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ENARTIS NEWS

HOW TO PREVENT OXIDATION DEFECTS DURING AGEING OR IN THE BOTTLE

TAKE ACTION BEFORE IT'S TOO LATE

Oxidation *can occur at any time during the winemaking process, and it is a common challenge faced by winemakers and producers. The need to produce and keep wine fresh, young, and appealing until bottling is part of the quality standards imposed by consumers in an increasingly competitive market. Actions beginning in the early stages of winemaking should be taken to avoid certain defects from oxidation: atypical ageing, pinking, browning, and loss of complexity and aromatic intensity.*

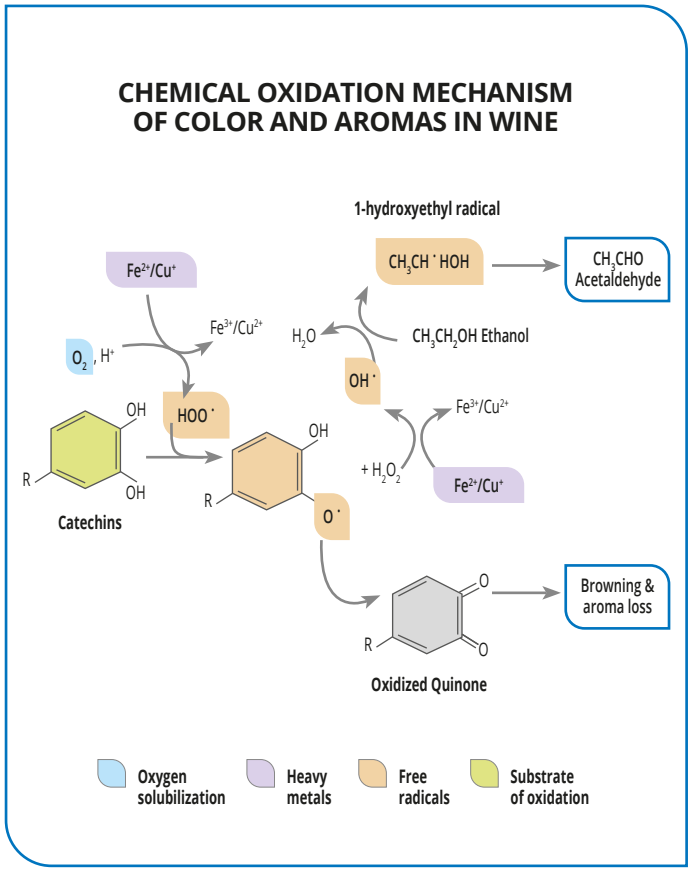
Avoiding oxidation means increased shelf life and, consequently, an improvement in the final quality of the wine.

OXIDATION MECHANISMS

When talking about oxidative mechanisms in winemaking, we mainly refer to two types of oxidations: enzymatic oxidation and chemical oxidation (non-enzymatic).

- **Enzymatic oxidation** mostly occurs in must by polyphenoloxidases (tyrosinase in the case of healthy grapes and laccase in the case of grapes affected by *Botrytis cinerea*).
- **Chemical oxidation** prevails in fermented wine and during ageing and represents a redox reaction catalyzed by metals like Cu^{+} and Fe^{2+} that convert oxygen into highly reactive radicals capable of oxidizing several organic compounds.

These reactions, both enzymatic and chemical, result in the formation of final products called quinones, a strong oxidant for must and wine.



FACTORS INVOLVED

- Oxygen and presence of metals.
- High content of easily oxidizable polyphenols such as hydrocinnamic acids and catechins.
- Variety of grapes (mainly high phenolic and/or thiol content).
- High level of polyphenoloxidases (PPO) activity.
- Winemaking techniques (pressing, reductive conditions, etc.).
- Vintage (seasons with high temperatures and exposure to light).

WHAT DOES OXIDATION REPRESENT IN WINE?

Oxidative wines are characterized by a loss of youthful and fresh characters with flattening on the palate and bitter sensations. Acetaldehyde levels increase due to Strecker degradation. Varietal aromas are transformed into sweet, honey, and prune aromas and stewed fruit flavors. Wine color becomes darker with a predominance of gold, brown and orange tones.

In addition to **browning**, wine can suffer other types of oxidation defects in the bottle:

- **atypical ageing:** usually occurs in white wines which are less than one year old. Varietal aromas are quickly lost while other undesirable aromas such as soap, floor polish, and old wax appear as well as a yellow-orange color.
- **pinking:** is the appearance of pink color in white wines and usually occurs during bottling. The intensity of the pink varies from pinkish to salmon-red blush and normally does not result in any change in wine aroma and taste, only color.

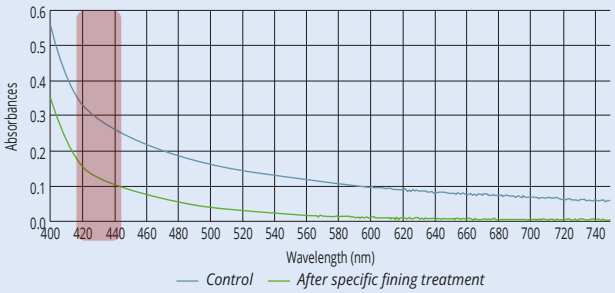
Although the exact mechanism is not yet well known, wine exposure to oxygen and phenols are involved. There are different variants by which this defect can occur, but recent studies conclude that the compound responsible is the anthocyanin malvidin-3-O-glucoside present in small concentrations (≈0.3 mg/L) in white wines produced under reductive conditions.

