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PREPARATION, PHYSICAL-CHEMICAL CHARACTERIZATION AND SENSORY ANALYSIS OF A CREME FEITO WITH JAMBO FLOWERS (Syzygium malaccense L.)

ELABORAÇÃO, CARACTERIZAÇÃO FÍSICO-QUÍMICA E ANÁLISE SENSORIAL DE UM CREME FEITO COM FLORES DE JAMBO (Syzygium malaccense L.)

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ABSTRACT

Amazonia, located mainly in the North of Brazil, is a region with a wide and rich biodiversity, mainly in flora, presenting numerous fruit species, both exotic and native to the Amazon forest. Jambo (Syzygium malaccense) is an exotic species present in the Amazon, where its fruits are widely consumed by local populations. Still, its flowers, intended for human consumption, do not usually be used for food. This study sought to prepare a jambo flower cream, and characterize the physical-chemical point of view of such a product, in addition to carrying out a sensory analysis with untrained testers. The physical-chemical results suggest that the product is of good quality, not very acidic (pH = 6.61). On the other hand, a sensory analysis carried out revealed some jambo flower cream oil.

Keywords: Amazonia. Tropical Fruits. Plants Eat not Conventional. Physical-Chemical Quality.

RESUMO

A Amzônia, cituada principalmnete no Norde do Brasil, é uma região detentora de uma biodiversidade ampla e rica, principalmente em tremos de flora, apresentando inúmeras

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espécies frutíferas, tanto exótica como nativa da floresta amazônica. O jambo (Syzygium malaccense) é uma espécie exótica presente na Amazônia, onde seus frutos são amplamente consumidos pelas populações locais. Todavia, suas flores, embora próprias para consumo humano, não costuma ser aproveitadas para alimentação. O presente estudo buscou elaborar um creme de flores de jambo, e caracterizar do ponto de vista físico-químico tal produto, além de realizar uma análise sensorial com provadores não treinados. Os resultados fíisco-químicos sugerem ser o produto de boa qualidade, não sendo muito ácido (pH = 6,61). Por outro lado, análise sensorial efetuada revelou uma boa aceitação do creme de flores de jambo.

Palavras-chave: Amazônia. Frutas Tropicais. Plantas Comestíveis não Convencionais. Qualidade Físico-Química.

RESUMEN
A Amzônia, cituada principalmnete no Norde do Brasil, é uma região detentora de uma biodiversidade ampla e rica, principalmente em tremos de flora, presentando innumerables especies frutíferas, tanto exóticas como nativas de la floresta amazónica. El jambo (Syzygium malaccense) es una especie exótica presente en la Amazonia, donde sus frutos se consumen ampliamente en las poblaciones locales. Todavia, sus flores, embora próprias para consumo humano, não costuma ser aproveitadas para alimentação. El presente estudio buscou elaborar um crema de flores de jambo, y caracterizar do ponto de vista físico-químico tal produto, além de realizar uma análise sensorial com provadores não treinados. Los resultados físico-químicos sugerem ser o producto de buena calidad, não sendo muito ácido (pH = 6,61). Por otro lado, analise sensorial efetuada revelou uma boa aceitação do creme de flores de jambo.

Palabras clave: Amazonia. Frutas Tropicales. Plantas Comestíveis não Convencionais. Calidad Físico-Química.

1 INTRODUCTION

The jambeiro (Syzygium malaccense) is part of the Myrtaceae family, originating in Asia, mainly India. However, this fruit tree is present in much of Brazil, highlighting the North and Northeast regions with the highest occurrence. Its fruit stands out for its red color, resulting from the presence of anthocyanins. The fruit is also considered an unconventional food plant (PANC) (De Lima Pantoja Neto et al., 2024).

