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Development of beer diet jams sweetened with artificial or natural sweeteners

Sandra Beserra da Silva
sandrabeserrab@gmail.com
http://orcid.org/0000-0001-5908-4198
Universidade Estadual de Maringá, Maringá, Paraná, Brasil.

Maria Rosa Zorzenon
mariarosazorzenon@hotmail.com
http://orcid.org/0000-0003-1080-8911
Universidade Estadual de Maringá, Maringá, Paraná, Brasil.

Paula Gimenez Milani
pgmfernandes2@uem.br
http://orcid.org/0000-0003-0851-6872
Universidade Estadual de Maringá, Maringá, Paraná, Brasil.

Silvio Claudio da Costa
sccosta@uem.br
http://orcid.org/0000-0001-9002-3000
Universidade Estadual de Maringá, Maringá, Paraná, Brasil.

Flavio Augusto Vicente Seixas
favseixas@gmail.com
http://orcid.org/0000-0002-0117-6919
Universidade Estadual de Maringá, Maringá, Paraná, Brasil.

ABSTRACT

The objective of this work was to develop formulations of beer jams sweetened by using natural compounds extracted from stevia, such as steviosides and rebaudiosides A and C. Formulations sweetened by using artificial compounds or sucrose were elaborated for centesimal and sensory evaluations aiming at comparison purposes. The final formulations were demonstrated to be microbiologically safe for consumption. The centesimal evaluation shows that the greatest physical-chemical differences are found in the formulation sweetened with sucrose regarding those using sweeteners: lower energy and higher levels of protein, moisture, ash, and total soluble solids. The residual alcohol content was 0.9 ºGL in all formulations. The general sensory evaluation showed statistically significant differences among all formulations, which indicates products of different characteristics, with averages ranging between "I liked it slightly" and "I liked it moderately". Regarding the purchase intent, the formulation sweetened with a mix of sucralose/rebaudioside-C/stevioside/rebaudioside-A (F4) was the one with the highest purchase intention and best evaluated regarding all other attributes. These results demonstrate that the formulation of beer jam sweetened with a sucralose/stevia mix (F4) was the most appreciated in the set of its functional properties, sensory evaluation, purchase intent and presented an average acceptability index of 80%. Thus, the use of natural sweeteners, such as stevia derivatives, can be considered a viable alternative to replace sucrose in beer jams.

KEYWORDS: jam; beer; rebaudioside-A; stevioside; sucrose.

INTRODUCTION

The diet food industry aims to expand its products offering innovations to reach an increasing audience. In this way, it seeks to develop and produce healthy food containing the necessary and recommended nutritional properties for people who need to ingest low calories and/or have restrictions in terms of sugar consumption. Their target audience is individuals who have metabolic disorders, such as obesity, diabetes, hypertension, or metabolic syndrome (Hellfritsch *et al*., 2012; Mooradian *et al*., 2017), or simply people who want to lose weight.

According to the World Health Organization, obesity is indicative of a predisposition to chronic diseases such as diabetes, cardiovascular abnormalities, hypertension, and cancer. However, they are treatable disorders that can be prevented through changes in lifestyle and eating habits. One of the factors that can lead to the development of obesity is the poor quality of food, more specifically the consumption of food rich in sugars and fats, which are capable of increasing the amount of fat in one's liver and body, in addition to insulin resistance (Johnson *et al*., 2017).

The use of non-caloric sweeteners has become more popular nowadays as an alternative to sugars. Associated with this, scientific research in this field becomes increasingly relevant in the approach of functional foods (Silva *et al*., 2019). Artificial sweeteners such as aspartame, acesulfame-k, sucralose, and saccharin, as common as they are widespread, are mentioned in reports that correlate them with adverse effects that can alter glucose homeostasis (Pearlmen *et al*., 2017). Because of this, *Stevia rebaudiana* becomes an alternative of natural sweetener, since it contains steviol glycosides, as rebaudioside-A, which contain greater sweetening power than sucrose, in addition to providing functional and nutraceutical effects, such as reduction in the postprandial glycemic index (Samuel *et al*., 2017).

