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Yeast / Bacteria Interaction. Practical aspects in Mediterranean and Rhone red wines

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Introduction

This paper presents the main slides showed during the April 22nd 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 have an effect on winemaking and that those interaction can be also identified using routine on-line analysis.

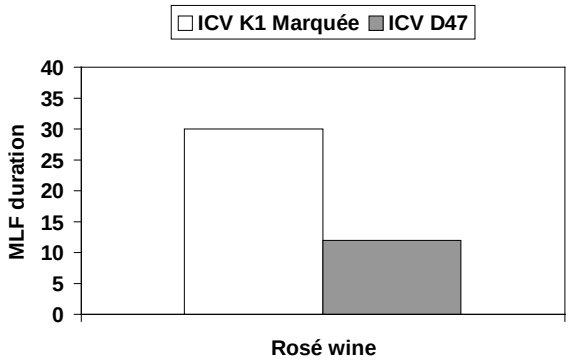
Slide 1 . Some definitions used in this conference.

Yeast / Bacteria interaction =

- One bacteria with different practical behavior in wines fermented with different yeast
- Different bacteria with different behavior according to the yeast used for fermentation

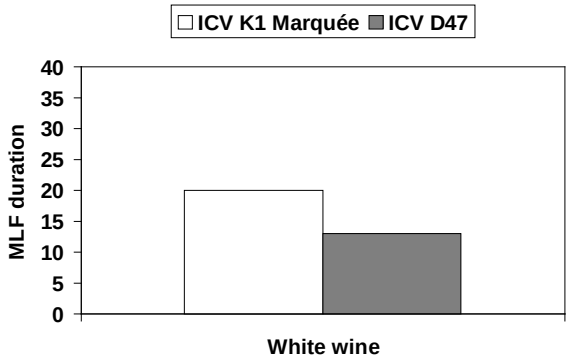
MLF « enological lag phase » = Duration of stable malic acid level in wine
LAB = Lactic acid bacteria

Slide 2. 1990: first practical information on yeast / bacteria interaction in Mediterranean and Rhone wines.
Figure °1: MLF duration in days according to the yeast used for juice fermentation. Rosé 1990. *From: Classeur Biotechnologies. ICV in house document.*



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 40 mg/L, the « ICV D47 » wine had 20 mg/L.

Figure °2: MLF duration in days according to the yeast used for juice fermentation. White 1990. *From: Delteil, 2001. Australian Grapegrower and Winemaker.*

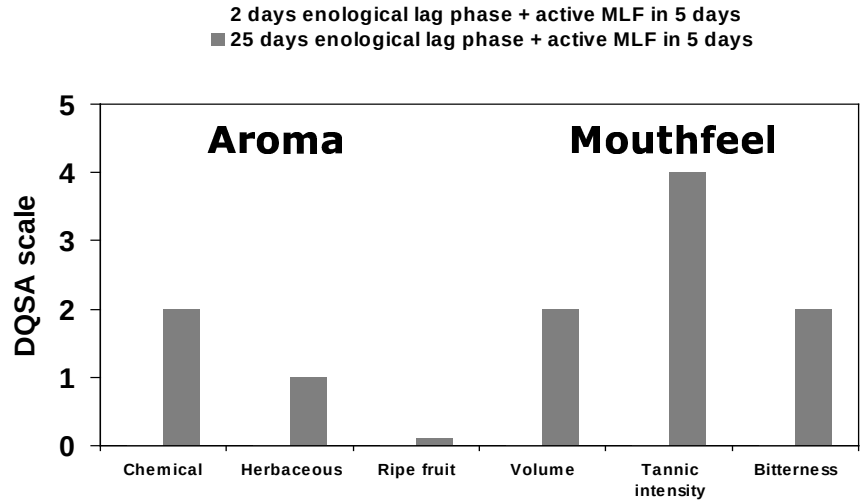


Comments on figure 2: the main reason for duration differences is not the Total SO_2. The two wines had 10 mg/L before inoculation. Both wines had very similar Total Acidity and pH.

With those first results it appeared that the yeast have a practical impact on the MLF duration. In some case, the causes are some easy to measure parameters. In other cases, some parameters that are not routinely measured are involved.

Slide 3. Could a late MLF have an impact on wine style ?

Figure °3: effect of MLF lag phase duration on wine sensory profile. Red wine, 1998. *From: Delteil, 2001. Australian Grapegrower and Winemaker.*



Comments on figure 3: in this trial, no spoilage yeast (*Brettanomyces sp.*) or spoilage bacteria (*Pediococcus sp* or *Lactobacillus sp.*) grew during the longer lag phase. Chemical phenomenons 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 enological lag phase has an impact on wine style. Since then, we characterize each new enological yeast on its MLF duration impact.

