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EVALUATION OF THE PROXIMATE COMPOSITION AND SENSORY PROPERTIES OF CAKES AND BISCUITS FORTIFIED WITH AFRICAN YAM BEAN, AND MORINGA OLIFERA FLOUR

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ABSTRACT

This research work Evaluated the proximate composition and Sensory properties of Cakes and Biscuits fortified with African yam bean, and moringaoleifera flour. The study tends to address the protein calorie malnutrition by producing cakes and biscuit using African yam bean and moringaoleifera. The research design is experimental design. Cakes and biscuit were produced using African yam bean, moringa and wheat flour in different proportion, the nutrient contentand the sensory properties product were analyzed using statistical package for social science (SPSS), version 17 which was express using one way analysis of variance (ANOVA) and Durcan's multiple range test was used to separate/compare the means that was obtained after each experiment. Different was considered significant when P<0.05a based on the data collected and analyzed, there is significant difference between fortified and the unfortified terms of fat, moisture, crude fiber, protein, carbohydrate and Ash, at 0.05 level of significance. Also there is significant different between the fortifiedand the unfortified in terms of colour, taste, mouthfeel, Aroma, texture and General acceptability at P<0.05 level of significance. The researcher concluded that there is need for increase in the utilization of food crops, grains and tubers to meet the growing need of Nigeria population, also production of cakes and biscuit using AYB and Moringa leave increases the nutrient content of the snacks. She recommends that food industries should employ graduates of home economics and food science and technology to develop more foods from AYB and Moringa which will reduce unemployment of youths as well the Local food products and also to reduce fatigue uncounted during processing.

KEYWORDS: Proximate composition, sensory properties, cakes biscuits, African yam bean, Moringa olifera flour.

INTRODUCTION

Wheat (TriticumSpp) is a cereal grain originally from the Levent region of the near East but now cultivated worldwide (Belderok*et al.,* 2000). In 2013, wheat production was the third most produced cereal after maize and rice, While in 2009, it was the second most produced cereal after maize (Shewry, 2009). Curtis *et al*. (2002) observed that wheat is leading source of vegetable protein (12.61g per 100g) than other major cereals (Maize, Corn or Rice).

Wheat grains are used to make flour for the production of snack. Wheat is rich in manganese, phosphorus, magnesium an d selenium. It is also a good source of Zinc, copper, iron and potassium. Calcium is also found in wheat in small quantities (Hopkins, 2015). Food products from wheat include bread, biscuit, cake, crakers, pudding wheat paste, rolls, pie among others.

African yam bean (Sphenostylis Stenocarpa) is one of the most important tuberous legumes of Tropical Africa. It is usually cultivated as a secondary crop with yam in Nigeria. A few farmers who still hold some seed stock especially the white, with black eye pattern plant it at the base of yam mounds in June or July (Ekpo, 2006). The crop flourishes and takes over the stakes from senescing yam. It flowers and begins to set fruits from late September and October. The large bright purple flowes result in long linearpods that could house about 20 seeds. The seed grains and the tubers are the two major organs of immerse economic importance as food for Africans. The indigenous crop has huge potentials for food

security in Africa. However, there are cultural and regional preferences (Uguru and Madkaife, 2001).

The proportion of the essencialamaino acid in the protein of AYB is over 32% with Iysine and lensine predominant (Onyenekwe, Njoku and Ameh 2000). The crude protein in AYB seed is lower than the one in soybean. However, the amaino acid spectrum indicated that most of the essential amaino acid especially lysine and methionine level in AYB are higher than those in other legumes including soybean (National Research council, 2007).

Also the amaino acid (Lysine and Methionine) values in AYB seed are higher than in pigeon pea, cowpea and Bambara groundnut. (Uguru and Madukaife, 2001) as reported by Ekpo(2006), the amaino acid profile of AYB compare favourably with the whole chicken egg and can meet the daily requirement prescribed by food and Agricultural organization (FAO) and world health organization (WHO).

Moringa Oleifera, originally from India is the only plant that has every kind of amaino acid. The nutrient content in Moringa Oleifera include: Vitamine A, 678mg, vitamin C 220mg, Calcium 440mg, Potassium 259mg and proteins 6.7gm (Gopalan, 2011).

