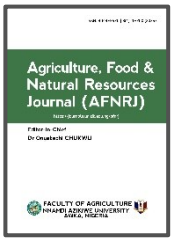
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Original Article

Quality evaluation of biscuits produced from wheat flour using peanut butter as fat substitute

OPEN ACCESS

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ABSTRACT

Quality evaluation of biscuits produced from wheat flour using peanut butter as a fat substitute was studied. Five samples were produced using 100% wheat flour (BBZ: 100% butter; RMD: 10% butter and 90% peanut butter; OKW: 20% butter and 80% peanut butter; BFB: 30% butter and 70% peanut butter; FMB: 40% butter and 60% peanut butter) and were subjected to different analyses: mineral, proximate, and vitamin composition, as well as sensory evaluation. The data obtained were statistically analyzed using ANOVA and mean separated by the Duncan Multiple Range Test ($p<0.05$). The moisture, protein, fat, fiber, ash, and carbohydrate ranged from 7.22 - 9.35%, 3.95 - 4.25%, 18.35 - 26.98%, 0.39 - 1.23%, 1.85 - 2.40% and 56.65 - 66.40% respectively. The samples contain significant ($p<0.05$) amounts of potassium (27.50-45.00 mg/100g), calcium (202.50-237.50 mg/100g), magnesium (47.50-67.75 mg/100g), iron (7.85-9.25 mg/100g), phosphorus (160.00-195.00 mg/100g), and sodium (262.50-287.50 mg/100g) content. The addition of peanut butter had a significant effect on the mineral content of the biscuits due to the presence of the peanut. The samples contained ascorbic acid (4.80-5.30 mg/100g), vitamin B1 (0.09-0.15 (mg/100g), Vitamin B2 (0.19 - 0.22 mg/100g) and Vitamin B3 (1.73 - 1.83mg/100g). The value of sensory scores for taste, colour, appearance, texture, and overall acceptability ranged from 7.50 - 9.10, 5.70 - 7.10, 7.90 - 8.90, 8.10 - 8.80 and 7.60-8.00 respectively. There was a significant ($p<0.05$) difference among samples in the sensory panelist ratings of taste, colour, appearance, texture, and overall acceptability.

KEYWORDS: *Biscuits, Mineral, Peanut butter, Proximate, Wheat*

INTRODUCTION

Biscuits are ready-to-eat, convenient and cheap snacks that are consumed by all age groups in many countries (Adebowale *et al.,* 2012). Biscuits occupy primary position, both for production and consumption as compared to other bakery products (Ahmad & Ahmed, 2014). Biscuits are usually dried to low moisture content with a soft consistency. Thus, it is a baked product that has much lower moisture content as compared with other baked products thereby prolonging its shelf life. The main ingredients of biscuit include wheat flour, margarine (fats), sugar, and water while other ingredients such as milk, aerating agent, emulsifier, flavour and colour can be included and hence, are called optional ingredients (Ajibola *et al.,* 2015). However, each of the ingredients used in the production of biscuit plays a specific role. Biscuits can be fortified or enriched to meet specific nutritional needs of consumers. This is because

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consumer health is of paramount interest in the food industry. Snack food industry is growing globally with rapid introduction of new products. These new products are formulated with the intention of meeting up with specific health or organoleptic needs of consumer (Omah & Okafor, 2015).

Peanut (*Arachis hypogaea L.*) is the cheapest source of protein and also known as groundnut because it grows underground (Abegaz *et al.,* 2006). It is one of the leading agricultural crops of the world for the production of edible plant oil and protein (Adegoke *et al.,* 2004). They are usually consumed after roasting or boiling, they have many value-added products that have been developed with a number of applications in bakery, confectionery and the general consumer market. Peanuts can be processed into different forms such as peanut butter, peanut flour, peanut oil, candy, chocolate, cake and others (Wang, 2018). Peanut butter contains sweeteners and salt can be added to enhance flavour while small amounts of stabilizers are used to prevent oil separation (Riveros *et al.*, 2010). Incorporating peanut butter as substitute for shortening in biscuit will not only reduce the risk of diseases like obesity, coronary heart disease and cancer, but will also improve the nutritional qualities, sensory and organoleptic properties of the baked products.

