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EFFECT OF SUBSTITUTION LEVELS ON THE PHYSICOCHEMICAL AND SENSORY PROPERTIES OF CAKE AND CHIN-CHIN MADE FROM WHEAT/ COCOYAM FLOUR BLENDS

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Cocoyam (Colocasia esculenta) tubers were processed into flour and composite flour of wheat/cocoyam blends were formulated at the levels of 0, 10, 20, 30 40 and 50% and labelled A, B, C, D, E and F samples, respectively. The blends were used in the production of cakes and chin-chin to study the effect of substitution levels on the chemical, physical and sensory properties of the products. The chemical result of the cake samples showed that the substitution of Cocoyam Flour (CF) to Wheat Flour (WF) increased the moisture, ash and crude fibre content of the product from 28.83-35.10%, 1.43-1.70% and 1.10-1.33%, respectively. It was observed to decreased the protein, fat and carbohydrate content of the product from 16.19-9.64%, 13.91-10.41% and 37.36-28.70%, respectively. Increasing substitution level of cocoyam flour increased the bulk density of the flour blends from 0.65-0.93%, batter density (0.75-0.96%) and cake weight (35.65-42.21 g) while cake volume and volume index was observed to decreased at an increasing substitution levels from 261.45-235.28 cm^3 and 115.72-100.25, respectively. The sensory result of the cake samples showed that the control sample had significantly higher ($p<0.05$) likeness in all the analysed attributes. The overall acceptability showed that the composite flour cakes were accepted by the panelists up to 30% level of CF substitution. The chemical result of chin-chin showed that the incorporation of CF to WF decreased the moisture and protein values from 11.65-6.75% and 15.57-9.99%, respectively. While ash, crude fibre, fat and carbohydrate content of chin-chin was observed to increase at increasing levels of substitution from 1.46-1.79%, 1.10-4.35%, 25.87-37.59% and 42.86-49.04%, respectively. The sensory result of control chin-chin sample was significantly preferred to those with CF substitution just as in cakes but the overall acceptability showed that up to 50% levels of substitution were accepted by the panelists.

Keywords: Wheat/Cocoyam flour, Cake, Chin-Chin, Proximate, Sensory properties

INTRODUCTION

Increasing urbanization in African countries is changing the food habit and preference of the population towards convenience foods. Change in consumption pattern towards cake, chin-chin and similar foods made from wheat flour has become very popular in Nigeria. This has led to nutritional disorders and socio-economic implications (Alozie *et al.*, 2009) such as high cost of wheat importation as it cannot be grown here in Nigeria. Cake is one of the relished and palatable soft baked products produced by baking a batter containing wheat flour, baking powder, beaten eggs, with or without shortening, sugar and essence as principal ingredients. Cake is a major baked product in the fast food industry and highlight of many celebrations. They are highly cherished by children and women. Chin-chin is a fried snack popular in West Africa. It is sweet, hard, donut-like baked

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or fried dough of wheat flour, eggs and other customary baking items (Akubor, 2004) and ground nutmeg can serve as flavouring agent. It is usually kneaded and cut into small squares of about one and a quarter of an inch thick before frying (Mepba *et al.,* 2007). The ban on importation of wheat into the country has contributed immensely to present high cost of these bakery and confectionary products. Partial or complete substitution of wheat flour with staple crops, fruit residues, unripe plantain flours in cookies, cake and chin-chin production could tremendously reduce their high cost posed by wheat importation (Morton and Satin, 2008). Research on cookies substituted with cashew apple residue by Ebere *et al.* (2015), cakes produced from the blends of wheat/unripe plantain flour enriched with Bambara groundnut protein concentrate by Kiin-Kabari and Banigo (2015), as well as chin-chin enriched with Moringa leaf powder by Emelike and Ebere (2016) were all reported to reduce the importation of wheat flour and to improve the nutritional quality of these baked products.