A snack is a portion of food often smaller than a regular meal generally eaten between meals (Damon, 2015). Traditionally, snacks are prepared from ingredients commonly available in the home often leftovers cold cuts, sandwiches, nuts fruits and the likes are used as snack. Snack foods are often subjectively classified as junk food because they typically have little or no nutritional value and are not seen as contributing towards general health and nutrition (Damon, 2015).

The primary purpose of snacking is to take the edge off pre-meal time hunger without exceeding the everyday calorie needs. Mindful snacking or eating a nutritious properly portioned snack when hunger strikes boost the intake of essential nutrients and health promoting food substance such as fibre and antioxidants. Over consumption of bakery product without high nutritive value or careless snacking can easily take one over the daily energy requirement and provide little or no nutritional benefit, thereby resulting to malnutrition and its consequent range of diseases (Compbell, 2010).

Malnutrition can be defined as the insufficient excessive or imbalanced consumption of nutrients. Subnutrition occurs when an individual does not consume enough food. It may mean, the person has a poor diet that gives them the wrong balance of basic food groups. Poor diet may lead to a vitamin or mineral deficiency, among others essential substances, sometimes resulting in scurvy, a condition where an individual has a vitamin C (Ascorbic acid) deficiency (Nordquist, 2015).

World health organization(WHO) and the food and Agricultural organization of the United Nations (FAO) (2006) defined food fortification as the practice of deliberately increasing the content of an essential micronutrient, that (vitamins and minerals) in a food irrespective of whether the nutrients were originally in the food before processing or not , so as to improve the nutritional quality of food supply and to provide a public health benefit.

Food fortification was identified as the second strategy of four by WHO and FAO to begin decreasing the incidence of nutrient deficiencies at the global level. Foods are fortified to replace nutrients which were lost during manufacturing of the product.

It is upon this background that the researcher wishes to evaluate the proximate composition and sensory properties of cake and biscuit fortified with AYB and Moringa Oleifera.

Purpose of Study

The purpose of this study is to evaluate the proximate composition and sensory properties of cake and biscuit fortified with AYB and moringaoleifera.

MATERIALS AND METHODS

The research Design

This study is experimental research it involves production of cake and biscuit with 100% of wheat flour which is the control group and production of cake and biscuit which was fortified with some percentage of A Y B and moringaoleifra which is the experiment group.

The Study Area

This study was conducted in department of Home Economics in AlvanIkoku University of Education Owerri. The school was established in April, 1963 as the advanced Teachers Training College by the defunt Eastern Nigeria government on the grounds of the old shell amp, Owerri. It has expanded across the Orlu Road on the Nworie River. It is located in Owerri the capital of Imo State.

Materials

2kg of wheat flour was purchased from Ekeonunwa market, and sieve using 1mm sieve and store in an air tight container.

