ISSN: 1984-5529

Científica

Jaboticabal

v.46, n.3, p.207–214, 2018

http://dx.doi.org/10.15361/1984-5529.2018v46n3p207-214

Physicochemical, antioxidant and sensory properties of fermented milk beverage with added prebiotic and caja-manga pulp

Propriedades físico-químicas, antioxidantes e sensoriais de bebida láctea fermentada adicionada de prebiótico e polpa de cajá-manga

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Recebido em: 21-06-2017; Aceito em: 01-02-2018

Abstract

The objective of the study was to evaluate the physicochemical, antioxidant and sensory properties of fermented milk beverage with added prebiotic and caja-manga pulp. Three milk beverage formulations were prepared, with 25% and 30% caja-manga pulp and a control (pulp-free) formulation. The following were evaluated: physicochemical characteristics (pH, acidity, proximal composition, color), total phenolics, antioxidants (DPPH, ABTS, FRAP), and sensory properties (preference, acceptance, and purchase intention). Differences were observed between the beverages regarding the physicochemical characteristics, and the composition varied according to the pulp concentration added. The beverages with pulp presented higher phenolic content than control formulation. The formulations with 25% and 30% pulp presented antioxidant capacity by the DPPH method with no significant difference between them. However, it was not possible to observe the antioxidant capacity of the pulp-free beverage for this method. No antioxidant capacity was detected by the ABTS and FRAP methods for all beverages studied. The milk beverages presented good sensory acceptance and antioxidant capacity due to the bioactive compounds present in the caja-manga pulp, which contributes to the claim of functionality of this food.

Additional keywords: total phenolics; oligofructose; fermented product; *Spondias dulcis*.

Resumo

O objetivo do estudo foi avaliar as propriedades físico-químicas, antioxidantes e sensoriais de bebida láctea fermentada adicionada de prebiótico e polpa de cajá-manga. Três formulações de bebida láctea foram preparadas com 25% e 30% de polpa de cajá-manga e uma formulação-controle (isenta de polpa). Foram avaliadas as características físico-químicas (pH, acidez, composição proximal e cor), fenólicos totais, antioxidantes (DPPH, ABTS e FRAP) e sensoriais (preferência, aceitação e intenção de compra). Foram observadas diferenças entre as bebidas quanto às características físico-químicas, sendo que a composição variou de acordo com a concentração de polpa adicionada. As bebidas com polpa apresentaram maior teor de fenólicos que a formulação-controle. As formulações com 25% e 30% de polpa apresentaram capacidade antioxidante pelo método DPPH sem diferença significativa entre si. Entretanto, não foi possível observar capacidade antioxidante da bebida sem polpa para este método. Não foi detectada capacidade antioxidante pelos métodos ABTS e FRAP para todas as bebidas estudadas. As bebidas lácteas apresentaram boa aceitação sensorial e capacidade antioxidante decorrente dos compostos bioativos presentes na polpa de cajá-manga, o que contribui para a alegação de funcionalidade deste alimento.

Palavras-chave adicionais: fenólicos totais; oligofrutose; produto fermentado; *Spondias dulcis*.

Introduction

Brazil occupies the sixth place in the world production of milk, with a production volume in 2016 of about 27 million tons. Regarding milk products, the high production of cheese ranks the country as the fourth largest producer (766 thousand tons) (USDA, 2016). Whey is the byproduct of cheese production, of high nutritional value (rich in calcium and phosphorus), whose proteins have excellent functional properties. However, whey has a high organic matter content, and great polluting potential when unduly discarded (Ha & Zemel, 2003; Siqueira et al., 2013). In this way, the use of whey has a great environmental appeal and considerable economic importance since it is involved in the preparation of desserts, beverages, soups, meat products, dairy products, and bakery products (Alves et al., 2014).

With the increasing demand for healthier products, the food industry has been investing more and more in the manufacture of milk beverages, using a mixture of whey and other ingredients in their formulation (Castro et al., 2009). Among these ingredients, oligofructose stands out, one of the main prebiotics available on the market, capable of promoting health benefits due to the modulation of the intestinal microbiota (FAO/AGNS, 2007). Oligofructose consumption inhibits the growth of pathogens in the gut, increases calcium absorption from the diet, and alleviates the symptoms of constipation (Saad et al., 2013). In addition to oligofructose, in the formulation of some milk beverages, fruit pulps are added, which provide pleasant sensory properties (Siqueira et al., 2013). These fruits contain in their composition bioactive compounds that help in the prevention of certain diseases (Yahia, 2009), and if properly processed, can maintain the contents of bioactive compounds (Fabbri & Crosby, 2016). These phytochemicals are products of secondary metabolism, whose large number of diversified structures are divided into several classes according to their carbon skeleton (Martinez--Valverde et al., 2000). Among them stand out the phenolic compounds, known to exhibit antioxidant activity, whose action is related to the number and position of hydroxyls present in the molecule (Rice-Evans, 1996).

