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Biscuit Making Potentials of Cooking Banana and Yellow Maize Flour Blends

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Authors' contributions

This work was carried out in collaboration among all authors. Author NNU designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AIA and NMOA managed the analyses of the study. Author AIA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The study was carried out to determine the biscuit making potentials of cooking banana and yellow maize flour blends. Cooking banana and yellow maize were processed and milled into flour then blended for composite biscuit production. The samples were coded as follows; A=100:0, B=90:10, C= 80:20, D=70:30, E=60:40 and F=0:100 of maize and cooking banana respectively. All the samples were subjected to laboratory analysis for proximate and minerals using standard methods. Sensory properties of the biscuit were also evaluated by 20 panelist. Data was subjected to analysis of variance (ANOVA) using SPSS and the result recorded as mean ± standard deviation while the mean was separated using Duncan New Multiple Range ($P<0.05$). The results were 0.50 to 120.75% protein, 4.08 to 5.10% moisture, 3.45 to 7.15% fat, 2.13 to 3.68% fibre and 77.81 to 82.91% carbohydrate. The minerals were 0.50 to 120.75 mg Ca, 4.10 to 12.75 mg Fe, 124.66 to 176.10 mg Mg, 10.32 to 24.75 mg Na, 1.45 to 2.13 mg Zn and 50. 22 to 116.33 mg P. There was significant different ($P\leq0.05$) in texture, colour, appearance, flavor and overall acceptability of

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biscuits made from the composite flour. The study has revealed that biscuits of high nutrient dense and acceptable organoleptic properties could be produced from yellow maize and cooking banana composite flour blends. The use of yellow maize and cooking banana flour in biscuits preparation resulted in significant improvement in the nutrient content of the composite biscuits.

Keywords: Cooking banana; biscuit; maize; organoleptic property.

1. INTRODUCTION

Nigeria has been completely dependent on imported wheat for the manufacture of baked goods and deep fat frying products [1]. Research efforts in tropical countries were currently at steps to identify those non-wheat sources that could be used as an alternative to wheat flours, thus affecting savings in foreign exchange by limiting wheat importation. Such non-wheat flours are obtained from other cereals, legumes, tubers and root crops, for example, maize, rice, soybean, sorghum, cassava, sweet potato, potato and plantain [2,3,4,5,6,7]. These non-wheat flours are not only more nutritious than wheat flour but they are also more affordable, available and acceptable in terms of organoleptic properties.

Biscuits are ready-to-eat, cheap and convenient food products that are consumed among all age groups in many countries [8,9]. There are also sugar free biscuits for people with sugar related cases. Biscuits have been reported to be rich in fat and carbohydrates; hence they can be referred to as energy giving food as well as good sources of protein and minerals [10]. High level of acceptability of this snack could be as a result of packaging, easy availability, shelf-life, taste and they are cheaper than other snacks. Biscuit as cheap as 10.00 naira are obtainable in shops all over Nigeria which are very nutritious and of great taste.
Cooking banana locally known as '*Ogede Bello*' was introduced into Nigeria by International Institute of Tropical Agriculture to check the incidence of black sigatoka disease. It is found to possess good agronomic characteristics and is less seasonal in production than dessert banana and plantain [11,12]. There are scanty work on cooking banana but it is used traditionally in the treatment of diabetes mellitus.

Maize botanically known as *Zea mays* was first domesticated by the indigenous people in Southern Mexico [13]. Maize is one of the most widely grown cereal and cash crop. It is an important crop with diverse uses, it has low cost and also has tolerance to environmental stresses and it is highly productive. Several researches have been conducted with the composite flour to make different products ranging from breakfast cereal, confectioneries and baked foods. Raw yellow maize kernels are composed of 76% water, 19% carbohydrate, 3% protein 86 calories and are good source of the B vitamins, thiamin, niacin, pantothenic acid (B5) and folate [14].

2. METHODS

2.1 Procurement of Raw Materials

Two kilogram (2 kg) of yellow maize (*Zea mays*) seed and 1.5 kg of cooking banana were purchase from Ogbete Main Market Enugu, Nigeria.

2.2 Processing of Raw Materials

2.2.1 Production of yellow maize flour

Maize was thoroughly cleaned by picking out all broken kernels together with other foreign particles and then sorted to obtain the wholesome ones. Then 1kg of maize kernels were washed, soaked in 10 L of water and allowed to stand for 72 hours at room temperature (27°C).The maize were spread on the trays and dried in a tray dryer (Model EU 850D, UK) at 50°C for 24 h with occasional stirring at intervals of 30 mins to ensure uniform drying and ground into flour using attrition mill (Model Globe P44, China). The flour samples were passed through a 0.45mm mesh size sieve. It was then packaged in an air tight polyethylene bag, stored in a plastic container with lid and kept in a freezer until needed for analysis.

