Yeasts and Wine

What are yeasts?

Yeasts are single-celled microorganisms responsible for transforming grape sugars into alcohol, which we know as Alcoholic Fermentation (hereinafter AF).

Depending on the time of year the yeasts are found in different places. Thus, in winter, the vineyard soil is the main habitat for yeast, while in summer it is carried by the wind and insects, especially bees. Therefore, it can be stated that there are no yeasts linked to different grape varieties, but there are different strains (types of yeasts), indigenous and commercial, which, depending on the criteria of the winemaker, will determine the final profile of the wine.

Saccharomyces Cerevisiae (hereinafter SC) is the only type of yeast capable of driving AF to the end. There are many yeasts present at the beginning of the AF, but none, except the SC, can culminate it, provided that the appropriate conditions are given that are a healthy vine and a temperature not exceeding 30 degrees Celsius during fermentation.

Although SC is responsible for AF, it is a yeast that is not found very often in the vineyard. Paradoxes of nature. However, in some winery's studies have been carried out where it has been possible to isolate autochthonous yeasts that are capable of completing the fermentation.

There are also yeasts that do not favor AF, microorganisms that can even produce "organoleptic" alterations, vinegar or mold, and which in fact are the most abundant during the first hours of fermentation. The organoleptic properties are all those descriptions of the physical characteristics that the matter has in general, as the senses can perceive them, such as its taste, texture, smell, color or temperature.

Native yeasts Vs commercial yeasts

There is often talk of the incidence of yeasts and their ability to create a certain uniformity in wines, and at the same time, that they enhance the nuances of a specific terroir. So not everything is black or white. Certain viticultural areas enjoy the presence of native Saccharomyces strains that, in addition to expressing the terrain from which they come, also stand out for their excellence and organoleptic contribution to the wine. This is the case of the Montrachet, Épernay or Pasteur Champagne vines, to give three examples.

But it is no less true that there are yeasts generated in vitro that allow them to highlight certain characteristics of the wine, especially fruit aromas, since many of them contain "esters" that are the cause of the enhancement of aromas. Esters are chemicals that are formed when an acid is combined with an alcohol, and the water is removed.

Native or commercial, yeasts are today a very relevant component on which great wines of a specific profile are made, although their reason for being is none other than reproduction. It is the oenological culture developed over the last century that has determined the role of yeasts in winemaking processes.

What are wine yeasts and what are they for?

Fermentation is a metabolic process carried out by some microorganisms, mainly yeasts, as part of their vital processes. During this biochemical reaction, these small unicellular organisms break down certain organic compounds to extract from them the chemical energy that they store in their molecular bonds. It is therefore a catabolic process. A process that occurs in the absence of oxygen, which led its discoverer, the French microbiologist and chemist Louis Pasteur to define fermentation as "life without air" (la vie sans l'air). But what is really interesting about fermentation is that through the action of yeasts, it allows some substances to transform into others.

Thus, depending on the initial compounds and the products obtained from the reaction, we can talk about different types of fermentation:

1. Alcoholic Fermentation. Alcoholic fermentation is an anaerobic (without oxygen) process carried out by yeasts and some kinds of bacteria. These microorganisms transform sugar into ethyl alcohol (also called ethanol or grain alcohol, a clear, colorless liquid and the main ingredient in alcoholic beverages) and carbon dioxide (an odorless, colorless gas).

Alcoholic fermentation begins after glucose enters the cell. Glucose breaks down into pyruvic acid. Pyruvic acid is a key organic compound in metabolism. Organic acids considerably improve the composition, stability and organoleptic characteristics of all wines. Organoleptic characteristics are all the characteristics of the wine that are perceptible by the senses of sight, smell, and taste, that is, the color, smell, texture and flavor of the wine.

2. Acetic Fermentation. Acetic fermentation is bacterial fermentation by Acetobacter, a genus of aerobic bacteria, which transforms ethyl alcohol into acetic acid, the characteristic substance of vinegar.

3. Lactic fermentation that consists of a partial oxidation of glucose, carried out by lactic bacteria or by animal muscle cells (when they run out of oxygen to breathe).

4. Malolactic fermentation that takes place, more generally, in red wines after alcoholic fermentation and consists of the transformation of malic acid into lactic acid by means of bacteria that are naturally found in the grape itself and therefore also in the freshly fermented fine.