Coronary heart disease, obesity and cancer have been implicated with excess intake of fat in diet (Akoh, 2008). Biscuits typically contain around 22-30% fat (Farheena *et al.,* 2015) which makes them unhealthy especially for those suffering from coronary heart diseases. Hence, this study will help modify the composition of biscuits, cut down the amount of fat by reducing the saturated fats with the inclusion of the peanut butter while creating a new marketing nitch for the production of peanut butter. The aim of this research was to produce biscuits from wheat flour and peanut butter.

MATERIALS AND METHOD

Materials

The wheat flour and peanut used for this study were purchased at Sabo Market in Ikorodu, Lagos State, Nigeria. Other ingredients: sugar, baking powder, whole eggs, salt, and milk used in the production of the biscuit formulations were also obtained from the same market.

Production of Peanut Butter

The peanut butter was prepared according to the method described by Olawuni *et al.,* (2019) with little modification. The purchased peanuts were graded and sorted to remove damaged nuts and dirt. 1kg of the sorted peanuts were soaked with 52g of salt for 20minutes. Water was added to cover the peanuts; the soaked peanuts were dewatered and spread out on a tray to dry. Fine sand was heated in a pan over a burning fire and the peanuts were added, left to roast for 10minutes with continuous stirring. After roasting, the skins of the peanuts changed from bright red to dull red and the peanuts from white to light brown. The roasted peanuts were spread on a tray to cool in order to stop the cooking process. The skins on the cooled peanuts were removed by rubbing the roasted peanuts between the palms and discoloured and spoilt nuts were removed. Cleaned peanuts were subjected to blending using electric blender (BAJAJ TWISTER MIXER GRINDER) and the peanut butter was packaged in an airtight glass container and stored at ambient temperature. The flow chart for the preparation of the peanut butter is as shown in Figure 1.

Preparation of Biscuits

The mixing ratios of the biscuit formulations were as presented in Table 1 while the biscuit was prepared using the method described by Peter-Ikechukwu *et al.,* (2017). The wheat flour and baking powder were mixed and sifted. Sugar and peanut butter were mixed manually. In a separate bowl, egg and milk flavour with water were mixed and added to the flour-based mixture and kneaded into a dough. The dough was rolled and flattened on a platform using a wooden rolling pin. The dough was cut out into shapes using a cutter and arranged on a greased baking tray for baking. The cut-out dough was baked at 150ºC for 25 min in the oven. After baking, the biscuits were cooled, packed in high -density polyethylene bags (Zip lock bag) and kept at ambient temperature for further analysis. The flow chart for the production of the biscuit is as shown in figure 2.

Table 1: Proportions for the production of biscuits Table 2: Recipe for the production of biscuits

Sample	Wheat flour (%)	Margarine (g)	Peanut butter (g)
BBZ	100	100	-
RMD	100	10	90
OKW	100	20	80
BFB	100	30	70
FMB	100	40	60

Ingredients: Wheat flour= 100 g, Butter= Varied, Peanut butter= Varies, Salt= 0.2 g, Sugar= 5 g, Milk= 15 mL, Eggs= 2 pcs

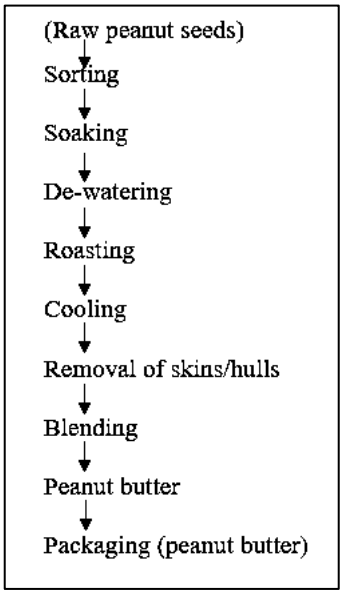


Figure 1: Preparation of peanut butter Source: Olawuni *et al.,* (2019)

