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Proximate Composition And Organoleptic Properties Of Wheat Rock Cake Fortified With Cassava And Sesame Seeds Flour

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Abstract

The formula for the production of rock cakes was developed by the study cakes using composite flour of cassava/sesame at five levels of substitution (100:0:0, 90:4:6, 80:7:13, 70:12:18, and 70:15:25). Proximate composition and sensory properties were determined. The result of the proximate composition showed that the rock cake samples contained 19.32±28.54% moisture, 1.30±2.49% ash, 6.75±9.84% fat, 0.50±1.30% crude fiber, 7.67±16.15% crude protein, and 51.35±55.78% carbohydrate. The rock cake samples were evaluated using a 5-point hedonic scale. The data was analysed with ANOVA. The AOAC method was used to determine proximate compositions of the various rock cake samples. The results showed a significant difference between the two. The rock cake samples have a higher level of nutrient. The difference between the composite rock cake and the whole wheat rock cake is the amount of vitamins and minerals content. The sensory attributes of the rock cakes showed that a rock cake made with wheat-cassava-sesame blended flours was accepted. 4% and 6% could be supplemented with wheat flour in pastry preparation with no effect on the nutrients or sensory attributes.

Keywords: Wheat, Cassava, Sesame, Composite flour, rock cake, proximate composition, sensory analysis

Introduction

Consumer demand for food product quality in terms of flavour, safety, convenience, and nutrition is increasing, resulting in increased market rivalry for natural, healthy, and functional foods, one of which is rock cake [1]. By altering the rock cakes' composition, efforts are being undertaken to improve their nutritional value and functionality. Increased mineral content and protein availability for quality and availability are frequently achieved by raising the wheat grain ratio with various supplements [2]. Wheat, the primary ingredient in pastry making, is imported into Ghana at a significant expense in terms of foreign exchange earnings, resulting in high pastry prices. To make rock cake more affordable to low-income earners, which make up the majority of customers, new local nutrition sources that have been neglected and exploited as wheat alternatives for rock cake manufacture are needed.

Cassava (Manihot esculenta) is a commonly used drought-tolerant crop that can be grown on marginal soils and produces excellent yields even when growth circumstances are difficult [3]. In Africa, it is the most important vegetative grown food staple, and it is a major industrial crop in Latin America and Asia [4]. It is grown as a subsistence crop in underdeveloped nations around the world, with an estimated global population of 500 to 1,000 million people [5]. It has become the most common staple food crop in Sub-Saharan Africa and the South-West Indian Ocean islands [6], where it has formed the primary portion of traditional households' diet. Cassava flour has been effectively substituted for wheat (Triticum aestivum L.) in the production of rock cakes and sweets. It is a reliable and low-cost food supply that ensures global food security by meeting people's carbohydrate dietary needs, particularly in low-income nations [7]. Cassava has a wide range of uses in product diversification, from food to non-food items [8]. Cassava flour can be used to make cassava strips [9], pasta [10], biscuits [11], porridges [12], instant flour [13], and starch [14]. Due to physiological deterioration that occurs immediately after harvest, cassava has a short shelf life [15]. The presence of hydrogen cyanide (HCN) in roots also limits its application in food production. Proper storage conditions have yet to be established to address the significant postharvest losses of cassava roots. One way to get the most out of it is to turn the collected storage roots into value-added components right away.

