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PROXIMATE AND SENSORY PROPERTIES OF COOKIES DEVELOPED FROM WHEAT AND COOKING BANANA (*MUSA ACUMINATA*) FLOUR BLENDS FOR HOUSEHOLD UTILIZATION

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ABSTRACT: *The proximate and sensory properties of wheat-cooking banana flour cookies were determined. Unripe cooking banana flour was processed into flour and used in composite with wheat flour for cookies production. Wheat and cooking banana composite flour was mixed in the ratios of 100:0, 90:10, 80:20, 70:30, and 50:50, coded as samples A, B, C, D and E, respectively and used to produce cookies. Supplementation of wheat flour with cooking banana flour significantly p<0.05) increased the ash (1.35-2.10%), crude fibre (1.06-2.81%) and moisture contents (2.78-8.92%) of the cookies while a decrease in the fat (31.38-29.29%), protein (8.32-7.53%) and carbohydrate (55.11-49.35%) was observed. The sensory results also showed that cookies with 10% substitution of cooking banana flour was preferable for colour, texture, aroma and taste and this compared favourably with 100% wheat flour cookies. The present result recommended that cooking banana flour has high potential as value added ingredient in cookies production for household utilization and its incorporation will promote its utilization thereby reducing dependency on wheat flour.*

KEY WORDS: Cooking banana flour, cookies, proximate and sensory properties

INTRODUCTION

Cookies are a form of confectionary product which are consumed all over the world as snack food by children, adults and on a large scale in developing countries where protein and caloric malnutrition are prevalent (Chinma, Igbadul and Omotayo, 2012). They are popular baked products due to their low manufacturing cost, convenience and long shelf-life (Onwurafor, Uzodinma, Chikwendu and Nwankwo, 2019). They can serve as a vehicle for delivery of important nutrients if readily made available to the population (Chinma and Gernah, 2007). The demand for wheat flour in the production of cookies has significantly increased due to the progressive increase in the consumption of cookies and utilization of wheat flour by households in Nigeria (Ayo-omogie and Odekunle, 2016). This partly stimulated the use of wheat-based composite flour in cookies production with the aim of improving the nutritional content of the cookies and also enhances crop utilization (Kiin-Kabari and Giami, 2015). Recently, attempts have been made to produce cookies with high sensory ratings and nutritional properties from blends of wheat/plaintain composite flours (Mepba, Eboh and Nwaojigwa, 2007), wheat/cashew nut flour (Ojinnaka and Agubolum, 2015), Wheat/African walnut flours (Barber and Obinna-Echem, 2016), Wheat/African breadfruit (Agu, Ayo, Paul and Folorunsho, 2007), wheat/tiger nut flour blends (Akajiaku, Kabuo, Alagbaoso, Orji and Nwogu, 2019).

Cooking banana (*Musa acuminata*) is a species of banana native to South East Asia and most diverse in Malaysia and Indonesia (Harith, Yasim, Harun, Omar, and Musa, 2018). This species is a hybrid of wild and cultivated bananas scientifically known as *M. acuminata Colla* (AAA Group) 'Dwarf Cavendish'. They are usually grown as house plants and can be eaten raw. This specie of banana is the most important cultivar representing approximately 50-60% of the total banana production (Oliveira, Cordeiro, Evtuguin, Torres and Silvestre, 2007). The fruits are short, stubby and highly angular of 8-13 cm long and 2.5-5.5 cm in diameter (Ogbonna, Izundu, Ikeyi and Ohia, 2016). In Nigeria, *Musa acuminata* is available year round in the Southern part of the country but highly underutilized. According to Ogbonna *et al*. (2016), it is highly restricted in utilization to produce flour and fried chips, thereby predisposing the crop to rapid post-harvest spoilage which is also contributed by its physiological metabolic activities and high moisture content. Ayo-Omogie, Adeyemi, and Otunola (2010) reported cooking banana to be rich in minerals, ash and ascorbic acid. According to Ogbonna *et al*. (2016), the unripe cooking banana flour contains 5.69-6.47% protein, 0.41-0.70% fat, 2.58-3.16% ash and 89.66-91.30% carbohydrate. Odenigbo, Asumugha, Ubbor, Nwauzor, Otuonye, Offia-Olua, Princewill-Ogbonna, Nzeagwu, Henry-Uneze, Anyika, Ukaegbu, Umeh and Anozie, (2012) stated that there is a low preference for cooking banana in Nigeria, hence the need for its utilization by households in the production of cookies. Lemchi, Tshiunza, Onyeka and Tenkouano (2005) identified that poor knowledge and poor market value are among the factors hindering the adoption of cooking banana processing and utilization methods in Nigeria.

