CHAPTER 47

Paraty the estrada real: the chemistry of cachaça aging

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Elias de Souza Monteriro Filho
UNESP - Institute of Chemistry
Rua prof. Francisco Degni, 55 – Araraquara, SP,
CEP: 14.80-0060

Angelica Ramos da Luz
UNESP - Institute of Chemistry
Rua prof. Francisco Degni, 55 – Araraquara, SP,
CEP: 14.80-0060

Raul Natale Junior
UNESP - Institute of Chemistry
Rua prof. Francisco Degni, 55 – Araraquara, SP,
CEP: 14.80-0060

Miguel Ruiz
UNESP - Institute of Chemistry
Rua prof. Francisco Degni, 55 – Araraquara, SP,
CEP: 14.80-0060

João Bosco Faria
UNESP – Faculty of Pharmaceutical Sciences
Rod. Araraquara - Jaú Km 1, - Araraquara, SP,
CEP. 14801-902
E-mail: fazjb@fcfar.unesp.br

Sinara Munich
UFSM – PPG Science Education: Chemistry of Life and Health Av. Roraima, 1000, Santa Maria - RS
CEP 97105900
E-mail: sinaramunchen@yahoo.com.br

Martha B. Adaime
UFSM – PPG Science Education: Chemistry of Life and Health Av. Roraima, 1000, Santa Maria - RS
CEP 97105900

Leinig Antonio Perazolli
UNESP - Institute of Chemistry
Rua prof. Francisco Degni, 55 – Araraquara, SP,
CEP: 14.80-0060
E-mail: leinig.perazolli@unesp.br

ABSTRACT
Since the development of the Gold Cycle, Paraty has shown prominence in the production of cachaça, which was consumed both by the national market and by slaves in Africa and by gold in the mines, being transported by the Estrada Real. The transport was carried out in oak barrels outside the country and in national wood barrels for the local market. Over time it was observed that each type of wood incorporated different odors and flavors to the cachaça. Considering that the cachaça is produced from the fermentation of the juice, different from the Rum, which is produced from the fermentation of molasses, and that the aging in different types of wood added specific sensory and chemical characteristics, allowed to establish the Cachaça as a genuinely Brazilian product.

Keywords: Paraty, History, Chemistry, Cachaça, Aging.

1 INTRODUCTION

Cachaça is the second most consumed beverage by Brazilians, with consumption estimated at 70 million daily doses (Lima et al, 2006). This drink is very appreciated for its flavor and characteristic aroma, from the fermentation, distillation and optionally aging.

To be considered aged, the final composition of the product must be at least at least 50% of its volume aged in wooden barrels, for a minimum period of one year

(Odello et al, 2009). The specific sensory characteristics of the drink are given by the presence of hair at least 1% by mass of secondary compounds such as higher alcohols, esters, carboxylic acids

and carbonyl compounds that are formed during the production and aging of brandy (Nascimento et al, 1998).

Considering the importance of this product in the Brazilian historical, economic and social scenario and the possibility of its approach in the teaching of chemistry, a historical and

chemistry of cachaça for the construction of a reference material for the study of the theme, as well as and for planning educational activities.

