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Nutrient Composition and Sensory Properties of Cake Made From Wheat (*Triticum Aestivum*) and African Yam Bean *(Sphenostylis Stenocarpo)* Flour Blends

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Abstract

The general objective of this research was to assess nutrient composition and sensory properties of cakes made from wheat (*Triticum aestivum)* and African yam bean (*Sphenostylis stenocarpo)* flour blends. Specifically, it determined the proximate composition, sensory evaluation and general acceptability of the cakes. Experimental design was employed. Wheat flour (WF) was supplemented with African yam bean flour (AYBE) and used to bake queen cakes at various ratios (WF/AYBE 100:0, 80:20, 75:25, 50:50, 0:100). The 100% WF cake served as control. A 9-point hedonic scale was used for data collection. Proximate analysis was carried out using standard methods. Results of proximate analysis showed significant increase ($p<0.05$) in protein content (9.2-17.4%), ash (3.7-5.5%) and crude fiber (0.14-1.80%) in AYBE supplemented cakes. There was also significant decrease ($p<0.05$) in carbohydrate (70.26-63.1%) and fat (17.7-13.2%) contents. There was no significant difference ($p<0.05$) in moisture contents (14.4-14%) of test samples. Sensory evaluation results showed that all cakes samples had high rating for all evaluated attributes. The 20% and 25% AYBE supplementation compared favourably with control (100% WF). Cakes form other supplementation levels were generally acceptable as they were neither liked nor disliked.

Keywords: Flour, Cakes, Attributes, Blends, Proximate, Sensory, Evaluation.

Introduction

Most snacks are poor sources of protein and the protein that is present is often of poor nutritional quality. This is because they are prepared mostly from plant food products especially cereals wheat *(Triticum aestivum)* or starches. It is possible to improve the nutritional quality of starchy combination with more available plant protein like legume (Akpapunam and Darbe, 1993; FAO, 1988). Therefore baking with wheat or starchy crops alone does not provide the necessary amino acids, thus the need to blend with legume flour.

Legumes belong to leguminosae family which is the largest family seed plants. It has about 600 genera with

13000species but only twenty species are wildly cultivated in various part of the world and form a part of human diet in appreciable amounts (Mudambi, Rajagopal, 2009). There are rich in protein, iron, B vitamins which makes them excellent food when eating in small amount. Some contain carotene (vitamin A); some also have extra value of being rich in oil. Examples are the various groundnuts ad probably most valuable underexploited food crops which can be promoted are the legumes ad the nuts (Subbulakshmi and Udipi, 2008).

The diversification of food use of some unknown and uncommon legumes for families is imperative considering the ranging high cost of living and inflationary rates in Nigeria. One of the consequences is that low and middle income families in Nigeria cannot afford the other first class proteins like meat, fish, milk, etc. There is therefore need to explore the use of some unknown and known legumes as foods in the production of snacks especially for children and adults.

African yam bean *(Sphenostylis stenocarpo)* is one of the less known legumes that are commonly traditionally prepared from moistures of grains, legumes, cereals and small amount of vegetables or animal protein and consumed in many tropical countries. In west Africa other legumes like cowpea are eaten or consumed with cereal in dishes like rice and beans, jollof rice, yam pottage, akara and pap, maize and beans, moin-moin, etc. (Ihekoronye, and Ngody, 1985).

There are some special forms legumes are consumed traditionally. However, not many people know these forms. Consequently the consumption rate of the legumes tends to be low in spite of their high nutritional values. There is therefore need to evolve ways of processing some of these legumes to diversify their food use and value. This is because the availability of processed legumes forms primarily whole, husked legumes and flours can promote increased legume consumption. Traditional methods of dehulling in West African involve sundrying and wet milling or soaking. The African yam bean used drying method, since it was processed into flour.

