Chitosan in sparkling wines produced by the traditional method: influence of its presence during the "Prise de Mousse"

Fabio Chinnici*, Ana Gabriela Buglia, Antonio Castro Marín, Claudio Riponi
Department of Agricultural and Food Sciences, Alma Mater Studiorum, University of Bologna, Italy
***Email:** fabio.chinnici@unibo.it

Introduction:

- Chitosan, a natural polysaccharide derived from fungal chitin (**figure 1**), has been quite recently admitted in winemaking as clarifying, antimicrobic and contaminant reducing agent [1].
- However, other features, such as antiradical and antibrowning activity have been recognized to this polymer [2].
- Due to these latter characteristics, chitosan has been proposed as potential sulphite substitute.
- In the production of sparkling wines obtained following the traditional method, the second fermentation (Prise de Mousse) is a crucial step that needs to be carried out avoiding oxidation and/or sluggish or unwanted fermentations.
- Chitosan could have the potential to fulfils both the functions but, information about the impact of its presence during the fermentation are still scarce.
- In this work we tried to deepen such a subject by comparing the chemical and sensory characteristics of sparkling wines obtained with i) the presence of chitosan (20 g/HL) or ii) sulfure dioxide (60 mg/L), during the "prise de mousse".

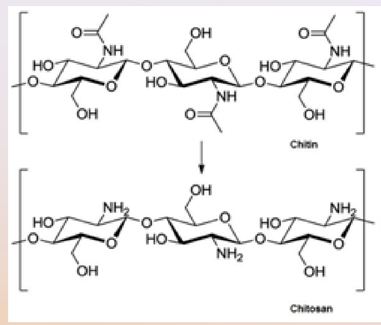

Figure 1. General structure of chitosan

Material & methods

Samples: Sulfite-free base wines, obtained from cv Pinot gris and Pignoletto grapes, were filtered under nitrogen, added of 25g/L of beet sucrose and arranged in two distinct trials by adding sulfur dioxide (60 mg/L) or chitosan from fungi (250 mg/L). For each trial, 50 bottles were prepared and closed with bidules after inoculation with 25 g/HL of dried active yeasts (*Saccharomyces cerevisiae* strain 1042 from University of Bologna – ESAVE collection) and ammonium phosphate addition (250 mg/L). Six bottles (three each trial) were provided of manometer to monitoring the internal pressure development. All the bottles were left at controlled temperature (18°C) during the pris de mousse that lasted about 1 month during which the pressure increase was daily annotated and the bottles were agitated to facilitate the chitosan resuspension. All the analysis were performed after 4 months from inoculation.

Chemical and sensory analysis: All the routine analytical determinations were carried out according to OIV official methods. Organic and phenolic acids were determined according to Castro et al. [3]. Sensory analysis was performed by 17 trained panelists on testing cards specific for sparkling wines. A QDA test was performed on a astructurate 10 cm scale. Further, hedonistic and ranking tests were also carried out. Data were elaborated by means of ANOVA and Friedman test to evaluate sample, panelists and replication variability of data.

Result and Discussion

- **Fermentation**

The increase of bottle pressure is shown in **figure 2**. Fermentation was regular and lasted about 1 month with little differences between samples, the KT bottles being marginally slower. However, at the end of fermentation, the reached internal pressure was the same in both KT and SO_2 trials.
At the end of secondary fermentation, fixed parameters of wines (**table 1**) were indeed the same in all the wines, except for tartaric acid which was tendentially lower in KT wines, and acetic acid, lower in sulfite added samples.

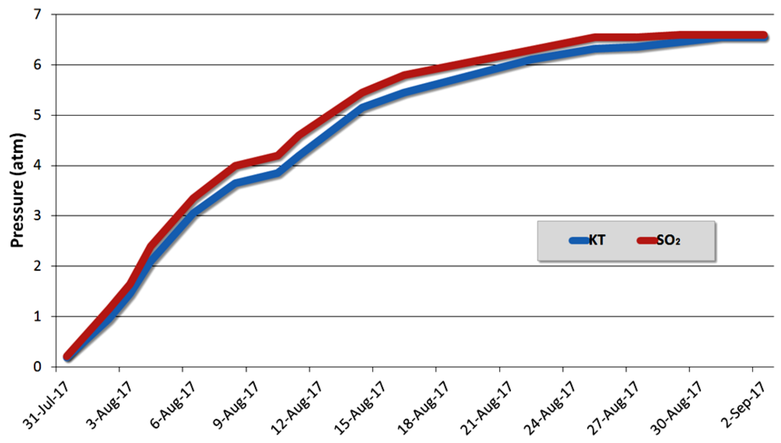

Figure 2. Pressure increase in bottle (KT= Chitosan, SO_2= sulphur dioxide)

