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RESEARCH ARTICLE

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DEVELOPMENT AND SENSORY EVALUATION OF EXTRA JELLY, LIGHT AND DIET OF CERRADOCASHEW WITH PEPPER ADDITION

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ABSTRACT

Throughout Brazil and also in the world, fruit growing remains one of the activities that stand out most in the following: economic and social aspects. Cashew is a fruit that has great representation in the food industry, however, only its chestnut has been well explored. The jams are a potential example to develop new products in the face of good acceptance in the consumer market, also, pepper is considered as a condiment known worldwide, improving and highlighting the aroma and flavor of products. The objective of this work was to elaborate and verify the sensory and commercial acceptance of a cashew jelly with pepper addition. The present work was carried out at the Laboratory of Fruit and Vegetable Technology of the Federal University of Tocantins, Palmas - TO. Sixty untrained judges participated in the sensory evaluation, and the means of the attributes related to the preference of the evaluated sample were complemented by descriptive statistical analysis of the respective standard deviations and coefficients of variation. The tests used in the research were: hedonic scale and attitude or intention scale. According to the results, it can be concluded that the "extra" sample of cashew jelly from the Cerrado addition of pepper was better evaluated by the judges, both for sensory analysis and for purchasing intention, a fact that may be related to the concentration of the sweetener used about the other samples.

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INTRODUCTION

Brazil stands out in Latin America compared to other countries in fruit production, occupying the third place in the world ranking, highlighting among these the cashew production (Siqueira *et al.*, 2012). Of all the cashew species available in Brazil, in the north-central region of the country, as in the states of Goiás and Tocantins that holds the Cerrado biome, the *Anacardium humile*, popularly known as Cerrado cashew, a median tree of 3 to 6 meters high (ASSIS, *et al.*, 2007), stands out. Its pulp has been consumed natural products in the form of juices, liqueurs, ice cream, and sweets. It is an uncultivated species, but easily found in its natural habitat (KUKOSKI, *et al.*, 2005). The use of the cashew peduncle is considered an important source of income for families who survive extractivism and family farming since it has great acceptance in the foreign and internal market (ASSIS, *et al.*, 2007).

The jelly is considered as the result of cooking the whole fruits or cuts of their pulp, or even their juice, which are usually added sugar and water and concentrate, even when obtaining consistency with gelatinous form. In this formulation, glucose or sugar can also be placed to give brightness to the product, concerning the syrup this should be used until when it presents enough °Brix to appear the gelling process at the moment the product is cooled (ARAÚJO, *et al.*, 2012., NACHTIGALI, *et al.*, 2004). The cultivation of peppers is one of the practices that has been widespread in all Brazilian states, by producers of all classes, in turn, is highly appreciated as a condiment, thus having important representation in the vegetable sector, not only for agriculture but also for the food industry. The ability to give aroma and flavor to food makes plantations increase the possibility of profitability, precisely because it is possible to add to various types of food products such as canned foods, sauces, liquor, jam, among others (LIMA, *et al.*

2017). An important step in the process of introducing new food to the market is the use of sensory analysis to verify consumer acceptance of this product. It is performed through the use of human senses: vision, taste, smell, hearing, and skin sensitivity (ARAÚJO, *et al*, 2014; VENDRUSCOLO, *et al*, 2012). Because of the above, this study aimed to elaborate and evaluate the nutritional and sensory quality of cashew jelly with the addition of pepper.

MATERIAL AND METHODS

Raw material: It was used for the elaboration of the cashewofthe Cerrado jams of the species (*Anacardiumhumile*) with the addition of pepper (*Capsicum baccatum* var. pendulum), sucralose and Finn® brand sweetener, pectin, citric acid, acquired in the local trade, they were harvested at the appropriate maturation stage, obeying the uniformity of color and size with the absence of rots.

