Yeast/bacteria interaction: practical aspects in Mediterranean and Rhone red wines

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Introduction

This paper presents the main slides shown during the 22 April 2002 Lallemand conference in Biarritz (France). The goal of this presentation is to show some experimental results that call attention to the practical impact of yeast/bacteria interaction. These trials were made in the complex wine matrix. They don't have the ambition of explaining phenomenon. Their only ambition is to show that yeast/bacteria/wine interaction really has an effect on winemaking and that this interaction can also be identified using routine on-line analysis.

Some definitions used:

- Yeast/bacteria interaction:
  - one bacteria with different practical behaviour in wines fermented with different yeast
  - different bacteria with different behaviour according to the yeast used for fermentation
- MLF <enological lag-phase> = duration of stable malic acid level in wine
- LAB = Lactic acid bacteria

1990: first practical information on yeast/bacteria interaction in Mediterranean and Rhone wines

Comments on Figure 1: The main reason for duration differences is the total SO_2 in the wine before inoculation. The <ICV K1 Marquée> wine had 40mg/L, the <ICV D47> wine had 20mg/L.

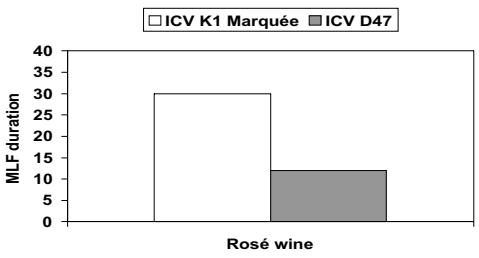


Fig. 1. MLF duration in days according to the yeast used for juice fermentation. Rosé 1990. Source: Classeur Biotechnologies. ICV in house document.

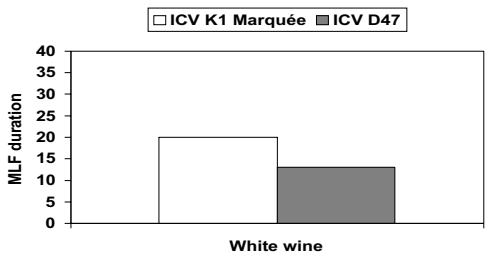


Fig. 2. MLF duration in days according to the yeast used for juice fermentation. White 1990. Source: Delteil, 2001. *The Australian Grapegrower & Winemaker.*

Comments on Figure 2: The main reason for duration differences is not the total SO_2. The two wines had 10mg/L before inoculation. Both wines had very similar total acidity and pH.

With these first results it appears that the yeast has a practical impact on the MLF duration. In some cases, the causes are some easy-to-measure parameters. In other cases, some parameters that are not routinely measured are involved.

Could a late MLF have an impact on wine style?

Comments on Figure 3: In this trial, no spoilage yeast *(Brettanomyces sp.)* or spoilage

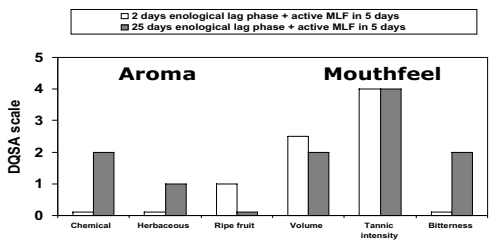


Fig. 3. Effect of MLF lag-phase duration on wine sensory profile. Red wine, 1998. Source: Delteil, 2001. *The Australian Grapegrower & Winemaker.*

bacteria *(Pediococcus sp.* or *Lactobacillus sp.)* grew during the longer lag-phase. Chemical phenomena explain the important change in the wine-style during the longer lag-phase.

These preliminary works showed that yeast may have an impact on MLF duration and that MLF oenological lag-phase has an impact on wine-style. Since then, we characterise each new oenological yeast on its MLF duration impact.

