

Iogurte de leite de cabra bicamada adicionado de geleia de tamarindo (*Tamarindus indica* L.) e maracujá-do-mato (*Passiflora cincinnata* Mast): Caracterização e aceitabilidade

Bilayer goat's milk yogurt with tamarind (*Tamarindus indica* L.) and wild passion fruit (*Passiflora cincinnata* Mast) jam: Characterization and acceptability

Yogurt de leche de cabra bicapa agregado con jalea de tamarindo (*Tamarindus indica* L.) y maracuyá salvaje (*Passiflora cincinnata* Mast): Caracterización y aceptabilidad

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Resumo

O objetivo deste estudo foi desenvolver um iogurte à base de leite de cabra com uma camada de geleia de tamarindo ou de maracujá no fundo da embalagem (iogurte bicamada), bem como realizar a caracterização físico-química, microbiológica e sensorial do produto. Para fins de comparação, os produtos lácteos de cabra foram comparados com o mesmo, de leite de vaca. As análises físico-químicas demonstraram que as amostras estão dentro dos padrões da legislação, tanto para os iogurtes quanto para as geleias. Em relação às análises microbiológicas não houve crescimento microbiano em nenhuma das amostras avaliadas. Os testes sensoriais foram realizados com 60 provadores os quais possuíam idades entre 14 a 32 anos. Foram avaliados os atributos sensoriais relacionados à “aparência”, “cor”, “aroma”, “consistência” e “sabor”, dentre eles apenas a consistência apresentou diferença significativa devido às características químicas do leite de cabra, no entanto, em valores percentuais o iogurte de leite de cabra foi avaliado com as maiores notas. Na impressão global e de intenção de compra, a análise dos dados obtidos evidenciou que os valores atribuídos pelos provadores estão situados nas maiores notas da escala hedônica. Sendo assim, para os iogurtes de leite de cabra bicamada de geleia de tamarindo ou maracujá-do-mato, os resultados são favoráveis e de alta aceitabilidade. Esses resultados denotam a possibilidade de inserção desses novos produtos no mercado regional tendo em vista a aceitação do produto pelos provadores bem como a intenção de compra, além da valorização dos frutos regionais presentes nas geleias elaboradas.

Palavras-chave: Produto lácteo; Frutos regionais; Leite fermentado; Aceitação; Teste com consumidor.

Abstract

The aim of this study was to develop a goat's milk-based yogurt with a layer of tamarind and passion fruit jelly on the bottom of the package (bilayer yogurt) as well as to carry out the physical-chemical, microbiological and sensory characterization of product. For comparison purposes, goat's milk products were compared with the same cow's milk product. The

physicochemical analyzes showed that the samples are within the standards of the legislation, both for yogurts and jams. Regarding microbiological analyzes, there was no microbial growth in any of the samples evaluated. Sensory tests were carried out with 60 tasters that were aged between 14 and 32 years. Sensory attributes related to “appearance”, “color”, “aroma”, “consistency” and “flavor” were evaluated, among them only consistency showed a significant difference due to the chemical characteristics of goat's milk, however, in percentage values goat's milk yogurt was rated with the highest grades. In the global impression and purchase intention, the analysis of the data obtained showed that the values attributed by the tasters are located in the highest scores of the hedonic scale. Thus, for bilayer goat's milk yogurts with tamarind or wild passion fruit jams, the results are favorable and highly acceptable. These results denote the possibility of insertion of these new products in the regional market in view of the acceptance of the product by the tasters as well as the intention to purchase, in addition to the appreciation of the regional fruits present in the jams elaborated.

Keywords: Dairy product; Regional fruits; Fermented milk; Acceptance; Consumer test.

