Use of linear sweep voltammetry to determine the harvest date of Sauvignon blanc plots

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Sauvignon blanc wines typically present aromas of grapefruit, passion fruit, tomato leaf or boxwood, thanks to the presence of thiols such as 4-mercaptopentan-2-one, 3-mercaptohexan-1-ol, or 3-mercaptohexyl acetate (Darriet 1995, Tominaga 1996). The detection limits of these compounds are between 0.8 and 60 ng/L (Subileau, 2008). These aromatic notes lend the Sauvignon blanc wines a fresh profile that is key to their appreciation, including during their blending.

The influence of the harvest date on the concentration of these compounds and the fresh profile of the Sauvignon blanc is well-known (Peyrot des Gachons 2000; Lagarde Pascal 2013). In practice, berry tasting can help in determining the harvest date of the Sauvignon blanc but remains difficult to put in place. Preliminary linear sweep voltammetry work for tracking grape maturity of several varieties of whites seems to indicate that it brings complementary information to the traditional monitoring of grape maturity. The objective of this work was to confirm voltametry can be used as a decision making tool when triggering the harvest, with the objective of producing a wine with a fresh profile.

Maturity control were carried out twice a week, starting from véraison on 3 plots. A linear sweep voltammetry measurement was carried out on the juices made from the grape samples. One of the plots was harvested on two different dates and two vinification processes, with and without maceration on must lees, were carried out. Finally, after alcoholic fermentation, the wines obtained from this trial were compared to the wines made with harvest date determined from traditional maturity control.

Materials and method

Bi-weekly maturity controls were carried out on 3 plots of Sauvignon blanc from Mas La Chevalière. 200 berries were harvested according to the OIV protocol. After being weighed, they were pressed using a laboratory press. Immediately after pressing, to avoid any oxidation of the juice (Ugliano 2015), an analysis by linear sweep voltammetry was carried out using a NomaSense PolyScan (Wine Quality Solutions, Vinventions) on disposable carbon-based printed electrodes. Brix was measured with a refractometer.

Two harvest dates, four days apart, were determined on one of the plots. The grapes were harvested mechanically and pressed in a non-inert manner to optimize the possible formation of thiol precursors

(Roland 2010). The must was divided evenly into two vats of 100 hl, both with enzymes (Lafazym XL press, 2 mL/100 kg) and sulfites at 4 g/hl. One of them had settled within 24 hours; the other underwent a maceration on must lees of 7 days at 5°C with stirring of the must lees twice a day. All had yeast added (Zymaflore X5 20 g/hl) and the fermentation was thermoregulated at 18°C.
After the alcoholic fermentation, the thiols were analyzed by the SARCO laboratory in the 4 wines. These wines were tasted for a descriptive analysis in parallel with a Sauvignon blanc wine from the domain by a jury of 7 expert tasters just after alcoholic fermentation and again after 1 or 2 months of storage in vats.

Results:

Linear sweep voltammetry is an electrochemical technique. A working electrode, a reference one and a counter electrode are put in the sample to be analyzed. During the analysis, increasing voltages are applied on the electrodes, which provokes the progressive oxidation of compounds according to their potential for oxidation. The intensity generated by these oxidations is due to the composition of the sample. When achieved on disposable printed electrodes, this technique is particularly simple to apply and doesn't need any specific preparation of the sample. In the case of maturity controls, the only precaution consists of taking the measurement immediately after crushing the grapes to get the juice to avoid any oxidation (Ugliano 2015). In order to facilitate real-time interpretation of the results, several indicators have been calculated using voltammograms. For example, an index corresponding to the wine total phenolic compounds measured using the Folin-Ciocalteu (gallic acid equivalent mg/L) can be calculated, as well as An index corresponding to the current transmitted in the region of the easily oxidized phenolic. These two parameters, respectively called PhenOx and EasyOx, can also be used to characterize the samples of grape and must with the objective of anticipating or managing certain oenological practices.

Since 2013, numerous maturation follow up have been carried out on different grape varieties using this technology.

Firstly, in Burgundy, on Chardonnay (Laroche domain), these tests were carried out in parallel with the classic methods of maturation monitoring (TAP, AT, pH analyses, etc.) The harvesting decisions were taken according to the usual rules of the domain, with the objective of obtaining fresh aromatic profiles. Systematically, decreases in the values of the PhenOx et EasyOx indicators (Figure 1) were observed during the maturation over 2 consecutive vintages (2013 and 2014) and the dates of the harvest generally coincided with the minimum values of these indicators.

