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[EVALUATION OF QUALITY ATTRIBUTES OF BREAD PRODUCED FROM BLEACHED PALM-OIL, MARGARINE AND LARD.

[1]Makanjuola, Olakunle Moses and [2]Adepegba, Adetokunbo Oluwole
Department of Food Technology, Federal Polytechnic, Ilaro, Ogun State.

Abstract:*Quality attributes of bread produced with bleached palm oil, margarine and lard as shortenings were investigated in this research with using standard analytical methods. Selected chemical properties of the shortening revealed acid values of 3.02mgKOH/g and 0.62mgKOH/g for bleached palm oil, margarine and lard respectively. Saponification values ranged from 191.60mgKOH/g-228mgKOH/g. Iodine value varied from 57.10g/100g-64.80g/1000g-2.60meq/1000g for the three oils under investigation. Physical characteristic of bread samples produced such as loaf volume, loaf weight, specific volume and oven spring with is shortenings revealed significant difference (P≤0.05) among samples. Effect of shortenings on bread samples produced for sensory analysis viz crumb colour, crumb texture, crust colour, taste, aroma and overall acceptability showed mean scores of 4.75, 6.81 and 5.45 for bread samples produced with margarine, bleached palm oil, and lard respectively, indicating panelist preference for bread samples were least preferred. However, irrespective of the significant differences (P≤0.05) in the quality attributes of the bread sample, the use of plant oils and lard in the production of bread have been demonstrated.*

Keywords*: Quality Attributes, Bread, Bleached Palm Oil, Margarine, Lard*

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I. Introduction

Bread is an important staple food whose consumption is steady and increasing in Nigeria. It is the loaf that results from the baking of dough which is obtained from a mixture of flour, salt, sugar, fat, yeast and water (1). Among the bakery products, bread has been the principle food in over half of the countries around the world compared to other types of baked goods. (2). Bread has been used as human food since ancient times and has been contributing over 50% of dietary energy due to its high carbohydrate contents (3). Also, evidence from food consumption survey indicates that there is growing increase in the consumption of bread in Nigeria (4).

Consumption of baked products isgreatly increasing due to the ever increasing urbanization, the product cost competitiveness, their ready to eat convenience, availability of various products (bread, biscuits, cake, cookies) with varying taste and texture characterisitics as well as their nutritional profile and longer shelf life (3). Oils and fats contribute to tenderness of various baked products. Proper amount of fat or shortening in bread dough improves the volume, grain texture, crust tenderness and keeping quality of the bread and makes the dough more elastic (2, 5).

Fat is an essential macro nutrient, and vegetable oils, such as palm oil are widely used in the food industry and highly represented in the human diet(6). Crude palm oil is an edible vegetable oil extracted from the fleshy part of ripe palm fruit (Elaeisguineensis). Palm oil extracted from the mesocarp of palm fruit contains approximately 50% fats and 40% unsaturated fats (7,8). The oil palm consists of 16 carbon saturated fatty acid, palmitic acid, monounsaturated oleic acid and 10% linoleic acid which is an unsaturated omega-6 fatty acid. Palm oil is also high in vitamin K and dietary magnesium. It is rich in minor components which have nutritional attributes with about 500-700ppm of carotene consisting mainly of α and β carotene that constitute 90% of the total carotene (7, 9). Crude palm oil (CPO, also known as red palm oil, RPO), extracted either by wet or dry processes contains both healthy beneficial compounds, such as triglycerides (TAGs) vitamin E, carotenoids, phytosterols, as well as impurities such as phospholipids, free fatty acids (FFAs), gums and lipid oxidation products (6). Palm oil application in food industries has exponentially grown for the texture, the fragrance and the neutral taste it guarantee in the finished products. Palm oil is generally found in baked goods, candies, cakes, cheese analogs, chips, chocolate, confectionary, fat, cookies, cooking oil, crackers, doughnuts, frozen meals (pan cake, pies, pizza, potatoes) ice cream, industrial frying fats, peanut butter, salad dressings, snacks etc (6).