With the progressive increase in the consumption of cookies in Nigeria, the composite flour of wheat/cooking banana if adopted has the potential to add value to an indigenous crop like cooking banana and at the same time conserve foreign exchange spent on wheat importation. The aim of the study therefore is to evaluate the proximate and sensory properties of wheat-cooking banana flour cookies.

MATERIALS AND METHODS

MATERIALS

Freshly harvested unripe cooking banana (*Musa acuminata*) fruits organically produced were obtained from the University farm, Rivers State University. Commercial wheat flour and the rest of the ingredients (i.e. fat, sugar, eggs, salt and vanilla flavour) used in the cookie production were purchased from Mile 3 market, Port Harcourt, Rivers State. Other laboratory materials and

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chemicals were collected from the Department of Food Science and Technology Laboratory, Rivers State University, Port Harcourt, Rivers State, Nigeria.

METHODS

Production of Cooking Banana flour

Cooking banana flour was prepared according to the method described by Ogbonnaya, Onumadu and Nwogu (2018). Unripe cooking banana were washed in tap water and peeled using hand pressure to obtain the pulp. The pulp were sliced (5 mm) and dried at 60°C for 24 h in a hot-air oven (Model QUB 305010G, Gallenkamp, UK), milled and sieved through a 500 mm British standard sieve (Model Bs 410, Endecotts Ltd, London, UK). The flour obtained was stored in an air-tight plastic container at room temperature (37°C) until used.

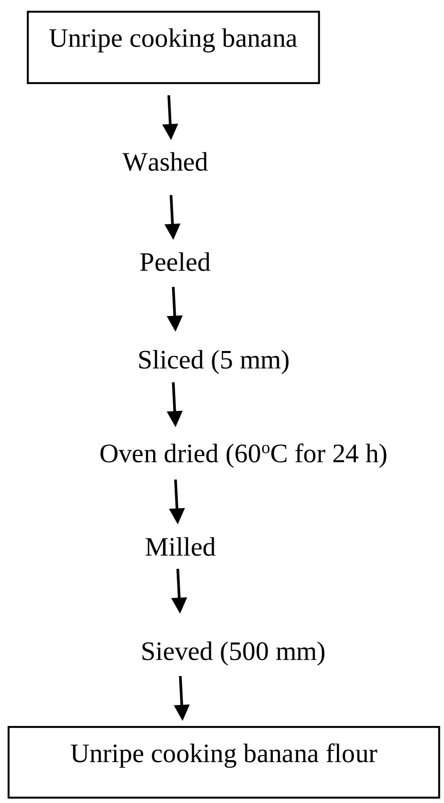

Fig 1: Flow diagram for the processing of unripe cooking banana flour
Source: Ogbonnaya *et al*. (2018)

Recipe formulation and cookies preparation

Cookies were prepared with varying levels (0-50%) of wheat flour substituted with cooking banana flour using standard ingredients shown in Table 1. The method of McWatters, Ouedraogo, Resurrection, Hung, and Philips (2003) as described by Giami and Barber (2004) was used for the preparation of the cookies. Briefly, the flours, sugar, baking powder and salt were hand mixed in a bowl. This was followed by addition of the fat and further mixing by hand to obtain a bread crumb-like mixture. The liquid was transferred into food processor (Homeluck). The liquid (egg and vanilla flavour) was then added and the mixture mixed at medium speed for 3-5 min to obtain the dough. The dough was manually rolled out on a floured board into sheets of uniform thickness of 4 mm and cut with a circular cookie cutter with diameter of 4 cm. The cut dough was transferred to baking trays lined with grease-proof paper and baked at 180^{o}C for 10-15 min in an oven. Thereafter, the baked cookies were cooled at room temperature and subjected to sensory evaluation after 24 h.

