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PHYSICOCHEMICAL CHARACTERISTICS OF SUGARCANE JUICES SOLD AT THREE DIFFERENT POINTS IN CUIABÁ - MT

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ABSTRACT

Background: Sugarcane juice is an excellent substrate for the growth of a large and diverse microbiota, and poor quality of it can affect the health of consumers. This study aimed to evaluate the acidity parameters of the juice extracted from minimally processed sugarcane at three different points in Cuiabá - MT. **Methods:** In the juice samples, the following parameters were analyzed: Brix (soluble solids), pH, acetic (volatile) acidity, and sulfuric (total) acidity. **Results**: All the Brix values were above 18. The pH values were between 5 and 6. The total and volatile acidity was below 0.8. **Discussion:** The Brix values found in this study are similar to other studies (standard deviation of 1.7). The variety of sugarcane significantly influences the Brix and its sampling period. Inappropriate handling of sugarcane promotes the microbiological decrease of the final product. The pH values were satisfactory, but the changes in temperature in one of the juices (sudden change from 24 to 22.7ºC) caused its pH to differ from the value found for the others. The total and volatile acidity content is related to the storage time of the juice, which can be contaminated by bacteria and microorganisms, affecting the characteristics of the product. When the acidity value is more significant than 0.8, there was a change in these characteristics, which did not happen in this work. **Conclusions:** The Brix values indicate an adequate maturation of the analyzed juices. The pH values are in the ideal range for sugarcane juice. The volatile and total acidity is in the ideal range, indicating quality standards for sugarcane juice.

Keywords: *Garapa. Sugarcane juice quality. Physicochemical analysis.*

1. INTRODUCTION

Sugarcane juice is a beverage obtained from crushing sugarcane through mills, and generally, its consumption is made by adding ice and citrus fruits. *Garapa*, as it is also known, is an energy drink with about 18.2% sucrose. However, it also highlights the minerals magnesium and calcium (12.5mg/100g and 9.1g/100g, respectively) and the presence of ascorbic acid (2.8mg/100g) (Rodrigues *et al.*, 2019; Santos *et al.*, 2021).

In many cities in Brazil, the sale of sugarcane juice in establishments and municipal fairs is a tradition, as is the case in the city of Cuiabá - MT.

The juice sold on public roads has some advantages, such as lower price and convenience; however, it brings together negative aspects regarding hygienic-sanitary issues (Hamerski, 2009; Andrade, 2014).

The organic acids present in sugarcane juice, in addition to citric acid, include aconitic, malic, oxalic, glycolic, succinic, and fumaric acids, among others. The composition of sugarcane varies according to the variety, stage of maturation, soil, and climatic and agricultural conditions; however, with a short shelf life due to its rapid microbiological and biochemical deterioration (Blake; Clarke; Richards, 1987).

According to Gallo (1989) and Kaufmann (2021), as it contains nutrients, high water activity, and pH between 5.0 and 5.5, sugarcane juice is an excellent substrate for growing a large and diverse microbiota. In this way, inadequate procedures in handling a food product, from the hygienic-

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sanitary point of view, compromise human health, especially when it comes to this food, which is a favorable environment for microbial development.

Considering the factors mentioned above, this study aimed to evaluate the acidity parameters of the juice extracted from minimally processed sugarcane collected at three different points in Cuiabá - MT.

2. MATERIALS AND METHODS

2.1. Materials

- 1% phenolphthalein indicator solution.
- 20 mL pipette;
- 250 mL beaker;
- 50 mL beaker;
- 500 mL bottle;
- Automatic burette;
- Cotton;
- Digital refractometer Atago Master-53M;
- Magnetic capsule;
- Magnetic stirrer Marconi MA 085;
- pH meter Marconi MA-522;
- Plastic stick.
- Standardized 0.1N NaOH solution;
- Stemless funnel, 100 mm diameter;
- Stemless funnel;
- Thin absorbent tissue paper.

2.2. Methods

In the juice samples, the following parameters were analyzed: Brix (soluble solids), pH, acetic (volatile) acidity, and sulfuric (total) acidity, carried out in the premises of the Water Monitoring Laboratory - IFMT - Campus Bela Vista.

2.2.1. Brix

The Brix analysis was performed for the filtered juice and the decanted juice.

