Use of fumaric acid to both improve acidity and inhibit malolactic fermentation in wines

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Introduction

Fumaric acid or (2E)-But-2-enedioic acid (CAS# 110-17-8) is a diprotic acid (Fig. 1) formed in the citric acid cycle from the oxidation of succinate by the enzyme succinate DH. It is accepted as food additive to regulate acidity and named E297. Fumaric acid is under evaluation in OIV but permitted by the Codex Alimentarius for many food products.

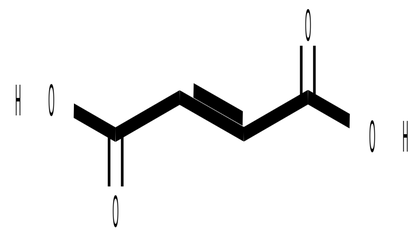

Figure 1.
Fumaric acid

It is useful as acidification agent, has been reported as 1.5 folds more acidic than citric acid [1].but also it has a strong effect on the growth of lactic acid bacteria (LAB) and the development of malolactic fermentation (MLF) [2-3]. We have evaluated the utility of fumaric acid to delay or block the MLF because the potential applications to get more **freshness** in red wines of warm areas, to **keep the acidity** of white and rose wines and to improve bottle ageing of natural sparkling wines.

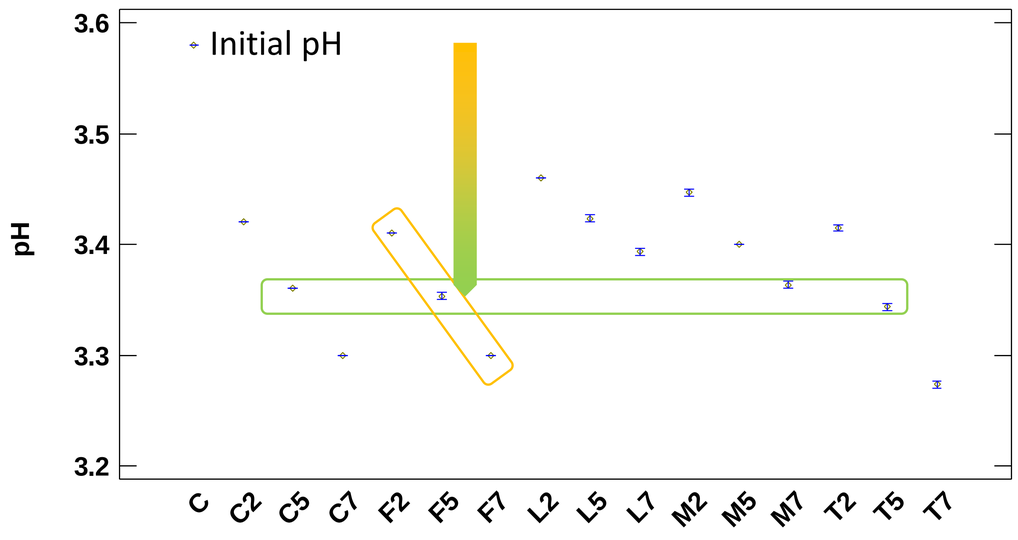

Figure 2.
Effects on pH of 300, 600 and 900 mg/L of fumaric acid (F2, F5 & F7). Equivalent molar concentrations of citric acid (C), lactic acid (L), malic acid (M) and tartaric acid (T)

Results and Discussion

The increase in acidity produced in wines is similar to citric acid, stronger than either lactic or malic and slightly weaker than tartaric acid. Use of 600-900 mg/L can reduce pH values in around 0.2 units depending on the buffer power of wine (Fig. 2). When used it must be considered the low solubility of fumaric acid in aqueous solutions. The acidification is enough to have some repercussion in color of red wines.

The double bond produce a high absorbance in UV so can produce mistakes in the measure of phenol contents in wines when they are evaluated by the absorbance at 280 nm.

The use of fumaric acid at 600 mg/L (Fig. 3f) have similar inhibitory effects in MLF to the use of 500 mg/L of lysozyme (Fig. 3d) or 75 mg/L of total SO2 (Fig. 3e). Lactic acid also show a high inhibitory effect on MLF at high doses (>4 g/L) (Fig. 3c).

When is evaluated by a taste panel the addition of 600-900 mg/L in red wines is undetected ($p<0.05$) in triangular tastings. Concerning specific attributes some panelist observed slight changes in either acidity or wine body (Fig. 4).

