ENARTIS NEWS

FERMENTATION HAS FINISHED: TIME FOR SO_2 MANAGEMENT

When both alcoholic or malolactic fermentations finish, a winemaker's instinct is to add SO_2 as soon as possible to protect wine from oxidation or from the risk of microbial contamination. In reality, this action can prejudice wine quality and longevity. Let's see how.

END OF ALCOHOLIC FERMENTATION

Let's consider the situation of a wine that is not meant to go through malolactic fermentation. Usually, right after alcoholic fermentation, wine is racked off gross lees and then SO_2 is added to prevent malolactic fermentation onset and for antioxidant protection. The fine lees that remain in the wine consist of residual yeast cells from fermentation. They are intended to positively contribute to wine quality by increasing mouthfeel, aroma complexity, colloid stability and by keeping redox potential low. All this is very true if SO_2 addition is done at the right time. In fact, it takes approximately 10 to 15 days for yeast to die after the completion of fermentation. Any addition of SO_2 done in this time period, when yeast is still active, will lead to the formation of H_2S and SO_2 binders which are mainly acetaldehyde, pyruvic acid and α-ketoglutaric acid.

These two mechanisms help yeast turn SO_2 into less harmfull compounds, but also create enological problems: appearance of reduction and increase of bound SO_2 content.

What are the possible solutions? How do you postpone SO_2 addition without risk of oxidation or wine spoilage?

Activated chitosan is an effective alternative to the early addition of SO_2 (Diagram 1). It can be used to avoid malolactic fermentation onset and to protect wine from other contaminants. Chitosan kills bacteria and wild yeast by altering their cell membrane permeability, without triggering any biochemical reactions that could produce spoilage compounds. Hydrolysable tannins can replace the SO_2 antioxidant effect and help to protect wine during this delicate phase.

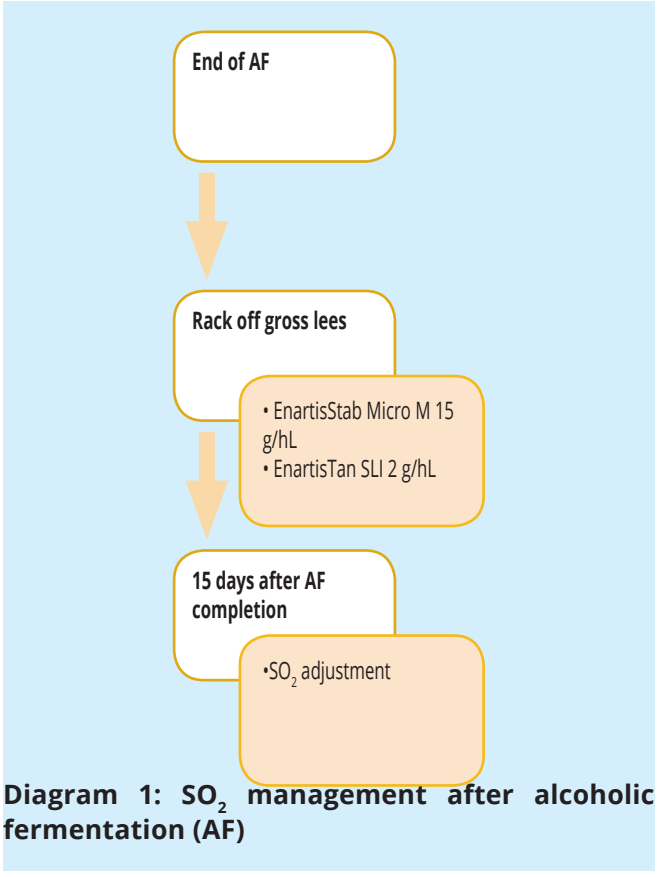

Diagram 1: SO_2 management after alcoholic fermentation (AF)

ABOUT ACETALDEHYDE

Acetaldehyde or ethanal is the most important volatile wine carbonyl compound. It can be formed biologically (by yeast at the start of alcoholic fermentation) and chemically (mainly after alcoholic fermentation when wines are not protected from oxidation from atmospheric oxygen). Acetaldehyde has a green grass, apple-like or nutty aroma (threshold of approx. 100 mg/L) and can combine SO_2 (1 mg/L acetaldehyde combines 1.4 mg/L SO_2). According to a recent study conducted by Cornell University on 200 wines, it typically accounts for about 80% of the irreversibly bound SO_2 in white wines and 50% in red wines (Figure 1). Acetaldehyde can be degraded by yeast during the later stages of alcoholic fermentation. Malolactic bacteria degrade acetaldehyde during malolactic fermentation but most significantly in the first week after malic acid depletion.

