

MITIGATING THE EFFECTS OF CLIMATE CHANGE ON WINE PRODUCTION USING ACTIVATED CHITOSAN AND TECHNICAL TANNIN



Inspiring innovation.

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INTRODUCTION

Some of the biggest challenges for the wine industry result from increased temperatures and long periods of water stress due to climate change. These conditions favor accelerated ripening of fruit which leads to higher sugar content, delayed phenolic ripeness, increased pH, and decreased acidity.

This consistent rise in pH comes with a lower effectiveness of sulfur dioxide (SO₂), requiring higher doses to provide the desired microbiological and antioxidant protection. A wine with a pH of 4.0 requires up to four times the dose of SO₂ compared to a wine with a pH of 3.2 to achieve the same molecular SO₂ and therefore microbial control.

After many years of research and experience, Enartis has observed that quality, stable wine can be obtained even when reducing or removing SO₂ additions. This was achieved using various allergen-free and vegan-friendly products with the same antioxidant, antioxidasic, and antimicrobial properties as SO₂, regardless of wine pH.

Pre-activated chitosan derived from *Aspergillus niger* can be an alternative to SO₂ during all stages of the winemaking process due to its antioxidant, antioxidasic, and antimicrobial effect. It has demonstrated strong results in controlling a wide spectrum of spoilage microorganisms such as *Botrytis cinerea*, *Acetobacter*, *Lactobacillus*, *Pediococcus* even at high pH (pH 3.9). Furthermore, it can limit oxidation reactions by chelating metals such as copper and iron, which are catalysts of enzymatic and non-enzymatic oxidation reactions. This is useful as climate chaos and organic farming necessitate increased copper use in vineyards.

Specifically formulated **technical tannins** have been selected and purified to provide strong antioxidant protection, as well as inhibit bacteria growth over time. This blend is also particularly beneficial in situations where wines contain a low amount of free SO₂, preventing oxidation and increasing the shelf life of the finished product.

MATERIALS & METHODS

MATERIALS

- **EnartisStab MICRO M** is a preparation of pre-activated chitosan. It is designed to disrupt the cellular functions of a wide spectrum of microorganisms, inhibiting their activity and growth while leaving *Saccharomyces cerevisiae* populations unaffected.
- **HIDEKI** is a technical tannin composed of molecular fractions obtained through the selection and purification of gallic, ellagic, and condensed tannins, which were selected to be the most efficient in terms of antioxidant and microbiostatic action.

ANALYSES

- **Lactic acid and malic acid:** Malolactic fermentation progress was tracked by periodically analyzing malic acid consumption and lactic acid formation using the enzymatic multiparameter Dionysos 150-SinaTech.
- **pH:** A pH-meter was used to track pH throughout the experiments.
- **Molecular SO₂:** Analyses with Dionysos 150-SinaTech using a colorimetric kit were used to determine free SO₂. Consequently, molecular SO₂ was calculated using free SO₂, temperature, alcohol, and pH data.
- **Petri dish:** Culture plating with selected media for *Lactobacillus*, *Brettanomyces*, and *Acetobacter* were used to track bacterial development.
- **Absorbance 420 nm:** Optical density was measured by spectrophotometer to track the amount of yellow and brown color in wine.

