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Physicochemical stability and sensory acceptance of a carbonated cashew beverage with fructooligosaccharide added

Luciana C. Nogueira[1*], Rafael T. Parmanhane[1], Adriano G. Cruz[1], Maria Ivone M.J. Barbosa[2]

[1]Instituto Federal de Educação, Ciência e Tecnologia do Rio de Janeiro (IFRJ), Mestrado. Profissional em Ciência e Tecnologia de Alimentos (PCTA), - 20270-021 - Rio de Janeiro, RJ.
[2]Universidade Federal Rural do Rio de Janeiro (UFRRJ), Instituto de Tecnologia (IT), Departamento de Tecnologia de Alimentos (DTA) - 23890-000 Seropédica, RJ.

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The objective of this research was to determine the shelf life of a carbonated cashew beverage with fructooligosaccharides added using two different processing methods: by using additives (potassium sorbate/sodium benzoate) without pasteurization and by using pasteurization at 90°C for 1 min with addition of preservatives. Physicochemical analyzes (pH, titratable acidity, soluble solids (°Brix), vitamin C, reducing sugars) and sensory evaluation (triangular test and acceptance test) were performed throughout 60 days of storage at 20°C. The results show a decrease in vitamin C content in both processing methods ($p < 0.05$), while the other physicochemical parameters were similar and stable during the shelf life period. Hedonic scores between 5.0 (neither liked, nor disliked) and 6.0 (slightly liked) were obtained during the test period. The results suggest that it is possible to develop a potentially prebiotic cashew beverage that presents suitable physicochemical and sensory parameters.

Key words: Prebiotic beverages, stability, sensory analysis.

INTRODUCTION

The consumer is currently seeking foods that promote wellness and health, and with the ability to reduce the risk of some non-transmissible chronic diseases; and this has encouraged the development of new food products, enabling innovation and creation of new branches in the food sector (Moscatto, 2004). Functional foods can be described as foods or nutrients whose ingestion leads to important physiological changes in the body that are separate and distinct from those associated with their role as nutrients. They develop or activate some specific metabolic or physiological pathways/processes, promoting beneficial health effects such as longevity and reduced risk of chronic diseases. These foods do not present preventive effects neither cure diseases (Wlliamson, 2009). Prebiotics are functional foods that are not digestible in the human intestinal tract and beneficially affect the host by stimulating the growth of beneficial bacteria in the colon. Additionally, the prebiotic may inhibit the growth of pathogens, providing additional benefits to the host (Delgado et al., 2010). Prebiotics are currently identified as non-digestible carbohydrates, including lactulose, inulin and oligosaccharides, such as fructooligosaccharides (FOS), that are used by beneficial bacteria in the colon that use these ingredients as energy sources (Wang, 2009).

Among the many prebiotics available for food companies, fructooligosaccharides have been intensively used to develop many types of food products. Besides, promoting beneficial health effects, they also present a similar sweetness as compared to sucrose (Renuka et

*Corresponding author. E-mail: luciana.nogueira@ifrj.edu.br.

al., 2009) and, therefore, FOS are an excellent alternative in the development of products for diabetics and people on a low-calorie diet (Wang, 2009). Positive effects of the addition of FOS on quality parameters of processed foods have been observed in many food matrices, such as yogurt (Cross et al., 2013; Cruz et al., 2013), low-fat custards (Tarrega et al., 2010), pineapple, mango and orange juices (Renuka et al., 2009), soy-based desserts (Granato et al., 2012), fermented dairy beverages (Castro et al., 2009) and cakes (Volpini-Rapina et al., 2012). Among the Brazilian tropical fruits of great economic interest, cashew is a rich source of vitamin C, has antioxidant properties and acts in the prevention of cancer, *Helicobacter pylori* (causative agent of acute gastritis), besides being a source of bioactive compounds (Oliveira et al., 2012). Despite the potential of FOS as a functional ingredient, to date, there are few studies available in the literature regarding new product development and the effect of the addition of FOS on physicochemical properties, stability and sensory quality of food products, especially tropical fruit beverages such as carbonated cashew beverages.

Based on the afore-mentioned considerations, the present study aimed to: (1) develop a carbonated cashew-based functional beverage supplemented with FOS and (2) evaluate its physicochemical and microbiological stability and its sensory acceptance for 60 days of storage at room temperature by using two methods of conservation (by adding chemical preservatives such as ascorbic acid, potassium sorbate and sodium benzoate; or by using pasteurization at 90°C for 1 min).

