THE VARIATION OF OXIDATION-REDUCTION POTENTIAL IN RED WINES

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INTRODUCTION

Wine is considered a precious aliment in the food industry. The quality of red wines depends on their composition, especially on the high content of phenol substances. Phenol complex substances present the most of consuming oxygen substances in red wines involved in many oxidation-reduction reactions, diminishing the red-ox potential values.

Amount of phenol substances and oxidation-reduction potential can be manipulated by different treatments of the wine. The oxidation-reduction potential may be reduced by treatments: with sulfur dioxide, ascorbic acid, because these adjuvants possess antioxidant properties, thus protecting the wine from oxidation according to the literature [3].

The red-ox potential values increase at treating with cold, and on the strength of dissolved oxygen at low temperatures. The pasteurization of wine decreases the oxidation-reduction potential.

Measurement and correction of oxidation-reduction potential values are important in wine production, especially the red one.

1. MATERIALS AND METHODS

The aim of this research was to study the variation of oxidation-reduction potential values in red wines Cabernet-Sauvignon and Merlot produced in different areas of the country, under the influence of technological treatments.

As material for analysis served red wines from Cabernet Sauvignon and Merlot grapes grown in wine regions: South (Cahul and Leova) and South-East (Talmaza), harvest 2009.

Oxidation-reduction potential value was determined by potentiometer method using HANNA 211.

Technological treatments applied to red wines, Cabernet Sauvignon and Merlot included:

- Treatment with different doses of 5% solution SO_2: 50 mg / L, 75 mg / L, 100 mg / L, 150 mg / L.
- Treatment with ascorbic acid: 50 mg / L, 75 mg / L, 100 mg / L, 125 mg / L. Measurements were made after three days of treatment.
- Treating with cold wines was done by keeping over three days at temperatures:-5 ^{0}C, 0 ^{0}C, 5 ^{0}C.
- Pasteurization was carried out by maintaining the samples at 80 ^{0}C for 30 min., later followed by sudden cooling.

2. RESULTS AND DISCUSSION

Physical-chemical and specific indices (table 1) that belong to the same grape varieties Merlot and Cabernet Sauvignon differed from one area to another being directly determined from soil and climate conditions based on made analysis.

Table 1. Specific and chromatic indices of red wines (Cabernet-Sauvignon and Merlot) from different wine regions of Moldova

Wine	Total phenols, mg/L	Total anthocyanins, mg/L	Ic*, u.a.	Nc**, u.a.
Cahul				
Cabernet-Sauvignon	2267	253	17,3	0,58
Merlot	2235	227	16,3	0,58
Leova				
Cabernet-Sauvignon	2233	222	14,9	0,51
Merlot	2227	197	14,2	0,51
Talmaza				
Cabernet-Sauvignon	2229	208	13,1	0,46
Merlot	2217	194	12,0	0,51

* - Intensity of color;
** - Hue.

We noticed that red Cahul wines (locality located on south end of Moldova) are characterized by an increased content of total phenols, total anthocyanins, according to the results, which is conditioned by the geographical location of this region. It is characterized by a great number of sunny days and hours of light per year and conditions that ensure full maturity of the grapes and emphasize the value of wines in this wine region.

Red-ox potential values vary according to the wine area. These are caused by increased content of phenolic compounds and that they are inversely proportional to the amount of phenolic substances. The oxidation-reduction potential values from figure 1 note that it is smaller in Cahul wines, for Leova wines an increase of 13% Cabernet Sauvignon wine and 3% Merlot wine. The oxidation-reduction potential values in Talmaza wines increased by 15% in Cabernet Sauvignon wine and for Merlot wine about 14 %.

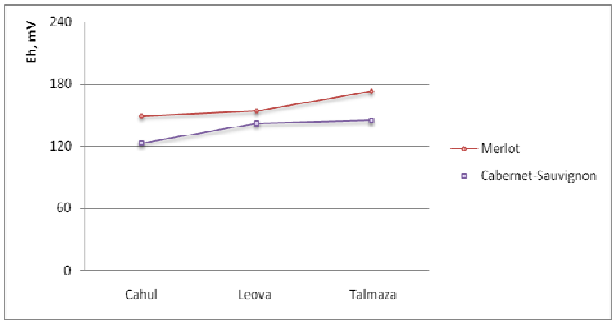

Figure 1. The dependence of red-ox potential in the red wines on wine zone.

• Treatment with sulfur dioxide (SO_2)

The antioxidant action of sulfur dioxide shall be exercised through several levels, namely: the destruction of oxidation-redaction enzymes that catalyze oxidation reactions, by combining directly with oxygen and easily oxidizable substances [1]. It should be noted that SO_2 cannot stop completely oxidation of wines, but can maintain acceptable limits for its normal development.

To determine and to investigate the dynamic variation of oxidation-reduction potential in red wines: Cabernet-Sauvignon and Merlot were given different doses of SO_2. The results obtained are shown in table 2.

Table 2. The red-ox potential values in red wines, after treatment with SO2.

Wine	Doses, mg/L	Red-ox potential, mV		
		Cahul	Leova	Talmaza
1	2	3	4	5
Cabernet-Sauvignon	Inițial	123	142	145
	50	117	102	116
	75	103	94	114
	100	97	91	107
	150	91	89	101
Merlot	Initial	149	154	173
	50	122	123	150
	75	114	110	136
	100	107	106	123
	150	99	98	109

Analyzing the obtained results, we found that oxidation-reduction potential value decreased on average by 19%.

