Quality of Margarine Produced from Coconut and Cashew Kernel Oil Blends and their Potential as Shortening for Biscuit Production

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ABSTRACT

Background: *Confectionery formulation from shortenings contain hydrogenated fat which lowers its nutritional value due to the presence of large amount of saturated fatty acids. These saturated fatty acids in humans raise the levels of Low-Density Lipoproteins (LDL) which may lead to coronary heart diseases, obesity etc.*

Objective: *This study evaluated the quality of margarine produced from coconut and cashew nut kernel oil and their potential as shortening in biscuit production.*

Methods: Coconut and cashew nut kernel oils were extracted and used for margarine production at a ratio of 100:0 (sample B), 80:20 (sample C), 70:30 (sample D) and 60:40 (sample E). Simas margarine (100% vegetable oil) served as the control (sample A). The samples served as shortenings and used in the production of biscuits which were packaged until needed for analysis.

Results: *Free fatty acid value of the margarines ranged from 0.47-1.84% while the peroxide value results ranged from 0.35-3.99 meq/kg. The protein content in the biscuits ranged from 11.64 – 26.14%, crude fibre ranged from 6.49 – 12.46%. The weight of the biscuits ranged from 4.19 - 5.66 g while the height ranged from 0.32 - 0.48 cm. The sensory evaluation showed that sample B was the most liked.*

Conclusion: *The study showed that margarine produced from coconut and cashew kernel oil blends can be used as a substitute for shortening at the levels of 70:30 thus, promoting the utilization of cashew nut oil and serving as a healthier option for biscuit produced from regular shortening.*

Keywords: Shortening, Biscuit, Margerine, Coconut oil, Cashew nut oil.

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INTRODUCTION

Consumer interest in healthy eating is shifting towards the potential health benefits of foods known as functional foods (1), which positively affects one or more target functions such as reduction of diseases in the body along with its nutritional effects.

Shortening is any fat usually of animal or vegetable origin, that is solid at room temperature used to make crumbly pastry and other food products. Examples of fat used as shorteners include butter, margarine and lard. Shortening refers more to margarine than butter. It makes the resulting food crumbly or to behave as if it had short fibers. Solid fat prevents cross-linkage between gluten molecules. This cross-linking would give dough elasticity so it could o stretched into longer pieces (2). In pastries such as cake, which should not be elastic, shortening is used to produce the desired texture.

Margarine is a non-dairy product created by

hydrogenation used for spreading, baking and cooking (3). It is a substitute for butter and unlike butter, it is made of refined vegetable oil, water and milk. Unfortunately, most margarine fats are prepared from partial hydrogenation where trans-fatty acid (TFA) formation is inevitable (4). Adverse health effects have been associated with the consumption of semi- solid fats containing trans-fatty acids from partially hydrogenated oils (4). Most of the oils used in margarine production are low in bioactive compounds and little has been done in searching for alternative sources of oil with antioxidant properties and richer bioactive compounds (5).

Cashew (*Anarcardium occidentale*) is made up of a fruit in which the kernel is embedded. The kernels are a good source of protein (19.8%), fat (47.1%) and iron (9%) (6). Emelike and Barber (7) reported that the oil content in cashew kernel is mainly oleic (73.73%), linoleic (13.60%) and stearic acids (10.20%) in the ratio of 1:2:1 making it useful for lowering blood serum cholesterol. Besides, they contain relatively important amounts of minerals like calcium (504.0 mg/kg), iron 90.8 mg/kg), zinc (31.3 mg/kg), copper (16.4 mg/kg), potassium (5600 mg/kg), phosphorus (4600 mg/kg), magnesium (2400 mg/kg) and sodium (22.8 mg/kg) all measured in dry weight. They are also used in the food industry as an ingredient in various confectionery products. The kernels can be eaten in roasted form, fried and sometimes salted or sweetened with sugar, garlic, ginger and honey (8). They can also be grounded and processed into table spreads (9).

Coconut oil (*Cocos nucifera*) has generated discussions about its possible effects on health, especially for being an oil rich in saturated fat (10). Unlike other vegetable oils, coconut oil is chemically very stable and not easily oxidized. It is very resistant to free radical attack and in combination with other oils, acts as an antioxidant, helping to prevent the oxidation of other oils (3). Most of the fatty acids in coconut oil (CO) are composed by medium chain; thus, they are directly absorbed by the intestine and sent to the liver to be used as an energy source (11). The main fatty acids (FA) found in CO are the lauric (12:0), myristic (14:0) and palmitic (16:0) acids, which represent 46%, 17% and 9% of the FA, respectively (12). On the other hand, CO contains high level of lauric acid that is directly absorbed by enterocytes and may prevent the fat deposition in blood vessels. Furthermore, Vasudevan (13) reported that the amount of cholesterol present in this oil (0.012 mg of dietary cholesterol for each 85 g of CO) is very small.