FIGURES

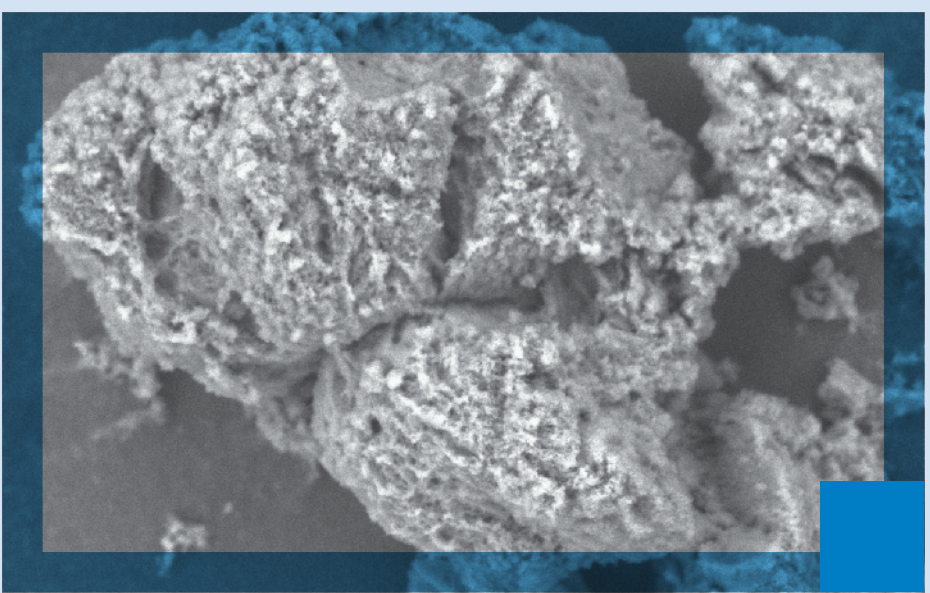
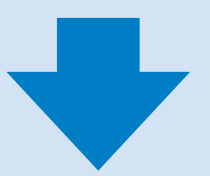
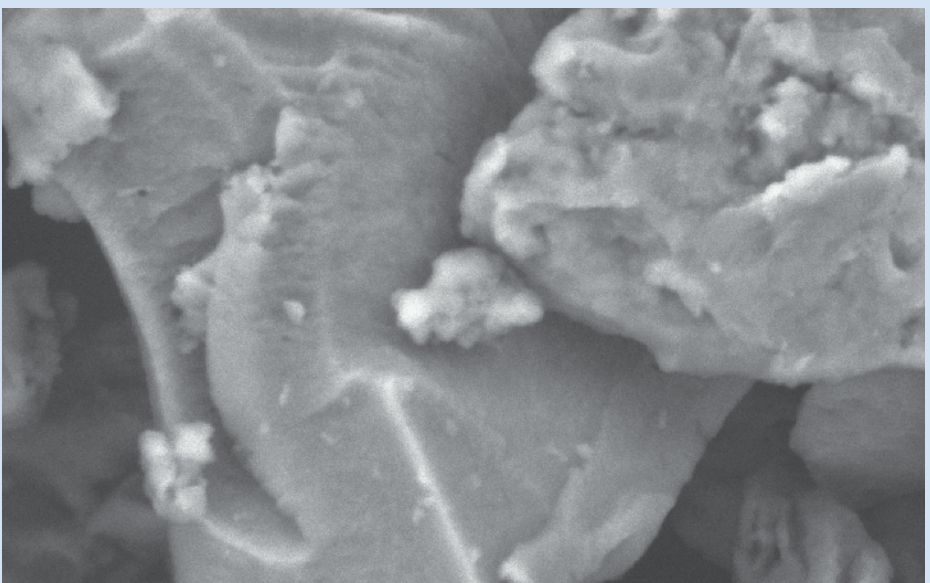


Figure 1

Standard chitosan vs Enartis pre-activated chitosan.
Images taken with a scanning electron microscope

