DRY APRICOT BRANDY: DEVELOPMENT AND PHYSICOCHEMICAL CHARACTERIZATION OF A NEW BEVERAGE

AGUARDENTE DE DAMASCO SECO: DESENVOLVIMENTO E CARACTERIZAÇÃO FÍSICO-QUÍMICA DE UMA NOVA BEBIDA

BRANDY DE ALBARICOQUE SECO: DESARROLLO Y CARACTERIZACIÓN FISICOQUÍMICA DE UNA NUEVA BEBIDA

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ABSTRACT
The global distilled beverage market has been influenced by a notable change in consumer behavior, which is increasingly looking for products with a differentiated flavor profile. In this context, fruit spirits have become an interesting option, due to the variety of flavors they can offer. The objective of this work was to produce a fruit brandy, using dried apricots as raw material. Dried apricots have an intense and unique flavor, which meets new consumer trends. For the production of this drink, initially a fermentation must was prepared that consisted of maceration water from the dried fruits. The wort was inoculated with a commercial strain of Saccharomyces cerevisiae and fermentation was conducted in a single-batch system, in a closed vessel equipped with airlock. The distillation was carried out in a copper still equipped with a dephlegmator and the separation of the head, heart and tail fractions was carried out according to the estimated volume of the distillate. The brandy obtained was submitted to physicochemical analysis by gas chromatography with flame ionization detector. The results showed that all analytical parameters were in compliance with the Brazilian legislation. Regarding the sensory characteristics, the drink presented a clear appearance, with a mild and fruity odor and flavor.

Keywords: Fruit brandy. Dried apricots. Copper still.

RESUMO
O mercado global de bebidas destiladas tem sido influenciado por uma notável mudança no comportamento do consumidor, que busca cada vez mais produtos com perfil de sabor diferenciado. Nesse contexto, os destilados de frutas têm se tornado uma opção interessante, devido à variedade de sabores que podem oferecer. O objetivo deste trabalho foi produzir uma aguardente de frutas, utilizando damascos secos como matéria-prima. Os damascos secos possuem um sabor intenso e único, que atende às novas tendências de consumo. Para a produção dessa bebida, inicialmente foi preparado um mosto fermentado,

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constituído pela água de maceração dos frutos secos. O mosto foi inoculado com uma cepa comercial de Saccharomyces cerevisiae e a fermentação foi conduzida em sistema de batelada única, em recipiente fechado equipado com câmara de ar. A destilação foi realizada em alambique de cobre equipado com deflegmador e a separação das frações cabeça, coração e cauda foi realizada de acordo com o volume estimado do destilado. A aguardente obtida foi submetida à análise físico-química por cromatografia gasosa com detector de ionização de chama. Os resultados demonstraram que todos os parâmetros analíticos estavam em conformidade com a legislação brasileira. Quanto às características sensoriais, a bebida apresentou aparência límpida, com odor e sabor suaves e frutados.

Palavras-chave: Aguardente de frutas. Damascos secos. Alambique de cobre.

RESUMEN

El mercado global de bebidas destiladas se ha visto influenciado por un cambio notable en el comportamiento del consumidor, que busca cada vez más productos con un perfil de sabor diferenciado. En este contexto, los aguardientes de frutas se han convertido en una opción interesante debido a la variedad de sabores que ofrecen. El objetivo de este trabajo fue producir un brandy de frutas utilizando albaricoques secos como materia prima. Los albaricoques secos tienen un sabor intenso y único, que responde a las nuevas tendencias de consumo. Para la producción de esta bebida, inicialmente se preparó un mosto de fermentación compuesto por agua de maceración de los frutos secos. El mosto se inoculó con una cepa comercial de Saccharomyces cerevisiae y la fermentación se realizó en un sistema de lote único, en un recipiente cerrado con esclusa de aire. La destilación se realizó en un alambique de cobre equipado con un deflegmador y la separación de las fracciones de cabeza, corazón y cola se realizó según el volumen estimado del destilado. El brandy obtenido se sometió a análisis fisicoquímico mediante cromatografía de gases con detector de ionización de llama. Los resultados mostraron que todos los parámetros analíticos cumplían con la legislación brasileña. En cuanto a las características sensoriales, la bebida presentó una apariencia límpida, con un aroma y sabor suaves y afrutados.

Palabras clave: Aguardiente de frutas. Albaricoques secos. Alambique de cobre.

