EFFECTS OF BUTYLATED HYDROXY TOLUENE ON THE KEEPING QUALITY OF *KULIKULI*, A NIGERIAN SNACK.

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ABSTRACT

The effect of butylated hydroxy toluene (BHT), a synthetic antioxidant at different concentrations on the keeping quality of the groundnut snack was studied. Groundnut seeds were sorted, roasted, dehulled, winnowed and milled into a paste. The paste (2000 g) was then spiced with onion (65.3 g), pepper (20.3 g) and salt (39.4 g). To the paste, 400 mile of distilled water was added and the mixture was properly kneaded and pressed manually for oil extraction. After oil extraction, the resultant cake was weighed and divided into five equal portions (400 g each). To each portion of the cake 100 ppm, 150 ppm, 200 ppm, 250 ppm and 300 ppm butylated hydroxy toluene were added and properly mixed representing samples A, B, C, D and E respectively. The cake was shaped into cylindrically of nearly uniform thickness and deep fried until hard, crunchy, hard and dry brown snack. After drying, the snacks were cooled and packaged in a plastic container and stored at room temperature until need for analysis. The quality indices studied include peroxide value, free fatty acid, saponification value and sensory attributes. The result of the study showed that there was decrease levels of peroxide value, free fatty acid and saponification value with increased level of butylated hydroxy toluene over the storage period. For sensory attributes, all the parameters measured were not significantly influenced by different levels of butylated hydroxy toluene. Therefore, synthetic antioxidant investigated can be used at higher concentrations 200, 250 and 300 ppm for deterioration free groundnut snack production.

KEYWORDS: Groundnut, paste, cake, snack, free fatty acid, peroxide value, saponification.

INTRODUCTION

Groundnut based local snack, *kulikuli* is a common snack in West Africa such as Ghana, Togo, Nigeria among others. The snack is popular in Northern part of Nigeria and it production and processing are mainly carried out by women as a source of income (Emelike and Akus, 2018; Desai *et al*., 1996). The local snack is made from ground dry roasted groundnut (paste). Spices such as powdered pepper and other ingredients such as salt, sugar, onion are added to the paste and properly mixed together prior to frying. The paste is stripped of excess oil and the resulting cake is moulded into different shapes. The oil extracted from the paste is then heated to fry the shaped cake until it solidifies, hard, crunchy and allowed to cool before packaging in nylon or plastic containers or glass container (Desai *et al*., 1996; Adebesin *et al*., 2001).

The local snack is a good source of protein, fat, crude fibre, minerals as well as some B-group vitamins (Aletor and Ojelabi, 2007; Oladimeji and Kolapo, 2008). Due to high protein content of the snack, it makes it suitable as supplements for carbohydrates foods such as *gari* and pap. Ground form of the snack is seasoned with spices and used in the production of local meat snack called 'kilishi'. Furthermore, the snack is commercially used as a protein source in formulating feed for livestock (Akano and Atanda, 1990).

Deep-fat-frying of the cake affects the quality of the oil as well as that of the fried snack. It leads to the hydrolysis of poly unsaturated fatty acids and destruction of vitamin E which is a natural anti-oxidant. Degradation of the oil makes it susceptible to lipid oxidation (Damame *et al*., 1990). This limits the shelf life and storage stability of both the oil and the fried snack. Furthermore, lipid oxidation reactions are accelerated by high temperature, presence light and oxygen exposure (Fontanella, 2015). The reactions in the snack lead to rancidity which shortens the shelf life and affects storage stability, texture and brings about off-flavour development and these affect the processing of the snack in commercial scale.

The development of rancidity in snacks can be eliminated by the use of food additives, especially anti-oxidants such as butylated hydroquinone (TBHQ), butylated hydroxy toluene (BHT), butylated hydroxy anisole (BHA) (Fontanella, 2015). The anti-oxidants aero usually added in low concentration (Halliwell and Gutteridge, 1995). Therefore, this study is designed to assess the effective dosage of

butylated hydroxy toluene on the keeping quality of *kulikuli* snack.

MATERIALS AND METHODS

Sources of raw materials

Groundnut, onion, salt and pepper (powdered form) were gotten from Minna, Niger State and the anti-oxidant (butylated hydroxy toluene) from Ilorin, Kwara State.

