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Research Article

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Evaluation of Some Chemical and Physico-Chemical Properties of Maize and Pigeon Pea (*Cajanus cajan*) Flour Blends and Sensory Properties of Local Snack (*Kokoro*) Produced from the Blends

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Abstract

This work was aimed at producing composite flour from pigeon pea and yellow maize at different substitution levels for *kokoro* production. A Composite of yellow maize and pigeon pea flour was made at ratio of 100:0, 90:10, 80:20 and 70:30 w/w. The proximate composition, physico-chemical properties, and anti-nutritional factors of the flour blends were determined. Each blend was traditionally processed into snack (*kokoro)*. The samples of *kokoro* were subjected to sensory evaluation. Water absorption decreased from 255.73% to 188.70% as level of substitution increased. The swelling capacity of the blends ranged from 0.79% to 1.63% while bulk density ranged from 0.72g/cm^3 to 0.79 g/cm^3. Protein, fat and ash contents recorded a value range of 12.36 to 14.55%; 19.72 to 22.96% and 2.40 to 3.34%, respectively. Sensory evaluation of *kokoro* indicated highest score of 5.96 with 20% substitution level with respect to taste followed by the control sample with a score of 5.82. With respect to general acceptability, control sample had the highest score of 5.98 followed by 20% substitution level with a score of 5.96. Good snack production using substitution of maize flour with pigeon pea flour up to 20% level could be encouraged at commercial level.

Keywords

Pigeon pea, *Kokoro*, Snacks, Sensory properties

Introduction

Kokoro is a popular local snack. Most often, snack foods do not provide nutrients in adequate quantities for the body [1, 2]. This may be due to their composition or production processes therefore it is necessary to ensure required nutrients in adequate amount. Addition of vegetable protein such as textured vegetable protein could be one way of increasing the nutritional value of the product by introducing more protein into it [3-5]. Pigeon peas are gradually going into extinction due to their tough texture and long cooking time. However, the ignorance of people towards processing methods has reduced their utilization as well. Encouraging the use of under-utilized crops benefits the small holder farmers as one of the better ways to reduce nutritional, environmental and financial insecurity [6-8]. Their contribution to food security cannot be underestimated [9, 10]. Encouraging the consumption of a broader range of plant species, among other things promotes good health and nutrition, income generation and ecological sustainability. Several studies have been carried out to improve the protein quality of *kokoro* by enriching with plant protein such as soybean and groundnut to enhance its nutritional quality [1, 4, 11-14]. This research work is

aimed at evaluating some chemical properties of yellow maize-pigeon pea flour blend and the effect on sensory properties of local snack (*kokoro*).

Materials and Methods

Materials

Pigeon pea (*Cajanus cajan*) and yellow maize (*Zea mays*) grains were purchased from Bodija market in Ibadan, Oyo state and Ilesa, Osun state respectively while vegetable oil, salt and sugar were purchased from a local market in Ogbomoso, Nigeria.

Production of pigeon pea flour and maize flour

Grains of pigeon pea were cleaned and winnowed to remove extraneous materials and damaged seeds. It was then hydrated in boiling water for 20 min, subsequently dehulled and dried for 6 h in a cabinet drier. The grains were milled in a milling machine to a very fine particle size to produce pigeon pea flour. The flour was then sieved through a 40 µm mesh sieve after which the pigeon pea flour was stored in a plastic container.

Similarly, dried yellow maize was dried, sorted and cleaned to remove foreign particles together with discolored and damaged seeds. It was milled in the milling machine to a very fine particle size, sieved through a 100 µm mesh sieve and stored in a plastic container.