Table 1: Ingredient formulations for the production of wheat-cooking banana cookies

Ingredient	**Samples**				
	A	**B**	**C**	**D**	**E**
Wheat flour (g)	100	90	80	70	50
Cooking banana flour (g)	-	10	20	30	50
Sugar (g)	50	50	50	50	50
Margarine (g)	100	100	100	100	100
Milk (g)	250	250	250	250	250
Egg	1	1	1	1	1
Vanilla (ml)	0.5	0.5	0.5	0.5	0.5

Sensory Analysis

The sensory attributes such as colour, texture, aroma, taste, and overall acceptability, of the five cookie samples were evaluated using a nine (9) point Hedonic scale ranging from 1 (extremely dislike) to 9 (extremely like) (lwe, 2002). A 20-member panelists consisting of staff and students from the Rivers State University, Port Harcourt were selected to evaluate the sensory attributes of the cookies.

Proximate Analysis

The moisture, protein, carbohydrate, fat, crude fibre and ash content of the cookies were determined using the methods described by AOAC (2012). Moisture content was determined by drying 5 g of the milled cookies at 130°C for 1 h in an air oven (Sanyo Gallenkamp, Weiss Technik, West Midlands, UK). Ash was determined by incinerating the sample in a muffle furnace (Sanyo Gallenkamp, Weiss Technik, West Midlands, UK) at 550°C for 2 h. Fat was determined by extracting 0.5 g of sample with petroleum ether in a micro soxhlet extraction unit (Gerhardt, Bonn, Germany). Protein content of the cookies was determined by Kjeldahl method while carbohydrate was obtained by difference of moisture, protein, fat and ash from 100%.

Statistical Analysis

All experiments and analyses were carried out in duplicate and the mean calculated. Data was subjected to analysis of variance (ANOVA) using the SPSS version 23 (SPSS, IBM, Chicago USA). Duncan Multiple Range Test (DMRT) was used to separate means where significant differences existed at p=0.05.

RESULTS AND DISCUSSION

Proximate composition of cookies produced from wheat/cooking banana flour blend

Table 2 shows the proximate composition of cookies from wheat and cooking banana flour blend. There was a significant increase ($p<0.05$) in the moisture content of the cookies from 2.78% in 100% wheat flour cookies to 8.92% in cookies with equal proportion of wheat and cooking banana flour blend. This increase was also reported by Ayo-Omogie and Odekunle (2015) for wheat-cardaba banana flour blend cookies. They reported that moisture increase in the composite products resulting from Cardaba banana flour substitution might be due to higher moisture content of the dough. Ho, Noor Aziah and Azahari (2013) further added that the dietary fibre of banana flour have high water absorption capacities than wheat flour mixing. Bakery products with moisture less than 13% are stable from moisture-dependent deterioration (Ayo-Omogie and Odekunle, 2015). The moisture content of all the cookies produced was below this specified moisture content. High moisture content in the composite flour cookies is needed for easier mastication, swallowing, refreshing and hydration.

Fat content of the cookies ranged from 29.29% in cookies with equal proportion of wheat-cooking banana flour to 31.38% in 100% wheat flour cookies. There was a decrease in the fat content of the cookies as substitution of wheat flour with cooking banana flour increased. This same trend was also observed by Edima-Nyah and Ukwo (2016) who reported a decrease in fat content of banana-cocoyam composite flour blend biscuits (10.90-7.37%) as the substitution with banana flour increased. Fat plays a significant role in predicting the shelf-life of food products and as such, high fat content could be undesirable in baked food products as it promotes rancidity leading to development of unpleasant and odorous compounds (Ihekoronye and Ngoddy, 1985).

