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Functional properties of milk drinks flavored with mangaba pulp and enriched with passion fruit bark flour

Lígia Campos de Moura[1], Marco Antônio Pereira da Silva[1]*, Geovana Rocha Plácido[1], Márcio Caliari[2], Diene Gonçalves Souza[1], Jéssica Leal Freitas e Souza[1], Juliana Aparecida Célia[1], Kênia Borges de Oliveira[1], Karen Martins Leão[1] and Luiz Eduardo Costa do Nascimento[1]

[1]Instituto Federal Goiano Campus Rio Verde – Brazil.
[2]Universidade Federal de Goias – Brazil.

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Dairy foods including dairy based drinks play an important role in human nutrition. The flour of the passion fruit peel has high potential for use in the enrichment dairy drinks improving the nutritional and technological qualities besides an alternative to reduce waste by-products in the food industry. Thus, this study aimed to evaluate the physical and chemical parameters, texture, color, chemical composition, scanning electron microscopy (SEM), phenolic compounds, antioxidant, viability of lactic bacteria and sensory profile of milk drinks added mangaba pulp and passion fruit peel flour of the (FPFP). Four milk drinks formulations were processed with concentrations of 5; 10; 15 and 20% mangaba pulp and 1% of passion fruit peel flour. The dairy beverages showed results physical and chemical, microbiological and sensory consistent with those described in the literature and as expected, with a high sensory acceptability of milk drinks with increased by 10% mangaba pulp.

Key words: Color, fermented milk, scanning electron microscopy (SEM), viability.

INTRODUCTION

The Brazilian cerrado has a large variety of exotic fruit species with potential interest to food industries and source of income for local people (Souza et al., 2012). Mangaba (*Hancornia speciosa* Gomes) is one of a fruit plant native to Brazil belonging to the Apocinaceas family, and found in various regions of the country, from the Northeastern coast to the cerrado region of Mid-Western, Northern and Southeastern Brazil (Vieira-Neto, 1994).

In recent years, there has been an increased consumption of fruit-based drinks associated with a reduction in the consumption of fresh fruits (Zulueta et al., 2007). The development of new products such as milk drink is among the various forms of use of milk whey from the dairy industry (Oliveira, 2006) by including fruit pulp and waste. In this context, the functional properties of

*Corresponding author. E-mail: marcotonyrv@yahoo.com.br.

passion fruit bark have been studied in recent years, especially those related to the content of fiber, calcium and sodium, with values higher than those of fruit pulp; the iron content also stands out, allowing the use of passion fruit bark as a source of fiber and minerals (Cordova et al., 2005).

The development of milk drinks flavored with mangaba and enriched with passion fruit bark flour can be an alternative to add functional value to products and become more attractive to consumers. Thus, this study aimed to evaluate the physicochemical profile, texture, color, scanning electron microscopy, total phenolic content, antioxidant activity, viability of lactic acid bacteria and sensory profile of milk drinks flavored with mangaba and enriched with passion fruit bark flour.

MATERIALS AND METHODS

Frozen mangaba pulp (*Hancornia speciosa* Gomes) was purchased and packed in polyethylenetube directly from Jatobá Farm, municipality of Caçu, GO, Brazil.with the following geographical coordinates 18° 33'S and 51° 08'W.

A total of 7.2 L of milk were collected obtained from the Dairy Cattle Sector of the Instituto Federal Goiano, Rio Verde Campus, and transported to the Laboratory of Animal Products for the processing of fermented milk drinks. A total of 4.8 L of Mozzarella cheese whey was collected from dairy industry in Rio Verde, GO, Brazil. The whey were then packed in aseptic packages and transported to the laboratory of Animal Products for the processing of 12 L of milk drinks.

Passion fruit bark flour

For drying of passion fruit bark, 1 kg of previously ground bark was used. Drying was carried out by positioning the tray with dimensions of 800 mm x 600 mm at the central region of the drying oven with air circulating and renewal model MA 035 Marconi® at temperature of 60°C and air flow of 7.728 kg / m^2.s. After drying, passion fruit bark flour was obtained by three millings in Diogomaq® multipurpose grinder and conditioned at room temperature in low density polyethylene bags for later use.

