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ASSESSMENT OF CHEMICAL AND ANTINUTRITIONAL PROPERTIES OF BREAKFAST MEAL PREPARED FROM BLENDS OF BANANA AND AFRICAN YAM BEAN

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ABSTRACT

Banana (Musa sapientus) and African yam bean (Sphenostylis stenocarpa) are nutritional food sources that are valuable industrially even in consideration for a balanced nutrition. This research work evaluates the production of breakfast meal from blends of Banana and African yam bean (AYB). Banana and AYB were mixed in the ratio 90:10, 80:20, 70:30 and 100:0 (control) for the production of breakfast meal. Crude protein, ash, crude fiber, fat and carbohydrate content of mixtures were determined using the AOAC methods. Vitamins, minerals and anti-nutrient composition of the breakfast meal were determined using standard methods and data were analyzed using Analysis of Variance (ANOVA). Sensory attributes were determined using 9-point hedonic scale by forty panelists. The results of the proximate analysis showed that protein ranged from 5.41-11.26%, fat content (1.97-4.56%), carbohydrate (72.71-79.89%), fiber (0.39-0.57%), ash (3.23-3.97%) and moisture content (7.86-8.20%). Oxalate (8.73-4.38%) decreased with increase in AYB inclusion. Tannin values ranged from 17.09-26.73% and phytate ranged from 11.59-46.77%. The sensory evaluation by the panelists shows that the product was widely accepted. Samples 100:0 and 90:10 were mostly preferred in terms of colour, texture, taste, crispiness, sweetness, flavour, appearance and general acceptability. Hence, the fortification of banana flakes with AYB can be encouraged as a breakfast meal.

Keywords: Banana, African yam bean, Proximate composition, Anti-nutritional factor,

Introduction

Gross intake of energy staple foods in some parts of Africa has led to Protein Energy Malnutrition (PEM) and household food and nutrition insecurity. Harnessing plant protein from many legumes sources (Nwokolo, 1996) to substitute for the costly and unavailable animal protein in most developing countries would help in reducing malnutrition and associated health risks. Legumes are diversified in quality and quantity of the available essential amino acid present in them (Iqbal *et al*., 2006). Supplementation of carbohydrate with protein rich food is important in reducing PEM.

Banana is one of the traditional fruits adaptable to wide ecological range. Bananas offer great medical benefits (Sampath Kumar *et al*., 2012). Its high nutritional value especially the high carbohydrate content with low glycemic index and vitamins makes it an important choice for complementary or breakfast meal. However, banana is deficient in protein and this necessitates the need for fortification with protein rich food to ensure a complete and balanced food. African yam bean (AYB) is an underutilized crop due to its hardy nature (Adebowale *et al.*, 2009). Its seed is a highly priced food legume in south eastern Nigeria (Asoiro and Ani, 2011) owing to its high crude protein content. AYB is rich in amino acids which is comparatively high to what is obtained in whole chicken's egg (Ekpo, 2006). The proportion of the essential amino acid in the protein of AYB is over 32%, with lysine and leucine being predominant (Onyenekwe *et al*., 2000).

Complementing African yam bean with banana in a way will increase its potential and reduce problem of protein energy malnutrition. Production of breakfast meal from banana and AYB will be relatively cheap and suited to local eating habit. This research work has potential of increasing the utilization of AYB and banana, diversifying sources of food for human, reducing the risk of some diseases, solving the problem of malnutrition and acute food shortage. This work evaluated some quality attributes of breakfast meal from blends of Banana and African yam bean (*Sphenostylis stenocarpa*).

Materials and Methods

Banana (*Musa sapentium*) and African yam bean (*Sphenostylis stenocarpa*) were obtained from

Odo-oba market, Ogbomoso, Oyo state and a local market in Ondo state, respectively.

Preparation of samples

Banana was sorted, cleaned, washed and blanched at 50 ºC. The blanched banana was then drained, weighed and dried in the cabinet dryer at 60 ºC until dried. The dried banana was dry milled into flour. African yam bean seeds were sorted, cleaned and soaked for 12 h in warm water so as to ease dehulling. The dehulled bean was dried at 60 ºC and milled into flour. Banana and AYB flour were mixed in ratio 100:0, 90:10, 80:20 and 70:30, respectively. Xanthan gum, vegetable oil and water were added in appropriate ratios. The mixed flour was precooked in the pressure pot for 30 min to form dough. The dough obtained was allowed to cool and then flattened with the use of a rolling pin and a cold extruder was used to get desired shapes and sizes. The samples were then spread on a foil sheet and placed in the oven to bake for 30 minutes at 105-110 ºC. The obtained flakes were allowed to cool and packaged. The flow chart for breakfast meal production is shown in Figure 1.

Analyses

Banana flake samples obtained were analyzed for moisture (using oven-drying method), ash, crude fiber, crude fat, protein and carbohydrates contents following the method of AOAC (2005). Vitamin A, vitamin B_1, tannin and oxalate were estimated using the methods of AOAC (2005).