Cake is a conventional snack produced from wheat *(Triticum aestivum)* flour with other ingredients. In a country like Nigeria where there is malnutrition due to deficiencies in protein and calories which contributes to more than half a million deaths of newborn (Onyezili, 1999). African yam bean *can* be utilized as a complementary protein in carbohydrate based foods to improve their nutritional quality. Incorporation of African yam bean flour into wheat based products make the foods useful protein and energy sources with good nutritive value. This study thus seeks to prepare and evaluate the nutrient composition as well as the acceptability of cakes produced from wheat and African yam bean blends. The aim is to promote the diversification and utilization of *African yam beans*

The study is expected to create awareness on the diversified food use of the known legumes especially African yam beans. This is because as this beans is used in the preparation or production

of cakes which is different from the traditional uses (boiling, it would provide information that may enhance the maximum utilization and diversification and diversification of the available use of the beans. This would be through seminars and workshops, in churches, local communities, nutrition talks in schools and cooking demonstrations.

Objectives

The general objective of this research was to assess the nutrient composition and sensory properties of cake made from wheat *(Triticum aestivum)* and African yam bean *(Sphenostylis stenocarpo)* flour blends. Specifically the study determined:

1. proximate composition of the cakes
2. sensory characteristics and general acceptability of the cakes.

Materials and Methods

***Design of study*:** The study used experimental design; it developed five blends of:

Wheat flour (WF), 100%, = AW_0

Wheat flour/ African yam bean 80:20 WF/AYBE (AW_1)

Wheat flour/ African yam beans 75:20 WF/AYBE (AW_2)

Wheat flour/ African yam beans 50:50 WF/AYBE (AW_3)

African yam beans 100% 100^oG/AYBE (AW_4)

Materials: Wheat flour and African yam bean were obtained from Abanwan village in Erei, Biase Local Government Area Cross River State of Nigeria. African yam bean seeds were sorted, washed, sun dried and weighed. The seeds were roasted for 10 minutes and milled using a laboratory hammer mill (model ED-5, Thomas Wiley, England) and sieved into fine flour with a 1mm mesh sieve. The purchased wheat) flour was sieved using the same mesh screen to obtain same particle size with African yam flour.

Parts of wheat flour (WF) were substituted with 20%, 25%, 50% African yam bean flour (AYBE) by weights. Each blend was separately mixed in a Philip blender (FIR 2811 model) for three minutes at high speed. The various flour blends were packed separately in airtight plastic containers till needed.

Preparation of Cakes: The cakes were prepared according to the method described by Ukam,(2014); Ceserani, Kinton, and Foskett, (1995) as follows:

1. The fat and sugar were creamed together until fluffy (double in size) using a wooden spoon in a stain less steel bowl
2. This was followed by the addition of the liquids (beaten eggs and milk).
3. The sieved flour with salt and baking powder were gradually folded into the cream (mixture).
4. The baking tins were greased with fat and the mixture was poured into the tin and
5. Baked at oven temperature of 180^oc for 20 minutes.

Formulation of flour blends (composite flours): The wheat and African yam flours were formulated as follows: Parts of wheat flour (WF) were substituted with 20, 25, and 50% African yam and African yam beans substituted as follows: 80, 75 and 50% respectively.

Each blend was separately mixed in a Philip blender (FIR 2811 model) for three minutes at high speed to ensure a thoroughly blend. They were then packed separately in an airtight container till when they were used.

The preparation of the cake samples were as follows:

Wheat flour	100
African yam bean flour	100
Sugar	80
Eggs (beaten)	4
Milk	60mls
Baking powder	5
Salt	to taste

Procedures for Preparation of the Cakes: For the first sample of flour (composite flour): The sample constituted only the wheat flour of 100%. To this flour baking of powder of 5g and salt a pinch of salt was added. Fat and sugar were creamed until fluffy, after which the beaten eggs and milk were added to the cream and mixed very well to incorporate air. The flour was added gradually and turned until the mixture was smooth. The cake washed tins were greased with fat and then the cake was poured into it and then put into a pre-heated oven of 220^{o}c for 30 minutes. It was removed from the tin and allowed to cool for chemical analysis and coded for sensory evaluation.