Making jams: The processing of cashewofthe Cerrado jams was carried out at the Laboratory of Fruit and Vegetable Technology (LAFRUHTEC/UFT). Sensory analyses were realistically analyzed at the Sensory Analysis Laboratory, both located at the Federal University of Tocantins, Campus - Palmas. In the first stage, the whole fruits underwent a process of cleaning and sanitization in chlorinated water at 200 ppm for 15 minutes, then manual operations of the separation of the chestnuts from the peduncles of the Cerrado cashews were performed. Soon after, the Cerrado cashews underwent peeling processes in an industrial stainless-steel pulping plant, subsequently, a pulp bleaching process with a temperature of 90°C was applied for 3 minutes to inactivate darkening enzymes and decrease the microbiological load. Then, the pulps were packed in polyethylene plastic bags and stored in a freezer at -18°C until the jelly was made. The types“extra” and light jams were prepared with Cashewof Cerrado pulp, being used in the formulations, concentrations of 50%, and 25% sucrose, respectively. For the diet jam, 40% of a mixture of sucralose and Stevie sweeteners was used to add to the pulp mixture, according to the calculation of sweetness intensity and the limits of use of sweeteners in foods (CÂNDIDO and CAMPOS, 1996).

Table 1: Formulation of Cerrado cashew jelly (*Anacardiumhumile*) with the addition of pepper (*Capsicum baccatum*var.pendulum)

| Formulation | Jellies | | |
|-----------------------------|---------|-----|-----|
| | F1 | F2 | F3 |
| Pulp (%) | 50 | 75 | 60 |
| Saccharose(%) | 50 | 25 | - |
| SaccharoseandSweeteners (%) | - | - | 40 |
| Pepper (%) | 3 | 3 | 3 |
| Pectin (%) | 1,5 | 1,5 | 1,5 |
| Citric acid (%) | 0,5 | 0,5 | 0,5 |

F1: “Extra” type jelly; F2: Light Jelly; F3:Diet Jelly.

The cooking took place in a stainless steel pan with continuous manual agitation until concentration. For all formulations, citric acid (0.5% over sugar weight) was added. The pH was adjusted between 3 and 3.4 which is ideal for the elaboration of jellies (SOUZA-VIANA *et. al.*, 2012). Pectin was added to the end of the cooking process so that excessive heating degradation did not occur. To dissolve pectin, it was mixed with sucrose (25% of the total) and with 150 mL of water at 60 °C. Then, when the jelly reached 63° Brix, diluted pectin was added and mixed until the final concentration of soluble solids of 65°Brix. In the diet and light formulations, the same

procedure was followed, replacing sucrose with the sweetener’s sucralose and Stevie (Finn® brand) reducing sucrose by 25% in light, with soluble solids concentrations at 43.9 and 48°Brix, respectively. The products were packed in glass containers, previously sterilized at 100°C/15 minutes with capacity for 100g, and closed with a metal lid for vacuum formation inside. The heat treatment was performed in a water bath at 100°C for 15 minutes, then the products were cooled by adding cold water and then stored at room temperature.

Sensory Analysis: The acceptance tests of "extra", light and, a diet of cashews (*Anacardiumhumile*) with the addition of pepper (*Capsicum baccatum* var. pendulum) were performed at the Federal University of Tocantins, with 60 untrained judges, men and women aged between 18 and 60 years, consumers of cashew pulp and also pepper. The samples encoded with three-digit digit digits containing 20 grams of the jams at room temperature were served to each judge, in individual cabins illuminated with fluorescent light and accompanied by a glass of mineral water for washing the palate in the range of each sample and cracker cream. In the acceptability test, the attributes of color, scent, flavor, texture, and overall impression were evaluated, using a structured hedonic scale of nine points "1=very disliked., 5=neither liked/disliked., 9=I liked it very much" (CHAVES, 2002). The consumer's attitude towards the intention to purchase the product was evaluated through a five-point scale, where 1 "certainly wouldn't buy" and 5 "certainly would." For the sensory tests, the maximum individuality necessary for the evaluation of the samples by the tasters was maintained. To evaluate the preference of the tasters, and ordering test was used, where the tasters were instructed to order the samples in ascending order according to their preference. The ordering test was also used to compare the sweetness intensity and pepper intensity of the jams produced. Nutritional information on energy value, carbohydrates, proteins, total fats, saturated fats, trans fats, dietary fiber, and sodium were determined according to ANVISA Resolution RDC 360/03 - Technical Regulation on nutritional labeling of packaged foods. The indicated portions were determined based on a diet of 2000 kcal considering a healthy diet (BRASIL, 2003a). To calculate the Nutritional Information, the Brazilian Table of Food Composition (TACO) was used to estimate nutrients and energy (NEPA, 2016). And data from published scientific studies were used to evaluate foods not found in the table. The total energy value of the prepared foods was estimated by multiplying the values obtained by the appropriate conversion factors, carbohydrates and proteins by 4kcal.g⁻¹, and total fats by 9kcal.g⁻¹ (BRASIL, 2005b).

