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PROXIMATE COMPOSITION, FUNCTIONAL AND SENSORY PROPERTIES OF 'TUWO' PREPARED FROM MAIZE (Zea mays) AND BAMBARA GROUNDNUT *(Vigna subterranea)*

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ABSTRACT

Tuwo is a non-fermented, gel like, maize based *food commonly eaten among the Hausa ethnic group in Nigeria. This study aims to investigate the effect of fortification of maize tuwo using Bambara groundnut on the proximate composition, functional properties and sensory attributes of Bambara-maize tuwo. Blends of the tuwo were produced using response surface methodology and were subjected to sensory evaluation to determine consumer acceptance with respect to quality attributes such as appearance, texture, aroma, texture and mouth feel. The proximate composition of the flour blends showed an increase in protein, fibre ash, and fat content with an increase in the levels of Bambara groundnut and a decrease in carbohydrate and moisture content. Protein, ash, fibre, fat, moisture and carbohydrate content varied in the range 8.05–22.25%, 0.69–1.83%, 1.19–3.62%, 2.06–6.68%, 3.31–4.90 and 62.31 –75.41% respectively. The water absorption capacity increased with increase in the level of Bamabara substitution (1.25-1.70 g/ml) while the swelling index decreased slightly with an increased in Bambara substitute (2.00-2.50 g/ml). The result of the sensory evaluation shows that tuwo prepared from maize-Bambara flour compare favorably with 100% maize tuwo. The overall result has shown that it is possible to produce acceptable tuwo from the combination of maize and Bambara groundnut flour blends.*

Keywords: Bambara groundnut, proximate composition, functional properties, maize tuwo, maize flour

INTRODUCTION

Protein-energy malnutrition has been noted to occur mostly when children are weaned from liquid to semi-liquid foods . Therefore, there is a need to supplement their food in order to have a nutritionally balanced food. Tuwo is a non – fermented thick pudding prepared from rice or maize flour and is usually served with different types of soup like gbegiri, egusi, kubewa, tafshe, kuka e.t.c. . Tuwo in most Hausa communities and household has become favourite food giving to their babies as weaning food because of the high cost of weaning food. However, this tuwo is majorly carbohydrate food which lacks the essential amino acids that are required for the growth of these little children. Thereby, leading to high incidence of protein malnutrition within the Hausa community . Maize (zea mays) is an African cereal consumed by both adults and infants in different forms like ogi, tuwo, abari, eko, agidi, aadun elekute, egbo e.t.c. . It is also used in some industries as a raw material in production of starch, beer, soap, glue e.t.c. It is also used in formulation of animal feed. Maize has a total protein content of about 7-12%, fats 1.1 - 4% and 70 - 78% carbohydrate . Cereal products are limiting in some essential amino acids which make them have poor nutritional value . Consequently, children fed solely on cereals are prone to diseases such as kwashiorkor and marasmus to mention a few. Therefore the need for the fortification of cereal with legume that has essential amino acids that are lacking in cereal becomes essential.

Bambara groundnut (Vigna subterranean) is an underutilized indigenous crop of African origin whose full potential has not been explored. It is the third most important legume seed after groundnut (Arachis hypogeal) and cowpea (Vigna unguiculata) in Africa . It is tolerant to drought and poor soils which has the ability to yield in conditions where other legumes such as groundnut and soya bean fails completely. This underutilized legume could be considered as a potential alternative source of plant protein with a protein content of 18-27%. Bambara protein is high in lysine (6.03 g/100 g protein) and its amino acid composition is comparable to other commonly consumed legumes such as soybean . It is interesting to note that Bambara protein has a relatively high amount of methionine (1.78 g/100 g protein) an essential amino acid that is usually lacking in other legumes . Since maize lacks lysine

which is present in abundant in Bambara protein, the combination of cereal-legume gives rise to food with relatively balanced amino acid . Therefore, this study is aimed at evaluating the effect of Bambara flour substitution on the proximate, functional and sensory attributes of tuwo.

MATERIALS AND METHODS

Sample collection

Bambara groundnut and maize grains were obtained at central market at Oja Oba, Ilorin Kwara State. The white variety of maize grains was chosen because it is often used by the people and also because of its resultant white/creamy colour which is most preferred by the consumer.

Preparation of Bambara flour and maize flour

Maize is cleaned to remove stones, pellets, and other extraneous materials by winnowing, and the maize is then dehulled. After dehulling, the grits gotten from the dehulling process is then milled, after milling; it is sieved to remove the chaff then we have our maize flour, it is then kept in air tight container until needed. Bambara flour was obtained as described by with some modifications. Briefly, Bambara groundnut seed was sorted, cleaned and soaked in water for 8 hours. After soaking, it was dehulled and dried in an oven at a temperature of 35℃ ±5. The seed was milled into fine flour and sieved through a sieve with aperture 0.300m, packed in a polythene bag and stored in refrigerator at temperature of 4°C.

