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Vitamins, Functional and Sensory Attributes of Biscuit Produced from Wheat-Cocoyam Composite Flour

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Abstract

The vitamins, functional and sensory attributes of wheat-cocoyam composite flour and its biscuit baking potential were studied using standard analytical methods. Cocoyam flour were produced and used to substitute wheat flour at different substitutional levels viz 90:10%, 80:20%, 70:30%, 60:40%, 50:50% with 100% wheat flour as control. The resultant biscuit produced showed that vitamin C ranged from 17.17-78.92mg/100g, vitamin B2 ranged from 8.02-35.96mg/100g, vitamin B5 varied from 0.08 to 0.05mg/100g, vitamin B6 ranged from 1.0-6.20mg/100g while vitamin B9 ranged from 0.27-1.27mg/100g respectively. Fat soluble vitamins were present at appreciable amounts in the sample, revealing 0.45, 0.53, 0.68, 1.60, 2.28 and 5.67mg/100g for control,10%, 20%, 30%, 40% and 50% cocoyam flour substitution. Highest values of 380, 376, 367(mg/kg) were recorded by biscuits from 60:40%, 70:30% and 50:50% wheat cocoyam composite flour in terms of sodium content. Potassium also show significant levels, ranging from 83.53-193.83mg/kg. Whereas the functional properties of composited flour and sensory attributes of biscuits were deferred significantly ($p \leq 0.05$), textural quality of biscuits showed no significant ($p \geq 0.05$) difference. Wettability was found to increase with increase in cocoyam incorporation. However, biscuit of acceptable quality comparable to that of 100% with flour can be produced from 50:50 wheat-cocoyam flour blends, hence enhancing the utilization of cocoyam and reducing overdependence on wheat flour for baking products.

Keywords: Vitamins, functional, sensory, composite flour, biscuit.

INTRODUCTION

Biscuit is one of the most commonly consumed cereal food products next to bread, because it is readily available as ready-to-eat, convenient and inexpensive food containing dietary fibers with health benefits (1). Biscuits are produced primarily from cereal grain flour, mainly wheat, as baked food products. Wheat flour is used to produce bread, biscuit, confectioneries, noodles, pastas and even vital wheat gluten, (2). Cocoyam (*Colocasia esculenta*) is an edible root crop grown in the tropics of which Nigeria is a leading producer. In the sub-Saharan Africa, cocoyam contributes significantly to the calorie requirement in the diet of the people in these regions, supplied through the edible starchy storage corms and cormels (3).

There is increasing demand for ready-to-eat snack food products due to urbanization especially among the school children. This growing trend means an increasing reliance on wheat which is not grown in the tropics and this scenario could continually put pressure of foreign reserves of affected countries like Nigeria (4). In Nigeria, however, major root crops that are grown other than wheat include cassava, cocoyam, and sweet potato can be substituted for wheat flour to bake snack foods. Efforts have been with reports to partially replace wheat flour with non-wheat flours as a potential strategy to increase utilization of indigenous crops domiciled in Nigeria, with the aim of adding values to those crops (4, 5)

Several studies have been conducted on the physical and baking properties of biscuits produced from flours and/or starches of underutilized cereal grains, legumes, breadfruits, soybeans, cocoyam and plantains (4, 6). Ammar *et al*. used Taro flour as partial substitute of wheat flour in bread making while Giwa *et al*. (8) investigated the quality characteristics of biscuits of wheat-quality protein maize flour blends. Also, cookies developed from wheat-cocoyam flour blends have been reported (9). Similar, there have been reports on the physico-chemical and sensory properties of cookies from partially germinated pigeon pea, fermented sorghum and cocoyam flour blends (3). Study on the physicochemical and sensory properties of biscuits from wheat-cassava flour blends enriched with soy flour has been documented. However, until now, information on functional biscuit from wheat-cocoyam flour blends is scanty. Therefore, the objectives of this present research work are to produce quality biscuits from wheat-cocoyam composite flour as well as determining its vitamins, functional and sensory properties.

MATERIALS AND METHODS.

Source of materials

wheat flour (Golden penny), margarine, granulated sugar (Dangote), iodine salt (Dangote) baking powder, flour, were purchased from a reputable store in Ilaro metropolis, Yewa-South Local Government Area of Ogun State, Nigeria.

