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# Proximate, Mineral and Sensory Analysis of Maize-Soybeans Composite Flour Biscuit Enriched With Edible Insect "Kanni"

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## ABSTRACT

*Maize was fortified with soybeans flour and was enriched with edible insect "kanni". Maize, soybeans and "kanni" were extracted and processed into raw dried flour. Appropriate quantities of maize, soybeans flour and "kanni" (on dry weight basis) were measured and mixed at different concentrations while 100% maize flour as control. Proximate, mineral and sensory analysis of biscuits made from the flour was determined. The proximate, mineral and sensory properties of maize-soybeans composite flour biscuit samples (A, B and C) were evaluated. The biscuits contained moisture (10.42-11.02%), protein (11.85-15.95%), ash (1.75-2.11%), fat (16.18-17.26%), fibre (2.52-4.36%) and carbohydrate content (49.95-56.00%), respectively. Major mineral contents in the biscuits were sodium, iron, zinc, potassium, magnesium and calcium of 40.95-73.25, 1.75-2.45, 1.22-1.53, 50.76-87.45, 8.15-11.22 and 78.75-108.56mg/100ml, respectively. However, sample C (15% SB and 15% K) had the highest value of fibre, protein and carbohydrate content as well as highest mineral value of sodium, magnesium and iron. However, overall acceptability of sample C was significantly higher than others. This study reveals that the flour blend can be use for production of biscuits and can be a substitute for wheat flour in pastries.*

## Keywords

Maize, Soybeans, Biscuits, Composite flour.

## Introduction

Maize (Zea mays L.) is the third most important cereal in the world after rice, wheat, and ranks fourth after millet, sorghum and rice in Nigeria [1]. It is a good source of carbohydrate, vitamins and minerals and it can be processed into a wide range of food items and snacks. On the other hand, maize is rich in methionine but deficient in lysine and tryptophan [2] and low in calcium. Some of the maize-based snacks in Nigeria include: aadun (maize pudding), kokoro (maize cake) and donkwa (maize-peanut ball). Because of its worldwide distribution and lower prices relative to other cereals, maize has a wider range of uses than any other cereal [3]. Within the developing world, maize has become a stable food in many parts of the world. In addition to its use as food for humans, it is also used as animal feed and for various industrial purposes. Maize is also used for corn ethanol, animal feed and other products such as corn starch and corn syrup [4].

Legumes are relatively minor crops despite their role as a source of protein and oil in the diet of people of the developing world. Legumes rank next to cereals as source of human food and provide much of the needed protein to the vegetarian population. Soybeans (Glycine max) are a species of legume native to East Asia, widely grown for its edible bean, which has numerous uses. According to Food and Agriculture Organization (FAO), soybeans plant is classified as an oilseed rather than pulse. Soybeans are considered an inexpensive source of high-quality protein (38%-55%) that are abundantly rich in lysine and essential amino-acid that are deficient in most cereal grains [5] but low in sulphur amino acids, lutein and xanthenes. Soy-based foods may provide additional benefits for consumer due to their hypolipidemic and anti cholesterolemic properties with reduced allergenicity [6].

Edible insects are widely exploited food source by many indigenous populations in most regions of the world. Throughout the world, a large portion of the human population consumes insects as a regular part of their diet. Insects' consumption, called

Entomophagy, has played an important role in the history of human nutrition in Africa [7]. Currently, edible insects are gaining much attention for their high nutritional value and environmental advantage over meat production [8]. Among the edible insects in Nigeria are winged termite (Macrotermes nigeriansis); palm tree weevil (Rhynochophorus species) larva, raphis palm and coconut tree beetle/weevils; mandibulate soldiers of termite caste; crickets, locust. These tropical insects are eaten at one or two stages in their life cycle, either at the larvae or adult stage or both. Therefore, on the basis of complementary, the combination of maize and soybean flours in food formulations enrichment with "kanni" could potentially provide most of the nutrients needed by children and the elderly. The objective of this work therefore was to determine the proximate, mineral and sensory properties of maize-soybeans composite flour enriched with "kanni".

## Materials and Methods

### Sources of Raw Materials

Maize, soybeans, edible insect "kanni", sugar, baking powder, milk and butter used for this study were obtained from Oja Oba, Ado-Ekiti. The experiment was carried out in the Processing Laboratory in the Department of Food Technology, Federal Polytechnic, Ado-Ekiti. The biscuit samples were produced based on the modified method described by [9].

