Annals. Food Science and Technology
2016

INVESTIGATING THE EFFECTS OF SPROUTING ON QUALITY ATTRIBUTES OF COCOYAM FLOUR AND ITS PERFORMANCE AS COMPOSITE OF WHEAT IN BREAD PRODUCTION

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Abstract
This study was focused on investigating the effects of sprouting on the functional and antinutritional properties of cocoyam flour. The performance of incorporating unsprouted cocoyam flour (UCF) and sprouted cocoyam flour (SCF) in wheat flour during production of bread was also investigated. Percentage substitutions of 5, 10, 15 and 20 of each UCF and SCF were used in wheat flour to produce composite breads, coded as UC5B, UC10B, UC15B, UC20B, SC5B, SC10B, SC15B and SC20B respectively. Bread made from whole wheat flour without incorporating UCF or SCF served as control (WWB). Results of the functional properties indicated percentage increases of 28.26, 2.21, 71.14, 39.10, 156.49, 32.01 and 11.89 in bulk density, water absorption capacity, oil absorption capacity, emulsification capacity, wet-ability, gelation capacity and gelation temperature in SCF over the UCF. Antinutritional properties, however recorded percentage reductions of 23.86, 1.69, 8.77, 30.08, 9.52 and 26.38 in SCF over the UCF. Analysis of the proximate composition of the bread samples showed enhancement in ash content of sample containing 5% SCF substitution in wheat, having the highest value of 1.53%. Result of sensory evaluation showed that although the WWB had higher scores than others, it did not differ significantly (p>0.05) from many of those containing cocoyam flour in the sensory attributes crust, taste, aroma and general acceptability. The study concluded that sprouting of cocoyam had significant and desirable influence on the functional and antinutritional properties of cocoyam flour. Acceptable bread could be produced from sprouted and unsprouted cocoyam flour.

Keywords: sprouting; functional and antinutritional properties; sprouted cocoyam flour; unsprouted cocoyam flour; sensory evaluation

Submitted: 16.01.2016 Reviewed: 04.04.2016 Accepted: 30.05.2016

1. INTRODUCTION

Composite flours are usually obtained from mixtures of two or more vegetable flours (Olaoye and Ade-Omowaye, 2011). They can be used in the making of many food products, especially baked products such as bread and biscuits, where vegetable flours are partially substituted in wheat flour for economic reasons. In Nigeria, bread is an important stable food which consumption is steady and increasing; however, bread is relatively expensive due to its exclusive production from wheat flour. Wheat is not cultivated in the tropics for climatic reasons and this factor makes wheat flour very expensive in comparison with other vegetable flour (Edema *et al*., 2005). Research efforts in promoting the use of composite flours in which flour from locally grown crops and high protein seeds replace a portion of wheat flour for use in bread are on the increase in many tropical countries of Africa. This could help decrease the demand for imported wheat and produce protein enriched bread (Olaoye and Ade-Omowaye, 2011). It should however be noted that such composite bread technology would still require 70 percent wheat flour for effective rising of dough (Eggleston et al., 1992).
Cocoyam (*Xanthosoma sagittifolium*) is a tropical root tuber, belonging to the Araceae family (Bede et al., 2013). It is grown in Nigeria and in many other parts of the tropics and sub-tropics of Africa (Sefa-Dedah and Agyir-Sackey, 2004).
In Nigeria, and many parts of West Africa, cocoyam tubers are commonly eaten boiled, roasted, pounded and sometimes mixed with other staples such as yam, cassava or plantain.

According to FAO (1991), the estimated world production of cocoyam has been estimated at 5.5 million tons annually, with Ghana and Nigeria being considered as the world's leading producers (Sefa-Dedah and Agyir-Sackey, 2004). Cocoyam is nutritionally superior to other roots and tubers in terms of digestible crude protein and minerals (Olayiwola et al., 2012). The crop has also been noted to possess the smaller starch grain size than other root crops and tubers, making cocoyam a suitable food for certain individuals with particular ailments (Bede, 2013).

In Nigeria, many challenges are usually associated with post-harvest storage and processing of cocoyam, making it vulnerable to losses. Such challenges include poor availability of storage and processing facilities.