Processing of milk drinks

Milk drinks were processed in the ratio of 60% milk + 40% whey (3 L for each treatment), with the addition of 10% sucrose. Subsequently, the mixture was submitted to heat treatment at 90°C / 3 min of pasteurization. After pasteurization, temperature was adjusted to 42°C of glass-house with the addition of starter culture composed of *Lactobacillus acidophilus* LA-5®, *Bifidobactrium lactis* Bb-12® and *Streptococcus thermophilus* were added in the amount of 400 mg for each repetition. The milk were subjected to fermentation at temperature of 42°C (BOD Quimis® model Q-315) to pH 4.5. After milk drink coagulation, BOD temperature was reduced to 20°C to break the clot under aseptic conditions with a glass rod in circular movement for one minute. Then, 1% passion fruit bark flour and various proportion of mangaba pulp: 1 –Milk drinkadded of 5% mangaba pulp; Treatment 2 - Milk drink added of 10% mangaba pulp; Treatment 3 - Milk drink added of 15% mangaba pulp and Treatment 4 - Milk drink added of 20% mangaba pulp. Milkdrinks were stored in sealed glass bottles under refrigeration at 5°C until time of analyses.

Physicochemical assessment, color and texture profile

Milk, milk whey and milk drinks were analyzed for pH and titratable acidity. pH was measured using digital bench potentiometer - model LUCA® - 210P and titratable acidity was determined according to Brasil (2006).

The moisture content of the milk drinks was determined at 105°C for a period of 24 h using an oven with forced air circulation as proposed by AOAC (1995). The total ash contents were determined at 550°C for about 10 h by the total carbonization of the organic matter in a muffle furnace (Bravac, M2) as described by AOAC (1995). For the crude protein analysis, total nitrogen was determined by micro-Kjeldahl method for milk drink treatments according to official method No. 960.52 of AOAC International (1995). Total nitrogen was converted into crude protein using factor 6.38 as a. The equipment used was digester block (Tecnal, TE-0070) and nitrogen distiller (Tecnal, TE-0363). Fat was assessed using the Gerber method.

Evaluations of the antioxidant activity of milk drinks were determined according to methodology described by Rufino et al. (2007). The total phenolic content present in the ethanolic extract of mangaba fruit was determined by spectrophotometry in the visible region using the Folin-Ciocalteu method (Sousa et al., 2007).

Instrumental color parameters (L *, a * and b *) of milk drink and passion fruit bark flour samples were analyzed in HunterLab colorimeter model Color Flex EZ at the Laboratory of Postharvest of Plant Products, Federal Institute of Goiás, Rio Verde Campus, GO, Brazil.The L * values (lightness or brightness) ranged from black (0) to white (100), and chroma values a * ranged from green (-60) to red (+60) and chroma b * values ranged from blue to yellow, that is, from -60 to +60, were used to determine the Hue color index (hue angle) for milk drink, these parameters were used in calculations to determine the Hue color index (hue angle), which defines color intensity. Hardness, peak stress, adhesive strength, adhesiveness and resilience were determined in Brookield® texturometer model CT3, load cell of 25 kg at the Laboratory of Postharvest of Plant Products upon compression test at 30%, trigger of 5 g, speed of 1 mm / s and probe tip TA4 / 100. All analyses were performed each seven days of storage for one month in triplicate for each treatment with three replicates.

Scanning electron microscopy (SEM)

SEM of fruit pulp and milk drinks added of mangaba and enriched with passion fruit bark flour was held at the Multi-User Laboratory of High Resolution Microscopy, Federal University of Goiás with microscope Jeol®, JSM-6610, equipped with EDS, Thermo Scientific NSS Spectral Imaging. Samples were previously lyophilized (Enterprise II / Terroni®), defatted by extraction in Soxhlet method No. 1.122 (IUPAC, 1979) and covered with ultrathin gold layer (electrically conductive material), allowing the SEM operating principle by emission of electron bundles through a tungsten filament.

Count of viable lactic acid bacteria and coliforms

Analyses of total coliforms, *Escherichia coli* (Brasil, 2003) and estimation of viable lactic acid bacteria (Silva et al., 1997) were performed at the Laboratory of Food Microbiology (IF Goiano) at storage times of 1, 8, 15, 22 and 29 days. About 25 g of fermented fermented milk were weighed and added to 225 ml of sterile peptone water and after homogenization, the solution was diluted to concentrations of 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5} and 10^{-6}.

The enrichment step for total coliform count with differential for *E. coli* used 1 ml aliquots of concentrations of 10^{-1}, 10^{-2} and 10^{-3}, which were transferred into test tubes containing 10 ml of Lauryl sulfate broth (LST) and incubated at 35°C for 24 h. Then, the presence of coliforms was confirmed using Brilliant Green Bile Broth (BG) incubated at 35°C for 24 h and in *E. coli* broth (EC) incubated for 24 h in water bath at 45°C.