Impact of different yeast on MLF duration, with the same selected LAB

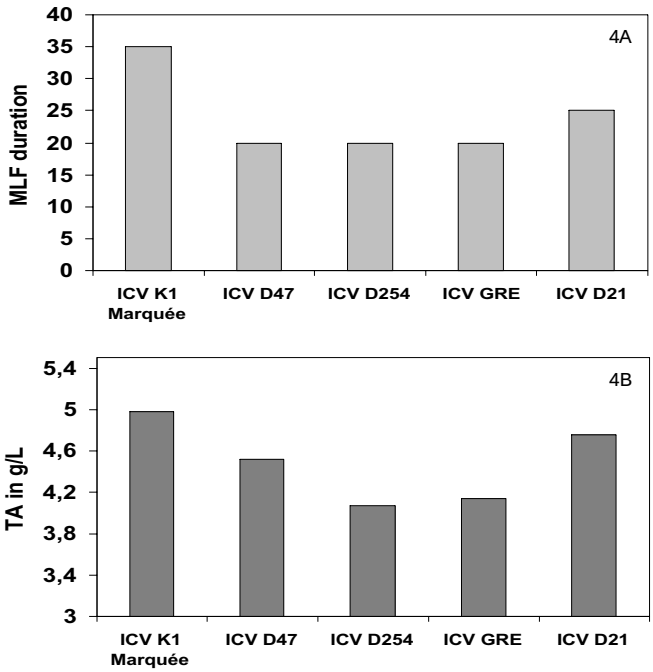


Fig. 4. 4A and 4B. Merlot 2000, short maceration, 13.5%vol. 4A: MLF duration after LAB inoculation. 4B: Total acidity in the wines before LAB inoculation. Source: ICV R&D Department 2001 Report. ICV in-house document.

Comments on Figure 4: In this trial, there were no SO_2 differences in the wines before LAB inoculation. With a broader range of yeast, practical differences can still be measured on the MLF duration. In this case, the total acidity in the wine before inoculation can explain a part of the differences due to ICV K1 Marquée and ICV D21. But on the other hand, <ICV D47> wine undergoes MLF as rapidly as wines with lower total acidity. Another trial that shows that classical parameters interact with LAB. It also shows that in some cases one has to look for less obvious explanation.

To try to understand these reactions we started a special experimental program with an incomplete factorial plan:

- three different grapes
- two different yeasts
- two maceration durations
- two SO_2 addition levels on the grapes before alcoholic fermentation

Interaction between two oenological yeasts and two LAB populations. Two different grapes: Merlot and Syrah

Comments on Figure 5A and 5B: At the end of alcoholic

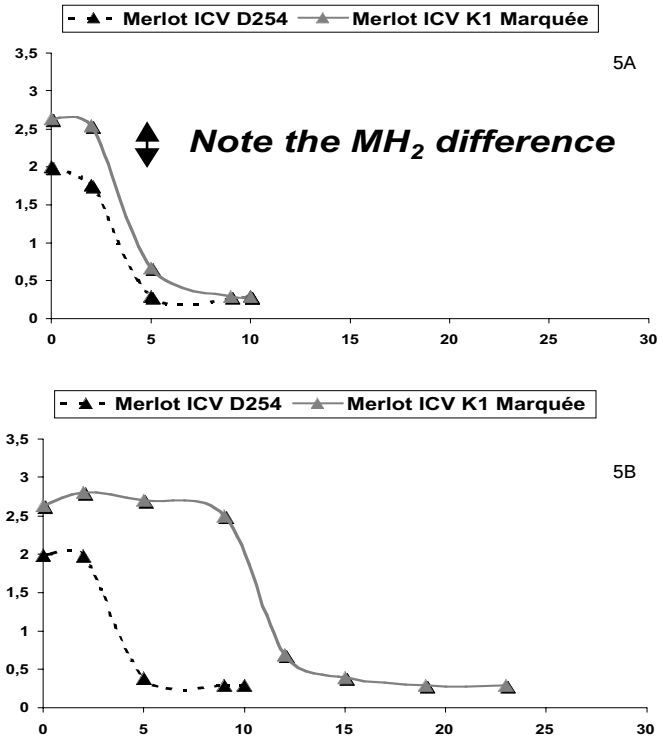
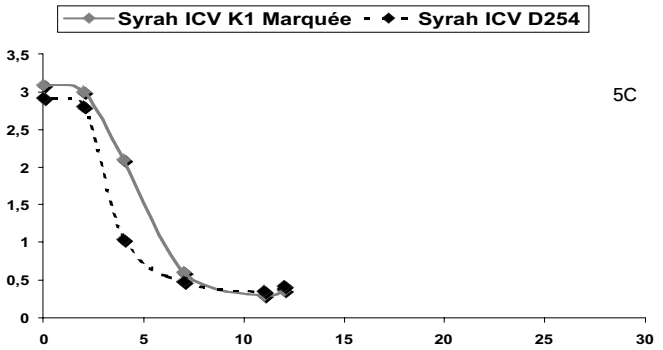
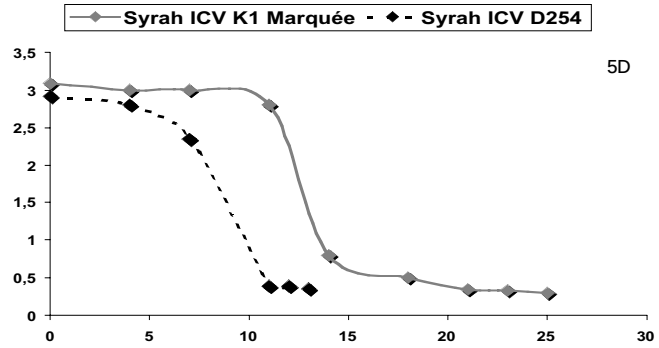