According to Olayemi et al. (2012), 20-40% losses of cocoyam occur during post- harvest storage. Some research efforts that could be made in limiting such losses may include processing of cocoyam into flour for use as composite with other flours, especially wheat, in the production of baked food products such as bread.

Such practice may help promote utilization of cocoyam and save foreign exchange involved in importation of wheat flour. The present study therefore aimed at using sprouted and unsprouted cocoyam flours as composite of wheat flour in the production of bread.

2. MATERIALS AND METHODS

Source of Material

Ede ocha species type of cocoyam tubers (*Xanthosoma sagittifolium*) were obtained from National Root Crops Research Institute, Umudike, Abia State, Nigeria, for use in this study. The tubers were transported to the food processing laboratory in the Department of Food Science and Technology, Michael Okpara University of Agriculture, Abia State, Nigeria, for immediate use.

Sprouting of cocoyam tubers

This was carried out using the modified methods of Moran (2007) and Sanful and Darko (2010). The cocoyam tubers were sorted to remove defective parts and then soaked in clean water for 10 min. The tubers were removed from the water and kept in moistened traditional jute sacks for 3-5 days at room temperature (25-28^{o}C). The sprouted cocoyam tubers were harvested and then processed into flour.

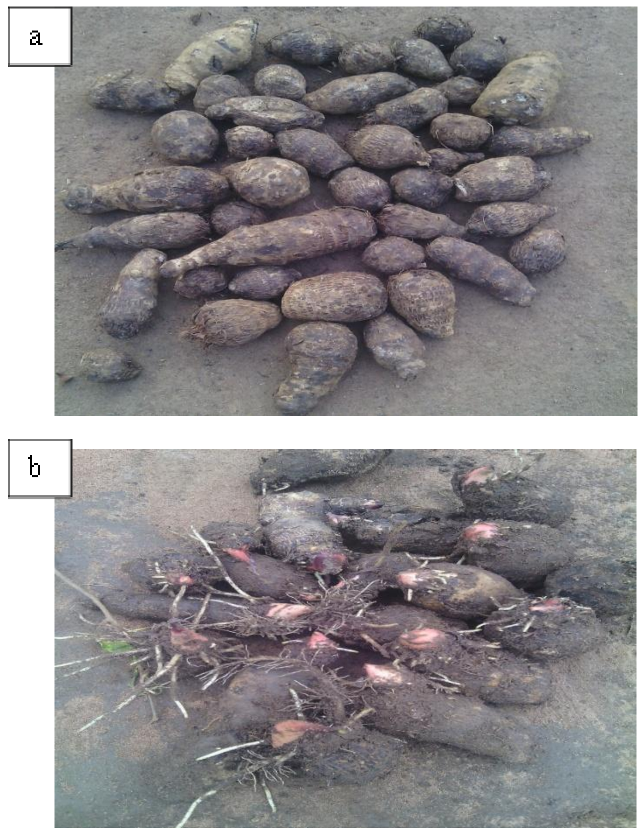

Figure 1 Unsprouted (a) and sprouted (b) cocoyam tubers.

Processing of sprouted and unsprouted cocoyam tubers into flour

The unsprouted and sprouted cocoyam tubers (Figures 1a and 1b) were peeled and thoroughly washed with clean water. They were cut into thin slices (0.5 x 3.5 x 5 mm) and then dried in air drying oven (Gallenkamp, USA) at 65^{o}C for 24-36 h. The dried cocoyam slices were milled using hammer mill machine (tiger-extruda 6.5 hp, UK) and sieved (using 0.02 µm mess size sieves) to obtain unsprouted and sprouted cocoyam flour.

Determination of functional properties of the unsprouted and sprouted cacoyam flours

Water absorption capacity and bulk density were determined using the respective methods of Mbofung et al. (2006) and Wang and Kinsella (1976). Foaming capacity and gelation capacity were determined by methods of Okezie and Bello (1988) and Abulude (2001) respectively.

