STUDY ON THE ENOLOGICAL POTENTIAL OF THE MERLOT VARIETY

INTRODUCTION

Grape varieties are not adaptable to all edaphoclimatic conditions. Their properties and enological potential cannot be extrapolated *a priori* between different zones. The information that is available in literature on each variety reflects the genetic potential of said variety, since there are numerous factors that influence their subsequent expression.

The response of a variety to different parameters and factors, such as the Winkler Scale, rainfall, nature and soil depth, temperature range and insolation, cultural care and harvest, determines the quality of the grape and its enological potential (Carbonneau, 2000).

The Merlot variety occupies a global surface area of 220,000 hectares, making it one of the most cultivated varieties. It is one of the most important red varieties in the so-called emerging countries or countries of the new wine-making world due to its adaptation to produce balanced wines, very much in line with the current red wine consumption trend; in other words, structured wines with great aromatic complexity, that have been aged for short periods of time and can be consumed two to ten years after being made. It has an extensive presence in Australia, Chile, the United States and South Africa, since it is currently one of the most used varieties in these countries.

The surface area of Merlot in Spain is still small and its cultivation is relatively recent; the planting carried out in Catalonia (Priorat and Penedès) in the early 1980s are the oldest and their cultivation is being authorized in several Spanish denominations of origin. In the Valencia Denomination of Origin, it is registered as a preferred or authorised variety, despite the fact that no studies have been conducted on adaptation to the denomination's edaphoclimatic conditions; there is a planted surface area of 226 hectares, placing it in eleventh place as far as the most cultivated varieties go (CRDO Valencia, 2009).

The purpose of this work is to study the enological potential of the Merlot variety in the Clariano sub-zone of the Valencia Denomination of Origin. To that end, the chemical and sensorial characteristics of the wines obtained have been analysed using grapes with differing degrees of maturity and by making red wines with differing maceration times.

1. MATERIALS AND METHODS

The study was conducted on the edaphoclimatic conditions of La Vall dels Alforins located in the south of the Province of Valencia, where the vineyard, with a surface area of 1,388 hectares, constitutes the most economically significant source of agricultural production.

To study the enological potential of a variety in a certain situation, it is necessary to carry out consecutive comparative vinifications of samples that determine the organoleptic profile of the wines made (Boursiquot, 2000). So, the work plan consisted of making eight wines with a grape with differing degrees of maturity and using differing maceration times during fermentation. Other factors that may influence the composition of the wine were left unchanged for the eight wines that are the subject matter of this study.

The vinifications were carried out in 100 litre plastic containers. Beforehand, the grape was de-stemmed and gently crushed with a rubber roller before being put into the containers. Fermentation was carried out with indigenous yeasts present in the grape, adding 8 g/L of sulphur dioxide to the must. The eight musts from the same batch (in order to rule out any influence from agronomic factors on the results) were fermented separately. The characteristics and treatments conducted in said musts are gathered in Chart 1.