There are many challenges for the food industry regarding the development of functional products, being one of them the increased awareness of consumers who wish to improve their quality of life and choose healthier habits, without giving up their favorite foods. In this context, beer is one of the most popular alcoholic beverages consumed worldwide, and its consumption has been growing steadily in the last decade (Amienyo; Azapagic, 2016, Humia et al., 2020). Despite its alcohol content, beer also has many nutrients, such as vitamins, minerals, carbohydrates, amino acids, and bioactive compounds (Ducruet et al., 2017, Zapata et al., 2019, Humia et al., 2019). Beer is well known for its diuretic effect and, reports are describing that the moderate intake of this alcoholic beverage is associated with a rapid reduction in insulin resistance, consequently, with a lower risk of type II diabetes, conditions associated with cardiovascular diseases (Joosten, 2011). In addition to alcohol content, beer also has a high concentration of CO_2, acid pH, and antimicrobial components from hops, which leads to good microbiological stability. In terms of functionality, beer also contains antioxidant compounds (Wieme *et al*., 2014), however, since it is an alcoholic beverage, its consumption is restricted to adults, besides being prohibited in many countries. Due to its alcoholic and protein content, beer is a non-recommended beverage for people affected by certain metabolic disorders, such as gouty arthritis.

Given the increasing beer consumption worldwide, and considering the restrictions inherent to the consumption of this beverage by certain clienteles, this study aimed to develop beer jams sweetened with natural or artificial sweeteners as alternative options. The majority of people affected by type II diabetes are obese adults with recommendations for dietary restriction, especially in terms of fat, sugar, and alcohol. In this way, the product developed in this work aims to reach this specific audience given the alternative and the nutraceutical properties that a diet beer jam can offer. A formulation sweetened with sucrose was also developed for nutritional, sensory, and acceptability comparison purposes.

MATERIALS AND METHODS

JAM DEVELOPMENT

The experiments were carried out in the Laboratory of Food from Vegetable Source at the State University of Maringá, in Umuarama, state of Paraná, Brazil, at the Technology Department (DTC/UEM). The ingredients were purchased from local markets, including the sweeteners used.

The jam formulations were made according to Table 1. A commercial beer in the presentation "pure malt" with an alcohol content of 4.40% was used, where all dry ingredients (except the sweeteners) were slowly incorporated into the beer, under continuous stirring in a pot. Next, the mixture was cooked for five minutes, mixing manually in a continuous way until reaching the jam point, where the ºBrix was measured. So, the cooking was interrupted, and the sweeteners were added.

Table 1. Formulations used in the preparation of beer jams.

Ingredients	F1	F2	F3	F4
Beer (mL)	150.0	150.0	150.0	150.0
Corn Glucose (g)	22.0	-	-	-
Dietary fiber (polydextrose) (g)	2.5	2.5	2.5	2.5
Ascorbic acid (g)	0.8	0.8	0.8	0.8
Citrus pectin (g)	1.5	3.0	3.0	3.0
Citric acid (g)	0.5	0.5	0.5	0.5
Xanthan gum (g)	0.3	0.3	0.3	0.3
Carboxymethylcellulose (g)	-	0.3	0.3	0.3
Sucrose (g)	30.0	-	-	-
Sucralose/Acesulfame-K (g)	-	4.0	1.6	-
reb-C/stevios/reb-A (g)	-	-	2.4	-
sucralose/reb-C/stevios/reb-A (g)	-	-	-	4.0

The jams were stored in glass jars sealed with metal lids previously sterilized and dried. Then, the glasses were closed, pasteurized in a water bath at 100 °C for 15 minutes, inverted, and left to cool at room temperature. The bottles were stored under ambient conditions (25 °C) and protected from light for 1 week, for further analysis. The following formulations using commercially available sweeteners were prepared: (F1) using sucrose; (F2) sweetener 2, containing sucralose and acesulfame-K; (F3) sweetener 3, containing rebaudioside-

A/stevioside/rebaudioside-C and; (F4) sweetener 4, containing sucralose/rebaudioside-A/stevioside rebaudioside-C. All commercial sweetener presentations contained lactose above 90% as a vehicle.

