International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Quality Evaluation of Wheat and Kidney Beans Cake.

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DOI: https://doi.org/10.55248/gengpi.5.0524.1126

ABSTRACT

Cake was coded as PDP, APC, and ADC and manufactured in the ratios of 100:00, 70:30, and 60:40. The cake samples' approximate composition data showed higher levels of protein (g/100g), 7.076 - 8.86%, fat (g/100g), 32.43% - 32.43%, moisture (g/100g), ash (g/100g), 1.71 - 2.17%, and carbohydrate (g/100g), 43.8 - 44.75%, respectively. Twenty inexperienced panelists, both male and female traders, were used to assess the sensory qualities of cakes. A nine-point hedonic scale was used to rate the cakes' appearance, flavour, texture, and general acceptability (where 1 represents a strongly dislike and 9 represents an intense liking). Based on a subjective assessment, a sample of cake composed of 70% kidney bean flour and 70% wheat flour *was the most preferred in terms of overall acceptability.* Regarding general acceptability, there were no discernible (p>0.05) changes in the sensory qualities of the cakes between the composite and control cake samples. The acquired data were analyzed using ANOVA, and at the 5% probability level, the significance difference was acknowledged. According to the study's findings, kidney bean flour can replace wheat flour in cake recipes up to 30% of the time without having a negative impact on the finished product's sensory qualities.

Keywords: Kidney bean, wheat flour, cake, bakery product.

1.0 Introduction

Cakes are frequently eaten as snacks, especially in the fast food and bakery industries [1]. A lot of cake recipes are categorized based on the components, sides dishes, and methods of preparation [2]. Baking powder, eggs, flour, margarine, and flavoring agent are used in their production [1]. The preferred grain for making this snack is wheat, but because of Nigeria's climate, it is not widely cultivated there, which drives up the cost of the product. Prices for wheat flour tend to rise in tandem with an increase in the cost of importation when demand rises [3].

The reason for this high cost is that population growth has led to a rise in the demand for imported goods by increasing the consumption of baked goods and processed foods. Ordinary wheat is farmed all over the world, but it is imported from nations with unfavourable climates for wheat production to make the flour used to make baked goods. In order to preserve foreign exchange, creating flour from domestic ingredients will help to lower the price of importing wheat flour into the nation. The competitiveness of kidney beans against other legumes is increased, their application in different food systems is expanded, and their economic efficiency is increased when they are baked.

Furthermore, if kidney bean consumption rises, farmers must plant more of these plants, which will boost their earnings and raise the added value. Because kidney beans are high in protein, delicious, and contain some antioxidants, minerals, and polyphenols, they are often used to a variety of food preparations. A cup of boiling kidney beans (177g) has about 15g of protein, or 27% of the total calories (4). Kidney beans are high in protein. Eliminating wheat flour in favor of a local grain will save foreign exchange and lower production expenses.

According to [4], flour from other crops such as maize, millet, millet, cassava, potatoes, and rice has been added to wheat flour to increase the use of local crops and reduce the cost of importing wheat. Blending different flours for pastry preparation is mainly practice in tropical countries where the soil and climate are not conducive for commercial wheat production. This study investigated the production, proximate, and sensory features of blended cake made with wheat and kidney beans.

2.0 MATERIALS AND METHODS

2.1 Source of Raw Materials

The experiment was conducted at the Department of Food Chemistry, African Center for Excellence, Benue State University Makurdi, Nigeria. Wheat flour, kidney bean, margarine, eggs, sugar, salt and baking powder were purchased from Modern Market, Makurdi, Nigeria.

2.2 Production of kidney bean flour (KBF)

The flour was made using the procedure as stated by Bolad et al. [5]. After removing some stones and debris, the flour was ground with a pestle and mortar until it was homogenized, and it was then sieved through a 250 mm cloth to extract the flour. In preparation for the experiments, flour samples for chemical analysis were stored in airtight plastic bottles and frozen at -26°C in a lab freezer.

2.3 Formulation of Blends

Three distinct cake samples with the codes PDP, APC, and ADC were manufactured in the ratios of 100:00, 70:30, and 60:40. APC and ADC were composite samples that contained 70% wheat flour, 30% kidney bean flour, and 60% wheat flour and 40% kidney bean flour, respectively. A sample labeled PDP, which contained 100% wheat flour, served as the control. To achieve homogeneous mixing, wheat-kidney bean composite flours were combined in an Akai food mixer. The composition of components used to make cakes is currently given in table one (1).

Table 1: Formulation of ingredients for cake making

INGREDIENTS	PDP	APC	ADC
Wheat flour (g)	100	70	60
Sugar (g)	60	60	60
Margarine (g)	150	150	150
Eggs	5	5	5
Baking	10	10	10
Vanilla essence (ml)	5	5	5

Control Sample PDP, 100% wheat flour, APC, 70 % wheat flour and 30% kidney bean flour and ADC, 60% wheat flour and 40% kidney bean flour.