Recipe formulation

The powdered recipes were mixed according to the method of [1]. Flour mix one (YM100) contained 200 g of yellow maize, 1000 cm^3 of vegetable oil, 5 g of salt and 20 g of sugar, flour mix two (YMP10) 180 g of yellow maize, 20 g of pigeon pea flour, 1000 cm^3 of vegetable oil, 5 g of salt, 20 g of sugar, flour mix three (YMP20) contained 160 g of yellow maize flour, 40 g of pigeon pea flour, 1000 cm^3 of vegetable, 5 g of salt, 20 g of sugar, flour mix four (YMP30) contained 140 g of maize flour, 60 g of pigeon pea flour, 1000 cm^3 of vegetable oil, 5 g of salt, 20 g of sugar. Combination of each mixture was done at equal proportions. Each of the samples was put in different containers, labeled accordingly and used for analyses

Preparation of kokoro

This was done essentially by a modification of the traditional method of "kokoro". In each case, the blends of composite flour (maize flour and pigeon pea flour) were thoroughly mixed. Salt and sugar were added to the mixture. 100 cm^3 of water was boiled and the mixtures were poured and mixed to form dough in each samples. The dough was allowed to cool, kneaded manually for 5 min, cut into pieces and the pieces were rolled on a chopping board that was sprinkled with maize flour. The rolled out pieces were then fried in a large quantity of hot refined oil for 5 min in a deep fat metal colander for all round frying. The fried pieces were drained in a stainless steel sieve and allowed to cool down. They were later packed in low density polyethylene bags and sealed.

Chemical analyses

The flour blends were analyzed for proximate composition (Protein, ash, fat, fiber, moisture and carbohydrate contents) according to [15] and anti-nutritional factors (phytates and tannin) according to [16].

Sensory evaluation

This was carried out on *kokoro* using a 50 member panel that are familiar with and eat the snack. Each panelist was asked to score each attribute on a seven point hedonic scale where 1 and 7 represent dislike extremely and like extremely respectively. The attributes evaluated were taste, color, texture, crispness, flavor, appearance and overall acceptability.

Statistical analysis

All data were subjected to statistical analysis using Statistical Analysis System (SAS) software. Statistically significant differences ($p< 0.05$) in all data were determined by Analysis of Variance (ANOVA) while least significant difference was used to separate the means.

Results and Discussion

Proximate composition of kokoro

The results of proximate composition are as shown in table 1. The moisture content value ranged from 4.29% to 8.70% with the sample containing 30% enrichment with pigeon pea flour having the highest value while the combination with 20% enrichment with pigeon pea flour had the least value. There was significant difference ($p\leq0.05$) in all the samples. The moisture content of any food is an index of its water activity (aw) [17]. This implies that yellow maize-pigeon pea flour blends may have a short shelf life due to their high moisture content. The crude protein content ranged between 12.36% and 14.55%. The result showed that protein content increased as the level of enrichment with pigeon pea flour increased. The control was significantly different from the other samples. The high protein content of the pigeon flour accounted for increase in the protein content of maize-pigeon pea flour snack compared to 100% maize flour snack. Protein content is one of the most important qualities of any food. FAO [18] recommended a protein content of 20% for any food. Means followed by the same letter down the column are not significantly different ($p< 0.05$) from one another. The ash content value was recorded which ranged between 2.40% and 3.34% , with the sample containing 20% enrichment with pigeon pea flour having the highest value while the one with 10% enrichment with pigeon pea flour having the least value.

Table 1: Proximate composition of wheat-pigeon pea flour blends (%).

Sample	Protein	Ash	Fibre	Fat	Moisture	Carbohydrate
YM100	12.36^{c}	2.65^{b}	1.42^{a}	17.27^{b}	6.23^{b}	60.03^{a}
YMP10	13.48^{b}	2.40^{b}	4.97^{a}	19.72^{b}	5.13^{c}	54.31^{b}
YMP20	14.16^{b}	3.34^{a}	1.36^{a}	23.10^{a}	4.29^{d}	53.70^{b}
YMP30	14.55^{b}	2.60^{b}	4.63^{a}	22.96^{a}	8.70^{a}	46.57^{b}

Means followed by the same letter down the column are not significantly different ($p< 0.05$) from one another.
YM = 100% Yellow maize flour.
YMP10 = 90:10 (Yellow maize flour: Pigeon pea flour).
YMP20 = 80:20 (Yellow maize flour: Pigeon pea flour).
YMP30 = 70:30 (Yellow maize flour: Pigeon pea flour).