Caja-manga (*Spondias dulcis*), an exotic fruit originating from Polynesia (Youmbi et al., 2010), is little known to the general public, and is cultivated in the North and Northeast of Brazil, being also known as *cajarana* and *taperebá-do-sertão* (Ribeiro, 2010). This fruit, which on the European continent is known as *ambarella* or *golden apple*, has a pleasant aroma and taste, and a considerable content of vitamins, minerals and phenolic compounds (Graham et al., 2004). Due to its good sensory and nutritional properties, caja-manga has aroused interest in the development of different products (Damiani et al., 2011; Lago-Vanzela et al., 2011).

The objective of this work was to evaluate the antioxidant properties of caja-manga pulp and the effects of its addition on the physicochemical, antioxidant and sensory characteristics of fermented milk beverages.

Material and methods

Production of fermented milk beverage

The mature fruits of caja-manga (*Spondias dulcis*) (75% of the skin with yellow color), according to classification for fruits that ripen from green to yellow (De Oliveira et al., 2002), were purchased in the city of Ribeirão Preto-SP, Brazil. The fruits were washed and soaked in sodium hypochloride (50 mg L^{-1}) for 15 minutes. Then, the whole fruits were submerged in water at 80 °C/30 minutes. The fruits were peeled, the peel was scraped, and the obtained mass was sieved for retention of the lump and fibers. The obtained pulp was homogenized and the total soluble solids of the pulp were determined using a refractometer (BioBrix, Curitiba, Brazil). Sucrose was added up to the concentration of 40 °Brix, and then the pulp was pasteurized at 90 °C/2 minutes. The pulp was stored in plastic containers and kept under freezing (-18 °C) until use.

In the elaboration of the fermented milk beverage, homogenized pasteurized milk was used, with fat content standardized at 3%, and whey from Minas Frescal cheese production. The milk/whey mixture (70:30) with added powdered milk (1% w/v), sucrose (8% w/v), oligofructose (10% w/v; Beneo®, Clariant-Orafti) and thickener (0.5% w/v; modified starch and gelatin - TECGEM AA 073 BF, Gemacom Tech) was pasteurized at 65 °C/30 minutes and cooled to 37 °C, when the lactic culture consisting of *Lactobacillus acidophillus* La-5, *Bifidobacterium* Bb-12, and *Streptococcus thermophilus* (BioRich®, Chr. Hansen) was added. BioRich® culture was chosen for its rapid acidification and because it contains probiotic microorganisms, being added according to the manufacturer's recommendations described on the product label (1 packet - 400 mg for 1 liter of beverage). Fermentation was carried out at 37 °C for an average period of four hours. The pH was measured during fermentation until pH 4.6. After fermentation, the milk beverages were cooled, gently stirred, and the caja-manga pulp was added. Pulp concentrations were determined through preliminary tests, where formulations containing 25 and 30% caja-manga (beverages B25 and B30) showed acceptable fruit flavor characteristics. In the physicochemical analyses, for comparison purposes, a control beverage (BC) without the addition of fruit pulp was elaborated. The milk beverage manufacture was repeated three times for each formulation.

Physicochemical analyses

The physicochemical analyses were performed in triplicate regarding the caja-manga pulp and milk beverages in up to 7 days from the preparation date. The pH, acidity, moisture, total solids, lipids, proteins, ashes, and total carbohydrates (by difference) were determined (AOAC, 2005).

For color analysis, the Minolta Chroma Meter CR-400 colorimeter (Konica Minotta, Japan) was used, and a standard ceramic white was used as a blank. The analyzed parameters were L* (luminosity), a* (red - green component), and b* (yellow - blue component). Five measurements were taken for each sample.

Determination of phenolic compounds and antioxidant capacity

The extraction of phenolic compounds was carried out the day after the production of the caja-manga pulp and milk beverage. The resulting extract was kept under refrigeration (5 °C) until analysis to determine the total phenolic content and antioxidant capacity. These analyses occurred within 21 days after the production and were performed in triplicate.