Oil absorption capacity of the flour blends was determined using the following method of Sathe et al. (1981). A quantity of the flour (2 g) was mixed with 20 ml of oil in a Moulinex blender (Model dePC 3, France) at high speed for 30 sec. The sample was allowed to stand at 30°C for 30 min and then centrifriged at 10,000 rpm for 30 min. The volume of supernatant in a graduated cylinder was noted. Density of oil was determined to be 0.93 g/ml. Swelling index was determined using the method of Tharise et al. (2014). All determinations were carried out in triplicates.

Determination of antinutritional properties in unsprouted and sprouted cocoyam flours

Polyphenols were determined according to the Prussian blue spectrophotometric method (Price and Bulter, 1977) with little modification. Three milliliters of methanol was added to 60 mg of flour sample in test tube and was shaken manually for 1 min. The mixture was then filtered using a filter paper (Whatman No. 1). The filtrate was mixed with 50 ml distilled water and analyzed at 50 min. About 3.0 ml solution of 0.1 M $FeCl_3$ in 0.1 M HCl was added to 1.0 ml of filtrate, followed by addition of 3.0 ml freshly prepared $K_3Fe(CN)_6$. The solution was gently shaken and allowed to stand for 3 min, after which the absorbance was monitored on a spectrophotometer (Pye Unicam SP6-550 UV, London, UK) at 720 nm. A standard curve was obtained, expressing the result as tannic acid equivalents - the amount of tannic acid (mg/100 g) that gives a color intensity equivalent to that given by polyphenols after correction by blank sample.

Trypsin inhibitor and α-amylase activities were determined according to the methods of AOAC (2005).

Oxalate determination was carried out using the method of Leyva et al. (1990).

Production of bread from blends of unsprouted/sprouted cocoyam and wheat flours

The different flour blends used in the production of bread samples are shown in Table 1. Other ingredients used along with the flour blends were fat, sugar, baking powder, salt, eggs, milk powder, nutmeg and water.

The method of AACC (1984) was used for production of bread from the different flour blends, involving a bulk fermentation process. A quantity (200 g) each of the flour samples was weighed and addition of required amount of water was done to obtain dough; this was kneaded on a pastry-board to smoothen.

The dough was initially fermented for 2 h at 30^{o}C before subsequently kneaded to expel carbon dioxide and then tighten-up the dough to ensure improvement in the textural properties of the product (bread).

The dough was sized and moulded into the baking pans for final proofing at 30^{o}C for 2 h. Baking of the dough was carried out in a forced air convection electric oven (380V, ROHS Deck Baking Oven, Hangzhou 311121, China) at 230^{o}C for 30 min.

Determination of physical characteristics of bread samples

The height (cm), weight (g), width (cm) and length (cm) of each bread sample were determined using laboratory metric ruler and weighing balance. Determinations were carried out in replicates.

Table 1 Different blends of sprouted, unsprouted cocoyam and wheat flours used for bread production

Blends	Wheat flour (%)	Sprouted cocoyam flour (%)	Unsprouted cocoyam flour (%)
WWF	100	-	-
UC5WF95	95	-	5
UC10WF90	90	-	10
UC15WF85	85	-	15
UC20WF80	80	-	20
SC5WF95	95	5	-
SC20WF80	90	10	-
SC15WF85	85	15	-
SC10WF90	80	20	-

WWF, whole wheat flour; UC5WF95, 5% unsprouted cocoyam flour and 95% wheat flour; UC10WF90, 10% unsprouted cocoyam flour and 90% wheat flour; UC15WF85, 15% unsprouted cocoyam flour and 85% wheat flour; UC20WF80, 20% unsprouted cocoyam flour and 80% wheat flour; SC5WF95, 5% sprouted cocoyam flour and 95% wheat flour; SC10WF90, 10% sprouted cocoyam flour and 90% wheat flour; SC15WF85, 15% sprouted cocoyam flour and 85% wheat flour; SC20WF80, 20% sprouted cocoyam flour and 80% wheat flour

Analysis of proximate composition of bread samples

Proximate analysis of moisture, ash, fat, and protein contents of the different bread samples were determined using the methods of Association of Official Analytical Chemists (AOAC, 2005). Carbohydrate was determined by difference.