The sample with 20% enrichment was significantly different from the other samples. This could be attributed to the fact that there is higher amount of ash content in pigeon pea flour compared to the amount in yellow maize flour. Ash is used to measure the amount of inorganic compounds in food [11]. The sample with 10% enrichment with pigeon pea flour had the highest value while control had the lowest value. There was no significant difference in all the samples. Fibers are made up of glucose linked together in a form that cannot be broken down by digestive process [19]. The percentage fat content in yellow maize ranged from 23.10% to 17.27%. The control and 10% enrichment with pigeon pea flour was significantly different ($p \leq 0.05$) from the other samples and could be attributed to higher amount of fat in pigeon pea flour compared to yellow maize flour. The storage life of the blend may be increased due to their low fat content because all fats and fat-containing foods contain some unsaturated fatty acids and hence are potentially susceptible to oxidative rancidity (Uzo-Peters *et al.*, 2008) [4] and when exposed to warm or hot air rancidity will not be encouraged. The carbohydrate content was higher in 100% yellow maize flour than the enriched blends. The percentage carbohydrate content ranged between 60.03% and 46.47%. The result indicated that the control was significantly different ($p \leq 0.05$) from the other samples. This was due to the relatively low carbohydrate content of pigeon pea flour. The higher carbohydrate yield makes ideal since energy is required for rapid growth.

Anti-nutritional composition of kokoro

The phytate content ranged from 14.32 mg/100 g to 8.24 mg/100 g with sample containing 30% enrichment with pigeon pea flour having the highest value and a sample with 20% enrichment with pigeon pea flour having the lowest value as reported in table 2. The sample with 10% enrichment with pigeon pea flour was significantly different from the other samples. The result of tannin content showed that 100% maize flour has the highest tannin content of 0.37 mg/100 g and 30% enrichment with pigeon pea flour has the lowest value of 0.21 mg/100 g (Table 2). This implies that the tannin content decreased with an increase in enrichment with pigeon pea flour. Also the control and 30% enrichment with pigeon pea flour were significantly different from other samples.

Functional properties of the flour blends

TThe results of the functional properties are as presented in table 3. The water absorption capacity value was recorded which ranged between 255.73% and 188.70% with the sample containing 100% maize having the highest value while 10% enrichment with pigeon pea flour had the least value. The result obtained indicated that samples absorbed water of higher weight than their original weight. Adelakun *et al.* (2005) [11] reported the same trend in addition of soy and maize flour mixes for production of kokoro.

The sample with 10% enrichment with pigeon pea flour had the highest bulk density while the ones with 20% and 30% enrichment with pigeon pea had the least bulk density. There was no significant difference ($p \leq 0.05$) in the bulk density of all the samples. An increase in bulk density would be useful in the packaging of the flour and the space it occupies in a container.

The result of swelling capacity ranged from 0.79% to 1.63% with 100% maize having the lowest swelling capacity and 10% enrichment with pigeon pea flour having the highest swelling capacity. The control and sample with 10% enrichment with pigeon pea flour was significantly different from the other samples.

The oil absorption capacity was between the ranges of 119.88% to 97.98% with the control having the highest value while the sample with 10% enrichment with pigeon pea had the lowest value. There was no significant difference in the oil absorption capacity of all samples.

Sensory attributes of kokoro snack from the maize-pigeon pea flour blends

The result in table 4 showed that the sample with 20% enrichment with pigeon pea flour had the highest value 5.90% for taste with 30% enrichment with pigeon pea recording the lowest value of 5.06%. This could be due to the fact that at this level of substitution, the beany flavour of legume did mask the taste of maize but just complimented it giving it a slightly more desirable different taste compared to *kokoro* made with whole maize flour. The appearance value ranged between 5.35% and 5.76% with 30% enrichment with pigeon pea flour having the least value and 20% enrichment with pigeon pea flour having the highest value. For aroma, 20% enrichment had the highest value while 30% enrichment with pigeon pea flour had the lowest value ranging between 5.62% and 4.95%. There was a significant difference ($p \leq 0.05$) in 30% enrichment

Table 2: Anti-nutritional composition of wheat-pigeon pea flour blends (mg/100g).