Chemical Analysis: Proximate analysis for the cake samples was carried out using Association of Official Analytical Chemists (AOAC, 2005) method. This method was used to determine the nutrients composition, including moisture, protein, fat, fibre, ash and carbohydrate content was estimated by simple difference. The sum of percentages of protein, fat, ash, fibre and moisture were subtracted from 100% to obtain the value of carbohydrate. The caloric value was calculated by multiplying values obtained for carbohydrate, fat and protein respectively and taking the sum of the products.

Sensory Evaluation

***Selection of panel*:** Staff and students of the Department of Home Economics, Cross River State College of Education, Akamkpa were involved in the study. A 15-member panel comprising of eight staff and seven students (one male) (six females) were randomly selected amongst the members of staff and students of the Department of Home Economics, Cross River State College of Education, Akamkpa was used for the sensory evaluation.

***Data Collection*:** The study was carried out under white light in the food laboratory within the Department in the midmorning hours (10am). The laboratory was quiet without noise and/or interruption. The panelists were separately seated, each provided with a glass of clean tap water to rinse their mouths between the five evaluation sessions of three minutes interval. The 100% wheat flour cake served as control. The five cake samples were presented in two digits coded white plastic plates and were evaluated for colour, texture, flavour, taste and general acceptability.

***Instrument for Sensory Evaluation*:** The attributes that were evaluated are colour, taste, appearance, flavour,

texture and overall acceptability using a 9 point hedonic scale in which I represents the least score (dislike extremely) and 9 the most desirable score (like extremely) for any attribute (Dias, Faria, Mercadante, Bragagolo and Banass, 2007).

***Data Analysis*:** Means were separated using Duncan's Multiple Range Test (DMRT) and judged significantly different at 95% confidence level ($p<0.05$).

Findings of the Study

Table 1: Nutrient Composition of Cakes from WF, AYBE and WF/AYBE Blends

Parameters	**Samples**				
Parameters	AW_0 WF:AYBE 100:0	AW_1 WF:AYBE 80:20	AW_2 WF:AYBE 75:25	AW_3 WF:AYBE 50:50	AW_4 WF:AYBE 0:100
Moisture	14.4^a	14.21^a	14.19^a	14.08^a	14.0^a
Crude protein	9.2^a	11.41^b	11.52^b	16.11^c	17.40^d
Crude fat	16.7^a	16.30^a	16.00^b	14.90^c	13.20^d
Crude fiber	0.14^a	0.52^b	0.68^b	1.10^c	1.80^d
Ash	3.7^a	4.12^b	4.51^b	4.95^b	5.50^c
Carbohydrate	70.26^a	67.65^b	67.29^a	62.94^b	62.1^b
Caloric value	468.14^a	462.94^b	459.24^b	450.3^b	436.8^d

WF-Wheat (Triticum aestivum) flour: AYBE African yam bean (Sphenostylis stenocarpo) flour ^{a,b,c,d}Values on the same row with different letters are significantly different at $P<0.05$

Table I shows that the proximate composition of the cakes samples which indicated the moisture composition ranging from 14g (AW_4) to 14.21g W.F: AYBE respectively. Protein ranged from 9.2g (AW_0) to 17.40 (AW_4) each. Fibre was between 0.14 (AW_0) and 1.80 (AW_4) respectively. Ash content ranged from 3.7g AW_0 to 5.50g (AW_0). CHO was between 62.1g (AW_4) to 70.26g AW_0 and caloric value ranged from 436.8g (AW_4) ton 468.14g AW_0.

Table 2: Sensory Evaluation Scores for Cakes Samples

Sample	**Colour**	**Texture**	**Parameters Taste**	**Flavour**	**General acceptability**
AW_0	8.0^a	8.3^a	7.9^a	8.1^a	7.9^a
AW_1	7.8^a	8.1^a	7.5^a	8.0^a	7.8^a
AW_2	7.6^a	7.8^b	7.0^b	7.5^b	7.5^a
AW_3	7.0^b	7.8^c	6.6^c	6.8^c	6.2^b
AW_4	6.8^b	6.3^d	6.3^c	6.0^d	5.8^b