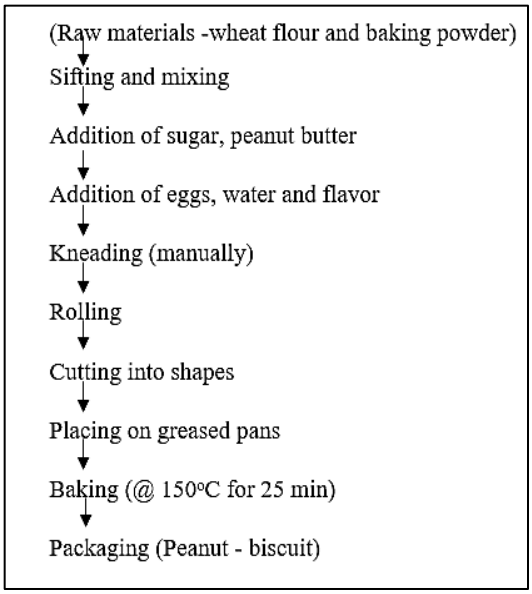


Figure 2: Production of biscuits from wheat flour and peanut butter (Modified method). Source: (Peter-Ikechukwu *et al.,* 2017)

Determination of Chemical Composition of the Biscuit Produced from Wheat flour Substituting Peanut butter as Fat

The moisture content was determined using hot air oven as described by (AOAC, 2005). An empty crucible was weighed and 2 g of sample was transferred into the crucible. This was taken into the hot air oven and dried for 24hours at 100^0C. The crucible and its content were cooled in the dessicators and weight taken. The loss in weight was regarded as moisture content. The protein content, fat content, ash content, fibre content and carbohydrate were determined using the method as described by AOAC (2005).

Determination of Mineral Composition of Biscuit Produced from Wheat flour Substituting Peanut butter as Fat

The mineral contents of the samples were determined by the procedure of AOAC (2005). Calcium, Magnesium, Sodium, Manganese, Zinc, Phosphorus, and Iron contents were determined with Atomic Absorption Spectrophotometer (Thermo scientific S Series Model GE 712354, Sweden) after digesting with perchloric - nitric acid mixture. Prior to digestion, 0.50 g of the samples were weighed into a 125 ml Erlenmeyer flask with the addition of perchloric acid (4 ml), concentrated HNO_3 (25 ml) and concentrated sulphuric acid (2 ml) under a fume hood. The contents were mixed and heated gently in a digester (Buchi Digestion unit K-424) at low to medium heat on a hot plate under perchloric acid fume hood and heating was continued until dense white fume appeared. Heating was continued strongly for half a minute and then allowed to cool followed by the addition of 50 ml distilled water. The solution was allowed to cool and filtered completely with a wash bottle into a Pyrex volumetric flask and then made up with distilled water. The solution was then read on the Atomic Absorption Spectrophotometer.

Determination of Vitamins in Biscuit Produced from Wheat flour Substituting Peanut butter as Fat

Determination of Riboflavin (Vit. B_2)

Fumes of each sample was extracted with 100 milliliters of 50% ethanol solution shaken for 1 hour and was filtered. 10 milliliters of 30% hydrogen peroxide (H_20_2). The mixture was allowed to stand on a steam bath for 30 minutes, after such 2 minutes of Na_2S0_4 solution was added. It was dilated to 50 milliliters with distilled water and its spectrophotometer at 510 nm wavelength. Meanwhile, a standard riboflavin solution was prepared and diluted. The reading was taken with reagent blank at zero, the equation 1 was used to compute the value of Riboflavin.

$$\text{Riboflavin}(\text{mg}/100) = \frac{100 \times Au \times C \times Vf \times D}{W \times A_s V_a} \quad (1)$$

Where, W=weight of sample analyzed, Au = absorbance of the test sample, As = absorbance of the standard solution, Vf = total volume of filtrate, Va= volume of filtrate analyzed, C = concentration of the standard, D = dilution factor where applicable

Determination of Vitamin B_1 (Thiamine)

