Proximate And Sensory Characteristics of Fried Peanut Burger Prepared with Different Food Flours (Oat Flour, All-Purpose Wheat Flour, High Quality Cassava Flour)

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Abstract— This study aims to investigate the proximate and sensory attributes of peanut burger samples prepared using three different types of flour: All-purpose wheat flour (a brand name), Oat flour, and Cassava flour. Fresh peanuts were sorted, rinsed, blanched at 100°C for 15 min, strained and air-dried at room temperature (27°C ± 2°C) for 24 h. Sugar was stirred with whisked egg and the solution was simultaneously sprinkled alongside with flour and salt on the peanuts. They were then fried at temperature of 150–180°C for 3-4 min. Nutritional parameters, including moisture, crude fats, crude proteins, crude fiber, total ash, carbohydrates and energy content, were analyzed. The range of values for moisture content, crude fat, crude protein, crude fibre, total ash, carbohydrate and energy contents were 10.33-13.37%, 9.39 -15.03%,6.88-14.61%,1.76-3.98%,1.26-3.24%,52.81-67.34% and 381.38-404.92kcal. The results reveal significant variations in nutritional content among the three samples. Oat flour peanut burgers exhibited the highest protein and fat content, while cassava flour counterparts contained the highest moisture and carbohydrate levels. Whole wheat flour samples often fell between the other two in terms of nutritional composition. Additionally, sensory evaluations encompassing color, flavor, taste, texture, and overall acceptability were conducted. Sensory evaluations indicated that oat flour peanut burgers received the highest scores for color, flavor, taste, texture, and overall acceptability, making them the preferred choice among the panelists. Cassava flour samples, on the other hand, tended to score lower in these attributes. The choice of flour type significantly influences the nutritional composition and sensory appeal of peanut burgers, with oat flour-based peanut burgers emerging as the favored option in terms of both nutritional content and sensory attributes. This study provides valuable insights for product development and consumer satisfaction in the peanut burger industry.

***Index Terms*— Peanut burger, Oat, Flour, Cassava, Proximate.**

1. Introduction

Contrary to what some in the West might think, a peanut burger is not a hamburger made out of peanuts. Rather, it is a popular West African snack that is loved by kids and adults alike. Made by coating peanuts (also called groundnuts) and then frying them, this snack is easy, inexpensive and delicious (Godfrye, 2022). Snack foods are the items eaten for pleasure and during relaxation, they play vital roles in our day-to-day life. These include peanut/groundnut burger; deep fried potato chips, biscuits, sausages, doughnuts, etc. Civilization has changed our eating lifestyle making us more dependent on snack foods (Babalola et al., 2021). Health related issues are also increasing among the people. Though warnings had been given by nutritionists concerning the eating of fried foods, which contain enormous quantities of calories, cholesterols and saturated fats, the demand for it is still on increase daily. In order to maintain a healthy lifestyle, the consumption of fat-based foods should be moderated (Vinothini et al., 2015). Peanut burger snack is a very simple crunchy snack. Itis as well a spicy and delicious treat. Some Nigerian sometimes call this snack 'groundnut burger' or 'coated peanut' however, one thing is common, it is simply coated with flour and sugar (Babalola et al., 2021). This snack product involves encasing whole or chopped peanuts in a delicious coating comprised of flour, cornstarch, seasonings, and spices. The thickness and texture of the coating can vary, ranging from a light and crispy shell to a thicker, more substantial crunch. The coated peanuts are then fried or baked until the coating turns golden brown, resulting in a crispy shell that adds a delightful texture to each bite. In Nigeria, ready –to-eat peanut burger consumption is continually increasing among children. Nigeria with its diverse agricultural productivity, could offer customized regional formulae for the production of peanut burger. The finished product strikes an ideal mix between the delightful crunch of the coating and the natural nuttiness of the peanuts.

