enartis

N-E-W-S

# Technical Article

Via San Cassiano 99, - 28069 San Martino Trecate NO, Italia - www.enartis.com

# MICRONIZED CALCIUM: THE ULTIMATE SOLUTION FOR ADVANCED STABILITY

Tartaric stabilization in wine has traditionally focused on controlling potassium bitartrate precipitation, commonly known in enology as cream of tartar. In recent years, however, another form of tartaric instability has been observed with increasing frequency: the precipitation of calcium tartrate, a salt that forms under different conditions and at different times than potassium bitartrate.
This is driven by both rising global temperatures and modern winemaking practices. Today, calcium instability in wine is emerging as a growing concern and is no longer limited to wines from regions characterized by water stress or vintages with particularly high temperatures.

## From Calcium Accumulation in Grapes to the Formation of Calcium Tartrate in Wine

Calcium is an essential element for plant growth; it plays both a structural role as a component of cell walls and membranes and a signaling role as a messenger in response to thermal and water stress. It accumulates primarily in the cell wall and vacuole, and its transport occurs almost exclusively through the xylem in response to transpiration. Under thermal stress, calcium increases tolerance to high temperatures by reducing membrane permeability and water loss, while under water stress, it promotes stomatal closure and limits dehydration.
In grape berries, 75–90% of calcium accumulation occurs before veraison, and its accumulation is influenced by alkaline soils, nitrate availability, high pre-veraison transpiration, and calcium mobilization in response to environmental stress.
In wine, calcium may form calcium tartrate (CaT), a poorly soluble salt that precipitates slowly and often unpredictably, even after bottling.
The kinetics of precipitation are complex.
The main factors include pH, calcium concentration, and tartaric acid concentration. Alcohol content and the presence of natural colloids also play a significant role and should not be underestimated.
The dissociation equilibrium of tartaric acid is regulated by pH. As pH increases, the concentration of tartrate ions rises, increasing the likelihood of calcium tartrate formation and precipitation (Fig. 1).