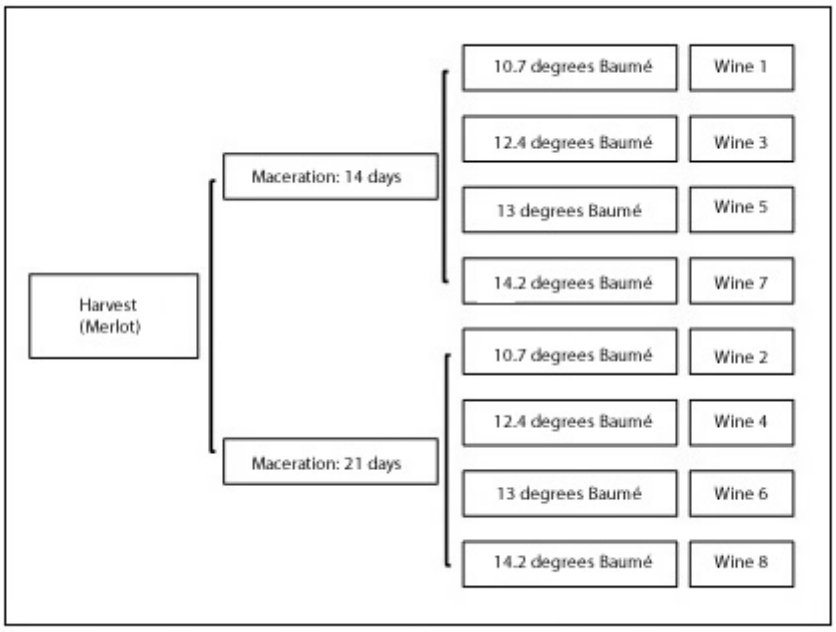

Chart 1: Characteristics of the wines made

The containers were filled with inert gas, a mix of CO_2 and nitrogen, before inserting the crushed grape, then the lid was fitted to minimise the action of polyphenol oxidases until the start of the alcoholic fermentation, since once started, the released CO_2 itself impedes all contact between the must/wine and oxygen. During fermentation two plungings were carried out daily.

From the samples of each finished wine, differing parameters necessary to evaluate the general characteristics of the wine and its preservation capacity were analysed, as well as its enological potential. The parameters analysed were volatile acidity, total acidity, pH, free sulphur, reducing sugars, alcohol content, colouring intensity (CI, as a sum of the absorbencies to 420 and 520 mn) and total polyphenol index (TPI) measured by the optical density index at 280 nm (Crouzet, 1999). Both the colouring intensity and the total polyphenol index were measured daily to control their evolution from the fifth day of storage until devatting. The qualitative determination of the malic acid was also carried out by paper chromatography in order to ensure the malolatic fermentation process was complete.

The sensorial analysis of the wines was conducted by a panel of expert wine tasters by following a mixed qualitative and quantitative method. The quantitative analysis was conducted over five quantifiable parameters: olfactory intensity, intense aromatic persistence (IAP) in the mouth, concentration in the mouth, tannin intensity and acidity, with a scoring scale of 1 to 5 being established for all those except IAP, the higher score being awarded for the quality of the attribute evaluated by the wine taster. For the qualitative determination, the wine tasting panel described the dominant aromas, both in the nose and in the mouth, of each wine. The mean values were calculated from the wine tasting technical specifications of the six wine tasters, who conducted the organoleptic exam.

For the statistical treatment of the results obtained with the eight wines made, the SPSS 10.0.6 program was used. The experience was carried out in duplicate and each analytical determination was repeated three times.

2. RESULTS AND DISCUSSION

During the year of the study, precipitations in the zone were very scarce, in the order of 197 mm, quite a bit less than annual measured precipitations that are around 350 mm. Consequently, the yield fell to a total of 2,600 kilos per hectare (1.3 kilos per stock). It should be pointed out that, under identical drought conditions, the fall in yield of other varieties with identical rootstocks, soil type, conduction system, age, plantation density and treatments was much less pronounced, which points to a deficient adaptation of the Merlot variety under drought conditions. Its poor adaptation to drought conditions is reason enough not to recommend it for planting in zones that are at risk of suffering prolonged periods of no rainfall, and even in other zones with low rainfall, with the exception of vineyards that have irrigation facilities.

As far as the results obtained for the common parameters (Table 1) are concerned, it is necessary to highlight the elevated values of total acidity in the wines obtained with

grapes harvested at 10.7 ºBé and 12.4 ºBé. In general, the fermentation completions were very slow and, as a consequence, residual sugar levels were high. This slowing down may be due to the fact that the micro-vinification conditions did not favour contact between the must in fermentation and oxygen, which means that the yeasts may have lacked oxygen. The volatile acid and free sulphur dioxide levels are normal and guarantee the proper preservation of the wine (Ruiz Hernandez, 1997).