Resumen

El objetivo de este estudio fue desarrollar un yogur a base de leche de cabra con una capa de jalea detamarindo o de maracuyá en el fondo del paquete (yogur bicapa), así como llevar a cabo la caracterización físico-química, microbiológica y sensorial del producto. Para fines de comparación, los productos lácteos de cabra se compararon con la misma de leche de vaca. Los análisis físico-químicos mostraron que las muestras están dentro de los estándares de la legislación, tanto para yogures como para jaleas. Con respecto a los análisis microbiológicos, no hubo crecimiento microbiano en ninguna de las muestras evaluadas. Se realizaron pruebas sensoriales con 60 catadores con edades comprendidas entre 14 y 32 años. Se evaluaron los atributos sensoriales relacionados con "apariencia", "color", "aroma", "consistencia" y "sabor", entre ellos solo la consistencia mostró una diferencia significativa debido a las características químicas de la leche de cabra, sin embargo, en valores porcentuales El yogur de leche de cabra fue calificado con las mejores calificaciones. En la impresión global y la intención de comprar, el análisis de los datos obtenidos mostró que los valores atribuidos por los catadores se ubican en los puntajes más altos de la escala hedónica. Por lo tanto, para los yogures de leche de cabra bicapados con tamarindo o maracuyá, los resultados son favorables y altamente aceptables. Estos resultados denotan la posibilidad de inserción de estos nuevos productos en el mercado regional en vista de la aceptación del producto por parte de los

evaluadores, así como la intención de compra, además de la apreciación de las frutas regionales presentes en las jaleas elaboradas

Palabras clave: Productos lácteos; Frutas regionales; Leche fermentada; Aceptación; Prueba de consumo.

1. Introduction

The United Nations Food and Agriculture Organization (FAO) reports that goat's milk is the third most produced milk in the world (FAOSTAT, 2020). Brazil stands out as the largest goat milk producer in South America with an estimated production of 8,779 million liters per year (IBGE, 2017). The Northeast Region of Brazil represents more than 90% of milk production, followed by the South and Southeast region (Costa, Queiroga & Pereira, 2009). The chemical composition of goat's milk, as well as that of other small ruminants, composed of proteins of high biological value, essential fatty acids, high mineral and vitamin bioavailability, qualifies it as a food of high nutritional value, representing great importance in the feeding of infants and the elderly, due to the characteristics of hypoallergenicity and greater digestibility (Verruck et al., 2019).

It is worth mentioning that goat's milk has been used by the food industry in the production of various dairy products (Ranadheera et al., 2019; Verruck et al., 2019). Among dairy products, one of the alternatives for consuming goat's milk is in the form of fermented drinks (Mituniewicz-Małek et al., 2019). In this context, yogurt is highlighted for its attractive sensory characteristics and acceptability. In addition, it presents one of the best profitability margins for the manufacturer of this product, since it does not require a process of concentration in processing (Araújo et al., 2012).

Consumer unfamiliarity with goat's milk has been identified as one of the main reasons for the lower acceptability of certain goat's milk products compared to equivalent products made from cow's milk (Costa et al., 2014). It is important to highlight that the goat's milk matrix is composed of short chain fatty acids, represented by caprylic, capric and capric acids, which negatively influence the acceptance of its derivatives towards unusual consumers due to its characteristic 'goaty' flavor (Costa et al., 2015; Verruck et al., 2019). In this sense, increasing exposure to goat's milk products may be a strategy to improve consumer acceptance for goat's milk products and goat's milk products. In addition, simple technological changes, such as adding fruit pulp, may be possible strategies to improve consumer acceptance of yoghurts to those produced from this milk (Lima et al., 2019).

According to Mayer & Fiechter (2012), goat's dairy products (yogurt and different varieties of cheese) can provide a profitable alternative to cow's milk products, due to their specific flavor and the natural and healthy image to consumers. Thus, goat's milk is an excellent matrix for the development of a wide variety of innovative products and functional foods (Silanikove et al., 2010; Silveira et al., 2015), such as that added with endemic fruits from Brazilian regions.

Due to the territorial extension, geographical position, soil and climatic conditions Brazil stand out as one of the largest fruit producers on the world (Pereira et al., 2012; Verruck et al., 2020). The unique properties of tropical fruits, mainly its sensorial characteristics, has shown great consumer interest in these fruits (Duarte et al., 2010). Thus, several fruit species not widely studied have been evaluated more recently, as an alternative to traditional species (Pereira et al., 2012; Verruck et al., 2020). The addition of pulp of citrus fruits endemic in the Brazilian semi-arid region, such as tamarind (*Tamarindus indica* L.) and wild passion fruit (*Passiflora cincinnata* Mast), in food products being studied with a view to the insertion of new products and the valorization of native fruits (Silva et al., 2020). In addition, consumers and their acceptance are the most important agents in this perspective. Thus, to assess the acceptance of a food, sensory analysis with untrained tasters who habitually consume the product in question is an alternative. Sensory tests are included as a guarantee of quality as they are an integrated multidimensional measure, in which the consumer will determine the parameters of interest related to the sensory quality of the food (Minim, 2018).

