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Evaluation of Cookies from Wheat Flour, Soybean Flour And Cocoyam Flour Blends

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ABSTRACT
Cookies were produced from blends of cocoyam flour (*Xanthosomassagittoforus*), soybean flour (*Glycine max)* and wheat flour *(titricumspp)*. The cocoyam and soybean were processed into flour and used to substitute wheat flour at different proportions which are 80:10:10, 70:20:10, 60:30:10 and 50:40:10 while 100% wheat was used as control. The functional properties and the proximate analysis of the flours were determined as well as the proximate analysis, the physical properties and the sensory properties of the cookies as well. The chemical composition of the cookies shows that the moisture contents had varying values of 8.17%, 8.07%, 7.97%,7.73% and 7.5% respectively, the protein content also had varying values ranging from11.63%-9.90% respectively. 100% wf had the highest fat content of 19.60% followed by 80%wf:10%cf:10%sf, 70%wf:20%cf:10%sf, 60%wf:30%cf:10%sf and lowest was in 50%wf:40%cf:10%sf. The highest ash content was recorded in 50%wf:40%cf:10%sf (6.73%) with 100%wf having the lowest(6.07%). The carbohydrate content varied from 53.37%-51.40%. The crude fibre of 50%wf:40%cf:10%sf was the highest value of 4.37, 60%wf:30%cf:10%sf (4.33), 70%wf:20%cf:10%sf (4.20%), 80%wf:10%cf:10%sf (4.10%) while 100%wf had the lowest (4.07%). The functional properties of the flour shows that there was no significant difference ($p<0.05$) between the loose bulk density (0.43%) of the samples, but the pack density varied from 0.77%-0.74% with soybean flour having the highest value and wheat flour the lowest. Soybean flour had the highest WAC value of 200.00%, cocoyam flour had 185.00% and soybean flour had 180.00% respectively. The OAC varied from 173.00%-166.67%, the emulsifying capacity value ranged from 17.33%-14.33%. For the SC, soybean flour and cocoyam flour had the same value of 1.60% while wheat flour had the lowest value of 1.40%. The gelatinization temperature value was between 68.63%- 65.33% respectively. The sensory evaluation shows that the cookies reduced in colour as well as the overall acceptability as the substitution increases. The taste, texture and appearance of sample 80%wf:10%cf:10%sf was the highest (4.40%, 4.40% and 4.60%) of all the cookie sample. It can therefore be concluded that flours can be replaced with up to about 20% substitution (10% cocoyam and 10% soybean) in cookie production without affecting the sensory qualities of the cookies. Also soybean can be used substitute flours to increase the protein intake in human diets
Key Word: Wheat, Cocoyam, Soybean, Cookies and Replacement

INTRODUCTION

Cookies are a form of confectionary products usually dried to a low moisture content (Okaka, 2009). Compared to biscuit, they tend to be larger with a softer chewer texture. They are consumed extensively all over the world as a snack food and on a large scale in developing countries where protein and caloric malnutrition are prevalent. (Chinma and Gernah, 2007)

With the increased advocacy on the consumption of functional foods by world nutrition bodies due to different health problems related to food consumption such as celiac diseases, diabetes and coronary heart diseases, the recent **WHO** recommendations to reduce trend in nutrition is the consumption of low carbohydrate diets, including slowly digested food products as well as increased intake of functional foods (Hurs and Martins, 2005). The food industries are faced with the challenge of producing food products containing functional ingredients in order to meet the nutritional requirements of individuals with health challenges. Cookies can therefore serve as a vehicle for delivering important nutrients if made readily available to the population (Chinma and Gernah, 2007).

The consumption of wheat flour is on the increase due to the increase demand for noodles, bread, biscuits etc. The use of indigenous flour as substitute for wheat to produce composite flour for baking is therefore necessary (Abulade et al, 2005). Based on the nutritional advantages, availability and economical value of cocoyam and soybeans, they therefore are potential source for composite with wheat.

Objectives of this work include; to produce cookies from the composite flours of wheat, cocoyam and soybeans, to carry out proximate analysis as well as physical characteristics of the cookies and to carry out sensory evaluation on the cookies produced.

MATERIALS AND METHOD

Materials

Raw cocoyam (*Xanthosoma sagitofforus*) was purchased at Sabo market, Ikorodu, Lagos State as well as the soybean (*Glycine max*) and the wheat flour (*Triticumspp*) .The equipment used were knife, standard sieving machine, weighing balance, milling machine, oven, oven drier, tray, bowls and rolling pins.

