

Development of sub-product from the waste from bacaba processing (*oenocarpus bacaba* Mart) as a source of value aggregation and income generation

Desenvolvimento de subproduto a partir do resíduo do processamento da bacaba (*oneoscarpus bacaba* Mart) como fonte de agregação de valor e geração de renda

Desarrollo de subproductos de los residuos del procesamiento de bacaba (*oenocarpus bacaba* Mart) como una fuente de adición de valor y generación de ingresos

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Abstract

The integral use of fruits in the elaboration of new products is a clean and viable technological alternative. This type of utilization is necessary to allow the fruit considered seasonal to be available to the consumer throughout the year, adding value and generating income for the communities that produce them. The aim of this study was to use the residue of bacaba processing in the elaboration of a jelly, contemplating the whole cycle of information necessary for this product to be in the market, focusing on income generation for the producers of this fruit. The composition of the raw material used for processing was initially determined. After that, the jelly formulations were developed and the best formulation was stored for the determination of its shelf life and analysis of its production viability. It was possible to obtain a jelly formulation that will promote the valuation of a by-product that would be discarded generating a market alternative for small and medium producers.

Keywords: Fruit processing; By-product; Family farming; Sustainability; Profitability.

Resumo

O aproveitamento de forma integral de frutos na elaboração de novos produtos é uma alternativa tecnológica limpa e viável. Este tipo de aproveitamento se faz necessário para permitir que os frutos considerados sazonais estejam à disposição do consumidor todo o ano, agregando valor e gerando renda para as comunidades que os produzem. O presente trabalho teve por objetivo utilizar o resíduo do processamento da bacaba na elaboração de uma geleia, contemplando todo o ciclo de informações necessárias para que esse produto possa estar no mercado, com foco na geração de renda para os produtores desse fruto. Foi determinada, inicialmente, a composição da matéria-prima utilizada no processamento. Em seguida as formulações da geleia foram desenvolvidas e a melhor formulação foi armazenada para a determinação do seu prazo de validade e análise de sua viabilidade de produção. Foi possível obter

uma formulação de geleia que irá promover valorização de um subproduto que seria descartado gerando uma alternativa mercadológica para os pequenos e médios produtores.

Palavras-chave: Processamento de frutas; Subproduto; Agricultura familiar; Sustentabilidade; Rentabilidade.

Resumen

El uso completo de las frutas en la elaboración de nuevos productos es una alternativa tecnológica limpia y viable, ya que permite que los alimentos de temporada se consuman durante todo el año, agregando valor y generando ingresos para las comunidades que los producen. El presente trabajo tuvo como objetivo utilizar el residuo del procesamiento de bacaba en la elaboración de una gelatina, contemplando todo el ciclo de información necesaria para que este producto esté en el mercado. Inicialmente, se determinó la composición de la materia prima utilizada en el procesamiento. Luego se desarrollaron las formulaciones de gelatina y se almacenó la mejor formulación para determinar su vida útil y analizar su viabilidad de producción. Fue posible obtener una formulación de gelatina que promoverá la valorización de un subproducto que sería descartado, generando una alternativa de mercado para pequeños y medianos productores.

Palabras clave: Procesamiento de frutas; Subproductos; Agricultura familiar; Sostenibilidad; Rentabilidad.

1. Introduction

The Brazilian Amazon region is home to almost half of the 500 native fruit species of the country. Besides tasty, these fruits are sources of vitamins and minerals. They also display a wide range of utilities: they are used in the production of juices and desserts, and may become valuable industrialized products, such as cosmetics, beverages, medicines, supplies and sweets, among others (Reynol, et al., 2018).

Bacaba (*Oenocarpus bacaba* Mart.) is one of the most important species in the Brazilian Amazon, and is widely used by its population (Noda, 2012). The relevance of the species is highlighted by more than 50 usage records, from feeding to commerce within riverside communities in Pará (Germano, et al., 2014). The potential of bacaba is usually concentrated in its pulp processing and oil extraction. Its fruit pulp is consumed as natural juice or in derivative products such as beverages, jams and ice creams (Neves, et al., 2015). Its fruit processing generates a residue that is predominantly composed by its peel, (disposal material).

The waste disposal does not consider the potentiality in reusing them. This is why the term “subproducts” is used, in order to reinforce the fact that these materials may be used as substrates for the recovery of compounds and development of new products, promoting its value adding (Galanakis, 2012).

