PREFERMENTATIVE CO_2 SATURATION OF GRAPE MUST TO OBTAIN WHITE WINES WITH LOW SO_2 CONTENT

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Introduction

Sulphur dioxide (SO_2) has a significant importance in Oenology because of its antioxidant and antibacterial properties (1, 2). From the sensorial point of view, SO_2 can give unpleasant flavors and odors to wine (3) and also the presence of sulfites in wines can lead to pseudo-allergic reactions in some people (4). That's why the international Organization of Vine and Wine (OIV) has reduced the maximum limits of the total SO_2 in wines.

The aim of this work is to study the possibility of replacing SO_2 partially or totally, by saturating the must with CO_2.

Material and methods

Three types of wines were made from the same Airén and Chardonnay must and under the same conditions: Control wine (A= 0% CO_2-50 mg/L SO_2), reduction of SO_2 in half (B= 100% CO_2-25 mg/L SO_2) and total reduction of SO_2 (C= 100% CO_2-0 mg/L SO_2). For obtaining wines B and C the must was saturated with CO_2. The equipment used to achieve CO_2 saturation at atmospheric pressure was an Inyecvin (Carburos metálicos), which has a porous diffuser that helps the diffusion of CO_2 into the must.

The oenological parameters of all wines were analyzed according to the official methods of the OIV, its volatile composition by GC-MS and finally were evaluated sensory by consumers and expert tasters.

Results

By saturating the musts with CO_2 and decreasing doses of SO_2, the alcoholic fermentation starts earlier and it occurs more slowly which offers an advantage for the desirable formation and retention of aromas.

No technologically important variations in the usual oenological parameters were observed in freshly bottled wines by saturating the musts with CO_2 and decreasing SO_2 doses (**Table 1**).

Table 1: *Basic oenological parameters of bottled Airén and Chardonnay wines*

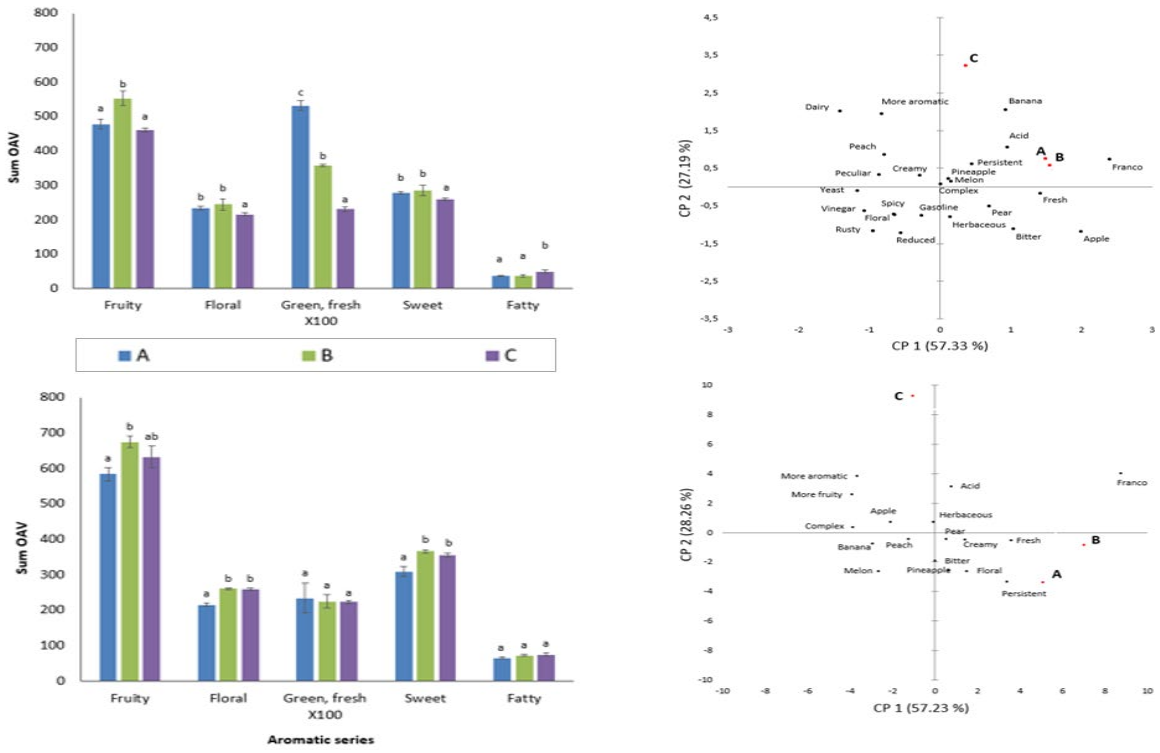
Vinos	A	B	C
	Chardonnay 2018		
Alcoholic degree (% v/v)	13.05 ± 0.04	13.00 ± 0.06	13.13 ± 0.07
Total acidity (g/L)	5.33 ± 0.05 b	5.14 ± 0.03 a	5.14 ± 0.05 a
pH	3.33 ± 0.02 a	3.48 ± 0.01 b	3.44 ± 0.01 b
Total SO_2 (mg/L)	129 ± 2 c	65 ± 6 b	10 ± 2 a
Free SO_2 (mg/L)	31 ± 1 c	14 ± 5 b	1 ± 1 a
Glucose and Fructose (g/L)	0.24 ± 0.01 c	0.19 ± 0.00 b	0.06 ± 0.01 a
Acetic acid (g/L)	0.37 ± 0.02 b	0.34 ± 0.01 b	0.30 ± 0.02 a
Malic acid (g/L)	2.84 ± 0.05	2.86 ± 0.03	2.88 ± 0.05
Lactic acid (g/L)	0.17 ± 0.01	0.16 ± 0.00	0.16 ± 0.01
Glycerin (g/L)	5.76 ± 0.05	5.98 ± 0.05	5.97 ± 0.15
Catechins (mg/L cat.)	19.92 ± 1.30 b	19.64 ± 1.05 b	14,19 ± 0.85 a
Folin	4.77 ± 0.10 c	4.46 ± 0.10 b	3.57 ± 0.46 a
	Airén 2019		
Alcoholic degree (% v/v)	12.03 ± 0.05 b	12.31 ± 0.06 c	11.79 ± 0.04 a
Total acidity (g/L)	3.67 ± 0.19 b	3.41 ± 0.09 ab	3.22 ± 0.16 a
pH	3.60 ± 0.03	3.65 ± 0.01	3.64 ± 0.05
Total SO_2 (mg/L)	105 ± 6 c	66 ± 5 b	7 ± 2 a
Free SO_2 (mg/L)	26 ± 4 b	20 ± 5 b	2 ± 2 a
Glucose and Fructose (g/L)	0.22 ± 0.02 b	0.17 ± 0.01 a	0.18 ± 0.03 ab
Acetic acid (g/L)	0.33 ± 0.02 b	0.28 ± 0.01 a	0.30 ± 0.01 a
Malic acid (g/L)	0.98 ± 0.03 b	1.04 ± 0.04 b	0.67 ± 0.26 a
Lactic acid (g/L)	0.00 ± 0.00 a	0.00 ± 0.00 a	0.21 ± 0.10 b
Glycerin (g/L)	5.87 ± 0.13	5.75 ± 0.19	5.94 ± 0.31
Catechins (mg/L cat.)	43.40 ± 0.69 c	39.83 ± 0.06 b	35.03 ± 2.99 a
Folin	5.43 ± 0.12 c	4.63 ± 0.23 b	3.40 ± 0.26 a