Therefore, the objective of this study was to develop a goat's milk-based yogurt with a layer of tamarind and passion fruit jelly on the bottom of the package (bilayer yogurt) as well as to carry out the physical-chemical, microbiological and sensory characterization of product. For comparison purposes, goat's milk products were compared with the same cow's milk product.

2. Material and Methods

2.1 Jams manufacture

Extra jams (50% fruit: 50% sugar) were made in the following flavors: passion fruit (*Passiflora cincinnata* Mast) and tamarind (*Tamarindus indica* L.). For processing, 300g of frozen pulp (Salifrutas, Brazil) were previously thawed in a domestic refrigerator ($\approx 4^\circ\text{C}$) and mixed with purified water to a total volume of 1 liter. Then, the pH was corrected to around 3.30 with sodium bicarbonate (NaHCO_3), with the objective of reaching the ideal pH for gelation.

The pulps diluted in water were subjected to heating (± 100 °C), then they were added with the sugar and pectin mixture and homogenized until complete dilution. Sugar was quantified based on the total weight of the diluted pulp and the pectin was measured based on the amount of sugar in the proportion of 1.5g of pectin for each 100g of sugar.

According to the specific legislation, the final soluble solids content of the jams must be at least 63 °Brix. The ideal point for the produced jelly was determined using the refractive index at 68 °Brix and this was verified with the use of a digital refractometer (Reichert, AR200, Buffalo, USA). After the passion fruit and tamarind jams were ready, they were cooled to ± 40 °C. Thus, 10 grams of each jam were added in polypropylene packaging, with a capacity of 30 grams with a lid.

2.2 Yogurt manufacture

Two formulations of yogurt were produced. One was produced from goat's milk and another with cow's milk to be used as control in the study. The first yogurt was prepared with 1 liter of goat's milk treated by Low Temperature Long Time (LTLT) pasteurization (65 °C for 30 minutes), 8% sucrose, 4% powdered milk and lactic culture composed of *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus* (Yoflex®, Chr.Hansen, Hønsholm, Denmark), according to manufacturer's instructions. This mixture was homogenized and 20g were placed in the packages containing the tamarind or passion fruit jam at the bottom. The mixture was incubated at 44 ± 1 °C in Biochemical Oxygen Demand oven - DBO (EL101/4, Eletrolab, Brazil), until reaching a pH of 4.6, followed by cooling and storage at 4 ± 1 °C for 24 h. The control sample with cow's milk was prepared following the same instructions, however, it was used 1 liter of UHT cow's milk and full-fat cow's milk powder (Nestlé®, Rio de Janeiro, Brazil) for this purpose. Therefore, it was obtained four yogurts samples: goat's yogurt with tamarind jam; goat's yogurt with passion fruit jam; cow's yogurt with tamarind jam; and cow's yogurt with passion fruit jam.

2.3 Physicochemical analysis

The pH was analyzed using the potentiometric method using a pH meter (mPA, Tecnoyon, Piracicaba, Brazil) (Brasil, 2005). The total soluble solids content of the jams were determined by direct reading on a refractometer (AR200, Reichert, Buffalo, USA), with a scale in Brix degrees (°Brix), according to the methodology of the Adolfo Lutz Institute

(Brasil, 2005). The determination of total titratable acidity of the samples was performed using the acidimetric method in which the samples were titrated with 0.1M NaOH solution and 0.1% phenolphthalein solution as indicators and the results were expressed in % of lactic acid for yogurts, according to the methodology described by Normative Instruction No. 68 of MAPA (Brasil, 2006).

2.4 Microbiological analysis

Microbiological analyzes were performed according to the methodology described by APHA (2015), and the total count of coliforms at 30 °C and 45 °C, and molds and yeasts was determined as required by RDC 12/2001, which establishes microbiological standards for food (Brasil, 2015). The results were expressed in Colony Forming Unit per gram (CFU/g) for mold and yeast product and Most Probable Number (MPN) per mL of product for coliforms.