The significant growth of family agriculture as a form of additional income generation is evident. In this sense, one must reflect on the importance of the production and commercialization of regional fruits in the composition of family income in a long-term sustainable way (Brazil, 2002). In this context, the processing of goods is an important strategy that allows the conquer of new markets and the adding of value to the products, as well as higher profits to the producers (Gomes, et al., 2016).

Therefore, the aim of this study was to use the residue from bacaba processing in the development of jam, determining the physicochemical composition of the residue of bacaba processing; optimizing the development of jam through the utilization of bacaba residue; monitoring the microbiological and sensorial changes of the best jam formulation along its storage, considering all the cycle of information necessary so that this product can reach its market, focusing on the income generation for the producers of this fruit.

2. Material and Methods

Type of research

This is a quantitative analytical research, with collection of raw materials in the field and determination of compounds and data analysis in the laboratory (Perreira et al., 2018).

Obtaining the raw material

The fruits from the bacaba tree (*Oenocarpus bacaba* Mart.) were obtained in the rural area (9°59'55.8"S and 50°59'11.2"W) from Vila Rica – MT. After harvest, all samples were sorted according to quality criteria related to the color of the peels (purple) and the absence of visible damages and rottenness. Afterward, fruits were sanitized under running water and sank into a chlorine solution (100 ppm) for 15 minutes, followed by a last wash under running water (Silva & Gonçalves, 2016).

Obtaining and preparing of the residue

For the residue obtaining, fruits were softened, sank into warm water (45 °C for 40 minutes). They were then crushed so that the pulp was released from drupe (Cymerys, 2005). Afterward, the product obtained through the crushing procedure was filtered in order to separate the residue from the juice. After its obtaining, residues were kept frozen.

The residue was composed by pomace and, mostly, the fruit peels, excluding only its seeds. It was obtained from the first filtration from the fruit processing for the obtaining of the bacaba beverage.

Characterization of the residue

In order to characterize the residue, we analyzed its proximate composition, fiber, pH, titratable acidity, color and reducing and non-reducing sugars, in accordance with the methodologies described by the Adolfo Lutz Institute (IAL, 2005) and the Association of Official Analytical Chemists (AOAC, 2000). All analyses were performed in triplicate with seven repetitions each and submitted to the average and standard deviation calculations using Microsoft Excel.

Jam processing

We used a complete factorial planning 2³, as described in Table 1, for the jam processing. The residue obtained from bacaba processing was submitted to boiling water blanching for 10 minutes and then ground using a household blender. Later, sucrose was added in the proportion of each formulation and the ingredients (citric acid and pectin) were added in the quantities (%) referring to the total of sugar.

Table 1 - 2³ experimental design, for the tests of preparation of bacaba jelly.

Assay	Coded variables			Real variables		
	X1	X2	X3	X1 (%)	X2 (m/m)	X3 (%)
1	+1	+1	+1	1	60/40	3
2	-1	-1	+1	0	40/60	3
3	+1	-1	+1	1	40/60	3
4	-1	+1	+1	0	60/40	3
5	+1	+1	-1	1	60/40	0
6	-1	+1	-1	0	60/40	0
7	+1	-1	-1	1	40/60	0
8	-1	-1	-1	0	40/60	0
9	0	0	0	0,5	50/50	1,5
10	0	0	0	0,5	50/50	1,5
11	0	0	0	0,5	50/50	1,5

Source: Authors (2020).

Initially, we added 70% of the sugar, later, pectin and the surplus sugar, and finally we added citric acid (Torrezan,

1998). The °Brix soluble solid content was between 65 and 68, measured using a refractometer.

After processing, jams were hot-bottled in previously sterilized transparent glass containers (350 mL), closed with a tinplate lid internally coated with epoxy-phenolic resin. After chilling, jams were stored at 6-10 °C cooling temperature.

Micribiological analyses

Prior to sensorial analysis, the produced jam samples were sent to the General and Applied Microbiology Laboratory (LMGA) – UFT for carrying out the pertinent microbiological analyses.

