PROXIMATE COMPOSITON, ENERGY VALUE AND FUNCTIONAL PROPERTIES OF INSTANT PLANTAIN – BREADFRUIT COMPOSITE FLOUR

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ABSTRACT
The study investigated the proximate composition and functional properties of instant plantain breadfruit composite flour. The flour was prepared from precooked unripe matured plantain and breadfruit. Instant flour made from plantain (P) and breadfruit (B) were blended together in ratios: 100 P : 0 B (A); 75 P : 25 B (B); 50 P :50 B (C); 25 P : 75 B (D) and 0 P :100 B (E)). The proximate composition, energy value and functional properties of the flours were analysed with standard procedures. The proximate composition are moisture (6.93 % to 8.50 %); protein (3.59 % to 3.30 %); fat (1.64 % to 2.53 %); fiber (3.95 % to 8.06 %); ash (2.36 % to 2.99 %); carbohydrate (76.15 % to 80.13 %) and energy (332.56 Kcal/100g to 357.67 Kcal/100g) The functional properties are bulk density (BD) (0.69g/g to 0.86 g/g); water absorption capacity (WAC) (250.01 % to 335.01%); oil absorption capacity (OAC) (0.99g/g to 1.39 g/g); solubility index (SI)(8.99 % to 14.78%) and swelling power (SP) (4.62 g/g to 7.38 g/g). Blending of plantain and breadfruit flours together resulted in flours with improved nutrient and functional properties.

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KEYWORDS: Breadfruit, composite flour, functional properties, plantain, proximate composition.

INTRODUCTION

Plantain (*Musa paradisiacal L.*) is perennial crop cultivated widely in the world and it rank fourth as the foremost food crop after rice, wheat and maize. they serve as main staple diet for millions of people in the humid and sub-humid parts of Africa and are used for beverages, fermentable sugars, medicines, flavorings and cooked foods by steaming, boiling or frying (Aderounmu, 2006, Adepoju et al., 2012,). They are starchy, less sweet variety of bananas having carbohydrate of about 32%, and rich in iron, dietary fibre, calcium, vitamin A, B6 and C (Abioye et al., 2011; Adegunwa et al., 2014). Recently, unripe plantain has gained popularity in consumption among adult individuals in Nigeria especially diabetic patients due to its health benefits. (Oko, et al., 2015) However, plantain is gradually becoming useful in formulating weaning food and producing composite flour (Ogazi et al., 1996; Otegbayo et al., 2002; Olaoye et al., 2006; Mepba et al., 2007).

Breadfruit (*Artocarpusaltilis*), a tropical fruit is originated from bread nut (*A. camansi* Blanco), a native to New Guinea Indonesia and the Philippines, and later spread widely throughout the Pacific, Caribbean African and Asian continents (Deivanai & Bhore, 2010). The fruit is observed as alternative to yam for the poor man in Nigeria because it is cheaper and can replace yam in several traditional food recipe, and production of flour, which serve as raw material for many confectionary products (Amusa & Kehinde, 2002; Mayaki et al., 2003). Breadfruits comes in different sizes, shapes and surface texture, and colors ranging from light green to yellow when mature, it has soft creamy flesh with a nice fragrant, comprising of sucrose, fatty acids and ellagic acid, calcium, iron and sodium. (Huie, 2002).

Composite flour is a mixture of several flours of roots, tubers, cereals and legumes origin alone or added to wheat flour (Adeleke & Odedeji, 2010; Julianti et al., 2015, Awolu et al., 2015). Compositing flours is advantageous because it reduces the money spent on importation of wheat flour, and is an avenue for utilization of underutilized crops (Chandra et al., 2015; Aluge et al., 2016; Arise et al., 2017). The use of unusual agricultural product like breadfruit in making of instant flour can enlarge the usage of non- wheat flour, hence increasing farmer's income and will also enhances the industrial utilization of both plantain and breadfruit. The usage of plantain and breadfruit flours for both infant and adult diets are becoming popular among Nigerian citizens, thereby mixing breadfruit with plantain may likely provide comparatively inexpensive nutrients for both the children and adults. This research work is aimed at investigating the proximate composition, energy value and functional properties of composite instant plantain breadfruit flour.

MATERIALS AND METHODS

Matured unripe plantain was purchased from a local market, Sayedero Ilaro, while breadfruit was purchased from Oja Odan market, both in Ogun state, Nigeria.

Preparation of instant plantain flour

The plantains were washed thoroughly with clean water, peeled with the use of a clean knife, sliced into sizes of 2mm thick, into water to avoid browning and blanched at 100^0C for five minutes to make it instant. The blanched plantain was sun dried for 72 hours, milled by hammer mills and sieved. The milled flour was packed into a tightly closed plastic container to avoid air pending further use.