There was a decrease in the protein content of the composite cookies as compared to 100% wheat flour cookie from 7.53-8.22%. This decrease was not significant ($p>0.05$) for all the cookie samples. This finding is in agreement with that of Edima-Nyah and Ukwo (2016) who reported that decrease in crude protein of cookies was a result of increase in banana proportion. Ayo-Omogie and Odekunle (2015) also reported a decrease of wheat-Cardaba flour blend cookies from 20.97-12.97% due to increase in substitution of cardaba banana flour. The protein plays a part in the organoleptic properties of the cookie samples in addition to being a source if amino acids (Usman, Ameh, Alife and Babatunde, 2015).

Ash contents of the cookies increased from 1.35% in 100% wheat flour cookie to 2.10% in cookies with equal proportion of wheat-cooking banana flour blend. Significant differences existed in the ash contents of the cookies. Ash content of any food material is an indication of the non-organic compound containing mineral content of food. The cookies produced from equal proportions of wheat and cooking banana flour had the highest ash content implying that when used as composite flour, it will improve the mineral content of the product. This finding is in correlation with that of Ayo-Omogie and Odekunle (2015) who also reported an increase in ash content of cookies produced from wheat-cardaba banana flour blends from 0.52-1.20% as the substitution with cardaba banana flour increased.

The crude fibre content of the cookies increased significantly ($p<0.05$) from 1.06% in 100% wheat flour cookies to 2.81% in cookies with equal proportion of wheat and cooking banana flour blend. This correlates with the findings of Loza, Quispe, Villanueva and Pelaez (2017) that the addition of banana flour increased the crude fibre content of wheat flour cookies. Onyekwelu and Ogbu (2017) also reported an increase in fibre content of wheat, unripe plantain and moringa leaf blend cookies from 0.50-2.00% as the substitution with unripe flour increased. Ayo-Omogie and Odekunle (2015) also reported an increase from 0.07-1.07%. Increase in fibre content of the cookies suggests that these products will aid digestion thereby preventing constipation (Elleuch, Bedigian, Besbes, Blecker, and Attia, 2011).

There was a significant decrease ($p<0.05$) in the carbohydrate content of the cookies from 55.11% in 100% wheat flour cookie to 49.35% in cookies with equal proportion of wheat flour and cooking banana flour blend. Cookies made from 100% wheat flour have been reported to contain high amount of carbohydrate due to the higher amount of carbohydrate in wheat flour (Hawa, Satheesh and Kumela, 2018). The low carbohydrate content in wheat/cooking banana flour blend cookies will not favour better production of energy in meeting the daily activities. Ijeh, Ejike, Nkwonta and Njoku (2010) reported that high carbohydrate is important as it provides the energy needed to do work; however, low carbohydrate content in diets is also of advantage for diabetic patients that need very low carbohydrate contents in their diets. This indicates the formulated cookie blends will be suitable for diabetic patients, overweight and obese persons.

Table 2: Proximate composition of cookies produced from wheat/cooking banana flour blend

Samples	Moisture (%)	Fat (%)	Protein (%)	Ash (%)	Crude fibre (%)	Carbohydrate (%)
A	$2.78^{c}\pm0.61$	$31.38^{a}\pm2.48$	$8.32^{a}\pm0.00$	$1.35^{b}\pm0.07$	$1.06^{b}\pm0.05$	$55.11^{a}\pm0.10$
B	$3.57^{c}\pm0.11$	$31.12^{a}\pm0.97$	$8.32^{a}\pm0.00$	$1.50^{b}\pm0.29$	$1.42^{b}\pm0.24$	$54.07^{a}\pm0.49$
C	$5.62^{b}\pm0.11$	$30.72^{a}\pm0.42$	$8.18^{a}\pm0.00$	$1.60^{ab}\pm0.14$	$1.63^{b}\pm0.03$	$52.25^{b}\pm1.16$
D	$6.32^{b}\pm0.04$	$29.41^{b}\pm0.75$	$7.89^{a}\pm0.61$	$2.00^{a}\pm0.56$	$1.91^{ab}\pm0.23$	$52.47^{b}\pm1.06$
E	$8.92^{a}\pm1.01$	$29.29^{b}\pm1.41$	$7.53^{a}\pm0.00$	$2.10^{a}\pm0.14$	$2.81^{a}\pm0.72$	$49.35^{c}\pm0.91$

