FUNCTIONAL PROPERTIES AND SENSORY QUALITY OF BAMBARA GROUNDNUT AND COWPEA FLOUR FOR EKURU PRODUCTION

JENFA, D. M & AKINRINDE, I. M

Department of Food Technology, The Federal Polytechnic Ilaro, P.M.B. 50, Ogun State, Nigeria.
jenfamary@gmail.com and akinrindeibk@gmail.com; 08132560868

ABSTRACT

The mixture of Cowpea and Bambara groundnut flour for Ekuru production was evaluated. The analysis carried out include functional properties and sensory evaluation. Different ratio of Cowpea and Bambara groundnut flour were measured. The composition include 100% Cowpea, 100% Bambara groundnut, 80:20, 20:80, 50:50 and 60:40 Cowpea:Bambara groundnut flour. Mixtures of Cowpea and Bambara groundnut flour were significantly different in their water absorption capacity, oil absorption capacity, bulk density, dispersibility, swelling power and solubility ($p>0.05$). Ekuru made from 20% Bambara groundnut and 80% Cowpea was the most acceptable.

KEYWORDS: Cowpea, Bambara groundnut, Ekuru.

1. INTRODUCTION

Bambara groundnut (Vigna subterranea (L.) Verdc.) is a pulse with subterranean fruit-set and small holders cultivate them (Linnenann & Azam-Ali, 1993). The crop is wide spread in the south of the sahara (Ocran et al., 1998). Bambara groundnut is not attacked by pests and disease in any of the production regions. However, in mois t conditions. it may be susceptible to various fungal diseases (Baudoin & Mergeai, 2001). Bambara groundnut is a popular crop in Sub-Saharan Africa. It is highly nutritious and also plays important roles in people's diet. The seed contains about 63% carbohydrate, 19% protein and 6.5% oil (Goli, 1997).

Cowpeas are grown widely in savannah regions of the tropics and sub-tropics, especially in western and central African countries. They are also cultivated extensively in California, the southeastern United States and Puerto Rico. Nigeria is currently the world's largest cowpea producer accounting for about 22% of total production, followed by Brazil, which produces around 10% (IITA, 2007). Depending on the specific cultivar, the pods can be curved, straight or even coiled, and the seeds may be solid colours (red, black, brown, tan or white) or speckled, spotted, or marbled. The seeds vary in shape from kidney-shaped to round, depending on how tightly packed they are in the pod. (IITA 2007). The family is called Fabaceae, the subfamily, Faboidea, the genus and species is called *Vigna unguiculata*. The common names are cowpea, black-eyed pea, black-eyed bean, crowder pea, southern pea, field pea, china bean (IITA, 2007). Cowpea contains around 25% protein and are low in fat. As with most legumes, they are poor in some of the sulphur-containing amino acids needed for a complete protein; however, the amino acids in cowpeas are complemented by those found in cereal grains. They are also an excellent source of fibre, calcium, folic acid and vitamin A (IITA, 2007).

Ekuru is another cowpea based staple food consumed in Nigeria and in some other West African countries. It is a popular kind of food in Southern and Western part of Nigeria where it is used as a culture and traditional food by the people (Adedokun *et al*., 2014). It serves as a nutritional food in traditional, cultural and religious functions especially among the Yoruba's. Ekuru can be eaten with prepared sauce made of spices and seasoning or vegetable soup. However, most people prefer consuming it with eko or agidi.

This paper aims at solving the underutilization of Bambara groundnut in Nigeria and also improving the nutritional quality of Bambara groundnut fortifying with Cowpea. The problem came as a result of Bambara groundnut grown extensively in Nigeria but it is one of the underutilized legume in Nigeria, hence the need for its processing. Research shows that Bambara groundnut is seasonal, hence processing it into raw materials will increase it's availability and the shelf life. Protein malnutrition coupled with calorie deficiency is widespread in many developing countries. The legumes including pulses and beans are important dietary foodstuff. Bambara groundnut is a source of protein and Cowpea is also a source of protein. In view of improving food security and nutritional wellbeing of the people that rely on Bambara groundnut and Cowpea, improving the nutritional quality of Bambara groundnut fortifying with Cowpea is necessary.

The key objectives here are to determine the functional properties of Bambara groundnut and Cowpea blends and to determine the Sensory quality of Ekuru prepared from Bambara groundnut and Cowpea blends.

2. METHODOLOGY

2.1 Source of samples
Bambara groundnut and Cowpea were purchased from Kuto market, Abeokuta, Ogun state. Nigeria.

2.2 Preparation of flour samples
The samples were prepared according to the method described by Olapade & Adetuyi (2007), and Odedeji & Oyeleke (2011).

2.3 Production of Bambara groundnut flour
Bambara groundnut was sorted to remove dirts. It was then soaked for 9 hours and dehulled until the seed coat loosened. The loosed coats were floated off in water while the dehulled cotyledons were drained properly and dried in an oven at 65ºC for 23 hours. The dried bambara groundnut were milled in an attrition mill and then sieved and packaged in high density polyethylene bag and tightly sealed until needed. Olapade & Adetuyi (2007).

