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ENARTIS NEWS
METALS AND WINE OXIDATION

Metals have gained attention in recent years for their impact on wine quality. In particular, metals such as copper and iron have become the subject of numerous studies because of their impact on wine oxidation. Since oxidation is a major concern for wine quality and shelf life, it is important to understand how these metals impact the process of oxidation.

CHEMICAL OXIDATION INVOLVING COPPER AND IRON

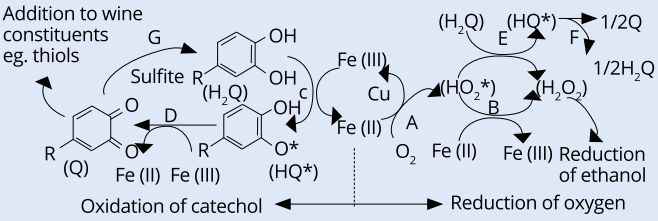
While there are many compounds involved in chemical oxidation of wine, metals should be of primary interest to winemakers. The effect of metals on wine oxidation is not a new concept. In fact, metals have been recognized as players in wine oxidation for decades. Additionally, continued research conducted over the past twenty years has revealed the importance of transition metals such as copper and iron as critical for wine oxidation reactions (Cacho 1995, Danilewicz 2003, Clark et al. 2002).

EFFECT OF COPPER ON WINE OXIDATION

Copper reacts with oxygen directly when oxygen is dissolved in wine in the first step of oxidation. While oxygen does not readily oxidize phenolic compounds catechin or catechol, it is able to react directly with copper first, beginning a cascade of oxidation which involves iron and di-phenol. Levels as low as 0.05 mg/L of copper have been shown to dramatically impact the rates of oxidation in model wine (Danilewicz 2007). It has also been shown that increasing copper concentration directly impacts the rates of phenolic oxidation (Danilewicz 2007). This makes copper an interesting prospect to consider for controlling oxidation rates.

EFFECT OF IRON ON WINE OXIDATION

Iron is the second catalyzer in the chemical oxidation of di-phenols in wine. After copper (I) is oxidized to copper (II), copper (II) reacts with iron (II) forming iron (III). This form of iron can then go on to oxidize di-phenols, forming quinones (Danilewicz 2013). Additionally, this cascading reaction can go on to form acetaldehyde, which contributes to bruised apple aroma and loss of freshness. In the presence of sulfite, these reactions recycle, leading to an accumulation of bound sulfite. Studies have shown that higher levels of iron can lead to faster rates of oxidation (Danilewicz 2007).



The above image shows the roles of copper and iron in oxidation of wine di-phenols. Image source Danilewicz 2013. Am. J. Enol. Vitic. 64: 316-324

SOURCES OF COPPER AND IRON

Sources of Copper

Copper levels can vary depending on vineyard sprays and additions of copper sulfate for sulfide aroma management. However, even levels of copper as low as 0.05 mg/L have been found to accelerate oxidation reactions (Danilewicz 2007). Copper naturally found in grape juice has been reported to mostly be taken up by yeast during fermentation. However, some residual levels have been reported to increase after fermentation depending on yeast strain and initial copper levels (Darriet et al. 2001).

Sources of Iron

Process equipment improvements over the last several decades have mostly eliminated heavy contamination of grapes and wine with iron, with the exception of some accounts of vineyard trellising equipment making its way into mechanically harvested fruit. Depending on the vineyard site, natural levels of iron found in wine can easily exceed 5 mg/L. One visual cue for potential high iron levels is the presence of bright, red-colored soils. With this in mind, regular monitoring of iron levels in juice prior to fermentation is recommended to understand the potential for oxidation and which sites which may be more prone to naturally high iron levels.

Other metals

There are several other metals in wine which have been shown contribute to wine oxidation. Aluminum, manganese and zinc have all been found to contribute to wine oxidation (Danilewicz 2007, Kreitman 2016). Manganese, in combination with residual levels of copper and iron, was found to further facilitate oxidation. Aluminum and zinc have been shown to increase in some types of alternative packaging but are not often found in substantial amounts in wine naturally.

