

Impact of adding milk whey, probiotic and prebiotic in passion fruit drinks

Impacto da adição de soro, probiótico e prebiótico em bebidas de maracujá

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ABSTRACT

The objective of this study was to evaluate the impact of adding milk whey, probiotic and prebiotic to passion fruit drinks in order to develop potentially symbiotic foods. Four formulations containing *Lactocaseibacillus rhamnosus* GG (LGG) and fructooligosaccharide (FOS) were prepared and evaluated. An increase in acidity and reduction in pH were found during storage at 6.5 °C. The soluble solids, lactose and protein contents of the drinks increased in proportion with the whey concentration used in the formulations. All formulations presented LGG viability above 10⁷ CFU/mL throughout storage (28 days) and can therefore be classified as potentially probiotic products. The addition of LGG and FOS to the drinks did not compromise acceptance of the products, and informing the consumers of the presence of probiotic, prebiotic and milk whey had a positive impact on the evaluation when compared with the tropical passion fruit juice without such additions. These results highlight the potential use of milk whey as an ingredient in the production of a new product, meeting the consumer demand for functional products, as well as minimizing the problem of whey disposal, principally by small scale dairy plants.

Keywords: tropical fruits, functional drink, probiotic, prebiotic, healthy, acceptability.

RESUMO

Esse trabalho objetivou avaliar o impacto da adição de soro de leite, probiótico e prebiótico em bebidas de maracujá a fim de desenvolver alimentos potencialmente simbióticos. Foram preparadas e avaliadas quatro formulações de bebidas contendo *Lactocaseibacillus rhamnosus* GG (LGG) e fructooligosacarídeo. Constatou-se aumento de acidez e redução do pH durante o armazenamento a 6,5 °C. O teor de sólidos solúveis, lactose e proteína das bebidas aumentou proporcionalmente à concentração de soro utilizado nas formulações. Todas as formulações apresentaram viabilidade de LGG superior a 10⁷ UFC/mL durante toda a estocagem (28 dias), podendo ser classificadas como produto potencialmente probióticos. A adição de LGG e fructooligosacarídeo às

bebidas não comprometeu a aceitação dos produtos, além disso, ao informar os consumidores da presença de probiótico, prebiótico e soro houve um impacto positivo na avaliação das mesmas quando comparadas ao suco tropical de maracujá sem adição. Desta forma, destaca-se a potencial utilização de soro de leite como ingrediente na produção de um novo produto que atende à demanda do consumidor por alimentos funcionais, além de minimizar o problema de descarte de soro, principalmente, por laticínios de pequeno porte.

Palavras-chave: frutas tropicais, bebida funcional, probiótico, prebiótico, saúde, aceitabilidade.

1 INTRODUCTION

The world population is constantly better informed concerning which foods to consume, resulting in an increasing demand for high quality, functional foods. Thus the development of well accepted products possessing high nutritional value has become a tendency in the food area.

Much research has been carried out aimed at developing products that meet consumer wishes for functional foods, and milk whey has been widely studied. This is a co-product produced during cheese manufacture, containing protein of high nutritional quality and a well-balanced amino acid content (BALDISSERA et al., 2011; AMARAL et al., 2018). Whey is a low-cost, quite profitable product, but producers and small dairies in Brazil frequently dispose of it into rivers and springs, causing pollution and prejudice to the environment.

The addition of fruits to whey modifies its sensory characteristics, since *in natura* whey is a food with low sensory acceptance (SOARES et al., 2011). The use of tropical fruits, for instance passion fruit, which has high nutritional value due to its polyphenolic substances (ZERAIK, YARIWAKE, 2010), polyunsaturated fatty acids (BARBIERI, LEIMANN, 2014) and fiber (SANTANA et al., 2011) contents, amongst other classes of substances, in combination with the addition of functional ingredients such as probiotics and prebiotics, shows great market potential. It should be mentioned that recently, in addition to the functions of nutrition and sensory appeal, another tendency related to functionality has been attributed to foods.

A symbiotic product is one that possesses probiotics and prebiotics in its constitution. The presence of prebiotic can aid the passage of the probiotic through the gastrointestinal tract since it is a substrate for the microorganisms (VITALI et al., 2010). In technological terms, the prebiotic results in a competitive advantage for the probiotic

microorganisms (PIMENTEL, GARCIA, PRUDÊNCIO, 2012). Thus the objective of this study was to evaluate the impact of adding milk whey, probiotic and prebiotic to passion fruit drinks so as to develop potentially symbiotic drinks.