MATERIALS AND METHODS

Whole cashew juice and carbonated water were acquired in a local market of Rio de Janeiro, RJ, Brazil, while fructooligosaccharides (FOS, Corn Products, São Paulo, SP) was donated by Corn Products. Ascorbic acid, potassium sorbate and sodium benzoate were purchased by Sigma Aldrich. The polyethylene terephthalate (PET) packaging were donated by Refrigerantes MIL- Rio de Janeiro (RJ).

Development of the functional beverages

For the preparation of the functional beverage, the whole cashew juice (2 L) was added to the carbonated water (2 L) and the content was homogenized. Then, FOS (2% w/v) was added to the mixture and the resulting beverage was divided into two equal parts: one part was not subjected to the heat treatment and preservatives were added to the product (F1) at concentration of 30 mg/100 ml and 50 mg/100 ml, while the other portion was subjected to pasteurization in 5 L isothermal container (90°C/1 min, F2), with subsequent cooling to room temperature (20°C). Finally, the beverages were packaged in sanitized transparent polyethylene plastic bottles (100 ml).

Stability study

To evaluate the stability of the cashew beverage, the test samples (F1 and F2) were stored at room temperature (about 20°C) and subjected to physicochemical, microbiological and sensory acceptance tests on days 0, 10, 20, 30, 40, 50 and 60 of storage. The physicochemical analyses were based on the quantification of vitamin C, total soluble solids (°Brix), reducing sugars, total titrateble acidity (% w/w of citric acid) and pH (IAL, 2005). Samples were also analyzed for molds and yeasts, where the diluted samples were inoculated in potato-glucose agar (Merck, São Paulo, Brazi) and the plates were incubated for 7 days at 35°C. The counts of total coliforms and thermotolerant coliforms were performed according to the Most Probable Number method (Brazil, 2003).

Sensory acceptance

The sensory analysis of the cashew-based beverages was performed using a two-step approach: firstly, a triangular test was used to verify if consumers were able to distinguish the samples, while an affective test was used to assess the products' acceptability. For this purpose, a hedonic scale of 7 points (7 = extremely liked; 1 = extremely disliked) was utilized. A total of 31 potential consumers who had the habit of drinking cashew juice and had availability to participate in the tests were recruited to participate in the study. Moreover, the purchase intent was also assessed by means of a 5-point hybrid hedonic scale (1 = I would certainly buy, 5 = I would never buy). Each subjected used individual booths (white light, 20°C) to evaluate the samples (20 ml), which were coded with 3-digit numbers (Meilgaard et al., 2007).

Statistical analyses

The results of physico-chemical, microbiological and sensory analysis were submitted to Student-t test for independent samples, using a significance level of 5% ($p < 0.05$). For the physicochemical data obtained during the shelf life assessment, the means values for each dependent variable together with the standard deviation were calculated using the software Microsoft Origin 8.0 (OriginLab, Northampton, USA).

RESULTS AND DISCUSSION

Physico-chemical analyses

Overall, the mean values of the physicochemical parameters in the test samples showed non-significant changes ($p > 0.05$) during the 60 days of storage with the exception of vitamin C (Table 1). In this context, just the data obtained for vitamin C values will be discussed and presented. The beverage subjected to heat treatment (F2) had a lower content of vitamin C in comparison to the cashew-based beverage with preservatives ($p < 0.05$). However, during the 60 days of storage, the loss of vitamin C in beverages was similar. In the control beverage, a decreased content of vitamin C was obtained (19.8%), while in F1, the loss of ascorbic acid reached up to 20.0%. These values were close to those found by Maia et al. (2001) over the same storage period for cashew juice, and authors reported that the final vitamin C content was lower in a pasteurized beverage added with preservatives once the heat treatment caused a 5.2% loss of vitamin C when compared with the beverage supplemented with preservatives. In fact, the degradation of vitamin C is multifactorial, and its activity is diminished

Table 1. Physico-chemical parameters of prebiotic cashew beverage along 60 days storage.

Physico-chemical parameter	Beverage	
	F1	F2
Brix	9.11[a]	9.12[a]
pH	3.83[a]	3.81[a]
Tiratable acidity	3.38[a]	3.25[a]
Reducing sugar	3.43[a]	3.51[a]
Vitamin C	43.8[a]	41.5[b]

F1, additives without pasteurization; F2, additives with pasteurization; a-bMean values in the same column not followed by the same letter are significantly different (P < 0.05).

Table 2. Sensory acceptance of prebiotic cashew beverage added with additives without pasteurization along 60 days.

