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# THE INFLUENCE OF LOW TEMPERATURE ON STABILIZATION PROCESS OF WINE

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## Abstract

*In laboratory condition we tested the time - refrigeration effect, for 90 days at 4℃, 90 minutes at 0℃ and 90 minutes at -4℃ on stabilization and composition of white and red wines. Wines were sampled before and after the industrial cold stabilization process then subjected to refrigeration tests in the laboratory. Measuring the conductivity of the wine with time monitored the time course of potassium bitartrate precipitation at low temperature.*
***Keywords**: refrigeration, wine, potassium bitartrate*

## Introduction

Grape is rich in tartaric acid and potassium. Therefore grape juice and wine have high concentrations of potassium bitartrate (Tofan, 2005). Tartaric acid may be most immediately recognizable to wine drinkers as the source of "wine diamonds," the small potassium bitartrate crystals that sometimes form spontaneously on the cork. These "tartrates" are harmless, despite sometimes being mistaken for broken glass, and are prevented in many wines through cold stabilization. The tartrates that remain on the inside of aging barrels were at one time a major industrial source of potassium bitartrate.

However, tartaric acid plays an important role chemically; lowering the pH of fermenting "must" to a level where many undesirable spoilage bacteria cannot live, and acting as a preservative after fermentation. In the mouth, tartaric acid provides some of the tartness that isn’t currently of present interest in the wine world, although citric and malic acids also play a role. The modern practice of extended hang time, where grapes are allowed to sit on the vine nearly until they become raisins, can dramatically reduce the taste of tartaric acid in a wine, leaving it smoother but also potentially less compatible with food (Ribereau-Gayon, 1962).

Due to the fermentation process and the consequent production of ethanol wine becomes a supersaturated solution of potassium bitartrate than spontaneously precipitates. Wine quality is not altered by the presence of this crystalline deposit. However the removal of excess potassium hydrogen tartrate before bottling is always required in order to satisfy consumer preference (Angele, 1992).

The techniques currently used in the processing units of wine to prevent potassium hydrogen tartrate precipitation include: cation exchange, electrodialysis and refrigeration (Baldwin, 1986) whereby holding the wine at a superiority temperature of frost point the excess potassium bitartrate is precipitated. This process is called cold stabilization (Pomohaci, 2001; Tofan, 2002). In this case the addition of potassium hydrogen tartrate seed crystals to the wine helps potassium hydrogen tartrate precipitation.

The present work was undertaken to verify the effect of the industrial stabilisation process on the potassium hydrogen tartrate stability and composition of due types of wines. In the laboratory three conditions of refrigeration were tested and parameters of selected wine were monitored before and after each refrigeration test.

## Experimental

For analysis, two types of wines were used: white-Casla and red-Cabernet. The cold stabilization method used is refrigeration in the laboratory using acid bitartrate of potassium crystals. The wines were sampled before (BS) and after (AS) similar industrial cold stabilization contact processes using potassium hydrogen tartrate crystals.

After sampling the wines were stored for seven days at 22°C then used for the refrigeration tests in the laboratory. Wines were also stored for three months at +4°C as a control.

For refrigeration test three conditions currently used in the enological practice were tested: long-time refrigeration at +4°C for 3 months, control, and short-time 90 min refrigeration at 0°C and -4°C mini-contact stability tests (Gheorghe, 1997).

During cooling, the wine was stirred at 200 rpm using an automatic homogeniser. The wine remained in contact with the precipitate and its conductivity was measured at 15 sec intervals until equilibrium was reached.

The conductivity meter was equipped with a nickel-platinum probe (cell constant = 0.92 $cm^{-1}$) and a temperature compensation probe (PT100). An RS232 serial interface allowed the conductivity data to be transferred to a DEX 386 personal computer. The conductivity meter was standardized to size on the temperature 22°C.

## Results and Discussions

After three months of storage at +4°C several wines had visible deposits (table 1).

