JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 08, ISSUE 04, 2021

NUTRITIONAL COMPOSITION AND CONSUMER ACCEPTABILITY OF ROCK CAKE PRODUCED FROM WHEAT, BAMBARA GROUNDNUT AND COCOYAM BLENDED FLOUR

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Abstract

Pastries are produced from wheat, a cereal cultivated largely in temperate regions but imported by countries in the tropics with adverse climatic conditions. This study aimed to carry out the nutritional composition and sensory analysis of rock cake produced from Wheat, Bambara groundnut, and cocoyam blended flour. Rock cake samples were produced and coded as DD1 (100:0:0), DD2 (80:12: 8%), DD3 (60:30:10), DD4 (40: 40:20) and DD5 (20:50:30) with sample DD1 serving as a control. Proximate composition of rock cake samples was determined using the (AOAC, 2007) method. Proximate analysis revealed 11.49-23.46% moisture, 1.25-3.86% ash, 6.37-15.38% fat, 1.28-5.44% fiber, 7.85-14.95% protein, and 50.89-60.55% carbohydrate contents. A nine-point hedonic scale was used to evaluate the acceptability of the rock cake samples with 9-representing like extremely and 1- dislike extremely. Data were subjected to ANOVA and the significant differences were determined using Duncan's multiple range tests. The results from the study revealed that increasing cocoyam and Bambara groundnut flour resulted in a corresponding increase in ash, fat, fiber, protein, and carbohydrate contents of the fortified rock cake samples. The sensory evaluation showed no significant differences between the control and rock cake samples made with 8% cocoyam and 12% Bambara groundnut flour. However, the control rock cake and other composite samples were statistically different in all the parameters assessed. It was concluded that rock cake made with 100% wheat flour and that of 8% cocoyam and 12% Bambara groundnut flour incorporation were accepted

Keywords: wheat flour, cocoyam flour, Bambara groundnut, rock cake, sensory evaluation

Introduction

In many celebrations and fast-food sectors, cakes are served as snacks (Kiin-Kabari and Banigo, 2015). There are a variety of cake recipes to choose from, each with its classification based on

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ingredients and cooking methods (Eke et al., 2008). They are made by mixing margarine with flour, beaten eggs, sugar, and baking powder (Kiin-Kabari and Banigo, 2015). Wheat (Triticumaestivum) enhances the worldwide diet with more calories and proteins than other regularly consumed grains (Kumar et al., 2011). Wheat grain contains a lot of nutrients, specifically protein (Koehler and Wieser, 2013). Products such as semolina, bread, scones, noodles, and other confectionery goods can all be prepared from it (Kumar et al., 2011; Sramkovaet al., 2009). Wheat is the cereal of choice for snack production; however, it cannot be produced in tropical areas, including Ghana, due to climate conditions. As a result, in areas where wheat is scarce, people rely on imports or avoid it entirely in their diets to make baked goods (Holt et al., 1992).
In Ghana, cocoyam (Xanthosomasagittifolium) is a common staple food. Its use in the preparation of rock cakes would reduce the need for imported wheat, promote its use for better health, and aid in the fight against nutritional deficiencies. When compared to flour made exclusively from one of these sources, a combination of flours made from legumes, tubers, or cereals offers a higher nutritious value (FAO, 1995). Moreover, flours derived from a mix of tubers and legumes are known to be high in protein and calories (Chinma et al., 2007). Cocoyam is a nutrient-dense food that provides considerable amounts of carbohydrates. It contains easily digestible starch, as well as considerable levels of nutritional fiber, protein, and vitamins B and C (Sefa-Dedeh&Sackey, 2004). Xanthosomasagittifolium is boiled, baked, fried, roasted, mashed into fufu, or processed into flour, according to Opoku-Agyemang, et al., (2004).