### Proximate Analysis

The standard procedure of Association of Official Analytical Chemist International [10] was used for the analysis of moisture content, ash, fat, protein, fibre and carbohydrate of the biscuit samples produced.

### Sensory Evaluation

Biscuit samples were evaluated using nine-point hedonic scale. Staff and students of the Department of Food Technology, Federal Polytechnic Ado-Ekiti were used as taste panelists.

### Statistical Analysis

Laboratory analyses were carried out in triplicates. Data obtained were analyzed using ANOVA at 5% significance level. Means were separated using Turkey's Test using SPSS Statistical Product Service Solution Version 23.0

## Results and Discussion

Proximate composition of maize-soybeans flour enriched with "kanni" was shown in Table 1. Sample B had the highest moisture content with the value of 11.02% compared to sample A which had the lowest moisture content of 10.08%. This result agreed with 9.6- 13.5% reported by [11] and [12] respectively. The increased in the moisture content in sample B might be as a result of the added 'kanni'. The protein, fat, fibre and ash contents increased in the maize-soy flour blends. The protein content was 11.85% in sample A as compared to 14.75 and 15.95% respectively in sample B and C. This is similar fat, fibre and ash contents in the flour blends. The protein, fibre, and ash values compared favorably with those reported by [13,14]. The moisture content of the mixture decreased as the percentage substitution of the 'kanni' increased. While the protein content increased as the enriched 'kanni' flour increased. This might be due to high protein content of 'kanni'. The highest fat content was noticed in sample C while the lowest was observed in sample A. The increased in fat content in sample C might be due to high percentage of 'kanni' present compared to sample A which does not contain 'kanni'. High fat content in foods helps to produce more calories in the body, which can be utilized as a source of energy. Although, the sample with the highest fat content will be prone to rancidity. Also, fibre content of sample C (4.36%) was higher while sample A had the lowest fibre content of (2.52%). The high fibre content of sample C was due to the high percentage of 'kanni' compared to sample A. Foods having high fibre content thus improve the passage of waste and acts as an anti-constipation.

Mineral composition of maize-soybeans flour enriched with "kanni" is shown in Table 2. The maize-soy flour blend with "kanni" contained a significant amount of important minerals: calcium, potassium, zinc, magnesium and iron. Calcium is responsible for many regulatory functions, such as normal cardiac rhythm maintenance, blood clotting, hormone secretion, muscle contraction and enzyme activation [15]. The calcium content (108.56mg/100g) obtained in sample C was significantly ($p>0.05$) higher than the values of other samples, this may be due to a higher percentage quantity of 'kanni' present in the sample. Zinc is very important for growth, sexual development, the healing of wounds as well as normal functioning of the immune system and other physiological processes. The increase in mineral content of biscuits could be due to increase in substitution levels of "kanni" in the samples compared to sample a (control). Maize flour contains high levels of important minerals such as potassium, zinc, calcium and iron [16]. The mineral contents of the biscuits increased as the "kanni" flour substitution increased for all the mineral content analyzed. Other researchers have also reported increased in calcium content of composites flour with an increase in soybeans supplementation [17].

Sensory evaluations include colour, flavour, taste, appearance and overall acceptability was shown in Table 3. The mean scores of colour ranges between 5.20 - 6.65. Colour is an important factor that facilitates the consumer's preference for product acceptability. Sample C had the highest mean score for appearance of all the samples evaluated because of the high fat content in the sample. However, overall acceptability mean scores ranged from 5.23-6.73 among the samples. Meanwhile, the results showed that the overall acceptability of sample C was not significantly different ($P = .05$) from other samples. However, sample C was most preferred among the samples presented for sensory evaluation.

## Conclusion

The findings from this study showed that supplementing maize flour with soybeans flour enriched with "kanni" resulted to increase in fat, protein, crude and ash content of biscuit. Hence, incorporation of "kanni" edible insect could eradicate malnutrition among populace in the developing countries.