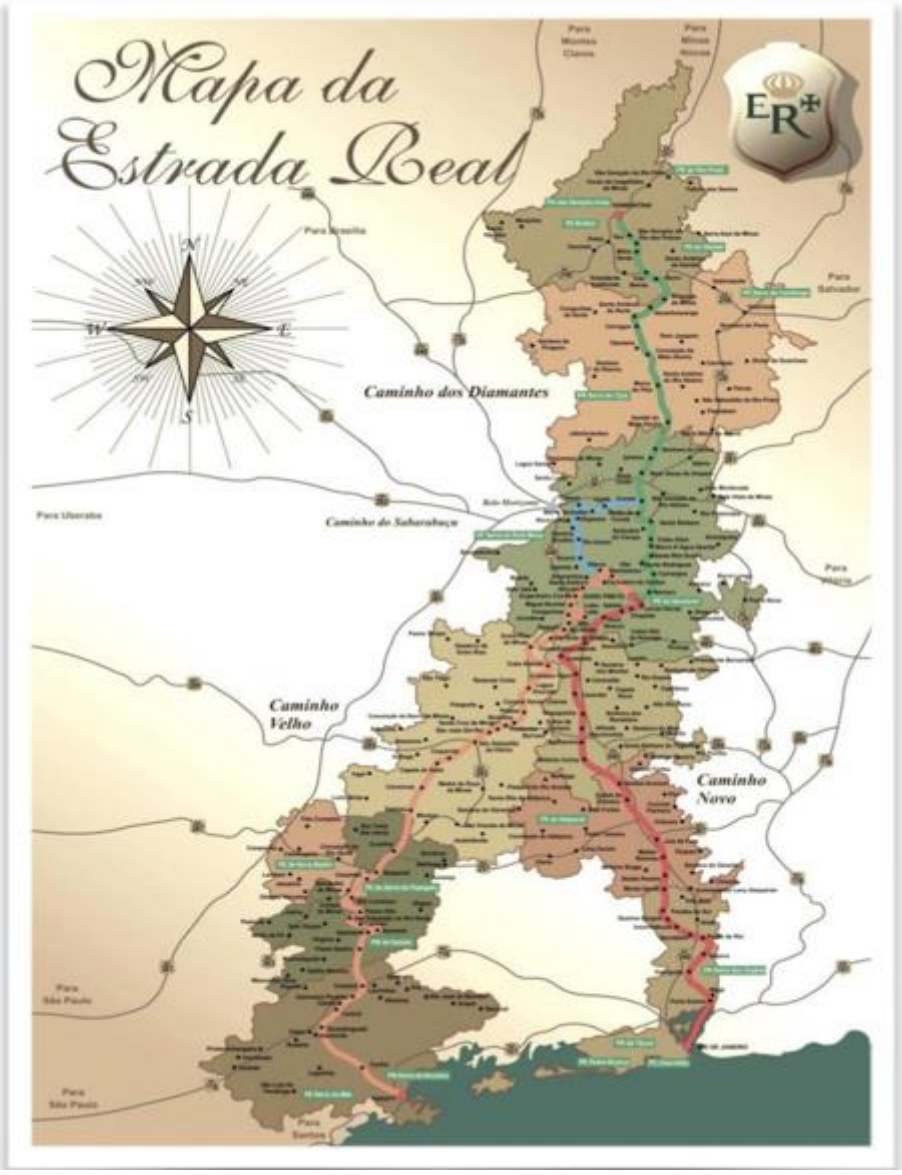
2 THE ROYAL ROAD AND THE AGING OF CACHAÇA: ASPECTS HISTORY

With the discovery of gold in the region of Minas Gerais, at the end of the 17th century, the focus of Brazilian economy abandoned the already decadent production of sugar to start the extraction of

ores. To ensure that all due taxes from this mining would be paid to the Crown

Portuguese, the government built and forced that all the flow of gold and slaves was done through of Estrada Real, which created an important trade route linking the region of Paraty and the mines, to the capital, in Rio de Janeiro, illustrated in Figure 1.

Figure 1: Map of the old and new Estrada Real



In addition to supplying the national market, cachaça was also an important commodity in the exchange when trading slaves with African tribes. So that the drink could be taken to Europe or Africa, it was required that the barrels used for storage and transport were made in oak. The reason for this requirement was due to the contact of the wood with the beverage. ended up altering the sensory characteristics of the product. Since it is already used in the storage of other European spirits, oak provided the characteristics that least clashed with other traditional European drinks.

Obtaining these oak barrels and vats turned out to be an expensive and complicated task, a since the country did not have the necessary oak for the production of these barrels. Due to this question, cachaça destined for export was stored and transported in oak barrels brought from Europe, while the barrels intended for local consumption were made with wood national species that showed adequate physical characteristics, such as Ipê-amarelo, Umburana, Balm, Sassafras or Peanut.