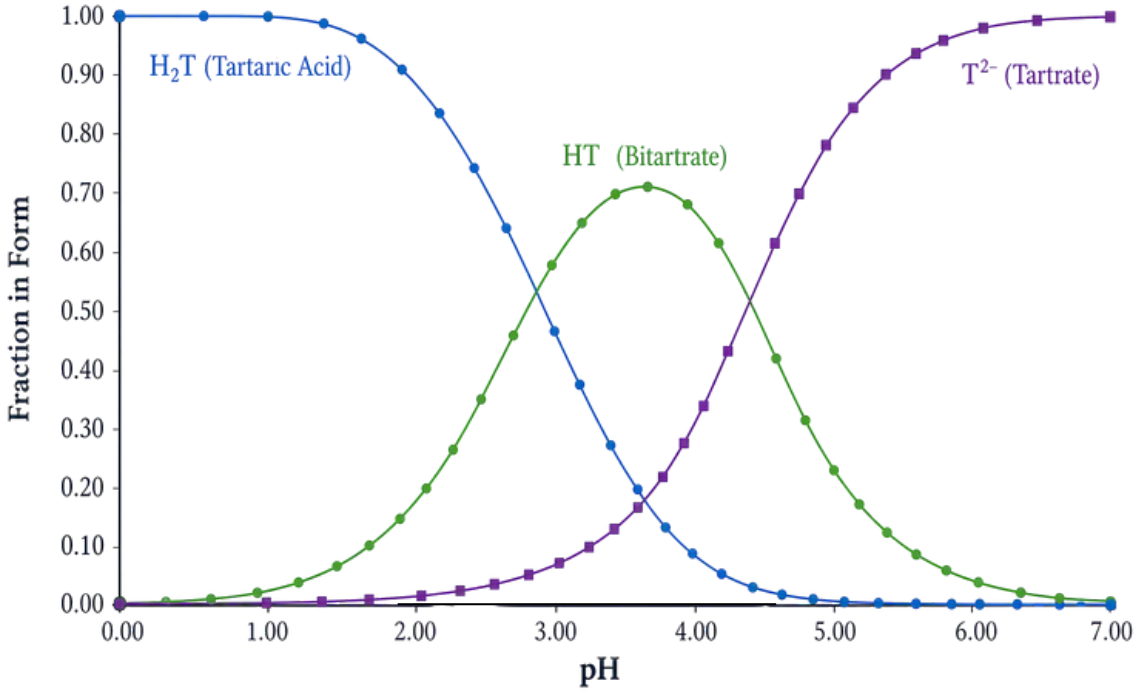


Fig. 1A - 1 - Solubility curve of tartrate as a function of pH. (Smith, V. 2012)

Although crystal formation in the bottle does not affect food safety, it can negatively impact the wine's visual appeal and perceived quality, leading to significant economic and reputational consequences for producers.

Calcium tartrate crystals exhibit regular, well-defined, and angular shapes that are more distinct than those of potassium bitartrate, making them readily identifiable under microscopic observation (Fig. 2).

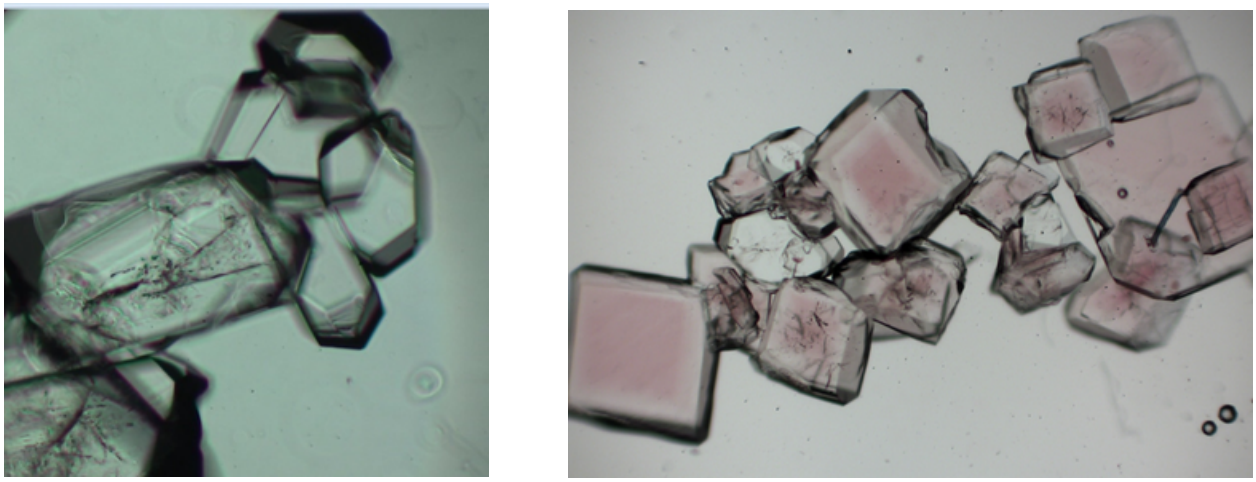

Fig. 2 - Calcium tartrate crystals observed under an optical microscope.

## Addressing Calcium Instability: Balancing Sustainability, Organoleptic Impact, and Efficacy

Traditional tartaric stabilization techniques, such as extended cold stabilization, offer limited protection against calcium tartrate instability. Likewise, commonly used protective colloids, including gum Arabic, carboxymethyl cellulose (CMC), and potassium polyaspartate (KPA), are generally ineffective at preventing calcium tartrate formation. Metatartaric acid can inhibit calcium tartrate crystallization; however, its effectiveness is only temporary. Due to its susceptibility to hydrolysis, metatartaric acid gradually degrades over time, resulting in a rapid decline in its protective effect (Fig. 3).