	Wine 1	Wine 2	Wine 3	Wine 4	Wine 5	Wine 6	Wine 7	Wine 8
Volatile Acidity (g/L)	0.45	0.35	0.35	0.34	0.43	0.53	0.16	0.40
Total Acidity (g/L)	8.5	8,2	7.4	7.3	6.9	7	6.5	6.2
pH	3.15	3.23	3.35	3.36	3.32	3.30	3.60	3.65
Free Sulphur (mg/L)	27	46	32	32	26	35	43	34
Reducing Sugars (g/L)	3.4	2	2.6	3.2	3.6	2	1	1.5
Alcohol Content (% vol.)	11,3	11	12.6	12.8	13.4	13.1	14.3	14.5
Colouring Intensity	2.34	2.10	2.58	2.11	2.35	2.13	2.03	1.80
Total Polyphenols (TPI)	107	105	99	101	106	99	74	74

Table 1: Common analytical parameters of the wines made. Volatile acidity in g/L of acetic acid. Total acidity in g/L of tartaric acid.

Table 2 shows representations of the mean values of the colouring intensity (CI) and total polyphenol index (TPI) parameters at the time of devatting. It can be observed in this table how, solely for those wines submitted to a maceration period of 21 days, as the degree of maturity of the wine increases, both the polyphenol concentration and colour of the wines decrease (Kelebek et al., 2006; Cano-López et al., 2001); this effect does not exist for those wines submitted to a relatively short maceration period (14 days). These results could be due to polymerisation and precipitation phenomena associated with vatting.

The reduction in colouring intensity and total polyphenol index observed in the wines from the grape harvested in a slight state of over-maturation (14,2ºBé) could also be due to the degradation of the cell walls during maturation of the grape skin that is produced parallel to the formation of ethanol, associated with the phenomena of over-maturation. The degradation of the cell walls can put the phenol compounds of the vacuoles in contact with the enzymes responsible for their oxidation. Likewise, the presence of ethanol in the grape skin may produce a polymerisation of phenol compounds in the vineyard, the grape having already been picked (Santos, 1997; Zamora. 1998).

The CI and TPI values for the eight wines are exceptionally high if we take into account that Moutounet (2000), in his work carried out on phenol compounds, comes to the conclusion that a red wine must have a minimum TPI of 35 in order to bear being aged in barrels, and that Pérez (1999) states that a red wine with a TPI greater than 75 can be considered of exceptional quality. Likewise, the CI values of a good red wine are traditionally around 0.8-1.2. Therefore, the TPI values are of double magnitude to the observations in Burdeos por Glories (1998), showing a very important relationship between the effect of native soil and polyphenol synthesis.

It can even be observed that the Merlot variety has, according to the definition of enological potential of Carbonneau (2000), greater enological potential when it is cultivated in the conditions of the Valle dels Alforins (Valencia Denomination of Origin) than when it is cultivated in the conditions of the ITV station of Burdeos (Cayla, 1991).

Charts 1 and 2 show the evolution of the CI in the eight wines made, depending on whether they have undergone a short maceration period (14 days) or a long one (21 days), respectively.