MICROBIOLOGICAL EVALUATIONS

The microbiological analyses were performed at the Laboratory of Food Microbiology from the DTC/UEM, according to the methodology proposed by Silva Silva *et al*. (2001) and the recommendations by RDC 12/2001 – ANVISA (The Brazilian Health Regulatory Agency) (2001) for jams. The total counts of yeasts and molds, *Salmonella* spp, as well as coliforms at 45 °C were evaluated.

SENSORY EVALUATIONS

Sensory evaluations were carried out in the Laboratory of Sensory Analysis from the DTC/UEM, at individual stands under white light, after the project approval by the State University of Maringá Ethics Committee (CAAE 18718013.3.0000.0104). To verify the acceptance and preference of the panelists, a 9-point hedonic scale was adopted (1=extremely unpleasant) (9=extremely appreciated). The evaluated attributes were general aspect, appearance, aroma, flavor, and consistency. In addition, the intention to purchase the product was verified, according to the scale (5=definitely buying it; 1=definitely not buying it). The acceptability index (AI) was calculated according to the equation (Equation 1):

$$AI\ (\%) = (A/B) \times 100 \qquad \text{(Equation 1)}$$

where *A* represents the average score and *B* represents the maximum score on the hedonic scale that the product received.

The characterization of the sensory team regarding the frequency of beer consumption was also evaluated. The sensory panel consisted of 50 untrained individuals of both genders, aged between 15 to 55 years. The panel participants were previously instructed on how to complete the evaluation form and conduct the analysis. Samples of ~2g were served to the panelists randomly in white disposable cups coded with random numbers on an evaluation kit composed of a glass of potable water for oral hygiene between each sample, plus cream crackers and the evaluation and research consent forms. It is important to note that there was a space in the evaluation form in which panelists could give free feedback, and they are free to eat or not the jams with cream crackers.

CENTESIMAL AND PHYSICOCHEMICAL CHARACTERIZATION OF JAMS

The quantification of the moisture content, ash, total protein, total fiber, total soluble solids (ºBrix), and pH were carried out according to the methodology proposed by the Adolfo Lutz Institute (IAL, 2005), carbohydrate was estimated by difference. The alcohol content was determined using an ebulliometer, a complete kit for determining alcoholic degree (Mylabor, São Paulo). The equipment was calibrated according to the manufacturer's standards. These analyses were performed in duplicates, however, if the results deviate more than 5% a third analysis was made. The color of the jams was evaluated by using a Minolta® colorimeter, model CR400, illuminant D65, and the CIELAB color scale. The device was calibrated using a white ceramic plate. The *L**, *a**, and *b** values were determined and they mean, respectively: Luminosity, red/green coordinate (where +*a* indicates red and –*a* indicates green), and yellow/blue coordinate (where +*b* indicates yellow and –*b* indicates blue). These analyses were performed in triplicates.

STATISTICAL ANALYSIS

The results were evaluated using the Tukey and ANOVA tests, at the significance level of 5%.

RESULTS AND DISCUSSION

PHYSICAL-CHEMICAL CHARACTERIZATION OF JAMS

The search for the best formulation of beer jam in this work was innovative research because, to date, no scientific data is reporting to this product. Figure 1 shows the four products developed in this work