AW_0 100%WF cake; AW1 - 80:20; AW_2 - 75:25; AW3 50:50 WF: AYBE respectively; AW_4 100% AYBR where WF wheat flour: AYBE African yam flour ^{a,b,c,d} Values on the same row with different letters are significantly different at $P<0.05$

Table 2 shows the sensory evaluation indicated the color values ranged from 68% (AW_4) to 8.0 (AW_0), texture ranged between 6.3 (AW_4) to 8.3 (AW_0); taste 6.3 (AW_4) to 7.9 (AW_0); flavour 6.0 (AW_0) to 8.1 (AW_4) and general

acceptability ranged from 5.8 Aw_4 to 7.9(AW_0) respectively.

Discussion of Findings

Result of the nutrient composition of cakes produced from wheat *(Triticum aestivum)* and African yam bean *(Sphenostylis stenocarpo)* flour blend (Table I) showed that protein, crude fiber and ash) from cake AW (100% WF) to AW_4 (100% AYBE) differed when compared with control. The parameters increased with African yam bean *(Sphenostylis stenocarpo)* flour. Wheat *(Triticum aestivum)* flour like other cereals is limiting in lysine and typtophan but rich in sulphur containing amino acids, methionine and cystine. The reverse is the case for African yam bean *(Sphenostylis stenocarpo)* flour (Ene-obong and Carnovale, 1992). The proteins of wheat *(Triticum aestivum)* flour yam bean flour thus complement each other's limiting amino acids, thus, producing cakes of better nutritional quality. The utilization of lesser known legumes that are cheaply available and equally rich in protein reduces protein energy malnutrition resulting from high cost of animal protein and commonly accepted legumes like cowpeas.

The higher fiber and ash content of cakes produced for WF/AYBE blend further justifies the nutritional importance of African yam bean *(Sphenostylis stenocarpo)*. The utilization of fiber rich leguminous plant food in developing countries to combat high incidence of diabetes has been of considerable interest in recent years. The resultant effect of utilization of WF/AYBE (AW_4) blend will increase intake of dietary fiber and subsequent reduction in the prevalence of chronic diseases.

There was no significant difference in the moisture content of the blends when compared with the control (14.40 vs 14.21 vs 14.19 vs 14.08 and 14.00) respectively, indicating that the blends competed favourably with the control wheat *(Triticum aestivum)* flour. This implied that there is increase in their shelf life. However, there was a significant difference in the crude protein content of the blends especially with AW_4 (17.40g) when compared with high control AW_0 (9.2g). This indicated the high content of protein of African yam bean *(Sphenostylis stenocarpo)* flour (Subbulakshmi and Udipi, 2008). Again, there was also significant difference in their fat contents especially for AW_4 (13.20g) when compared with the control AW_0 (16.70g), indicating that African yam bean *(Sphenostylis stenocarpo)* flour could be used both at home and confectionary industry for especially the obese, hypertensive ad diabetes patients.

The ash content also differed significantly more especially for African yam bean *(Sphenostylis stenocarpo)* flour AW_0 (5.50g) when compared with control AW_0 (3.7g). This is an indicative of the higher mineral content of African yam bean *(Sphenostylis stenocarpo)* over the control. The carbohydrate value of African yam bean *(Sphenostylis stenocarpo)* flour was lower (62.1g) than the control AW_0 (70.26g) and differed significantly. The caloric value of the control (wheat *(Triticum aestivum)* flour) was much higher (70.2g) than African yam bean *(Sphenostylis*

stenocarpo) flour (AW_0) 62.1g. There was also a significant difference ($p<0.05$). This indicated that the cakes (snacks) produced from African yam flour ad blends could be used for weight control and the diabetics. The fibre value of African yam bean *(Sphenostylis stenocarpo)* flour AW_4 (1.80g) differed significantly with the control (0.14g) and other blends. This showed that African yam bean *(Sphenostylis stenocarpo)* flour could be utilized in the production of cookies, cakes, snacks and foods for the obese (those watching their weight and the diabetes). Therefore, the utilization of less known legumes that are cheaply available and rich in protein could reduce protein energy malnutrition resulting from high cost of animal protein and commonly accepted legumes like cowpea.