2.5 Sensory analysis

The sensory analysis was approved by the Ethics Committee with the number 51211015.0000.5588. Hedonic tests were carried out to evaluate the acceptance of bilayer goat's or cow's milk yogurt samples flavored with regional fruits of tamarind and passion fruit according to Dutcosky (2013). For the test, the samples were coded with random numbers of three digits, using the experimental model of complete randomized blocks. The tests were applied in individual booths, using white light and the samples served monadically in disposable 30 mL pots with a lid, at a temperature of 15 ± 1 °C during approximately 15 minutes for each person. Samples of yogurt based on each type of milk (goat and cow) in the two types of flavors (tamarind and passion fruit) were served separately in two blocks. The consumers were not informed about samples composition, i.e. samples made with goat's or cow's milk yogurt. Tasters familiar with the testing procedures and consumers of yogurt were used.

Sixty judges participated in the test and the data analysis followed the standards required by ABNT NBR ISO 11136 (2016), for sensory evaluation of food and beverages using a hedonic scale. To assess acceptability, cards with a hedonic scale of nine points were used, ranging from "I disliked extremely" (score 1) to "I liked it extremely" (score 9), for the tasters to express the acceptance of the samples in relation to the color, aroma, flavor, global impression attributes and buying attitude (Minim, 2018).

2.6 Statistical analysis

The results were evaluated by analysis of variance (ANOVA) and the means compared by the Tukey test at $p \leq 0.05$ using the Excel software version 2010.

3. Results and Discussion

To obtain a jam with an optimum point for gelation, pH values and total soluble solids content present in the product are decisive. These physical-chemical parameters of the maracujá-do-mato and tamarind jams were evaluated and are listed in Table 1.

Table 1. Physicochemical characteristics of tamarind and wild passion fruit jams.

Sample	pH	Total Soluble Solids (°Brix)
Tamarind jam	3.2	68
Wild passion fruit jam	3.4	68
Law standards*	2.7 a 3.7	64 – 71

*ANVISA (1978).

It was found that the physical-chemical parameters of the jams are within the values established by law. The optimum gelation point of the formed gel structure is determined when it does not have a soft consistency (> 63 °Brix) and there is no crystal formation (< 71.5 °Brix) (Torrezan, 1998). Regarding the pH, in order to reach an optimum value for the degree of gelation, it was necessary to correct it, before the manufacture of the jam. The passion fruit pulp had a pH corrected from 2.89 to 3.42 and that of tamarind from 2.48 to 3.25. Oliveira (2014) used this process to prepare umbu-cajá jams, thus obtaining pH values of 3.2 similar to those presented in this study. The total soluble solids results are in line with the results of the study conducted by Maia et al. (2014) that performing the elaboration and sensory analysis of tamarind jam and also obtained 68 °Brix. Mota (2006) when working with blackberry jam obtained a final concentration of total soluble solids of 67 °Brix and pH of 3.26 to 3.41, as well as Ferreira et al. (2012) also obtained a concentration of soluble solids of 67 °Brix for mixed watermelon and tamarind jam. These results are similar to those presented in this work with values of 3.2 and 3.4 and total soluble solids content of 68 °Brix.

Brazilian legislation does not establish specific parameters for yogurt made with goat's milk, therefore, the standards established by Normative Instruction No. 46 of October 23, 2007 of MAPA dealing with cow's milk were considered for comparison purposes (Brasil, 2007). The results of the physicochemical analyzes of pH and titratable acidity of goat's milk and cow's milk yoghurts were obtained from the average values of three repetitions and are shown in Table 2.

Table 2. Physicochemical characteristics of goat's and cow's milk yogurts.

Sample	pH	Titratable acidity (% lactic acid)
Goat's milk yogurts	4.62	0.8
Cow's milk yogurts	4.69	0.7
Law standards*	4.5 – 4.7	0.6 – 2.0

*Brasil (2007).