The count of lactic acid bacteria was carried out using MRS culture medium. About 25 g of milk drink was added to 225 mL of 0.1% peptone water. After homogenization, the samples were serially diluted (10^{-1} to 10^{-7}) and 0.1 mL of the liquates from appropriate dilution were inoculated into pre-dried MRS Agar sterilized petri dish in duplicate. After then the inoculated plates were addition of the culture medium (with over layer) and solidification, dishes were incubated at 35°C for three days. After this period, count of dishes of the same dilution that contained between 25 and 250 colonies was performed with the aid of colony counter.

Sensory analysis

To perform the sensory analysis, the "Development of fermented milk drinks flavored with cerrado fruits and enriched with passion fruit bark flour" project was submitted to the Ethics Committee on Research Involving Human of the Instituto Federal Goiano and was approved under protocol No. 020/2013.

Sensory analysis was performed by 50 untrained panelists; the model used for the analysis was the acceptance test for comparison of milk drinks enriched with passion fruit bark flour and different mangaba pulp concentrations. The sensory evaluation was based on scores given by judges through a 9-point hedonic scale, where value one represents" disliked extremely" and nine "liked extremely", in which flavor, color, aroma, acidity, viscosity and appearance of milk drinks were judged. Along with overall appearance of the product, purchase intent for each sample was also analyzed. Sensory analysis was performed in individual booths at the Laboratory of Sensory Analysis, Instituto Federal Goiano, Rio Verde Campus, GO, Brazil. The four samples were coded with three-digit numbers and delivered under white light in 50 ml white cups to each of the panelists.

Statistical analysis

The sensory analysis of milk drinks flavored with mangaba and enriched with passion fruit bark flour, proximate composition, color and texture parameters were evaluated in a fully randomized design using analysis of variance and the Tukey test at 5% probability and the Statistical SISVAR® software, according to Ferreira (2010).

RESULTS AND DISCUSSION

Table 1 shows the mean values and standard deviation of the physicochemical analysis of milk and whey used in the processing of fermented milk drinks. The fat and protein content of the milk in percentage in the present study were 4.6 and 3.08 respectively. The milk product used in this study was showed a titrable acidity of 0.15 g/100 mL and pH value of 6.72.

The physicochemical composition values of milk are compatible with limits established by Brazilian milk quality legislation (Brasil, 2011), with fat and protein values above 3.0 and 2.9%, respectively, freezing point below of -0.535° H and acidity ranging from 0.14 g of lactic acid / 100 ml to 0.18 g of lactic acid / 100 ml.

Table 1. pH, fat, protein, titratable acidity of milk drinks flavored with mangaba and enriched with passion fruit bark flour expressed in Mean ± standard deviation.

Parameter	Milk	Milk Whey
Fat (%)	4.60 ±0.00	0.40 ±0.07
Protein (%)	3.08 ±0.01	2.66 ±0.04
Acidity (g of lactic acid/100 mL)	0.15 ±0.01	0.11 ±0.00
pH	6.72 ±0.01	6.44 ±0.01

Different results were observed by Santos (2011), who evaluated milk quality. The authors found compliance with legislation regarding fat content; however, protein values, freezing point and titratable acidity of pasteurized milk were in disagreement with current legislation. The average pH value of milk in this study is in agreement with the pH results recorded for (6.32 to 6.75) by Raimondo et al. (2009).

The physicochemical parameter recorded for milk whey (fat, 0.4%; protein, 2.66%; acidity, 0.11 g of lactic acid/100 mL and pH, 6.44) in the present study (Table 1) is comparable with physicochemical characteristics studied for milk whey by Teixeira and Fonseca (2008). The average pH value of milk in this study corroborates results by Raimondo et al. (2009) with variations from 6.32 to 6.75.

Comparing the physicochemical characteristics of whey used for obtaining milk drinks with the study by Teixeira and Fonseca (2008), it was possible to verify fat results of 0.77 and 0.68% protein of 0.84 and 0.80%, freezing point of -0.565 and -0.555° H and H°, titratable acidity of 13.17° D and 12.49° D and pH 6.19 and 6.3, for mozzarella and fresh cheeses, respectively. Thus, the results of this study indicated skimming of milk whey and excessive loss of casein from cheese mass to whey. Freezing point, titratable acidity and pH were similar to values presented by Teixeira and Fonseca (2008), and in this study, acidity was slightly lower and pH was higher.

