Solutions for winemaking
LAMOTHE-ABIET

LOW SO_2 WINEMAKING

Increasing public concern with sulfite content in wine as well as wine quality loss by high sulfite additions has created the need for new winemaking tools and practices to reduce sulfite use. SO_2 has been one of the most used wine additives for centuries because of its anti-oxidant and anti-microbial activities. For winemakers, reducing SO_2 means greater commitment of time and responsibility in avoiding the risk of exposing an unprotected wine to chemical and microbiological changes.

Lamothe-Abiet offers options able to replace SO_2 for its anti-oxidant, anti-oxidasic, and anti-microbial activities and produce quality, low or SO_2–free wines. The entire process of winemaking must be reviewed, especially sanitation and oxygen protection, using appropriate equipment and sanitation protocols.

WHY WE USE SO_2:

1. Protect grapes, juice, and wine from oxidation
2. Reduce oxidases enzyme (PPO and laccase) activities
3. Control microbial growth, activity, and contamination to limit juice and wine spoilage

ALTERNATIVES TO SO_2 - ANTI-OXIDANT AND ANTI-OXIDASES ACTIVITY

Oxidation is one of the main concerns for a winemaker as it affects wine stability and sensory properties of wine causing browning, loss of flavor and aroma, and unbalanced mouthfeel.
Grape and juice oxidations are mostly happening via enzymatic reactions while wine oxidation reactions are chemical. Enzymes responsible for phenolic compounds oxidation in juice are polyphenol oxidases (PPO) and laccase in Botrytis-infected grapes.

PPO's, in presence of O_2, transform phenolic compounds and catechins into quinones, strong oxidants responsible for juice browning. This reaction is very fast and occurs within about 15 minutes beginning from when the berries are in contact with air (open, damaged, or crushed), thus making the respect of berry integrity during processing essential. In wine, chemical oxidation reactions are much slower and highly impacted by the redox potential of the wine and temperature. Very similar reactions, involving the formation of quinones from oxidation of phenolic compounds, not via enzymatic activities but starting with an activation of the oxygen into a radical via redox reactions.

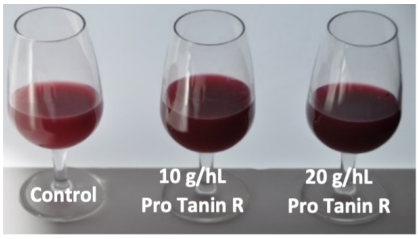
SO_2 Alternatives for Minimizing Oxidations:

For enzymatic oxidation to happen, oxidases, O_2, and phenolic substrates must be present.

1. Reducing O_2 Solubilization in Juice and Wine. Limiting exposure to air to prevent the solubilization of oxygen in juice and wine is the first step to prevent oxidation. In addition to using inert gas, and inert press such as **Bucher Inertys**, chemical inertization is possible using compounds that quickly react with oxygen and oxygen radicals before they enter the oxidation mechanism. Gallic and ellagic tannins have a high capacity for O_2 consumption and can be used to replace SO_2 on this action.

- **Tanin Gallique a l'alcool** for white/rose grapes and juices
- **Pro Tanin R** for red grapes
- **Tan&Sense Volume** for wines during racking, transfer

2. Reducing Oxidase Enzyme Activity. With 50 mg/L SO_2, it is possible to decrease up to 90%the PPO activity but higher dosages are necessary to effectively inhibit laccase, resulting in negative consequences for alcoholic and malolactic fermentation and wine quality. Gallic and ellagic tannins have a strong affinity with proteins, so they can bind with enzymes, thus inactivating PPO and laccase.



- **Tanin Gallique a l'alcool** for whites/roses
- **Pro Tanin R** for reds

3. Removing Phenolic Compounds. Phenols are the main substrate of oxidation. Removing phenolic compounds with fining agents is an efficient way of minimizing the oxidation process and stabilizing wine. Juice fining can help produce wines with a fresher color, higher content of aromatics, and less sensitivity to oxidation.

- **Polymix** (PVPP, Casein) or **Polymix Natur** (PVPP, yeast extracts, bentonite)

4. SO_2, Glutathione and Cysteine derivates can react with quinones formed during the oxidation process, producing the "Grape Reaction Product" (GRP). As GRP is no longer a potential substrate for further oxidation, the reactions of oxidation are stopped. Protecting grape's glutathione and using yeast derivates rich in glutathione and cysteine can be an alternative to SO_2 to reduce oxidation reactions.

- **OptiThiols** in juices
- **Aroma Protect** in wines

ALTERNATIVES TO SO_2 - ANTI-MICROBIAL ACTIVITY

The anti-microbial activity of sulfur dioxide is mainly due to the molecular form whose concentration depends on free sulfur content, pH, temperature, and alcohol content. Each micro-organism has a different sensitivity to SO_2, therefore, the quantity necessary to inhibit their growth and activity is specie dependent.

SO_2 Alternatives for Controlling Microbial Development:

1. On grapes and juices, it is possible to inhibit the development of spoilage microbes by bio-protection, using 'positive' microbes to colonize the environment and inhibit the development of others, while respecting a natural microbial equilibrium.