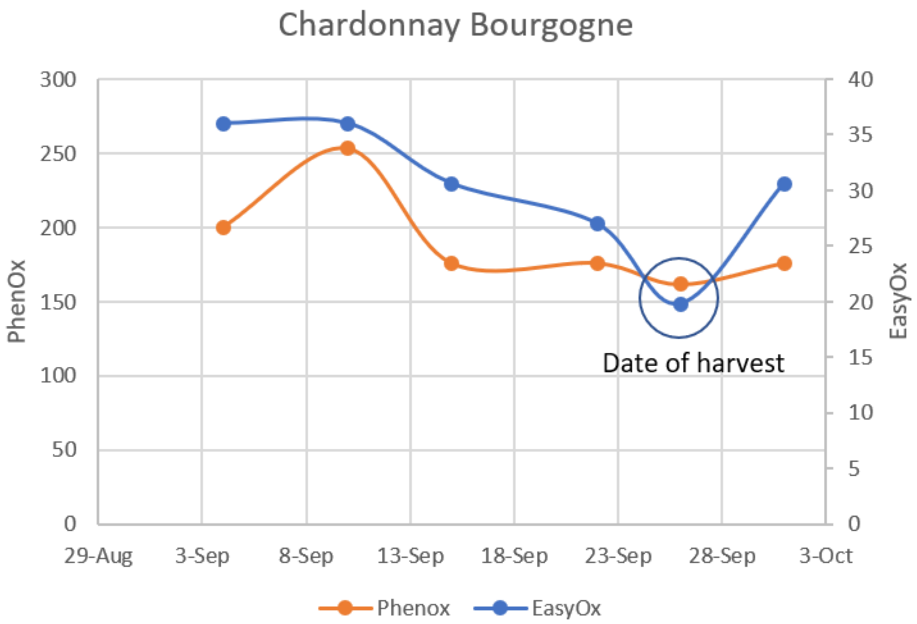


Figure 1: Evolution of the PhenOx and EasyOx indicators of Chardonnay (Bourgogne) juice during maturation.

In Languedoc, on the Sauvignon blanc plots, the same observation was made in 2015. The berry tasting, in parallel with the voltammetric measurements, showed the appearance of the sensation of thiolic aromas when the indicator values reached a minimum.

Finally, in 2016, in Jurançon, voltametric measurements were carried out on Petit and Gros Manseng at the Nigri domain in parallel with maturity follow up made by Dyostem® (Vivelys). These maturation follow up, that were continued until later dates, also highlighted a decrease of the indicator (figure 2) coinciding with the sugar loading stop and the thiol profile by Dyostem. In the present example, the measurement of average volumes of berries has additionally allowed the calculation of indicators by berry and therefore highlighted that decreases in indicators are not linked to the increase in the volume of berries due to dilution.

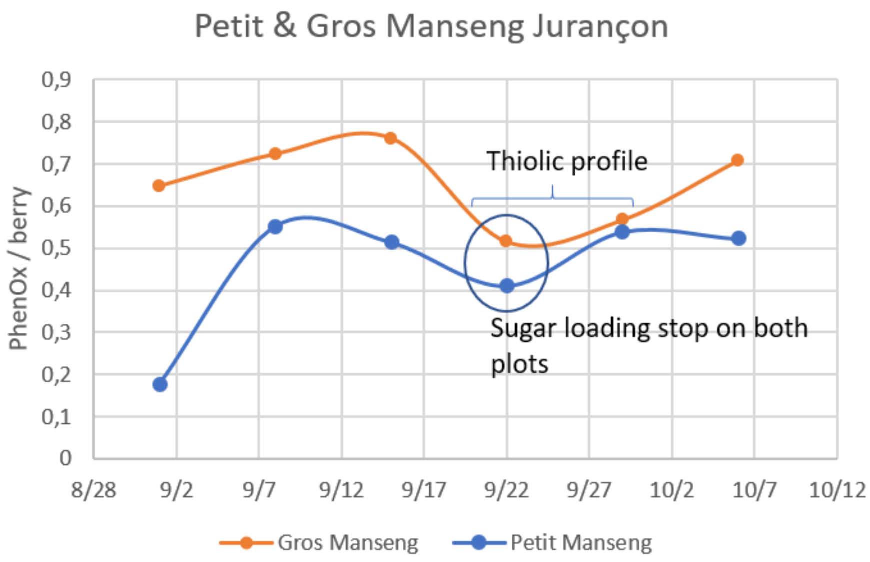


Figure 2: Evolution of the PhenOx indicator per berry for Petit and Gros Manseng (Jurançon) plots during maturation. Sugar loading stop and thiolic window indicated by Dyostem®.