Production of groundnut snack

Groundnut was manually sorted to remove extraneous materials. Sorted groundnut was then roasted in the laboratory in electric roasting machine at 100°C for 10 min. and allowed to cool at room temperature for 30 min. De-hulling and winnowing were carried out manually to remove the skin. Winnowed dahls were milled in to a paste using an electric grinding machine. To 2.2 kg of the paste, 20.30 g of powdered pepper, 20.30 g salt and 65.3 g onion were added and thoroughly mixed in a laboratory blender. Oil extraction was carried out via wet oil extraction method by adding 400 ml of distilled water, followed by stirring, kneading and pressing the mixture until oil separates. After the oil extraction, the cake was then weighed (2000 g) and divided into 5 equal parts (400 g each). Butylated hydroxy toluene (BHT) (antioxidant) was added to each part at the following concentrations 100 ppm, 150 ppm, 200 ppm, 250 ppm and 300 ppm and properly mixed representing samples A, B, C, D and E respectively. The cake shaping was carried out manually to flat rounded shape. The shaped cakes were then dip-fried in the oil at 130°C for 5 min to harden and make the snacks crunchy. Fried snacks were allowed to cool at room temperature (27 $\pm$ 0.2°C) for 10 min and packaged in high density polyethene sac and kept at room temperature for the duration of the study.

Methods

Free fatty acid

This was determined as described by (AOAC, 2005). Neutral solvent was prepared by adding 190 ml of ethanol to 10 ml of distilled water and 200 ml of ether. 50 ml of neutral solvent was added to 1 g of the sample. Three drops of indicator (1% phenolphthalein) and the mixture was thoroughly shaken and titrated with potassium hydroxide (0.1 N) until pink colour persisted for 15 seconds. Free fatty acid was carried out at intervals of two weeks for two months duration and calculated thus:

$$\text{FFA} = \frac{\text{Titre (ml)} \times 5.61}{\text{Weight of sample used}}$$

Peroxide value

This was determined as described by AOAC (2005). Acetic acid and chloroform were added together in ratio 2:1 and twenty five (25) mile of the mixture was added to 1 g of the test sample. One (1) mile of potassium iodide was immediately added to the mixture and kept in a dark place for 10 minutes. After which 30 ml of distilled water and 1 ml of starch were added and then shaken. The mixture was titrated with sodium thiosulphate (0.002 N). The peroxide value was determined at intervals of two weeks for two months. The peroxide value is often reported as number of ml of 0.002 N (M) sodium thiosulphate per g of sample.

Saponification value

This was determined as described by AOAC (2005). 1.8 g of NaOH was put into 100 ml of distilled water and 25 ml of the mixture was added to 1 g of the sample. 5 ml of ethanol was added and heated for 1 h. After heating, it was allowed to cool at room temperature and 1 ml of phenolphthalein was added. The mixture was titrated with hydrochloric acid (titration = a ml). Blank was carried out at the same time (titration = b ml). Saponification value determination was done at intervals of two weeks for two months and was calculated thus:

$$\text{Saponification value} = \frac{\text{(b-a) x 28.05}}{\text{Wt. (g) of sample}}$$

Sensory evaluation

The sensory evaluation of the snack samples was carried out by 20 untrained panellists from Food Science and Nutrition Department, FUT, Minna. 9 point Hedonic scale with 1- representing extremely like and 9- extremely dislike. The panellists were presented with the coded samples and were asked to judge the samples on the basis of texture and overall acceptability. The assessors were instructed on the basic taste panel procedures. They were equally instructed to take a sip of water and pause for a few seconds before tasting each sample and to re-taste if not sure of their decisions.

Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) using statistical analysis system (SAS) version 9, (2012). Mean were separated using Duncan's multiple range test (DMRT) at 5% level of probability.