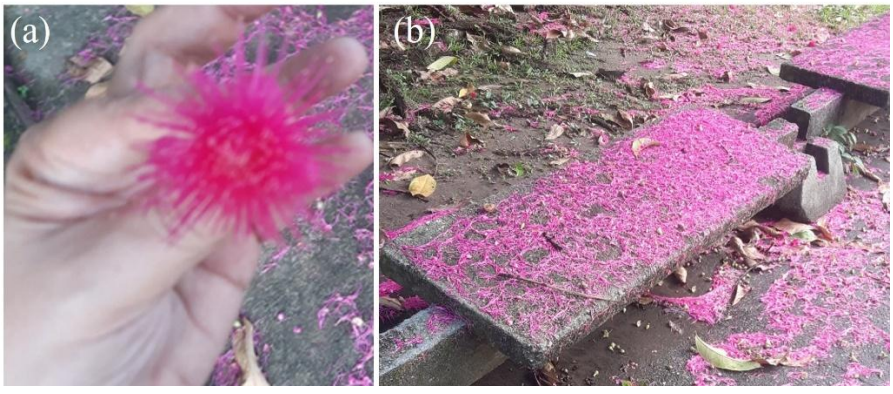
PANCs are plants they are useful not only as another food alternative, but also are species that carry with them a great ecological and economic importance, since they contribute to the maintenance of environmental balance and can also be used as a form of extra income, when commercialized (Corrêa et al., 2022).

Barreira (2015) states that there is a tendency to study PANCs, and the use of such plants is increasing, and they are used as an alternative to diversify the human menu.

The flowers of the red jambo have an exuberant appearance, sweet aroma, pinkish color, and have several stamens (Figure 1 (a)), forming a reddish colored carpet on the ground during the flowering period of the tree (Figure 1 (b)) (De Souza et al., 2022).

Figure 1

(a) Specimen of red jambo flower; (b) "Carpet" formed by flowers fallen from a jambeiro tree on a bench



Source. The authors (2024).

Jambo flowers feature four small petals, with an intense red color, and the large number of red stamens, approximately 3.5 cm long, is something very prominent in these flowers, which are born in the defoliated parts of the branches (caulifloria), and

can be observed only inside the crown.

Mota (2023) highlights that the "Pink color and peculiar aroma are the striking characteristics of the jambu flower, its flowers have the ability to convey the feeling of comfort, benefiting urban landscaping". And, in addition, this author also points out that jambo flowers are "easily found in backyards, flowerbeds and squares, the flowers that fall from the jambeiro tree have numerous benefits".

Mota (2023) also points out that "jambo flowers are the only ones that can be frozen for food purposes. The fillets of the stamens that are the male organs of the flower allow the formation of the 'pink carpets' that we find lying on the ground."

Guinea et al. (2022) highlight that flowers, In general, they have been used in gastronomy around the world for centuries as food, and species considered non-toxic, innocuous and have nutritional properties are used, as well as bioactive compounds that have anticancer, antimicrobial, antidiabetic, antioxidant and protection against cardiovascular diseases.

Augusta et al. (2013) studied the presence of total anthocyanins in red jambo flowers from Seropédica, in the State of Rio de Janeiro, finding an average content of 30.56 mg/100 g-1, leading the authors to conclude that "the jambo flower can be used as a possible raw material in the development of new products".

The objective of the present study was to develop a cream with red jambo flowers (Syzygium malaccense) and perform its basic physicochemical characterization, as well as a sensory analysis conducted with untrained tasters.

2 METHODOLOGY

2.1 NATURE OF THE RESEARCH

The present study is of the experimental type, of qualitative and quantitative character, as it intends to develop a product (flower cream with red jambo), analyzing the physicochemical characteristics of the product, and sensorially analyzing its organoleptic qualities (smell, flavor, texture and color) through specific forms for data collection with untrained evaluators (Pereira et al., 2018).