5. Butyric fermentation, which is the conversion of carbohydrates into butyric acid by the action of bacteria of the species Clostridium butyricum under absolute anaerobic conditions (absence of oxygen). It is characteristic of bacteria of the genus Clostridium and is characterized by the appearance of putrid and unpleasant odors.

Today we will get to know a little better these microorganisms responsible for the little miracle that the transformation of must into wine supposes. We will see what the fermentation process consists of; what are the main types of yeasts that intervene in the alcoholic fermentation of

wine and how these can be used by wineries to condition the final organoleptic characteristics of the product (color, smell, texture, flavor).

How does the alcoholic fermentation of wine work?

Within the wine-making process, the most fundamental part is the alcoholic fermentation of the must, since it is the moment in which this grape juice is transformed into wine. This transformation occurs as part of the metabolic processes of certain yeasts that are present within the fermentation tanks together with the must, skins, lees, etc. What the yeasts in question do is feed on the sugar and other compounds in the must to obtain energy from them. To do this, they degrade these natural sugars from the grape, decomposing them and obtaining different products: ethanol, the alcohol in wine; carbon dioxide; nicotinamide adenine dinucleotide, an enzyme that allows certain biological processes of oxidation and reduction, as well as energy production, to take place; and adenosine triphosphate or ATP, a nucleotide that serves as an energy source for yeast cells (and most other organisms) to carry out their vital functions.

What are the main types of yeasts involved in the fermentation of wine?

Yeasts are very abundant single-celled fungi in nature and there are a large number of different families, species and strains of them. At the time of must fermentation, there may be a large quantity of different yeasts in the tanks (Rhodotorula, Candida, Pichia…).

However, as we have seen, only one of them will survive the entire wine fermentation process. We are talking about Saccharomyces Cerevisiae, SC, a yeast whose resistance to the presence of alcohol and carbon dioxide allows it to carry out the complete fermentation of the wine.

From its scientific name in Latin, we can extract a large amount of information:

- Saccharo means sugar.
- Myces, fungus and
- Cerevisiae is the Latin name for beer.

Not surprisingly, this yeast is responsible for the fermentation of this drink, but also for the fermentation involved in the process of making bread. Thus, we can say that SC is the dominant yeast that works the magical transformation of must into wine.

How are yeasts used in the winemaking process?

What is really interesting about this whole matter is that the different types of yeast, more specifically, the different strains of Saccharomyces that are used during production, will have a certain influence on the final organoleptic characteristics of the wine. Thus, some yeasts will consume more sugar, others may contribute to reducing the acidity of a wine, modify some of its aromatic qualities, etc.

During the winemaking process, the ability to influence the characteristics of the wine through the use of yeasts by winemakers and wineries is materialized in 3 main aspects:

• The choice of yeasts to use. The yeasts used in the fermentation of wine have been studied and cataloged for more than 60 years. Since the 1980s, they are studied even at the genetic level. Thus, each winery uses the yeast strains that most interest them in order to enhance certain characteristics in their wines: fruity aromatic components, amount of sugars, density, etc.

• The use of native or commercial yeasts. To make a wine, native yeasts can be used, which are those that are found naturally in the grape skins, coming from the vineyard, the terroir, contact with insects such as bees, with the wind, etc .; or commercial yeasts can be used, which are added in powder form to the fermentation tanks.

o In the first case, the elaboration through the use of native yeasts is more expensive and there must be a full control and monitoring of the entire fermentation process to ensure that the dominant strain is adequate. The positive part is that the strain used is unique to a specific vineyard or even a specific plot of the vineyard, so the resulting wine will show a unique personality, due to the influence of this strain on its final organoleptic characteristics: aroma, body, acidity, sweetness.

o In the second case, when using commercial yeasts, the fermentation process is much more stable and controlled. The downside is that these commercial yeasts can be used by many wineries at the same time, so other differentiating factors must be sought to shape the particular personality of the wine.

• The exhaustive control of the alcoholic fermentation process. Control of temperature, nutrient concentrations, fermentation time. There are countless factors that can determine the final result of the alcoholic fermentation of the must. Thus, one of the tasks of winemakers is to determine what are the conditions in which fermentation must be carried out, in order to enhance a series of characteristics in the elaboration of a wine. For example, to make white wines, lower fermentation temperatures are usually used, so that the yeast metabolism is slower and the fermentation takes place more stable and for a longer time. In this way, certain subtle aromatic nuances are preserved that with a more accelerated fermentation would be lost.