The method of Onwuka (2005) was used for determining Vitamin B_1. Two (2 g) of sample was weighed out and 50 ml of alcoholic NaOH was added and allowed to stand for few minutes before being filtered out. Ten (10 ml) of filtrate was measured out and 10 ml of potassium dichromate added. The absorbance was read at 430 nm. Calculation of Vitamin B_l as achieve using equation 2:

$$\text{Vitamin Bl} = \frac{100 \times Au \times C \times Vf \times D}{W \times A_s V_a} \quad (2)$$

Determination of Niacin (Vit. B_3)

Five (5 grams) of the sample was treated with 50 millilitres of IN sulphuric acid and shaken for 39 minutes, 3 drop of ammonia solution was added to the sample and filtrate into a 50 millilitres volumetric flask and 5 millilitres of potassium cyanide was added. This was acidified with 5 milliliters of 0.02N sulphuric acid and absorbance was measured in the spectrometer at 470 nm wavelength. A standard niacin solution was prepared and diluted. 10 milliliters of the solution was analyzed as discussed above. The readings were made with reagent blank at zero and equation (3) was used to compute the Niacin value

$$\text{Niacin(mg/100} = \frac{100 \times Au \times C \times Vf \times D}{W \times A_s V_a} \quad (3)$$

Sensory Evaluation

The method described by Iwe , (2002) was use for the sensory analysis. The sensory evaluation of the biscuits was evaluated for texture, taste, aroma, crust colour, crumb colour and general acceptability by a twenty-man panel on a 9-point hedonic scale (1 = extremely dislike, 9 = extremely liked).

Statistical Analysis

The analysis of variance (ANOVA) was performed to examine the significant level in all parameters measured least significant difference (LSD) test was used to separate between all the means. All analysis performed in triplicate (n-3).The level of significance was visible.

RESULTS AND DISCUSSION

Proximate Composition of Biscuits Produced from Wheat Flour Substituted with Peanut Butter as Fat Substitute

The proximate composition of the biscuits is presented in Table 3. Moisture content is very essential for life maintenance and analysis of it is one of the most widely used instruments which determine the way the food was processed and its shelf life (Akinsanmi *et al.,* 2015). Cookies are generally low moisture foods. The value of moisture varied from 7.22-9.35%. The highest value was observed in sample BBZ (*100% butter)* while the lowest value was found in sample BFB *(70% Peanut butter and 30% butter)*.The moisture content reduced with addition of peanut butter. There was significant difference ($p<0.05$) among the samples. Sanni *et al.,* (2006) reported that lowering the moisture content of a product leads to a better shelf stability of such product. Foods with lower moisture content have greater shelf stability since spoilage is often caused by microbial activities and related chemical reactions that require higher moisture levels. The value of moisture in this study is lower than 9.50-12.30% recorded by Singh and Arivuchudar (2018) who worked on formulation and evaluation of peanut flour incorporated cookies.

The value of protein ranged from 3.95-4.25% with sample FMB *(60% Peanut butter and 40% butter)* having the highest value while sample BBZ (*100% butter)* had the lowest value. There was no significant ($p>0.05$) difference among the samples. The protein content of the samples increased with increase in the peanut butter. This indicates that peanut butter is a good source of protein. The high protein content of the samples will be of great importance in reducing protein-energy malnutrition resulting from high cost of animal protein and commonly consumed legumes. The results of the presents study were lower to the results of Farzana & Mohajan (2015) who reported protein content of 17.8% in biscuits prepared from soybean and wheat flour. The results in this present study were lower when compared with 7.75-11.64% protein content reported by Olawuni *et al.,* (2019) who worked on incorporation of peanut butter as substitute for shortening in biscuit production.

Fats are an integral part of cookies being the third largest component after flour and sugar (Manley, 2000). The value of fat ranged from 18.35-26.98%. The highest value was found in sample BBZ (*100% butter)* while the lowest value was observed in sample FMB *(60% Peanut butter and 40% butter)*. The result revealed that the fat content reduced with addition of peanut butter due to incorporation of peanut butter instead of 100 % butter. There was significant ($p<0.05$) difference among the samples. Peanut butter has around 75%-80% unsaturated fats, which is good for the heart (Sadaf *et al.,* 2013). This result is in agreement with results reported by Akubor and Ukmuru (2003) who reported the fat content of the biscuits prepared from wheat and soybean increased from 14.6 to 24.0% with increase in soy bean flour. These fat values in this study were higher than the results of 1.8-4.8 % for biscuits made from millet (Eneche, 1999).