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The formulation and production of nutritional peanut burger from the easily available food flours is vital for the healthy feeding of ever-increasing population of our country Nigeria and will reduce the need to import food flours to meet the demand. Due to increased interest in the consumption of functional foods, pastries with high nutritional and sensory properties have been produced from non-wheat-based composite flour (Okpala and Okoli, 2011) The economy of any country importing wheat flour the production of baked food such as peanut burger would be greatly improve such product, therefore efforts are made for partially replacing wheat flour with non-wheat flour as a possible for increasing the utilization of indigenous crops cultivated in Nigeria. Groundnut or peanut (Arachis hypogea Linn) is a plant which belongs to the family of Fabaceae. Botanically, it is a legume although it is widely identified as a nut and has similar nutrient profile with tree nuts (Ros, 2010). Peanut seeds are eaten raw, boiled or roasted, made into butter or paste and are used for thickening soups (Campos-Mondragón et al., 2009). Groundnuts were originally considered to be food for animals; then they were used as food for slaves. They have now become an important source of protein in many developing countries. All-purpose wheat flour is the conventional flour used in baking in Nigeria. Oats (Avena sativa L) is a cereal rich grain commonly used for breakfast cereals. Oat (Avena sativa L.) is unique among all cereal crops because it possesses many nutrients that bear value for human food, animal feed, health care, and cosmetics This cereal is an important source of carbohydrates, dietary soluble fiber, balanced protein, lipids, different phenolic compounds, vitamins, and minerals (Snag et al.,2017). Because of the growing awareness of the public toward healthy eating habits, oat has received increased attention from scientific researchers and industries. Food-based companies are considering better nutritional composition together with the popularity of ancient grains and are developing novel food products by incorporating oats as an ancient grain in breakfast cereals, beverages, bread, and infant foods (Buut et al.,2008,). Although oats are mainly used in breakfast cereals and snack bars, the inclusion of it in different products would greatly benefit consumers because of its health promoting attributes [Snag et al., 2017)]. Cassava (Manihot esculenta Crantz) is one of the most important staple food crops grown in Nigeria and in tropical Africa. Common amongst the lowland tropics, sub- humid tropics of West and Central Africa, it is a primary source of calorie for about two-fifths of Africans (Oni and Oyelade, 2014). Cassava (Manihot esculenta Crantz) is the chief source of dietary food energy for the majority of the people living in the lowland tropics, and much of the sub-humid tropics of West and Central Africa (Tsegia and Kormawa, 2002).

This work therefore seeks to produce peanut burger using oat flour, all-purpose wheat flour and cassava flour with the aim of comparing the nutritional and sensory properties of the peanut burgers obtained from these flours respectively.

2. Materials And Methods

Quaker Quick Oats (4kg), All-purpose flour (4kg) and cassava tubers (6kg) used in the study were purchased from Eke-Oko market, Oko, Orumba North Local government Area of Anambra state, Nigeria. Quaker Quick Oats was milled and sieved to obtain the oat flour. Cassava tubers were processed using the high-grade processing method for cassava flours as described by Oti and Ukpabi (2006). Production of Peanut burger was prepared according to the method described by Christina (2016) using the recipe itemized in Table 1. Fresh peanuts were sorted, rinsed, blanched at 100°C for 15 min, strained and air-dried at room temperature (27°C ± 2°C) for 24 h. Sugar was stirred with whisked egg and the solution was simultaneously sprinkled alongside with food flours and salt on the peanuts respectively. The process was repeated till all the peanuts were evenly coated after which it was deep fried, strained and packaged.

Table 1: Ingredients — Quantity (g)

Peanut	100.0
Food flour	50.0
Sugar	20.0
Eggs	30.0
Salt	2.0

3. Laboratory Analysis

A. Proximate composition determination

The moisture, crude protein (N × 6.25), crude fat and crude fibre were obtained using AOAC (2010) standard methods. Carbohydrate was obtained by difference. Energy was calculated.

B. Moisture content determination

Two grams of each sample was weighed into dried weighed crucible and dried in an oven at 105OC for 3h. The dried samples were put into desiccators, cooled and reweighed. The process was repeated until constant weight was obtained. The difference in weight was calculated as the percentage moisture of the original sample.

$$\text{Percentage (\%) moisture} = \frac{W_2 - W_1}{W_2 - W_3} \times \frac{100}{1}$$

Where W1 = Initial weight of empty dish
W2 = Weight of dish and undried sample
W3 = Weight of dish and dried sample

C. Ash content determination

Two grains of each sample were weighed into a crucible, dried in an oven for 3h at 100OC, then transferred into a muffle furnace at 550OC. Heating continued and was stopped when the material turned ashy in colour. The dish and ash were reweighed after cooling in a desiccator at room temperature. The weight of the residual ash was calculated.

$$\text{Percentage (\%) ash} = \frac{\text{Weight of Ash}}{\text{Weight of original sample}} \times \frac{100}{1}$$