2 MATERIAL AND METHODS

2.1 OBTAINING THE PASSION FRUIT PULP

The passion fruits were selected, washed under running water, sanitized for 20 min in water containing 100 mg/L active chlorine, rinsed with drinking water, cut in half and the pulp removed using a stainless steel spoon. The pulp was used immediately after removal to prepare the drinks, first homogenizing in a blender (Arno Clic'pro Juice LN4S, Brazil) and then removing the seeds using a sieve.

2.2 PREPARING THE PASSION FRUIT DRINKS

Four formulations were prepared, varying the whey powder concentration (4%, 6%, 8% and 11%) but maintaining the concentrations of pulp, sugar (Table 1), prebiotic (FOS) and probiotic (*Lacticaseibacillus rhamnosus* GG) constant. After weighing the whey, sugar and pulp, water was added to complete the final mass to 1000 g. After preparing the formulations, 1.5 g of FOS was added to each final 200 mL drink portion (BRAZIL, 2008). The prepared drinks were transferred to 100 mL flasks and pasteurized at 90 °C for 5 seconds in a water bath. They were then cooled and stored at 6.5 °C.

Tropical passion fruit juice contained 12.5% pulp and 10% sugar with no addition of whey powder, prebiotic or probiotic was also prepared to be used for comparison in the sensory analysis.

Table 1. Experimental design of the passion fruit drinks formulations

Formulations of the passion fruit drinks	Percentage of whey powder diluted in water (%)	Whey powder (g)	Passion fruit pulp (g)	Sugar (g)	Water (g)*	Final mass (g)
1	4	40	125	100	735	1000
2	6	60	125	100	715	1000
3	8	80	125	100	695	1000
4	11	110	125	100	665	1000

*Amount of water added to complete the final mass to 1000 g.

2.3 OBTAINING THE PROBIOTIC TO ADD TO THE PASSION FRUIT DRINKS

Initially, the contents of a capsule containing 10^{10} cells of *L. rhamnosus* GG (Culturelle®) were added to 300 mL of deMan, Rogosa & Sharpe (MRS, Neogen, USA)

broth, and placed in an incubator at 36 °C for 18 hours for activation. The MRS broth was subsequently removed by centrifugation at 7000 g for 10 min at 5 °C (Thermo Fisher Scientific, Sorvall™ Stratos™ Centrifuge Series, Germany) and the cell pellet obtained added to a saline solution (0.85% NaCl) for washing. This material was subsequently centrifuged again under the same conditions and the saline solution discarded. A portion of 0.1 g of the pellet was then added to 100 mL of each pasteurized passion fruit drink formulations to obtain a final product with approximately 10⁸ CFU/mL of *L. rhamnosus* GG.

2.4 PHYSICOCHEMICAL ANALYSES

Lactic acid, pH, and the soluble solids, protein and lactose contents were determined according to the Association of Official Agricultural Chemists - AOAC (2016). These analyses were carried out after 0, 7, 14, 21 and 28 days of storage at 6.5 °C.

2.5 MICROBIOLOGICAL ANALYSES

Filamentous fungi and yeasts were determined according to Beuchat, Cousin (2001), coliforms at 36 °C and at 45 °C according to Kornacki, Johnson (2001) and the presence or absence of *Salmonella* spp. according to Andrews et al. (2001). These analyses were carried out after 0, 7, 14, 21 and 28 days of storage at 6.5 °C to verify the safety and microbiological quality of the product.

2.6 DETERMINATION OF THE VIABILITY OF *L. rhamnosus* GG

The viability of the *L. rhamnosus* GG in the drinks was also determined immediately after manufacture (T₀) and after 7, 14, 21 and 28 days of storage at 6.5 °C. The count was determined in deMan, Rogosa & Sharpe culture medium (MRS, Neogen, USA) according to Richter, Vedamuthu (2001).

2.7 SENSORY CHARACTERIZATION OF THE POTENTIALLY SYMBIOTIC PASSION FRUIT DRINKS AND OF THE TROPICAL PASSION FRUIT JUICE

The analyses were carried out in sensory booths under white light and controlled temperature (23 °C). The samples were analyzed after 15 days of storage at 6.5 °C using 65 untrained consumers. All the sensory analyses were carried out twice. In the first analysis, the consumers were not being informed of the drink composition, and in the

second analysis, the consumers were informed of the whey concentrations added to the drinks and also of the probiotic and prebiotic used. In addition the claims concerning the products were made available in the booths to inform the consumers of the definitions and possible benefits of the drinks developed (Figure 1).

Figure 1. Functional claims presented to the consumers in the second sensory evaluation (second stage) prior to consuming the drinks developed.

Do you know what probiotics are?

Probiotics are good microorganisms that remain alive even after the digestive process. For a food to be called probiotic, the product should show a probiotic count equal or greater than 1,000,000 per 100 mL of product.