It was found that the values of pH and titratable acidity of the yogurt samples are within those established in the legislation the product. Araújo et al. (2012) working with yogurt made from cow's and goat's milk, found values of 4.85 for yogurt made from cow's milk and 4.99 for the same goat product. On the other hand, Marinho et al. (2012) made goat's milk yogurt with umbu pulp and obtained a product with a pH of 3.87 to 4.05, as well as Silva (2013), that working with goat's milk yogurt and semi-arid fruits, found values from 2.93 to 3.20 for the same product, results that are inferior to those presented in the present work

For the titratable acidity parameter, also observed in Table 2, the value obtained for goat's milk yogurt was higher than the value for cow's milk yogurt, with 0.8 and 0.7 (% of lactic acid), respectively. These values were lower than those of Araújo et al., (2012), which had an acidity of 0.9 to 1.0. However, Queiroga et al., (2011) and Silva (2013) obtained similar values for goat's milk yogurt with values close to 0.75 and 0.7 to 0.9, respectively. Possibly, these results differed from the present study due to the fact that most authors incorporate the fruit pulp to the yogurt (stirred yogurt), unlike the bilayer yogurt elaborated in this work (separate layers), in which the fruit jam, responsible for the flavor, was added to the bottom of the container in which the sample was served and analyzed separately.

The microbiological results of bilayer goat's or cow's milk yogurts with tamarind or wild passion fruit jams, for analysis of coliforms at 30 °C and 45 °C, did not show turbidity or

gas formation in any of the evaluated samples (<3 MPN/mL), which indicates the absence of these microorganisms. Colony growth was also not observed for the analysis of molds and yeasts (<10 CFU/g). Regarding coliforms at 30 °C and 45 °C, their presence is indicative of unsatisfactory sanitary practices in the production process (APHA, 2015). Likewise, the determination of molds and yeasts is related to the shelf life of the product, and a high count of them affects the quality of the product, considering that yogurt with sugar or added fruits are especially susceptible to the growth of fungi, as Moreira et al., (1999) points out.

These results are supported by Araújo et al. (2012) that prepared goat's and cow's milk yogurt in which the microbiological evaluation also did not show any growth for any of the analyzes. The same also occurred in the study of Queiroga et al. (2011) that developed goat's milk yogurt with tropical fruit jam and did not indicate the presence of any of the microorganisms analyzed. According to MAPA Resolution No. 46 of October 23, 2007 (Brasil, 2007), which regulates the Fermented Milk Identity and Quality standards, the product evaluated is in accordance with the current parameters, showing that the production process was carried out responsibly in accordance with Good Manufacturing Practices - GMP.

The judges who participated in the sensory analysis showed the following profile: 67% male and 33% female, 14 to 32 years old that consume yogurt frequently. The sensory attributes "appearance", "color", "aroma", "consistency" and "flavor" of the bilayer goat's or cow's milk yogurts with tamarind or wild passion fruit jams samples were evaluated and the results are shown in Table 3 and Figure 1.

Table 3. Mean values (\pm standard deviation) assigned to the sensory attributes of bilayer goat's or cow's milk yogurts with tamarind or wild passion fruit jams.

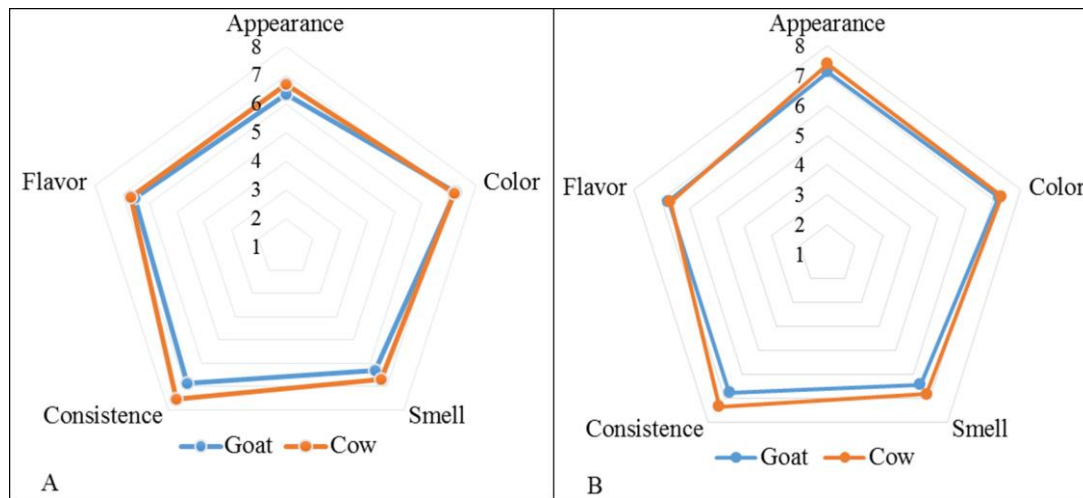
Attributes	Tamarind jam addition			Wild passion fruit jam addition		
	Goat's milk yogurt	Cow's milk yogurt	MSD*	Goat's milk yogurt	Cow's milk yogurt	MSD*
Appearance	7.03 \pm 2.05 ^a	7.28 \pm 1.73 ^a	0.54	7.13 \pm 1.93 ^a	7.40 \pm 1.58 ^a	0.56
Color	7.22 \pm 1.88 ^a	7.17 \pm 1.64 ^a	0.50	7.20 \pm 1.88 ^a	7.30 \pm 1.69 ^a	0.64
Aroma	6.33 \pm 2.11 ^a	6.68 \pm 1.89 ^a	0.60	6.43 \pm 1.91 ^a	6.82 \pm 1.84 ^a	0.48
Consistency	6.85 \pm 2.04 ^b	7.53 \pm 1.75 ^a	0.61	6.75 \pm 1.92 ^b	7.33 \pm 1.87 ^a	0.58
Flavor	6.55 \pm 2.60 ^a	6.70 \pm 2.11 ^a	0.61	6.75 \pm 2.06 ^a	7.40 \pm 2.41 ^a	0.61

