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Quality And Sensory Attributes of Microwave Treated Flour of Composite Bambara Bread

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Abstract

Effect of microwave heat treatment was investigated on the proximate and sensory quality of wheat-bambara bread. The Wheat flour (WF) and microwave bambara seed flour were blended in the following ratios: A = 100% wheat flour(control); sample B = 90:10, 5 minutes treated microwave wheat – with bambara flour; sample C = 90:10, 10 minutes treated microwave wheat – with bambara flour; sample D = 90:10, untreated wheat – with bambara flour; sample E = 80:20, 5 minutes treated microwave wheat – with bambara flour; sample F = 80:20, 10 minutes treated microwave wheat –with bambara flour; sample G = 80:20, untreated wheat –with bambara flour in production of bread. The samples were analyzed for proximate composition and sensory evaluation. The results showed that the moisture content ranged from 15.03 to 17.94%; Protein content ranged from 13.42 to 17.05%; Fat content ranged from 2.03 to 2.76%; Ash content ranged from 2.36 to 2.94%; fiber content ranged from 1.76 to 2.45%; and carbohydrate ranged from 57.34 to 63.89%. The sensory evaluation shows that bambara bread composed of 10 and 20% composite flour were not significantly different in most sensory attributes and acceptability from the control. Bambara bread microwave treated on sensory quality, ability to purchase composite bread showed low means score to each of the characteristics.

Keywords: Bambara bread, Composite bread, Proximate composition, Sensory properties, Wheat flour

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1. Introduction

Bambara is an underutilized legume crop with great potentials for global food security and nutrition (Xin, *et al*., 2020); it originates from Africa, precisely west central Africa, with Nigeria being the largest producer of Bambara, with an approximate production of 0.1million tonnes (Hillocks *et al*., 2012). Bambara groundnut is a cheap source of plant protein and it's highly nutritious and termed a 'complete food' which is as a result of the balanced macronutrients it contains (Xin *et al*., 2020). Due to the anti-nutritional factors present in bambara groundnut, processing such as boiling, milling, fermentation, soaking, malting/germination are traditional processing methods which are implored in order to help reduce the anti-nutrients. These traditional processing methods are low cost and are important in making the crop safe to eat and fit for consumption. Xin *et al*. (2020) discussed the potentials of modern method of processing which will also improve nutritional quality, modify some properties. Utilisation of microwave, autoclave and infrared heating methods are advanced techniques of processing Bambara groundnut which can be used on an industrial scale compared to traditional processing methods that are used at small scale and household level. (Oyeyinka *et al*., 2020). Microwave heating of foods is a promising method of Bambara processing which will not require soaking before cooking as leaching of nutrients may occur (Oyeyinka *et al*., 2020).

Bread is widely accepted, popular and consumed all over the world; it is a staple food that is essential in man's day to day activity. Although bread is one of the oldest foods, its consumption is increasing every day, this is due to its higher sensory, textural and nourishing attributes, ready to eat convenience just as cost intensity (Giannou and Tzia, 2007). The major raw material for bread production is wheat flour, in Nigeria, wheat is not readily available as it not cultivated in Nigeria due to the climate condition, which has led to the importation of wheat (Edema *et al*., 2005; Olaoye *et al.*, 2006). The ever-increasing cost of wheat importation has led to an increasing price of bread daily, this has led to research on combination of both wheat and non-wheat flours known as composite flours for bread production in order to reduce cost production and increase utilization of readily available raw material. Endeavors has been made and as yet being made to build the utilization of composite flours where flour from native yields can be utilized for bread production, leading to a reduced demand for imported wheat, utilization of legumes to replace a portion of wheat flour, thereby giving us a protein-enhanced bread (Giami *et al*, 2004; Olaoye *et al*., 2006). Studies have demonstrated the use of different flour as substitute to wheat flour such cereals, i.e. corn, root and tuber crops i.e. cassava, legume i.e. peanuts (Adebowale *et al.*, 2009). These ingredients convey characteristic colours, texture and nutritional value which might be great in pastry items, recipes, and other food items. The composite flours are of extraordinary possibilities to emerging nations, as this would reduce wheat importation with an increased potential and utilization of locally grown crops (Hugo *et al.*, 2003). Wheat because it is a cereal that has limiting nutrients, this then call for its fortification with microwave Bambara groundnut seed.