Sensory evaluation of the bread samples

The bread samples produced from the flour blends of unsprouted/sprouted cocoyam and wheat were subjected to sensory evaluation for the attributes of appearance, crumb, crust, taste, aroma and general acceptability. A fifty semi trained member panel was used, and scores were allocated by the panelists based on a 9-point hedonic scale, ranging from 1 (dislike extremely) to 9 (like extremely).

The data collected were subjected to statistical analysis to determine possible differences among samples.

Statistical analysis

The effect of incorporation of usprouted/ sprouted cocoyam flour in wheat on the breads produced from them were analyzed by subjecting the data obtained to analysis of variance (ANOVA) using the statistic software, Design expert (Stat-Ease Inc., East Hennepin Ave, Minneapolis, Version 6.0.6).

Significant differences were determined at $p < 0.05$.

3. RESULTS AND DISCUSSION

Sprouting of cocoyam tubers was observed to have significant effects ($p<0.05$) on most of the functional properties of the cocoyam flours (Table 2).

The sprouted cocoyam flour may thus have advantage over the unsprouted counterpart due to its higher values recorded in most of the functional properties.

A study carried out by Bede *et al.* (2013) on the effect of sprouting on some physicochemical properties of cocoyam flour were similar observation in the property of gelation temperature to those obtained in the present study, where increase was recorded in the sprouted cocoyam flour over the unsprouted counterpart.

Table 2 Functional properties of sprouted and unsprouted cocoyam flour

Samples	BD (%)	WAC (g/ml)	OAC (g/ml)	EC (%)	WA (%)	GC (%)	GT (°C)	SI (%)
UCF	0.46^b±0.01	4.53^b±0.12	4.40^a±0.10	40.33^b±0.58	11.10^b±0.10	3.03^b±0.01	61.67^b±0.58	10.60^a±0.10
SCF	0.59^a±0.01	4.63^a±0.12	7.53^a±0.12	56.10^a±0.10	28.47^a±0.06	4.00^a±0.00	69.00^a±0.00	10.37^a±0.06
% RD	-	-	-	-	-	-	-	2.17
% IC	28.26	2.21	71.14	39.10	156.49	32.01	11.89	-

Values are means of replicated samples. Means with different superscript letters across columns are significantly different ($p<0.05$). UCF, unsprouted cocoyam flour; SCF, sprouted cocoyam flour; BD, bulk density; WAC, water absorption capacity; OAC, oil absorption capacity; EC, emulsification capacity; WA, wet-ability; GC, gelation capacity; GT, gelation temperature; SI, swelling index; % RD, percentage reduction; % IC, percentage increase.

Table 3 Antinutritional properties of sprouted and unsprouted cocoyam flour

Samples	Oxalates (mg/100g)	Tannins (mg/100g)	Phytates (mg/100g)	Trypsin inhibitor (mg/100g)	α –amylase inhibitor (U/g)	Polyphenols (mg/g)
UCF	2.64^a±0.01	1.18^a±0.10	1.14^a±0.01	1.23^a±0.62	0.21^a±0.09	2.35^a±0.91
SCF	2.01^b±0.01	1.16^a±0.01	1.04^a±0.02	0.86^b±0.17	0.19^a±0.03	1.73^b±0.25
% RD	23.86	1.69	8.77	30.08	9.52	26.38
% IC	-	-	-	-	-	-

Values are means of replicated samples. Means with different superscript letters across columns are significantly different ($p<0.05$). UCF, unsprouted cocoyam flour; SCF, sprouted cocoyam flour; % RD, percentage reduction; % IC, percentage increase

Results of the antinutritional properties of the UCF and SCF indicate that sprouting resulted in decrease in most of the properties (Table 3). Values of oxalates (2.01 mg/100g), tannins (1.16 mg/100g), phytates (1.04 mg/100g), trypsin inhibitor (0.86 mg/100g), α –amylase inhibitor
(0.19 U/g) and polyphenols (1.73 mg/g) were recorded for SCF while 2.64, 1.18, 1.14, 1.23, 0.21 and 2.35 were obtained for the UCF. This indicates that sprouting of cocoyam resulted in flour with reduced antinutritional factors. Antinutrients are undesirable in foods as they tend to form complexes with certain components and render them unavailable for assimilation in the body (Olaoye et al., 2015). For example, phytates and oxalates usually form insoluble salts with mineral elements such as zinc, calcium and iron to prevent their utilization in the body (Sarkiyayi and Agar, 2010). The ability of tannins to form complex with protein, thereby making it nutritionally unavailable, has also been noted (Reed et al., 1985).

