OCHRATOXIN A IN WINES: CURRENT KNOWLEDGE

FIRST PART: FACTORS FAVOURING ITS EMERGENCE IN VINEYARDS AND WINES

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Early emergence in the vineyard

Mould development begins with veraison

Numerous studies show that the *Aspergillus* species responsible for Ochratoxin A production can be found on the grapes from veraison onwards, and sometimes even as soon as setting. The moulds will develop most rapidly between veraison and maturation (see Figure 1).

Ochratoxin A can be found on grapes one month before harvest.

Studies conducted by ICV in 2001 with Cabernet Sauvignon have shown that Ochratoxin A traces could be found on grapes one month before harvest.

Several factors favour the emergence of Ochratoxin A on grapes

- The climate during the growth period

The studies conducted by Foulon-Sopagly between 1999 and 2002 underline the vintage effect. The frequency and extent of must contaminations were much higher in 1999 and 2002. The climatological conditions and more specifically the precipitation received in August and September could explain these differences between vintages.

FR	ENG
% volume	% of wines by volume
moyenne	average
µg/L	µg/l
Categories OTA µg/L	Ochratoxin A ranges [µg/l]

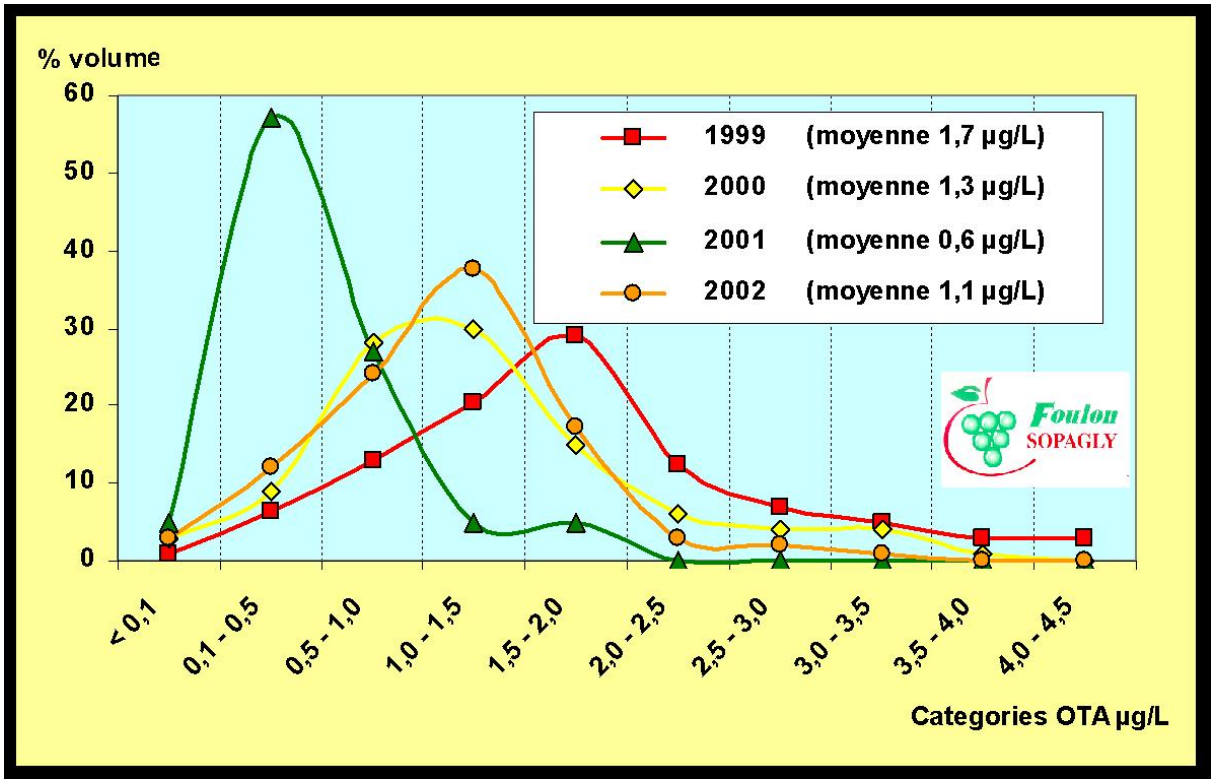


Figure 1: Considerable differences among the Ochratoxin A contaminations of Carignan musts could be found between 1999 and 2002 in the Mediterranean (data by Foulon-Sopagly).

- Grape maturation

Many observations have shown that wine Ochratoxin A concentrations tend to increase with grape maturity.
ICV studied the Ochratoxin A levels in 84 wines of the 1998 to 2001 vintages produced in its pilot winery. These wines were produced from grapes harvested from the same plots at different maturities.

