THE Rum UNIVERSITY

Rum Appreciation In The 21st Century

Lesson IV

Lesson IV: Distillation Methods Part I: Pot Still Rums

Yeast: The Unsung Hero

Saccaromyces cerevisiae is the most exploited microorganism known to mankind. It is the primary yeast used for the production of virtually all potable and industrial (non potable) ethanol. According to G. M. Walker, author of "Yeast Physiology and Biotechnology," ethanol is quantitatively and economically the world's premier biotechnological commodity. In the year 2000, there were about 24 billion liters of ethanol produced worldwide.

The fermentation of molasses in the rum industry differs from that of feedstocks (such as corn, milo and potatoes) in that feedstocks contain carbohydrates stored as starch. Because of this, the feedstocks must be pre-treated by cooking and enzymatic action to hydrolyze the starch into fermentable sugars. On the other hand, the carbohydrates in molasses are already in the form of sugars so they do not require any pretreatment.

When producing sugar from sugarcane juice, the cane is crushed in a mill. The crushing causes the juice to be extracted from the cane. Once collected, the juice is heated, clarified (through filtration and the addition of lime) and then evaporated to concentrate the sugar and cause it to crystallize. The remaining syrup is then centrifuged to separate the crystals from the syrup. Once the crystals have been removed, the remaining residue is referred to in the industry as "Grade A Molasses." This syrup is then evaporated once again to collect even more sugar crystals. The subsequent remaining syrup is then referred to as "Grade B Molasses." This process is sometimes repeated one more time to extract even more sugar, yielding a "Grade C Molasses" as residue.

Sugar factories normally evaporate and centrifuge the syrup a maximum of three times. The decision to process more or less times is based on the price they can sell the sugar for, versus the price they can sell the molasses with the varying levels of remaining fermentable sugars.

From a sugar production perspective, blackstrap molasses represents sugar mill waste. When the domestic (and/or international) price of sugar is high, mills strive to get as much of it out of the cane syrup, leaving behind molasses which have a very low level of remaining sugar. This is bad news for rum distilleries who depend on molasses for production of their rums, as they will need a lot more molasses than before in order to distill the same amount of alcohol.

How much sugar do I need to make rum?

In the early days, long before industrialized sugar mills, the sugar plantation owner's table of equivalence looked something like this:

1 Acre of Land equals
10 Tons of sugarcane, equals
1 Ton of sugar, equals
30 Gallons of Rum

Today's formula (a bit more technical), based on sugar-rich molasses, looks like this:

1 Ton molasses with 46% fermentable sugars = 920 pounds of sugar. Based on the Gay-Lussac equation for ethanol production from glucose by fermentation, this is equal to 470.21 pounds of ethanol, which is equal to 71.46 gallons of ethanol. Using the Pasteur Yield (which is a formula based on a statement by the notable scientific that it is impossible to get more than 95% of the maximum theoretical yield), we have an adjusted value of 67.89 gallons. This last number needs to be adjusted even further by a value which represents "plant efficiency," which denotes the extent to which the plant's equipment and processes can get close to the Pasteur Yield. The average plant efficiency is around 90%, which gives as a final number of 61.10 gallons per ton of molasses. What a difference technology makes!

Enough said about the sugar industry. This is not, after all, supposed to be a course on sugar processing. Let us focus our attention now on what happens once our friend Saccaromyces cerevisiae gets to know his sweet friends.

The Basics of Fermentation

By definition, fermentation (performed by yeast) is the exothermic process (one which liberates energy in the form of heat) of converting sugars into alcohol and carbon dioxide gas. In addition to sugar, nitrogen and phosphorus are necessary for the growth and reproduction of new yeast tissue. There is usually a sufficient amount of phosphorus in sugarcane juice and in molasses, but not nitrogen, which is very often added before the fermentation process as a nutritional supplement for the yeast.

Fermentation in the context of rum refers to the process by which yeast acts on a sugar-rich liquid (or "mash") to convert as much of the sugar as possible into alcohol. In the French West Indies, this sugar-rich liquid is nothing more than pure sugarcane juice. In the rest of the sugar-producing world, the liquid is (more often than not) molasses diluted with water. In this later case, molasses is the thick residue obtained from the extraction of sugar crystals from the sugarcane juice. The sugar content of molasses varies from one source to another, but tends to be in the 30-40% range. However, as sugar mills become more modernized, extraction methods tend to reduce this percentage considerably, with direct negative consequences to the rum industry. The lower the sugar concentration in the molasses, the lower the amount of rum that distillers will be able to produce.