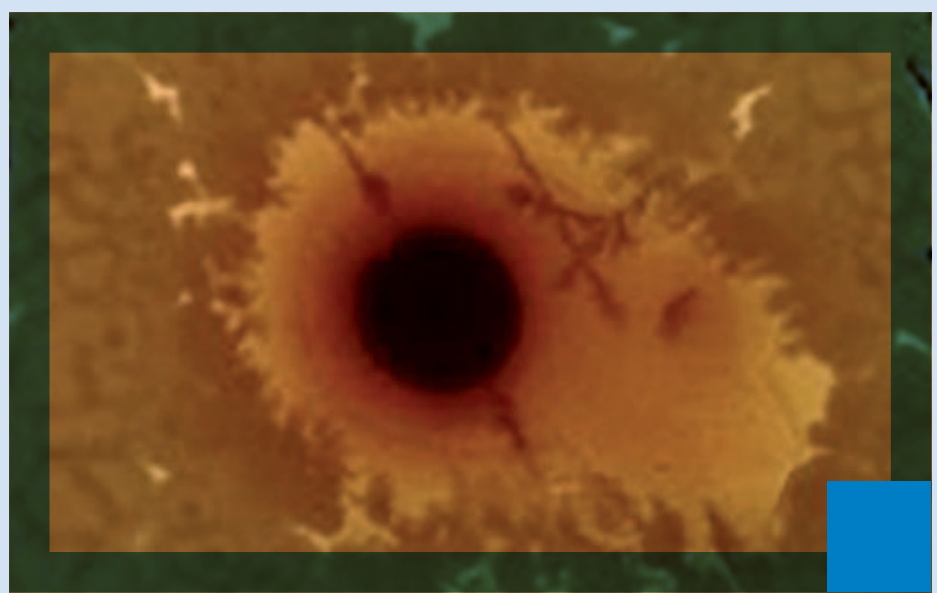
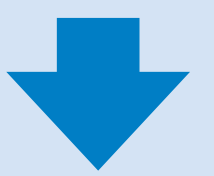
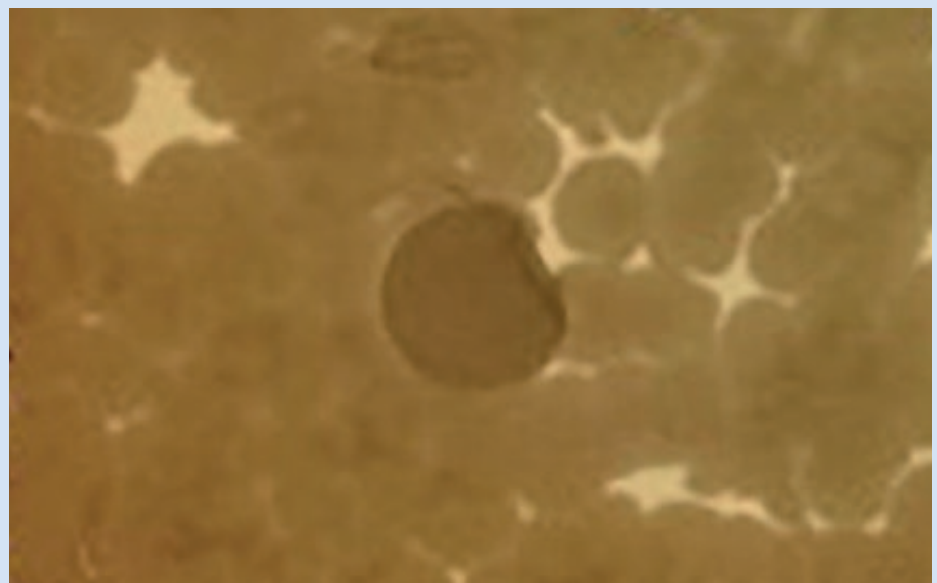


Figure 2

HIDEKI's inhibiting effect
on lactic acid bacteria growth.