2.2 COLLECTION OF RED JAMBO FLOWERS (SYZYGIUM MALACCENSE L.)

Red jambo flowers (Syzygium malaccense L.) were collected manually from 15 trees present on the Belém campus of the Federal University of Pará (UFPA), with

geographical coordinates equal to -1.4734459 and -48.4544914. After collection, the flowers were washed to remove dust and other soils from the environment, and this stage and the subsequent ones of this work were carried out at the Laboratory of Physics Applied to Pharmacy (LAFFA). The cleaned flowers were kept in the refrigerator until they were used.

2.3 PREPARATION OF RED FLOWER CREAM (SYZYGIUM MALACCENSE L.)

The cream of red jambo flowers (Syzygium malaccense L.) was developed and produced at the Laboratory of Physics Applied to Pharmacy (LAFFA), at the Federal University of Pará. In its making, the following were used: 200 g of fresh red jambo flowers (Syzygium malaccense L.); 200 g of condesado milk; 200 g of heavy cream; and 100 g of pure bee honey (Apis mellífera L.).

The 200 g of red jambo flower (Syzygium malaccense L.) was weighed on a semi-analytical scale (Figure 2) and then boiled in 100 mL of mineral water, for approximately 15 mimuths, to soften the flowers (Figure 3).

Figure 2

Weighing the flowers

Source: Authors, 2024.

Figure 3

Flower Cooking Process

Source: Authors, 2024.

In a simple household blender, the 200 g of condesado milk, the 200 g of cream and the 100 g of pure honey were placed, and the jambo flowers were added (Syzygium malaccense L.) after boiling and drying (Figure 4). The blender was turned on at maximum speed and the mixture was processed for 10 minutes. After the blender time, the product obtained was taken to a glass dish previously cleaned and sanitized, going to the refrigerator until the time of its physical-chemical and sensory analyses.

Figure 4

Addition of flowers to the other ingredients already put in a blender

Source: Authors, 2024.

2.4 PHYSICOCHEMICAL ANALYSIS OF THE CREAM

Physicochemical analyses were carried out on samples of red jambo cream prepared following methods already described in the literature (AOAC, 1990; Cecchi, 2003; Adolfo Lutz, 2008).

The measurement of pH and electrical conductivity (EC) was performed after weighing 2 g of cream and dilution with 30 mL of distilled water, and after complete homogenization of the solution, a pH electrode and a conductivity electrode were inserted, both devices previously calibrated, in the prepared solution, and the readings were performed directly on the displays of the respective devices.

The total soluble solids (TSS) content was obtained by transferring 3 to 4 drops of the cream to the top of the prism of a portable refractometer with an internal scale for TSS, measured in or Brix.

Acidity was performed by the titrametric method, using a 0.01 mol/L NaOH solution and 1 % phenolatein alcohol solution. The volume (V) spent in titration until the appearance of a slightly pink color was recorded and taken to equation (1), where m is the cream mass used in titration, C is the base concentration, f is the base correction factor and V is the volume spent in the process.

$$Acidez\ (\%) = \frac{V.C.f.100}{m} \quad (1)$$

By definition, the Ratio is the division between the TSS content and the acidity of the sample.

The moisture content was determined by the gravimetric method that consisted of weighing about 2 g of cream (mi) in a previously tarted crucible (mc), which was conducted to the oven at 105º C until constant weight (mf) and the moisture was determined through equation (2).

$$Umidade\ (\%) = 100 - \left(\frac{m_f - m_c}{m_i}\right).100 \quad (2)$$

2.5 SENSORY ANALYSES OF THE CREAM

The development of the sensory analysis of red jambo flower cream (Syzygium malaccense L.) was carried out following the methodology proposed by Minim (2018)

and Dutcosky (2019), which allows the determination of purchase intention and tests the acceptance of the product with untrained fitting rooms. Therefore, about 10 g of red jambo flower cream (Syzygium malaccense L.) were provided to 90 untrained tasters who, after signing an informed consent form, observed the color, texture and smell/aroma of the product and tasted it, and then answered a sensory analysis form (Figure 5).