Both the long travel times and the local storage in these barrels caused sensory changes related to the aging of the drink, which conferred characteristics color, flavor and aroma of cachaça, related to each type of wood used (Trindade, 2006; Miranda, 2008).

3 AGING: CHEMICAL ASPECTS

3.1 THE CHOICE OF WOOD

The aging of cachaça is an important parameter for improving its quality sensory, since this stage affects from the intensity of the color, which acquires tones ranging from a light yellow to tones close to brown, to the aroma and flavor, which starts to have characteristics woody, sweet, or fruity, depending on the aging time and the wood used.

In addition, the process also reduces sensory factors considered negative, such as acidity, the intense alcoholic flavor (Otello et all, 2009).

During the cachaça storage process, it is considered as an aging process.

only the situation in which the product is stored in a barrel or wooden barrel for a period of at least one year. The types of wood most chosen for the construction of barrels are balsam,

jatobá, umburana, canéla-sassafras, jequitibá, yellow ipe or peanut. At this stage, the contact

drink with the wood of the barrel will gradually provoke several chemical reactions that will change the final product.

Figure 2: The different stages of aging of cachaça

Due to the semi-permeability of wood, the aging process allows both the loss of certain components to the environment, such as water and ethanol, as the entry of oxygen, allowing the oxidation process of the aldehydes and higher alcohols generated in wort fermentation.

Among the compounds from wood that are incorporated into the beverage, there are phenolic compounds, flavonoids (figure 3) and tannins (Dewik, 2002), as well as products of partial decomposition of macromolecules, such as lignin (figure 5) and cellulose, into monomers soluble compounds, such as aldehydes and phenolic acids (Trindade, 2006; Ventura and Giraldez, 2006).

Figure 3: Luteonin, Quercetin and Rutin. Examples of flavonoids found in woods. Observing their structures, it is possible to notice that the main structure of the molecules is very similar. The addition of different radicals generates different products.products (Dewik, 2002).

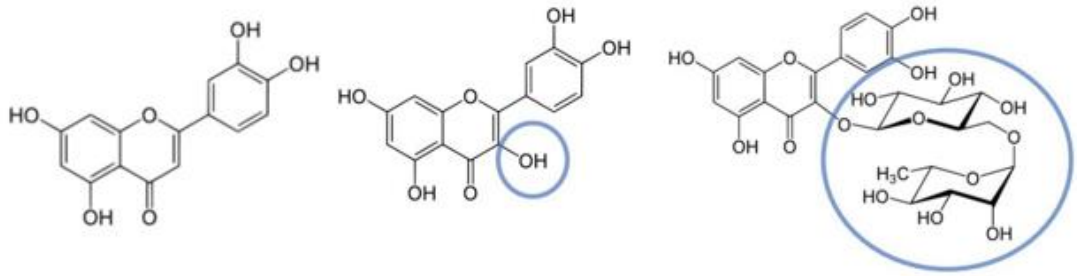
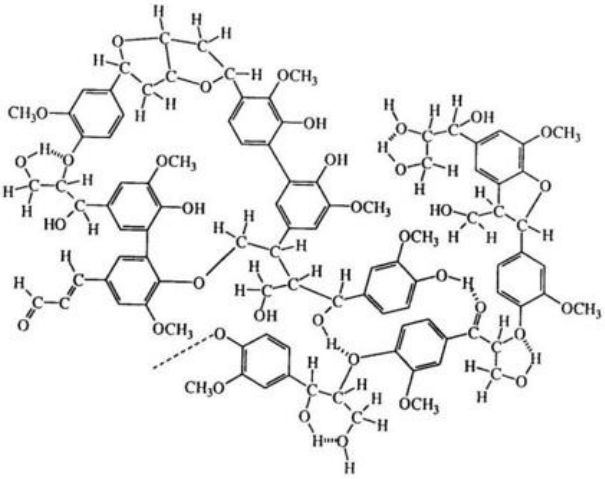


Figure 4: Example of the complexity of the chemical molecule of lignin. (Infoschool, 2012).