The maturation monitoring by linear sweep voltammetry was implemented at Mas la Chevalière on 3 plots of Sauvignon blanc. In all cases, a minimum was observed for the PhenOx (figure 3) and EasyOx indicators. The average weight of the berries at each sampling point was calculated. Each indicator, multiplied by the average weight of the berries allows the estimation of an indicator perberry, in the same way as described for the calculation of the quantity of sugar per berry (Deloire 2011). This allows us to eliminate from the testing the effects of dilution or concentration linked to meteorological conditions, for example. The evolution of the PhenOx and EasyOx indicators by berry allowed us to confirm that the decreases were not linked to a dilution phenomenon. The quantity of sugar per berry, estimated in the same way, allowed us to evaluate the sugar loading stop around August 9th on these 3 plots. It confirmed that the minimum of the indicators coincides with this stop, known to be the start of the berry aromatic sequence (Deloire 2011). To date, no hypothesis ons to the origin of this phenomenon has been put forward; work started on this subject.

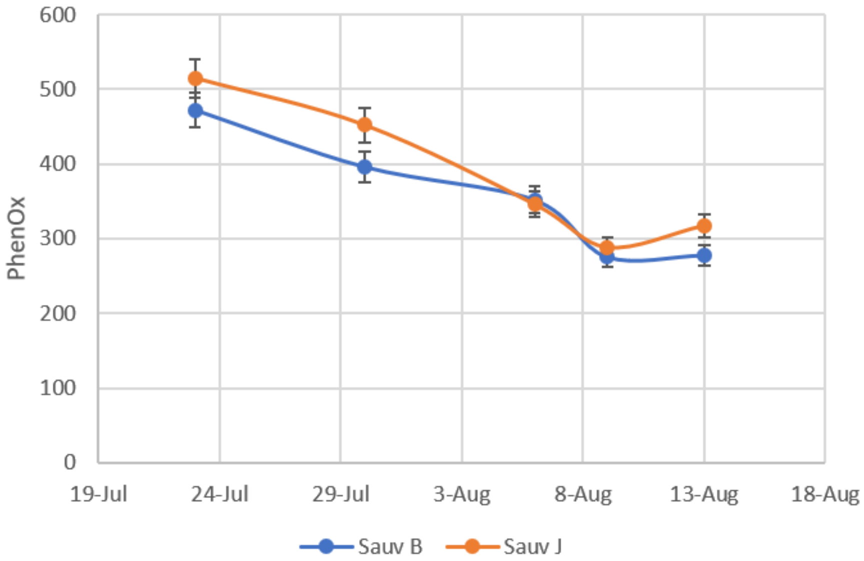


Figure 3: evolution of the PhenOx indicator of 2 plots of Sauvignon Blanc at Mas la Chevalière during the maturation.

The achievement of the minimum was confirmed on August 13th, and the plots were harvested on 2 dates, August 18th and August 22nd, which is 9 and 13 days after reaching the minimum indicators.

By comparison, the other plots on the domain were harvested when their potential alcoholic content by volume reached 12.5 % vol, which led, on average, to harvesting dates estimated to be 13 to 17 days after the cessation of sugar loading estimated as before (Deloire 2005). One of the wines from these plots was used as a control for the trial, as it was considered as representative of the Sauvignon blanc profile of the domain.

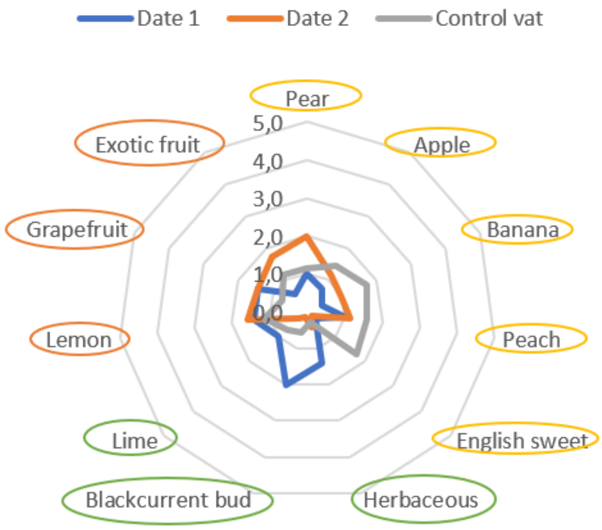
Analytical and organoleptic profile of the wines

The analysis of thiols carried out on the 4 wines from this trial (dates 1 and 2, stabulated and non-stabulated on must lees) showed concentrations of 3MH of around 300 ng/L, which is 5 times over the perception threshold. However, no significant difference in concentration was found by the analysis. The level of uncertainty is quite high (20%) on the analysis of these compounds, which frequently makes it difficult to highlight any significant differences.

On the contrary, three tastings were carried out at 1-month intervals from the end of alcoholic fermentation and showed the profile differences between the trials and the control wine of the domain. Only the results of the tasting 1 month after the fermentation (figure 4) are presented here, but all tastings led to similar evaluations.

