EVALUATION OF THE PHYSICOCHEMICAL AND ORGANOLEPTIC PROPERTIES OF COOKIES PRODUCED MALTED COWPEA, UNRIPE PLANTAIN AND SWEET POTATO FLOUR

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ABSTRACT

The present study was conducted on preparation and quality evaluation of malted cowpea, unripe plantain and sweet potato flour cookies. The cookies are produced from cowpea, unripe plantain and sweet potato flour blends formulated in the ratio 90:5:5 (A), 85: 5:10 (B), 80:5:15 (C) and 100% (D) while the 75:5:20 wheat flour (sample E) prepared as control. Functional properties of the composite flour were determined and the quality of cookies produced were evaluated for physicochemical and organoleptic or sensory properties using standard methods. Bulk density, oil absorption capacity and gelatinization temperature of the flour samples decreased significantly (p<0.05) as the level of sweet potato flour addition increased. Increase in swelling, water absorption and emulsification capacities were observed and the values were higher than the control. Fortified cookies had similar physical properties with the control in term of thickness, diameter and spread ratio. Crude protein, crude fat, ash and crude fibre of fortified cookies also increased significantly when compared with the control while the carbohydrate content of the fortified cookies had the lowest values. Selected anti-nutrients (HCN, tannin, oxalate and phytate) had values higher than the control except saponin content of samples B, C and D which was lower than the control. The sensory result indicated that sample D (100% cowpea flour cookies) was most preferred followed by sample A based on aroma, appearance, taste and general acceptability. The study recommended that nutritionists are encouraged to write a detailed "nutrition textbook" that would specify the standardized preparation and processing methods that would be adopted in order to produce tasty, sweet-smelling, creamy, well-garnished, attractive, well-spiced and well-balanced cookies or snacks for optimal health of the consumers.

Keywords: Evaluation, Physicochemical, Organoleptic, Cookies, Composite Flour.

Introduction

Cookies are basically baked or cooked snack containing flour, sugar, egg, certain type of oil, butter or fat including oaks, nuts, and raisins among other ingredients. Vijerathna et al. (2019) see cookies as conveniently baked products that are ready-to-eat and readily available in different shapes and sizes (like small, flat, oval, etc.) in shops, supermarkets and even open markets at an affordable cost with high nutritive value. In view of this, cookies represent the most popular bakery items consumed among persons across varying gender and age groups globally due to their very sweet, tantalizing and acceptable taste as well as relatively cheap variants and their low water activity that allows for a long shelf life (Chauhan et al., 2015; Usman et al., 2015; Bello et al., 2020b). In Nigeria, emphasis and reliance on malted cowpea flour especially in the pastry and bakery industries is considered an innovation that would help attain the quest towards utilizing relatively cheap leguminous and carb-rich crops with dietary proteins and essential nutrients with nutritional and economic benefits to the consumers across varying demographic characteristics.

Cookies are also known as biscuits that is made from popular cereal, legume and carb-rich foods that are commonly consumed by majority of the populace across the child, adolescents, adults and aged demographic stratification. However, there appears to higher consumption of cookies especially among the pre-school and school aged children in pre-primary, primary and secondary schools in Nigeria. This standpoint underscored why Olapade and Adeyemo (2014) stated that the ready-to-eat, convenient, readily digestible, appetizing and inexpensive nature of cookies makes it as the appropriate and acceptable food or snack that is consumed by those on transit from home to school, workplace, worship or catching up with an appointment.

Despite the easiness of accessing and utilizing cookies, however, there appears to be a very serious challenge. The challenge is that the rising consumption of bread, pasta and cookies as staple foods has been confronted with the reality of the corresponding increase in the importation of wheat, which has negatively impacted and plummeted or plunged the economy and foreign exchange of most developing countries including Nigeria to a very precarious situation (Okpala & Chinyelu, 2011). There is no doubt that over-reliance on particular product (like wheat) as raw material for producing other finished food products could be associated with social, economic, nutritional, health and even diplomatic issues. This warranted Tao and Li (2018) call for global action for the production of alternative food sources and raw materials to produce cookies in order to boost the health, economy and productivity of individuals especially in developing countries. The foregoing assertion thus, necessitated the development of cookies from the composite flour of different foodstuffs such as cereals, legumes, seeds, nuts, vegetables, fruits, tubers, etc. in order to complement nutrition, create alternative for shortage, and provide therapy for nutritional diseases (Okpala et al., 2013; Asouzu, 2014; Asouzu, 2017; Asouzu, 2020; Olapade et al., 2020).

The consideration of the nutritional and economic variability of legumes and carb-rich crops in the production of nutritive and cost-effective cookies would suffice in this study. This standpoint underscores the consideration of cowpea (*Vigna unguiculata*) as one of the leguminous crops unripe plantain (*Musa paradisiaca*), and sweet potato (*Ipomoea batatas (L) Lam*) that have been well documented for its immense nutritional benefits as well as the prospects towards contributing to food security by forming part of daily staple diets of the populace (children, adolescents, adults and aged) in most developing countries including Nigeria (Hamid et al., 2015; Stagnari et al., 2017). However, the improper documentation and poor advocacy by the governments and even from the angle of nutritionists continue to de-market and delimit the popularity and usage of especially cowpea that is regarded as a poor man's meat due it being major sources of dietary proteins and essential nutrients (Bhat & Karim, 2009; Shevkani et al., 2015). Hence, it becomes imperative to explore firstly, the nutritional viability and then benefits like economic, social and cultural preservation for using cowpea in the production of cookies.

