Distillation of Spirits: Moonshining

This paper begins by giving a brief overview of the basic materials and necessary background information of distilling alcoholic spirits. Once the basics have been solidified, the article then explains the processes of distilling spirits; from creating the mash; to assembling the still; to the actual distillation process and techniques. It then concludes with the hazards and appeals of distilling spirits.

Introduction:

The consumption of alcohol has always been at the roots of American culture, starting with the pilgrims brewing shortly after disembarking the Mayflower to prevent water borne illness’, to prohibition and its creation of bootleggers and organized crime, to its prevalence in modern day social situations. Simply put, alcohol is everywhere in American society and it is entrenched in its culture, but oddly enough a great majority of our population knows little to nothing about how liquor is made.

Many people believe that “Moonshine is made in bathtubs”, “Moonshine is a ‘country bumpkin’ redneck drink and is made by such people”, “Moonshine tastes terrible”, “Moonshine is always extremely high in alcohol content”, and “Moonshine will make you go blind”. Everyone has different ideas about what moonshine is, its effects, how it’s made, and who makes it, due to the lack of information about distilling spirits available to the general public. In reality, moonshine is produced fundamentally in the same manner as the spirits that can be bought in stores, such as Jack Daniels and Smirnoff, and moonshine, like commercialized spirits, can come in all varieties and flavors such as gin, scotch, vodka, and most commonly whiskey.

Basic Distilling Materials:

Distilling spirits, at heart, is very basic. So simple you could say that almost any “country bumpkin” with a can do attitude can do it. In its most simple form, all that is required is a mash, which is a recipe of different types of sugars and yeast to produce alcoholic spirits when distilled, and a still to distill the desired alcohol out of the mash. These are the essentials of distilling spirits, and now that they have been covered we can delve deeper into their intricacies, and how they work together to produce spirits.
Creating the Mash:

The mash in its most simplistic form is comprised of fermentable sugars, spices and ingredients for added flavors, water, and yeast. In more detail, the mash is a fermentable starchy mixture from which alcohol or spirits can be distilled [2]. It is created by combining a mixture of sugar based ingredients, most commonly malted barley and other grains such as corn, rye, and wheat, with water, and then heating this mixture. This allows for the enzymes in the malt to break down the starch in the grain into sugars [3]. Once the mash has reached a safe temperature of 18⁰ C to 30⁰ C that won’t kill or stunt the production of yeast, which is a single celled eukaryotic organism, the yeast is added [4]. The amount of yeast added depends on the volume of the mash and the amount of fermentable sugars inside of it. The final step is to put the mash in an air tight container with an air lock on it and let it sit in a temperature stable climate of 18⁰ C to 30⁰ C for typically 10 -14 days, which is when all of the sugar has been used up by the yeast or the yeast has died.

As the mash sits there, the yeast metabolically converts the sugars into acids, gases, and most importantly different types of alcohol. Since the yeast, in addition to alcohol, produces gases and the process takes place in a sealed air tight container, Figure 1.0, it is essential to have an airlock, Figure 1.1, on the mash container to keep it from bursting from a pressure build up. The airlock works so that these gasses can escape while at the same time keeping the unwanted gasses that would hinder the yeast’s metabolism from getting in.

Figure 1.1: Standard Airlock

Figure 1.0: Air Tight Fermenting Container

Reasons for the Still:
The still is an essential piece in distilling because it allows for the distiller to extract the desired alcohol from the mash, which is ethanol. As yeast metabolizes the sugar in the mash it produces different types of alcohol. When the mash is finished fermenting it will consist of a combination of acetone, methanol, ethyl acetate, ethanol, 2-propanol, 1-propanol, and water [5]. Acetone, methanol, and 1-propanol are hazardous to one’s health, and they are the alcohols responsible for causing blindness and even worse, death. Therefore they must be separated from the desired ethyl acetate and ethanol. To accomplish this a still is required. There are many different types of stills, with the most prevalent being the pot still and the reflux still. For the sake of time and the length of this article, only the reflux still will be discussed, but both the pot still and the reflux still fundamentally work in the same manner.

How it Works: The Still

The reflux still, like most stills, is made out of copper, and it is comprised of three main parts, the boiler which is labeled as the flask, the column, and the condenser as seen in Figure 1.2. The mash is placed in the boiler where it is heated. Once the mash heats up to the required boiling temperatures of the alcohol, the alcohols will begin to evaporate. This vapor then moves up into the column and then to the condenser. Once in the condenser the vapor is then condensed back into its liquid form. The condenser accomplishes this by running cool water through the outer pipe of the condenser. This causes the inner pipe where the vapor is moving through to remain cold enough to condense the hot vapor into liquid form. Once the vapor has been condensed into liquid form in the condenser, the liquid then flows into the glass collection container.

