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Incorporation of Peanut Butter as Substitute for Shortening in Biscuit Production.

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Abstract: *The production and evaluation of biscuits produced by the incorporation of peanut butter as substitute for shortening in biscuit was studied. Biscuit samples were prepared with margarine (fat) substituted with peanut butter (PB) in ratios; BSA (100:0), BSB (75:25), BSC (50:50), BSD (25:75) and BSE (0:100) where BSA was the control. The standard method of biscuit preparation was adopted. Proximate and Physical analysis were carried out on the biscuit samples produced to determine their qualities and the data obtained were analyzed statistically using ANOVA and Fisher's LSD was used to separate the means. Proximate analysis showed that moisture content increased from 0.5 to 2.63%, crude fibre increased from 0.7 to 2.1%, ash content increased from 1.03 to 2.77% and protein content increased from 7.75 to 11.64% while fat content and carbohydrate decreased progressively with increasing levels of peanut butter substitution from 20.20 to 13.02% and 69.82 to 67.84% respectively. The weight of the biscuit increased with increase in peanut butter substitution.*

Keywords: *Biscuits, peanut butter, Shortenings, Sensory properties, proximate composition, Physical Properties.*

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I. Introduction

Biscuits are ready-to-eat, convenient and cheap snacks that are consumed by all age group in many countries (Adebowale*et al.*, 2012). The word 'Biscuit' was derived from theLatin word 'Biscoctus', meaning twice cooked (Macrace*et al*., 1993). They are wheat based food product; the wheat variety commonly used for biscuit is the soft type. 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,water while other ingredients such as milk, aeratingagent, 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 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 and Okafor 2015).

The word 'Fat' refers to the lipid food group, and is used to mean both fats and oil. Fat is an essential part of diet, the taste of baked products depend greatly on the flavour of the fat. The fat used imparts flavor, texture and appearance of the baked product (Pyler, 1988). It is an important ingredient used to raise energy density in formulation of fortified blended foods for vulnerable population (Islamiya*et al.*, 2016). On the other hand, excess intake of fat in diet may lead to higher risk of diseases/disorders like obesity, coronary heart disease and cancer (Akoh, 1988). As biscuits are typically higher in fat content, it becomes difficult to prepare biscuits by reducing fat contents in their formulation to lower the risk of such diseases. To reduce the amount of fat in bakery products, fat replacers from plant origin like peanut butter are used (Sanchez *et al.*, 1995).

Peanut (*Arachishypogaea 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 canbe processed into different forms suchas peanut

butter, peanut flour, peanut oil, candy, chocolate, cake and others. Peanuts vary in colour from red to brown and are usually coarse in appearance.

It is estimated that as much as 30% of the population from many countries in the world are suffering from malnutrition (FAO, 2000). In many African countries, often deaths are reported as due to malnutrition and they would possibly be prevented by providing a protein rich diet (Sanghvi and Murray, 1997). Peanut and peanut added foods could provide such a nutritious diet. The World Health Organization recommended an average requirement of 0.66g of protein per kg of ideal body weight, and a 'safe level' of 0.86g/kg of body weight. (Food and Nutrition Board, 2002). Peanuts contain more plant protein than any other legume or nut. Peanuts, which are a rich source of protein and essential amino acids, can help in preventing malnutrition (Pelto and Armar-Klemesu, 2011). Moreover, peanuts contain lipids and carbohydrates which are energy rich compounds, capable of complementing the basic energy demands of the human body (Settaluri*et al.,* 2012). Peanut is one of the most widely used legumes due to its nutrition and taste, and it occupies a rank of major oilseed crop in the world. In the production of peanut butter, peanuts are roasted, blanched and sorted before grinding into a creamy consistency. Peanut butter contains aminimum of 90% peanuts, sweeteners and salt can be added to enhance flavor while small amounts of stabilizers are used to prevent oil separation (APC, 2011).

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 organolepticproperties of the baked products.