RESULTS AND DISCUSSION

The most important indexes that allow to estimate oxidative stability of finished products are: free fatty acids (FFA) to determine the process of acidification of fatty component, peroxide value (PV) to indicate the degree of primary oxidation and p-Anisidine value (AnV) to evaluate the formation of molecules (aldehydes and ketones) responsible for the organoleptic alterations (Fontanella, 2015). The higher the degree of free fatty acid, the higher the

degree of hydrolytic rancidity and vice versa. The result of this study (Table 1) shows that, samples with higher concentration of BHT showed no variability in free fatty acid values, while sample with the least concentration of BHT (samples A and B) had the highest FFA content throughout the period of this study. This implies that, higher concentration used in this study which is within the safe permitted level in food samples, has the capacity to prevent lipid oxidation.

The peroxide value is used to measure oxidative rancidity of fatty food product. The lower the peroxide value the better the oil content (Ihekoronye and Ngoddy, 1985). Also, it is used as an index of early stage of lipid oxidation. The result of this study (Table 2) shows that different concentration of BHT significantly ($p \leq 0.05$) affects peroxide value of the samples. The peroxide value of the samples decreases as the concentration of BHT increases. The result obtained in this study agrees with the findings of Oladimeji *et al*. (2013) and Azuma *et al*. (1999) who reported that, antioxidative effect of BHT was dependent on concentration. This result implies that, inclusion of BHT in the snack at 250 ppm and 300 ppm per 400g has the potency to control lipid peroxidation.

The saponification value is use to indicate the size of fatty acid chain esterified to glycerol and gives the index of the average length of the fatty acid chain. The result from Table 3 shows that saponification value of the samples decreased as the concentration of BHT increased. During the storage period, samples D and E showed significantly ($p<0.05$) reduced vales, while sample A with 100 ppm BHT per 400g of sample had significantly ($p<0.05$) high saponification value throughout the seven week duration for this study. However, samples B and C showed mild increase during the storage period.

The sensory attributes (Tables 4 and 5) in term of texture and general acceptability of the snack samples over seven week of storage showed that, the samples were not significantly different from each other throughout the study period. This implies that, different levels of BHT and the storage time had no significant influence on the texture and general acceptability of the snack.

CONCLUSION AND RECOMMENDATIONS

Kulikuli snack with high concentration of BHT (samples D and E) showed significantly low levels of free fatty acid and peroxide values. Therefore, inclusion of BHT in the snack can be done at 250 ppm or 300 ppm per 400 g of the cake prior to frying.

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Table 1: Free fatty acid (mg/g) groundnut snack treated with butylated hydroxyl toluene over a period of seven week

Week	A	B	C	D	E
1	3.97^{a}±0.07	3.87^{a}±0.07	3.43^{b}±0.07	3.41^{b}±0.07	3.30^{b}±0.07
3	4.60^{a}±0.07	4.50^{a}±0.07	4.02^{b}±0.07	3.80^{b}±0.07	3.50^{b}±0.07
5	5.08^{a}±0.03	5.08^{a} ±0.03	4.50^{b}±0.03	4.02^{b}±0.03	3.97^{b}±0.03
7	5.08^{a}±0.07	5.08^{a}± 0.07	4.70^{b}±0.07	4.60^{b}±0.07	4.02^{b}±0.07

Data are means ± standard error of duplicate determination.
Means with common superscripts in the row are not significantly different at $p \geq 0.05$.
Key A = Groundnut snack treated with 100 ppm of BHT; B = Groundnut snack treated with 150 ppm BHT; C = Groundnut snack treated with 200 ppm BHT; D = Groundnut snack treated with 250 ppm BHT; E = Groundnut snack treated with 300 ppm; BHT anti-oxidant; BHT = Butylated hydroxy toluene.

Table 2: Peroxide value (meqO_2/kg) of groundnut snack stored over seven week period

Week	A	B	C	D	E
1	9.35^{a}±0.58	8.25^{a}±0.48	8.00^{ab}±0.67	7.00^{b}±0.98	6.75^{b}±0.38
3	10.40^{a}±0.81	9.50^{a}±0.71	8.35^{ab}±0.81	7.50^{b}±0.82	6.95^{b}±0.79
5	3.50^{a}±0.36	3.35^{a}±0.36	2.30^{ab}±0.36	1.60^{b}±0.36	1.30^{b}±0.36
7	3.50^{a}±0.30	3.25^{a}±0.29	2.00^{ab}±0.20	1.30^{b}±0.30	0.75^{b}±0.31

Data are means ± standard error of duplicate determination.
Means with common superscripts in the row are not significantly different at $p \geq 0.05$.
Key A = Groundnut snack treated with 100 ppm of BHT; B = Groundnut snack treated with 150 ppm BHT; C = Groundnut snack treated with 200 ppm BHT; D = Groundnut snack treated with 250 ppm BHT; E = Groundnut snack treated with 300 ppm; BHT anti-oxidant; BHT = Butylated hydroxy toluene.

