Inspiring innovation.

ENARTIS NEWS

SUSTAINABLE APPROACH TO ACHIEVE TOTAL TARTARIC STABILITY

EASILY STABILIZE POTASSIUM BITARTRATE AND CALCIUM TARTRATE!

Once alcoholic fermentation comes to an end, it's time to start stabilizing wine to prevent defects from appearing in the bottle. One of the most common defects is the appearance of crystals at the bottom of the bottle, generally from potassium bitartrate instability. In recent years, the presence is also due to calcium instability, leading to the precipitation of calcium tartrate. The increased presence of calcium in wine may be an effect of climate change. Global warming and heat stress lead to an increase in Ca^{2+} *in the vineyard and consequently in must, as well as higher pH conditions that promote instability, influencing the degree of dissociation of tartaric acid and the formation of its calcium salts.*

While the formation of potassium salts can be avoided with the use of protective colloids, calcium stabilization requires specific interventions.

STABILIZATION METHODS

There are various stabilization methods:

- **Subtractive**

  Traditionally used. It consists of reducing the concentration of tartaric acid and/or potassium and/or calcium in wine (calcium reduction depends on the methods used).

  Most of the substrative methods are usually **physical treatments**, commonly used in large wineries.

- **Additive**

  New method that has been growing steadily in recent years due to its multiple enological advantages. It consists of using protective colloids or crystallization inhibitors to achieve stabilization, while being more respectful of the sensory qualities and environmentally friendly.

Choosing a method is based on habit of use, the winery's production size, treatment efficiency, logistics, etc.

Currently, process efficiency is closely related to sustainability. The wine industry requires improved environmental sustainability due to the challenges of climate change and increase in production costs. Winemakers are required to use practices that drastically reduce energy consumption while making it easier to manage the process.

HOW STABILIZATION METHODS HAVE EVOLVED: PROs AND CONs

1 *Cold Stability*

The most traditionally used method for the stabilization of potassium bitartrate (KHT), still widely used today. It has shown to have many limitations, among them are:

- Large energy consumption.
- High consumption of potable water.
- High CO_2 emissions.
- Labor intensive.
- Variable stabilization times, which makes winery scheduling difficult.
- Not reliable for calcium tartrate (CaT) stabilization. It has little effect on CaT precipitation, because TH^- concentration decreases, but Ca^{2+} concentration remains constant.
- Negative impact on sensory characteristics: decreased acidity and structure, increased risk of oxidation due to higher dissolved oxygen and, therefore, a decrease in wine shelf-life.
- Stabilize color by precipitating the unstable color but leads to a significant loss of final color intensity.

These lead to higher production costs, poorer stabilization process performance, and overall low sustainability.

2 *Cation Exchange Resins*

Physical treatment that was introduced in the 70s. It selectively exchanges K^+ and Ca^{2+} ions for H^+ protons, leading to a significant reduction in pH. It is a fast and relatively inexpensive process. Although it has some drawbacks:

- Difficult to manage (uncontrolled elimination).
- Its effectiveness on tartaric stability is mainly due to its action of lowering the pH of wine, which has a sensorial impact.
- High consumption of potable water and generation of wastewater that must be subsequently managed.
- Strong sensory impact, so it is not recommended to treat the entire volume, nor is it advisable for certain wines such as young red wines.
- It does not stabilize color, requiring alternative methods to stabilize it later.

3 *Electrodialysis*

Currently, the most effective physical treatment which began being used in the 90s. It is a fast and controlled process. It separates K^+ and Ca^{2+} ions efficiently under the effect of an electric field. Disadvantages include:

- High cost.
- Requires high water consumption and generates a substantial amount of wastewater.
- Eliminates tartaric acid and increases the risk of oxidation, thus affecting sensory qualities of wine and its ageing potential.
- It does not stabilize color, requiring alternative methods to stabilize it later.