The probiotics promote a variety of proven health benefits, such as, for example:

- ✓ Help food digestion;
- ✓ Improve the synthesis of the vitamin B complex;
- ✓ Show a hypocholesterolemic effect;
- ✓ Show an anti-carcinogenic effect;
- ✓ Are used in the treatment and prevention of diarrhea.

The drinks prepared for this test contain *Lacticaseibacillus rhamnosus* GG (LGG) with counts of this bacterium of 100,000,000 per 100 mL. LGG is highly tolerant of intestinal conditions and shows good capacity to adhere to and colonize the intestinal mucosa, which only confers positive points.

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And prebiotics, do you know what they are?

Prebiotics are non-digestible food components such as the fibers in fruits and vegetables, which have a beneficial effect on the consumer. Since they are special fibers, they selectively stimulate the multiplication of probiotics in the colon. Prebiotics promote:

- ✓ Stimulate intestinal bacteria;
- ✓ Increase calcium absorption;
- ✓ Decrease bacterial translocation;
- ✓ Decrease the risk of colon cancer.

The prebiotic present in the drinks is fructooligosaccharide (FOS), widely used in a variety of foods.

The acceptance test was carried out using a nine-point hedonic scale varying from “liked extremely” (score of 9) to “disliked extremely” (score of 1) for the attributes of appearance, aroma, flavor, color and overall impression (STONE, BLEIBAUM, THOMAS, 2012). The samples were presented in complete balanced blocks in a monadic way (MACFIE et al., 1989). In addition the buying intention of the consumers with respect to the products was evaluated using a five-point hedonic scale varying from “would certainly buy” (score of 5) to “would certainly not buy” (score of 1) (MEILGAARD, CIVILLE, CARR, 2006).

The Comment Analysis was carried out by asking the consumers to describe the attributes they liked (L) and disliked (D) with respect to each sample. The consumers were free to express the attributes they judged ideal to characterize each sample (SYMONEAUX, GALMARINI, MEHINAGIC, 2012). This methodology was applied twice, the first time with no information concerning the composition of the potentially symbiotic passion fruit drinks and the second time with availability of this information (addition of whey, probiotic and prebiotic).

The project was approved by the Committee of Ethics in Research of the Federal Institute of the Southeast of Minas Gerais, with the emission of a Presentation Certificate of Ethical Appreciation (CAAE n°. 23346719.1.0000.5588).

2.8 STATISTICAL ANALYSES

The results of the physicochemical analyses and of the viability of *L. rhamnosus* GG in the potentially symbiotic passion fruit drinks were evaluated with three repetitions using a 4x5 factorial scheme, with four treatments (drinks with the addition of 4%, 6%, 8% and 11% of whey powder) and five storage times (0, 7, 14, 21 and 28 days). The results were analyzed using an analysis of variance (Anova) and Tukey's test at 5% significance for the comparison of the means. The statistical results were obtained using the Dell Statistica data analysis software system, version 13.

An analysis of variance (Anova) and Tukey's test at 5% significance were also used for the acceptance results, the independent qualitative variables being: consumer and samples; and the dependent variables: appearance, aroma, flavor, color and overall impression. The statistical analyses of the two acceptance tests (before and after receiving information concerning the functional claims for the products) were carried out separately.

For the analysis of buying intention, once again the analysis of variance (Anova) and Tukey's test at 5% significance were applied, the qualitative independent variables being the consumer and the sample and the variable dependent, the buying intention.

A contingency table was set up for the Comment Analysis containing the citation frequencies of the sensory attributes mentioned for each sample. Since this was a free description method, synonymous words were grouped together using a Portuguese language dictionary as the criterion, as recommended by Ares et al. (2010). In addition, free description generates attributes with infrequent citation, and hence only attributes with above 10% citation for at least one sample were considered significant. The

contingency table was evaluated by Chi-square global. The significance of the data was subsequently verified and it was possible to evaluate the contingency table by Chi-square per cell, allowing one to verify if the values observed were smaller, the same or larger than the theoretical values (SYMONEAUX, GALMARINI, MEHINAGIC, 2012). A correspondence analysis was also carried out using the contingency table (product versus attributes L and D) in order to visualize the relationship between the product and the attributes liked (L) and disliked (D). The comparison of the comment analysis data, with and without information concerning the benefits of the drink, was evaluated using the Multiple Factor Analysis (MFA), forming two cross tabulation matrices. The Rv coefficient was also obtained from the MFA and represents the correlation coefficient.

