Feasibility in Using Banana Flour in Bread Production: Centesimal and Sensory Analysis

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Abstract Brazil produces about six million tonnes per year of banana (*Musa spp*), with 35 kg/inhabitant/year average consumption. Banana peel represents about 47–50% (w/w) of ripe fruit but it doesn't have industrial applications; sometimes it is used in animal feed but in small-scale. On the other hand, banana flour already has proved to be a very promising ingredient, is used in baking, diet products, children's food, and animal feed. Based on these benefits and considering the great banana productivity in Brazil, the present work proposes the development of formulations of bread from banana flour, as well as analyze the sensory parameters, where acceptance tests were carried out, with a hedonic scale of 9 points; the attributes evaluated: flavor, appearance, texture, aroma, and overall impression. The results showed that the formulations, in general, have been accepted, except that produced by a mixture composed of 70% banana flour and 30% wheat flour, which presented a significant difference in relations with the other, for all attributes analyzed.

Keywords Banana · Flour · Baking · Sensorial analysis · Centesimal analysis · Acceptance

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1 Introduction

Banana (*Musa spp*) is one of the most consumed fruits in the world, whose consumption is increased every year, due to its high energy content (about 100 kcal per 100 g of pulp), for presenting easily assimilable carbohydrates, and also for being rich in vitamins, potassium, phosphorus, calcium, and iron, when compared to apples or oranges [1].

In green bananas, the main component is the starch (55–93% of the total solids content), and as the fruit matures, the starch is converted to sugars (glucose, fructose, and sucrose), reducing the acidity and, consequently, increasing sweetness [2].

The concentration of starch in the green banana makes it of great industrial interest, and beside the fact that its shell surpasses the pulp content of some nutrients, this organic residue became an inexpensive source of carbohydrates and minerals [3]. In this context, the flour of the green banana peel appears in the bakery industry, which can be used as supplementation or in partial substitution of wheat flour. Moreover, the fact that banana flour is not digested by the small intestine makes it very efficient in diets to eliminate weight [4].

Bread is one of the most popular foods and one of the main caloric sources of diet in many countries and it is, therefore, the subject of many types of research, in order to add nutritional value to the product, either by enhancing the nutrient content or by correcting its deficiencies [5].

The consumer market for bread has grown, varying from region to region. The Southeast and South Regions of Brazil consume around 35 kg/inhabitant/year, while the Northeast reaches only 10 kg/inhabitant/year. The consumption of bread in Brazil is 27 kg per year per person, which represents half of the proportion recommended by world organizations such as the WHO—60 kg/inhabitant/year—, and the FAO—50 kg/inhabitant/year. Baked goods occupy third place in the Brazilian shopping list, representing, on average, 12% of the family budget for food [6].

Considering the great interest in the industrialization of green banana peel, together with the great popularity of bakery products, the present work[1] aims to analyze the viability of the use of banana flour in the development of form loaves formulations, alternative nutritional enrichment of the product, as regards the fiber content. The different formulations were tested by means of sensorial acceptance tests.

2 Materials and Methods

In order to obtain banana flour, bananas of the variety nanica (Musa acuminata'Dwarf Cavendish') were used in the ¾ fat development stage, that is, still green. First, the fruits were dehydrated in tray drier (Macanuda, MS-P), and then crushed in the industrial crusher (Metvisa, LQ-25). The obtained flour was evaluated for moisture,

[1]This research was carried out by the author at the University of Taubaté.

protein content, ashes, and fat. The bread loaf was prepared by adding the banana flour, partially replacing the wheat flour, following different formulations, in relation to the proportions of brown flour/flour.

The sensorial attributes of the different bread formulations (flavor, appearance, texture, aroma and overall impression) were analyzed by means of acceptance tests with a hedonic scale of 9 points of conducting a survey are the agility and economy in obtaining data, as well as obtaining data grouped in tables, which allow a rich statistical analysis.

2.1 Characterization of the Banana Flour

The processed banana flour was initially characterized, and physicochemical analyses were performed to determine its centesimal composition, and the following physicochemical analyses were performed:

Moisture [7—Method 16192];
Ashes [7—Method 16196];
Total Lipids [8];
Proteins [7—Method 38012].

The analyses concerning the characterization of the banana flour were carried out in triplicate, to verify if there is a divergence of results in the repetitions.

2.2 Processing of Loaves

The preparation of this type of bread followed the basic formulation composed of flour, biological yeast, eggs, salt, sugar, and milk. Instead of wheat flour, it was used a mixture composed of BANANA FLOUR + WHEAT FLOUR in different proportions, as follows:

$F1$: 100% wheat flour
$F2$: 50% wheat flour + 50% banana flour
$F3$: 70% wheat flour + 30% banana flour
$F4$: 30% wheat flour + 70% banana flour.