Table 3: Saponification value of groundnut snack treated with butylated hydroxy toluene taken at week two interval

Week	A	B	C	D	E
1	263.49^{a} ±4.04	234.44^{b}±5.04	215.46^{c}±4.94	187.46^{d}±4.04	128.38^{e}±4.0
3	275.25^{a}±10.00	195.93^{b}±9.98	232.20^{b}±10.20	148.37^{c}±11.00	91.36^{e}±10.00
5	340.32^{a}±8.43	287.51^{b}±8.43	238.95^{c}±8.43	221.95^{c}±8.43	178.93^{d}±8.43
7	388.86^{a}±15.13	279.50^{b}±15.13	250.97^{b}±15.13	234.47^{bc}±15.13	190.95^{c}±15.13

Data are means ± standard error of duplicate determination.
Means with common superscripts in the row are not significantly different at $p \geq 0.05$.
Key A = Groundnut snack treated with 100 ppm of BHT; B = Groundnut snack treated with 150 ppm BHT; C = Groundnut snack treated with 200 ppm BHT; D = Groundnut snack treated with 250 ppm BHT; E = Groundnut snack treated with 300 ppm; BHT anti-oxidant; BHT = Butylated hydroxy toluene.

Table 4: Sensory score for texture from week one to week seven

Week	A	B	C	D	E
1	8.07±0.00	8.17± 0.00	8.01±0.04	8.09±0.03	8.07±0.00
2	8.07±0.15	7.97±0.25	8.07±0.15	8.07±0.15	8.07±0.15
3	8.07±0.00	8.07±0.00	8.08±0.00	8.07±0.00	8.08±0.00
4	8.07±0.00	8.07±0.00	8.07±0.00	8.17±0.80	8.0 7±0.00
5	6.33±0.18	6.13±0.18	6.40±0.18	6.23±0.18	6.40±0.18
6	6.40±0.00	6.50±0.01	6.70±0.00	6.40±0.00	6.40±0.00
7	6.40±0.14	6.40±0.14	6.40±0.14	6.40±0.14	6.40±0.14

Data are means ± standard error of duplicate determination.
Means with common superscripts in the row are not significantly different at $p \geq 0.05$.
Key A = Groundnut snack treated with 100 ppm of BHT; B = Groundnut snack treated with 150 ppm BHT; C = Groundnut snack treated with 200 ppm BHT; D = Groundnut snack treated with 250 ppm BHT; E = Groundnut snack treated with 300 ppm; BHT anti-oxidant; BHT = Butylated hydroxy toluene.

Table 5: Sensory score for general acceptability from week one to week seven

Week	A	B	C	D	E
1	7.23±0.10	7.26± 0.00	7.30±0.00	7.03±0.00	7.33±0.00
2	7.93±0.13	7.93±0.13	7.93±0.13	7.93±0.13	7.93±0.13
3	7.83±0.10	7.93±0.00	7.90±0.10	7.93±0.00	7.93±0.00
4	7.93±0.00	7.90±0.10	7.93±0.00	7.92±0.01	7.93±0.00
5	6.53±0.20	6.53±0.20	6.53±0.20	6.53±0.20	6.53±0.20
6	6.53±0.15	6.63±0.25	6.53±0.15	6.77±0.25	6.77±0.25
7	6.07±0.15	6.06±0.13	6.07±0.15	6.07±0.15	6.05±0.13

Data are means ± standard error of duplicate determination.
Means with common superscripts in the row are not significantly different at $p \geq 0.05$.
Key A = Groundnut snack treated with 100 ppm of BHT; B = Groundnut snack treated with 150 ppm BHT; C = Groundnut snack treated with 200 ppm BHT; D = Groundnut snack treated with 250 ppm BHT; E = Groundnut snack treated with 300 ppm; BHT anti-oxidant; BHT = Butylated hydroxy toluene.