Samples	Phytate	Tannin
YM100	12.16^{b}	0.37^{a}
YMP10	8.24^{c}	0.28^{b}
YMP20	12.46^{b}	0.26^{b}
YMP30	14.32^{a}	0.21^{c}

Means followed by the same letter down the column are not significantly different ($p < 0.05$) from one another.
YM = 100% Yellow maize flour.
YMP10 = 90:10 (Yellow maize flour: Pigeon pea flour).
YMP20 = 80:20 (Yellow maize flour: Pigeon pea flour).
YMP30 = 70:30 (Yellow maize flour: Pigeon pea flour).

Table 3: Functional properties of the maize-pigeon pea flour blends (%).

Samples	WAC (%)	BD (g/dm^3)	SC (%)	OAC (%)
YM100	255.73a	0.75a	0.79c	119.88a
YMP10	188.70a	0.79a	1.63a	97.98a
YMP20	191.50a	0.72a	1.21b	191.50a
YMP30	203.36a	0.72a	1.20b	110.73a

Means followed by the same letter down the column are not significantly different ($p < 0.05$) from one another.
WAC: Water absorption Capacity; BD: Bulk Density; SW: Swelling Capacity.
OAC: Oil Absorption Capacity.
YM = 100% Yellow maize flour
YMP10 = 90:10 (Yellow maize flour: Pigeon pea flour)
YMP20 = 80:20 (Yellow maize flour: Pigeon pea flour).
YMP30 = 70:30 (Yellow maize flour: Pigeon pea flour).

Table 4: Sensory evaluation of 'kokoro' prepared from wheat-pigeon pea flour blend.

Sample	Taste	Appearance	Aroma	Smoothness	Crunchiness	General Acceptability
YM100	5.82[b]	5.70[b]	5.47[b]	5.58[b]	5.61[b]	5.98[c]
YMP10	5.74[b]	5.66[b]	5.39[b]	5.55[b]	5.53[b]	5.64[b]
YMP20	5.90[b]	5.76[b]	5.62[b]	5.54[b]	5.80[b]	5.96[c]
YMP30	5.06[a]	5.35[a]	4.95[a]	5.10[a]	4.54[a]	5.15[a]

Means followed by the same letter down the column are not significantly different ($p < 0.05$) from one another.
YM = 100% Yellow maize flour.
YMP10 = 90:10 (Yellow maize flour: Pigeon pea flour).
YMP20 = 80:20 (Yellow maize flour: Pigeon pea flour).
YMP30 = 70:30 (Yellow maize flour: Pigeon pea flour).

with pigeon pea flour which could be due to the higher beany flavour concentration in it than other samples.

The smoothness of samples ranged between 5.10% and 5.58%. The value decreased as the level of enrichment increased. Also the sample with 30% enrichment with pigeon pea flour was significantly different from the other samples. The level of crunchiness was higher in 20% enrichment with pigeon pea flour with a value of 5.80% while the sample with 30% enrichment with pigeon pea flour had the lowest value of 4.54%. There was a significant difference between 30% enrichment and other samples. The control was the most preferred with a value of 5.98% while 30% enriched sample had a value of 5.15% which is significantly different from other sample. The highest acceptance of control could be as a result of familiarity with the taste of *kokoro* produced from 100% yellow maize flour. However as substitution level increased, the aroma, taste, appearance, smoothness and crunchiness of the product became different from standard whole maize *kokoro*. This difference could have been as a result of the higher oil content which would have affected the taste, appearance and aroma of the products, the increase would also result in masking of taste and aroma which would have become increasingly beanier in aroma and taste.

Conclusion

From this study, acceptable *kokoro* with high protein and fat contents was produced which increased as the level of substitution of pigeon pea flour increased. The sensory attributes indicated that *kokoro* supplemented with 30% pigeon pea had least score. Preference for 20% pigeon pea substituted samples for all the sensory qualities were not significantly different ($p < 0.05$) from that of the control except for general acceptability. Based on these facts, substitution of maize flour with pigeon pea flour up to 20% level could be encouraged at commercial level.

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Competing Interest

The authors declare no competing interest in this research work.

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