The flour, together with the biological yeast, was sieved to be added in a spiral kneader (Paniz, AE-25) and homogenized to the mixture composed of eggs, sugar salt, and milk. Thereafter, the dough was shaped and baked at 180 °C for 30 min.

2.3 Sensory Evaluation

In the present work, the different formulations for bread loaf were subjected to sensory analysis for appearance, flavor, and aroma, with reference to the product

prepared in a conventional manner (i.e., from wheat flour), the samples served in single portions, in white disposable plates and coded with three figures.

In the sensory analysis, the evaluations were made using 40 testers, as indicated by Stone and Sidel [9]. Prior to sensory testing, each tester signed the free and closed consent term. Because it was a work involving human beings, it had to be submitted to the evaluation of the Research Ethics Committee of the University of Taubaté, according to protocol nº 603/11. Along with the bread loaves samples, each taster received a score sheet containing 9 faces corresponding, respectively to 9 (extremely enjoyed), 8 (liked very much), 7 (liked moderately), 6 (liked slightly), 5 (displeased slightly), 3 (displeased moderately), 2 (disliked a lot) and 1 (disgusted extremely). For the intent to buy the test, it contained 5 faces, corresponding to 5 (would certainly buy), 4 (possibly buy), 3 (maybe buy/not buy), 2 (possibly not buy), and 1 (certainly would not buy).

In order to verify significant differences between the different product formulations, Variance Analysis (ANOVA) was necessary, in relation to the attributes analyzed.

3 Results and Discussion

3.1 Characterization of Products

Table 1 presents the results concerning the characterization of banana flour, where each value represents the average of the three, and the values in parentheses, the respective standard deviations.

In relation to the results expressed in Table 1, it can be verified that the batches of the products that were used in the elaboration of the different bread formulations presented centesimal composition characteristics of each product, according to results obtained by Neto et al. [10].

Table 1 Physical and chemical properties of banana flour

Analysis (%)	Content (standard deviation)
Moisture	6.63 (0.03)
Ash	0.048 (0.007)
Lipid	0.0071 (0.0002)
Protein	4.534 (0.080)

Table 2 Sensory analysis of the bread enriched with banana flour

Attribute	*F*.1	*F*.2	*F*.3	*F*.4
Texture	6.90[a]	5.35[b]	5.13[b]	4.45[b]
Flavor	7.03[a]	5.16[b]	5.16[b]	3.81[c]
Appearance	7.19[a]	5.55[b]	5.23[b]	5.35[c]
Global impression	6.94[a]	5.03[b]	5.09[b]	4.13[c]

[a] and [b] correspond to statistical parameters; the same item, along the same line, means that there is no significant difference with respect to a certain sensory parameter

3.2 Sensory Analysis

The results of the sensory analysis, referring to the four different formulations of bread enriched with banana flour, are shown in Table 2.

The results presented in Table 2 showed that the formulations, in general, presented a great acceptance, except that elaborated from a mixture composed of 70% of banana flour and 30% of wheat flour, which presented significant difference before the others, with respect to all attributes analyzed.

From the results of Table 2, it can be observed that banana flour-enriched bread presented satisfactory acceptability since, except for the *F*4 formulation, the others presented scores above 5 for all attributes, indicating good acceptance. Still, in relation to the results of Table 2, it can be observed that the different formulations of bread form presented significant differences in relation to all the attributes.

For all the sensorial attributes analyzed, it was observed that the greatest rejection, by the tasters, was for the formulation 4, which proves the impossibility of replacing the wheat flour for banana flour by more than 50%, in the production of bread. The satisfactory acceptability of formulations 2 and 3 demonstrate viability in the nutritional enrichment of loaves, partially replacing wheat flour with banana flour to a certain extent (50% banana flour and 50% wheat flour), although preference, by the tasters, was by formulation 1, that elaborated with 100% of wheat flour.

4 Conclusion

From the results presented in the previous item, it can be concluded that, except for the formulation *F*.4, the others presented good acceptance, being that they differed significantly from the one elaborated with 100% of wheat flour, in relation to all the sensory attributes. In this way, it can be affirmed that the addition of the banana flour interferes in the organoleptic qualities of the bread of form. The formulations, in general, presented satisfactory acceptability, except that elaborated from a mixture composed of 70% of banana flour, which proves the viability in the nutritional enrichment of bread loaves with banana flour to some extent.

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