Cocoyam (*Colocasia esculenta*) is an herbaceous, monocotyledonous crop that belongs to the Araceae family (Purseglove, 2005). It constitutes one of the six most important roots and tuber crops worldwide (Ekanem and Osuji, 2006; Ndabikunze *et al.,* 2011). Cocoyam has some nutritional advantages over other root and tuber crops (Nnabuk *et al.,* 2012). It is fair in protein (7-9%), yam has less than 6% protein, cassava is a poor source of protein (<3%) while potatoes are poor in protein but fair in their supply of the B-vitamins. Cocoyam supplies easily digestible starch (Sefa-Dedeh and Sackey, 2002) and are known to contain substantial amounts of protein, vitamin C, thiamine, riboflavin, niacin and significant amounts of dietary fibre (Niba, 2003). They contain beta-carotene, iron and folic acid which protects against anaemia (FAO, 1990; and Sukamoto, 2003). It has been reported that cocoyam possesses the smallest starch grain-size relative to other roots and tubers; its starch is highly digestible because of the size of the starch granules (Lyonga and Nzietchueng, 2008). This makes cocoyam suitable for several food products for potentially allergic infants and persons with gastro-intestinal disorders as well as diabetic patients (Onyenobi *et al.,* 2010). The smallest starch molecules of cocoyam have been associated with increased digestibility over other crops, making it suitable for feeding pertinent, production of confectioneries and baby foods (Enech, 2013). The carbohydrate fraction of cocoyam consists of 2.6% pentosans which makes it a possible alternative for industrial pentosans used in confectionery (Ubalua and Chukwu, 2008). Despite the economic importance and nutritive value of cocoyam as a staple food, there is limited information on their post-harvest characteristics, very poor research attention to enhance its utility and production (Watanabe, 2002) in Nigeria and many other nations. Its industrial potential and contribution to food security has been under-estimated (Ekwe *et al.,* 2009) as it had been regarded as "poor man's food" or "women's crop". Recently, research efforts have been made by few scientists to improve the utility of cocoyam by producing gari from cocoyam and cassava tubers (Bamidele *et al.,* 2014), chin-chin with modified cocoyam starch and wheat (Falola *et al.,* 2014), as well as cake prepared from wheat and cocoyam flour blends (Yetunde and Chiemela, 2015).

In Nigeria, the demand for baked foods has been growing continually and there has been an increase in the reliance on imported wheat. Nigeria's climate and weather condition does not support the cultivation of wheat but produces staple crops like cocoyam which presently has limited application in the food industry. It would be beneficial to integrate the utilization of cocoyam on an industrial scale and also create varieties especially in the production of pastries and confectioneries. Therefore, the objective of this research is to process cocoyam flour and substitute levels of it to wheat flour in cake and chin-chin snacks' production. Then, analyse the effect of these substitution levels on the chemical, physical and sensory properties of the products.

MATERIALS AND METHOD

Materials

Cocoyam (*Colocasia esculenta*) tubers were purchased from mile 3 market in Diobu Area of Port Harcourt. Wheat flour and ingredients such as margarine, sugar, fresh eggs, salt, milk, flavours and sodium bicarbonate (baking powder) were purchased from Everyday Supermarket in GRA Phase I, Port Harcourt, Rivers State, Nigeria.

Methods

Production of Cocoyam Flour

The cocoyam tubers were sorted and carefully washed in running water and manually peeled using stainless steel knife. The peeled tubers were rewashed with distilled water and sliced into 0.5 cm thick. The slices were blanched at 75 ^{o}C for 15min in potable water. The slices were spread in an aluminium foil folded racks, transferred to an oven (Gallenkamp, England) and dried to a constant weight at 50 ^{o}C for 12 h. The dried cocoyam chips were dried milled into flour using FOSS, Cyclotec 1093, Sweden and sieved through a 50 mm micro particle size sieve to obtain smooth cocoyam flour. The flour was stored in an air-tight container and stored at 4 °C for further studies (Njintang *et al.,* 2008).

Formulation of Wheat/Cocoyam Composite Flour Blends

Composite flour was prepared by substituting wheat flour with cocoyam flour in the percentage proportion of 100:0, 90:10, 80:20, 70:30, 60:40 and 50:50% labelled A, B, C, D, E and F samples, respectively. Sample A with 0% cocoyam flour served as control. Kenwood mixer was used for mixing flour samples at speed 5 for 7 min to ensure uniformity.