2.2.2 Production of green banana flour

The green bananas were peeled, chopped, dried and milled [15]. One and half kilogramme of green banana were washed with deionized water, peeled, sliced into smaller pieces, soaking in 0.5% sodium metabisulphite for 5 minutes to prevent enzymic browning, spread on the tray and dried in a tray dryer (Model EU 850D, UK) at 50°C for 24 h with occasional stirring of the slices

at intervals of 30 mins to ensure uniform drying and ground into flour using attrition mill (Model Globe P44, China). The flour samples were passed through a 0.45 mm mesh size sieve. It was then packaged in an air tight polyethylene bag, stored in a plastic container with lid and kept in a freezer until needed for analysis.

2.2.3 Formulation of composite blends

Maize and cooking banana flours were thoroughly mixed together at varying proportions of 100:0, 90:10, 80:20, 70:30, 60:40and 0:100 in a kenwood blender (Mini-processor, Model A 90LD, Thom Emi Kenwood Small Appliances Ltd, Hampshire, UK) to obtain homogenous composite blends. The composite blends were packaged in plastics containers, labeled and stored in the refrigerator for further use.

2.2.4 Proportion of ingredients

The proportion of ingredients used in cookies production were the method of Tyagi et al. [16].

Recipe
Flour 100 g
Sugar 50 g
Margarine 26 g
Sodium bicarbonate 1.10 g
Salt pinch
Unsweetened liquid milk 7.5 ml
Egg 3 round ball
Vanilla flavor 2.5 ml
Water 8 ml

2.3 Preparation of Biscuit

Creaming method of biscuit production was used. The margarine and sugar were first creamed simultaneously until it became creamy and fluffy. Flour, sodium bicarbonate and all other dried ingredients were hand mixed in a bowl and transferred to the creamy fat and sugar. Egg, vanilla flavor and water were added to the mixture and thoroughly mixed with hand. The mixture was transferred into food processor (Home luck). The mixture was mixed thoroughly at medium speed for 5 minutes to obtain the dough. The dough was manually rolled out on a flat and smooth floured board into sheet of uniform thickness and cut with a rectangular and circular biscuit cutter. The cut dough was transferred into baking trays lined with grease and baked at 180°C for 20 minutes in a domestic oven (camara, Italy). The biscuits were cooled at ambient temperature. Part of the biscuits were used for sensory evaluation and the other part for chemical analysis.

2.4 Chemical Analysis

2.4.1 Proximate composition

The moisture, protein, fat, fibre and ash content of the samples was determined using the method of AOAC [17,18].

2.4.2 Determination of carbohydrate content

Carbohydrate content was calculated by difference. The estimated percentages of crude protein, ash, fat, fibre and moisture was summed up and the value subtracted from 100%.

CHO = 100% - % (protein + fat + ash + fibre +moisture).

2.4.3 Mineral determination

The mineral contents, namely: Na, K, Ca, Mg, Cu, Mn, Hg and Pb contents were determined by the method described by Pearson [19] using a Pye Unicam SP9 Atomic Absorption Spectrophotometer (AAS) connected to an SP9 computer (Pye Unicam Ltd, York Street, Britain). Total phosphorus was determined by the spectrophotometric molybdovanadate [19].

2.5 Sensory Evaluation

Twenty (20) semi trained panelist consisting of staff and students of the Department of Food Science and Technology, Enugu State University of Science and Technology, Enugu were recruited and used for the study. The sensory parameters were rated on the basis of 9- point hedonic scale ranging from 1 (dislike extremely) to 9 (like extremely). The cookies were prepared from both the control and the composites flour. Five pieces of each of the samples were placed on a plate and served to the panelist to evaluate for the attributes of colour, mouthfeel, texture and overall acceptability. Prior to the sensory test, the cookies were individually coded. Clean water was provided to the judges to rinse their month in-between testing of the biscuits to avoid residual effect [20]. Expectoration cups with lids were provided for the panelists who were not interested to swallow the samples.

2.6 Statistical Analysis

All the analysis conducted in this study was reported as mean ± standard deviation. One-way ANOVA was used to determine the statistical

significance of the results. Duncan new multiple range test was applied to separate the mean [14].