So far, studies have been carried out on the effect of microwave treatment on cooking time, sensory, colour and dietary properties of bambara groundnut (Oyeyinka *et al*., 2020). Protein digestibility was also investigated and was discovered that they improve with microwave heating (Alajaji and El-Adaw, 2006). This research focuses on the utilization of microwaved Bambara groundnut flour in composite with wheat flour for bread production which is yet to be studied. This study will encourage the use of locally produced crops as a complement in bread production thereby reducing dependency on imported crops and the use of microwave heating over traditional processing method as this will help for industrial production processes.

2. Material and Methods

Sources of material

Bambara groundnuts (*V. subterranean*) were purchased from a retail market in Oja-Odan Yewa South, Ogun State, Nigeria and kept in a polyethylene bag on a dry place. Bread flour (Honeywell flour), dry yeast, full cream milk, vegetable shortening, egg, salt, sugar, baking powder and ascorbic acid were purchased from a retail market in Ilaro, Ogun State. All the chemicals used were of analytical grade.

Preparation of sample

Microwave treatment of Bambara groundnut

Microwave oven (Model MEJ11K, LG, Kuala Lumpur, Malaysia) was preheated to have a standard temperature that is uniform, by first heating 200 mL of water for 50sec. The samples (100 g each) were heated in a polyethylene container for 5 min. and 10 min. using the microwave oven set at 360 W. The samples were mixed manually with the spoon in order to have homogeneous mixture (Seema *et al.*, 2012).

Sample formulation

The Wheat flour (WF) and microwave bambara seed flour were blended in the following ratios: A = 100% wheat flour (control); sample B = 90:10, 5 minutes treated microwave wheat – with bambara flour; sample C = 90:10, 10 minutes treated microwave wheat – with bambara flour; sample D = 90:10, untreated wheat –with bambara flour;

sample E = 80:20, 5 minutes treated microwave wheat – with bambara flour; sample F = 80:20, 10 minutes treated microwave wheat -with bambara flour; sample G = 80:20, untreated wheat – with bambara flour respectively.

Table 1: Recipe for the production of breads

Ingredients	Quantity in gram
Wheat flour	100
Sugar	8
Yeast	2
Fat	4
Salt	1.5
Water	59-60ml
Baking	130 ºC at 90 min.

Source*:* Abdoulaye *et al.*, (2013)

Proximate analysis

AOAC (2010) method was used for the proximate analysis determination

Determination of moisture content

About 2 g of bambara bread was weighed into a pre weighed crucible, and then kept in an oven with at a temperature of 100°C to a constant weight for 24 hours through the night. At the end of 24 hours, the sample was removed and kept in a desiccator to cool for 10 minutes before weighing.

$$\%\text{Moisture Content} = \frac{W_2 - W_1}{W_0} \times 100$$

Where W_2= Weight of crucible + oven dried sample

W_1= Weight of empty crucible

W_0= Weight of sample

Determination of ash content

Two grams (bambara bread) was weighed into a crucible with known weight, which had been previously dried with an oven and cooled in the desiccator. An electric heater was used to char the organic matter after which it was transferred into a muffle furnace with a temperature of 600 °C, this was carried out for 6 h. The crucible with sample was cooled in a desiccator before it was weighed.

$$\%\text{ Ash} = \frac{W_2 - W_1}{W_0} \times 100$$

Where W_2= Weight of crucible + ash

W_1= Weight of empty crucible

W_0= Weight of sample

Determination of crude fat

1 g of bambara bread was weighed into an extraction thimble that is liberated from fat which was shut gently with cotton fleece. The thimble was put in the extractor and fitted up with a reflux condenser. Dried Soxhlet cup of 250 ml was gauged and ¾ of its volume was loaded up with petrol ether (edge of boiling over of 40°C - 60°C). The cup, extractor with condenser set was put on the heater for about 6 hours; steady water was running from the tap for buildup of the ether fume. The set was washed with ether spills and the temperature of the heater was decreased for ether to bubble tenderly. Thimble with the Bambara bread was dried, extractor and condenser supplanted and refining proceeded until the jar was basically dried. The jar with the fat and oil was eliminated, cleaned and dried to a steady weight in the stove.