Distillation Process:

![Figure 1.2: Basic Reflux Still Components](image)
Note: The description of the distillation process in the next section refers to the reflux still in Figure 1.3. The basic reflux still in Figure 1.2 is too simplistic for actual distilling and is only supplied to inform the reader about the key components of the reflux still.

Now that the fundamentals of the mash and still have been explained and a better understanding for the basics has been garnered, the last thing to do is to put it all together and distill. The process begins with the distiller syphoning the fermented mash into the boiler of the still. Syphoning, instead of pouring it, is important because it allows for all of the mash to enter the boiler while keeping the dead yeast at the bottom of the mash out. The yeast at the bottom of the mash, if put into the boiler, can cause unwanted flavors to get into the final distillate. Once the mash has been put into the boiler, the rest of the still is put together by attaching the column to the boiler and sealing it with rye paste. Rye paste is made of mixing water and common flour together, and as the still heats up the rye paste will bake on, forming an airtight seal. Then the distiller configures the condenser by connecting the female end of a hose to continuous water source, such as a spigot, and then connecting the other end to the water input spout on the bottom of the condenser. Next the male end of a separate hose is attached to the top output spout of the condenser to serve as a drain source. Once the condenser is set up, the water source is slightly turned on so that only a small trickle of water can be seen exiting the output hose of the condenser. When the still has been fully assembled with the mash in the boiler, the column attached to the boiler with the rye paste, and the condenser set up with flowing cold water, it is ready to turn on the heat source and begin the distillation process.

Figure 1.3: Reflux Still for Distillation [7]

Turn on the heat source to a low to medium temperature. It is key to cook the mash extremely slowly for multiple reasons. First off, if you cook the mash too quickly it will result in burning the mash and the final distillate will have a burnt unwanted taste. Secondly and more importantly, if you cook the mash too quickly it will make it impossible to accurately separate the toxic alcohols from the ethanol. This is so because each type of alcohol has a different evaporation temperature. Therefore if you heat the mash too quickly it can reach the vaporizing point of the ethanol before all of the earlier toxic alcohols have been evaporated and condensed. This will result in a final distillate that is comprised of multiple types of alcohol, not just ethanol. For example, acetone evaporates and turns into steam at 56.5°C, methanol evaporates at 64°C, ethyl acetate evaporates at 77.1°C, ethanol evaporates at 78°C, 2-propanol evaporates at 82°C, and 1-propanol evaporates at 97°C [5]. Since all of these alcohols have relatively close vaporizing points, it is essential to cook the mash slowly so that they vaporize and condense one at a time so only pure ethanol can be extracted.

Once that the still has begun to heat up slowly it will begin to reach the vaporizing point of acetone, 56.5°C. Once it reaches that point, the temperature will remain constant until all of the
acetone has vaporized. As it vaporizes it will be condensed and acetone will begin to trickle into the collection jar. This process of evaporation, condensation and collection continues exactly the same for all of the alcohols at their respective vaporization temperature. Once both the acetone and methanol has been condensed the temperature of the mash begins to rise from methanol’s vaporizing temperature to ethyl acetate and ethanol. When this happens all of the toxic acetone and methanol has been removed from the mash and the collection container should be emptied so that only the ethanol will be in the collection jar when it is produced. After the ethanol has been distilled out the temperature will rise to 2-propanol’s vaporizing point at 82⁰ C [5]. When this is happens the distillation process has ended and the collection jar should be immediately removed so that the 2-propanol does not contaminate the collected ethanol.

**Conclusion:**

Distilling spirits is highly dangerous to do, and hence that why it is illegal to do unless one has a permit from the government and follows the regulations laid out by that permit. That being said, creating your own alcohol to drink is a rewarding process. Not only is it a feat that only a select few undertake and can accomplish, but it also produces spirits that taste exponentially better than those sold in stores. This is because the distillers of commercialized spirits run their distilled spirits through filtering processes that strip the flavors of the mash from the spirit, producing a crisp spirit ideal for use with mixers such as Coca-Cola. If one plans to undertake this project, use extreme caution, and do the required and necessary learning in order to avoid very real and hazardous dangers.

**Sources:**


