Obtaining brandy from the alcoholic fermented cashew tree, Goiano, Brazil

Obtenção de aguardante a partir de fermentado alcoólico de caju-de-árvore-do-cerrado Goiano, Brasil

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ABSTRACT

The process of obtaining the brandy consists of adding yeast to the must to transform the sugar into alcohol, the same microorganism as the fermentation agent. This work aimed to produce brandy from fermented cashew juice and perform physical-chemical analyses. The following analyses of alcohol at 20 °C, pH, total acidity, fixed and volatile were performed, as well as the color parameters in the CIEL system, (L*) luminosity (black/white); (a*) coloring in the red/green region and; (b*) coloring in the yellow/blue range; (c*) Chromaticity is the ratio of a*/b*; (h*) saturation and color angle and; (G*) brightness of the measured color. According to the literature, the results obtained were for alcohol 38.2ºGL and pH 4.53, with an alcoholic degree of 38 to 54% in volume at 20 °C, and its optimum pH for brandy, which is between pH 4.0 and 5.0 at higher levels. The total (38.99) and fixed (3.19) acidity found in this study corroborate the literature regarding volatile acidity, 97.37 mg/100ml of anhydrous alcohol expressed as acetic acid. The L* value (52.59) in the brandy sample presented lighter colors because it was closer to white, as well as the low values of a*(-1.18) and b*(2.47) values evaluated.

Chromaticity presented 2.14; chroma defines color intensity, assuming values close to zero for neutral colors (gray) and around 60 for vivid colors. The values obtained for H* were high, whose value obtained 115.51, which characterizes the color of yellow, where hue-angle indicates the saturation of the object's color, is the angle formed between a* and b*. Therefore, they follow the literature and Brazilian legislation based on the results obtained.

Keywords: microorganism, sugar, fermentation.

RESUMO

O processo de obtenção da aguardente consiste em adicionar levedura ao mosto para transformar o açúcar em álcool, o mesmo microorganismo que o agente de fermentação. Este trabalho visava produzir aguardente a partir do suco de caju fermentado e realizar análises físico-químicas. Foram realizadas as seguintes análises de álcool a 20 °C, pH, acidez total, fixa e volátil, bem como os parâmetros de cor no sistema CIEL, (L*) luminosidade (preto/branco); (a*) coloração na região vermelho/verde e; (b*) coloração na faixa amarelo/azul; (c*) cromaticidade é a proporção de a*/b*; (h*) saturação e ângulo de cor e; (G*) brilho da cor medida. De acordo com a literatura, os resultados obtidos foram para álcool 38,2ºGL e pH 4,53, com um grau alcoólico de 38 a 54% em volume a 20 °C, e seu pH ótimo para aguardente, que está entre pH 4,0 e 5,0 em níveis mais altos. A acidez total (38,99) e fixa (3,19) encontrada neste estudo corroboram a literatura sobre acidez volátil, 97,37 mg/100ml de álcool anidro expresso como ácido acético. O valor L* (52,59) na amostra de aguardente apresentou cores mais claras porque estava mais próximo do branco, assim como os baixos valores de a*(-1,18) e b*(2,47) avaliados. A cromaticidade apresentou 2,14; a cromaticidade define a intensidade da cor, assumindo valores próximos a zero para cores neutras (cinza) e em torno de 60 para cores vivas. Os valores obtidos para H* foram altos, cujo valor obtido 115,51, que caracteriza a cor de amarelo, onde matiz-ângulo indica a saturação da cor do objeto, é o ângulo formado entre a* e b*. Portanto, eles seguem a literatura e a legislação brasileira com base nos resultados obtidos.

Palavras-chave: microorganismo, açúcar, fermentação.

1 INTRODUCTION

The Cerrado biome composes an immeasurable heritage of renewable natural resources, emphasizing exotic fruit species with peculiar and intense sensory characteristics. These unique characteristics have ensured the fruits a potential for national and international exploitation, provoking the interest of consumers and contributing to the search of industries for innovations that provide a competitive development in the food industry (Santana, 2019; Morzelle et al., 2015).

Among the numerous fruits, we highlight cashew, which is widely held by Brazil's social and economic importance, thus allowing extensive advantages over the rest of the productive countries (Araújo, 2015). The high production of cashew swells causes a high

rate of waste (Neves et al., 2020). The high degree of perecibility of the peduncle also contributes to waste. After 48 hours of harvest, if kept at room temperature, the peduncle is unsuitable for use (Silva Neto, 2000). The amount wasted presents a high concentration of nutrients that have the potential for use for conversion by microorganisms. The production of alcoholic beverages from the cashew stalk can be an alternative to waste, besides adding value to the cashew crop and generating income for the regions of Brazil (Silva & Nery, 2020; Torres Neto et al., 2006).