The early harvest date (noted as date 1) generally appears more intense in terms of fresh notes (blackcurrant bud, lime) to the nose. It is described as having a rather vegetal taste in the mouth. The second date of harvest is described as having a riper profile (lemon, grapefruit, exotic fruit) and fermentative (pear) to the nose and in the mouth. The control wine that was harvested and vinified in the traditional way on the domain appears to be more fermentative (banana, peach) to the nose and in the mouth.

On the mouthfeel, the first date appears systematically more acid than the second. The control wine was described as sweeter but also more bitter and astringent than the 2 harvest dates.



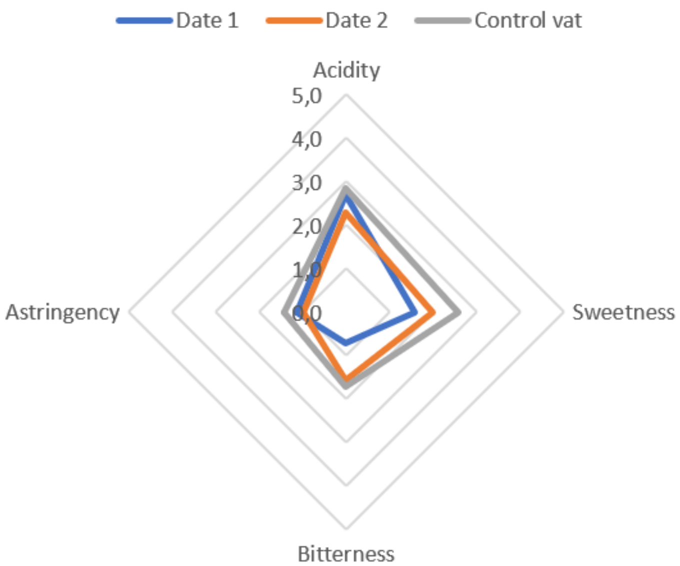


Figure 4: organoleptic evaluation of the wines from the Sauvignon blanc harvest on the 2 dates and comparison with a control wine from the domain. Top, description of the aromatic profile with, in green,

descriptors of fresh thiol, in orange, ripe thiols, and in yellow, descriptors of fermentative aromas. Below, balance on the palate.

The effect of the maceration on must lees was not significantly highlighted in this example, even if generally speaking, the methods that used a maceration on must lees present higher notes for the fresh aromatic descriptors (blackcurrant bud, lemon, passionfruit, etc.).

The Tukey test highlighted that from the end of the AF, the non-stabulated wine from date 1 was described as significantly different from the stabulated and non-stabulated vats from date 2.

Lastly, a preference test was carried out with a panel of around 30 professionals. The first date, stabulated or non-stabulated, was systematically considered to be the preferred wine of the panel.

Conclusion:

This work has highlighted that linear sweep voltammetry is a tool that is easy to use and complementary to the traditional methods of maturity control. This technique adds a complementary decision parameter for the initiation of the grape harvesting, at least in the case of white wine varieties harvested to obtain fresh profiles such as Sauvignon blanc or Manseng.

Its simplicity lies in the use of disposable electrodes and in direct measurement of the juice without prior preparation of the sample. In the case of maturity controls, measurement must be achieved as soon as the juice is obtained to avoid rapid oxidation of the juice.

The work on Sauvignon blanc described here has allowed us to highlight once again the effect of sequential harvests on the profile of the wine obtained. The difference of 4 days between the 2 harvest dates, defined thanks to the PhenOx indicator, leads to wines with distinct organoleptic profiles.

Our thanks go to the Nigri domain (Jurançon) and the Laroche domain (Chablis)

Summary

Sauvignon blanc wines typically present aromas of grapefruit, passionfruit, or boxtree. Intensity of these aromas is often linked to their quality. The influence of the harvest date on the fresh profile of the Sauvignon blanc is well known. A simple technique could facilitate maturation testing and facilitates decision making for harvest date. Linear sweep voltammetry on disposable printed electrodes offers this ease of use, and the data from Petit and Gros Manseng in the South West or from Chardonnay in Bourgogne has already demonstrated that the voltammetric signals showed significant decreases at the time of the optimal dates for obtaining the fresh or thiol profiles. This data will be presented in this article.

The objective of this work is to evaluate the use of linear sweep voltammetry on disposable printed electrodes to make decision on harvest date to produce Sauvignon Blanc wines with fresh profile.

The maturation of three plots was followed up using this method, in parallel with traditional maturity controls. One of the plots was harvested on two harvest dates, and two vinification processes, with and

without maceration on must lees, were carried on. Finally, after alcoholic fermentation, the wines produced from this trial were compared to the wines harvested at the traditional date for the domain.

Same behavior of voltammetric signals was observed here. The wines obtained from the harvests on these dates showed a fresher character than those harvested with traditional maturation control, which confirmed the advantage of using this technique in the initiation of the harvesting.

Keywords: Sauvignon blanc, maturation, electrochemistry, decision making tool, harvest date, fresh profile

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