Production of instant breadfruit flour

A sharp steel knife was used to peel the matured green breadfruits and sliced into water. The sliced pulp was blanched at 100^0C for five minute, dried and milled to obtain precooked breadfruit flour, which was subsequently packed in an airtight polyethylene bag awaiting further use (Giami et al. 2004).

Table 1: Formulation of instant plantain- breadfruit flour blend

Sample	% Instant Plantain	% Instant Breadfruit
A	100	0
B	75	25
C	50	50
D	25	75
E	0	100

A=100% Instant Plantain Flour, B=75% Instant Plantain Flour, 25% Instant Breadfruit Flour, C= 50% Instant Plantain Flour, 50% Instant Breadfruit Flour, D=25% Instant Plantain Flour, 75% Instant Breadfruit Flour E= 100% Instant Breadfruit Flour

Determination of Proximate Composition

Determination of crude protein, moisture, crude lipid, ash, crude fibre contents were carried out using the method described in (AOAC, 2005). Determination of carbohydrate was calculated by subtracting the total addition of percentages of moisture, protein, fat, ash and fibre from 100% (Onwuka, 2005). Energy value was estimated using Atwater factor (Adegunwa et al., 2014)

Energy (E) = (4× %protein) + (4× %fat) + (4× %carbohydrate)

Determination of functional properties

Bulk density was determined using the method of (Akpapunam & Markakis, 1981), WAC and OAC were determined according to the method described by Okezie and Bello (1988), while SP and SI were determined by the method of (Takashi and Sieb, 1988).

Statistical analysis

Triplicates analyses were determined on all the dataobtained and statistical significance established using one-way analysis of variance (ANOVA). Mean comparison and separation was done using Duncan Multiple
range (DMR) test at p≤ 0.05, described by the SPSS 16.0 statistical package.

RESULTS AND DISCUSSION

Proximate Composition

Table 2: Proximate composition (%) and energy value (Kcal/100g)of instant plantain- breadfruit flour

SAMPL	MOISTURE	PROTEIN	FAT	FIBER	ASH	CARBOHYDRA	ENERGY
A	8.50c±.47*	3.30a±.02	1.64a±.07	8.06^e±.17	2.36a±.02	76.15a±.45	332.56a±16.48
B	8.06c±.01	3.38b±.00	1.84b±.04	7.12^d±.22	2.42a±.04	77.19b±.04	339.86ab ±.14
C	7.77b±.42	3.43b±.01	1.98c±.02	6.16^c±.08	2.64b±.04	78.03b,c±.47	343.66 bc ±.39
D	7.48b±.00	3.50c±.01	2.38d±.00	5.24^b±.11	2.82c±.04	78.67c,d±.03	350.86 c ±.14
E	6.93a±.08	3.59d±.05	2.53e±.04	3.95^a±.08	2.99d±.08	80.13d±.08	357.67 cd ±.21

**Values are Mean± SD of triplicate determinations, and Mean values in the same column with different superscripts are significantly different at P < 0.05.*

A=100% Instant Plantain Flour, B=75% Instant Plantain Flour, 25% Instant Breadfruit Flour, C= 50% Instant Plant Flour, 50% Instant Breadfruit Flour, D=25% Instant Plant Flour, 75% Instant Breadfruit Flour E= 100% Instant Breadfruit Flour

Table 2. depicts the result of instant plantain-breadfruit composite flour proximate composition The moisture content of instant plantain flour (8.50%) is significantly (p< 0.05) higher than that of instant breadfruit flour (6.93 %). Moisture content

obtained in the present study is lower than what was reported (10.75%) by Adegunwa et. al, (2014), and are within the stipulated moisture content for flours. Shelf life of flour depends on moisture content of flour, the low moisture contents recorded for the instant plantain-breadfruit flour blends suggest good keeping quality of the samples.

The protein contents varied significantly from sample A (3.30 %) to sample E (3.59 %), and the percent fat content of the instant plantain -breadfruit follow the same trend of sample A (1,64 %) and sample E (2.53 %). The positive impact breadfruit had on the protein and fat contents of composite flour suggest nutrients enrichment in the flour blends because of high protein and fat in breadfruit (Nwabueze et al., 2008).

The ash content of all samples ranged from sample A (2.36 %) to sample E (2.99 %), The high percent ash content of instant breadfruit flour suggests that it could be a good source of minerals, hence improving the mineral content of the composite flours. The fiber content of plantain component of the flour blend is higher than the breadfruit. Fiber is reported to have beneficial effects on preventing colon cancer because it aid digestion and facilitate bowel movement (Shankar & Lanza, 1991).