Alcoholic beverages are classified according to Brazilian legislation as fermented (beer and wine), mixtures (liqueur, bitter and appetizer, compound spirits, and mixed beverages), distilled (cachaça, rum, whiskey, and cognac), and rectified style (vodka and gin) (Aquarone et al.,2001). The main difference between the distilled beverage (whisky, brandy, cognac, vodka) and the fermented beverage (wine and beer) is the alcohol content; the distillate contains a higher alcohol content due to the concentration process that occurs when distillation takes place. It is important to note that all distilled beverages originate from a fermentation process (Abujamra, 2009). Among the distilled beverages, spirits stand out, obtained from the distillation of fruits, cereals, or sugarcane (Lea & Piggott, 2012). Therefore, fruit spirits are fermented-distilled alcoholic beverages (Alvarenga, 2011).

The use of fruit juices to prepare alcoholic beverages uses these fruits to avoid waste when one does not have an immediate consumption, adding value to regional drinks. From the fermented fruit, fruit spirits are obtained by distillation, which is necessary to adapt the production process according to the raw material (Asquieri et al., 2009).

According to Decree No. 6891/2009, fruit brandy is an alcoholic beverage of thirty-six to fifty-four percent by volume, at twenty degrees Celsius, obtained from the simple alcoholic distillate of fruit or distillation of fermented fruit must (Brazil, 2009). The production process of the brandy can be divided into four main stages: raw material preparation, fermentation, distillation, and aging, the latter being optional in Brazil (Aquino et al., 2006) and mandatory in the United States and England (Boza; Oetterer, 1999). Although the aging stage is not a legal requirement for product commercialization in Brazil, more and more producers have incorporated this stage in brandy production (Isique et al., 2009).

Brazilian legislation differentiates between brandy and cachaça. According to the Ministry of Agriculture, Livestock and Supply (MAPA). Cachaça is the typical and

exclusive name of a beverage obtained from distilling fermented sugarcane must with alcohol content between 38 and 48% by volume. It may receive the addition of up to 6 g/L of sugars, expressed in sucrose. In turn, brandy is a beverage obtained from the distillation of any other must (including sugarcane) with alcoholic graduation between 36 and 54% by volume (Brazil, 2005).

The raw material used in the production of brandy in Brazil is almost entirely sugarcane, however other raw materials can be used (Cardoso, 2001). Currently, several distilled beverages can be found in the literature, mainly fruit spirits, such as melon (Hernández-Gómez et al., 2005), mango (Alvarenga, 2006), cajarana (Alves, 2011), and banana (Matos, 2015).

Fruit spirits have many fixed and volatile compounds that determine the flavor and aroma of the final product. Some types of fruit spirits mentioned in the legislation are Kirchs, Dirchwassee when it comes to cherry brandy, Slivowicz, Slibowika, and Mirabella, when it comes to plum brandy or Calvados when it comes to apple brandy (Brazil, 2009).

Regarding the production process of cachaça or brandy, they are obtained through alcoholic fermentation, defined as the transformation of fermentable sugars into ethyl alcohol and carbon dioxide by the action of yeasts, usually of the genus Saccharomyces (Moreira et al., 2019). This process begins with the must fermentation, which lasts on average twenty-four to forty-eight hours. It is usually performed by a conventional batch system (adding the inoculum, and all must be fermented to the fermentation vat). As soon as the yeast comes into contact with the must, fermentation begins, which is divided into three phases: preliminary or pre-fermentation; main fermentation and complementary fermentation or post-fermentation, which consists of the occurrence of cell multiplication and yeast adaptation, ethanol production, and excessive gas release and decreased fermentative activity (Moura et al., 2020).

Thus, several compounds are formed during the fermentation process of the must, derived from the transformation of sugars and other chemical reactions. Among these compounds, the major product is ethyl alcohol. However, several others are formed in smaller quantities in the same process and are called secondary compounds. Inadequate quantities, the presence of these components is significant, as they will contribute to the flavor of the final drink. The secondary compounds are aldehydes, superior alcohols, esters, and organic acids (Cardoso, 2013). The excessive presence of these compounds is not desirable to production and may cause undesirable characteristics for the final

product, which may be related to several factors, such as poor hygienic and sanitary conditions of the still, poor nutritional conditions of the must for yeast, contaminated yeast, inadequate conditions of temperature, pH and aearer (Cardoso, 2013; Brazil, 2014).

Thus, this work aimed to produce brandy from fermented cashew juice and perform physical-chemical analyses.