Phytate was determined using Maga (1982) method. Two grams of each juice sample was weighed into 250 ml conical flask. A hundred ml of 2% hydrochloric acid was added to soak each sample in the conical flask for 3 hours. This was filtered through a double layer hardened filter paper. Fifty ml of each filtrate was placed in 250 ml conical flask and 100 ml of distilled water was added into each solution as indicated. This was titrated with standard iron (III) chloride solution which contained 0.00195 g iron per ml.

Sensory attributes were determined using descriptive and preference test. Samples were rated for colour, texture, taste, crispiness, sweetness, flavour, appearance and general acceptability using a 9-point hedonic scale where 1 = like extremely, 2 = like very much, 3 = like moderately, 4 = like a little, 5 = neither like nor dislike, 6 = dislike a little, 7 = dislike moderately, 8 = dislike very much, 9 = dislike extremely.

Statistical Analysis

The results obtained from the chemical analysis and sensory analysis of the product was subjected to Analysis of Variance (ANOVA) with significance level of $p<0.05$ while Duncan Multiple Range (DMR) test was used to separate the differences in the mean values obtained.

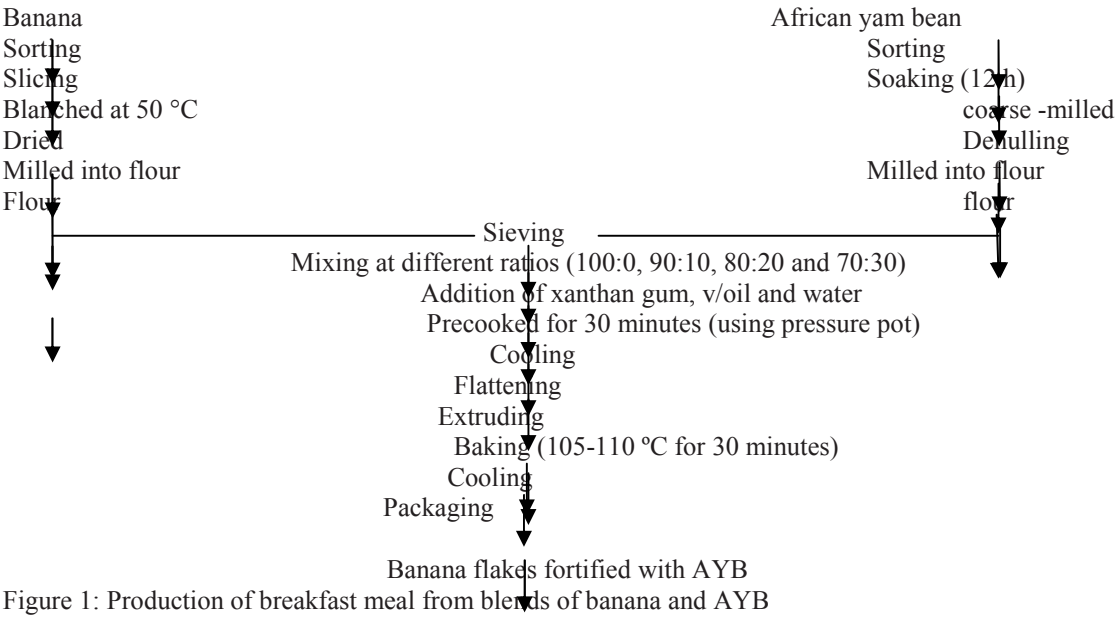

Figure 1: Production of breakfast meal from blends of banana and AYB

Results and Discussion

Proximate composition

The results of the proximate analysis are shown in Table 1. Protein values obtained ranged from 5.41-11.26% (Table 1). Banana flour with 30% AYB inclusion had the highest value while the control (100% banana) had the lowest. Protein contents of samples increased as level of AYB in the blends increased. The higher the percentage of AYB presents in the breakfast meal the higher the protein, this agreed with the report of Akinwande *et al*. (2014) who observed increase in the protein content of ready-to-eat breakfast cereals from blends of whole maize and African yam bean. The fat content of the breakfast meal ranged from 1.97-4.56%. The sample with 30% inclusion of AYB had the highest value of fat while the sample with 100% banana had the least value. This agrees with a report from Igbabul *et al*. (2014) who reported increase in fat of complementary/breakfast meal from blends of African yam bean with other food crops. The fat content was observed to be lower than 10% recommended by FAO (1996). The low content of fat in breakfast produced meal indicates that the food can be recommended for people requiring low fat diet.

The moisture content ranged from 7.86 to 8.20% with the control (100% banana) having the highest value. The moisture content of a food determines the storability of the food. The breakfast meal with 30% AYB inclusion has the lowest moisture percentage which means it's going to stay longer than others this is so because increase in moisture content of the food may allow the presence of molds, bacteria and insects all of which would cause deterioration of the food. It's evident from the result that the reduction in moisture content would prolong the storage of the breakfast meal.