The sesame plant (Sesamum indicum L.) is an annual herbaceous plant in the Pedaliaceae family [16]. Benniseed (Africa), benne (Southern United States), gingelly (India), gengelin (Brazil), sim-sim, semsem (Hebrew), and tila (Sanskrit) are all names for sesame seed [17]. Because of its highly stable oil content, nutritious protein (rich in methionine, tryptophan, and valine), and savory nutty roasted flavour, it is one of the world's most important and oldest oilseed crops [18] [19. It has been used extensively for thousands of years as a seed of worldwide significance for edible oil, paste, cake, confectionery purposes, and flour [19] [20]. Sesame (Sesamum indicum L.) is an annual herb. Sesame seeds are high in copper, manganese, calcium, phosphorus, iron, zinc, and vitamins, among other minerals [21] [22]. Sesame seeds also include cholesterol-lowering lignans (sesame and sesamolin), which can help to avoid excessive blood pressure [23] [24]. The proximate composition of sesame seeds reveals that they contain significant amounts of proteins, which can be used to generate composite flour with greater protein content for rock cake production [25] [26]. Sesame cultivars' physicochemical makeup has received minimal scientific research. This study's scientific findings may be valuable for sesame production, marketing, the food industry, human nutrition, and maximum utilization, particularly for the benefit of sesame-growing countries. As a result, sesame seed and cassava flour can be used to supplement processed wheat flour in the production of rock cakes, adding fiber, resistant starch, vital minerals, and vitamins. The aim of the study was to undertake proximate composition and organoleptic attributes of wheat rock cake fortified with cassava and sesame seeds flour.

Materials and Methods

Source of materials

Wheat flour, cassava tubers (M. esculenta), and white sesame seeds (Sesamum indicum L) were all bought at the Kumasi Central Market in Ghana's Ashanti area. Other ingredients were purchased from a super market in Tafo, Ghana, including salt, margarine, nutmeg, milk powder, egg, baking powder, and vanilla essence.

Processing of cassava into flour

The cassava roots were ground into flour following [27] procedure. Fresh cassava roots were peeled, rinsed, grated, water squeezed out and sun-dried before being dried for 12 hours at 45°C in an oven. A hammer mill was used to mill the dried grits and the flour was sieved and packaged for use.

Defatted sesame seeds flour production

With minor modifications, defatted sesame seeds flour was made according to the method reported by [28]. To achieve full fat sesame seeds flour, sesame seeds were sorted, soaked (6 hours) in clear tap water at room temperature, cleaned, drained, sun dried for 6 hours, then milled into flour using an attrition mill (Globe P44, China). 0.45mm mesh was used to filter the full fat sesame seeds flour. For one hour, 500 grams of flour were defatted in one liter of petroleum ether. The defatted sesame seeds flour was dried overnight in an oven and processed into fine powder with a kitchen blender (Philips, model HR 1702) before being stored in plastic containers with lids until needed.

Composite flour blends formulation

Shittu et al.'s [29] approach was used to make the flour blends. On a percentage dry weight basis, refined wheat, cassava, and defatted sesame seeds flour were combined into five ratios: 90:4:6, 80:8:12, 70:13:17, and 60:15:25, with 100% refined wheat flour serving as the control and used in the preparation of the various rock cake examples.

Table 1 Formulation of ingredients for rock cake preparation

INGREDIENTS	KO	K1	K2	K3	K4
Soft wheat flour (g)	100	90	80	70	60
Cassava flour (g)	0	4	8	13	15
Sesame seed flour (g)	0	6	12	17	25
Margarine (g)	6	6	6	6	6
Baking powder(g)	10	10	10	10	10
Salt(g)	1	1	1	1	1
Water (mL)	150	150	150	150	150
Nutmeg (g)	1	1	1	1	1
Vanilla essence (mL)	1	1	1	1	1
Sugar (g)	40	40	40	40	40
Eggs (g)	20	20	20	20	20

Rock cake samples: K0 (100% wheat flour, 0% cassava flour and 0% sesame seeds flour), K1 (90% wheat flour, 6% cassava flour and 4% sesame seeds flour), K2 (80% wheat flour, 13% cassava flour and 7% sesame seeds flour), K3 (70% wheat flour, 18% cassava flour and 12% sesame seeds flour) and K4 (60% wheat flour, 25% cassava flour and 15% sesame seeds flour).

Methods of preparing rock cake

The rock cakes were made with specially developed wheat, cassava, and sesame flour combinations. With minimal adjustments, rock cakes were made according to the AOAC's [30] procedure. Sifted wheat flour was combined with fat and mixed together. Before adding sugar, milk, vanilla essence, sugar, and water, the eggs were beaten. To make soft dough, the mixture was mixed into the flour. The dough was divided into portions and baked in a preheated oven at 220°C in a greased baking patty pan. The baked goods were allowed to cool before being packaged for further investigation. The composite rock cakes were made using the same techniques.