Food legumes *(Fabaceae*) have been identified as the second most valuable plant source for human nutrition. Also, cowpea (*Vigna unguiculata*) is among the indigenous edible leguminous crop to Africa is widely distributed in regions of tropical and temperate climates (Obimba et al., 2015). In the same vein, Asouzu (2017) stated that the unripe plantain (*Musa paradisiaca*), and sweet potato (*Ipomoea batatas (L) Lam*) are indigenous starchy fruit, and starchy vegetable crop respectively as well as carb-rich foods that are grown in Nigeria. This standpoint has led to the recent developments in Nigeria where governments at virtually all levels (like federal, state and local government) has collaborated with the research institutes to encourage the use of composite flours in the production of food products such as cookies, bread etc. Several studies have reported the use of composite flour in cookies production (Akusu et al., 2019; Obinna-Echem & Robinson, 2019; Ukeyima et al., 2019; Bello et al., 2019; Bello et al., 2020a; Wabali et al., 2020). All these efforts were aimed at improving the nutritional values of the cookies and also to enhance the prospects of using varied crop utilization and production prospects (Shevkani et al., 2015).

The quest towards using cowpea flour as raw materials for the production of other blends of foods underscored the essence of technology in nutrition. Accordingly, one of such nutritional-induced technology is the composite flour technology that has been used as a means for extending scarce supplies of wheat-alternative like cassava, corn and even cowpea towards the production of bread, cookies (like biscuits) among other pastries and baked goods (Idowu et al., 1996; Naiker et al., 2019). In selecting the components to be used in composite flour blends, the materials should preferably be readily available, culturally acceptable and provide increased taste, attractive colour, charming aroma as well as nutritional potential (Shevkani et al., 2015).

Composite flour is a mixture of flours, starches, pulse, legumes and other ingredients intended to replace wheat flour totally or partially in the making of bakery and pastry products. The use of composite flours had advantages of reducing high cost on importation and encourages the use of our locally grown crops as flour crop in supplementation of protein for human (Hugo et al., 2000; Hasmadi et al., 2014, Bello et al., 2019). Legume proteins can be successfully used in baked products to obtain a protein fortified products with improved amino acid balance (Bojňanská et al., 2012; Mohammed et al., 2012; Shevkani et al., 2015). This standpoint justified the assertion of Usman et al. (2015); Vijerathna et al. (2019), and Olapade et al. (2020) that the evaluation or determination of the proximate composition and sensorial attributes of foods (like cookies) that are produced from the blend, formulation and processing of another food or crop as raw materials would undoubtedly improve nutritional innovations.

In specificity, malted cowpea flours are predominantly composed of starch (35.0-52.0%), which has unique properties (i.e., low gelatinization temperature, freeze thaw stability) and serves as an important energy source for human nutrition (Tinus et al., 2012). Besides, the non-starchy nature of cowpea flour stems as the most likely characteristic that would influence its water holding capacity (Li & Zhu, 2017). On the other hand, unripe plantains are carb-rich food and a good source of fibre, vitamins and minerals with antioxidants that fight free radicals. Also, sweet potatoes are considered starchy vegetables based on their high-carb content, which provides an energy boost (Asouzu, 2014; 2017; 2020). This would eventually become an added advantage when cowpea, unripe plantain and sweet potato to be used to produce cookies that are renowned for low water activity. This would present a win-win situation for both bakers and consumers as well as the government in attaining a healthy and well-nourished populace as well as economically-stable populace in a country like Nigeria. It is against this backdrop that this study was premised on evaluating the physicochemical and organoleptic properties of cookies produced from malted cowpea (*Vigna unguiculata*) flour, unripe plantain (*Musa paradisiaca*), and sweet potato (*Ipomoea batatas (L) Lam*).

Materials and Methods

Materials Procurement

Cowpea grains were purchased from Oil Mill market, Port Harcourt Rivers State, Nigeria. Ingredients used for cookies production (margarine, egg, vanilla essence, baking powder and sugar) were purchased from Mile One market in Port Harcourt metropolis Rivers State, Nigeria. In addition, all the chemicals that were used for the analysis are of analar grade.

Material Preparation

Preparation of malted cowpea flour

One (1) kg of cowpea grains was weighed, sorted, washed and oven dried (model NAAFCO BS Oven: OVH-102) at 60 °C for 20 h. The dried wheat grain was milled in hammer mill, sieved through 150 um wire mesh and packaged in air tight plastic container, labelled and store in a refrigerator (model-AM- 200, Nexus Haier Thermocool, China) at a temperature of 4 ºC prior to analysis.

Production of malted cowpea flour cookies

The production of malted cowpea flour led to the adoption of the method that was defined by Arisa et al. (2013) as idea method to be used in the production of cookies. This led to the provision of the sugar (140 g) and margarine (220 g) that were creamed together at medium speed until fluffy. Also, egg (120 ml) was added during mixing of sugar and margarine for about 30 minutes that the continual mixing took place. After the mixing, 380 g of sifted flour, 12 g of baking powder and 25 g of vanilla essence flavour were slowly added to the mixture and kneaded or molded to form dough. At the end of this, the dough was then rolled on a flat rolling board sprinkled or strewn with flour to a uniform thickness that enable it to be cut to a uniform diameters. The cut dough was left for 30 min to rest and placed on a greased or oiled baking trays and baked in the oven at 180 ºC for a period of 30 minutes as stated by Bello et al. (2020b). In addition, the baked products were cooled at ambient temperature for 30 min, after which they were packaged in high density polyethylene that were labelled and stored at room temperature for various determinations.