Confectionery formulation from shortenings contains hydrogenated fat which lowers the nutritional value due to the presence of large amount of saturated fatty acids. These saturated fatty acids in humans raise the levels of low-density lipoproteins (4) which may lead to coronary heart diseases, obesity, cancer. Hence the use of cashew oil-based margarine, containing mono and polyunsaturated fatty acids to substitute shortening used in commercial baking for a healthier product. This study will be of great significance to consumers, **cashew nut farmers and processors. It will impact on households and caterers by providing healthy substitute for shortening which will be suitable for pastry products.**

MATERIALS AND METHODS

Sample collection

Coconut and roasted cashew nut kernels were purchased from Sangana market, Mile 1, Port Harcourt, Rivers State, Nigeria. Flour, sugar, shortening (margarine), eggs, baking powder, milk, lemon, skimmed milk and salt were purchased from Mile 3 market also in Port Harcourt, Nigeria.

Extraction of oil from coconut and cashew kernel

The method described by Ityotagher and Terhile (14) was used in the production of oil from coconut and cashew kernels. Roasted cashew kernel was sorted and crushed into smaller particles using a blender. Coconut was crushed and blended into paste using a blender as well. The paste was boiled and then filtered using a double layer of cheese cloth to remove solid particles present in it. The filtrate was heated again until the water evaporated leaving the oil which was scooped into plastic bottles and stored at 8^{0}C until it was used.

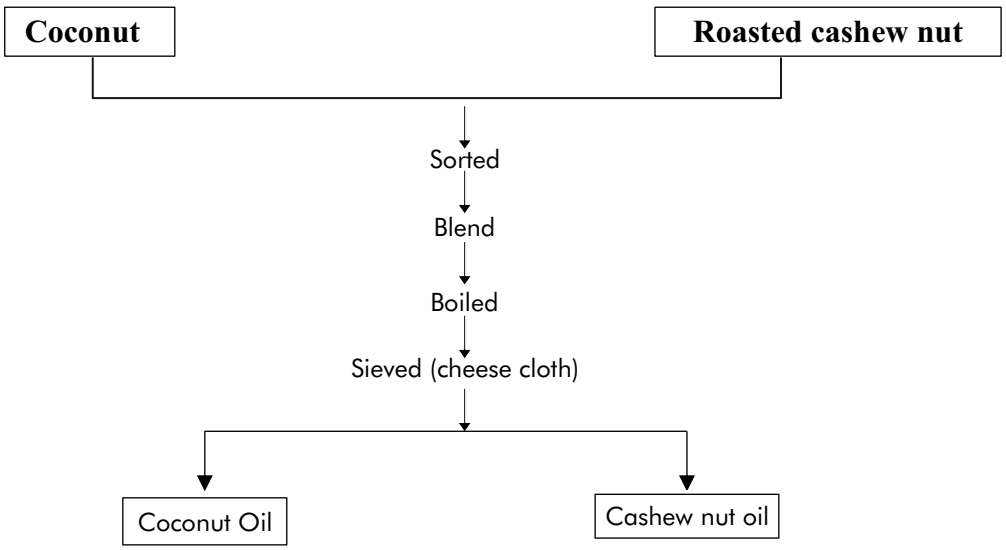

Fig 1: Extraction of coconut and cashew nut oil
Source: Ityotagher and Terhile (14).

Production of margarine

Production of margarine from coconut and cashew nut oil

As shown in Fig 2, coconut oil and cashew oil were put in a small pot. Below the pot, ice cubes were kept to make the mixture cool enough to frost. Then using a homogenizer, the mixture was homogenized. After that, skimmed milk powder (16.25% of total amount of oil), sugar (0.28%), egg yolk (4.5%), salt (0.75%) and lemon juice (3.75%) were added to the oils and mixed thoroughly with a spoon and cooled in the refrigerator as described by Maria *et al.* (15).