The addition of mangaba pulp increased acidity and reduced the pH of milk drinks (Table 2). A similar situation was reported by Kempka et al. (2008) and Kruger et al. (2008) with increased acidity and decreased pH during storage of milk drinks, which was associated to the action of *L. acidophilus*, known for its great capacity to produce acid during fermentation.

Table 2 shows increasing the mangaba pulp concentration in the formulation of milk drinks with passion fruit bark flour can be related to the study by Matta et al. (2012), who found that the medium would be enhanced with higher concentration of oatmeal for multiplication and production of lactic acid by lactic acid bacteria. The titratable acidity values of the milk drink formulations were compatible with the range from 0.6 g of lactic acid / 100 g to 2.0 g lactic acid / 100 g reported by Brasil (2007). Moisture and total solids contents were significantly different (p> 0.05) only in milk drink with 20%

Table 2. Mean values and standard deviation of titratable acidity and pH of milk drinks flavored with mangaba and enriched with passion fruit bark flour.

Mangaba (%)	Titratable Acidity (%)	pH
5	0.73 ±0.01[c]	4.12 ±0.01[a]
10	0.74 ±0.01[bc]	4.12 ±0.01[a]
15	0.76 ±0.01[ab]	4.02 ±0.01[b]
20	0.77 ±0.01[a]	4.03 ±0.01[b]
VC (%)	**0.99**	**0.19**

Means followed by same letter in the column do not differ significantly according to the Tukey test at 5% significance level.

Table 3. Proximate composition of milk drinks flavored with mangaba and enriched with passion fruit bark flour.

Mangaba (%)	Moisture (%)	Total Solids (%)	Ash (%)	Protein (%)	Fat (%)
5	81.23±0.84[a]	18.77±0.84[b]	0.53±0.06[c]	2.93±0.04[a]	1.33±0.27[a]
10	81.71±0.10[a]	18.29±0.10[b]	0.20±0.01[d]	2.94±0.20[a]	1.53±0.25[a]
15	80.92±0.77[a]	19.08±0.77[b]	1.50±0.14[b]	2.97±0.13[a]	1.63±0.35[a]
20	78.65±0.84[b]	21.35±0.84[a]	3.23±0.03[a]	3.09±0.05[a]	1.70±0.20[a]
VC (%)	**0.88**	**0.88**	**5.84**	**4.17**	**17.37**

Means followed by same letter in the column do not differ significantly according to the Tukey test at 5% significance level.

Table 4. Antioxidant activity and total phenolic content of milk drinks flavored with mangaba and enriched with passion fruit bark flour.

Mangaba Pulp (%)	Antioxidant activity, EC_{50} (g/L)	Total phenolic content (mg GAE/100 g)
5	5922.40	36.00
10	3950.00	37.00
15	4285.05	18.00
20	7507.12	19.00

Means followed by the same letter in column are not significantly different from each other according to the Tukey test at 5% significance.

mangaba pulp, since the gray values differed in all treatments due to the influence of different pulp concentrations. Similar values were found by Clarice et al. (2015).

Table 3 shows moisture and total solids contents differed significantly (p> 0.05) only in milk drink with 20% mangaba pulp, since the gray values significantly differed (p> 0.05) in all treatments. Significant differences in ash content in all treatments of milk drinks added of flour were observed, and this parameter increased with increasing FCM concentration, a result that was expected because flour has ash content of 9.85 g / 100 g and its addition is a factor that significantly contributed to increase the ash content of milk drinks.

The protein levels had no significant difference among treatments, but the highest protein content was found in the last treatment. This fact can be explained by the high protein content of passion fruit bark flour (11.76%) observed by Souza et al. (2008) and the protein content of 13.86% of FCM found in the present study. Bastiani (2009) used 1% flaxseed meal in skimmed yogurt and obtained 3.47% protein, value close to that obtained for milk drink enriched with passion fruit bark flour. All milk drink formulations showed protein content above legal standards (1.7%) defined by Normative Instruction No. 16 of August 2005 of MAPA (Brasil, 2005).

The fat content showed no significant difference (p <0.05) among treatments. Similar values were found by Cunha et al. (2008), who found fat content ranging from 1.43 g / 100 g to 2.01 g / 100 g in a study on the influence of the use of cheese whey and probiotic bacteria on the properties of fermented milk drinks. In the study by Farias and Lima (2006), pasteurized milk drink added of fruit (guava) showed fat values of 1.46%.

Table 4 shows the antioxidant activity was demonstrated by EC_{50}, which represents the effective concentration to achieve 50% of the antioxidant activity estimated at 100%. When the DPPH solution comes into

Table 5. Mean color coordinates of milk drinks flavored with mangaba and enriched with passion fruit bark flour.