The trend of Ochratoxin A concentrations was to increase with maturity, but with high variability depending on the plots.

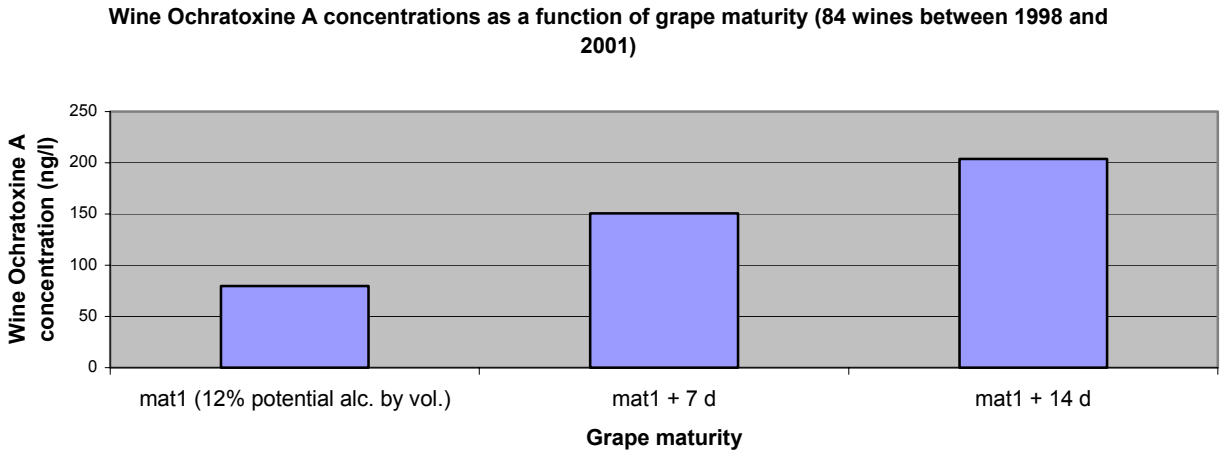
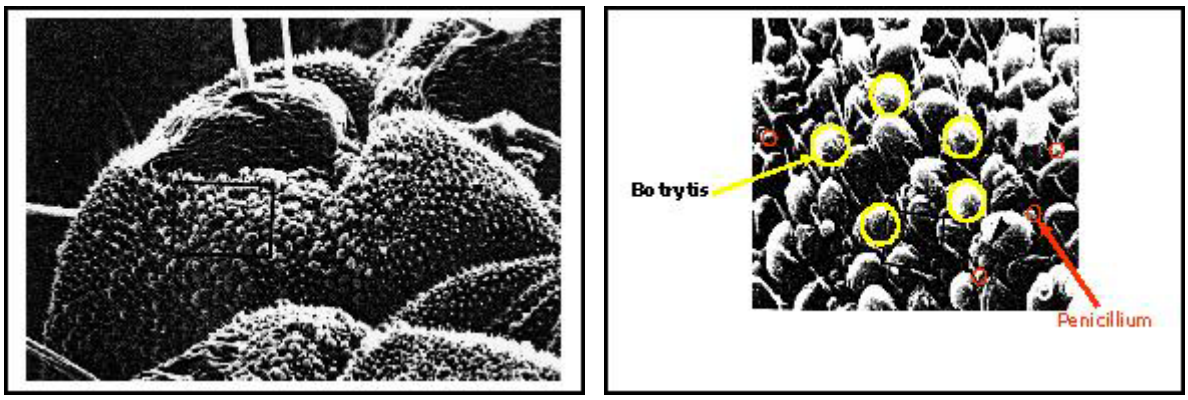


Figure 2: The trend of wine Ochratoxin A concentrations is to increase with grape maturity (ICV studies)

- Grape caterpillars (Cochylis or Eudemis)



(x 200) (x1200)

Figure 3: Penicillium spores can be carried between the scales of the grape caterpillar epidermis (left picture, head of grape caterpillar, magnification 200 x; right picture, epidermis, magnification 1200 x). *Photographs by M. Fermaud & R. Le Menn, INRA 1989.*

Grape caterpillars probably play an important role in the spreading of Ochratoxin A producing moulds. On the one hand, they carry the spores caught between the scales of the epidermis as shown by Fermaud and Le Menn (INRA Bordeaux) for *Botrytis* in 1989.
On the other hand, the perforations and micro-lesions create contamination opportunities for *Aspergillus* thus allowing Ochratoxin A production after pulp contact.
Studies conducted in 2001 and 2002 by ICV have shown a tight correlation between the number of perforations from grape caterpillars and wine Ochratoxin A concentrations: the more perforations, the higher was the wine contamination.