3. RESULTS AND DISCUSSION

3.1 Proximate Composition

The proximate composition of the biscuits was presented in Table 1. The moisture content of the biscuits was between 4.08-5.10%/100 g. Sample A had the least moisture of 4.08% while sample F had the highest moisture content of m5. 10%/100 g. The result is in line with the values reported by Chinma et al. [21] on biscuit produced from tiger nut and pigeon pea flour blends (4.05-5.92%/100 g). The low moisture content of food is commendable since high moisture content of food affect their shelf life and predispose them to microbial spoilage. The moisture values (4.08-5.10%) of biscuits obtained in this study is below the maximum level (6.0%) recommended by Nigerian Industrial Standard (NIS) requirement for biscuit [22]. The protein content of the cookies ranges from 2.56-7.80%/100 g. The protein values of biscuit samples obtained in this study is lower than the values (9.21-11.00%) reported by Hooda and Jood [23] for wheat-fernugreek flour biscuits and 5.00-14.19% reported by Ayo et al. [24] for Acha-soybean biscuits. Protein is important in growth, building and maintenance of cell in the body. The fat content of the biscuits ranged between 3.45-7.15%/100g. The value of fat 3.45-7.15% obtained in this study is lower than the value 11.24-18.40%/100g reported by Chinma et al. [21] for tiger nut and pigeon pea flour biscuits. The fibre content of the biscuits ranged between 1.86-3.81%/100 g with sample A having the least fibre and B having the highest fibre. The fibre value (2.13-3.68%) obtained in this study is below the maximum level (5.00%) recommended [25]. Fibre has been reported to reduce the onset of hemorrhoids, diabetes, high blood pressure and obesity. The carbohydrate content of the biscuits ranged from 77.81-82.11%/100 g. Sample A had the lowest carbohydrate while sample B had the highest carbohydrate. Carbohydrate is the source of fuel for the central nervous system and energy for working muscles. They also spare protein from being used as an energy source and enable fat metabolism.

3.2 Minerals

The mineral composition of the biscuits are presented in Table 2. The iron content of the biscuits ranges between 4.10-12.25 mg/100 g. There is an increase in thye iron level of biscuits with an increase in the substitution level with cooking banana. The result of this study is in line with Chinma et al. [21] that recorded 3.18-3.81 mg/100 g iron on the biscuit made from tiger nut and pigeon pea flour blends. Ironis a component of myoglobin, a protein that provides oxygen to muscles and supports metabolism in humans [26]. The calcium content of the biscuits ranged from 0.60-120.75 mg/100 g. Sample A had the least calcium while sample F had the highest calcium (120.75 mg/100 g). Calcium is important for proper bone development in infants and young children [27]. The zinc content of the biscuits was between1.50-2.13 mg/100 g. Zinc support normal growth and development during pregnancy, adulthood and adolescent. It also stimulates the activities of vitamins, formation of red and white corpuscles, healthy functioning of the heart and normal growth [28]. The phosphorus content of the biscuits ranged from 50.22-116.33 mg/100 g. The phosphorus content of the biscuits differs significantly (P≤0.05) from each others and increased significantly with increase in substitution with cooking banana flour. Phosphorus is an important nutrient that plays a significant role in the formation of Adenosine Triphosphate (ATP) in the body [29].

Table 1. Proximate composition of biscuits prepared from maize and cooking banana flour blends (%)

Sample	Protein	Fat	Ash	Fibre	Moisture	Carbohydrate
A	7.80^{a}±0.01	7.15^{a}±0.05	1.03^{f}±0.26	2.13^{f}±0.26	4.08^{f}±0.12	77.81^{e}±0.07
B	5.30^{b}±0.27	4.99^{b}±0.21	1.27^{e}±0.59	2.20^{e}±0.86	4.22^{e}±0.02	82.11^{b}±0.21
C	5.13^{c}±0.16	4.7^{c}±0.09	1.80^{d}±0.86	2.40^{d}±0.28	4.43^{d}±0.50	81.54^{c}±0.11
D	4.40^{d}±0.38	4.30^{d}±0.92	2.35^{c}±0.06	2.55^{c}±0.81	4.80^{c}±0.26	81.60^{c}±0.33
E	3.46^{e}±0.86	3.60^{e}±0.09	2.80^{b}±0.01	2.80^{b}±0.01	4.95^{b}±0.09	82.39^{a}±0.16
F	2.56^{f}±0.38	3.45^{f}±0.59	4.30^{a}±0.12	3.68^{a}±0.16	5.10^{a}±0.11	80.91^{d}±0.86

