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Characterization of Wheat Flour Bread Fortified with Banana Flour

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Abstract

Breads were formulated from wheat flour incorporating 5%, 10%, and 15% banana flour. The baking properties of bread, such as loaf volume, specific volume, and moisture content, were evaluated. The proximate composition of the formulated bread was analyzed. Bread volume decreased with increasing banana flour, whereas the bread weight and moisture content significantly increased with the increasing level of banana flour. It was a noticeable observation that the ash content increased in a noticeable amount by increasing the proportion of banana flour. The color of both crumb and crust of bread was improved by incorporating 5% banana flour in bread formulation. The analysis of bread containing 5% banana flour showed moisture 33.55%, Protein 8.575%, fat 2.60%, ash 1.59%, crude fiber 1.20%, total sugar 1.75%, carbohydrate 53.685%, respectively. The formulation of banana blend (5%) bread was wheat flour 190g, banana flour 10g, yeast 4g, sugar 8g, salt 4g, fat 8g, moisture 130 ml. Semi-trained panelists carried out the sensory analysis. The response of the taste panelist was statistically analyzed. The flavor, color, and overall acceptability of bread containing 5% banana flour give the highest average score value. The bakery industry may use banana flour for incorporation into the bread making without much affecting the sensory qualities with improved fiber contents.

Keywords

Bread, Banana, Sensory Evaluation, Banana Flour

1. Introduction

Banana (*Musa paradisiaca*, Musaceae family) has a high nutrient value and is one of the world's most common fruits. Banana shows high flavonoids, dietary fibre (DF), and stubborn starch (RS) than when ripe at the early stages [1]. It is probably one of the oldest grown crops in the world. Banana is consumed in many ways and has many dietary and therapeutic advantages. Ripe bananas are used in various ways in our human diet, from simply peeling and eating out of hand to cutting and serving in fruit bowls and salads, sandwiches, custards, and gelatines mashed into ice cream, bread, muffins, and cream bread.

In Bangladesh, the popularity of bread is growing, and they are not limited to higher-income groups alone. Bread is easier for various formulations to fulfil a wide variety of market demands about taste and nutrition. Highly nutritious banana bread is a common food supplier to vulnerable groups of pregnant mothers, young schools, and kids [2]. Also, bread is consumed worldwide, contributing particularly in developing countries to the consumption of proteins, lipids, and carbohydrates. Thus, banana flour has an excellent opportunity to improve bread and increase its nutritious value. Although the market offers a wide variety of bread styles, white bread still represents the first option for many customers because of its sensory qualities. The high percentage of rapidly digested starch (RDS), which correlates positively

with the in vivo postprandial glycaemic index (pGI) after 20 minutes of digestion, is considered a high glycaemic food [3]. The addition of banana flour in the bread can increase the bread's nutritional quality, which directly benefits Bangladesh's malnutrition problem. Based on information so far accumulated, the present study has been undertaken to achieve the optimum formulation of bread incorporating various banana flour and evaluating the baking quality and sensory features of those.

2. Methods

This study was carried out in Food Technology and Rural Industries Department laboratories, Bangladesh University of Agriculture, Mymensingh, Bangladesh.

2.1 Materials

2.1.1 Banana flour/powder

Uniformly mature ripen bananas were collected from the local market. Then, the bananas were peeled and screened through a mesh to remove off fibrous portion. After that, the foaming agent (albumen) was added at the rate of 5% by weight of the mashed banana and mixed until the fine foam was obtained. This process was done promptly to avoid any browning or discoloration. The fine banana foam was spread on a tray and dried at 55^{o}C in a cabinet drier until it became suitable for making flour. The dried sample ground into fine banana flour and stored at 4oC until further use.

2.1.2 Wheat flour (Maida)

Commercially available wheat flour (Maida) was collected from the local market and used in bread preparation.

2.1.3 Formulation for bread from banana flour

A different proportion of banana flour replaced the wheat flour. The formulation of banana blend bread is outlined in Table 1.

2.1.4 Procedure for bread preparation

The bread was made according to the method described by Kent (1994) [4]. The yeast was initially rehydrated (8 ml of water/g of yeast) in warm water (40°C) for 10 minutes to start fermentation. Sugar and salt were dissolved in a measured amount of water. All the ingredients were mixed for about 10 minutes to prepare control and fortified bread. The prepared dough was left 2 hours away to allow the fermentation process. To avoid dehydration, the dough was coated with moistened fabric. Upon two hours of fermentation, the gas involved was "knocked out" so that the temperature could stand, and the thorough mixing could be carried out. After 1 hour of resting, the dough is divided into roughly shaped loaf size (i.e., 200 gm). The dough pieces were rested at around 27°C for 10-15 minutes (1st proof) and shaped into final form to tighten the dough mechanically so that the gas and water could better spread, be stored, and placed in pre-greased baking cups. The dough was again rested in the baking pan for the final tests at 370°C for 60 minutes and then baked for 40 minutes at temperature 230°C in the oven. The loaves were allowed to cool for a minimum of 2 hr. at 24°C before evaluation.