Margarine and table spreads are water-in-oil emulsions with the aqueous phase consisting of water, salt and preservatives while the fatty phase, which contributes to the polymorphic behavior of margarine is a blend of oils and fats (10). According to (10, 11), a good margarine should not suffer oil separation, discolouration, hardening, sandiness, graininess, and water separation. The oils and fats process conditions and handling

methods used should be selected so as not to produce a strong crystal network (10, 12). Bakery margarine is used like shortening as bakery fat and in short pastry, cakes, cookies, bread and pastries. Bakery margarine us firmer, require no refrigeration and formulated to withstand dough working and at the same time, provide lubrication for cake leavening (10, 13).

Lard is a pork fat in both its rendered and unrendered form. It is obtained from any part of the pig where there is a large amount of adipose tissue. It can then be transformed by thermal treatment to fats with various aspects. (14). Lard has been the shortening of choice in bread making because it possess several unique characteristics compared to other fats. It isused to be in plentiful supply; readily available from local hog abattoirs at low cost. Also, because of its low solids content at dough imparting excellent shortening characteristics to the bread or other baked food (15). According to (16), lard is one of the cheapest edible fat and oils, consequently, lard deliberately added into the food product to reduce the production cost. From the religious point of view, the presence of lard in any food products is not allowed. For this reason, several analytical methods either physical or chemical based methods have been developed to identify lard (17, 18). Lard, however, was not a primary product but rather a by product of the pork processing industry (15).

Over the years, numerous studies have been carried out on the use of fats in baked product. The characterisitcs white pan bread as affected by tempering of the fat ingredient was studied by (2) influence of margarine and /or coconut oil on the quality of bread prepared from wheat flour (19) (20) studied the characteristics of bread and buns made with lard and vegetable oils of different iodine value. Also, the effect of shortening on the sensory characteristics of wheat bread was undertaken by (21), yeast bread containing oils varied in fatty acid composition. Effect on sensory panel acceptability by (22) while analysis of bread improver in whole wheat bread crumb was researched into by (23). Therefore, the objectives of this present work are to produce high quality bread using bleached palm oil, margarine and lard as fat (Shortening), as well as evaluating the quality attributes of the bread produced using these fats, thereby increasing the domestic use of pant oils and lard.

II. Materialsand Methods

Source of Materials

Quality hard wheat flour (Golden penny, Nigeria), granulated sugar (Dangote) baker's yeast, table salt (Dangote), Blue Band Margarine (Lever Brothers, Nigeria) were purchased from a Departmental store in Abeokuta ,Ogun state. Apple fruits were obtained from the school farm of the Federal Polytechnic, Ilarowhile lard was purchased from a local piggery within Ilarometropolis.

Processing of Palm Oil

The unit operations involved in the processing of palm fruits into palm oil are sterilization, threshing or stripping, milling and digestion, pressing and clarification. Sterilization of palmfruit was achieved by boiling to make stripping easy after which the sterilized palm fruits were pounded to crush the fruits in order to get homogeneous pulp for liberation of oil from the cells of the mesocarp. Pressing was then carried out to obtained crude oil, followed by clarification in settling tank containing water and heated to about 95^0C. Pure oil was skimmed off from the top and impurities were allowed to settle down. The oil was then heated and dried to remove water.

Bleaching of Palm

The bleaching of palm oil was carried out using the method reported by (7). The adsorption method was used. 2.5litres of crude palm oil was put in a heating vat with same pieces of activated clay and heated for 30 minutes at 110^0C. at the end of the heating, the oil was allowed to cool and then filtered using muslin cloth to remove the particles.

Production of Bread.

