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Proximate and Acceptability of Rock Cake Prepared from a Blend of Corn Chaff (*Zea Mays L.*) and Wheat Flour (*Triticum Aestivum L*)

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Abstract: *The study was conducted to examine the nutritional composition and consumer acceptability of rock cake produced from a blend of wheat flour and corn chaff. The proximate composition of the rock cake was determined using the AOAC (2005) method. Three samples of rock cake were fproduced and coded as Sample A (control) containing 100% wheat flour, sample 'B' 80% wheat flour and 20% corn chaff while sample C involved 60% wheat flour and 40% corn chaff. The results of proximate composition of the various flour indicated increasing level of Carbohydrate (37.08% to 40.0%), Moisture (19.14% to 24.51%), Fat (25.33% to 32.4), Protein (7.72% to 9.60%) and Ash (0.97% to 1.47%). A panel of fifty (50) untrained judges was engaged for the Sensory Analysis based on a hedonic scale of 1-5. Data obtained were subjected to Analysis of variance (ANOVA) and differences in means were computed using Least Significant Difference (LSD) test at 95% confidence interval. Statistical Package for Social Scientists version 20 was used for all computations. Results indicated that corn chaff could be partially incorporated into wheat flour up to 40% level in production of cake without any adverse effect on the sensory characteristics of the products. Rock cake made from 60% wheat flour and 40% corn flour was accepted by the consumers.*

Key words: Maize Chaff, Wheat flour, Proximate composition, Rock Cake, Composite flour.

1. INTRODUCTION

Cake is a baked product made from sugar, egg, shortening, milk and leavening mixed together to make a fluffy baked product [2]. It is described as a delicate, highly sweetened, non-yeast baked products [1]. Cake has been a staple food in our diet and its continued popularity has inspired the development of the newer and more desirable goods available today on the market [3]. They can be eaten alone, as a snack or refreshment during picnics (Signori, 2004). Baked goods have increased in Ghana over the years, as they are patronized by more Ghanaians. The growth in Ghana has increased the consumption of processed food and bakery products thereby increasing the import demand [4].

Corn chaff is a leftover corn mill industry commodity [5]. The chaff is the dry, scaly coating of corn seeds with fragments of cotyledon and endosperm that is common among which is the residue from milling corn seeds into powder. Nutritional compositions of corn chaff are the carbohydrate (1.64%), fibre (22%), moisture (60.31%), ash (6.40%), fat (1.56%) and protein (9.09%) [6]. Wheat flour is used to make bread, rolls, and pastry goods. However, soil and climatic conditions in most developing countries do not allow or make it difficult to grow wheat locally. The use of composite flours has been successful in providing proteins for human humankind as well as promoting greater use of local or domestic agricultural products as well [7, 8]. [9], has recorded high acceptance of composite sorghum-maize-wheat flour cookies in Nigeria. Local replacement of wheat flour by raw material is due to the demand for confectionery products [10].

Wheat production in Ghana is limited and wheat meal is imported to meet the needs of local bakery products for flour. The use of cereal and other plant proteins, especially from underused oil seeds, as an enrichment for convenient snack foods has been identified as a viable alternative to increasing the nutritional level of teeming millions in various parts of the world [11]. The objective of this research work was to determine the proximate and consumer acceptability of Rock cake prepared from partially dried corn chaff incorporated into wheat flour

2. MATERIALS AND METHODS

2.1 Source of Raw Material

The maize chaff was obtained from the Kumasi Central Market, alongside with wheat flour, butter, eggs, baking powder, nutmeg, sugar, powdered milk and flavour was obtained.

2.2 Sample Preparation

The dry corn was sorted to remove dirt, stone and bad seeds. The corn was washed and dried before removing the chaff using a sized reduction machine. The chaff was dried in the oven at 60^{o}C and was used to partially replace the wheat flour.

