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QUALITY CHARACTERISTICS OF BISCUITS PRODUCED FROM COMPOSITE FLOURS OF WHEAT, COCOYAM AND GOLDEN MELON SEED.

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Abstract: Biscuits are nutritive snack produced from unpalatable dough that is transformed into appetizing products through the application of heat in the oven. Cocoyam corms and golden melon seed were processed into flour blends and biscuit was produced from wheat, cocoyam and golden melon flour blends. The composite flour was analyzed for functional properties like bulk density, water absorption, swelling power, solubility and dispersibility while Proximate properties like protein, fat, crude fibre, moisture content, carbohydrate; and sensory analysis were carried out on different blends of the biscuit produced using standard methods. The result of proximate properties shows that addition of golden melon flour (GF) at 10, 15, 20% had low moisture content. No significance difference (P<0.05) was observed in the Ash and crude fibre content of all samples. The fat content had an increase at 5% level of golden melon flour (GF). The highest carbohydrate content was observed in the biscuit containing the highest proportion of cocoyam flour (CF). The biscuit sample with 60%(WF):30%(CF):10%(GF) has the highest protein content. On the basis of sensory score, biscuit produced from 70%WF: 25%CF: 5%GF were ranked highest and more acceptable than others. The successful supplementation of golden melon flour (GF) at 10% level brought an increase in the protein content which will help to alleviate the problem of protein energy malnutrition since consumption of biscuit in Nigeria is high.

Keywords: Biscuit, Composite Flour, Proximate Composition, Functional Properties

INTRODUCTION

Composite flour can be described as a mixture of several flours obtained from roots and tubers, cereal and legumes e.t.c. with or without the addition of wheat flour (Adeyemi and Ogazi, 1985). It can also be a mixture of different flours from cereal, legumes, or root crops that is created to satisfy specific functional characteristics and nutrient composition. Wheat (*Triticum aestium L*) is one of the important cereals grains because of its use for the preparation of many baked products. Wheat does not grow in tropics and has to be imported by countries in these regions. Incessant increase in the cost of wheat has in turn led to constant increase in prices, which had led to the need to develop alternative to the use of locally grown crops. Cocoyam is a root crop grown in the tropics (Ihekernye and Ngoddy, 1985). It has fine granular starch which has been reported to improve binding and reduce breakage of snacks product (Hung, 2005). Most of the commercial biscuits in the market contain 8-12% protein (PAG Guidline, 1971). This amount is not enough to fulfill the protein requirements of the children. Flour from local grown crops and high protein seeds are partially used to replace wheat flour for use in baked food and producing protein enriched products (Olaoye *et al.*, 2006). Biscuits are one of the popular cereals foods, apart from bread, consumed in Nigeria. They are ready to eat, convenient and inexpensive food products, containing digestive and dietary principles of vital importance (Kulkarni, 1997). They are nutritive snacks produced from unpalatable dough that is transformed into appetizing product through the application of heat in the oven (Kure *et al.,* 1998). In this study biscuits will be produced from wheat, cocoyam that is locally available and has been reported to improve binding and reduce breakage in snacks product and melon seed that is high in protein. The aim of this project work is to determine the quality characteristics of biscuits produced from composite flours of wheat, cocoyam and golden melon seed.

MATERIALS AND METHOD

Cocoyam was brought from Isihun market, Sagamu in Ogun State while golden melon was bought from Kuto market, Abeokuta Ogun State both in Nigeria.

Production of Flour

Production of Cocoyam flour

The cocoyam flour was prepared using the method described by Okaka, (1997). The corns was washed, peeled, sliced and blanched at 80°C for four minutes. The blanched cocoyam was dried and milled to pass through 40-mesh sieve (British standard) and packaged in air tight container until needed (Fig 1)

Cocoyam Corns

↓

Washed

↓

Peeled

↓

Sliced

↓

Blanch (80)°C for four minutes

↓

Dried

↓

Milled

↓

Sieved

↓

Cocoyam Flour

Fig 1: Flow chart of cocoyam flour
Source: Okaka, (1997)

Production of Golden Melon

The golden melon seed was extracted, washed, drained, dried (sun drying), milled and sieved through 40-mesh sieve (Figure 2).