Statistical Analysis: The results of the sensory analysis were evaluated by the Variance Analysis (ANOVA) and the Tukey test used to verify a significant difference between the means of the attributes (p≤ 0.05), using the Software SISVAR 5.0 (FERREIRA, 2011). The data were presented in tables and the attributes (color, scent, flavor, texture, and overall impression) in the form of histograms relating to the percentage of individuals and the grades assigned. The results obtained by the ordering test were treated statistically by the Friedman method (CHAVES, 2002).

RESULTS AND DISCUSSION

The sensory attributes and their mean values for the Cerrado cashew jelly with the addition of pepper in the "extra", light,

and diet formulations are described in table 2. According to the results obtained, it was found that the attributes that presented significant differences between the jellies were color, flavor, scent, texture and overall impression, while the aroma attribute did not present statistical difference between the three jellies at the level of 5% significance by the Tukey test. As for the purchase intention, no significant difference was observed between the "extra" and light samples, placing on the scale between the terms "probably would buy" and "certainly would." However, the diet sample differed statistically. According to table 02, it is possible to observe that there was a statistically significant difference in the color attribute. Figure 01 shows that approximately 95% of the tasters gave scores between 6-9 while for light and diet jams the percentage of tasters who gave scores between the terms "Liked slightly" and "liked the color of the jellies very much" were 85 and 75%, respectively. Silva *et al.* (2012) carried out a sensory analysis of "bacupari" jelly, a fruit also typical of the Brazilian Cerrado, and stated that during the cooking of the product there may have been a possible Maillard reaction, where this process there is the release of a pigment (melanoidins) in conjunction with the caramelization process that may have helped in the darkening of the formulation, causing rejection of the tasters. Regarding the evaluation of aromas, it is observed that the scores are lower averages than other attributes, a situation that can be confirmed by the work of Sampaio (2007), who states that although they do not constitute a large group within the area of flavor chemistry, some researchers over the last 3 decades have sought to identify volatile compounds present in cashew and derived products, in addition to determining the importance of each volatile on the exotic scent of this pseudo-fruit. Regarding the purchase intention (Figure 1f) we can observe that approximately 68% of the tasters stated that they probably and/or certainly would buy the "extra" jam, 57% stated that they would probably and/or certainly buy light jelly while 40% stated that they probably and/or certainly would buy the diet jelly.

Only 16% of testers said they would certainly or probably not buy the "extra" jam, 11% said they would certainly or probably not buy the light jam while 41% said they would certainly or probably not buy the diet. It is worth noting that the development of low caloric value products with high nutritional value, as well as sensory characteristics equal to or greater than traditionally processed foods, is a challenge for the food industry. This result shows good acceptance for "extra" light jam and a low acceptance for diet jam among tasters. However, it is worth mentioning those diet products are intended for people with diabetes, hyperglycemia, or prone to obesity and cardiovascular diseases (Rodrigues *et al.*, 2007), which presents the need for food consumption with the restriction of a specific nutrient such as glucose. In this sense, if this product had been evaluated by tasters who usually consume sweeteners, the average acceptance values would be higher. In a work carried out by Castro, *et al.* (2016) in the preparation of fruit jam with pepper it can be observed that if the jams were put up for sale, they would possibly have a satisfactory demand with commercialization values between R\$ 8.00 and R\$12.00, with an average of R\$10.00 representing a final total of 85.42% of purchase claim. The work took into account that pepper and fruit jam with pepper are products with levels of acceptability and sensory acceptance considered ideal, being thus easily inserted in food industries, and with potential for commercialization. Lago *et*

