

## ASSESSMENT OF SOME CHEMICAL AND SENSORY PROPERTIES OF *DONKWA* PRODUCED FROM THE BLEND OF MAIZE AND BAMBARA GROUNDNUT

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### ABSTRACT

This work investigated the compositional characteristics of donkwa produced from maize and bambara groundnut blends at 10%, 20%, 30%, and 50% of substitution levels of bambara groundnut. Samples were compared with donkwa prepared from 60:40 maize to peanut (control) as conventionally prepared and were analyzed for proximate composition, microbiology and sensory attributes. The results indicated the increasing trends with increased substitution levels with bambara groundnut for moisture (4.44-4.82%), protein (16.97-20.73%) and fibre (4.55-4.61%) contents while the decreasing trend was observed for ash (4.94-4.93%), fat (10.77-8.76%) and carbohydrate (58.32-56.13%) contents of the donkwa from maize and bambara flour mixes and the control sample. Microbial analysis indicated a decrease trend in the total viable count and an increase trend in yeast counts with increased substitution levels with bambara groundnut. No mould count was observed in the produced donkwa. Sensory attributes revealed that sample made from maize and peanut (60:40%) was most preferred, followed by sample prepared from 30% bambara groundnut substitution, though there were no significant differences in all samples in term of other attributes except in taste. In conclusion, the produced donkwa showed increases in nutritional composition with increased in substitution levels of bambara groundnut. This suggests that bambara groundnut is a good alternative raw material for producing acceptable donkwa. Also, it is a way of improving utilization of bambara groundnut.

**KEYWORDS:** Acceptability, Bambara Groundnut, donkwa, Maize, Peanut

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### INTRODUCTION

The current trend has indicated that most school children and adults depend to a large extent on snacks as they can hardly wait for breakfast before leaving early in the morning for schools and office work respectively. This has necessitated in producing highly acceptable snack foods with high nutritional quality that is also affordable by potential consumers. Likewise such foods, especially when appropriately enriched, could also serve as a way of solving the problem of malnutrition (Adejuyitan *et al.*, 2014).

Different snack foods have been made from maize (a cereal grain), which are consumed to prevent hunger before main meals or just for the fun of eating them during relaxation. However, they are deficient in some essential amino acids like lysine and tryptophan. These amino acids can be supplied to the food by complementing maize with legumes such as bambara groundnut, groundnuts and soybeans which are better sources of sulphur and amino acids (Okaka, 2005). Such

combinations have usually improved balance of amino acids in the products made from them (Ameida-Dominguez *et al.*, 1990).

Bambara groundnut (*Vigna subterranea* (L) Verdc.) is an indigenous African legume that is reported to have wide adaptation to a range of environments. It is popular among subsistence farmers in sub-Saharan African. Several studies have reported on the nutritional composition of bambara groundnut seeds, particularly as a protein source (Belewu *et al.*, 2008; Ijarotimi and Esho, 2009; Oyeleke, 2012). The seed is regarded as a balanced food because when compared to most food legumes, it is rich in iron and protein, contains high lysine and methionine (Adu-Dapaah and Sangwan, 2004). In addition, Bambara groundnut is known to contain 63% carbohydrates, 18% oil and the fatty acid content is predominantly linoleic, palmitic and linolenic acids (Minka and Bruneteau, 2000).

*Donkwa* is a popular local snack made and consumed mostly in the Northern part of Nigeria, it is a local snack which is traditionally made from roasted maize and groundnut (maize-groundnut ball) and commonly consumed in the Northern-part of Nigeria. It is a mixture of dried-peanut and maize with or without the addition of kakandoro to prevent dysentery. The mixture is molded into small ball shapes (i.e. *donkwa* or *dodonkwa*). It is known as Isha in Nigeria and as “Emumu”, the difference is that sugar and at times little pepper is added to the mixture of peanut and maize flour to make “Emumu” (Adejuyitan *et al.*, 2012). Most Nigerian maize-based snacks including *donkwa* are characterized with low nutritional value and inconsistent sensory qualities arising from crude and non-standardised processing operations characterize. Similarly, they are known by using the same raw materials that could lead to neglect and underutilization of other crops. Hence this work investigated the use of bambara groundnut in *donkwa* production with the objectives of characterizing the compositional characteristics and evaluating the acceptability.

