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QUALITY CHARACTERISTICS OF COOKIES PRODUCED FROM COMPOSITE FLOURS OF CASSAVA AND CUCURBITA MIXTA SEED

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ABSTRACT

The use of cucurbita mixta flour substitution in cassava flour from 5 to 30% each for the production of cassava-cucurbita mixta (CCM) cookies was evaluated for proximate, functional and consumer acceptability. Fresh samples of cucurbita mixta were sorted and dried at 60^0C for 6hrs to produce six blends with cassava flour baked to produce cookies. Data obtained showed that protein, ash content and gross energy increased with increased proportion of cucurbita mixta seed flour. The protein content of the resulting cookies increased significantly from 2.10-20.05% with a corresponding decrease in the carbohydrate content from 82-55.10% and swelling power from 2.20-1.57%, water absorption capacity 2.30-1.85, bulk density 0.79-0.60 while foam stability increased from 8.60 to 13.08. The ash content increased with progressive increase in the proportion of cucurbita mixta flour, the highest value (5.40%) was recorded for the 30% cookies. At 20% level of substitution with cucurbita mixta flour, there was no noticeable difference in the organoleptic qualities of the composite product and that obtained from pure cassava flour alone. Apart from adding value and varieties to cookies, the data obtained clearly show the nutritional potentials of cucurbita mixta as alternative food ingredient for protein fortification and a good source of amino acids for children and adult which will reduce problem of food security among where malnutrition due to protein deficiency is prevalent.

Keywords: Cassava flour, cucurbita mixta seed flour, cookies, physicochemical analysis

INTRODUCTION

Cookies are flat, dry, sweet biscuits. The word biscuit comes from the French word '’biscuit”, twice-cooked, and is a literal description of what happened in the early days of biscuit making. Research into the use of tropical crops has shown that biscuits and other pastries such as meat-pie, cookies, cake etc could be made from flours of locally available crops such as sweet potato, cassava, corn, rice, millet, sorghum etc [1]. Cookies are convenient snacks product dried to a very low moisture content taken among young people and adult to provide energy [2]. This food is made from unleavened dough [3]. It is produced from a mixture of flour and water which may contain fat, sugar and other ingredients mixed together into dough which is rested for a period and passed between rollers to make a sheet [4]. It provides an excellent means of improving the nutritional quantity of foods through incorporation of less expensive high quality protein, minerals, vitamins and has been employed in food product enrichment [5]. The consumption of which is steady and increasing in Nigeria. It is however, relatively expensive, being made from imported wheat that is not cultivated in the tropics for climatic reasons. Wheat importation represents an immense drain on the economy while also suppressing and displacing indigenous cereals, with a resultant detrimental effect on agricultural and technological development. The need for strategic development and use of inexpensive local resources in the production of popular foods such as cookies has been recognized by organizations such as the Food and Agricultural Organization (FAO), the International Institute for Tropical Agriculture (IITA), Nigeria and the Federal Institute for Industrial Research, Oshodi (FIIRO), Nigeria.