Freshly harvested matured cocoyam corms were obtained from the Botanical Garden of Science Laboratory Department, Federal Polytechnic, Ilaro, Ogun State. All reagents and chemicals used were of analytical grade.

METHODS

Processing of Cocoyam into Flour.

Cocoyam flour were produced according to the method described earlier (11). Fresh cocoyam corms were washed, sorted, peeled, washed again and cut into thin slices of 5mm size. The slices were blanched in hot water for a period of 10 minutes, then dried at 50 °C for 8 hours, allowed to cool and milled into flour using a laboratory hammer mill (Falling Number Laboratory Mill 3100, Perten Instruments, Hagersten, Sweden) fitted with 500 µm mesh screen.

Production and Baking of Biscuits

Different proportions of wheat-cocoyam flours were made viz: 90:10, 80:20, 70:30, 60:40, 50:50 with 100% wheat flour as control. Sugar, and margarine were accurately weighed, mixed in a stainless bowl and creamed until the mixture became light and fluffy. Milk powder was added to the cream while still mixing, allowed to mix for 20 minutes after which composite flour, baking powder, salt was gently poured into the mixture to obtain the dough. The dough was kneaded using a wooden rolling pin, on a flat-smooth board with intermittent sprinkling of flour to ease the kneading operation.

Dough samples for biscuits were cut into shapes using a cutter and then placed on already oiled flat baking trays. The dough was baked at 250 ºC for 20 minutes in an oven until they are light brown in colour. Biscuits after baking were allowed to cool for about 30 minutes, stored in airtight plastics containers for further analysis.

Degermation of Water-Soluble Vitamins (Vitamin B2, B5, B6 and B9)

Water-soluble vitamins were determined using the methods described previously (12). The vitamin B group was extracted according to the previous method (13) .Biscuit samples were grounded, and about 10 g of grinded sample was placed in 25 ml of H_2SO_4 (0.1N), incubated for 30 minutes at 121 ºC. The incubated content was cooled, and the pH was adjusted to 4.5 using sodium acetate (2.5 M), then 500 mg of diastase enzyme added. The mixture was then stored overnight at 35 ºC, later filtered using Whatman No.4 filter paper. The filtrate was diluted with 50 ml deionized water and filtered through a micropore filter (0.45µm). Exactly 20 microliters of the filtrate were injected into the HPLC system for the quantification of vitamin B content using vitamin B standards. Standard stock solutions thiamine, riboflavin, niacin, pyridoxine and cobalamin were prepared according to (12). A reversed phase-(RP) HPLC column (Agilent ZORBAX Eclipse Plus C18:250 × 4.6mm ID5 um) through the isocratic delivery mobile phase (0.5 ml/minute) was used for the chromatographic separation. Absorbance through UV was recorded at 270mm at room temperature.

Determination of Vitamin C

Vitamin C content of biscuit samples were determined as described (14) in triplicates. Samples were blended and homogenized with an extracting solution containing metaphosphoric acid (0.3 M) and acetic acid (1.4 M) .The mixture was poured into a conical flask and agitated at 10000 rpm for 15 minutes. The mixture was filtered through Whatman No 4-filter paper. L-ascorbic acid (100 mg) in a metaphosphoric acid (0.3 M)/acetic acid (1.4 M) solution to a final concentration of 0.1mg/ml was prepared and used as ascorbic acid standard. Quantification of ascorbic acid content was carried out on a HPLC system. A RP-HPLC column through isocratic delivery of a mobile phase (A/B 33/67: A: 0.1 M potassium acetate, pH 4.9, B: acetonitrile : water [50:50] at of 1ml/min was used for the Chromatographic separation. Measuring UV absorbance (254 mm) at room temperature, vitamin C content was calculated.

$$\text{Vitamin C } (\mu g/100\ g) = \frac{(0.0000833\ x\ titre\ value\ x\ 100000)}{(weight\ of\ sample\ (g) x\ 200}$$

Sodium and Potassium Determination.

Sodium (Na). And Potassium (K) concentration were determined by using the standard flame emission photometer.

Functional Properties.

Bulk density.