Crude fibre according to Joel and Fagbemi (2014) supports the health of gastrointestinal and metabolic systems in man. The value of fiber ranged from 0.38-1.23% Sample BBZ (*100% butter)* had the highest value while sample OKW *(80% Peanut butter and 20% butter)* had the lowest value. There was significant ($p<0.05$) difference among the samples. Fibre aids in lowering blood cholesterol level and slows down the process of absorption of glucose, thereby helping in keeping blood glucose level in control (Anderson *et al.,* 2009). Olawuni *et al.* (2019) reported fibre content to range from 0.7-2.10% for peanut biscuit. These values were in line with this present study. The value of ash ranged from 1.85-2.40%. The highest value was found in sample FMB *(60% Peanut butter and 40% butter)* while sample BBZ (*100% butter)* had the lowest value. There was significant ($p<0.05$) difference among the samples.

According to Idris (2011), ash content is generally taken to be a measure of the mineral content of the original food. The samples with peanut butter contain high value when compared with the control. This showed that the peanut butter samples might be a good source of minerals. Earlier report had indicated that legumes are good sources of ash (Farzana &Mohajan,2015). However, the results in this present study were lower than 17.77-21.15% recorded by Nour (2021). The value of carbohydrate ranged from 56.65-66.40%. The highest value was recorded in sample FMB *(60% Peanut butter and 40% butter)* while the lowest value was found in sample BBZ (*100% butter)*. There was significant difference ($p<0.05$) among the samples. The carbohydrate content increased with the addition of peanut butter. The high carbohydrate contents of the samples favours better production of energy in meeting the daily activities. The value of carbohydrate in this study was similar when compared with (67.84-69.82%) for biscuits samples prepared from peanut butter (Olawuni *et al.*, 2019).

Table 3: Proximate Composition of Biscuits Produced from Wheat Flour Substituted with Butter as Fat Substitute

Sample	Moisture (%)	Protein (%)	Fat (%)	Fiber (%)	Ash (%)	Carbohydrate (%)
BBZ	$9.35^{a}\pm0.08$	$3.95^{a}\pm0.21$	$26.98^{a}\pm0.70$	$1.23^{a}\pm0.08$	$1.85^{b}\pm0.07$	$56.65^{c}\pm0.97$
RMD	$7.55^{d}\pm0.07$	$4.00^{a}\pm0.14$	$20.83^{bc}\pm0.45$	$0.39^{c}\pm0.08$	$2.25^{a}\pm0.07$	$64.98^{ab}\pm0.24$
OKW	$8.54^{b}\pm0.13$	$4.05^{a}\pm0.21$	$19.83^{cd}\pm1.09$	$0.38^{c}\pm0.04$	$2.25^{a}\pm0.07$	$64.96^{ab}\pm1.12$
BFB	$7.22^{e}\pm0.11$	$4.05^{a}\pm0.07$	$21.94^{b}\pm0.09$	$0.92^{b}\pm0.04$	$2.35^{a}\pm0.07$	$63.53^{b}\pm0.06$
FMB	$8.14^{c}\pm0.13$	$4.25^{a}\pm0.07$	$18.35^{d}\pm0.07$	$0.46^{c}\pm0.15$	$2.40^{a}\pm0.14$	$66.40^{a}\pm0.11$

Means with the same superscript in a column are not significantly difference (P>0.05). KEY: Sample BBZ: 100% Butter; Sample RMD: 90% Peanut butter and 10% Butter; Sample OKW: 80% Peanut butter and 20% Butter; Sample BFB: 70% Peanut butter and 30% Butter; Sample FMB: 60% Peanut butter and 40% Butter

Mineral Content of Biscuits Produced from Wheat Flour Substituted with Peanut Butter as Fat Substitute