INTRODUCTION

The global distilled spirits market is growing significantly, mainly due to economic factors and changing consumer preferences. Economic development and rising incomes in some regions of the world are boosting sales of distilled spirits, particularly those in the *premium segment*. In addition, globalization and international trade have facilitated access to a wide range of distilled spirits from different regions of the world (Statista, 2023).

In addition to economic factors, the distilled spirits market has been influenced by a notable change in consumer behavior, which is increasingly looking for differentiated products. Generation X (born between 1965-1980) and millennials (born between 1980-2000) are increasingly interested in beverages with innovative and pronounced flavors, such as craft beers and *premium spirits* (Grand View Research, 2022). In this context, fruit spirits emerge as an interesting option, as the diversity of raw materials available for their manufacture provides a wide variety of different flavors, which can meet the expectations of consumers in this segment.

Fruit brandies, also known as fruit *brandies*, are distilled from fruit wines. These drinks are produced in several countries around the world. The most important producing regions are the French provinces of Normandy, Brittany and Maine, followed by areas stretching from Lorraine and Alsace (France) through Baden (Germany) and Northern Switzerland. Croatia, Serbia and other countries of the former Yugoslavia, as well as other Central and Eastern European countries such as the Czech Republic, Hungary, Romania and Slovakia, are also important producers (Buglass, 2011).

Depending on the country where they are manufactured, fruit spirits are given different names. For example, in France they are called "*eau de vie de fruit*"; in Germany, "*schnapps*"; in Hungary, "*pálinka*". According to the raw material used, fruit spirits can be classified into three categories: those obtained from pome fruits, of which apples and pears are the most common; those obtained from stone fruits, especially cherries, plums, apricots and peaches; and, finally, those obtained from berries such as blueberry, currant and arbutus. Some fruit spirits are internationally recognized, such as *Calvados*, an apple brandy produced in France; *Kirsch* (or *Kirschwater*), a cherry brandy made in Germany; and *Slivovitz*, a blue plum brandy produced in several Eastern European countries (López *et al*., 2017).

The process of making fruit spirits consists fundamentally of four steps: preparation of the fruit must, fermentation, distillation and storage. The must can be prepared with the juice or pulp of the fruit, and is usually fermented in a simple batch system, with temperature control (Claus and Berglund, 2005). Distillation is usually conducted in copper stills, following a traditional process known as "French style", or in discontinuous distillation columns, a method called "German style" (Spaho, 2017).

Like sugarcane brandy, fruit spirits may or may not be aged. In some countries in Central and Eastern Europe, it is possible to find both unaged (white) and aged versions of these drinks. In some cases, aging is mandatory, as with Calvados, mentioned above, and *Somerset cider*, a traditional English cider. Both undergo an aging process in oak barrels for at least two years (Buglass, 2011). On the other hand, in Brazil, the aging of fruit spirits is prohibited (MAPA, 2011), so as not to detract from the original flavor of the fruit used as raw material.

The objective of this study was to produce a brandy from the dried fruits of the apricot (*Prunus armeniaca*). Apricots are enjoyed by consumers all over the world due to their aroma, flavor, and sweetness. The fruits are sold fresh or dried, or even in the form of industrialized products such as jams and juices (Greger and Schieberle, 2007). The biochemical transformations that occur during the drying process intensify its sensory characteristics, creating an even richer and more sophisticated aroma and flavor profile. This makes dried apricots a promising option for the production of a beverage with unique and authentic sensory characteristics, in line with the current global consumption trend.

To date, there is no distilled beverage made from the dried fruits of the apricot on the market, which made this study even more attractive.

METHODOLOGY

RAW MATERIAL

For the manufacture of the brandy, two kilograms of dried apricots (*Prunus armeniaca*) were used, purchased from the Brazilian Food Company (CEASA) in João Pessoa, Paraíba, Brazil.

PREPARATION OF THE WORT

The fermentation must was prepared using maceration water of the raw material, obtained from the immersion of two kilograms of dried apricots in a container containing seven liters of water. To facilitate the diffusion of soluble solids, the fruits were sliced, thus increasing the contact surface between the fruits and the water. Sodium metabisulfite (0.01% w/v) was added to avoid contamination by microorganisms during the maceration period. The container was capped and remained at rest for twenty-four hours. After this period, the container was opened and the fruits were removed. Thus, five liters of wort were obtained at 12 ºBrix, a value measured using a refractometer with automatic temperature correction. It is recommended that musts intended for the fermentation of brandy have concentrations between 14-16 ºBrix (Chaves, 2007). In this study, it was decided to ferment the must at 16 ºBrix. To achieve this concentration, two hundred grams of refined sugar were added to the wort, an amount determined through a mass balance. After correcting the concentration of soluble solids, the wort was supplemented with corn bran (5 g/L) and received the addition of five drops of hop extract (LACTOSTAB)® to inhibit the growth of bacteria during fermentation. Finally, the pH of the wort was adjusted to 4.5 with the addition of citric acid.