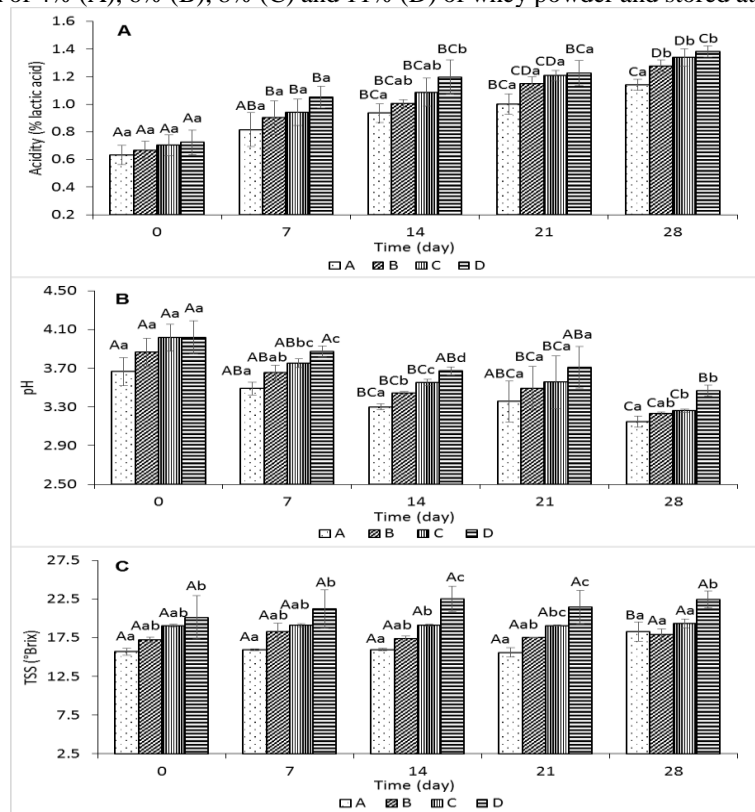
The statistical analyses were carried out using the XLSTAT software (version for Windows 2012.5, Adinsoft, Paris, France).

3 RESULTS AND DISCUSSION

3.1 PHYSICOCHEMICAL CHARACTERIZATION OF THE DRINKS

There was no interaction ($p > 0.05$) between the time and treatment of the drinks with different whey concentrations with respect to the acidity, pH value or soluble solids content (Figures 2 A*, B* and C*). However these variables showed differences with time (Table 2), showing an increase ($p < 0.05$) in acidity over 21 days and a reduction ($p < 0.05$) in pH over 28 days storage of the drinks at 6.5 °C (Table 2). Amaral et al. (2018), working with grape juice containing whey, found an average pH value of 3.6, in agreement with the mean values found throughout the storage time for all the drink formulations developed in the present study (Table 2).

Figure 2. Mean values for acidity (A*), pH (B*) and soluble solids (C*) in the potentially symbiotic drinks with the addition of 4% (A), 6% (B), 8% (C) and 11% (D) of whey powder and stored at 6.5 °C for 28 days.



Different capital letter indicates significant differences ($p < 0.05$) over time for the same sample. Different lower case indicates significant differences ($p < 0.05$) among the samples at the same time.

Table 2. Mean physicochemical characteristics of all the drinks formulations with time

Time (days)	Acidity (% lactic acid)	pH value
0	0.68 a	3.89 d
7	0.93 ab	3.69 c
14	1.06 bc	3.49 b
21	1.47 d	3.53 b
28	1.28 cd	3.28 a

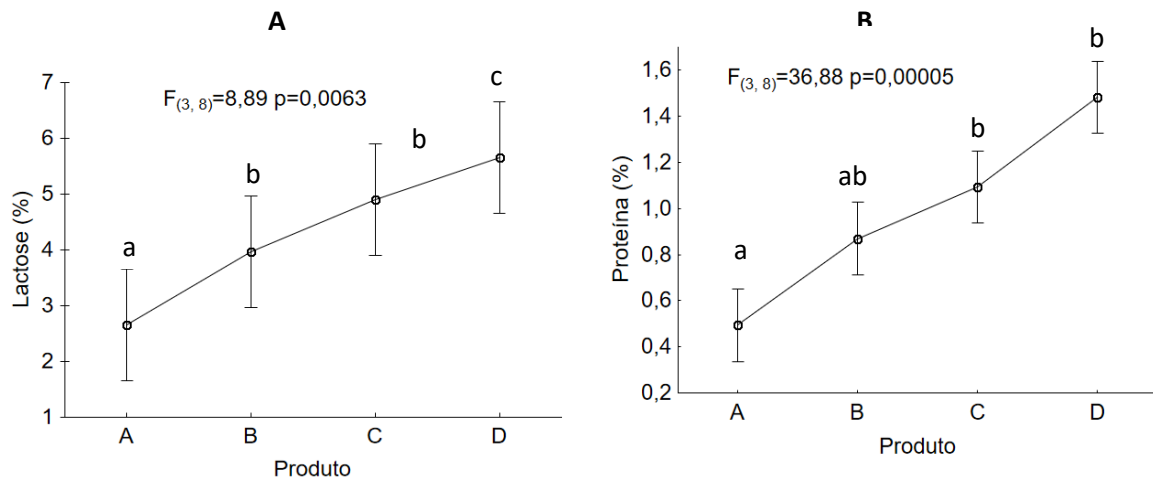
Means followed by the same letter in the same column do not differ at the 5% level of probability.