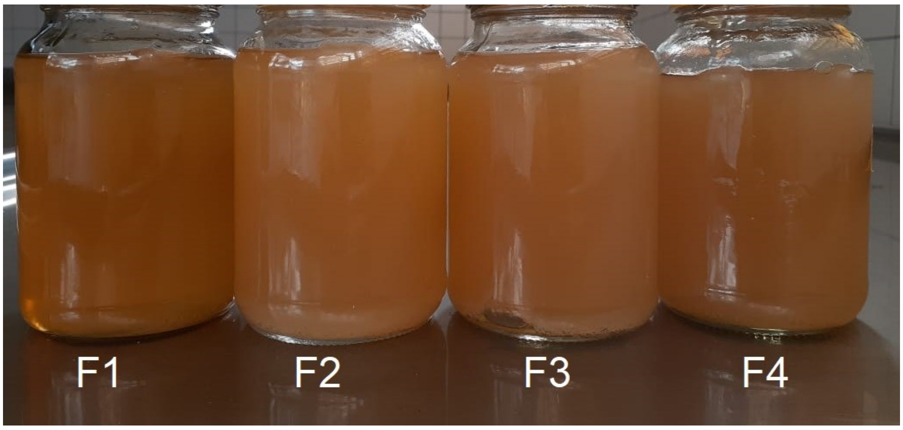

Figure 1. The visual aspect of the four formulations of beer jams developed in this work.

Table 2 presents the average values from the physical-chemical analyses, and the color attribute from the formulations of beer jams evaluated. In general, the jam sweetened using sucrose and corn glucose showed a significant difference ($p<0.05$), regarding the results found for jams sweetened using natural or artificial compounds but, the difference more or less depends on the parameter evaluated. These results were already expected since sucrose is a disaccharide composed of glucose and fructose and is also considered a nutritious and caloric compound. Thus, the energy value (calories) of the formulation (F1) was 132.8 kcal×100 g^{-1}, while those from the other formulations ranged from 25.6 kcal×100 g^{-1} to 30.0 kcal×100 g^{-1}. Diet beer jams provided approximately fivefold fewer calories in comparison with conventional jams (sweetened with sucrose). These results were satisfactory since the search for low-calorie foods by those who want to lose weight or prevent and treat metabolic diseases is growing every day. These facts have boosted the search for diet products because, in addition to their nutritional aspects, they also bring physiological benefits and metabolic effects on health, such as preventing hyperglycemia or improving glucose tolerance, both in healthy and diabetic people (Derivi *et al*., 2002).

Table 2. Parameters obtained from the physical-chemical analysis of the formulations of beer jams developed in this work.

Analysis		F1	F2	F3	F4
Calories (Kcal)		132.8 ± 0.74[a]	25.6 ± 0.53[b]	28.8 ± 0.64[c]	30.0 ± 0.48[c]
Proteins (g×100 g^{-1})		1.1 ± 0,04[a]	2.8 ± 0.17[b]	2.6 ± 0,01[b]	3.0 ± 0,01[c]
Fibers (g×100 g^{-1})		3.1 ± 0.01[a]	3.4 ± 0.18[a]	3.5 ± 0.16[a]	3.6 ± 0.01[a]
Moisture (g×100 g^{-1})		64.3 ± 0.54[a]	89.3 ± 0.21[b]	88.9 ± 0.03[b]	88.1 ± 0.03[b]
Ashes (g×100 g^{-1})		1.1 ± 0.01[a]	2.9 ± 0.02[b]	2.4 ± 0,03[c]	2.7 ± 0,09[b]
Carbohydrate (g×100 g^{-1})		30.2 ± 0.22[a]	1.7 ± 0.12[b]	2.7 ± 016[c]	2.6 ± 0.10[c]
TSS (°Brix)		31.9 ± 0.15[a]	10.9 ± 0.10[b]	12.9 ± 0.06[c]	12.9 ± 0.06[c]
Alcohol content °GL		0.9 ± 0.20[a]	0.9 ± 0.20[a]	0.9 ± 0.20[a]	0.9 ± 0.20[a]
pH		3.40 ± 0.00[a]	3.43 ± 0.01[a]	3.43 ± 0.01[a]	3.43 ± 0.01[a]
Color	a*	1.94 ± 0.17[a]	1.79 ± 0.08[ab]	1.47 ± 0.07[bc]	1.87 ± 0,11[ab]
	b*	17.23 ± 0.63[a]	12.66 ± 0.89[b]	12.07 ± 0.56[b]	16.46 ± 0.46[a]
	L*	63.68 ± 0.62[a]	68.55 ± 0.43[b]	49.42 ± 0.71[c]	62.78 ± 0.74[a]

NOTE: Values with different letters in the row are significantly different at the 5% level by the ANOVA test.
TSS: Total Soluble Solids.