Golden melon pod
↓
Breaking
↓
Removal of seed
↓
Washing
↓
Drying
↓
Milling
↓
Sieving
↓
Golden melon flour

Fig 2: Flow Chart of Golden Melon Flour

Formulation of Flour Composites

Composite blends of wheat, cocoyam and golden melon flour were formulated as shown in Table 1. The flours were thoroughly mixed to obtain homogeneous blends. Samples were stored in airtight containers at room temperature until ready for use.

TABLE 1: LEVEL OF SUBSTITUTION OF WHEAT-COCOYAM-GOLDEN MELON FLOUR MIXES

WHEAT F (%)	COCOYAM F (%)	GOLDEN MELON F (%)
100	-	-
70	25	5
60	30	10
50	35	15
40	40	20

F= Flour

Biscuit Production

Biscuits were produced from the five blend formulations using the method of Olaoye *et al.* (2007). All ingredients except flour and sodium bicarbonate were added with continued mixing. The dough was then placed on a cutting board, rolled out until uniform thickness and textures were obtained. Biscuit cutter was used to cut the sheet of rolled dough into desired shapes and sizes. The shaped dough pieces were then baked at about 220°C for 15 min, allowed to cool, packed and stored (Kure et al., 1998).

Evaluation of Functional Properties of Composite Wheat-Cocoyam-Golden Melon Seed Flour

Bulk Density

Bulk density of the composite flour was determined according to the method of Wang and Kinsella, 1976.

Swelling Power and Solubility of Starch/Flour

Swelling power was determined according to the method of Dubois *et al.*, 1956. (Takashi and Seib, 1988).

Water Absorption Capacity (WAC)

Water absorption capacity was determined according to the method of Sosulski, 1962.

Dispersibility (Flour and Flour Blends)

Dispersibility was determined according to the method described by Kulkarmi *et al.*, 1995.

Proximate Analysis

The proximate composition of the wheat, cocoyam, golden melon biscuit samples was determined using standard methods (AOAC, 1995; Pearson, 1976). The samples were analyzed for crude fibre, moisture, ash, crude protein, crude fat and carbohydrate (by difference).

Sensory Evaluation of the Produced Biscuits

The organoleptic evaluation of the biscuit samples was carried out for consumer acceptance. A total of 25 semi trained panelists were used to evaluate the sensory attributes including colour, aroma, taste, crispiness and overall acceptability (Ihekoronye and Ngoddy, 1985). The scores were subjected to analysis of variance (ANOVA) using the statistical package for social statistics (SPSS). Means was separated using the Duncan multiple range test (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

