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# Evaluation of the quality of instant fufu flours prepared from corn, cassava and soybean flour blends

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## Abstract

Flour samples were prepared from corn, cassava and soybean. The corn flour (COF), cassava flour (CAF and soybean flour were used to prepare fufu flour blends. The chemical composition of the samples were determined. The flour blends were used to prepare fufu meals which were evaluated for their sensory properties. The fufu meal containing COF, CAF and SBF had higher ash, crude protein and crude fat contents than the control (COF-CAF blend). The levels of these nutrients increased with the level of SBF in the blends. The COF-CAF blend contained 2.0% ash while the ash content of the COF-CAF-SBF blend varied from 2.1 to 4.3%. The protein content increased from 8.9% in the COF-CAF fufu to a range of 11.6 to 25.6% for the COF-CAF-SBF fufu blend. Similarly, the fat contents increased from2.8% in the COF-CAF fufu blend to a range of 4.1 to 11.7% in the blend containing SBF. The COF-CAF fufu (350.8 Kcal/100g) and the COF-CAF-SBF fufu (360-402.3 Kcal/100g) contained adequate amount of energy. The energy values of the fufu supplemented with SBF increased with the amount of SBF in the blends. The scores of the fufu meal supplemented with SBF for all the sensory attributes and overall acceptability evaluated except color increased up to 20% level of SBF incorporation and thereafter, dropped steadily.

**Key words:** Corn, Cassava, Soybean, Blends, Fufu, Composition, Sensory properties.
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## Introduction

Cassava supplies about 70 % of the daily calorie of over 50 million people in Nigeria (Akubor and Ukwuru, 2003). It is essentially a carbohydrate food with low protein, fat, essential minerals and vitamin contents (Anyankunbi *et al.,* 1991). Cassava root also contains large amount of toxic cyanogenic glycosides (linamarin and lotaustralin) which are hydrolyzed by linamarase to hydrocyanic acid (HCN) when the plant tissue is damaged during harvesting and processing (Yeoh *et al.,* 1996, Oyetoro, 2013). Cassava roots are processed by various methods into various products that vary with local customs and preferences. Such products include flour, gari, lafun, fufu, pupuru, akara etc. Details and methods of preparation these products vary and this greatly affects the quality of the finished products. Cassava products are consumed as staple foods in most states of Nigeria where cassava is grown.

Fufu is a thick paste made by boiling flour in water, stirring vigorously with a wooden paddle until a desired consistency is formed. Fufu flour could be prepared from cassava, yam, potatoes, cocoyam, cereals etc. The composition of fufu depends on the raw material used for its preparation. Cassava fufu is widely consumed in all the parts of Nigeria and it is the most popular fufu product (Akubor and Ukwuru, 2003). The methods for the preparation of cassava flour that is used for making cassava fufu vary widely

among the various tribes in Nigeria. Generally, cassava flour is prepared by washing fresh cassava roots, peeling, washing, soaking in water for 3 days, shredding, sun drying, milling and sieving. This traditional method of processing cassava reduces the toxic cyanogenic glycosides (Achi and Akoma, 2006). The microorganisms involved in the fermentation of cassava flour include species of *Bacillus, Klebsiella, Leuconostoc, Corynebacterium, Candida and Lactobacillus* (Oyedeji *et al.,* 2011). The lactic acid bacteria associated with cassava flour production are considered as probiotics (Fuller, 1989). Probiotics are alive microbial food/feed supplements which beneficially affect the host animal by improving its intestinal microbial balance. (Fuller, 1989). The health benefits associated with consumption of probiotics include decrease in rotavirus shedding in infants, reduction in antibiotic-associated diarrhea, reduction in the incidence of childhood atopic eczema and management of inflammatory bowel disease such as Crohn's disease (Oyedeji *et al.,* 2011). Fermented cassava products such as such as gari, flour, lafun are considered as functional foods as these are rich in dietary fiber, vitamins and essential minerals as well as LAB.

