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Proximate Composition and Sensory Evaluation of Unpolished Rice-Wheat Composite Cake

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Abstract: *The study examined the acceptability of cake using wheat and unpolished rice flour blend. Proximate composition and sensory characteristics of composite cake samples were determined using the A.O.A.C (2005) methods and preference test respectively. Three unique products were produced and coded as ABC (100% wheat flour), BDE (20% wheat flour and 80% unpolished rice flour) and CFG (80% wheat flour 20% and unpolished rice flour). The proximate composition of the cake samples ranged between moisture 41.35 $\pm$ 24.19, ash 1.26 $\pm$ 0.96, crude protein 7.92 $\pm$ 7.5, crude fat 36.94 $\pm$ 28.07 and carbohydrate 40.74 $\pm$22.49. Also, the results obtained from the proximate composition shows an increased in moisture, protein and carbohydrates of the composite cake samples produced. The study revealed that, consumers were satisfied with the taste, texture, colour, aroma and after-taste of product (BDE).*

Keywords: Unpolished rice, Composite flour, Cake, Proximate composition, Wheat flour

INTRODUCTION

Rice (*Oryza sativa L.)* is a staple food of about three billion individuals around the globe. The substance of protein, starch, fat, minerals and nutrients, particularly E and B, relies upon genetic variety [1] [2]. To prepare rice cake of the European sort, nonappearance of gluten in rice flour could be remunerated by utilizing of mixes with wheat flour. In this way, assembling of such cake represents an innovative test; as was accounted for before, rice expansion inferiorly affects wheat flour rheological properties. The flour blend shows less water ingestion, a more extended development time, a higher degree of batter softening and a higher gelatinization temperature contrasted with wheat flour [3] [4] [5].

Wheat flour is one of the major basic ingredients in bread and cake making because of its gluten division, which is responsible for the versatility of the dough by making it broaden and trap the carbon dioxide produced by yeast during fermentation [6]. However, in tropical nations, production of wheat is restricted and importation of wheat flour to meet the demand is necessary [7]. Impressive exertion has been made to advance the utilization of composite flours in which flour from indigenous crop replaces a portion of wheat flour for use in cakes and other flour products, in this manner diminishing the interest for imported wheat and animating production and utilization of locally grown non-wheat agrarian products [8] [9] reported that acceptable cakes could be produced from wheat flour substituted with up to 50% of rice flours. Wheat contains all essential nutrients; 12% water, carbohydrates (60-80%), proteins (8-15%) containing adequate amounts of all essential amino acids (except lysine, tryptophan and methionine), fats (1.5-2%), minerals (1.5-2%), vitamins and 2.2% crude fibers.
Studies on the utilization of different oilseeds, cereals, vegetables and high protein seeds in cake making have been accounted for [10] [11]. These examinations indicated that 2 to 10% non-wheat flour can be utilized in cakes and breads without inconvenient changes in bread qualities and tactile traits of cakes. Besides, cereals, cassava, plantain and different tubers crops have been accounted for to be elective wellsprings of significant basic materials for cake and bread making [6] [12] [13] [14].

This recommend that, prospects and supports for the utilization of rice flour for production of cake if possible would assist with bringing down the reliance of non-industrial countries on imported wheat. This study therefore, aimed at investigating the nutritional composition and sensory attributes of rice-composite cake at different levels of rice flour substitution for human consumption.

MATERIALS AND METHODS

Source of raw material

The unpolished rice was obtained from the Kumasi central market in the Ashanti region of Ghana. Other materials such as Wheat flour, yeast, sugar, baking powder, eggs, margarine, and vanilla were obtained also procured.

Processing rice into flour

A simple procedure involving sorting and milling of broken rice samples was used for the preparation of the rice flour. Sorting was performed to remove coloured pieces and chaff from the bulk. The sorted clean rice was milled to obtain flour.

Sample formulation

Three samples were formulated, to achieve a desirable results as well as nutritional composition with regards to the acceptability of the composites ingredients involved. This procedure was performed using values obtained from Food Composition Tables [15] to obtain a product that could meet the specified [16] guidelines. Rice was used in part as a carbohydrate source and mainly as to promote its utilization in bakery products and wheat to provide protein. Formulations sample combination was shown in Table 1. The three sample formulations were screened for cake

Table 1: Recipe for the cake preparation

INGREDIENTS	A	B	C
Wheat flour (soft) (%)	100	20	80
Rice flour (%)	0	80	20
Margarine (g)	200	200	200
Baking powder(g)	10	10	10
Sugar (g)	100	100	100
Eggs	4	4	4
Vanilla essence (ml)	2	2	2
Salt (g)	½	½	½

Preparation of cake

100g of Sugar together with 200g of margarine was creamed until fluffy. Eggs were thoroughly whisked and incorporated gradually into the creamed mixture. Wheat flour was sifted, and all dry ingredients mixed with the flour. The flour was then incorporated into the butter and combined thoroughly until a desired texture was achieved. The mixture was portioned into a greased baking tins and baked in a preheated, oven maintained at 200°C for 30 minutes until it turns slightly browned. After baking, it was cooled on and stored in an airtight container for sensory evaluation and proximate analysis.