al. (2006) mention that the decrease in the number of sugars (glucose and sucrose) added in Java plum jelly (*Syzygiumcumini* Lamarck) had a positive effect on chemical and sensory quality since it avoids extremely sweet flavor. Freitas *et al.* (2008) when analyzing "gabirola" jelly, reported that the addition of citric acid at 1.0 and 1.5% helped mask the bitter taste of "gabirola", and the control sample was excluded from the analyses because the mean acceptance score was less than six. For Lima *et al.* (2017) when evaluating the intention to purchase pepper jelly with "pequi" bark pectin, the results were excellent with average scores above six and below eight (between I liked slightly and liked a lot), for all samples analyzed. It can be affirmed that there was no statistically significant difference regarding the preference between the samples of light and diet jelly at the level of 5% significance. However, the sample of "extra" jam differed significantly from the level of 5% significance, being the least preferred sample. Then the "extra" 53% jelly sample and was the most preferred by the ordering test.

In a study conducted Cavallini and Bolini (2005) where they compared the temporal perception of sweetness, bitterness and fruit flavor in reconstituted mango juice and sweetened with sucrose, cyclamate/saccharin mixture 2:1, aspartame, sucralose, and stevia, it was observed the rejection by sweeteners used in light products was much higher when compared to traditional (sucrose). Observed in the results of the evaluation of pepper intensity in the samples of jellies, it is concluded that the degree of pepper used in the "extra" and light sample that existed differ between them at 5% significance. The diet jelly sample did not have a significant preference at 5% significance. Therefore, the "extra" samples with 45% and light with 21.7% presented lower intensity of pepper form of greater preference for the tasters. Diet jam with 61.7% with more intensity of pepper according to evaluators, a fact that may be linked to a higher concentration of sucrose which may have masked the more specific flavor of the pepper. Araújo *et al.* (2014) when performing a similar study, noticed that a sample of pepper jelly with pineapple made with peppers with high pungency content was rejected by most tasters. Freitas, *et al.* (2008) when evaluating the sensory acceptance of a "garirola" jelly, reported that the most bitter taste also had great rejection by the tasters, the explanation for this distaste would be linked because the Cerrado product was not present frequently in the consumption of tasters in this region, or even little widespread. In a work developed by Amaral, *et al.* (2012) in the sensory analysis of pulp jelly and passion fruit peel, excellent results were obtained in the acceptability of the developed product, in this, it is highlighted that among the sensory methods available to measure the acceptance and preference of consumers about one or more products, the structured hedonic scale of nine points becomes the most reliable, besides the ease of use with the judges, for this fact, also used in this analysis. Information regarding the nutritional composition of the cashew jelly of the Cerrado with the addition of pepper is inserted in table 4. The caloric values of the cashew jelly of the Cerrado with the addition of pepper varied between 97kcal/20g, 54kcal/20g, and 32kcal/20g in the formulations "extra", light and diet, respectively. The reduction of calories for light and diet jams found about traditional can be justified by the reduction and replacement of sucrose by sweeteners in the formulations of the jams. Silva *et al.* (2012) evaluated the caloric value of mixed jellies from the bark of the yellow passion fruit (*Passiflora edulisflavicarpadegener*) and found values of 201.3kcal/100g for traditional,

Table 2 - Results of the means, standard deviations, and variance of the scores attributed by the tasters to the different formulations of cashew jelly (*Anacardiumhumile*) with the addition of pepper(*Capsicum baccatum* var. pendulum).