The soluble solids contents of the potentially symbiotic drinks increased ($p < 0.05$) with increase in the concentration of whey powder added to the drink (Figure 2C*) and were higher than the values found in the grape juices with added whey analyzed by Amaral et al. (2018).

The potentially symbiotic drinks containing 4% of whey powder showed lower ($p < 0.05$) lactose and protein concentrations than the others (Figure 3 A* and 3 B*). Fruit drinks containing whey are receiving a lot of attention due to their increasing potential on the market. Apart from their sensory characteristics, these drinks are extremely nutritive and energetic, and can be especially useful in areas where the lack of food is leading to

certain nutrient deficiencies (YADAV, YADAV, KALIA, 2010). Consequently the drinks developed in the present study have functional appeal, considering that the whey proteins are constituted of essential amino acids and can provide benefits to the consumers.

Figure 3. Mean values for the percentages of lactose (A*) and protein (B*) in the potentially symbiotic drinks with the addition of 4% (A), 6% (B), 8% (C) and 11% (D) of whey powder.

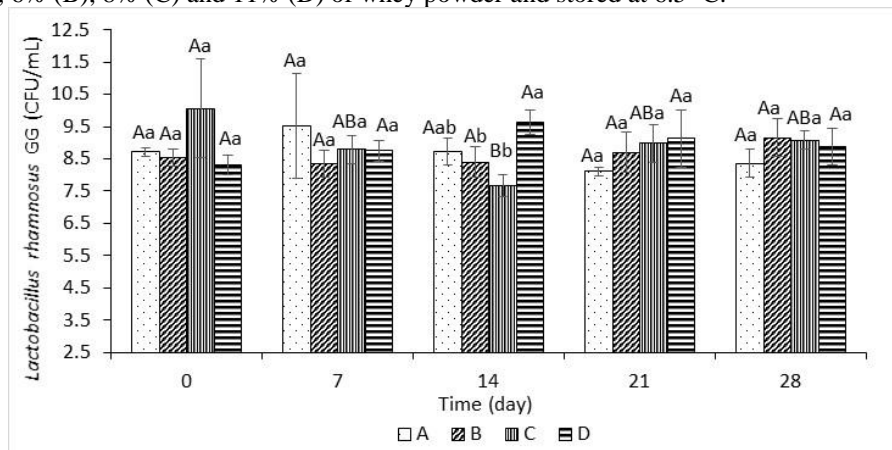


Means followed by the same letter in figures A* or B* do not differ at the 5% level of probability.

3.2 VIABILITY OF *L. rhamnosus* GG IN THE DRINKS

The different treatments of the drinks, as also the storage time, did not influence ($p > 0.05$) the viability of *L. rhamnosus* GG (Figure 4). The lowest *L. rhamnosus* GG count was 7.5 Log CFU/mL, found in the drink containing 8% whey powder (Figure 4). Thus the drinks developed are potentially symbiotic and the consumer will be ingesting a minimum of 10^9 CFU of probiotic bacteria on ingesting a 100 mL portion of any of the drinks.

Figure 4. Mean values for the *L. rhamnosus* GG count in the potentially symbiotic drinks with the addition of 4% (A), 6% (B), 8% (C) and 11% (D) of whey powder and stored at 6.5 °C.



Different capital letter indicates significant differences ($p < 0.05$) over time for the same sample. Different lower case indicates significant differences ($p < 0.05$) among the samples at the same time.

The minimum concentration of probiotic microorganisms necessary to promote a beneficial effect on the host is not clear in the literature (MARTINS et al., 2013). Some researchers suggest concentrations above 10^6 CFU/mL (BANSAL et al., 2016; FIORDA et al., 2016; SHORI, 2016), whilst others suggest concentrations of at least 10^7 to 10^8 CFU/g (LOURENS-HATTINGH, VILJEON, 2001). Thus, based on the literature consulted, the potentially symbiotic drinks developed could be considered promising vehicles of probiotic bacteria since they contain above 10^7 CFU of *L. rhamnosus* GG per milliliter of product (Figure 4).