MEASUREMENT PARAMETERS TO CONSIDER

A series of analyses can be carried out to determine the level of sensitivity of a wine to oxidation. Among them, we commonly find:

- **Catechins:** Phenolic compounds analyzed for their tendency to oxidize. Values above 20 mg/L indicate a high risk of oxidation.
- **Absorbance readings:** The entire color spectrum is evaluated, mainly 420 and 440nm, indicating yellow and brown tone.
- **Metals:** Iron and copper are the catalysts responsible for transforming oxygen into free radicals.
- **Dissolved oxygen:** Oxygen solubilization in wine is the first step of oxidation.

Enartis, in its latest research and tests, has observed that the reduction in **catechin concentration is not directly proportional to a reduction in the risk of oxidation**. Wines with high catechin content and treated with fining agents have resulted in wine with no oxidation defects, neither color browning nor presence of oxidized notes even without obtaining a significant reduction in catechins concentration (*Graphic 1*). This leads us to think that the reduction of other easily oxidizable polyphenols such as hydroxycinnamic acids, which are not regularly analyzed and evaluated, play a fundamental role in the oxidation process. Therefore, the determination of the catechin content does not serve as a primary indicator in the evaluation of oxidation risk. It is necessary to evaluate, after fining treatment for example, its sensory and visual effect by tasting and reading of absorbances as well as performing an oxidability test.



Graphic 1: Evaluation of the color oxidation impact by broad spectrum absorbance reading in a white wine with high catechin content (45 ppm). After fining treatment, the concentration of catechins has remained practically the same (42 ppm), while the optical density at 420 and 440 nm has been reduced.

MANAGE AND ADAPT THE WINEMAKING PROCESS

The use of specific and innovative tools to prevent and avoid oxidation mechanisms can improve and maintain high wine quality. It also helps to decrease the use of SO_2, preserving and respecting the characteristics of wine.

WINEMAKING STAGE	GOAL	ENARTIS RECOMMENDATIONS	WHY
GRAPE RECEPTION	Inhibit the activity of polyphenol oxidase (PPO) enzymes.	**EnartisTan ANTIBOTRYTIS** Gallic and ellagic tannins. **EnartisTan ROUGE** Ellagic, gallic and condensed tannins.	**Oxidative enzymes** are always present in grapes. In healthy grapes, the oxidative action of **tyrosinase enzyme** is easy to inhibit due to its high sensitivity to SO_2. The opposite happens when grapes have been affected by *Botrytis cinerea* and **laccase enzyme** is present. To inhibit its action, large quantities of SO_2 are needed and even then, only part of its activity is inhibited. For this reason, it is necessary to use **specific antioxidant and antioxidasic tannins to supplement or replace the use of SO_2**.
JUICE OR WINE CLARIFICATION	Reduce the content of easily oxidizable polyphenols, the main substrates of oxidation.	**COMBISTAB AF** PVPP and pea protein. **CLARIL AF** PVPP, bentonite and pea protein. Also effective in unstable protein removal. **CLARIL ZR** Alternative to the use of PVPP. Contains bentonite, pea protein and activated chitosan. **ENOBLACK PERLAGE** Activated carbon in pellet form (dust-free). Alternative to the use of PVPP or other fining agents. Also effective in metal reduction.	**Fining strategy can significantly reduce the risk of oxidation defects** by removing substrates and catalysts that play a key role in oxidation reactions. The use of **plant-based fining agents and activated chitosan** has been shown to improve alcoholic fermentation, sensory profile, filtration, overall wine stability and shelf life. Depending on the composition of the selected fining agent, it also improves protein stability by reducing the amount of bentonite use in the final wine. The use of fining agents **during fermentation amplifies the effectiveness of their application**.
	Remove metals that transform oxygen into free radicals.	**CLARIL HM** PVI/PVP and activated chitosan. **PLANTIS AF-Q** Alternative to the use of PVI/PVP. Contains pea protein and activated chitosan. Highly effective in iron removal.	
POST-ALCOHOLIC FERMENTATION / AGEING	Manage dissolved oxygen before it's too late.	**EnartisTan SLI** Untoasted American oak tannin. **HIDEKI** Blend of selected tannins with high antioxidant and bacteriostatic activity. **INCANTO NC range** Inactivated yeast with specific tannins.	**Avoid oxygen solubilization** during winemaking practices with high risk of exposing wine to oxidation (racking, filtration, bottling, etc.) with **selected tannins**. Use of **inactivated yeast** to efficiently and naturally consume oxygen entering the solution, while improving the sensory profile and overall stability of wine.
PRE-BOTTLING	Stabilize redox potential and block free radicals.	**EnartisTan SLI** Untoasted American oak tannin. **CITROSTAB rH** Synergistic coadjuvant with a balanced formulation.	Wine redox potential tends to increase during ageing. **Stabilizing wine redox potential** will preserve the vibrant and fresh characteristics of youthful wines. Hydrolyzable tannins and pre-bottling adjuvants can be used to extend wine shelf life by rapidly **scavenging radicals** and balancing the redox potential. **Significant reduction or replacement of SO_2**.

These products are also part of the strategy to prevent oxidation of red wines.

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