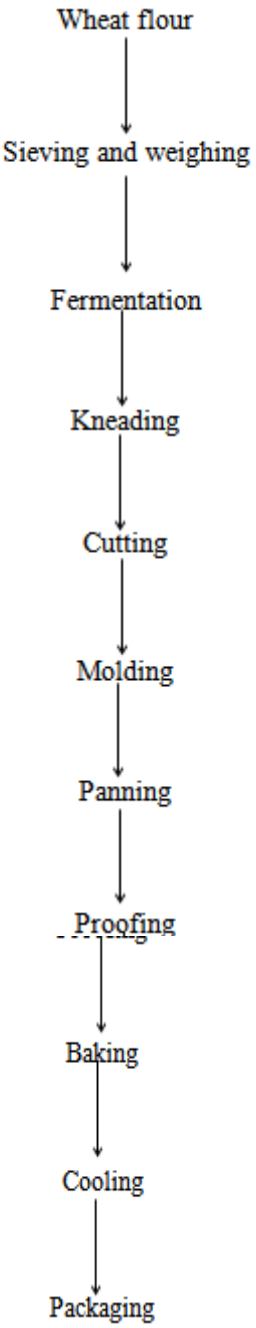
Bread samples were produced using straight dough method described by (3)

Recipe of the Bread Formulation

Wheat flour	500g
Baker's yeast	12.5g
Fat(Bleached palm oil, margarine and lard)	25g
Granulated sugar	12.5g
Salt	5g
Water	312.5ml.

500g of wheat flour, 12.5g of baker's yeast, 12.5g of granulated sugar, 5g iodized salt and 312.5ml of deionized water were properly mixed in a mixing bowl for about 15minutes to obtain a smooth consistency.

The dough was then allowed to ferment (Primary proofing) for 2 hours. At the expiration of 2hours, the fermented dough was kneaded using a kneading machine with stainless surface for 20minutes until a fine –silky structure was obtained. Cutting and molding of the dough was carried out using dough cutting machine and molder into different sizes and shapes, followed by panning. Secondary proofing was allowed to takeplace while maintain relative humidity of 85-90%. Baking was done in an electric oven air temperature of 220^0C for 25minutes. The baked bread were then allowed to cool and packaged in 0.2mm thick polyethylene bags, then stored at ambient condition (29 ± 1^0C) for subsequent analysis. All reagents and chemicals used were of analytical grade



Flow chart for the Production of Bread

Experimental Analysis

Acid Value

Each oil sample (1.0g) was weighed and dissolved with 50ml of ethanol in a conical flask. Two drops of Phenolphthalein indicator were added and titrated to pink end point (Which persisted for 15 minutes) with 0.1N potassium hydroxide solution (KOH). Acid value was calculated using the equation below (28, 24)

Acid value -56.1xvxc/m

Where,

56.1 is the equivalent weight of KOH

V is the volume in the ml of standard volumetric KOH solution used

C is the exact concentration in KOH solution used (0.1N)

M is the mass in grams of the test oil (1g)

Saponification Value

Saponification value was estimated according to titre metric method described by (25). Two grams of each oil sample was weighed into conical flask and 25ml ethanolic potassium hydroxide was added. The solution was refluxed for 2 hours with time shaking. One ml (1ml) of phenolphthalein was added and titrated with 0.5N hydrochloric acid (HCl). The same process was conducted for blank determination. The saponification value was calculated using the formula below (25,28).

Where:

56.1 is the equivalent weight of KOH

Vo is the volume in the ml of standard volumetric HCl solution used for blank test

V1 is the volume in ml of the standard HCl solution used for sample

C is the exact concentration of the standard HCl (0.5N)

M is the mass in grain of the test sample (oil) (2g)

Peroxide value

Peroxide value was evaluated according to AOCS official method cd8-53(2003). Five (5g) grams of each oil samples were weighed into a conical flask and 30ml of solvent mixture of glacial acetic acid – chloroform in the ratio of 3:2, respectively, were added to the oil samples. Half ml saturated potassium iodide (KI) solution was added to the solution and allowed to stand or 1 minute, thereafter, 30ml of distilled water were added and titrated with 0.01n sodium thiosulphate solution using starch indicator until the yellow colour was discharged. A blank was prepared alongside the oil sample. Peroxide value was calculated as stated below (29, 28)