Proportion of Ingredients for Cakes and Chin-Chin Preparation

The proportion of ingredients used consists of flour (200 g), margarine (125 g), sugar (50 g), salt (0.2 g), baking powder (2 g), nutmeg (0.2 g), milk (75 ml), 3 fresh eggs, vanilla essence (5 ml), water (30 ml) for chin-chin and without water for cakes.

Preparation of Cakes

Creaming method was used in the preparation of cakes by creaming margarine and sugar manually for 15 min in a stainless steel bowl until light and fluffy. Eggs were beaten for 3 min, milk and vanilla essence added. It was added to the creamed mixture gradually while beating continued. Composite flour blends were separately sieved together with salt, nutmeg and baking powder and gradually folded into the mixture with a metal spoon. The mixing continued until a soft consistency batter was formed. The batter was transferred to a six inch greased baking pan and baked in a preheated oven (Omega Dako, Model-Ms, 209) at 200 °C for 30 min and a further 20 min at a reduced temperature of 170 °C. A skewer was inserted into the cake centre to ascertain if it is cooked. When cooked, the caked were allowed to cool in the tin for 3 min before turning out on wire racks for further cooling and analysis (Ceserani and Kinton, 2008).

Preparation of Chin-Chin

The method of Akubor (2004) was used in the preparation of chin-chin with some modifications. The composite flour blends, sugar, margarine, egg, baking powder, nutmeg, milk and water were mixed together at appropriate rate in a large bowl. The dough was placed on a floured surface and kneaded until smooth and elastic. The kneaded dough was rolled out to approximately 1.5 cm thick and cut into small squares of 1.5 by 1.5 cm in size. Vegetable oil (Corn oil) was put inside a deep fryer (MC 1800 model) and allowed to hot enough until the temperature of fryer reached 180 °C. The dough cubes were placed in the hot oil and the chin-chin was deep fried for 8min until golden brown. The fried chin-chin was removed and drains off excess oil, package and stored at room temperature (28±2 °C) for analysis.

Chemical Composition

The Chemical composition of cakes and chin-chin samples were analysed for moisture, ash, protein, crude fibre and fat using the Standard Assay method as described by AOAC (2012). Total carbohydrate was determined using the Anthrone reagent method as reported by Osborne and Voogt (1978).

Physical Properties of Wheat/Cocoyam Flour Blends and Cake

The physical parameters measured include bulk density of the flour blends, batter density, cake weight, cake volume and cake volume index. Bulk density of the wheat/cocoyam flour blends were determined by the method described by Narayana and Narasinga-Rao (1982). A calibrated centrifuge was weighed and samples were filled to 5 ml by constant tapping until there was no further change in volume. The content was weighed and from the difference in weight, the bulk density of the sample was calculated. Batter density was determined as the ratio of the weight of a standard container filled with batter to that of the same container filled with water (density, 1 g/cm^3). The weight of the cake samples were determined by the weight measurement using the digital electronic balance (Model HL250 AZ and Coy Ltd., Korea). Cake volume was calculated using the cone equation such as; cake volume (cm^3) = πh (d^{2} + db + b^2); where d and b are upper and lower diameters of cake. The volume index of the cake samples were measured using AACC template method (AACC, 2000). Cake was cut vertically through the center and the height of the cake measured at three difference points (A, B and C) along the cross-sectioned cake using the template. Volume index = A + B + C; Where B = height of the cake at the centre points, A and C = height of the cake at points 2.5 cm away from the centre towards the left and right sides of the cake, respectively.