Analytical methods

Determination of Functional Properties of Malted Cowpea Flour

Onwuka (2005) outlined food analysis method was adopted in the determination of bulk density, water absorption capacity, oil absorption capacity and gelatinization temperature while the method adopted by Bello et al. (2020b) for swelling index determination was adapted in this study.

Physical Properties of Cookies

The determination of the diameter, weight, and thickness of the cookie was in accordance with the method that was described by Jemziya and Mahendran (2017) while the spread ratio was calculated by dividing the diameter of the cookie with its thickness.

Determination of Anti-Nutritional Factors of Cookies

The method described by Onwuka (2005) was used to determine Total oxalate. The method articulated by Allen et al. (1974) was used for the determination of tannin. Hydrogen cyanide (HCN) was determined using alkaline filtration method as described by AOAC (2005) while the method that was described by Wheeler and Ferrel (1971) was used to determine phytic acid.

Organoleptic Test/Sensory Evaluation of Cookies

Organoleptic evaluation or sensory characteristics of the cookies was carried out using twenty (20) judges drawn from Staff, undergraduate and postgraduate students from Ignatius Ajuru University of Education Rumuolumeni community. The acceptability of the cookies was evaluated using the indices of aroma/flavor, colour/appearance, consistency, taste, temperature and general acceptability. The rating were on a nine- point hedonic scale ranging from 9 (like extremely) to 1 (dislike extremely) according to the method adopted by Asouzu (2014).

Accordingly, a nine-point hedonic scale was used to help the panelist fully expressed their degree of liking/disliking of which 9 will be the highest (like extremely) while 1 the least (dislike extremely). Like extremely to like slightly contribute good while dislike slightly to dislike extremely constitute poor. Neither like nor dislike showed that the product is neither good nor bad. All panelists were regular consumers of cookies, water at room temperature was provided to rinse their mouth between evaluations.

Statistical Analysis

All data obtained from the physicochemical and organoleptic or sensory characteristics assessments formed the data for this study. Thus, the data generated were subjected to statistical analysis using Analysis of Variance (ANOVA). The means were then separated with the use of Duncan's New Multiple Range Test (DNMRT) using the Statistical Package for the Social Sciences (SPSS) 22.0 software.

Results and Discussion

Functional Properties of Cowpea, Unripe Plantain and Sweet Potato Composite Flour

Table 1 shows the functional properties of cowpea, unripe plantain and sweet potato composite flour. Composite flour had significant ($p<0.05$) reduction on the bulk density when compared with sample E (i.e., wheat flour-Control). It ranged from 0.85-0.93 g/ml. Sample B had the highest value while the lowest value was observed in sample D. The decrease in the value of bulk density of the composite flour could be attributed to decrease in carbohydrate with increase in sweet potato flour addition. This finding is in agreement with Adelekan et al. (2013) that found the range of values from 0.62-0.90 g/ml for trifoliate yam and pumpkin seed flour blends. Hence, the relatively low values of bulk density for composite flour according to Tumwine et al. (2018), make the cowpea, unripe plantain and sweet potato composite flour suitable for high nutrient density formulations of foods. Also, Table 1 shows that the swelling capacity of composite flour ranged from 1.13 g/ml in sample A to 1.30 g/ml in sample D while sample E had 1.23 g/ml. The studies by Adebowale et al. (2012) and Bello et al. (2020b) observed that swelling index represents the water absorption of granules during heating. This finding is comparable and consistent with Bello et al. (2020a) whose value ranged from 1.13-1.24 g/ml for sprouted sorghum, pigeon pea and orange fleshed sweet potato flour blends.

Water absorption capacity (WAC) of the composite flour ranged from 0.55-0.92 g/g in samples A to D with sample E (i.e., Control) having 0.71 g/g. Samples B and C were not significantly ($p>0.05$) different. WAC is very vital in during the processing of food products because it affects its baking quality, viscosity and consistency of the products. Increase in WAC may be attributed to the low protein and high carbohydrate contents in the composite flour which agrees with the findings of Ohizua et al. (2016) and Bello et al. (2017). Also, oil absorption capacity ranged from 0.63 g/g (sample A) to 1.11 g/g (sample D) with sample samples C and D not significantly ($p>0.05$) different from sample E (1.12 g/g).

This finding is in agreement with the range of findings that was observed by Meka et al. (2019) and Bello et al. (2020b) in their studies for yellow maize, soybeans, and jackfruit seed composite flour, and for wheat, unripe plantain and fluted pumpkin seed composite flour cookies respectively. Gelatinization temperature (GT) decreased significantly and ranged from 78.00 ºC in sample C to 84.00 ºC in sample A while sample E (i.e., Control) had the highest GT of 87.00 ºC. The lowest GT observed in sample C showed that composite flour took less time to gelatinized due to the increased in sweet potato flour. This finding is within the range of 75.00 ºC - 81.00 ºC observed by Bello et al. (2020b). Variation in the gelation characteristics of composite flours as observed in this study aligned with Iwe et al. (2016) whose observance of varying gelation characteristics was attributed to the relative ratio of protein, carbohydrates and lipids that make up the flours as well as their interaction. There was no significant (p>0.05) effect on the emulsification capacity of the composite flour when compared with the control. The increasing emulsification and fat binding during processing are primary functional properties of protein. This finding is lower than the result obtained by Ajani et al. (2016) whose value ranged from 10.05-18.86% for composite of wheat and breadfruit.