The crude fiber ranged from 0.39-0.57% in the breakfast meal. Crude fiber decreased as concentrations of AYB increased. Control sample is significantly different from samples with 10-30% level of AYB inclusion. According to FAO (1996), the recommended fiber contents of food products consumed by children and adults should not exceed 5%. Ash was significantly higher in 100% banana than other samples with inclusion of AYB. The higher the AYB inclusion, the lower the minerals present in the sample. This confirmed the findings of Sampath-Kumar *et al*. (2012) who reported that banana is a rich source of vitamins and minerals. Ndidi *et al*. (2014) also stated that minerals are very important in human diet.

Table 1: Proximate Composition of breakfast meal produced from Banana and AYB

Sample	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	CHO (%)
100% B	8.20± 0.01b	5.41± 0.08d	1.97± 0.13d	3.97± 0.33a	0.57± 0.04a	79.89± 0.16a
90B:10AYB	8.09± 0.12bc	8.07± 0.05c	3.49± 0.78c	3.58±0.11b	0.48± 0.01b	76.30± 0.19b
80B:20AYB	8.54± 0.05a	10.53± 0.33b	4.11± 0.03b	3.35± 0.04b	0.40± 0.01c	73.09± 0.21c
70B:30AYB	7.86± 0.17c	11.26± 0.03a	4.56± 0.06a	3.23± 0.06b	0.39± 0.01c	72.71± 0.19c

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

Keys: B - Banana; AYB - African yam bean; CHO - carbohydrate

Table 2: Anti-nutritional properties and selected vitamins of breakfast meal from blends of Banana and AYB

Sample	Phytate mg/100g	Oxalate mg/100g	Tannin mg/100g	Vitamin A (µg/100g)	Vitamin B_1 (mg/100g)
100% B	11.59±1.46d	8.73± 0.54a	17.09±0.18c	0.93± 0.05d	0.20± 0.00a
90B:10AYB	17.70± 1.73c	4.38± 0.29b	18.01±0.11c	1.52± 0.11c	0.21± 0.01a
80B:20AYB	28.72± 1.48b	8.48± 0.44a	19.84±0.86b	1.98± 0.78b	0.22± 0.01a
70B:30AYB	46.77± 1.16a	8.69± 0.50a	26.73±0.50a	2.91± 0.26a	0.22± 0.01a

Means with the same alphabet within the same column are not significantly different (p>0.05)

Keys: B - Banana; AYB - African yam bean

Vitamins and Anti-nutritional factor

Vitamin A contents of the produced breakfast meal ranged from 0.93-2.91%. The highest value of vitamin A was obtained from samples with 30% inclusion of AYB. The presence of vitamin in the product increased as there is increase in the AYB inclusion of the product. Consumption of this food will also reduce the menace of vitamin A deficiency disease in developing countries. There was no significant difference in Vitamin B_1, calcium and magnesium of all samples. Oxalate (8.73-4.38%) decreased with increase in AYB inclusion. Tannin values ranged from 17.09-26.73 mg/100 g and phytate from 11.59-46.77 mg/100 g. Tannin possessed a stringent property that helps in healing of wounds and inflamed mucous membranes (Okwu, 2004) and can inhibit the generation of superoxide radicals due to its antioxidative property (Chung *et al*., 1998).

Sensory attributes

The result of the sensory evaluation (Table 3) showed that the breakfast meal was widely accepted. Control sample was the most preferred followed with the sample having 10% AYB in terms of colour, flavour, texture, taste, crispiness, sweetness, appearance and general acceptability. The beany flavour present in the product gave a characteristic taste but also affected the colour of the breakfast meal in such that the higher the inclusion, the darker its colour. The sensory evaluation shows that the product was widely accepted and sample from 90:10 bananas with AYB were mostly preferred in terms of colour, texture, taste, flavour, appearance and general acceptability.

Table 3: Sensory Evaluation of Breakfast Meal from Blends of Banana and AYB

Sample	Colour	Texture	Taste	Crispiness	Sweetness	Appearance	Overall acceptability
100% B	3.80±0.69a	3.30± 0.47a	3.05± 0.69a	2.95±0.01a	2.75± 0.55a	3.60a±1.23a	3.00± 0.97a
90B:10AYB	2.95±0.51b	2.70±0.47b	2.70±0.80b	2.70± 0.80a	2.45± 0.83ab	2.85±0.99b	2.40± 0.59b
80B:20AYB	2.25±0.55c	2.60±0.50b	2.40±0.75b	2.50±0.60a	2.40± 0.68ab	2.40±0.68bc	2.30± 0.73b
70B:30AYB	1.55± 0.60d	2.05±0.51c	2.25±0.72b	1.85±0.99b	2.15± 0.49b	2.05±0.51c	1.60± 0.59b

Means with the same alphabet (s) within the same column are not significantly different (p> 0.05)

Keys: B - Banana; AYB - African yam bean

Conclusion

The protein and vitamin A composition of the breakfast meal increased with increase in inclusion of AYB. The presence of AYB also affected the percentage of anti-nutrients present in the breakfast meal. Phytate and tannins were more prominent in the samples while the amount of oxalate reduced in the product during processing. The use of plant protein in product development is a good approach in meeting protein and energy requirements especially in regions where protein malnutrition is prevalent.

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