The lower values of antinutrients recorded in the SCF than UCF may be very advantageous when the flour is used in production of food products, especially baked products. This is because of the adverse effects known to be associated with antinutrients.

The physical characteristics of the bread samples that were determined are presented in Table 4.

The heights (cm) ranged between 4.2 and 5.8, with the UC20B (bread from 20% unsprouted cocoyam flour and 80% wheat flour) and WWB (bread from whole wheat flour) having the lowest and highest values respectively.

Table 4 Physical characteristics of the bread samples

Bread samples	Height (cm)	Weight (g)	Width (cm)	Length (cm)
WWB	5.8^{a}±1.20	245^{c}±12.2	7.4^{a}±0.92	14.0^{a}±3.08
UC5B	5.2^{ab}±0.72	257^{c}±18.2	7.3^{a}±1.28	13.4^{ba}±3.28
UC10B	5.1^{ab}±0.04	257^{c}±25.5	6.9^{ab}±0.28	14.0^{a}±3.22
UC15B	4.7^{b}±0.86	259^{c}±64.5	6.5^{b}±2.10	13.6^{a}±2.17
UC20B	4.2^{b}±0.07	282^{ab}±23.3	6.2^{b}±1.28	12.8^{b}±0.82
SC5B	5.3^{ab}±1.02	270^{b}±25.5	7.0^{a}±2.14	13.7^{a}±3.26
SC10B	5.0^{ab}±0.09	297^{a}±23.31	7.2^{a}±3.25	13.2^{ab}±1.43
SC15B	4.6^{b}±0.71	264^{b}±34.2	6.7^{ba}±0.76	12.6^{b}±0.55
SC20B	4.8^{b}±1.02	274^{b}±10.2	6.8^{ba}±2.1	12.8^{b}±5.21

Values are means of replicated samples. Means with different superscript letters across columns are significantly different ($p<0.05$).

WWB, bread from whole wheat flour; UC5B, bread from 5% unsprouted cocoyam flour and 95% wheat flour; UC10B, bread from 10% unsprouted cocoyam flour and 90% wheat flour; UC15B, bread from 15% unsprouted cocoyam flour and 85% wheat flour; UC20B, bread from 20% unsprouted cocoyam flour and 80% wheat flour; SC5B, bread from 5% sprouted cocoyam flour and 95% wheat flour; SC10B, bread from 10% sprouted cocoyam flour and 90% wheat flour; SC15B, bread from 15% sprouted cocoyam flour and 85% wheat flour; SC20B, bread from 20% sprouted cocoyam flour and 80% wheat flour

Table 5 Proximate composition (%) of the bread samples

Bread samples	Moisture	Ash	Crude fibre	Protein	Fat	Carbohydrate
WWB	20.73^{b}±0.06	1.18^{b}±0.07	1.18^{a}±0.21	11.37^{a}±0.30	0.73^{e}±0.14	64.71^{a}±0.06
UC5B	26.37^{a}±0.06	1.41^{a}±0.22	0.86^{b}±0.14	6.01^{c}±0.18	1.92^{a}±0.13	63.44^{a}±1.28
UC10B	24.07^{ab}±0.06	1.36^{d}±0.14	0.92^{b}±0.17	10.26^{b}±0.06	1.42^{b}±0.71	62.01^{b}±0.80
UC15B	23.30^{b}±0.10	1.30^{b}±0.45	0.99^{b}±0.11	11.20^{a}±0.52	0.98^{c}±0.14	62.34^{b}±0.11
UC20B	22.57^{b}±0.06	1.24^{b}±0.28	1.24^{a}±0.18	11.27^{a}±0.21	0.86^{d}±0.17	62.82^{b}±0.07
SC5B	21.33^{b}±0.06	1.53^{a}±0.11	1.21^{a}±0.19	11.30^{a}±0.34	0.68^{e}±0.19	63.94^{a}±0.04
SC10B	22.53^{b}±0.06	1.45^{a}±0.12	1.02^{b}±0.22	11.02^{b}±0.20	0.98^{c}±0.17	63.01^{a}±0.05
SC15B	23.67^{b}±0.06	1.40^{a}±0.14	0.90^{b}±0.17	10.11^{b}±0.01	1.35^{b}±0.11	62.54^{b} ±0.23
SC20B	24.27^{ab}±0.06	1.31^{b}±0.16	0.83^{b}±0.01	6.96^{c}±0.01	1.88^{a}±0.01	64.75^{a}±0.09