Values are mean ±standard derivation of 3 replication. Mean with different superscript along the same column are significantly different(P<0.05) M = 100% Yellow Maize Flour, B= 90:10 Yellow maize and cooking banana flour, C= 80:20 Yellow maize and cooking banana, D= 70::30 Yellow maize and cooking banana, E=60:40 Yellow maize and cooking banana and F 100% cooking banana

Table 2. Mineral composition of biscuits prepared from maize and cooking banana composite flour blends (mg/100g)

Sample	Fe	Ca	P	Zn	Mg	Na	K
A	4.10f±0.45	0.60^{e}±0.65	50.22^{f}±0.30	1.50^{d}±0.79	176.10^{a}±0.69	10.32^{f}±0.01	82.11^{f}±0.04
B	4.38^{e}±0.01	0.50^{e}±0.65	64.53^{e}±0.24	1.45^{d}±0.03	158.09^{b}±0.76	12.71^{e}±0.50	85.60^{e}±0.21
C	4.67^{d}±0.02	15.25^{d}±0.34	78.39^{d}±0.81	1.63^{c}±0.01	142.13^{c}±0.42	14.30^{d}±0.11	95.45^{d}±0.07
D	5.25^{c}±0.72	18.10^{c}±0.01	90.07^{c}±0.68	1.88^{b}±0.47	137.00^{d}±0.13	16.14^{c}±0.24	101.22^{c}±0.81
E	8.80^{b}±0.50	21.80^{b}±0.01	100.25^{b}±0.42	1.98^{b}±0.65	133.27^{e}±0.50	16.62^{b}±0.01	138.70^{b}±0.81
F	12.25^{a}±0.42	120.75^{a}±0.65	116.33^{a}±0.50	2.13^{a}±0.81	124.66^{f}±0.01	24.75^{a}±0.42	150.66^{a}±0.02

Values are mean ±standard derivation of 3 replication. Mean with different superscript along the same column are significantly different(P<0.05) M = 100% Yellow Maize Flour, B= 90:10 Yellow maize and cooking banana flour, C= 80:20 Yellow maize and cooking banana, D= 70::30 Yellow maize and cooking banana, E=60:40 Yellow maize and cooking banana and F 100% cooking banana

Table 3. Sensory properties of biscuits prepared from maize and cooking banana composite flour blends

Sample	Appearance	Texture	Flavour	Colour	Overall acceptability
A	6.30^{a}±0.42	7.30^{a}±0.33	6.90^{a}±0.08	7.50^{a}±0.33	7.00^{a}±0.61
B	5.80^{b}±0.08	7.10^{b}±0.61	6.40^{b}±0.75	6.90^{b}±0.23	6.70^{b}±0.60
C	5.60^{c}±0.33	7.00^{c}±0.42	6.50^{c}±0.02	6.40^{c}±0.75	6.60^{c}±0.08
D	4.50^{d}±0.61	6.80^{d}±0.23	6.40^{d}±0.42	6.20^{d}±0.61	5.00d±0.33
E	4.30^{e}±0.75	6.40^{e}±0.02	6.00^{e}±0.47	5.10^{e}±0.04	4.60^{e}±0.42
F	4.00^{f}±0.02	6.20^{f}±0.75	5.30f±0.33	5.00^{f}±0.08	4.50^{f}±0.75

Values are mean ±standard derivation of 20 replication. Mean with different superscript along the same column are significantly different(P<0.05) M = 100% Yellow Maize Flour, B= 90:10 Yellow maize and cooking banana flour, C= 80:20 Yellow maize and cooking banana, D= 70::30 Yellow maize and cooking banana, E=60:40 Yellow maize and cooking banana and F 100% cooking banana

3.3 Sensory Properties

The sensory properties of the biscuits was presented in Table 3. Sample A which is 100% biscuit prepared from maize flour scored highest in all the sensory attributes studied. The high score of the sensory attributes of sample A could be as a result of the taste and colour of yellow maize. The low rating of sample F could be attributed to the unripe nature of the cooking banana. There was significant different (P≤0.05) in texture, colour, appearance, flavor and overall acceptability of biscuits made from the composite flour. Sensory properties and the level of nutrients in foods are the major attribute that lead to consumers over all acceptability of a developed recipe.

4. CONCLUSION

The study has revealed that biscuits of high nutrient dense and acceptable organoleptic properties could be produced from yellow maize and cooking banana composite flour blends. The use of yellow maize and cooking banana flour in biscuits preparation resulted in significant improvement in the nutrient content of the composite biscuits. The composite biscuits had acceptable organoleptic properties in which the overall acceptability was 7.00 and 4.50 for biscuits made from 100% yellow maize and 100% cooking banana flour blend respectively which is like moderately and dislike slightly using the hedonic scale.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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