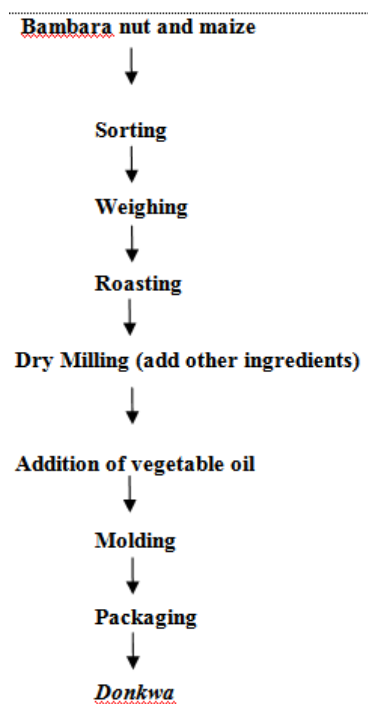
## MATERIALS AND METHODS

### Sample Preparation of *Donkwa* from Maize, Bambara Nut and Peanut

Bambaragroundnut, peanut and maize are used for the study and were obtained from Bodija market in Ibadan, Oyo state, Nigeria. One kilogram (1 kg) of bambara nut seeds was sorted to remove extraneous materials. The seeds were roasted on a sand bath at 180 °C for 20 min as reported by Seena and Sridhar (2006). The method described by Adejuyitan *et al.* (2014) was adopted for the preparation of *donkwa* (maize -peanut ball). About 1kg of maize and 200g of groundnut and maize was roasted and milled together into a powdery form. Three grams (3g) of ground pepper (*capsicum* spp.); 20g of granulated sugar and 2g of common salt were added to taste. About 20ml of vegetable oil was added to form paste and the mixture was rolled into ball shape and ready for consumption. The same procedure was used for the production of *donkwa* from bambara nut and maize with different ratio as shown in the Table 1. The flowchart of processing is also illustrated in Figure 1.

**Table 1: Formulation of Bambara Groundnut and Maize Powdery Mixture**

Formulation	A	B	C	D	E
Maize%	90	80	70	50	60
Bambara Groundnut%	10	20	30	50	-
Peanut%	-	-	-	-	40



Source: (Adejuyitan, 2014)

Figure 1: Flowchart for the Processing of *Donkwa*

### Proximate Analysis

Proximate analysis of the maize and bambara groundnut based *donkwa* samples was carried out in duplicates. Protein, fibre, fat, moisture, ash and carbohydrate contents were determined using the method of Association of Analytical Chemists (AOAC, 2005). Nitrogen was determined by micro-kjedahl method, described by (AOAC, 2005) and percentage of nitrogen was converted into protein by multiplying with 6.25.

### Microbiological Analyses

The total microbial loads of the freshly prepared *donkwa* from maize and peanut (control) and *donkwa* samples from maize and bambara nut were evaluated for total viable, mould, yeast and coliform count as described by APHA (2005).

### Sensory Evaluation

The sensory attributes were evaluated on the colour, taste, flavour, texture and overall acceptability. This was served to a panel of ten judges who were mainly the students and staff of the Department of food Science and Engineering, Ladoke Akintola University of Technology, Ogbomosho, Oyo State, Nigeria. This panel comprises people that are familiar with *donkwa*. The panelists were asked to score each sample on the nine-point hedonic scale.

## RESULTS AND DISCUSSIONS

The results of proximate composition are presented in the Table 2, it was evaluated that the crude protein of the produced *donkwa* increased from 16.97 to 20.73% as the level of substitution of bambara groundnut blend increases. Sample A (90:10%) of maize and bambara groundnut had the lowest value of protein, whereas sample E (60:40%) of maize and peanut had the highest value of 20.73%. This result is in agreement with the findings of Adejuyitan *et al.*(2014)

also the result compared favourably with Aletor and Ojelabi(2007) who obtained 28.55% as a crude protein. The increase in protein is the result of high protein content of bambara groundnut reported by Nwanna *et al.* (2005). Protein is needed as building blocks for the body, necessary for growth and for repair of damaged tissues (Wardlaw, 2004).