Mangaba pulp	L*	a*	b*	Chroma	ºHue	ΔE*
Control	83.39±0.12[a]	0.64±0.03[d]	20.08±0.12[d]	20.09±0.12[d]	88.18±0.07[a]	---
5%	81.48±0.06[b]	1.07±0.01[b]	22.92±0.03[c]	22.95±0.03[c]	87.32±0.01[c]	3.46±0.02[c]
10%	81.64±0.06[b]	0.90±0.03[c]	23.84±0.20[b]	23.86±0.20[b]	87.85±0.08[b]	4.16±0.16[b]
15%	80.37±0.03[c]	1.22±0.01[a]	25.77±0.05[a]	25.80±0.05[a]	87.30±0.02[c]	6.47±0.04[a]
CV (%)	**0.09**	**2.24**	**0.51**	**0.51**	**0.06**	**1.99**

*Means followed by the same letter in column are not significantly different from each other according to the Tukey test at 5% significance.

Table 6. Means of texture parameters for milk drinks flavored with mangaba and enriched with passion fruit bark flour.

Mangaba pulp	Hardness (g)	Peak stress (N/m^2)	Adhesive strength (g)	Adhesiveness (mJ)	Resilience
Control	49.11±9.49[b]	438.78±85.04[b]	11.56±2.96[c]	0.73±0.27[b]	0.03±0.02[a]
5%	50.67±5.74[b]	452.78±51.34[b]	13.11±1.45[bc]	0.93±0.34[b]	0.02±0.01[ab]
10%	54.22±6.51[ab]	484.56±58.19[ab]	15.78±4.41[ab]	1.29±0.61[ab]	0.01±0.01[b]
15%	62.44±6.84[a]	558.00±61.08[a]	17.56±3.57[a]	1.70±0.75[a]	0.01±0.01[ab]
VC (%)	**13.46**	**13.48**	**22.64**	**45.69**	**69.02**

Means followed by same letter do not significantly differ according to the Tukey test at 5% significance.

contact with a substance that can donate a hydrogen atom, the reduced form of the generated radical is accompanied by loss of color, and the greater the consumption of DPPH (2,2-diphenyl-1-picrylhydrazyl) by a sample, the smaller the EC_{50} value and the higher its antioxidant activity (Ali et al., 2008).

Milk drinks flavored with mangaba and enriched with passion fruit bark flour showed high EC_{50} values and therefore low antioxidant activity. The highest activity was found for treatment with 10% mangaba pulp, with EC_{50} of 3950.0 g / l, and the lowest activity for treatment with 20% mangaba pulp, with EC_{50} of 7507.12 g / l.

The antioxidant activity is quite variable among food products, with different antioxidant power and different behavior for each analysis methodology, either by DPPH and FRAP, use of different concentrations of extracts, making it difficult to compare with literature data (Rocha et al., 2013). The content of phenolic compounds was expressed by gallic acid equivalent, with results varying from 18.00 mg GAE / 100 g for milk drink with 15% mangaba pulp to 37.00 mg GAE / 100 g for milk drink with 10% mangaba pulp.

Table 5 shows the brightness coordinate (L *) decreased with the addition of higher levels of mangaba pulp, in contrast, coordinates a * and b *have increased. There is a slight tendency to red due to an increase in a * (+), and clear increase of yellow color due to higher b * values (+). These coordinates influenced the elevation of saturation (Chroma) and the total color difference among treatments (ΔE *). This behavior can be attributed to higher concentrations of yellow color compounds such as carotenoids, present in mangaba pulp. Hue was higher in treatment with 5% mangaba pulp, than in the other treatments. The findings correspond to the first quadrant of the HSV three-dimensional diagram, between 0º (red) and 90º (yellow), showing predominance of yellow color with slight darkening for milk drinks with higher mangaba pulp levels (Kubo et al., 2013).

Table 6 shows regarding the texture of milk drinks enriched with FCM, hardness, stress and adhesiveness parameters significantly increased after the addition of 15 to 20% mangaba pulp concomitant with the decline of resilience.

The hardness, stress and Adhesiveness of milk drinks were significantly increased with the addition of 15 and 20% mangaba pulp (Table 6). This is might be due to reorganization of the protein matrix with the addition of a higher concentration of polysaccharides and stronger molecular bonds. The visual aspect of this treatment is of greater viscosity. The interactions between milk proteins and polysaccharides have great importance in the development of structure and texture in milk products (Corredig et al., 2011). But, the addition of polysaccharides that do not interact with protein affects the rheological and microstructural properties of yoghurt (Acero-Lopez et al., 2010).

