INFLUENCE OF SULPHUR DIOXIDE AND DIMETHYL DICARBONATE ON WHITE WINES QUALITY

INFLUENȚA DIOXIDULUI DE SULF ŞI A DIMETIL DICARBONATULUI ASUPRA CALITĂȚII VINURILOR ALBE

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Abstract. *Being a complex system in continuous evolution, wine needs different stabilization and conditioning treatments.Sulphur dioxide and dimethyl dicarbonate areone of the most used in winemaking because they have an important role in wine protection and stabilization. For this study, nine wine variants were obtained from a blend of Fetească Regală and Muscat Ottonel varieties. All samples were treated with6 % SO_2 solution and dimethyl dicarbonate liquid solution, in various concentrations. The aim of this experiment was to follow the evolution of physical-chemical and chromatic parameters of wines, depending on treatments used and the analyzes period. The analyzes were repeated and compared at three months difference. Both treatments, SO_2 and dimethyl dicarbonate showed significant influence on the physical-chemical and chromatic characteristics of wines, depending on added substances concentration and the analysis periods, representing a good alternative for modern winemaking.*

Key words: wine stabilization, dimethyl dicarbonate, sulphur dioxide, physical-chemical parameters, color parameters

Rezumat*. Fiind un sistem complex într-o continuă evoluție, vinul necesită diferite tratamente de stabilizare şi condiționare. Dioxidul de sulf şi dimetildicarbonatul sunt cele mai utilizate substanțe în ultima perioadă în vinificație, deoarece au un rol important în protecția şi stabilizarea vinurilor. Pentru acest studiu s-a realizat un număr de nouă variante obținute dintr-un cupaj de Fetească Regală şi Muscat Ottonel. Toate variantele au fost tratate cu o soluție de dioxid de sulf de concentrație 6% şi dimetildicarbonat soluție lichidă, în diferite concentrații. Scopul acestui studiu a constat în urmărirea evoluției parametrilor fizico-chimci şi cromatici ai vinurilor în funcție de tratamentele administrate şi de perioada de analiză. Analizele au fost efectuate şi comparate, la trei luni diferență. Ambele tratamente au avut o influență asupra parametrilor fizico-chimici şi de culoare ai vinurilor, în funcție de concetrațiile administrate şi perioada de analiză, reprezentănd o bună alternativă pentru vinificația modernă.*

Cuvinte cheie: stabilizarea vinurilor, dimetildicarbonat, dioxid de sulf, parametri fizico-chimici, parametri cromatici

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INTRODUCTION

Recent studies have focused on the quality of food and beverages, consumers being increasingly concerned about their health. In this context,one of the current main challenges of modern enology is the use of sulphur dioxide (SO_2) in wine-making. Nowadays,attempts are concentrated to replace sulphur dioxide with other substances that play a significant role in wines stabilization. The attention of researchers has focused in particular on wine'scomposition, observing the changes resultedfrom using these stabilization substances.In practice, stability is achieved by subjecting the wine under certain conditions to treatments and operations which as a whole form the conditioning process (Pomohaci, 2001). There area lot of substances that can be used to protect wine'scomposition and itscolor parameters. This group includes those products that protect the must or wine from oxidation and are able to inactivate or kill microorganisms (Cotea, 1985).Sulphur dioxide is used in solution form in various concentrations, have a sickly odor, known to be the most useful andrecommendedpreservative due to its antioxidant, antiseptic and antibacterial actions (Ribéreau-Gayon*et al*., 2006).The origin of sulfur dioxide can be biological and technological. The biological one is produced by yeasts during fermentation and the technological one consists in the introduction inmust and wine of sulfur dioxide in various other forms.Total sulphur dioxide exists as both free sulfur dioxide and bound sulfur dioxide in wine. The active form is represented by free sulfur dioxide that protects thewine against oxidation and microorganisms. When wine pH is low, small amounts of free sulfur dioxide can be effective in microbiological control.Another substance that is increasingly used in enology is dimethyl dicarbonateor DMDC. It's a colorless liquid with a sharpodorbeing ayeastinhibitor and preservative for alcoholic beverages, especially low alcohol wines. It is used as an antimicrobial agent and the efficacy depends on pH values (lower pH requires less DMDC for equivalent antimicrobial action) (Ough *et al*. 1978). Numerous factors such as wine composition, temperature, species, strains, initial contamination are very important to the action of DMDC (Bartowsky, 2009).After its addition in wines, it is immediately decomposedinto alcohol and carbon dioxide, compounds that are always present in wines. DMDC can be used to prevent spoilageyeastgrowth in wines as well as to stop alcoholic fermentation in the production of sweet wines or to disinfect musts by removing native flora present (Costa *et al*., 2008).This compound is in trial to be used instead of SO_2 in vinification (Divol *et al.,* 2005).It wasapproved in the European Union for use in wines at the maximum amount of 200 mg/L at bottling (for wines that contain more than 5 g/L of residual sugar) (Regulation (EC) No 643/2006. However, the inability of DMDC to obstruct numerous bacterialgrowth, using the maximum dose of DMDC legally authorized, and to protect the wine from oxidation makes its use alone in winemaking not sufficient to totally substitute SO_2. A certain synergistic activity exists, increasing the inactivation effect against wine yeast and bacteria between DMDC and sulphur dioxide in both potassium and sodium metabisulphite salt.