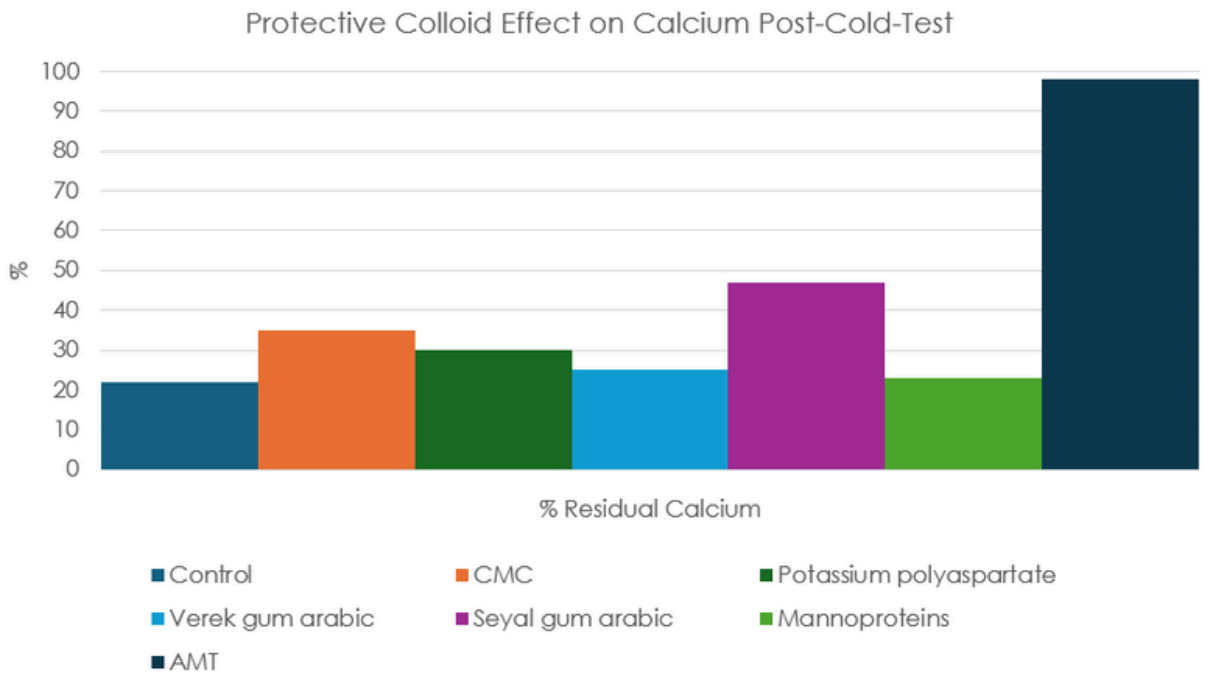


Fig.3. Comparison of traditional protective colloids and their effect on calcium tartrate stability.

Physical stabilization techniques such as electrodialysis and ion-exchange resins can effectively reduce calcium instability. However, these methods are costly, energy-intensive, highly dependent on winery conditions, and, above all, may negatively impact the wine's sensory characteristics.
To overcome these limitations, enological research has developed innovative approaches based on crystallization nuclei.
When the concentration of dissolved salts exceeds their solubility limit, these nuclei promote controlled crystal formation and precipitation.
The Enartis Research & Development team has been examining and developing an alternative, highly effective solution based on micronized L(+) calcium, marketed as ENOCRISTAL Ca, for several years now. When added to the tank immediately after alcoholic fermentation, it acts as a crystallization nucleus, accelerating the formation and precipitation of calcium tartrate crystals in the winery and preventing their later appearance in bottle.
Numerous trials conducted in wineries around the world have demonstrated that ENOCRISTAL Ca can achieve complete calcium tartrate precipitation within 15 to 20 days under constant and uniform temperature conditions (Fig. 4 & 5).

