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STUDIES ON THE INFLUENCE OF CLIMATE CONDITIONS ON THE QUALITY OF *MERLOT* WINES

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Abstract

To highlight the influence of the climatic conditions of the harvest year on the main biochemical parameters, and therefore on the quality of the red wines obtained from the Merlot variety, 4 wines obtained in the Dealu Mare region were analyzed, in 2013, 2014, 2015 and 2016. The climate of the studied years presented differences in temperature and precipitation, leading to different accumulations of sugars and phenolic compounds; climatic conditions also had an influence on the other quality parameters of the wines. The biochemistry analysis of the wines aimed: alcoholic strength (vol% alcohol), total acidity (g/L tartaric acid), volatile acidity (g/L acetic acid), total and reduced dry extract (g/L), glycerol content (g/L), the content in total and free SO_2 (mg/L). The influence of climatic conditions on the chromatic characteristics of Merlot wines was highlighted by spectrophotometric analysis of the total content of polyphenols (A280), the total content of tannins (g/L), including tannin structure (gelatin index, HCl index and ethanol index, %), content in anthocyanins (mg/L) and coloring intensity.

Key words**:** *Merlot variety, the influence of the climatic conditions, polyphenols, anthocyanins*

INTRODUCTION

The quality of the wines represents a complex system, in which are involved numerous factors [16]. The most important of these are: environmental factors (Eco pedoclimatic factors of the wine-growing area, annual climate), biological factors (grape variety, rootstock) and human factors (culture technology, winemaking techniques) [4, 22]. Of these factors, the annual climate can vary within quite large limits, significantly influencing the quality of the harvest and implicitly the quality of the obtained wine [9, 24]. Thus, the annual climatic factors can be particularly favorable and then we can talk about an exceptional year, which will lead to the expression of the maximum potential of the varieties and therefore to obtaining high quality wines [17, 24]. On the contrary, they can be very weak years for the viticulture, the adverse climatic conditions having repercussions on the quality of grape harvested and wine.

Description of the Merlot vine variety

Merlot is a French grape variety, originating from the Medoc peninsula, part of the renowned Bordeaux wine region [5, 22]. Here, it was cultivated long before the invasion of phylloxera and together with other varieties such as *Cabernet Sauvignon*, *Cabernet Franc* and *Malbec*, is part of the current assortment of the Malbec region. In the Bordeaux region, the *Merlot* variety occupies about 58% of the area cultivated with vine plantations, with Appellations Saint-Emilion and Pomerol [5].

In our country, the *Merlot* variety was brought to the end of the 19th century, as a result of the recovery action of the Romanian viticulture, the "exterminated" viticulture (as in fact all of Europe's) by phylloxera [18, 21].

Although, from a qualitative point of view, *Merlot* wine more rarely equals *Cabernet*

Sauvignon wine, the variety has started to be grown on larger areas due to grape production, much higher than the production of *Cabernet Sauvignon* [19, 21, 22]. The two varieties, with their common ancestor, are cultivated worldwide (but especially in Europe), somewhat in tandem, leading to the obtaining of high quality, elegant red wines that complement each other in blends [5]. If *Cabernet Sauvignon* wine is a stronger, full-bodied wine, with a higher tannin content and a wide aroma, *Merlot* is a delicate wine, with a color intensity and a lower acidity than *Cabernet* [2]. The *Merlot* wine has a discrete, fine fruitiness, reminiscent of raspberries and cherries, but may have, depending on the Eco pedoclimatic conditions a wider aromatic palette (strawberries and fresh raspberries, red currants, cherries, plums) [6, 8].

Merlot wine behaves very well in blends, especially with *Cabernet Sauvignon*, where the complexity of *Cabernet* complements the delicate and sweet aromas of *Merlot*. Blends are often made with other wines, such as *Syrah* or *Cabernet franc* [22]. The aroma and texture of *Merlot* wine, as well as *Cabernet's*, differs depending on the climatic conditions of the wine area as well as the year of harvest [11]. Thus, in areas with warmer climate, or in the years with higher temperatures during the ripening of the grapes, the *Merlot* wine becomes slightly more corpulent, with stronger, distinct aromas [5].

*Agrobiologically characteristics of the Merlot variety***.** *Merlot* variety has medium and high vigor, medium fertility, slightly variable and average productivity. Production reaches about 10 t/ha, higher yields recorded on clay-limestone soils [12]. The variety's resistance to frost is low, so it is recommended that the location of the vineyard plantation with *Merlot* take into account the cold currents in winter. The *Merlot* variety is also sensitive to drought [22]. The sensitivity of the variety also manifests during flowering, the flowers can easily abort if the temperatures are lower [12]. Also, the variety is sensitive to the **v**ineyard physio paths, called "honey" phenomena [12].