We performed analyses aiming to count molds and yeasts in accordance with what is established by RDC no. 12 of January 2001 (Brazil, 2001), as well as bacterial analyses with focus on total coliforms, coliforms at 45 °C and *Salmonella* sp., as recommended by the National Commission on Food Norms and Standards no. 12 of 1978 for the obtaining of additional data on the hygienic-sanitary state of the product along its processing (Brazil, 1978). The microbiological analyses were performed in accordance with the methodologies recommended by the American Public Health Association (APHA, 2001).

Sensorial analyses – determining the best formulation

In order to optimize the 11 formulations submitted to the sensorial analysis, we applied methodologies of global desirability (Harrington Junior, 1965) and response surface (Box & Draper, 1985) using the software Statistic 7.0. We aimed to assess the influence of the citric acid concentration, residue/sugar ratio and pectin concentration (independent variables), over the response variables: taste, texture, global impression and purchase intention.

The sensorial analysis was first submitted to the Research Ethics Committee of the Federal University of Tocantins – UFT (opinion no. 3.096.105/2018). After the committee approval, volunteer evaluators that agreed to take part in the study signed an informed consent form (ICF).

The sensorial analysis was performed with non-trained tasters, over 18 years old. The formulations were submitted to acceptance tests for attributes of taste, texture and global impression, in which we used a structured hedonic scale composed of nine scores with the following classification: 1= I strongly disliked it and 9= I really liked it, for its sensorial attributes. A scale of five scores was used to assess purchase intention, anchored by the hedonic evaluations: 1= I would not buy it at all and 5= I certainly would buy it (Stone & Sidel, 1993).

Determining the expiry date of jams

The optimized formulation was packaged in glass and polypropylene containers, and kept at two different temperatures (25 and 35 °C) (independent variables), considering the microbiological quality and sensorial characteristics (color, taste and texture) along its storage (0, 30, 60, 90 and 120 days) as relevant factors over the response variables (dependent variables).

In the beginning of the storage (time zero), and along each storage stage, we assessed the microbiological and sensorial stability of the jam. Microbiological analyses were performed in accordance with APHA (2001) for the standards of the product referred to in RDC no. 12 of 2001 (Brazil, 2001).

We performed a quantitative-descriptive analysis (QDA) in order to assess the sensorial quality, for obtaining the sensorial characteristics of the jam during its storage. The determining of the descriptive terms for the attributes was carried out using basic principles of the quantitative-descriptive analysis method (Stone & Sidel, 1993). The recruitment of evaluators was carried out by means of oral invitation, when they were explained the objective and the way the project would be executed. In total, there were 25 evaluators in the team, selected due to their aptitude on visual acuity and ability in detecting

and describing the sensorial characteristics through the application of a discriminatory test (IAL, 2008).

We also performed a sensitivity test for the four basic tastes (acid, bitter, sour and sweet). Individuals who presented ability in recognizing the four basic tastes were selected for the developmental stage of the descriptive terminology for jam samples. Along this stage, 17 evaluators were selected.

Bacaba residue jams were offered to evaluators so that they could describe the similarities and differences between them concerning their color, taste and texture. After individual evaluations, evaluators discussed the obtained terms for the identification of the relevant sensorial characteristics of the attributes of the jam, under the supervision of a leader. Some correlated terms were eliminated and synonyms were grouped.

We created a consensual list of descriptive (Table 2) and reference terms. Based on the chosen terms, we set up the evaluation form, with non-structured scales of 9 cm and attribute intensity varying from 1 (lower intensity) to 9 (higher intensity) (ABNT, 2016; Moussaoui & Varela, 2010).

After training and final evaluators selection, the most preferred jam was submitted to the quantitative-descriptive analysis (QDA), performed by 17 trained evaluators (Stone & Sidel, 1993). The sensorial tests were conducted under conditions that assured the individuality of the evaluations as well as other evaluation requirements. Along the evaluation period, some evaluators were excluded from the team since they lacked availability to perform the tests. Therefore, eight evaluators remained in the team.

Table 2 - Terms describing bacaba residue jelly and references used by the judges in the quantitative descriptive analysis test.