Sensory Evaluation

Sensory evaluation of the cakes and chin-chin samples were conducted after baking and frying using the method described by Giami and Barber (2004) for fluted pumpkin cookies with some modifications. A panel of twenty consumers comprising of staff and student from Department of Food Science and Technology, Rivers State University of Science and Technology, Port Harcourt, Nigeria was used. Criteria for selection was that panelist were 18 years of age, regular consumers of cakes and chin-chin and were neither sick nor allergic to any food. They were trained in the use of sensory evaluation procedures. Samples were served on white disposable plates at each session, properly coded with 3-digit random numbers to prevent bias. The organoleptic attributes such as; taste, appearance, texture, flavour and overall acceptability of cakes and chin-chin were evaluated using a 9-point hedonic scale as described by Iwe (2010), where 9 denote extremely desirable and 1 denote extremely undesirable. Necessary precautions were taken to prevent transfer of flavour during the analysis by ensuring that panelist rinse their mouth with potable water after each evaluation.

Statistical Analysis

Analyses were done in triplicate and all data obtained were subjected to Analysis of Variance (ANOVA) using Statistical Package for Social Science (SPSS) version 20.0 software 2011. Duncan's New Multiple Range test was used to identify significant difference at 5% probability according to the method described by Wahua (1999).

RESULTS AND DISCUSSION

Chemical Composition of the Composite Cakes

The substitution of wheat with cocoyam flour in cake production increased the moisture content of the product from 28.83-35.10% (samples A and F, respectively) and showed no significant difference ($p<0.05$) in all the wheat/cocoyam composite flour cakes while sample A with 100% wheat flour had significantly lower moisture as presented in Table 1. This is in agreement with the report of Yetunde and Chiemela (2015) who observed an increase in moisture content of cakes produced from wheat/cocoyam flour blends. Ash and crude fibre values were equally observed to increase at increasing levels of cocoyam flour substitution with a range of 1.49-1.70% and 1.10-1.33%, respectively and showed no significant difference in all the samples. The high crude fibre of the composite cakes may be attributed to high crude fibre content of cocoyam flour than wheat flour (Ikpeme *et al.*, 2010). Kiin-Kabari and Banigo (2015) reported the same increase in ash and crude fibre values of cakes produced from wheat/plantain/Bambara groundnut composite flour blends. Ebere *et al.* (2015) equally reported significantly higher ash and crude fibre of cookies with added levels of cashew-apple residue compared to those from 100% wheat flour. This is an indication that our Nigerian local materials contains high ash and crude fibre than the imported wheat and they can be used to replace or substitute wheat flour in the production of snacks to reduce the importation of wheat flour into Nigeria, as well as used as a functional ingredients. The increase in crude fibre equally agreed with the literature stated by Niba (2003) that cocoyam contains a significant amount of dietary fibre. Protein content of cakes with substitution level up to 20% cocoyam flour compared significantly with cakes produced from 100% wheat flour. Yetunde and Chiemela (2015) also reported no significant difference between cakes produced from 100% wheat flour and those substituted with 20% cocoyam flour. Significantly higher ($p<0.05$) fat value (13.91%) was observed in cakes produced with 100% wheat flour compared to those substituted with levels of cocoyam flour.

Table 1: Chemical Composition of Composite Flour Blends Cakes

Samples	Moisture (%)	Ash (%)	Protein (%)	Crude Fibre (%)	Fat (%)	Carbohydrate (%)
A	28.83 ± 0.04^{b}	1.43 ± 0.01^{a}	16.19 ± 0.02^{a}	1.10 ± 0.01^{a}	13.91 ± 0.01^{a}	37.36 ± 0.01^{a}
B	30.72 ± 0.03^{a}	1.55 ± 0.01^{a}	16.17 ± 0.01^{a}	1.13 ± 0.01^{a}	11.53 ± 0.03^{b}	34.82 ± 0.04^{a}
C	32.17 ± 0.09^{a}	1.58 ± 0.01^{a}	15.97 ± 0.03^{a}	1.17 ± 0.22^{a}	11.46 ± 0.02^{b}	33.90 ± 0.05^{a}
D	33.23 ± 0.04^{a}	1.60 ± 0.01^{a}	15.09 ± 0.03^{b}	1.21 ± 0.04^{a}	10.41 ± 0.01^{c}	32.52 ± 0.06^{a}
E	34.06 ± 0.06^{a}	1.62 ± 0.01^{a}	12.31 ± 0.01^{c}	1.28 ± 0.02^{a}	10.37 ± 0.02^{c}	31.32 ± 0.08^{a}
F	35.10 ± 0.14^{a}	1.70 ± 0.01^{a}	9.64 ± 0.02^{d}	1.33 ± 0.01^{a}	12.27 ± 0.03^{c}	28.70 ± 0.18^{b}