**Table 1:** Proximate composition of maize and soybean flour enriched with "kanni".

| Samples | Moisture content | Ash | Fat | Fibre | Protein | Carbohydrate |
|---|---|---|---|---|---|---|
| A | 10.08 ± 0.02$^{ab}$ | 1.75 ± 0.02$^{a}$ | 16.18 ± 0.02$^{a}$ | 2.52 ± 0.01$^{b}$ | 11.85 ± 0.01$^{a}$ | 52.22 ± 0.00$^{c}$ |
| B | 11.02 ± 0.01$^{b}$ | 1.92 ± 0.04$^{b}$ | 17.05 ± 0.02$^{b}$ | 3.91 ± 0.00$^{b}$ | 14.75 ± 0.04$^{b}$ | 49.95 ± 0.02$^{d}$ |
| C | 10.42 ± 0.01$^{a}$ | 2.11 ± 0.00$^{a}$ | 17.26 ± 0.05$^{c}$ | 4.36 ± 0.00$^{a}$ | 15.95 ± 0.01$^{bc}$ | 56.00 ± 0.01$^{c}$ |
| D | 10.15 ± 0.01$^{a}$ | 2.95 ± 0.00$^{a}$ | 3.07 ± 0.05$^{c}$ | 4.70 ± 0.00$^{a}$ | 13.42 ± 0.01$^{bc}$ | 65.85 ± 0.01$^{c}$ |

Means in a column with the same superscripts are not significantly different from one another ($P$ = .05).

**Keys**

Sample A 80% Maize flour, 20% Soybeans flour (control)
Sample B 70% Maize flour, 20% Soybeans flour, 10% kanni
Sample C 65% Maize flour, 20% Soybeans flour, 15% kanni
Sample D "Kanni"

**Table 2:** Mineral composition (mg/100g) of maize and soybean flour enriched with "kanni".

| Samples | Na | Ca | K | Zn | Mg | Fe |
|---|---|---|---|---|---|---|
| A | 41.70 ± 0.02$^{a}$ | 78.75 ± 0.02$^{a}$ | 50.76 ± 0.02$^{a}$ | 1.22 ± 0.01$^{b}$ | 8.15 ± 0.01$^{a}$ | 1.75 ± 0.00$^{c}$ |
| B | 58.70 ± 0.01$^{b}$ | 91.35 ± 0.04$^{b}$ | 60.35 ± 0.02$^{b}$ | 1.24 ± 0.00$^{b}$ | 9.06 ± 0.04$^{b}$ | 2.16 ± 0.02$^{d}$ |
| C | 73.25 ± 0.01$^{c}$ | 108.56 ± 0.00$^{c}$ | 87.45 ± 0.05$^{c}$ | 1.53 ± 0.00$^{a}$ | 11.22 ± 0.01$^{bc}$ | 2.45 ± 0.01$^{c}$ |

Means in a column with the same superscripts are not significantly different from one another ($P$ = .05).

**Keys**

Sample A 80% Maize flour, 20% Soybeans flour (control)
Sample B 70% Maize flour, 20% Soybeans flour, 10% kanni
Sample C 65% Maize flour, 20% Soybeans flour, 15% kanni

**Table 3:** Sensory properties of maize and soybean flour enriched with "kanni"

| Samples | Appearance | Colour | Flavour | Taste | Overall Acceptability |
|---|---|---|---|---|---|
| A | 5.01 ± 0.02$^{ab}$ | 5.26 ± 0.02$^{a}$ | 5.10 ± 0.02$^{a}$ | 5.05 ± 0.01$^{b}$ | 5.23 ± 0.01$^{a}$ |
| B | 5.30 ± 0.01$^{b}$ | 6.30 ± 0.04$^{b}$ | 6.30 ± 0.02$^{b}$ | 6.75 ± 0.00$^{b}$ | 6.65 ± 0.04$^{a}$ |
| C | 6.70 ± 0.01$^{a}$ | 6.65 ± 0.00$^{a}$ | 6.55 ± 0.05$^{c}$ | 16.90 ± 0.00$^{a}$ | 6.73 ± 0.01$^{a}$ |

Means in a column with the same superscripts are not significantly different from one another ($P$ = .05).

**KEYS**

Sample A 80% Maize flour, 20% Soybeans flour (control)
Sample B 70% Maize flour, 20% Soybeans flour, 10% kanni
Sample C 65% Maize flour, 20% Soybeans flour, 15% kanni


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