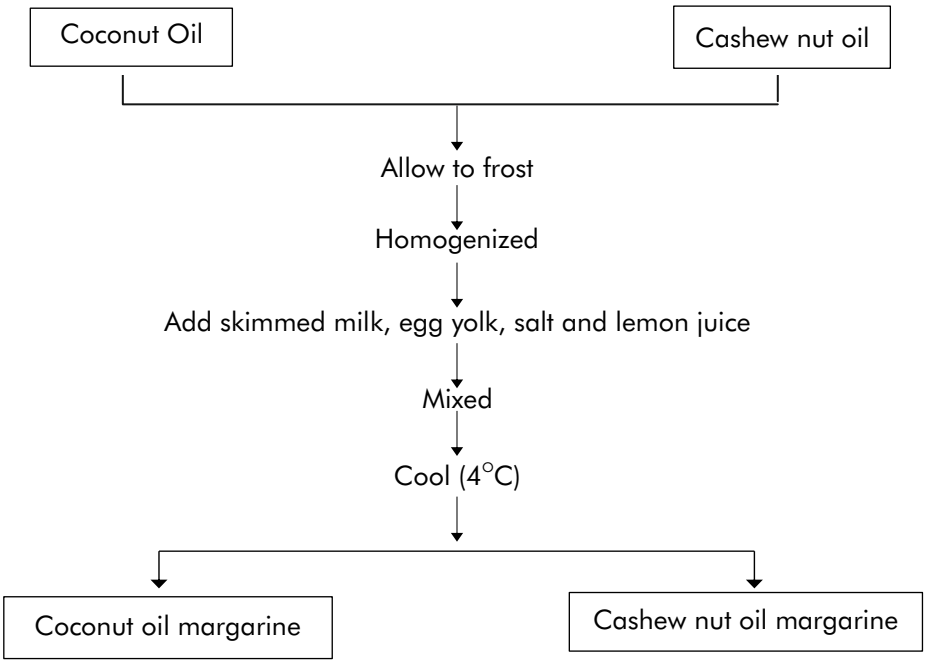

Fig 2: Production of coconut-cashew oil margarine
Source: Maria et al. (15)

Margarine blends for Preparation of Biscuits
The coconut-cashew nut margarine blends were prepared in the following ratios; 100:0 (sample B; 100% coconut oil margarine), 80:20 (sample C; 80% coconut and 20% cashew nut oil margarine), 70:30 (sample D; 70% coconut and 30% cashew nut oil margarine) and 60:40 (sample E; 60% coconut and 40% cashew nut oil margarine). Simas margarine (100% vegetable oil) served as the control (sample A).

Preparation of biscuits
The biscuits were prepared as per standard recipe of American Association of Cereal Chemists (AACC) (16). Wheat flour and baking powder were mixed together and sieved. Sugar and hydrogenated shortening (control) or coconut-cashew margarine (treatment) were creamed using a hand mixer (Sonifer hand mixer, SF-7010). The egg, milk and vanilla flavour were added and mixed at a slow speed for 5 minutes. The sieved flour and baking powder were added and mixed with clean hands. The dough was further placed on a stainless metal table and kneaded for 4 minutes until it reached full development. It was rolled with a rolling pin and cut into shapes using a circular metallic cutter. The cut dough was placed on fat greased pans and baked at 180°C for 25 minutes in a baking oven as shown in Fig 3.

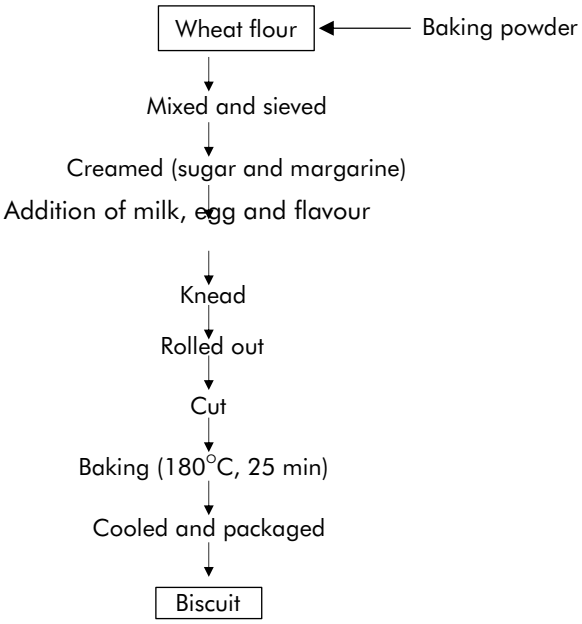

Fig 3: Preparation of biscuit Source: Sadaf (17)

Ingredients (g)	A	B	C	D	E
Flour	200	200	200	200	200
Sugar	30	30	30	30	30
Simas margarine (Control)	100	-	-	-	-
Coconutoil margarine	-	100	80	70	60
Cashew nut oil margarine	-	-	20	30	40
Egg	1 small	1 small	1 small	1 small	1small
Baking powder	0.5	0.5	0.5	0.5	0.5
Liquid milk	1 Tbsp	1Tbsp	1Tbsp	1Tbsp	1Tbsp

KEYS
A*= 100% Vegetable oil margarine (Simas margarine)*
B*= 100% Coconut oil margarine*
C*= 80% Coconut oil and 20% Cashew nut oil margarine*
D*=70% Coconut oil and 30% Cashew nut oil margarine*
E*= 60% Coconut oil and 40% Cashew nut oil margarine*

Determination of physical properties
The weight, diameter, height and spread ratio of the biscuits were determined according to the method of Ikuomola *et al*. (18).

Determination of proximate composition of the biscuit samples
The moisture, protein, crude fibre, fat and ash contents of samples were analysed using the standard analytical method described by Association of Official Analytical Chemists (AOAC) (19). Moisture was obtained gravimetrically after drying to a constant weight at 70°C in a hot air oven (DHG 9140A). Fat was determined using soxhlet extraction method with petroleum ether. Kjeldahl method and a nitrogen conversion factor of 6.25 was used for crude protein determination. Ash content was determined gravimetrically after the incineration of the samples in a muffle Furnace (Model SXL) at 550°C for 2 h. Enzymatic gravimetric method was utilized in the determination of crude fibre. Carbohydrate was calculated by difference {100 - (Crude protein + crude fibre + ash + fat)}.