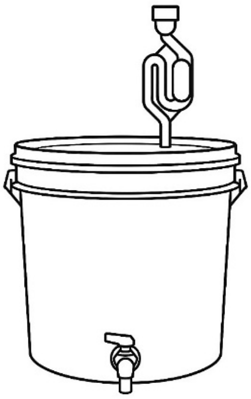
YEAST

The yeast production was carried out using the active dry yeast LNF CA-11, which is a selected strain of *Saccharomyces cerevisiae* produced by Angel Yeast Co., Ltd. In a 1.0 L becker, five grams of the yeast were hydrated in 100 mL of water for thirty minutes. Then, 400 mL of the wort, 5 grams of yeast extract, and a drop of hop extract were added. After 24 hours, the yeast obtained was introduced into the fermentation vessel.

FERMENTATION

Fermentation was carried out in a single batch system, conducted in a closed vessel, without agitation and without pH and temperature control. The evolution of the process was monitored by observing the formation of bubbles in the *airlock* (Figure 1). The end of fermentation was identified by the absence of bubbles, at which time the residual concentration of sugars was measured with a Brix saccharimeter. The value obtained was adjusted with Brix correction tables as a function of temperature. Finally, the alcohol content was determined using a buliometer.

Figure 1 – Fermentation vessel with *airlock*.



Source: Authored by the author.

DISTILLATION

The distillation was carried out in a copper still with a useful volume of eight liters, heated over direct heat and equipped with a dephlegmator (Figure 2). The separation of the head, heart and tail fractions was carried out according to the estimated volume of the distillate, calculated according to the methodology reported by Chaves (2007):

$$V_{dest} = V_{vinho} * (Brix_{mosto} - 2)/100 \quad (1)$$

Where:

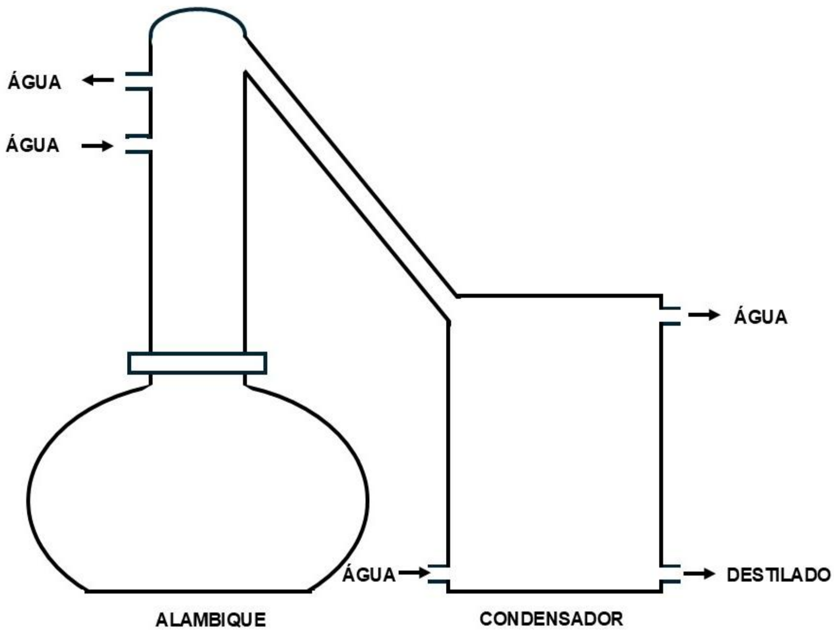
V_{dest} = Estimated volume of distillate, in liters;

V_{vinho}= Volume of wine (fermented must), in liters;

$Brix_{mosto}$ = Concentration of soluble solids of the wort, before fermentation.

According to this method, the head and tail fractions each correspond to ten percent and the heart fraction to eighty percent of the estimated volume of the distillate.

Figure 2 – Copper still equipped with dephlegmator and condenser.



Source: Authored by the author.

ALCOHOL CONTENT ADJUSTMENT

According to current Brazilian legislation, fruit brandy can have an alcohol content ranging from 36 to 54 ºGL. In this study, it was decided to produce a brandy with 40 ºGL, as this is a very common value in fruit spirits available on the market.