For the extraction of phenolic compounds and determination of the antioxidant capacity of the caja-manga pulp and milk beverages (BC, B25, and B30), 50 g of the sample were extracted with methanolic solution, and the resulting mixture was filtered and diluted (Larrauri et al., 1997; Canuto et al., 2010). All solutions were centrifuged at 6000 rpm, with the supernatant being separated and conditioned in a freezer until spectrophotometric analysis.

The content of total phenolic compounds was determined according to the Folin-Ciocalteau method by interpolating the absorbance of the samples against a calibration curve constructed with gallic acid standards (0.010 to 0.045 mmol L^{-1}). Absorbance was measured on a DR 5000 spectrophotometer (Thermo Scientific, USA) at 765 nm, and the results expressed as milligram gallic acid equivalent (GAE) per 100 g sample (Kim et al., 2003).

To determine the antioxidant capacity of the caja-manga pulp and milk beverages, 10 μL of each sample was added to 4 mL of the solution of the cation radical of 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS●+) diluted. After six minutes of reaction, spectrophotometer reading was performed at 734 nm, and the responses were expressed as μM Trolox 100 g^{-1} sample by comparing the absorbances of the samples with a calibration curve plotted for Trolox methanolic solutions (1.0 to 8.0 mmol L^{-1}) (Sánchez-González et al., 2005). The antioxidant capacity of the samples to reduce iron was evaluated using the FRAP reagent. The test was performed with 4.4 mL FRAP [mixture containing 2,4,6-tri (2-pyridyl)-s-triazine (TPTZ), $FeCl_3$, and acetate buffer], with 441 μL water and a 147 μL aliquot of the Trolox standard solution or the sample. The mixture was homogenized and maintained in a water bath at 37 °C/30 minutes. Standard Trolox solutions at different concentrations (100 to 1000 mmol L^{-1}) were used for calibration, and the results were expressed as μM trolox $100g^{-1}$ sample (Rufino et al., 2006).

The capacity to scavenge the radical 2,2-diphenyl-1-picrylhydrazyl (DPPH●) was evaluated in a method described by Rufino et al. (2007). After appropriate dilutions, 0.1 mL of each diluted sample was transferred to a tube containing 3.9 mL of the DPPH solution. The spectrophotometer readings of the samples, at 515 nm, were monitored every minute, where absorbance reduction was observed until its stabilization. The result was expressed as efficient concentration (EC_{50}), i.e., the amount of antioxidant needed to decrease the initial concentration of DPPH by 50%.

Microbiological and sensory analysis

Prior to the sensory analysis, coliforms were determined at 35 °C and 45 °C (Most Probable Number – MPN) in order to guarantee the microbiological safety of the milk beverages (Brasil, 2003). The sensory analysis of milk beverages with added caja-manga pulp was performed by 95 untrained judges (Dutcosky, 2007). The following tests were performed: paired preference test; overall acceptance test, through a nine-point hedonic scale (ranging from 1, “dislike extremely”, to 9, “like extremely”); and purchase intention test, with a 5-point scale (ranging from 1, “definitely would not buy”, to 5, “definitely would buy”). Samples were codified and served to the judges, simultaneously, in plastic cups (50 mL), at 4 ± 1 °C.

Statistical analysis

The results were submitted to analysis of variance, and significant differences among the samples were evaluated using the Tukey test at 5% significance level, performed using Statistica software version 7.0 (Statsoft Inc., Tulsa, OK, USA). To evaluate the data regarding acceptance, purchase intention, and antioxidant capacity by the DPPH method, Student's t-test was applied. Data of the sensory preference test were analyzed using the significance table for two-tailed paired test at 5% probability level (Dutcosky, 2007). Data were expressed as mean ± standard deviation.

Results and discussion

Physicochemical analyses

Table 1 presents the results of the physicochemical analyses performed for caja-manga pulp and milk beverages (BC, B25, and B30). The pH of beverages B25 (4.17) and B30 (4.11) was lower than that of the control beverage

BC (4.61), and this may be related to the use of fruit pulp, which contributes to keeping the pH low. In fact, the caja-manga pulp presented acidic pH values similar to previous studies of caja-manga pulp (2.78 to 2.81) and acid fruits grown in Brazil, such as carambola (1.94 to 3.37) (Aché & Ribeiro, 1950; Lima et al., 2012). The acidity found in milk beverages ranged from 0.59 to 0.71 g lactic acid 100 g^{-1}, results close to those found by Cunha et al. (2008), who described values of 0.70 to 0.72 g lactic acid 100 g^{-1}. The legislation does not establish acid values for fermented milk beverages, however, the values obtained are within the usual values of acidity (0.6 to 2.0 g lactic acid 100 g^{-1}) for fermented milks (Brasil, 2007).