Peroxide value=10x(v1-v2)/m

Where

V1= volume$Na_2S_2O_3$ for determination of test sample in ml

V2=volume $Na_2S_2O_3$ for determination of blank solution in ml

M=mass of test sample in gram (5g)

Iodine Value

5grams (5g) of oil samples was into 250ml conical flasks and then 25ml of carbon tetrachloride was added to each oil sample, the content was mixed well. 25ml of carbon tetrachloride reagent was added to each solution and swirled for proper mixing, and kept in the flask in dark for half an hour . after standing, 15ml of potassium iodide solution was added and then 100ml of distilled water was added into the mixture, with 1ml starch indicator added to the sample solution. Then, the liberated iodine was titrated with 0.01N of sodium thiosulfate

Loaf Volume

Loaf volume was measured by small seeds displacement method described by (26). A container was used to measure the volume using small grains. Rapeseeds were poured into the container of known volume until the bottom was covered. The loaf was placed inside the container which was then filled to the top with more seeds. The extra rapeseeds, which equal the loaf volume, were measured in a graduated cylinder. The specific volume of the loaf was calculated using World Grain Statistic (2007).

Oven Spring

The oven spring of bread samples produced was estimated from the difference in height of dough before baking and after baking.

Loaf Weight
Loaf weight was measured 30 minutes after the loaves were removed from the oven with the aid of graduated laboratory scale (CE-4101, Camry Emperors, China) all the readings recorded in grams (g).

Specific Loaf Volume
The specific loaf volume was determined by dividing the loaf volume by its corresponding loaf weight (cm^3/g)

Sensory Evaluation of Bread Samples
The bread samples were subjected to sensory evaluation test about 1 hour after baking by a semi-trained 40 member panel drawn from staff and students of the Federal Polytechnic, Ilaro, Ogun State Nigeria that was very familiar with bread. Degree of acceptance or likeness or preference was expressed using a 9 point hedonic scale, where 9 represents the highest score and 1 the lowest score. The sensory attributes evaluated were crumb colour, crumb texture, crust colour, taste, aroma and overall acceptability. The samples were served to each panelist on a tray in a random fashion.

Statistical Analysis
Data obtained were analyzed using analysis of variance (ANOVA) to determine difference in sample means. Duncan's Multiple Range Test (DMRT) was used to separate the means ($p \leq 0.05$) with statistical package for social science version 16.0 for windows (SPSS inc.Illonis, U.S.A).

III. Results and Discussion

Table I: chemical characteristics of bleached palm oil, margarine and lard

Oil sample	Acid value (mg/KOH/g	Saponification value (mg/KOH/g)	Iodine value (g/100g)	Peroxide value(Meq/1000g)
Bleached palm oil (A)	3.02 ± 0.02^{a}	191.60 ± 0.32^{b}	62.13 ± 0.08^{a}	1.10 ± 0.22^{c}
Margarine (B)	0.50 ± 0.05^{c}	228.40 ± 0.41^{a}	57.10 ± 0.10^{b}	2.60 ± 0.18^{a}
Lard (C)	0.62 ± 0.10^{b}	201.60 ± 0.28^{b}	64.80 ± 0.07^{a}	1.25 ± 0.20^{b}

Data are mean value of triplicate determinations with standard deviation. Values with the same letters in the same columns are not significantly different from each other ($p \leq 0.05$)
Key:
Sample A: Bleached Palm oil
Sample B: Margarine
Sample C: Lard

Table II: Physical Characteristics of Bread Samples Produced using Bleached Palm oil, Margarine and Lard.