^{a-b} Lowercase letters superscript in the same line indicate statistical difference at 5% significance level between the samples for each jam flavor. *MSD: Minimal Significant Difference.

Source: Research data.

In none of the samples of bilayer goat's and cow's milk yogurts with tamarind or wild passion fruit jams there was observed a significant difference for the evaluated attributes, except for consistency. In addition, the average values of the scores assigned to the attributes were situated from “I liked it slightly” and “I liked it regularly”. Regarding the characteristic of flavor and aroma, no difference was observed between goat's and cow's milk yogurt in the present study. However, Silva (2013) when evaluating goat's milk yogurt with umbu cajá pulp, reported that the tasters identified the very strong aroma and flavor of goat's milk, as well as Galdino et al., (2010) also observed rejection of the goat's milk in yogurt samples with forage palm pulp, which was not observed in the present study. This result is favorable in relation to the product developed in our study because it states that, unlike other studies, bilayer yogurt made with goat's milk did not show any perceptive difference in flavor and aroma when compared to that developed with cow's milk. This behavior could be explained by Vedran et al. (2010) that reported that during fermentation of goat's milk its characteristic ‘goaty’ taste becomes less noticeable.

Figure 1. Graphic representation of the sensory attributes of bilayer goat's or cow's milk yogurts with tamarind (A) or wild passion fruit (B) jams.



Source: Research data.

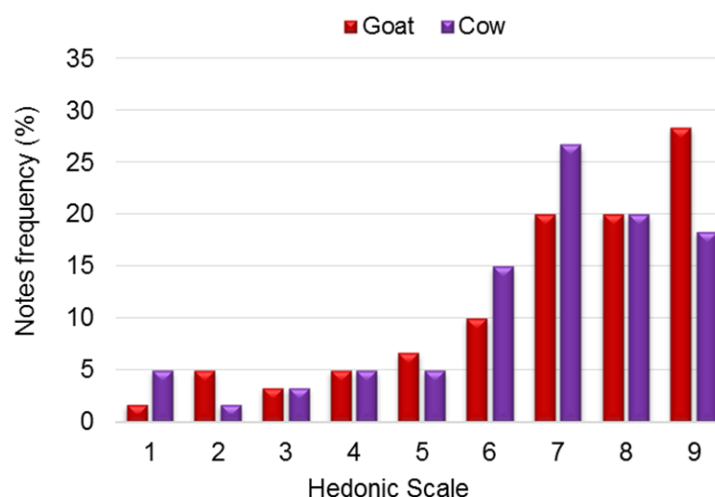
For the consistency attribute, even though the averages obtained correspond to the highest scores on the hedonic scale (7- I liked it regularly and 9- I liked it very much), the highest absolute values were attributed to the consistency of cow's milk yogurt, showing preference of tasters with regarding this attribute. A yogurt with less gel network firmness was also the result of Silva (2013) work on the production of goat's milk ice cream and yogurt with fruits from the semi-arid region. The yogurt samples did not show firm consistency, obtaining average values corresponding to "neither liked nor disliked", evidencing the indifference of the tasters in relation to this attribute, which can be justified by the chemical characteristics of goat's milk with regard to the product's protein fractions. The processing conditions, textural characteristics, and sensorial attributes of goats' milk products are affected by the differences between cow's and goat's milk individual caseins (Amigo & Fontecha, 2011). These differences concerns mainly to α_{s1} -casein and are related to genetic polymorphisms and their frequencies in goat populations (Raynal-Ljutovac, Lagriffoul, Paccard, Guillet, & Chilliard, 2008). The casein micelles in goat's milk are also smaller when compared to cow's milk and consequently more friable (Miocinovic et al., 2016; Clark & García, 2017). Therefore, the proportion of small-sized casein micelles is higher in goat's milk than that of cow's milk, which could be related to the lower consistency index of goat's milk and its dairy products (Verruck et al., 2019). However, despite this already known characteristic, researchers are continually seeking to further improve texture and viscosity parameters of goat's milk products, such as added heat-denatured whey protein to the milk,

