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Honey Breads made with flour of different varieties of green banana

Pães de Mel elaborados com farinha de diferentes variedades de banana verde

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Abstract

The objective of this study was to develop chocolate covered Greek honey cookies (honeyroons) with cooked green banana flours of two varieties: silver (FBVCP) and nanicão (FBVCN), characterizing them physically, chemically, physicochemically and sensorially. The cooked green banana pulps were dehydrated in a ventilated oven at 65ºC / 20 h and ground, thus obtaining the Cooked Green Banana Flour. Three formulations of honeyroons were developed by modification of the standard formulation (P), with partial replacement of the wheat flour by FBVCP and FBVCN in 30% and with 15% of both flours, respectively called A, B and C honeyroons. The physical analyzes for FBVC were the residuals of the losses of the processing and the final yield. As for the honeyroons, weight, height and diameter, before and after cooking, density, thermal factor and yield were analyzed in random samples consisting of units from the same batch. The chemical and physicochemical analyzes of flours and honeyroons were: moisture, ash, insoluble food fiber (FAI), protein, lipids, resistant starch (RS) and carbohydrates (by difference), titratable acidity and pH. The honeyroons were also sensorially analyzed by untrained university tasters (Federal University of Rio de Janeiro - UFRJ), applying the preference test with the ordering into 37 tasters, and acceptance through the 9-point hedonic scale for the attributes appearance, aroma, texture, flavor and overall appearance into 73 tasters, with their consent, and approved by the Research Ethics Committee of the University under number 164/07. Regarding the physical characteristics, the yields of the flour were 17% and, for the honeyroons, the largest difference ($p \leq 0.05$) was expressed in the reduction of the post-cooking

height for the formulations with the flours, due to the high content of fiber and RS in the honeyroons. The silver and nanicão FBVC presented humidity according to the Brazilian legislation, high content of RS, protein, FF and ashes. The honeyroons elaborated with the flours consequently presented chemical and nutritional profile higher than the standard and were considered food sources of FF and RS. The titratable acidity and pH were higher ($p \leq 0.05$) for the honeyroons elaborated with the flour of the nanicão variety. All honeyroons were considered equally preferred and were well accepted, with IA≥ 80% in the evaluated attributes. It was concluded that the use of flour added nutritional and functional value to the honeyroons, because it increased the FF, RS, protein and mineral content to the products, without modifications of the sensorial characteristics and with good sensorial acceptance, providing sensorial and nutritional quality.

Keywords: Green banana. Green banana flour. Honey bread. Food fiber. Resistant starch.

Resumo

Objetivou-se desenvolver pães de mel com farinhas de banana verde cozida de duas variedades: prata (FBVCP) e nanicão (FBVCN), caracterizando-os física, química, físico-química e sensorialmente. As polpas de banana verde cozidas foram desidratadas em estufa ventilada a 65ºC/20 h e moídas, obtendo assim as Farinhas de Banana Verde Cozida. Foram desenvolvidas três formulações de pão de mel por modificação da formulação padrão (P), com substituição parcial da farinha de trigo pelas FBVCP e FBVCN em 30% e com 15% de ambas as farinhas, sendo estes denominados, respectivamente, de pão de mel A, B e C. As análises físicas para FBVC foram os resíduos das perdas do processamento e o rendimento final. Já para os pães de mel peso, altura, e diâmetro antes e pós-cocção, densidade, fator térmico e rendimento, foram em amostras aleatórias constituídas de unidades provenientes de uma mesma fornada. As análises químicas e físico-químicas realizadas das farinhas e dos pães de mel foram: umidade, cinzas, fibra alimentar insolúvel (FAI), proteína, lipídios, Amido resistente (AR) e carboidratos (por diferença), acidez titulável e pH. Os pães de mel também foram analisados sensorialmente por provadores não treinados da universidade (Universidade Federal do Rio de Janeiro-UFRJ), aplicando o teste de preferência ordenação em 37 provadores e aceitação através da escala hedônica de nove pontos para os atributos aparência, aroma, textura, sabor e aspecto global em 73 provadores, com seu consentimento e aprovado

