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PHYSICO-CHEMICAL AND SENSORY EVALUATION OF BISCUIT PRODUCED FROM BLEND OF WHEAT, COWPEA AND LOCUST BEAN PULP FLOUR

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ABSTRACT

The physical, chemical and the sensory properties of biscuits produced from wheat, cowpea and locust bean pulp flour were evaluated. The study examined both the chemical and the sensory properties of the biscuit produced. Cowpea and locust bean pulp flour blend was incorporated into the traditional recipe to replace 0, 20, 30, 40 and 50% of refined wheat flour at different ratios of 100:0,80:20 and 70:30, 60:40 and 50:50 to prepare biscuit samples A,B,C,D and E respectively. All the biscuits samples were analyzed for moisture, ash, fibre, fat, protein, some minerals and carbohydrate. Results showed that the mixture of cowpea and locust bean pulp flour significantly increased the moisture, ash, fibre, fat protein and carbohydrate contents of the biscuit samples from 4.30 to 8.15%, 0.53 to 2.08%, 0.59 to 0.97%, 17.55 to 22.7%, 8.89 to 13.63% and 57.03 to 65.81% respectively. Calcium, iron and phosphorus content of the bscuit were also enhanced. There were no significant differences ($p > 0.05$) in the flavor, appeal, mouth feel, taste and the colour of the samples as compared with the control sample. Using the mixture of cowpea and locust bean pulp to blend wheat flour for biscuit making is very beneficial because it enriches the biscuits with protein and iron. It is readily available.

Key words: Biscuits, chemical properties, wheat, cowpea flour, locust bean pulp

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INTRODUCTION

Nigeria is faced with the problem of malnutrition due to deficiencies of protein and calories (Ewere, 2008). Protein-calorie sources of vegetable origin have been proposed as a solution to this problem. In Nigeria and many African countries cowpea *(Vigna unguiculata)* is a legume grown extensively for its seed. Cowpea is consumed in a variety of ways including boiling seeds alone or in combination with rice or yam. They are also used in the preparation of "akara" (fried cowpea paste) and *moinmoin* (cooked cowpea paste). The protein in cowpea seed is rich in essential amino acid like lysine and tryptophan (Ewere, 2008). They are also rich in vitamins and minerals. However, cowpea is deficient in methionine and cysteine (Ewere, 2008). However, cowpea is deficient in methionine and cysteine (Ewere, 2008). Therefore, cowpea seed is valued as a nutritional supplement to cereals and an extender of animal protein (Ewere, 2008). Africa locust bean tree is widely distributed in the savannah vegetative zone of Nigeria. The tree produces fruits in pods. The pods contain dry yellow powdery pulp. The pulp is liked for its sweet taste. Earlier studies on African locust bean pulp have been

concerned with its chemical composition and nutritive value (Nwafor, 2009). The carbohydrate content is made of about 19% reducing sugar, 9% non-reducing sugar and 31% other forms of carbohydrate (Keay *et al*., 2009). Its content of crude fibre is fairly high. There is the need to diversify the use of cowpea, wheat and locust bean pulp for food other than the traditional ones. Also a wheat and locust bean pulp with cowpea blend will provide a nutritionally balanced food for both infants and adults because of the improved nutrient and energy content. Such flour blend is likely to be less expensive than all wheat flour. However, the use of food ingredients depends to a large extent on their functional properties (Kinsella, 2009). The functional properties of wheat and African locust bean pulp flour blends showed desirable properties for baked products. It was shown that a blend of 90% wheat flour and 10% of locust bean pulp flour would produce biscuits of acceptable quality Nwafor, (2009). Snack food consumption has been on the increase due to urbanization and increase in the number of working mothers. This development can be exploited by the food industries to formulate nutritious snack foods. Snack food such as cookies which are readily accepted by the populace can thus serve as a vehicle for important nutrients.