Determination of Peroxide value (PV) and Free fatty acid (FFA) of the margarine samples
The PV and FFA (as oleic) of the margarine samples were determined using titration method as described by AOAC (19).

Sensory Evaluation of the biscuit samples
The sensory test was conducted by a twenty-member semi-trained panel consisting of students of the Department of Food Science and Technology and the Department of Home Science and Management, Rivers State University, Port Harcourt, Rivers Sate, Nigeria, who are regular consumers of biscuits. Biscuits baked with the margarine produced, along with the control sample were presented in coded form on white disposable plates and presented to the panelists. The assessors were also provided with portable water for rinsing the mouth in between evaluation. The quality attributes (taste, aroma, colour, texture, flavour, crispiness, appearance and overall acceptability) of the biscuits were evaluated and rated by the panelists in a 9-point hedonic scale of 1 to 9, with 9 as liked extremely and 1 as disliked extremely using the sensory scale.
Statistical analysis
All the analysis were carried out in duplicate. Statistical analysis was performed using Statistical Package for Service Solution (SPSS), version 26. Data obtained were subjected to Analysis of Variance (ANOVA) and difference between means were compared using Turkey's Multiple comparison tests with 95% confidence level.

RESULTS
Free Fatty Acid and Peroxide Value of margarine produced from blends of coconut and cashew nut oils
Table 2 below shows the results for Free fatty acid (FFA) and peroxide value (PV) of margarine samples produced from blends of coconut and cashew nut oil.
The FFA values ranged between 0.47- 1.84%, with sample B (100% coconut oil margarine) having the highest value and C (80% coconut oil and 20% cashew nut oil margarine) having the lowest value.
The PV ranged from 0.35 – 3.99 meq/kg with sample B having the least value and sample A (100% vegetable oil margarine) having the highest value.

Physical properties of biscuits prepared with shortenings produced from coconut and cashew nut oil margarines
The physical properties of biscuits produced with shortenings made from coconut and cashew nut oil margarine blends are shown in Table 3.
The spread ratio of the samples ranged from 6.81-10.09 with sample D (70% coconut oil and 30% cashew nut oil margarine) recording the lowest value and sample C having the highest value.
Weight of biscuits ranged from 4.18- 5.66 g with sample B having the lowest value and sample C having the highest value.
The height of biscuits ranged between 0.32-0.475 cm with sample C having the lowest value and sample D having the highest value.
Diameter of the biscuits ranged from 2.45- 3.21 cm with sample B having the lowest value and sample C having the highest value.

Proximate composition of biscuits prepared with shortenings produced from coconut and cashew nut oil margarines
The physical properties of biscuits produced with shortenings made from coconut and cashew nut oil margarine blends are shown in Table 4.
Moisture content ranged from 2.17 – 5.80%, with sample C having the lowest value and sample B having the highest value.
Ash content ranged from 0.75- 0.85% with sample D having the lowest value and sample C having the highest value.
The protein content ranged from 11.64 – 26.14% with sample E (60% coconut oil and 40% cashew nut oil margarine) having the lowest value and sample B

Table 2: Free fatty acid and peroxide values of margarine produced from blends of coconut and cashew nut oil

Samples	Free fatty acid (%)	Peroxide value (meq/kg)
A	$1.76^{ab}\pm0.09$	$3.99^{a}\pm1.13$
B	$1.84^{a}+0.78$	$0.35^{c}\pm0.07$
C	$0.47^{c}\pm0.07$	$1.25^{b}\pm0.49$
D	$0.84^{b}\pm0.00$	$0.80^{c}\pm0.00$
E	$0.83^{b}\pm0.60$	$0.40^{c}\pm0.14$

Values are means ± Standard Deviation of duplicate determinations. Means in the same column with different superscript are significantly different at $p<0.05$

Table 3: Physical properties of biscuits prepared with shortenings produced from coconut and cashew nut oil margarines

Samples	Spread ratio	Weight (g)	Height (cm)	Diameter (cm)
A	$8.62^{b} \pm 0.02$	$5.52^{c} \pm 0.00$	$0.39^{b} \pm 0.00$	$3.17^{a} \pm 0.00$
B	$7.01^{d} \pm 0.00$	$4.19^{e} \pm 0.02$	$0.36^{bc} \pm 0.03$	$2.45^{c} \pm 0.07$
C	$10.09^{a} \pm 0.01$	$5.66^{a} \pm 0.00$	$0.32^{c} \pm 0.00$	$3.21^{a} \pm 0.01$
D	$6.81^{e} \pm 0.03$	$5.44^{d} \pm 0.00$	$0.48^{a} \pm 0.00$	$3.15^{a} \pm 0.01$
E	$7.75^{c} \pm 0.01$	$5.56^{b} \pm 0.00$	$0.33^{c} \pm 0.01$	$2.62^{b} \pm 0.03$

Values are means ± Standard Deviation of duplicate determinations. Means in the same column with different superscript are significantly different at $p<0.05$

Table 4: Proximate composition (%) of biscuits prepared with shortenings produced from coconut and cashew nut oil margarines