The refractometer prisms were cleaned with distilled water (reagent water type IV, from ASTM D1193) and rinsed with adsorbent paper. About 50 mL of the juice was filtered on cotton, discarding the first 10 mL of the filtrate. With the aid of a plastic stick, a few drops of the filtrate were placed on the prism, and the reading was carried out with the corrected Brix (Jaywant; Singh & Arif, 2022; de Aquino *et al*., 2018).

2.2.2. pH

The pH value was measured for the filtered juice and for the decanted juice.

The electrode was placed in the sample until it covered the glass bulb, and the pH was read (Instituto Adolfo Lutz, 2008).

2.2.3. Total acidity (sulfuric acidity)

About 100 mL of the sample was filtered with cotton over the Becker. Then, 20 mL of the sample was pipetted and placed in a 250 mL Erlenmeyer flask, adding another 50 mL of distilled water and 7 drops of phenolphthalein. The contents of the Erlenmeyer flask were titrated with the standardized 0.1N NaOH.

The sulfuric acidity (mgH_2SO_4/L of juice) was calculated using Equation 1 (Instituto Adolfo Lutz, 2008).

$$A = \frac{n * f_{NaOH} * N * 1000}{V} \qquad (1)$$

where:

A: Acidity (mgAcid/L of juice);

n: volume of NaOH solution used in the titration (mL);

f_{NaOH} : NaOH correction factor;

N: normality of the NaOH solution;

V: sample volume (mL).

2.2.4. Volatile acidity (Acetic acidity)

About 100 mL of the sample was filtered with cotton. 10 mL of the filtrate was transferred to a 250 mL Erlenmeyer flask, and 100 mL of previously neutralized distilled water was added. 4 drops of phenolphthalein indicator solution were added to the solution, and then it was titrated with 0.1N NaOH solution until the indicator turned from colorless to red. The volume spent was noted (Brereton, 2003).

The acetic acidity of the juice was calculated using Equation 1, and the result is given in $mgCH_3COOH$/L of juice

2.2.5. Acquisition of juices

For this work, three juices were analyzed. The juices (Figure 1) were acquired in October 2022, at 3 different points in the city of Cuiabá, Mato Grosso, Brazil, and the georeferencing of the juice collection point 1, 2, and 3 can be seen in Figures 2, 3, and 4, respectively.

Figure 1. Sugarcane juices

3. RESULTS AND DISCUSSION

3.1 Results

The results of the physicochemical analyzes are shown in Table 1. Brix and pH were measured for filtered and decanted juices. Sulfuric and acetic acidity was measured just for filtered juices.

Table 1. *Physicochemical analysis results*

Variable	Juices			
	Type	**1**	**2**	**3**
ºBrix	Filtered	21	23.5	23
	Decanted	22	24.5	24
pH	Filtered	5.51	5.11	5.44
	Decanted	5.78	4.74	5.39
Total acidity (g H_2SO_4/L of juice)	Filtered	0,166	0,307	0,173
Volatile acidity (g CH_3COOH/ L of juice)	Filtered	0,218	0,396	0,208

3.2 Discussions

Analyzing the Brix values found in this study, it is noted that they are similar to those found by Soares (2017), Kunitake (2012), Andrade (2014), and Rodrigues *et a*l. (2019), with a standard deviation of 1.7.

According to Soares (2017), Brix values above 18 indicate an adequate maturation of the sugarcane. Thus, there is uniformity in the maturation of the analyzed juices. The author emphasizes that the variety of sugarcane significantly influences the Brix and its sampling period.

The filtered pH results are within the range found by Kunitake (2012), Andrade (2014), and Rodrigues *et a*l. (2019). Gallo (1989) and Kaufmann (2021) says that the pH of the sugarcane must be between 5.0 and 5.5. Other authors (Prati; Camargo, 2008; Rodrigues *et al*., 2019) found pH values between 5 and 6.17 and stated that these are satisfactory. Analyzing the pH results for the filtered juice, these are in the cited ranges, but analyzing the results for the decanted juice, juice 2 are not in the ranges.

It has already been mentioned that the quality of the sugarcane juice depends on the variety, stage of maturation, soil, and climatic and agricultural conditions of the sugarcane. Also, slightly acidic pH levels (between 5 and 6) favor microbial growth. Inappropriate handling of sugarcane, such as storage failures, inappropriate handling, storage, environmental and personal hygiene conditions, and failures in cleaning mills and other equipment, promotes the microbiological decrease of the final product (Galvão *et al.*, 2019).