Table 1. Functional properties of cowpea, unripe plantain and sweet potato composite flour

Sample (C:P:S)	Bulk density (g/ml)	Swelling capacity (g/ml)	Water absorption capacity (g/g)	Oil absorption capacity (g/g)	Gelatinization temp. (°C)	Emulsification capacity (g/ml)
A (90:5:5)	0.89^{ab}±0.04	1.13^{c}±0.02	0.55^{d}±0.00	0.63^{c}±0.00	84.00^{b}±1.00	0.85^{a}±0.02
B (85:5:10)	0.93^{ab}±0.02	1.24^{a}±0.02	0.85^{b}±0.00	0.87^{b}±0.20	82.00^{c}±1.00	0.83^{a}±0.01
C (80:5:15)	0.87^{ab}±0.05	1.25^{b}±0.02	0.84^{b}±0.00	1.09^{a}±0.00	78.00^{d}±1.00	0.87^{a}±0.05
D 100:0:0)	0.85^{c}±0.01	1.30^{a}±0.00	0.92^{a}±0.00	1.11^{a}±0.20	80.00^{e}±1.00	0.81^{a}±0.02
E (75:5:20)	0.89^{a}±0.03	1.23^{a}±0.00	0.71^{c}±0.00	1.12^{a}±0.05	87.00^{a}±1.00	0.86^{a}±0.04

Values are means ± SD of triplicate determinations. Means in the same column with different superscript are significantly (p<0.05) different. C = Cowpea flour, P = Unripe plantain flour, S = Sweet potato flour

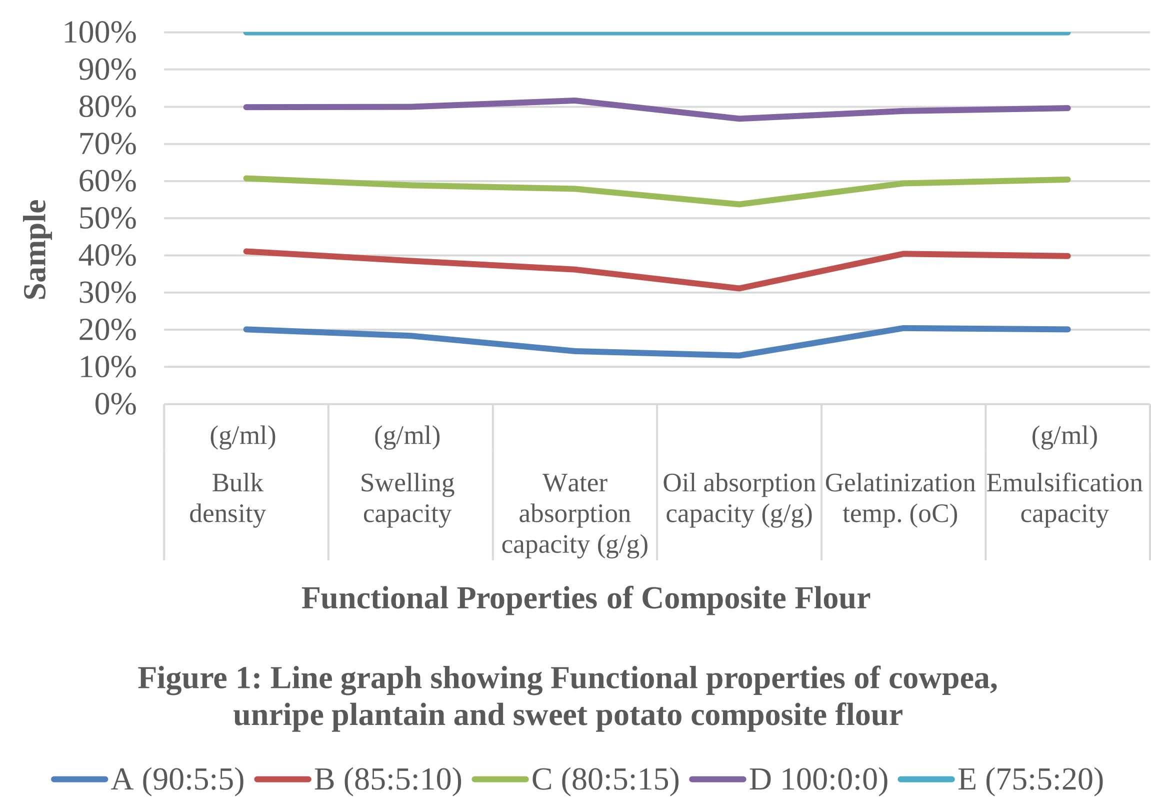

Figure 1: Line graph showing Functional properties of cowpea, unripe plantain and sweet potato composite flour

Physical Properties of Cowpea, Unripe Plantain and Sweet Potato Composite Flour Cookies

The result of the physical properties of cookies produced from cowpea, unripe plantain and sweet potato composite flour cookies is shown in Table 2. Fortification of cowpea flour and unripe plantain flour with sweet potato flour had a significant ($p<0.05$) increased on the weight of the cookies whose value ranged from 15.15-19.36 g for samples A and D, respectively, while sample E (i.e., Control) had 16.08 g. This result is an indication of an increase in the binding properties of the flour and of the texture of the cookies. In terms of thickness, the thickness of the cookies ranged from 0.95-1.24 cm while the sample E having the value of 1.04 cm. This finding is in agreement with the finding in the study by Bello et al. (2020b), which found a weight range of 15.08-19.29 and thickness range of 08.89-1.17 in their fortified cookies produced from wheat flour, unripe plantain, and fluted pumpkin seed composite flour.