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CHEMICAL COMPOSITION, PHYSICAL AND SENSORY PROPERTIES OF CAKES PREPARED FROM FLOUR BLENDS OF WHEAT AND CASHEW NUT KERNELS.

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ABSTRACT

The chemical composition, physical and sensory properties of cakes prepared from flour blends of wheat and cashew nut kernels were investigated. Wheat and cashew nut kernels flour were blended at different proportions (100:0%; 90:10%; 80:20%; 70:30%; 60:40% and 50:50%) for cake making where 100% wheat flour was used as standard. Addition of cashew nut kernels four to wheat flour increased chemical composition of cake samples such as moisture, protein, fat, crude fiber, ash contents from (13.19 to 14.42%), (23.05 to 29.36%), (3.41 to 7.06%), (3.57 to 3.95%), (1.42 to 4.02%), while carbohydrate content decreased from (54.28 to 41.19Kcal), similar trend was observed for wheat flour. Mineral elements of cakes such as copper, iron, magnesium, sodium, calcium and phosphorus ranged from 0.13 to 0.19mg/100g, 2.95 to 4.43mg/100g, 61.65 to 164.64mg/100g, and 273.52 to 264. 24mg/100g, 56.33 to 123.27.05 mg/100 g and 298.70 to 356.03 mg/100g respectively. The weight (32.25 to 34.30 g) and volume (242.05 to 246.11 cm^3) of wheat-cashew nut kernels flour cake increased, whereas batter density and volume index of cakes decreased from (0.90 to 0.83) and 103.65 to 99.47) with increasing levels of cashew nut kernels flour. There was no significant ($p \geq 0.05$) difference in crust and

crumb colour, crumb grain and texture between wheat cake and composite cakes but taste and overall acceptability of composite cakes were significantly different from the standard.

Keywords: wheat, cashew nut kernels, cake, flour blends,

Introduction

are soft bakery products produced batter containing wheat flour, powders and beaten eggs, with or without shortenings (IFIS, 2005). Cake serves as a medium for delivery of important nutrients and the nutritional content varies with the type of flour used. There is an increase in demand of baked products such as cakes, bread and cookies resulting to high demand for imported wheat flour in Nigeria.

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Amino acids, which include lysine, tryptophan, isoleucine and leucine and it has a high biological value (Bicalho and Schuch, 2001). The full fat cashew nut kernels contain protein 20.23%, ash 6.26%, fat 45.17% ,crude fiber 4.55%, carbohydrate 11.39%, energy value 533.01 kcal, iron 3.00 g, calcium 321.66 g, phosphorus 450.13 g, sodium 101.24 g, potassium 503.16 g.(Alobo*et al.*,2009). Considering these impressive chemical and functional properties of cashew nut kernels and its full fat flour it may represent a useful material in food systems.

The present research therefore aimed at evaluating the effect of cashew nut kernels flour addition on the chemical composition, physical and sensory properties of wheat flour and cakes prepared from their flour bends.

Materials and Methods

Three kilograms of wheat flour (Golden Penny), cashew nut seeds and other ingredients were all purchased from Minna Central Market, Nigeria while the Department of Food Science and Technology, Federal University of Technology, Minna provided the facilities for the work.

Preparations of cashew nut kernels flour

Cashew nut kernels flour was prepared as described by Alobo*et al.* (2009). The nuts were split open with knife to release the kernels. The kernels were dried at 60ºC in an air-draft oven (Gallenkamp 300 plus series, England) and then ground into flour using attrition mill (Globe P 44, China). The flour samples were passed through 75µm mesh size sieve, packaged in an air tight polyethylene bag and transferred into a plastic container with lid then stored in a refrigerator from where samples were taken for analysis.

Formulation of blends

Wheat flour and cashew nut kernels flour was mixed at varied proportions (100: 0%; 90 : 10 %; 80 : 20%; 70 : 30 %; 60 : 40% and 50 : 50%) where 100% wheat flour served as standard. A Kenwood mixer was used for mixing samples at speed 6 for 5 minutes to achieve uniform mixing.