In this study, the addition of mangaba pulp levels greater than 15% suggests reorganization of the protein matrix with the insertion of a higher concentration of polysaccharides and stronger molecular bonds, resulting in increased hardness, stress and adhesiveness. The visual aspect of this treatment is of greater viscosity. The action of the starter culture microorganisms was more pronounced in milk drinks with the highest concentration

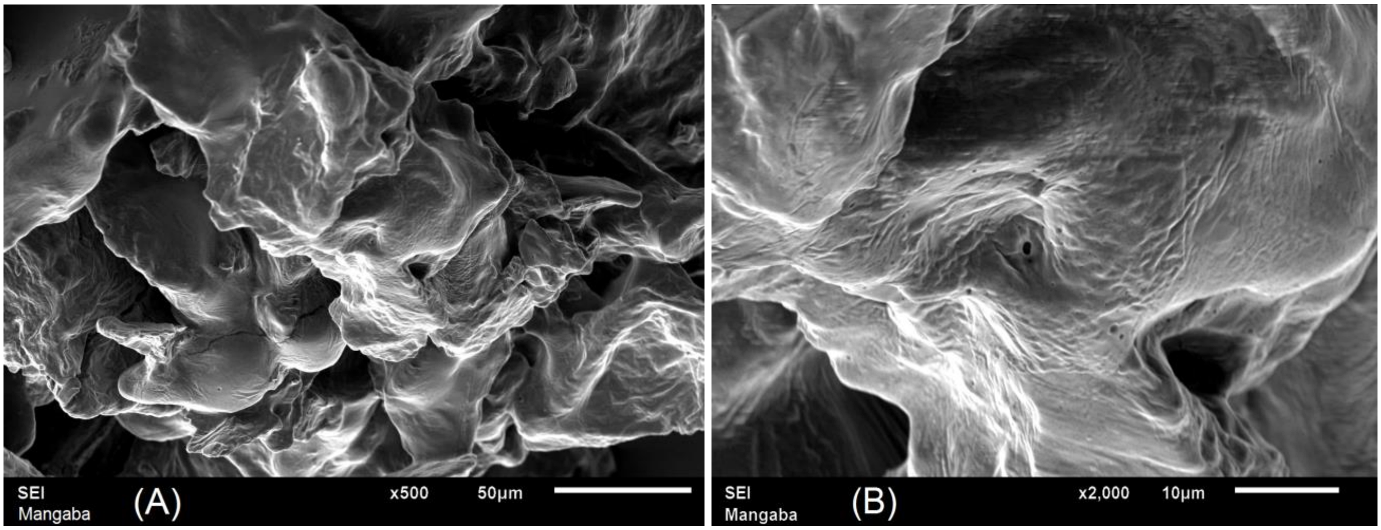

Figure 1. Electronic scanning micrographs of mangaba pulp at magnifications of (A) 500X and (B) 2000x.

of mangaba pulp and consequently higher contents of carbohydrates to be metabolized. The higher lactic acid production (Table 2) caused a greater decrease in the electric charge of casein micelles and changes in texture.

Figure 1 shows the scanning electron micrographs of mangaba pulp. They show a clear, dense and compacted matrix with rough surface, suggesting links between polysaccharides and fiber. There are dark rounded inserts, possibly corresponding to the position of fat globules. Figure 2 shows scanning electron micrographs of milk drinks with mangaba pulp concentration of 5, 10, 15 and 20%. Figure 2 shows in micrographs, lighter regions represent matrix composed of proteins, polysaccharides and fibers, whereas darker regions suggest the apolar phase, with the initial position of fat globules.

In milk drink with 5% mangaba pulp (A), the matrix seems to be dense, homogeneous and in continuous phase. After the addition of 10% mangaba pulp (B), the dense matrix becomes rough. With the addition of 15% of mangaba pulp (C), the microstructure is fibrous with overlapping particles, similar to micrograph of mangaba pulp (Figure 1). Finally, milk drink with 20% mangaba pulpshowed granular microstructure.

The addition of mangaba pulp at levels up to 20% shows molecular rearrangement among matrix components of milk drinks enriched with FCM, with changes in texture, leading to increased hardness, stress and adhesiveness. All of the fermented milk samples were not showed typical colony of coliforms in this study which is in agreement with the study reported by Tebaldi (2005). Regarding the count of coliforms, none of the samples showed typical colony formation, which results are similar to those reported by Tebaldi (2005) in 20 samples of fermented fermented milks commercialized in southern Minas Gerais.