Fig. 5. 5A and 5B: Merlot 2000, long maceration (14 days), 13.5% vol. Malic acid concentration in wines: evolution with time. 5C and 5D (see page 60): Syrah 2000, long maceration (14 days), 13.0% vol. Malic acid concentration in wines: evolution with time. 5A and 5C: inoculation with selected LAB. 5B and 5D: non-inoculated with LAB. Source: Blateyron & Delteil, 2002, OIV Bratislava Congress proceedings.



fermentation, the wine fermented with ICV K1 Marquée has a higher concentration in malic acid (indicated as "Note the MH2 difference" in Figure 5A). This difference is quite common between wines fermented with ICV K1 Marquée and ICV D254. With both LAB populations, the kinetics are slower in the wines fermented with ICV K1 Marquée. The yeast ICV K1 Marquée amplifies the differences between the selected LAB population and the non-inoculated population. On the contrary, the malic consumption kinetics are more similar in the wines fermented with yeast ICV D254, whatever the LAB population.

Comments on Figure 5C and 5D: Again, the malic acid concentration is higher in the wine fermented with ICV K1 Marquée but with a far smaller difference. With the inoculated LAB population, the kinetics are very similar to the Merlot trial



(Figure 5A). With the non-inoculated LAB population, the wine fermented with ICV K1 Marquée has the same kinetics as the Merlot. The wine fermented with ICV D254 has a different behaviour compared to the Merlot (Figure 5B).

With the inoculated selected LAB population there is little yeast and grape interaction in these trials.

With the non-inoculated LAB there is an important bacteria/yeast/grape interaction.

The effect of the SO_2 addition to crushed grapes on the MLF completion duration: 5g/hl and 10g/hl SO_2. Two LAB populations

Comments on Figure 6: At the end of alcoholic fermentation, the wine made with 10g/hl SO_2 in the must had only 10mg/L more total SO_2 than the wine made with 5g/hl. This slight difference may explain the differences in the malic consumption kinetics. As already shown (Delteil, 2001) different SO_2 additions to crushed grapes have an impact on the MLF duration, even when the residual total SO_2 before LAB inoculation is low. With the non-inoculated LAB population, the oenological lag-phase is longer, but the differences between the two SO_2 additions are similar to the difference between the two inoculated variants.

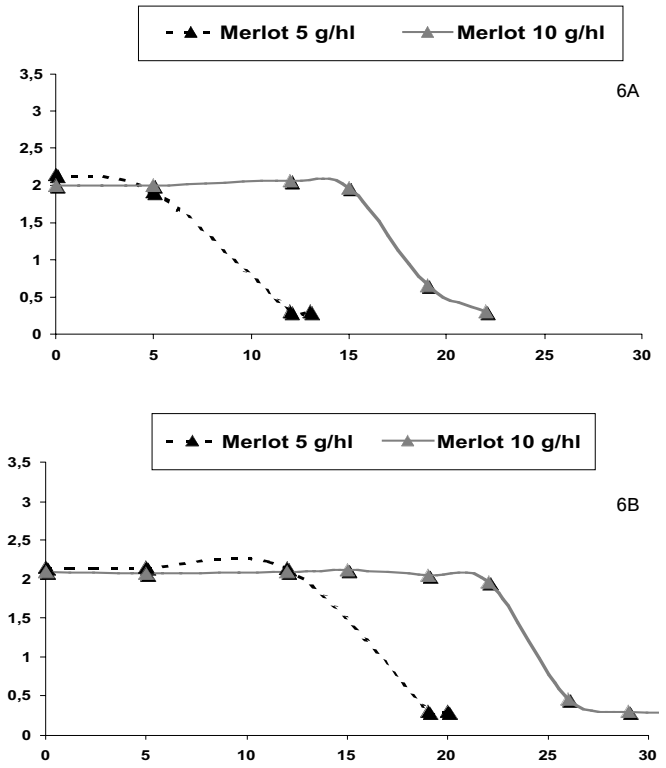


Fig. 6. 6A and 6B. Merlot 2000, short maceration (5 days), 13.5% vol, ICV D254 yeast. Malic acid concentration in wines: evolution with time. 6A: Inoculation with selected LAB. 6B: Non-inoculated with LAB. Source: Blateyron & Delteil, 2002, OIV Bratislava Congress proceedings.