Figure 5

Sensory analysis sheet

UNIVERSIDADE FEDERAL DO PARÁ – INSTITUTO DE CIÊNCIAS DA SAÚDE – FACULDADE DE FARMÁCIA
PESQUISA DE ACEITAÇÃO DE CREME DE JAMBO

ENTREVISTADO: _____ DATA: _____ IDADE: _____ SEXO: ( ) M ( ) F

Você está sendo convidado a participar de uma pesquisa de aceitação de um produto (***CREME DE JAMBO***), caso você aceite participar desta pesquisa, saiba que seu nome não será divulgado, apenas sua opinião fará parte de um banco de dados que será utilizado para fins de elaboração de trabalho acadêmico. Você não terá nenhuma despesa com essa pesquisa, e nem receberá nenhum provento financeiro por participar dela.

1- Por favor, avalie a amostra servida e indique o quanto você gostou ou desgostou de cada um dos atributos sensoriais do produto (sabor, aroma, textura e cor) dando notas de acordo com a escala abaixo.

(1) Desgostei muito (2) Desgostei moderadamente (3) Desgostei ligeiramente
(4) Nem desgostei, nem gostei (5) Gostei ligeiramente (6) Gostei moderadamente
(7) Gostei muito

a) Cor Nota: _____ b) Aroma Nota: _____ c) Textura Nota: _____ d) Sabor Nota: _____

2- Por favor, após degustar a amostra servida, marque a alternativa que melhor corresponde ao seu julgamento (atitude).
( ) Comeria isso sempre que tivesse oportunidade. ( ) Comeria isso frequentemente.
( ) Comeria de vez em quando. ( ) Comeria isso se tivesse acessível, mas não me esforçaria para isso.
( ) Não gostei disso, mas comeria ocasionalmente. ( ) Só comeria isso se não pudesse escolher outro alimento.
( ) Só comeria isso se fosse forçado(a).

Source: Authors, 2024.

The percentages of acceptance, indifference and rejection were obtained and the Acceptability Index (AI) of the red jambo flower cream (Syzygium malaccense L.), expressed in %, was determined through equation (3), and that B is the average of the scores found for the 4 sensory attributes (color, smell, texture and flavor) of the cream, and C is the highest score attributable to the product, which, as a 7-point hedonic scale was used (Figure 5), becomes C = 7 (De Lima Pantoja Neto et al., 2024; De Oliveira Paixão et al., 2024).

$$IA(\%) = \frac{B}{C}.100 \quad (3)$$

2.6 STATISTICAL ANALYSES

The data obtained from the physicochemical analyses of the cream and its

sensory analysis were tabulated in Excel 2010 spreadsheets, where they underwent basic descriptive statistical treatments (calculations of means, standard deviations, construction of graphs), in addition to the chi-square tests being applied to evaluate the difference or not between male and female tasters.

3 RESULTS AND DISCUSSIONS

3.1 PHYSICOCHEMICAL ANALYSIS

The results found for the physicochemical variables of red jambo cream samples (Syzygium malaccense L.) are summarized in Table 1.

Table 1

Results of the physicochemical analyses for the cream of red jambo flowers (Syzygium malaccense L.)

Statistics	ph	EC (mS/cm)	OSH (the Brix)	Acidity (%)	Ratio	Moisture (%)
Average	6,61	0,89	28,71	0,71	41,51	73,51
DP	0,03	0,11	0,23	0,12	7,23	1,45
CV (%)	0,49	12,14	0,81	17,06	17,41	1,98
Maximum	6,65	1,04	29,00	0,92	54,78	75,18
Minimum	6,56	0,82	28,30	0,52	30,97	72,65

Source: Authors, 2024.

The average pH found for the red jambo flower cream was 6.61, characterizing the product as low acidity. The product made is less acidic than the sweet in syrup (jam) made by De Lima Pantoja Neto et al. (2024) with red jambo pulps, which obtained an average pH of 4.85.