Bambara groundnut has about 14–24 g of dietary protein per 100g and is also a good source of phytochemicals such as phenolics, which have antioxidant effects (Diedericks&Jideani, 2013). Fresh, semi-ripe, and completely developed Bambara groundnut seeds are typically cooked or roasted. However, because of its extended cooking time, the use of Bambara groundnut is restricted (Ojimelukwe, 1999). In comparison to legumes like cowpea, the Bambara groundnut is underutilized. Drought tolerant and able to thrive in soils deemed unproductive for the cultivation of other popular legume species such as groundnuts (Arachis hypogea) and common beans, the Bambara groundnut offers significant agronomic advantages (Anchirinah et al., 2001). Innovative kinds of Bambara groundnut utilisation, according to Brough et al. (1993), may increase production. Bambara beans flour can be used to make Koose (fried bean cake) (Alobo, 1999), Moimoi (steamed bean cake) (Barimalaa et al., 2005), bread (Alozie et al., 2009), cookies (Kiin-Kabari&Giami, 2015). The functionality of Bambara groundnut flour is linked to its applicability in the development of various products (Eltayeb et al., 2011).

The search for alternatives to wheat flour in bakery and other culinary applications has become essential for economic, nutritional, and/or health reasons. Wheat prices on the global market have become erratic, according to Rodrick (2008), with prices doubling between 2005 and 2007, and increasing by 26% between October 2011 and October 2012. The commodity's price volatility puts pressure on developing economies, which rely significantly on imports to meet their wheat requirements. One potential solution has been to partially substitute wheat flour with flours from tuber crops and pulses. These underutilised crops are both abundantly available and reasonably priced. Flours from these indigenous crops can improve the nutritious profile of the composite flour produced. Furthermore, customers with wheat gliadins allergies will benefit from the usage of non-protein flour because their exposure to this wheat protein is minimised.

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This study aimed to carry out the nutritional composition and sensory analysis of rock cake produced from Wheat, Bambara beans, and cocoyam blended flour.

Material and methods

Materials

Cocoyam was purchased at a tuber market, sorted and washed, and stored in jute bags at room temperature (28°C) before being ground into flour. A small market in Kumasi provided soft wheat flour and other ingredients.

Bambara groundnut flour

Bambara groundnut seeds were separated, and the bean was steeped in distilled water for 24 hours before being dehulled by hand. The seeds were then boiled for 10 minutes, rinsed, and dried for 6 hours at 50°C in an air circulation oven. Using 0.25 mm sieves, the dried samples were milled and sieved into flour (Olaoye et al., 2006)

Cocoyam flour development

Cocoyam was hand-picked and rinsed under the tap. It was peeled by hand with a stainless steel knife, rinsed, and sliced to a uniform thickness (about 5 meters). To inactivate enzymes that could induce browning, the slices were blanched in hot water (80°C) for 5 minutes before chilling in cold water. The slices were dried overnight in a dry oven at 105°C after being placed on a stainless-steel tray. To make flour out of the dried cocoyam, a mortar and pestle were used. The flour was sifted and stored in a plain polythene bag until further analysis.

Formulation of composite flour blends

With various quantities of cocoyam and Bambara groundnut 0, 12, 20, 40, 50% and 0%, 8%, 10%, 20%, 30% addition in whole wheat flour, the blends of whole wheat flour, cocoyam flour, and Bambara groundnut flour were made. To get a homogeneous blend, the flours were carefully combined with the help of a Binatone food mixer. The samples were kept in an airtight container at (an ambient temperature of 302°C) and labeled until they were needed for rock cake preparation.

Table 1 ingredient for rock cake preparation

INGREDIENTS	KO	K1	K2	K3	K4
Soft wheat flour (g)	100	80	60	40	20
Cocoyam flour (g)	0	12	30	40	50
Bambara groundnut seed flour (g)	0	8	10	20	30

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Margarine (g)	50	50	50	50	50
Baking powder(g)	1	1	1	1	1
Sugar (g)	40	40	40	40	40
Water+ Milk (mL)	150	150	150	150	150
Vanilla essence (mL)	1	1	1	1	1
Eggs	2	2	2	2	2

Keys: DD1 (100% wheat flour), DD2 (80% wheat flour, 12% cocoyam flour and 8% Bambara groundnut seeds flour), DD3 (60% wheat flour, 30% cocoyam flour and 10% Bambara groundnut seeds flour), DD4 (40% wheat flour, 40% cocoyam flour and 20% Bambara groundnut seeds flour) and DD5 (20% wheat flour, 50% cocoyam flour and 30% Bambara groundnut seeds flour).

