H_2S and mercaptans: discoveries made by Vincente Ferreira, winner of the 2015 Oenoppia-SIVE award

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Research by Vincente Ferreira, winner of the 2015 International Oenoppia-SIVE (Italian Society of Viticulture and Oenology) award, was presented at the SIMEI trade show in Milan on 4 November 2015. This research is overturning conventional approaches to reduction phenomena and providing new elucidations. The following summary explains.

What we know about reduction

Reduction is the opposite chemical reaction to oxidation. Reduction is the gain of electrons whereas oxidation is the loss of electrons. Reduction in wine that has lacked oxygen is expressed by the formation of unpleasant odours, which are well-known to wine-makers and rejected by experienced tasters. The molecules responsible for these odours are sulphur derivatives, the most well-known of which are hydrogen sulphide (H_2S) and mercaptans (MeSH). These are volatile sulphur compounds. The intensity of their organoleptic impact varies from slight hints of sewage, cabbage and onion to extremely repulsive rotten egg odours. In all cases, reduction masks wine aromas and makes it undrinkable. An initial remedy for reduction is to decant the wine into a carafe. Fortunately, these faults are often temporary if there is an adequate oxygen supply. In the worst cases, however, they are sometimes irreversible when too much reduction has occurred. In these cases, the wine loses all its initial qualities. Wine-makers are aware of this issue and are very vigilant to ensure the correct balance between oxidation and reduction throughout the wine-making and maturation process.

All wines potentially risk developing reduction odours. H_2S is formed naturally during yeast fermentation from sulphur already present in grapes, sulphates and even from commonly added sulphites. Difficult fermentation conditions (high alcohol, yeast nutrient deficiencies) encourage yeast to produce H_2S. In these cases, wine-makers supply oxygen or perform fining using copper-based preparations. To this end, wine-makers of old put wine into copper containers for a period. Try it yourself: put a copper coin into wine with reduction odours. You'll notice that they disappear.

Despite all this, wine may develop reduction odours either during maturation or much later, after bottling. The prevailing hypotheses in oenology handbooks used to be that this is due to sulphur-based compounds in wine spontaneously reducing into mercaptans (apart from yeast action). But this explanation is inadequate and even erroneous.

Full English version of Vincente Ferreira's scientific article

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What we did not know and that has been discovered by Vincente Ferreira

Ferreira's team has demonstrated for the first time that H_2S and mercaptans in wine are not only present in volatile (odorous) form. They also exist in odourless complexes (with other other molecules) and are hence undetectable. Wine contains many sulphur compounds that may be released throughout its life span in bottles since these combinations are reversible.

Which molecules combine with H_2S and mercaptans?

Copper combines with all volatile sulphur compounds and is precisely the substance used by wine-makers of old to correct reduction faults. What they did not know, however, is that these harmful molecules did not disappear. They were simply concealed…just waiting for favourable conditions (no oxygen in bottles) under which to resurface.

Iron also combines with these molecules, although with less intensity.

What happens to sulphur compounds in complexes?

Complexes formed with metal cations are completely stable and soluble. No precipitation was observed during experiments and these complexes are not removed by filtration.

Ferreira's research has shown above all that volatile sulphur compounds increase continuously under favourable conditions (no oxygen, high temperature). Ferreira has also proved that small quantities of mercaptans are formed in some wines from the remains of sulphur amino acids. This ability is also linked to the catalytic activity of some metals.

Ferreira's team has created models to predict long-term developments in wine reduction odours according to various factors and thus recommend appropriate preventive measures.

The only effective prevention proved to date by Ferreira's team is micro-oxygenation over prolonged periods. But this new knowledge will undoubtedly open up the scope for new oenological treatments to remove metal complexes containing sulphur compounds...watch this space!

This is the purpose of wine science: to improve understanding in order to improve practice.

Vincente Ferreira received the 2015 Oenoppia-SIVE award at the SIMEI trade show in Milan on 4 November 2015. The award comes with €7,500 to support research on reduction phenomena in wine carried out by his laboratory (LAAE, Laboratory of Aroma Analysis and Enology at the University of Zaragoza, Spain).

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