The mean EC was 0.89 mS/cm, with a very wide variation in results, indicated by the Pearson Variation Rate (CV) of 12.14 %. This variable is little explored in food analyses, as it indirectly indicates the amount of ions present in the materials. Comparing the EC of the red jambo flower cream produced in the present study with the EC of the red jambo pulp obtained by De Lima Pantoja Neto et al. (2024), which obtained an average value of 0.41 mS/cm, it is noticed that the cream of jambo flowers presents, on average, more dissolved ions in the product.

The average TSS content was 28.71º Brix, which is much lower than the average value of 63.70º Brix obtained for jambo vermelho jam (De Lima Pantoja Neto et al., 2024) and the value between 83.38º Brix and 87.49º Brix found for fig jam in syrup (Dos Santos et al., 2018).

The average titratable acidity was 0.71 %, with a very high variability, represented by a CV of 17.06 %. This average acidity value is lower than the average of 2.62 % obtained for jambo pulp jam made by De Lima Pantoja Neto et al. (2024). The value found confirms the low acidity indicated by the pH of the product.

The average ratio was 41.51, with a wide variation of values expressed in the CV value of 17.06, which follows the variation in acidity, an expected fact since the ratio is the result of dividing TSS by acidity. It should also be noted that this Ratio value is higher than the value of 23.12 found for the red jambo pulp jam made by De Lima Pantoja Neto et al. (2024), therefore, jambo flower cream has a sweetness 1.97 times the sweetness of red jambo pulp jam.

The average moisture content of the product was 73.51 %, a result much higher than the average moisture content of 30.50 % found for the jambo pulp jam (De Lima Pantoja Neto et al., 2024). Moisture is a critical factor in food quality and safety, as it affects the texture, taste, appearance, and shelf life of the product. Therefore, moisture analysis is one of the most important measures in food analysis, as it helps to ensure the balance between the quantity of water and the quality of the product.

3.2 SENSORY ANALYSIS

The age and gender profile of the untrained tasters participating in this study are shown in Tables 2 and 3.

Table 2

Age profile of the poorvadores

Age group	Frequency
[18; 20[	24
[20; 22[	30
[22; 24[	14
[24; 30[	13
[30; 40[	3
[40; 65]	4
Total	**88**

* 2 tasters did not inform their age.

Source: Authors, 2024.

Table 3

Gender distribution of tasters

Gender	Percentage (%)
Male	54,44
Female	45,56

Source: Authors, 2024.

It is noted that the untrained tasters participating in this research were young people, with 54 (60%) being up to 21 years of age and mostly male (54.44%).

Table 4 and Figure 6 present the results obtained for the four sensory attributes studied.