Also, the diameter of the cookies ranged from 0.90-1.19 cm with sample C having the highest diameter and was not significantly ($p>0.05$) different from the sample E (1.05 cm). Implicitly, the diameter and thickness of cookies increased with the addition of sweet potato flour. The spread ratio of the fortified cookies ranged from 0.94-0.98 in samples D) and B respectively, thereby, indicating no significant ($p>0.05$) difference in spread ratio of all the cookies. This finding aligns with AbuSalem and Abou-Arab (2011) and Bello et al. (2020b) that found an increase in diameter and thickness of up to 15% and no change in spread ratio in cookies from the integration of Bambaara groundnut flour. Hence, the finding of this study on physical properties of fortified cookies align with Asouzu (2014) which found that the physical properties such as weight, thickness, diameter and spread ratio are very important attributes in the nine (9) dishes developed from local dietary fibre rich foods in Enugu State, Nigeria.

Table 2: Physical properties of fortified cookies

Sample (C:P:S)	Weight (g)	Thickness (cm)	Diameter (cm)	Spread ratio
A (90:5:5)	$15.15^{c}\pm0.75$	$0.95^{c}\pm0.22$	$0.90^{d}\pm0.01$	$0.95^{a}\pm0.02$
B (85:5:10)	$16.31^{bc}\pm0.18$	$1.18^{b}\pm0.01$	$1.14^{b}\pm0.00$	$0.98^{a}\pm0.01$
C (80:5:15)	$16.94^{b}\pm0.57$	$1.24^{a}\pm0.09$	$1.19^{a}\pm0.06$	$0.97^{a}\pm0.00$
D (100:0:0)	$19.36^{a}\pm1.46$	$1.13^{b}\pm0.71$	$1.07^{c}\pm0.42$	$0.94^{a}\pm0.05$
E (75:5:20)	$16.08^{bc}\pm0.27$	$1.04^{b}\pm0.09$	$1.05^{c}\pm0.02$	$0.96^{a}\pm0.03$

Values are means ± SD of triplicate determinations. Means in the same column with different superscript are significantly ($p<0.05$) different. C = Cowpea flour, P = Unripe plantain flour, S = Sweet potato flour

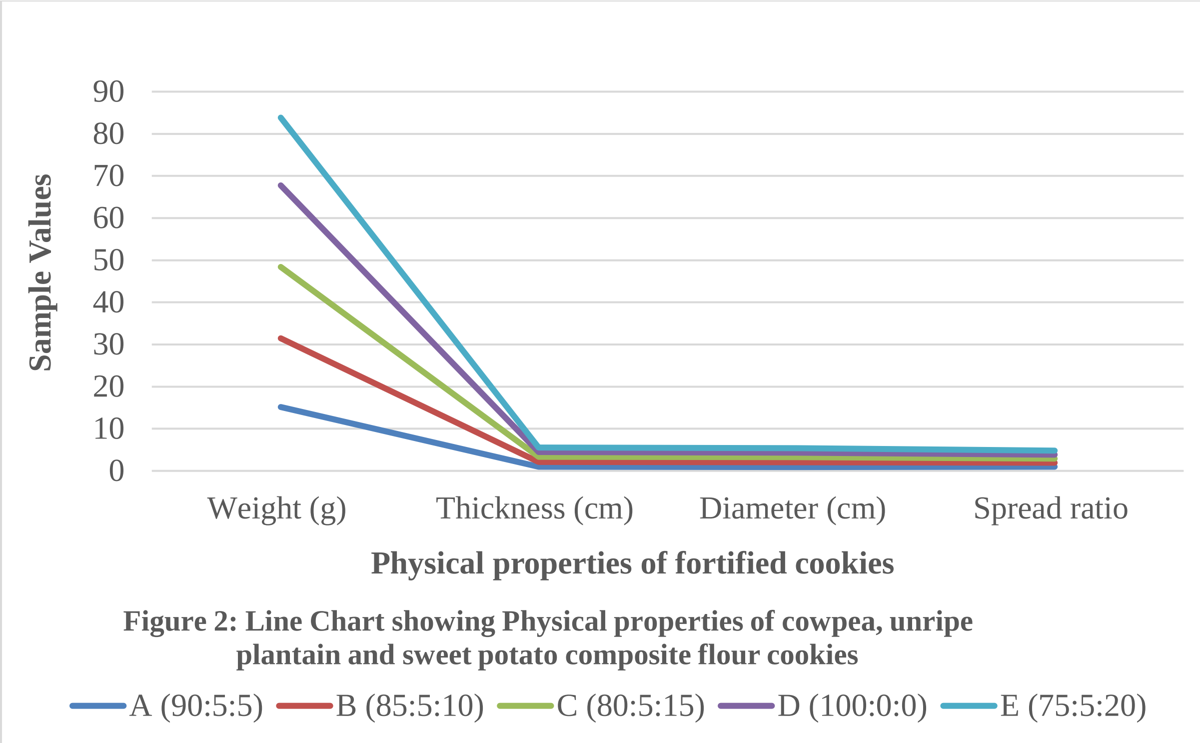

Figure 2: Line Chart showing Physical properties of cowpea, unripe plantain and sweet potato composite flour cookies