Functional Properties

Functional properties are those parameters that determine the application and use of food material for various uses (Adebowale *et al.*, 2012). The functional properties of wheat (W)-cocoyam (C)-golden melon seed (G) flour (F) is shown in Table 2. It shows that the bulk density both trapped and untrapped of the flour samples ranged within 0.51-0.67g/cm ^{3} and 0.34-0.48g/cm ^{3} respectively, with sample 40WF:40CF:20GF having the lowest value and sample 50WF:35CF:15GF having the highest value. This result fell within the range reported for by Ubbor and Akobundu (2009), who stated that the bulk density of composite flours of water melon seed, cassava and wheat ranged from 0.595-0.725g/cm^3.The water absorption capacity of the blends ranged within 193.48-209.21% with sample 100WF:0CF:0GF having the highest value and sample 60WF:30CF:10GF having the lowest value of gelatinization. This result shows that the composite flour have good gelling property. Water absorption capacity is important in bulking and consistency of products as well as in baking applications (Niba *et al.,* 2001). The swelling power of the flour samples at 65°C, 75°C¸85°C and 95°C ranged within 103.59-105.99%, 102.89-105.51%, 105.48-112.03% and 120.57-138.06% respectively. Flour samples of the blend increased from 103.59% in sample 60WF:30CF:10GF to 105.99% in 40WF:40CF:20GF at 65°C. At 75°C, the swelling power increased from 102.89% in sample 100WF:0CF:0GF to 105.51% in sample 60WF:30CF:10GF. At 85°C, the swelling power increased from 105.48% in sample 70WWF:25CF:5GF to 112.03% in 100WF:0CF:0GF. At 95°C, the swelling power increased from 120.57% in flour sample 40WF:40CF:20GF to 138.06% in sample 70WF:25CF:5GF. Swelling power is also related to the water absorption index of starch based flour during heating (Loos *et al.,* 1981). The solubility of the flour samples at 65°C, 75°C, 85°C and 95 °C ranged within 0.90-2.58%, 0.41-1.78%, 1.39-2.68% and 0.60-2.91% respectively. At 65°C and 75°C, the flour samples increased from 0.90-2.58% and 0.41-1.78 with sample 40WF:40CF:20GF having the lowest value and sample 100WF:0CF:0GF having the highest value at both degree. At 85°C, sample 50WF:35CF:15GF had the lowest value with sample100WF:0CF:0GF having the highest value. At 95°C, flour sample value increased from 0.60-2.91% with sample 40WF:40CF:20GF having the lowest value and sample 70WF:25CF:5GF having the highest value. The dispersibility of the flour sample ranged between 62.00-76.00% with flour sample 50WF:35CF:15GF having the lowest value and sample 40WF:40CF:20GF having the highest value. This result is in accordance to Adebowale *et al.,* (2012), who reported that the dispersibility of sorghum- wheat composite flour ranged between 73.5 and 76.5°C with 100% wheat flour having the lowest value than that of sorghum- wheat flour samples. However, the values of dispersibility are relatively high for all the composite flour and hence, they will easily reconstitute to give fine consistency dough during mixing (Adebowale *et al.,* 2008).

TABLE 2: FUNCTIONAL PROPERTIES OF COMPOSITE FLOUR BLENDS OF WHEAT-COCOYAM-GOLDEN MELON SEED

SAMPLE PARAMETERS	WF:CF:GF 100:0:0	WF:CF:GF 70:25:5	WF:CF:GF 60:30:10	WF:CF:GF 50:35:15	WF:CF:GF 40:40:20
BD trapped (g/cm^3)	0.61^c	0.61^b	0.53^d	0.67^a	0.51^e
BD untrapped (g/cm$^{3)}$	0.43^c	0.44^b	0.41^d	0.48^a	0.34^e
WAC (%)	209.21^a	198.87^c	193.48^e	198.11^d	208.34^b
Swelling A (%)	104.83^c	103.98^d	103.59^e	105.12^b	105.99^a
Swelling B (%)	102.89^e	105.21^d	105.51^a	105.30^c	105.37^b
Swelling C (%)	112.03^a	105.48^e	110.52^b	108.11^c	106.45^d
Swelling D (%)	122.03^a	138.06^a	122.98^b	122.75^c	120.57^e
SolubilityA(%)	2.58^a	2.39^a	1.12^b	0.99^b	0.90^b
Solubility B (%)	1.78^a	1.12^b	0.53^d	0.86^c	0.41^e
Solubility C (%)	2.68^a	1.86^c	1.91^b	1.39^c	1.43^c
Solubility D (%)	0.84^b	2.91^a	0.89^b	0.99^b	0.60^c
Dispersibility (%)	70.00^b	74.00^{ab}	70.00^b	62.00^c	76.00^a

KEY
WF = Wheat Flour — **Swelling A = swelling at 65°c** — **Solubility B = solubility at 75°c**
GF = Golden Melon Seed Flour — **Swelling B = swelling at 75°c** — **Solubility C = solubility at 85°c**
CF = Cocoyam Flour — **Swelling C = swelling at 85°c** — **Solubility D = solubility at 95°c**
BD = Bulk Density — **Swelling D = swelling at 95°c** — **Solubility A = solubility at 65°c**
WAC = Water Absorption Capacity

