Original

Influence of thermal treatment of wood on the aroma of a sugar cane spirit (cachaça) model-solution

Influência do termotratamento da madeira no aroma de uma solução-modelo de cachaça

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Abstract

The aging process of alcoholic beverages is generally conducted in wood barrels made with species from *Quercus* sp. Due to the high cost and the lack of viability of commercial production of these trees in Brazil, there is demand for new alternatives to using other native species and the incorporation of new technologies that enable greater competitiveness of sugar cane spirit aged in Brazilian wood. The drying of wood, the thermal treatment applied to it, and manufacturing techniques are important tools in defining the sensory quality of alcoholic beverages after being placed in contact with the barrels. In the thermal treatment, several compounds are changed by the application of heat to the wood and various studies show the compounds are modified, different aromas are developed, there is change in color, and beverages achieve even more pleasant taste, when compared to non-treated woods. This study evaluated the existence of significant differences between hydro-alcoholic solutions of sugar cane spirits elaborated from different species of thermo-treated and non-treated wood in terms of aroma. An acceptance test was applied to evaluate the solutions preferred by tasters under specific test conditions.
Keywords: *amburana; aroma; sugar cane spirit; balsam; oak; aging; sugar cane spirit; thermal treatment.*

Resumo

As bebidas alcoólicas são, geralmente, envelhecidas em tonéis de madeira fabricados a partir de espécies do gênero *Quercus* sp. Devido ao alto custo de aquisição e necessidade de importação, existe demanda por alternativas de uso de outras espécies nativas e da incorporação de novas tecnologias que aumentem a competitividade da cachaça brasileira. Sabe-se que, com a aplicação de termotratamento, vários compostos são alterados, desenvolvem-se aromas, altera-se a coloração e as bebidas adquirem gostos mais agradáveis. Este trabalho mostra a diferença significativa entre soluções-modelo hidroalcoólicas de cachaça, envelhecidas em diferentes espécies de madeira, em suas formas termotratadas e não termotratadas, avaliadas em relação a seu aroma. O teste de aceitação aplicado verificou as soluções preferidas pelos provadores, nas condições determinadas do teste.
Palavras-chave: *amburana; aroma; cachaça; bálsamo; carvalho; envelhecimento da cachaça; termotratamento.*

1 Introduction

The quality of a distilled beverage is judged by its color, aroma, and taste. These sensory characteristics depend not only on the raw material used and industrial conditions such as fermentation and distillation, but they are also closely linked to the aging process. The storage of alcoholic beverages in wooden barrels provides sensitive improvements to the product. These changes are caused by various chemical and physical reactions, which distinguish the maturation of distillates aged in wooden barrels from products simply stored in sealed containers, such as those made of steel or glass bottles.

After leaving the distillation column, the beverages have usually a strong and pungent aroma, no color, and high alcoholic graduation. That is when the main high-quality distillates are placed in contact with wood, in which they undergo different reactions that are capable of significantly change its color, aroma, and taste making them more pleasant to taste. Thus, the aging process adds greater value to the final product.

Since the most ancient times, when the aging process started being used in alcoholic beverages, oak originated from some species of the genus *Quercus* sp has been the most frequently used wood. Besides presenting physical characteristics that enable the manufacture of barrels, oak leads to distinctive features in beverages after the aging period. Oak also provides through its thermal treatment, the formation of an important aromatic class, as demonstrated by many specialized studies on this subject (CHATONET, 1995; VIVAS, 1998; MOSEDALE, 1996).

In Brazil, the main alcoholic beverage is sugar cane spirit, which has been incorporating new production technologies to compete with other distillates produced worldwide, such as rum, whiskey, and cognac, among others.

During the manufacturing process of the barrels, one of the most important procedures is the heat treatment of the wood. This practice (the thermal treatment) is not applied in a

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systematic way in Brazil, but it is believed that it could improve the competitiveness of Brazilian woods in relation to oak.

In the attempt of assessing the influence of hydro-alcoholic model solutions of sugar cane spirits on this procedure, different species of wood, including thermo-treated and non-treated woods, were compared through sensory tests.

Due to the large variation of sugarcane spirit characteristics, and to its agricultural origin (sugarcane varieties, handling, and climate conditions), and also for being submitted to industrial processes (fermentation, distillation etc.), sugar cane commercial brands present large variety, which makes the scientific evaluation of the true influence of the wood on the drink difficult.

Therefore, this experiment used a sugarcane spirit model solution with alcoholic graduation of 55% in volume, which is the average concentration used in industry before the aging process.

2 Materials and methods

The woods used in this study were Amburana (*Amburana cearensis*), balsam (*Myroxylom balsamum*) from Brazilian forests and oak (*Quercus* spp.) imported from the United States. Firstly, the samples, obtained from the barrel industry, were reduced to chips with approximately 3 cm^2 in area and an average thickness of 3 mm, and then submitted to thermal treatment in Furnace-type electric oven under constant temperature of 175 °C for 120 minutes, as proposed by Francis, Sefton and Williams (1992).