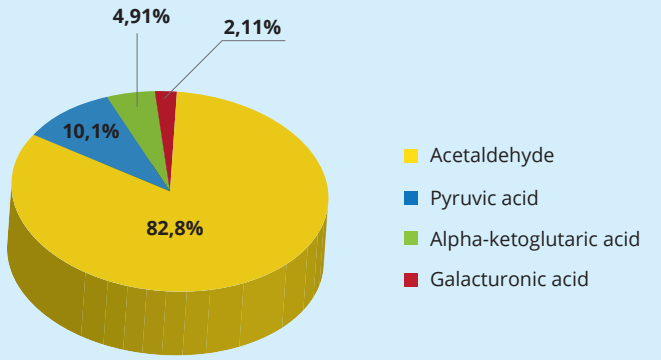

Figure 1. Approximate share of major wine carbonyls for bound SO_2 of white wines. Data from N. Jakowetz et al. (2011)

END OF MALOLACTIC FERMENTATION

It is known that lactic acid bacteria have the ability to degrade acetaldehyde. Acetaldehyde is produced by fermenting yeast. Depending on the strain, its content at the end of alcoholic fermentation can vary from 10 to 50 mg/L. Acetaldehyde degradation by bacteria takes place, in part, simultaneously with malic acid fermentation but mainly after malic acid depletion: acetaldehyde content decreases only by 1/3 during malolactic fermentation and by 80-85% in the 3 weeks after its completion (Figure 2). In a similar way, lactic acid bacteria also reduce other carbonyl compounds produced during alcoholic fermentation like pyruvic acid and α-ketoglutaric acid. This means that an early addition of SO_2 after malic acid depletion, can turn into the bound form by up to 80%.

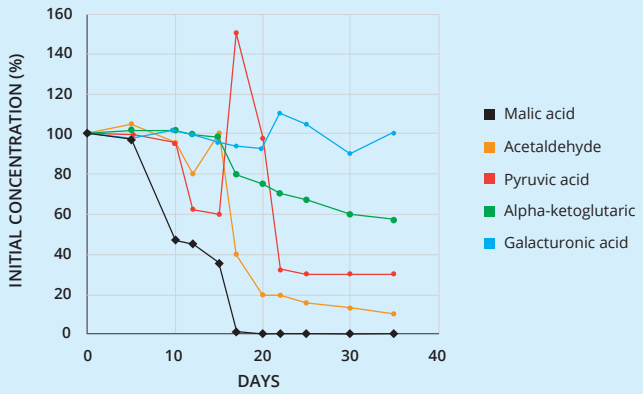

Figure 2: Kinetics of carbonyl compound degradation by lactic acid bacteria. Data from N. Jakowetz et al. (2011)

WHEN SHOULD SO_2 BE ADDED?

To fully take advantage of malolactic fermentation's contribution towards decreasing the total SO_2 level, delaying SO_2 addition by 7-10 days after malolactic fermentation completion is advised (Diagram 2). This is a good compromise that allows the reduction of SO_2 by approximately 75% without unnecessarily increasing the risk of organoleptic deviations caused by possible contaminants. The addition of tannins can help protect wine from oxidation.

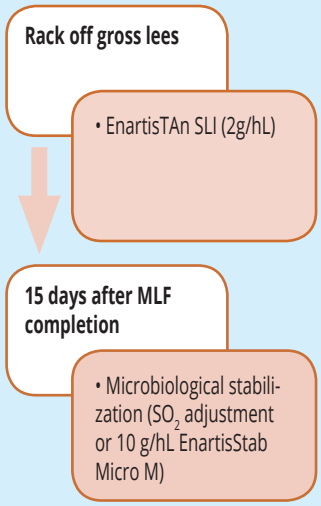

Diagram 2: SO_2 management after malolactic fermentation (MLF)

HOW TO MANAGE SO_2 ADDITIONS DURING WINE MATURATION?

If SO_2 content is sought to be reduced or even eliminated, the use of antioxidant and antimicrobial alternatives are a great help.

Activated chitosan is an antimicrobial fining agent that can be used during the entire vinification process to control spoilage microorganisms. Contrary to SO_2, it is an allergen-free substance and its antimicrobial activity is not significantly influenced by wine pH. It can be used to control *Brettanomyces, Acetobacter, Pediococcus, Lactobacillus, Oenococcus* and *Zygosaccharomyces*.

The **copolymers of polyvinylimidazole and polyvinylpyrrolidone (PVI-PVP)** and activated chitosan are capable of absorbing iron and copper, the real culprits of turning oxygen, a weak oxidizer, into the most active and dangerous free radicals.

Tannins, particularly hydrolizable ones, are very effective in scavenging both oxygen and free radicals and limiting their effects.

Fine lees maintain a low redox potential and consume active oxygen.

Activated chitosan	EnartisStab Micro M	Preparation based on activated chitosan designed for the treatment of must and cloudy wine. It can be used for reducing spoilage yeast and bacteria and to prevent the onset of unwanted malolactic fermentation.
	EnartisStab Micro	Pure activated chitosan. Recommended for removing *Brett* and its off-flavors.
PVI-PVP	Stabyl Met	Copolymer of PVI/PVP and silica. Prevents oxidation, browning, pinking and formation of haze by removing the main catalysts of oxidation, iron and copper.
	Claril HM	Synergistic combination of chitosan and PVI/PVP to reduce the concentration of iron, copper, hydroxycinnamic acids and catechins, which are key players in the process of oxidation.
Tannins	EnartisTan Blanc	Gallic tannin with a high antioxidant effect that strengthens the protective action of SO_2.
	EnartisTan SLI	Tannin produced from untoasted American oak with a unique process that makes it extremely effective in blocking oxidation and prolonging wine shelf life.
Fine lees	Surlì Natural	Inactivated yeast selected for replacing natural lees and simulating the effect of *sur lie* ageing.
	EnartisStab SLI	These selected "active lees" balance wine redox potential, scavenge oxygen and prevent the oxidation of wine color and aromas during storage.

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