To obtain the brandy with the desired alcohol content, the heart fraction was diluted with a volume of distilled water calculated by the solution dilutions equation (Brown *et al.*, 2005), as described below:

$$C_1 * V_1 = C_2 * V_2 \quad (2)$$

Where:

C1 = Alcohol content of the heart fraction;

V1 = Volume of the heart fraction;

C2 = Alcohol content of the brandy;

V2 = Volume of brandy with alcohol content C2;

ANALYSIS

The quality control of the brandy produced was carried out according to the standards of identity and quality of fruit spirits, established in Normative Instruction No. 15/2011, of MAPA. Analyses were performed to determine the concentrations of volatile acidity, aldehydes, higher alcohols, esters, furfural, methanol and the coefficient of congeners. These analytical parameters were determined by gas chromatography, using an Agilent 8860 chromatograph equipped with a flame ionization detector (FID). Separation was performed in a J&W DB-FATWAX Ultra Inert column (30 m × 0.25 mm, 0.25 µm). Hydrogen (30 mL/min) and air (300 mL/min) were used in the detector. Hydrogen was used as a carrier gas, with a flow rate of 1 mL/min. The sample injection (0.5 µL) was performed with a split of 1:30. The temperature of the injector and detector was 250 °C.

RESULTS AND DISCUSSION

FERMENTATION

After 144 hours (six days) from the inoculation of the wort, the formation of bubbles in the *airlock* has ceased completely, indicating the end of fermentation. Several authors have reported similar fermentation times in studies on the production of fruit spirits. While in the production of alcoholic distillates from sugarcane the fermentation takes from 18 to 30 hours, in the production of fruit spirits this process can extend for several days. Oliveira *et al*. (2020) studied the production of a mango brandy, in which fermentation took seven days. This same period was reported by Abud *et al*. (2019) in the production of a brandy made from a mixed must of mango and passion fruit. Claus and Berglund (2005) state that fermentations of fruit musts can last ten days or more. On the other hand, Alves *et al*. (2008) reported a relatively shorter fermentation time of 88 hours in a study on the production of guava brandy.

The result of this stage was a wine with a fruity aroma, typical of fermented musts free of contamination, with notes of apricot, in addition to the characteristic odor of yeast. The residual concentration of soluble solids was 0.33 °Brix and the alcohol content reached 7.5 ºGL.

DISTILLATION AND ADJUSTMENT OF ALCOHOL CONTENT

To obtain an aromatic, balanced fruit distillate and, above all, within the quality parameters established by legislation, it is essential to correctly make the cuts during distillation, efficiently separating the unwanted compounds into the head and tail fractions.

The distillate fractions can be separated based on their sensory characteristics. Experienced distillers perform this analysis using mainly the sense of smell to recognize the distinct aromas and, on some occasions, also the taste to confirm the specific nuances of the different fractions. The second indicator of the cutoff points that can be used is the quantification, using an alcoholmeter, of the alcohol content of the distillates that are being collected in the still, especially for the separation of the heart and tail fractions. Finally, the third indicator of cut-off points that can be used is the temperature of the distillate vapor, before it enters the condenser. Because the various compounds present in the distillate have different boiling points, temperature monitoring helps identify the transitions between head, heart, and tail. Each of the mentioned cutting methods has its limitations, and the best approach is to use them together as guidelines for separating congeners during distillation (Spaho, 2017).

However, there are other separation methods that, although simpler, are also efficient and are therefore widely used. The first uses the total volume of wine to be distilled as a basis for estimating the volume of each fraction (Souza *et al*., 2013). The second, used in this study, estimates the total volume of the distillate, from which the volume of each fraction is determined (Chaves, 2007). The results are described below.

The estimated total volume of the distillate was 700 mL, calculated according to Equation (1). Thus, the first 70 mL (10%) collected during distillation were considered as head and discarded, while the subsequent 560 mL (80%) were classified as heart and stored. Distillation was then stopped, since the tail fraction was of no use in this study. The heart fraction had an alcohol content of 43 ºGL, measured with a Gay-Lussac alcoholmeter and corrected using a temperature correction table. This value is consistent with the results reported by several authors, who used the same distillation methodology used in this study For example, Asquieri *et al*. (2009), when studying the production of jabuticaba brandy, obtained a heart fraction with an alcohol content of 39 ºGL. Alves *et al*. (2008) recorded 39.9 ºGL in the heart fraction of a guava brandy, the same concentration reached by Silva *et al*. (2013), in the production of orange brandy.

