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Sensory Attributes, Poximate And Mineral Compsition Of *Vigna unguiculata* Enriched With Crayfish, Dried Fish And Dried Onions

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Abstract
Bean seeds flour was enriched with crayfish, dried fish and dried onions. Five samples were generated using the response surface method. Sample A (100%) beans was the control, B (50% beans, 15% crayfish, 25% dried fish, 10% dried onion), C (50% beans, 17% crayfish, 27% dried fish, 5% dried onion), D (51% beans, 20% crayfish, 23% dried fish, 5.3% dried onions) and E (50% beans, 15% crayfish, 28.5% dried fish, 6.4% onions). Steamed beans pudding and bean cakes were prepared with the samples. Sensory attributes of the steamed beans pudding and bean cakes were carried out. Proximate and mineral composition of the enriched bean flour was evaluated. The sensory score of the bean cakes ranged from 6.40-8.70 for colour, 6.90-7.90 for texture, 6.90-8.00 for aroma, 6.50-8.20 for taste and 6.80-7.80 for general acceptability. There was significant (P<0.05) difference among the samples for proximate composition. Ash (3.11%-6.43%), moisture (9.42%-10.48%), fat (13.19%-17.32%), crude fibre (2.26%-2.65%), protein (13.78%-21.83%) and carbohydrate (41.13%-61.22%). Mineral evaluated were sodium, potassium, calcium, magnesium and iron. The mineral were measured in part per million with the value ranged as followed: 527-610, 1536-1870, 210-284, 780-950 and 75.90-102.00 respectively. The result showed that the samples were rich in proximate composition and mineral.

Keywords: *Bean flour, enriched, sensory attributes, mineral, proximate composition*

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I. Introduction

Cowpea (*Vigna unguiculata)* is a grain legumewidely distributed in tropical and sub-tropical countries of Africa, Asia, Southern Europe and Central South America (Davis, 2013). The seed of cowpea can be cooked in the dried form, sprouted, or ground into flour.It is also consumed in the form of '*akara'* (fried cowpea paste) and *moi*-moi (steamed cowpea paste). Legumes are multipurpose crops at the household, cottage and large scale levels and flours have been processed from different types of legumes. Due to changing trends in consumer demands for more convenient products, cowpea flour has added to household convenience (Ashaye*et al*., 2000; Fasoyiro, *et al*., 2010). Cowpea is an affordable alternative protein source to the people of the rural communities in Nigeria and other developing countries (Obasi, 2014). Cowpea protein is deficient in essential sulphur containing amino acid like methionine and cysteine compare to animal protein but is comparativelyrich in lysine and tryptophan (Adediran *et al*.,2013).Though cowpea contains some anti-nutritional factors like oxalate, phytate, tannin, lectin and stachyose (Ileke, 2014), they are reduced significantly by soaking, cooking, boiling and pre-processing methods (Udensi, 2005). Cowpea is a popular, most economical and nutritious leguminouscrop in Africa commonly called 'beans' in Nigeria. It contains about 17.04- 24.3% protein, 11.10% to19.35% moisture, 0.62% to 2.13% fat, 1.88%- 6.3% fiber, 2.60% to 3.36% ash, 55.90% - 63.6% carbohydrates, 0.00074% thiamine, 0.00042% riboflavin and 0.00281% niacin (Henshew, 2003; Obasi, 2014).

The common unit operations involved in flour production include washing, soaking, de-hulling, drying, milling, sieving and packaging. Crayfish is rich in essential vitamins and minerals. It contains abundant amount of vitamin B, copper, selenium, protein, iron, zinc, and amino acids.Crayfish is an animal polypeptide, containing 36-45% crude protein. It is a freshwater crustacean with high nutritive value, true digestibility, net protein utilization, high content of essential amino acid, and protein efficiency that is favourable compared to casein (FAO/WHO/UNU 2002; Ibironke *et al*., 2012). Crayfish total fat is 1g, saturated fat 0g, cholesterol 0g, 126mg crayfish is equivalent to 200mg egg.The sodium is 170mg, dietary fiber 0mg, sugar 0mg, calories 80mg compared to beef 242mg calories (Nahid and Fayza, 2009; Ibironke*et al*., 2014). Protein content in fish is 16-20% of the total weight.Dried fish contain 70-80% protein, omega-3-fatty acid, peptides and minerals (Asbjorn*et al*., 2007).Onions contain omega-3-fatty acids and polyphenols which help the body to regulate blood fat level, sugar level as well as the cholesterol level of blood. They also help to decrease blood vessels

inflammation, lowers the risk of having some types of cancer such as colorectal, laryngeal and ovarian cancer. Onion is also a good source of biotin, manganese, vitamin B6, copper, vitamin C, fibre, phosphorus, potassium, folate and vitamin B1 (Ali *et al*., 2000).