TABLES

Antimicrobial effect

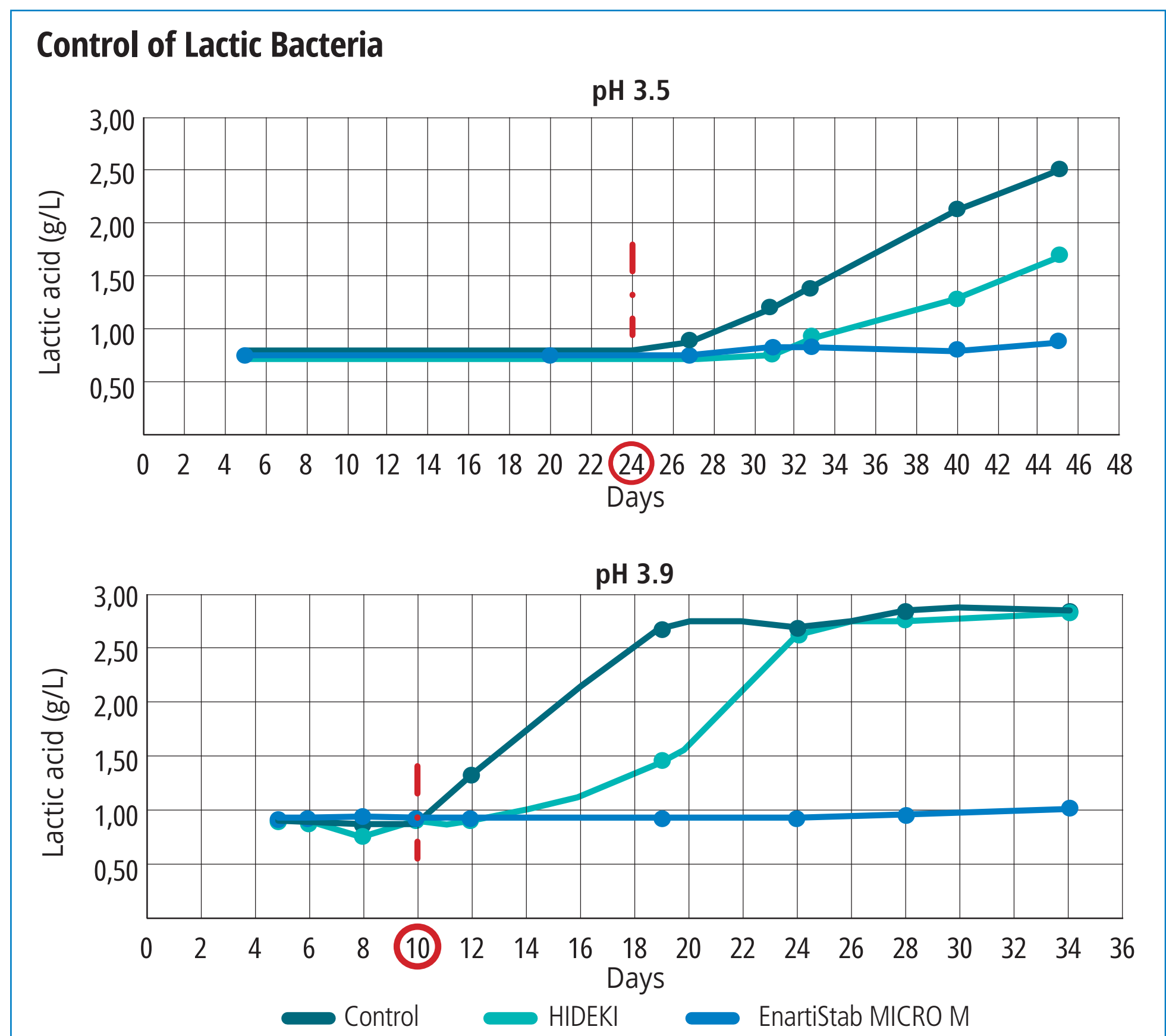


Figure 3. Effect of 10 g/hL EnartisStab MICRO M and 5 g/hL HIDEKI on white wines at different pH with <0.1 mg/L of molecular SO₂ and inoculated with 1 g/hL (10⁶ CFU/mL) of a highly resistant *Oenococcus oeni* strain.