**Table 2: Proximate Composition of *donkwa* (%) Produced from Blend of Maize and Bambaranut**

Sample	Moisture	Protein	Ash	Fat	Fibre	Carbohydrate
A	4.44±0.14 <sup>a</sup>	16.97±0.03 <sup>a</sup>	4.94±0.02 <sup>a</sup>	10.77±0.22 <sup>b</sup>	4.55±0.02 <sup>a</sup>	58.32±0.06 <sup>c</sup>
B	4.16±0.17 <sup>a</sup>	18.09±0.11 <sup>b</sup>	4.93±0.00 <sup>a</sup>	10.93±0.00 <sup>b</sup>	4.51±0.03 <sup>a</sup>	57.37±0.02 <sup>d</sup>
C	5.57±0.10 <sup>ab</sup>	18.24±0.16 <sup>b</sup>	4.98±0.09 <sup>a</sup>	11.51±0.43 <sup>b</sup>	4.60±0.00 <sup>b</sup>	55.10±0.08 <sup>b</sup>
D	5.60±0.12 <sup>b</sup>	18.66±0.19 <sup>c</sup>	4.84±0.12 <sup>a</sup>	11.49±0.09 <sup>d</sup>	4.60±0.03 <sup>b</sup>	54.81±0.06 <sup>a</sup>
E	4.82±0.68 <sup>b</sup>	20.73±0.07 <sup>d</sup>	4.93±0.03 <sup>a</sup>	8.76±0.52 <sup>ab</sup>	4.61±0.01 <sup>b</sup>	56.13±0.08 <sup>c</sup>

Mean values are obtained from the determination of duplicate

Values with the same subscripts in the same column are not significantly different (p<0.05)

A = 90 % maize, 10% bambara nut *donkwa*

B = 80% maize, 20% bambara nut *donkwa*

C = 70% maize, 30% bambara nut *donkwa*

D = 50% maize, 50% bambara nut *donkwa*

E = 60% maize, 40% peanut *donkwa*

The Fat content of the *donkwa* ranged from 10.77 to 8.76% with increased in the level of substitution of maize and bambara nut flour. The fat content of sample C had the highest value while sample E had the least value. This may be due to the addition of vegetable oil to other samples to enable molding of the samples. Fat is an essential component of tissues and a veritable source of fat soluble vitamins (A, D, E and K). It is able to supply thrice the amount of energy required by the body Wardlaw, (2004). There was no significant differences at (p<0.05) between samples A, B and in samples C, D and E in the crude fibre contents of the sample investigated. The crude fibre content of *donkwa* produced from maize and peanut (4.61%) was slightly higher than other samples. The result indicated that the fibre content of produced *donkwa* from maize and groundnut was higher than that of *donkwa* produced from maize and bambara nut.

Total viable count of produced *donkwa* decreased from  $1.3 \times 10^8$ - $1.4 \times 10^7$ cfu/ml with the increases in the substitution levels of bambara flour. Sample C that comprised of 70:30% of maize, and bambara nut had the highest total viable count whereas control sample E (60:40%) of maize and groundnut had the least of  $1.4 \times 10^7$ cfu/ml. This implies that total viable count decreased with increase in substitution of bambara nut. This trend is in line with Joshua *et al.* (2014) on microbial and nutritional quality of bread produced from composite flour. Yeast count of the produced *donkwa* increases with the increased in the substitution levels of bambara nut from  $1.2 \times 10^6$ - $3.0 \times 10^7$ cfu/ml. The values of all *donkwa* produced from maize and bambara nut are lower than that of control sample E (60:40) of maize and peanut which has the value of  $3.00 \times 10^7$ cfu/ml. This trend is in line with the reports of Joshua *et al.*(2014) on the production of bread from wheat and potato blend. The moulds were not detected in any of the samples at p<0.05 The result showed that samples are within the limit set by the Standard Organization of Nigeria, which states that the counts of aerobic bacteria must not exceed 100 cfu/g and according to the report of Joshua *et al.* (2014). This showed that such *donkwa* is safe for consumption as there is no fecal contamination.