Note: $^{a, b, c, d}$ Means with different superscripts in the same column are significantly different at 5% level of probability. ± = Standard Deviation of duplicate readings. **Keys:** Sample A = Wheat/Cocoyam (100:0), B (90:10), C (80:20), D (70:30), E (60:40), F (50:50).

There was a gradual reduction in fat content of cakes as substitution of cocoyam flour blends increased with a range of 11.53-10.27% for samples B and F, respectively with no significant difference between samples A and B, as well as D, E and F samples. Carbohydrate values of cakes with substitution levels of cocoyam flour up to 40% compared favourably with cakes produced with 100% wheat flour, though a decrease was observed as substitution levels increased.

Physical Properties of wheat/Cocoyam Flour Blends and the Cake

The observed increase in batter density and cake weight with increasing levels of cocoyam flour in the blends may be attributed to increasing bulk density of the flour blends as presented in Table 2. Chinma and Gernah (2007) reported that weight of snack products are related to the bulk density of the flour blends. The higher cake volume and cake volume index of sample A (100% wheat cake) than the composite blends (samples B-F) may be attributed to the level of gluten in the wheat flour. Gluten in wheat flour is responsible for gas retention during dough development and baking. Akubor and Ukwuru (2003) and Chinma *et al.* (2012) reported improvement in the physical and sensory properties of baked products due to level of gluten in composite flour which makes dough to become extensive and strong, thereby allowing the dough to rise and prevent easy escape of carbon dioxide (CO_2) gas during baking. Thus, as the level of cocoyam substitution increases in the composite flour, the cake volume and cake volume index decreased significantly.

Sensory Evaluation of Cakes

From the sensory analysis, cakes produced with 100% wheat flour had significantly higher ($p<0.05$) preference in all the attributes analysed, though the values obtained from cakes produced with wheat/cocoyam composite flour blends showed that the produced cakes were acceptable by the panelists as shown in Table 3. An increase in sensory preference of taste, appearance, texture, flavour and overall acceptability were observed up to 30% cocoyam flour substitution to wheat flour. This is an indication that acceptable cakes can be produce with up to 70:30 of wheat/cocoyam composite flour blends, thereby reducing the usage of wheat flour by 30% in cake production. The result of Yetunde and Chiemela (2015) showed that 50% cocoyam flour can be used to produce acceptable cakes. The reduction in the acceptability of cocoyam flour substituted cakes in this study and that reported these researchers could be associated with geographical location to which the analysis was conducted.

Proximate Composition of Chin-Chin

From the analysis, it was observed that the moisture content of the chin-chin samples decreased at an increasing substitution of cocoyam to wheat flour with a range of 6.75% (sample F) to 11.65% (sample A) with no significant difference ($p<0.05$) between samples A, B and C while significant difference existed in other samples as presented in Table 4. Sanni *et al.* (2006) reported that lower the moisture content of a product to be stored, the better the shelf stability of such products. This is in indication that cocoyam flour has higher shelf stability than wheat flour. Hence, 50% substitution of cocoyam to wheat flour will be effective in

Table 2: Physical Properties of Wheat/Cocoyam Flour Blends and the Cake

Samples	Bulk Density of Flour Blends (%)	Batter Density (%)	Cake Weight (g)	Cake Volume (cm^3)	Cake Volume Index
A	0.65^f	0.75^f	35.65^f	261.45^a	115.72^a
B	0.70^e	0.79^e	36.72^e	258.71^b	113.43^b
C	0.78^d	0.84^d	37.34^d	251.82^c	110.72^c
D	0.84^c	0.89^c	38.92^c	246.54^d	106.64^d
E	0.89^b	0.92^b	40.62^b	238.67^e	103.41^e
F	0.93^a	0.96^a	42.21^a	235.28^f	100.25^f

Note: [a, b, c, d, e, f] Means with different superscripts in the same column are significantly different at 5% level of probability. Results are means of duplicate reading. **Keys:** Sample A = Wheat/Cocoyam (100:0), B (90:10), C (80:20), D (70:30), E (60:40), F (50:50).

