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Research concerning the impact of sulphurous anhydride on demisec and demisweet wine maturation

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Abstract We have made observations and measurements in a private winery from Buziaş (Timis County) on the wines from the grape cultivars Fetească albă, Sauvignon, and Pinot gris aiming at identifying the optimal dosage of sulphurous anhydride that ensures the reducing evolution during maturation in the barrel of demisec and demisweet wines.

The condition for a wine to become valuable, with particular organoleptic features, is to go through several stages: formation, maturation, and ageing; during maturation and ageing, there are a lot of changes that give the wine the features and qualities specific to the grape cultivar.

Since preserving primary aroma, colour, and fructuosity is the main element of reducing wines, it is compulsory to maintain oxidation as low as possible in the maturation recipients: in this process, using sulphurous anhydride is important. It also contributes to the formation of the bouquet in the bottle and of the sulphitic bouquet.

Research focused on several moments of wine technology of reducing demise and demisweet wines meant to improve as much as possible the quality features of these types of wine.

Research results showed that using higher rates of sulphurous anhydride in initial sulphitation we eliminate the necessity of sulphitation during barrel maturation and maintaining a constant ratio between total and free SO_2 is possible only through re-sulphitation.

Key words

wine maturation, wine sulphitation, demisec and demisweet wines

The vini-viticultural sector has developed lately very much due to the investment funds in agriculture from the European Union. They have established modern vinification units that have all the facilities for the application of modern technology.

The viticultural area Buziaş – Silagiu, famous for its wines has been ignored for a long while.

The production and quality potential of some grape cultivars in the exceptional oeno-climate conditions of the Buziaş – Silagiu hills as well as the tradition of cultivating vine, has started to attract more and more Romanian and foreign investors. Therefore, they have started to re-establish the old plantations and the young plantations established with modern technologies started to change the desolating landscape.

Increased exigencies for quality are a distinct trait of the present wine consumer, and they develop with economic and social changes. Wine consumers' requirements are more and more related to the wine naturalness, authenticity, and typicity.

Wine should be related, through its qualities, to the production site, be characterised by "typicity" features, have a distinct personality, and wear the local cachet. Demisec, demisweet, and sweet wines are appreciated by most refined consumers and are considered high quality products [3,4]. They are produced in few vineyards and from grape cultivars with high quality features.

SO_2 is a varied and constant way of producing different types of wines playing a major role in the development and preservation of wines. Despite all this, consumption of wine with a high content of SO_2 is a potential hazard for human health [1,5].

If the wine was suprasulfitat, sulfur removal can be done by putting it in broad contact with air. In this sense, the wine is drawn into the fermentation vessels, aeration devices are used to disperse particles as fine wine [2].

The clarification of wine, among other methods (bentonite, centrifugation), is used by clearing and sulphitation [6].

Material and Method

Research was carried out in the years 2008, 2009, and 2010 in a private winery from Buzias (Timis

County, Romania) and consisted in applying doses of sulphurous anhydride on demise and demisweet wines from the following grape cultivars: Fetească regală, Sauvignon, and Pinot gris. The goal was to find the optimal dosage that ensures the reducing activity during barrel maturation and the dosages that ensure the most constant ratio between total and free SO_2.

The Silagiului Hills have been famous for the wines produced there due to the oeno-climate favourability. The viticultural centre Buziaș – Silagiu has been acknowledged for the production of controlled appellation of origin quality wines – harvested upon full maturity and controlled appellation of origin quality wines – harvested late – sec, demise, and demisweet.

Due to its action, SO_2 is a varied and constant way of producing different types of wines playing a major role in the development and preservation of wines. Despite all this, consumption of wine with a high content of SO_2 is a potential hazard for human health.

Fermentation was stopped in the studied wines through strong sulphitation, after which they were transferred into different capacity barrels to study the relationship between vessel size and dynamics of total and free SO_2 and the measure in which vessel capacity impacts wine maturation. Wines were stored for maturation in a cellar, in good preservation conditions (8-10^{0}C and 75% moisture). We sued oak barrels measuring 500 l and 250 l, given that vessel size impacts considerably wine maturation duration.

Table 1

Organisation of the experiment

Nr. crt.	Grape cultivar	Capacity	Total SO_2 (mg/l)
1	Fetească regală	500	180
2	Sauvignon	500	250
3	Pinot gris	250	200

The three grape cultivars we studied had a content of alcohol between 11 and 12.8 vol %, an acidity between 4.41 in the grape cultivar Pinot gris and 4.60 in the grape cultivar Fetească regală, and total SO_2 oscillated between 180 mg/l in the grape cultivar Fetească regală and 250 mg/l in the grape cultivar Sauvignon.

After the second decantation, we obtained a total SO_2 content between 150 and 180 mg/l, and during the research period we maintained free SO_2 above 20-30 mg/l, a minimal threshold to ensure and maintain antioxidant protection in these wines.

We measured free SO_2 through the current iodometric method "Ripper", and we measured total SO_2 through the double current iodometric method "Ripper".

Table 2

Wine features

Nr.	Grape cultivar	Harvest	Alcohol (%)	Acidity (g/l)	Sugar (g/l)	Total SO_2 (mg/l)
1	Fetească regală	2008	11,0	4,60	12	180
2	Sauvignon	2008	12,8	4,48	35	250
3	Pinot gris	2008	12,2	4,41	50	200

Results obtained

Table 3 presents the dynamics of free and total SO_2 in the grape cultivar Fetească regală. In this grape cultivar, after stopping the fermentation, the dynamics of the total sulphur dioxide was 190 mg/l. At this level the total SO_2 continued to decrease and, a year later, it reached 178 mg/l. This decrease was achieved quicker at the beginning of the maturation, but the more the oxygen was fixed by the free SO_2, the decrease rate diminished.