2.5 Method of Preparation

The cake was made using a modified version of [6]. In a mixing bowl, the margarine and sugar were manually creamed for forty minutes, until the mixture became light and fluffy. A rotary whisk was used to beat the eggs for three minutes, and five milliliters of vanilla essence were added. It was blended into the whipped mixture gradually. Using a metal spoon, flour samples from various combinations were gradually combined after being sifted through a different sieve with baking powder and salt. After pouring the batter into cake pans that had been greased, the oven was warmed to 200°C and baked for 50 minutes. In order to determine the cake's doneness, a dagger was inserted in the center.When cooked, the cake was removed from the tin allowed to cool in a wire rack, and packaged for evaluation and proximate analysis.

Proximate composition

We evaluated the cake samples to find out how nutritious they were. The characteristics that were ascertained using established procedures [7] included the contents of moisture, ash, protein, fat, and carbohydrates.

Moisture content and total solids: Oven Drying Method

A sample weighing five grams (5g) was moved to the plate that had been previously dried and weighed. For five hours, the dish was baked at 105°C under thermostat control. After being taken out, the dish was weighed and allowed to cool to room temperature in a desiccator. After another 30-minute drying period, it was cooled down once more and weighed. Until a steady weight was achieved, the processes of drying, cooling, and weighing were repeated. (Alternatively, the sample might be dried for eight hours, until a consistent weight was reached, in an oven with a thermostat). The average was discovered after the determinations were repeated [8].

Calculations

$$\%Moisture \frac{W2-W1}{W} X\ 100 \quad (1)$$

Where:

W_2=Weight of the crucible and dry Sample

W_1=Weight of empty crucible

W=Weight of the Sample

ASH CONTENT

A 5g sample was weighed and pre-dried in a crucible covered with tar. Crucibles were inserted with the use of tongs, gloves, and safety glasses within a cool muffle furnace. At roughly 60°C, the crucibles ignited for two hours. When the temperature fell to 250ºC or below, the muffle furnace was shut off and opened. Care was taken to open the door so as not to spill any powdery ash. Crucibles were moved to a desiccator equipped with a porcelain plate and desiccant using safety tongs. Before weighing, the desiccator was shut and the crucibles were allowed to cool.

$$\% \, Ash = \frac{(W3-W1)}{(W2-W1)} \, x \, 100 \qquad (2)$$

Where:

W1 = Weight of empty crucible,

W_2 = Weight of crucible + sample before ashing,

W_3 = Weight of crucible + content after ashing.

Fat content: soxhlet extraction

A precisely weighted 250 ml round-bottom flask was previously dried (in an air oven at 100°C). A dried sample weighing 5.0g was measured using a 22 ×80mm paper thimble. To ensure that the sample was not lost, a little piece of cotton or glass wool was inserted into the thimble. The apparatus was built after 150ml of petroleum spirit B.P. 40–60°C was introduced to the round-bottom flask. The soxhlet extractor was linked to a condenser, which was left on the heating mantle for four or six hours. Thimble was taken out after extraction, and solvent was recovered by distillation. To evaporate the solvent, the flask and fat/oil were heated to approximately 103°C in an oven. In a desiccator, the flask and its contents were allowed to cool to room temperature. The flask was weighed to determine weight of fat/oil collected.

$$\% \, fat \frac{Weight \, of \, extracted \, fat}{Weight \, of \, sample} X \, 100 \qquad (3)$$

Crude fibre determination

In a 750ml Erlenmeyer flask, two grams (2g) of the crude fat determination sample were weighed. After adding 200 milliliters (200 ml) of 1.25% H2SO4, the flask was placed on a hot plate and connected to the condenser right away. Within a minute of coming into touch with the solution, the contents boiled. After 30 minutes, the flask was taken out and quickly filtered through a funnel of linen fabric before being thoroughly cleaned with water. The filtrate, which contained the acid hydrolysis sample, was cleaned and put back into the flask using 200 milliliters of 1.25% NaOH solution. After the flask was attached to the condenser, it boiled for precisely thirty minutes. Following a thorough water wash and filtering through Fischer's crucible, 15 milliliters of 96% alcohol were added.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.

$$\% \, Crude \, fibre = \frac{Loss \, in \, weight \, after \, incineration}{Weight \, of \, original \, food} \times 100 \qquad (4)$$

Protein Determination

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 H2SO4 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.