pelo comitê de ética em Pesquisa da Universidade sob o número 164/07. Quanto às características físicas, os rendimentos das farinhas foram de 17%, e para os pães de mel, a maior diferença ($p \leq 0,05$) expressou-se na redução da altura pós-cocção para as formulações com as farinhas devido ao elevado teor de fibra e AR nos pães. As FBVC prata e nanicão apresentaram umidade em conformidade com a legislação brasileira, elevado teor de AR, proteína, FA e cinzas. Os pães de mel elaborados com as farinhas, consequentemente, apresentaram perfil químico e nutricional superior ao do padrão e foram considerados alimentos fontes de FA e AR. A acidez titulável e o pH foram maiores ($p \leq 0,05$) para o pão de mel elaborado com a farinha da variedade nanicão. Todos os pães de mel foram considerados igualmente preferidos e obtiveram boa aceitação, com IA≥ de 80% nos atributos avaliados. Conclui-se que a utilização das farinhas agregou valor nutricional e funcional, pois aumentou o teor de FA, AR, proteínas e minerais aos produtos, sem modificações das características sensoriais e com boa aceitação sensorial, propiciando qualidade sensorial e nutricional.

Palavras-chave: Banana verde. Farinha de banana verde. Pão de mel. Fibra alimentar. Amido resistente.

Introduction

Over the past few decades, consumer interest in products with food fiber and resistant starch has increased.

The starch resistant (RS) to enzymatic hydrolysis can be physiologically defined as the sum of the starch and degradation products of the undigested / absorbed starch in the small intestine of the healthy individual, however, it can be fermented in the large intestine.[1]

RS can rise in starchy products when they undergo drastic hydrothermal processing.[2,3] On the other hand, it can be found naturally in green fruits,[3] as banana, for example.[4,5] The green fruit presents hardness and high astringency, due to the presence of soluble phenolic compounds, being no longer appreciated by consumers.[6,7] Thus, *in natura* or cooked green banana flour is still the best form for its use and consumption, also avoiding its post-harvest waste.

In the diet, its inclusion is seen as positive by several studies, a fact that is related to its nutritional composition[6-8] due to its high resistant starch content, its reducing biological action on the glycemic index[9] and its role for the health and integrity of the colon.[10,11] The literature has presented the use of green banana flour as a replacement option for other flours widely used in Brazil, such as wheat flour, in the elaboration of food products.[12-16]

Thus, the present work aimed to develop chocolate covered Greek honey cookies (honeyroons) with cooked green banana flours of two varieties: silver (FBVCP) and nanicão (FBVCN), characterizing them physically, chemically, physicochemically and sensorially.

Methodology

Raw material

All the experimental work was developed in the laboratorial complex (Laboratório Dietético e de Análise de Alimentos - Dietary and Food Analysis Laboratory) of the Instituto de Nutrição Josué de Castro (Josué de Castro Nutrition Institute), located in the Centro de Ciências da Saúde da Universidade Federal do Rio de Janeiro (Health Sciences Center of the Federal University of Rio de Janeiro).

The raw materials were the green bananas of the species *Musa cavendishi*, varieties silver and nanicão (d'água). The green fruits were purchased in the municipal market of Rio de Janeiro in August 2015, approximately 16 kg, between stages 1 and 2 of maturation determined through the maturity scale of Von Loesecke.[17] The green bananas were removed from the bunches still in peels and washed in running water for the removal of physical dirt, such as dust, dirt and leaves. Soon after, they were placed in chlorinated solution (132 grams of the sanitizer Bioclor at 0.66% of the brand Noordhen Brasil, in 20 liters of water) for 20 minutes, according to the manufacturer's instructions.[13]

Obtaining the cooked green banana flour (FBVC)

The green fruits had their ends cut to facilitate cooking, these ends being reserved for later accounting of the residues and then discarded. The bananas were arranged in pressure cookers submerged in water and baked for 20 minutes.