Sample	Moisture	Ash	Crude protein	Fat	Crude fibre	Carbohydrate
A	$2.30^{b}\pm0.14$	$0.75^{a}\pm0.14$	$13.02^{b}\pm0.22$	$24.38^{a}\pm0.88$	$6.49^{c}\pm0.43$	$53.06^{a}\pm0.06$
B	$5.80^{a}\pm0.00$	$0.80^{a}\pm0.07$	$26.14^{a}\pm0.22$	$22.63^{a}\pm0.39$	$10.27^{b}\pm0.13$	$34.36^{b}\pm0.36$
C	$2.17^{b}\pm0.18$	$0.85^{a}\pm0.14$	$13.02^{b}\pm0.22$	$19.58^{b}\pm0.48$	$9.25^{b}\pm0.73$	$55.13^{a}\pm0.66$
D	$5.27^{a}\pm0.04$	$0.75^{a}\pm0.00$	$12.11^{c}\pm0.18$	$17.49^{b}\pm1.13$	$8.65^{b}\pm0.70$	$55.72^{a}\pm1.63$
E	$4.75^{a}\pm0.71$	$0.77^{a}\pm0.04$	$11.64^{c}\pm0.13$	$14.96^{c}\pm0.30$	$12.46^{a}\pm0.16$	$55.42^{a}\pm1.33$

Values are means ± Standard Deviation of duplicate determinations. Means in the same column with different superscript are significantly different at $p<0.05$

having the highest value.
Fat content ranged from 14.96 – 24.38% with sample E having the lowest value and sample A having the highest value.
Crude fibre content ranged between 6.49 – 12.46% with sample A having the lowest value and sample E having the highest value.
Carbohydrate content ranged from 34.36 – 55.72% with sample B having the lowest value and sample D having the highest value.

Proximate composition of biscuits prepared with shortenings produced from coconut and cashew nut oil margarines

The physical properties of biscuits produced with shortenings made from coconut and cashew nut oil margarine blends are shown in Table 4.
Moisture content ranged from 2.17 – 5.80%, with sample C having the lowest value and sample B having the highest value.
Ash content ranged from 0.75- 0.85% with sample

D having the lowest value and sample C having the highest value.
The protein content ranged from 11.64 – 26.14% with sample E (60% coconut oil and 40% cashew nut oil margarine) having the lowest value and sample B having the highest value.
Fat content ranged from 14.96 – 24.38% with sample E having the lowest value and sample A having the highest value.
Crude fibre content ranged between 6.49 – 12.46% with sample A having the lowest value and sample E having the highest value.
Carbohydrate content ranged from 34.36 – 55.72% with sample B having the lowest value and sample D having the highest value.

Sensory evaluation of biscuits prepared with shortenings produced from coconut and cashew nut oil margarines

The physical properties of biscuits produced with shortenings made from coconut and cashew nut oil margarine blends are shown in Table 5.
Taste and aroma ranged from 6.3 – 7.8 and 6.55-8.05 respectively with sample E recording the lowest value and sample A recording the highest value.
Colour ranged from 5.7-8.05 with sample E having the lowest value and sample D having the highest value.
Texture ranged from 6.3-7.8 with sample E having the lowest value and sample B having the highest value.
Flavour ranged from 6.05-7.45 with sample E having the lowest value and sample A having the highest value.
Crispiness ranged from 6.4-7.55 with sample D having the lowest value and samples A and B having the highest value.
Appearance and overall acceptability of the samples ranged from 5.85-8.0 and 6.1-7.6 respectively, with sample E having the lowest value and B having the highest value.

DISCUSSION

High FFA content in fat may cause oxidation and lead to development of offensive taste and flavour in the oil (20). Low FFA in fat indicates that the fat will be stable over a long period of time and protect against rancidity (21). Blending coconut oil with cashew nut oil reduced the FFA value of the margarine samples, and were similar to 0.56-0.98% reported by Miyanui et al. (5) for margarine produced with blends of avocado peel and virgin coconut oil. High quality fats are low on FFA, the lower the FFA, the more acceptable it is to man in terms of palatability (21). Hence, the margarine produced from blends of coconut and cashew nut oils are of higher quality than the 100% vegetable oil and 100% coconut oil in this study.
Peroxide value of fats indicate the degree of primary oxidation and the likeliness of the fat becoming rancid. The standard for margarine in terms of peroxide index is set at a maximum limit of 4 meq/kg (5). All the samples had PVs below the maximum limit hence they were of good stability. Sample A (3.99 meq/kg) however was close to the threshold and will tend to go rancid faster than the other samples.
Spread ratio is used to determine the ability of a biscuit to rise (22). The higher the spread ratio of biscuits the more desirable it is. Sample C with the highest spread ratio of 10.09 will indicate low dough viscosity (23), as doughs with lower viscosity cause high spread ratio and vice versa. There was significant difference ($p<0.05$) between samples, in their spread ratios.
The weight of biscuit is affected by the amount of air incorporated during the baking process. The less air incorporated the heavier the biscuit. Blending coconut and cashew nut margarine increased the weight of the biscuits which were similar to 4.48-5.41g of cookies reported by Orisa *et al*. (23) for cookies produced from flour blends of wheat and defatted African elemi.
Melting point of lipids used in baking could affect the height of the baked product. Lipids with low melting point are not able to absorb air bubbles. This allows air to escape before dough expansion can begin resulting in rupture and lower height of biscuit (24). The low heights of the biscuit samples can be attributed to the low melting points (10-25℃) of the oil used in the margarine production (25, 26).
Blending coconut oil margarine with cashew nut oil margarine increased the diameter of the biscuit samples, and were similar to 3.03-3.10 cm reported by Orisa *et al*. (23) for cookies produced from blends of wheat ad defatted Arican elemi flours.
Biological agents and chemical reactions leading to deterioration and spoilage of food are water dependent. The low moisture content observed in the biscuit samples (2.17-5.80%) indicates that the samples will have long shelf life, as according to Ayo-Omogie and Odekunle (27), bakery products with moisture less than 13% are stable from moisture-dependent deterioration.
The ash content is a measure of all mineral present in a product (28). There was no significant difference ($p>0.05$) in the ash content of all samples, sample C however had the highest value (0.85%).
Blending of coconut margarine with cashew nut