which aggregates to caseins through S-S bridges causing greater water holding capacity in the product and consequently greater consistency/viscosity (Verruck et al., 2019).

As mentioned by Bezerra (2010), this difference in consistency can be predicted since this product has low viscosity and a fragile structural network, the formation of fragile clots, characteristic of goat's milk products, constitutes barriers to the production of this type of derivative. For this author, the nature of the milk used becomes a decisive factor for flavor and aroma attributes, among others, and can be valued with the addition of elements that favor sensory characteristics, such as fruits, special preparations, dairy solids and not dairy solids.

For global impression test, the data obtained showed that the values attributed by the tasters are situated on the hedonic scale between "I liked it regularly" and "I liked it very much". For goat milk bilayer yogurt the averages were 6.77 for tamarind and 6.97 for wild passion fruit and for yogurt made with cow's milk 6.65 for tamarind and 6.90 for wild passion fruit. These values did not indicate a significant difference at $p \leq 0.05$ by the Tukey test. Figure 2 presents the frequency data of the notes for global impression of samples of bilayer yogurt from goat and cow's milk with tamarind jam (*Tamarindus indica* L.).

Figure 2. Frequency of global impression notes for goat's and cow's milk bilayer yogurt with tamarind flavor (1-I disliked very much; 2-I disliked much; 3-I disliked regularly; 4-I disliked slightly; 5-I neither liked nor disliked; 6-I liked slightly; 7-I liked it regularly; 8-I liked much and 9-I liked very much).

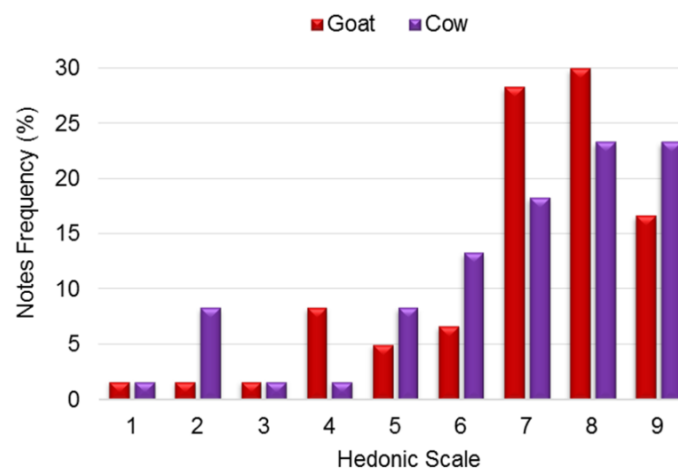


Source: Research data.

As a percentage of the grades related to the global impression of tamarind flavored yogurt, both for goat's and cow's yogurt, 68.3% of the tasters chose goat's milk yogurt and

65% for cow's milk yogurt. In addition, 28.3% of the tasters attributed the maximum value of the scale for yogurt with goat's milk against 18% for yogurt with cow's milk, which shows that the goat's milk yogurt flavored with tamarind presented the highest scores of the tasters and their consequent acceptance. This corroborates with the study of Queiroga et al. (2011) that in research involving the production of natural yogurt and tropical fruits from goat's milk, concluded that this product represents a viable alternative for the increase of the goat dairy sector, being able to contribute to the strengthening of this segment in the dairy industry. In view of the acceptability of goat's bilayer yogurt with regional fruit jam, there is another option for goat's milk derivatives to add value to this raw material yet, which already has proven market growth. An example in addition to milk production are goat's milk cheeses, which already have high added value (Bomfim et al., 2013). The evaluation of the overall impression of goat's and cow's milk bilayer yogurts flavored with wild passion fruit jam is shown in Figure 3.