Starting load of dry Soxhlet jar - W1

Last weight of stove dried jar + oil/fat – W2

Weight of sample- W_0

$$\% \text{ Crude Fat} = \frac{W_2 - W_1 \times 100}{W_0}$$

Determination of crude protein

0.5g of Bambara bread was painstakingly weighed into the processing tube and was guaranteed it was at the base of the jar. A tablet of catalyst and 10ml of concentrate were added, opening of the assimilation block heaters in a smoke cabinet for 4 h. The review was cooled and painstakingly moved into 100 ml volumetric jar completely washing the processing tube with refined water. 5ml piece of the overview was then pipette into the refining mechanical assembly and 5ml of 40% NaOH was added. The combination was steam refined for 2 min. into 500 ml funnel shaped flagon containing 10 ml of 2% Boric corrosive with blended marker arrangement and put at the getting top of the condenser. The arrangement was then titrated against 0.01N HCl in a 50 ml burette.

$$\% \text{ Nitrogen} = \frac{\text{Titer Value x Atomic Mass Nitrogen x 100}}{\text{Normality of HCl used x 4}}$$

% Crude Protein = % Nitrogen × 6.25

Determination of crude fibre

2g of bambara bread was weighed into 600 ml beaker and 200 ml hot 1.25% was added, after which it was placed in digestion apparatus on a pre-heated plate, left to boil and reflux for 30 min. for hydrolysis of protein and carbohydrates. Filtering through Whatman paper and washing of the residue with distilled water until filtrate was neutral was carried out subsequently. The buildup was moved into the measuring glass and 200 ml NaOH was added before returning to the digestion apparatus to bubble and ebb for 30 min. It was separated and washed with refined water until filtrate is impartial. The buildup was then moved into the crucible and dried at 100 °C through the night. It was cooled in the desiccator, weighed and set in the heater at 600 °C for 6 h. It was cooled and weighed.

$$\% \text{ Crude Fibre} = \frac{A - B \times 100}{C}$$

Where;

A= Weight of digested sample
B=Weight of ashed sample
C= Weight of sample

Determination of carbohydrate content
The difference between sum of the values for moisture, crude protein, crude fat, crude fibre and ash in percent.

Sensory evaluation
Untrained panellists participated in the consumer studies which were 60 in number. Each of them was given a pre-screening structure to acquire data about age, sexual orientation, training finished, purchasing propensities for bread, recurrence of bread utilization, and potential food sensitivities. Panellist who claimed to have food allergy, were not allowed to participate. Consent forms were given to panellist, and they were educated about the procedure and need for the study. Each of bambara bread was tested by the panellist in order to prevent unfairness in the report. Distilled water and unsalted crackers were accommodated purging their sense of taste between tests. Specialists assessed the bambara bread utilizing a decadent scale (9 = like incredibly; 5 = neither like nor despise; 1 = disdain very) to decide the degree of preference for five tangible characteristics: texture, appearance, colour, flavor, and by and large overall acceptability.

Statistical analyses
All experiments were conducted in triplicate for the bambara bread. The outcomes were communicated as the mean ± standard deviation. Information were analysed by one-way analysis of variance (ANOVA), trailed by Fischer's least significant difference (LSD) test to isolate the means utilizing XLSTAT software. The significance level was set at $p \leq 0.05$.

3. Results and Discussion

Proximate analysis

Table 2: The proximate composition of Bambara bread based on the microwave heat treatment

Parameters	**Samples**						
(%)	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Moisture	17.94±0.003	16.51±0.001	15.03±0.003	17.62±0.04	16.77±0.003	15.14±0.05	17.46±0.003
Ash	2.81±0.001	2.63±0.003	2.71±0.001	2.85±0.003	2.68±0.003	2.74±0.003	2.94±0.003
Fibre	1.90±0.001	1.76±0.04	1.87±0.003	2.15±0.04	1.83±0.04	1.83±0.006	2.45±0.003
Fat	2.03±0.04	2.14±0.006	2.24±0.003	2.42±0.03	2.22±0.003	2.29±0.003	2.76±0.04
Protein	13.42±0.003	14.14±0.001	14.26±0.003	15.62±0.003	15.74±0.002	15.92±0.003	17.05±0.003
CHO	61.90±0.006	62.81±0.02	63.89±0.06	59.34±0.006	60.76±0.05	62.08±0.03	57.34±0.04

Values are mean± standard deviations of triplicate determinations.