Table 5: Sensory evaluation of biscuits prepared with shortenings produced from coconut and cashew nut oil margarines

Samples	Taste	Aroma	Colour	Texture	Flavour	Crispiness	Appearance	Overall acceptability
A	7.80 ^{a} ± 1.01	8.05 ^{a} ± 1.05	7.85 ^{a} ± 1.03	7.50 ^{a} ± 1.39	7.45 ^{a} ± 1.14	7.55 ^{a} ± 1.14	7.85 ^{a} ± 1.03	7.56 ^{a} ± 0.89
B	7.30 ^{ab} ± 0.97	7.60 ^{ab} ± 1 09	7.75 ^{a} ± 0.96	7.80 ^{a} ± 0.89	7.30 ^{a} ± 1.08	7.55 ^{a} ± 0.99	8.00 ^{a} ± 0.97	7.60 ^{a} ± 0.56
C	6.85 ^{bc} ± 1.34	7.05 ^{bc} ± 1.39	6.90 ^{b} ± 1.29	6.90 ^{ab} ± 1.55	6.95 ^{ab} ± 1.31	6.95 ^{ab} ± 1.35	6.80 ^{b} ± 1.36	6.90 ^{a} ± 0.84
D	7.70 ^{ab} ± 1.75	7.60 ^{ab} ± 0.94	8.05 ^{a} ± 0.99	7.55 ^{a} ± 1.3	7.50 ^{a} ± 1.79	6.40 ^{b} ± 2.01	7.75 ^{a} ± 1.16	7.40 ^{a} ± 1.1
E	6.30 ^{c} ± 2.00	6.55 ^{c} ± 1.95	5.70 ^{c} ± 2.0	6.30 ^{b} ± 1.97	6.05 ^{b} ± 2.13	6.85 ^{ab} ± 2.36	5.85 ^{c} ± 1.75	6.10 ^{b} ± 1.50

Values are means ± Standard Deviation of duplicate determinations. Means in the same column with different superscript are significantly different at $p<0.05$

margarine reduced the protein content of the biscuit samples, and there was significant difference ($p<0.05$) between samples. Protein in food is very essential as it is responsible for body building and repair of worn-out tissues (29). They are important food components especially for children.

There was a significant decrease ($p<0.05$) in the fat content of biscuits produced from the blends of coconut and cashew nut oil. The fat content of samples decreased as the level of substitution increased. Ojinnaka and Agubolum (30), have reported 20.50% fat content in digestive biscuits. This value is in agreement with that obtained from the biscuit samples produced therefore yielding a desirable fat content of the product. Fat plays a significant role in determining the shelf life of food products and as such, relatively high fat content could be undesirable in baked food products. This is because fat can promote rancidity in food leading to development of unpleasant and odorous compounds (30).

The crude fibre content of the samples was relatively higher than the control (sample A). This could be attributed to the inclusion of coconut oil in the margarine formulation. Coconut is known to have higher content of fibre; this implies that the biscuits contain the appropriate amount of fibre which is of good value to the consumer. The fibre is important in enhancing bowel movement and in ameliorating diabetes, atherosclerosis and hypertension (31).

There was significant difference ($p<0.05$) between the control (sample A), the coconut-cashew nut margarine blends and the coconut margarine. Blending coconut and cashew nut margarine increased the carbohydrate content of the biscuit samples. The high carbohydrate content of the samples suggests a high energy content of the biscuits (32). High-energy foods tend to have a protective effect in the optimal utilization of other nutrients (29). This means the biscuit may serve as a good source of energy for consumers.

Sensory analysis is an important criterion for assessing quality in the development of new products and for meeting consumer requirements (32). Values ranges from 6.55-8.05 with no significant difference. There was a significant decrease ($p<0.05$) in the values for aroma showing that the samples with blends of coconut and cashew nut shortenings were liked the least, except for sample D that was ranked 7.60 with the 100% coconut shortening.