In order for wood to be considered suitable for the construction of barrels, it must have some features. The first one is a high density, to guarantee a good impermeability and avoid a large loss of volume of the beverage to the environment. The wood must also have good mechanical strength and durability, to reduce the risk of cracks, deformations and damage caused by the action of time or fungi and insects (Trindade, 2006).

The choice of wood will also determine which substances will be extracted for the cachaça during the aging process. Through the use of chromatographic analysis, it is possible to identify the main extracted molecules that differentiate the sensory changes caused by each woods. Figures 5 to 8 illustrate which they are. these molecules:

Figure 5: Main molecules that characterize aging in Amburana.

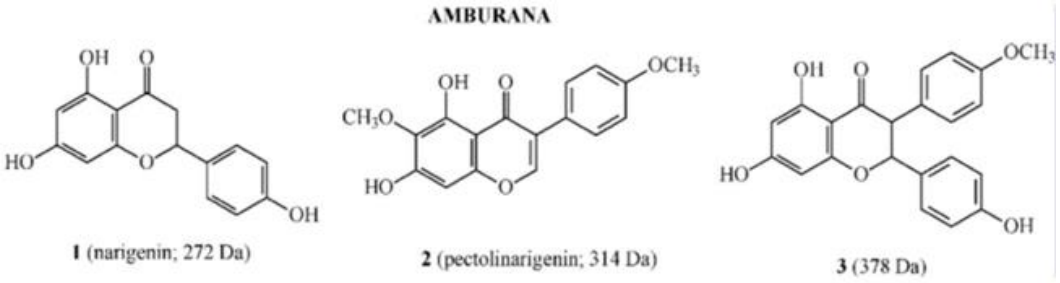


Figure 6: Main molecules that characterize aging in Jequitibá.

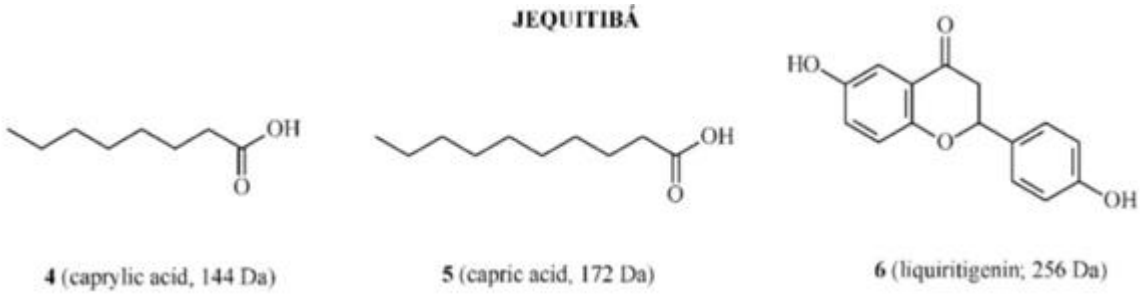


Figure 7: Main molecules that characterize aging in Balsam.