A = 100% wheat Bread.

B = 90:10, 5 min treated microwave wheat - bambara bread.

C = 90:10, 10 min treated microwave wheat - bambara bread.

D = 90:10, untreated wheat - bambara bread.

E = 80:20, 5 min treated microwave wheat - bambara bread.

F = 80:20, 10 min treated microwave wheat - bambara bread.

G = 80:20, untreated wheat - bambara bread.

The result shown in Table 2 above indicated the proximate composition of bambara bread based on the microwave heat treatment. The moisture content ranged from 15.03to 17.94%. The lowest moisture content of 15.03% was recorded in Sample C 90:10, 10 minutes treated microwave wheat - bambara bread while the highest moisture content of 17.94% was recorded in sample A 100% wheat bread. At the baking temperature (which is regularly more noteworthy than 100°C) the moisture content of the raw samples was greatly reduced. However, as food materials differ, their capacity also differs for absorbing moisture this may be present as occluded or absorbed water. Which can therefore be concluded that even with baking at high temperature, definitely moisture will still be in the food sample which was also observed in this research (Edema *et al.*, 2005). Bambara bread produced in this research has high moisture content. Nonetheless, high moisture content accommodates more prominent movement of water-solvent catalysts and co-compounds required for metabolic exercises of these plants (Iheanacho & Ubebani, 2009). The crude fat ranges from 2.03 to 2.76%. The lowest fat content of 2.03% was recorded in Sample A 100% wheat bread and the highest fat content of 2.76% were recorded in Sample G 80:20, untreated wheat - bambara bread. Utilization of (crude) lipids in huge sums is a decent dietary propensity and prescribed to people experiencing overweight or heftiness. (Sodipo *et al.,* 2000; Erukainure *et al.,* 2011). The ash content ranged from 2.63 to 2.94%. The highest ash content of 2.94% was recorded in sample G 80:20 untreated wheat-bambara bread while the lowest ash content of 2.63% was recorded in Sample B 90:10, 5 minutes treated microwave wheat - bambara bread.

The percentage crude fibre ranges from 1.76 to 2.45%. The lowest fibre content of 1.76% was obtained in Sample B 90:10, 5 minutes treated microwave wheat - bambara bread and the highest fibre of 2.45% was observed in sample G 80:20 untreated wheat bambara bread. The unrefined fiber content was viewed as 6.74±0.01%. Rough fiber assists with forestalling stoppage, gut issues and heaps. Filaments in the eating regimen are important for absorption and for successful disposal of squanders, and can reduce the serum cholesterol, the hazard of coronary illness, hypertension, obstruction, diabetes, colon and bosom malignant growth (Sodipo *et al*., 2000). Protein helps in building and keeping up with all tissues in the body, shapes a significant piece of compounds, liquids and chemicals of the body and furthermore helps structure antibodies to battle disease and supplies energy (Jonhson, 2006). Proteins are fundamental natural mixtures of high sub-atomic weight found in every living tissue. Protein content in examples went from 13.42 to 17.05%. The most elevated worth was recorded in example G, 80:20 untreated wheat-bambara bread while the least in sample A 100% wheat bread. Plant food sources that give over 12% of their calorific worth from protein have been demonstrated to be great wellspring of protein like cabbage, 12.8% and lettuce, 14% and furthermore unrefined protein in the verdant plants would need dietary supplementation with proteins from oats and vegetables (Erukainure *et al*., 2011). Carbohydrate content in samples ranged from 57.34 to 63.89%. The highest value was recorded in Sample C = 90:10, 10 minutes treated microwave wheat - bambara bread while the lowest in sample G, 80:20 untreated wheat-bambara bread. The suggested allowance for carbohydrate dietary allowance values for vulnerable groups such as adults, children, pregnant and lactating moms are 130, 130, 175 and 210 g separately (FNB, 2002).