The fact that FOS are capable of stimulating the growth and activity of probiotics so as to promote intestinal health has been well established (OLIVEIRA et al., 2011). Freire, Ramos, Schwan (2017) showed that the addition of FOS favored the growth of *Lactobacillus acidophilus*, and that this substrate, when used for fermentation, showed a combined effect on the population when carried by a rice and corn drink. Valero-Cases, Frutos (2017) showed that inulin improved the viability of *L. acidophilus* in carrot and orange nectars, reaching 7.68 Log CFU/mL, whereas a smaller survival rate was observed in products fermented without inulin supplementation.

3.3 MICROBIOLOGICAL QUALITY OF THE DRINKS

The mean counts of filamentous fungi and yeasts at all times evaluated were $< 2.1 \times 10^1$ CFU/mL and the Most Probable Numbers of coliforms at 36 °C and at 45 °C were < 3.0 in all the samples evaluated (data not shown). The presence of *Salmonella* spp. was

not found in any of the drinks. It should be pointed out that their low pH values contributed to the inhibition of microbial growth.

3.4 SENSORY CHARACTERIZATION OF THE DRINKS

In general the addition of whey to the drink formulations had no negative impact on product acceptance (Table 3). Prior to the presentation of information to the consumers concerning the composition of the products, the potentially symbiotic passion fruit drinks with added whey did not differ from the tropical passion fruit juice for any of the attributes evaluated (Table 3). However, after presentation of information concerning the composition of the products, the addition of whey, probiotic and prebiotic had a positive impact on acceptance of the potentially symbiotic drinks for all the attributes evaluated, when compared with the tropical passion fruit juice (Table 3).

Table 3. Mean scores for the sensory acceptance and buying intention before and after providing information about the composition of the tropical passion fruit juice and the potentially symbiotic drinks with different whey powder concentrations

Formulations (% whey)	Appearance		Aroma		Flavor		Color		Overall liking		Buying Intent	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
A (0%)	6.63a	5.44c	7.03a	5.53b	6.12a	4.78b	6.66a	5.20c	6.55a	5.09b	3.338a	3.683b
B (4%)	7.30a	7.28ab	6.88a	6.90a	6.42a	6.72a	7.28ab	7.27ab	6.87a	6.73a	3.433a	4.174a
C (6%)	7.37a	7.67a	6.83a	7.25a	6.48a	7.01a	7.58a	7.89a	7.00a	7.27a	3.657a	4.358a
D (8%)	7.08a	6.88ab	7.25a	6.82a	7.04a	6.52a	7.25ab	6.69b	7.13a	6.76a	3.776a	4.324a
E (11%)	6.78a	6.51b	7.15a	6.74a	6.95a	6.76a	6.97ab	6.55b	6.92a	6.73a	3.726a	4.319a

The hedonic scores (appearance, aroma, flavor, color, overall liking) signify the following: 1 = disliked extremely; 9 = liked extremely. The buying intent scores signify the following: 1 = would certainly not buy; 5 = would certainly buy. Means with the same letter in the same column do not differ according to Tukey's test ($p > 0.05$).

For the samples with added whey, the attributes of appearance, aroma, flavor and color received a score between 6 and 8 (liked slightly and liked a lot) independent of the whey concentration used (Table 3), suggesting that the addition of this component, probiotic and prebiotic to fruit drinks could be an interesting option for consumers.

Prior to the presentation of information to the consumers concerning the ingredients in the drinks, there was no significant difference ($p > 0.05$) in the buying intention (Table 3). However, after informing the consumers about the ingredients used in the drinks there was a difference ($p < 0.05$) between the sample of tropical passion fruit juice and the other drinks, the former presenting a lower buying intention (Table 3), showing that consumers are demanding products containing functional ingredients.

In the Comment Analysis, the consumers were requested to describe each sample with the attributes they liked and disliked. The replies obtained were compiled into six ‘Liked’ (L) and seven ‘Disliked’ (D) attributes (Table 4). After presenting the information concerning the products, the samples were also described using six ‘Liked’ (L) and seven ‘Disliked’ (D) attributes (Table 5), and it was shown that, in general, the attributes cited for the samples were the same, with or without prior information.