Methods

Cocoyam Flour Production

Cocoyam samples were peeled with knife and sliced using 4mm slicing machine and washed with water. The slices were blanched at 75°c for 15 minutes in portable water. The blanched slices were oven dried at 60°c for 9 hours and milled with a milling machine to obtain flour which was subsequently sieved through a standard sieve of 2.5, 2.0, 1.5, 1.0, and 0.5 to yield a flour of fine texture Oti and Akobundun, (2007).

Soybean Flour Production

Soybeans were picked and winnowed to remove dirt and unwanted particles. The winnowed soybean was then washed and afterwards blanched for 15 minutes at 75°c in an aluminum bowl. It was then oven dried at 60°c for 9 hours and milled with a milling machine to obtain flour which was subsequently sieved through a standard sieve of 2.5, 2.0, 1.5, 1.0, and 0.5 to yield a flour of fine texture. (United state department of agriculture).

Cookies Production

Formulation of Blends

The three flour blends were formulated at different ratios with wheat being the highest; the table below shows the blends and the ratios.

TABLE 1:- Blend Formulations

Wheat flour	Cocoyam flour	Soybean flour
100	-	-
80	10	10
70	20	10
60	30	10
50	40	10

Baking

The five blend formulations were baked using a temperature of 160°c for 15 minutes, the weighed fat and sugar was creamed together with a wooden spoon until soft and white in a mixing bowl, the eggs was then whisked into it and blended by mixing. Milk was added to the mixture and afterwards the flour and the other ingredients were added. It was kneaded until smooth and lump less and then rolled out thinly. The dough was cut with a cookie cutter into a précised size and shape and then placed gently on the oven tray then baking starts. After baking it was spread on the clean working table and allowed to cool, it was then packaged and labeled.

PROXIMATE COMPOSITION : Protein, fat and oil, Crude fibre, ash, moisture and carbohydrate were determined by the methods prescribed in AOAC, 1990 while functional properties were by Pearson, 1976

Sensory Evaluation

The sensory evaluation was performed using the method of Akinjaiyeju, 2009. A 20 man panelist was used from Lagos state polytechnic students for the evaluation of the cakes for taste, appearance, texture, flavor and general acceptability. The scoring was based on a 5 point hedonic scale ranging from 1 (very poor) to 5 (very good). The value obtained from the sensory evaluation was statistically analyzed using SPSS.

RESULT AND DISCUSSION

Results

TABLE 2 The Physio-Chemical Composition of Cocoyam Flour, Wheat flour and Soybean Flour Blends

Samples	Moisture content	Protein	Ash	Fat	Carbohydrate	Crude fibre
Wheat flour	9.10 ± 0.10^{b}	6.57 ± 0.12^{b}	2.47 ± 0.12^{a}	3.40 ± 0.10^{a}	77.10 ± 0.47^{c}	0.77 ± 0.06^{a}
Soybean flour	8.83 ± 0.06^{a}	13.30 ± 0.26^{c}	3.50 ± 0.10^{c}	6.30 ± 0.00^{b}	66.82 ± 0.21^{a}	1.23 ± 0.06^{c}
Cocoyam flour	9.17 ± 0.15^{b}	5.53 ± 0.25^{a}	2.77 ± 0.06^{b}	3.27 ± 0.12^{a}	78.10 ± 0.47^{b}	1.03 ± 0.06^{b}

Mean in the same column followed by the same letter are not statistically different at 5% significant level ($p<0.05$).

TABLE 3 Functional Properties of Cocoyam Flour, Wheat Flour and Soybean Flour

Sample	Water absorption capacity	Swelling capacity	Emulsifying capacity	Gelatinization temperature	Oil absorption capacity	Bulk density (loosed)	Bulk density (packed)
Wheat	180.00±0.00^{a}	1.40±0.00^{a}	15.83±0.29^{b}	65.33±0.29^{a}	155.0±0.0^{a}	0.43±0.0^{a}	0.74±0.0^{a}
Soybean	200.0±0.01^{b}	1.60±0.0^{b}	17.33±2.89^{c}	68.63±0.12	173.0±2.89^{c}	0.43±0.00^{a}	0.77±0.0^{c}
Cocoyam	185.0±0.0^{c}	1.60±0.36^{b}	14.33±0.42^{a}	66.83±0.29^{b}	166.67±0.28^{c}	0.43±0.0^{a}	0.76±0.0^{b}

Mean in the same column followed by the same letter are not statistically different at 5% significant level ($p<0.05$).

