability of the cake samples ($p<0.05$).

IV. CONCLUSION

The results showed that soybean-unripe plantain flour blend exhibits good functional properties necessary for cake production. The addition of unripe plantain significantly improved the functional properties of the flours. The nutritional quality of the cakes produced from these flour blends compared very well with the 100% wheat flour cake and was in most cases superior. The cakes were high in moisture, protein, fat, and carbohydrate (except the soy bean /unripe plantain (40:60) cake but relatively low in ash and fibre. The result of proximate and functional properties obtained shows that sample A (soy bean/unripe plantain (80:20)) was the best blends among others. The sensory attributes of all the composite cakes (except the soy bean/unripe plantain (60:40) cake) compared well with the control and were all acceptable. Thus, it can be concluded that various formulations of soy bean-unripe plantain flours can totally replace wheat flour in production of nutritious cakes of acceptable sensory quality.

REFERENCES

[1] Abioye, V. F., Ade-Omowaye, B. I. O., Babarinde, G. O. and Adesigbin, M. K. (2011).Chemical, physico-chemical and sensory properties of soy-plantain flour. *African Journal of Food Science* 5(4): 176 – 180.

[2] Adeyeye, A. and Ajewole, K. (1992). Chemical Composition and Fatty Acid Profile of Cereals in Nigeria, Food Chem., 44, 41-44.

[3] Akubor P 1 (2003) Functional properties and performance of cowpea/plantain / Wheat flour blends in Biscuits. Plant food Nutrition 58:1-8.

[4] Alasalvar, C. Grigor, J. M, Zhang, D. Quantick, P. C. and Shatudi, F. (2001) Comparison of volatile, phenolics, sugars, antioxidants, vitamins and sensory equality different coloured carrot varieties. *J. Agric food chem.* 49:1410 - 1416.

[5] AOAC (1990), Association of official analytical chemist official method of analysis, 14th edition, Washington *D.C. USA* pg 45 - 55.

[6] AOAC (2005). Association of Official Analytical Chemist, Official Methods of Analysis, 18th edition *USA* Pp 19 - 27.

[7] AOAC, (2000). Approved method. The association of official analytical chemist, St. Paul, Minnesota, UAS, Method 44 - 15A, 46 - 12, 30 - 25 and 1 - 8. Pp 1 - 2, 34, 36 - 38.

[8] Bamidele, E A, Cardoso AO, Olaofe O. (1990). Rheology and Baking Potential of Wheat/Plantain Composite Flour. *J. Sci. Food Agric*.51(3);421-424.

[9] De Almeida, V. U., Bonafe, E. G., Muniz E. C., Masusluta, M., de souza, N. E. and Visenainer, J. V. (2009). Optimization of the carrot leaf dehydration aiming at the preservation of omega 3 fatty acids. Quimica Nova. 32(5): 1334 - 1337.

[10] Eke, O.S. and Akobundu, N.T. (1993). Functional properties of African yam bean (*Sphenostylis stenocarpa*) seed flour as affected by processing. Food Chem. 48:337-340.

[11] Fatuori, B. Madukwe M., Tenkouamo A., Agwu (2007). A review of policy acts and initiative in plantain and banana innovation system in Nigeria. *Afr. J. Biotechnol*. 6(20):2297 - 2302.

[12] Gazalli, H.,, Malik, A. H., Jalal, H., Afshan, S. and Mir. Ambren (2013). Promenade composition of carrot powder and Apple pormace powder. *Inern J. Food Nutri. Safety*. 3(1): 25 - 28.

[13] Hart, A. D. (2006). Determination of micro-nutrient and colour variability among new plantain and banana hybrid flour. *World J. Chem*. 1(1) 23-27.

[14] Hashimoto, T. and Nagayama. T. (2004) Chemical composition of ready to eat fresh carrot *J. Food Hygiene Soc. Japan* 39. 324 - 328.

[15] Ibeanu, V., Onyechi, U., Ani, P. and Ohia, C. (2016). Composition and sensory properties of plantain cake. *African Journal of Food Science*, 10(2): 25-32.