After cooking, the pulp and peels were separated from the bananas, being counted and discarded. The cooked green banana pulps were then fractionated into small pieces, crushed and dehydrated in a greenhouse at 65°C for 20 hours, considering the masses of the silver and the nanicão varieties.[13] Afterwards, they were ground in a hammer mill, with a 0.75 mm blade for 3-5 minutes, to obtain the flour (Figure 1).

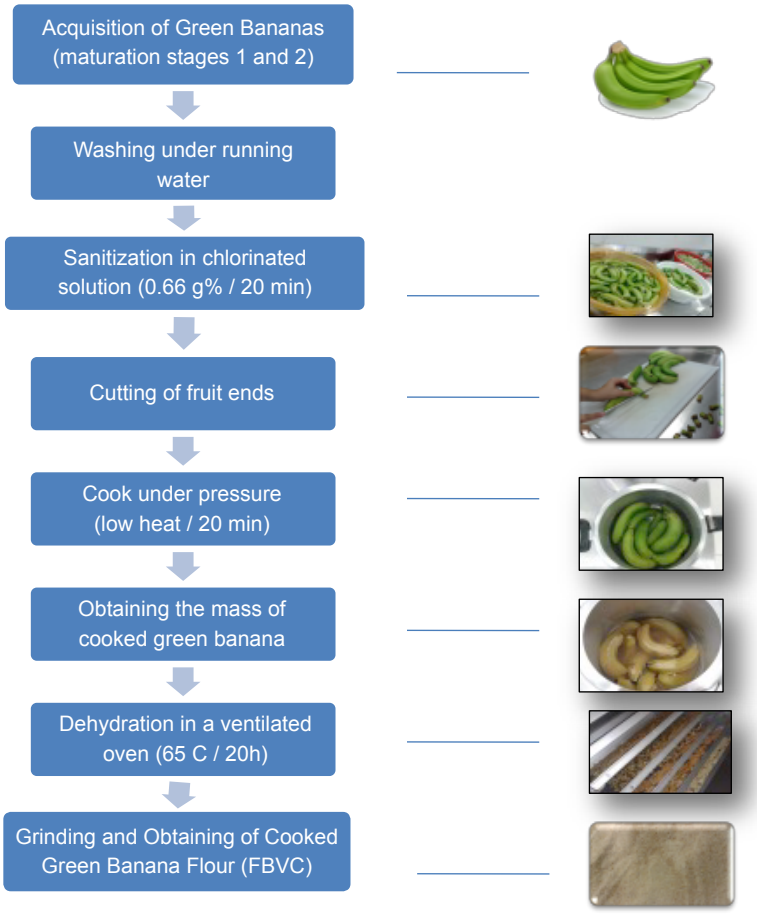

Figure 1. Flowchart for obtaining the Cooked Green Banana Flour.

The obtained flours were then conditioned in glass containers, duly identified and stored in a freezer (-18°C) for further analysis, and its application in honeyroons formulations.

Physical, chemical and physicochemical analyzes of flours and products

By physical analysis of the flour, we mean the weights obtained in the processing stages of the fruit (collected the residues) until the final flour is obtained, as well as its appearance characteristics (color and texture). Yet, the determination of the physical parameters of the honeyroons followed

the procedures described by Silva et al., 2001:[18] for weight, height and diameter before and after cooking, density, thermal factor and yield, conducted with ten units from the same batch sampled at random as soon as they were cooled to room temperature.

The chemical and physicochemical analyzes of the flour, in triplicate: the moisture contents were obtained by gravimetric method using heat in an oven at 105ºC until constant weight; of the ash by incineration in muffle at 550°C; of the total food fiber by non-enzymatic gravimetric method with addition of acetone and alcohol in an oven at 105°C until constant weight; of the proteins, they were obtained from the nitrogen determination by the Kjedahl digestion method, with conversion by factor 6.25 to obtain the amount of protein in grams; of the lipids, they were determined by continuous extraction in solvent by the Soxhlet method; of the titratable acidity, by titration method with 0.1 N sodium hydroxide and phenolphthalein indicator; of the pH, it was determined by electrometric method - all according to the methodologies proposed by the Adolfo Lutz Institute.[19] The resistant starch was obtained by Ramos, Leonel and Leonel.[4] Carbohydrates were determined by difference between the total mass (100g) and the sum of the other components analyzed (moisture, ash, food fiber, proteins, lipids and resistant starch).