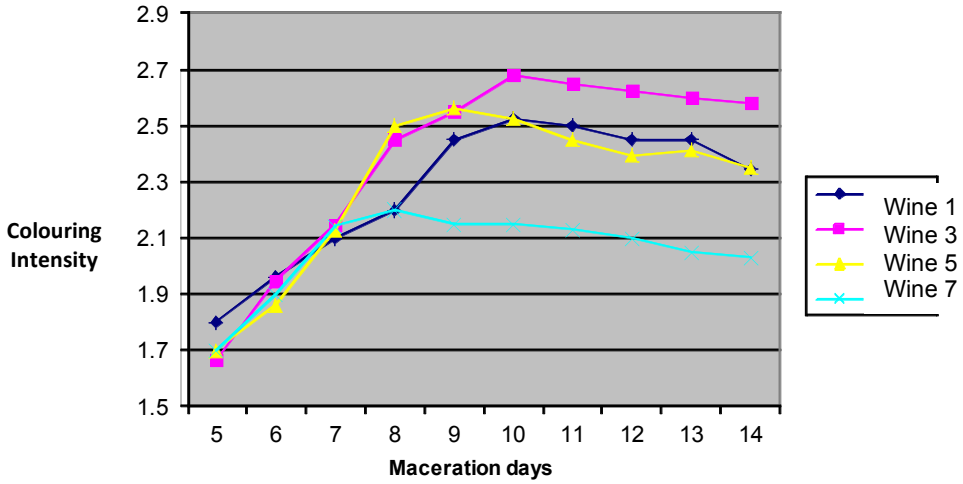

Chart 1: Evolution of colouring intensity (CI) in wines macerated for 14 days

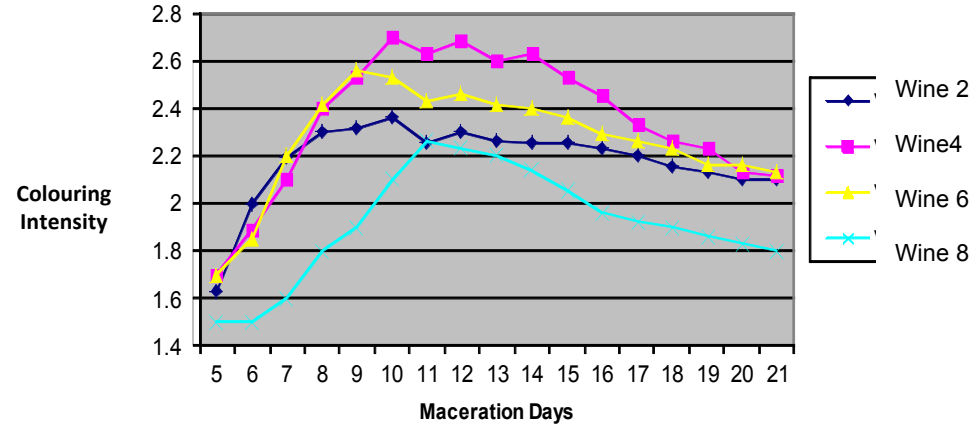

Chart 2: Evolution of colouring intensity (CI) in wines macerated for 21 days

The maximum CI is reached in the eight wines between the eighth and tenth day of maceration, which then gently and gradually drops until devatting. This CI drop is due to several phenomena, including the formation of antocian-tannin polymers that precipitate or are dragged by the lees in its sediment, a lower proportion of cation flavilium in the wine as a consequence of the increase in pH during maceration, or to the combination of the antocians with the sulphurous dioxide, giving colourless forms (Ruiz Hernández, 1999; Tomasset, 1998; Vivas, 1993).

In Chart 1 we can observe how within the group of short maceration wines, the wine from more mature grapes is that which presents a lower CI. Chart 2 shows how there are barely any differences between the final CI values for the long maceration wines, with the exception of that corresponding to the grape with greater state of maturity, which has a final value slightly lower at 1.8.

Charts 3 and 4 show the evolution of TPI in the wines, grouping the four short maceration wines and the four long maceration wines together. The maximum extraction of polyphenols is reached between the eighth and eleventh day of vatting. Then, a gradual drop begins, which tends to become increasingly gentler until it stabilises, as is the case with the wine from the most mature grape and with greater maceration time. This drop in TPI is associated with the differing polymerisation phenomena amongst phenol compounds and the precipitation of polyphenols with the lees. (Vivas, 2000).

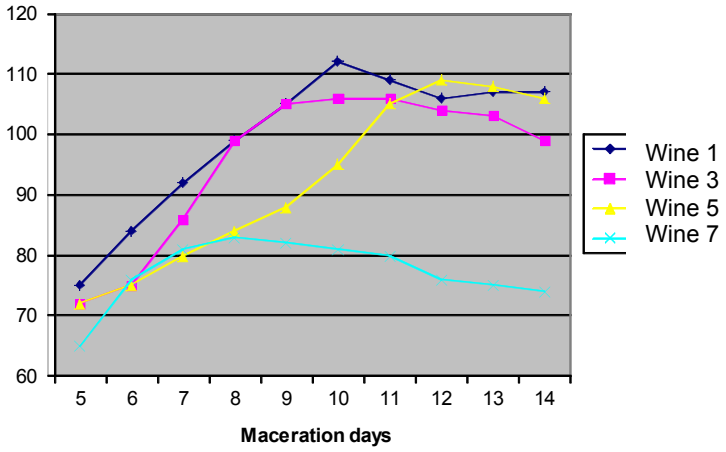

Chart 3: Evolution of Total Polyphenol Index (TPI) in wines macerated for 14 days