| Attribute | “Extra” | Light | Diet | p-Value |
|-----------------|------------------------|-------------------------|------------------------|---------|
| Color | 7,86±0,95 ^a | 7,08±1,19 ^b | 6,40±1,32 ^c | 0,000* |
| Flavor | 7,36±1,28 ^a | 7,08±1,39 ^{ab} | 6,25±1,93 ^b | 0,007* |
| Scent | 6,25±1,56 ^a | 6,00±1,77 ^a | 6,28±1,93 ^a | 0,723 |
| Texture | 7,78±1,06 ^a | 6,86±1,28 ^b | 6,75±1,44 ^b | 0,001* |
| Global printing | 7,50±1,07 ^a | 6,82±1,27 ^{ab} | 6,25±1,49 ^b | 0,000* |
| Purchase intent | 3,95±0,96 ^a | 3,60±0,82 ^a | 2,91±1,16 ^b | 0,000* |

Averages followed by equal letters, in the same line, do not differ significantly between each other at the 95% confidence level ($p \leq 0.05$). * Significant at the level of 5% by the F test.

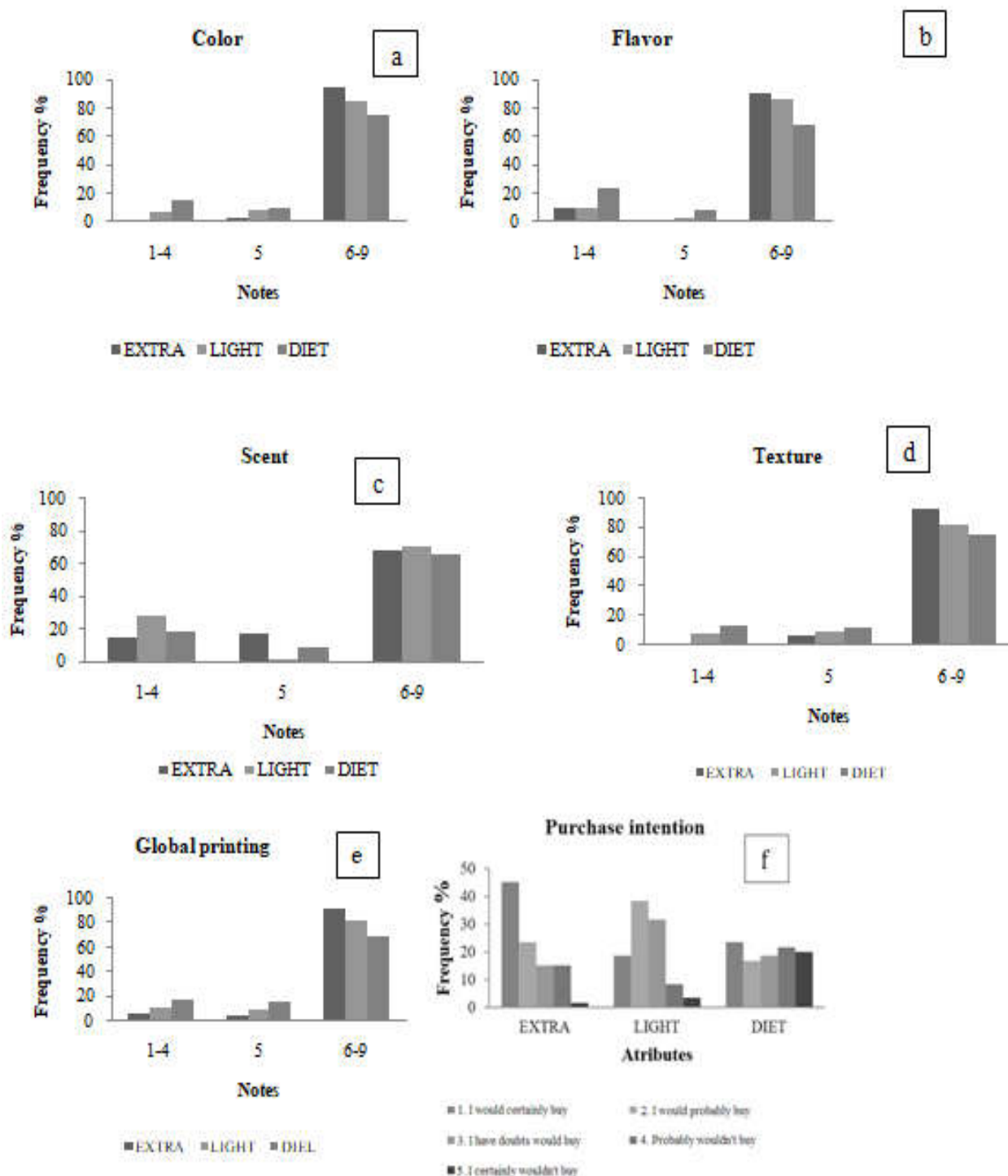