In our country, the *Merlot* variety is cultivated on an area of about 1200 ha in several wine-growing areas: Oltenia and Hills of Muntenia (in all the wine centers of Dealu Mare vineyard; in Samburesti vineyard, and in Drăgășani vineyard), Crisana and Maramures (Minis), the Hills of Moldova (Cotesti), Dobrogea Hills (Murfatlar) etc [15]. Although, the *Merlot* variety can lead to obtaining high quality wines, sought both in Europe as well as internationally side, its sensitivity requires careful zoning and establishment of plantations, in areas that allow it to reach the maximum potential of the variety.

The climatic conditions (temperature, luminosity, precipitation) determine a variation of the potential of the variety, intervening both on the production and on the quality of the wine.

MATERIALS AND METHODS

In order to highlight the influence of climatic conditions on the quality of *Merlot* wines, 4 wines were analyzed obtained in the Dealu Mare region from the 2013, 2014, 2015 and 2016 harvest. The basic physico-chemical parameters were analyzed: alcoholic strength, total acidity, volatile acidity, total dry extract, reduced extract and glycerol. Based analyzes were performed by standard methods [23]: refractometric method for determining the amount of sugar in grapes (with digital refractometer for the measurement of percentages Brix, HI96801); Schoorl method for determining reducing sugars in wines (g/L sugars); distillation method, for alcoholic strength (vol% alcohol); titrimetric method for total acidity (g/L acid tartric); distillation method with the distiller *Saunier Cazenave* (by entrainment volatile acids, followed by their titration in distillate in the presence of an indicator) for acidity volatile (g/L acid acetic); densimetric method, variant Tabarié for total dry extract (g/L) and volumetric method for glycerol (g/L) [23].

As for the specific analyzes, the polyphenolic composition of wines was judged by the content in total polyphenols, tannins and anthocyanins [3]. Analyzes have been carried

out in the wine by UV-VIS spectrometry techniques [7, 10].

Total content of polyphenols have been determined by TPI technique, using A_{280}. Total polyphenols index (TPI) is determined by multiplying the value of the absorbance by the dilution factor (TPI = A_{280} x DF) [21].

Tannins (g/L) have been determined by the Ribereau-Gayon method and tannins structure after Glories method, based on the following indicators: gelatin index (for astringent tannins %); HCl index (for condensed tannins, %); ethanol index (for the macromolecular associations tannins-polysaccharides, %). These indicators was determined by spectrophotometric method at λ = 280 nm [11]. The anthocyanins (mg/L) were determined by the Ribereau-Gayon method through the pH difference [21]. Color intensity was determined by summing the optical densities of the wine at the wavelengths: λ=420 nm, λ=520 nm and λ=620 nm.

RESULTS AND DISCUSSIONS

The basic chemical parameters of the wines were analyzed by the methods described in the previous chapter, the results of the analyzes being shown in Table 1.

Table 1. Basic chemical parameters of *Merlot* musts and wines

Wines	Chemical parameters of *Merlot*									
	tthe content of musts in sugars (g/L)	alcoholic strength of wines (vol % alcohol)	residual sugars of wines (g/L)	total acidity (g/L tartaric acid)	volatile acidity (mg/L CH_3COOH)	total dry extract (g/L)	reduced extract (g/L)	glycerol (g/L)	total SO_2 (mg/L)	free SO_2 (mg/L)
M_{2013}	228.4	13.0	4	6.18	0.3	29.8	25.8	9.4	165	35
M_{2014}	212.5	12.2	3.5	6.48	0.42	26.4	22.9	8.0	108	40
M_{2015}	235.5	13.6	3.3	5.42	0.61	30.9	27.6	9.7	155	30
M_{2016}	220.5	12.5	4.2	5.65	0.47	28.6	24.4	8.5	180	48

Source: Author's results.

Thus, the climatic conditions of the harvest years 2013, 2014, 2015 and 2016 led to variations in the accumulation of sugars in grapes, variations that were not, however, very significant. We note the year 2015 in which the favorable climatic factors led to the highest concentrations of sugars in grapes (Fig. 1).