Crude protein = % Total Nitrogen = (Titre blank) x Normality x $N_{2.}$ Nitrogen factor = 6.25

Crude protein= % total Nitrogen X 6.25 (5)

Determination of carbohydrate content of bread samples

Carbohydrate content was determined by difference according to Ihekoronye and Ngoddy (1985) as follows:

$$\% \, Carbohydrate = 100 - (\%moisture + \%Protein + \%Fat + \%Ash + \%Fibre) \qquad (8)$$

2.9 Sensory Evaluation

The sensory properties of cakes were evaluated using untrained panellists comprising male and female petty traders. Cakes were evaluated for crust appearance, flavour, texture, and overall acceptability using nine points Hedonic scale (where 1 = liked extremely and 9 = disliked extremely). A slice of cake from each blend was presented to panellists. Each panellist was provided with a glass of tap water to rinse the mouth between evaluations.

2.10 Statistical Analysis

Data obtained was subjected to analysis of variance (ANOVA) and Significance difference was accepted at 5 % probability level

RESULTS AND DISCUSSION

The proximate composition of the different cake products is shown in Table 2. The samples' moisture contents varied from 13.74 to 15.37%. Sample ADC (60 percent wheat flour and 40 percent kidney bean flour) had the lowest moisture content, whereas sample PDP (control sample) had the highest. It's possible that the varied substances utilized in the control sample contributed to its increased moisture content. The sample PDP (100% wheat flour) differed ($p<0.05$) considerably from the other samples, although there were no significant differences ($p>0.05$) amongst the composite samples.

The cake products would have a long shelf life due to the low moisture contents in samples APC (70% wheat flour, 30% kidney bean flour) and ADC (60% wheat flour and 40% kidney bean flour), as lower moisture content in baked goods is essential for extending food product shelf life [9]. In contrast, the control sample might have a shorter shelf life because high moisture content has been linked to baked goods spoiling quickly due to microbial proliferation [10]; [11]. All of the samples had moisture contents that were comparable to those stated by [12].

The cakes had ash contents ranging from 1.69±0.16 to 2.19± 0.03. With 2.17%, sample ADC (60 percent wheat flour and 40 percent kidney bean flour) had the highest ash content, while the control group (100 percent wheat flour) had the lowest, at 1.69%. The control PDP (100% wheat flour) and the composite samples (APC, 70% wheat flour, 30% kidney bean flour, and ADC, 60% wheat flour and 40% kidney bean flour) showed a significant difference ($p<0.05$) in this investigation. This investigation agrees with [13], which revealed 2.20 to 2.57% ash contents. An indication of the minerals contained in the cake samples is the presence of ash [14].

When the amount of supplementation rose, the ash content of the composite cakes also increased, suggesting that the inorganic nutrients in the composite cake were richer than in the wheat cake. The high level of ash content in the kidney bean flour used in the replenishment may have contributed to the rise in the ash content of the composite cakes. Sample ADC (60% wheat flour, 40% kidney bean flour) had the highest protein level of 9.02%, followed by sample APC (70% wheat flour, 30% kidney bean flour) with 7.69%. The protein content of the composite cake samples ranged from 7.02 to 9.02%.

Sample PDP had the lowest protein content, at 7.02%. As kidney bean flour was added in greater amounts, the protein level rose. The findings were at odds with those of [15] and [16], whose research on composite rock cake made of wheat, cassava, and cocoyam revealed that all of the rock cake samples generated had comparatively low protein contents. The findings of the proximate analysis indicate that there was a significant difference ($p<0.05$) among all of the cake samples that were made. Food protein is essential since it helps rebuild damaged tissues and aids in bodybuilding. As the body's building blocks, proteins are essential for growth and the healing of damaged tissues, making them particularly vital for children's diets.

The fat amount varied between 29.12± 0.38 and 33.44± 0.30, with the greatest fat percentage (33.44%) found in sample ADC (70% wheat flour, 30% kidney bean flour). The increased amount of 40% kidney bean flour supplementation added to the wheat flour may be the cause of the sample ADC's higher fat content.

The sample PDP, which contained 100% wheat flour, had the highest carbohydrate content at 44.65%, followed by the sample APC, which contained 70% wheat flour and 30% kidney bean flour, and the sample ADC, which contained 60% wheat flour and 40% kidney bean flour. The carbohydrate content of the other cake products varied from 44.65± 0.24 to 43.14± 1.00. This observation could be explained by wheat flour's high glucose content. No significant differences ($p>0.05$) were found between the composite samples according to the results.