The built density (g/cm^3) of flour samples was determined described previously (15). Exactly 10g of sample was weighed into 50 ml graduated measuring cylinder and packed by gently tapping the cylinder on the bench top (10 times) from a height of 5cm. The volume of the tapped sample was recorded as weight (g)/volume (ml).

$$\text{Bulk density (g/ml)} = \frac{weight\ of\ sample\ (g)}{volume\ of\ sample\ after\ tapping\ (ml)}$$

Water Absorption Capacity (WAC)

WAC of samples was determined as described by (15). Exactly 1g of each sample was mixed with 10ml of distilled water in a conical centrifuge tube and allowed to stand at ambient temperature (30±2 ºC) for 30 minutes, then centrifuged for 30 minutes at 3000 rpm. Water absorption was examined as percent water bound per gram flours. This was calculated as shown below:

$$\text{WAC (\%)} = \frac{(weight\ of\ sample\ after\ drying - weight\ of\ sample\ before\ drying\ )}{weight\ of\ sample} \text{ x } 100$$

Oil Absorption Capacity (OAC)

OAC of samples was determined as described by (15). Exactly 1 g of sample mixed with vegetable oil (specific gravity 0.9092) and allowed to stand at room temperature (30±2 ºC) for 30 minutes, then centrifuged for 30 minutes at 3000 rpm. Oil absorption was calculated as shown below:

$$\text{OAC (\%)} = \frac{weight\ of\ sample\ after\ drawing\ oil - weight\ of\ sample\ before\ drawing\ oil}{weight\ of\ sample} \text{ x } 100$$

Wettability

Wettability of flour samples was determined according to the procedure described by (15). Exactly Into a 25 ml graduated measuring cylinder with a diameter of 1cm, exactly 1 g of flour sample was weighed. With a finger placed over the open end of the cylinder, inverted and damped at a height of 10 cm from the surface of 600 ml beaker, containing 500ml of distilled water. The finger was then removed, and the fresh sample allowed to damp. Wettability was recorded as the time required for the sample to be completely wet

Sensory Evaluation

A semi trained panellists (male and female) were constituted to 30 in numbers comprising of varying age group with non-similar eating habit were used to evaluate the sensory quality of biscuit samples. The panellists were made of staff and students of the Federal Polytechnic Ilaro, who did not have an allergy to biscuits Samples were randomly coded and served to the panellists in their separate booths in the sensory evaluation room. Panellists were asked to evaluate the samples for taste, colour, crispness, texture, appearance and overall acceptability using a 9-point hedonic scale, ranging from 1(extremely dislike), to 9 (extremely like). The data generated were subjected to analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT) were used to separate the means at 5% confidence level.

RESULTS AND DISCUSSION

Water Soluble Vitamin.

The vitamin C contents of biscuit samples (Table 1) were 17.17 mg/100 g, 33.7 8mg/100 g, 57.72 mg/100 g, 58.28 mg/100 g, 69.17 mg/100 g and 78.92 mg/100 g for 100% biscuit (control), 90:10, 80:20, 70:30, 60:40 and 50:50 wheat-cocoyam composite biscuits respectively. The maximum level of vitamin C content of biscuit (78.92 mg/100 g) was observed in the 50% substitutional levels of cocoyam flour and significantly higher than the values obtained from other samples. Lowest value of vitamin C (17.17 mg/100 g) observed in 100% wheat could be attributed to non-incorporation of cocoyam. Cocoyam is a rich source of vitamin C (16). There are significant differences ($p \leq 0.05$) in vitamin B2 (riboflavin) contents of the samples. It ranged from 8.02 mg/100 g to 35.96 mg/100 g for all biscuit samples. Vitamin B2 helps to break down proteins, fat and carbohydrates band plays a vital role in maintaining of body's energy supply. However, these values is above than the recommended daily intake of 0.3-1.6 mg/100 g (17). Vitamin B5 contents of the biscuit samples did not differ significantly($p \leq 0.05$). Samples substituted with 40% cocoyam flour had the highest value of 0.75mg/100g while sample with 50% cocoyam had the least (0.07 mg/100 g). This result is not in agreement with the work of (18) that reported 0.157 mg/100 g to 0.477 mg/100 g for ready to eat snacks. Vitamin B5 (Pantothenic acid) is reported essential for carbohydrate and protein metabolism and are vital for growth and functioning of body cells (19). Vitamin B6 (pyridoxine) ranged from 0.00 mg/100 g to 24.40 mg/100 g while vitamin B6 (folic acid) varied from 0.27 mg/100 g to 1.27 mg/100 g respectively.