Theobjective of this research is aimed at the incorporation of peanut butter as substitute for shortening in biscuits, determination of the functional properties and proximate composition of the biscuit produced. Nevertheless, biscuits are important snacks consumed in most parts of the world by both adults and children. Coronary heart disease, obesity and cancer have been implicated with excess intake of fat in diet (Akoh, 1998). Biscuits typically contain around 22-30% fat (Farheena*et al.,* 2015) which make 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 peanut butter while creating a new marketing nitch for the production of peanut butter.

II. Materials and Methods

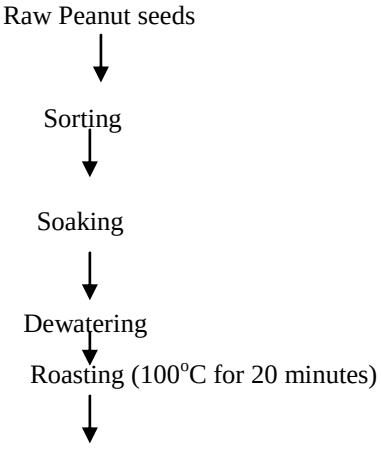
Source of materials

The baking materials were purchased from local market in Ihiagwa, Owerri in Imo State while the Chemicals and equipmentsused were obtained from Food Science and Technology department Laboratory and Biochemistry department laboratory both in Federal University of Technology Owerri, Imo State.

Peanut Butter Preparation

The peanut butter was prepared according to Woodroof (1983). The purchased peanuts were graded and sorted to remove damaged nuts and dirt. 1000g of the sorted peanuts were soaked with 52g of salt for 20minutes. Water was added to cover the peanuts, the soaked peanuts were dewatered andspread out on a tray to dry. Fine sand was heated in a pan over 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 grinding in a roller mill and the peanut butter was packaged in an airtight glass container and stored at ambient temperature.

Raw Peanut seeds



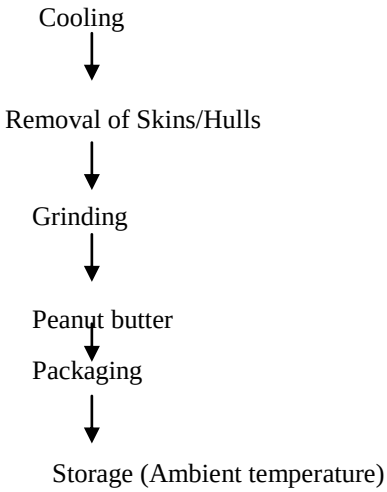


Figure 1: Flow diagram for the production of Peanut butter

Fat Formulation Ratios

Biscuits were prepared using the Rubbing in method (Peter-Ikechukwu*et al.,* 2016) with margarine (fat) substituted with peanut butter (PB) in the following ratios 100:0, 75:25, 50:50, 25:75, 0:100.

Table 1: Fat Formulation Ratios

Samples	**Margarine (Fat)**	**Peanut butter(PB)**
BSA	100	0
BSB	75	25
BSC	50	50
BSD	25	75
BSE	0	100

The ratio of Margarine to butter is shown as follows: BSA=100: 0 (Control), BSB=75: 25, BSC=50: 50, BSD=25: 75, BSE=0: 100.

Production of Biscuit

100% refined wheat flour and 0.5% baking powder were mixed and sifted. 35% granulated sugar and margarine/peanut butter (as per treatment) was mixed, the mixing was done manually.In a separate bowl, egg, vanilla and milk flavours 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 to a thickness of 3.5mm 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 were baked at 150^{o}C for 25 minutes in the oven (Peter-Ikechukwu, *et al*., 2016). After baking, the biscuits were cooled and packed in low density polyethene bags and kept at ambient temperature for 24hours before analysis.