The greater the addition of caja-manga pulp, the greater the amount of total solids found in beverages B25 and B30, and consequently the lower the moisture. The pulp presented lower moisture content when compared to other literature reports for caja-manga pulp, whose values ranged from 84 to 89 g 100g^{-1} (Damiani et al., 2011; Lima et al., 2012).

Table 1 – Physicochemical characterization of caja-manga pulp and fermented milk beverages.

Parameters	Caja-manga pulp	BC [(1)]	B25	B30
pH	2.82 ± 0.01	4.61± 0.01a	4.17 ± 0.01b	4.11 ± 0.01c
Acidity[2]	1.32 ± 0.04	0.59 ± 0.03b	0.71 ± 0.02a	0.71 ± 0.01a
Moisture (g 100 g^{-1})	61.26 ± 0.27	74.81 ± 0.06a	71.95± 0.07b	71.07 ± 0.02c
Soluble solids (g 100 g^{-1})	38.74 ± 0.27	25.19 ± 0.06c	28.06 ± 0.07b	28.94 ± 0.02a
Protein (g 100 g^{-1})	1.43 ± 0.31	2.62 ± 0.03a	2.31 ± 0.02b	2.13 ± 0.02c
Lipid (g 100 g^{-1})	0.03 ± 0.01	2.15 ± 0.01a	2.01 ± 0.02b	2.05 ± 0.03b
Ash (g 100 g^{-1})	0.46 ± 0.01	0.69 ± 0.00a	0.62 ± 0.00b	0.62 ± 0.00b
Carbohydrates (g 100 g^{-1})	37.02 ± 0.29	19.79 ± 0.13c	23.05 ± 0.19b	24.08 ± 08a
Color parameters[3]				
L*	38.09 ± 1.10	82.83± 0.04a	76.80 ± 0.07b	76.20 ± 0.32c
a*	2.27 ± 0.19	4.00± 0.01c	4.70 ± 0.20a	4.58 ± 0.05b
b*	18.02 ± 0.36	8.70 ± 0.02c	16.76 ± 0.06b	18.39 ± 0.11a

(1) BC – Beverage control; B25 - beverage with 25% of pulp; B30 - beverage with 30% of pulp; 2 citric acid 100 g^{-1} for the preparation of pulp and lactic acid 100 g^{-1} for the milk beverages; 3 Results expressed as mean ± standard deviation of three repetitions in triplicate, except for color parameters (five replicates). Different letters in the same line indicate a significant difference by the Tukey test ($p < 0.05$).

Even though the amount of proteins was higher than that described in the literature (0.78 to 0.89 g 100 g^{-1}) for caja-manga pulp, this fact did not increase the concentration of protein in beverages B25 and B30. Beverage B30, which presented the lowest protein content, is in accordance with the current legislation that determines a minimum protein content of 1.0 g 100 g^{-1} for fermented milk beverages with any addition (Brasil, 2005; Damiani et al., 2011; Lima et al., 2012).

Regarding lipids, it was observed that the sample BC presented a higher percentage when compared to beverages B25 and B30. However, there was no significant difference between the beverages added with pulp ($p>0.05$). Similar to that observed for protein contents, the amount of lipids in the pulp, which was lower than those reported in the literature (0.59 to 0.61 g 100 g^{-1}), did not increase the lipid content of beverages with added caja-manga pulp (Damiani et al., 2011; Lima et al., 2012).

The ash content of BC was higher than those beverages B25 and B30 ($p<0.05$), according to Table 1. Carbohydrate content ranged from 19.79 to 24.08 g 100 g^{-1} for lactic beverages (Table 1) (including added oligofructose). BC presented lower content than beverages B25 and B30 ($p<0.05$). This is due to the presence of sucrose and other sugars from the fruit itself in the pulp preparation, which increased the carbohydrate contents of beverages added with the caja-manga pulp.