4 *Additives*

Protective colloids emerged in the 2000s. This alternative approach is much more respectful of wine characteristics. Various protective colloids with different stabilizing effects are currently available on the market (*Table 1*). In general, since these additives do not require chilling the tank, they can be considered environmentally sustainable, leading to a significant reduction in electricity (up to 60-90%) and potable water consumption, as well as CO_2 emissions.

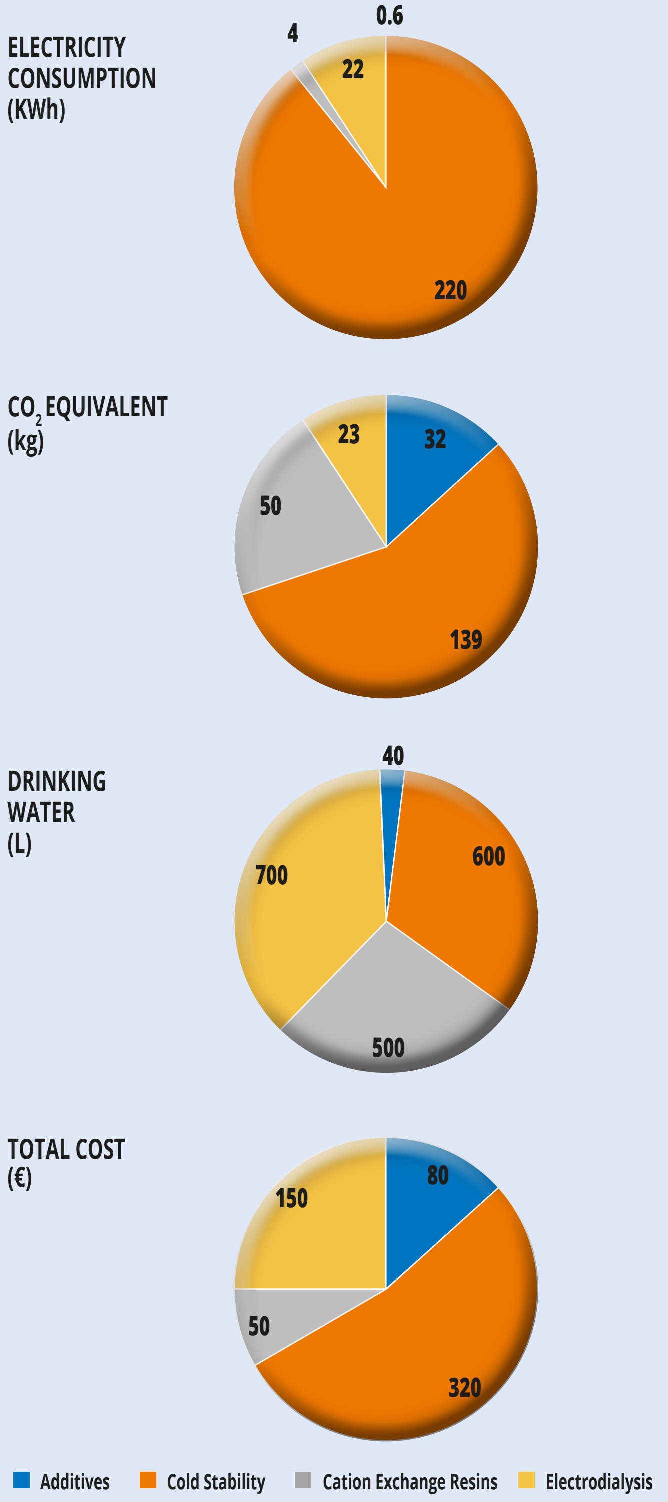


Figure 1. Evaluation of stabilization methods made by the European Stabiwine project.