The mineral content of the biscuits is as shown in Table 4. The value of potassium and calcium ranged from 27.50-45.00 mg/100g and 202.50-237.50 mg/100g respectively. The highest value was found in sample FMB *(60% Peanut butter and 40% butter)* while the lowest value was recorded in sample BBZ (*100% butter)*. There was significant difference ($p<0.05$) among the samples. The value of potassium and calcium increased with increase in the level of peanut butter. The U.K. Department of Health recommended intake of 1000 mg/day of calcium for adult and 550 mg/day for infants and children (Pravina *et al.,* 2013). Calcium helps in the formation of bones and also provides support and rigidity to skeletal bones (Pravina *et al.,* 2013). Singh and Arivuchudar, (2018) who worked on formulation and evaluation of peanut flour incorporated cookie recorded the calcium value which ranged from 29.00-65.28 mg/100g which is lower than this present results. The value of magnesium varies from 47.50-67.75 mg/100g. The highest value was obtained in sample BFB *(70% Peanut butter and 30% butter)* while the lowest value was found in sample BBZ (*100% butter)*. There was significant difference ($p<0.05$) among the samples. The value of iron varies from 7.45-9.25 mg/100g with sample OKW *(80% Peanut butter and 20% butter)* having the highest value while sample RMD *(90% Peanut butter and 10% butter)* had the lowest value. There was significant difference ($p<0.05$) among the samples. Iron is an essential trace element which plays vital roles such as hemoglobin formation and oxidation of fats, protein and carbohydrates (Mlitan *et al.,* 2014). The WHO (2005), daily recommended intake of iron for children (6-59 months) is 5.8 mg/100g. The value of phosphorus ranged from 160.00-195.00 mg/100g.The highest value was found in sample FMB *(60% Peanut butter and 40% butter)* while the lowest value was observed in sample BBZ (*100% butter)*. There was significant difference ($p<0.05$) among the samples. The phosphorus content increased with the addition of peanut butter. The value of sodium varies from 262.50-287.50 mg/100g. Sample OKW and FMB *(60% Peanut butter and 40% butter)* had the highest value while sample RMD *(90% Peanut butter and 10% butter)* had the lowest value. There was significant difference ($p<0.05$) among the samples. Sodium is a vital mineral that regulates fluid balance in the body and also in the proper functioning of muscles and nerves. High sodium content in the body has been associated with high blood pressure in the body (Olusanya, 2008). The value of sodium in this study compares favourably with 220-640 mg/100g recorded by Mcwatters, (2009) for formulated and commercial peanut crackers.

Vitamin Composition of Biscuits Produced from Wheat Flour Substituted with Peanut Butter as Fat Substitute

The vitamin composition of the biscuits is presented in Table 5. The value of ascorbic acid ranged from 4.80-5.30 (mg/100g). The highest value was found in sample FMB *(60% Peanut butter and 40% butter)* while the lowest value was found in sample RMD *(90% Peanut butter and 10% butter)*. Sample RMD *(90% Peanut butter and 10% butter)* was significantly ($p<0.05$) different from other samples. Presence of vitamin C provides antioxidants which help the body to develop resistance against infectious agents and the production of collagen which provides elasticity to the skin and nourishment to the hair (WHO, 2004). The value of vitamin B_1 ranged from 0.09-0.15 with sample BFB having the highest value while sample OKW *(80% Peanut butter and 20% butter)* had the lowest value. There was significant difference ($p<0.05$) among the samples. The value of vitamin B_2 ranged from 0.18-0.22 with sample FMB *(60% Peanut butter and 40% butter)* having the highest

value while sample BBZ had the lowest value. The result showed that the vitamin B_2 slightly increased with increasing level of peanut butter. There was significant difference ($p<0.05$) among the samples. Vitamin B_1 (Thiamine) and Riboflavin (Vitamin B_2) are energy-releasing water-soluble vitamins since they are the precursor of co-enzymes, thiamine pyro-phosphate (TPP) and flavine adenine dinucleotide (FAD) respectively (Ebuehi *et al.,* 2007). TPP is required for decarboxylation reactions in the degradation of carbohydrates, and assists in the biosyntheses of antibodies and some amino acids (Ebuehi *et al.,* 2007). The value of vitamin B_1 and B_2 in this study was similar when compared with vitamin B_1 and B_2 which ranged from 0.12-0.32 and 0.07-0.12 respectively by Singh and Arivuchudar, (2018) who worked on formulation and evaluation of peanut flour incorporated cookies. The value of Vitamin B_3 varies from 1.73-1.83. The highest value was recorded in sample BFB *(70% Peanut butter and 30% butter)* while the lowest value was found in sample BBZ (*100% butter)*. There was significant difference ($p<0.05$) among the samples. The result showed that the peanut butter samples had higher values when compared with the control.