Aromas and density

The yeasts of the wine, in addition to fermenting, generate several secondary products, mainly aromas, but also substances that contribute to the density of the wine. Which aromas are formed or others depends in part on the strain of Ceresevisiae that is fermenting.

So, if you want to ferment with native yeast you have to be very careful, control and know that it is indeed a Ceresevisiae that is fermenting your must. A commercial yeast is already selected and never gives these problems. However, many commercial yeasts produce certain aromas, intense and very marked; If many wineries use the same yeast, the wines all become the same, tiresome.

Perhaps the most famous commercial yeast is Sauvignon Blanc, which gives aromas of tropical fruits, especially passion fruit. It is used for white wines and especially for Verdejo. But its abuse, it makes heavy and cloying wines. The great advantage of native yeasts is that they are unique to your plot, to your vineyard. They are part of the originality of your wine. After years of commercial yeast dominance, biodynamic trends in wine and, above all, small wineries have

returned to work with these "house microorganisms". But to do it well, the preparation must be pampered. It's just a matter of working well.

During fermentation, yeast interacts with the sugars in the wort to create ethanol - commonly known as ethyl alcohol - and carbon dioxide (CO_2, as a by-product). In winemaking, the temperature and speed of fermentation are important factors, as well as the oxygen levels present in the must at the beginning of fermentation. The risk of stopped fermentation and the development of various wine defects can also occur during this stage, which can take 5 to 14 days for primary fermentation and potentially another 5-10 days for a second fermentation.

Fermentation can take place in stainless steel tanks, in open wooden vats, inside a barrel and also inside the bottle as occurs in the production of many sparkling wines (Cava and Champagne) among others during the second fermentation. Bottle fermentation is a method aimed at the production of sparkling wines since, with it, bubbles of carbon dioxide are created.

Likewise, clay jars have been used throughout history to ferment, rest and mature wine. These pottery vessels give the drink a particular aromatic profile, highly appreciated by consumers and different from that of wines aged in barrels or in stainless steel. With the arrival of technological advances and new ways of making, many producers abandoned amphorae. However, some wineries still opt for the production in jars to give their wines the differential value provided by an artisanal production process that recovers the flavor of their land.

Wine fermentation

The wine fermentation process refers to the catalytic function that converts must or grape juice into an alcoholic beverage.

History

The natural presence of fermentation means that it was probably first observed in a long time by humans. The first uses of the word "fermentation" in relation to winemaking was in reference to the apparent "boiling" in the must that comes from the anaerobic reaction of the yeast with the sugar in the grape juice and the release of dioxide carbon. The Latin fervere literally means to boil. In the mid-19th century, Louis Pasteur took notes on the connection between yeast and the fermentation process in which yeast acts as a catalyst and mediator through a series of reactions that convert sugar into alcohol. The discovery of the Embden-Meyerhof pathway by Gustav Embden, Otto Fritz Meyerhof, and Jakub Karol Parnas in the early 20th century further contributed to the understanding of the complex chemical processes involved in the conversion of sugar to alcohol. (Metabolic pathway of anaerobic glycolysis. It begins with the phosphorylation of glucose and ends up producing lactic acid under anaerobic conditions, whereas under aerobiosis it gives rise to pyruvic acid.)

In winemaking, a distinction is made between wild yeasts that are naturally present in wineries, vineyards, and in the grapes themselves (sometimes known as the "pruina" or the "blush" of the grape) and cultivated yeasts, which are specifically isolated and inoculated for use in winemaking. The most common wild yeast genera found in winemaking include Candida, Klöckera /

Hanseniaspora, Metschnikowiaceae, Pichia, and Zygosaccharomyces. Wild yeasts can produce high-quality, unique-tasting wines; however, they are often unpredictable and may present fewer desirable traits for the wine and may even contribute to its deterioration. The traditional winemakers, especially; however, many manufacturers prefer to control fermentation with predictable cultured yeasts. The most commonly used cultured yeasts in winemaking belong to the Saccharomyces cerevisiae species. Within this species are several hundred different yeast strains that can be used during fermentation to affect the heat or vigor of the process and enhance or eliminate certain characteristic varietal flavors. The use of different yeast strains is an important contribution to the diversity of wines, even among the same grape variety.