Table 4: Physio-Chemical Composition of Cookies Produced From Cocoyam Flour, Soybean Flour and Wheat Flour Blends

Samples	Moisture	Fat	Protein	Ash	Crude fibre	Carbohydrate
ADC (100%wf)	7.5±0.15^{a}	19.60±0.10^{c}	9.90±0.10^{a}	6.07±0.06^{d}	4.07±0.06^{a}	51.80±0.26^{ab}
BDC (80%wf:10%cf:10%sf)	7.73±0.12^{ab}	18.87±0.15^{b}	11.63±0.21^{c}	6.20±0.10^{b}	4.10±0.10^{a}	51.40±0.30^{a}
CDC (70%wf:20%cf:10%sf)	7.97±0.12^{bc}	18.67±0.15^{b}	11.03±0.15^{b}	6.43±0.06^{c}	4.20±0.06^{a}	51.70±0.35^{a}
DDC (60%wf:30%cf:10%sf)	8.07±0.15^{c}	18.27±0.15^{a}	10.83±0.06^{c}	6.67±0.06^{d}	4.33±0.06^{b}	52.27±0.21^{b}
EDC(50%wf:40%cf:10%sf)	8.17±0.15^{c}	18.07±0.15^{a}	10.33±0.15^{b}	6.73±0.06^{d}	4.37±0.15^{b}	53.37±0.31^{c}

Mean in the same column followed by the same letter are not statistically different at 5% significant level ($p<0.05$).

KEYS

ADC- 100% wheat flour

BDC- 80%wheat flour, 10% cocoyam flour,10%soybean flour

CDC- 70%wheat flour, 20% cocoyam flour, 10 % soybean flour

DDC- 60% wheat flour, 30% cocoyam flour, 10% soybean flour

EDC- 50% wheat flour. 40% cocoyam flour, 10% soybean flour

TABLE 5: Sensory evaluation of Cookies Produced from the Wheat Flour, Cocoyam Flour and Soybean Flour Blends.

Samples	Appearance	Colour	Taste	Texture	Overall acceptability
ADC (100%wf)	4.20±0.42^{c}	4.40±0.52^{c}	4.20±0.92^{b}	4.30±0.67^{c}	4.60±0.52^{c}
BDC(80%wf:10%cf:10%sf)	4.60±0.70^{c}	4.30±0.67^{c}	4.40±0.52^{b}	4.40±0.52^{c}	4.40±0.70^{c}
CDC (70%wf:20%cf:10%sf)	4.00±0.67^{b}	3.90±0.99^{ab}	4.20±0.79^{b}	3.80±0.92^{ab}	3.90±0.57^{ab}
DDC (60%wf:30%cf:10%sf)	4.00±0.94^{ab}	3.80±0.79^{ab}	4.30±0.82^{b}	3.60±0.97^{ab}	3.60±1.07^{a}
EDC (50%wf:40%cf:10%sf)	3.40±0.97^{a}	3.50±0.85^{a}	3.70±1.06^{a}	3.10±0.99^{a}	3.20±0.79^{a}

Mean in the same column followed by the same letter are not statistically different at 5% significant level ($p<0.05$).

Discussion

The physio-chemical composition of cocoyam flour, wheat flour and soybean flour are shown in Table 2. The moisture contents of the samples ranged from 8.83-9.17%.the highest moisture content was observed in cocoyam flour while the lowest was observed in the soybean flour. There was no significant difference ($p<0.05$) between the wheat flour and cocoyam flour. The protein content of the flours ranged from 5.53-13.30%, with soybean flour having the highest and cocoyam flour having the lowest value. Significant difference ($p<0.05$) exist among all the samples. The ash content of the sample ranged from 2.48-3.50%, soybean had the highest percentage of total ash while wheat flour has the lowest. Fat content ranged from 3.27-6.30, with soybean having the highest and cocoyam having the lowest. There was no significant difference ($p<0.05$) between wheat and cocoyam flour. The carbohydrate content ranged from 66.83-78.10%, cocoyam had the highest protein content and soybean flour had the lowest. The crude fibre content ranged from 0.77-1.23%, with soybean having the highest and wheat flour having the lowest.

The functional properties of cocoyam flour, wheat flour and soybean flour are shown in Table 3. Water absorption capacity ranged from 180.00-200.00%, the highest value was found in soybean flour while the lowest was in wheat flour. There was significant difference ($p<0.05$) among all of the flour samples. The swelling capacity of the flour ranged from 1.40-1.60%, with soybean and cocoyam flour having the same value and wheat having the

lowest. There was no significant difference between the soybean flour and the cocoyam flour. The emulsifying capacity ranged from 14.33-17.33%, soybean flour had the highest and cocoyam flour was recorded to have the lowest value. There was significant difference ($p<0.05$) among all the samples. The gelatinization temperature ranged from 65.22-68.63%, there was significant difference between all the samples. The oil absorption capacity ranged from 155.00-173.00%, soybean had the highest value and wheat had the lowest. Significant difference ($p<0.05$) occurred among all the samples. There was no significant difference in the bulk density (loosed) of the three sample, the flours also had the same percentages (0.43%). The packed bulk density of the three samples range from 0.74-0.77%, with soybean and flour having the highest and wheat flour having the lowest. Significant difference existed among the entire three samples.