Sample D had the highest value (8.05) for colour, which suggests that it was considered most attractive and appealing to the panelists, when compared to the other samples. Colour is the most important sensory attribute that influences consumer preference and acceptance of any product especially in food products. It is one sensory attribute consumers explore in purchasing new products due to its aesthetic appeal. Sample E was scored the lowest for colour (5.70) and this explain why it also recorded the least overall acceptability score (6.10) This finding agrees with Zoulias *et al.* (33) who opined that colour is a vital quality trait of biscuits.

When compared with the other samples, sample A was ranked best (7.80) for taste. This could be due to the fact that the panelists were more familiar with the taste of biscuit produced with shortening from vegetable oils. Significant difference ($p<0.05$) existed between samples. Hossain et al. (2016) had earlier opined that the variance in taste of biscuits can be a result of levels of substitution of raw materials employed in its preparation. It can therefore be concluded that the taste of the biscuits was affected by the level of substitution of margarine used in its preparation.

The blending of coconut and cashew nut margarine reduced the texture and crispiness rating of the samples when compared with the 100% coconut margarine. Overall acceptability scores showed that shortening produced from 70% coconut and 30% cashew nut margarine was liked best when compared with the 100% vegetable margarine and 100% coconut margarine. Sample E was scored the lowest and differed significantly ($p<0.05$) from the other samples.

CONCLUSION

Coconut-cashew oil margarine was used as shortening to produce biscuits. The result showed that the blend of coconut and cashew oil for margarine production improved the quality of the biscuits produced. The biscuits produced have increased nutrient content which is desirable for good health and well-being of consumers. This study shows that the biscuits produced from coconut and cashew oil blends at 70:30 was the most acceptable among the other biscuit samples and it had a good fibre, ash and carbohydrate value. The use of this margarine as a substitute in biscuit will go a long way in enhancing the nutrition of the consumer.

REFERENCES

1. Obinna-Echem, P. C., Amadi, A. O., Ekuma, C. C., and Fyne-Akah, H. (2024). Quality Attributes of Wheat-Tigernut Flour Blends and Chin-Chin Produced from the Blends. IPS Journal of Nutrition and Food

Science, 3(1), 102–109. https://doi.org/10.54117/ijnfs.v3i1.39.
2. Moncel, B (2022). What is Shortening? A Guide to Buying and Cooking with Shortening. *The Spruce eats*. https://www.thespruceeats.com/what_is_shortening-1328458#:~:text=and%20vegetable%20oils.-,Varieties,and%20cake%20or%20icing%20shortening. *Assessed 15/08/2024*
3. Toma, M.A, Amin, M.D and Alim, M.A. (2020). Evaluation of Margarine Quality Prepared from Sunflower and Coconut Oil. Asian Food Science Journal, 15(1): 20-28. https://doi.org/10.9734/AFSJ/2020/v15i130142
4. Adhikari, P., Shin, J.A., Lee, J.H., Hu, J.N., Zhu, X.M. and Akoh, C.C. (2010). Production of Trans-Free Margarine Stock by Enzymatic Interesterification of Rice Bran Oil, Palm Stearin and Coconut Oil: Trans-Free Margarine Produced by Interesterification. Journal of the Science of Food and Agriculture, 90, 703-711.
5. Miyanui, S., Ngwasiri, P., Muala, W., Ngangmou, N., Ambindei, W. and Ngassoum, M. (2024). Extraction, Production and Quality Evaluation of Margarine from Oil Extracted from Waste Biomass Peels of Avocado and Virgin Coconut Oil, Using Chitosan from Reared Shells as Preservative. Journal of Agricultural Chemistry and Environment, 13, 142-168. doi: 10.4236/jacen.2024.131010.
6. Emelike, N.J.T., Barber, L.I. and Ebere, C.O. (2015). Proximate, mineral and functional properties of defatted and undefatted cashew (*Anacardium occidentale Linn)* Kernel flour. European Journal of Food Science and Technology. 3(4): 11-19
7. Emelike, N.J.T. and Barber, L.I. (2018). Effect of cashew kernel and soybean oils on bloodstream cholesterol and triglyceride of Albino rats (*Rattus rattus*). Asian Food Science Journal 1(2): 1-6.
8. Emelike, N. J. T. and Akusu, M. O. (2019). Physicochemical, mineral and sensory characteristics of cashew nut milk. International Journal of Food Science and Biotechnology, 4(1), 1-6.
9. Nwosu, J.N., Iwouno, J.O., Uzoukwu, A.E., Anyanwu, C.O. and Osuchukwu, O.A. (2014). Evaluation of the Proximate and Sensory Properties of Spread Produced from Cashew Nut and Groundnut Blend. Austin Journal of Nutrition and Food Science 2(6): 10-31.
10. Boemeke L, Marcadenti A, Busnello FM, Bertaso C. and Gottschall A. (2015). Effects of coconut oil on human health. Open Journal of Endocrine and Metabolic Diseases, 5:84-87.
11. DebMandal, M. and Mandal, S. (2011). Coconut (*Cocos nucifera L.: Arecaceae*): In Health Promotion and Disease Prevention. Asian Pacific Journal of Tropical Medicine, 4:241-247.
12. Zaeromali, M., Nateghi, L. and Yousefi, M. (2014). Production of industrial margarine with low trans fatty acids and investigation of physicochemical properties. European Journal of Experimental Biology, 4(1):583-586.
13. Vasudevan, D.M. (2013). Coconut oil and health controversy. International Journal of Health and Rehabilitation Sciences, 2:157-164.
14. Ityotagher, P.A. and Chihichan, T. (2020). Production and Quality Evaluation of Margarine from Blends of Melon and Palm Kernel Oils. World Journal of Food Science and Technology, 4(3): 74.
15. Maria A.T., Md. Ruhul, A. and Md. Abdul S. (2020). Evaluation of Margarine Quality Prepared from Sunflower and Coconut Oil. Asian Food Science Journal. 15(1): 20-28.
16. AACC (2000). Baking Quality of Cookie Flour-Micro Method. *AACC Method 10-52,* pp.1-7.
17. Sadaf, J., Bibi, A., Raza, S., Waseem, K., Jilani, M.S. and Ullah, G. (2013). Peanut butter incorporation as substitute for shortening. International Food Research Journal, 20(5): 3243-3247
18. Ikuomola, D.S., Otutu, O.L. and Oluniran, D.D. (2017). Quality assessment of cookies produced from wheat and malted barley (Hordeum Vulgare) bran blends. Cogent food and agriculture.2017:3:1:1293471. https://10.1080/23311932.2017.1293471
19. AOAC. (2012). *Official Methods of Analysis*. Association of Official Analysis Chemists. 19th Ed. Washington D.C. USA.
20. Soon, C.C. and Kar, L.N. (2020). *Lipids and Edible Oils*. In Encyclopedia of Food Sciences and Nutrition (Third Edition), pp 345-353. Academic Press.
21. Aremu, M.O., Ibrahim, H. and Bamidele, T.O. (2015). Physicochemical