Values are means of replicated samples. Means with different superscript letters across columns are significantly different ($p<0.05$).

WWB, bread from whole wheat flour; UC5B, bread from 5% unsprouted cocoyam flour and 95% wheat flour; UC10B, bread from 10% unsprouted cocoyam flour and 90% wheat flour; UC15B, bread from 15% unsprouted cocoyam flour and 85% wheat flour; UC20B, bread from 20% unsprouted cocoyam flour and 80% wheat flour; SC5B, bread from 5% sprouted cocoyam flour and 95% wheat flour; SC10B, bread from 10% sprouted cocoyam flour and 90% wheat flour; SC15B, bread from 15% sprouted cocoyam flour and 85% wheat flour; SC20B, bread from 20% sprouted cocoyam flour and 80% wheat flour

The highest height recorded for the WWB could obviously be due to its higher content of wheat flour than in other samples. This invariably implies that the WWB sample had the highest gluten content, the predominant protein in wheat responsible for trapping gas formed during proofing which permits rising of dough (Luchian and Canja, 2010). The weights (g) of the breads were in the range of 245 and 297 g, the lowest being recorded for the WWB sample and the highest for SC15B (bread from 15% sprouted cocoyam flour). The lowest value of width (6.2 cm) was recorded for UC20B while the highest (7.4 cm) was obtained for the WWB sample. In length, the bread samples had values between 12.6 and 14.0 cm. The values recorded for the physical characteristics of the bread samples generally vary, while similar results were obtained in some cases. Additionally, there were significant differences ($p<0.05$) in some of the physical characteristics of the bread samples.

Shown in Table 5 is the proximate composition of the bread samples. The WWB sample had the lowest value (20.73) of moisture content while the highest value (26.37) was recorded for UC5B (bread from 5% unsprouted cocoyam flour and 95% wheat flour). The moisture contents recorded in this study indicate that the bread samples may attain optimal shelf lives, provided that the right packaging materials are used and storage conditions are not abused (Olaoye *et al.*, 2006). The SC5B bread sample had the highest ash content (%), followed by SC10B. The lowest content of 1.18 was recorded for the WWB sample. The results of the ash contents generally indicate that bread samples containing UCF and SCF had higher contents of ash than those without cocoyam flour (i.e. whole wheat bread, WWB). Also, sprouting of cocoyam caused increase in the ash contents of the bread samples. This could be advantageous to consumers of bread, as their nutritional intake may be enhanced. The highest crude fibre was recorded for the UC20B sample and the lowest for SC20B. Protein content was higher in the WWB than other bread samples containing cocoyam flour. No significant difference ($p>0.05$) was however recorded between protein contents of WWB, UC20B and SC5B samples.

The result of sensory evaluation of the bread samples is presented in Table 6. The WWB sample recorded higher scores than others in all the sensory attributes of appearance, crumbs, crust, taste and aroma. Significant difference ($p<0.05$) was observed in the attribute of appearance between the WWB and other bread sample. The same observation was recorded in the attribute of crumb except SC15B. No significant difference ($p>0.05$) occurred between the WWB and UC5B/UC20B bread samples in the sensory attribute of crust. Taste recorded similar scores in the WWB, UC5B and UC15B samples, and they did not differ significantly ($p>0.05$) from each other.