Proximate Composition

AOAC [31] was used to analyse the proximate composition (moisture, protein, fat, fiber, and carbohydrate) of the wheat-cocoyam-Bambara groundnut composite bread

Oven Drying Method Moisture Content and Total Solids

Two 2 grams (g) of the bread samples were transferred in to the previously dried and weighed dish. The bread was cooked for 5 hours at 105 degrees in a thermostatically controlled oven. The dish was removed and weighed after cooling to room temperature in a desiccator. It was then dried for another 30 minutes, chilled, and weighed once again. The process of drying, cooling, and weighing was repeated until the weight remained constant. (Alternatively, samples could be dried for at least 8 hours in a thermostatically controlled oven to produce a constant weight.) The results were double-checked, and the average was found.

Calculations

% Moisture (wt/wt) = wt $\underline{H_2O \text{ in sample}}$ ×100
Wt of wet sample
% Moisture (wt/wt) = $\underline{\text{wt of wet sample - wt of dry sample}}$ ×100
Wt of wet sample
% Total solids (wt/wt) = $\underline{\text{wt of dried sample}}$ ×100
Wt of wet sample
Where wt = Weight of sample/spread

Ash content

Two grams (2g) of the cookies sample was weighed into a tarred crucible and was pre-dried. Crucibles were placed in cool muffle furnace using tongs, gloves and protective eyewear. The crucibles Ignited for 2 hours at about 600 degrees Celsius. Muffle furnace was turned off and opened when temperature dropped to at least 250^{o}C preferably lower. The door was carefully opened to avoid losing ash that may be fluffy. Safety tongs was used to transfer crucibles to a desiccator with a porcelain plate and desiccant. Desiccator was closed and crucibles were allowed to cool prior to weighing.

Calculations

%Ash = $\underline{\text{wt of ash}}$ ×100
Wt of sample

%Ash = (wt of crucible + ash) – wt of empty crucible ×100
(wt of crucible + sample) – wt of empty crucible
Where wt = Weight of sample

Fat content: soxhlet extraction

Previously dried (air oven at 100°C) 250 ml round bottom flask was weighed accurately. Two grams (2g) of dried sample to 22 ×80mm paper thimble or a folded filter paper was weighed. A small piece of cotton or glass wool was placed into the thimble to prevent loss of the sample; 150ml of petroleum spirit B.P 40-60°C was added to the round bottom flask and assembled the apparatus. A condenser was connected to the soxhlet extractor and reflux for 4 - 6 hours on the heating mantle. After extraction, thimble was removed and recovered solvent by distillation. The flask and fat/oil was heated in an oven at about 103°C to evaporate the solvent. The flask and contents were cooled to room temperature in a desiccator. The flask was weighed to determine weight of fat/oil collected.

% Fat (dry basis) = fat/oil collected × 100
Weight of sample
% Fat (dry basis) = (wt of flask + oil) – wt. of flask × 100
Weight of sample

Crude fibre determination

Two grams (2g) of the sample from crude fat determination was weighed into a 750ml Erlenmeyer flask. Two hundred milliliters (200ml) of 1.25% H_2SO_4 was added and immediately flask was set on hot plate and connected to the condenser. The contents were boiled within 1 minute of contact with solution. At the end of 30 minutes, flask was removed and immediately filtered through linen cloth in funnel and washed with a large volume of water. Filtrate (containing sample from acid hydrolysis) was washed and returned into the flask with 200ml 1.25% NaOH solutions. Flask was connected to the condenser and was boiled for exactly 30 minutes. It was then filtered through Fischer's crucible and washed thoroughly with water and added 15ml 96% alcohol. Crucible and contents was dried for 2 hour at 105 °C and cooled in desiccator and it was weighed. Crucible was ignited in a furnace for 30 minutes and after that it was cooled and reweighed.