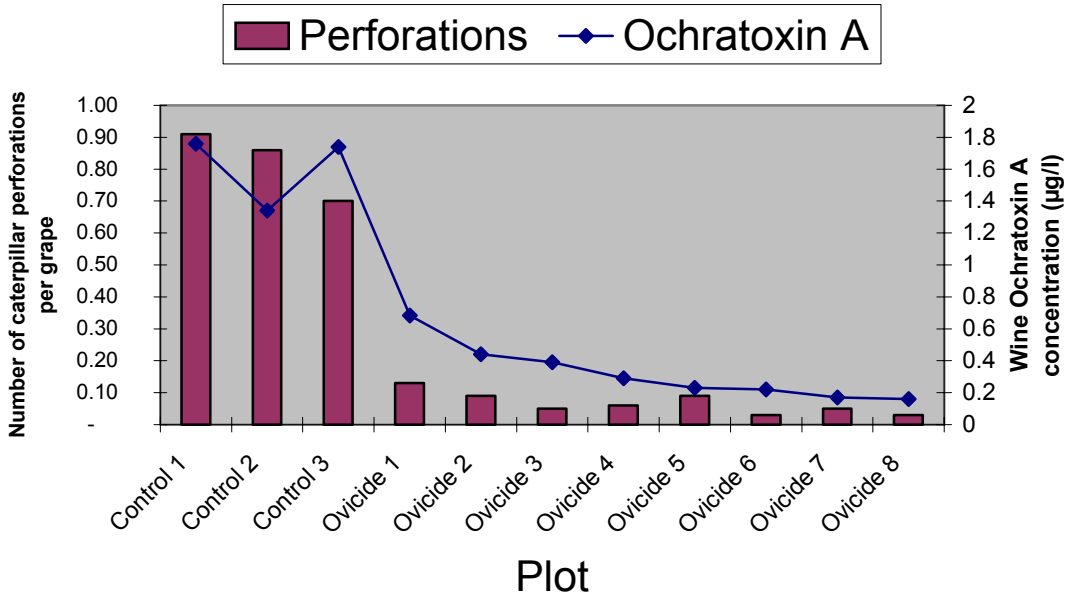


Figure 4: In the ICV studies, the number of grape caterpillar perforations was proportional to the wine Ochratoxin A concentrations.

- Main risk factor: Poor sanitary quality of grapes.

The study conducted by the ICV in 2001 with 204 wines of the pilot winery collection showed that the majority of wines with high Ochratoxin A levels originated from grapes of poor sanitary quality even though not all of them were automatically responsible for contaminated wines. These grapes may reach very high Ochratoxin A levels at advanced maturity levels.
In the case of healthy grapes, waiting for phenolic maturity does not lead to a significant increase of wine contamination.

However, other factors may intervene, such as skin thickness (grapes with thin and more fragile skin facilitating pulp contamination by moulds), and may explain the presence of Ochratoxin A in wines made with very mature grapes of excellent sanitary quality.

Figure 9: Effect of the sanitary status and grape maturity on Ochratoxin A contamination of wines (ICV results from 84 wines)

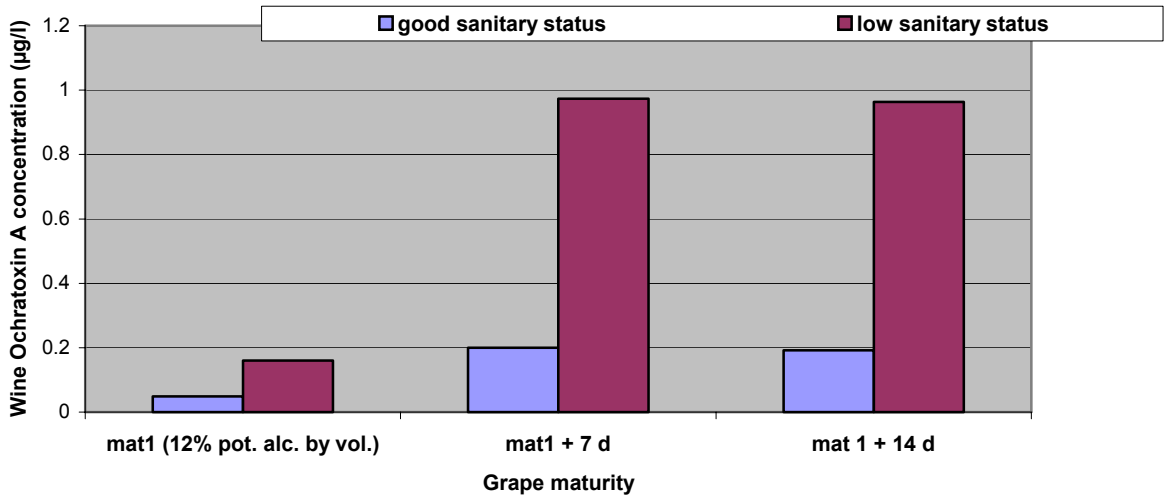


Figure 5: The highest Ochratoxin A concentrations are found in wines made from grapes of low sanitary quality, especially at advanced grape maturity (ICV results from 84 wines).