DESCRIPTORS	REFERENCES
SHINE	Superficial aspect of the jelly, amount of reflected light.
Weak	Little or no glare
Strong	Too much shine
COLOR	Bacaba characteristic
Weak	Murrey
Strong	Violet
FLAVOR	Result of the association of the ingredients used to make the jam
sugary	low / strong
Acid	low / strong
SMELL	Propriedade percebida pela volatilidade do aroma
Sugary	low / strong
Acid	low / strong
TEXTURE	Gel firmness
Weak	Little or no firmness
Strong	Very firm
ARENOSITY	Presence of granular particles in the jelly
Weak	Little or no particle
Strong	Too much particle
ASTRINGENCY	Feeling of being tied in the mouth
Weak	No sensation
Strong	Green fruit feel
GLOBAL QUALITY	Joint assessment of the sensory characteristics of the jam

Source: Authors (2020).

3. Results and Discussion

Characterization of the bacaba residue

The composition of the bacaba residue is described in Table 3.

Table 3 - Physical and chemical composition of bacaba residue.

CONSTITUENT (%)	AVERAGE ± SD
Humidity	60,01 ± 1,56
Ashes	1,24 ± 0,096
Lipids	12,70 ± 0,14
Reducing sugars	1,97 ± 0,054
Total sugars	5,51 ± 0,33
Total titratable acidity	2,27 ± 0,28
pH	6,12 ± 0,059
Soluble solids (° BRIX)	3,04 ± 0,18
Fibers	1,31 ± 0,29
Proteins	1,14 ± 0,13
Total carbohydrates	23,6

Source: Authors (2020).

The bacaba residue, composed mostly by its fruit peels, presented low levels in parameters considered important for the production of jams (total and reducing sugars, total titratable acidity, Ph and soluble solids). However, the legislation allows the correction of such parameters through the adding of sugars and organic acids (e.g. citric acid), aiming to compensate any deficiency in the raw material content (Brazil, 2005).

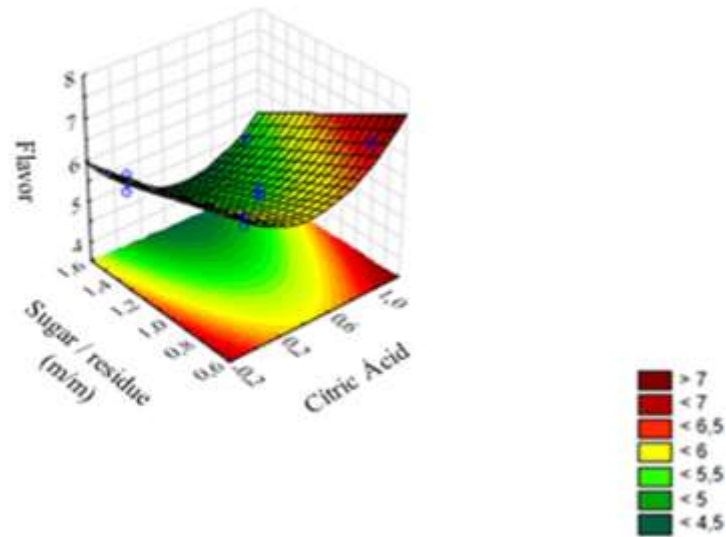
Microbiological analysis

The counting of total coliforms and coliforms at 45 °C indicate that all jam samples were in accordance with the Brazilian legislation (Brazil, 1978), that recommends the absence of coliforms (i.e. <3 MPN). We did not observe the presence of *Salmonella* sp. in any of the elaborated samples, indicating that the results are in accordance with the Brazilian legislation (Brazil, 1978), which recommends the absence of this microorganism within 25g of the product. According to RDC no. 12 of 2001, which addresses health microbiological standards for food, jams must present mold and yeast counting under 10⁴ CFU/g so that it can be considered safe for consumption. Our results suggest that all 11 formulations were in accordance with the levels recommended in the legislation (<1x10 estimated).

Sensorial analysis – determining the best formulation

The sensorial analysis was carried out by 57 random evaluators (35 men and 22 women) within an 18-59 age range. As seen in Figure 1, the evaluators tended to show a higher interest for the taste of formulations with higher concentrations of citric acid and sugar, since the increase in the taste grades was proportional to the increase in such independent variables (acidity and residue/sugar). This behavior probably has to do with the fact that the citric acid is an organic acid, and gives the product a more pleasant taste, being commonly used in the production of jams (Ribeiro, et al., 2016).