Anti-Nutritional Composition of Cowpea, Unripe Plantain and Sweet Potato Composite Flour Cookies

The result of the anti-nutritional composition of cookies produced from composite of cowpea flour and unripe plantain flour fortified with sweet potato flour is shown in Table 3. Fortified cookies had significant (p<0.05) increase in the HCN content when compared with control. It ranged from 1.26-2.92 mg/100g in samples B and D respectively, while the control sample had the lowest value of 1.05 mg/100 g. This finding aligned with the position of Bello et al. (2020b) that found the HCN level of 1.21-2.80 mg/100g in fortified cookies produced from composite of wheat flour and unripe plantain flour fortified with germinated pumpkin seed flour. This range of HCH level are within the acceptable range for human consumption. However, Bello et al. (2020a) observed that 200 mg of HCN equal to 100 mg fresh weight is considered dangerous for plants. Also, fortification of cowpea flour with unripe plantain and sweet potato flour had a significant (p<0.05) increase in the tannin content of cookies whose value ranged from 2.32-5.46 mg/100g in samples B and D respectively, while the Control (Sample E) had lowest value (2.17 mg/100g). Bello et al. (2020b) reported that tannin is known to bind protein including digestive enzymes leading to poor protein digestibility. Accordingly, the lower tannin content in the produced cookies made it safe for consumption. The range of values 242.00-297.41 mg/100g for samples B and D respectively and the value of 128.35 mg/100 g for the control indicated that the fortified cookies had the highest oxalate value when compared with the control sample. Bello et al. (2020b) reported that high oxalate diet can increase the risk of renal calcium absorption, which has been implicated as a source of kidney stones. In addition, the higher level of oxalate that was obtained in the fortified cookies agrees with the finding of Bello et al. (2018) whose values ranged from 243.40-385.36 mg/100g for yellow yam, plantain and pumpkin seed flour blends cookies.

Table 3: Anti-nutritional (mg/100g) composition of fortified cookies

Sample (C:P:S)	HCN	Tannin	Oxalate	Phytate	Saponin
A (90:5:5)	1.43^{d}±0.02	3.16^{d}±0.03	255.26^{d}±0.03	21.26^{a}±0.10	13.28^{a}±0.02
B (85:5:10)	1.26^{c}±0.03	2.32^{c}±0.01	242.00^{c}±0.10	19.13^{a}±0.02	5.46^{e}±0.03
C (80:5:15)	2.74^{b}±0.03	5.43^{b}±0.02	271.26^{b}±0.12	16.04^{c}±0.01	5.89^{c}±1.14
D (100:0:0)	2.92^{a}±0.01	5.46^{a}±0.02	297.41^{a}±0.02	14.51^{d}±0.02	5.62^{d}±0.03
E (75:5:20)	1.05^{e}±0.02	2.17^{e}±0.01	128.35^{e}±0.03	16.27^{b}±0.01	7.28^{b}±0.02

Values are means ± SD of triplicate determinations. Means in the same column with different superscript are significantly ($p<0.05$) different. C = Cowpea flour, P = Unripe plantain flour, S = Sweet potato flour, HCN = Hydrogen cyanide.

The fortification of cowpea flour with unripe plantain and sweet potato flour had a significant ($p<0.05$) effect on the phytate content of the cookies whose value ranged from 14.51 mg/100 g in sample D to 19.13 mg/100 g (Sample B), while sample E had 16.27 mg/100g. This finding is consistent with Bello et al. (2020b) that lethal point of phytate within 25 mg/100g is acceptable. Accordingly, phytate binds some essential mineral nutrients in the digestive tract and can result in mineral deficiencies (Bello et al., 2020a). Consequently, the fortification of cowpea flour and unripe plantain with sweet potato flour had a significant ($p<0.05$) increase in the saponin content of the cookies whose values ranged from 5.46-13.28 mg/100g in sample B and A respectively while sample E had the value of 7.28 mg/100g. This finding is also similar with the study by Bello et al. (2020b) that found range of values of 5.02-10.14 in their fortified cookies produced from wheat flour, unripe plantain, and fluted pumpkin seed composite flour.