This study was aimed at evaluating the sensory attributes of beans cake (*akara*) and steamed beans pudding (*moimoi*) from undehulled beans enriched with crayfish, dried fish and dried onions. Proximate and mineral compositions of the enriched beans flour were also evaluated.

II. Materials And Methods

Materials

Brown beans, crayfish, dried fish, dried onions and pepper were purchased from Uchi market, Auchi, Edo State, Nigeria.

Methods

Sample preparation

Bean seeds were sorted to remove stones, chaff, foreign matter and milled usingdisc attrition mill. Dried fish, crayfish and dried onions were also sorted and milled into powder with mixer grinder (marlex Excella blender model DMN/DIC/PMT/02-03/206).

Formulation for instant bean flour

Response surface method software was used to formulate the samples for the sensory evaluation, proximate and mineral composition of the fortified bean flour.

FORMULATION OF ENRICHED BEAN FLOUR(grams)

SAMPLES	BEANS FLOUR	CRAYFISH	DRIED FISH	DRIED ONIONS
A	100	0	0	0
B	50	15	25	10
C	50	17	28	5.0
D	51.2	20	23.4	5.4
E	50	15	28.5	6.5

PREPARATION OF ENRICHED BEAN FLOUR FOR BEAN CAKE

Enriched undehulled cowpea flour was prepared using the formulation in Table 1 above while bean cake (akara) was prepared using methods described by McWatters (1983) with slight modification. 100 g of enriched flour was mixed with measured volume of water to form consistent paste. The paste was whipped severally to incorporate air for about 3 mins. Ingredients like granulated pepper (5g) and salt (1.0g)were also added. The whipped paste was then scooped in ball-like shape into already pre-heated vegetable oil (190^{o}C) in a deep fryer. The scooped balls were frequently turned until golden brown colour was obtained.

PREPARATION OF ENRICHED BEAN FLOUR FOR STEAMEDBEAN PUDDING

Traditional method of moi-moi preparation as described by Akusu and Kiin-Kabari(2012) was adopted for moi-moi preparation with slight modification. The enriched cowpea flouras shown on Table 1 above was mixed gradually in a bowl using a wooden spatula separately forthefivesamples. One hundred grams (100g)of the enriched bean flour was mixed with dry grinded pepper (10g), salt (1.3g), and vegetable oil (5ml). 300ml of warm water (50^{o}C) was added in the bowl containing the flour mixtures and mixed using awooden stirrer until a smooth paste was formed. The paste was scooped into aluminum foil which were steamed in a pot of boiling water for 1 hour. The steamed gelled paste (moi-moi) samples were removed, cooled and evaluated for sensory properties

Sensory evaluation

Sensory evaluation of the bean cakes (akara) and steamed bean puddings (moimoi) were carried out using nine-point hedonic scale by twenty panelists consisting of both students and staff of Food Technology Department, Auchi Polytechnic, Auchi, Edo State who were regular eaters of akara and moi-moi. Sensory attributes evaluated were colour, taste, texture, aroma and general acceptability.

Proximate analysis

The proximate and elemental analysis was done according to standard procedures (AOAC, 2000). All the chemicals used in this work were of analytical grades.

Determination of moisture content Procedure: A glass petri-dish was accurately weighed, after which an approximately 1.0g of sample was added and reweighed and the weight recorded as (w_1). This was kept in a vacuum oven for 1 hour at the 105^{o}C, the dish was removed from the oven, cooled and re-weighed and recorded as (w_2). This Ape, et. al International Journal of Basic and Applied Science, Vol. 04, No. 02, October 2015, pp.