Formulation of the products

Honeyroons formulations are listed in Table 1, as well as its preparation technique. Three formulations of honeyroons were developed by modification of the standard formulation (P), with partial replacement of wheat flour by FBVCP and FBVCN in 30% and with 15% of both flours, being called, respectively, honeyroons A, B and C. Afterwards, they were given a chocolate bath and, therefore, refrigerated for 20 minutes.

Table 1. Formulation of honeyroons made with cooked green banana flour, Rio de Janeiro-RJ, 2015.

Ingredient (g/mL)	Formulations			
	STANDARD	A	B	C
Wheat flour	37,5	26,25	26,25	26,25
FBVCP	-	11,25	-	5,625
FBVCN	-	-	11,25	5,625
Cocoa	3	3	3	3
Brown sugar	9,5	9,5	9,5	9,5
Honey	10	10	10	10
Corn Glucose	10	10	10	10
Margarine	4	4	4	4
Milk	25	25	25	25
Cinnamon	1,6	1,6	1,6	1,6
Clove tea	1,3	1,3	1,3	1,3
Bicarbonate	0,75	0,75	0,75	0,75
Yeast	0,1	0,1	0,1	0,1

FBVCP: Cooked green banana flour of the silver variety.; FBVCN: Cooked green banana flour of the nanicão variety; Standard: 100% wheat; A: 30% FBVCP; B: 30% FBVCN; C: 15% FBVCP and 15% FBVCN.

Preparation technique:

1. Sift, weigh and mix all dry ingredients: cocoa, brown sugar, cinnamon and flour; 2. Add margarine and mix; 3. Add honey and corn glucose, and mix; 4. Add the liquid milk and clove tea, and mix; 5. Finally, add the bicarbonate and the yeast, and mix well. Place it in little greased cake molds; 6. Bake it for about 12 minutes/180°C in a preheated oven; 7. After cooling, make the milk or semisweet chocolate bath, put in refrigeration for 20 minutes; 8 - Pack and serve.

Sensory analysis of the products

The sensorial analysis of the products followed the procedures described by Dutcosky,[20] in which the samples were coded with three digit random numbers, offered in complete randomized blocks balanced with the records: profile of the tester and the test itself. The tasters signed the Informed Consent Term.

Preference Test (Ordering): The preference for honey bread was analyzed through the ordering test performed with 37 untrained tasters, selected at random. Each taster received the four samples of honey bread (P, A, B and C) of approximately 9g each and they evaluated the overall appearance.

Acceptance test: Acceptability was analyzed through the hedonic scale of nine points, ranging from 'I liked it very much' (maximum score, 9) and 'I disliked it very much' (minimum score, 1), performed with 73 untrained tasters, being potential consumers of the product. They received three samples of honeyroons (9 g each) made with FBVC (A, B and C) and the hedonic scale to evaluate how much they liked or disliked each of the attributes: appearance, aroma, texture, flavor and global aspect.

Statistical analysis

Physical, chemical, physicochemical and sensory analysis data were submitted to analysis of variance (ANOVA) followed by the Tukey test with significance at 5% level. For the preference test, the Friedman table[20] ($p \leq 0.05$) was used to interpret the results, and to be considered of good acceptance, the criterion was of AI% $\geq$ 70%.[20] The analyzes were done in statistical software *Statistical for windows* version 6.0.

Results and Discussion

There are literary reports that fruits of the same genus and botanical species[4,5] present different culinary properties (paste and retrograde properties), physiological and biochemical properties, demonstrating that the species harbor variations in the behavior of different genotypes to the amount, shape and crystalline structures, especially resistant starch. Therefore, we aimed to work with green banana flours obtained from the same plant species, but from two varieties of greater circulation in the retail trade.