Figure 3. Frequency of global impression notes for goat's and cow's milk bilayer yogurt with wild passion fruit flavor (1-I disliked very much; 2-I disliked much; 3-I disliked regularly; 4-I disliked slightly; 5-I neither liked nor disliked; 6-I liked slightly; 7-I liked it regularly; 8-I liked much and 9-I liked very much).



Source: Research data.

It can be seen that goat's and cow's milk bilayer yogurts with wild passion fruit jam were accepted with values assigned between "I liked it regularly" and "I liked it a lot", i.e. 75% for goat's milk yogurt and 65% for cow's milk yogurt. Also, it was observed that of this total, 30% rated goat's milk yogurt as "I liked it a lot", against 23.3% for cow's milk yogurt.

It is important to note that the flavor of fruit jam caused a difference in acceptance, in percentage values, for goat's milk yogurt, with the flavor of wild passion fruit being best evaluated, which was not observed for the same product when produced with cow's milk. For goat's milk-based yogurt, it was observed that the sensory characteristics of the new product pleased the consumer group studied. Queiroga et al., (2011) also evaluated goat's milk yogurt with tropical fruit jams in the flavors of pineapple, passion fruit, cajá and umbu, and also obtained average values between "I liked it regularly" and "I liked it very much", which proves the widespread acceptance of yogurt made with goat's milk by consumers.

In relation to goat's milk yogurt, the global impression showed the highest values for yogurt with wild passion fruit jam, in which 75% of the tasters rated it "I liked it regularly" and "I liked it very much" against 68% for the tamarind jam flavor. Which shows the preference for goat's milk yogurt with passion fruit jam. This result is in line with that obtained by Araújo et al., (2012) that also evaluated the acceptance of goat's milk yogurt flavored with passion fruit in which 40% of the evaluations were among the highest scores (8 and 9), also showing the acceptance of goat's milk-based yogurt.

Regarding the purchase attitude of the products developed in this study, it was possible to identify that, for both yogurt made with goat's and cow's milk, the highest frequency of grades was among the highest scores on the hedonic scale corresponding to "probably would buy" and "would certainly buy" for both evaluated flavors. However, in percentage values, 35% of the tasters stated that they "would certainly buy" goat's milk yogurt with tamarind jam, against 18.3% of cow's milk yogurt of the same flavor. The same happened with samples flavored with wild passion fruit jam, in which 60% said they "probably would buy" and "they would certainly buy" goat's milk yogurt and of that total, 33.3% said they would probably buy the product while 28.3% "would certainly buy" cow's milk yogurt with the same flavor.

In assessing the purchase intention of goat's bilayer yogurt samples with tropical fruits, Queiroga et al., (2011) found that the values attributed in hedonic terms were between "maybe bought / maybe not bought" and "possibly would buy", values quite different from those obtained in this work, where the tasters stated that they would certainly buy goat's milk bilayer yogurt. Still on the bilayer yogurt of goat's milk, with respect to the two flavors studied in the present work, 60% of the notes indicated that the tasters "would probably buy" and "certainly buy the product" made with wild passion fruit jam. On the other hand, cow's milk yogurt showed no difference between the evaluated flavors. This acceptance of goat's milk yogurt is probably related to the lack of information about the use of goat's milk in the production of yogurt samples for the judges and as stated by Ribeiro (1997), this avoids

prejudice against goat's milk products and therefore, it showed great acceptance for the product.

4. Final considerations

Regarding physicochemical and microbiological analyzes, all are in accordance with the recommendations of Brazilian legislation. For goat's milk bilayer yogurt, the main object of the study, the results are favorable, as it envisages the possibility of insertion of this new product in the regional market, with a view to its acceptance by the tasters and their purchase intention verified in sensory analysis. Thus, goat's milk bilayer yogurt is able to be produced and marketed, thus diversifying the dairy product of goat origin.

As a suggestion for future studies, it is indicated to check which factors, in addition to casein, could interfere in the consistency of goat's milk yogurt and in the greater firmness of the gel network.

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