2 MATERIALS AND METHODS

2.1 METHODOLOGY

The present research was characterized as a laboratory, and qualitative study, with these qualitative methods, are those in which it is essential the interpretation the researcher with his opinions about the phenomenon under study, as well as the reflexive practice of social emphasis that is investigated and the investigation process is essential (Pereira et al., 2018).

2.2 RAW MATERIALS

Anacardium othonianum was obtained from the native vegetation of Montes Claros de Goiás-GO-Brazil (geographic coordi-born: 16° 0602000S and 51° 1701100W; altitude: 419 m). The ripe fruits of the entry were harvested manually between September and October 2017. They were transported to the Federal Institute of Education Science and Technology of Goiano. They were selected, washed, sanitized, packaged, and frozen in a freezer of -80 °C (CL468-40, Coldlab, Piracicaba, SP, Brazil) until the preparation of the juice. The juice was pasteurized at 80 °C for 20 min, packed in LDPE plastic (10 m thick), and frozen at -80 °C (deep-frozen, Coldlab) until alcoholic fermentation. The material was thawed (6 °C) and subsequently polished using a professional mixer (Skymsen, Metalúrgica Siemsen LTDA, Brusque, Santa Catarina, Brazil) and mixed with filtered water (3:1 w/w). Alcohol use was performed using a pure culture of microorganisms, Saccharomyces *cerevisiae* of commercial dry yeast (Fleischmann, Pederneiras, SP, Brazil).

2.3 MAKING THE BRANDY

The preparation of the brandy involved two main parts: the preparation of alcoholic fermented and the distillation of alcohol to obtain the final product. The stages of preparation of the fermented, distillation of the cashew brandy of the Cerrado, and the

physicochemical analyses were carried out in the Laboratory of Biotechnology and Microbiology of Food of the Federal Institute of Goiano - Campus Rio Verde.

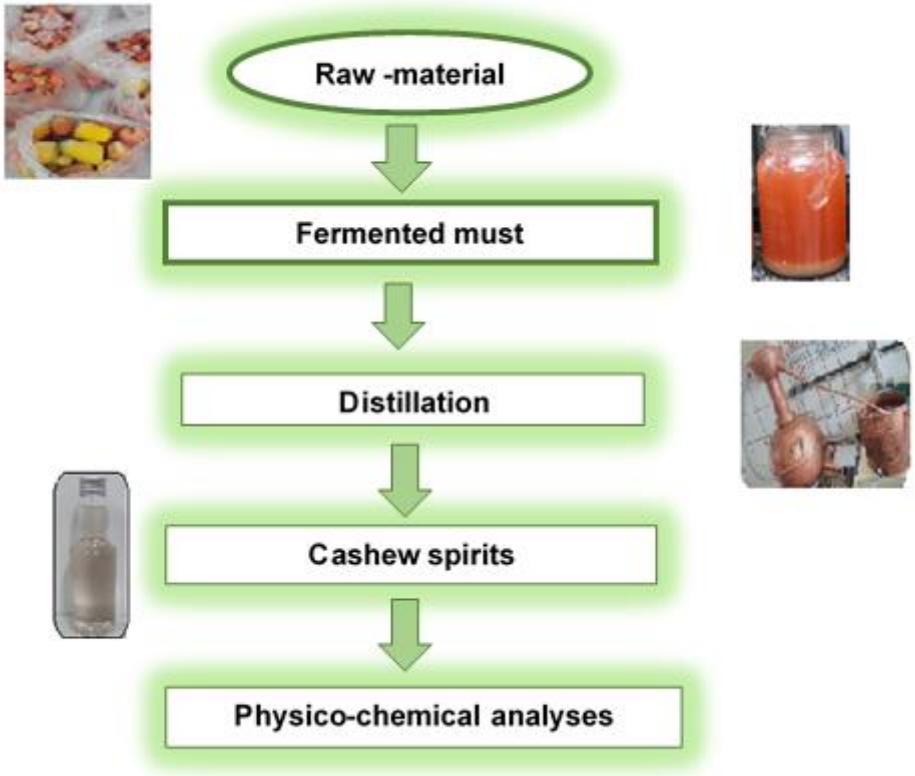
2.3.1 Preparation of fermented must

For the preparation of the must to be fermented, Figure 1, initially it was carried out with fermented cashew juice from the Cerrado, the fermentation of cashew juice with the addition of lyophilized yeasts, then with the aid of a digital field refractometer, the soluble solids content of the broth to be fermented was checked, and a correction of Brix was made with distilled water leaving it with 15º Brix. After this correction, 10 grams of dehydrated Saccharomyces *cerevisiae* yeast of the Fleishman brand acquired in the domestic market of Rio Verde were inoculated in 5 liters of diluted sugarcane *to* carry out the fermentation process that lasted approximately 48 hours. After this period, ºBrix was rechecked to verify that the fermentation had already finished and if must was fit for the distillation stage.