Proximate Composition

Proximate composition is important in determining the quality of raw materials and often the basis for establishing the nutritional value and overall acceptance of the consumers (Ojuku *et al.,* 2012). Proximate composition of the biscuits produced from composite blends of wheat, cocoyam and golden melon seed flour is shown in Table 3. Moisture content is an index of stability of food. The amount of moisture in food affects its keeping quality, the nutrient and rate of microbial spoilage (Bollin and Stafford, 1974). There was a gradual decrease of moisture content from 8.31% in the biscuit sample with ratio 70WF: 25CF: 5GF to 4.83% in the sample 60WF: 30CF: 10GF. Echendu *et al.* (2004) reported that low moisture content enhances keeping quality of flour. From the result obtained biscuit sample with 60WF: 30CF: 10GF has the lowest moisture content with value 4.83%. Ash content is a measure of the total mineral content of a food (Vunchi *et al.*, 2011). The ash content decrease from 1.32% in the biscuit sample with 60WF: 30CF: 10GF to 1.27% in sample with 50WF: 35CF: 15GF. Lower ash content may be due to increase in activity of microorganisms utilizing the mineral for growth (Ashaye *et al.,* 2006). The increase in ash content helps in releasing more nutrients, leaving the antinutrient (Echendu, 2004).

TABLE 3: PROXIMATE PROPERTIES OF FORMULATED BISCUIT SAMPLES FROM WHEAT-COCOYAM-GOLDEN MELON SEED FLOUR BLENDS

Sample Parameters	WF:CF:GF 100:0:0	WF:CF:GF 70:25:5	WF:CF:GF 60:30:10	WF:CF:GF 50:35:15	WF:CF:GF 40:40:20
MOISTURE %	5.93[b]	8.31[d]	4.83[a]	7.74[c]	5.89[b]
ASH %	1.01[a]	1.17[a]	1.32[a]	1.27[a]	1.23[a]
CRUDE FIBRE %	0.89[a]	0.96[a]	0.79[a]	1.02[a]	0.94[a]
PROTEIN %	9.46[bc]	8.50[ab]	9.57[c]	8.39[a]	8.78[abc]
FAT%	14.47[b]	15.31[c]	14.75[b]	13.41[a]	14.36[b]
CARBOHYDRATE %	68.24[c]	65.75[b]	68.77[a]	68.15[c]	68.80[b]

KEY: WF = Wheat flour, CF = Cocoyam flour, GF = Golden melon flour
Values with sample alphabets in a row are not significantly difference ($P < 0.05$)
Values are means of triplicate readings.

The crude fibre content of the composite biscuit increased with cocoyam flour from 0.79% in the 60WF: 30CF: 10GF to 1.02% in the 50WF: 35CF: 15GF. However, this was below 2.0% maximum allowable fibre content recommended by Nigerian raw materials research and development council (RMRDC, 2004). The biscuit sample with 50WF: 35CF: 15GF has the highest fibre content 1.02% which is below the required level of fibre recommended by RMRDC. The fat content ranged from 15.31% of biscuit sample with 70WF: 25CF: 5GF to 13.41% biscuit sample with 50WF: 35CF: 15GF. The result also supports the findings of Iwoka *et al.,* (1994) who reported that starch has low fat content. Also the decrease in fat content implies an increase in shelf life for the blends samples as earlier reported by Onwuka *et al.,* (2008) in the sensory attributes of wheat sesame cookies. Proteins are large biological molecules, or macromolecules, consisting of one or more chains of amino acid residues (en.m.wikipedia.org/wiki/protein). The protein content of the biscuit sample increased at the level of 60WF: 30CF: 10GF with value 9.57% while the biscuit sample with 50WF: 35CF: 15GF has the lowest value. This is similar to the earlier findings of Okoye *et al.* (2007) where the protein content of biscuit reduced slightly with supplementation of starch based product. From this result the value of protein reduced as cocoyam flour increased in the blends of 50WF: 35CF: 15GF. The carbohydrate content initially increased as the cocoyam flour and golden melon flour ratio increased in the biscuit sample with 60WF: 30CF: 10GF from 68.77% to 68.80% in the biscuit sample with 40WF: 40CF: 20GF. And this could be attributed to the high population of cocoyam in the blends. It has been reported that all the solid nutrient present in roots and tubers (like cocoyam), are carbohydrate predominate (Enwere, 1998).