There was a significant difference in the color attribute of the control, wheat *(Triticum aestivum)* flour over the blends of AW_3 and AW_4. There was also significant difference in the texture of the control AW_2, AW_3 and AW_4. This may be due to the increase in supplementation of African yam bean flour to wheat flour which is serving as control. The taste of the wheat flour (control) differed significantly with the taste of the blends of AW_2, AW_3 and AW_4 respectively. This is also as a result of the supplementation ratio of African yam bean flour increase to wheat flour control and probably the beany flavour. This was also the trend for the flavour attribute.

The results of the study also show a significant decline ($p<0.05$) in carbohydrate and fat content hence, lower caloric values of cakes from WF/AYBE blends. This implies that it could be a good snack for the diabetic and the obese people.

The most significant decrease was observed in the cakes made from 50% AYBE supplementation. It is interesting that general acceptability and indeed all other evaluated parameters decreased from control to AW_4. However all cakes were generally acceptable since none scored below minimum acceptable rating of five on a 9 point hedonic scale. The cake sample from 20% AYBE supplementation show no significant difference ($p<0.05$) with the control cake (100% WF) in all attributes evaluated. Cakes of acceptable qualities can be produced from wheat flour supplemented with up to 25% of African yam bean flour as cake samples made from 20% and 25% AYBE supplementation compare favourably with control cake (100%% WF).

At other levels of supplementation, there were significant differences ($p<0.05$) although scores were above minimum in all parameters. Cake production from WF/AYBE blends may be answer to increase in consumption and utilization of this less known legume with the resultant effect of increase intake of quality protein, minerals and dietary fiber. The general acceptability of the cake products also followed the same trend.

Conclusion

This research assessed the nutrient composition, and sensory properties of cake made from wheat *and* African yam bean. Experimental design was employed for the research. Wheat Flour (WF) was supplemented with African

yam bean Flour (AYBE) and used to bake queen cakes at various ratios (WF/AYBE 100:0, 80:20, 75:25, 50:50, 0:100). The 100% WF cake served as control. To determine the general acceptability of the blends samples as compared to the control sample, the other four samples were subjected to sensory evaluation using a 9 point hedonic scale for colour, texture, taste and general acceptability. The objectives of the study were to prepare flour blends, determine the proximate composition of the cakes and conduct sensory evaluation and general acceptability. The proximate analysis for moisture, protein, fat, fibre and carbohydrate were done using standard methods. Proximate analysis showed significant increase ($p<0.05$) in protein content (9.2-17.4%), ash (3.7-5.5%) and crude fiber (0.14-1.80%) in AYBE supplemented cakes. Result revealed that there was a significant decrease ($p<0.05$) in carbohydrate (70.26-63.1%) and fat (17.7-13.2%) contents. There was no significant difference ($p<0.05$) in moisture contents (14.4-14%) of test samples. Sensory evaluation results showed that all cakes samples had high rating for all evaluated attributes. The 20% and 25% AYBE supplementation compared favourably with control (100% WF). Cakes form other supplementation levels were generally acceptable as they were neither liked nor disliked.

Recommendations

Since the result of the findings showed that the blends of Africa yam bean flour at 100% nutrients composition was comparably higher and better as follows; moisture 14g (good shelf quality), crude protein 17g (cheaper and available means of reducing micronutrient protein deficiency), fat 13.20g lower than the other blends (good for weight control). Higher fibre1.80 (to increase bowel movement and weight control), ach content 5.50g higher than the other blends (increase in mineral content), lower carbohydrate content (62g) than the other blends (weight control and reduction in the incidences of diabetes) and lower calorie value (436.8g): control of obesity. Therefore Africa yam bean flour is hereby recommended based on these findings for usage both in the home and in the confectionary industry.

It was also recommended that nutrition education and advocacy campaigns should be carried out the communities, churches and cooking demonstrations by nutritionists, home economists, to sensitize the public on the nutrient density of the African yam bean.

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