2.3.2 Distillation of Fermented Must

Before the beginning of distillation, the fermented must be filtered with a fabric worldwide being sanitized to remove impurities from fermentation.

Figure 1: Cachaça production flowchart



Source: Personal archive

2.4 PHYSICOCHEMICAL ANALYSES

The physicochemical analyses were performed according to the physicochemical methods of distilled beverage studies described by the Adolfo Lutz Institute manual (Lutz, 2008).

2.4.1 Alcohol content (°GL)

The alcohol content was determined according to the OIV (MA-AS312-01A, 2012). Briefly, 15 mL of the sample was distilled (TE-012, Technal, Piracicaba, Brazil), and two-thirds of the total volume of the distilled sample was collected. Its volume was 15 mL with distilled water (Neves et al., 2020). Density and alcohol content was determined using a digital meter(DMA35, Anton-Paar, São Paulo, Brazil) after cooling the sample at 20 °C.

2.4.2 pH determination

The electrometric process with a pHmeter was used, a specially adapted pot that allows a direct, precise, and straightforward determination of the pH. It was calibrated with commercial cap solutions of pH 4.0 and 7.0 (Lutz, 2008).

2.4.3 Density

The pycnometer method (Lutz, 2008) was used to determine its determination.

2.4.4 Determination of total, volatile and fixed acidity

The total titratable acidity was determined by potentiometric titration. 10 mL of sample was added and diluted in 200 mL of distilled water, and 3 drops of phenolphthalein solution were added and titrated with NaOH 0.1 mol solution. L^{-1}. The acidity content was determined considering the volume of alkali spent on titration (AOAC, 2005).

The sample was titrated with 0.1 mol NaOH solution to determine volatile acidity. L^{-1} and use of the phenolphthalein indicator at 1%, a sample volume (50 mL) was added in aluminum capsules and evaporated in a water bath at a temperature of 98ºC, ideal for the process to occur quickly. The residue present in the capsules was washed with 100mL of distilled water and transferred to an Erlenmeyer to titrate. The results were obtained through equation (1).

$$Av = \frac{Eq\ x\ n\ x\ N}{10\ x\ V} \quad \text{(Eq. 1)}$$

where:

Av = volatile acidity.

n = volume of sodium hydroxide solution spent on titration in mL.

N = normality of sodium hydroxide solution.

V = sample volume in mL.

Eq = equivalent in gram of acetic acid (60).

Expressed in grams of acetic acid per 100 mL of sample (g/100 mL) or 100 mL of anhydrous alcohol (Lutz, 2008).

The determination of fixed acidity is due to the difference between total and volatile acidity, and the volatile acidity must be corrected.

2.5 COLORIMETRY DETERMINATION

The color was evaluated instrumentally in electronic equipment Colorimeter Hunter Lab, the Color Quest II model, and previous calibration (Hunterlab, 1998). Color parameters were: L*, a*, b*, Chroma, and Hue angle. The L value provides luminosity, ranging from white (L=100) to black (L=0). The value of a* characterizes coloration in the region from red (+a*) to green (-a*), and the value b* indicates coloration in the range

from yellow (+b*) to blue (-b*) (Harder et al., 2007). The Chroma indicates the saturation of the object's color, which is the angle formed between a* and b*. Hue-Angle is where you get the actual color of the analyzed object through the relationship between the values of a* and b*

2.6 DATA ANALYSIS

The data acquired in the physicochemical studies were tabulated and represented in spreadsheets in the Microsoft Excel program®. All calculations were done in triplicate.

3 RESULTS AND DISCUSSION

The cashew brandy of the Cerrado Goiano was submitted to physicochemical analyses (volatile acidity, alcohol content, Brix, and pH), following the Analytical Standards of the Adolfo Lutz Institute((Lutz, 2008). All analyses were performed in triplicate, calculating mean and standard deviation.

Table 1 shows the physicochemical analyses performed in the alcoholic fermented brandy of cerrado-tree cashew goiano.

Table 1: Physiological analyses of alcoholic fermented brandy of cerrado-tree cashew from Goiano.