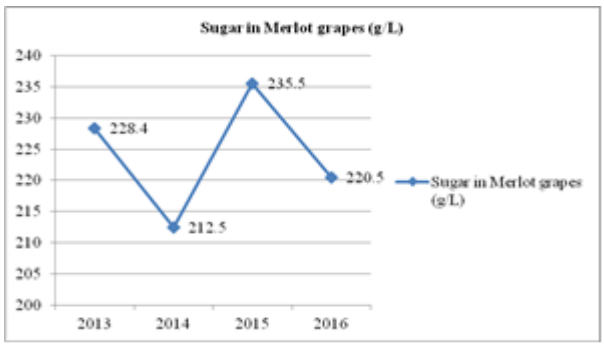

Fig. 1. Variation of sugar accumulation in *Merlot* grapes during the study years
Source: Author's results.

The alcoholic strength of the wines, obtained after the complete alcoholic fermentation of the musts also registered variations, from 12.2 vol% to 13.6 vol% alcohol.

The variations were significant but in all cases the wines registered the alcoholic strength necessary for their classification in the DOCC wine category, produced in the area of origin, within the Dealu Mare region (Fig.2).

The amount of residual sugars obtained from the alcoholic fermentation allowed the wines to be classified in the category of dry wine.

The total acidity of the wines registered normal values; however, in 2014 the high value of the total acidity produced a slight imbalance of the wine (Fig.2).

The total dry extract also, recorded variations, the favorable climatic conditions of 2015 leading to high values of this parameter in *Merlot* wine (Fig.3).

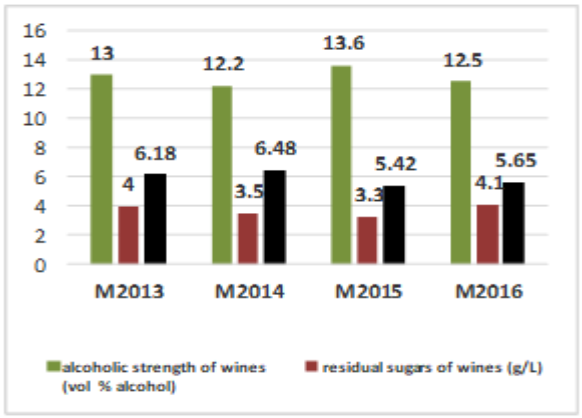

Fig.2 The alcoholic strength, total acidity and residual sugars of wines
Source: Author's results.

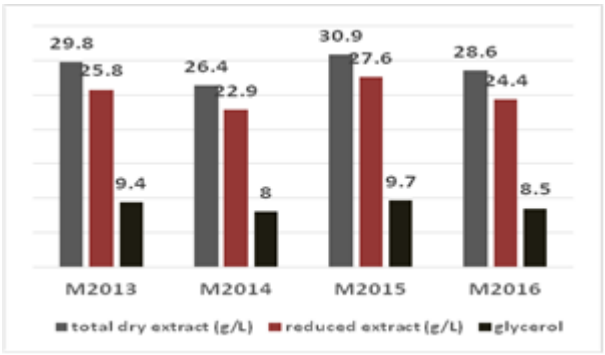

Fig.3 Content of wines in dry extract, reduced extract and glycerol
Source: Author's results.

Glycerol, the compound considered to be the most important by-product of alcoholic fermentation, contributes to the formation of dry extract, but also to the retention and revelation of wine aromas [14, 20]. Finally, glycerol influences the organoleptic qualities of the wine and therefore its quality. The amount of glycerol varied in tandem with the alcohol concentration of the wines, *Merlot* wine 2015 being characterized by the highest amount of glycerol (Fig.3).

In addition to the described parameters, the volatile acidity of the wines obtained during the 4 years of study was analyzed (Table 1). In most wines, the value of volatile acidity was below 0.5 g/L acetic acid. *Merlot* wine 2015 registered a slightly increased value of this very important parameter for the health and therefore the quality of the wine. The higher amount of volatile acids in the wine obtained this year may be a consequence of the high sugar concentration of the grapes-raw material. Also, in Table 1 are shown the SO_2 values, totally and freely, the most important exogenous substance for the stability of the wines, which also intervenes in many transformations suffered by the wine compounds. Both total and free SO_2 are within normal limits.

The polyphenolic composition of the analyzed *Merlot* wines was assessed by the total polyphenols content, the tannin content, the tannin structure of the wines, as well as by the anthocyanin content [13].

Regarding the total polyphenols content, *Merlot* wine is characterized by an average polyphenols content, compared to the other quality red wines: *Cabernet Sauvignon*, *Pinot noir*, *Feteasca neagra*. From the analysis of the results one can observe the influence of the climatic conditions and on the polyphenolic content of the wines (Fig.4).