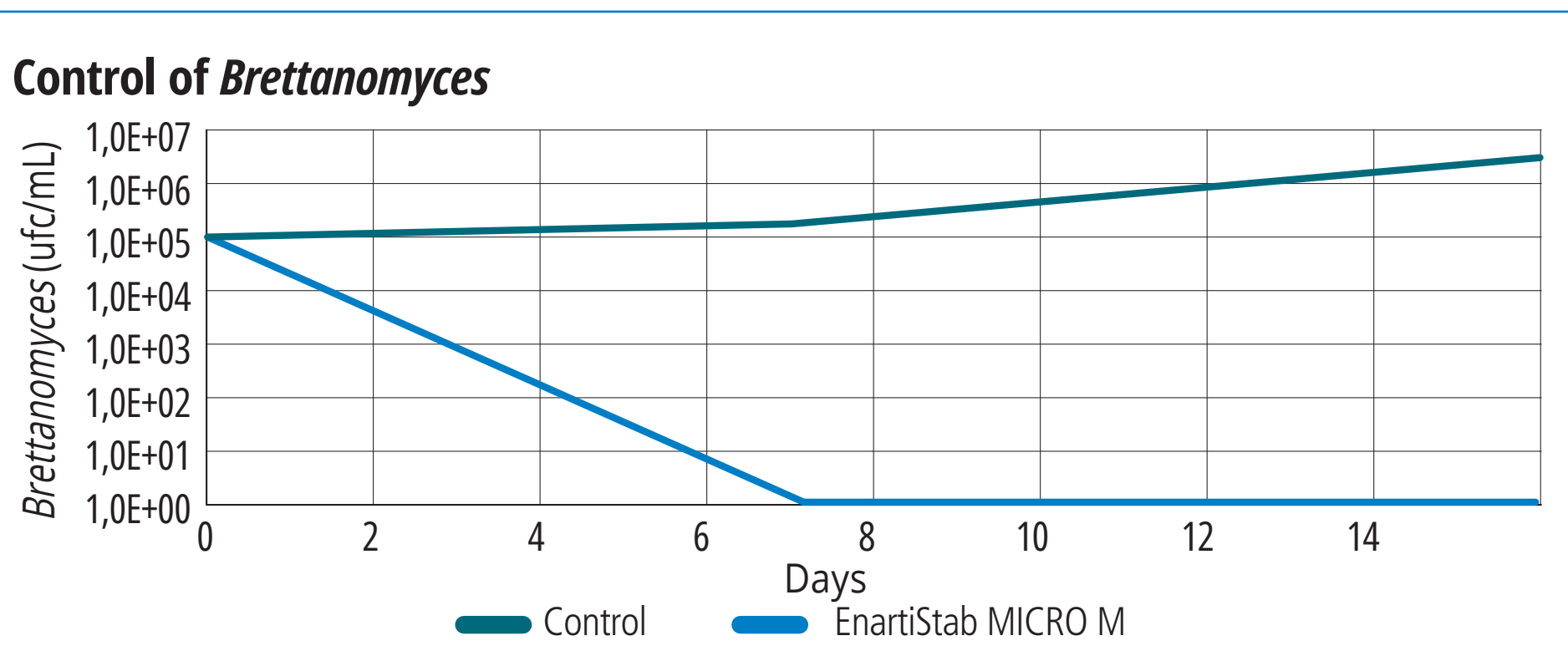


Figure 4. Effect of 10 g/hL EnartisStab MICRO M on red wine at pH 3.55 and 0.36 mg/L of molecular SO₂. The wine was inoculated with 10⁶ CFU/mL of *Brettanomyces*.