Table 4

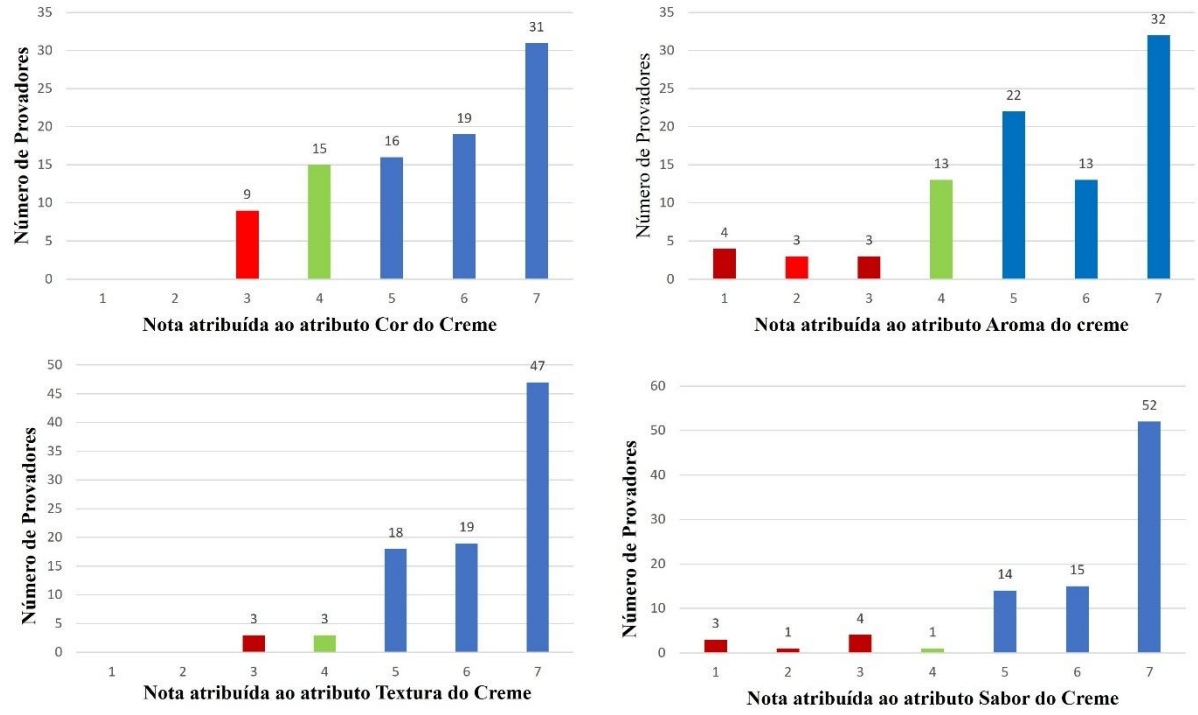
Distribution of scores assigned by tasters to the four attributes

	Sensory Attribute			
Note	**Colour**	**Aroma**	**Texture**	**Flavor**
1	0	4	0	3
2	0	3	0	1
3	9	3	3	4
4	15	13	3	1
5	16	22	18	14
6	19	13	19	15
7	31	32	47	52
Total	**90**	**90**	**90**	**90**
Average	**5,53**	**5,36**	**6,15**	**6,05**
TA (%)	**79,00**	**76,57**	**87,86**	**86,43**

Source: Authors, 2024.

Figure 6

Distribution of grades given to the four sensory attributes



Source: Authors, 2024.

Regarding the color attribute of the jambo flower cream, 66 (73.33 %) of the tasters approved the product, 15 (16.67 %) neither approved nor disapproved, with a score of 4, and only 9 (10.00 %) disapproved, giving a score of 3 to the color item. Within the scale of scores attributable to the sensory acts of the present study (from 1 to 7), the color attribute obtained an overall average of 5.53 points, and was then considered an acceptable color for the product (mean ≥ 4.00, which is the midpoint of the adopted scale). Its acceptance (TA) was 79.00%, higher than 70%, which is considered the minimum acceptance limit, and, in addition, this attribute is one of the most favorable to the acceptance of a product by the consumer (Dos Santos et al., 2018).

The sensory attribute "aroma" obtained an approval of 67 (74.44 %) of the tasters, and a rejection of 10 (11.11 %), with 13 (14.44 %) of indifference (grade 4), in addition to an overall average of 5.36, thus being the sensory attribute most poorly evaluated by the tasters. As much as jambo cream has been approved in the aroma attribute, since the average was higher than 4, it would be interesting to reformulate the product with some flavoring agent that improves its aroma.

The sensory attribute "texture" had an approval of 93.33 % (84) of the tasters, an indifference of 3.33 % (3), and an equal rejection, presenting the highest average attributed to the product, which was 6.15.

On the other hand, the sensory attribute "taste" was accepted by 81 (90.00%) of the participants in this study, and disapproved by 8 (8.88%), with an indifference of 1 (1.11%) of the tasters. His average score was 6.05, being, on average, approved by the tasters.