Next, a hydro-alcoholic model solution was prepared (ethanol/deionized water) with 55% (v/v) of ethanol and pH 4.25, adjusted with acetic acid, to perform the extraction of compounds from the wood according to model proposed by Mosedale (1995). A total of 4 g of sawdust were then added to 200 mL of solution to extract wood compounds.

The extraction lasted eight hours under continuous agitation and controlled temperature of 20 °C (± 3 °C). Next, the extracts were filtered and stored (VIVAS, 2001).

Samples of amburana, balsam and oak model solutions, in their thermo treated and non-treated forms, were diluted with deionized water to a concentration of 21% ethanol before being sensorially analyzed (MOSEDALE, 1996). The following tests were applied.

2.1 Triangular test

Species of thermo-treated and non-treated wood were evaluated for their aroma. Three coded samples (two equal and one different) were simultaneously presented, and none of them was identified as the control. The tasters were asked to indicate which of the three samples differed from the other two.

The sensory test was conducted with 24 untrained tasters from both sexes, aged between 20 and 50 years, in individual cabins of sensory evaluation equipped with red lights, using transparent glass cups serving around 20 mL of sample for the aroma evaluation (DUTCOSKY, 1996; CARDELLO; FARIA, 2000). The samples were randomized, according to Cochran and Cox (1966).

It is important to remember that, as the sensorial analysis was limited only to the evaluation of aroma, this experiment did not require the ethics committee approval (Chart 1).

2.2 Preference ordering test

The ordering test allows the comparison of three or more samples concerning a given attribute and consists of presenting the samples in a random and balanced way. The tasters are asked to list the samples in crescent order according to their preference. The results are calculated by the sum of scores for each sample and statistically evaluated by the Friedman's test using the data from the Newell and MacFarlane table (ASSOCIAÇÃO..., 1994).

The six samples were coded and simultaneously presented to 36 untrained tasters in a random way, according to Cochran, Cox (1966). The tasters were asked to list the samples in crescent order according to the aroma of the different solutions. The tests were performed under the same conditions used in the preference test as described above (DUTCOSKY, 1996) (Chart 2).

3 Results and discussion

3.1 Triangular test

The triangular test evaluated the existence of significant differences between samples that suffered different treatments (thermo-treated and non-treated wood from the same species).

Each test involved a team of 24 tasters, and the probability level adopted was 0.001. Thus, the minimum number of responses required by the significance table of the triangular test (DUTCOSKY, 1996) was 16 hits.

Chart 1. Model of form used in the sensory evaluation of the difference test.

Difference test – triangular	
Product: sugar cane spirit solution	Date:
Attribute: aroma	Taster name:
Tree samples are presented. Circle the one sample that is different from the other two:	
_____ _____ _____	

Chart 2. Model of card used in the sensory analysis of the preference ordering test.

Preference test– ordering					
Product: sugar cane spirit solution				Date:	
Attribute: aroma				Taster name:	
Please taste the aroma of the samples and list them in crescent order according to your preference					
Preference:			Sample number:		
01	02	03	04	05	06
Liked very much					Disliked very much

The 24 responses obtained were composed of 17 hits and seven errors, or 71% of tasters could distinguish significant differences between treatments (thermo-treated and non-treated woods) for the aroma of amburana sugar cane spirit solutions. For balsam, the responses were composed of nineteen hits and five errors, or 79% of testers could distinguish a significant difference between treatments for the aroma of sugar cane spirit solutions. The responses for the aroma of oak sugar cane spirit solutions were composed of eighteen hits and six errors, or 75% of tasters observed a significant difference between treatments (thermo-treated and non-treated wood).

Thus, for the three species of wood examined, significant sensory differences were observed between thermo-treated and non-treated wood samples for the aroma of sugar cane spirit solutions.

3.2 Preference ordering test

This test aimed to compare several samples on the aroma of sugar cane spirit solutions and to assess the preference of consumers in relation to the three woods (amburana, balsam and oak) in the two treatments (thermo-treated and non-treated wood). The results were evaluated by the Newell and Mac Farlane's table, cited by Dutcosky (1996), where the critical difference between the overall ordering would have to be greater than or equal to 46.

Table 1. Sum of scores given by tasters to the different treatments.

	Amburana	Balsam	Oak	Thermo – treated Amburana	Thermo – treated Balsam	Thermo – treated Oak
Sum of scores	91	82	137	141	136	170

Table 2. Ordering of preference of samples in relation to the aroma of the solution*.

Species	
Thermo-treated oak	a
Thermo-treated amburana	a
Oak	a
Thermo-treated balsam	ab
Amburana	bc
Balsam	c

* Preference ordering test – Newell and Mac Farlane.

The ordering-preference test on the aroma of the solutions showed that thermal treated oak extract was the most preferred, followed by thermo-treated amburana, non-treated oak and thermo-treated balsam without significant differences. The last ones in preference were thermo-treated balsam, non-treated amburana, and finally, non-treated balsam.

4 Conclusions

The difference test showed, for the three species, that it was possible to distinguish, in terms of aroma, thermo-treated samples from non-treated ones in solutions obtained from the same wood.

The ordering test showed preference for thermo-treated oak, thermo-treated amburana, non-treated oak and thermo-treated balsam, but with higher scores for thermo-treated oak.

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