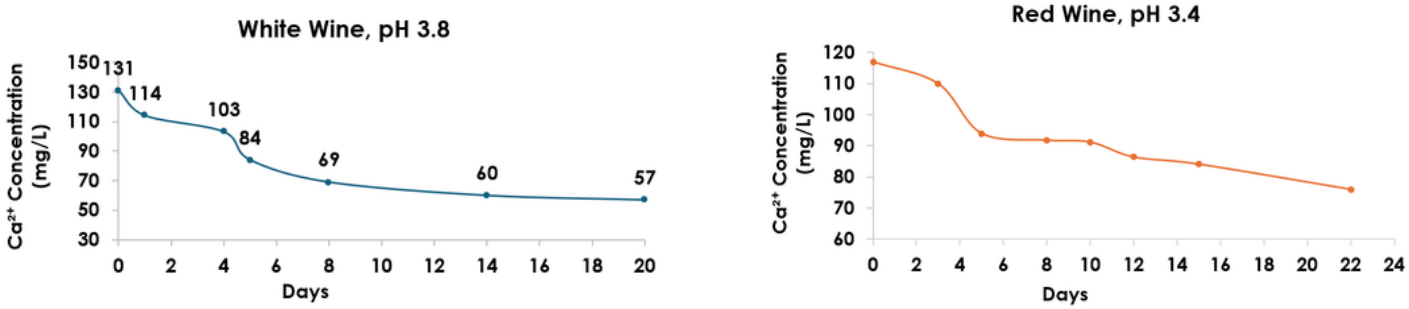


Fig. 4 & 5 - Reduction in calcium concentration in red and white wines over time. A significant decrease in calcium concentration is observed during the 20-day period, contributing to improved wine stability.

One of the key advantages of ENOCRISTAL Ca is that it does not require refrigeration, resulting in significant energy savings compared with conventional stabilization techniques. In addition, it preserves the wine's organoleptic and quality characteristics, unlike some physical treatments such as electrodialysis. As a result, ENOCRISTAL Ca offers a highly attractive combination of effectiveness, operational simplicity, cost efficiency, and sustainability.

## Micronized Calcium During Secondary Fermentation in Prosecco

The benefits of ENOCRISTAL Ca are not limited to post-fermentation stabilization. Excellent results have also been achieved during secondary fermentation in autoclave, as demonstrated in trials conducted at a Prosecco-producing winery. ENOCRISTAL Ca was added directly during autoclave filling and kept in suspension throughout the refermentation phase. The wine was then aged in the autoclave for approximately 2 to 3 months at -3°C to promote perlage integration. At the end of this phase, the wine underwent tangential filtration.
Throughout the entire process, there were no instances of unwanted calcium release into the wine, confirming the reliability of the treatment.
The performance of ENOCRISTAL Ca was also compared with that of a conventional product based on racemic calcium.

| | **Post-Treatment Calcium (ppm)** | **Final Calcium Stability (Stable if <15)** |
|---|---|---|
| 30 g/hL Racemic Tartaric Acid | 102 | 24 |
| **30 g/hL ENOCRISTAL Ca (Micronized Calcium Tartrate)** | **63** | **2** |

The base wine initially contained 112 ppm of calcium and showed a calcium instability value of 49, according to analyses performed at the winery.

The results demonstrated that ENOCRISTAL Ca effectively reduced calcium concentration and achieved calcium tartrate stability during secondary fermentation, without requiring any modifications to standard winery practices. In addition, the autoclave agitator ensured continuous suspension of the micronized crystals, promoting uniform contact with the wine and enhancing treatment efficiency.

## ENOCRISTAL Ca: The Definitive Solution for Calcium Stability

Calcium instability is now a major challenge for modern winemaking.
ENOCRISTAL Ca supports winemakers as a technologically advanced, sustainable solution that complies with current regulations. It accelerates the nucleation and growth kinetics of calcium tartrate crystals, optimizing stabilization times and process costs without altering the wine's organoleptic properties.