2.5 Physicochemical properties of the cake

The proximate compositions of the cake were determined using the [16] 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 [16].

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

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

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

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 was completely immersed in the solution. 10ml of the digested sample solution was measured into the decomposition flask of the Kejdahl unit, fixed it and added 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 was collected. Before distilling another sample 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 was 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:

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

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 = $\frac{(100\text{-}\%\ \text{moisture}) \times \text{wet basis}}{100}$

Sensory Analysis

The products were evaluated for their sensorial attributes including appearance, colour, taste, crispness and texture (for cakes), aroma, mouth feel, after-taste and over all acceptability. A nine-point hedonic scale was used to test for the above-mentioned sensory attributes for the cake. The evaluation was undertaken by a panel of fifty (50) consumers. The coded samples were presented to each panel member for evaluation. Panelists were provided with water to refresh their palate before evaluating successive samples.

Statistical analysis

Data were analyzed using the Statistical Package for Sciences (SPSS, version 21.0) statistical software to generate means and standard deviations of triplicate determinations. Statistical parameters were estimated using Analysis of Variance (ANOVA). Differences between means were evaluated by the Duncan's new multiple range test, and significance was accepted at P<0.05.

3.0 RESULTS AND DISCUSSION

Sensory evaluation for composite flours

Table 2: percentage on sensory score for the cake

Sensory quality attributes	ABC F(%)	BDE F(%)	CFG F(%)
Colour	47(95.91)	47(95.91)	39(79.59)
Texture	42(85.71)	41(83.67)	40(81.63)
Aroma	45(91.83)	45(91.83)	45(91.83)
Taste	45(91.83)	45(91.83)	45(91.83)
After taste	45(91.83)	35(71.43	34(69.38)
Appearance	46(93.87)	46(93.87)	46(93.87)
Overall Acceptability	45(91.83)	47(95.91)	39(79.59)
Total	**49(100)**	**49(100)**	**49(100)**

Source: Field work, 2020. ABC= 100% Wheat flour, BDE= 20% wheat flour and 80% Rice flour, CFG = 80% Wheat flour and 20% rice flour

Results of sensory evaluation of cake samples prepared with the composite flour as compared to the control shown in Tables 2 based on the respondent's preference to the product by score with 'like extremely, like very much and like moderately. Subsequently, based on the highest sensory scores for the cake samples produced with the two composite. Colour and appearance, like any other sensory attribute, play a major role in determining consumer acceptance of food products. Particularly in bakery goods, colour and appearance constitute one major sensory characteristic that determines consumer choice in Ghana. Colour and appearance therefore are important sensory properties considered in all food product development efforts. For these sensory attributes, there were significant differences (P<0.05) in the composite cake samples and the control. The low rating of colour and appearance compared to the control can be attributed to the darker colour and brownish appearance of the cake across composite flours as the substitution for composite flour increased.

Table 3: Aroma and taste of the cake for the cake

Sensory quality attributes	ABC F (%)	BDE F (%)	CFG F(%)
Dislike very much	4(8.16)	4 (8.16)	13(26.53)
Like moderate	8(16.33)	8 (16.33)	20(40.82)
Liked very much	20(34.69)	20(34.69)	12(24.49)
Like extremely	17(40.81)	17(40.81)	4(8.16)
Total	**49(100)**	**49(100)**	**49(100)**

Source: Field work, 2020. ABC= 100% Wheat flour, BDE= 20% wheat flour and 80% Rice flour, CFG = 80% Wheat flour and 20% rice flour

Aroma and taste are two key sensory attributes which affect the perception of food to be consumed. For aroma and taste, Composite cake was rated the same in the degree of likeness as the control ("like very much") with 91.83% respectively. Statistically, there was no significant difference (P>0.05) between Composite sample CFG and the control samples ABC for aroma and taste. The other composite flours produced cake samples with similar but significantly reduced aroma and taste scores. There were no significant difference (P>0.05) between sample ABC, BDE and CFG. This can be attributed to the relatively lower substitution of unpolished rice flour. The presence of more rice flours could have accounted for the lower ratings of sample CFG.