2.4 Production of Cowpea flour
Cowpea was sorted to remove dirts. It was then steeped for 30mins and the hull was removed. The dehulled cowpea was dried in an oven at 70ºC for 9 hours. The dried cowpea was milled and sieved and later packaged in high density polyethylene bag and tightly sealed until needed. Odedeji & Oyeleke (2011).

2.5 Production of Ekuru
Cowpea flour was mixed with Bambara flour thorougly in a mixing bowl using a wooden spatula. 100ml of warm water was then added and mixed thoroughly to form a smooth paste after which a big stainless spoon was used to scoop the mixed sample into a nylon, packaged and steam cooked for about 40minutes. The samples were left for cooling. (Ogundele *et al.,* 2015).

2.6 Functional Properties of Bambara groundnut and Cowpea blends
1. Water absorption capacity
2. Oil absorption capacity
3. Swelling power and solubility
4. Bulk density
5. Dispersibility

2.6.1 Water absorption capacity
Water absorption of flour was measured according to the centrifugation method described by Onwuka, (2005). 1g of sample was weighed in a centrifuge tube and 10ml of water was added and mixed thoroughly. The dispersion was allowed to stand for 30mins, followed by centrifugation for 15mins at 3000 rpm. The sample was re-weighed, the amount of water retained in the sample was recorded as weight gained. The water absorption capacity (WAC) was calculated.

2.6.2 Oil absorption capacity
Oil absorption capacity was also determined using the method described by Onwuka, (2005). 1g of sample was mixed with 6ml of corn oil in pre-weighed centrifuge tubes. The content was stirred for 1minute with a thin brass wire to dispense the sample evenly in the oil. After a holding period of 30minutes, the tubes were centrifuged for 25minutes to drain the oil prior to reweighing. Oil absorption capacity (OAC) was weighed as weight of oil bound per weight of the sample on a dry basis.

2.6.3 Swelling power and solubility
This was determined by the method described by Oladele and Aina (2007). One gram of the flour was mixed with 10 ml distilled water in a centrifuge tube and heated at 80 ^{0}Cfor 30 minutes. This was continuously shaken during the heating period. The tube was removed from the bath, wiped dry, cooled to room temperature (28 ^{0}C) and centrifuged for 15mins at 2200 rpm. The supernatant was evaporated, and the dried residue weighed to determine the solubility.

The swollen sample (paste) obtained from decanting supernatant was also weighed to determine the swelling power. Swelling power was calculated as weight of the paste/weight of dry sample.

2.6.4 Bulk density

Bulk density was done according to the method of Asoegwu *et al.* (2006). A known amount of sample was weighed into 50ml graduated measuring cylinder. The sample was packed by gently tapping the cylinder on the bench top from a height of 5cm. The volume of the sample was recorded.

$$\text{Bulk density} = \frac{\text{Weight of Sample gml or g/cm}}{\text{Volume of Sample after tapping}}$$

2.6.5 Dispersibility

This was determined by the method described by Kulkarni (1991). 10grams of flour was suspended in 100ml measuring cylinder and distilled water was added to reach a volume of 100ml. The set up was stirred vigorously and allowed settling for 3hrs. The volume of settled particles was recorded and subtracted from 100. The difference was reported as percentage dispersibility.

2.7 Sensory Evaluation

The Ekuru samples were served, coded and presented to a set of panel of judges who were familiar with the product for sensory evaluation. The personnel scored the color, flavour, taste, texture and overall acceptability. Acceptability test was conducted with 50 panelists who evaluated the sensory quality of Ekuru using A nine (9) point Hedonic Scale 1 to 9 representing.

2.8 Statistical Analysis

All data obtained in this study were analyzed statistically by analysis of variance (ANOVA) with the application of Duncan's multiple range tests using Statistical package for Social Sciences (SPSS).

3. RESULTS AND DISCUSSION

3.1 Functional Properties

Table 1: Functional properties of Cowpea and Bambara groundnut Blends

Sample	Water absorption capacity (g/g)	Oil absorption capacity (g/g)	bulk density (g/cm^3)	Dispersibilty (%)	Swelling power (%)	Solubility (%)
C100	2.80±0.01^{bc}	4.79±0.01^{e}	1.65±0.01^{c}	81.50±0.50^{a}	4.78±0.01^{d}	26.50±0.50^{b}
B100	2.50±0.07^{a}	4.92±0.03^{d}	1.68±0.01^{d}	87.50±0.50^{c}	3.90±0.02^{a}	32.50±2.50^{c}
C80B20	2.84±0.07^{bc}	4.72±0.02^{c}	1.44±0.01^{ab}	84.00±1.00^{b}	3.91±0.02^{a}	27.00±1.00^{b}
C20B80	2.79±0.03^{c}	4.35±0.01^{a}	1.43±0.01^{a}	85.00±1.00^{b}	4.96±0.01^{e}	28.00±1.00^{b}
C50C50	2.69±0.01^{b}	4.64±0.01^{b}	1.44±0.01^{ab}	85.00±0.01^{b}	4.36±0.01^{b}	23.50±1.50^{a}
C60B40	2.88±0.01^{c}	4.33±0.01^{c}	1.45±0.01^{b}	82.00±1.00^{a}	4.66±0.03^{c}	28.50±0.50^{b}
LSD	0.04	0.12	0.02	2.50	0.30	4.0