1-8 www.insikapub.com 3 process was repeated until a constant weight was attained. This process was repeated for all the samples, and the moisture content was calculated in percentage as follows: % moisture = x 100 … (1)
Determination of ash content Procedure:- 1.0g of sample was accurately weighed in a platinum crucible and recorded as w1, this was transferred to muffle furnace at the temperature of 5500C for 8 hours until a white ash was obtained. The platinum crucible was removed and place in a dedicator to cool and weighed, the value was recorded as w2, Percentage as was calculated as % ash = x 100 … (2) This was repeated for all samples.
Determination of fats and oil Cold method of extraction was used to determine fats and oil in all the five samples, 10g of samples of accurately weighed into round bottom flasks then 50ml of n-hexane was added to each of the samples and covered for 24 hours for proper extraction of oil after which clean and dried empty beakers were weighed and weights noted. The samples were decanted into the beakers and were heated to dryness and transferred in a desiccator to cool and weighed and new weights taken. Percentage fats were calculated thus; % fat or oil = x 100 … (3)
Crude fiber determination 2.0g of cowpea seed coats were digested in 200ml of 1.25% H2SO4, the mixture was boiled for 30min. and was filtered and washed with hot water to reduce the acidity, this was tested with PH paper, and the residue was again digested in 200ml of 1.25% NAOH. The mixture was heated for 30min. filtered and washed with hot water and dried in an oven, this was transferred to a platinum crucible and weighed (w1) then heated in a furnace at 5500C to ash and weighed again (w2). Percentage crude fibre was calculated as: % crude fibre = x 100 … (4)
Protein determination The protein nitrogen in 0.5g of dried samples was converted to ammonium sulphate by digestion with concentrated H2SO4 and in the presence of C2SO4 and Na2SO4. This was heated and the ammonia involved was steam distilled in 4% boric acid solution, the nitrogen from ammonia was deduced from the titration of the trapped ammonia with 0.1N H2SO4 with methyl red indicator until a pink colouration was observed indication the end point of titration. Protein was calculated by multiplying the deduced value of nitrogen by a protein constant 6.25mg.
Carbohydrate determination The carbohydrate content of the samples was estimated as the difference obtained after subtracting the values of organic protein, ash content, fat or oil, crude fibre, and moisture content from 100. That is 100- (protein + ash + oil + crude fibre + moisture content).
Mineral composition
Mineral composition, namely: Na, K, Ca, Mg and Fewere determined by the wet ashing method. The Atomic Absorption Spectrometer (Chem. Tech Analytical, Alpha Model No 2543,JenwayLtd, England) was used to determine the concentrations ofthe metals in the samples by flame atomization, using air acetyleneflame and single element hollow cathode lamp.
Statistical Analysis
Data obtained were analyzed using Analysis of Variance (ANOVA), and the means comparisons were carried out using the least significant differences (LSD) at the 5% level of probability using the IBM SPSS statistics 23 software.

III. Results And Discussion

Results

Sensory attributes of bean (akara) and puddings (moi-moi) prepared from enriched undehulled beans flour are represented with tables 2&3 below.There was significant ($P<0.05$) difference in the sensory scores. The sensory scores of the bean cake ranged from 6.40-8.70 for colour, 6.90-7.90for texture, 6.90-8.00for aroma, 6.50-8.20 for taste and 6.80- 7.80 for general acceptability. Sample A (100% beans) had the highest sensory score (8.70±0.61) for colour followed by sample B (50% beans: 15% crayfish: 27% dried fish: 10% dried onions) (7.40±0.61), Sample E (50% beans:15% crayfish:28.5% dried fish:6.4% dried onions)(6.70±0.61), Sample D (51% beans: 20% crayfish: 23% dried fish: 5.3% dried onions)(6.60±0.61) and Sample C (50% beans: 15% crayfish: 27% dried fish:5.0% dried onions)(6.40±0.61) respectively. Sample A was most preferred for colour because it was most appealing in appearance as a result of the non inclusion of the other ingredients. However, the non-inclusion of the other ingredients made Sample A to be least preferred for aroma, taste and general acceptability. For texture Sample B (7.90±0.50) was most preferred followed by Sample A (7.60±0.50), Sample E (7.20±0.50), Sample C (7.00±00) and the least Sample D (6.90±0.50). For aroma, taste and general acceptability Sample B (8.00±0.54) was most preferred (Table 2).

The result for steamed pudding ranged from 6.50-7.90 for colour, 6.90-7.40 for texture, 6.40-7.60 for aroma, 6.30-8.10 for taste and 6.60-7.60 for general acceptability.There was no significant ($P<0.05$) difference in the sensory attributes of steamed beam pudding from enriched beans for colour between samples A and B as well as between samples C and D. There was significant ($P<0.05$) difference for texture, aroma, taste and general acceptability. Sample A in term of colour was the most preferred and Sample C least preferred this may be due to the fact that inclusion of fish and crayfish affected the colour. For texture, aroma and general acceptability Sample B (7.70±0.57) (7.60±0.61) (8.00±0.49) was most preferred.

