THE ART AND SCIENCE OF Fruit Distillate Fermentation

PART 1

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INTRODUCTION

Fruit-based spirits, or brandies, once sat on top of the alcohol food chain. Unfortunately, few things stay the same forever, and fruit-based spirits fell in popularity behind grain-based spirits such as whiskey, vodka, and gin, due to poor harvests, wars, alcohol prohibition, and a host of other reasons. However, in recent years, fruit-based brandies have enjoyed a rise in popularity across the globe. This trend started in Europe, where many countries have continued distilling fruit-based spirits rooted in national tradition: Germans distill Schnapps, Grappa is Italy's national spirit, Greeks drink Ouzo, Spain has Orujo, Poland produces Sliwowica (or Slivovitz), Romania enjoys Tuica, and in Hungary there is Pálinka. The distilleries in these countries have developed their own distilling techniques and styles, primarily by focusing on improving the fruit fermentation process to obtain higher alcohol yields and better product quality.

This three-part article series will discuss the topic of fruit selection, preparation, and fermentation for an eau de vie, EDV, style brandy. In part one of the series, we will discuss the characteristics of a quality EDV, fruit sourcing, fruit preparation for fermentation, the basics of fermentation, and yeast selection.

CHARACTERISTICS OF A QUALITY EAU DE VIE (EDV)

An exceptional EDV is built on the following three principles:

1) Use the best available fresh and ripe fruit
2) Design the fermentation process based on the characteristics of the fruit used
3) Execute the perfect distillation with focus on making the cuts of heads, hearts and tails at the right time based on the fruit used

A top quality EDV captures the essence and the soul of the fruit on the nose, on the palate, and in the finish. From a judge's perspective, there are five major qualities used to evaluate an EDV. Using a traditional tulip-shaped glass, judges focus on:

Aroma purity

The aroma of the spirit should be flawless, recalling memories of ripe, fresh fruit, or an aromatic fruit jam. The presence of solvent-like or off-putting aromas are signs of low quality fruit, improper fermentation technique, wrong timing when making the cuts during distillation, or poor sanitation of the equipment between production runs.

Aroma specificity

The product's aroma should be specific to the fruit that it is made of. The secondary floral and fruit aromas can supplement the characteristics of the primary fruit aroma, making the tasting experience more complete. Having the secondary aroma present in the distillate is a good indicator of a quality EDV, however, it should never overwhelm the specific aromas of the primary fruit. If

someone can tell that the spirit is made of Stanley prune-plum (Prunus domestica "Stanley") that means that the distiller used the right type of plum and did a good job representing that plum in the brandy (and of course that the judge has a good nose!).

Taste purity

The product should be clean, with no burn or foreign flavors of sourness or bitterness on the palate.

Taste specificity

The product must taste like the fruit that was used for the base of the spirit. The additional sweetness or bitterness can come from the fermentation or from the seed of the fruit, making the taste of the spirit more complete. However, this should never overwhelm the primary fruit.

Harmony

The aroma and taste should be in balance. When consuming a spirit, the first natural first step is to smell the product, to breathe in the complex fruity and floral aromas. The second step is to taste the product with an expectation of a long lasting pleasant taste of the fruit that was used to create the spirits. A taste that falls short of what the aroma promises is considered out of balance.

Exceptional EDVs must deliver on all five essential characteristics by placing equal emphasis on sourcing the highest quality raw ingredients and flawlessly executing the fermentation and distillation processes.

FRUIT SOURCING

Much like when dining in a fine steakhouse, where the best steaks come from the finest cuts of meat, a quality EDV requires fragrant, flavorful, and sugar-rich fruit. Past practices of using fruit that has fallen on the ground or rotted should never be entertained by a distiller serious about producing a quality EDV. While fruit juices and concentrate could be used, the EDV produced using these alternatives typically lack the aroma that would be obtained from fresh fruit picked at the peak of harvest.

Each fruit and varietal will present its own unique characteristics and challenges. When sourcing, look for aromatic fruits with the right level of ripeness. Generally, fruit that is over-ripened produces a final distillate that lacks fresh fruit characteristics and aromas, and gives a jam-like taste to the spirit. If the fruit is unripe, then the final product will lack aroma and the distiller can expect a lower spirit yield due to lower quantities of fermentable sugars present in the fruit.

If conditions allow, it is important to know where your fruit comes from and to actively work with your orchard or supplier. When visiting the orchard, use a refractometer to measure the BRIX or sugar content of the fruit. Manual refractometers are available, but digital devices are easier to use, clean, and provide more accurate results. Look for more sugar-rich fruits (higher BRIX reading on the refractometer) as this will provide a higher alcohol yield for your mash.

FRUIT PREPARATION FOR FERMENTATION

Sanitizing & Washing

Having sourced the right fruit for the EDV, next comes the critical step of sanitizing the equipment for mash preparation. While simple to understand, if not treated properly, various factors can ruin the mash. For example, bacteria on the equipment, poor fruit selection or rotten fruit, bad water (too many salts, improper pH, presence of chemicals), the use of inadequate sanitizing equipment, and the presence of detergents from poor washing practices are a few of the more common culprits that can ruin your mash.

In a recent case study, an EDV distillery in Hungary was distilling a pear brandy, and upon the first sniff of the distilled spirit, the master distiller identified an issue with the mash. The aroma had traces of ethyl acetate and acetaldehyde in the heads which are sure indicators that there is bacteria in the mash being distilled. Given the fact that the spoiled mash would yield low quantities (due to longer heads) and a poor quality product, the distiller decided to stop the distillation run and dump the entire batch. This example shows the costly consequences when proper sanitary procedures are not implemented.