Cassava is one of the most drought tolerant crops and can be successfully grown on marginal soils, giving reasonable yields where many other crops do not grow well. It derives its importance from the fact that it contains high percentage of carbohydrate and is a valuable source of cheap calories especially in developing countries. The Collaborative Study on Cassava in Africa (COSCA) revealed that between 1961 and 1999, total cassava production in Africa nearly tripled from 33 million tonnes per year from 1961 to 1965, and to 87 million tones per year from 1995 to 1999, in contrast to the more moderate increases in Asia and Latin America [6]. One of the advantages cassava has over other starchy crops is the variety of uses to which the roots can be put. Apart from being a staple food for humans especially in Africa, it also has an excellent potential use as livestock feed, and in textile, plywood, paper, brewing, chemical and pharmaceutical industries. In Nigeria, cassava is traditionally processed into a wide range of products; one of such is cassava flour through a drying process. However, the nutritional quality of cassava flour can be improved by mixing it with cucurbita mixta seed flour which is very nutritious. Cucurbita Mixta, which is also known as Cushaw pumpkin is specie of *Cucurbitaceae.* The 25-26 peers of *Cucurbita* are native to the America, most from North America [7]. *Cucurbita mixta* is an excellent source of protein (37%) while its carbohydrate content is low; it is also rich in iron, B vitamin and trace elements. It is a natural source of magnesium, phosphorus, zinc, vitamin A & C [7]. Mature young fruits, male flowers, seed and young tips of the vine are consumed. The seed of cucurbita mixta is flat and endorsed in a yellow white husk, although some of the varieties produce seed without shells. Some of the research findings on cucurbita mixta seed revealed that is used as oil source, soup making and it is used medicinally [8] but scanty or no research information is available on the use of its flour for the enrichment of the low protein flour since cucurbita mixta seed flour is rich in protein (37%). It contains 50 percent oil and 35 percent proteins. *Cucurbita mixta* seed is rich in most amino acid except methionine acid, this of high nutritional values. They can also be toasted with or without salting, or they can be cooked into soup with or without removing the hulls. If the seeds are to be stored, it should be carefully dried in the sun or at lowest salting, the seed retain most of their nutrient content for year and are convenient for later user, the seed can be cooked with or without dehulling, or can be ground into nutrition oily meal [9].

MATERIALS AND METHODS

Source of Materials: The cassava root tubers used for this study were obtained from Federal Industrial Research Institute Oshodi (FIIRO). The cucurbita mixta seed was obtained from a local market in Lagos.

Production of Cucurbita Mixta Seed Flour: The cucurbita mixta seed flour was prepared by adopting the method described by[10] but with little modification. The cucurbita mixta seeds were extracted, washed, drained and dried at temperature of 60^{o}C for 6h. The dried seeds were milled and sieved through 60 mesh sieve. The cucurbita mixta seed flour was sealed in a cellophane bag and stored at room temperature (25^{o}C) for further analysis (Fig. 1).

Cassava flour production: The cassava roots were harvested, peeled, washed and grated. The resulting mash was bagged in a sack and dewatered using hydraulic press. The dewatered cake was sun dried and then further dried effectively in thermo-regulated oven (Gallen, BS model 0v-160) at a temperature of 60^{0}C for 3-4 h. The resulting material was milled and sieved into flour of 250µm particle size. The flour was sealed in cellophane bag and stored at room temperature (25^{o}C) until needed for further analysis (Fig. 2).

Formulation of flour composites: Composite blends of cassava and cucurbita mixta flour was 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 cassava- cucurbita mixta flour mixes

Flour	%	%	%	%	%	%	%
Cassava	100	95	90	85	80	75	70
Cucurbita mixta	0	5	10	15	20	25	30

Production of Cookies: Production of cookies was carried out according to the method described by [4]. The formula preparation of cookies is shown in Tables 1 and 2 by using 0, 5, 10, 15, 20, 25 and 30% cucurbita mixta flour. The sugar powder and shortening were mixed together for 10 min at slow speed with a dough mixer and then dissolved sodium and ammonium bicarbonate in 50 ml water. During the mixing at slow speed, the vanilla, fructose syrup and sodium meta-bisulphate were added. The skimmed milk, the flour and other ingredients were mixed together at slow speed for 10 min and water was added, mixed with other ingredients at high speed for 20 min. The mixing of the dough was continued until reached full development. The biscuits were baked in a conventional electric oven at 220°C for 7 min. Samples were evaluated for both physical and sensory characteristics immediately after cooling.

Proximate analysis of samples: The protein, fat, crude fibre, moisture contents were determined according to [11], while the carbohydrate was determined by difference. The total ash was determined according to [12]. The gross energy values were estimated by multiply the values of crude protein, fat and carbohydrate by their respective physiological fuel value of 4, 9 and 4 respectively. The minerals were determined is Atomic Absorption Spectrophotometer, (Ass) Indel 703[13]. Phosphorus was estimated colorimetrically by the ammonium molybdate methods.