Table 1. Formulation of banana blend bread

Ingredients	Samples			
	S_1	S_2	S_3	S_4 (Control)
Wheat flour (g)	170	180	190	200
Banana Flour (g)	30	20	10	0
Yeast (g)	4	4	4	4
Sugar (g)	8	8	8	8
Salt (g)	4	4	4	4
Fat (g)	8	8	8	8
Water (ml)	130	130	130	130
*Bread Improver	1.00	1.00	1.00	1.00

*Bread improver = potassium bromate 0.30 g, ascorbic acid 0.50 g; calcium sulfate 7.50 g; ammonium chloride 8g and malt flour 36.70 g for good quality bread.

2.2 Evaluation of physical characteristics of bread

Initially, the volume of the bread is an important quality parameter. The seed transfer method, defined by Ott in 1987 [5], was used to measure the bread volume. The volume was calculated by subtracting the measured volume of rapeseed mustard seed needed to fill an empty container and fill that same container that holds the bread. The baked bread weight

and volume have also been measured following the same method.

2.3 Proximate composition analysis

Prepared banana flour and white flour bread were analyzed for moisture, protein, ash, crude fiber, and total sugar content by the method described in AOAC (2010) [6]. Carbohydrate content was determined by the subtraction method.

2.4 Sensory evaluation of bread

A semi-trained panel did the sensory evaluation. A 1-9-point hedonic rating test [7] was used to assess the degree of acceptability of color, flavor, texture, and overall acceptability of banana bread containing 5%, 10%, and 15% banana flour. The score was arranged in a frequency table and statistically evaluated for variance analysis. However, if any variation existed, Duncan's New Multiple Range Test procedure was followed.

2.5 Statistical analysis

All the analysis were conducted in triplicate, and the data were all subjected to ANOVA (analysis of variance) to determine significant differences among the various samples using statistical software SPSS (version 11.0 SPSS inc. Chicago, IL, USA)) at the 0.05 level.

3. Results

3.1 Proximate composition of banana flour

The proximate composition of the banana flour is presented in Table 2. Several authors also reported almost similar results. Gopalan et al. (1971) [8] and Kawamura (1967) [9] reported that banana flour contained 1.1% to 1.87% proteins, 0.016% to 0.4% fats, 19.33% to 25.8% carbohydrate, respectively. The variations in the results may be due to ripening quality, varietal differences, agroecological condition, fertilizer use, storage conditions, analysis methods, etc.

Table 2. Composition of banana flour

Component	Quantity (%)
Moisture	14 ± 0.95
Protein	1.7 ± 1.05
Fat	0.4 ± 0.56
Ash	1.52 ± 0.06
Crude fiber	1.07 ± 0.14
Total carbohydrate (% by difference)	81.31 ± 0.98

3.2 Proximate composition of banana bread

The bread was prepared with 0%, 5%, 10%, and 15% banana flour, and subsequently, the bread's proximate compositions were determined. The results of the analyses are shown in Table 3. The highest moisture content, 35.78%, was found in the control sample compared to four different formulations. The moisture content was decreased gradually with the addition of banana flour, which possibly due to the contribution of solids content from banana flour. These results agreed with Viana et al. (2018) [10], where sliced bread was fortified with green banana flour. The protein percentage of banana flour bread declined marginally with the increase in banana flour. It may be that the banana flour contained a small amount of protein, and as the banana flour replaces wheat flour, the protein content of wheat flour was also substituted. Thus, adding banana flour to bread can decrease bread's protein content. Andrade et al. (2018) [11] also found this decrease in protein during banana-flour baking. The fat contents of different bread were 2.48 to 2.91%, presented in Table 3. Though banana flour is not rich in fat but with wheat, the total fat content has increased. Oyetoro et al. (2016) [12] also reported that fat content decrease with green banana flour incorporation.

Table 3. Proximate composition of bread incorporated with banana flour

Components (%)	Bread without Banana Flour (S_4)	Bread with 5% Banana Flour (S_3)	Bread with 10% Banana Flour (S_2)	Bread with 15% Banana Flour (S_1)
Moisture	35.78 ± 0.27	33.55 ± 1.05	32.55 ± 0.85	31.95 ± 1.33
Protein	8.75 ± 0.35	8.5 ± 0.04	8.05 ± 0.87	7.86 ± 0.85
Fat	2.48 ± 0.88	2.60 ± 1.02	2.88 ± 0.98	2.91 ± 1.05
Ash	1.49 ± 0.56	1.59 ± 0.26	1.6 ± 0.96	1.8 ± 0.88
Crude fiber	0.9 ± 0.04	1.20 ± 0.37	1.3 ± 0.16	1.42 ± 0.74
Total sugar	1.87 ± 0.26	1.75 ± 0.09	1.72 ± 0.87	1.68 ± 1.26
Carbohydrate	50.60 ± 0.19	52.56 ± 0.06	53.32 ± 1.22	53.76 ± 2.04