Table 1: Water Soluble Vitamins contents of Biscuits Produced from Wheat-cocoyam Flour Blends.

SAMPLES (mg/100g)	PARAMETERS				
	VITAMIN C	VITAMIN B2	VITAMIN B5	VITAMIN B6	VITAMIN B9
SAM	17.17±0.08^{a}	27.49±0.70^{d}	0.35±0.01^{a}	1.00±0.00^{a}	0.27±0.01^{a}
DAN	33.78±0.14^{b}	10.24±0.12^{b}	0.48±0.53^{a}	1.65±0.03^{c}	1.27±0.02^{c}
APK	57372±0.14^{c}	35.96±0.01^{c}	0.08±0.01^{a}	2.00±0.00^{a}	0.72±0.02^{b}
MIL	58.28±0.14^{d}	9.05±0.00^{a}	0.09±0.01^{a}	2.95±0.01^{b}	1.00±0.00^{d}
BIL	69.17±0.21^{e}	8.02±0.00^{a}	0.75±0.02^{a}	4.40±0.01^{d}	0.78±0.03^{c}
FIN	78.92±0.35^{f}	23.63±0.92^{c}	0.07±0.01^{a}	6.20±0.00^{a}	0.80±0.32^{bc}

Values are means ± standard deviation of duplicate determination. values on the same column with the same superscript letter (s) are not significantly different ($p > 0.05$).

Key: SAM – 100% Wheat flour and 0% cocoyam flour:
DAN -90% Wheat flour and 10% cocoyam flour:
APK - 80% Wheat flour and 20% cocoyam flour:
MIK- 70% Wheat flour and 30% cocoyam flour:
BIK - 60% Wheat flour and 40% cocoyam flour:
FIN - 50% Wheat flour and 50% cocoyam flour

Fat Soluble Vitamins and Mineral Contents

The result of the fat-soluble vitamins and selected mineral are as shown in Table 2. The levels of retinol (vitamin A) in the biscuit samples increases with increase the inclusion of cocoyam. It ranged from 0.45 mg/100 g to 5.67mg/100 g. Therefore, significant differences($p \leq 0.05$) exist between the samples. Vitamin A is a vital micronutrient in complimentary food. The sodium content of the samples ranged from 315 mg/kg to 388 mg/kg. The sodium content do not show a particular pattern as the values fluctuated for example at 50% cocoyam inclusion the sodium level was 367 mg/kg at 20% cocoyam inclusion, it was 315mg/kg while at 100% wheat flour 388 mg/kg(the highest value). Potassium value ranged between 83 mg/kg and 193 mg/kg for all samples showing significant difference ($p \leq 0.05$) among samples. The trend revealed increased in the potassium level as the level of cocoyam flour increased. However, both sodium and potassium are required for the maintenance of osmotic-regulation of the body fluids, redox potential, the muscle and nerve irritability, control glucose absorption and enhancing the normal retention of protein during growth (20).

Table 2: Fat Soluble Vitamins (vitamin A) and Selected Mineral Contents of Biscuits Produced from Wheat-cocoyam Flour Blends.

Samples	**Prameters**		
	Vitamin A (mg/ 100g)	**Sodium (mg / kg)**	**Potassium (mg/kg)**
SAM	0.45±0.02^{b}	388.0±2.8^{f}	83.5±0.1^{a}
DAN	0.53±0.01^{c}	345.5±0.7^{b}	129.0±0.0^{c}
APK	0.68±0.02^{d}	315.0±1^{a}	148±1.4^{e}
MIL	1.60±0.02^{e}	376±1.41^{d}	162±1.4^{f}
BIK	2.28±0.02^{a}	380±0.2^{e}	188.4±0.6^{b}
FIN	5.67±0.01^{f}	367.1±0.1^{c}	193.8±0.2^{d}

Values are means ± standard deviation of duplicate determination. values on the same column with the same superscript letter (s) are not significantly different ($p > 0.05$).