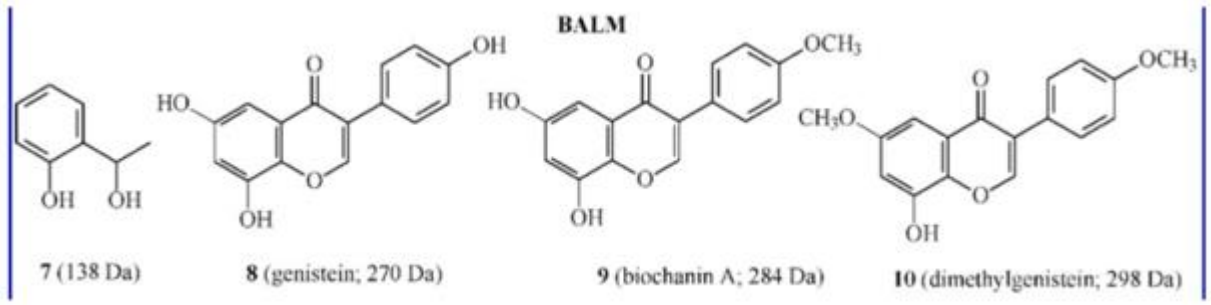
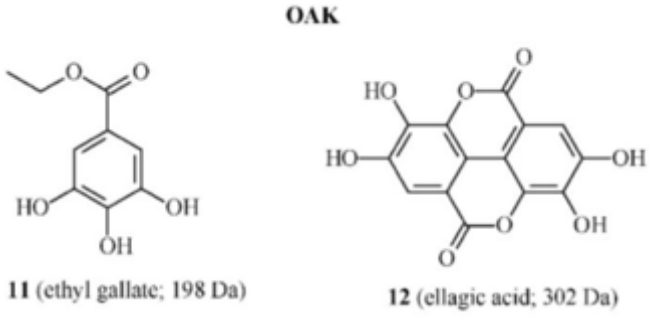


Figure 8: Main molecules that characterize aging in oak.



11 (ethyl gallate; 198 Da) **12** (ellagic acid; 302 Da)

3.2 THE REACTIONS INVOLVED IN THE AGING PROCESS

According to studies by Miranda (2008), during the aging process, the intensification in the concentration of esters, alcohols such as n-propanol, isobutyl and isoamyl. O aging is the result of a series of reactions between the chemical components of the cachaça and those that are extracted from wood, which are also responsible for the differentiated color of aged drink.

Even though the aging process is still not completely unraveled (Miranda and Martins, 2008; Pinheiro, 2003), there is a consensus regarding the chemical steps of (Boscolo) oxidation of alcohols and aldehydes for the formation of esters, as well as the extraction, decomposition and esterification of wood lignin. At this stage, the formation of the complex ethanol-lignin, which degrade into coniferyl and synaptic alcohols, later oxidized to esters, which are the main responsible for attributing the characteristic flavors and aromas of each wood to the liquor.

In this third step, there is also the elimination of sulfur compounds, such as thiols, the dimethylsulfide and mercaptans, which are eliminated due to their high volatility.

Figures 9 and 10 illustrate the esterification process, in which aldehydes and acids carboxylic acids resulting from fermentation and distillation react to form esters and water. This process is responsible for giving the aged cachaça a smoother flavor. After the processes described, the cachaça will be ready to be bottled and sold.

Figure 9: Example of the process of oxidation of aldehydes to carboxylic acids (Acetaldehyde plus oxygen to acetic or ethanoic acid).

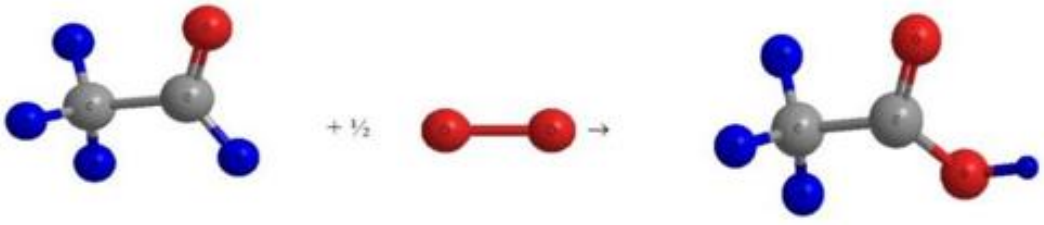
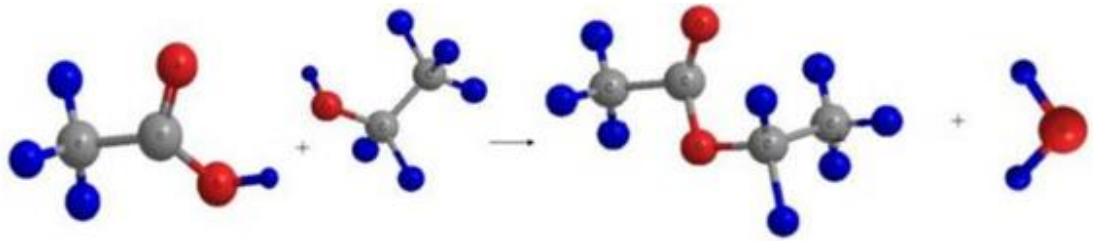