Evaluation of functional properties: The oil and water absorption capacities, bulk density, emulsion stability, emulsion capacity, wettability were determined according to the method described by [12], the gelatinization temperature, gelation capacity were determined according to the method described by [13]. The foam stability and capacity, swelling index were determined according to the method described by [14].

Physical analysis of cookies: The biscuit break strength was determined according to the method of [14]. Analysis of variance (ANOVA) was carried out to test statistically the significance of any change in flow and break strength of the biscuit at 95% confidence level.

Sensory evaluation: The cookie quality was assessed by a test panel of 20 judges. Each product was evaluated by the panel of judges on a 9-point hedonic scale where 1 represented like extremely while 9 represented dislike extremely. The cookies were evaluated for quality characteristics such as colour, taste, texture, aroma, crispness and overall acceptability [18]. The scores were subjected to analysis of variance (ANOVA) and the treatment means separated using Duncan's multiple range tests.

Statistical analysis

The data obtained from study and sensory evaluation was statistically subjected to analysis of variance (ANOVA) and means separation was by [16]. The least significant difference (L.S.D) value was used to determine significant differences between means and to separate means at $p < 0.05$ using SPSS package version 15.0.

Cucurbita mixta fruit

Washing

Cutting

Removing of seeds

Separation of unwholesome ones

Drying

Dehulling

Drying

Grinding

Cucurbita-mixta seed flour

Fig. 1: Flow chart for Cucurbita mixta Seed flour Production

Cassava tubers
↓ Peeled
Washed
↓
Grated
↓
Dewatered
↓
Dried
↓
Milled
↓
Sieved
↓
Packaged
↓
Cassava flour

Fig. 2: Flow chart for Cassava flour Production

RESULTS AND DISCUSSION

Proximate composition of cookies: The results of the proximate composition of the cookies are shown in (Table 2). This results show that the blend CCM_5 (cucurbita seed flour/cassava flour; 75:25) had the highest protein content while sample C_1 (cassava flour; 100:0) had the lowest. There was significant difference ($p<0.05$) in protein content among the blends except for CCM_5 and CCM_6 . The high protein content of the CCM_5 (cassava flour/Cucurbita seed flour; 75:25) is due to the level of cucurbita seed flour, which contains high protein content. The high protein content in the cucurbita supplemented food would be of nutritional importance in most developing countries like Nigeria where many people can hardly afford high proteinous foods because of their high cost. According to [20], protein content of the cassava based composite flours could be elevated through the incorporation of legume flours. The chemical composition of flour samples used in this study compared favourably well with that reported by [18,19,20]. This similar observation was made in a research study by [24] who showed an increase in the protein content with corresponding increase in the proportion of bambara flour supplementation in biscuit production from cassava-wheat-bambara flour blends. The blend CCM_1 (cassava/cucurbita seed flour, 95:5) had the highest carbohydrate content while the blend CCM_6 (cassava flour/cucurbita seed flour, 70:30) had the lowest. There was significant difference ($p<0.05$) among the blends and the high carbohydrate content of CCM_6 and low carbohydrate content of CCM_1 explain the difference.

Table 2: Proximate Composition of blend samples

	Components (%)								
Samples	Moisture	Protein	Fat	Ash	Fibre	CHO	Energy	P	Fe
WCC_1	10.28a	2.10a	1.22a	2.26a	1.66a	82.50a	353.22	78.5	7.13
CCM_1	9.52b	18.10b	4.81b	3.82b	3.13b	60.62b	377.66	140.0	9.38
CCM_2	8.75c	18.55c	5.32c	4.46c	4.25c	58.67c	375.98	165.0	11.55

CCM_3	8.44d	19.20d	5.55d	5.02d	4.71d	57.08d	374.80	178.2	13.65
CCM_4	8.25e	19.59e	5.84e	5.24e	4.92e	56.15e	353.79	180.0	15.25
CCM_5	8.35f	20.00f	6.00f	5.35f	5.00f	55.34f	351.23	182.0	15.55
CCM_6	8.37f	20.05f	6.06f	5.40f	5.02f	55.10g	353.09	185.1	16.05