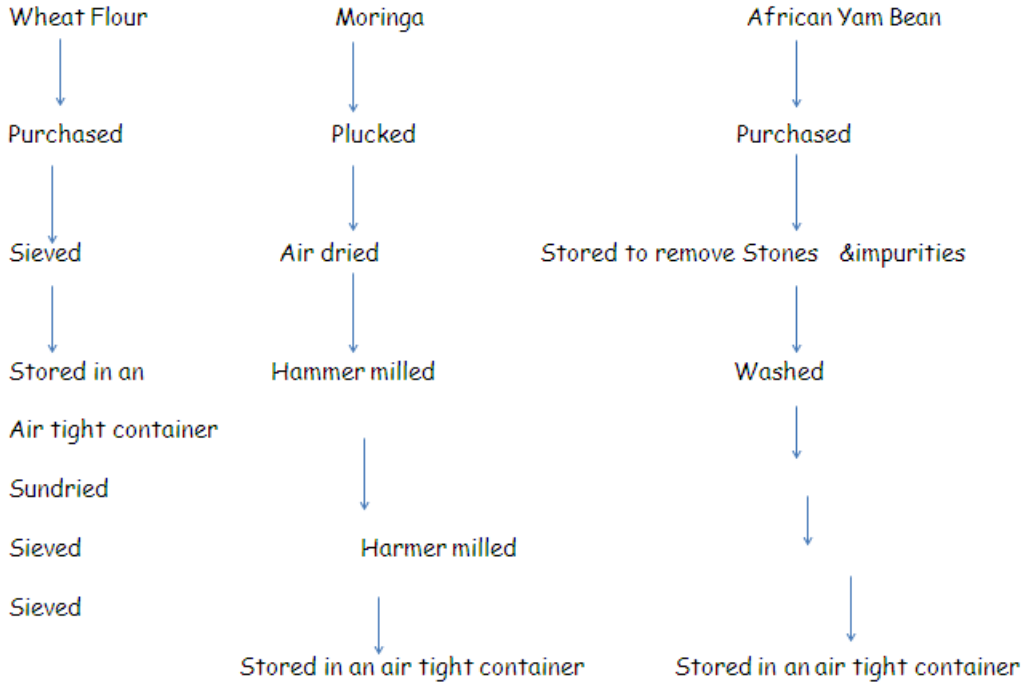
The Moringa

Moringa leave was plucked, air dried into fine flour, sieved using 1mm sieve and store in an air tight container.

The African Yam Bean

A Y B seed was purchased from Ekeonunwa Market, hand-picked and washed to remove the hull and impurities. It was sun dried and harmmer milled into flour, sieved using 1mm sieve and stored in air tight container.

Flow Chart of the Food materials



Formulation of Composite Flours

The proximal based on the basic recipe of cake and biscuit made from the basic recipes. The wheat flour will be fortified in the following ratios.

1. Cake: 50% wheat, 30% A Y B & 20% Moringa 70% wheat, 20% A Y B & 10% Moringa.
2. Biscuit 50% wheat, 30% A Y B & 20% Moringa 70% wheat, 20% A Y B & 10% Moringa.

Preparation of Cake & Biscuit

Table 4: Recipe for Cake.

Recipes	Sample A	Sample B	Sample C
100%w	50%w/30%A Y B/20%M	70%w/20%AYB/10%M	
Flour (g) W	500	250	350
AYB_	150	100	
M_ 100	50		
Butter (g)	250	250	250
Sugar (g)	250	250	250
Eggs (Pieces)	4	4	4
Baking Powder (Tea Spoon)	2	2	2
Milk (ml)	150	150	150

W= wheat flour
AYB= African Yam Bean flour
M= Moringa Oleifera flour

METHOD

Creaming of butter and sugar until fluffy (doubled its size) in a stainless stell bowl using wooden spoon, followed by addition of liquids (beated egg & milk) when the mixture starts scattering the sieved flour with baking powder will be folded into the mixture gradually with a metal spoon.

Preparation of Biscuit (short bread)
Table 5: Recipe for biscuit.

Recipe	Sample D	Sample E	Sample F
	100%W	50%W/30%AYB/20%M	70%W/20%AYB/10%M
Flour (g)	W 350	175	245
	AYB _	105	70
	M _	7035	
Butter (g)	225	225	225
Sugar (g)	100	100	100
Milk (ml)	100	100	100

W= wheat Flour
AYB= African Yam Bean flour
M =moringa Oleifera flour

Methods

1. Crease and base line a 30.5cm (12m) round sandwich tin, sift the flour and salt, rub in the butter and add the sugar knead lightly to mix.
2. Roll out the mixture to a circle and press it evenly into the tin.
3. Bake at 170-180^{oc} (325- 350^{oF}) 3-4 for 1-1/2 hours until colored. Dredge with sugar
4. Cut into portions while still warm and leave to cool in the tin on a wire rack and then remove from tin. (Onyemaobi, Ihekoronye and Okoro, 2015).

Chemical analysis of the baked products

Proximate and some vitamin composition of cakes and biscuits made from only wheat, and blends of wheat, AYB and moringaoleifera in their ration was chemically analyzed in their triplicates.

i. Crude protein determination
ii. The micro-kjeldahl method associated of official analytical chemists (AOAC, 1995) that involved digestion, distillation and titration was used in determining the crude protein content of the snack samples.