Methods of preparing rock cake

Specially developed wheat, cocoyam, and Bambara groundnut flour combinations were used to make the rock cakes. The AOAC's (2007) procedure for making rock cakes was followed with minor modifications. The fat and sifted wheat flour was mixed together. The eggs were whisked together before being added to the sugar, milk, vanilla extract, sugar, and water. The mixture was combined with flour to make soft dough. In a greased baking patty pan, the dough was divided into portions and baked at 220°C in a preheated oven. Before packaging the baked goods for further investigation, they were allowed to cool. Using the same techniques, composite rock cakes were created.

Proximate composition of wheat, cocoyam and Bambara groundnut rock cake

AOAC (2007) was used to determine the proximate analyses of the fortified rock cake samples and the control sample. Moisture, ash, fat, crude fiber, crude protein, and carbohydrate (by differential) were all calculated.

Sensory Evaluation

Twenty (20) untrained market women were used to evaluate the rock cake samples. Using a nine-point Hedonic scale, the following sensory attributes were evaluated: taste, flavour, colour, texture, and overall acceptability. On this scale, 1 indicates "very dislike," while 9 indicates "highly like." The panelists' responses were then statistically analyzed.

Statistical Analysis

Using SPSS, all data sets were subjected to Analysis of Variance (ANOVA) (Version 15, 2007). The significance of the discrepancy was determined using Duncan's multiple range tests.

Results and Discussion

Tables 2 and 3 indicate the moisture, fat, carbohydrate, protein, ash, and fiber contents as well as the sensoryevaluation of the rock cake samples.Moisture is one of many environmental conditions that support microbial growth and spoilage. As a food preservation principle, the water activity level in food product should prevent microbial growth and thus prolong the shelf life of food. The moisture content of the composite rock cake samples decreased significantly as

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the substitution of the cocoyam and Bambara bean flour levels increased. The highest value of moisture content was obtained in rock sample DD1 (100% wheat flour) with 23.46%, while the lowest value was observed in rock cake sample DD5 (20% wheat flour, 50% cocoyam flour and 30% Bambara groundnut seeds flour) with 11.49%. This finding agrees with that reported by Mepba (2007) but differs from studies reported by Njintang (2008).They found that increasing the amount of non-wheat flour in their composite bread enhanced the moisture content. According to Tekle (2020), this occurrence can be explained by the non-wheat flour's superior water-holding capacity when compared to wheat flour. The high moisture content in the control rock cake sample indicates that the product will not last long before deteriorating. In terms of moisture content, there was a considerable difference.
Ash refers to the inorganic residue remaining after either ignition or complete oxidation of organic matter in a foodstuff, and it represents the total mineral content in food (Nielsen, 2010). Availability of minerals in diet helps in the metabolism of macro nutrients for the release of energy. The ash content in the rock cakes produced ranged from 1.25% -3.86%. There was a noticeable increment in the ash content of the composite rock cake samples from 1.89 to 3.86% with increase in the levels of cocoyam and Bambara groundnut flour substitution. This rise in ash content could be attributed to the higher quantities of ash in the cocoyam and Bambara groundnut flour as compared to wheat flour. This agrees with the findings of Masamba et al., (2014) who reported an increase in the ash content of wheat-cassava bread. This is consistent with the findings of Masamba et al., (2014), who found that the ash content of wheat-cassava bread increased.

The fat content of the rock cake samples ranged from 6.37% to 15.38% with the control sample DD1 (100% wheat flour) having the highest fat content (15.38%), while the lowest was sample DD5 (20% wheat flour, 50% cocoyam flour and 30% Bambara groundnut seeds flour) with 6.37%.The fat content decreased with increase in the Bambara and cocoyam flour formulation; this could be due to their low-fat contents as reported by Eddy et al.,(2007). Fat gives moistness, flavour, and colour in pastry products.