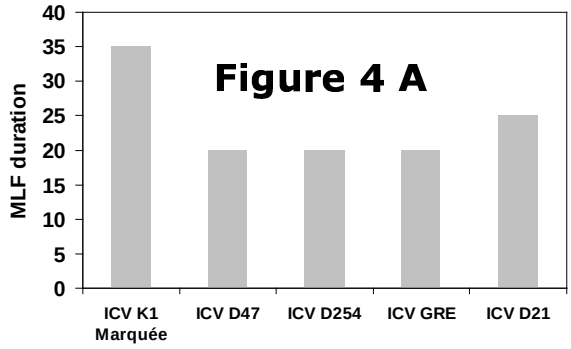
Slide 4. Impact of different yeast on MLF duration, with the same selected Lactic Acid Bacteria.

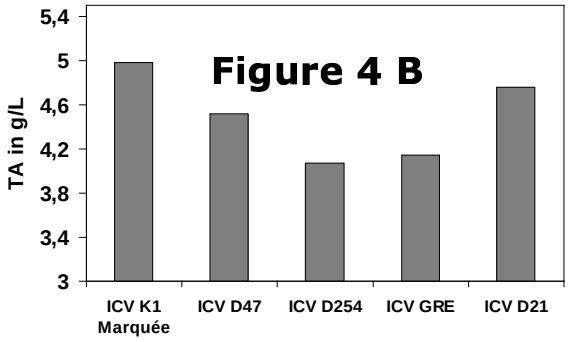
Figure 4 A & B. Merlot 2000, short maceration, 13,5%vol.

A. MLF duration after LAB inoculation.

B. Total Acidity in the wines before LAB inoculation

From: 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 be still 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 TA. 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.

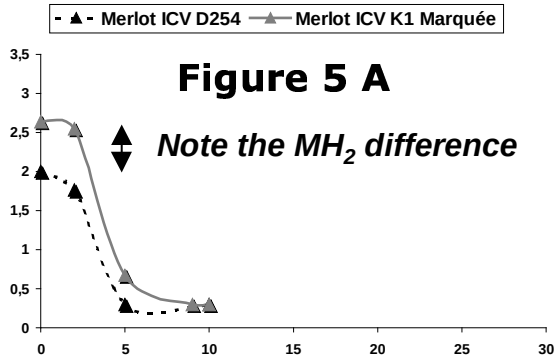
Slide 5. To try to understand these reactions we started a special experimental program with an incomplete factorial plan:

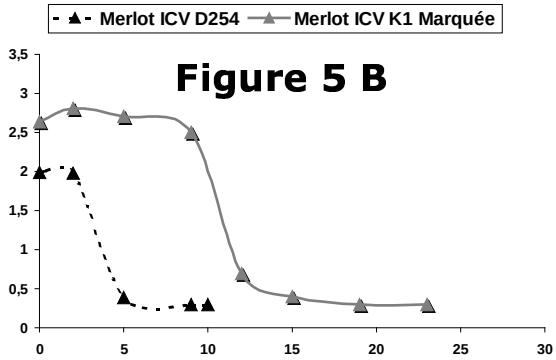
- 3 different grapes,
- 2 different yeasts,

- 2 maceration durations,
- 2 SO_2 addition levels on the grapes before alcoholic fermentation.

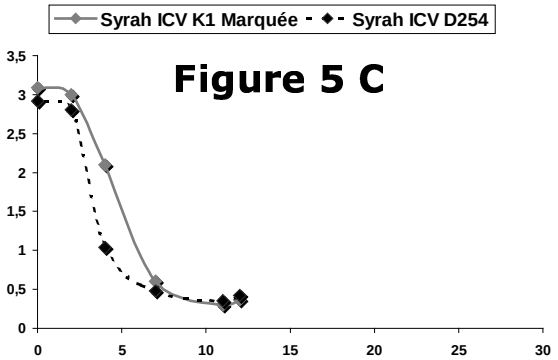
The next slides show the main results.

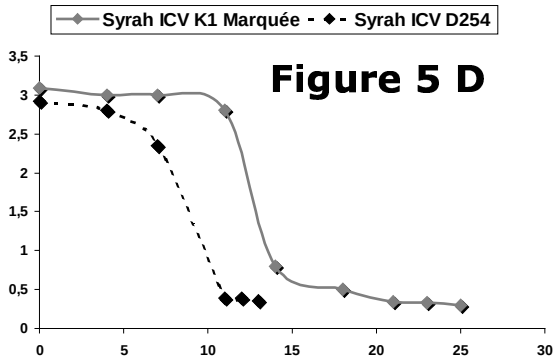
Slide 6. Interaction between two enological yeasts and two LAB populations. Two different grapes: Merlot and Syrah.
Figure 5 A & B. Merlot 2000, long maceration (14 days), 13,5%vol. Malic acid concentration in wines: evolution with time.
Figure 5 C & D. Syrah 2000, long maceration (14 days), 13,0%vol. Malic acid concentration in wines: evolution with time.
A & C. Inoculation with selected LAB
B & D. Non inoculated with LAB
From: Blateyron & Delteil, 2002, OIV Bratislava Congress proceedings.





Comments on figure 5 A & B: At the end of alcoholic 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.