Due to the lack of studies presenting centesimal characterizations of jams, especially those without fruit or fruit juice, as well as reduced caloric content, our results were compared with products of similar composition. Although the fiber content obtained in the four formulations did not show a statistically significant difference ($p < 0.05$), it was slightly lower in the F1 formulation. The fiber content in the beer jams developed in this work presented levels ranging from 3.10 to 3.60 g×100 g^{-1}, results similar to those reported by Polesi *et al*. (2011), who obtained 3.69 g×100 g^{-1}, in a study on the development of low-calorie mango jam. This result was already expected because all formulations were added of dietary fiber (polydextrose) and citrus pectin. According to O'Shea *et al*. (2012), fibers can improve the characteristics of the product, such as syneresis, since it can retain water, which increases viscosity and improves the sensory properties and texture of a product. It is important to emphasize that the physiological effects of fiber consumption have been the focus for the prevention of type 2 diabetes associated with diet products (Mello e Laaksonen, 2009).

Moisture content is one of the most frequently analyzed properties and the most important one regarding microbiological safety since it is considered an indicator of product quality, especially when it comes to jams. The moisture content obtained for the F1 formulation was much lower than those from other formulations, which had values ranging between 88.06 and 89.33 g×100 g^{-1}, thus, not statistically different from each other. It is expected that the moisture content of the jam sweetened with sucrose will be lower than those made with sweeteners since diet jams have a higher moisture content due to the presence of fibers necessary to replace sucrose (or soluble solids) in their formulations. The average pH values reported in this study are close to 3.4, a satisfactory result since products presenting pH below 4.5 tend to inhibit the action of *Clostridium botulinum*, an anaerobic microorganism that causes botulism (Souza *et al*. 2016). In addition, pH between 3.0 and 3.5 can promote a good gel structure, which provides adequate texture to the final product.

Table 2 shows ash content between 1.06 and 2.94 g×100 g^{-1} in all formulations, while protein content ranged between 1.11 and 3.05 g×100 g^{-1}, values higher than those reported by Carvalho *et al*. (2013), who developed strawberry jams sweetened with rebaudioside-A and sucralose. In their work, the averages for ash and protein content were 0.54 and 1.35 g×100 g^{-1}, respectively. This difference is due to the lower content of ash and protein in beer compared to fruits, substances that were the bases of the compared jams.

The total carbohydrate present in the F1 formulation was equivalent to 30.2 g×100 g^{-1}, a value considered 88% higher than those from beer jams made with sweeteners, which showed averages from 1.7 to 2.6 g×100 g^{-1}. This fact is explained by the substitution of maize sucrose and glucose by the sweeteners (F2, F3, and F4), which confirms the success of this work in developing a jam of low sugar and calory content. Regarding the results obtained for TSS, the formulation F1 was the one with the highest ºBrix, which was already expected since this formulation was sweetened with sucrose plus corn glucose, while the other formulations were sweetened with sweeteners. According to Cervera-Chiner et al. 2021, the TSS content tends to decrease following the sucrose content, which justifies the other formulations having smaller ºBrix. The alcoholic levels obtained in the jam formulations were 0.9 ºGL on average. This value is within the parameters required by resolution nº 12 from the National Commission of Norms and Standards for Food (CNNPA) (Brasil, 1978), which defines that jams can be added with optional alcoholic ingredients up to the maximum limit of 1.9% of alcohol by volume in the final product.

The results for color parameters of the beer jams are also shown in Table 2. They indicate a lighter color, considering the Luminosity value *L**, as it is closer to white (1000) than to black (0). We can observe that the F3 formulation obtained an average value of 49.42, lower than the average values of F1, F2, and F4 formulations. This darkening may have probably occurred due to the reaction between F3 compounds such as lactose, pectin, and dietary fiber, which may have promoted caramelization reactions due to thermal processing. The average values for parameter *a** were less than 2, which was already expected since this parameter indicates red. Regarding the parameter *b**, which tends towards yellow, the values ranged between 12.07 and 17.23, which is expected. These results associated with parameter *L** (luminosity), correspond to the characteristic color of beer jams, which is bright light yellow.