Table 2.0 SENSORY ATTRIBUTES OF BEAN CAKES FROM ENRICHED BEANS FLOUR

SAMPLES	COLOUR	TEXTURE	AROMA	TASTE	GENERAL ACCEPTABILITY
A	$8.70^{a}\pm0.61$	$7.60^{a}\pm0.50$	$6.90^{c}\pm0.54$	$6.50^{c}\pm0.68$	$6.80^{b}\pm0.66$
B	$7.40^{b}\pm0.61$	$7.90^{a}\pm0.50$	$8.00^{a}\pm0.54$	$8.20^{a}\pm0.68$	$7.80^{a}\pm0.66$
C	$6.40^{c}\pm0.61$	$7.00^{a}\pm0.50$	$7.30^{b}\pm0.54$	$7.10^{ab}\pm0.68$	$7.40^{a}\pm0.66$
D	$6.60^{c}\pm0.61$	$6.90^{b}\pm0.50$	$7.50^{b}\pm0.54$	$6.90^{ab}\pm0.68$	$7.20^{a}\pm0.66$
E	$6.70^{c}\pm0.61$	$7.20^{a}\pm0.50$	$7.80^{a}\pm0.54$	$7.20^{ab}\pm0.68$	$7.20^{a}\pm0.66$

Values are means of triplicates ±SD. Colum with different superscripts are significantly (P<0.05) different

Table 3.0 SENSORY ATTRIBUTES OF STEAMED BEANS PUDDING FROM ENRICHED BEANS FLOUR

SAMPLES	COLOUR	TEXTURE	AROMA	TASTE	GENERAL ACCEPTABILITY
A	$7.90^{a}\pm0.77$	$7.40^{a}\pm0.57$	$6.40^{b}\pm0.61$	$6.30^{c}\pm0.53$	$6.60^{b}\pm0.49$
B	$7.40^{a}\pm0.77$	$7.70^{a}\pm0.57$	$7.60^{a}\pm0.61$	$7.90^{b}\pm0.53$	$8.00^{a}\pm0.49$
C	$6.50^{b}\pm0.77$	$7.00^{ab}\pm0.57$	$7.00^{ab}\pm0.61$	$7.30^{ab}\pm0.53$	$7.40^{ab}\pm0.49$
D	$6.70^{b}\pm0.77$	$6.90^{b}\pm0.57$	$7.20^{a}\pm0.61$	$6.60^{c}\pm0.53$	$6.90^{b}\pm0.49$
E	$7.00^{ab}\pm0.77$	$7.20^{a}\pm0.57$	$7.50^{a}\pm0.61$	$8.10^{a}\pm0.53$	$7.60^{ab}\pm0.66$

Values are means ±SDof triplicates. Colum with different superscripts are significantly (P<0.05) different

The proximate composition (ash content, moisture content, fat content, crude fibre, protein and carbohydrate) of enriched undehulled bean flour as shown in table 4.0 below ranged as followed: 3.11%-6.43%, 9.42%-10.67%,13.19%-17.32%, 2.26%-2.65%, 13.78%-21.83% and 41.13%-61.22% respectively. Ash content in a food gives an indication of minerals present, it could be inferred that the enrichment with crayfish, dried fish and onions increased the ash content of the flour samples. The ash content and moisture content of this study were in agreement with the work of Ape *et al*., 2015 who reported ash content ranged of 4.80-9.30 and moisture content of 9.70-14.00 for four species of cowpea. The protein content of this study was in agreement with the work of Malomo *et al*., 2017 who reported protein content range of 19.24-23.94%. However, the fat content, crude fibre and carbohydrate of this study were higher than previous studies. The high protein content of this study is an advantage because protein is needed for repair of worn out tissues, healthy body functioning and development of the body.

Fibre is also important in human diet as it reduces the risk of colon cancer, slow down the release of glucose in the blood and decrease reabsorption of bile salt (Gibney, 1989). The bean seeds used to prepare the enriched bean flour for this study were not dehulled so as to provide the dietary fibre needed by the diabetics and for healthy digestive system.