According to [17] Rice bran has a characteristic bland flavour that is neither bitter nor sweet. The flavour is described as insipid rancid, musty and sour due to its ready deterioration in commercial lots. [18] reported that rice bran present in the unpolished brown rice flour had a sweet, slightly toasted, nutty flavour which may be the main contributing factor in affecting the taste of the biscuits. The recorded results may be associated with these reasons. The results also revealed that the panelists preferred the taste of the control (product ABC) and BDE followed by CFG respectively. From the hedonic scale, the taste of product ABC and BDE were rated liked very much respectively. The score of the taste attribute obtained in this study was similar to those of [19] [20].

Table 4: Texture and after -taste of the cake

Sensory quality attributes	ABC F(%)	BDE F(%)	CFG F(%)
Dislike very much	3(6.12)	4(8.16)	13(26.53)
Like moderate	9(18.37)	8(16.33)	20(40.82)
Liked very much	20(34.69)	20(34.69)	12(24.49)
Like extremely	17(40.81)	17(40.81)	4(8.16)
Total	**49(100)**	**49(100)**	**49(100)**

Source: Field work, 2020. ABC= 100% Wheat flour, BDE= 20% wheat flour and 80% Rice flour, CFG = 80% Wheat flour and 20% rice flour

The scores for texture and after- taste which depicts softness and chewiness of the composite cake samples decreased with rice flour substitution as shown by the ratings describing them in Table 3 compared to the control. However, Composite sample CFG produced cake with ratings of "like moderately". Cake containing rice flour up to 80% had the lowest sensory rating relative. The contribution of additional fibre ostensibly from rice, in the composite blends might have resulted in the hard texture of the cake relative to the control [5]. Substitution of wheat flour with non-wheat flour in bakery products resulted in the retention of less gas hence producing a dense texture that is undesirable to the consumer.

Table 5: Colour of the cake

Sensory quality attributes	ABC F(%)	BDE F(%)	CFG F(%)
Dislike very much	4(8.16)	47(95.91)	39(79.59)
Like moderate	8(16.33)	41(83.67)	40(81.63)
Liked very much	20(34.69)	45(91.83)	45(91.83)
Like extremely	17(40.81)	45(91.83)	45(91.83)
Total	**49(100)**	**49(100)**	**49(100)**

Source: Field work, 2020. ABC= 100% Wheat flour, BDE= 20% wheat flour and 80% Rice flour, CFG = 80% Wheat flour and 20% rice flour.

From the analysis of the perception of the colour of the three cake presented to each respondent, 94% of the respondents liked the colour of Product BDE, while 88% and 67% liked the colour of Product ABC and CFG respectively. However, 41% of the respondents liked the colour of Product BDE very much while only 29% and 24% liked the colour of Product ABC and CFG.

Product ABC consisted of 100% wheat (which served as the control). From the hedonic scale, product ABC was rated to be like extremely while the rest of the products were rated like very much. The product ABC was significantly ($P < 0.05$) different from products ABC containing 100% wheat flour. Similar to this finding, [19] reported that the sensory score of *Kuih Talam Pandami (KTP)* added with 30-90% of unpolished brown rice powder received significantly lower score for colour compared to the control sample. The results however, disagreed with [22] Bunde *et al.* (2010) who reported no significant difference in colour the control biscuits and 10-40% unpolished rice flour

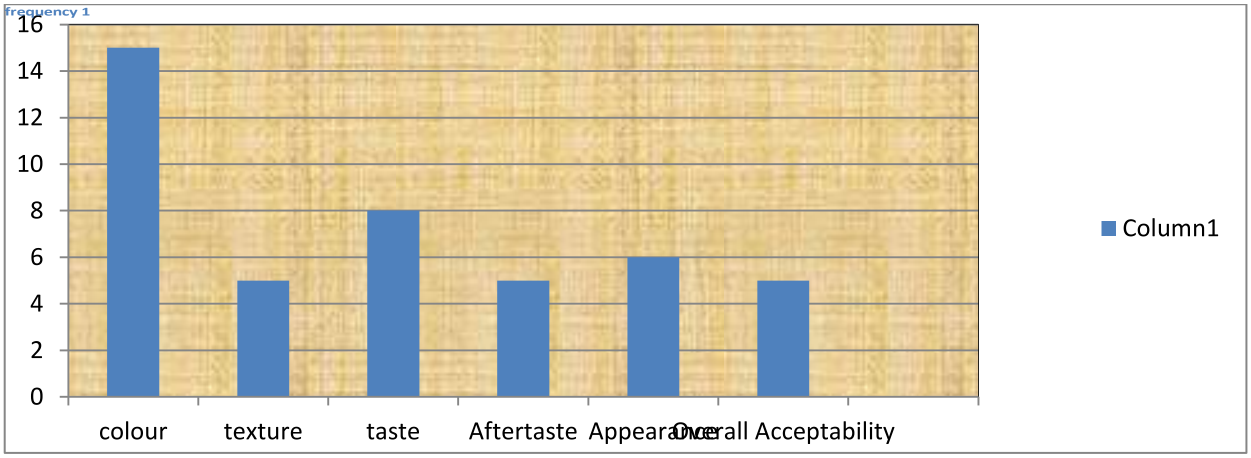

Figure 1: **The most important sensory attribute of the cake**
Source: Field work, 2020

