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Studies regarding the impact of aging time on color of red wine merlot obtained in recas vineyard

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Abstract

The goal of this study was to investigate the chromatic properties of red wines processed in famous Romanian vineyards. Were analyzed bottled red wines, from 2011 harvesting year in the Recas vineyard. From Recas were analyzed Merlot red wines. The establishment of chromatic and antioxidant characteristics is extremely important because these properties have a decisive role in red wines quality inoculation. These wines were aged in glass bottles for 0, 3, 6 and 12 months. For both young (analised immediatly after bottled) and aged wines in different stages of aging, was monitorised the evolution of chromatic characteristics in terms of chromatic parameters determined through Glories method, content of monomeric anthocyanins determined through differential pH, structure of wine color through fractions of monomeric, polymeric pigments and co-pigments which participate in total color of wines, chemical age of wines and the ionization degree of anthocyanins. Ageing process leads to a chromatic structure modification and so the percent of yellow and blue pigments increases and that of red pigments decreases at the total color of wines.

Keywords: anthocyanins, chromatic parameters, polyphenols, red wines

1. Introduction

The establishment of chromatic and antioxidant characteristics is extremely important because these properties have a decisive role in red wines quality inoculation. Polyphenols compounds from the red wines, even in small concentrations, had a significant antioxidant capacity, due to their special adapted chemical structure [3]. Polyphenols quantity and quality from the red wines depend on vineyard, grapes varieties and winemaking process [7]. Polyphenolic compounds structure change with the evolution of a red wine due to the polymerization, condensation and oxidation reactions. Anthocyanins pigments, especially monomeric forms, responsible for wine antioxidant properties pass as polymers with different molecular masses [6]. The color components of wine are the important parameters that contribute to the sensory characteristics and the antioxidant properties of wine [3,9-11]. Objective measurement of the components of wine color is an essential part of the modern concept of winemaking called "*red wine color management*", in relation to their antioxidant characteristics. Chromatic changes perceptible during a red wine evolution are accompanying antioxidant properties. Chromatic parameters have a definitely role in a wine's evolution, but are insufficient for its antioxidant properties specification. In order to have a complete view, the obtained results through red wines color analysis, must be correlated with the obtained results in case of antioxidant capacity determination and polyphenols content modifications. On world's plan there are studies which confirm the existence of a strong correlation between polyphenols content and wine antioxidant capacity, also the dependence between antioxidant capacity and different forms of anthocyanins: monomeric, polymeric, copigmented [7,8]. In this paper are presented the results obtained in the case of chromatic parameters and antioxidant power

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determinations for some red wines assortments obtained in famous vineyards from Romania. We are evaluating different red wine types regarding the chromatic and antioxidant characteristics. On the base of obtained results were established the correlations between polyphenols compounds, total antioxidant capacity and chromatic features which helps to appreciate the red wines quality.

2. Materials and method

Wine samples. There were studied red wines from Recas vineyard from 2011 Merlot black grapes. These wines were aged in glass bottles for 0, 3, 6 and 12 months and marked after ageing period (0, 3, 6, 12) and Recas vineyard (R), as following: 0-M-R, 3-M-R, 6-M-R, 12-M-R. For both young (analised immediatly after botteled) and aged wines in different stages of maturation, was monitorised the evolution of chromatic characteristics through:

- chromatic patameters determined through Glories method;
- content of total monomeric anthocyanins determined through differential pH;
- structure of wine color through fractions of monomeric anthocyanins, polymeric pigments and co-pigmented anthocyanins which participate to the expressing of total red wine color;
- chemical age of wines and the degree of anthocyanins ionization.

Red wine color analysis was done in accordance with Boulton's spectrophotometric method [2]. For each wine the following parameters were measured by spectrophotometric assay: fraction of color due to monomeric anthocyanins (MA), co-pigmented anthocyanins (CA) and polymeric anthocyanins (PA).

Chromatic properties were determined according to Glories method [5]. By this methods it was determined: the color intensity (IC, expressed in AU-absorbance units was given by the sum of the A_{420nm}, A_{520nm}, and A_{620nm}), the color tonality (T was expressed by the ratio of the A_{420nm} and A_{520nm}) and the wine chromatic structure expressed by the yellow, red and blue pigment contribution (%) to the red wine color.

Total monomeric anthocyanins content were quantified by the pH-differential method [4]. Anthocyanins pigments undergo reversible structural transformations with a change in pH. The colored oxonium form predominates at pH 1.0 and the colorless hemiketal form at pH 4.5. The anthocyanins content (mg • L^{-1}) was calculated as cyanidin-3-glucoside.