	METATARTARIC ACID	MANNOPROTEINS	SEYAL GUM ARABIC	CARBOXYMETHYL CELLULOSE (CMC)	POTASSIUM POLYASPARTATE (KPA)
Stabilizing Effectiveness	High	Medium, Low	Medium, Low	High	High
Lasting Stabilizing Effect	Low	High	High	High	High
Filterability	High	Medium	Medium*	Medium*	High
Reactivity with Color Compounds	None	None	Low-Medium	Yes (it cannot be used in red wines)	None
Reactivity with Wine Proteins	Yes	None	None	Yes	Yes

Table 1. Protective colloid characteristics. High effect/reaction · Medium effect/reaction · Low effect/reaction
* Dependent on CMC degree of polymerization and gum Arabic's average molecular weight

CLUES TO IDENTIFY TARTARIC UNSTABLE WINES

Wines Prone to Potassium Bitartrate Instability (KHT)

For the most part, all young wines have higher tartaric instability. During the ageing process, wines may naturally stabilize. This depends on several factors, such as the type of wine, storage conditions, etc., but most wines will show some final instability when analyzed. Additionally, when blending different types of wine close to bottling, even if they were previously stabilized, the change in physical-chemical balance could potentially generate instability.

Wines Prone to Calcium Instability (CaT)

When it comes to calcium instability, the situation is much more complex since its precipitation is unpredictable. Overtime, several parameters can promote or inhibit this instability:

- **Promoting factors**: high calcium and tartaric acid content and high pH.
- **Inhibitory factors**: gluconic acid, malic acid, citric acid, colloids, etc.

In general, wines with these parameters risk instability:

High calcium concentration: >60-80 mg/L Ca^{2+}
High pH: >3.4
High tartaric acid: >1.5-3.0 g/L

Enartis, after years of research and analysis of thousands of wines from different parts of the world, has observed that, mainly, the risk of calcium tartrate instability in wines with **pH >3.4** is reduced over time as precipitation occurs more rapidly. While in wines with **pH <3.4**, the risk of instability is maintained over time as there is hardly any dissolved T^{2-}. **This cannot be used as a rule, as there are other factors such as calcium and tartaric acid (H_2T) concentration**, which can change the level of instability and cause this phenomenon to occur more rapidly.

Cases where CaT precipitation is less likely
(considering that the main factors promoting this instability are not very high):

- Red wines, as their structure is more complex and contains many colloids that help reduce instability.
- White or rosé wines with a high malic acid content, as it acts as an inhibitor.
- White or red wines aged on lees, as mannoproteins also act as inhibitors.

Cases where CaT precipitation is more common:

- Wines with low pH, high calcium or H_2T concentration, and few inhibitors.
- Wines with high pH, high concentration of calcium or H_2T, and few inhibitors.

ENARTIS STABILIZATION STRATEGY

Enartis has developed two products to achieve total tartaric stability for the stabilization of potassium bitartrate and calcium tartrate, allowing for a sustainable process, lower production costs, and respecting the quality of the wine:

ENOCRISTAL Ca* (learn more about ENOCRISTAL Ca) speeds up the formation of calcium tartrate crystals, promoting their precipitation and reducing the final calcium concentration in wine. It requires 7-10 days of contact time without the need to chill the tank, saving energy and decreasing costs for wineries.