The objective of this study therefore was to determine the physical chemical and sensory properties of biscuits produced from the blend of cowpea, locust bean pulp and wheat.

MATERIALS AND METHODS

Ingredients procurement: Cowpea (*Vigna unguiculata*) seeds, African locust bean and wheat flour were all purchased from the central market in Anyigba, Dekina Local Government Area of Kogi State, Nigeria. Anyigba is located in the derived guinea savannah zone of Nigeria on latitude 7^0 15 and $7^0$29' N of equator and longitudes $7^0$11' and $7^0$32' E of the Greenwich meridian. (Ifatimehin *et al*, 2009). The African locust bean fruit pods were harvested from Kogi state University farm. The pods were packaged in a basket and stored in the laboratory prior to use.

Biscuit preparation: The cowpea was sorted, soaked in water for 5 minutes, the seed coat was removed, the water was drained and then the cowpea was dried to 10% moisture content and ground. The locust bean pods were split open to remove the pulp and the pulp was pounded lightly in a mortar. Thereafter the pulp was separated from the seeds by winnowing and then finely ground. The cowpea and locust bean pulp powder were mixed together in the ratio 1:1 to form Cowpea and locust bean pulp flour blend that was incorporated into the traditional recipe to replace 0, 20, 30, 40 and 50% refined wheat flour at different ratios (100:0,80:20, 70:30, 60:40 and 50:50 respectively) to prepare the biscuits. Biscuits were produced from the five formulations using the method described by Nwafor (2009). All the ingredients were weighed accurately. The pre-weighed flour, sugar, salt and baking powder were mixed thoroughly. Shortening agents and eggs with average weight of 90 grams were added to each sample and mixed properly to make adequate dough and then the dough was rolled to a uniform sheet of thickness. The sheet was cut according to the desired shape and size of biscuits with a cutter and baked in the oven at a temperature of 105^0C for 20 minutes, after baking the biscuits were allowed to cool for 30 minutes and the biscuits were stored in airtight plastic container for further analysis. Preparation of biscuit samples were carried out in the Food processing laboratory of Food Nutrition and Home Sciences department of Kogi State University, Anyigba.

Five biscuit samples labeled A, B, C, D and E were produced from various combinations of cowpea, locust bean pulp and wheat flour blends. Biscuit sample A represents biscuits produced from 100g wheat flour, B represents biscuits produced from 80g wheat and 20g cowpea-locust bean pulp flour; C represents biscuits produce from 70g wheat and 30g cowpea-locust bean flour; D represents biscuits produced from 60g wheat and 40g cowpea-locust bean pulp flour blend while E represents biscuits produced from 50g wheat and 50g cowpea-locust bean pulp flour blend.

Table 1: Ingredient composition of biscuits produced from varying levels of cowpea-locust bean pulp flour (g)

	Biscuit Samples				
	A	**B**	**C**	**D**	**E**
Ingredients(g):					
Wheat flour	100	80	70	60	50
CLBP flour blend	-	20	30	40	50
Baking powder	5.0	5.0	5.0	5.0	5.0
Salt	2.0	2.0	2.0	2.0	2.0
Powdered sugar	15	15	15	15	15
Egg (1 egg/sample)	90	90	90	90	90
Milk powder	20	20	20	20	20
Total (g)	230	230	230	230	230

CLBP = Cowpea-Locust bean pulp

Chemical analysis: The Proximate composition and mineral content of the biscuit samples were determined according to methods described by AOAC (2000). Values are means of triplicate determinations.

Sensory Evaluation: The five samples of the biscuit were served to 20 semi-trained panelists made up of a population of staff and students of Kogi State University, Anyigba, who were familiar with the sensory attributes-taste, aroma, flavour, colour and texture. A9-point hedonic scale was designed to measure the degree of preference of the samples. Data obtained were subjected to analysis of variance.