Raw materials (Wheat flour and Baking powder)

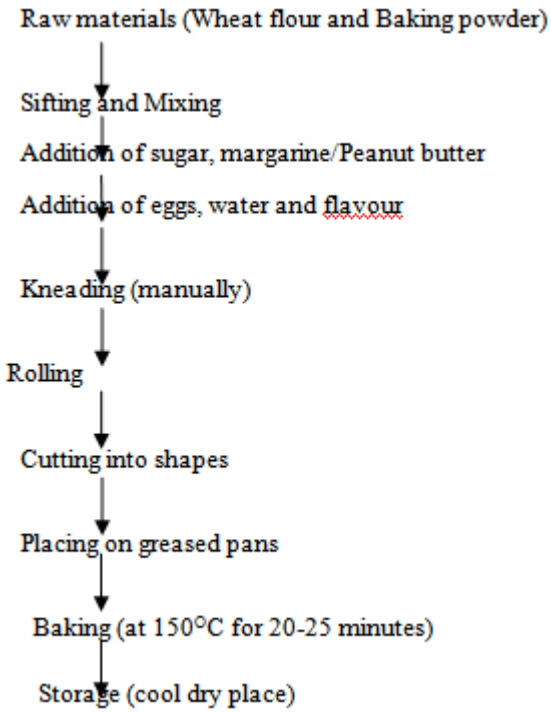


Fig 2: Flow diagram for the production of Biscuits

Plate .1 Control BSA (100:0)

Plate 2 BSB (75:25)

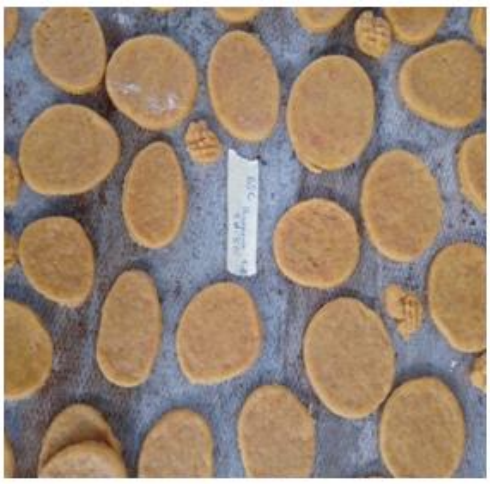


Plate 3.3: BSC (50:50)

Plate 3.4: BSD (25:75)

Plate 3.5: BSE (0:100)

Evaluation of the Physical Properties of Biscuits

Determination of Diameterand the weight of the Biscuit samples

The modified method according to Ayo *et al*., (2007) was used to determine the diameter and the weights of biscuits respectively.The biscuit diameter was determined by measuring each biscuit unit randomly picked using a vernier caliper and the average taken while the weights were determined by randomly picking and weighing on electronic weighing balance and the mean weights were recorded.

Determination of Biscuit spread ratio

The spread ratio was determined using the method of Gomez *et al*., (2007). Three rows of well-formedbiscuits were made and the height measured. Also, the same biscuits were arranged

Determination of thickness of Biscuit

The method according to MacWalter*et al*., (2003) was used. The thickness of cookies was measured using vernier caliper which placed horizontally across the cookies, followed by duplicate reading.

Statistical Analysis

The data obtained was subjected to the analysis of variance (ANOVA) using Microsoft excel package 2007 and the treatment means separated using fisher's least significant difference (LSD) test.

III. Result and Discussion

Proximate Properties of the Biscuit Samples

The result of the proximate properties of the biscuit samples are shown in Table 2.0.

Moisture Content

The moisture content of the biscuit samples ranged from 0.5% to 2.63%. BSE had the highest moisture content of 2.63% followed by BSD with 2.0%, BSC with 1.5%, BSB with 0.83% and BSA had the least moisture content of 0.5%. The data indicated that the moisture content progressively increased with increasing levels of peanut butter in biscuits. There was significant difference between the biscuit samples ($p<0.05$).Sudha*et al*., (2007) reported that gradual increase in moisture content of biscuits with the increase of peanut supplementation might be attributed to higher amount of fibre in peanut butter and that fibre has strong affinity for water and products containing fibre. Baked products with low moisture content would have extended shelf life. (Ayo *et al.*,2007). Packaging in airtight container would ensure a longer shelf life for the biscuit.