Figure 1- Histograms of the frequency of acceptance scores of the attributes evaluated for jelly Cerrado cashew with the addition of pepper

Table 3. Sums of orders for the formulations of cashew jelly from the Cerrado with the addition of pepper.

| Attributes | Jelly | | |
|---------------------|------------------|------------------|------------------|
| | “Extra” | Light | Diet |
| Preference | 103 ^a | 121 ^b | 136 ^b |
| Sweetness intensity | 86 ^b | 126 ^a | 148 ^a |
| Pepper intensity | 141 ^a | 125 ^a | 94 ^b |

Sum pairs of orders followed by the same letter do not differ from each other, by Friedman's test, at 5% of significance(p≤0,05).

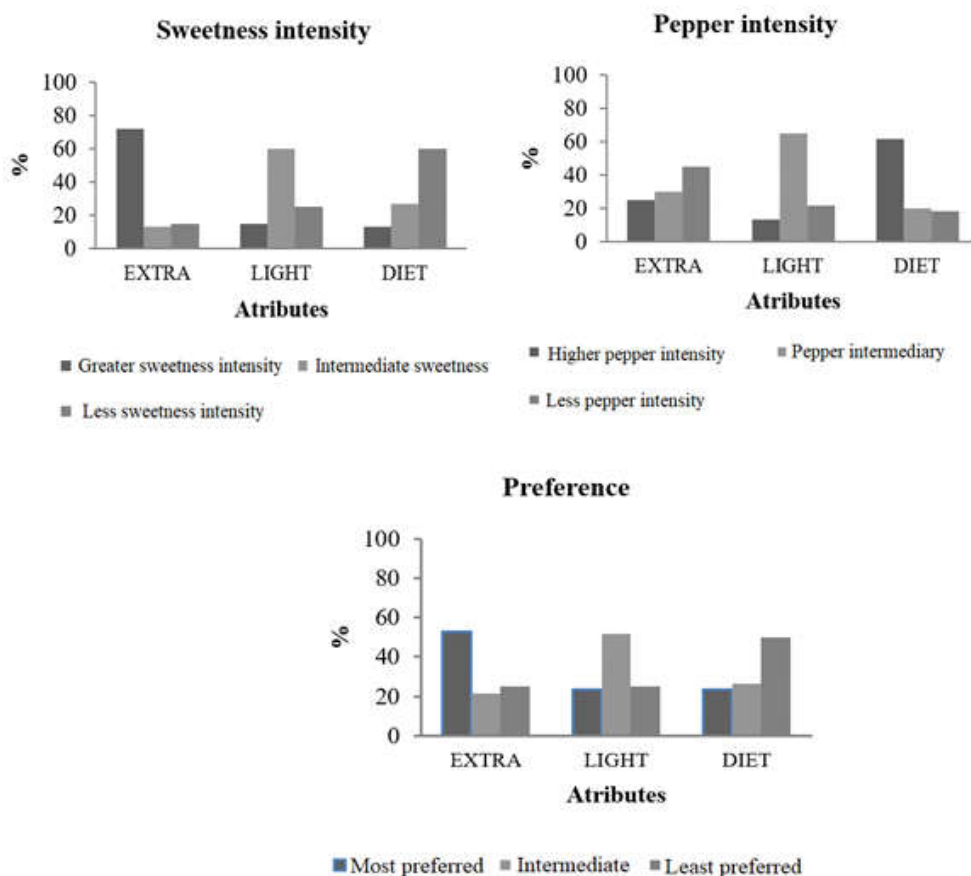


Table 4 - Nutritional composition of cashew jelly from the Cerrado with the addition of pepper.

