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The dual role of sulfur dioxide as an antimicrobial and antioxidant in winemaking

The complex role of sulfur dioxide in winemaking

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The use of sulfur dioxide (SO2) or anhydrous sulfurous in winemaking has been a subject of extensive research and discussion among enologists and scientists. As a powerful antimicrobial and antioxidant, sulfur dioxide plays a critical role in both the winemaking process and the final quality of wine. However, it's essential to consider various aspects of its usage, from microbial control to effects on flavor and aging

potential.

Antimicrobial Activity

Sulfur dioxide's antimicrobial properties are twofold. Firstly, it hampers the nutritional capabilities of microorganisms by reacting with specific substances and inhibiting oxygen uptake. Secondly, it can penetrate cells, leading to either temporary inhibition of their activity (fungistatic or bacteriostatic effect) or cell death (fungicidal or bactericidal effect), depending on the concentration and environmental conditions. Generally, low concentrations of SO2 and higher pH levels result in a fungistatic effect, whereas higher concentrations and lower pH result in a fungicidal effect.

The antimicrobial action is particularly effective against lactic acid bacteria during malolactic fermentation, where sulfur dioxide levels between 10 to 20 mg/liter can be sufficient for wines with low pH. However, acetic acid bacteria are more resilient, requiring higher concentrations of SO2 for effective control.

Selective Yeast Effects

One of the most valuable properties of sulfur dioxide in winemaking is its selective action on yeast. In standard doses, SO2 can inhibit the growth of lactic acid bacteria while allowing for yeast multiplication and alcoholic fermentation. This selectivity helps prevent issues like "lactic spoilage," where an overgrowth of lactic acid bacteria can compromise the final product.

Activation of Alcoholic Fermentation

Sulfur dioxide also has implications in activating and selecting yeasts for alcoholic fermentation. Enologists have multiple strategies at their disposal, ranging from pre-fermentation treatments to complex yeast inoculation techniques, each aiming for specific aroma profiles and wine characteristics.

Antioxidant and Anti-enzymatic Effects

Oxygen exposure during storage can lead to undesirable changes in a wine's aroma and flavor. Sulfur dioxide offers robust protection against oxidative reactions, safeguarding the wine during its post-fermentation life. It also prevents enzymatic oxidations catalyzed by enzymes like tyrosinase and laccase, especially during the pre-fermentation phase.

Clarifying and Solvent Effects

Sulfur dioxide can act as a coagulant, aiding in the sedimentation of particles during wine clarification. However, higher concentrations could potentially inhibit malolactic fermentations and elevate the levels of combined SO2, which is increasingly being restricted by health guidelines and winemaking regulations.

A Note on Sensory Impact

While the antimicrobial and antioxidant properties of sulfur dioxide are beneficial, excessive levels can impart a pungent, burnt sulfur aroma that masks the wine's natural fragrances. On the flip side, moderate concentrations can enhance the preservation of varietal aromas and prevent their oxidative degradation.

The use of sulfur dioxide in winemaking is a finely tuned balancing act. It offers significant benefits in microbial control, fermentation activation, and oxidation prevention, but improper use can have deleterious effects on the final product. As always, the skill and judgment of the enologist are crucial in leveraging these attributes effectively.