Days	0	15	30	45	60
Overall acceptance	5.35[a]	5.71[c]	5.77[c]	5.67[b,c]	5.45[a,b]

in the presence of light and oxygen (Prati, 2004). In our particular case, a relevant factor that caused a significant reduction of vitamin C was the packaging system employed (transparent and with a considerable oxygen permeability). The values of pH and acidity remained stable in relation to the storage period. However, a significant difference ($p < 0.05$) was observed between values obtained on the 20th day of storage for the sample added with preservatives. The acidity presented a slight decrease during storage, probably as a consequence of the decrease in ascorbic acid content, but no significant difference ($p < 0.05$) between the cashew-based samples was observed.

Mean values of 9.12 °Brix for the pasteurized beverage supplemented with additives (F2) and 9.11 °Brix for the beverage with additives (and no pasteurization) (F1) were obtained. No significant variation ($p < 0.05$) was obtained during the storage period. With respect to the content of reducing sugars, no significant difference ($p < 0.05$) was observed during the storage period, suggesting that the fructooligosaccharides added to the cashew-based beverage did not undergo hydrolysis during storage. This fact is noteworthy once it sets up the functional potential of the cashew-based beverage throughout the storage, and proves the stability of FOS added to the product.

Microbiological analyses

During the storage period, the total counts of molds, yeasts, 45 and 35°C coliforms were in accordance with the legislation n°12/2001 from the Brazilian Health Surveillance Agency (ANVISA). Low counts of coliforms (< 0.3 MPN), yeasts and molds (< 10 CFU/ml) were obtained during the storage period. This indicates that the production of the cashew-based beverages was performed aseptically, and that the preservation processes were effective to inhibit the growth of microorganisms during the storage period.

Sensory acceptance

No difference was observed between the test beverages using the triangular test ($p < 0.01$), indicating that samples presented similar sensory properties regardless of the applied treatment which the beverage has undergone. After the triangular test which provides only an insight about possible differences among samples, the acceptance test was performed in order to assess the overall impression of sample F2. The data analysis from the acceptance test (Table 2) showed that in the period between 15 and 30 days, there was no significant difference ($p < 0.05$) of acceptance, and a lower acceptance mean value was attained in the course of the 60 days. However, no significant difference was obtained in the storage period tested in this study. Therefore, the beverage F2 presented a good acceptance by consumers because 83.9% of the scores were higher or equal to 4 (4 = not liked nor disliked). This result is somewhat important from the nutritional standpoint; once a glass (200 ml) of the cashew-based beverage contains a total of 4 g of FOS which enables the food company to declare the product, it is a source of 'fibers that contribute to the balance of the intestinal microflora. Considering this 200 ml portion, the F2 sample had the potential to present prebiotic effects. Regarding the purchase intent during the storage period, on the 30th day of storage, sample F2 presented a higher purchase intent (83.9%), while the result in the period between the 15th and 60th days was lower; 61 and 3% of the scores were comprehended between 3 and 4 (3 = buy occasionally, 4 = certainly buy). Although, a low percentage of purchase intention was attained, this result is still valuable because the cashew-

based beverage with FOS presents very different sensory properties as compared to similar products on the Brazilian market.

In a general way, it is possible to observe that the beverages developed in this study presents a great potential to be marketed; however, descriptive sensory tests such as quantitative descriptive analysis, optimization of the formulation aiming to obtain a high sensory acceptance and physicochemical stability are necessary. Additionally, comparative studies with similar commercial products available on the marketplace should be performed in order to compare these new formulations with well-known and highly consumed cashew-based beverages. In fact, a prebiotic food/beverage must present similar sensory performance as compared to that of conventional products (Cruz et al., 2010). Finally, the impact of the technology used to manufacture the potentially prebiotic beverage should be assessed with respect to consumer perception, since the addition of chemical preservatives in the formulation of processed food products is perceived as a negative factor and, therefore, can result in the rejection of the product (Shim et al., 2011).

Conclusion

The results obtained in this study suggest that both technological processes to the development of a cashew-based beverage supplemented with FOS provided physicochemical stability to the test samples. However, the vitamin C content as well as the acceptance of the beverages was diminished during the storage period, probably due to packaging system employed. Comparing the two conservation processes, it is possible to note that the addition of preservatives to the cashew-based beverage is more suitable because the beverage retained a higher content of vitamin C, and also presented similar ($p > 0.05$) physicochemical and microbiological characteristics as compared to the sample subjected to pasteurization. Another point that should be considered is that the simple addition of preservatives is less expensive than the pasteurization process. In this sense, further studies regarding the sensory profiling of the beverages developed in this study are necessary in order to optimize the formulation.

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