% Crude fibre = weight of crude fibre × 100
Weight of sample
% Crude fibre = wt of crucible + sample (before – after) ashing × 100
Weight of sample
Where wt= Weight of sample/spread

Protein Determination

Digestion Method

The Kjeldahl technique was used to determine the crude protein content of the samples. The process consists of three fundamental steps: (1) digestion of the sample in sulfuric acid with a catalyst, which results in nitrogen conversion to ammonia; (2) distillation of the ammonia into a trapping solution; and (3) titration of the ammonia with a standard solution to determine its concentration. Percentage of crude protein content of the samples equals percentage nitrogen 6.25, according to this approach.

Carbohydrate content

The calculation of available carbohydrate (nitrogen-free extract-NFE) was made after completing the analysis for ash, crude fibre, ether extract and crude protein. The calculation was made by adding the percentage values on dry matter basis of these analysed contents and subtracting them from 100%.

Calculation:

Carbohydrate (%) =100 - (% moisture + % fat + % protein + % ash)

x. Calculation for dry basis = $\frac{(100 - \%\ moisture) \times wet\ basis}{100}$

Sensory Evaluation

The organoleptic characteristics of the bread samples were evaluated by a 20 member trained panelists drawn from Kumasi Technical Senior School, comprising both staff and students who were regular rock cake consumers. The whole wheat and composite breads were evaluated for taste, aroma, texture, crumb colour and general acceptability using a 5-point hedonic scale in which 5 = extremely liked and 1 = extremely disliked as previously used [32].

Statistical Analysis

The data obtained was subjected to Analysis of Variance (ANOVA) and Duncan Multiple range test was used to separate means where significant differences existed and data analyses was achieved using SPSS software version 16.0.

Results and discussion

The proximate profile of the various rock cake samples are presented in Table 2. The moisture content ranged from 19.32-28.54% with the control rock cake ($K_{0=}$ 100% wheat flour) having the highest moisture content of 28.54% while the least was for sample K4 (60% wheat flour, 15% cassava flour and 25% sesame seeds flour), with 19.32%. With the addition of sesame flour, the moisture level of the composite rock cake reduced significantly (p >0.05), which is a favourable quality characteristic since it may extend the product's shelf life. The low moisture level in foods could be due to some of the water being firmly devoted to food mediums, making it inaccessible to food pathogens' proliferative activity and possibly promoting the composite rock cake samples' long shelf life [33]. The high fat content of the sesame seeds (27.00g/100g) may have influenced negatively the rock cake samples' water retention [34]. The moisture level of wheat-cassava-sesame composite rock cake (19.32 to 26.28%) was lower than that of wheat-African yam bean composite bread samples (25.65 to 28.40%) and higher than the wheat-sorghum composite biscuit (10.24 to 11.24%) [35] [36]. There was a significantly different (P <0.05) in moisture contents of the control rock cake and the composite samples.

The overall mineral content in food is represented by ash, which is the inorganic residue left following either ignition or completes oxidation of organic materials in a food [37]. Mineral availability in the diet aids in the metabolism of macronutrients for energy release. The ash content increased significantly

(P<0.05) as the amount of cassava and sesame flour blends increased. Rock cake sample K4 (60% wheat flour, 15% cassava flour and 25% sesame seeds flour) recorded the highest amount of ash content (2.49%) followed by sample K3 (70% wheat flour, 12% cassava flour and 18% sesame seeds flour) with 2.15% while the control sample K0 (100% wheat flour, 0% cassava flour and 0% sesame seeds flour) recorded the least amount of ash content (1.30%). The Alozie et al. [38] and Mashayekh et al. [39] reported 1.18-1.38 percent, 4.28-5.97 percent, and 1.1-1.4% increases in ash content of wheat-sunflower, wheat-Bambara nut, and wheat defatted soy bread, respectively. The mineral components are essential to support the production of critical body cells and tissues, as well as build immunity to enhance the body's defensive mechanism, are reflected in the ash level of a food material.

The Fat content varied between 6.75-9.84% with a tock cake sample K4 (60% wheat flour, 15% cassava flour and 25% sesame seeds flour) having the highest amount of fat content (9.84%) while the least was the control (6.75%). It was observed that increasing the proportions of cassava and sesame flour resulted in the high fat content of the composite rock cake. The high fat content (61.21 g/100g) of sesame seeds can be linked to the high fat content (61.21 g/100g) of wheat-cassava-sesame composite rock cakes [40]. The energy density, flavour, and scent of a dietary material are influenced by its fat content, as evidenced by the energy content and sensory qualities of wheat-cassava-sesame composite rock cakes. The high fat content of wheat-cassava-sesame composite rock cakes may boost consumption of beneficial unsaturated fats/fatty acids, which promote vigour and productivity while reducing weight gain associated with unhealthy fat consumption.