Physical, chemical and physicochemical analyzes of flours

Approximately 16 kg of green banana of the two varieties (silver and nanicão) were used as raw material. From which 8 kg of boiled green banana pulp were obtained, accounting for 52% of the fruit *in natura*. After dehydration in a ventilated oven, about 3 kg (17%) of FBVC were obtained, corresponding to the total yield of 17% from the fruit *in natura*. Both flours were cream-colored, with homogeneous appearance, but the amount of seed in the silver variety was much higher.

The chemical and physicochemical composition of the flours is described in Table 2.

Table 2. Chemical (g%) and physicochemical composition of flours produced from two varieties of cooked green banana. Rio de Janeiro-RJ, 2015.

Parameters	Flours	
	FBVCP	FBVCN
Moisture (%)	4,20[a]	5,80[b]
Ashes (%)	2,50[a]	2,50[a]
Food fiber (%)	0,54[b]	3,80[a]
Proteins*(%)	4,93[a]	4,92[a]
Lipids (%)	0,90[a]	0,80[a]
RS* (%)	20,43[a]	10,40[b]
Carbohydrates **(%)	76,53[a]	61,75[b]
Titratable acidity (p/v)	7,00[b]	13,50[a]
pH	5,30[a]	5,00[b]

FBVCP: Cooked green banana flour of the silver variety; FBVCN: Cooked green banana flour of the nanicão variety; *RS: Resistant starch, calculated from Ramos et al.,[4]. * Calculated by difference {100 – (Moisture, ashes, proteins, lipids, food fiber and RS)}. Values followed by equal letters on the same line do not differ from each other (p>0.05).

The moisture content of the two flours was lower than that recommended by the legislation, which is not more than 14%[21] for wheat flour. Fasolin et al.[22] also reported lower moisture content in green banana flour than that found in legislation. According to Fernandes et al.,[23] flours with humidity above 14% allow the development and growth of microorganisms, such as fungi, and the reduction of flour stability. Therefore, the quantity determined in the FBBV contributes to the stability of the product and its microbiological safety.

Regarding Fixed Mineral Residues (Ashes), the results for the two types of flour produced in this study were higher than those described by Anvisa legislation,[21] which is up to 2.15 g% for whole meal flour, but close to that of Medeiros et al.[24] regarding the formulation of green banana flour. From the analysis found, the FBVC can be classified as whole meal.

For insoluble fiber, the value found in the FBVCP (0.54 g/100 g) was below that verified by Borges, Pereira and Lucena[6] in green banana flour (1.01 g/100 g). For the contents of the FBVCN, it was three times higher than that described by the authors (3.80/100 g). Important aspect, according to Resolution n^0 54 of November 12, 2012, of Anvisa, since it can be considered food source of this component.[25]

There were values of protein content higher than cereal flour: maize = 6.94 g% and rice = 6.7 g%, and very close to the contents of semolina and special wheat flour (12.7 and 9.4 g%), respectively,[26] and close to those found by Borges, Pereira and Lucena[3] for green banana flour.

The lipid content of 0.90 g/100 g for FBVCP and 0.80 g/100 g for FBVCN was close to that found by Borges, Pereira and Lucena[6] in green banana flour (0.88 g/100 g), but below that reported by Fasolin et al.[22] for the same type of flour (1.89 g/100 g). The low lipid content found in the FBVC correlates well with the lower possibility of lipid oxidation deterioration reactions, increasing the stability of the product in the storage, potentiated with the reduced moisture content and energetic value found in the flour.

There is an expressive amount of resistant starch (RS) in the obtained flours: FBVC-silver and nanicão, with 20.43 and 10.40 g%, respectively. According to Freitas & Tavares,[6] green banana is an excellent source of native resistant starch, with predominance of granules of oval and elongated shapes of different sizes, and polymorphism between banana varieties, which may be of interest in technological applications and nutritional benefits. As for carbohydrates, they are high but complex.