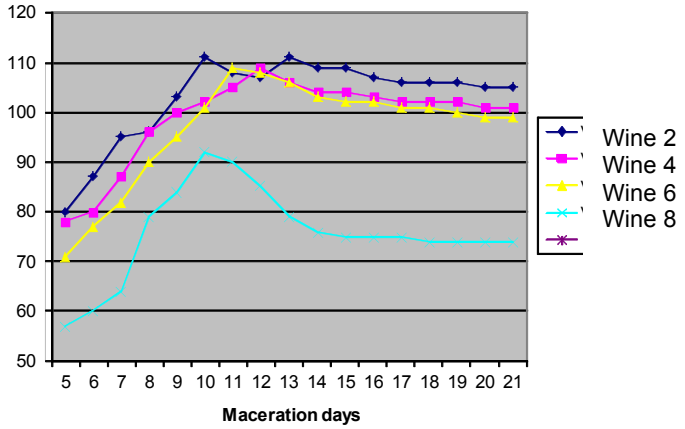

Chart 4: Evolution of Total Polyphenol Index (TPI) in wines macerated for 21 days

Chart 3 shows how the variation between the final TPI values is not much for the short maceration wines, though the TPI of the wine made with a more mature grape is

slightly lower than the other three. In Chart 4 it can be observed how for the long maceration wines the final TPI values are very similar, except for the wine made with a more mature grape, which is also lower. The statistical analysis conducted shows that there are no significant differences at 99% of the CI and TPI values obtained for the eight wines made.

With respect to the sensorial analysis, Table 2 shows the relationship of aromatic descriptors found by the panel of wine tasters in the organoleptic exam conducted, as well as the number of wine tasters who found the different aromas in the wines. The most aromatically complex vines, complexity being the number of differing descriptors found in a wine, are the wines of intermediate maturity (12.4 and 13 ºBé), and the least complex wines coming from the more mature grapes (14.2 ºBé). These results concur with those obtained by Sapis (2000) in the work on Moscatel wines with a small skin, in which a terpene drop is produced in the concentration when the grape is very mature.

	Wine 1	Wine 2	Wine 3	Wine 4	Wine 5	Wine 6	Wine 7	Wine 8
Berries	6	6	6	5	-	3	2	2
Mature fruit	-	-	-	1	-	3	4	4
Plum	-	-	-	1	2	-	-	-
Flowers	-	-	-	1	-	-	-	-
Bay	-	-	-	1	-	-	-	-
Violets	-	-	-	-	-	-	-	2
Vegetable	3	3	1	-	4	-	-	-
Pepper	3	1	-	-	2	-	-	-
Herb	-	-	-	-	1	-	-	-
Spice	3	2	2	2	3	3	-	-
Cinnamon	-	-	-	-	1	-	-	-
Liquorice	1	1	-	-	-	-	-	-
Tobacco	3	-	1	1	2	1	-	-
Chocolate	-	-	-	1	-	-	-	-
Honey	-	-	-	-	1	-	-	-
Yeast	-	-	-	-	2	-	2	-
Alcohol	-	-	1	-	-	1	-	-

Table 2: Aromatic descriptors of the wines and values of the frequency of perception of the wine tasters.

Table 3 shows the mean values of the results obtained in the sensorial analysis of the wines made. It can be observed how the olfactory value grows with the maturity of the grape. This growth in the olfactory intensity, even for a state of slight over-maturation, may be due to the greater alcoholic richness of the wines made with a more mature grape. The mean values obtained (3.58) correspond, according to the analysis method followed, to high quality wines, the differences being statistically significant with respect to the other wines.