Experimental design and Statistical Analysis: The experimental design was a completely randomized design (CRD). Data were subjected to statistical analysis using a one way analysis of variance (ANOVA). Mean scores were separated by Duncan multiple range test (DMRT) of SPSS 20.0 package (SPSS, 2010).

RESULTS AND DISCUSSION

The proximate properties of the biscuit samples are presented in Table 2. The moisture content of samples ranged from 4.30 to 8.15% with sample B having the highest moisture content while sample E had the lowest moisture content. There were significant ($p < 0.05$) differences in the moisture content. Sample E had the lowest moisture content (4.30%), which implies that the sample will have good storage stability since most spoilage microorganisms are moisture dependent for their activity (Shaibu, 2012).

The ash content of the biscuits samples varied significantly ($p < 0.05$) from 0.53 to 2.08%. Sample C had the highest ash

content while sample E had the least ash content.

The fibre content of the samples (0.59 - 0.97%) varied significantly with sample E having the least fibre content while sample C had the highest value. Samples A and D were similar but are significantly ($p < 0.05$) different from other samples. The significant increase in crude fibre resulting from supplementation with cowpea-locust bean pulp flour could contribute to the health of the gastro-intestinal system and metabolic system of man.

The fat content of the samples ranged from 17.55 to 22.7% with sample E having the least fat content while sample D had the highest fat content. There were significant ($p < 0.05$) differences amongst the samples.

The protein content of the samples ranged from 8.89 to13.63% and it varied significantly ($p < 0.05$). Biscuit sample E, had the highest protein content and sample A had the least. The higher protein content as the level of cowpea-locust bean flour increased can be hinged on the high protein content of cowpea (23.4%) and locust bean pulp (25.70%) as reported by Daisy (2009) and Ewere (2008).

The carbohydrate content of the samples ranged from 57.03±0.03 to 65.81±0.01% with sample A having the highest carbohydrate content while sample B had the least carbohydrate content. There were significant ($p<0.05$) differences amongst the five samples. Nwafor (2009) however reported a range of 60.40 - 68.90%. The variation in carbohydrate content could be attributed to method of processing as well as the sources of the cowpea and locust bean among others. .

Table 2: Proximate composition (%) of biscuits produced from varying levels of cowpea-locust bean pulp flour

Biscuit samples	**A**	**B**	**C**	**D**	**E**	**SEM**
Levels of CLBPF (g)	**0**	**20**	**30**	**40**	**50**	
Parameters (%):						
Moisture	6.85^{b}	8.15^{a}	7.20^{b}	5.55^{c}	4.30^{d}	0.13
Ash	1.50^{b}	1.95^{a}	2.08^{a}	1.55^{b}	0.53^{c}	0.04
Crude fibre	0.79^{c}	0.86^{b}	0.97^{a}	0.81^{c}	0.59^{a}	0.06
Fat	16.17^{c}	19.30^{a}	17.85^{b}	19.85^{a}	17.55^{b}	0.01
Crude protein	8.89^{c}	12.71^{a}	13.24^{a}	11.60^{b}	13.63^{a}	0.07
Carbohydrate	65.81^{a}	57.03^{c}	58.67^{c}	60.65^{b}	63.41^{a}	0.11

$^{a-d}$Means along the same row with different superscript(s) are significantly ($p < 0.05$) different.
CLBPF = Cowpea-Locust bean pulp flour; SEM = Standard error of mean.

Mineral and vitamin content of biscuit samples (mg/100g) produced from varying levels of cowpea-locust bean pulp flour is as shown in table 3 below. There were significant ($p < 0.05$) differences in the value for iron (24.40 – 660.52mg/100g), phosphorous (181.58 – 280.77mg/100g) and calcium (660.53 – 910.04mg/100g).

Vitamin C content of the biscuits ranged from 50.31 to 76.77mg/100g and this corroborates the report of France and Martin (2007). Sample E had the highest Vitamin C while sample D had the least Vitamin C. There were significant ($p < 0.05$) differences amongst the samples.