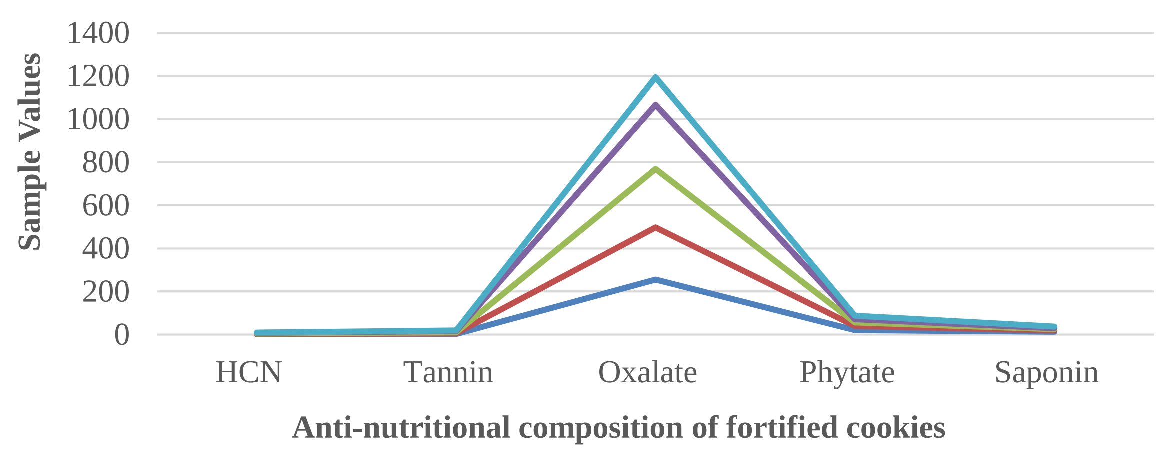

Figure 3: Anti-nutritional composition of cowpea, unripe plantain and sweet potato composite flour cookies

Organoleptic Properties of Cowpea, Unripe Plantain and Sweet Potato Flour Cookies

The organoleptic properties (sensory score) of cookies produced from composite of cowpea and unripe plantain composite flour fortified with sweet potato flour is shown in Table 4. The result showed that the fortified samples had the highest rating scores in all the organoleptic properties or attributes (such as aroma, appearance, taste, texture, temperature and general acceptability) that were evaluated when compared with the control. These tested organoleptic attributes aligned with Asouzu (2014) that conducted organoleptic tests of diets from recipe developed from local fibre rich foodstuffs under six major attributes: aroma/flavour, taste, appearance/colour, and texture/consistency, temperature and general acceptability.

The analysis of the sensory or organoleptic properties are as follows: The value for aroma/flavour ranged from 6.92-7.48 in samples A and D, respectively while the control had 5.05 for aroma. Appearance/colour had range of values 6.49-7.33 for samples A and D, respectively with the control having a higher appearance value of 5.20. The range of values for taste include 6.76 (Sample A) and 7.52 (Sample D) for the fortified cookies, while the control had value of 4.13 for taste. Also, the fortified cookies had texture/consistency values that range from 6.71-7.82 for samples A and D, respectively while control had texture value of 6.82. The value for Temperature ranged from 5.11-5.84 in samples C and D, respectively while the control had 4.92 as Temperature value. In specificity, the increase in aroma/flavor, taste and texture/consistency scores in samples D, B, A and C of the fortified cookies may be caused by reduced in polyphenol that will not give a bitter taste in these samples. The finding is contrary to the finding in the study by Bello et al. (2020b) that found reduction in flavour and taste scores in samples B, C and D of the fortified cookies produced from wheat, unripe plantain and fluted pumpkin seed composite flour was due to the increased in polyphenol which resulted to a bitter taste in those samples.

Table 4: Organoleptic Evaluation of Fortified Cookies

Sample (C:P:S)	Aroma	Appearance	Taste	Texture	Temperature	General Acceptability
A (85:5:10)	$6.92^{ab}\pm1.38$	$6.49^{c}\pm1.17$	$6.76^{c}\pm1.52$	$6.71^{a}\pm1.61$	$5.37^{a}\pm1.12$	$6.55^{c}\pm1.35$
B (90:5:5)	$7.36^{a}\pm0.94$	$7.28^{ab}\pm1.14$	$7.25^{b}\pm1.21$	$7.34^{a}\pm1.32$	$5.62^{a}\pm1.10$	$6.94^{b}\pm1.17$
C (80:5:15)	$7.43^{bc}\pm1.44$	$7.19^{ab}\pm0.65$	$7.29^{d}\pm1.50$	$7.26^{a}\pm1.29$	$5.11^{a}\pm1.04$	$6.83^{d}\pm1.24$
D (100:0:0)	$7.48^{a}\pm1.21$	$7.33^{a}\pm0.85$	$7.52^{a}\pm0.93$	$7.82^{a}\pm1.05$	$5.84^{a}\pm0.62$	$7.33^{a}\pm1.03$
E (75:5:20)	$5.05^{a}\pm0.71$	$5.20^{a}\pm0.71$	$4.13^{e}\pm0.91$	$4.67^{a}\pm1.13$	$4.92^{a}\pm1.01$	$4.78^{e}\pm0.87$

Values are means ± SD of triplicate determinations. Means in the same column with different superscript are significantly ($p<0.05$) different. C = Cowpea flour, P = Unripe plantain flour, S = Sweet potato flour.

In addition, Table 4 shows that the control had the lowest value of 4.78 for general acceptability while the fortified cookies had range of values of 6.55-7.33 for samples A and D respectively. Hence, Sample D (100% cowpea flour) was found to be generally accepted by the panelist followed by sample B (90% unripe plantain flour, 5% sweet potato flour and 5% cowpea composite flour cookies). This finding is similar to the finding by Asouzu (2014) that found that three (3) dishes out the nine (9) diets from recipe developed from local fibre rich foodstuffs were rated high on the nine-point hedonic scale by the twenty judges that were engaged in the study. Also, the generally acceptable of the three (3) dishes based on the nine-point hedonic scale is in agreement with the study by Bello et al. (2020b) that used the 9-point hedonic scale to conveniently determine the general acceptability of the fortified cookies produced from wheat, unripe plantain and fluted pumpkin seed composite flour. Hence, the 9-point hedonic scale is considered very appropriate in measuring the food preferences especially in developed recipes.