In response to the most important sensory attribute for the composite cake, the respondents after analyzing the sensory attributes of the sample stated their preference for the products presented to them. The result shows 15 respondents representing 30.61% preferred colour as the most important attribute, 8 respondents representing 16.32% preferred taste, 6 respondents representing 12.24% preferred Appearance,4 respondents representing 8.16% for Aroma whilst 5 respondents representing 10.20% for texture, Aftertaste and Overall acceptability respectively (Figure1). This clearly shows that colour was the most important by 53% majority of the respondents. Their most important attribute was influenced by the crispy nature of the cake.

Table 6: Over all acceptability of the cake

Sensory quality attributes	ABC F(%)	BDE F(%)	CFG F(%)
Dislike very much	4(8.16)	2(4.08)	13(26.53)
Like moderate	8(16.33)	10(20.40)	20(40.82)
Liked very much	16(32.65)	20(34.69)	12(24.49)
Like extremely	17(40.81)	21(42.86)	4(8.16)
Total	**49(100)**	**49(100)**	**49(100)**

Source: Field work, 2020. ABC= 100% Wheat flour, BDE= 20% wheat flour and 80% Rice flour, CFG = 80% Wheat flour and 20% rice flour

Over all acceptability scores generally revealed that majority of the respondents (91%) preferred Product BDE (95.91%) and Product CFG (73.47%). This implies that the consumers preferred sample BDE produced using 20% wheat flour and 80% rice flour substitution. Composite sample BDE produced cake samples was rated highest (like extremely) amongst all attributes and Product BDE was significantly ($P < 0.05$) different from the rest of the products. From the hedonic scale, product BDE was rated to be liked extremely with the rest of the product rated to be very much liked. The acceptability scores for the current study support the statement made by [23] 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 [19] [20]. Increase in acceptability was observed as the level of substitution of unpolished brown rice increased.

Table 7: Proximate composition of cake samples

Components	Sample-ABC Control	Sample-BDE	Sample-CFG
Moisture Content	24.17±1.39	19.39 ± 0.48	41.35 ± 0.16

Ash content	1.26 ± 0.028	1.24 ±0.017	0.96 ± 0.12
Crude protein	7.32 ± 0.16	7.5 ±0.29	7.92 ± 7.07
Crude fat	36.94 ± 0.17	31.02±0.23	28.07 ± 0.81
Carbohydrate content	30.28 ±**1.**37	40.74 ±0.40	22.49 ±2.12

Values are averages of duplicates readings (Mean ±SD). Means with different data

Source: Field work, 2020. ABC= 100% Wheat flour, BDE= 20% wheat flour and 80% Rice flour, CFG = 80% Wheat flour and 20% rice flour

The final blend composition of 80% and 20% rice flour was used to prepare cake samples and the quality evaluated. The results obtained for the chemical compositions investigated are shown in Table 6. Generally, the values for ash and protein were lowest in the composite flour produced caked samples and higher in the control wheat flour produced samples albeit not significant (P>0.05) with fat content of the cake. These differences could be attributed to the composite flour blend components. Ash content of the composite blend decreased due to the significantly higher mineral content of all the non-wheat flours. The reverse however was recorded for the carbohydrate values for both products. These results are in agreement with those obtained by [23] Ndife et al. (2011). The relatively low carbohydrate values in sample ABC and CFG of the composite flour products may be attributed to the high levels of wheat flour used relative to the control.

The moisture content of the samples ranged between 24.17% for control wheat flour rock cake to 19.39% for the composite flour (Sample BDE) cake and 41.35% for sample CFG (Table 5). Generally, the cake samples contained very low moisture (19.39 and 24.17%, respectively, for the control wheat flour and composite flour with low quantity level of rice blend). The higher moisture content in the composite flour sample CFG products relative to the control may be attributed to the blend composition of the large quantity of composite flour blend. Soluble protein contained in CFG flour contributes to a greater moisture holding capacity [5]. In addition, the high fibre content in the composite blend caused retention of moisture.

Conclusions

In conclusion, the study showed that rice flour could be incorporated as baking ingredient with wheat flour for making cake. The results of consumer acceptance showed that cake with 20% wheat flour and 80% rice flour substitution was acceptable by the consumers. Finally, cake of good quality could be produced from wheat and unpolished rice flour blends. Substitution of wheat flour with rice fractions resulted in significant increase in protein and moisture contents and met the recommended minimum requirements of food.

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