3. Results and discussions

In order to determine total monomeric anthocyanins it was used differential pH method and monomeric anthocyanins pigments were expressed as cianydin-3-glucoside. The evaluation of chromatic parameters was through Glories method. Using this method were quantified chromatic parameters: color intensity (IC), tone (T) and the contribution of yellow, red and blue pigments expressed in percent (%) at the wine color. The analysis of red wine color was made after Boulton (1996). The fractions of red wine color caused by monomeric anthocyanins, polymeric anthocyanins and co-pigmented anthocyanins were noted MA(%), PP(%), CA(%).

From Table 1 and Figures 1 and 2 could be seen the chromatic structure obtained with Glories method. From these data we could conclude that for red wines the participation of red pigments is bigger (more than 45%) at wine color.

Table 1. Chromatic parameters of red wines determined through Glories method

Sample	A_{420}	A_{520}	A_{620}	I.C*	T	Chromatic structure		
						Yellow pigments (%)	Red pigments(%)	Blue pigments (%)
0-M-R	3,301	4,183	0,712	8,20	0,79	40,28	51,04	8,69
3-M-R	3,365	3,974	0,735	8,07	0,85	41,68	49,22	9,10
6-M-R	3,412	3,806	0,751	7,97	0,90	42,82	47,76	9,42
12-M-R	3,487	3,608	0,795	7,89	0,97	44,20	45,73	10,08

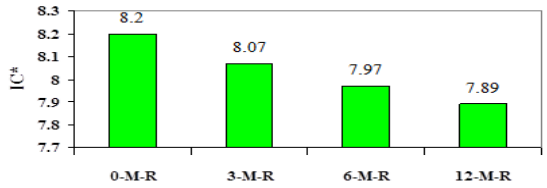

Figure 1. Graphical representation of Merlot red wine colour intensity IC*

During wine ageing the percent of yellow pigments increased and that of red pigments decreased, but both types of pigments are more balanced in aged wines. Red pigments are predominant both in young and aged wines. Yellow pigments contribute with less then 45% at red wine color.

It was observed that during red wines ageing the values of absorbance at λ=520nm decreased and those at λ=420 nm and 620 nm increased. This phenomenon is caused by transformation of monomeric anthocyanins in polymeric pigments. The

highest values of color intensity were for young red wines while the smallest values for IC were observed at aged red wines. From Table 2 and Figure 3 it was observed that through ageing was modified chromatic structure because of the color stabilization phenomenon.

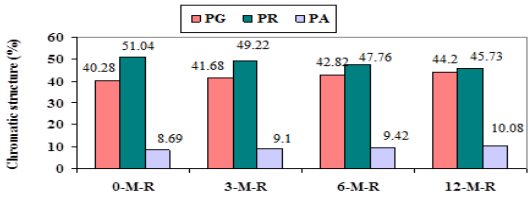

Figure 2. The evolution of chromatic structure of Merlot wine during ageing period

During wine ageing the percent of yellow pigments increased and that of red pigments decreased, but both types of pigments are more balanced in aged wines. Blue pigments participate at red wines color in a smaller percent (8,69-10,08% for CS and 7,40-9,47% for PN). Red pigments are predominant both in young and aged wines. Yellow pigments contribute with less then 45% at red wine color.

It was observed that during red wines ageing the values of absorbance at λ=520nm decreased and those at λ=420nm and 620nm increased. This phenomenon is caused by transformation of monomer anthocianes in polymer anthocianes. The highest values of color intensity were for young red wines, mostly for young red Cabernet Sauvignon. The smallest values for IC were observed at aged red wines (for 12-PN the value of IC was 6,34). From table 2 data it was observed that through ageing was modified chromatic structure because of the color stabilization phenomenon.

Table 2. Wines color structure evolution during ageing

Sample	PP (%)	AM (%)	AC (%)	Monomer anthocianes (mg/L)
0-M-R	12,05	58,18	29,77	187,93
3-M-R	19,18	53,92	26,9	175,16
6-M-R	35,15	41,88	22,97	151,22
12-M-R	55,52	28,68	15,80	114,21

The colour percent given by polymeric pigments increased and that due to monomeric and co-pigmented anthocyanins decreased. During ageing monomer anthocyanins pass in the form of polymeric anthocyanins with different molecular weight. The phenomenon of red colour evolution is named wine ageing. The stability of colour could be related to the decreasing of monomer and co-pigments anthocyanins. Because of these changes appear different combinations between tannin and different form of anthocyanins and intermolecular associations which has red colour.