2.3 Sample formulations

Three samples of rock cake were formulated and coded as; sample A (control) containing 100% wheat flour, sample 'B' 80% wheat flour and 20% corn chaff while sample C involved 60% wheat flour and 40% corn chaff

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Table 1: Formulation of Composite Flour and other Ingredients for rock cake Preparation

INGREDIENTS	A	B	C
Wheat flour (soft) (%)	100	80	60
Corn chaff (%)	0	20	40
Margarine (g)	30	30	30
Sugar (g)	30	30	30
Vanilla essence (ml)	3	3	3
Baking powder (g)	1.5	1.5	1.5
Milk Powder (g)	2	2	2
Water (ml)	15	15	15
Egg	2	2	2

2.4 Method of preparation

The formulated mixtures of wheat flour and corn chaff were used for the preparation of the rock cakes. Rock cakes were produced according to [12] method with minor modifications. Wheat flour was sifted and fat incorporated and rubbed together. Eggs were whisked before adding sugar, milk, vanilla essence, sugar and water. The mixture was incorporated into the flour to form soft dough. Dough was portioned into a greased baking patty tin and baked in a preheated oven at 220^{o}C. The baked products were cooled and packaged for further analysis.

2.5 Physicochemical properties of the sesame spread

The proximate composition of the rock cake was determined using the [12] method

2.5.1 Moisture content and total solids: Oven Drying Method

Five grams (5g) of the sample was transferred to the previously dried and weighed dish. The Dish was placed in an oven and thermostatically controlled at 105 degrees for 5 hours. Dish was removed and placed in a desiccator to cool to room temperature and weighed. It was then dried again for 30 minutes, cooled down again and weighed. Drying, cooling and weighing were repeated until a constant weight was reached. (Alternatively, sample could be dried in a thermostatically controlled oven for at least 8 hours where a constant weight would be achieved). The determinations were duplicated and the average found [13]

Calculations

$$\% \text{ Moisture (wt/wt)} = \frac{\text{wt } H_2O \text{ in sample}}{\text{Wt of wet sample}} \times 100$$

$$\% \text{ Moisture (wt/wt)} = \frac{\text{wt of wet sample-wtof dry sample}}{\text{Wt of wet sample}} \times 100$$

$$\% \text{ Total solids (wt/wt)} = \frac{\text{wt of dried sample}}{\text{Wt of wet sample}} \times 100$$

Where wt= Weight of sample/spread

2.5.2 Ash content

5g 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 degrees 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 allowed crucibles to cool prior to weighing

.

Calculations

$$\%Ash = \frac{\text{wt of ash} \times 100}{\text{Wt of sample}}$$

$$\%Ash = \frac{(\text{wt of crucible+ ash}) - \text{wt of empty crucible} \times 100}{(\text{wt of crucible+ sample}) - \text{wt of empty crucible}}$$

Where wt= Weight of sample/spread

2.5.3 Fat content: soxhlet extraction

Previously dried (air oven at 100°C) 250 ml round bottom flask was weighed accurately. 5.0g of dried sample to 22 ×80mm paper thimble or a folded filter paper was weighed. A small 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.

$$\% \text{ Fat (dry basis)} = \frac{\text{fat/oil collected} \times 100}{\text{Weight of sample}}$$

$$\% \text{ Fat (dry basis)} = \frac{(\text{wt of flask + oil}) - \text{wt. of flask} \times 100}{\text{Weight of sample}}$$

2.5.4 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.

$$\% \text{ Crude fibre} = \frac{\text{weight of crude fibre} \times 100}{\text{Weight of sample}}$$

$$\% \text{ Crude fibre} = \frac{\text{wt of crucible + sample (before – after) ashing} \times 100}{\text{Weight of sample}}$$

Where wt= Weight of sample/spread

2.5.5 Protein Determination

2.5.5.1 Digestion Method

Two grams (2g) of sample and a half of selenium –based catalyst tablets and a few anti -bumping agents were added to the digestion flask. Twenty five milliliters (25ml) of concentrated H_2SO_4 was added and the flask was shaken for the entire sample to become thoroughly wet. Flask was placed on digestion burner and heated slowly until boiling ceased and the resulting solution was clear. The sample was then cooled to room temperature and digested sample solution was transferred into a 100ml volumetric flask and made up to the mark.