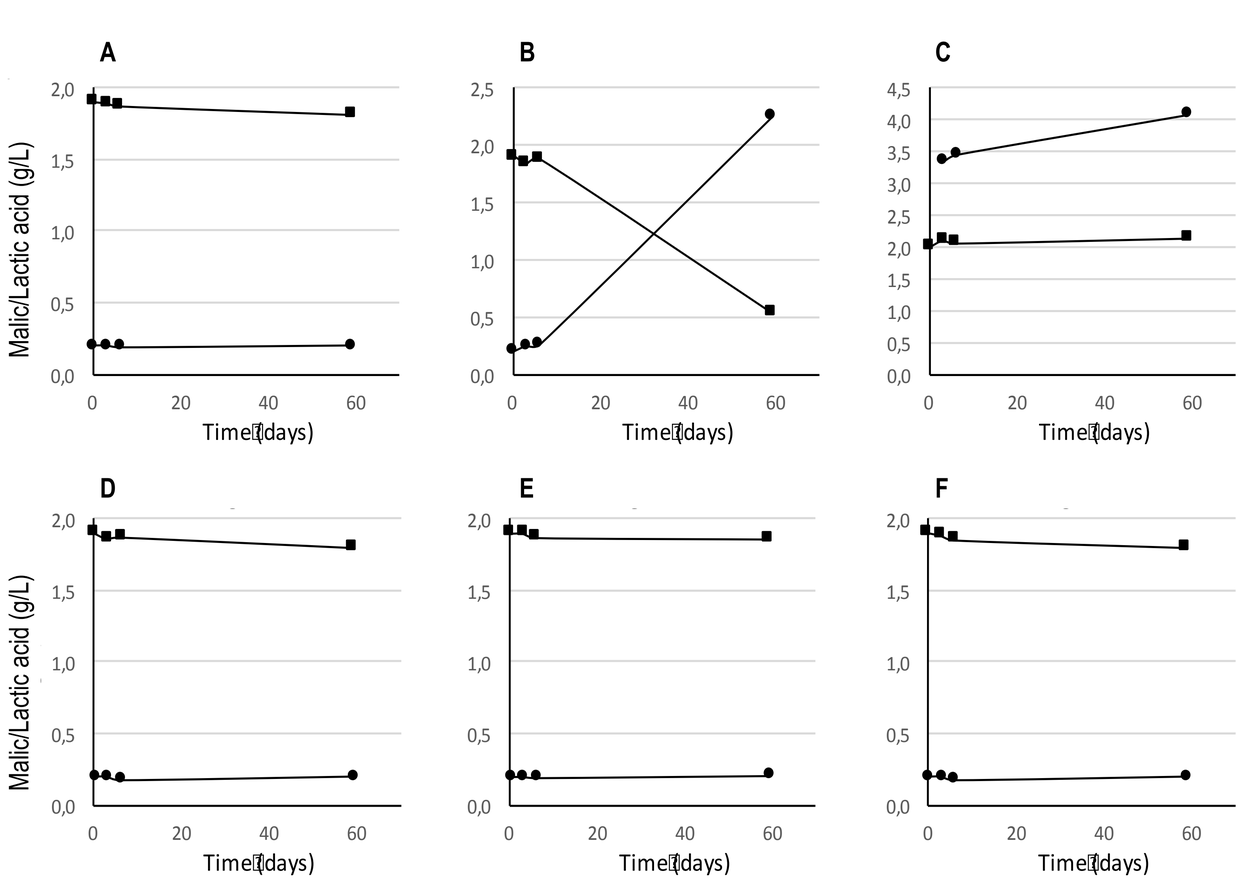

Figure 3.
Malic acid (▪) and lactic acid (●) concentration in control wine (a), inoculated with 10^6 CFU/mL of *O. oeni* alpha (b), inoculated and with 5 g/L of lactic acid (c), 500 mg/L of lysozyme (d), 75 mg/L of total SO_2 (e), and 600 mg/L of fumaric acid (f).

Conclusions

Fumaric acid is an useful additive to improve slightly pH, but also to **preserve malic acid acidity** and **freshness** in wines from warm areas.

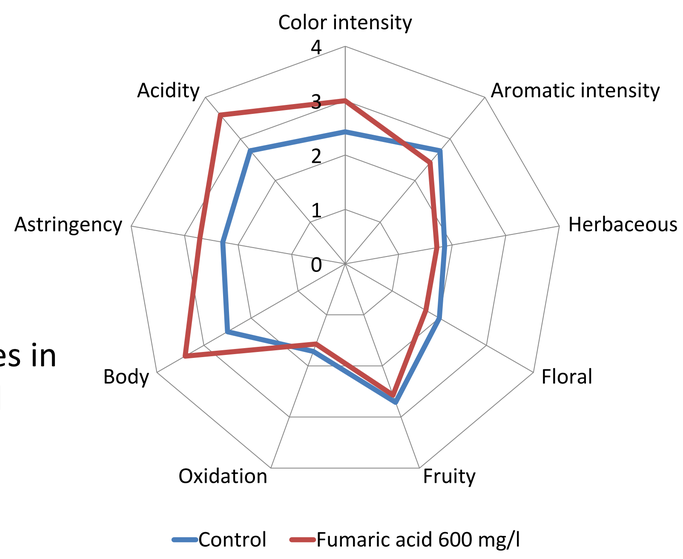

Figure 4.
Sensory attributes in control wine and treated with 600 mg/L of fumaric acid.

Materials and Methods

-Red wine made from Vitis vinifera Garnacha variety was used as sustrate. Etahnol content 12 % v/v, pH 3.6, TPI 44.
-Fermentations were performed in triplicate at 20 ºC, with liquid cultures of *Oenoccocus oeni* strain Alpha® Lallemand.
-Malic and lactic acids concentrations were followed by enzymatic analysis.
-Bacterial counts were performed by plating in MLO media under anaerobic conditions (CO_2 atmoshere).
-Triangular and preferences test were used to evaluate sensory effect. Taste panel was formed by 8 people.

References

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