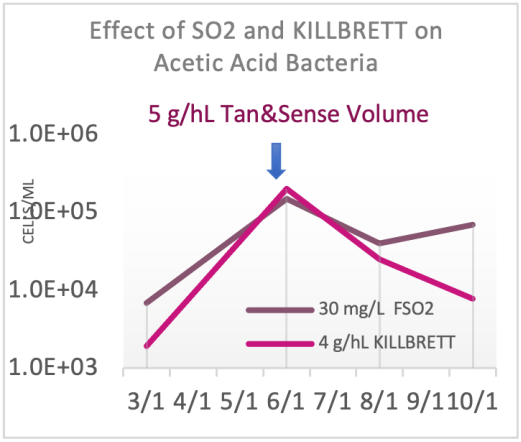
- **Excellence B-Nature**

2. Chitosan's anti-microbial activity is highly effective, non-specific (can control both yeast and bacteria), and not dependent on juice and wine pH, which makes it a reliable alternative to SO_2. It works by contact: the positive charges present on its surface attract negatively charged microorganisms in juice. It alters the permeability of the cell membranes, causing micro-organisms to die and then precipitate.

- **KillBrett**

3. As most of the spoilage microbes live in aerobie (especially acetic acid bacteria), scavenging oxygen radicals and maintaining wine in a low redox potential limit nutrient availability and limit their development. Ellagic tannins, particularly from untoasted oak, are very efficient in scavenging oxygen radicals.

- **Tan&Sense Volume**



The population of Acetic Acid Bacteria is reduced after the addition of Tan&Sense Volume and better controlled with KillBrett than maintaining 30 mg/L of F.SO_2Trial during aging in barrel, red wine, pH 3.7

ALTERNATIVES TO SO_2 – LAMOTHE-ABIET PRODUCT INFO

Tanin gallique a l'alcool – Pure gallic tannin, developed for whites and roses, to scavenge oxygen radicals and inhibit oxidase enzymes such as laccase and PPO. Tannin Gallique a l'alcool can be sprinkled directly on grapes or in juice.

Pro Tanin R – Pro-anthocyanidin tannin, developed for application on red grapes, to scavenge oxygen radicals, inhibit oxidase enzymes such as laccase and PPO and eliminate reactive proteins, thus protecting grape polyphenols. Pro tannin R is instantaneously soluble, simply sprinkle it on the top of the grapes at picking.

Tan&Sense Volume – Pure untoasted oak tannins (ellagic tannin), with a high capacity to scavenge oxygen radicals, and buffer redox potential. Tan&Sense Volume is a gentle tannin, that increases sweetness, and roundness perception. We recommend using 0.5 – 1 g/hL every transfer, racking, or movement of the wine to protect from oxidation.

Polymix Natur' – PVPP, Yeast extracts, Bentonite. Vegan, allergen-free fining agent focused on removing oxidized and easily oxidable phenolic compounds. Polymix Natur' treats and prevents oxidation, improves oxidative stability, wine expression, and elongates wine shelf life.

OptiThiols - Inactivated yeasts, naturally rich in glutathione and cysteine derivates. To be used pre-fermentation, it releases glutathione, which can trap the quinones and limit oxidation reactions. The cysteine derivates can be used by yeast to produce thiolic compounds and increase aromatic freshness and intensity.

Aroma Protect - Inactivated yeasts, naturally rich in glutathione, a natural antioxidant, sulfurous tripeptide with great reductive power. When used during aging, Aroma Protect gives immediate protection against the oxidative mechanisms, releasing glutathione into the wine, significantly slowing down oxidation phenomena.

Excellence B-Nature – non-*Saccharomyces* yeast, pure *Metschnikovia pulcherrima*, non-fermentative. It inhibits the development of spoilage microbes such as other non-*Saccharomyces*, and bacteria on grapes and juice. Excellence B-Nature is an organic anti-microbial solution, used as an alternative to SO_2 on grapes. It protects grapes/juices from microbial contamination during transport and processing, does not inhibit *Saccharomyces cerevisiae*, and reduces SO_2 combining compounds production, thus increasing SO_2. Excellence B-Nature can be sprinkled directly on grapes, without rehydration.

KillBrett – Pure chitosan, wide spectrum anti-microbial agent. KillBrett eliminates and inhibits Brettanomyces, Lactic Acid Bacteria, and Acetic Acid Bacteria. It can be used during the entire process of winemaking, we recommend using it as preventive, post MLF, at 4 g/hL.

LOW SO_2 WINEMAKING GUIDELINES

	RED WINES	WHITE/ROSE WINES
HARVEST AND GRAPE TRANSPORTATION	Excellence B-Nature at 30-50 g/ton to prevent microbial spoilage. Pro Tanin R, 150-180 g/ton to inhibit oxidase enzymes activities and scavenge O_2.	Excellence B-Nature at 30-50 g/ton to prevent microbial spoilage. Tanin gallique a l'alcool, 50 g/ton to inhibit oxidase enzymes activities and scavenge O_2.
SETTLING CLARIFICATION		Polymix Natur' at 15-40 g/hL to remove phenolics and limit oxidation reactions. At racking: OptiThiols at 30 g/hL to improve anti-oxidant protection.
ALCOHOL FERMENTATION	Rehydrate yeast with OenoStim at 25 g/hL. Ensure good yeast nutrition and limit off-flavors production with Optiflore O at 40 g/hL. At 1/3 fermentaion, if low initial YAN (<150), add 20-30 g/hL of OptiFerm.	
MLF (if desired)	Co-inoculation: add Oeno1 at 1g/hL, 1 day after AF starts. Sequential inoculation: add Oeno1 at 1g/hL after AF is completed .	
AGEING	Once AF and MLF are completed: rack off gross lees after fermentation. Use inert gas during transfer. Aroma Protect at 10-20 g/hL to lower redox potential and increase natural wine resistance to oxidation. Tan&Sense Volume at 1 g/hL every racking to protect from oxidation and scavenge oxygen radicals. KillBrett at 4 g/hL to prevent microbial development and contamination.	