2.5.5.2 Distillation Method

To flush out the apparatus before use, distilled water was boiled in a steam generator of the distillation apparatus with the connections arranged to circulate through the condenser, for at least 10 minutes. The receiving flask was lowered and continued to heat for 30 seconds in order to carry over all liquid in the condenser. 25 ml of 2% boric acid was pipetted into 250ml conical flask and 2 drops of mixed indicator added. The conical flask and its contents was placed under the condenser in such a position that the tip of the condenser is completely immersed in solution. 10ml of the digested sample solution was measured into the decomposition flask of the Kejdahl unit, fixed it and add excess of 40% NaOH (about 15-20ml) to it. The ammonia produced was distilled into the collection flask with the condenser tip immersed in the receiving flask till a volume of about 150ml– 200ml is collected. Before distilling another sample and on completion of all distillations, the apparatus was flushed as in step 1 above. Steam was allowed to pass only until 5ml of the distillate is obtained.

2.5.5. 3 Titration Method

The Distillate with 0.1N HCL solution was titrated. The acid was added until the solution became colourless. Any additional acid added made the two solutions become pink. The nitrogen content was determined in duplicate, and a blank determination was run using the same amount of all reagents as used for the sample. The blank was meant to correct for traces of nitrogen in the reagents and included digestion as well as distillation methods.

Calculation:

$$\% \text{ Total nitrogen} = \frac{100 \times (Va-Vb) \times NA \times 0.01401 \times 100}{W \times 10}$$

Where:
Va- volume in ml of standard acid used in titration
Vb- volume in ml of standard acid used in blank
NA- normality of acid
W- Weight of sample taken

2.5.6 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 (%) = % crude fibre + % NFE
OR
Carbohydrate (%) =100 - (% moisture +% fat +% protein +% ash)

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

2.6 Sensory Analysis

A panel of fifty untrained judges was engaged for the Sensory Analysis based on a hedonic scale of 1-5; where 1 = Dislike extremely and 5 = like extremely under the following characteristics: colour, texture, Aroma, taste, aftertaste and overall acceptability.

2.7 Statistical analysis

The results obtained from the various analyses were subjected to Analysis of variance (ANOVA) and differences in means were located using Least Significant Difference (LSD) test at 95% confidence interval. Statistical Package for Social Scientists version 20 was used for all computations.

3. RESULTS AND DISCUSSION

Table 2: Sensory Evaluation of the Rock cake

Samples	Colour	Texture/ Crispiness	Aroma	Taste	Aftertaste	Overall acceptability
A	3.02±1.40	2.96±1.3	3.80±1.50	2.84±1.53	2.82±1.55	3.08±1.07
B	3.02±1.40	2.96±1.37	3.10±1.50	2.84±1.53	2.82±1.55	3.08±1.07
C	4.18±1.04	3.68±1.32	3.10±1.21	3.82±1.24	3.80±1.26	4.80±0.40
LSD	1.138	0.924	0.80	0.859	0.859	0.875

Sample A (control) containing 100% wheat flour, sample 'B' 80% wheat flour and 20% corn chaff while sample C involved 60% wheat flour and 40% corn chaff.

Source: Field Survey (2020)

Results of colour of rock cake samples containing different level of blended corn chaff and wheat flour composite recorded a significant difference ($P<0.05$) between the control; sample A (100% wheat flour) and the composite sample C(80% wheat flour and 40% corn chaff). It was observed that majority of the respondents liked the colour of product (C) due to high percentage of corn chaff incorporated into the cake. Cookie color is promoted primarily during baking process from the Maillard reaction between protein and reducing sugars. Starch caramelization and dextrinization, which are accelerated by heating, affect the cookie colour [14]. The scores for texture of the composite cake samples decreased with increase in composite of corn chaff when compared to whole wheat cake (control sample A). The cake with 40% corn chaff and wheat flour (sample C), had the best texture when compared to that of the control (A). The result is in line with, [15 they observed that hardness of cookies is increased by the