Values are expressed as mean ± standard deviation of duplicate determination. Means with the same letters along the same column are not significantly different ($p>0.05$).

KEYS:
A= 100% Wheat flour
B= Wheat flour 90%: Cooking banana 10%
C= Wheat flour 80%: Cooking banana 20%
D= Wheat flour 70%: Cooking banana 30%
E= Wheat flour 50%: Cooking banana 50%

Sensory properties of cookies produced from wheat/cooking banana flour blend

Table 3 shows the mean sensory scores of cookies produced from wheat and cooking banana flour blend. The control (100% wheat flour cookies) was rated significantly ($p<0.05$) higher than the rest of the cookies for the attributes of colour, texture, aroma, taste and overall acceptability. There was no significant difference ($p>0.05$) in the colour of all the cookie samples produced while the 10% substitution with cooking flour banana flour was not significantly different ($p<0.05$) from the control for colour, texture, aroma and taste. Both the control and the 10% cooking banana flour substitution were therefore the most preferred by the panelist. This suggested that the substitution level that was comparable to that of 100% wheat flour cookies was 10% and as the substitution of cooking banana flour increased in the cookie blend, the level of preference reduced. The result of the sensory evaluation of the cookies are similar to the findings of Ojinnaka and Agubolum (2012) who reported that increasing the levels of cashew nut in the cookies resulted in significant decrease in the sensory attributes of cookies. Similar findings were also made by Barber and Obinna-Echem (2016) for wheat and African walnut flour cookies.

Table 3: Mean sensory scores of cookies produced from wheat/cooking banana flour blend

Samples	Colour	Texture	Aroma	Taste	Overall Acceptability
A	4.45^{a}	4.46^{a}	4.82^{a}	4.91^{a}	4.66^{a}
B	3.73^{a}	3.91^{ab}	4.18^{ab}	4.18^{ab}	4.00^{b}
C	3.36^{a}	3.18^{bc}	3.55^{b}	3.55^{b}	3.41^{bc}
D	3.46^{a}	2.55^{bc}	3.73^{b}	3.64^{b}	3.34^{c}
E	3.64^{a}	2.55^{c}	3.64^{b}	3.64^{b}	3.36^{c}

Means with the same letters along the same column are not significantly different ($p>0.05$).

KEYS:
A= 100% Wheat flour
B= Wheat flour 90%: Cooking banana 10%
C= Wheat flour 80%: Cooking banana 20%
D= Wheat flour 70%: Cooking banana 30%
E= Wheat flour 50%: Cooking banana 50%

CONCLUSION

The proximate composition of the cookies in this study showed that cooking banana (*Musa acuminata*) flour can be used successfully as a partial substitute for wheat flour at a range of 0-

15%. It was also observed that the quality of cookies could be improved in terms of crude fibre and ash with the use of cooking banana flour. The cookies with 10% substitution of cooking banana flour was preferable for colour, texture, aroma and taste and this compared favourably with 100% wheat flour cookie. The use of cooking banana flour would therefore go a long way in reducing dependency on wheat flour in Nigeria.

Recommendations

It is therefore recommended that composite cookies of acceptable quality be produced by substituting wheat flour with cooking banana flour at levels not exceeding 10%. Regular supply, improvement of product strategy and quality, publicity and introduction of health claims on the nutritional quality of the product in terms of minerals and dietary fibre should be carried out in order to enhance the acceptability of the cookies.

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