If you ever visit a rum distillery that ferments in open containers and have the opportunity to observe a (large) fermentation tank during its vigorous fermentation state, you will see that the liquid in the tank appears to be boiling violently, producing a large amount of carbon dioxide. While there is a certain amount of heat being released, the temperature is nowhere near boiling, and the vigorous fermentation is the result of the work of the particular strain of yeast employed by the distillery.

Regardless of the fermentation process used, one of two things can happen that will affect the yeast in the mash:

a) if the amount of sugar is high enough, the concentration of alcohol can reach a level at which the yeast is no longer able to survive, or

b) the amount of heat produced during fermentation can raise the temperature of the mash to a point that kills the yeast. Because it would be wasteful to have either of the previous scenarios occur, the concentration of sugar (either from the molasses or the cane juice) has to be measured and adjusted before the yeast is added to the mash.

By definition, distillation is the process of separating one element from many others in a liquid solution through a process of boiling and condensation of vapors. Distillation is an essential part of making rum. Its first objective is to separate the alcohol from the fermented wash produced during the fermentation process. Its second objective is to remove the undesirable congeners from the alcohol and to retain the desired ones.

Once fermentation takes place, the resultant wash has an average of about 6% to 8.5% alcohol, which is separated from the rest of the liquids and solids through distillation.

During distillation, heat is applied to a liquid mix until it reaches boiling. At this point, the vapor being released has a high concentration of the element in the mix with the lowest boiling point. Once this component has been evaporated from the mix, if heat continues to be applied, the element with the next lowest boiling point will commence to evaporate, and so on. Proper distillation and condensation techniques allow for a high degree of separation of components from a liquid mix. There are two distinctive types of distillation devices: pot stills and continuous distillation columns. In this lesson we will focus on pot stills (also known as "alembic stills"). The continuous distillation columns will be covered in detail in Lesson V.

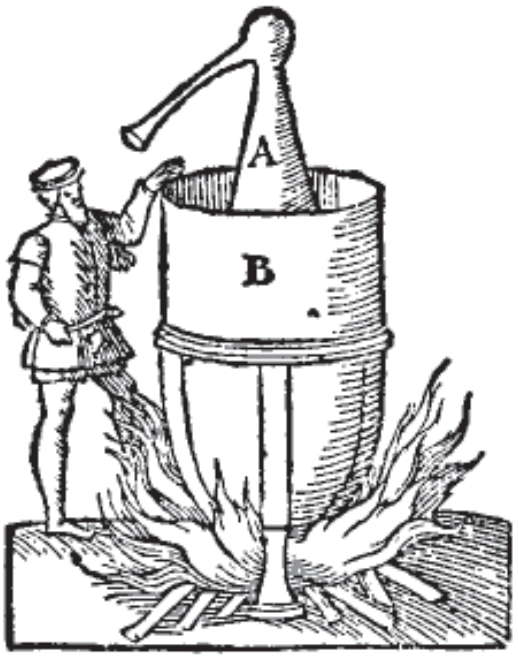
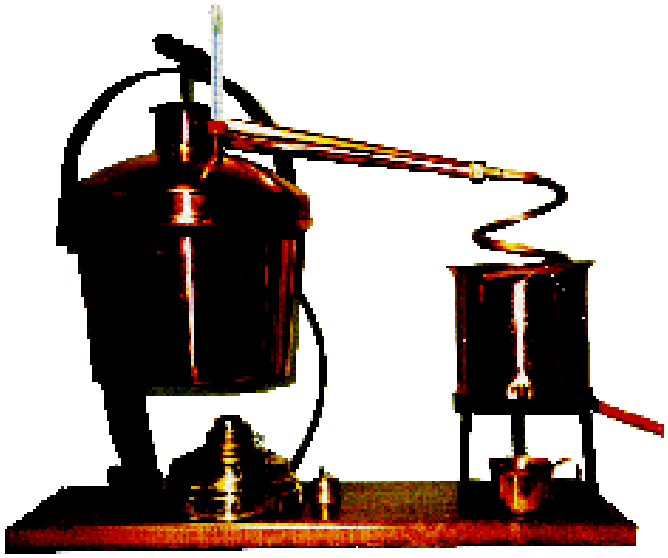


Illustration of an early still. "A" is the neck of the still and the body is contained in "B".