Mean± standard deviation (n=3); mean values followed by different letters in a row are significantly different ($p< 0.05$ level), according to the Student-Newman-Keuls test.

In terms of colour, it should be noted that all wines of both varieties had similar values of luminosity and that the saturation of musts with CO_2 produced wines with more green tones and the decrease in doses of SO_2 with more yellow notes (**Figure 1**).

In relation to volatile composition, the saturation of musts with CO_2 and the reduction of SO_2 doses produced wines with higher concentrations of compounds responsible for fruity and floral notes (**Figure 2 I**). At the sensory level, the results of volatile analysis were corroborated and both trained tasters and consumers positively valued the wines (**Figure 2 II**).

***Figure 1**: Color of Airén must and wines at different steps: Before racking, after racking, end alcoholic fermentation, bottled wines.*



I II

***Figure 2**: Amount of OAV of the different families of aroma and sensory analysis of Airén and Chardonnay wines*

Microbiological stability and colour were monitored for 12 months (**Table 2**), a normal marketing period for young wines, with the following conclusions obtained: Signs of malolactic fermentation were observed in wines without SO_2 (C). However, wines with low doses of SO_2 (B) remained perfectly stable.

Table 2: *Microbiological and colour stability of Airén and Chardonnay wines 12 months after bottling*

	A	B	C
	Chardonnay 2018		
Ácido acético (g/L)	0.37 ± 0.01 a	0.34 ± 0.03 a	0.41 ± 0.04 b
Ácido málico (g/L)	2.78 ± 0.09 b	2.80 ± 0.06 b	0.07 ± 0.12 a
Ácido láctico (g/L)	0.00 ± 0.00 a	0.00 ± 0.00 a	1.67 ± 0.02 b
L*	99.031 ± 0.194 b	98.781 ± 0.100 b	96.678 ± 1.123 a
a*	-0.844 ± 0.064 b	-1.035 ± 0.058 ab	-1.172 ± 0.209 a
b*	6.157 ± 0.623 a	7.190 ± 0.283 b	10.432 ± 0.610 c
Absorbancia a 420nm	0.084 ± 0.010 a	0.100 ± 0.005 a	0.162 ± 0.020 b
	Airén 2019		
Ácido acético (g/L)	0,26 ± 0,04 a	0,22 ± 0,01 a	0,35 ± 0,01 b
Ácido málico (g/L)	0,91 ± 0,02 b	0,94 ± 0,01 b	0,01 ± 0,00 a
Ácido láctico (g/L)	0,00 ± 0,00 a	0,00 ± 0,00 a	0,62 ± 0,01 b
L*	97,837 ± 0,552	98,424 ± 0,058	97,533 ± 0,985
a*	-0,517 ± 0,073	-0,453 ± 0,026	-0,484 ± 0,348
b*	4,853 ± 0,278 a	5,505 ± 0,156 a	8,773 ± 0,847 b
Absorbancia a 420 nm	0,083 ± 0,010 a	0,083 ± 0,002 a	0,128 ± 0,007 b

Mean± standard deviation (n=3); mean values followed by different letters in a row are significantly different ($p < 0.05$ level), according to the Student-Newman-Keuls test.

With regard to colour after 12 months the wines of both varieties evolve in a favorable way, a slightly more intense color, but no notes of oxidation are seen. Effective control of acetic acid bacteria over time has been proven as the volatile acidity of these wines is similar to that of control wines and does not increase the year of bottling.

Conclusions

The results presented in this study provide useful information for the wine sector, as CO_2 saturation of grape must during the prefermentative phase could be an alternative additive for reducing doses of SO_2 in white wines, providing stable wines over time with unique aromatic profiles.

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