Table 4: Mineral Content of Biscuits Produced from Wheat Flour Substituted with Peanut Butter as Fat Substitute

Sample	Potassium (mg/100g)	Calcium (mg/100g)	Magnesium (mg/100g)	Iron (mg/100g)	Phosphorus (mg/100g)	Sodium (mg/100g)
BBZ	$27.50^{b}\pm3.54$	$202.50^{b}\pm3.54$	$47.50^{c}\pm3.54$	$7.85^{c}\pm0.07$	$160.00^{d}\pm7.07$	$267.50^{b}\pm3.54$
RMD	$32.50^{b}\pm3.54$	$212.50^{b}\pm3.54$	$52.50^{c}\pm3.54$	$7.45^{d}\pm0.07$	$162.50^{cd}\pm3.54$	$262.50^{b}\pm3.54$
OKW	$37.50^{ab}\pm3.54$	$230.00^{a}\pm7.07$	$62.50^{ab}\pm3.54$	$9.25^{a}\pm0.07$	$187.50^{ab}\pm3.54$	$287.50^{a}\pm10.61$
BFB	$45.00^{a}\pm7.07$	$235.00^{a}\pm7.07$	$67.75^{a}\pm3.89$	$8.60^{b}\pm0.14$	$175.00^{bc}\pm7.07$	$272.50^{ab}\pm3.54$
FMB	$45.00^{a}\pm0.00$	$237.50^{a}\pm3.54$	$55.00^{bc}\pm0.00$	$9.05^{a}\pm0.07$	$195.00^{a}\pm0.00$	$287.50^{a}\pm3.54$

Means with the same superscript in a column are not significantly difference (P>0.05). KEY: Sample BBZ: 100% Butter; Sample RMD: 90% Peanut butter and 10% Butter; Sample OKW: 80% Peanut butter and 20% Butter; Sample BFB: 70% Peanut butter and 30% Butter; Sample FMB: 60% Peanut butter and 40% Butter

Table 5: Vitamin Compositions of Biscuits Produced from Wheat Flour Substituted with Peanut Butter as Fat Substitute

Sample	Ascorbic acid (mg/100g)	Vitamin B_1 (mg/100g)	Vitamin B_2 (mg/100g)	Vitamin B_3 (mg/100g)
BBZ	$5.25^{a}\pm0.07$	$0.13^{ab}\pm0.01$	$0.18^{b}\pm0.01$	$1.73^{b}\pm0.01$
RMD	$4.80^{b}\pm0.00$	$0.11^{c}\pm0.01$	$0.19^{b}\pm0.01$	$1.77^{b}\pm0.01$
OKW	$4.85^{a}\pm0.07$	$0.09^{c}\pm0.01$	$0.19^{b}\pm0.01$	$1.82^{a}\pm0.02$
BFB	$5.15^{a}\pm0.07$	$0.15^{a}\pm0.01$	$0.21^{ab}\pm0.01$	$1.83^{a}\pm0.01$
FMB	$5.30^{a}\pm0.14$	$0.11^{bc}\pm0.00$	$0.22^{a}\pm0.01$	$1.77^{b}\pm0.02$

Means with the same superscript in a column are not significantly difference (P>0.05). KEY: Sample BBZ: 100% Butter; Sample RMD: 90% Peanut butter and 10% Butter; Sample OKW: 80% Peanut butter and 20% Butter; Sample BFB: 70% Peanut butter and 30% Butter; Sample FMB: 60% Peanut butter and 40% Butter

Sensory Scores of Biscuits Produced from Wheat Flour Substituted with Peanut Butter as Fat Substitute