Preparation of tuwo

Maize tuwo was prepared from each maize/Bambara mix using a method as described by , with some modifications. Briefly, the overall ratio of flour to water used in maize tuwo preparation was 1:3.5 (w/v). Cold slurry of the flour was first prepared by mixing 20% of the desired quantity of flour (1.0 Kg) with 25% of the desired quantity of water (3.5 litres). This was followed by bringing 60% of the water into boiling, and the cold slurry initially prepared was added to this boiling water coupled with vigorous stirring, using a wooden flat spoon, to form a pap-like consistency. The remaining quantity of the flour (80% of the desired total) was then added gradually to the boiling pap-like paste with continuous stirring so as to facilitate non-formation of lumps and to ensure a homogenous gel formation. The remaining quantity of water (15% of the desired total) was finally added to the formed gel, covered properly without stirring and allowed to cook for about 7 min after which it was stirred vigorously to ensure smoothness of the gel. The final product so obtained is called maize tuwo.

Functional properties of maize-Bambara flour blend

The functional properties of maize-Bambara flour blend such as water absorption capacity (WAC), and swelling power were determined. WAC was determined according to the method of . Flour samples (1 g) were suspended in 5 ml of water in a centrifugal tube. The slurry was shaken on a platform tube rocker for 1 min at room temperature and centrifuged at 3000 rpm for 10 min. The supernatant was decanted and discarded. The adhering drops of water were removed and reweighed. WAC was expressed as the weight of sediment/ initial weight of flour sample (g/g). The swelling power of flour was determined based on a modified method of . Approximately 0.1 g of sample was transferred into a weighed graduated 50 ml centrifuge tube. Distilled water was added to give a total volume of 10 ml. The sample in the tube was stirred gently by hand for 30 seconds at room temperature, and then heated at 60°C for 30 min. After cooling to room temperature, the samples were centrifuged for 30 min at 3000 rpm. The weight of sediment was recorded.

Proximate analysis of maize-Bambara flour blend

Moisture, fat and ash contents were determined using AOAC methods (AOAC, 2000). The protein content was determined by Kjeldahl method (N×6.25). Total carbohydrate was calculated by difference.

Sensory evaluation

The prepared tuwo was evaluated by a panel of fifty untrained judges drawn from the University of Ilorin, Nigeria for attributes of colour, texture, flavor, crispiness and general acceptability on a hedonic scale of 1-9, where 1 = dislike extremely and 9 = like extremely. Scores were collated and analyzed statistically

Statistical analysis

Experiments were conducted in triplicates. Data obtained were subjected to Analysis of Variance (ANOVA) using SPSS version 16.0. The differences between the mean values were evaluated at 5% confidence level using Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Water absorption and Swelling capacity

There were significant differences ($p < 0.05$) in the functional properties of the maize and Bambara

groundnut flour blends (Figure 1). The water absorption capacity values increased with increasing levels of Bambara groundnut flour in the flour blends. However, there was a decrease in swelling capacity (SC) as the level of Bambara groundnut increased.

The water absorption capacity values ranged from 1.25-1.70 g/mL with sample T5 (79.11% maize: 20.89% Bambara flour) having the highest value while sample T0 (control: 100% maize) had the least value. The increase in WAC of the flour with increasing inclusion of Bambara groundnut flour may be attributed to the increase in the amount of protein the flour blends. It has been reported that Bambara protein contains more of hydrophilic amino acids which are water-loving amino acids . The result in the current study follows the trend reported by . The author reported an increase in WAC with an increase in beniseed inclusion in maize flour

The values of swelling capacity ranged from 2.00-2.50 g/mL. The decrease in swelling capacity of the flour with increasing inclusion of Bambara groundnut flour may be attributed to the reduction in the amount of maize in the flour blends. Maize is richer in starch and may absorb more water when compared with Bambara groundnut flour. The values of the swelling capacity obtained in this study are greater than 0.95-1.4 g/mL reported for corn flour partially substituted with defatted groundnut . The swelling capacity is a function of the product to rise when having interaction with water.