As indicated in Table 2, the crude fiber content ranges from 1.38% to 5.44%. The results have shown a higher percentage value (5.44%) for rock cake sample DD5 (20% wheat flour, 50% cocoyam flour and 30% Bambara groundnut seeds flour and the least mean value was for the control rock cake sample (1.28). It was noticed that increasing the Bambara groundnut and cocoyam flour resulted in a corresponding increase in the fiber content of the composite rock cakes. The discrepancies between the mean values from the table were substantially different (at $P < 0.05$). The composite rock cakes' higher fiber content, have various health benefits, including assisting intestinal digestion and reducing constipation.

The protein content in the rock cakes samples varied from 7.85% to 14.65%. There was an increase in protein with an increase in cocoyam and Bambara groundnut flour. Sample DD5 (20% wheat flour, 50% cocoyam flour, and 30% Bambara groundnut seeds flour) has the highest protein value of 14.95%, followed by sample DD4 (40% wheat flour, 40% cocoyam flour, and 20% Bambara groundnut seeds flour) with 12.82% and the least was sample DD1 (100% wheat flour) with 7.85% protein content. The increase in protein is as expected because according to Basman and Koksel (2003), Bambara groundnut contains 18-24% protein while wheat was reported to contain 11-12% protein. The increase could be attributed to the added effect. The

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increase in protein content would be useful in eliminating the challenges of protein deficiencies among all age groups, especially in areas where many people can hardly afford protein foods because of the high cost (Basman and Koksel, 2003).

The carbohydrate content of the rock cake samples ranged from 50.89 to 60.55%, with composite rock cake made with 20% wheat flour, 50% cocoyam flour, and 30% Bambara groundnut seeds flour having higher carbohydrate content (60.55%) while the least value of carbohydrate was observed in rock cake sample DD1 (50.89%), with the proportion of 100% wheat flour (Table 2). The results revealed that increasing the cocoyam content in the rock cake resulted in a corresponding increase in the carbohydrate content. This observation can be explained by cocoyam's high carbohydrate content. Carbohydrate predominates in roots and tubers, according to Enwere (1998). Carbohydrate helps with fat metabolism. According to Onyeike et al. (2008), cocoyam contains carbohydrates in the form of starch. Eddy et al., (2007) also reported an increase in carbohydrate content due to blending with cocoyam flours.

Table 2: Proximate composition of the composite rock cake

Samples	**Moisture** (%)	**Ash** (%)	**Fat** (%) (%)	**Fiber**	**Protein** (%)	**CHO** (%)
$\mathbf{K_0}$	23.46^a	1.25e	15.38^a	1.28e	7.85e	50.89e
$\mathbf{K_1}$	20.50^b	1.89^d	13.07^b	2.29d	9.69^d	53.27^d
$\mathbf{K_2}$	17.21^c	2.61c	10.65^c	3.58c	10.67^c	56.04^c
$\mathbf{K_3}$	14.35^d	3.23^b	8.49^d	4.50b	12.82^b	58.30^b
$\mathbf{K_4}$	11.49^e	3.86a	6.37^e	5.44a	14.95^a	60.55^a

Values in the same column with different superscripts are significantly different ($p>0.05$). Keys: DD1 (100% wheat flour), DD2 (80% wheat flour, 12% cocoyam flour and 8% Bambara groundnut seeds flour), DD3 (60% wheat flour, 30% cocoyam flour and 10% Bambara groundnut seeds flour), DD4 (40% wheat flour, 40% cocoyam flour and 20% Bambara groundnut seeds flour) and DD5 (20% wheat flour, 50% cocoyam flour and 30% Bambara groundnut seeds flour).

Sensory analysis of wheat, cocoyam and Bambara groundnut rock cake

Table 3 shows the sensory scores for the attributes used to evaluate the rock cake. Rock cake fortified with cocoyam-Bambara groundnut composite flours, as well as 100% wheat flour, was assessed similarly in terms of characteristics. However, compared to the other rock cake samples, the aroma rating for 50% cocoyam flour and 30% Bambara groundnut seeds rock cake was significantly lower. Rock cake made with whole wheat flour performed better thanthe composite rock cakes. With a rise in the quantity of cocoyam and Bambara groundnut flour, the mean value for aroma decreased.