Pot still with retort and condenser.
Picture from: **www.schnapps.co.at**

Pot stills are the earliest distillation devices (also used in the production of Brandy and Single Malt Scotch). A basic pot still consists of three parts: the **kettle**, where the liquid mixture is boiled, the **condenser**, which cools down the vapors coming from the kettle, and the **gooseneck**, which connects the kettle to the condenser. The liquid obtained from this type of distillation is also known as "single distillate," since it is processed through the still only once. On occasion, this liquid is processed a second time, thus producing a "double distillate" which is cleaner and stronger than the single distillate.

Most of the alcohols created during fermentation (including ethyl alcohol) have a boiling point of around 78.5° Celsius (173.3° F). Some higher alcohols boil at lower temperatures than others. Since this boiling point is much lower than that of water, when the fermented mass is heated, these alcohols are the first ones to evaporate. This allows the distillers to separate them from the undesirable byproducts and remnants from fermentation. The first alcohols to come out of the still

are commonly referred to as the “heads” or “high wines” and contain a large amount of aldehydes and esters. These alcohols are responsible for some of the fruity aroma found on the distillate. Following a very small amount of “heads,” the still begins extracting mainly ethyl alcohol (or ethanol), from the fermented liquid. This goes on until very little alcohol is left in the pot still, when the “tails” or “low wines” come out. The “tails” part of distillate contain fusel oils, which are the heaviest alcohols produced during fermentation.

There are several schools of thought when it comes to separating the heads and the tails from the ethanol. In some schools of thought (ie. Puerto Rican), the rum has to be as clean as possible. In other words it should be as free from aldehydes, esters and fusel oils. Other schools of thought, however, advocate the presence of fusel oils (ie. Trinidad) in the rum. At the end of the day, it is a matter of personal preference.

Hands-on Exercise: The Original Heavyweights

In the beginning, all rums were distilled using pot stills. Today most rums in the world are produced using continuous distillation columns.

For this exercise you will need your Rum Essence Kit (Lesson I). If you don’t have one, you still have time to put one together. We’ll continue referencing it during the remaining lessons in this course. Please read Lesson I if you need instructions.

You will need:

White Rum jar from the Rum Essence Kit
Molasses jar from the Rum Essence Kit
1 or 2 bottles (or samples) of 100% Pot Still rum. If you don’t have any at home, visit your local liquor store and look at the labels. Many rums from Guyana and Jamaica are still made with pot stills.
1 Snifter

Directions:

As we described in Lesson II, all rums start their lives as white, un-aged alcohol. It is only appropriate, then, for us to start this exercise by examining the White Rum stored in our jar. Evaluate the aroma, looking for traces of molasses or any other sweet elements. If your white rum is aged, look for and evaluate any traces of oak that may be present. Try to describe with words the feelings you are experiencing. The collective sum of these “feelings” is referred to in the industry as the “Organolepic” characteristic of a rum. Once you are satisfied with your assessment of the white rum, reach for the pot still rum. Pour about 1 to 2 ounces of the pot still rum into the snifter. Make sure you do not overfill the snifter, as doing so will increase your chances of having accidents when swirling the snifter.

Now it is time to evaluate the color. As you may recall from Lesson III, gold and dark rums often get their color from tannins and/or caramel. In some cases, distillers add molasses to the finished product to give it the sweetness and color they desire. Using your sense of olfaction alone, try to determine the source of this rum’s rich, dark color. You may find it useful to revisit the Molasses jar to verify your findings.

Now use your sense of taste to further analize the rum. Are there tannins present? Is there a marked oak taste? If so, you are probably looking at a pot still rum which has been aged for more than a couple of years. If no tannins are present and there are no traces of oak/wood elements, it is very likely the color was added in the form of caramel.