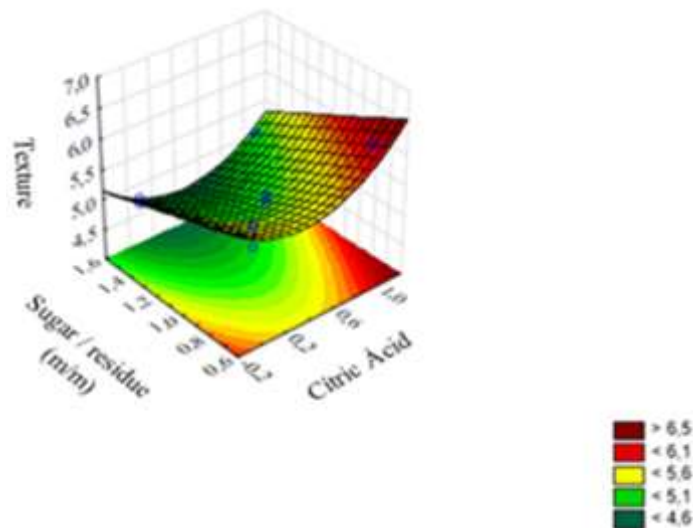
Figure 1 - Response surface for the flavor attribute.



Source: Authors (2020).
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The texture acceptability (Figure 2) was influenced by the concentration of citric acid (0.8 – 1.2), i.e., the higher the acid quantity in the formulation, the greater the consumer preference tendency. The adding of acidulants aims to decrease pH values in order to obtain an adequate gelation and enhance food taste, what leads the consumer to the perception of an adequate texture for jams (Torrezan, 1998).

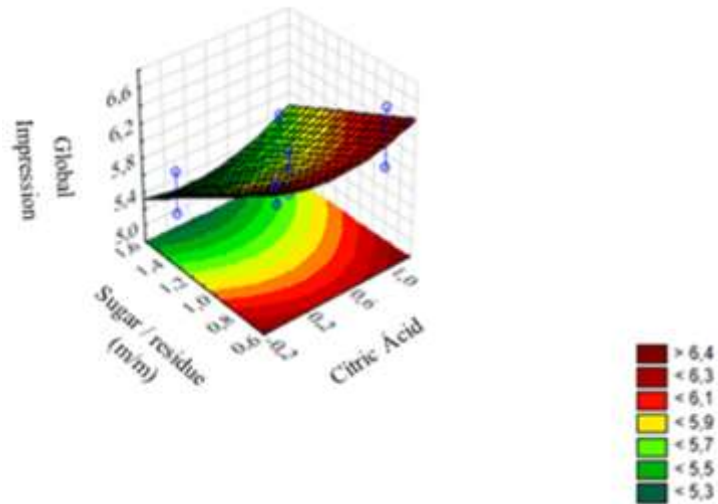
Figure 2 - Response surface for the Texture attribute.



Source: Authors (2020).

Our results for global impression confirm that tasters demonstrated indifference for the citric acid concentration in the jam, as shown in Figure 3. On the other hand, the residue/sugar ratio (0.6 – 1.0) tended to influence its global impression, since the attributed grades showed an increasing trend as the quantity of sugar in the formulations increased. In this context, Oliveira et al. (2014) highlighted the fact that the glaze-ness of jams is influenced by sugar, what may have an impact on the consumer's global impression.

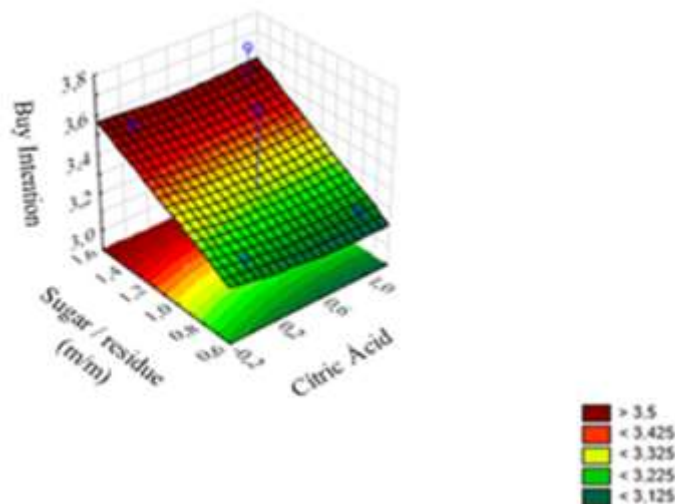
Figure 3 - Response surface for the Global Impression attribute.