Key: SAM-100% Wheat flour and 0% cocoyam flour:

DAN -90% Wheat flour and 10% cocoyam flour:
APK - 80% Wheat flour and 20% cocoyam flour:
MIK- 70% Wheat flour and 30% cocoyam flour:
BIK - 60% Wheat flour and 40% cocoyam flour:
FIN - 50% Wheat flour and 50% cocoyam flour

Functional Properties

The functional properties of flours are shown in Table 3. The bulk density (g/ml) of flour measures without the influence of any compression: The bulk density of samples ranged from 0.55g/m to 0.97g/m. There are significant differences (p≤0.05) in the samples, with 100% wheat flour having the highest value and 50% cocoyam inclusion having the least value. Bulk density depends on the particle size as well as initial moisture content of the flours. High bulk density of flour may suggest their potentials for use in food preparation, while low bulk density would be advantageous in the formulation of weaning formula (21). (22) suggested that high bulk density means its suitability to be used as thickeners in food products since it helps to reduce paste thickness which is crucial to convalescent and child feeding. Wettability is a function of ease of dispersing flour samples in water and the lowest wettability dissolve fastest in water. Wettability of the flour sample varied from 109 seconds to 139 seconds, revealing significant differences among samples. The study revealed that the wettability value reduced with increasing addition of cocoyam flour with wheat flour in different ratios. The water absorption capacity for all the flour being evaluated ranged from 49%-112%, reveling significant difference (p≤0.05) among samples. substituting cocoyam flour for wheat flour adversely affected the amount of water absorbed. This could be due to molecular structure of cocoyam flour which inhibited the water absorption capacity as reported (23). The oil absorption capacity ranged from 102% to 167% for the flour samples. 100% wheat flour (control) had the least value of 102% oil absorption capacity while 30% cocoyam inclusion had the highest oil absorption capacity. The presences of high fat content in the two flours might have impacted greatly oil absorption capacities of the composited flours. The presence of polar side chain, which might burn the hydrocarbon side chain of the oil among the flours (23), may be responsible for significant differences (p≤0.05) in the composite flours. However, the major chemical component affecting oil absorption capacity could be the proteins due to the presence of hydrophilic and hydrophobic parts (24).

Table 3: Selected Functional Properties of Wheat-cocoyam Composite Flours.

Sample	**Parameters**			
	Bulk Density (G/Ml)	**Wetability (Seconds)**	**Water Absorption Capacity (%)**	**OIL Absorption Capacity (%)**
SAM	$0.97{\pm}0.01^{d}$	$139.3{\pm}0.9^{c}$	$112.5{\pm}3.5^{d}$	$102.5{\pm}3.5^{a}$
DAN	$0.74{\pm}0.04^{c}$	$136.7{\pm}0.1^{d}$	$66.5{\pm}9.9^{d}$	$139.0{\pm}12.7^{bc}$
APK	$0.67{\pm}0.04^{bc}$	$132.3{\pm}0.8^{c}$	$94.6{\pm}5.66^{c}$	$167.5{\pm}10.6^{d}$
MIK	$0.57{\pm}0.03^{ab}$	$123.5{\pm}1.7^{b}$	$66.5{\pm}9.91^{b}$	$157.5{\pm}3.5^{cd}$
BIK	$0.55{\pm}0.03^{ab}$	$109.5{\pm}1.2^{a}$	$49.0{\pm}1.4^{a}$	$136.0{\pm}5.6^{b}$
FIN	$0.55{\pm}0.03^{a}$	$109.5{\pm}0.4^{a}$	$111.5{\pm}2.1^{d}$	$113.0{\pm}4.2^{a}$

Values are means ± standard deviation of duplicate determination. values on the same column with the same superscript letter (s) are not significantly different (p > 0.05).
Key: SAM - 100% Wheat flour and 0% cocoyam flour:
DAN -90% Wheat flour and 10% cocoyam flour:
APK - 80% Wheat flour and 20% cocoyam flour:
MIK- 70% Wheat flour and 30% cocoyam flour:
BIK - 60% Wheat flour and 40% cocoyam flour:
FIN - 50% Wheat flour and 50% cocoyam flour