In relation to the color parameters of the milk beverages, the increase in the amount of caja-manga pulp decreased the value of L*, and this decrease of luminosity may have been influenced by the color of the caja-manga pulp, since the color of the ingredients used in the formulation influences directly on the color of the product (Dello Staffolo et al., 2004; Aryana & McGrew, 2007). Beverages B25 and B30 presented higher values ($p<0.05$) than BC for the coordinates a* and b* as a function of the increase in the addition of the pulp, i.e., the addition of the pulp contributed to the increase of the yellow coloration.

Determination of phenolic compounds and antioxidant capacity

The result obtained in the determination of the total phenolic compounds (TP) of the caja-manga preparation was 47.86 mg GAE 100g^{-1} sample (Table 2).

Table 2 – Total phenolic content and antioxidant capacity by ABTS, DPPH and FRAP assay of caja-manga pulp and fermented milk beverages.

Assay[1]	Caja-manga pulp	BC [(2)]	B25	B30
TP (mg GAE 100 g^{-1}) [(3)]	47.86 ± 1.44	2252.94 ± 120.23b	3174.21 ± 49.73a	3262.52 ± 75.15a
ABTS (µM trolox 100 g^{-1})	220.99 ± 67.32	ND [(4)]	ND	ND
FRAP (µM trolox 100 g^{-1})	108.10 ± 5.35	ND	ND	ND
DPPH (EC_{50} µg mL^{-1})	15.62 ± 2.13	ND	2434.95 ± 1.41a	2107.33 ± 114.20a

[(1)] Results expressed as mean ± standard deviation of three repetitions in triplicate; [(2)] BC - control beverage; B25 - beverage with 25% of pulp; B30 - beverage with 30% of pulp; [(3)] GAE - gallic acid equivalent; [(4)] ND - not detected; Different letters in the same line indicate a significant difference (p <0.05) (by Tukey's test; for DPPH by t-test).

In the study by Islam et al. (2013), when determining the content of phenolic compounds in caja-manga, the authors obtained the following values for the methanolic and chloroform extract: 659.74 and 214.59 mg GAE g^{-1} dried fruit, respectively. The lower TP of this work may be related to the fact that a pulp was used instead of a dried fruit such as in Islam et al. (2013). In a study by Melo et al. (2010) and Vieira et al. (2011), fruit pulp analysis showed that umbu (*Spondias tuberosa*) and caja (*Spondias mombin* L) presented phenolic compound contents of 32.70 mg catechin 100 g^{-1} and 70.92 mg GAE 100 g^{-1}, respectively. Total phenolics was reported for yellow fruits such as *physalis* (Rockenbach et al., 2008) and mango (Vasco et al., 2008) to be in the order of 57.9 and 60.0 mg GAE 100 g^{-1}, respectively. Thus, the results found for the caja-manga pulp (Table 2) are close to that of fruits of the genus *Spondias* and other yellow fruits (*physalis* and mango), whose phenolic compound extraction used both a methanolic solution and a method of determining TP similar to this work.

Beverages B25 and B30 did not show any difference in the content of phenolic compounds (Table 2). The milk beverages with caja-manga pulp had a higher content of phenolic compounds than the control beverage ($p<0.05$) due to the aggregation of phenolic compounds of the caja-manga pulp. In addition, BC has phenolic compounds, which may be related to the presence of phenolic compounds in milk (thiophenol, phenol, *o*-cresol, *p*-cresol, *m*-cresol, 2-ethylphenol, thymol, and carvacrol), previously described in studies conducted by Conell & Fox (2001).

To evaluate the antioxidant capacity of fruits and byproducts or associated products, the methods differ according to the experimental conditions and the way of quantifying the antioxidant capacity, thus, a set of different methods is used for evaluation (Wojdylo et al., 2008). The antioxidant capacity of the caja-manga pulp was evaluated using different methods: ability to react with ABTS●+ radical, reducing power measured by the FRAP method, and scavenging of DPPH● free radicals. The caja-manga pulp was able to scavenge ABTS●+ and DPPH● free radicals, as reported by Costa (2010) for caja-manga extract. Costa (2010) reported that the caja-manga extract concentration that inhibited or scavenged 50% of the reactive species (IC_{50}) by ABTS and DPPH methods was 17.92% and 42.53%, respectively. There is no way to make a direct comparison with the work of Costa (2010), since there is difference in the unit of expression of the results, as well as in the technique and solvents used. In fact, in the preparation of samples, Costa (2010) used phosphate buffer (pH = 7) to extract compounds with antioxidant action, and it is known that the solvent has an effect on the antioxidant capacity of food (Pérez-Jiménez & Saura-Calixto, 2006). Similarly, Vieira (2010) described the same difficulties in comparing their results with those in the literature in studies that determined the antioxidant capacity of apple. Regarding the antioxidant analysis by FRAP method, this is the first work that presents results for this analysis. As there are no other works, it is not possible to compare, but based on a yellow fruit such as *physalis*, Lopez et al. (2013), using the FRAP method, described antioxidant capacity of 99.70 µM trolox 100 g^{-1} fruit.