The counts of viable lactic acid bacteria in the four treatments showed satisfactory results, above limits set by legislation, which must be at least 10^6 CFU / g, and results show that the initial addition of probiotic bacteria was sufficient for obtaining probiotic products because values greater than 10^7 CFU / ml were found. The average values found for the count of lactic acid bacteria for milk drinks were 1.29 x 10^7 CFU / mL ± 0.03 for treatment with 5% pulp, 1.42 x 10^7 CFU / ml ± 0.08 for treatment with 10% pulp, 1.93 x 10^7 CFU / ml ± 0.19 for treatment with 15% pulp, and 2.14 x 10^7 CFU / mL ± 0.10 for treatment with 20% pulp, which are above the minimum value of 10^6 CFU / g of viable lactic acid bacteria, as recommended by Normative Instruction No. 16 of August 23, 2005 (Brasil, 2005). The main function of lactic acid bacteria in foods is the acidification of these products with the production of organic acids that inhibit the growth of undesirable bacteria (Forsythe, 2002). Sensory analyses were performed with students, teachers and servers of the Federal Institute of Goiás, Rio Verde Campus. Overall, 50 untrained panelists were used for sensory analysis. The sensorial properties of milk drink flavored with mangaba were generally considered as acceptable value while the addition of 5 and 10% mangaba pulp showed the highest average values of sensory characteristics. It was observed that milk drink flavored with mangaba can be considered as sensory acceptable product, and the addition of 5 and 10% mangaba pulp showed the highest average values (Table 7).

The mean values of milk drinks added of different mangaba pulp concentrations were between hedonic terms liked slightly (6) and liked moderately (7) for color, texture, flavor and aroma attributes. The purchase intent test was also performed to complement the sensory analysis. This test was applied to the same panelists who