The CNNPA resolution nº 12 (Brasil, 1978), specifies to a product be considered as jam, it must be obtained by cooking fruits as whole or in pieces, from the pulp or juice, with water, sucrose and can be concentrate until it acquires gelatinous consistency. It is allowed the addition of glucose, inverted sugar, acidulants, and pectin to compensate for any deficiency in the acidity or pectin content from the fruit. It must present semi-solid consistency and also the color, odor, and flavor from the original fruit. So, according to this resolution, the product developed in this work does not match into this category, since it was not developed with fruits and/or fruit juice. Although the current legislation does not classify the product as jam, there is no specific regulamentation for products developed with ingredients based on beer, wine, or similar. Given the above, the characterization of the product developed here as beer jam is purely commercial, since it may be compared with other similar products already on the market, which are identified (called) as beer jams.

MICROBIOLOGICAL EVALUATIONS

According to the results obtained from the microbiological analysis for Salmonella, total yeasts, molds, and coliforms at 45 °C, all samples of beer jams presented satisfactory sanitary conditions, in compliance with the parameters for food security established by the Brazilian legislation from resolution RDC nº 12, from January 2, 2001.

SENSORY EVALUATION

The averages of the attributes evaluated in the tests for acceptance and purchase intent using a hedonic scale are shown in Table 3. It is important to highlight the panel of tasters, in which 25 (50%) are frequent beer consumers; 10 (20%) drink beer 2-3 times a week; 5 (10%) drink once a week; 7 (14%) rarely drink and 3 (6%) do not drink beer.

Table 3. Average scores from the evaluation of the sensory acceptance of beer jams (n = 50).

Aspect evaluated	F1	F2	F3	F4
General aspect	6.8 ± 1.08^a	6.1 ± 1.33^b	6.4 ± 1.21^c	7.5 ± 0.86^d
Appearance	6.9 ± 1.13^a	6.5 ± 1.34^b	6.5 ± 1.34^b	7.2 ± 1.26^d
Consistency	7.0 ± 0.99^a	6.6 ± 1.35^b	6.3 ± 1.45^c	7.0 ± 1.14^a
Aroma	6.6 ± 1.43^a	6.7 ± 1.43^b	6.5 ± 1.46^c	7.3 ± 1.19^d
Flavor	6.6 ± 1.46^a	6.0 ± 1.66^b	6.3 ± 1.64^c	7.5 ± 0.94^d
Buy intention	3.5 ± 0.99^a	2.9 ± 0.84^b	3.0 ± 0.92^c	4.1 ± 0.71^d

NOTE: Values with different letters in the row differ significantly at the 5% level by the ANOVA test.

At first sight, the four formulations had significant differences in all evaluated parameters, which can be interpreted as if they were quite different products. The criterion for adding sweeteners was purely gravimetric (same amount) without taking into account the ability to produce the sweet taste from each one, a fact that may have contributed to differentiate them from each other.

Regarding the properties evaluated, F1, F2, and F3 formulations had means between 6.0 and 7.0 that correspond to the impression “I liked it slightly”. However, F2 and F3 formulations received the lowest scores. Only F4 formulation obtained means $\geq$ 7.0 in all evaluated parameters, which corresponds to the impression “I liked it moderately”. Thus, F4 formulation emerges as the most promising diet product. This becomes more relevant in a food market that offers only beer jam sweetened with sucrose.

In addition, the number of food industries that are concerned about the welfare and health, as well as disease prevention of their consumers, is increasing. Following this trend, they are investing in the development of technologies for food production with reduced or zero calories, without losing their audience’s approval. The acceptability index of the products developed in this work (Table 4), suggests it is a promising alternative or, at least, a starting point for the improvement of the product. The formulation F4 presented an average acceptability index of 81%, while the other formulations presented averages between 70 to 78% for all attributes evaluated. The exception was the formulation F2 that presents AI of 68% for the general aspect and 67% for flavor. According to Dutscosky, 1996, an acceptability index with good repercussion is equal to or greater than 70%.

Table 4. Acceptability index (%) for general aspect, appearance, consistency, aroma, and flavor of beer jams.