The overall total acceptability (TA) was 82.46 %. When compared to red jambo jam, made by De Lima Pantoja Neto et al. (2024), it can be seen that the cream of red jambo flowers has a lower overall acceptance than that product, which was 92.50%. However, the product can be considered accepted, as it presented a TA ≥ 70% (Dos Santos et al., 2018).

Table 5 and Figure 7 show the distribution of scores assigned to each sensory attribute, considering the gender of the taster.

Table 5

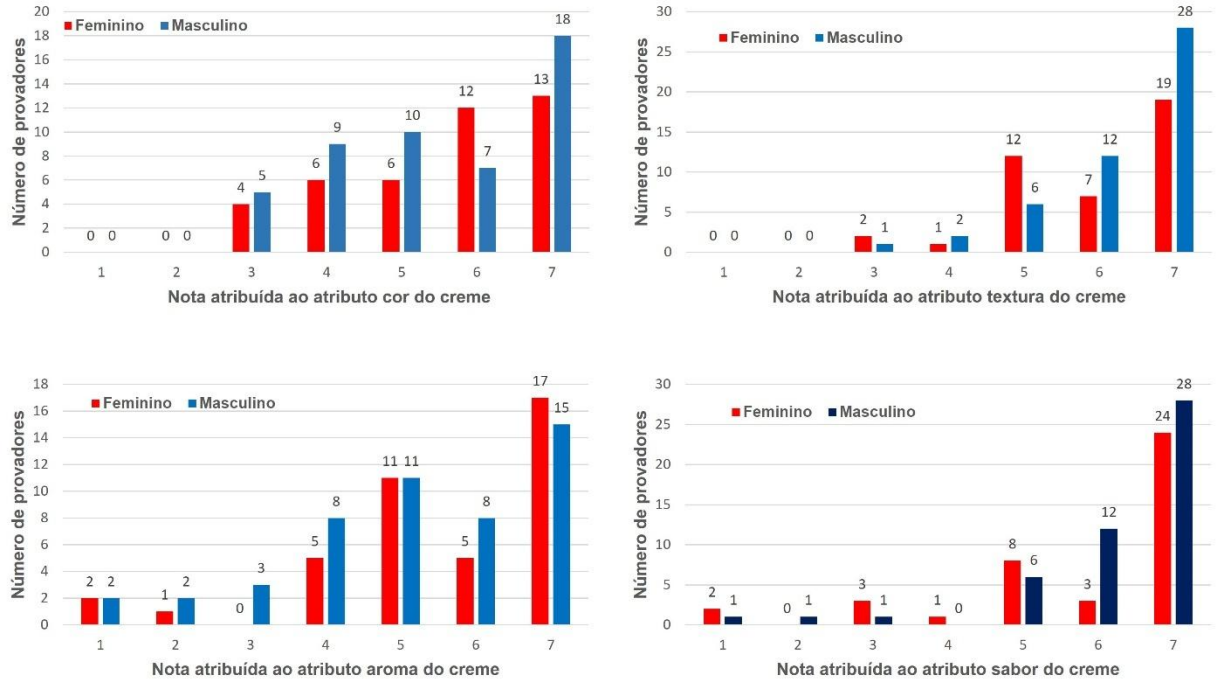
Scores attributed to the four sensory attributes considering the gender of the taster

	Attributes distributed by sex							
	Colour		Aroma		Texture		Flavor	
Note	Fem.	But.	Fem.	But.	Fem.	But.	Fem.	But.
1	0	0	2	2	0	0	2	1
2	0	0	1	2	0	0	0	1
3	4	5	0	3	2	1	3	1
4	6	9	5	8	1	2	1	0
5	6	10	11	11	12	6	8	6
6	12	7	5	8	7	12	3	12
7	13	18	17	15	19	28	24	28
Total	**41**	**49**	**41**	**49**	**41**	**49**	**41**	**49**
Average	**5,58**	**5,49**	**5,56**	**5,49**	**5,97**	**6,31**	**5,88**	**6,05**
p-Value		**0,944**		**0,295**		**0,455**		**0,313**
X2		**0,005**		**1,098**		**0,558**		**1,016**
TA (%)	**79,71**	**78,43**	**79,43**	**78,43**	**85,28**	**90,14**	**84,00**	**86,43**

Source: Authors, 2024.