Source: Authors (2020).

As observed in Figure 4, the optimal region for purchase intention was between 1.1 and 1.6 when it comes to the residue/sugar proportion, demonstrating that the purchase intention is influenced by the jam sugar concentration, since the higher the sugar concentration was, the greater were the grades for this attribute. Lopes, (2007) attests that the adding of sugar improves the appearance and taste of the final product, what may have been influent over the jam purchase intention.

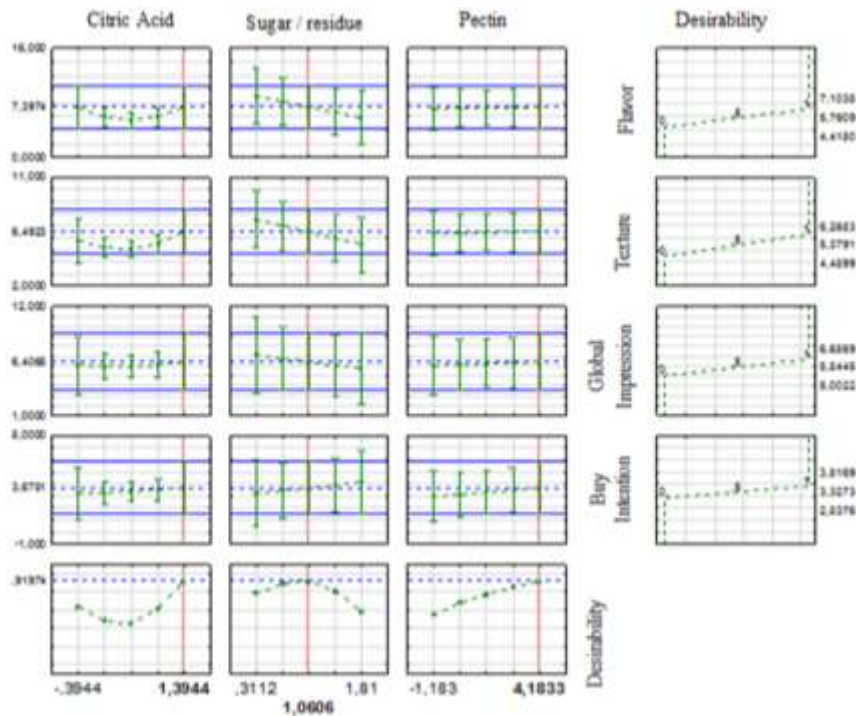
Figure 4 - Response surface for the Purchase Intent attribute.



Source: Authors (2020).

The desirability index (Figure 5) showed an optimal concentration of 1.39 for citric acid, 1.06 for the residue/sugar ratio and 4.18 for pectin.

Figure 5 - Desirability index for jelly from bacaba residue.



Source: Authors (2020).

Such values meet the ones observed in formulation no. 3 from our experimental design (Table 1) (citric acid: 1%; residue/sugar ratio: 40/60; pectin: 3%), justifying the selection of this formulation as the most desired, since the desirability index directed two variables (citric acid and residue/sugar ratio) into the formulation. This was the formulation selected for the expiry date determination, since this is a requirement for products to be commercialized.

Determining the expiry date of jams

In Table 4, it is possible to observe the microbiological analysis results for the bacaba residue jam under different storage conditions. Our results show that samples stored in polypropylene containers presented microbial growth at 25 °C after 45 days (counting: 8.1×10^2 CFU/g at 45 days and $>10^4$ CFU/g at 60 days (Table 4).

Table 4 - Results of microbiological analyzes of bacaba residue jelly under different storage conditions.

Temperature	Time (days)	Molds and Yeasts / Glass	Molds and Yeasts / Polypropylene
25°C	0	<1X10 (est)	<1X10 (est)
	30	<1X10 (est)	<1X10 (est)
	45	<1X10 (est)	8,1 x 10 ² UFC/g
	60	<1X10 (est)	>10 ⁴ UFC/g
	90	>10 ⁴ UFC/g	>10 ⁴ UFC/g
	120	>10 ⁴ UFC/g	>10 ⁴ UFC/g
35°C	0	<1x10 (est)	<1X10 (est)
	30	<1x10 (est)	<1X10 (est)
	45	<1x10 (est)	<1X10 (est)
	60	<1x10 (est)	<1X10 (est)
	90	<1x10 (est)	8,3 x 10 ² UFC/g
	120	<1x10 (est)	4,8 x 10 ² UFC/g

Est= estimated

Source: Authors (2020).