MANAGING METALS CONTENT IN WINE

Fining for Metal Removal

While some sources of increased metals may be unavoidable in the winemaking process, winemakers still have the ability to control these metal levels by removing them with fining agents. Previous methods have been developed for metal removal; however, these methods came with dramatic decreases in wine quality and even potential health hazards. Ferrocyanide was applied for iron removal but had potential health hazards associated with the production of cyanide. Other methods such as ion exchange resins had dramatic negative impacts on wine quality. However, newer fining agents such as PVI/PVP and pre-activated chitosan have been shown to be very effective metal removers, while maintaining wine quality.

Fermentation Metal Removal

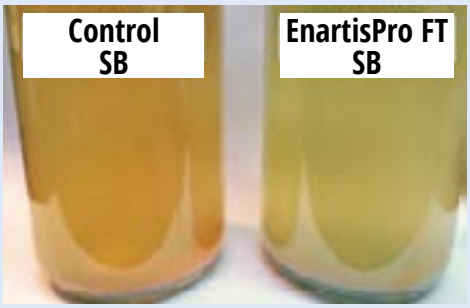
Early removal of copper and iron from wines is advantageous because that will limit wine ability to oxidize during processing and aging. For this reason, EnartisPro XP and EnartisPro FT were developed. These yeast derived polysaccharide blends contain PVI/PVP, a cross-linked polymer which binds and removes metals. When applied in the must, they reduce enzymatic oxidation process by interfering on both laccase and tyrosinase activity.

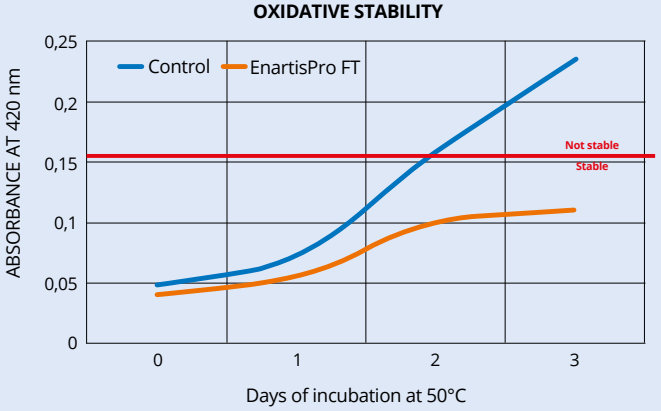
EnartisPro XP

It is a blend of PVI-PVP and inactivated yeast rich in immediately available mannoproteins. Due to its high capability in binding metals, it reduces the activity of oxidases (tyrosinase and laccase) by blocking copper. Consequently, wine is richer in aromatic compounds, presents a fresher color and is more resistant to oxidation and ageing. EnartisPro XP is recommended for the protection of aromas and aromatic precursors of non-thiolic varieties allowing for the full expression of the varietal characteristics.
Application: enhance aroma; antioxidant protection; extension of wine shelf life
Dosage: 30-50 g/hL
Packaging: 1 kg

EnartisPro FT

EnartisPro FT (Free Thiols) is a blend of PVI-PVP and inactivated yeast rich in immediately available mannoproteins and sulfur-containing amino acids. Because of its high capacity for removing metals, it reduces the activity of oxidases (tyrosinase and laccase) by blocking copper. Consequently, wine is richer in aromatic compounds, presents a fresher color and is more resistant to oxidation and ageing. It is recommended in the vinification of thiolic varieties which protects the varietal aroma and promotes the synthesis of new thiols
Application: enhance thiols; antioxidant protection; extension of wine shelf life.
Dosage: 30-50 g/hL
Packaging: 1 kg