Figure 7

Distribution of scores for the four sensory attributes considering the sex of the taster



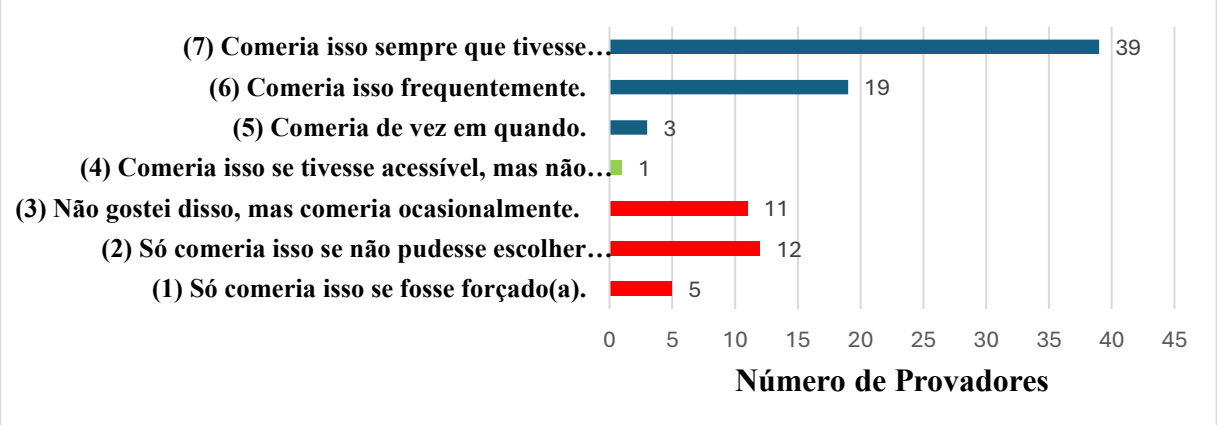
Source: Authors, 2024.

Total acceptability among female tasters was 82.11 % and among male tasters it was 83.36 %.

Figure 8 shows the distribution of consumption intention expressed by the tasters when answering question 2 of the Evaluation Form (Figure 5).

Figure 8

Manifested intention to consume the product



Source: Authors, 2024.

It can be seen that 61 (67.78 %) of the tasters manifested a positive intention to consume the product, indicated by the blue bars in Figure 8. Only 1 (1.11 %) of the consumers were neutral in terms of consumption (green bar in Figure 8), and 28 (31.11 %) manifested that they were not willing to consume the product (red bars in Figure 8). Thus, the acceptance of the product for consumption via direct declaration is lower than the acceptance obtained by the analysis of its sensory characteristics.

5 CONCLUSION

The physicochemical results found suggest that the prepared product has a good quality in terms of the variables investigated, however, its high pH (6.61) says that the cream has a low acidity, which can favor the development of microorganisms. Therefore, the product needs to be very well stored and stored, preferably under refrigeration, and consumed, if not frozen, in a short time.

By using red jambo flowers, which are usually despised, this formulation constitutes a way of using parts traditionally not used by the population, for food consumption. Therefore, it can be seen as a form of consumption that meets the sustainable development goals (SDGs) of the United Nations (UN).

The cream was well accepted by the tasters, whether male or female, suggesting the consumption of such a product, if produced for commercialization.

It is also noteworthy that it would be interesting to expand the present study by performing analyses of phytochemical compounds, such as Vitamin C content, microbiological analyses, analysis of metallic element contents, centesimal analysis, among others, which complement the results obtained in this study.

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