Values with the same superscript in the same column are not significantly different ($p>0.05$), values are mean±standard deviation of duplicate determinations, LSD=least significant difference,

Key: C100:100% cowpea, B100:100% Bambara groundnut, C80B20:80% cowpea+20% Bambara groundnut, C20B80:20% cowpea+80% Bambara groundnut, C50B50:50% cowpea+50% Bambara groundnut,, C60B40:60% cowpea+40% Bambara groundnut.

From **T**able 1, B100 had the highest dispersibility while C100 had the least and although there was no significant difference in the dispersibility of C20B80, and C50B50. C20B80 had better swelling power while C50B50 had the least swelling power. Swelling power related often to their protein and starch content (Woolfe, 1992). Higher protein content in flour may cause the starch granules to be embedded within a stiff protein matrix, and which subsequently limits the access of the starch to water and restricts the swelling power (Aprianita *et al.*, 2009). The amylopectin is primarily responsible for granule swelling; the high content in amylopectin in composite flour with higher level of sweet potato starch would increase the swelling power of composite flour (Tester & Morrison, 1990). Moorthy &

Ramanujam (1986) ‘‘reported that the swelling power of granules is an indication of the extent of associative forces within granule’’. As a result of swelling there is an increment in the solubility as reported by (Akubo, 1997). B100 was more soluble although there was no much disparity in the solubility of C100, C80B20, C20B80, and C60B40.

3.2 Sensory Characteristics of Ekuru

The sensory characteristics of Ekuru are shown in Table 2, significant difference ($p<0.05$) was observed between ekuru made from cowpea and bambara groundnut blends with respect to taste, texture, flavour and overall acceptability. It was observed that colour had no significant difference ($p<0.05$). Furthermore, the mean response of the hedonic scale test shows that colour, taste, texture, flavour and overall acceptability were liked slightly. Ekuru made from 20% Bambara groundnut and 80% Cowpea was the most acceptable.

Table 2: Sensory characteristics of Ekuru made from Cowpea and Bambara groundnut Blends

Flour blend	Colour	Taste	Texture	Flavour	Overall acceptability
C100	5.70±2.16[a]	5.74±1.88[ab]	5.10±1.94[bc]	5.28±2.09[b]	5.98±1.85[c]
B100	5.36±2.14[a]	4.04±2.15[a]	4.10±2.03[a]	4.12±2.04[a]	4.64±1.91[a]
C80B20	5.30±2.03[a]	4.70±1.91[ab]	4.46±2.15[ab]	4.66±2.00[ab]	6.06±1.93[ab]
C20B80	5.52±2.07a	6.44±1.05[b]	6.32±2.19[e]	4.70±2.[16ab]	5.52±1.83[bc]
C50B50	5.56±ss2.14a	4.98±1.96[ab]	6.16±1.69[de]	5.16±1.82[b]	5.46±1.91[abc]
C60B40	5.14±2.42[a]	4.60±2.24[ab]	5.44±2.29[cd]	4.42±2.17[ab]	5.24±2.41[abc]
LSD	0.14	0.70	0.16	0.12	0.46

Values with the same superscript in the same column are not significantly different ($p>0.05$), values are mean±standard deviation of duplicate determinations, LSD=least significant difference.

Key: C100:100% cowpea, B100:100% Bambara groundnut, C80B20:80% cowpea+20% Bambara groundnut, C20B80:20% cowpea+80% Bambara groundnut, C50B50:50% cowpea+50% Bambara groundnut,, C60B40:60% cowpea+40% Bambara groundnut.

4. CONCLUSION AND RECOMMENDATION

4.1 Conclusion

From the result, it was found that Bambara groundnut flour increased dispersibility, swelling power and solubility of Cowpea-Bambara groundnut blends significantly. The mixtures of Cowpea and Bambara groundnut flour at 80% to 20% gave the most acceptable steamed paste.

4.2 Recommendation

It is recommended that increased efforts should be made to encourage the cultivation of Bambara groundnut as well as its consumption/utilization in order to help curb food insecurity. Further work should also be carried out in the identification and characterization of the micro-organisms involved during the processing of bambara groundnut flour. More research should be intensifying in the extension of shelf-life of the bambara groundnut composite flour in other to ascertain its storage stability. There is need to research into the mineral content, anti-nutritional properties and amino acid analysis of bambara groundnut fortification. There is need to encourage large scale production of Bambara groundnut in order to combat the problem of proteinous food shortage in under developing countries where animal protein is costly.

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