The titratable acidity of the two flours (7.00 p/v for FBVCP and 13.50 p/v for FBVCN) was above the maximum established by the legislation[21] for various types of flour (maximum of 5.0 p/p for rye and corn flours). The pH values were close to those reported by Borges, Pereira and Lucena[6] in green banana flour (pH=5.30). These facts are explained by the leaching of organic acids present in the plant matrix, especially fruits and vegetables, when submitted to hydrothermal treatment.

Thus, these flours have satisfactory chemical and physicochemical profiles for stability before and during storage, as well as for their use.

Physical, chemical and physicochemical analyzes of the products

The physical characteristics are described in Table 3, and the chemical and physicochemical composition, in Table 4.

Table 3. Physical characteristics of honeyroons produced with flours of two varieties of cooked green banana, Rio de Janeiro, Rio de Janeiro, 2015.

Parameters	STANDARD	A	B	C
Weight (g)				
pre-cooking	7,30[b]	7,00[a]	7,00[a]	7,00[a]
post-cooking	6,10[a]	6,30[a]	6,50[a]	6,10[a]
Height (cm)				
pre-cooking	0,90[a]	0,90[a]	0,90[a]	0,90[a]
post-cooking	2,10[a]	1,80[bc]	1,90[b]	1,60[c]
Diameter (cm)				
pre-cooking	3,0[a]	3,0[a]	3,0[a]	3,0[a]
post-cooking	2,80[a]	2,80[a]	2,90[a]	2,90[a]
Density (g/mL)	0,70[b]	0,90[b]	1,50[a]	0,70[b]
Thermal factor	0,83[a]	0,90[a]	0,93[a]	0,89[a]
Yield (%)	83,00[a]	90,00[a]	93,00[a]	89,00[a]
		Chocolate bath		
Weight (g)	9,90[a]	9,80[a]	10,20[a]	9,70[a]
Height (cm)	2,30[a]	2,00[b]	2,20[ab]	1,70[c]
Diameter (cm)	2,80[b]	3,00[ab]	3,10[a]	3,00[ab]
Thermal factor	1,62[a]	1,56[a]	157[a]	1,57[a]
Yield (%)	162,00[a]	156,00[a]	157,00[a]	157,00[a]

Standard: 100% wheat; A: 30% Cooked green banana flour of the silver variety - FBVCP; B: 30% Cooked green banana flour of the nanicão variety - FBVCN; C: 15% FBVCP and 15% FBVCN. Values followed by equal letters on the same line do not differ from each other ($p>0.05$).

Table 4. Chemical (%) and physicochemical composition of honeyroons produced from flours of two varieties of cooked green banana, Rio de Janeiro-RJ, 2015.

Parameters	STANDARD	A	B	C
Moisture (%)	17,40^{ab}	18,00^{a}	16,80^{b}	17,40^{ab}
Ashes (%)	1,30^{c}	1,40^{b}	1,40^{b}	1,60^{a}
Fibers (%)	6,41^{ab}	4,38^{ab}	7,35^{a}	1,46^{b}
Proteins* (%)	10,34^{a}	9,85^{a}	9,85^{a}	9,85^{a}
Lipids* (%)	9,99^{a}	10,04^{a}	10,04^{a}	10,04^{a}
RS*** (%)	0,00	3,12^{c}	6,13^{a}	4,62^{b}
Carbohydrates ** (%)	53,64^{a}	45,00^{b}	39,61^{c}	46,54^{b}
Titratable Acidity (p/v)	1,10^{b}	1,10^{b}	1,70^{a}	1,10^{b}
pH	7,10^{ab}	7,11^{ab}	7,12^{a}	7,03^{b}

Standard: 100% wheat; A: 30% Cooked green banana flour of the silver variety - FBVCP; B: 30% Cooked green banana flour of the nanicão variety - FBVCN; C: 15% FBVCP and 15% FBVCN; *Calculated based on Fansolin et al.,[22] and Philippi.[26] ** Calculated by difference of the other chemical analyzes; ***RS: Resistant starch, calculated from Ramos et al.,[4]. Values followed by equal letters on the same line do not differ from each other (p>0.05).