Aspect evaluated	F1	F2	F3	F4
General aspect	76	68	71	83
Appearance	77	72	72	80
Consistency	78	73	70	78
Aroma	73	74	72	81
Flavor	73	67	70	83

The scores obtained from the purchase intent evaluation (Table 3) reinforce the impression that F4 beer jam (sweetened with a mix of sucralose and stevia compounds) was the most accepted. It is noteworthy that F1 and F3 jams, despite the significant difference in purchase intention, were assigned as the same concept ‘perhaps I would buy it’. As for the F2 formulation, the panelists rejected it by stating ‘probably I would not buy it’. In addition, from the free comments made on the evaluation form, the panelists reported that the F2 formulation provided a residual taste. This result is quite relevant since the panel of tasters is formed mainly by frequent beer consumers, therefore, connoisseurs of the product.

It is important to observe that the commercial presentations of the sweeteners used in this work contained lactose as a vehicle and, because of that, F2 to F4 formulations contained lactose in final amounts close to 1.6 g$\times$100 g^{-1}. In eventual commercial exploitation of F4 formulation, it would be necessary to use sweeteners in their pure form, so that people who are intolerant or allergic to this carbohydrate would be allowed to consume it without concerns. Thus, since F2 to F4 formulations contained lactose due to the commercial presentation of sweeteners, their concentration and eventual contribution to the taste of the final product was practically the same in all of them and can be ignored as an influence in taste.

CONCLUSIONS

The results indicate that the jams formulated in this work using natural or artificial sweeteners presented higher levels of protein, moisture, and ash, but traces of alcohol content. However, they showed lower levels of carbohydrates and reduced calories compared to the traditional formulation made with sucrose. The sensory evaluation of these products by panelists who are regular beer consumers/connoisseurs gives greater reliability to the results and demonstrates that the F4 formulation, sweetened with sucralose and stevia compounds (rebaudioside-A/stevioside/rebaudioside-C), was of greater acceptance. Thus, the use of natural sweeteners, such as stevia compounds, can be considered as a viable alternative to replacing sucrose in beer jams.

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Desenvolvimento de geleias diet de cerveja adoçadas com edulcorante artificiais ou naturais

RESUMO

O objetivo deste trabalho foi desenvolver formulações de geleias de cerveja adoçadas com compostos naturais extraídos da estévia, como esteviosídeos e rebaudiosídeos-A e C. Formulações adoçadas com compostos artificiais ou sacarose foram elaboradas para avaliação centesimal e sensorial para fins de comparação. As formulações finais demonstraram ser microbiologicamente seguras para consumo. A avaliação centesimal mostra que as maiores diferenças físico-químicas se encontram na formulação adoçada com sacarose em relação às que utilizam adoçantes: menor energia e maiores teores de proteína, umidade e cinzas e sólidos solúveis totais. O teor alcoólico residual foi de 0,9 ºGL em todas as formulações. A avaliação sensorial geral mostrou diferenças estatisticamente significativas entre todas as formulações, o que indica produtos de características diferentes, com médias variando entre "Gostei um pouco" e "Gostei moderadamente". Quanto à intenção de compra, a formulação adoçada com uma mistura de sucralose/rebaudiosídeo-C/esteviosídeo/rebaudiosídeo-A (F4) foi a que apresentou maior intenção de compra e foi mais bem avaliada em todos os demais atributos. Esses resultados demonstram que a formulação de geleia de cerveja adoçada com uma mistura de sucralose/estévia (F4) foi a mais apreciada no conjunto de suas propriedades funcionais, avaliação sensorial, intenção de compra e apresentou um índice de aceitabilidade médio de 80%. Assim, o uso de adoçantes naturais, como os derivados da estévia, pode ser considerado uma alternativa viável para substituir a sacarose em geleias de cerveja.

PALAVRAS-CHAVE: geleia; cerveja; rebaudiosídeo-A; rebaudiosídeo-C; esteviosídeo; sacarose.

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Correspondência:
Sandra Beserra da Silva
Universidade Estadual de Maringá, Maringá, Paraná, Brasil.