Ojeakpa is a popular traditional fufu prepared by the *Igalas* of Kogi State, Nigeria from corn and cassava flour blend. It is known as *nni oka* among the Ibos of Eastern Nigeria. The fufu is prepared by adding corn flour into boiling water and lightly stirred for 5-10 minutes to obtain a uniform mix. The cassava flour is then added and stirred vigorously to a gelatinous mass. The mass is then cooled and eaten with okro soup or equsi soup. In such preparations, various combinations of corn and cassava flours exist. The proportion of corn flour, however, is usually higher than the cassava flour. Cassava contains higher amount of starch than maize. Starch controls the texture of fufu. Onwuka *et al.,* (2010) reported that starch is the main component responsible for the formation of fufu dough Among the *Igalas*, the ratio 2:1 (corn: cassava) is widely used for the preparation of fufu.

The nutritive value of corn protein is low being deficient in lysine and tryptophan in addition to essential minerals and vitamins (Akpapunam and Darbe, 1994). However, maize is rich in cysteine and methionine. Thus, population which eat a lot of ojeakpa, do not receive adequate amount of nutrients. However, the protein quality of individual protein could be greatly improved by combining it with other protein sources. In recent years, research efforts in developing countries have helped in the improvement of protein quality of cereals and tuber crops. Various degrees of success have been reported in this area such as fortification of maize with soybean (soy-ogi), cassava with soy flour (cassava-soy flour), fermented yam flour supplemented with soy flour (yam -soy mixture) for preparation amala, a popular west African food. In this way, soybean is used in various foods to mitigate shortage of protein supplies (Temple *et al.,* 1991; Iwe, 2000). This is because soybean (*Glycine* max) is a cheap source of quality protein that is superior to all other plant foods. It has good balance of essential amino acids. It contains high amount of methionine which is lacking in cereals and tubers. Soybean is also rich in phytochemicals such as isoflavones which would benefit health. Foods containing large quantities of phytochemicals are associated with reduced risk of human diseases such as cancer, antherosclerosis, heart diseases etc. (Temple *et al.,* 1991).

Ojeakpa is gaining importance among the people in Nigeria. Therefore, supplementing it with soybean has the potential of providing cheap protein source and phytochemicals for the low income earners in the country. However, this may change the physicochemical properties of the maize and cassava flour blend as well as the acceptability of the paste (ojeakpa). Study on the preparation and nutritional potential of soy-ojeakpa would increase the awareness and provide baseline data on the product. Therefore, the objective of this study was to determine the chemical composition of corn, cassava and soybean flour blends and the sensory properties of ojeakpa prepared from the blends.

## Materials and Methods

**Source of materials:** Yellow variety soybean (Glycine max) seeds, white variety of corn (Zea mays) and freshly harvested sweet cultivar of cassava (Manihot esculenta crantz) roots were purchased from a local market in Idah Township, Kogi State, Nigeria.

**Preparation of corn flour:** Corn (11% moisture) were cleaned of extraneous materials, milled and screened through a 40 mesh sieve.

**Preparation of soybean flour:** Soybean seeds were cleaned, soaked in enough tap water and boiled in a plain pot with a lid. The hydrated seeds dehulled manually, oven dried (50$^{o}$C) and milled to pass through a 40 mesh sieve.

**Preparation of cassava flour:** The cassava flour was prepared as described by Akubor and Ukwuru (2003). The cassava roots were cleaned of sand, peeled manually with sharp kitchen knife, washed in tap water contained in a basin and then cut into uniform-sized slices (3cm x 1cm) of 0.4 cm thickness. The slices were incubated in sterile distilled water for 48h at 32$^{o}$C. During the wild fermentation, the water was changed poured off the slices at 24h intervals. The fermented were sun dried at 32$^{o}$C for 72h, milled a hammer mill and sieved through a 40 mesh sieve (British standard). The flour was packaged in high density polyethylene (HDPE) bag and stored in a refrigerator at 10$^{o}$C prior to use.

**Preparation soy bean-corn-cassava flour blends:** Table 1 shows the various proportions of the flours used for the preparation of soybean-corn-cassava flour blends. The flour blends were blended in a Kenwood blender and packaged in HDPE bags before used.

**Preparation of cooked fufu meal**: To prepare cooked meals, the various flour blends were dispersed into boiling water and cooked with continuous stirring over fire till a gelatinous mass was obtained and then cooled.