- One grain of each sample was digested with concentrated sulfuric acids.
- The digested samples was distilled and titrated to determine the total nitrogen (TN)'
- The crude protein (CP) was calculated by multiplying TN by the conversion factor 6.25 (AOAC, 1995)

$$\%N = \frac{\text{Titre } 14 \times \text{N of acid} \times 100}{\text{Weight of sample} \times 100}$$

%protein= %N x 6.25,
Fat determination (soxhlet method): The fat content of the sample was determined using the soxchlet extraction method AOAC (1995).
The extraction flask was washed, dried, cooled and weighed, 2g of the sample will be added.
The sample was weighed into a filter paper and introduced into a thimble.
Petroleum ether was added to the flask for extraction in the soxhlet apparatus.
After that, the extract was dried in an oven for 15 minutes at 100^{OC} to remove any remaining solvent, then was cooled in desiccators and reweighed.

Percentage fat was calculated as follows:

$$\%\text{ fat, Weight of flask with the extracted fat} = \frac{\text{Weight of empty flask} \times 100}{\text{Weight of sample}}$$

Ash Determination

The ash content of the samples was determined using the method of AOAC (1995).

Two grammes (2g) of each of the sample was weighed into clean crucibles of Known weight, then was heated in a furnance at 600^{oc} for 6hours, cooled in descators and reweighed.

The percentage ash was calculated using the formula below

$$\%\text{ ash} = \frac{(\text{weight of crucible + ash}) - (\text{weight of crucible}) \times 100}{\text{Weight of sample}}$$

iv. Crude Fibre
The crude fiber content was determined using the acid and alkaline digestion method of AOAC (1995).
Two grams of the sample was defatted with petroleum ether.
The sample was boiled under reflux for 30 minus with 20ml of solution containing 1.25g of $\pm S_2O_4$ per 100ml of solution.

The solution was washed in boiling water until the washing was no longer acidic.

The final residue was filtered through a thin but close pad of washed and ignited asbestors.

The residue was alive in an electric oven and reweighed. The residue was incinerated, cooled and weighed. The loss in weight after incineration x 100 was the percentage crude fibre.

The percentage fiber was calculated as follows

$$\% \text{ fibre} = \frac{\text{weight of fiber x 100}}{\text{Weight of sample}}$$

V. Moisture determination

- The sample (2g each) was accurately weighed into a pre-weighed crucible with easily removable lid (M_1)
- The uncovered crucible with its lid open was placed in a well-ventilated oven and maintained at 103 ± 20^{oc} for 16 hours.
- The lid was replaced and transferred to desiccators to cool for 30 minutes and was weighed as quickly as possible to 0.01mg.
- The crucible with sample and lid open was replaced in the oven for another 2 hours, will be cooled and weighed until the decrease in mass between successive weighing exceeds 0.05mg per grams of sample (fresh weight basis).
- The weight of dish, lid and sample after drying was M2. The lost in weight was reported as moisture content (AOAC, 1995).

Calculation

$$\% \text{ moisture} = \frac{M_1 - M_2 \text{ x } 100}{\text{Weight sample}}$$

Where:
M_1 = weight in g of dish, lid and sample before drying.
M_2 = weight of dish, lid sample after drying.

vi. Carbohydrate Determination
The digestible carbohydrate content of the snack samples was obtained by difference.

- Percentages of crude fibre, protein, fat, ash and moisture was summed up
- The value obtained was deducted from 100%.
- The carbohydrate 0f each sample is the difference in value.

Available carbohydrate = 100- (%protein +% fat +% crude fibre + % ash + % moisture).

vii. Estimation of energy
Energy was calculated from protein, fat and carbohydrate values, using water conversion factors (FAO, 1973). The energy can be expressed in terms of kilocalorie (kcal) or kilojoules (KJ). The average physiological fuel value of the energy nutrients was duly determined bearing in mind the digestibility of each nutrient as follows:
1g of carbohydrate yields 4 kcal of energy (17KJ)
1g of protein yields 4 kcal of energy (17KJ)
1g of lipids or fats yields 9 kcal of energy (37KJ).