The fiber contents of the various rock cake samples ranged from 0.50-1.30%, of which sample K4 (60% wheat flour, 15% cassava flour and 25% sesame seeds flour) recorded a high fiber content 0f 1.30% while the control rock cake fiber content was 0.50%. The results revealed a corresponding increase in fiber as the amount of cassava and sesame flour increased. The physiological role of crude fiber is to maintain intestinal distention for appropriate peristaltic action of the gastrointestinal tract. Okon [41] stated that a low-fiber diet is bad because it can promote constipation, and that such diets have been linked to colon disorders such as piles, appendicitis, and cancer. As a result, a diet rich in dietary fibre may be able to help prevent or alleviate certain illnesses.

The protein content in all the rock cake samples differed significantly (P<0.05) from each other. The protein content ranged from 7.67-16.5%. Rock cake sample K4 (60% wheat flour, 15% cassava flour, and 25% sesame seeds flour) recorded the highest protein content (16.15%) whereas the control rock cake sample was 7.67%. The protein content of the composite rock cake samples increased significantly (p<0.05) with the incorporation of cassava and sesame flour. Sesame seeds are said to have higher protein content than wheat [40] (FAO, 2012). In underdeveloped areas where animal protein dietary supplies are chronically inadequate, the high protein content of wheat-cassava-sesame composite rock cakes could be used to address inadequate protein intake and its related illness condition(s) (Protein Energy Malnutrition (PEM)). The increase in protein content of the composite rock cake samples matched [42] Nadeem et al., (2010)'s findings of a 14.59-15.62% increase in wheat-sunflower protein content. This study's protein content was higher than that of wheat-defatted flour. This study's protein level was higher than that seen in wheat-defatted soy bread [39] (Mashayekh et al., 2008). Sesame seeds flour contains high levels of amino acid, implying that the rock cake samples contain protein of high biological value and could help meet the human requirement for critical amino acids. Protein is an essential component for the development of new cells to replace worn-out body cells and tissues, as well as the framework for muscles since a shortage of protein causes stunted growth in both men and women [43] (Nweke et al., 2011). Incorporating cassava and sesame seeds into the manufacturing of rock cakes would enhance their use, broaden their culinary uses, and increase agricultural income. Incorporating cassava and sesame seeds into rock cake production will enhance its use, vary its food applications, and raise the income base of farm families participating in its production, all while raising the country's Gross Domestic Product (GDP) and diversifying its income sources.

The carbohydrate content ranged from 51.35-55.78% of which rock cake sample K4 (60% wheat flour, 15% cassava flour and 25% sesame seeds flour) having the highest carbohydrate content (55.78%) and the control sample recorded the lowest carbohydrate mean value of 51.35%. the findings revealed that statistically, there was a significant difference ($P<0.05$) between the control rock cake sample (K0) and the composite samples (K1, K2, K3, and K4). The increase in the carbohydrate content of the composite rock cake samples could be attributed to the proportions of cassava and sesame flour incorporation. The finding is dissimilar to the findings of [38] on decrease in carbohydrate content of wheat-Bambara nut breads. The glycemic index of a food is determined by its carbohydrate content (i.e. its impact on blood glucose level upon digestion and absorption). The carbohydrate composition of wheat-sesame composite bread revealed that just a small amount of glucose is released into circulation during digestion, allowing diabetics to keep their blood sugar levels steady during and after eating.