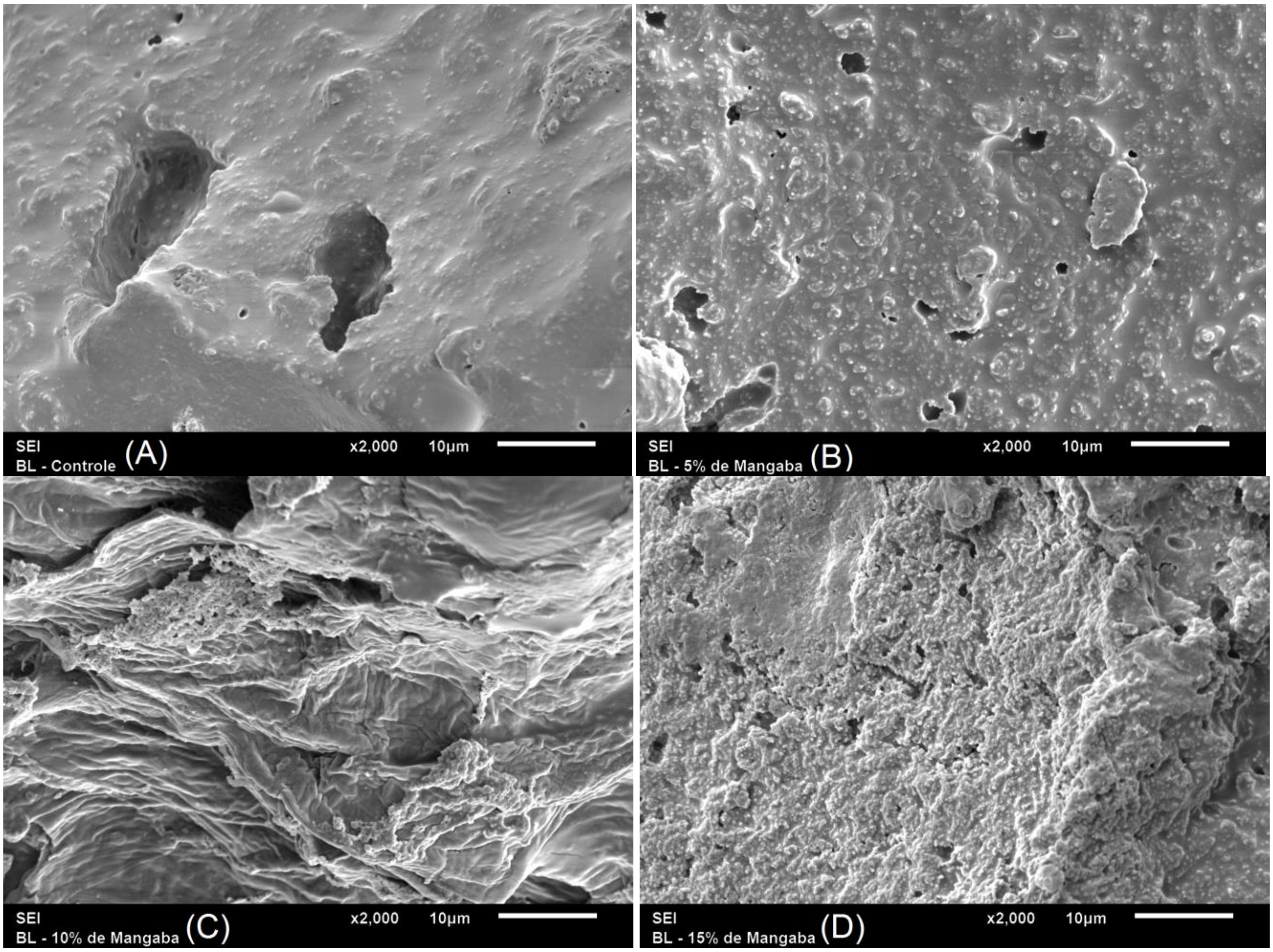

Figure 2. Scanning electronic micrographs at magnification of 2000x of milk drinks enriched with FCM and flavored with mangaba pulp at concentrations of: (A) 5%, (B) 10%, (C) 15% and (D) 20%.

Table 7. Means and concordance coefficient among judges (CC) participating in the sensory analysis of milk drink flavored with mangaba and enriched with passion fruit bark flour.

Sensory parameter	Treatment				VC (%)
	1	2	3	4	
Color	7.00±1.27[a]	7.28±1.12[a]	6.98±1.49[a]	6.62±1.72[a]	20.52
CC	39.70%	49.40%	33.56%	34.64%	
Aroma	6.86±1.34[a]	6.96±1.37[a]	6.88±1.27[a]	6.70±1.40[a]	19.67
CC	34.74%	32.15%	36.88%	33.56%	
Flavor	7.14±1.57[a]	6.96±1.75[a]	6.42±1.94[a]	6.22±2.02[a]	27.97
CC	33.15%	29.41%	22.51%	22.47%	
Acidity	6.94±1.28[a]	6.70±1.40[a]	6.80±1.42[a]	7.04±1.72[a]	22.43
CC	39.47%	32.77%	36.51%	31.62%	
Viscosity	6.58±1.90[a]	6.60±1.73[a]	6.78±1.53[a]	6.32±1.88[a]	27.80
CC	33.69%	38.31%	30.76%	21.67%	
Appearance	6.58±1.49[a]	6.60±1.50[a]	6.78±1.55[a]	6.32±1.61[a]	22.31
CC	37.12%	35.38%	37.60%	28.64%	

Different letters on the line significantly differ by the Tukey test at 5% probability. * Treatment 1 = 5% FCM; Treatment 2 = 10% FCM; Treatment 3 = 15% FCM; Treatment 4 = 20% FCM.

performed other tests. About 18% of untrained panelists reported consuming yogurt every day, followed by 52% who consumed once a week, 8% who consumed every 15 days and 22% who consumed once a month. It was observed that most panelists consumed yogurt at least once a week. It could be observed that for the four milk drinks analyzed in this study, panelists (88%) showed that they would buy yogurt flavored with mangaba pulp. Among non-buyers, a small portion (12%) would not buy if it were available in market. According to the global acceptance, the results were not significant, but in relation to the purchase intent, panelists showed preferences.

Sensory tests are of great importance in assisting the industry in developing new products or control them in order to achieve greater acceptance by the final consumer (Nogueira, 2004). Similar to the results found in this study, other authors reported good acceptance of products added of mangaba pulp.

Rocha et al. (2008) evaluated yogurts added of mangaba sweet and obtained 6.91 on the FACT scale (I would eat it frequently). Garcia and Travassos (2012) developed goat milk fermented with umbu sweet and found similar values, where the average values of parameters evaluated ranged from 6.07 to 7.17. Milk drinks flavored with mangaba proved to be an attractive product due to their sensory characteristics, showing technological potential, especially when related to the aspect of adding value to a cerrado product.

Conclusion

Milk drink flavored with mangaba and enriched with passion fruit bark flour showed physicochemical, microbiological and sensory results consistent with those described in literature and as expected, had high sensory acceptance.

Conflict of Interests

The authors have not declared any conflict of interests.

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