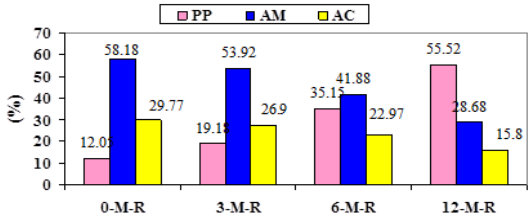

Figure 3. The evolution of Merlot colour during ageing

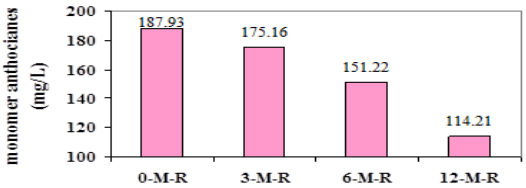

Figure 4. The evolution of monomer anthocianes Merlot during ageing

Polymeric pigments are very stable compounds responsible for the colour of aged red wine. The co-pigmented anthocyanins are the complexes which result at the reaction between anthocyanin molecules and those of co-pigments. This phenomenon causes a highlighting of colour because of the association between anthocyanins and co-factors. Monomer pigments and co pigments participate in young red wines colour with 15-27%. Polymeric pigments, which are mostly in aged wines, are stable colour compounds. This reveals that wines colour is under stabilization. Small value of co-pigmented anthocyanins is made by specific grape types with a small amount of co-factors [1,2].

So, the colour percent due to co-pigmented anthocyanins is higher in young wine than in the Merlot wines that followed the bottle-aging process. The aging process could take place for a period of several months or even years. From data showed in Tables 1and 2 it could be seen that during ageing, the decreasing of colour intensity is correlated with decreasing of monomeric and co-pigmented anthocyanins. From Table 3 and Figure 5, based on I1 value, results that the colour given by polymeric pigments represents about 55% from the colour assigned to total monomeric anthocyanins.

The chemical index I_2 values indicated that for young red wine, the major contributor to wine color were the pH-dependent wine pigments, while the polymeric pigments provided only a minor

contribution. For aged wines, it was recorded a contrary situation. The value of these indicators shows the gradual conversion of monomer anthocyanins in polymeric form during wine ageing.

According with data from Figure 6, the values obtained for degree of anthocyanins ionization "α" indicate that, 50% from total anthocyanins from young Merlot wine are in the flavonoid forms, reaching to be 89% at the end of aging process.

Table 3. The values of indices for „chemical age" and the ionization degree of anthocyanins

Sample	Chemical age (I1)	Chemical age (I2)	α (%)
0-M-R	0.12	0.31	50.02
3-M-R	0.19	0.38	57.11
6-M-R	0.35	0.45	68.31
12-M-R	0.55	0.68	89.09

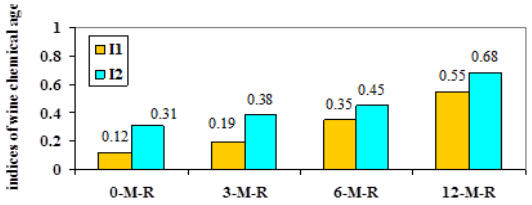

Figure 5. Changes occurred in the values of chemical age indices in response to Merlot wine bottle ageing

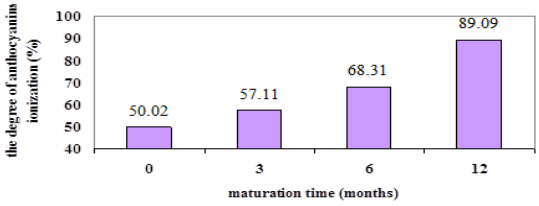

Figure 6. Changes occurred in the values of ionization degree of anthocyanins in response to Merlot wine bottle ageing

4.Conclusions

Ageing process leads to a chromatic structure modification and so the percent of yellow and blue pigments increases and that of red pigments decreases at the total color of wines. These conclusions were for both type of analyzed wines. The highest values for color intensity were obtained for young red wines, during ageing color intensity decreasing significantly. Regarding the color structure during ageing we can say that the color percent for polymeric pigments significantly increased and the fraction for monomeric and co-pigmented anthocyanins decreased.

Both indices I_1 and I_2 expressing the "*chemical age*" of wine, significantly increase with the color evolutions towards more stable form in terms of chemical structure. The chemical index I_2 values indicated that for young red wine, the major contributor to wine color were the pH-dependent wine pigments, while the polymeric pigments provided only a minor contribution. Red wines vary in their aging characteristics. Thus, some wines appear to age faster, reaching a superior quality, while others require more time of aging before reaching their optimum quality. Ageing process highlights through a specific indicators for chemical age of wine increasing during the entire investigated period.

Compliance with Ethics Requirements: Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human and/or animal subjects (if exists) respect the specific regulations and standards.

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