Table 3: Influence of the different types of wines on the mean values of the results obtained in the sensorial analysis.

	Wine 1	Wine 2	Wine 3	Wine 4	Wine 5	Wine 6	Wine 7	Wine 8
Olfactory Intensity	2.83 a	3.08 a	2.91a	2.83 a	3.16 a	3.16 a	3.58 b	3.58 b
IAP	4.5 a	4.75 a	5.58 b	5.25 b	6.16 c	6.33 c	5.58 b	6.25 c
Concentration	2.25 a	2.41 a	3 b	3.23 b	3.41 b	3.33 b	3 b	3.16 b
Tannin Intensity	3.5 a	3.41 a	3.33 a	3.08 a	2.75 b	2.58 b	2.41b	2.41 b
Acidity	3.16 a	2.83 a	2.5 a	2.66 a	2.58 a	2.5 a	2.16 b	2 b

For a same attribute, the values of the columns with the same letter present no significant differences; those with a different letter present significant differences at 1%, according to the Tukey multiple range test.

The intense aromatic persistence (persistence of the flavour in the mouth after ingesting or spitting out the wine), measured in seconds, was assessed by the panel of wine tasters using a scale of zero to infinity. As in the case of olfactory intensity, the wines with the highest values were those obtained from grapes with a greater maturity index, showing, for the wines macerated for 14 days, significant differences (Wines 3 and 4) with respect to those less mature wines (Wines 1 and 2). This highlights that for the wine tasting criteria followed, a wine is considered excellent when its intense aromatic persistence reaches seven seconds.

The wines with better values as far as concentration is concerned are not those from the most mature grape, but rather those of 13 ºBé. This result is related to the analytical results in which a smaller TPI can be observed in the wines made with a grape of 14 ºBé. Though these differences are not significant, it can be stated that the concentration in the mouth is related to the TPI of the wine from a certain degree of maturation of the grape, which in our case is at 12.4 ºBé.

The appreciation of the presence of tannin in the mouth drops with the maturity of the grape (Zamora, 2003), which confirms that the maturation of the tannins is produced simultaneously with the maturation of the grape skin, there being significant differences between the four wines with an alcohol content of less than 13 (those with more aggressive tannins and green wines) with respect to the wines with an alcohol content of over 13.

The results obtained through the sensorial analysis for the assessment of acidity concur with those obtained through the chemical analysis of total acidity and pH, maintaining a relationship with the phenomena of a reduction in the acidity in the grape during maturation.

CONCLUSIONS

The Merlot variety is capable of producing wines with great enological potential in the Valencia Denomination of Origin. However, due to its low adaptation to the climatic conditions of this zone of the Denomination of Origin (mean annual precipitations around 350 mm and risk of drought) it is only recommended that this variety be planted when there are irrigation facilities, otherwise the yield might be very low and its cultivation might not be of interest from an economic point of view.

There is an important variation in the acidity and the polyphenol content according to the harvest date. This behaviour causes the wines to have different chemical and organoleptic characteristics, as is reflected in the results of the analyses conducted. These variations must be taken into account when it comes to establishing the optimal harvest date. The wine made with a slightly over-matured grape experiences a reduction of the total polyphenol index, colouring intensity and concentration in the mouth. This loss may be due to the presence of ethanol and the degradation of the vacuole walls, which would enable the oxidant enzymes to come into contact with the polyphenols.

The wines with 14.0 degrees Baumé and macerated for 14 and 21 days (Wine 4 and Wine 8) have been given the worst values as far as aromatic complexity is concerned. These results, together with those obtained in the studies conducted on the degradation of aromas in white grapes, put into doubt the practice of harvesting red grapes with a slight over-maturation.

The results of the sensorial analysis show large organoleptic differences between the different wines made. Differences that must be taken into account when it comes to deciding the harvest, taking into account that very different wines can be obtained from the same batch. It is up to the technicians to decide on establishing the optimal harvest date according to the characteristics of the wine they want to make.

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