The addition of cultured yeast normally occurs first with the yeast in a dry or "inactive" state and is reactivated in hot water or diluted grape juice before being added to the wort. To proliferate and be active in fermentation, yeast needs to have access to a continuous supply of carbon, nitrogen, sulfur, phosphorus, as well as access to various vitamins and minerals. These components are naturally present in grape must, but their amount can be corrected by adding nutrient packets to the wine, in order to promote a more suitable environment for yeast. Oxygen is necessary as well, but in winemaking, the risk of oxidation and lack of alcohol production from oxygenated yeast requires that oxygen exposure be kept to a minimum.

After the introduction of the live yeasts to the grape must, the phosphates bind to the sugar molecules and those of the six carbons begin to divide into three pieces of carbon and go through a series of rearrangement reactions. During this process, the carboxylic (carbon atom) is released in the form of carbon dioxide with the rest of the components becoming acetaldehyde. The lack of oxygen in this anaerobic process allows acetaldehyde to be converted over time, through reduction, to ethanol. During the conversion of acetaldehyde, a small amount is converted, by oxidation, into acetic acid which, in excess, can contribute to the wine defect known as volatile acidity (vinegar contamination). After the yeast has completed its life cycle, it AFlls to the bottom of the fermentation tank as known sediment such as lees or wine feces.

Other compounds

The metabolism of amino acids and the breakdown of sugars by yeasts has the effect of creating other biochemical compounds that can contribute to the taste and aroma of wine. These compounds can be considered "volatile", such as aldehydes, ethyl acetate, esters, AFtty acids, fusel oils, hydrogen sulfide, ketones and mercaptans) or "non-volatile", such as glycerol, acetic acid and succinic acid. Yeast also has the effect, during fermentation, of releasing glycoside hydrolases that can hydrolyze aliphatic flavor precursors (a flavor component that reacts with oak), benzene derivatives, monoterpenes (responsible for the floral aromas of grapes such as Muscat and Traminer), isoprenoids (responsible for flavoring some spices in Chardonnay), and phenols. Some yeast strains can generate volatile thiols that contribute to the fruity aromas of many wines such as the gooseberry aroma commonly associated with Sauvignon blanc. Brettanomyces yeasts are responsible for the "barnyard aroma" characteristic of some red wines such as Burgundy and Pinot noir.

Considerations in winemaking

During fermentation, there are several factors that wine makers must take into account. The most notable is the internal temperature of the must. The biochemical fermentation process itself creates a large amount of heat residue that can push the must out of the ideal temperature range for wine. Typically, white wine is fermented between 18-20ºC although a wine maker may choose to use a higher temperature to take out some of the complexity of the wine. Red wine is usually fermented at higher temperatures of up to 29 ° C. Fermentation at higher temperatures can have detrimental effects on the wine, stunning the yeast and rendering it dormant and even "evaporating" some of the flavors in the wines. Some wine makers may ferment red wines at cooler temperatures, typical of white wines, in order to bring out more flavors from the fruit.
To control the heat generated during fermentation, the winemaker has to choose a suitable size container or use cooling devices of various types, from the ancient Bordeaux traditions of placing the fermentation vat on top of blocks of ice to today's modern use of sophisticated fermentation tanks with integrated cooling rings.

A risk factor involved in fermentation is the development of chemical residues and deterioration that can be corrected with the addition of sulfur dioxide (SO 2), although excess of it can lead to defects in the wine. A winemaker who wants to make a wine with high levels of residual sugar (such as a dessert wine) can stop the initial fermentation, either by lowering the temperature of the wort to stun the yeast or by adding a high level of alcohol (such as brandy) to the must to kill yeast and create a fortified wine.

Other types of fermentation

In wine making, there are different processes that go under the heading of "fermentation", but it might not follow the same procedure commonly associated with the fermentation of wine.

Carbonic maceration

The carbonic maceration process is also known as whole grape fermentation where instead of adding yeast, the fermentation of the grapes is stimulated to take place within the individual grape berries. This method is common in the creation of Beaujolais wine and consists of whole bunches of grapes stored in a closed container, with the oxygen in the container being replaced by carbon dioxide. Unlike normal fermentation, where yeast converts sugar to alcohol, carbonic steeping works with enzymes within the grape breaking down cellular matter to form ethanol and other chemical properties. The resulting wines are generally smooth and fruity.

Malolactic fermentation

Instead of yeast, bacteria play a critical role in malolactic fermentation, which is essentially the conversion of malic acid to lactic acid. This has the advantage of reducing acidity a bit and making the remaining wine taste milder. Depending on the type of wine the manufacturer is trying to produce, the malolactic fermentation can take place at the same time as the yeast fermentation.

Jorge Claro
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