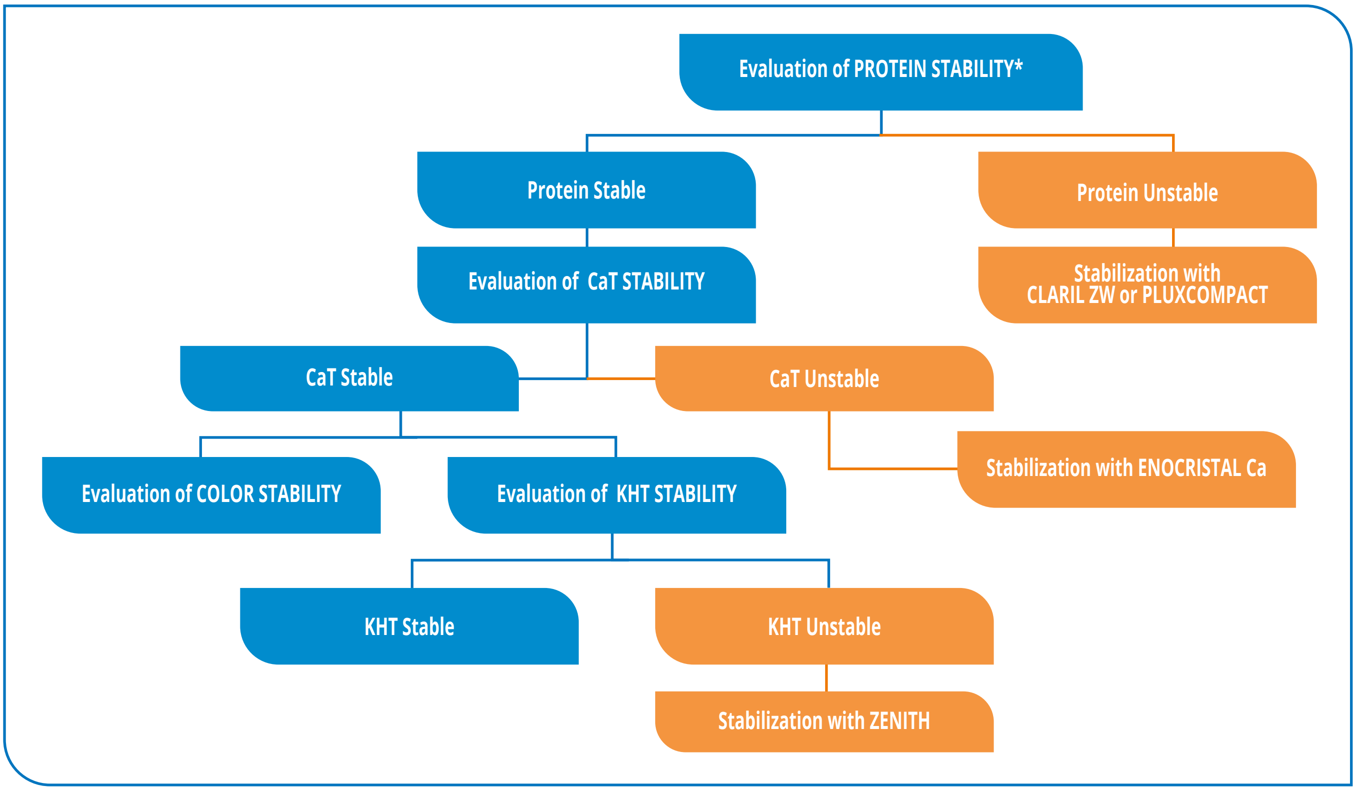
Its application is not recommended without preliminary trials in wines with pH ≤3, as there is a potential risk of calcium solubilization. Our laboratory will gladly assist with a risk assessment.

After reaching calcium stability with ENOCRISTAL Ca, rack off and/or filter. The wine is now ready for the addition of:

ZENITH (learn more about the ZENITH range) is a solution of potassium polyaspartate that blocks the formation and growth of potassium bitartrate crystals. It maintains the sensory characteristics of wine while preserving acidity, color, and structure. It extends wine shelf-life while increasing the stabilization process efficiency. ZENITH ensures a lasting stabilizing effect, even under suboptimal storage conditions. It can also be applied immediately prior to final filtration.

***ENOCRISTAL Ca has not been subjected to pre-market approval by the FDA and is not yet listed as GRAS for use in alcoholic beverages, therefore, it is not permitted for use in winemaking in the USA.** Food additives and color additives are subject to premarket approval by FDA and require a listing in Title 21 of the Code of Federal Regulations (21 CFR) providing for such use before they can be lawfully used in products marketed in the U.S. unless the use of the substance is GRAS for the intended use among experts qualified by experience and training. GRAS substances are exempt from pre-market approval and do not require a regulation listed in 21 CFR.*

OPTIMUM STABILIZATION FLOW CHART



Variation in the stabilization flow chart: to accelerate stabilization processes, it is possible to perform CaT stabilization at the same time as protein stabilization for white and rosé wines.

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