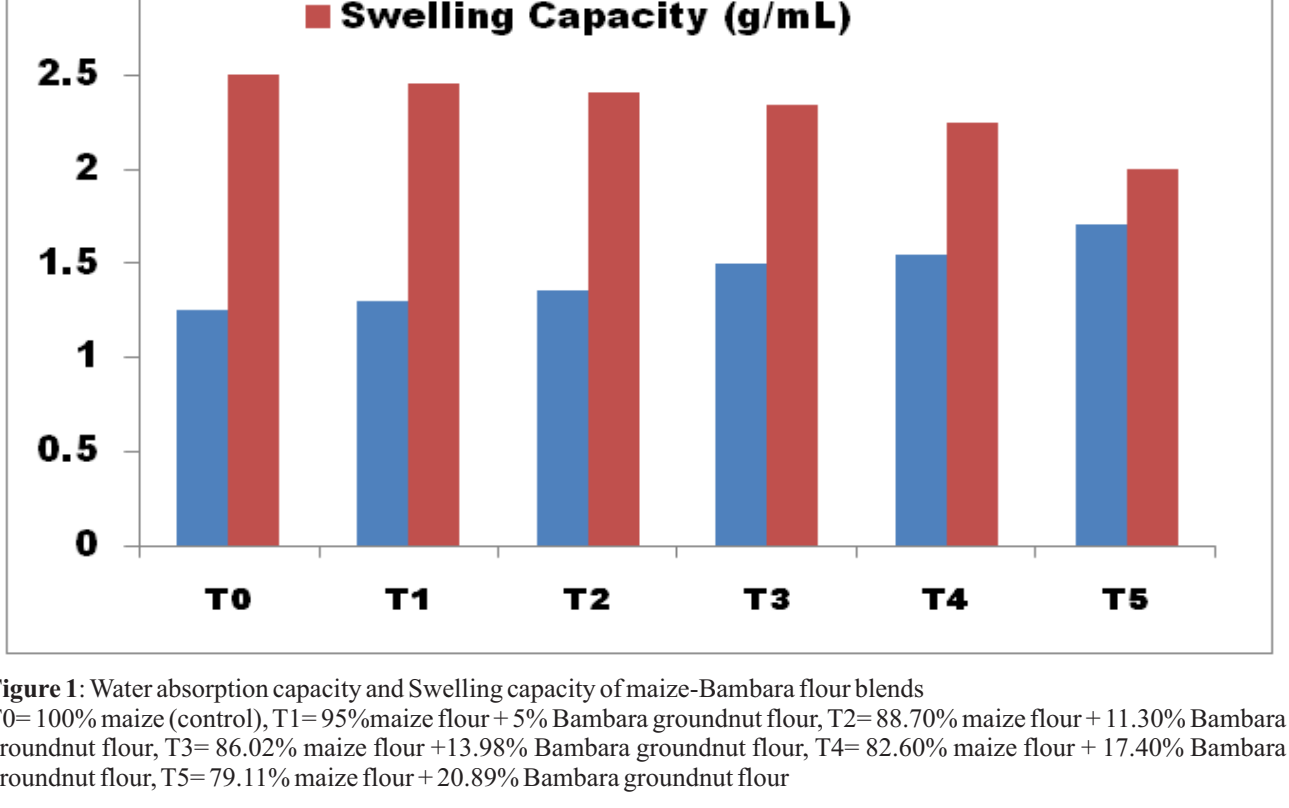

Figure 1: Water absorption capacity and Swelling capacity of maize-Bambara flour blends
T0= 100% maize (control), T1= 95%maize flour + 5% Bambara groundnut flour, T2= 88.70% maize flour + 11.30% Bambara groundnut flour, T3= 86.02% maize flour +13.98% Bambara groundnut flour, T4= 82.60% maize flour + 17.40% Bambara groundnut flour, T5= 79.11% maize flour + 20.89% Bambara groundnut flour

Proximate analysis

Table 1 shows the proximate composition of the maize-Bambara flour sample at different levels of Bambara substitution. The crude protein content ranged from 9.74% to 22.24%, where T5 (75% maize flour and 25% Bambara groundnut flour) had the highest protein content (22.24%) and T0 (control 100% maize) had the lowest content (9.74%). Protein content increased with increase in level of Bambara groundnut substitution. The protein values obtained for all samples were higher than 9.47-13.33% reported for composite flour of maize and sprouted pigeon pea . The crude fat content of the maize -Bambara samples ranged from 2.60% in T0 to 6.68%% in T5. Samples enriched with Bambara groundnut had higher ash contents, T5 had 1.73% compared to the control which had 0.69%. Crude fibre content of the maize-Bambara flour ranged from 1.19% in T0to 3.62% in T5.The moisture content ranged from 3.31% in sample T5to 4.9% in sample T0. The

carbohydrate content of the sample ranged from 62.31-72.87 % for samples with Bambara inclusion and 75.41% for control. The low carbohydrate is expected since carbohydrate is calculated by difference and since the protein content increased the carbohydrate content would decrease.