[16] Idoke, J O, Nwajiaku I (2013) Performance of riped and unripe plantain – wheat flour blend in biscuit production. *Int. J. Biol. Food vet. Agric. Eng.* 7 (12): 848 -851.

[17] Inyang, U. E., Nkop, S. E. and Umoh, E. B. (2017).Effect of the Stage of Ripening on the Nutrients, Anti-nutrients and Functional Properties of Flours Made from Whole Plantain Fruit. *Current Journal of Applied Science and Technology*, 24(1): 1-9.

[18] Khan, S. A., Saqib, M. N. and Alim, M. A. (2016). Evaluation of quality characteristics of composite cake prepared from mixed jackfruit seed flour and wheat flour. *J. Bangladesh Agril. Univ*. 14(2): 219– 227.

[19] Khhamum, F. M., Suramy, M. S., Krishon K.R, Santhanam, K. and Vis Ranathan, K.R. (2000). Dietary fiber content of commonly fresh and cooked vegetables consumed in India. Plant Food Hum, Nutrition 55:207-218.

[20] Kiin-Kabari, D.B. and Banigo, E.B. (2015).Quality Characteristics of Cakes Prepared from Wheat and Unripe Plantain Flour Blends Enriched with Bambara Groundnut Protein Concentrate. *European Journal of Food Science and Technology*, 3(3):1-10.

[21] Kure, O A, Bahago EJ, Daniel EA (1998).Studies on the proximate composition and effect of flour particle size of acceptability of biscuit produced from blends of soya beans and plantain flour. Namoda Tech. scope *J*. 3(2): 17-22.

[22] Leite, C. W, Boroski, M., Boeing, J. S., Aguiar, A.C., Franca, P. B., de Souza, N. E. and visentainer, J.V, (2011). Chemical characterization of leaves of organically grown carrot Dacus (*Dacus Carota L*.) in various stages of development for rise as food-Cienciae Tecnologia de Alimenos, Campinas, 31 (3): 735 - 738.

[23] Matil, K.F. (1971). Functional requirements of proteins for foods. *Am. Oil Chem. Soc*., 48, 477– 480.

[24] Mepha, H D, Eboh L. Nwajiawu SU (2007*). Chemical composition, Functional and Baking properties of wheat – plantain composite flours Afr. J. Food Agric Nutri Dev*. 7(1): 1-22

[25] Odenigbo, M.A. (2012). Knowledge, Attitudes and practices of people with type 2 Diabetes mellitus in tertiary health care centre Umuahia, *Nig J. Diabetes Metab*. 3:187 - 191.

[26] Ogazi (1988). Plantain Utilization and nutrition. In: Food crops production Utilization and Nutrition Proc. Of course at university of Nigeria Nsukka10-23 April 1988. Dotmat Pub, Ltd.

[27] Oke, O. L, Redhead J, Hussain M. A. (1998); Roots, tubers plantains bananas in human nutrition in food and Agriculture organization of the United Nations (FAO) and the information network on post-harvest operations (NOPH) Rome Italy P. 198.

[28] Olapade, A. A and Adeyemo A. M. (2014). Evaluation of cookies produced from blends of wheat, cassava and cowpea flours. *International Journal of Food Studies*; 3:175-185.

[29] Olorunda A O, Adelusola MA (1997). Screening of Plantain / banana cultivars for import, storage and processing characteristics. International symposium on genetic improvement of banana for resistance to disease and pests 7- 9th Sept, CIRAD, Montpellier, France,

[30] Onwuka, G.I. and Onwuka, N.D. (2005). The Effects of Ripening on the Functional Properties of Plantain and Plantain Based Cake. *International Journal of Food Properties*, 8(2): 347-353.

[31] Rodriquez- Amaya D.B. (2001). A guide to carotenoid analysis in foods. ILSI Press, Washington.

[32] USDA (2012). Agriculture Handbook: Composition of foods: vegetables and vegetables products, Raw, processed, prepared U. S. Government printing office Washington-D.C.
[33] USDA Nutrient Database (2010). Available at http://en.wikipedia.org/wiki/cooking plantain Reviewed 20th, March, 2021.