The presence of wild yeast, bacteria, or mold will metabolize with the sugar in the fruit mash and develop pungent compounds. To avoid this, make sure that all tools and tanks are sanitized before starting to process a new batch of fruit. Use the acidic, food-grade cleaning agents, and if possible, steam, to wash and clean the equipment, as this will thoroughly eliminate bacteria. After the tanks, hoses, grinders, and other equipment has been cleaned, rinsed, and sanitized, the next step is to clean the fruit using the proper washing technique.

There are several fruit washing techniques than can be used depending on the type of fruit. For example, pome (e.g., apple, pear) and stone fruits (e.g.,

plum, apricot, cherry) can be washed with a submerging technique. Softer fruits, such as berries (e.g., raspberries, blackberries) must be washed very carefully, using a shower wash technique. When making a berry brandy, be mindful of how your supplier transports the berries. At times, the bottom portion of a crate of berries can get smashed. If this happens, skip washing the entire crate because this would wash out all the precious juice from the fruit. Acid treatment can be used to sanitize all the berries to avoid the risk of contamination during fermentation.

During the washing process avoid using hot water and make sure that you remove every little bit of soil that is still stuck to the fruit. Depending on your equipment, either as you wash or afterward, make sure to inspect the fruit to remove any rotten or damaged pieces. When dealing with pome or stone fruits, be mindful of bruised pieces and remove them from the batch. Bruised fruit could introduce the fruit's wild yeasts, molds, and bacteria into the mash that could ruin the sensory quality of the product and decrease alcohol yield.

Grinding

Grinding the fruit to a juicy, pulpy, apple sauce-like consistency is a critical step in ensuring the successful fermentation process. During the fermentation, the fruit mash can be compared to a small ecosystem that lives inside the fermentation tank. In this ecosystem, the yeast, mold, and bacteria are racing and fighting each other for food and for space. Additionally, the mash is a constantly evolving medium where natural compounds like sugars and acids dissolve, alcohol and other yeast metabolites penetrate the fruit cells, enzymes catalyze reactions, and various chemical and biochemical processes occur. With this in mind, it is important to break down pome and stone fruits, and berries as much as possible prior to fermentation. A finer grind will expose more fruit surface and sugars for the yeast to consume. A chunky mash can result in a less aromatic final product, lower spirit yield, and potentially poor spirit quality.

When mashing stone-fruits, make sure to remove the pits. Pits must be removed before mashing the fruit and there are special grinders that perform this step by removing and separating the pits from the fruit flesh. The removed pits can be dried and a small quantity put back in the mash prior to distillation, providing additional aroma complexity for the final product.

When working with grapes, extra attention must be paid to the seeds to ensure that they remain intact. The goal is to avoid getting grapeseed oil in the brandy and therefore a more chunky mash is desired.

FERMENTATION BASICS

For both fruit and grain fermentation, the raw material dictates the required fermentation conditions. However, there is less room for error when dealing with fruit fermentation, and the final product yields are much lower when compared to more starchy grains.

In EDV production, the quality of the fruit provides the primary aromas and the fermentation imparts the secondary source of aromas. Secondary aromas are the "additional" aromas beyond the original fruit aroma that form due to yeast metabolizing and extracellular enzymatic reactions that take place when fruit and yeast cells pass their enzymes into the mash. These enzymes meet substrates and catalyze reactions, resulting in the formation of new compounds. Some of these compounds are volatile, meaning they evaporate and make their way into the final product during distillation, whereas non-volatile compounds (such as glucose) remain in the mash.

YEAST SELECTION

In grain mashes, maltose (or malt-sugar) and glucose are two of the most abundant sugars, while fructose, glucose, and sucrose serve as the most abundant sugars used for alcohol production during fruit mash fermentation. The difference in the type of the sugar may be considered minimal,

but has a significant impact on yeast metabolism. Since different yeast strains have different "tastes" for substrates, the right yeast selection is critical for improving sugar-to-alcohol conversion efficiency for fruit distillates. The type of yeast being used for a bourbon may not be the best choice for the production of an apple brandy. Furthermore, a yeast that may work for apple brandy will not be optimal for pear brandy.

When yeast faces "stress conditions", like non-optimal pH, high carbon dioxide level, or high alcohol level, it cannot perform at the same level as it would under optimal conditions. The yeast enzyme-set (or composition of special proteins) defines its viability and fermentation capabilities to do its work under a set of conditions. Changing the ambient condition affects the speed of fermentation, efficiency of alcohol production, and the types of secondary aroma compounds that are formed.

Imagine it like a novice tackling their first woodworking project. They will get there eventually, but may not perform the task as quickly, efficiently, or precisely as a skilled carpenter. When choosing a yeast strain to ferment your mash, make sure that you can provide the optimum conditions to your yeast, or risk ending up with a mediocre mash and end product.

Furthermore, a fruit mash is always acidic, much more so than a grain mash. The higher acidity and the presence of additional microbes result in more stress conditions that impact the yeast. These stress conditions create different compounds in the mash as the yeast metabolizes sugar into alcohol. Some of the compounds can be good for the final product and produce pleasant secondary aromas, while other compounds can produce off-putting aromas.

Through a considerate yeast selection, the use of good raw material, and the right mashing technique, you can provide the necessary conditions for yeast to synthesize good aroma compounds. Ultimately, the aroma profile of the final product can be achieved through appropriate yeast selection.

In Part 2 of this series, we will take a closer look at the fermentation process of fruit mash. ASM

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