Means of duplicate determination, Means with the same superscripts within the column are not significantly different ($p<0.05$)

WCC_1 = Whole cassava flour (100:0)
CCM_1 = cassava/cucurbita seed flour (95:5)
CCM_2 = cassava/cucurbita seed flour (90:10)
CCM_3 = cassava/cucurbita seed flour (85:15)
CCM_4 = cassava/cucurbita seed flour (80:20)
CCM_5 = cassava/cucurbita seed flour (75:25)
CCM_6 =cassava/cucurbita seed flour (70:30)

A decrease was observed in the level of carbohydrate from 82.50%-55.10% as well as the moisture content of fortified samples from 10.28-8.37% as the proportion of cucurbita seed flour increased (Table 2). The decrease in moisture level with increase in level of substitution might serve as an indication of increasing storage stability. This result indicates that the aim of fortification was to increase the protein content while producing a more shelf stable product due its lower moisture content. These findings were in agreement with the work of [25, 26]. The carbohydrate content decreased with increase proportion of the cucurbita seed flour supporting the claims of [27, 28]. Other research workers have reported similar findings [29, 30, 31, 32, 33]. The ash and fat content of the cucurbita supplemented cassava flour was noted to assume the same trend as the protein content. The highest fat and ash content of 6.06% and 5.40% were recorded for the 30%. Cucurbita seeds have been reported to contain appreciable amount of minerals and fat [32, 33, 34, 35].

Functional properties of the samples: The results of the functional properties of the samples are shown in Table 3. The water absorption capacity (WAC) and swelling power of the cassava-cucurbita blends decreased progressively as the proportion of cucurbita seed flour increased in the mixture sample. Carbohydrates have also been reported to influence water absorption capacity of foods [36]. The ability of protein to bind water is indicative of its water absorption capacity. The observed variation in water absorption among the cowpea flours may be due to different protein concentration, their degree of interaction with water and their conformational characteristics [37]. On the other hand, [37] reported that lower water absorption capacity is due to less availability of polar amino acids in flours. This effect could probably due to loose association of amylose and amylopectin in the native granules of starch and weaker associative forces maintaining the granules structure [38]. This result showed that the composite flours had good gelling property. Water absorption capacity is important in bulking and consistency of product as well as in baking applications [39]. High swelling capacity has been reported as part of the criteria for a good quality product [40].

Table 3: Functional Properties of cookies containing cucurbita seed flour

Samples	WAC	OAC	Bulk Density	Swelling index	Foam capacity	Foam stability
WCC_1	2.30	1.52	0.79	2.20	13.52	8.60
CCM_1	2.21	1.48	0.72	2.05	12.77	7.62
CCM_2	2.15	1.45	0.67	1.92	12.51	7.50
CCM_3	2.12	1.45	0.64	1.74	12.35	12.79
CCM4	1.95	1.37	0.62	1.65	12.28	13.25
CCM5	1.91	1.32	0.61	1.60	12.12	13.15
CCM_6	1.85	1.32	0.60	1.57	12.02	13.08

Means of duplicate determination, Means with the same superscripts within the column are not significantly different ($p<0.05$)

WCC_1 = cassava flour (100:0)
CCM_1 = cassava/cucurbita seed flour (95:5)
CCM_2 = cassava/cucurbita seed flour (90:10)
CCM_3 = cassava/cucurbita seed flour (85:15)
CCM_4 = cassava/cucurbita seed flour (80:20)
CCM_5 = cassava/cucurbita seed flour (75:25)
CCM_6 =cassava/cucurbita seed flour (70:30)