Table 2: Proximate composition of the composite rock cake

Samples	**Moisture** (%)	**Ash** (%)	**Fat** (%)	**Fiber** (%)	**Protein** (%)	**CHO** (%)
K_0	28.54a	1.30e	6.75a	0.50e	7.67e	51.35e
K_1	26.28^b	1.60^d	6.89^b	0.53d	9.45^d	52.55^d
K_2	23.98^c	1.92c	7.84^c	0.90c	11.56^c	53.39^c
K_3	21.15^d	2.15b	7.89d	1.06b	13.02^b	54.96^b
K_4	19.32^e	2.49a	9.84^e	1.30a	16.15^a	55.78^a

Values represent means and standard deviation replicate readings for various parameters. Values in the same column with different superscripts are significantly different ($p>0.05$). Rock cake samples: K0 (100% wheat flour, 0% cassava flour and 0% sesame seeds flour), K1 (90% wheat flour, 4% cassava flour and 6% sesame seeds flour), K2 (80% wheat flour, 7% cassava flour and 13% sesame seeds flour), K3 (70% wheat flour, 12% cassava flour and 18% sesame seeds flour) and K4 (60% wheat flour, 15% cassava flour and 25% sesame seeds flour).

The organoleptic attributes of the various rock cake samples

Sensory features of wheat-cassava-sesame rock cakes substitution at various degrees were investigated, including aroma, colour, texture, taste, and overall acceptance of the final product (Table 3). All sensory characteristics scores declined when the cassava and sesame flour ratio increased, according to the findings. Based on colour (4.14), texture (4.40), and aroma, the results revealed that 100% wheat rock cake (control) was preferred (3.27). Sample K1 (90:4:6) was the most preferred for colour (3.45), taste (4.40), texture (4.49), and aroma (3.45), as well as overall acceptability, among the wheat-cassava-sesame composite rock cake samples. The taste result agrees with [44], who stated that the taste is the most appreciated attribute. The composite rock sample received the highest overall acceptance score. There was no statistical difference between the whole wheat rock cake sample and the composite sample K1 ($P>0.05$). The composite rock cake with a larger percentage of cassava and sesame flour inclusion was ranked lowest for all of the characteristics measured during sensory evaluation of the rock cake samples (60:15:25). The high ash content of the composite rock cake samples may explain the decline in color with increasing degrees of cassava and sesame flour substitution. Overall, the participants chose rock cake sample K1 (90:4:6) as their favourite. Results from the sensory analysis revealed that rock cake can be prepared by supplementing 4% and 6% cassava and sesame seeds flour in pasty making without an adverse effect on the nutritional qualities.

Table 3: Sensory attributes of the wheat, cassava and sesame composite seeds rock cake

Samples	Aroma	Colour	Texture	Taste	Overall Acceptance
K_0	4.14^{a}	4.26^{a}	4.40^{d}	4.43b	4.40b
K_1	3.45^{b}	4.35^{b}	4.39^{b}	4.40^{b}	3.36b
K_2	3.30^{c}	3.13^{c}	3.48^{a}	3.34^{a}	3.28a
K_3	3.35^{d}	3.05^{d}	3.36^{c}	3.28^{b}	3.24b
K_4	2.15^{e}	2.11^{e}	2.95^{e}	2.50^{e}	2.10e

Values represent means and standard deviation replicate readings for various parameters. Values in the same column with different superscripts are significantly different ($p>0.05$). Rock cake samples: K0 (100% wheat flour, 0% cassava flour and 0% sesame seeds flour), K1 (90% wheat flour, 4% cassava flour and 6% sesame seeds flour), K2 (80% wheat flour, 7% cassava flour and 13% sesame seeds flour), K3 (70% wheat flour, 12% cassava flour and 18% sesame seeds flour) and K4 (60% wheat flour, 15% cassava flour and 25% sesame seeds flour).

Conclusion

Based on the results, a partial substitution up to 4% and 6% of wheat flour can be made in rock cake with no change in its physical and sensory qualities. The highest score in taste and overall acceptability was recorded with the substitution of 4% and 6% of sesame flour. The rock cakes would give the body sufficient quantities of the proteins it needs to function. The rock cake's nutrition attributes increased due to a continuing increase in the level of sesame cake flour and wheat flour. The rock cakes would give the body sufficient quantities of the proteins it needs to function. The rock cake's nutrition attributes increased due to a continuing increase in the level of sesame cake flour and wheat flour.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare

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