**Table 3: Microbiological Analysis on the Produced donkwa**

Sample	TVC (cfu/ml)	Mould (cfu/ml)	Yeast (cfu/ml)	Coliform (cfu/ml)
A	$1.3 \times 10^8$	Nil	$1.2 \times 10^6$	Nil
B	$1.2 \times 10^8$	Nil	$1.0 \times 10^6$	Nil
C	$1.4 \times 10^8$	Nil	$2.2 \times 10^6$	Nil
D	$8.3 \times 10^7$	Nil	$2.4 \times 10^7$	Nil
E	$1.4 \times 10^7$	Nil	$3.0 \times 10^7$	Nil

Mean values are obtained from the determination of duplicates.

Values with the same superscript in the same column are not significantly different ( $p < 0.05$ )

A = 90 % maize, 10% bambara nut *donkwa*

B = 80% maize, 20% bambara nut *donkwa*

C = 70% maize, 30% bambara nut *donkwa*

D = 50% maize, 50% bambara nut *donkwa*

E = 60% maize, 40% peanut *donkwa*

**Table 4: Sensory Evaluation of Donkwa**

Sample	Taste	Aroma	Appearance	Texture	Colour	Overall Acceptability
A	$7.00 \pm 0.98^a$	$7.09 \pm 0.92^a$	$7.45 \pm 0.96^a$	$7.09 \pm 1.23^a$	$7.40 \pm 1.18^a$	$7.59 \pm 0.91^a$
B	$7.45 \pm 0.96^{ab}$	$7.31 \pm 1.25^a$	$7.32 \pm 1.25^a$	$7.23 \pm 1.11^a$	$7.77 \pm 0.81^a$	$7.64 \pm 0.85^a$
C	$8.00 \pm 0.98^{bc}$	$7.50 \pm 1.01^a$	$7.45 \pm 0.91^a$	$7.36 \pm 1.09^a$	$7.86 \pm 0.83^a$	$7.55 \pm 1.26^a$
D	$7.50 \pm 1.10^{ab}$	$7.27 \pm 1.03^a$	$6.95 \pm 0.99^a$	$6.95 \pm 1.09^a$	$7.59 \pm 1.10^a$	$7.59 \pm 1.14^a$
E	$8.32 \pm 0.07^c$	$7.27 \pm 0.83^a$	$7.05 \pm 1.43^a$	$7.22 \pm 0.92^a$	$7.77 \pm 1.02^a$	$7.95 \pm 0.99^a$

Mean values are obtained from the determination of duplicates.

Values with the same letters in the same column are not significantly different ( $p < 0.05$ )

A = 90 % maize and 10% bambara nut *donkwa*

B = 80% maize, and 20% Bambara nut *donkwa*

C = 70% maize and 30% Bambara nut *donkwa*

D = 50% maize and 50% Bambara nut *donkwa*

E = 60% maize and 40% peanut *donkwa*

The mean score for the sensory evaluation of *donkwa* are shown in the Table 3. There was no significant difference at ( $p < 0.05$ ) in term of colour, aroma, appearance, texture and overall acceptability except for the taste. The *donkwa* produced compared favourably with the control sample (60:40% of maize and peanut) which does not significantly different from other samples except in term of taste. There was a general increase in the mean score of all parameters with an increase in bambara groundnut substitute. Sample C (70:30% of maize and bambara groundnut) had the highest mean value in the most of the parameters monitored except in taste while sample A (90:10% of maize and bambara groundnut) had the lowest mean value of all the parameter except in texture and appearance.

## CONCLUSIONS

The results of this research work suggest that bambara groundnut is a good alternative raw material for producing acceptable *donkwa* which is a way of improving utilization of bambara groundnut.

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