The use of DMDC allows asignificant reduction of sulphur content in grape juice or semi-sweet wines (Morata and Loira, 2017).

In this study, a blend of 70 % Muscat Ottonel and 30% FeteascăRegalăgrape varieties from Iasi vineyard was used.

MATERIAL AND METHOD

Muscat Ottonel and FeteascăRegală grapeswere harvested manually in autumn 2018, crushed and destemmed and thenpressed with a hydraulic press and the grape juice resulted was collected in an stainless steel tank to ferment. After fermentation, white wine was divided in 3 aliquot parts in which different amounts of sulfur dioxide have been administered: 40 ppm in the first one, 80 ppm in the second and 160 ppm in the third one.

The aim of this research was to analyze the influence of applied treatments (sulphur dioxide and DMDC) of stabilization onthe physical-chemical parameters of obtained wines samples. Standard analysesaccordingto the International Organization of Vine and Wine methods were repeated at three months differences, first analyses beingrealizedon the 9th of December 2018 and the second one on the 23rd of March 2019 in Laboratory of Oenology from Iasi.Characteristic parameters of color were determined according the Commission Internationaled'Eclairage (CIE, 1976), using characteristics of specific qualities of visual sensation: clarity, tonality, chromatic parameters, saturation, luminosity, hue (OIV-MA-AS2-11). Chromatic characteristics were evaluated using a Specord UV-VIS spectrophotometer. CIELab system characterizes color variations as perceived by the human eye, representing a uniform 3-dimensional space defined by colorimetric coordinates L*, a*, and b*. The vertical axis noted with L* measures from 0 – completely opaque, to 100 - completely transparent, and parameters "+a*" red, "-a*" green, "+b*" yellow, "-b" blue were registered (Main *et. al.,* 2007).

RESULTS AND DISCUSSION

The following physical-chemical parameters have been evaluated in two different period (at three months differences): ethanol content, total acidity, volatile acidity, total sugar,density and pH.Significant changes on white wines composition after the addition of this type of substance can be observed in table 1.

The ethanol concentration represents the result of fermentation sugars from musts (glucose and fructose) and causes some qualitative and quantitative changes in its chemical composition (Moreno and Peinado, 2012). First period of analysis shows an alcoholic strength between 14.3 % vol. (V1, V3)-15.4 % vol. (V7, V9) and second analysis shows values between 14.2 % vol. (V1)-15.3 % vol. (V8).

The total acidity parameter represents the total amount of acids presents in wines. The total acidity of V1, V2, V3 was 5.8 g/L tartaric acid and 6.3g/L at V6.Usually, if a wine has a high acidity level, it will have a low pH. High acid/low pH wines are stable as, in this type of environment, the growth of bacteria and other microorganisms is inhibited.pH is an important parameter in winemaking especially in wine stabilization. Ideal pH levels in wines are between 3.2-3.6 and analyzed samples are within this range.