Ash Content

Ash content is an indication of the mineral content of a food sample. The ash content of the biscuit samples increased with increasing peanut butter substitution in the biscuit.The ash content of the biscuit samples ranged from 1.03% to 2.77%. BSE had ash content of 2.77%, BSD had 2.2%, BSC had 1.73%, BSB had 1.2% and BSA having the least ash content of 1.03%. There was significant difference between BSC, BSD and BSE, however, BSA and BSB showed no significant difference ($p<0.05$). Legumes have been reported to be good sources of ash (Alabi and Anuonye, 2007).

Fat Content

The fat content of the biscuit samples decreased progressively with the increasing levels of peanut butter. BSA had the highest fat content of 20.3%, followed by BSB with 17.43%, BSC with 13.47%, BSD with 11.33% and BSE had the least fat content of 8.4%. The biscuit samples showed significant difference ($p<0.05$). Peanut butter has around 75%-80% unsaturated fats, which is good for the heart. (Sadaf*et al.,* 2013). These

findings are in accordance with the findings of Sadaf*et al.,* (2013). It is beneficial for the patients of hypertension since it is a low calorie diet. Hence, with increasing levels of peanut butter as a substitute for hydrogenated vegetable shortening, the fat content of biscuit decrease which is good for health.

Protein Content

It was observed from the data that protein content gradually increased with increasing levels of peanut butter in biscuits. The values ranged from 7.75 to11.64. The increase in the protein content of the biscuit is due to the significant quantity of protein in peanut butter. Peanut butter has been reported to be a good source of cheap protein. (Pelto and Armar-Klemesu, 2011). The findings are in accordance with the findings of Sadaf*et al.* (2013) who observed that protein content increased progressively as substitution of hydrogenated vegetable shortening with peanut butter increased. Regular consumption of this biscuit by children and adults could help increase their protein intake.

Table 2: Proximate Composition of the Biscuit Samples

Samples	Moisture content (%)	Fat (%)	Crude Fibre (%)	Ash (%)	Protein (%)	Carbohydrate (%)
BSA	0.50 ± 0.10^{e}	20.20 ± 0.07^{a}	0.7 ± 0.20^{c}	1.03 ± 0.21^{d}	7.75 ± 0.07^{a}	69.82 ± 0.08^{a}
BSB	0.83 ± 0.15^{d}	19.02 ± 0.01^{b}	1.17 ± 0.15^{b}	1.20 ± 0.20^{d}	9.26 ± 0.06^{b}	68.52 ± 0.03^{b}
BSC	1.50 ± 0.10^{c}	17.43 ± 0.06^{c}	1.20 ± 0.20^{b}	1.73 ± 0.25^{c}	10.0 ± 0.06^{c}	68.14 ± 0.08^{c}
BSD	2.0 ± 0.20^{b}	15.09 ± 0.09^{d}	1.87 ± 0.21^{a}	2.20 ± 1.70^{b}	10.84 ± 0.06^{d}	68.00 ± 0.06^{d}
BSE	2.63 ± 0.15^{a}	13.02 ± 0.06^{e}	2.1 ± 0.26^{a}	2.77 ± 0.20^{a}	11.64 ± 0.03^{e}	67.84 ± 0.01^{e}
LSD	0.2058	0.0731	0.2933	0.2956	0.0902	0.0992

Values are duplicate mean± standard deviation. Samples with different superscripts within the same column were significantly different($p<0.05$).

The ratio of Margarine to butter is shown as follows: BSA=100: 0 (Control), BSB= 75: 25, BSC= 50: 50, BSD= 25: 75, BSE= 0: 100.