Table 3: Sensory Evaluation of Composite Flour Blends Cakes

Samples	Taste	Appearance	Texture	Flavour	Overall Acceptability
A	7.90[a]	7.50[a]	7.10[a]	7.50[a]	8.05[a]
B	5.50[b]	5.30[b]	5.50[b]	5.45[b]	6.25[b]
C	6.00[b]	5.90[b]	5.55[b]	5.70[b]	6.75[b]
D	6.10[b]	5.90[b]	5.60[b]	5.80[b]	6.80[b]
E	5.55[c]	4.30[c]	5.10[b]	5.45[b]	5.65[c]
F	5.50[c]	4.25[c]	4.95[b]	5.30[b]	5.40[c]
LSD	0.53	0.68	1.46	0.65	0.61

Note: [a, b, c] Means with different superscripts in the same column are significantly different at 5% level of probability. ± = Standard Deviation of duplicate readings. **Keys:** Sample A = Wheat/Cocoyam (100:0), B (90:10), C (80:20), D (70:30), E (60:40), F (50:50).

the production of chin-chin with high shelf stability. The moisture content of all the chin-chin samples are rightly below 14% as Smith (1972) established that moisture content of dry pastry products should not exceed 14%. Increased in cocoyam flour substitution was observed to increase the ash content of the chin-chin samples by 1% with no significant difference ($p<0.05$) in the composite flour chin-chin products. Significantly lower ash was observed in sample A with 100% wheat flour. This observation is in agreement with the observation of Falola *et al.,* (2014) who reported that chin-chin produced from 100% wheat flour with the lowest ash content compared to those with cocoyam flour substitution. They further state that ash content is an indication of a rough estimation of the mineral values of products. Crude fibre of the chin-chin samples increased at increasing levels of cocoyam flour substitution and got to its peak at 40% cocoyam flour substitution with a range of 1.10-4.35% (samples A and E, respectively) and a significant difference ($p<0.05$) was recorded in all the samples except samples D and F. Falola *et al.* (2014) equally reported that crude fibre of chin-chin increased at increased levels of substitution of cocoyam to wheat flour. Carbohydrate values of the chin-chin ranged from 42.86% (sample A) to 49.04% (sample F) with no significant difference in all the samples. This may be attributed to higher starch content of the cocoyam flour to wheat flour. The high values of crude fibre and carbohydrate observed in composite flour chin-chin is an indication that cocoyam contain higher digestible starch and fibre than wheat flour. Cocoyam flour was observed to effect the protein content of the chin-chin samples negatively as levels of substitution increased with a range of 9.99-15.57% for F and A samples, respectively, with significant differences at 5% level of probability. This may be due to the gluten content of wheat flour which is an

Table 4: Proximate Composition of Composite Flour Blends Chin-Chin

Samples	Moisture (%)	Ash (%)	Protein (%)	Crude Fibre (%)	Fat (%)	Carbohydrate (%)
A	11.65±0.07[a]	1.46±0.02[b]	15.57±0.03[a]	1.10±0.01[e]	25.87±0.01[e]	42.86±0.14[a]
B	11.40±0.14[a]	1.75±0.03[a]	14.13±0.01[b]	1.49±0.01[d]	28.28±0.03[d]	43.75±0.23[a]
C	11.25±0.21[a]	1.76±0.01[a]	14.07±0.05[b]	2.33±0.04[c]	31.39±0.01[b]	47.80±0.19[a]
D	10.38±0.04[b]	1.77±0.03[a]	11.86±0.06[c]	3.12±0.05[b]	35.15±0.21[a]	48.98±0.39[a]
E	8.46±0.03[c]	1.78±0.01[a]	10.82±0.03[d]	4.35±0.07[a]	36.28±0.04[a]	48.71±0.12[a]
F	6.75±0.21[d]	1.79±0.01[a]	9.99±0.01[e]	3.05±0.06[b]	37.59±0.02[a]	49.04±0.11[a]

Note: [a, b, c, d, e] Means with different superscripts in the same column are significantly different at 5% level of probability. ± = Standard Deviation of duplicate readings. **Keys:** Sample A = Wheat/Cocoyam (100:0), B (90:10), C (80:20), D (70:30), E (60:40), F (50:50).