Table 4. Contingency table for the sensory attributes of liked (L) and disliked (D) cited by the consumers in the blind test

Attributes	Percent whey powder				
	0%	4%	6%	8%	11%
L_ Acidity	1 ^{NS}	1 ^{NS}	4 ^{NS}	4 ^{NS}	0 ^{NS}
L_ Appearance	3 ^{NS}	7 ^{NS}	6 ^{NS}	2 ^{NS}	4 ^{NS}
L_ Aroma	10 ^{NS}	8 ^{NS}	7 ^{NS}	10 ^{NS}	11 ^{NS}
L_ Color	12 ^{NS}	15 ^{NS}	16 ^{NS}	6 ^{NS}	8 ^{NS}
L_ Flavor	5 ^{(-)**}	12 ^{NS}	12 ^{NS}	15 ^{NS}	17 ^{NS}
L_ Texture/viscosity	3 ^{NS}	0 ^{(-)*}	7 ^{NS}	6 ^{NS}	2 ^{NS}
D_ Acidity	1 ^{(-)*}	7 ^{NS}	4 ^{NS}	4 ^{NS}	6 ^{NS}
D_ Appearance	6 ^{NS}	2 ^{NS}	3 ^{NS}	3 ^{NS}	3 ^{NS}
D_ Aroma	5 ^{NS}	8 ^{NS}	9 ^{NS}	2 ^{NS}	4 ^{NS}
D_ Uncharacteristic color	10 ^{NS}	3 ^{(-)*}	3 ^{(-)*}	8 ^{NS}	13 ^{(+)**}
D_ Too dilute	9 ^{(+)**}	4 ^{NS}	0 ^{(-)*}	0 ^{(-)*}	1 ^{(-)*}
D_ Flavor	8 ^{NS}	4 ^{NS}	8 ^{NS}	2 ^{NS}	3 ^{NS}
D_ Texture/viscosity	5 ^{NS}	6 ^{(+)*}	0 ^{(-)*}	1 ^{NS}	2 ^{NS}

(+): Frequency observed > Frequency expected

(-): Frequency observed < Frequency expected

The positive sign (+) indicates greater citation of this attribute for this sample and the negative sign (-) indicates less citation of this attribute

NS: Chi-squared by the cell test was not significant at the alpha level of significance = 0.100 (10%)

*: Chi-squared by the cell test was significant at the alpha level of significance = 0.100 (10%)

**Chi-squared by the cell significance test at the alpha level of significance = 0.050 (5%)

***: Chi-squared by the cell significance test at the alpha level of significance = 0.010 (1%).

Table 5. Contingency table with the sensory attributes of liked (L) and disliked (D) cited by the consumers, with information concerning the composition of the potentially symbiotic drinks

Attributes	Percent whey powder				
	0%	4%	6%	8%	11%
L_ Acidity	4 ^{NS}	6 ^{NS}	1 ^{NS}	7 ^{NS}	1 ^{NS}
L_ Appearance	9 ^{NS}	18 ^{NS}	11 ^{NS}	8 ^{NS}	14 ^{NS}
L_ Aroma	12 ^{NS}	15 ^{NS}	17 ^{NS}	21 ^{NS}	21 ^{NS}
L_ Color	12 ^{NS}	26 ^{NS}	25 ^{NS}	19 ^{NS}	19 ^{NS}
L_ Flavor	17 ^{(-)**}	29 ^{NS}	30 ^{NS}	30 ^{NS}	34 ^{NS}
L_ Texture	1 ^{NS}	4 ^{NS}	6 ^{NS}	3 ^{NS}	7 ^{NS}
D_ Acidity	3 ^{(-)*}	4 ^{NS}	4 ^{NS}	2 ^{NS}	5 ^{NS}
D_ Appearance	9 ^{NS}	2 ^{(-)*}	3 ^{(-)*}	10 ^{NS}	9 ^{NS}
D_ Aroma	15 ^{NS}	20 ^{NS}	17 ^{NS}	16 ^{NS}	14 ^{NS}
D_ Uncharacteristic color	12 ^{NS}	12 ^{NS}	8 ^{(-)*}	19 ^{NS}	24 ^{(+)*}
D_ Too dilute	11 ^{(+)**}	6 ^{NS}	4 ^{NS}	1 ^{(-)*}	2 ^{(-)*}
D_ Flavor	17 ^{NS}	21 ^{NS}	16 ^{NS}	19 ^{NS}	21 ^{NS}
D_ Texture/viscosity	3 ^{NS}	3 ^{NS}	3 ^{NS}	9 ^{NS}	11 ^{(+)*}

(+): Frequency observed > Frequency expected

(-): Frequency observed < Frequency expected

NS: Chi-squared by the cell test was not significant at the alpha level of significance = 0.100 (10%)

*: Chi-squared by the cell test was significant at the alpha level of significance = 0.100 (10%)