The oil absorption capacity ranged from 1.52-1.32. CCM_1 had the highest oil absorption capacity while CCM_6 (Cucurbita seed flour/cassava flour, 30:70) had the lowest. Oil flavours and gives soft texture to food. Absorption of oil by food products improves mouth feel and flavour retention. The bulk density of the flour samples ranged from 0.79-0.60(Table 3). Bulk density gives an indication of the relative volume of packaging material required and high bulk density is a good physical attribute when determining the mixing quality of a particulate matter [41]. The bulk density is a reflection of the load the flour samples can carry, if allowed to rest directly on one another. The density of processed products dictate the characteristics of its container or package product density influences the amount and strength of packaging material, texture or mouth feel [42]. According to [43], higher bulk density is desirable for greater ease of dispersibility of flours. In contrast, however, low bulk density would be an advantage in the formulation of complementary foods [44]. Since CCM_6 had the least bulk density it could be the most suitable for production of complementary foods. According to [37], protein has both hydrophilic and hydrophobic properties, and so can interact with water in foods. The swelling index of the sample ranged from 1.57- 2.20 among the blends. CCM_1 (cassava flour/Cucurbits seed flour, 95:15) had the highest swelling index while CCM_6 (cassava flour/Cucurbita seed flour, 70:30) had the least. The result of the foam capacity ranged from 13.52- 12.02. CCM_1 (Cassava/cucurbita seed flour, 95:5) had the highest foam capacity while CCM_6 (cassava flour/cucurbita seed flour, 70:30) had the lowest foam capacity. The foaming capacity (FC) of a protein refers to the amount of interfacial area that can be created by the protein while foam stability (FS) refers to the ability of protein to stabilize against gravitational and mechanical stresses [46]. Foam formation and foam stability are a function of the type of protein, pH, processing methods, viscosity and surface tension. Good foam capacity and stability are desirable attributes for flours intended for the production of variety of baked products such as angel cakes, muffins, cookies, fudges, *akara*, etc and also act as functional agents in other food formulations [47]. Foam stability

(FS) describes the ability of the proteins to form strong cohesive film around air vacuole that resists air diffusion from the vacuole.

Sensory evaluation of cookies prepared from composite flour

Colour: Colour is an important sensory attribute of any food because of its influence on acceptability. Colour is an important parameter in judging properly baked cookies as brown colour resulting from Maillard reaction is always associated with baked goods. It also shows the suitable raw material used for the preparation, provides information about the formation and quality of the product. The cookies scored between 3.2 and 6.6 on the 9 point-hedonic scale indicating that the cookies were at least liked slightly and agrees with the observations of [48]. Mean quality score of the colour of the cookies are given in the Table 4. It is evident from the results that significantly ($P< 0.05$) highest was by cookies prepared from CCM_5 (6.6) while significantly ($P< 0.05$) lowest by biscuits prepared from WCC (3.2). Judges disliked the cookies prepared from WCC (whole cassava cookies) and CCM_1 (cassava/cucurbita seed flour, 95:5) with respect to colour when subjected to sensory evaluation.

Flavour: Flavour is the main criterion that makes the product to be liked or disliked. Quality score for the flavour of the cookies revealed that the flavour of the biscuits varied significantly ($P<0.05$) among different treatments. The results in Table 4 indicated that the cookies prepared from CCM_5 (cassava/cucurbita seed flour, 75:25) and CCM_6 (cassava/cucurbita seed flour, 70:30) were scored significantly ($P< 0.05$) high (6.4) for flavour. With respect to the flavour, the judges accepted cookies from all the treatments of the composite flour containing cucurbita seed flour. Similar observations were noted during supplementing wheat flour with mustard protein concentrate and cotton seed flour for the production of cookies [49].