Regarding the physical characteristics of the honeyroons, there was no difference (p> 0.05) between the parameters analyzed before and after the chocolate bath, except at the post-cooking time before and after the chocolate bath. It can be observed that Standard honeyroons produced only with wheat flour presented a higher post-cooking height than the other honeyroons that had the addition of flours. This difference in height can be explained by the high fiber content of the flours, which prevents the pasta from expanding during cooking. For Perez and Germani,[27] similar results were found when developing salty type cookies with the addition of eggplant flour in different percentages.

Vilhalva et al.[28] also found a similar event in breads made from passion fruit peel flour (FCM). As the concentration of FCM increased, replacing wheat flour, the loaves presented smaller volume.

Regarding the humidity presented by the different products, when compared to the recommended moisture content for several types of breads, it was within the values established by the current legislation,[21] and a difference (p≤0.05) was found between formulations A and B, developed with FBVCP and FBVCN, respectively. Formulation A obtained the highest percentage among all formulations (18%), followed by the Standard and C formulations, both presenting 17.40%. The lowest moisture content was demonstrated by product B, with about 16.80% humidity.

Lower moisture contents were observed in honeyroons with higher resistant starch content, which is justified by the low water adsorption properties of resistant starch in products.[29]

Regarding the analysis of fixed mineral residue (RMF) or ashes, the products developed with green banana flour presented higher levels of RMF when compared to the standard formulation, which is closely related to the significant content observed for the flours of the silver and nanicão varieties. The study carried out by Borge, Pereira and Lucena[6] showed that banana flour provides a broad mineral composition, with potassium, phosphorus, calcium, magnesium, sulfur, nitrogen, boron, copper, manganese, zinc and iron, and its inclusion is indicated for the development of products with higher nutritional value. The analysis of the products showed a percentage of 1.60% for formulation C, followed by formulations A and B, with 1.40%, and finally by the Standard formulation, with 1.30%. The difference was considered significant between the Standard formulation and all types of formulations with the flours. There was also a difference ($p \leq 0.05$) between the formulations with only 30% of FBBV and formulation C, elaborated with both types of flours.

The analysis of total food fiber showed that there was a difference ($p \leq 0.05$) between the STANDARD formulation and of the C formulation of the honeyroons. The B formulation obtained the highest percentage, 7.35%, followed by the STANDARD one, with 6.41 %, by A, 4.38% and, with the lowest percentage by C formulation, 1.46%. According to the legislation,[20] a food are considered a source of food fiber when it has at least 3%, and is considered to be high in fiber when it has at least 6%. So, formulations B and STANDARD are high in fiber, and formulation A is a source of fiber. In Possamai, Waszczynskyj & Possamai,[30] , similar results were found between honey bread enriched with wheat bran, which yielded 6.04%, and honey bread enriched with linseed, 8.23%, considered as food with high fiber content. In commercially available packages of honeyroons, the value of food fiber varies from 0% to 1%.[29] Thus, it can be verified that the formulations developed in this study were enriched with the flour of the two banana varieties, becoming products with high fiber content, except for formulation C.

Regarding the protein and lipid analyzes, also in Table 4, all processed honeyroons had similar values ($p > 0.05$)

In the RS analysis of the products, formulation B had the highest percentage, 6.13%, followed by C, 4.62%, and by A, 3.12%. According to Freitas and Tavares,[5] green banana flour has a high starch content, 80% of which is of low caloric potential RS, that effectively participates in the prevention of chronic diseases and metabolic and intestinal disorders.[10,11,16,31]

In addition to these benefits, resistant starch application is suitable for most low moisture products, providing better appearance and texture and contributing to the expansion and crispness of products,[32] especially of baking, as developed in the present work.

The honey bread formulated with the flour of the nanicão variety (product B) presented increased titratable acidity and pH ($p \leq 0.05$) as a result of the greater amount of seeds in the pulp of this fruit[5] and of the formation of volatile compounds with characteristics during the cooking process.[33]

Sensory analysis of the products

Regarding the preference test, the majority of the evaluators were female (71%), were over 18 years old (87%), incomplete higher education (58%) and only 5% had ever consumed any product made from PBV or FBVC. According to Table 5, all samples were equally preferred.