replacement of wheat flour with king palm flour up to 30% level. [16], also reported that hardness of the cookies is increased by the replacement of wheat flour with water chestnut flour. Further, [17] stated that hardness of the cookies is caused by the interaction of proteins and starch by hydrogen bonding. The incorporation of maize chaff into wheat flour resulted in poor aroma scores. The results showed a decrease in the scores as the corn chaff was used to partially replace the wheat flour. Samples (B and C) with 20% and 40% corn chaff and wheat flour recorded low mean score. The control sample (A) had the highest mean score of approximately 4.0, which is liked slightly. The control sample recorded a significantly ($p<0.05$) difference from the other products. There was a significant ($p<0.05$) difference between the control sample (A) and the composite sample (C From the hedonic scale, the taste of product A was rated extremely liked with the rest rated very much liked. The score of the taste attribute obtained in this study was similar to those of [18] and [19]. There exist a significant ($p<0.05$) difference between the control sample (A) and sample (C) From the results, it could be observed that up to 40% replacement of corn chaff and wheat flour could be accepted by the consumers (that is, "slightly liked" with mean score of 4.0). [20], reported that bitter taste of unpolished brown rice is associated with saponin present in the rice bran found in unpolished brown rice powder and the amount of saponin in the products depends on the levels of the unpolished brown rice powder in the formulation of the product. This result is also similar to those of [18] and [19]. The sensory evaluation recorded high acceptance level for rock cake produced from 60% wheat flour and 40% corn chaff. There was a significant ($p<0.05$) different between the composite ample C from the control. The acceptability scores for the current study backs the report made by [20] that consumers choose foods based on the quality which is the degree of excellence and include taste, appearance, texture, colour, odour and nutritional content which have significance and make for acceptance. This result is similar to [18] and [19]. Increase in acceptability was observed as the level of substitution of unpolished brown rice increased.

Table 3: Proximate Composition

Sample code	Moisture%	Ash%	Fat%	Protein%	Carbohydrate%
A	19.149±0.2163	0.973±0.0173	32.146±0.2832	7.725±0.4238	40.006±0.4735
B	24.670±0.0820	1.438±0.0232	27.199±0.865	9.602±0.5750	37.089±1.5454
C	24.510±0.0197	1.466±0.0014	25.33±0.2559	8.772±1.0935	39.913±1.3678

Sample A (control) containing 100% wheat flour, sample 'B' 80% wheat flour and 20% corn chaff while sample C involved 60% wheat flour and 40% corn chaff.
Lab work, 2020

The moisture contents ranged from 19.14% to 24.51%. The control had a moisture content of 19.14 which is considerably low and within the safe limits for baked goods in order to ensure shelf stability and prevent microbial contamination. Sample C had a high moisture content of 24.51% and could be the fact that the c0rn chaff used was not well dried before using. The high moisture content in sample C could be associated to short shelf life of composite cake as they encourage microbial proliferation that lead to spoilage. The ash content of the cake increased from 1.43 to 1.46% with increase in the product C. The increase in the ash content could be as a result of corn chaff blends with wheat flour. The increase in the ash content could make the product a good source of minerals as observed by other researchers [15]. The fat content also increased from 27.19% to 32.14% in the composite wheat flour rock cake produced from a blend of maize chaff and wheat flour. Product (A) had the highest fat (32.146) content due to the 100% increase in the wheat flour. Product (B) had fat content of 27.19% while the control Product (C) had the lowest fat (25.33). The high fat content of the composite wheat flour can affect the shelf stability of the product [20, 21]. The protein content of the control is 7.72% and that for Product B and C is 9.60% and 8.77% respectively. The decrease is as a result of substitution of wheat flour (60%) with the corn flour of (40%). The protein level could be improved by increasing the content of the corn flour. Studies also revealed that, wheat have a low level of protein. The carbohydrate content was low in Product B (37.08%) and Product C (39.91%). Product A had the highest of carbohydrate content of 40.006%. The high carbohydrate was as a result of incorporating the corn flour 40% and wheat flour of 60%.

Conclusion

Results obtained from this work shows that corn chaff could be used to partially replace wheat flour in the production of quality rock cake. Corn chaff could be used as composite to wheat flour up to 40% level in production of rock cake without any adverse effect on the sensory characteristics of the products. The combination of increasing levels of corn chaff into the rock cake increased the overall acceptability of the cake. Usually, the addition of 20% and 40% corn chaff in rock cake could be recommended as the best level of preparing rock cake.

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