Once your evaluation of the sample is complete, empty the snifter and let it air dry. Wait at least an hour and come back to smell the empty snifter. Now that the alcohol has evaporated, what is left behind? In many cases, oak elements do not show up fully until/unless you perform this step. So don't be too quick to judge a rum until you've taken the time to thoroughly test it.

Optional Exercise:

Prepare a small amount of caramel (you can use leftover caramel from the Lesson III exercise). Set it aside and let it cool a bit. Pour a couple of ounces of white rum into a jar or glass. Slowly start adding very small amounts or pieces of caramel to the white rum, stirring constantly until the caramel is dissolved before adding more. Notice the color changing. Once you achieve a golden-amber color, STOP.

Compare the aroma of the caramelized sample to that of the white rum. Now compare the taste. Caramel tends to be almost odorless and tasteless when used in very small amounts. The more caramel you add to the sample, the easier it will be to detect it with your palate.

From the Rum Bar: Featured Cocktail

This is Lesson IV. If you've been with us since Lesson I , then you are already on your way to becoming a modern day Rum Runner. What better time then, to introduce you to the classic rum cocktail that shares that name.

Rum Runner #1

1 oz. White (or Dark) Rum
1 oz. Banana Liqueur
1 oz. Blackberry Brandy
1 tsp. Grenadine
5 oz. Sweet & Sour Mix
Shake with ice and strain into a cocktail glass.

Rum Runner #2

1/2 oz. Dark Rum
1/4 oz. Over-Proof Rum
3/4 oz. Banana Liqueur
3/4 oz. Blackberry Brandy
1/2 oz. Grenadine
3/4 oz. Lime Juice

Mix in a blender with ice. Serve in a 12-ounce glass. Yields:1.

Rum Runner #3

1 oz. Rum
1/2 oz. Blackberry Brandy
½ oz. Crème de Banana
Splash of Pineapple Juice
Splash of Orange Juice
Dash of Grenadine

Shake and serve on the rocks in a tall decorative glass. Float a bit of Dark Rum on top. Garnish with an orange wheel and a maraschino cherry.

Lesson 4 Questionnaire

Q: What determines if a sugar mill produces Grade A, B or C molasses?

Q: What grade of molasses is better for the production of Rum?

Q: What grade is Blackstrap molasses?

Q: What is added during fermentation as a nutritional supplement for the yeast?

Q: What type of gas is released during fermentation?

Q: What are the basic parts of a pot still and what are their functions?

Q: What are “Heads” and “Tails”?

Q: List three different ways in which a white rum could be transformed into a dark rum.

Answers to Lesson 3 Questionnaire

Q: In which way does the aging process resemble alchemy?

A: Alchemy is defined as the transformation of plain metals into gold. Aging transforms white alcohol into a "liquid gold."

Q: Where do most barrels used in aging of rum come from?

A: From the USA from bourbon distilleries.

Q: Describe the 3 main transformations that take place during the aging of rum.

A: **Esterfication**- reaction between acids and the ethanol or other alcohols, **Condensation**- molecules such as aldehydes and alcohols combine to form acetals and **Oxidation**- as air passes through the wood barrels causing the ethanol to oxidize into acetaldehyde which in turn will oxidize into acetic acid, then undergoes esterfication to ethyl acetate.

Q: If identical rums are made in two different climates, which rum will age faster?

A: Rums aged in tropical regions will age faster than those rums of colder climates unless the rums are aged in a temperature-controlled warehouse.

Q: What do we mean when we say that alcohol right out of the still is hygroscopic?

A: It means that it draws moisture out of anything it comes into contact with.

Q: Is it safe to drink moonshine?

A: Absolutely not! There are no health standards or regulations to control what is actually being distilled. Some ingredients that have been found in moonshine are lye, rubbing alcohol, paint thinner and formaldehyde (to name a few). As a result, it has been reported in the past that some people have gone blind, both temporarily and permanent. Also, some people have been known to be crippled with partial paralysis, sometimes resulting in death.

Q: What are some of the characteristics associated with the presence of tannins in a food or drink?

A: You may experience a dry bitter taste coating your mouth. Some examples are: grape skin, apple skin and walnuts.

Q: What are the two main methods employed to measure tannin levels?