Figure 10: Example of the process of esterification of carboxylic acids to esters. (Acetic acid plus ethanol for ethyl acetate and water).



All chemical reactions and dissolution processes of wood compounds during aging of cachaça, as well as other alcoholic beverages, allow the formation of large clusters of molecules, including esters, higher alcohols and aldehydes, which are in equilibrium with the ethanol, which is noticed in the form similar to an oil that flows in back of the cup immediately after being rotated/shaken so that the liquid wets the inner walls. It is formation is called “choro” or “tears of cachaça” (Figure 11).

Figure 11: Crying or tears from cachaça. Photo: Leinig Antonio Perazoli.

4 CACHAÇA IN CHEMISTRY TEACHING

There are several documents that guide curricula in Brazil, such as the Parameters National Curriculum for Secondary Education (PCNEM), National Curriculum Guidelines for High School and Educational Guidelines Complementary to National Curriculum Parameters (PCN+) (BRASIL, 1999; 2006; 2002) that make references to the contextualization and adoption of themes as strategies for approaching scientific knowledge. In Curricular Guidelines National for High School, everyday themes are pointed out as relevant:

An approach to social (everyday) themes and an experimentation that, not dissociated from theory, are not intended or mere elements of motivation or illustration, but effective possibilities of contextualizing chemical knowledge, making them socially more relevant. (BRAZIL, 2006, p.117)

Starting from everyday situations, one can seek the necessary knowledge to understand them. and, in this sense, cachaça can be a topic for the development of chemical knowledge, since that its production process involves several important concepts and processes related to distillation, fermentation, organic compounds, among others.

The work by Pinheiro et al (2003) surveys the history, production and chemical composition of cachaça, and points out some ways of deepening the theme in chemistry. Some examples cited are activities with label analysis, use of song lyrics known, presence in Brazilian cuisine, debates about its consumption, interactions between alcohol and human organism, among others.

Venquiaruto (2012) when researching in his thesis the popular knowledge of bread, wine and cachaça in a specific region of Rio Grande do Sul, addresses the production method of this drink by peasants. In addition, it relates chemical knowledge and the school context, and proposes some experimental activities for development in the discipline of chemistry that bring aspects related to cachaça, such as the formation of azinhavre.

The scientific and technological aspects are directly linked to the contributions of science in the production process, such as the separation of head, heart and tail in distillation, the technological artifacts such as equipment needed for distillation, as well as aspects related to the consumption of the product, its benefits and harms to the functioning of the human organism and behavioral changes. Therefore, we point out that this would be one of the possible approaches to the subject of cachaça at a medium or higher level in view of the knowledge chemicals, as it allows for a broader discussion, considering aspects of everyday life and problematizing important issues in society.

5 FINAL CONSIDERATIONS

Cachaça is a denomination by law, typical and exclusive of the sugar cane spirit produced in Brazil, a product established both in the historical characteristics of the production process and in chemical characteristics. This work studied the production process, transport in barrels of national woods and the aging of sugarcane brandy, exemplifying the conditions historical landmarks in the 16th to 18th centuries between Paraty and Minas Gerais, joined by the Estrada Real, which led to the production of cachaça, now recognized as a genuinely Brazilian product, representing an interdisciplinary tool for teaching sciences as different as History and Chemistry, both for higher education and secondary education.

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