Sample	Loaf volume (Cm^3)	Loaf weight (g)	Specific loaf volume (Cm^3/g)	Oven string (g)
A	593.02 ± 0.07^{b}	233.05 ± 0.12^{b}	2.54^{b}	0.41 ± 0.03^{d}
B	632.01 ± 0.05^{a}	237.03 ± 0.07^{a}	2.67^{a}	0.41 ± 0.02^{a}
C	578.04 ± 0.03^{c}	230.07 ± 0.01^{b}	2.51^{c}	0.40 ± 0.02^{a}

Data are means value of triplicate determinations with standard deviation. Values in the same row with different superscripts are significantly different ($p \leq 0.05$).
Key
Sample A: Bread produced with bleached palm oil
Sample B: Bread produced with Margarine
Sample C: Bread produced with Lard

Table III: Bread Sensory Analysis Produced with Bleached Palm Oil, Margarine and Lard

	SAMPLES		
Parameters	A	B	C
Crumb colour	5.52 ± 0.22^{b}	6.23 ± 0.13^{a}	4.78 ± 0.16^{c}
Crumb texture	4.65 ± 0.21^{b}	5.41 ± 0.17^{a}	4.63 ± 0.11^{b}
Crust colour	4.25 ± 0.18^{c}	5.33 ± 0.20^{a}	4.82 ± 0.23^{b}
Taste	4.28 ± 0.26^{c}	5.96 ± 0.15^{a}	5.21 ± 0.20^{b}
Aroma	3.41 ± 0.23^{b}	4.77 ± 0.22^{a}	4.84 ± 0.27^{a}
Overall accepatability	4.75 ± 0.20^{c}	6.81 ± 0.25^{a}	5.45 ± 0.22^{b}

Values are means plus standard deviation of triplicate determinations.
Means in the same row with different superscripts are significantly different ($p \leq 0.05$).
Key
Sample A: Bread produced with bleached palm oil
Sample B: Bread produced with Margarine
Sample C: Bread produced with Lard

Chemical Composition

The results of the selected chemical composition of oil samples are as shown on Table 1.

Acid value is a measure of the free fatty acids in oil. Its determination is often used as a general indication of the condition and edibility of the oil. Fatty acids are found in the triglyceride form. During processing, the fatty acids may get hydrolysed into free fatty acids. The acid values obtained for the three samples are 3.02mgKOH/g, 0.50mgKOH/g and 0.62mgKOH/g for bleached palm oil, margarine and lard respectively. According to literature (28, 29). The higher the acid value found in oils, the higher the level of free fatty acids which translates into decreased oil quality. The permissible level of acid value for all edible oils should be below 0.6mgKOH/g (measured in potassium hydroxide per gram (29). The acid values obtained in bleached palm oil and lard may be due to free fatty acid formed due to hydrolysis of triglycerides and also may be promoted due to reaction with moisture (30, 7). Bleached palm oil with 3.02mgKOH/g acid value has the tendency to become rancid due to off flavor. (28, 34). The low level of free fatty acid as obtained in margarine and lard suggests that the two oils are good edible oil which can be stored for a very long time without spoilage through oxidative rancidity and can also contribute to the stability of bakery product such as bread and allied products (7,32).

The saponification value is an indication of the molecular weights of triglycerides in oil, with the FAO/WHO recommending saponification value for palm oil variety at 190-209mgKOH/g (33). Saponification values of 191.60mgKOH/g, 228.40mgKOH/g and 201.60mgKOH/g were obtained for bleached palm oil, margarine and lard respectively, indicating significant differences within the samples ($p \leq .05$). higher saponification value indicates high proportion of lower fatty acids since saponification values is inversely proportional to the average molecular weight or chain length of the fatty acid (28, 31). Also, higher saponification value indicates high ester value, therefore confirming the suitability of the oil to be used for cosmetic and soap industry.