Table 4: Sensory attributes of cookies containing cucurbita mixta seed flour

Samples	Colour	Flavour	Taste	Crispness	Texture	Overall acceptability
WCC	$3.2±1.0^f$	$5.0±1.2^c$	$6.8±1.0^b$	$4.6±1.2^d$	$4.7±1.00^e$	$4.2±1.2^g$
CCM_1	$4.5±1.2^e$	$5.2±1.2^{bc}$	$6.8±1.02^b$	$5.0±1.2^c$	$5.1±1.10^d$	$4.6±1.2^f$
CCM_2	$5.0±1.2^d$	$5.2±1.2^{bc}$	$6.8±1.01^b$	$5.2±1.2^c$	$5.5±1.03^c$	$5.4±1.2^e$
CCM_3	$5.4±1.1^c$	$5.4±1.2^b$	$6.1±1.01^b$	$5.4±1.2^b$	$7.7±1.02^b$	$5.8±1.2^d$
CCM_4	$5.7±1.1^b$	$5.6±1.2^b$	$2.8±1.02^a$	$5.6±1.2^b$	$7.7±1.02^b$	$6.4±1.2^c$
CCM_5	$6.6±1.2^a$	$6.4±1.2^a$	$3.7±1.02^a$	$6.4±1.2^a$	$8.5±1.20^a$	$7.4±1.2^b$
CCM_6	$6.4±1.2^a$	$6.4±1.2^a$	$3.2±1.03^a$	$6.6±1.2^a$	$8.7±1.21^a$	$7.7±1.2^a$

Means of duplicate determination, Means with the same superscripts within the column are not significantly different ($p<0.05$)

WCC = Whole cassava flour (100:0) CCM_1 = cassava/cucurbita seed flour (95:5)
CCM_2 = cassava/cucurbita seed flour (90:10) CCM_3 = cassava/cucurbita seed flour (85:15)
CCM_4 = cassava/cucurbita seed flour (80:20) CCM_5 = cassava/cucurbita seed flour (75:25)
CCM_6 =cassava/cucurbita seed flour (70:30)

Crispiness: Crispness is a desirable quality of cookies. Table 4 showed the quality scores for the crispiness of the cookies; from the results, quality score for the crispiness of the cookies ranged from 6.6 to 4.6. The highest (6.6) significant value (P<0.05) for the quality score of the cookies prepared from CCM_6 (cassava/cucurbita seed flour, 70:30). Judges have disliked cookies prepared from WCC (cassava flour, 100:0) when subjected under sensory evaluation. The high fat content of cucurbita seed flour was obviously responsible for the higher scores and less crispness. The effect of fat on cookies crispness and other baked goods is well known.

Texture: The texture of the cookies containing cucurbita seed flour in their formulation was significantly affected with the increase in the level of cucurbita seed flour. Cookies prepared from CCM_1 (cassava/cucurbita seed flour, 70:30) got highest (8.7) significant (P<0.05) score while lowest score was obtained in the cookies prepared from WWC (cassava flour, 100:0). With respect to the texture, Judges accepted cookies prepared from all the treatments of the composite flour containing cucurbita seed flour. The high fat content of cucurbita seed flour was obviously responsible for the higher scores and less texture. The effect of fat on cookies texture and other baked goods is well known. These results are similar to the findings of [49].

Overall acceptability: The statistical analysis regarding the overall acceptability of cookies prepared from cucurbita seed flours is shown in Table 4.The results show that supplementation significantly affected the overall acceptability of the cookies. Maximum score (7.7) by cookies prepared from CCM_6 (cassava/cucurbita seed flour, 70:30) while minimum scores (4.2) and (4.6) were scored by the cookies prepared from WCC (Whole cassava cookies) and CCM_1 (cassava/cucurbita seed flour, 90:5). Cookies prepared from WCC and CCM_1 have been were rejected by judges with respect to overall acceptability. The results of the sensory evaluation of the cookies prepared from the different treatments of the composite flour are according to the findings of [50,51], who reported increasing the levels of flaxseed flour, matric flour and caw pea flour in the biscuit which resulted in significant decrease in the sensory attributes of the cookies.

CONCLUSION

The result of the study has shown that substitution of cassava flour with cucurbita mixta seed flour increased the protein content which was the basis of the study. It was further revealed that 30% cucurbita- mixta seed flour produced the overall best result in terms of the nutrient. The result confirmed that the quality of colour, aroma, crispness, texture and taste indeed influence the overall acceptability of the cookies. Cassava flour could therefore be replaced with up to 30% with cucurbita-mixta seed flour in cookie production without affecting the sensory qualities. This study has opened up new possibilities of application for cucurbita-mixta seed four and cassava flours. However, evaluation of protein quality of the cookies in future research would be desirable.

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