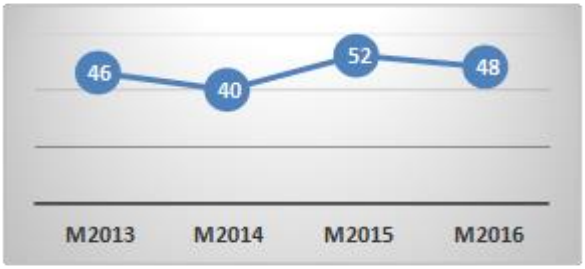

Fig.4. Variation of total polyphenols content (A_{280}) in *Merlot* wines
Source: Author's results.

Thus, in 2015 large accumulations of sugars were accompanied by higher accumulations of phenolic compounds, compared to the other years of study.

The tannin content was higher in the *Merlot* wine obtained in 2016, followed by the Merlot wines 2013 and 2015 (Fig.5).

Fig.5.Variation of the content in tannins (g/L) in *Merlot* wines
Source: Author's results.

The tannin structure of the varieties is a characteristic of them, the black grape varieties being characterized by a different content of tannins with astringent properties (Gelatin index), condensed tannins (HCl index) or macromolecular associations of tannins and polysaccharides (Ethanol index) [1, 25].
Merlot variety is characterized by a higher content of condensed tannins; percentage of condensed tannins was between 6.5% and 9% (Fig.6).

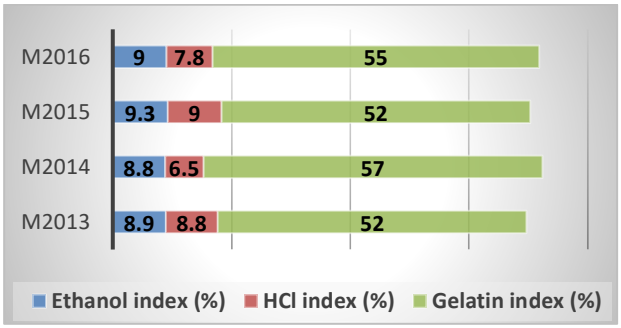

Fig.6. Structure of tannins in *Merlot* wines
Source: Author's results.

In terms of anthocyanin content, the highest accumulations were recorded in 2015. Large quantities of anthocyanins also accumulated in 2013 (Fig.7).

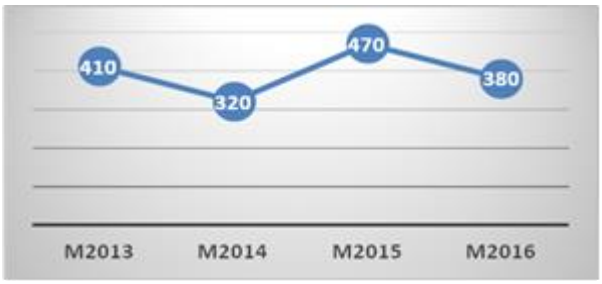

Fig.7. Variation of anthocyanin content (g/L) in *Merlot* wines
Source: Author's results.

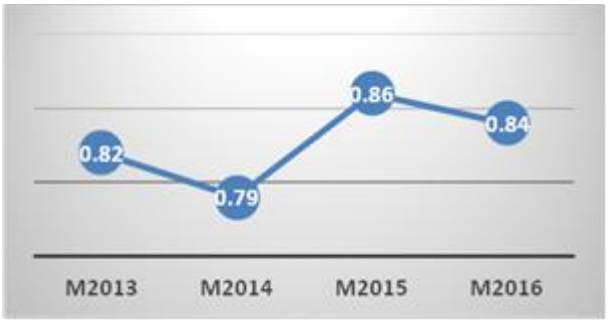

Fig.8. Color intensity (IC) in *Merlot* wines
Source: Author's results.

In 2015 the *Merlot* wines had a particularly pleasant, rich and heavy red-ruby color, with a value of 0.860 of the coloring intensity (Fig.8).

CONCLUSIONS

Merlot variety is sensitive to winter injury. Budbreak is fairly early and is thus susceptible to frost in the spring. The grapes are susceptible to diseases, especially to gray rot. Thus, the annual climatic conditions can influence the quality of *Merlot* wines.
The years 2013, 2014, 2015 and 2016 were different years in terms of climate, which led to variations in the composition and quality of the wines.
The analysis of the main biochemical parameters revealed the influence of the climate on the accumulation of sugars and, therefore, on the alcoholic strength, the content in dry extract, in glycerol, as well as on the chromatic characteristics of the wines.
In 2015 there were the highest accumulations of sugars but also the largest accumulations of phenolic compounds, including anthocyanins. The *Merlot* wine obtained this year was the most appreciated at the tasting, being a very well balanced wine, with an elegant red-ruby color, with the fresh aroma of raspberries and plums.

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