Sensory Evaluation

Biscuits prepared from wheat, cocoyam and golden melon seed flour were subjected to sensory evaluation for colour, taste, aroma, crispiness and overall acceptability. The result is shown in Table 4. The highest and lowest mean score for colour was 5.72 and 2.96 respectively. The colour of control sample 100% wheat was superior to that of the composite flour. The biscuits with 35% replacement of cocoyam flour and 15% golden melon seed flour had the lowest score for colour. The score for crispiness decreased with increase in the ratio of the cocoyam flour and golden melon seed flour. The biscuits with 40% replacement of cocoyam and 20% of golden melon seed flour had the least score. This result shows that the more the cocoyam the less the crispiness. Aroma is another important attribute that influence the acceptance of baked food even before they are tasted. The scores for aroma ranged between 2.88 and 5.92 with biscuit sample produced from70WF:25CF:5GF having the highest score and sample 40WF:40CF:20GF having the lowest score. This means that biscuits from 75% cocoyam substitution and 5% golden melon seed flour were acceptable. The score for taste ranged within 3.04-5.68, with biscuit samples produced from 70WF:25CF:5GF having the highest score and sample 40WF:40CF:20GF having the lowest score. For overall acceptability, the result confirmed that the quality of colour, aroma, crispiness, taste indeed influence the overall acceptability of tsshe biscuit. The biscuit sample produced from 70WF:25CF:5GF was the best in terms of the overall acceptability. There was significant difference ($p<0.05$) among the samples. This result differ from the findings of Akubor and Ukwuru (2005), who studied the effect of soy flour on the functional properties and biscuit making potential of soy bean and cassava flour blends. They observed that there was significant difference ($p>0.05$) in colour, taste, flavour, texture and overall acceptability of both soy enriched and unenriched flour blends cookies.

TABLE 4: SENSORY EVALUATION OF BISCUIT PRODUCED FROM WHEAT-COCOYAM-GOLDEN MELON SEED FLOUR

SAMPLE	COLOUR	CRISPINESS	AROMA	TASTE	O/A
A	5.72^{c}	5.12^{b}	4.48^{b}	5.36^{c}	4.92^{b}
B	5.16^{bc}	5.00^{b}	5.92^{c}	5.68^{c}	6.24^{c}
C	4.40^{b}	5.04^{b}	4.76^{b}	4.16^{b}	5.20^{b}
D	2.96^{a}	3.60^{a}	3.28^{a}	3.12^{b}	2.88^{a}
E	3.16^{a}	3.48^{a}	2.88^{a}	3.04^{a}	2.28^{a}

KEY
A = 100:0:0 Wheat-cocoyam-golden melon seed flour
B = 70:25:5 Wheat-cocoyam-golden melon seed flour
C = 60:30:10 Wheat-cocoyam-golden melon flour
D = 50:25:15 Wheat-cocoyam-golden melon seed flour
E = 40:40:20 Wheat-cocoyam-golden melon flour
Means with the same alphabets superscripts within the column are not significantly different.

CONCLUSION AND RECOMMENDATION

The result of this study has shown that substituting wheat flour with cocoyam flour and golden melon flour produced biscuits with significant difference in quality. At a level of 60% WF: 30% CF: 10% GF there was an increase in the protein content and fat content of the biscuit samples. Also in terms of aroma, taste and overall acceptability biscuits from wheat, cocoyam, golden melon seed flour composite was acceptable up to the supplementation level of 25% cocoyam flour and 5% golden melon seed flour. The use of cocoyam and golden melon seed flour in biscuit making would enhance the utilization of these crops in developing countries where it has not been utilized. Further work is necessary in terms of the microbiological examinations and shelf life of the products as this will help in improvement in the product.

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