**Table 1**. Results of refrigeration tests on wines

| Refrigeration | | | | Conductivity ($\mu$ S $cm^{-1}$) | | | | |
|---|---|---|---|---|---|---|---|---|
| Wine | Sample[a] | Temp. (°C) | Deposit[b] | at 22°C | Start[c] | End | Δ - value | Δ% |
| White | BS1 | 0 | **Yes** | 2180 | 933 | 830 | 103 | 11.0 |
| | BS2 | -4 | **Yes** | | 808 | 672 | 136 | 16.8 |
| | AS1 | 0 | No | 1595 | 771 | 749 | 22 | 2.8 |
| | AS2 | -4 | No | | 659 | 638 | 21 | 3.2 |
| Red | BS1 | 0 | No | 1920 | 789 | 767 | 22 | 2.8 |
| | BS2 | -4 | No | | 914 | 900 | 14 | 1.5 |
| | AS1 | 0 | No | 1910 | 918 | 911 | 7 | 0.8 |
| | AS2 | -4 | No | | 775 | 753 | 22 | 2.8 |

[a]Wines sampled before (BS) and after (AS) the industrial cold stabilization process. Laboratory test of refrigeration at 0°C and -4°C.
[b]Visible deposit after 3 months at +4°C (control).
[c]Mini – contact stability tests: refrigeration at 0°C and -4°C.

Table 1 shows the conductivity parameters of the wines. The conductivity Δ- values (<7%) were typical of stabilized wines and the samples lacked visible deposits after three months of storage at +4°C. The using of the decrease in conductivity of wine at the 5% level as interpretive criteria may be inappropriate compared to the visual of the refrigeration test e.g. 1-3 days at -4°C. The difference between the conductivity of wine at time zero and after 90 min was used as a wine stability index Δ-value. White wine showed the greatest instability, high Δ-value. In the red wines no precipitation occurred during the refrigeration test.

An attempt was made to relate the stability of the wine to the extent of potassium hydrogen tartrate precipitation obtained with the mini-contact stability test. Wine conductivity is directly proportional to potassium hydrogen tartrate concentration (Dunsford, 1981).

Therefore its measurement provides an effective way to monitor the wine stabilisation treatment.

The analysis endpoint was determined when no substantial decrease in wine conductivity was observed over 5 min interval ($<10 \mu S\ cm^{-1}$).

In the experimental conditions it took up to 90 min to reach this equilibrium. The absence of an induction step, the time interval, at the beginning of the cooling period, during which there is no decrease in conductivity, was attributed to the nucleation induced by the potassium hydrogen tartrate seeding. The conductivity decay rate of the refrigerated wines decreased with time. This result was mainly due to the precipitation of potassium hydrogen tartrate and the consequent reduction of the supersaturation status of the wine.

Figure 1, shows the changes in conductivity monitored at -4°C and 0°C for a white wine sampled before and after the industrial stabilization treatment.

Due to the complexity composition of wine it is difficult to predict potassium hydrogen tartrate stability. The mini-contact test at constant temperature is a fast and simple method for assessing the stability of wine with respect to potassium hydrogen tartrate precipitation. The results of this preliminary study indicate that conductivity may be used to verify the stability of wines. However a long-term survey is needed to compare the reliability of different predictive tests e.g. refrigeration versus mini-contact, depending on the storage temperature and type of wine.

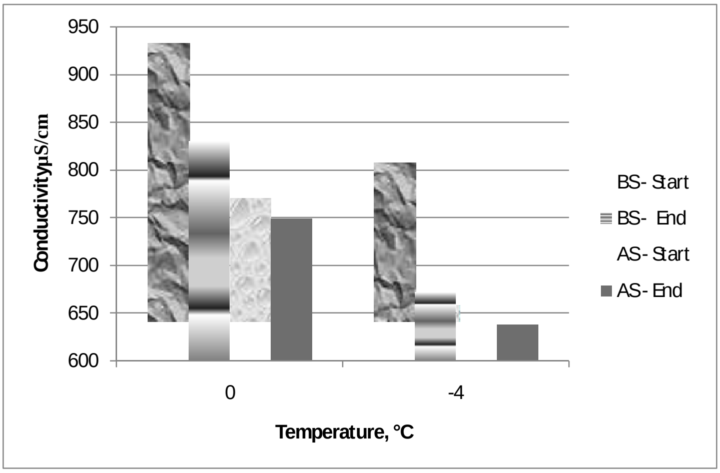


**Figure 1**. Change of conductivity at -4°C and 0°C for a white wine sampled before and after the industrial stabilization treatment function of temperature

## Conclusions

Prior to bottling, white wines are generally stabilized to remove unstable proteins and bitartrate instability. The bitartrates are generally removed by cold stabilisation at temperatures of minus 4ºC, like in this paper. Most red wines are not filtered or cold stabilized like white wines, therefore some red wines may produce deposits (or crust) mainly comprised of tannins, colour and tartrate crystals. These deposits are natural products and are not harmful in any way. In this paper we removed of potassium bitartrate for red wines, for obtaining a better quality of wines for satisfying consumer preferences. The consequences of this phenomenon on the sensorial attributes of wines must still be investigated.

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