The result that is conditioned by properties of SO_2 to protect wine from oxidation [1].

• Treatment with ascorbic acid

Ascorbic acid administration in various doses in red wines: Cabernet-Sauvignon and Merlot led to the results shown in table 3.

Table 3. Red-ox potential values in red wines, after treatment with ascorbic acid.

Wine	Doses, mg/L	Red-ox potential, mV		
		Cahul	Leova	Talmaza
Cabernet-Sauvignon	Initial	123	142	145
	50	90	86	89
	75	89	81	87
	100	70	78	84
	125	66	76	78
Merlot	Initial	149	154	173
	50	92	102	107
	75	89	88	93
	100	84	83	85
	125	79	79	81

According to data from research, red-ox potential values decrease on average about 39%, decrease that is conditioned by antioxidant properties of ascorbic acid, which occur on a single plane, limited only to the direct reaction of oxygen, a high speed reaction [4].

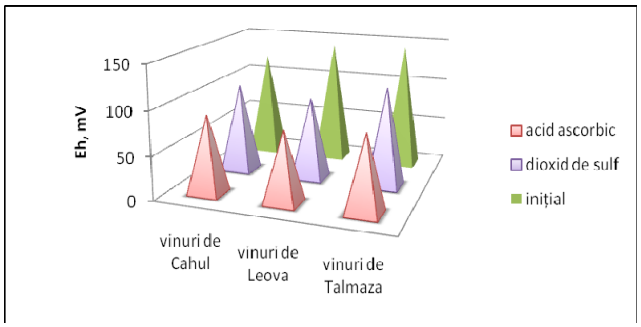

Figure 2. Oxidation-reduction potential change depending on the adjuvants used.

Analyzing the parallel action of used adjuvants on oxidation-reduction potential values, we see that in comparison with ascorbic acid, it is able to reduce SO_2 more pronounced red-ox potential values. Ascorbic acid is a greater reducing than the sulfur dioxide in the oxidation coupled with oxygen that's why it does not combine the two reactants simultaneously, but at first it reacts

with ascorbic acid and the sulfur dioxide reacts with reduction product of oxygen (hydrogen peroxide) [1,4].

Protective action against oxidation of ascorbic acid has a lower range than when using sulfur dioxide. Thus, treatment with ascorbic acid is effective only if it is coupled with a sulphitation, because it cannot take the other actions of SO_2. On the other hand coupling is dictated by the fact that ascorbic acid reacts with oxygen rapidly and has a protective role while the short-term sulfur dioxide requires several days to react with oxygen, prolonging its antioxidant action [3].

• Cold treatment and pasteurization

The treatment of Cabernet Sauvignon and Merlot wines with cold increased oxidation-reduction potential values according to table 4: approximately 6% at temperature 5 ^{0}C, 12% at 0 ^{0}C temperature, 18% at -5 ^{0}C temperature. All the obtained results are in correlation with data from the literature and namely, that achieved high levels is favored by activation of oxygen bound as peroxide and by the reduction of phenol substances concentration [4].

Table 4. Oxidation-reduction potential values in red wines after cold treatment.

Wine	T, ^{0}C	Red-ox potential, mV		
		Cahul	Leova	Talmaza
Cabernet-Sauvignon	Initial	123	142	145
	+5	158	145	161
	0	168	160	183
	-5	179	172	198
Merlot	Initial	149	154	173
	+5	163	168	185
	0	179	180	202
	-5	188	195	218

Wines pasteurization contributes significantly to the decline in oxidative potential, on average by 13%, figure 3. This is explained by the fact that with the increase of temperature increases the reaction speed of oxygen with easily oxidizable substances [2].

Analyzing the obtained results, figure 3 we can note that the technology treatment acts contrary to the oxidation-reduction potential values of red wines: pasteurization contributes to the reduction values of red-ox potential, but cold treatment increase them.

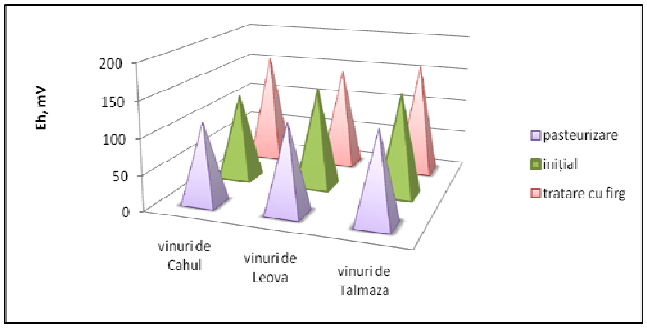

Figure 3. Variation of oxidation-reduction potential values in dependence with thermal treatments

3. CONCLUSIONS

Made experiments allowed to emphases the role of grapes growing area that has direct influence on the physic-chemical composition of wines and, in particular, oxidation-reduction potential values.

Use of sulfur dioxide as an antioxidant contributed to reducing oxidation-reduction potential values depending on the dose.

Ascorbic acid has been shown as the most powerful reducing; decreasing oxidation-reduction potential amount depending on the dose by 39 %.

Red-ox potential on treatment with cold wine registers an average increase of 12%. Increase caused by activation of oxygen bound as peroxide and increasing concentration component [Ox] of red-ox systems.

Pasteurizing wine helps to reduce oxidation-reduction potential, with approximately 13% due to the fact that with increasing temperature increases the reaction speed of oxygen with easily oxidizable substances.

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