Organoleptic Evaluation: This six products of cake biscuits made from wheat, AYB and moringa was produced for sensory evaluation. A panel of 25 judges was drawn from the Department of Home Economics, AlvanIkoku Federal University of Education, Owerri to assess the sensory attributes of cake and biscuits. The preference test on the snacks was scored for colour, flavor, mouth feel, aroma taste, texture and general acceptability by judges using a nine point Hedonic scale. The snacks was displaced, and labeled approximately in small plastic container with lids. Water and hand towel was provided for the judges for washing their hands. Drinking water was provided for them to rinse their mouths after each tasting. Assessment forms was provided and was collected at the end of the testing sessions.

A nine point Hedonic scale was adopted for sensory evaluation (Piggot, 1984). Where: like extremely (9), like very much (8), like moderately (7) like slightly (6), neither like nor dislike (5), dislike slightly (4), dislike moderately (3), dislike very much (2) and dislike extremely (1).

Statistical Analysis of Data
The statistical package for social science (spss), version 17 was used to analyze the data collected which was expressed using one way analysis of variance (ANOVA) and Duncan's multiple range test will be used to separate/ compare the means that will be obtained after each experiment. Difference will be considered significant when $p< 0.05$.

Data Analysis and Presentation of Result
Research Purpose One
Produce cakes and biscuits using blends of A Y B, wheat and moringa flour.

Different samples of cake and biscuit were produced. Sample A, B, C, D, E, and F.

Sample A, B, C are cake while D, E, F are biscuit. Sample A is the control which had 100% wheat flour, sample B is fortified with 30% A Y B, 20% moringa and 50% wheat flour, sample C is fortified with 10% moringa, 20% A Y B and 70% wheat flour. For biscuits,

sample D is the control which had 100% wheat flour. Sample E 50% wheat, 30% A Y B & 20% moringa, sample F, 70% wheat, 20% A Y B and 10% moringa.

Research Purpose Two

Determine the proximate composition of the different products according to their combinations.

Table 6: Proximate Composition of per 100g of the blends.

Sample	A	B	C
Fat	13.88	15.85	14.86
Moisture	20.78	20.17	22.16
Crude Fiber	1.66	2.00	2.04
Protein	15.24	19.50	16.50
Carbohydrate	46.34	40.39	42.43
Ash	2.00	2.09	2.01
	100	100	100

Table 6 shows the proximate composition of cake products according to their combinations.

Research Purpose Three

Compare the proximate composition of the fortified products with the unfortified products.

Table 7: Comparism of proximate composition of cake products.

Parameter	Cake A	Cake B	Cake C
Fat	13.88 ± 0.02^{c}	15.85 ± 0.02^{a}	14.86 ± 0.01^{b}
Moiture	20.78 ± 0.02^{b}	20.17 ± 0.02^{c}	22.16 ± 0.02^{a}
Crude Fibre	1.66 ± 0.02^{b}	2.00 ± 0.02^{a}	2.04 ± 0.02^{a}
Protein	15.24 ± 0.01^{c}	19.50 ± 0.03^{a}	16.50 ± 0.03^{b}
Carbohydrate	46.34 ± 0.13^{a}	40.39 ± 0.10^{c}	42.43 ± 0.11^{b}
Ash	$2.00\pm0.03b$	2.09 ± 0.02^{a}	2.01 ± 0.03^{b}

Values are means of duplicate determination ± standard deviations with different superscript are significantly different at 5% level of significance.

Table 7 shows the proximate composition of cake product sample A (100% wheat flour), sample B (50% wheat flour, 30% A Y B and 20% moringaoleifera flour), sample C (70% wheat flour, 20% A Y B and 20% moringaoleifera leave), fat content for samples are 13.88 ± 0.02^{c} (sample A), 15.85 ± 0.02^{a} (sample B) and 14.86 ± 0.01^{b} (sample C). There is significant difference among the three samples at $p<0.05$ level significant. (Sample C) has the highest moisture (whilesample A) has the least moisture. There is significant difference among the three sample at $p<0.05$ level of significance. Crude fibre for samples are 1.51 ± 0.02^{b} (sample A), 2.00 ± 0.02^{a} (sample B) and 2.04 ± 0.03^{a} (sample C). There is significant difference between sample A and sample and C at $p<0.05$ level of significance, but there is no significant difference between sample B and C at $p<0.05$. Protein content for samples are 15.24 ± 0.01^{c} (sample A), 19.50 ± 0.03^{a} (sample B) and 16.50 ± 0.03^{b} (sample C). There is significant difference among the three samples at $p<0.05$ level of significance. Carbohydrate content for sample are 46.34 ± 0.13^{a} (sample A), 40.76 ± 0.10^{c} (sample B) and 42.70 ± 0.11^{b} (sample C). There is significant difference between sample B and sample A & C at $p<0.05$ level of significance.