Evolution of Ochratoxin A concentrations in wines

Since 2001, the ICV has followed the evolution of Ochratoxin A levels in 7 batches of grapes, which were vinified by the R&D department. Ochratoxin A was measured in the grapes, the fermenting must and during wine ageing before and after bottling. This study allows to predict the evolution of Ochratoxin A levels in a contaminated wine.

Wine Ochratoxin A levels are correlated with those of grapes.

The studies conducted by ICV in 2001 and 2002 revealed a good correlation between the Ochratoxin A levels of grapes and wines: The most contaminated grapes produced the wines with the highest contamination.

Grape	Wine
Absence (< 0,01 µg/l)	**< 0,30 µg/l**
Low contamination (< 0,05 µg/l)	**0,30 to 0,80 µg/l**
High contamination (> 0,40 µg/l)	**> 1 µg/l**

Ochratoxin A appears during the first days of vatting.
After crushing, the Ochratoxin A content increases rapidly and, within 4 days, reaches levels similar to those measured in the bottle.

The maximum is reached after malolactic fermentation.
Afterwards, Ochratoxin A levels decrease, also after bottling.

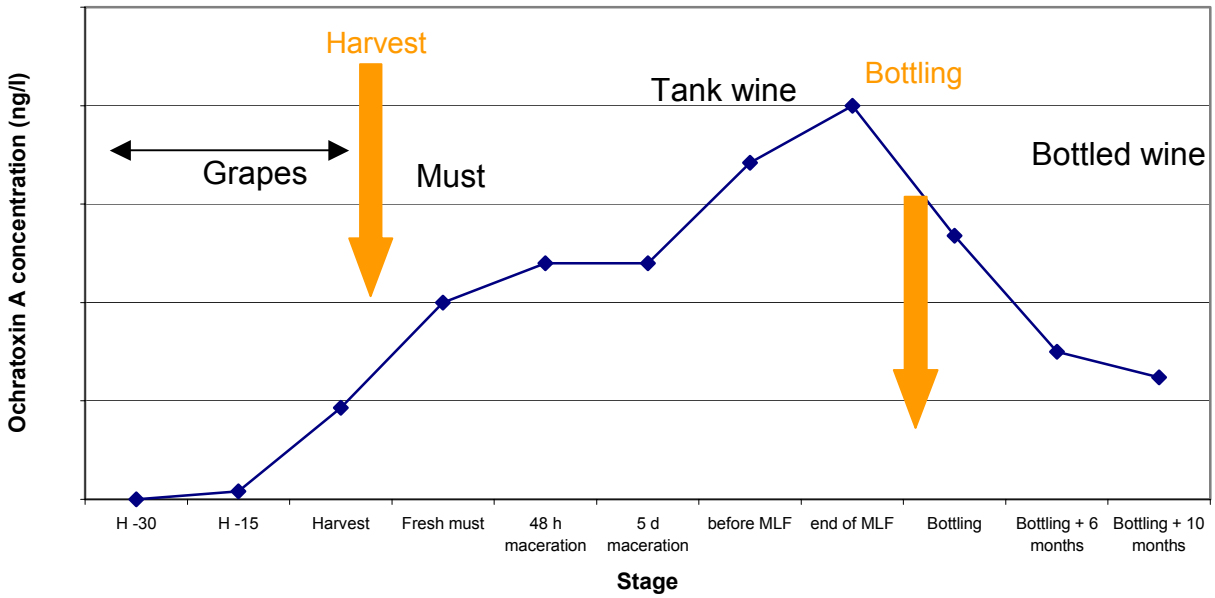


***Figure 6**: Prediction of Ochratoxin A evolution in grapes, musts and wines during vinification and ageing.*

This decrease, which is still poorly understood, could arise from:

- activity of wine lactic acid bacteria,
- Ochratoxin A adsorption on yeast cell walls: a study carried out by the ICV R&D department demonstrated that after 6 months of ageing on yeast lees, wines contained 12% less Ochratoxin A than the control.