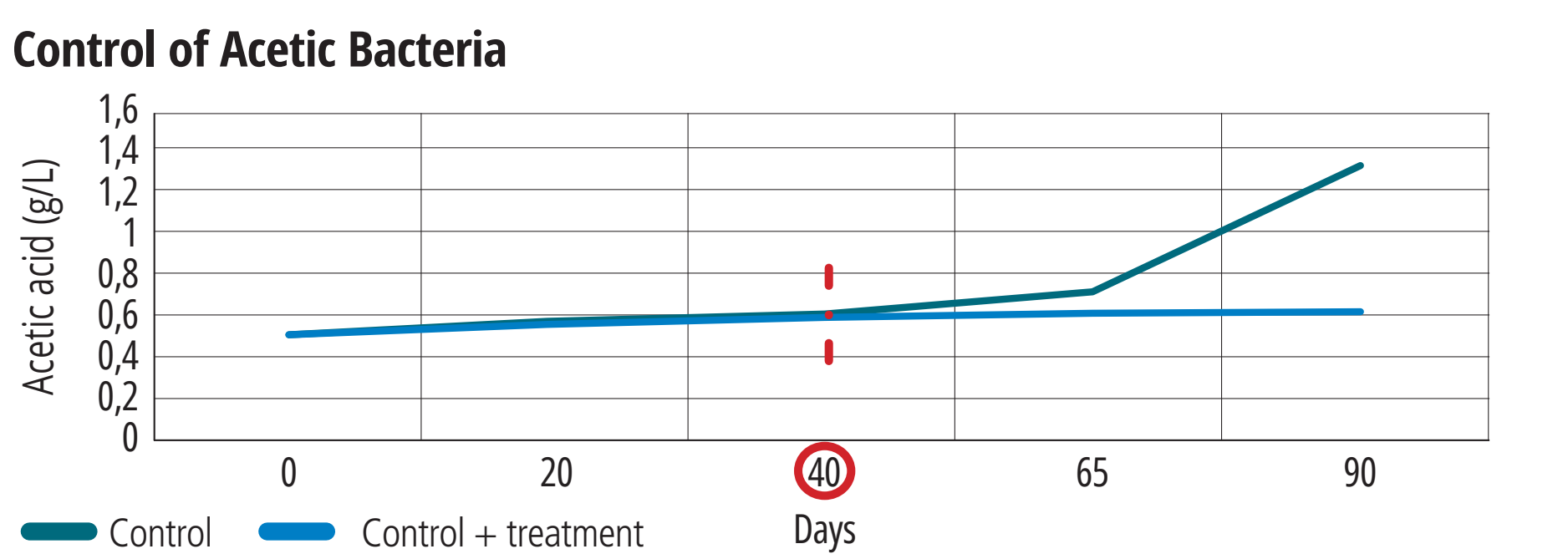


Figure 5. Effect of combined treatment with 5 g/hL EnartisStab MICRO M followed by 5 g/hL HIDEKI on a white wine at pH 3.4 and 0.12 mg/L of molecular SO₂. The wine was inoculated with 10⁶ CFU/mL of *Acetobacter*.

Antioxidant effect

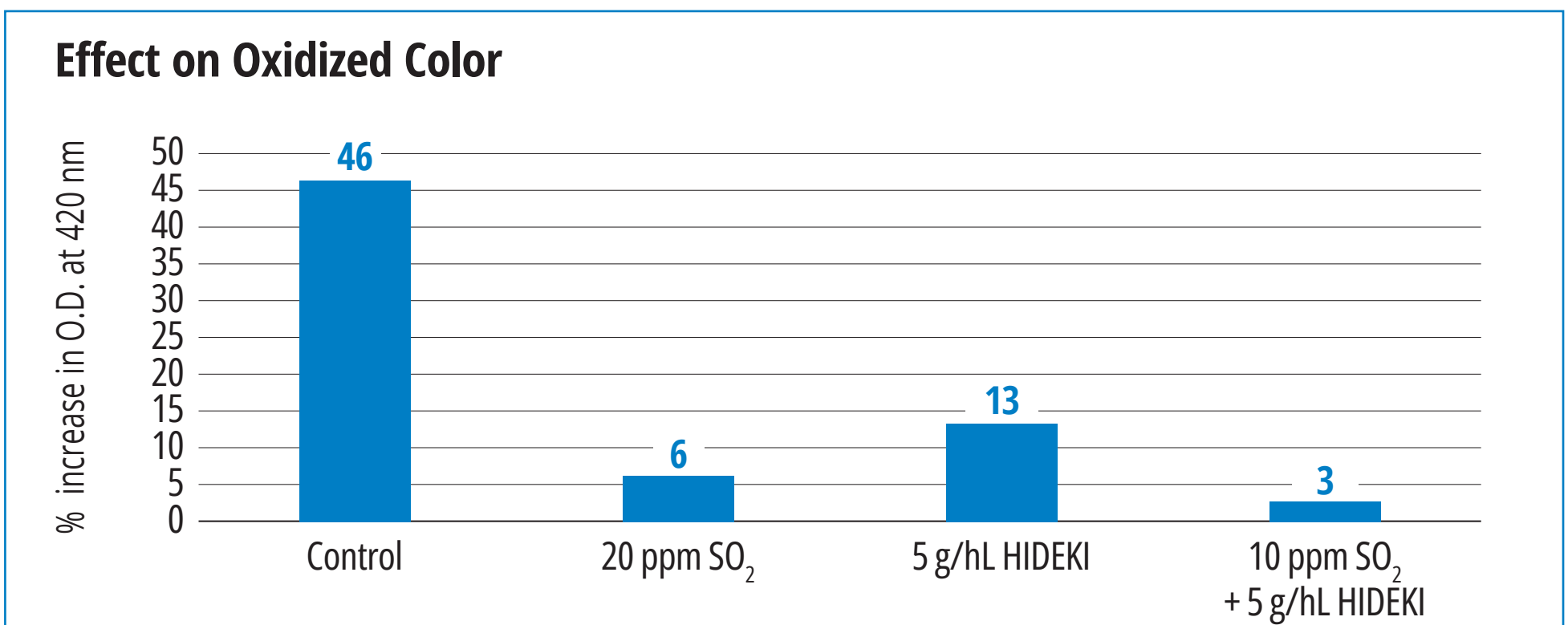


Figure 6. White wine with pH 3.5 exposed to air for 10 days. Lower optical density (O.D.) at 420 nm shows that HIDEKI aids SO₂ management.