According to Santos (2021), the greatest contamination of sugarcane juice occurs during the milling stages and during allocation in containers for sale. As can be seen in Figure 5, the place for grinding juice 2 is in a street fair, without minimal hygiene. Still, there was a change in temperature in the filtration (24 ºC) and decanted juice (22,7 ºC). Sudden temperature changes are a relevant factor in the chemical alteration of sugarcane juice (Santos, 2021).

Figure 5. Juice 2 grinding

Analyzing the volatile and total acidity of the juices, it is noticed that they are close to the values found by Soares (2017). The total acidity results are close to those of Tasso Júnior *et al.* (2010). Ripoli and Ripoli (2004) and Santos (2021) estimate acidity values below 0.8 as ideal quality standards for sugarcane juice. All values found are within this range.

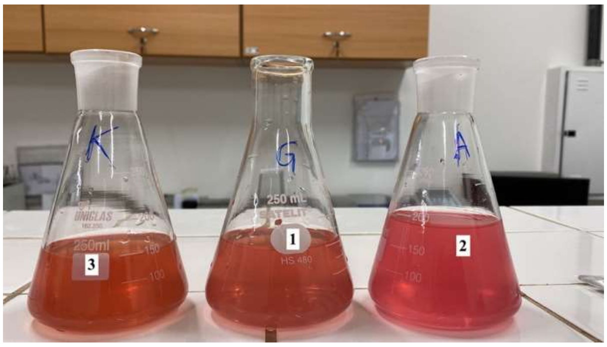

Figure 6. Volatile (acetic) Acidity

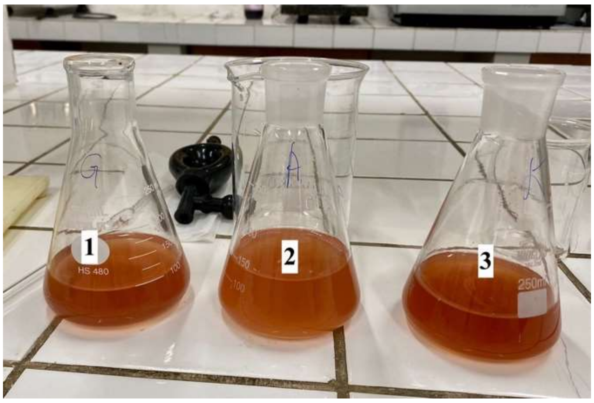

Figure 7. Total (sulfuric) Acidity

Tasso Júnior *et al.* (2010) relate the increase in acidity and dextran levels in sugarcane juice to storage time due to contamination by bacteria and microorganisms. The juice 2 was purchased 2 days after grinding, which also explains the higher acidity. It is observed that the juices with greater acidity are those where the hygiene of the place was more precarious. Also, the total acidity content is directly related to soil fertility, with the highest acidity levels found in more fertile soils (Tasso Júnior et al., 2010), which may suggest greater fertility in the soil of sugarcane juice 2.

In future studies, it is interesting to analyze the hygiene conditions of the places where the sugarcane juice was extracted and the soil where the sugarcane was cultivated, in order to, through the history of the juice, be able to better understand the physicochemical patterns and propose better justifications to the results generated.

4. CONCLUSIONS

From the analysis, it was possible to observe that the samples are within the standards commercialized in Brazil. All the Brix values were above 18, indicating an adequate maturation of the analyzed juices. The pH contents were between 5 and 6, ideal for sugarcane juice. The acetic and sulfuric acidity was always below 0.8, as indicated by the literature for good acidity.

5. DECLARATIONS

5.1. Open Access

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Figure 2. Georeferencing of the juice collection point 1 (Rua Miranda Reis, 784, Poção, Cuiabá-MT, Zip Code 78015-615)

Figure 3. Georeferencing of the juice collection point 2 (Av. Domingas Alves da Costa, 316 - São João Del Rei, Cuiabá - MT, Zip Code: 78093-080)

Figure 4. Georeferencing of the juice collection point 3 (Rua A 1, 196 - Jardim Nossa Sra. Aparecida, Cuiabá – MT, Zip Code: 78090-654)