Table 6 Result of sensory evaluation of the bread samples

Bread samples	Appearance	Crumb	Crust	Taste	Aroma	General Acceptability
WWB	$7.60^{a}\pm1.68$	$7.32^{a}\pm1.25$	$7.12^{a}\pm1.17$	$7.08^{a}\pm1.44$	$6.76^{a}\pm1.62$	$7.60^{a}\pm1.12$
UC5B	$6.24^{b}\pm1.33$	$5.88^{bc}\pm1.36$	$6.40^{ab}\pm1.63$	$6.84^{ab}\pm1.41$	$6.28^{abc}\pm1.54$	$6.72^{ab}\pm1.28$
UC10B	$5.80^{b}\pm1.63$	$6.28^{bc}\pm1.62$	$5.44^{b}\pm1.71$	$5.92^{bcd}\pm2.06$	$6.56^{ab}\pm1.73$	$6.60^{b}\pm1.68$
UC15B	$5.36^{bc}\pm1.71$	$6.00^{bc}\pm1.76$	$5.92^{b}\pm1.50$	$6.24^{ab}\pm1.74$	$5.72^{abc}\pm1.65$	$6.16^{b}\pm1.28$
UC20B	$5.92^{b}\pm1.68$	$6.00^{bc}\pm1.76$	$6.24^{ab}\pm1.72$	$6.56^{abc}\pm1.90$	$5.40^{c}\pm2.00$	$6.32^{b}\pm1.65$
SC5B	$5.80^{b}\pm1.61$	$6.24^{bc}\pm1.56$	$6.00^{b}\pm1.50$	$5.2^{d}\pm2.00$	$5.72^{abc}\pm1.72$	$5.80^{b}\pm1.73$
SC10B	$6.04^{b}\pm2.05$	$5.88^{bc}\pm2.30$	$6.08^{b}\pm1.80$	$6.00^{b}c\pm1.83$	$5.44^{bc}\pm2.00$	$6.72^{ab}\pm1.70$
SC15B	$6.16^{b}\pm1.93$	$6.48^{ab}\pm1.58$	$6.00^{b}\pm1.32$	$5.88^{bcd}\pm2.15$	$5.48^{bc}\pm1.83$	$6.76^{ab}\pm1.42$
SC20B	$4.68^{c}\pm2.06$	$5.24^{c}\pm2.13$	$5.52^{b}\pm1.45$	$5.56^{cd}\pm1.87$	$5.20^{c}\pm2.00$	$6.04^{b}\pm1.43$

Values are means of replicated samples. Means with different superscript letters across columns are significantly different ($p<0.05$).

WWB, bread from whole wheat flour; UC5B, bread from 5% unsprouted cocoyam flour and 95% wheat flour; UC10B, bread from 10% unsprouted cocoyam flour and 90% wheat flour; UC15B, bread from 15% unsprouted cocoyam flour and 85% wheat flour; UC20B, bread from 20% unsprouted cocoyam flour and 80% wheat flour; SC5B, bread from 5% sprouted cocoyam flour and 95% wheat flour; SC10B, bread from 10% sprouted cocoyam flour and 90% wheat flour;

SC15B, bread from 15% sprouted cocoyam flour and 85% wheat flour; SC20B, bread from 20% sprouted cocoyam flour and 80% wheat flour

The mean scores of sensory attribute of aroma were also similar in the WWB, UC5B, UC10B, UC15B and SC5B bread samples, and the values did not differ significantly from each other (p>0.05). Although the WWB sample had higher mean scores than others, it did not differ significantly (p>0.05) from the UC5B, SC10B and SC15B samples.

4. CONCLUSIONS

In conclusion, sprouting had significant and desirable influence on the functional and antinutritional properties of cocoyam flours. The reduction recorded in the antinutritional properties of the sprouted cocoyam flour is remarkable, and could be very beneficial in promoting nutritional intake of consumers of products made from the flour. Sprouting of cocoyam also enhanced the ash content of the bread made from composite sprouted cocoyam and wheat flours. Incorporation of sprouted cocoyam flour in wheat should therefore be encouraged by processors of bread and other baked foods, although approval of necessary standard regulatory bodies should be obtained. This could promote cultivation of cocoyam tubers by farmers and accrue in great saving of foreign exchange commonly expended on wheat importation.

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