A: One method is the Lowenthal permanganate titration- expresses the tannin in arbitrary percentage units and the second method is the Folin-Ciocalteau- expresses the tannin in terms of "total phenolics as gallic acid equivalents (GAE)".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Prichards' Fine Rum
A True American Spirit

A Brief History Of Rum in America

Think of Rum and visions of the tropics with its palm trees, fruity concoctions garnished with paper umbrellas may come to mind. Rum however and the role it played in the building of America is often forgotten.

The history and production of rum is older than America itself. The Pilgrims brought the distilled spirit with them on the Mayflower. From the mid 1600's to the early 1800's, rum played a major role in shaping the economic, political and social practices of early Americans. Rum was truly America's spirit of choice. Among the contents of his wine cellar, Thomas Jefferson listed 83 bottles of rum. Rum was so popular, it was supplied as a regular daily ration to the American military as late as 1862.

Long before the early settlers began to grow the grains necessary for the production of whiskey, rum distilleries flourished throughout the New England Colonies. In Rhode Island alone, over thirty distilleries produced rum from pure molasses from the West Indies and the Caribbean. In 1750, there were more than 60 rum distilleries in Massachusetts. Many are surprised to learn of the "Great Molasses Disaster" of Boston when 2½ million gallons raced down Commercial Street at a crest of 30 feet! The molasses was the property of the Purity Distilling Company!

Rum was instrumental to New England becoming the center of the distilling industry from the mid 1700's. Distilleries, clustered around Boston and Medford, Massachusetts and around Newport, Rhode Island, shipped rum to Africa where it was traded for slaves. New England, Africa and the West Indies became known as the slave triangle and rum was the reason for its existence and provided the financing for slavery in the American South.

Rum was colonial America's greatest export and New England's most profitable industry. Recognizing this market, the British Parliament attempted to increase its share of the rum market in 1733 by imposing taxes on molasses imported from foreign islands. This tax and the tax on tea led to American petitions, boycotts and ultimately to the American Revolution. The American taste migrated from rum to whiskey after that war and for almost two hundred years, little rum was consumed in this country.

The "New Rums"

It was another American war that resurrected the American taste for rum. As World War II ended, GI's returning from the Pacific with a taste for exotic drinks, fueled the new demand for rum. American tourists visiting the Caribbean enjoyed Mai Tai's and Planter's Punch made with rums, light on flavor and clear in color. Then with paper umbrellas, and a myriad of fruity concoctions, they have devised many other ways to make this rum of the tropics enjoyable.

The new rums of the post war period however, are distilled from a molasses unlike the molasses used to make the early American rums. Today, the large sugar refineries have learned to extract virtually every available sugar granule from each gallon of molasses to make white table sugar. The by-product, of this process is called "Black Strap", a thickened goo of a sticky residue, having a disgusting taste, a terrible smell and a limited fermentable sugar content.

Because it is cheap, black strap has only two common and viable uses. It can be mixed with animal feed to provide an increased source of carbohydrates for livestock and it can be used to make rum. Only through the use of column stills and multiple, high distillations, coupled with aging in used whiskey barrels, can the rum made from black strap become palatable.

As American As Apple Pie

America's rums were very different from the modern rums of the tropics. The first American rums were made from the same wonderful, sweet molasses that was used to make baked beans, brown bread and Indian pudding. Molasses was the sweetener of choice of the early American settlers who poured it over their pancakes and cornbread and since granulated sugar was either very expensive or non-existent in the new American colonies. Yes, it was even used by Martha Washington to make her apple pies.

Prichards' Fine Rum is an accurate recreation of America's first distilled beverage, rum. Our rum is made from sweet American molasses from the plantations of Louisiana and distilled in traditional copper pot stills using the techniques of the old master distillers. It is hardy in its flavor straight out of the still, bold and stout when aged in a proper barrel and truly a pleasure to sip as one would a fine brandy. Prichards' Fine Rum is most certainly, nothing like the rum of the tropics we have come to know today.

In an age of assembly line production and an exodus of job opportunities to overseas manufacturing, the words "hand crafted" and "American made" seem to have little relevance in today's market opportunities. Even in the production of classic American distilled spirits, the trend towards acquisitions and mergers, coupled with the development of column, continuous run stills has depersonalized this industry greatly. A bold new opportunity presented itself with the possibility of producing the first authentic American Rum to be distilled in the United States since the early days of America's history.