Monitoring the dynamics of the free SO_2 during the same period, we recorded a decrease of 8 mg/l, reaching 30 mg/l, a level that ensures antioxidant protection.

As for the ratio between total and free SO_2, it recorded an increasing evolution, i.e. from 5.0 to 6.5.

In the grape cultivar Sauvignon, the dynamics of free and total SO_2 in barrel maturation is shown in Table 4.

Analyses started on November 10, 2008, and ended on January 17, 2011.

In this grape cultivar, the decrease of total SO_2 was slower from the very beginning of the vessel maturation, so that after about one year, total SO_2 reached 215.4 mg/l, i.e. with 39.4 mg/l larger than in the grape cultivar Fetească regală during the same period.

As for the dynamics of the free SO_2 in the grape cultivar Sauvignon, we noticed a progressive decrease from 95.2 mg/l to 68.1 mg/l.

As far as the ratio total SO_2 free SO_2 is concerned, it recorded, during about one year, an increase from 2.6 to 3.1.

Table 3

Dynamics of free and total SO_2 in barrel maturation of the grape cultivar Fetească regală

Grape cultivar	Date of analysis	Total SO_2	Free SO_2	SO_2T/SO_2L
Fetească regală	17.11.2008	190	38,0	5,0
	02.03.2009	186	36,0	5,16
	10.05.2009	178	34,0	5,2
	13.06.2009	176	31,5	5,58
	24.09.2009	180	30,5	5,90
	24.11.2009	178	30,0	5,50
	08.03.2010	174	28,5	6,1
	10.02.2011	176	27,0	6,5

Table 4

Dynamics of free and total SO_2 in barrel maturation of the grape cultivar Sauvignon

Grape cultivar	Date of analysis	Total SO_2	Free SO_2	SO_2T/SO_2L
Sauvignon	10.11.2008	250,0	95,2	2,6
	18.01.2009	240,7	82,6	2,9
	07.07.2009	215,4	68,1	3,1
	10.03.2010	200,5	55,1	3,6
	24.08.2010	185,8	49,5	3,7
	17.01.2011	160,1	41,3	3,8

Table 5

Dynamics of free and total SO_2 in barrel maturation of the grape cultivar Pinot gris

Grape cultivar	Date of analysis	Total SO_2	Free SO_2	SO_2T/SO_2L
Pinot gris	20.03.2008	260,0	100,9	2,5
	07.10.2008	256,0	99,8	2,5
	06.02.2009	244,6	89,6	2,7
	27.09.2009	220,0	77,2	2,8
	16.11.2009	212,3	68,0	3,1
	15.01.2010	170,6	58,8	2,8
	16.03.2010	160,0	46,5	3,3
	11.05.2010	151,2	45,3	3,2
	12.07.2010	149,7	42,2	3,4
	23.09.2010	138,6	36,6	3,6
	23.11.2010	127,3	29,2	4,2
	03.02.2011	119,5	26,6	4,3

Table 5 shows the dynamics of free and total SO_2 in barrel maturation in the grape cultivar Pinot gris.

We started analysing on March 20, 2008, and we ended them on February 3, 2011.

Upon stopping fermentation, in the grape cultivar Pinot gris, total content of SO_2 was 260 mg/l, and after one year it decreased with 15.4 mg/l, reaching 244.6 mg/l, a lower value than in the grape cultivar Sauvignon during the same period.

Since in the grape cultivar Pinot gris the rate of free SO_2 was higher, a year later it decreased with 11.3. After this period, the decrease of the free SO_2 was more considerable.

As for the values of the ratio between total SO_2 and free SO_2, it increased during the period of analyses in all three studied grape cultivars.

Continuous decrease of free SO_2 in maturation barrels is related to the oxidation processes due to the penetration of the oxygen through the barrel's pores.

Compared to the other grape cultivars matured in larger barrels, in the grape cultivar Pinot gris, in which maturation took place in smaller barrels, the values of total and free SO_2 decreased more.

Conclusions

During manufacturing and maturation, wine needs protection against unwanted flora and excess of oxygen; therefore, it is absolutely necessary to use oenological materials known as antiseptics and antioxidants, among which the most usual is sulphur dioxide.

The clarification of wine, among other methods (bentonite, centrifugation), is used by clearing and sulphitation. SO_2 is a varied and constant way of producing different types of wines playing a major role in the development and preservation of wines. Despite all this, consumption of wine with a high content of SO_2 is a potential hazard for human health.

Analysis of the impact of sulphur dioxide doses on reductive demisec and demisweet wine maturation in vessels allows us to draw the conclusion that applying a higher dose of total SO_2 at the beginning of vessel maturation had a favourable impact on maturation, wine cleared better, and biological, chemical, and physical stability was maintained.

Higher doses of total SO_2 used initially needed re-sulphitation since free SO_2 that protects the wine decreased quicker towards the minimum admitted limit.

Re-sulphitations applied when free SO_2 decreased below 30 mg/l ensured normal evolution and convenient normal evolution and maturity duration of reductive wines.

We could also see that applying higher doses upon initial sulphitation, we eliminate the need for sulphitation over the duration of the barrel maturation.

As for the ratio between total SO_2 and free SO_2 we can say that maintaining this ratio constant can be done only through re-sulphitation.

Despite all this, we need to mention that producing reductive demise and demisweet wines with special features asks, besides barrel maturation, an ageing period in the bottle of at least one year.

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