Table 5: Sensory Evaluation of Composite Flour Blends Chin-Chin

Samples	Taste	Appearance	Texture	Flavour	Overall Acceptability
A	7.15[a]	7.30[a]	6.90[a]	7.10[a]	7.80[a]
B	6.30[b]	6.75[b]	6.40[a]	6.45[b]	6.90[b]
C	6.70[b]	5.60[c]	5.85[b]	6.25[b]	6.40[b]
D	6.85[b]	5.50[c]	5.95[b]	5.55[c]	6.40[b]
E	6.40[b]	4.95[d]	6.05[b]	5.90[c]	6.95[b]
F	6.95[b]	4.75[d]	5.55[c]	5.65[c]	6.45[b]
LSD	0.63	0.54	0.55	0.56	0.52

Note: [a, b, c, d] Means with different superscripts in the same column are significantly different at 5% level of probability. ± = Standard Deviation of duplicate readings. **Keys:** Sample A = Wheat/Cocoyam (100:0), B (90:10), C (80:20), D (70:30), E (60:40), F (50:50).

indication of protein value of wheat which is lacking in cocoyam flour. Researchers who equally reported a decreased in protein content of products from wheat/ cocoyam composite flour blends are Asumugha and Uwalaka (2000) for cookies, Falola *et al.* (2014) for chin-chin, as well as Yetunde and Chiemela (2015) for cakes.

Sensory Evaluation of Chin-Chin

The sensory result indicated that 100% wheat flour chin-chin obtained the highest likeness values in all the analysed attributes with the values of 7.15, 7.30, 6.90, 7.10 and 7.80 for taste, appearance, texture, flavour and overall acceptability, respectively as shown in Table 5. This is in agreement with the report of Falola *et al.* (2014) who equally observed highest likeness in all the attributes of chin-chin produced from 100% wheat flour compared to those with cocoyam flour substitution. There was no significant difference ($p<0.05$) in the taste of all the composite flour chin-chin samples. This is an evident that cocoyam flour did not significantly affect the taste of the product. The appearance of the chin-chin samples were observed to decreased at an increasing levels of cocoyam flour substitution. There was no significant difference between samples A and B in terms of the texture of the chin-chin. This showed that only 10% level of substitution were able to compare favourably with the texture of the control chin-chin sample. Products from 50% level of substitution had significantly lower ($p<0.05$) texture while there was no significant difference between C, D and E samples. The flavour of the chin-chin was retained up to 20% level of substitution with the values of 6.45 and 6.25 (B and C samples), respectively. The flavour of the chin-chin was observed to increase from 30% substitution level with no significant difference between samples D, E and F with the values of 5.55, 5.90 and 5.65, respectively. There was no significant difference in all composite flour chin-chin in terms of the overall acceptability with a range of 6.40-6.95 on a 9-point hedonic scale. This therefore indicated that all the chin-chin samples were accepted by the panelists.

CONCLUSION

Cocoyam flour was observed to improve the crude fibre and ash content of the produced cakes and chin-chin up to 50% level of substitution. This is an indication that cocoyam flour can serve as a functional ingredient in the formulation of food products for diabetic patients. Carbohydrate value was observed to decrease in cakes while it was increased in the composite flour chin-chin samples. Bulk density of the flour blends, batter density and cake weight was observed to increase at increasing levels of substitution while a decrease was observed in cake volume and cake volume index. The overall acceptability of the products showed that cakes were acceptable by the panelists up to 30% while chin-chin up to 50% level of cocoyam flour substitution.

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