The physio-chemical composition of the flours produced from cocoyam, wheat and soybean flour blends are shown in Table 5. The moisture content ranged from 7.5-8.17 with EDC having the highest value while ADC had the lowest. The fat content ranged from 18.07-19.60%, EDC had the lowest while ADC had the highest. There was no significant difference ($p<0.05$) between sample BDC and DDC likewise in CDC and EDC. The protein content ranged from 9.90-11.33%. There was no significant difference between ADC and DDC but significant difference exist among these samples and other samples. The crude fibre content ranged from 4.07-4.37%, EDC had the highest value while 100%wf had the lowest value. The carbohydrate content ranged from 51.40-53.37, BDC had the least value while EDC had the highest.

Sensory evaluation of the cookies produced from the blends are shown in Table 5. The appearance of the cookies ranged from 3.40-4.60%, with sample BDC having the highest while EDC had the lowest. There was no significant difference between ADC and BDC. The colour of the cookies ranged 3.50-4.40%, ADC had the highest and EDC had the lowest value. There was no significant difference ($p<0.05$) between sample ADC and BDC likewise CDC and DDC. For the taste, sample BDC had the highest while EDC had the least value. There was no significant difference ($p<0.05$) between ADC, BDC, CDC and DDC. The texture ranged from 3.10-4.40%, BDC had the highest while EDC had the lowest. The value of the overall acceptability ranged from 3.20%-4.60%, ADC had the highest value and EDC had the lowest. There was no significant difference between ADC and BDC as well as CDC and DDC.

The protein of the cookies increase at the addition of the soybean flour but here was significant disease as the level of cocoyam substitution increases. This can be explained by the fat that cocoyam is a poor source of protein and a good source of carbohydrate, predominantly starch and are consumed as energy yielding food (Onyieike, et al, 2004). Also Maillard reaction could be responsible for losses of protein as this depends on the intensity of heat and temperate as well as the drying method adopted (Oyenuga 1992). Soya bean had the highest protein content while cocoyam flour had the least. Ash is the total mineral content prevent in the samples. Soybean was reported to have the highest as content, with wheat having the lowest. The increase in ash content could be attributed to the higher level of ash content in the soybean and cocoyam flour than the wheat flour.

Crude fibre measures the cellulose, hemicelluloses and lignin content of food. The crude fibre content of the wheat flour was the lowest while that of soybean flour was the highest. The increase in crude fibre content of the cookies increased at the increase rate of cocoyam flour substitution. This is due to the fact that wheat flour had a lower fibre content compared to that of soybean and cocoyam flour. Crude fibre contributes to the health of the gastro intenstinal system and metabolic system in man. Fat acts as a flavor retainer and helps improve sensory properties of baked products (Ikpeme et al 2010). The high percentage of fat content in the cookies can be attributed to the presence of the soybean flour and the amount of oil and shortenings that was added during production. The fat content reduced at the increase of the cocoyam flour used-cocoyam flour had the least fat content while soybean had the highest. The water absorption capacity of flour is an important properly in foods. The ability of protein in flours to physically bind water is a determinant of its water absorption capacity (Ikpeme et al, 2010). The values of the water absorption capacity was very high especially in soybean flour because protein consists of sub units structure and dissociates on heating which is in agreement with the findings of Dey and Quensi (1988) which reported that protein subunit have more water binding site.

Absorption of oil by food products improves the mouth fed and retains flavor. It is an important parameter of flour used in baking (Ikpeme, et al, 2010). The gelling ability of the sample is due to the nature of the starch and protein and also their interaction during processing. Soybean flour had the highest gelatination temperature while wheat flour had the lowest.

With respect to overall acceptability, BDC and CDC were acceptable although ADC was preferred most while EDC were rejected. This indicated that up to 20%-30% substitution is acceptable especially 20% substitution which from the result shows similarities in the overall acceptability of cookies produced from ADC.

The result of the study has shown that substitution of wheat flour with cocoyam and soybean flour increased the protein content. It was further revealed that 10% of cocoyam, 10% soybean and 80% wheat flour blend produced the overall best result across all the parameter and nutrient. The result also confirms that the quality of colour,

appearance, texture and taste influenced the overall acceptability of the cookies. Flour could be therefore be replaced with up to 20% with 10% soybean and 10% cocoyam flour in cookie production without affecting the sensory qualities. Since the inclusion o10% cocoyam and 10% soybean is good for cookies, it could be tried with other baked product such as bread and biscuits.

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