**Table 1: The flour ratios used for the preparation corn-cassava-soybean flour blend fufu**

| Corn flour | Cassava flour | Soybean flour |
|---|---|---|
| 75 | 35 | 0 |
| 65 | 25 | 10 |
| 55 | 25 | 20 |
| 50 | 20 | 30 |
| 45 | 15 | 40 |
| 40 | 10 | 50 |

**Chemical analysis**: The crude protein (N X 6.25), crude fat (solvent extraction), crude fiber, ash and moisture contents were determined by the AOAC (2010) methods. The total carbohydrate content was calculated as 100 - (% Moisture + % Crude protein + % Crude fiber + % Ash + % Crude fiber). The caloric content was calculated using at water factors (4 × % Protein + % Crude fat + % Carbohydrate).

**Sensory evaluation of fufu:** A twenty member trained panel consisting of students and staff members (both males and females) of the Food Science and Technology, Federal polytechnic, Idah were selected based on experience and familiarity with ojeakpa for the sensory evaluation of the corn-cassava-soybean fufu samples. The tests were performed under fluorescent lighting in a sensory evaluation laboratory at 10 am in the morning. The cooked products were provided with egusi soup in three-digit coded white plastic plates. The corn-cassava flour fufu served as control. The order of presentation of the samples was randomized. Tap water was provided for the panelists to rinse their mouths in between evaluations. The panelist evaluated the samples for color, taste, flavor, texture and overall acceptability on a 9-point hedonic scale where 1 represented disliked extremely and 9 liked extremely.

**Statistical analysis:** The experiment was laid out on completely randomized design. Data were subjected to analysis of variance using statistical package for Social Sciences (SPSS, version 17, 2007). Significantly differently means were separated by least significant difference (LSD) test.

## Results and Discussion

### Chemical composition

The chemical composition of corn flour, cassava flour, soybean flour and the blends is shown Table 1. All the constituents of the corn flour except moisture and carbohydrate were higher than those of the cassava flour. On the other hand, the soybean flour contained more ash, protein, fat and energy contents but less carbohydrate and crude fiber contents than both the corn flour and cassava flour. While both the corn flour soybean flour contained the same amount of moisture, the CAF was significantly higher ($p<0.05$) in the carbohydrate content. The high protein content of soybean flour makes it a useful protein supplement for cassava and corn flours. The chemical composition values obtained in this study for the flours were similar to those of the previous reports (Longe, 1980; Sanni *et al.,* 1998; Ariahu *et al.,* 1999). The energy content of soybean flour was significantly higher ($p<0.05$) than those of the corn flour and cassava flour, probably due to its fat content. Energy value of a food is much more related to the fat content (Ihekoronye and Ngoddy, 1985). The corn flour (358.2 kcal/100g, cassava flour (303 kcal/100g) and soybean flour (440.5 kcal/100g) contained adequate amounts of energy, which were within the recommended daily allowance by the USA (UNECA, 1985). The energy values of the blends increased with the amount of SBF. The combination of the three flours significantly increased ($p<0.05$) the chemical composition of the when compared to the chemical composition of the corn-cassava flour which served as control. For instance, the ash, protein and fat contents of soy-corn-cassava flour blends increased with increase in the level of soy bean flour. This was probably due to addition effect as the soybean flour contained more of these nutrients than both corn flour and cassava flour. This indicates nutrients enhancement with soy flour addition. However, the crude fiber and carbohydrate contents slightly ($p>0.05$) decreased with the level of soybean flour in the blends. The high protein content of the supplemented fufu is of nutritional importance in most developing countries including Nigeria where many people can hardly afford protein rich foods because of the costs. The increase in protein content in this study is similar to other studies where soy bean flour was used in supplementation such as in soy- maize for agidi, wheat-soy plantain in bread.