Sensory Evaluation

The results of the sensory evaluation of biscuit samples from wheat-cocoyam flour blends were presented (Table 4). There are significant differences (p≤0.05) among colour ratings. Biscuit produced form 100%(control) wheat flour was rated highest while 70:30% (wheat-cocoyam) composite flour was rated least. The desired biscuit colour is obtained might due attributed to Maillard reaction products formed during baking. According to previous report (25), crispness is perceived when foods are chewed in-between molars. This is usually expressed as hardness and facturability. Significant differences exist (p≤0.05) among the values obtained for crispness. Sample substituted with 50% cocoyam had the highest value while 20% cocoyam inclusion had the least value. The crispness scores neither decreased nor increased rapidly with increasing incorporation of cocoyam flour with wheat flours. This is an agreement with report of (26) in a similar work. Previous work (27) described crispness is a complex attribute due to multiple sensations and physical parameters, combining molecular, structural, manufacturing processes and storage conditions (28),. The result of the taste showed that biscuit produced from 100% wheat flour had the highest taste score of 7.87 while 10% cocoyam inclusion had the least score of 6.57, revealing significant difference (p≤0.05) among treated samples: However, taste scores fluctuated with increasing inclusion of cocoyam in the formulation of the biscuit. Mean scores were at a range of 6.70-7.36, with 100% wheat flour having the highest score while 30% cocoyam flour inclusion has the least. However, the appearance showed that producing biscuit from all the formulations resulted in product with good appearance as judge by the panelist. There was no significant difference across the samples (p≤0.05) in terms of texture as all the samples have almost the same values. The overall acceptability scores revealed that biscuit produced form 100% wheat flour was judged best compared to those from composited flours, hence biscuit samples differ significantly (p≤0.05) existed between the biscuits produced.

Table 4: Sensory Evaluation of Biscuits Produced from Wheat-cocoyam Flour Blends.

SAMPLE	PARAMETERS					
	Colour	Crispiness	Taste	Appearance	Texture	Overall Acceptability
SAM	7.77 ± 1.04^{b}	6.60 ± 1.69^{ab}	7.37 ± 1.43^{b}	7.37 ± 1.61^{b}	7.13 ± 1.72^{a}	7.93 ± 1.23^{b}
DAN	6.77 ± 1.28^{a}	6.80 ± 1.16^{ab}	6.57 ± 1.92^{a}	7.07 ± 1.55^{ab}	6.60 ± 1.87^{a}	7.37 ± 0.97^{b}
APK	7.01 ± 1.09^{a}	6.07 ± 1.62^{a}	6.83 ± 1.44^{b}	7.27 ± 0.87^{ab}	6.40 ± 1.13^{a}	7.30 ± 1.56^{a}
MIL	6.83 ± 0.95^{a}	6.60 ± 1.50^{ab}	7.27 ± 1.23^{ab}	6.70 ± 0.92^{ab}	6.80 ± 1.16^{a}	6.80 ± 1.06^{ab}
BIK	6.83 ± 1.02^{a}	6.20 ± 1.56^{a}	6.67 ± 1.47^{b}	6.71 ± 1.25^{a}	6.30 ± 1.49^{a}	6.73 ± 1.34^{a}
FIN	7.70 ± 1.76^{a}	7.43 ± 1.45^{b}	7.10 ± 1.56^{ab}	6.97 ± 1.22^{ab}	6.80 ± 1.21^{a}	6.43 ± 1.48^{ab}

Values are means ± standard deviation of duplicate determination. values on the same column with the same superscript letter (s) are not significantly different ($p > 0.05$).

Key:
SAM - 100% Wheat flour and 0% cocoyam flour:
DAN -90% Wheat flour and 10% cocoyam flour:
APK - 80% Wheat flour and 20% cocoyam flour:
MIK- 70% Wheat flour and 30% cocoyam flour:
BIK - 60% Wheat flour and 40% cocoyam flour:
FIN - 50% Wheat flour and 50% cocoyam flour

CONCLUSION

The result showed that addition of cocoyam flour to wheat flour at different levels had no adverse effect on the vitamins, functional and sensory attributes of the biscuits, but rather the values obtained compared favourably to that of the control (100% wheat flour). The functional properties such as water absorption capacity, oil absorption capacity as well as bulk density have varying values, but wettability reduced as the cocoyam flour incorporated increased. Sensory evaluation revealed that appearance of biscuit decrease with increase addition of cocoyam flour to wheat flour. Biscuit produced from 50:50 flour blends had the highest rating for crispness, hence liked most by the panelist. Therefore, substituting cocoyam flour for wheat flour at equal proportion for the development of biscuits will boost the cultivation of cocoyam has the potential to increase cocoyam utilization, thereby reducing the pressure on our foreign exchange for imported wheat flour, now that climate change is reportedly affecting wheat production.

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