Table 2: Proximate composition of cakes produced from blends of wheat and kidney bean flours

Samples	Moisture	Ash	Protein	Fat	Carbohydrate
A	15.37^{a} ±0.03	1.69^{a}± 0.16	7.02^{a}± 0.29	29.12^{a}± 0.38	44.65^{a}± 0.10
B	13.80^{b} ± 1.05	1.94^{b}± 0.06	7.69^{b}± 0.18	32.42^{b}± 0.30	44.20^{b}± 1.00
C	13.75^{c} ± 0.25	2.19^{c}± 0.03	9.02^{c}± 0.50	33.44^{c}± 0.04	43.14^{c}± 1.00
LSD	0.01	0.02	0.02	0.03	0.04

Control Sample PDP, 100% wheat flour, APC, 70 % wheat flour and 30% kidney bean flour and ADC, 60% wheat flour and 40% kidney bean flour.

Sensory Properties of Cake Produced from Blends of Wheat and Kidney Bean Flour

Table 3 displays the findings of the examination of the cakes' sensory characteristics. In addition to providing information on the composition and quality of the product, the appearance shows the proper raw materials utilized in the preparation process [17]. Cakes prepared with a 70% wheat flour and 30% kidney bean flour mixture, sample APC, looked superior. The results of [18] are supported by the study, which made sponge cakes using locally farmed rice and blends of defatted soybeans with a tolerable inclusion level of 20% defatted soybean for coloring. This outcome demonstrates that in terms of appearance, samples PDP (100% wheat flour) and APC (70% wheat flour, 30% kidney bean flour) were accepted equally. Conversely, the control sample and sample APC were significantly (p≤0.05) different from sample ADC (60% wheat flour, 40% kidney bean flour). Taste is the main factor that determines the acceptance of any product which has the greatest impact as far as the market success of its product is concerned. The taste of the various cakes ranged from 7.20 - 8.17%. Cake prepared from 70% wheat flour, 30% kidney bean flour had the best score for taste followed by 100% Wheat flour. The results is similar to that of [19] whose work was biscuits made from sprouted lima bean, sprouted syrup and wheat flour and recorded better taste than wheat flour biscuits. Based on the results, it can be said that there were significant difference (p≤0.05) between the composite sample APC (100% wheat flour, 30% kidney bean flour) and the control PDP (100% wheat flour). The flavour score of the various cake products ranged from 7.80 ± 1.00 to 7.99 ± 0.82. The composite sample APC made of 70% wheat flour, 30% kidney bean flour had the highest flavour and was preferred by panellists followed by the control sample (100% wheat flour). The acceptance of the flavour follows a similar pattern. Blend percentage has a major impact on the food product's mean flavor score. As the amount of kidney bean flour supplementation grew, so did the flavor score of the cake made with both wheat flour and kidney bean flour. PDP (100% wheat flour) and APC (70% wheat flour, 30% water yam flour) samples have significantly different means (p<0.05).

The cakes' texture scores varied from 7.76 ± 1.21 to 8.16 ± 1.18. The cake sample APC, which had 30% kidney flour and 70% wheat flour, had the highest texture score of 8.16% and was the most preferred. The APC sample, which contained 70% wheat flour and 30% kidney bean flour, differed from the other cake samples in a significant way (p≤0.05). When making cakes, substituting 30% kidney bean flour for wheat flour (WF) yields good results in terms of sensory sensitivity.

In terms of general acceptability, the examination revealed that cake samples made with 70% and 30% kidney bean flour were the most liked. Table 3 displays the results of the sensory evaluations of cakes made using wheat and kidney bean composite flours (3).

Table 3: Sensory properties of cake from wheat and kidney bean blends

Samples	Appearance	Taste	Flavour	Texture	Overall Acceptability
PDP	$8.53^{a} \pm 0.95$	$8.01^{a} \pm 1.13$	$7.82^{a} \pm 1.17$	$7.76^{a} \pm 0.98$ab	$8.08^{a} \pm 0.88$
APC	$7.90^{b} \pm 0.72$	$8.17^{b} \pm 0.97$	$7.99^{b} \pm 0.82$	$8.16^{b} \pm 1.18$a	$8.63^{b} \pm 0.90$
ADC	$7.62^{c} \pm 0.70$	$7.19^{c} \pm 0.72$	$7.81^{a} \pm 1.00$	$7.47^{c} \pm 1.21$bc	$7.85^{c} \pm 0.80$
LSD	0.06	0.07	0.05	0.06	0.05

Control Sample PDP, 100% wheat flour, APC, 70 % wheat flour and 30% kidney bean flour and ADC, 60% wheat flour and 40% kidney bean flour.

Conclusion

The work's findings indicated that kidney flour may be utilized to make cakes of high caliber. Utilizing kidney bean flour to make baked goods that people enjoy, like cakes, can boost the crop's yield, consumption, and farmer earnings while lessening the need for wheat flour when making cakes. The findings of this study demonstrate that kidney bean flour can substitute wheat flour in high-quality cake recipes by up to 30% without having a negative impact on the finished product's sensory qualities.

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