Energy value ranged from 418.71Kcal-407.56 Kcal. Sample A was significantly different from the other four samples. The highest 418.71 kcal was recorded for the control (sample A) and the least value of 407.56 for sample E. The addition of crayfish, dried fish and dried onions generally increased the nutritional composition of the enriched undehulled bean flour in this present study.

Table 3.0 PROXIMATE COMPOSITION (%) OF ENRICHED BEANS FLOUR

Sample	Ash content	Moisture Content	Fat content	Crude fibre content	Protein content	Carbohydrate	E(kcal)
A	$3.11^{a}\pm1.00$	$9.42^{a}\pm1.00$	$13.19^{a}\pm1.00$	$2.52^{c}\pm1.00$	$13.78^{a}\pm0.25$	$61.22^{e}\pm1.00$	$418.71^{a}\pm1.00$
B	$5.29^{b}\pm1.00$	$10.67^{d}\pm1.00$	$16.59^{c}\pm0.28$	$2.58^{d}\pm1.00$	$16.35^{ab}\pm0.25$	$48.46^{d}\pm1.00$	$408.55^{b}\pm0.25$
C	$5.53^{c}\pm1.00$	$10.40^{bc}\pm0.10$	$16.54^{c}\pm0.28$	$2.44^{b}\pm1.00$	$18.92^{b}\pm0.25$	$46.12^{c}\pm1.00$	$409.02^{b}\pm0.25$
D	$5.74^{d}\pm1.00$	$10.29^{b}\pm0.10$	$16.42^{b}\pm1.00$	$2.26^{a}\pm1.00$	$21.83^{c}\pm0.21$	$43.42^{b}\pm1.00$	$408.78^{b}\pm0.25$
E	$6.43^{e}\pm1.00$	$10.48^{c}\pm0.24$	$17.32^{d}\pm1.00$	$2.65^{e}\pm1.00$	$21.79^{c}\pm0.21$	$41.13^{a}\pm1.00$	$407.5^{b}\pm0.25$

Values are means ±SDof triplicates. Colum with different superscripts are significantly (P<0.05) different

Mineral composition of the enriched undehulled beans flour was calculated in parts per million. The mineral analyzed were sodium, potassium, calcium, magnesium and iron. The values of sodium ranged from 527-610, potassium (1536-1875), calcium (210-284), magnesium (780-963) and iron (75.90-102). Sample C had the highest sodium while Sample A had the least sodium. Sample A had the highest potassium and calcium while sample E had the least potassium and Sample D had the least calcium. Sample D had the highest magnesium while sample E had the least. Sample D had the highest iron while sample B had the least. The result of this study showed that the enriched undehulled beans flour was rich in the mineral analyzed. Sample D had the highest values for magnesium and iron. The mineral contents in this study were higher than work reported by Malomo *et al*., 2017; Agbara *et al*., 2018.

Table 4.0 MINERAL COMPOSITION (PPM) OF ENRICHED BEANS FLOUR

SAMPLES	SODIUM	POTASSIUM	CALCIUM	MAGNESIUM	IRON
A	527.00^{a}±1.00	1875.00^{c}±1.00	284.10^{c}±1.00	910.00^{c}±1.00	82.50^{b}±1.00
B	530.00^{b}±1.00	1536.00^{a}±1.00	229.00^{b}±1.00	829.00^{b}±1.00	75.90^{a}±1.00
C	610.00^{e}±1.00	1810.00^{d}±1.00	250.00^{d}±1.00	950.00^{d}±1.00	98.00^{d}±1.00
D	580.00^{c}±1.00	1650.00^{b}±1.00	210.00^{a}±1.00	963.00^{e}±1.00	102.00^{e}±1.00
E	594.00^{d}±1.00	1690.00^{c}±1.00	235.00^{c}±1.00	780.00^{a}±1.00	91.10^{c}±1.00

Values are means ±SDof triplicates. Colum with different superscripts are significantly ($P<0.05$) different

IV. Conclusion

The enriched undehulled bean flour was found to be generally accepted but Sample B was mostly preferred organoleptically. The samples were rich in proximate and mineral compositions. The enriched undehulled beans flour can serve as a convenient food for the working class as well as a wholesome meal for every family. It is a functional food that will greatly impact the health of its consumers. It can be reconstituted to prepare bean cake (*akara*) and bean pudding (*moimoi*). The enrichedundehulled bean flour will provide both plant and animal protein which makes it healthy for all categories of persons- convalescent, the diabetic,and the aged and growing children. It will provide the required daily protein intake.

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