Table 5. Ranking of the preference sensory test, ordering the four formulations of honeyroons, Rio de Janeiro-RJ, 2015.

	Formulations			
	STANDARD	A	B	C
Ranking obtained	31[a]	25[a]	26[a]	39[a]

Standard: 100% wheat; A: 30% Cooked green banana flour of the silver variety - FBVCP; B: 30% Cooked green banana flour of the nanicão variety - FBVCN; C: 15% FBVCP and 15% FBVCN. Values followed by equal letters on the same line do not differ from each other ($p>0.05$), according to Friedman's test.

Possamai, Waszczynskyj & Possamai[30] enriched honeyroons with wheat bran, flaxseed, soybeans and oats, and the result was different: the honeyroons enriched with food fiber (20% wheat bran and 20% flaxseed) were preferred, and that of 20% oats and the standard (100% wheat flour) were also preferred, being in third place, and the least preferred, that of 20% soybean flour.

In the acceptance test, the majority were also female (68%), between 18-25 years old (57%), attending higher education (59%). The frequency of consumption of chocolate covered Greek honey cookies (honeyroons) by the tasters was, at least, fortnightly, while the one with the highest frequency of consumption was of biscuits, cakes and chocolates.

Table 6. Average score and Acceptability Index (IA%) of the acceptance test attributes for honeyroons formulations, Rio de Janeiro-RJ, 2015.

Attributes	A		B		C	
Appearance	7,64[a]	84,85[a]	7,68[a]	85,35[a]	7,89[a]	87,63[a]
Aroma	8,09[a]	89,90[a]	8,00[a]	88,87[a]	8,23[a]	91,41[a]
Texture	7,40[a]	82,32[a]	7,89[a]	87,63[a]	7,68[a]	85,35[a]
Flavor	7,59[a]	84,34[a]	8,09[a]	89,90[a]	8,05[a]	89,40[a]
Overall aspect	7,66[a]	85,10[a]	8,02[a]	89,14[a]	7,93[a]	88,13[a]

Standard: 100% wheat; A: 30% Cooked green banana flour of the silver variety - FBVCP; B: 30% Cooked green banana flour of the nanicão variety - FBVCN; C: 15% FBVCP and 15% FBVCN. Values followed by equal letters on the same line do not differ from each other ($p>0.05$).

The results of the acceptance test (Table 6) showed mean scores of the attributes for the three formulations above 7 (moderately liked), being in the acceptance zone of the tasters, with the Acceptability Index being higher than 70%, indicating as satisfactory the acceptance of the products elaborated with the flour in all the attributes. Similar results were found by Fasolin et al.,[22] which reported good acceptance of cookies produced with 10% and 20% of green banana flour, without difference ($p\leq0.05$) between this one and the standard (100% of wheat flour). Yet, Ritter & Mallman[29] reported acceptance of 69% of whole-grain honeyroons made with bran and wheat fiber.

Gilbert et al.[36] described that the high content of RS from modified corn starch, when added to the cookies, contributed to the reduction of digestible carbohydrates without altering the sensorial characteristics of the product.

Devoid of flavor, the flours can be incorporated into the chocolate covered Greek honey cookies (honeyroons), without altering the sensorial properties, especially aroma, flavor and color, besides supplying them with vitamins, minerals and high content of resistant starch (RS), a fact verified in the sensorial tests and as potentiality of functional ingredient.[11,35,37]

Conclusion

Cooked green banana flours of the silver and nanicão varieties can be used as sources of food fiber and resistant starch, but it is notorious that banana varieties harbor differentiations in these levels. However, both were able to add functional and nutritional value to the products developed from them.

Honeyroons made with the flours are sources of food fiber and resistant starch, and did not present changes in the mass growth characteristics or in the sensorial characteristics of the products, namely the taste, aroma, color and texture, with good acceptance, representing thus interesting alternatives to the STANDARD chocolate covered Greek honey cookies (honeyroons).

Collaborators

All authors contributed to the conceptions and design of the study, data analysis and final writing.

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