Table 8: Comparism of proximate composition of biscuit products.

Parameter	Biscuit C	Biscuit E	Biscuit F
Fat	20.80±0.02^{b}	24.76±0.01^{c}	24.77±0.03^{a}
Moisture	4.22±0.05^{b}	4.16±0.02^{a}	4.60±0.02^{c}
Crude Fiber	1.01±0.02^{b}	1.89±0.02^{b}	1.96±0.01^{a}
Protein	13.29±0.02^{c}	17.71±0.01^{a}	14.22±0.03^{b}
Carbohydrate	59.62±0.09^{a}	49.81±0.04^{c}	53.57±0.04^{b}
Ash	1.06±0.02^{b}	1.59±0.04^{a}	0.88±0.02^{b}

Values are means of duplicate determinations ± standard deviations with different superscript are significantly different at 5% level of significance.

Table 8 shows the proximate composition of biscuit product sample A (100% wheat flour), sample B (50% wheat flour, 30% A Y B and 20% moringaoleifera leave), sample C (70% wheat flour 20% A Y B and 10% moringa).

Fat content for samples are 20.80±0.02^{b} (sample D), 24.76±0.01^{a} (sample E) and 24.77±0.03^{a} (sample F). There is no significant difference between samples E and F but there is significant difference between sample D and samples E and F at p<0.05 level of significance.

Moisture content for samples are 4.16±0.05^{b} (sample D), 4.22±0.02^{a} (sample E) and 4.60 ±0.02^{a} (sample F). There is no significant difference between samples E & F but there is significant E and F at p< 0.05 level of signicance. Crude fiber content for sample are 1.01±0.02^{b} (sample D), 1.89±0.02^{a} (sample E) and 1.96±0.01^{a} (sample F). There is no significant difference between samples E & F but there is significant difference between sample D and sample E & F at p<0.05 level of signicance. Protein content for samples are 13.29±0.02^{c} (sample D), 17.71±0.01^{a} (sample E) and 14.22±0.0.3^{b} (sample F). There is significant difference among the three samples at p<0.05 level of significance. Ash content for sample s are 1.06±0.02^{b} (sample D), 1.59±0.04^{a} (sample E) and 0.88±0.02^{b} (sample F). There is no significant difference between samples D and F but there is significant difference between sample E and samples D & F at p< 0.05 level of significance.

Research Purpose Four
Evaluate the sensory properties of the different blends.

Table 9: Sensory Evaluation Mean Score For Sample ABCDEF.

Sample	Colour	Taste	Mouth feel	Aroma	Texture	General Acceptability
A cake	8.80	8.32	8.24	7.96	8.00	8.76
B cake	5.64	5.68	5.80	5.00	6.92	4.56
C cake	5.56	5.40	5.24	5.40	6.64	5.32
D biscuit	8.08	8.12	7.64	7.36	7.48	7.88
E biscuit	6.00	6.08	6.08	5.44	6.36	5.00
F biscuit	5.00	5.60	5.12	5.00	5.80	4.76

Table 9, Shows the mean score from the sensory evaluation of the products.

Research Purpose 5
Compare the Sensory attributes of Fortified with Unfortified.

Table 10: Result of Sensory Evaluation of Cake Product.

Parameters	Cake A (control)	Cake B	Cake C
Color	8.70±0.66[a]	5.85±1.87[b]	5.80±1.79[b]
Taste	8.10±0.91[a]	5.40±2.13[b]	5.35±1.72[b]
Mouthfeel	8.20±0.89[a]	5.75±2.02[b]	5.25±2.04[b]
Aroma	7.90±0.77[a]	5.25±2.27[b]	5.40±1.73[b]
Texture	7.80±0.77[a]	6.95±1.00[b]	6.80±0.90[b]
General Acceptability	8.45±0.83[a]	5.00±3.20[b]	5.40±2.56[b]

Values are means of duplicate determinations ± standard deviations with different superscript are significantly different at 5% level of significance.