Proportion of ingredients

The proportion of ingredients used consists of flour (100 g), sugar (62.5 g), margarine (47.9 g), baking powder (5.7 g) and vanilla essence (three drops) as described by Akubor (2004).

Preparation of cake

The method of Akubor (2004) was adopted for the preparation of cake. The margarine and sugar were creamed manually for 2 min in a bowl until soft and fluffy. The egg was beaten for 3 min, added to the mixture and mixed manually for 3 min. Flour samples from various composite blends were separately sieved, and baking powder was then added and mixed lightly by hand until soft dough was formed. The dough was transferred to a greased baking pan and baked in a

preheated oven at 200 ^{o}C for 30 min.

Chemical analysis

The moisture content, crude protein, fat content, crude fiber, ash content, carbohydrate and mineral determination were determined following the procedure outlined by AOAC (2000). The food energy values of the samples were determined according to the method described by Osborne and Voogt (1978).

Determination of physical properties of cake

Batter density was determined with a measuring cylinder and expressed as the relation between the weight of batter and the same volume of distilled water. Volume index of cake samples were measured using AACC template method 1091 (AACC, 2000) while the weight of cake samples were determined by weight measurement using the electronic digital balance.

Determination of sensory properties

A trained twenty-member panel consisting of students and staff members of Food Science and Technology Department of Federal University of Technology, Minna, Nigeria was selected based on their experience and familiarity with cake for the sensory evaluation. Cake samples prepared from each flour blend were presented in coded white plastic plates. The order of presentation of samples to the panel was randomized. Tap water was provided to rinse the mouth between evaluations. The panelists were instructed to evaluate the coded samples for appearance, crust colour, crumb grain, texture, aroma and overall acceptability. Each sensory attribute was rated on a 9-point Hedonic scale (1=disliked extremely while 9-liked extremely).

Statistical Analysis

Data were analyzed by analysis of variance (Steel and Torrie, 1980). The difference between mean values was determined by least significant difference (LSD) test. Significance was accepted at 5% probability level.

Results and Discussion

Tables 1 and 2 showed the chemical composition of flour blends from wheat and cashew nut kernels. There was no significant difference ($p \geq 0.05$) in moisture value among samples. The low moisture values (9.13 to 10.56%) obtained in this study is indicative that the flour samples will have good storage life. The protein content varied between 10.61 and 25.72% with 100% wheat flour having lowest protein content, while 100% cashew nut kernels flour had the highest protein value. The protein content of flour blends increased with increasing level of cashew nut kernels flour in the blends. There were significant differences ($p \leq 0.05$) in protein content among flour blends implying that the treatment had effect.

Table1: Proximate composition of flour blends from wheat and cashew nut kernels.

Flour blends (%) Wheat: Cashew nut	Moisture (%)	Protein (%)	Fat (%)	Crude fiber (%)	Ash (%)	Carbohydrate (%)
100:0 (control)	9.13^{b}±0.05	10.61^{g}±0.18	1.25^{g}±0.12	0.88^{e}±0.01	1.25^{c}±0.04	76.88^{a}± 0.60
0:100	10.56^{a}±0.13	25.72^{a}±0.24	12.18^{a}±0.25	5.27^{a}±0.06	7.64^{a}±0.00	38.63^{g}±0.47
90:10	9.25^{b}±0.07	12.03^{f}±0.16	3.04^{f}±0.07	1.68^{d}±0.01	1.89^{b}±0.03	72.11^{b}±0.56
80:20	9.33^{b}±0.20	13.74^{e}±0.05	4.11^{e}±0.10	2.14^{c}±0.04	2.06^{b}±0.09	68.62^{c}±0.72
70:30	9.51^{b}±0.11	14.89^{d}±0.17	5.52^{d}±0.12	2.75^{bc}±0.01	2.87^{ab}	

cashew nut kernels flours obtained in this study is in close agreement with values reported by Ayo *et al*. (2007) and Alozie*et al*. (2009) for cashew nut kernels flour and wheat flours respectively.