Vitamin A ranged from 50.31 to 76.77. Sample E had the highest Vitamin A

content while sample D had the least value. The values differed significantly ($p<0.05$). Sample E had the highest values for Vitamin A and C and sample D had the highest values for iron, calcium and phosphorous. This could be due to the higher content of the cowpea/locust bean pulp flour in sample D and E biscuits. Since cowpea and locust bean pulp were reported to be high in iron, calcium and phosphorus, this result was in line with the report of Nwafor (2009).

Table 3 Mineral and vitamin content of biscuits samples (mg/100g) produced from varying levels of cowpea-locust bean pulp flour

Biscuit samples	**A**	**B**	**C**	**D**	**E**	**SEM**
Levels of CLBPF (g)	**0**	**20**	**30**	**40**	**50**	
Calcium	715.14^{d}	720.31^{c}	830.60^{b}	910.04^{a}	660.52^{c}	0.27
Iron	24.40^{c}	26.55^{b}	26.51^{b}	27.60^{a}	20.09^{c}	0.16
Phosphorus	195.51^{d}	220.76^{c}	242.31^{b}	280.77^{a}	181.58^{a}	0.15
Vitamin A	9.53^{b}	8.73^{b}	9.17^{b}	5.15^{c}	10.69^{a}	0.04
Vitamin C	75.34^{a}	59.38^{b}	62.28^{b}	50.31^{c}	76.77^{a}	0.05

$^{a-d}$Means along the same row with different superscript (s) are significantly ($p<0.05$) different.
CLBPF = Cowpea-Locust bean pulp flour; SEM = Standard error of mean.

The organoleptic or sensory score of biscuits produced from wheat and varying levels of cowpea-locust bean pulp flour is as shown in table 4 below. All the sensory properties tested except aroma showed significant ($p < 0.05$) differences across treatments. Ikekoronye and Ngoddy (2005) however reported significant ($p > 0.05$) differences for aroma. Sample B (80g wheat flour and 20g cowpea-locust bean flour) had the best values for all the sensory properties evaluated in this study (colour, 6.47; taste, 6.33; aroma, 6.60; texture, 6.47 and overall acceptability of 6.53) while sample E had the least values. Nwafor (2009) however reported 90% wheat flour and 10% cowpea-locust bean pulp flour as best in terms of sensory properties. This discrepancy could be due to the method of processing the ingredients used (Guraja and Krishin, 2008).

Table 4: Organoleptic or Sensory Score of biscuits produced from wheat and varying levels of Cowpea-Locust bean pulp flour

Biscuit samples	**A**	**B**	**C**	**D**	**E**	
Levels of CLBPF	**0**	**20**	**30**	**40**	**50**	**SEM**
Sensory properties:						
Colour	6.33^{a}	6.47^{a}	5.13^{b}	5.40^{b}	5.40^{b}	0.89
Taste	5.47^{bc}	6.33^{a}	5.53^{bc}	5.60^{b}	4.93^{c}	0.78
Aroma	5.53	6.60	5.40	5.40	5.20	1.62
Texture	5.87^{bc}	6.47^{a}	6.00^{b}	5.53^{bc}	5.27^{c}	0.82
Overall acceptability	5.94^{ab}	6.53^{a}	5.60^{b}	5.80^{b}	5.47^{b}	0.82

$^{a-c}$Means along the same row with different superscript(s) are significantly ($p < 0.05$) different.
CLBPF = Cowpea-Locust bean pulp flour; SEM = Standard error of mean.

CONCLUSIONS AND RECOMMENDATIONS

- Supplementation with cowpea-locust bean pulp improved the crude fibre, protein, calcium, and iron significantly across the treatments.
- Biscuit sample with 80g wheat flour and 20g cowpea-locust bean pulp flour had the best sensory properties.
- Supplementation of wheat four with cowpea-locust bean flour at 20g is recommended in biscuit making.
- Further research should focus on the shelf life of the biscuits samples.

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