D. Fat content determination

Two grams of each sample was loosely wrapped with filter paper and with 120ml of petroleum ether. The fat content was extracted by soxhlet extraction technique for 5h. The percentage (%) oil content was calculated as follows:

$$\text{Percentage (\%) oil content} = \frac{W_2 - W_1}{W_3} \times \frac{100}{1}$$

Where W1 = Weight of empty extraction flask
W2 = Weight of the flask and oil extracted
W3 = Weight of the sample

E. Crude fibre determination

Two-gram (2g) sample and 1g asbestos were put into 200ml of 1.25% of H2SO4 in a flask and boiled for 30min. The mixture was poured unto a Buchner funnel fitted with cheese cloth, secured with a rubber band and allowed to filer. The residue was transferred into 200ml boiled NaOH and boiling continued for 30mins, and the mixture was filtered using the Buchner funnel. The residue was washed with alcohol twice, followed by thrice washing with petroleum ether. The residue was then transferred to a weighed, clean, dry crucible and dried in an oven to constant weight. The percentage (%) crude fibre of the samples was calculated as:

$$\text{Percentage (\%) crude fibre} = \frac{W_1 - W_2}{W_3} \times \frac{100}{1}$$

Where W1 = Weight of sample before incineration
W2 = Weight of sample after incineration
W3 = Weight of original sample

F. Crude protein determination

The micro kjeldahl method was adopted. Two grams of each sample digested using 10ml of Con. H2SO4 and one tablespoon of selenium catalyst in along necked digestion tube. Heating was done in a fume chamber. 10ml of the digest was mixed with equal volume of 45% of NaOH solution and poured into a kjeldahl distillation apparatus and the mixture was distilled and the distillate was collected into 4% boric acid solution containing 3 drops of methyl red indicator. Titration was done using 50ml of the distillate. The nitrogen content was calculated and multiplied with 6.25 factor to obtain the crude protein content.

$$\text{Percentage (\%) Nitrogen} = \frac{(100 \times N \times 14 \times VF)\ T}{100 \times Va}$$

Where N = Normality of Titre (0.IN)
VF = Total volume of digest: (100ml)
T = Titre value
Va = Aliquot volume distilled

G. Carbohydrate content determination

The Nitrogen Free Extract (NFE) method of AOAC (1990) was adopted. The carbohydrate was calculated as: weight by difference between 100 and the summation of other proximate parameters:

NFE = 100 – (M + P+ F1 +A + F2)

Where M = Moisture
P = Protein, F1= Fat, A = Ash, F2= Crude Fibre.

4. Sensory Evaluation

The sensory attributes were evaluated at room temperature (i.e., 25 ± 5◦C) by a panel of forty untrained judges comprising of Athletes and members of the Department of Food Technology, Federal Polytechnic Oko, Anambra State. The panelists were served with the peanut burger samples and a questionnaire. The samples were identified with three–digit code numbers and presented in a random sequence to panelists. The panelists were instructed to rinse their mouths with water after every sample and not to make comments during evaluation to prevent influencing other panelists. They were also asked to comment freely on samples on the questionnaires given to them. Sensory acceptability was evaluated based on the description of Aigster et al. (2011) for cereal snacks using a 9-point Hedonic scale for the following attributes: overall acceptance, colour, form, texture, and chewiness. The Panelists expressed their degree of liking or disliking.

5. Statistical Analysis

Data from proximate and sensory determinations were collected in triplicates and means± standard deviations (SD) were computed. Data obtained were analyzed by one way analysis of variance (ANOVA) using the SPSS version 23 (2015) statistical procedure and significance was accepted at $p<0.05$ level of probability.

6. Result And Discussion

Values are means ± standard deviation for triplicate readings. Values with different superscripts across the rows are significantly ($p<0.05$) different from each other.

The proximate composition and sensory scores of the peanut burger samples are presented in Table 2. The proximate composition of the peanut burger samples coated with different flours reveals significant variations in their nutritional content. Moisture content ranged from 10.33% (oat flour) to 13.37% (cassava flour), with all-purpose wheat flour falling in between at 11.96%. Fat content was highest in oat flour-coated samples (15.03%), followed by all-purpose wheat flour (12.00%), and lowest in cassava flour (9.39%). Protein content showed a similar trend, with oat flour-coated samples having the highest protein content (14.61%), followed by all-purpose wheat flour (11.07%), and cassava flour (6.88%). Ash content was highest in oat flour-coated samples (3.98%), followed by all-purpose wheat flour (2.28%), and lowest in cassava flour (1.76%). Crude fiber content was highest in oat flour-coated samples (3.24%), followed by all-purpose wheat flour (1.65%), and lowest in cassava flour (1.26%). Carbohydrate content was highest in cassava flour-coated samples (67.34%), followed by all-purpose wheat flour (61.05%), and lowest in oat flour (52.81%). Energy content followed a similar trend, with oat flour-coated samples having the highest energy content (404.92