Sensory evaluation

The sensory assessment of wheat and its composite bread tests are displayed on table 3. There was no huge ($p<0.05$) distinction in every one of the sensory boundaries. The crust colour result for the colour of the bambara bread tests went from 7.06 to 7.53 with the most elevated score been recorded in sample D 90:10 untreated wheat bread. The noticed scores show that the degree of treated and untreated of bambara seed flour in composite bread doesn't lessen the caramelization interaction this gives colour brown while baking is in progress. The rating for the taste of the manufactured composite treated and untreated breads were practically identical to those of 100% wheat bread and went from 6.80 to 7.60; no panelist showed a complete dislike for the flavor of any of the bambara bread, inferring that the flavor of the bambara bread was not impacted by the degree of supplementation and the microwave treatment. The aroma of the bread went from 6.93 to 7.47 aroma is identified with taste; this property showed a significant degree of relationship with taste. A decent degree of aroma force impacts taste. The texture went from 6.73 to 7.47 with the most noteworthy acquired in the 80:20, 5min. microwave treated wheat-bambara bread and least in the 90:10, 5min. microwave treated wheat-bambara bread. This showed that the degree of 5-minute microwave treatment impacts the nature of mixture that could give the texture known to bread. Outcomes for 10 and 20% subbed breads were tantamount to the control. It recommends that the nature of bread that can be delivered from wheat-bambara flours blends relies upon the degree of substitution. readiness to purchase the Bambara bread scored an imply that went from 6.80 to 7.27 with the most noteworthy been recorded for 90:10, 5min. microwave treated wheat-bambara bread, and least for 90:10 10, minute microwave treated wheat-bambara breads. Notwithstanding, the adequacy of the samples was tantamount to the mean score of the 100% wheat bread. It was likewise seen that the microwave heat treatment of bambara seed flour didn't fundamentally ($p<0.05$) influence the worthiness of the Bambara bread, this might have been brought about by the great taste and smell of the samples.

Table 3: Evaluation of sensory attributes of bambara bread based on the microwave heat treatment

PARAMETERS	SAMPLES						
	A	B	C	D	E	F	G
Crumb colour	7.73^{a}	7.74^{a}	7.73^{a}	7.80^{a}	7.67^{a}	7.74^{a}	7.73^{a}
Crust colour	7.40^{a}	7.30^{a}	7.06^{a}	7.53^{a}	7.30^{a}	7.40^{a}	7.40^{a}
Taste	7.47^{a}	7.00^{a}	7.50^{a}	7.60^{a}	7.30^{a}	6.80^{b}	7.10^{a}
Crust texture	7.30^{a}	7.47^{a}	7.27^{a}	7.30^{a}	6.73^{b}	6.80^{b}	7.30^{a}
Flavour	6.93^{b}	6.80^{b}	7.33^{a}	7.53^{a}	6.93^{b}	7.40^{a}	7.27^{a}
Aroma	7.13^{a}	7.47^{a}	6.93^{b}	7.13^{a}	7.27^{a}	7.07^{a}	7.20^{a}
Shape	7.80^{a}	7.47^{a}	7.47^{a}	7.67^{a}	7.27^{a}	7.27^{a}	7.53^{a}
Willingness to buy	7.13^{a}	7.27^{a}	6.80^{b}	7.07^{a}	6.80^{b}	6.87^{b}	6.60^{b}
Overall acceptability	7.27^{a}	7.47^{a}	7.53^{a}	7.33^{a}	7.33^{a}	7.13^{a}	7.67^{a}

Values are mean of duplicate determinations

A = 100% wheat Bread.

B = 90:10, 5 min treated microwave wheat - bambara bread.

C = 90:10, 10 min treated microwave wheat - bambara bread.

D = 90:10, untreated wheat - bambara bread.

E = 80:20, 5 min treated microwave wheat - bambara bread.

F = 80:20, 10 min treated microwave wheat - bambara bread.

G = 80:20, untreated wheat - bambara bread.

4. Conclusion

However, the composition in terms of proximate of the composite microwave heat-treated and untreated bambara-based breads were somewhat not quite the same as that of bread composed of 100% wheat, it was observed that bambara bread prepared with 10 and 20% wheat-bambara flour were not altogether divergent in most tangible qualities and agreeableness from the control. Bambara bread prepared with 10 and 20% microwave heat-treated bambara and untreated flours to be appraised higher than the control as far as aroma, colour, flavour, general worthiness. These outcomes showed that the 10 and 20% wheat/bambara microwave treated formula could be a practical choice to accomplish the ideal financial, food security and wellbeing.

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