FERMENTATION AND MALOLACTIC FERMENTATION

Fermentation is the process by which yeasts transform the sugars present in the must into alcohol. Very briefly, each sugar molecule (one hexose) can be transformed into two molecules of ethanol and two molecules of CO_2, obtaining energy in the form of ATP in the process (through Embden-Meyerhof-Parnes). Although this is the main metabolic pathway, other compounds such as glycerol, acetaldehyde or acetic acid also appear in the process, which contributes to providing specific organoleptic characteristics of great importance.

There are several types of yeast present in the skin. The majority are of oxidative metabolism (Kloeckera, Hanseniospora, Candida, Pichia), but there is also fermentative metabolism (Saccharomyces, Brettanomyces). The latter are responsible for the transformation of sugars into alcohol, carbon dioxide and other metabolic intermediates that provide aromas (sometimes unwanted, such as Brettanomyces) and consistency in wine.

The carbon source comes from sugars (glucose and fructose) present in the must. The final alcohol content will depend in the first instance on the concentration of the initial sugars. Therefore, a must containing between 170 and 250 g/L of sugar will produce wines between 10 and 15% by volume. Higher sugar concentrations can cause an osmotic shock in yeasts, which significantly affects their growth. Similarly, when the alcohol concentration exceeds 15%, the viability of yeasts is compromised.

Something more complicated is to guarantee the source of nitrogen, since there are important differences in the functions of the form of cultivation, the variety of the grape, the climatic conditions or the state of health of the same, so it is essential to ensure before the levels. of assimilable nitrogen, from amino acids and ammonium, reaches a minimum around 130-140 mgN/L. A decrease in nitrogen levels below a limit value can cause a sudden stop of fermentation. Nor is excess nitrogen recommended, since in this case there is a very violent fermentation, with very strong temperature increases, and it promotes the synthesis of urea, which provides negative aromas. Therefore, control of available assimilable nitrogen, regardless of its source, is essential throughout the fermentation process.

In the winemaking process, different phases occur. At first, the yeast concentration is insufficient to produce a significant level of sugar to alcohol conversion. The first phase, therefore, is to favor the growth of yeasts by properly regulating temperature conditions (between 13 and 30 °C) to favor oxidative metabolism (clearly much more energy efficient) and, by pumping, to maintain a contribution of sufficient oxygen.

Therefore, there is strong competition between existing yeasts and bacteria. The first yeasts that multiply are those of the genus Kloeckera, the most abundant in the skins, but they are not very interesting since they produce little alcohol and an excess of acetic acid and ethyl acetate. They are particularly sensitive to the presence of sulphites, a powerful antiseptic, so increasing their presence in the early stages is a way to control them and prevent them from competing with Saccharomyces for essential components. In fact, a common practice, if the winemaker decides to use commercial yeast strains instead of natural strains, is to add sulphites during the pressing phase, keeping the must in completely aseptic conditions until the time the strain is inoculated with selected yeast

Yeasts and bacteria are also sensitive to the presence of alcohol, so as soon as alcohol levels exceed 3-4 °C, many of the yeasts begin to die. Saccharomyces is much more resistant in these conditions and can accelerate its development, first slowly but then exponentially. It is these yeasts that will begin the fermentation process, reducing the available oxygen supply, and this will lead to the end of the fermentation, in which, when the nutrients are depleted, they will eventually die.

At the end of the fermentation, the level of sugar remaining in the wine must be low enough so that the fermentation process does not restart again (usually with glucose + fructose values below 0.5 g/L). However, in the case of sweet wines, the sugar content can be much higher. In this case, a new fermentation is avoided only by the effect of high ethanol content, so they are generally wines with 15% or more.

Once the alcoholic fermentation ends, the red wines undergo another fermentation process in which the malic acid is transformed into lactic acid. This type of fermentation is carried out by lactic bacteria, in particular those of the genus Oenococcus (the most important), Pediococcus and Lactobacillus. During this process, the bacteria are transformed in the absence of sugars, L-malic acid (with a strong herbaceous character) into L-lactic acid (much softer). This transformation has important implications on the characteristics of the wine, which will increase its pH (malic acid is much more acidic than lactic acid) while increasing its overall stability.

The development of Oenococcus is favored by maintaining the pH of the wine at any time below 3.2 and a high alcohol content. Under these conditions, this bacterium becomes dominant at the end of alcoholic fermentation, greatly improving the development of malolactic fermentation and reducing the production of acetic acid. However, above 3.6, the conditions are suitable for the development of Lactobacillus and Pediococcus, which act, in addition to residual sugars, tartaric acid (additional reducing acidity) and glycerol to increase the production of acetic acid. With pH values close to 4.0, the risk of lactic spoliage is already very important. D-lactic acid levels are a clear indicator of this problem.

KITS SinaTech FOR FERMENTATION CONTROL

Nutrients	SY2404	Glucose+Fructose
	SY2428	Total Sugars
	SY2407	Ammonia Nitrogen
	SY2408	Primary Amino Nitrogen
Bacterial control	SY2409	Free Sulfite
	SY2410	Total Sulfite
Process monitoring	SY2403	L-Lactic
	SY2413	D-Lactic
	SY2402	L-Malic
	SY2401	Acetic

For more than 10 years, Sinatech's commitment to the winemaker has always been working side by side to provide the most appropriate analytical solutions to control and monitor the winemaking process. Automatic methods easily adaptable to any work routine, with a personalized consulting team to help you implement it quickly and without problems

Sinatech: TeamWork