There is significant difference (p< 0.05) in the carbohydrate content of the flour blends ranging from sample A (76.15 %) to sample E (80.13 %), and the result supports the report of (Akpapunam et al., 1997). The energy of the flours, as shown in Table 2, varied significantly (p< 0.05) from sample A (332.56 kcal) to sample E (357.67 kcal), The addition of breadfruit to plantain flour caused an increase in the energy level of the flour blends.

Functional Properties

Table 3: Functional properties of instant plantain- breadfruit flour

SAMPLE	BD g/g	WAC %	OAC g/g	SI %	SWP g/g
A	.86^{d}±.00	250.01^{a}±.20	0.99^{a}±.46	14.78^{a}±.43	7.38^{d}±.55
B	.81^{c}±.01	295.76^{b}±1.51	1.12^{b}±.15	12.54^{b}±.08	7.53^{e}±.44
C	.76^{b}±.00	316.36^{c}±.86	1.21^{c}±.27	11.09^{c}±.24	6.44^{c}±30
D	.76^{b}±.00	326.93^{d}±.30	1.29 ^{d}±1.01	10.16^{d}±.08	4.26^{a}±.47
E	.69^{a}±.00	335.01^{e}±.15	1.39^{e}±.32	8.99^{e}±.16	4.62^{b}±.29

**Values are Mean± SD of triplicate determinations, and Mean values in the same column with different superscripts are significantly different at P < 0.05.*
A=100% Instant Plantain Flour, B=75% Instant Plantain Flour, 25% Instant Breadfruit Flour, C= 50% Instant Plantain Flour, 50% Instant Breadfruit Flour, D=25% Instant Planain Flour, 75% Instant Breadfruit Flour E= 100% Instant Breadfruit Flour

The composite flours' functional properties are depicted in Table 3, and they serve as determinant for suitability of food materials in various food processing. Bulk density of the instant plantain-breadfruit are statistically the same The choice of packaging materials for flours depends on the bulk density of the flour and is a function of the particle size and the density of the products. (Adebowale et al., 2008). Generally, high bulk density improves dispersibility and lessens paste viscosity, an essential consideration in baby feeding (Padmashrre et al., 1987).

Sample E is significantly (P<0.05) high in WAC(335 %) than sample A (250 %),and conforms with the findings of Adegunwa et al, (2014) and Ajatta, et. al ,2016 that the WAC of instant plantain- breadfruit flour and wheat flour respectively rose with increase in the level of inclusion of breadfruit. This observed trend might be due to the amount of hydrophobic amino acids because of high protein content of breadfruit that hinders the ability of its starch to absorb water

(Kaur & Singh, 2005). The tendency of flours to absorb water and swell is known as Water absorption capacity, and it improves yield and consistency of food products, thus given the food bulkiness (Osundahunsi et al., 2003).

The ability of flour to retain flavor is governed by its OAC, which is very important in food formulations (Odoemelam, 2000). There is significant ($p < 0.05$) increase in OAC of composite flours as the amount of breadfruit flour included in the composite increases ranging from 0.99 g/g to1.39 g/g. The breadfruit's OAC obtained in this study was between the values (1.25 g/g and 2.8 g/g) reported by Appiah et al., (2011) and Odoemelam, (2005) respectively. The flavor holding capabilities of flours is high with lower OAC (Oladele & Aina, 2007).

There is significant difference in the solubility index of the instant composite flour, Lowest is sample E (8.99 %) and the highest is sample A (14.78 %). Solubility aids digestibility of food and also food protein functionalities increases with higher solubility index, (Aprianita , Purwandari, (Watson, & Vasiljevic.2009), and the better the reconstitution of the flour.

As shown in Table 3, the swelling power of the instant plantain-breadfruit flours varied significantly, from sample E (4.62 g/g) to sample A (7.38 g/g), this variance may be attributed to the level of protein flours because a high protein content in flour reduces the starch granules affinity for water hence decreasing the swelling power (Aprianita , Purwandari, Watson, & Vasiljevic.2009). Swelling power is also a function of the ratio of α-amylose and amylopectin ratios, and low amylopectin contents in flour will result in low swelling power. The swelling power reported by Abioye, et al, (2011) for 100% plantain (8.22 g/100 g) is higher than the values obtained in this study for 100% plantain flour.
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CONCLUSION

It can be deduced from afore mentioned observation that blending of plantain and breadfruit flours together resulted in flours with improved proximate composition and functional properties, thus, could be utilized for product development in different food system, which could be an opportunity for industrial use.

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