Yet we observed microbial growth at 45 days, our counting is within the maximum limits established by the Brazilian legislation (Brazil, 2001), that determines a maximum acceptable limit of 10⁴ CFU/g for jams, as observed in jams stored at 35 °C in polypropylene containers, that presented 8.3x10² CFU/g at 90 days and 4.8x10² CFU/g at 120 days storage time. Microbial growth at 25 °C was observed after 90 days of storage in glass containers. This temperature is the optimal temperature for the development of fungi (Franco & Landgraf, 2008). However, in this study, we did not observe microbial growth at 35 °C.

Our microbial results allowed us to determine the average expiry date of the jam under each of the storage conditions: 45 days for plastic (polypropylene) containers and 60 days for glass containers. Considering the bacaba between-crop period (7-8 months) (Cymerys, 2005), our results offer an extra income source for producers and a better utilization of the bacaba residues, 60 days after the crop period and also during the between-crop period, since its residue, as well as its fruit pulp, can be frozen. In Table 5, it is possible to observe the quantitative-descriptive analysis (QDA) results for the bacaba residue jam under different storage conditions and its interaction with time. The storage time and its interactions with temperature and packaging types promoted significant influences over the jam sensorial characteristics.

Table 5 - Results of the mean test for descriptive evaluation of bacaba residue jelly under different storage conditions.

Descriptors Terms	Storage (days)					
	0	30	45	60	90	120
Color	5,72 ^b	6,39 ^{ba}	6,30 ^{ba}	6,80 ^a	nd	nd
shine	6,10 ^b	6,68 ^{ba}	6,78 ^{ba}	7,22 ^a	6,95 ^a	6,79 ^{ba}
Firm gel texture	6,30 ^{ba}	6,32 ^{ba}	6,81 ^a	6,54 ^{ba}	6,20 ^{ba}	5,87 ^b
Sandiness	6,98 ^{ba}	7,32 ^{ba}	6,69 ^b	7,26 ^{ba}	6,99 ^{ba}	7,44 ^a
Acid odor	4,34 ^a	3,45 ^{ba}	3,51 ^{ba}	3,12 ^b	nd	nd
Sweet odor	4,90 ^a	3,99 ^{cb}	4,33 ^{cb}	4,42 ^{ba}	3,67 ^c	4,07 ^{cb}
Sweet taste	6,49 ^a	6,12 ^{ba}	5,51 ^b	6,02 ^{ba}	nd	nd
Acid flavor	3,89 ^b	3,81 ^b	4,08 ^{ba}	4,83 ^a	nd	nd
Astringency	4,64 ^a	4,30 ^a	3,87 ^{ba}	3,90 ^{ba}	3,22 ^b	3,87 ^{ba}
Global Quality	5,26 ^a	5,40 ^a	5,41 ^a	5,50 ^a	5,63 ^a	5,76 ^a

Means followed by equal letters (line) do not differ by ($p > 0.05$) by Tukey's test. na: not determined. Source: Authors (2020).