| NUTRITIONAL INFORMATION The portion of 20 g | | | | | | |
|---------------------------------------------|---------------------|--------|---------------------|--------|---------------------|--------|
| | “Extra” | | Light | | Diet | |
| | Quantityper portion | %VD(*) | Quantityper portion | %VD(*) | Quantityper portion | %VD(*) |
| Energy Value | 97kcal=408kJ | 5 | 54kcal=227kJ | 3 | 32kcal=135kJ | 2 |
| Carbohydrates | 24g | 8 | 13g | 4 | 8g | 3 |
| Proteins | 0,1g | 0,2 | 0,1g | 0,2 | 0,3g | 0,4 |
| Total Fats | 0,03g | 0 | 0,05g | 0 | 0,1g | 0,2 |
| Fibers | 0,4g | 2 | 0,7 | 3 | 1g | 4 |
| Sodium | 19mg | 1 | 31mg | 1 | 48mg | 2 |

"It does not contain significant amounts of Trans Fats and Saturated Fat." (*)% Daily Reference Values based on a diet of 2,000 kcal or 8400 kJ. Your daily values may be higher or lower depending on your energy needs.

146.7kcal/100g for light and 113.4kcal/100g for diet formulation, with the caloric difference being associated with sugar substitution. The differently the carbohydrate values found can also be justified by the substitution of sucrose by sweeteners. According to Rocha (2010) and Pinheiro (2011), the cashew peduncle is rich in carbohydrates and, to a large extent, glucose, and fructose. The protein value of the jellies ranged from 0.1g/20g to 0.3g/20g. The low variation in the protein contents of jellies is justified by changes only in the amount of sugar and sweeteners in the formulations, which does not interfere in the protein composition. The protein values of the present study were similar to those found by Granada *et al.* (2005) when evaluating light pineapple jellies

(0.21g% to 0.28g%). Kinupp (2008) states that the protein content found in fruits and vegetables is low about animal products. Regarding lipid content, it is possible to observe in table 4 that all jellies presented low values (0.03-0.1%). Ribeiro lima (2008) confirms that the lipid content for the cashew peduncle is low because it is a vegetable source. However, Andrade(2006) justifies that these lipid contents may undergo alterations, with the reduction of the content by oxidation in the presence of oxygen, heat, light, and high-water activity present during the processing of the jellies. The jams had a fiber content of 0.4g/20g for "extra", 0.7g/20g for light, and 1g/20g for diet, although it is a cashew jelly with the addition of pepper cannot be considered a source of fiber.

Therefore, it cannot be included in the category of foods with "high fiber content" according to RDC No. 54/2012 (BRASIL, 2012). The sodium content of the jellies was low, which is considered a positive factor. Sodium is a mineral that should not be consumed in excess, as it leads to increased blood pressure, cardiovascular diseases, and other chronic diseases. The maximum sodium intake is 2g, or 2400mg per healthy people daily (SARNO, *et al.*, 2009). It is noteworthy that jellies with pepper addition contain substances with distinct antioxidant power, in addition to phenolic compounds, such as flavonoids, and anthocyanins, contain vitamins C and, carotenoids that contribute to the beneficial effects of these foods (Araújo *et al.*, 2014)

Conclusion

Based on the tests performed and sensory analysis it was possible to observe that the jelly of cashew of Cerrado with the addition of pepper has great potential for consumption since all attributes of sensory quality presented acceptability indexes higher than 70% and a purchase intention corresponding to "probably buy" and certainly would buy, moreover, the use of cashew or cashew from the Cerrado is very pertinent since there is abundant production throughout the Cerrado biome and still little explored by food industries.

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