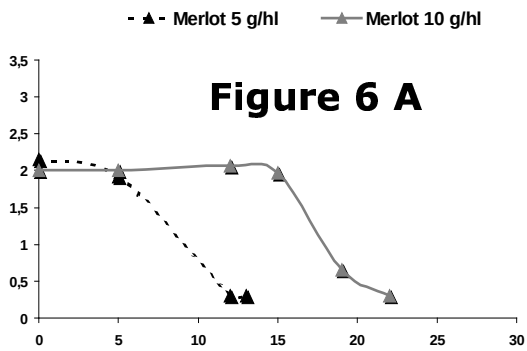


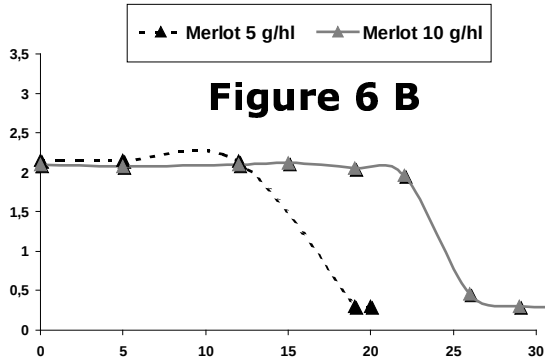


Comments on figure 5 C & D: Again, the malic acid concentration is higher in the wine fermented with ICV K1 Marquée but with a far smaller difference. With the inoculated LAB population, the kinetics are very similar to the Merlot trial (figure 5 A). With the non-inoculated LAB population, the wine fermented with ICV K1 Marquée has the same kinetics as the Merlot. The wine fermented with ICV D254 has a different behavior 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.

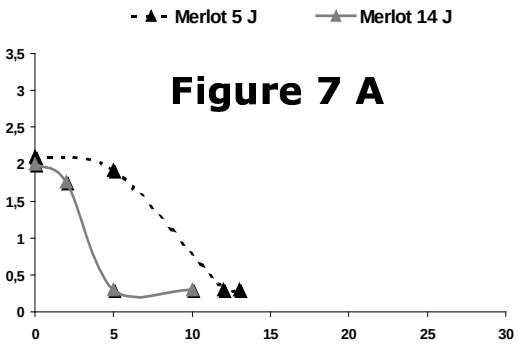
Slide 7. The effect of the SO_2 addition to crushed grapes on the MLF completion duration: 5 g/hl and 10 g/hl SO_2. Two LAB populations.
Figure 6 A & B. Merlot 2000, short maceration (5 days), 13,5%vol, ICV D254 yeast. Malic acid concentration in wines: evolution with time.
A. Inoculation with selected LAB
B. Non inoculated with LAB
From: Blateyron & Delteil, 2002, OIV Bratislava Congress proceedings.

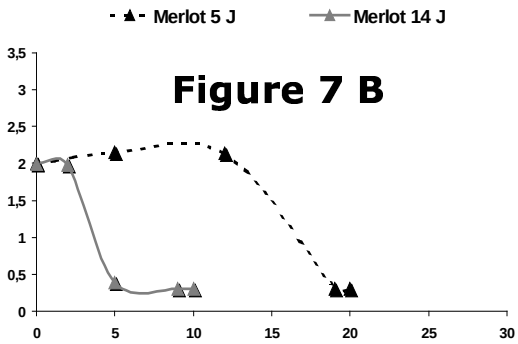




Comments on figure 6: At the end of alcoholic fermentation, the wine made with 10 g/hl SO_2 in the must had only 10 mg/L more Total SO_2 than the wine made with 5 g/hl. This slight difference may explain the differences in the malic consumption kinetics. As already shown (Delteil, 2001) different SO_2 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 enological lag phase is longer, but the differences between the two SO_2 additions are similar to the difference between the 2 inoculated variants.

Slide 8. Effect of two different maceration durations 5 versus 14 Days (J). Two LAB populations.
Figure 7 A & B. Merlot 2000, 13,5%vol, ICV D254 yeast. Malic acid concentration in wines: evolution with time.
A. Inoculation with selected LAB
B. Non inoculated with LAB
From: 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.

Slide 9. Summary and Conclusion
In this presentation we illustrated classical known yeast / bacteria interaction effects:

- the SO_2 produced by yeast (figure 1), and
- wine acidity variation due to the yeast (figure 3 & 4). These differences could come from a lower malic acid degradation (figure 5A & 5B). Succinic acid could be also 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 & 5).

Other elements could interfere: polysaccharides. For example, the yeast most favorable for LAB (ICV D47, ICV D254 and ICV GRE) are also high parietal polysaccharides producers (Delteil & Jarry, 1992 ; Rosi *et al*, 1998).
Longer maceration leads to quicker MLF kinetic (figure 7A & 7B). It also gives wines with higher concentration in grape polysaccharides.
In all trial, 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 & 6B), even when no Total SO_2 concentration difference can be measured in the wines (Delteil, 2001).
- Maceration length (figure 7A & 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 showed here can give research directions to try to better explain some results.

Literature cited:

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