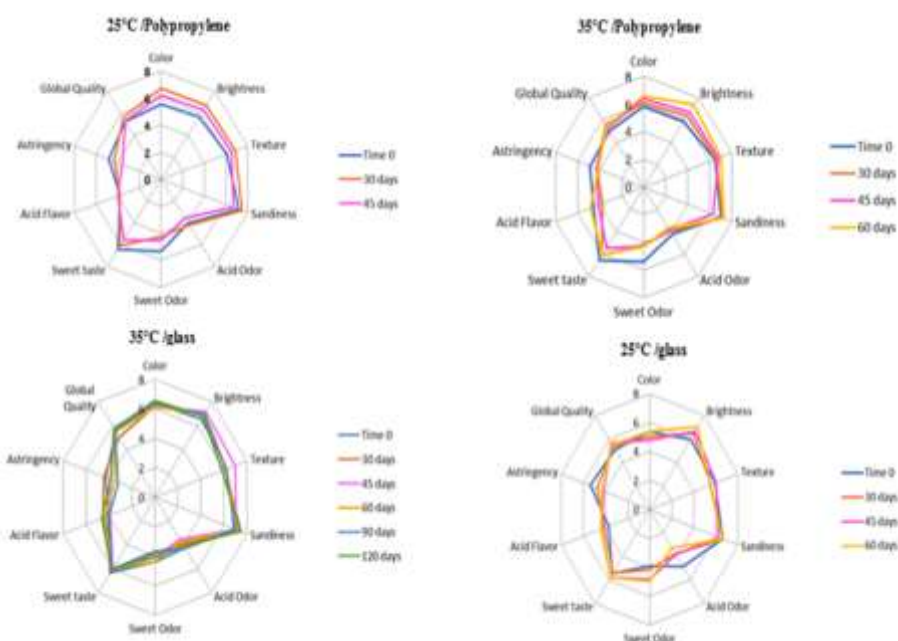
In general, there were significant differences between time-0 and 60-day stored jams concerning its color (darker), acid odor (less intense) and acid taste (intensified). The jam glaze-ness significantly differed between time-0 and 60-day jams, while its sweet odor and astringency significantly differed between 0 and 90 days. Its firm gel texture significantly differed between 45 and 120 days. Its gel texture at 120 days was less intense, and may have influenced its sandiness perception, which showed a significant difference between 45 and 120 storage days. We also observed a significant difference in its sweetness between 0 and 45 storage days.

The sensorial profile of the bacaba jam can be observed in Figure 6. Our results indicate that the attributes that best characterize this jam were color, acid taste and sandiness, since these were the attributes identified with higher intensity during its storage under different treatments.

However, we did not observe decrease in global quality along its storage (Table 5), since we did not observe a large decrease in the scores of the sensorial evaluation, with its global quality as the attribute that best represents the characteristics of a product during its storage, given that it is a result of the joint assessment of the sensorial characteristics. The best storage condition for the jam was considered to be the one at 25 °C in glass containers, since this is the condition that led to a lower intensification in the sensorial attributes along its storage.

In this sense, evaluating the utilization of non-conventional parts in food processing, as well as the adding of value to the Cerrado (Brazilian Savanna) fruits, more studies on the use of the bacaba residue become necessary for an adequate utilization of this resource, given that additional tests are necessary for the production of the jam, as indicated by our results. As an example, one may mention the combination of the bacaba residue and more traditional fruits, since fruits from the Cerrado tend to show lower sensorial acceptance for its characteristics, such as its intense and peculiar colors, tastes and smells (Lago-Vanzella, 2011, Arruda et al., 2016).

Figure 6 - Results for the sensory profile of bacaba residue jelly stored in polypropylene and glass packaging at 25 ° C and 35 ° C.



Source: Authors (2020).

Facing this scenario, the utilization of bacaba residue in the production of jam is admissible, since it was possible to identify a formulation with good sensorial acceptance and an expiry date relevant for commercialization. Additionally, the production costs would not demand a high investment by the producers, given that the jam production requires few equipment and brings along advantages such as the utilization of fruits that are inappropriate for natural (unprocessed) commercialization, as it also allows the use of surplus production (Lopes, 2007).

The value added to the raw material can be considered an extra production gain, given the fact that the average price of a natural bacaba can (14 kg) during the crop period varies from R\$ 15,00 to R\$ 30,00, while the price of the processed pulp (liter) varies from R\$ 4,00 to R\$ 15,00 (Imazon, 2018). In this sense, the processing adds value to the fruit, as it allows the utilization of surplus production for increasing household incomes. Therefore, as mentioned before, its residue jam becomes a good option for utilization.

4. Conclusion

Even with low levels for components required in jams formulations, the utilization of the bacaba residue was admissible for production after the correction of these parameters, what is allowed according to the Brazilian legislation.

The optimized formulation and the storage under different conditions revealed that the storage time, in correlation with the packaging and storage temperatures, caused significant differences in the product. However, sensorially, there was no significant loss in the scores along time. The best storage condition for the elaborated and optimized jam was at 25 °C in glass containers, since our results showed a lower intensification in the sensorial attributes along its storage under this treatment.

The study of the expiry date indicated an average storage time of around 45 days for plastic (polypropylene) containers and 60 days for glass containers, promoting the appreciation of a subproduct that would be disposed, providing

value and income generation for small and medium producers. As perspectives for study, it is intended to evaluate the physical-chemical characteristics in different types of packaging during the product's storage time.

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