The sensory scores of the biscuits are presented in Table 6. The taste ranged from 7.50-8.70%. Sample FMB *(60% Peanut butter and 40% butter)* had the lowest value while sample BBZ (*100% butter)* had the highest value. There was significant ($p<0.05$) difference between samples. The colour ranged from 5.70 - 7.10%. Sample BFB *(70% Peanut butter and 30% butter)* had the lowest value while sample BBZ (*100% butter)* had the highest value. There was significant difference ($p<0.05$) among the samples. The appearance ranged from 7.90 - 8.90%. Sample RMD *(90% Peanut butter and 10% butter)* had the lowest value while sample OKW *(80% Peanut butter and 20% butter)* had the highest value. There was no significant difference ($p>0.05$) among the samples. The values obtained in this research work showed that all the samples are acceptable by the panelists. The texture ranged from 8.10 - 8.80%. Sample FMB *(60% Peanut butter and 40% butter)* had the lowest value while sample RMD *(90% Peanut butter and 10% butter)* had the lowest value. There was no significant difference ($p>0.05$) among the samples. The values obtained in this research showed that all the samples are preferred by the panelists. The overall acceptability ranged from 7.60 - 8.00%. Sample BFB *(70% Peanut butter and 30% butter)* had the lowest value while samples RMD *(90% Peanut butter and 10% butter)* and BBZ (*100% butter)* had the highest value. There was no significant difference ($p>0.05$) in samples. All samples compare favourably with the control.

Table 6: Sensory Scores of Biscuits Produced from Wheat Flour Substituted with Peanut Butter as Fat Substitute

Sample	Taste	Colour	Appearance	Texture	Overall Acceptability
OKW	$8.70^{ab}\pm0.67$	$6.20^{ab}\pm0.92$	$8.90^{a}\pm0.88$	$8.70^{a}\pm1.06$	$7.90^{a}\pm0.99$
BFB	$8.00^{bc}\pm1.33$	$5.70^{b}\pm1.34$	$8.00^{a}\pm0.82$	$8.30^{a}\pm0.95$	$7.60^{a}\pm0.70$
RMD	$8.60^{ab}\pm0.84$	$6.80^{a}\pm0.79$	$7.90^{a}\pm1.29$	$8.80^{a}\pm1.03$	$8.00^{a}\pm0.82$
BBZ	$9.10^{a}\pm0.88$	$7.10^{a}\pm0.88$	$8.50^{a}\pm1.08$	$8.30^{a}\pm1.06$	$8.00^{a}\pm1.25$
FMB	$7.50^{c}\pm1.27$	$5.90^{ab}\pm1.37$	$8.32^{a}\pm1.13$	$8.10^{a}\pm0.99$	$7.70^{a}\pm1.16$

Means with the same superscript in a column are not significantly difference (P>0.05). KEY: Sample BBZ: 100% Butter; Sample RMD: 90% Peanut butter and 10% Butter; Sample OKW: 80% Peanut butter and 20% Butter; Sample BFB: 70% Peanut butter and 30% Butter; Sample FMB: 60% Peanut butter and 40% Butter

CONCLUSION AND RECOMMENDATIONS

The results of the findings showed that the protein, ash and carbohydrate content of the biscuits increased with increase in the level of peanut butter inclusion. With respect to mineral content, the potassium, calcium, magnesium and phosphorus also increased. All the samples contained appreciable amounts of vitamins. The scores for sensory attributes like taste, colour, appearance, texture and overall acceptability were generally acceptable. Conclusively, inclusion of peanut butter does not only enhance the nutritional and mineral content of the biscuits,which can impact health benefit by preventing degenerative disease. Biscuits produced from wheat flour substituting peanut butter as fat were acceptable based on the nutritional composition and sensory evaluation. However, further research work should be carried out on the textural profile analysis and shelf stability of the biscuits.

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Author's Contributions

Authors: ATA, BAZ, OAO & BOT managed data collection, interpretation of data, writing of manuscript, material support, and review of manuscripts and wrote the first draft of the manuscript. "ATA; BAZ and data analysis, and the development of the model. All authors read and approved the final manuscript.

Ethical Statement

Not applicable.

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