Table 2
Proximate composition and sensory attributes of Peanut burger samples coated with All-purpose wheat flour, oat flour and cassava flour

Parameters	Peanut burger samples		
	All purpose Wheat flour	Oat flour	Cassava flour
Moisture	11.96^{b}±0.07	10.33^{c}±0.57	13.37^{a}±0.35
Fat	12.00^{b}±0.01	15.03^{a}±0.06	9.39^{c}±0.34
Proteins	11.07^{b}±0.01	14.61^{a}±0.04	6.88^{c}±0.02
Ash	2.28^{b}±0.08	3.98^{a}±0.01	1.76^{c}±0.24
Crude fibre	1.65^{b}±0.02	3.24a±0.19	1.26^{c}±0.02
Carbohydrates	61.05^{b}±0.15	52.81^{c}±0.53	67.34^{a}±0.32
Energy	396.47^{b}±0.57	404.92^{a}±1.54	381.38^{c}±3.86
Colour	7.25^{b}±0.01	7.47^{a}±0.01	7.00^{c}±0.00
Flavour	7.14^{a}±0.01	7.33^{a}±0.03	6.23^{b}± 0.21
Taste	7.15^{b}±0.01	7.38^{a}±0.03	6.38^{c}±0.17
Texture	7.40^{b}±0.02	7.62^{a}±0.10	6.48^{c}±0.13
Overall acceptability	7.23^{b}±0.01	7.41^{a}± 0.03	6.52^{c}±0.08

kcal), followed by all-purpose wheat flour (396.47 kcal), and cassava flour (381.38 kcal). The nutritional composition reveals that Oat flour Peanut burgers had the highest protein, ash, fiber, fats, and energy content, making them a suitable choice for those looking for a more protein-rich and energy-dense option. Cassava flour peanut burgers were highest in carbohydrates, which might appeal to individuals seeking a higher carbohydrate content. Energy value synonymously referred to as calorific value is the number of calories in food, indicating the levels of utilizable energy (IFIS Publishing, 2005). Protein, fat and carbohydrate contribute to the energy value of a substance. It was calculated based on the concentration of fat, protein and carbohydrate.

The sensory attributes of the peanut burger samples coated with different flours also exhibited significant differences ($p<0.05$) (Table2). Color scores ranged from 7.00 (cassava flour) to 7.47 (oat flour), with all-purpose wheat flour falling in between at 7.25. Flavor scores were highest in oat flour-coated samples (7.33), followed by all-purpose wheat flour (7.14), and lowest in cassava flour (6.23). Taste scores followed a similar trend, with oat flour-coated samples having the highest taste score (7.38), followed by all-purpose wheat flour (7.15), and cassava flour (6.38). Texture scores were highest in oat flour-coated samples (7.62), followed by all-purpose wheat flour (7.40), and lowest in cassava flour (6.48). Overall acceptability scores were highest in oat flour-coated samples (7.41), followed by all-purpose wheat flour (7.23), and lowest in cassava flour (6.52). From the data, the Oat flour peanut burgers consistently scored highest in the sensory attributes of color, flavor, taste, texture, and overall acceptability. Wheat flour peanut burgers also performed well in sensory aspects while the Cassava flour peanut burgers generally received lower ratings. Oat flour-based peanut burgers demonstrate a balance between nutritional quality and sensory appeal, suggesting their potential as a market-preferred option.

7. Conclusion

The quality of the peanut burger is determined by the quality and amount of the components, particularly the flour. Ultimately, the choice of flour for peanut burger production should depend on the specific dietary and sensory preferences of the consumer. Oat flour peanut burgers are a good option for those seeking higher protein and energy content with excellent sensory qualities. Wheat flour peanut burgers offer a balance between nutritional components and sensory attributes. Cassava flour peanut burgers are an option for those preferring higher carbohydrates but may sacrifice sensory quality to some extent. The findings highlight the importance of considering both nutritional content and sensory appeal when selecting the flour for peanut burger production. This analysis can inform manufacturers and consumers in making informed choices based on their dietary and taste preferences.

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