Crude Fibre content

The values for crude fibre ranged from 0.7-2.1% with BSA having he least value and BSE having the highest value. There was significant difference between the biscuit samples, however, BSB with 1.17 and BSC with 1.20 did not differ significantly likewise BSD with 1.87 and BSE with 2.1. The increase is due to the increase in the substitution of margarine with peanut butter. This result was comparable to that of Sadaf*et al*., (2013) who reported an increase in crude fibre content with increase in peanut butter substitution.

Carbohydrate content

There was a decrease in the carbohydrate content as the substitution rate increased. The carbohydrate content ranged from 67.84-69.82% with BSA having the highest value and BSE having the least value. There was significant difference between allthebiscuit samples ($p<0.05$).

Physical Properties of Biscuit Samples

The result of the physical properties of the biscuit samples are shown in Table 3.0

Table 3.0: Physical Properties of the biscuit samples.

Samples	SpreadRatio (SR)	Thickness(cm)	Diameter(cm)	Weight(g)
BSA	1.82 ± 0.03^{b}	0.99 ± 0.55^{a}	5.52 ± 0.17^{a}	14.07 ± 1.60^{bc}
BSB	2.24 ± 0.16^{a}	0.82 ± 0.32^{a}	5.68 ± 0.57^{a}	16.30 ± 0.89^{b}
BSC	1.68 ± 0.09^{b}	1.04 ± 0.00^{a}	5.36 ± 0.30^{a}	$18.531.66^{a}$
BSD	1.78 ± 0.11^{b}	0.88 ± 0.11^{a}	5.21 ± 0.22^{a}	19.87 ± 1.29^{a}
BSE	1.65 ± 0.09^{bc}	1.24 ± 0.09^{a}	5.68 ± 0.57^{a}	20.22 ± 0.56^{a}
LSD	0.15			1.71

Values are duplicate mean± standard deviation. Samples with different superscripts within the same column were significantly different. ($p<0.05$).

Samples BSA=100% Margarine: 0% Peanut Butter (Control), BSB= 75% Margarine: 25% Peanut Butter, BSC= 50% Margarine: 50% Peanut Butter, BSD= 25% Margarine: 75% Peanut Butter, BSE= 0% Margarine: 100% Peanut Butter

Spread Ratio

The spread ratio was found to be the highest in BSB (2.24) while BSE had the lowest spread ratio (1.65). There was significant difference between BSB and all other biscuit samples while there were no significant differences among BSA, BSC, BSD and BSE ($p<0.05$).

Thickness

BSE had the highest thickness value of 1.24 and BSB had the least thickness value of 0.82. the results obtained therefore showed that there was no significant difference between all the biscuit samples ($p>0.05$).

Diameter

BSB and BSE had the highest diameter value of 5.68 while BSD had the least diameter value of 5.21. The results indicated that there were no significant differencesamong all the values ($p>0.05$)

Weight

The weight of the biscuit sample was highest in BSE (20.22g) and least value was scored by BSA (14.07g). Weight may be attributed to the packed bulk density of peanut butter. There was no significant difference between BSC, BSD and BSE, there was significant difference between BSC, BSD, BSE, BSB and control (BSA) ($p<0.05$). weight however is dependent on the overall aggregates or components of food samples (Apotiola, et al., 2013)

IV. Conclusion and Recommendation

Conclusion

Incorporating peanut butter as substitute for shortening in the production of biscuits had remarkable effects on its proximate composition. Hence, it was found out that there is increased protein content, ash content, crude fibre content and moisture content but reduced fat content and carbohydrate content and as a result, Chas helped to improve the nutritional composition of biscuit while reducing saturated fat with unsaturated fatty acids present in peanut butter.

The physical properties carried out such as spread ratio, thickness, diameter and weight showed that biscuits peanut butter had higher weight value than the control. Thickness and diameter were comparable to the control.

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