The highest ash content was found in the sample containing 15% banana flour and lowest in control bread. The ash content increased with the increasing level of banana flour in the bread samples. High levels of ash in samples of bananas are representative of high mineral components. In banana flour bread, Khoozani et al. (2020) [13] also obtained greater quantities of ash. The crude fiber content in prepared bread ranged from 0.9% to 1.42% and increased by the change in banana flour. The crude fiber represents a variable fraction of dietary fiber and includes mostly the lignin, cellulose, and hemicellulose components. Several authors, Asif-Ul-Alam et al. (2014) [14] and Nasution et al. (2012) [15], also reported a similar increase in fiber content with increasing banana flour in the baked product. The sugar content of different bread samples was 1.68% to1.87%, as shown in Table 3. The optimum level of sugar enhanced the bread's flavor, but more sugar content might be the cause of declining bread acceptability. The carbohydrate content of different bread samples varied from 51.493% to 54.175% (Table 3). The variations in carbohydrate contents among bread samples may result from the difference in protein, fat, ash, and moisture content of wheat flour and banana flour.

3.3 Physical properties of banana bread

Table 4 represents the physical characteristics of bread made of banana flour. Among the bread samples, the control bread had the highest volume. The volume of banana bread decreased with the increase of banana flour in the formulation due to the absence of gluten content in banana and lower bread volume. Furthermore, with the rising amount of bananas flour, the weight of bananas bread increased. This is possible because banana flour contained more mineral substances than wheat. The chemical study of banana bread indicates that the greater quantity of ash in banana bread predicts higher mineral material quantity in banana bread.

Table 4. Effect of various levels of banana flour on physical properties of banana bread

Physical Parameters	Bread without Banana Flour (S_4)	Bread containing 5% Banana Flour (S_3)	Bread containing 10% Banana Flour (S_2)	Bread containing 15% Banana Flour (S_1)
Volume (% based on control)	100	96.56	87.45	67.84
Weight (% based one control)	100	101.8	102.4	103.01
Specific Volume of Bread (%)	3.07	2.91	2.62	2.02

The specific volumes of different bread varied from 2.02 cc/gm to 3.07 cc/gm and gradually decreased with increasing banana flour in bread formulation. Therefore, this negative relationship between banana flour and breed-specific bread volume can be seen, which agrees with observations in other studies [16].

3.4 Sensory evaluation of banana bread

Bread containing banana flour at various levels was subjected to sensory evaluation. The preference for color, texture, flavor, and overall acceptability of bread are given in Table 5. A significant ($p \leq 0.05$) difference was observed in crumb color, crumb texture, crust color, flavor, taste, and overall acceptability among the bread samples.

Table 5. Mean sensory scores of bread containing banana flour at various levels

	Mean Scores					
Samples	Crumb color	Crumb texture	Crust color	Flavor	Taste	Overall Acceptability
Control	8.083a	7.61a	7.52a	7.96a	8.02a	7.92a
S_1	7.34a	7.08ab	7.22ab	7.49a	7.9ab	7.41a
S_2	7.16b	7.10b	7.03b	7.43a	7.5b	7.28a
S_3	6.76b	6.36c	6.05c	7.08b	6.8c	6.28b

S_1= Bread with 5% Banana flour, S_2 = Bread with 10% banana flour, S_3 = Bread with 15% banana flour.

The values are mean ± SD. The mean with different superscripts in a row differ significantly ($p \leq 0.05$)

The result showed that 5% of banana flour containing is the most acceptable in crumb color, crumb texture, and crust color. The acceptance of crumb and crust properties also decreases as the replacement degree increases. The sample S1 is most prominent with a mean 7.49 and 7.9 score, respectively, followed by the S_2 with a mean of 7.43 and 7.5, and the S3 sample with an average score of 7.08 and 6.8, respectively. According to panelist score, sample S_1 was the most preferred in terms of overall acceptability, while S_3 is the least accepted, reflecting the addition of banana flour with wheat flour. These results are in accordance with the finding of Oyetoro et al. (2016) [12] and Mongi et al. (2011) [17].

4. Conclusion

This study has demonstrated that bread made from wheat flour incorporating banana powder had a higher amount of moisture, protein, fat, and minerals than bread from wheat flour only (i.e., control). It was observed that wheat flour

could be substituted with banana flour to form banana flour bread up to 5% to achieve acceptable quality attributes. These findings will help generate technology that diversifies banana meal in the baking industry as a fortified formulation. However, more research should be carried out to determine how value-added ingredients in other food items are available.

5. Conflict of interests

The authors have no conflicts to declare.

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