In the distillation of fruit spirits in stills, the separation of the distillate fractions carried out in a single step (monodistillation) results in a heart fraction with a relatively low alcohol content, less than 45 ºGL (Buglass, 2011; Spaho, 2017). On the other hand, distillation in discontinuous columns allows the obtaining of heart fractions with higher alcohol concentration (García-Llobodanin, 2011). Thus, Oliveira et al. (2022) obtained a heart fraction with 52.9 ºGL in the distillation of a fermented mango must, while Abud et al. (2019), in a study on the production of a mixed mango and passion fruit brandy, reported a heart fraction with an alcohol content of 48.7 ºGL. However, the use of stills can produce distillates with even higher concentrations of ethanol. To do this, a double distillation must be carried out, which consists of two intermittent and consecutive distillations. In this way, it is possible to obtain heart fractions with alcohol levels between 60 and 70 ºGL (Douady, 2019).

After distillation, the alcohol content of the heart fraction was adjusted to 40 ºGL, a value commonly found in commercially available fruit spirits. For this, 42 mL of water were added to the heart fraction, as described in Equation 2, making a total volume of 602 mL of brandy at 40 ºGL.

PHYSICOCHEMICAL ANALYSIS

Table 1 presents the results of the physicochemical analyses of the brandy produced in this study.

Table 1 - Analytical parameters of fruit brandy.

Parameter	Amount obtained	Limits established by legislation	
		Minimum	Maximum
Alcohol content, in %, in v/v, at 20 ºC	40	36	54
Volatile acidity, in acetic acid, in mg/100 mL of anhydrous alcohol	4,25	-	100
Superior alcohol (sum of n-propyl alcohol, isobutyl alcohol and iso-amyl alcohol), in mg/100 mL of anhydrous alcohol	314,32	-	360
Aldehydes, in acetic aldehyde, in mg/100 mL anhydrous alcohol	7,65	-	30
Esters, in ethyl acetate, in mg/100 mL anhydrous alcohol	20,51	-	250
Sum of furfural and hydroxymethylfurfural, in mg/100 mL of anhydrous alcohol	-	-	5
Congener coefficient, in mg/100 mL of anhydrous alcohol	346,73	200	600
Methyl alcohol, in mg/100 mL anhydrous alcohol	6,24	-	400

Source: Decree No. 6,871/2009, I.N. Map No. 15/2011

The values obtained for all the parameters analyzed are within the limits established by the Brazilian legislation. To date, there are no records in the literature on studies of the production of dry apricot brandy that allow the comparison of results. However, it is possible to evaluate the results of some parameters, establishing relationships with the operational conditions adopted in this work.

Low acidity indicates the inhibition of the growth of contaminating microorganisms throughout the brandy manufacturing process. This inhibition occurred both in the preparation of the wort and in fermentation. In the first step, it was achieved by the addition of sodium bisulfite. In fermentation, contamination was minimized by conducting the process in a closed vessel, previously sanitized with alcohol at 70 ºGL.

The low concentration of methanol in this brandy is also a relevant aspect to be highlighted. In the manufacture of alcoholic beverages, methanol is originated by the degradation of pectin, a structural polysaccharide present in plants. Pectin is a polymer composed of hundreds of galacturonic acid molecules, which contain fragments of methanol. During fermentation, yeasts can hydrolyze pectin, releasing methanol. As fruits have a higher pectin content than sugarcane, the legislation establishes upper limits for methanol in fruit spirits (400 mg/100 mL of anhydrous alcohol), compared to sugarcane brandy (20 mg/100 mL of anhydrous alcohol). However, the concentration of methanol obtained in this study was low, even in relation to the allowed limit for sugarcane brandy. This is likely due to the composition of the mash and the efficiency of the distillation process in separating this contaminant. Generally, the production of fruit spirits involves fermentation of musts prepared from crushed or crushed fruits, making them highly rich in pectin and, consequently, favoring the formation of methanol during fermentation. In this study, fermentation was conducted in a must made with dried fruit maceration water, where the pectin concentration was probably very low. This factor, coupled with an efficient distillation process, resulted in a low concentration of methanol.

CONCLUSION

The methodology used in this study enabled the production of a brandy using dried apricots as raw material. The beverage obtained presented all the analytical parameters within the limits established by the Brazilian legislation. Additionally, the brandy presented favorable sensory characteristics, including a clear visual aspect with the presence of oiliness typical of brandies, as well as a mild and fruity odor and flavor.

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