characteristics of the oils Extracted from some Nigerian Plant Foods. Chemical Process Engineering Research, 32, 22-25.
22. Bala, A., Gul, K. and Riar, C.S. (2015). Functional and sensory Properties of cookies prepared from Wheat flour Supplemented with Cassava and Water Chestnut Flours. Cogent Food Agriculture, 1: 1019815. http://dx.org/10.1080/23311932.2015.1019815
23. Orisa, C.A., Amadi, A.O. and Owuno, F. (2023). Physicochemical and sensory properties of cookies produced from blends of wheat and defatted African elemi pulp flours. International Journal of Food Science and Nutrition, 8(4) :16-24.
24. Zhong, H. (2013). Effect of lipid Source on the Sensory Quality of Baked Products. All Graduate Theses and Dessertation. 1504. https://digitalcommons.usu.edu/etd/1504
25. Ekpa, O.D. and Ekpe, U.J. (1996). Effect of coconut oil concentration on the melting point profile and fatty acid formation of palm oil. Nigerian Journal of Chemical Research, 1:9-12.
26. NHR (2019). Organic Cashew nut Oil: Safety Data Sheet. Pp.1-5 www.nhrorganicoils.com
27. Ayo-Omogie, H.N. and Odekunle, O.Y. (2015). Substituting wheat flour with banana flour: Effects on the quality attributes of doughnut and cookies. Applied Tropical Agriculture, 22(2):134-137.
28. Orisa, C.A., Amadi, A.O., Achinewhu, S.C. and Owunna, R.N. (2023). Effect of selected spices on the proximate composition, shelf life and sensory properties of cashew nut butter. Research Journal of Food Science and Nutrition, 8(3): 40-47. https://doi.org/10.31248/RJFSN2023.162
29. Wardlaw, G.M. (2012). *Perspectives in Nutrition*. 6th Ed Mc Gram Hill Companies, New York.
30. Ojinnaka, M.C. and Agubolum, F. (2013). Nutritional and Sensory properties of cashew nut-wheat based cookies. American Journal of Food and Nutrition. 3(3):127-134
31. Elleuch, M., Bedigian, D., Roiseux, O., Besbes, S., Blecker, C. and Attia, H. (2011). Dietary fibre and Fibre-rich by-products of food processing: Characterization, technological functionality and commercial applications. Review on Food Chemistry, 124:411-421.
32. Obinna-Echem, P.C., Enente, U.J., Amadi, A.O and Fyne-Akah, H. (2023). Effect of Processing Methods on the Quality Characteristics of Ogi from two Varieties of Millet. Research Journal of Food Science and Quality Contro (RJFSQC). 9 (3) 1-18.
33. Zoulias, E.I., Piknis, S and Oreopoulou, S.V (2000). Effect of sugar replacement by polyols and Acesulfane-k on properties of low-fat cookies. Science Food Agriculture Journal, 80(14):2049-2056.