Analysis	**Goiano Bush-tree cashew brandy**	**Limit - Legislation**
Alcohol Graduation (%)	38.2± 0.00	36.00 - 54.00
Volatile acidity mg/100mL alcohol	97.37 ±1.00	150
Total acidity mg/100mL alcohol	38.99 ±1.00	-
Fixed Acidity mg/ 100mL alcohol	3.19 ±1.00	-
pH	4.53 ± 0.02	5.0*
Density (g/L)	0.903	-

*pH for cachaças.

The alcoholic degree of cashew brandy was 38.2 °GL, within the range required by the Brazilian Legislation, which is from 36 to 54 °C, for fruit brandy, obtained from the simple alcoholic distillate of fruit or by distillation of fermented fruit must (Brazil, 2008). Distillation must be carried out so that the distillate preserves the aroma and taste of volatile natural elements contained in the fermented must (Melo, 2018). A similar result of alcohol content was found in other studies involving the production of brandy of pepper brandy and jabuticaba, whose value was 37 and 39 °GL, respectively (Souza, 2017; Asquieri et al., 2009). In another study on sugarcane brandy, results were higher than this study, 45.10°GL (Viana et al., 2016). With this, the alcoholic degree is considered one of the parameters of great importance because it is one factor that characterizes the product, denomination of cachaça, or sugarcane brandy (Cravo, 2017; Duarte et al., 2020).

According to the Brazilian legislation, the volatile acidity of the alcoholic fermented brandy of Goiano-tree cashew was 97.37 mg/100mL of anhydrous alcohol expressed as acetic acid maximum value is 100 mg/100mL (Brazil, 2008). Volatile acidity is a secondary compound that depends on the fermentation process and control of factors fundamental to minimizing the occurrence of this acidity, such as the strain of the yeast used, purity of fermentation, time and temperature of fermentation, wort management, and especially hygiene (Henriques, 2014; Vicente, 2015).

Total acidity contributes to the aroma and taste of distilled alcoholic beverages. The natural processes of alcoholic fermentation provide higher total acidity values when compared with fermentative methods induced by homogeneous yeast cultures (Carvalho *et al*., 2011).

According to Normative Instruction No. 13, of June 29, 2005, of the Ministry of Agriculture, Livestock and Supply, Brasília - DF, item 2.2 and subitem 3.1.1. regulate volatile acidity in a maximum of 150 mg/100ml of anhydrous alcohol expressed in acetic acid. The high acidity found in this work may have been started by prolonged fermentation, allowing better results for yeasts. The pH of cashew brandy was 4.53, however, the Brazilian Legislation that deals with quality parameters of brandies does not predict the pH value, only for cachaças. In the literature, values of 4.36 were found for Monstera's delicious brandy (Barros, 2012). Values higher than this study with cashew brandy were found for pepper brandy, presenting a pH of 4.90 (Souza, 2017). A pH of 4.86 was verified in the heart fraction for banana brandy (Melo, 2018). In Mello's work (2012), carried out on the production of bee honey brandy, the density found was

0.906g/L, a value close to that found in the present work with cashew brandy analysis. Values for density are not established by legislation

The results of the color coordinates for the cachaça soborized with pepper are described in Table 2.

Table 2: Determination of the color coordinates of the cachaças.

Evaluated parameters	Goiano Bush-tree cashew brandy
L	52.59±0.01
a	-1.18±0.03
b	2.47±0.02
C	2.41±0.01
H	115.51±0.21

After being submitted to color analysis, the beverage showed a higher tendency to light color according to identity and quality standards. The L* value (52.59) in the brandy sample presented lighter colors because it was closer to white, as well as the low values of a*(-1.18) and b*(2.47) values evaluated.

Chromaticity presented 2.14 describes the intensity or quantity of color, indicating the proportion in which it is mixed with black, white, or gray, allowing to differentiate strong from weak colors. When this variable has values close to 0, neutral colors are predominant (gray), and bright colors are dominant when it has values relative to 60 (Couto *et al*., 2016).

The values obtained for H* were high, whose value obtained 115.51, which characterizes the color of yellow, where hue-angle indicates the saturation of the object's color, is the angle formed between a* and b*. The Hue angle (h *) ranges from 0 ° to 360 °, 0 ° is the angle corresponding to the color red, 90 ° for the yellow color, 180 ° for green color, and 270 ° for blue color (Abreu *et al*., 2011).

4 CONCLUSION

With the execution of the present work, it was possible to develop a new brandy option for alcoholic beverage consumers to contribute to recent trends for using the cerrado tree cashew from Goiano. Thus, considering the parameters analyzed volatile acidity, alcohol content, and pH, the quality potential of the manifold brandy became

evident because it was prepared according to standard methodological procedures for this type of product. It presented quality physical-chemical characteristics similar to the reference values found in the literature.

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