**Chi-squared by the cell significance test at the alpha level of significance = 0.050 (5%)

***: Chi-squared by the cell significance test at the alpha level of significance = 0.010 (1%).

The ‘Liked’ attributes that described the samples (without prior information concerning the ingredients) and which presented a larger number of citations were L_ aroma, L_ color and L_ flavor. The sample of tropical passion fruit juice (without the addition of whey powder, probiotic and prebiotic) was different from the others ($p < 0.05$), being highlighted by a low citation for L_ flavor, suggesting that the addition of whey, probiotic and prebiotic had a positive impact on the flavor of the drinks. For the samples with prior information concerning the ingredients, the Liked attributes most used were L_ appearance, L_ aroma, L_ color and L_ flavor. Once again the only sample showing a significant difference for the Liked attributes was the tropical passion fruit juice, which received few citations for L_ flavor as compared to the others, again suggesting that the addition of whey, probiotic and prebiotic had a positive impact on the flavor of the drinks. In the latter case the number of citations was greater for all the attributes, which could be related to the information presented to the consumers.

The drink samples containing 4%, 6%, 8% and 11% of whey powder showed a greater number of citations for L_ flavor without any significant difference between them in both situations (with and without prior information concerning the products), indicating that a whey concentration up to 11% was appreciated by the consumers with respect to flavor (Tables 4 and 5).

All the Disliked attributes presented many citations for at least one sample (Tables 4 and 5). The description D_ acidity for sample 0% (tropical passion fruit juice without added ingredients) was smaller and different from the others, suggesting that the drinks with added whey had an acidity that did not please the consumers, which could have been related to the fact that the acid flavor of the tropical passion fruit juice was masked in the drinks by the addition of whey powder. The potentially symbiotic drink containing 11% whey powder was awarded the highest score for D_ characteristic color as compared to 4% and 6%, which could be related to its greater soluble solids content which altered the characteristic passion fruit color. It should be noted that the consumers indicated that the potentially symbiotic drink containing 11% whey powder presented a yellowish and/or whitish color. The number of citations for D_ flavor was low for all the samples with no difference between them, indicating that the addition of whey, probiotic and prebiotic had practically no impact on their sensory quality.

It is important to note that the drinks did not receive any negative descriptions concerning off-flavors, which is desirable, since the addition of whey, probiotic and prebiotic could have generated some off-flavor/aroma in the tropical passion fruit juice.

For the samples with information concerning the composition (Table 5), the Disliked attributes most cited were D_ aroma, D_ uncharacteristic color, D_ too diluted, D_ flavor and D_ texture/viscosity. In addition, D_ aroma was one of the most cited attributes for all the samples, but with no significant difference between them. All samples containing whey were scored the same as the tropical passion fruit juice (0%) for this attribute, the same being observed for D_ flavor. The D_ uncharacteristic color was highly cited for the sample containing 11% whey and the least cited for that containing 6% whey. The attribute D_ texture/viscosity was also more cited for the sample containing 11% whey, differing from the other samples.

Figure 5A and 5B present the correspondence analysis of the contingency tables (Tables 4 and 5). The samples close to determined attributes were characterized by these attributes, and the samples close to each other were similar.

The correlation was high (Rv of 89%) between the results obtained before and after presenting the information concerning the ingredients used in the formulation of the drinks to the consumers. The fact of informing the consumers about the addition of whey, probiotic and prebiotic did not change the characterization of the samples. According to Hair et al. (2006), the factors obtained from the accumulated analysis of variance should reach 60% to be considered acceptable, and in the present analyses they reached 73.6%

and 80.93%. Thus the descriptors used were discriminated satisfactorily amongst the samples analyzed (Figures 5A and 5B).

Figure 5C shows the correlation between the comment analyses carried out “before” and “after” informing the consumers about the ingredients used in elaborating the drinks. The proximity of the “before” and “after” tests shows that, with respect to the sensory characterization by the comment analysis, the consumers were little influenced by receiving the information concerning the composition of the drinks.

4 CONCLUSIONS

The potentially symbiotic drinks developed with different whey concentrations presented satisfactory physicochemical and microbiological qualities. The drinks could be considered potentially symbiotic since they contained FOS as well as viable *L. rhamnosus* GG throughout storage, with a count above 10^7 CFU/mL. The addition of *L. rhamnosus* GG and FOS to the drinks with different whey powder concentrations did not compromise product acceptance, and it was shown that informing the consumers of the presence of probiotic, prebiotic and whey had a positive impact on their evaluation when compared with the tropical passion fruit juice without additions.

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Figure 5. Component analysis of contingency. Blind test (A) and with information concerning the composition of the potentially symbiotic drinks (B). The attributes are in blue and the samples in red. Comparison of the data with and without information concerning the benefits of the drinks, by a multiple factorial analysis of the samples (C).