Table 1: Proximate composition of maize-Bambara flour (%)

Sample	Moisture	Ash	Lipids	Protein	Fibre	Carbohydrate
T0	4.90±0.5^{b}	0.69±0.1^{a}	2.06±0.1^{a}	8.05±0.0^{a}	1.19±0.0^{a}	75.41±0.2^{f}
T1	4.80±0.8^{b}	1.83±0.2^{c}	2.74±0.0^{a}	17.94±0.4^{b}	1.25±0.0^{a}	72.87±0.4^{e}
T2	4.76±0.4^{b}	1.19±0.3^{b}	3.85±0.6^{b}	18.94±0.7^{c}	1.28±0.0^{a}	69.98±0.9^{d}
T3	4.23 ±0.5^{b}	1.56±0.1^{b}	5.12±0.4^{c}	19.54±0.1^{cd}	2.90±0.1^{b}	66.64±0.9^{c}
T4	3.83± 0.1^{a}	1.66±0.2^{c}	5.81±0.6^{c}	20.54±0.3^{d}	3.36±0.2^{c}	64.72±0.1^{b}
T5	3.31± 0.3^{a}	1.73±0.3^{c}	6.68±0.5^{d}	22.25±0.7^{e}	3.62±0.1^{c}	62.31±0.2^{a}

Values are mean of triplicate determinations. Values not followed by the same superscript in the same column are significantly different (p<0.05). T0= 100% maize (control), T1= 95%maize flour + 5% Bambara groundnut flour, T2= 88.70% maize flour + 11.30% Bambara groundnut flour, T3= 86.02% maize flour +13.98% Bambara groundnut flour, T4= 82.60% maize flour + 17.40% Bambara groundnut flour, T5= 79.11% maize flour + 20.89% Bambara groundnut flour

Sensory properties of *Tuwo*

The sensory qualities of *tuwo* from maize and Bambara flour is presented in table 2. Maize *tuwo* from the control was rated the highest in terms of aroma, colour, texture, mouth feel and general acceptance. It is interesting to know that *Tuwo* produced from 95% maize flour and 5% Bambara compared favourably with *tuwo* prepared from 100% maize. It was also observed that there was no significant difference (P>0.05) in the rating of the other *tuwo* samples. This suggests that the blend was more acceptable to the panelist in these parameters. It has also shown that sample MBI has the least general acceptability of all the samples. Interestingly, the inclusion of Bambara flour is accepted by the panelists as safe as none of the panelists developed any side effects diarrhoea and emesis after consuming the *tuwo* prepared from maize-Bambara blend blends

Table 2: Sensory attributes of *Tuwo*

Sample	Aroma	Appearance	Texture	Mouth Feel	General Acceptability
T0	7.60±0.5^{a}	7.55±0.1^{a}	7.50±0.1^{a}	7.20±0.0^{a}	7.90±0.0^{a}
T1	7.60±0.8^{a}	7.50±0.2^{a}	7.20±0.0^{a}	7.55±0.4^{a}	7.90±0.0^{a}
T2	6.90±0.4^{b}	7.45±0.3^{a}	6.95±0.6^{b}	6.95±0.7^{b}	6.80±0.0^{b}
T3	6.85 ±0.5^{b}	6.95±0.1^{b}	6.35±0.4^{b}	6.75±0.1^{b}	6.50±0.1^{b}
T4	7.05± 0.1^{a}	6.65±0.2^{b}	6.25±0.6^{b}	6.55±0.3^{b}	6.40±0.2^{b}
T5	6.65± 0.3^{b}	6.45±0.3^{b}	6.00±0.5^{b}	6.35±0.7^{b}	6.30±0.1^{b}

Values are mean of triplicate determinations. Values not followed by the same superscript in the same column are significantly different (p<0.05). T0= 100% maize (control), T1= 95%maize flour + 5% Bambara groundnut flour, T2= 88.70% maize flour + 11.30% Bambara groundnut flour, T3= 86.02% maize flour +13.98% Bambara groundnut flour, T4= 82.60% maize flour + 17.40% Bambara groundnut flour, T5= 79.11% maize flour + 20.89% Bambara groundnut flour

CONCLUSION

The study showed that low nutritional quality of *Tuwo* can be improved through supplementation with Bambara flour. This is reflected particularly in the improved protein (8.05-22.25%) which increased with increase in Bambara flour. *Tuwo* from maize-Bambara blend can serve as a nutritious food and weaning food to help redress the problem of protein-energy malnutrition especially in children

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