Customers view colour as a sensory attribute while purchasing new products. Rock cake sample DD1 with 100% whole wheat was rated highest in terms of colour, whereas the colour rating declined as the levels of Bambara groundnut and cocoyam flour substitution increased.
Rock cake sample made with 20% wheat flour, 50% cocoyam flour and 30% Bambara groundnut seeds flour received the lowest rating for colour. The mean rating for the 100% wheat rock cake and that made with 80% wheat flour, 12% cocoyam flour and 8% Bambara groundnut

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seeds flour was not statistically different; however, there was a significant difference between the colour of the control sample and the DD3, DD4 and DD5.

The texture of all the rock cake samples ranged from 6.95% to 9.43%. The texture of the composite rock cake samples decreased as the proportion of cocoyam and Bambara groundnut flour increased. This may be attributed to the high fibre content of the rock cake. It was observed that higher proportions of cocoyam and Bambara groundnut flour (30% and 50%) gave low scores on texture (Table 3). Nwanekezi (2013) reported that high substitution levels of other flours to wheat flour reduces the elastic properties of wheat flour which reduces the texture quality of the final rock cake

The taste of all rock cake samples ranged from 7.50% to 9.43%, with the control rock cake sample having the highest mean rating (9.43%) while rock cake made with 20% wheat flour, 50% cocoyam flour and 30% Bambara groundnut seeds flour was least preferred. This agrees with the findings of (Noorfarahzilah et al., 2014).However, increasing the cocoyam and Bambara groundnut flour contents had no discernible effect on the rock cake, which is consistent with cocoyam flour's bland taste. Similar findings were reported by Dewettinck (2008).

On a 9-point hedonic scale, the mean score for overall acceptability (Table 3) revealed that rock cake samples DD1 (100% wheat flour) and DD2 (80% wheat flour, 12% cocoyam flour, and 8% Bambara groundnut seeds flour) were acceptable to the panelists. The overall acceptance of the samples DD1 and DD2 did not differ significantly ($p>0.05$). However, there were significant differences ($p < 0.05$) between the control rock cake sample and the fortified samples DD3, DD4, and DD5. It was realised that as the composite flour in the rock cakes increases, it diminishes the overall acceptance. The researchers conclude that incorporating cocoyam and Bambara groundnut flour up to 8% and 12% in rock cake or pastry making is possible.

Table 3: Sensory analysis of wheat, cocoyam and Bambara groundnut rock cake

Samples	Aroma	Colour	Texture	Taste	Overall Acceptance
K_0	9.14^a	8.26^a	9.50^a	9.43^a	9.40^a
K_1	8.45^b	8.24^b	8.39^b	9.39^a	9.36^a
K_2	7.30^c	7.85^c	7.48^c	8.34^c	8.28^c
K_3	7.35^d	7.05^d	7.36^d	8.28^d	7.24^d
K_4	6.15^e	6.11^e	6.95^e	7.50^e	6.10^e

Keys: DD1 (100% wheat flour), DD2 (80% wheat flour, 12% cocoyam flour and 8% Bambara groundnut seeds flour), DD3 (60% wheat flour, 30% cocoyam flour and 10% Bambara groundnut seeds flour), DD4 (40% wheat flour, 40% cocoyam flour and 20% Bambara groundnut seeds flour) and DD5 (20% wheat flour, 50% cocoyam flour and 30% Bambara groundnut seeds flour).

Conclusion

Cocoyam and Bambara groundnut used as composite flours for the preparation of rock cake have proven to be the best option for making use of underutilised indigenous crops due to the

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nutritional contents they possess. The rock cake samples showed increased ash, fat, fiber, protein, and carbohydrate contents with increased proportions of cocoyam and Bambara groundnut flour reflecting the effect of the high protein content of Bambara groundnut on the prepared rock cake.Partially substituting wheat flour with cocoyam and Bambara groundnut flour as possible in this investigation, and rock cake samples made from this mixture with up to 8% and 12% cocoyam and Bambara groundnut flour supplementation could be used without making a concession to market preferences

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