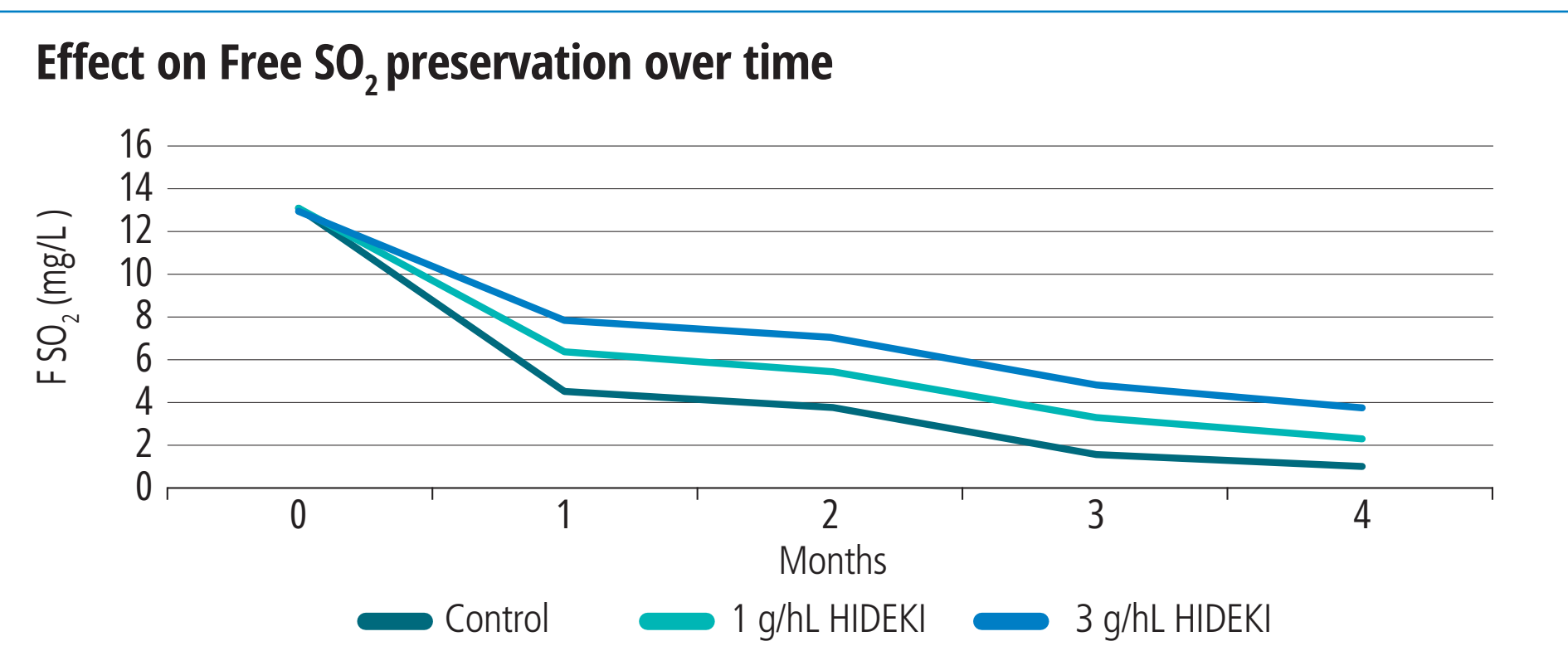


Figure 7. Bottling simulation: White wine into 0.5 L bottles at pH 3.5. HIDEKI is effective in protecting Free SO₂ (FSO₂) concentration over time.

CONCLUSIONS

The use of EnartisStab MICRO M, a preparation of pre-activated chitosan of fungal origin, in conjunction with HIDEKI, a blend of selected technical tannins, offers a promising solution for controlling bacteria, yeast, fungus, VA, and VSCs in wine production. Due to their effectiveness, allergen-free and vegan-friendly status, and the improvement of the sensory qualities of the final product, they provide sustainable and effective alternatives to traditional winemaking techniques. This is especially crucial in light of the challenges posed by climate change to wine production.