According to the analysis carried out in this present work. Iodine value of 62.13mg/100g, 57.10g/100g and 64.80g/100g were obtained for bleached palm oil, margarine and lard. Iodine value is a measure of overall unsaturation measured in g/100g of fat and it is used in the characterisation of oils and fats. It is a useful index to defect adulteration of palm oil with any other referable as animal fat (35). According to literature, (7), high iodine values shows that the oil samples are rich source of poly unsaturated fatty acids that is beneficial to health and helps in regulating and lowering blood cholesterol level and high blood pressure. It also shows that the oil has good qualities of edible oil (7,36). Animal fat is generally highly saturated which means that the animal fat solidifies at relatively high temperature (14, 37,38, 39). The lower iodine value of margarine will contribute to its greater oxidative storage stability. FAO/WHO recommended iodine value for palm oil in 50-55/gram and for other oil variety 112-129/gram.

Peroxide value is a test used to measure the concentration of peroxides and hydroperoxides as well as determination of oxidative rancidity. It is a useful indicator of the early stages of rancidity occurring under mild condition. One of the most parameters that influence lipid oxidation is the degree of unsaturation of its fatty acids. When double bonds of unsaturated fats are oxidized, peroxides are among the oxidation predicts formed (28). Good quality oil has a peroxide value less than 10 units (7, 40). The peroxide values obtained for the samples are 1.10meq/1000g, 2.60meq/1000g and 1.25meq/1000g (bleached palm oil, margarine and lard). FAO/WHO recommended peroxide values are ≤10meq/1000g. Oil with high peroxide values are unstable and become easily rancid. Oil becomes rancid when the peroxide value ranges from 20.0-40.0meq/1000g (7). High peroxide value is an indicator of oxidation level and the greater the peroxide value, the mix oxidized the oil is. Values obtained in this present work are all within the recommended level.

Physical Characteristics

Table 2 showed the result of physical characteristics of bread samples produced with bleached palm oil, margarine and lard. The loaf volume ranged from 593.02$cm^3$to 632.01cm^3 for the three samples of bread showing significant difference ($P \leq 0.05$) among samples. Bread produced with margarine has the highest loaf volume (632.01cm^3) while bread produced with lard has the least value of 578.04cm^3. According to a previous work, bakery margarine is firmer, provide cake leavening, and produce a high cake volume and stable cream. (10). The loaf weight varied between 230.07 to 237.03 revealing significant differences in weight. The observed weight of 237.03g in sample produced with margarine is a desirable quality attribute as consumers are often

attracted to bread with high weight with the belief that such bread has more substance for the same price (19,41). The specific loaf volume obtained by dividing the loaf volume by its corresponding loaf weight revealed 2.54cm^3/g, 2.67cm^3/g and 2.51cm^3/g for bread produced with bleached palm oil, margarine and lard respectively, indicating significant differences ($p \leq 0.05$) in the oven spring estimated from the differences in the height of dough before and after baking. The oven spring obtained for the three bread samples are 0.41g, 0.41g and 0.40g respectively.

Sensory characteristics of bread samples

The mean sensory scores of bread samples produced with bleached palm oil, margarine and lard are as shown in Table 3. It was noted that bread produced with margarine was rated best in terms of crumb colour, followed by bread produced with bleached palm oil while bread produced with lard was rated least. The crumb texture as rated by the panelist revealed that bread produced with margarine had the higher score over and above that of bleached palm oil and lard. Texture is a measure of the structure and the consistence and texture of margarine is principally dependent as the processing techniques as well as the oil and fats used in its manufacture. In terms of crust colour, panelist preferred bread samples produced with margarine, closely followed by lard with bleached palm oil preferred

IV. Conclusion

The result of this present work showed that chemical properties of fats revealed the quality characteristics of bread samples produced most especially the use of plant oils instead of oils from animal origin. The physical and sensory properties showed acceptable bread based on quality characteristics evaluated with the use of plant oils, thereby reducing the over dependence on oils and fats from animal source.

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