Effect of two different maceration durations: 5 versus 14 days (J). Two LAB populations

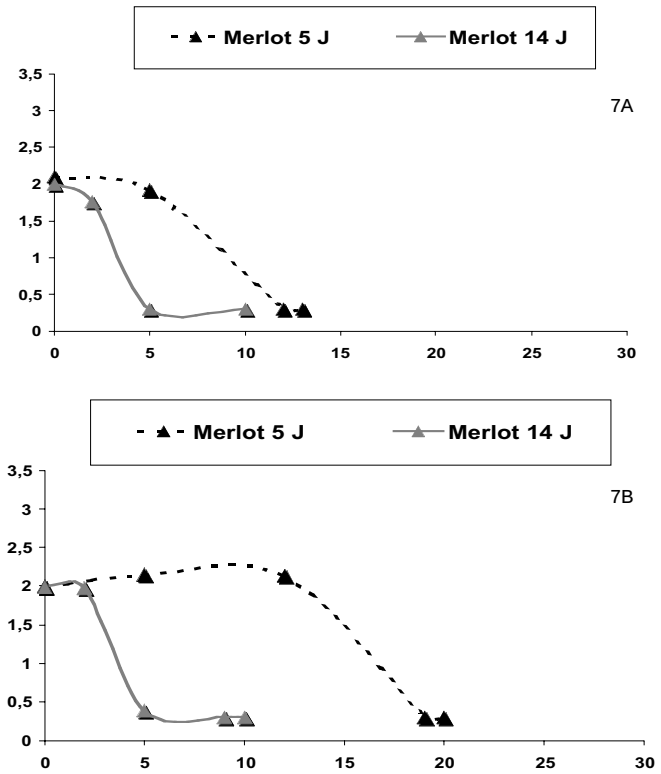


Fig. 7. 7A and 7B. Merlot 2000, 13.5%vol, ICV D254 yeast. Malic acid concentration in wines: evolution with time. 7A: Inoculation with selected LAB. 7B: Non-inoculated with LAB. Source: Blateyron & Delteil, 2002, OIV Bratislava Congress proceedings.

Comments on Figure 7: With both LAB populations, the longer maceration duration gives a faster MLF kinetic. With the non-inoculated LAB population, the difference between the two maceration durations is far greater than with the inoculated LAB variants.

Summary and conclusion

In this presentation we illustrated classical known yeast/bacteria interaction effects:

- the SO_2 produced by yeast (Figure 1)
- wine acidity variation due to the yeast (Figure 3 and 4). These differences could come from a lower malic acid degradation (Figure 5A and 5B). Succinic acid could also be one of the acids involved. ICV K1 Marquée yeast is producing more succinic acid than the other ICV yeast (ICV, personal communication from in-house document) on one hand and the ICV K1 Marquee yeast is always giving slower MLF kinetics (Figures 1, 2, 4 and 5).

Other elements could interfere: polysaccharides. For example, the yeast most-favourable for LAB (ICV D47, ICV D254 and ICV GRE) are also high parietal polysaccharides producers (Delteil and Jarry, 1992; Rosi *et al.* 1998).

Longer maceration leads to quicker MLF kinetic (Figure 7A and 7B). It also gives wines with higher concentration in grape polysaccharides. In all trials, differences are amplified with the non-inoculated LAB population.

We also illustrate the influence of some important winemaking parameters:

- SO_2 addition in the crushed grapes (Figure 6A and 6B), even when no total SO_2 concentration difference can be measured in the wines (Delteil, 2001).
- maceration length (figure 7A and 7B) with complex impact: pH increase with longer maceration, more grape polysaccharides, and higher acetaldehyde concentration.

The effects of those winemaking parameters are amplified with the non-inoculated LAB population.

With those known practical influences (yeast/bacteria/winemaking parameters) one can propose good practice recommendations to manage MLF at a production scale.

They are also still fields to explore, there is still some work for R&D teams to improve scientific knowledge and improve technical know-how. For that, some practical trials shown here can give research directions to try to better explain some results.

References

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Rosi I., Gheri A., and Ferrari S., (1998) Effet des levures produisant des polysaccharides pariétaux sur certaines caractéristiques des vins rouges pendant la fermentation. Revue Française d'œnologie. 172:24-26.

Delteil D., (2001) Practical management of malolactic fermentation for Mediterranean red wines. *The Australian Grapegrower & Winemaker*, Annual Technical Issue. 449a:31-36.

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