Table 1

Physical chemical parameters of analyzed samples

Sample	Sulphur dioxide doses(ppm)	DMDC doses (mg/L)	Ethanol % vol. alc.	Total acidity	Volatile acidity	Total sugar g/L	Density δ	pH
9.12.2018								
V1	40	0	14.3	5.8	0.3	17.7	0.9971	3.45
V2	40	100	14.3	5.8	0.27	18.5	0.9969	3.42
V3	40	200	14.4	5.8	0.29	18	0.9968	3.41
V4	80	0	15	6	0.28	18.7	0.9969	3.41
V5	80	100	15.1	6	0.28	18.6	0.9968	3.41
V6	80	200	15	6.3	0.29	17.9	0.9971	3.45
V7	160	0	15.4	6.2	0.26	14.9	0.9953	3.36
V8	160	100	15.3	6.2	0.25	14.7	0.995	3.38
V9	160	200	15.4	6.2	0.27	15.2	0.9949	3.37
23.03.2019								
V1’	40	0	14.2	4.89	0.39	20.7	0.9968	3.42
V2’	40	100	14.4	4.74	0.31	21.1	0.9964	3.41
V3’	40	200	14.3	5.81	0.21	21.6	0.9972	3.26
V4’	80	0	14.9	6.27	0.17	20.7	0.9969	3.25
V5’	80	100	15	6.12	0.18	21.3	0.9969	3.21
V6’	80	200	14.7	6.42	0.2	18.5	0.9963	3.26
V7’	160	0	15.2	6.12	0.17	17.5	0.9954	3.19
V8’	160	100	15.3	6.27	0.16	17.9	0.9953	3.19
V9’	160	200	15.2	6.12	0.16	17.3	0.9954	3.18

The volatile acidity of wines is measured by distillation, a process in which volatile acetic acid (main component= 95-99%) is separated from the other, non-volatile acids present in wines. In this case, insignificantdifferences have been noticed between 0.25 g/L acetic acid (V8)- 0.3 (V1) in first period and 0.16 (V8’, V9’) - 0.39 g/L acetic acid (V1’) during second analysis.

Reductive substances include all the sugars withketonic and aldehydicfunctions and are determined by their reducing action on an alkaline solution of a copper salt (OIV-MA-AS311-01A). Analyzed samples, during the first analysis, present concentrations of 14.7 g/L (V8) and higher concentrations, of 18.7 g/L (V4) and 17.3 g/L (V9’) – 21.6 g/L (V3’) in the second analysis trial.

Dimetyldicarbonate and sulphur dioxide have influenced the chromatic parameters of analyzed samples to varying degrees observed in table 2. The parameter “a*” presented the highest value at V3 sample (9.00) and the lowest at V9’ (0.26). The highest values of “b*” was recorded at the V3’ sample with 200 mg/L DMDC and the lowest at V9’. All samples presented positive values with more red and yellow shades.

Table 2

Chromatic parameters of obtained samples

Samples	Luminosity L (0-100)	Colorimetric coordinates		Chroma C	Tone H	Intensity	Tint	Colour simulation
		a red (+) green(-)	b yellow (+) blue(-)					
V1'	89.6	7.16	17.52	18.93	67.76	0.51	1.65	
V2'	84.5	5.55	21.98	22.67	75.84	0.80	191	
V3'	77.8	9.0	23.04	24.73	68.69	1.07	1.58	
V4'	96.9	1.21	6.16	6.27	78.87	0.17	2.26	
V5'	97.4	0.78	6.02	6.07	82.63	0.15	2.53	
V6'	97.2	0.91	6.07	6.14	81.43	0.16	2.42	
V7'	98.5	0.54	5.47	5.50	84.40	0.12	3.99	
V8'	98.2	0.41	5.28	5.30	85.61	0.12	3.57	
V9'	97.92	0.26	5.19	5.20	87.08	0.13	3.15	

The brightness is influenced by luminosity "L*" parameter andidentifiedby high values ranging from V3'-77.8 to V9'-97.72. Chroma values ranged from V9'-5.20 to V3'-24.73.Parameter such as tonality registered positive values for all samples (67.76- 87.08). The tint or hue parameter has been noted with values from V3'-1.58 to V7'-3.99.

CONCLUSIONS

1. Treatments of stabilization play an important role in wine quality, being essentials in modern winemaking. In this experiment, the results show small differences according to the time passed between analyses, which confirmed the synergic action between sulphur dioxide and DMDC.

2. Added substances have a positive effect separately, but, both treatments have a constructive influence to physical-chemical and chromatic parameters of analyzed samples.

3. The results of this study can confirm a good preservation of wine quality and a new alternative to reduce SO_2 concentrations.

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