Table 10 above shows the comparism of the sensory evaluation of cake products. Cake A (control) is significantly different from cake B and C in terms of color, taste, mouth feel, aroma, texture and general acceptability at $p<0.05$ level of significance but there is no significant difference between samples B and C in terms of colour taste, mouthfeel, aroma, texture and general acceptability at $p<0.05$ level of significance.

Table 11: Result of Sensory Evaluation of Biscuit Product.

Parameters	Biscuit D (Control)	Biscuit E	Biscuit F
Color	8.10±0.72[a]	6.30±1.60[b]	5.70±2.32[b]
Taste	8.15±0.93[a]	6.45±1.43[b]	5 .95±1.73[b]
Mouthfeel	8.00±0.86[a]	6.50±1.40[b]	5.45±1.96[b]
Aroma	7.40±1.00[a]	5.80±2.21[b]	5.15±2.08[b]
Texture	7.65±1.13[a]	6.55±1.40[b]	6.15±1.23[b]
General acceptability	7.90±1.17[a]	5.25±2.27[b]	4.85±2.80[b]

Values are means of duplicate determinations ± standard deviations with different superscript are significantly different at 5% level of significance.

Table 11 above shows the comparism of the sensory evaluation of biscuit products, biscuit D (control) is significantly difference from biscuit E and F in terms of color, taste, mouth feel. Aroma. Texture and general acceptability at $p<0.05$ level of significance. For samples E and F there is no significant difference in terms of color, taste, aroma, texture and general acceptability at $p<0.05$ level of significance.

DISCUSSION

Result of proximate composition of cakes and biscuits produced for wheat, African Yam Bean, and Moringa Oleifera leaves, flour blend at various ratios (WF/AYB/Moringa) 100:0:0, 50:30:20, 70:20:10. (Table 8 & 9) showed protein, crude fibre, ash and fat contents increased significantly at ($p<0.005$) than the control cake which has (100%) wheat flour to the fortified products that have some % of African Yam Bean and Moringa leave. It was observed that these parameters increased with increasing level of fortification of the wheat flour with African Yam Bean and Moringa Oleifera leave flour. Wheat flour, like other cereals, is limiting in lysine and tryptophan and rich in sulphur containing amino acids, methionine and cysteine while the reverse is the case for African Yam bean and moringaoleifera leave flour (Onoja, 2007). The proteins of wheat flour and African yam bean flour thus complement each other's limiting amino acids, thus producing cakes and biscuits of better nutritional quality. The utilization of lesser known legumes that are cheaply available and equally rich in protein cannot be over emphasized in reduction of protein energy malnutrition resulting from high cost of animal protein. The resultant effect of the utilization of

wheat flour, African yam bean and moringa leaves will increase intake of dietary fiber and subsequent reduction in the prevalence of chronic diseases. This finding confirms the findings of Onoja (2007), which stated that AYB has a high protein content. The results of the study also show a significant decrease ($p<0.05$) in carbohydrate for the fortified products. This however, lowers caloric values of cakes and biscuits. The control products has the highest carbohydrate, this is a result of only wheat flour in them. The sensory evaluation of the products (table 10 and 11) showed that there is significant difference between the control and the fortified products based on color, taste, mouth feel, aroma, texture and general acceptability at 0.05 level of significant ($p<0.05$). This finding does not confirm the findings of Alozie *et al.* (2009) which stated that there was no significant difference between the normal cake and the cake fortified with AYB in terms of sensory attributes. This difference might be as a result of moringaoleifera in the cakes.

CONCLUSION

Nigeria is a country with constant increase in population and as a result there is need for increase in the utilization of food crops, grains and tubers to meet the growing need of the population. Although the nation has for long depended mainly on wheat flour for production of baked foods and snacks despite its high cost, this research has proved that African yam bean flour and moringaoleifera leave flour can reduce the quantity of wheat purchased and utilized in snacks production. It will also ensure that teenagers and youth who consume snacks regularly consume adequate diet thereby ensuring healthy living. This is because snacks baked with African yam bean and moringa leave flour have relatively nutrient content.

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