For the pulp-free milk beverage (CB), it was not possible to observe the scavenging capacity of DPPH● free radicals, while the milk beverages elaborated with different concentrations of caja-manga preparation did not differ from each other ($p>0.05$) (Table 2). The antioxidant capacity of the beverage depends on the existence of a sufficient phenolic content (Almeida et al., 2011). It is believed that the incorporation of the pulp contributed to this phenolic content and the quality thereof (constituents and structural conformation of the phenolic compound), giving beverages B25 and B30 the ability to express antioxidant capacity (Prior et al., 2005; Almeida et al., 2011). In fact, the DPPH method may present negative results for the analysis of products whose antioxidants are of high molar mass since these structures may present steric hindrance, thus not reacting with DPPH● (Pérez-Jiménez et al., 2008).

The milk beverages were also analyzed by ABTS method, but it was not possible to observe the capture of the radical. The absence of antioxidant capacity may be related to the pH of the test, of 4.6, and the lipid concentration (2.01 to 2.15 g 100 g^{-1}), since Chen et al. (2003) reported that the antioxidant response in ABTS method occurs at pH 5 and with low lipid concentration (0.1 g 100 g^{-1}) for bovine milk.

For the FRAP assay, the results of milk beverages (70:30, milk:whey) were not positive, similar to the work of Chen et al. (2003), who observed antioxidant capacity only for the whey from bovine milk.

However, Najgebauer-Lejko et al. (2011) described antioxidant capacity by FRAP method for yogurt with and without green tea extract supplementation. Considering these reports, the different constituents and interactions between them may explain the various responses of antioxidant capacity (Pérez-Jiménez & Saura-Calixto, 2006). Indeed, the differences in relation to the other studies may be related to the interactions between the constituents of the food matrix and/or the low amount of whey used in the formulation, in addition to the different basis of each method.

Microbiological and sensory analyses

In order to guarantee safety in the sensory analyses, coliforms were counted at 35 and 45 °C, and beverages B25 and B30 were not contaminated by coliforms (<0.3 MPN mL^{-1}), in accordance with the standard required by legislation (Brasil, 2001). In the sensory analyses, the beverages with added pulp (B25 and B30) did not present significant difference in the preference test (p>0.05). Regarding acceptance, values of 7.94 (B25) and 7.80 (B30) were obtained. Both milk beverages were accepted. Acceptability indexes were 88.22% and 86.67%, respectively, with no differences between them (p>0.05). According to Dutcosky (2007), for a product to be considered sensorially accepted, it must obtain an acceptability rate of at least 70%. Thus, the milk beverages with added caja-manga pulp obtained good acceptance by the judges, which shows the interest for different flavors. Regarding the purchase intention, the samples also did not present a significant difference (p>0.05), with mean values of 4.12 (B25) and 4.02 (B30), which correspond to “probably would buy”. For beverage B25, 78.57% of the judges answered that they would “probably” or “definitely” buy the product (sum of the judges who answered notes 4 and 5), while for beverage B30, same response was given by 70.41% of the judges. These results indicate that if the beverages were offered for sale, they would probably have a satisfactory demand.

Conclusions

The addition of caja-manga pulp significantly affects the antioxidant capacity of the milk beverage by DPPH method. It was not possible to detect antioxidant capacity by FRAP and ABTS methods.

Fermented milk beverages with added caja-manga pulp showed good sensory acceptability and purchase intention by the judges. The addition of caja-manga pulp modified the physicochemical characteristics of the milk beverages, and the use of prebiotic contributed to the functional properties of the product. The elaboration of prebiotic fermented milk beverages flavored with caja-manga is an alternative for the use of this fruit in a new product and adding the properties of whey and oligofructose.

Acknowledgements

To the National Council for Scientific and Technological Development (CNPq), for granting financial support to the research (479636/2011-7).

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