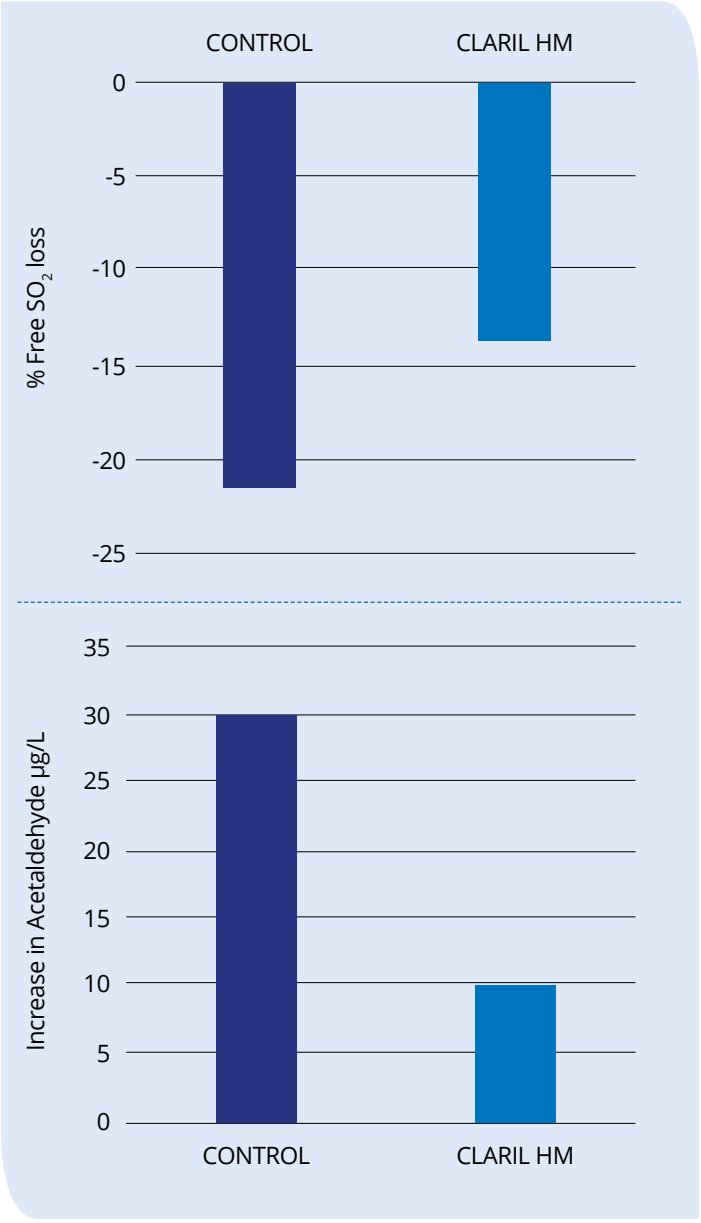




Comparing oxidative stability of Sauvignon blanc treated with and without EnartisPro FT

POST-FERMENTATION METAL REMOVAL

During aging or just prior to bottling, a fining agent such as Claril HM (blend of PVI/PVP and activated chitosan) can be utilized to safely and effectively remove metals. This fining agent can not only remove copper and iron, but also monomeric phenolics which can become oxidized to form brown pigments. This makes Claril HM a well suited treatment for limiting oxidation.



With these tools available, winemakers can better control metal levels in their wines, which will ultimately benefit wine's oxidative stability and shelf life.

CLARIL HM

This fining agent benefits from the synergistic actions of activated chitosan and polyvinylimidazole/ polyvinylpyrrolidone (PVI-PVP) to reduce the concentration of iron, copper, hydroxycinnamic acids and catechins, which are key players in the process of oxidation. Therefore, treatment with CLARIL HM allows the production of wines with a longer shelf life, more intense and persistent aroma and fresher color.
Application: prolong wine shelf life; prevent oxidation
Dosage: 30-50 g/hL
Packaging: 2.5 kg

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