### Sensory properties of fufu meals

The mean sensory scores for the fufu meal prepared from the various blends are presented in Table 2. For all the sensory attributes assessed, scores increased significantly ($p<0.05$) up to 20 % level of soybean flour addition and thereafter, scores decreased steadily. A part from color, the control (corn-cassava flour blend) received lower scores for other attributes than the fufu meal containing 20% soy bean flour. The score for color decreased on a 9-point Hedonic scale from 7.0 for the control to 3,8 for the blend containing 50% soybean flour. The control fufu meal was white and more preferred to the blend containing yellow soy bean flour. The panel responses showed that all the samples containing soybean flour had higher ratings for flavor than the control (corn-cassava flour blend). Like the sensory attributes, the blend containing 20% soybean flour scored higher for overall acceptability. Similarly, above the 20 % level of soybean flour addition, the overall acceptability scores also decreased significantly ($p<0.05$). These results suggest that soybean flour could be used to up to 20 % corn-cassava flour blend soy to produce fufu product with acceptable sensory characteristics.

**Table 2: Chemical composition of corn flour(COF), cassava flour(CAF), soybean flour(SBF) and the blends**

| COF:CAF:SBF | Moisture (%) | Ash (%) | Crude protein (%) | Crude fat (%) | Crude fiber (%) | Carbohydrate (%) | Calorie (Kcal) |
|---|---|---|---|---|---|---|---|
| COF | 10.6[b] | 2.7[c] | 10.2[g] | 3.8[f] | 1.9[a] | 70.8[b] | 358.2[g] |
| CAF | 11.0[a] | 1.2[c] | 1.7i | 0.3[h] | 1.5[a] | 85.2[a] | 303.0[i] |
| SBF | 10.0[b] | 4.4[a] | 41.8[a] | 20.7[a] | 1.4[a] | 21.7[i] | 440.3[a] |
| COF:CAF:SBF | | | | | | | |
| 75:25:0 | 11.9[a] | 2.0[c] | 8.9[h] | 2.8g | 1.9[a] | 72.5[c] | 350.8[h] |
| 65:25:10 | 10.7[b] | 2.1[c] | 11.6[f] | 4.1[e] | 1.8[a] | 68.7[d] | 360.1[f] |
| 55:25:20 | 10.6[b] | 2.3[bc] | 14.0[e] | 6.9[d] | 1.7[a] | 64.5d[e] | 376.1[e] |
| 50:20:30 | 10.5[b] | 2.8[b] | 17.0[d] | 8.5[c] | 1.6[a] | 59.6[f] | 382.5[d] |
| 45:15:40 | 10.4[b] | 3.0[b] | 21.1[c] | 10.1[b] | 1.5[a] | 53.9[g] | 390.5c |
| 40:10:50 | 10.3[b] | 4.3[a] | 25.6[b] | 11.7[a] | 1.4[a] | 48.7[h] | 402.1[b] |

Values are means of 3 replications. Means within a column with the same superscript were not significantly different($p>0.05$).

**Table 3: Mean sensory scores of fufu meal prepared from corn flour(COF), cassava flour(CAF) and soybean flour(SBF)**

| COF:CAF:SBF | Color | Flavor | Taste | Texture | overall acceptability |
|---|---|---|---|---|---|
| 75:25:0 | 7.5[a] | 4.0[d] | 5.0[b] | 5.5[d] | 5.0[c] |
| 65:25:10 | 6.5[b] | 5.5[c] | 5.4[b] | 6.5[b] | 6.0[b] |
| 55:25:20 | 6.0[c] | 7.0[a] | 6.9[a] | 7.0[a] | 7.3[a] |
| 50:20:30 | 5.0[d] | 6.0[b] | 5.5[b] | 6.0[c] | 5.5[c] |
| 45:15:40 | 4.0[e] | 5.0c | 4.8[c] | 5.0[e] | 4.0[d] |
| 40:10:50 | 3.8[e] | 4.2[d] | 4.0[c] | 4.3[f] | 3.8[d] |

Values are means of 20 replications. Means within a column with the same superscript were not significantly different($p>0.05$).

## Conclusion

Based on the results of this study, it may be concluded that soybean flour can be used to supplement corn-cassava flour blend for fufu production without adversely affecting the chemical composition and sensory properties of the fufu. Protein-calorie malnutrition is widely prevalent in developing countries and would be reduced by the use of cheap and available nutritious food stuffs. Corn, cassava and soybean crops are readily available at harvest and are widely accepted. Therefore, soybean flour supplementation of corn-cassava flour fufu would be advantageous to the Nigerian people who eat a lot of cassava fufu.

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