This finding is also consistent with Peryan (2005) which observed that organoleptic characteristics or sensory evaluations is a scientific discipline that analyses and measures human responses to the composition of food and drink in terms of appearance, flavour, colour, texture, temperature and taste. Furthermore, the accuracy and relevance of the rating on a nine- point hedonic scale according to Asouzu (2014), is squeal or predicated on the use of the range of values from 9 (like extremely) to 1 (dislike extremely) to determine the acceptability of foodstuffs and/or diets from developed local fibre rich foodstuffs. This hedonic scale helped the panelist to fully express and rate their degree of liking/disliking of which 9 will be the highest (like extremely) while 1 the least (dislike extremely) that is interpreted as "good" and "poor", respectively.

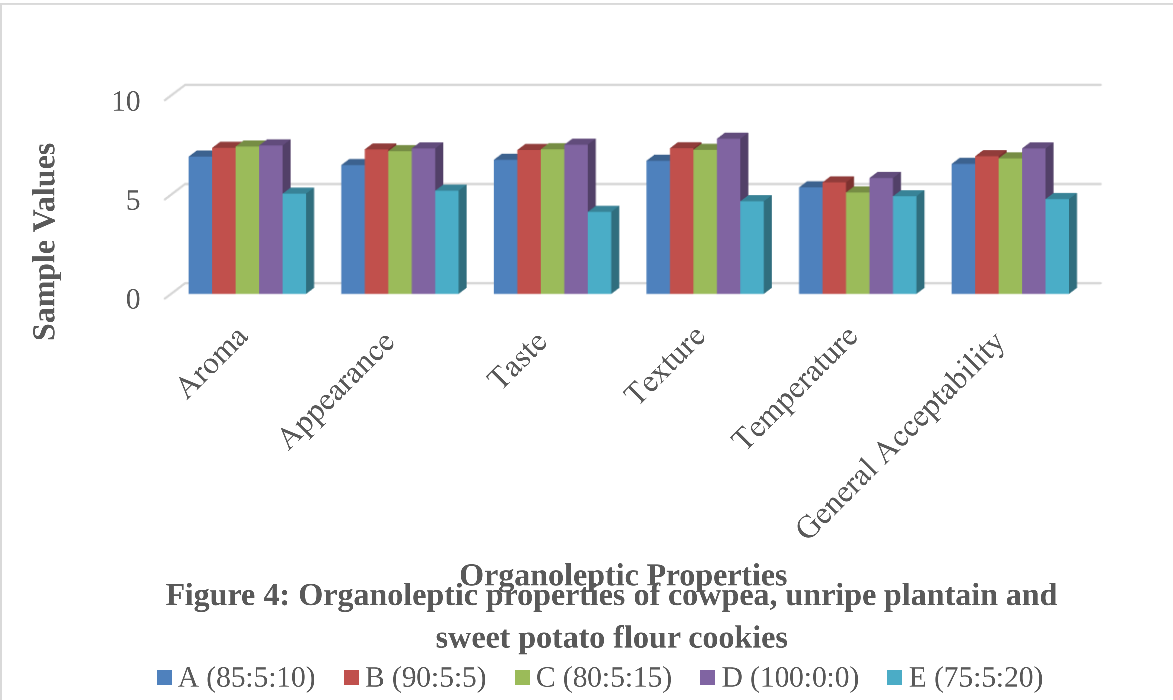

Figure 4: Organoleptic properties of cowpea, unripe plantain and sweet potato flour cookies

Conclusion

This study shows the composite flour of cowpea, unripe plantain and sweet potato is very important ingredient in food formulation as increase in water absorption and swelling capacities were observed when compared with control (75.5% wheat flour). It was also observed that fortified cookies had similar physical properties with the control in term of thickness, diameter and spread ratio. Increase in crude protein, crude fat, ash and high crude fibre contents were observed in the fortified cookies and this suggests that cookies could help reduce protein-energy malnutrition. The anti-nutrient levels in this study were lower than the lethal points which proved that the product is safe and good for consumption. Conclusively, from the fortified cookies indicated that sample B (cowpea flour) had the highest rating scores than the control in all the tested or evaluated attributes such as aroma, appearance, taste, texture, temperature including general acceptability.

Recommendations

1. Nutritionists are called upon to produce cost-effective, readily available and nutrient-fortified cookies from especially cowpea flour in view of its benefits of reducing protein-energy malnutrition.
2. Nutritionists are encouraged to write a detailed "nutrition textbook" that would specify the standardized preparation and processing methods that would be adopted

in order to produce tasty, sweet-smelling, creamy, well-garnished, attractive, well-spiced and well-balanced cookies or snacks for optimal health of the consumers.

3. Bakers and confectionaries should endeavour to use Hydrogen cyanide (HCN) level that is within the acceptable range for human consumption.
4. Fortified cookies produced from composite flour of cowpea, unripe plantain and sweet potato should be regularly produced and used as a staple food for all households in view of its capacity to help reduce protein-energy malnutrition and its associated illnesses.

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