	Base wine	SO_2	KT
alcohol content % vol.	9.05	10.60	10.52
reducing sugars g/L	< 1.0	1.7	1.9
pH	3.1	3.10	3.11
titratable acidity g/L	5.75	5.95	5.90
volatile acidity g/L	0.29	0.28	0.30
Total sulfur dioxide mg/L	6	54	9
free sulfur dioxide mg/L	< 0.3	13	< 0.3
citric acid g/L	0.27	0.27	0.25
tartaric acid g/L	3.57	3.55 a	3.44 b
malic acid g/L	0.24	0.20	0.22
lactic acid g/L	2.35	2.37	2.29
acetic acid g/L	0.16	0.18 b	0.24 a

Table 1. Fixed composition of wines before and after the secondary fermentation

- **Browning and Phenolic acids**

In general, the use of chitosan resulted in reduction of phenolic acids (**figure 3**). In Kt samples, GRP and p-OH benzoic acid were reduced by about 40%, with respect to SO_2 wines. Further, (+)-catechin and caftaric acid were reduced by about 35%. These data agree with results previously published [2, 4], where chitosan demonstrated to be able to adsorbs phenolic compounds in the outer layer of its crystalline structure. Oxydation could be one further option for their reduction. However browning of wines seems not to confirm this eventuality as D.O. 420 nm was 0.079 and 0.093 in KT and SO_2 samples respectively. Hence, this demonstrate that in treated wines, the browning was even better controlled by chitosan than by 60 mg/L of sulfite. On the other hand, the reduction in some compounds with active antioxidant activity could be re-garded as potentially detrimental for product chemical stability.

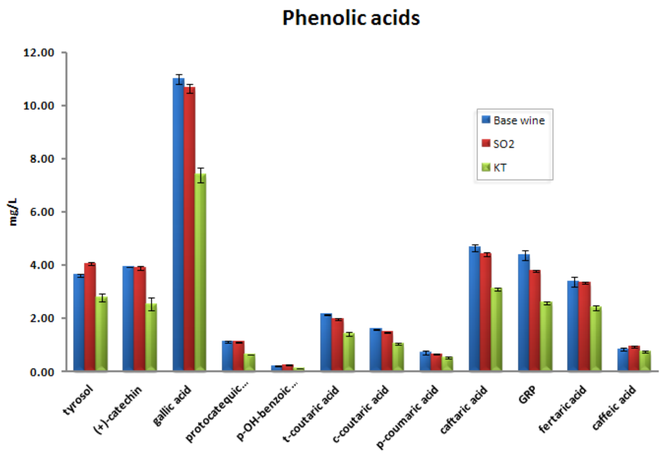

Figure 3. Phenolic acids in wines before and after the secondary fermentation

- **Volatile compounds and Sensory Analysis**

The presence of chitosan during fermentation, resulted in differences in the volatile composition (**figure 4**). As reported elsewhere [3] chitosan tends to enhance the content of volatile acids, probably as the consequence of a modification of yeasts cell membrane permeability and the following homeostatic imbalance. Due to this, ethyl esters tends also to be higher in KT samples even if, in this case, not in a significant manner, as , in contrast, was the case of alcohols.
Such differences are somehow reflected when sensory results are taken into account. Descriptive analysis (**figure 5**) highlighted that the presence of chitosan affected the foam and perlage characteristics, the both with reduced persistency in Kt wines. From the olfactory point of view, however, Kt wines were positively judged if compared with SO_2 samples, being higher in intensity, fruity character and yeast scent. Astringency was higher in KT wines which also possessed a better gustative balance. The ranking test, depicted in **figure 6** clearly shows that sulfite added sample were less pleasant from both the olfactory and gustative point of view, while no differences were detected by the panelists for the wines color. Overall, Kt wines were ranked as more pleasant with respect to SO_2 added wines.

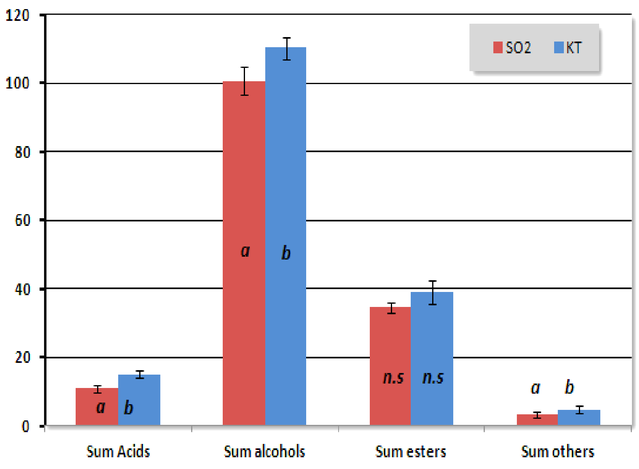

Figure 4. Volatile composition of wines as sum of chemical classes

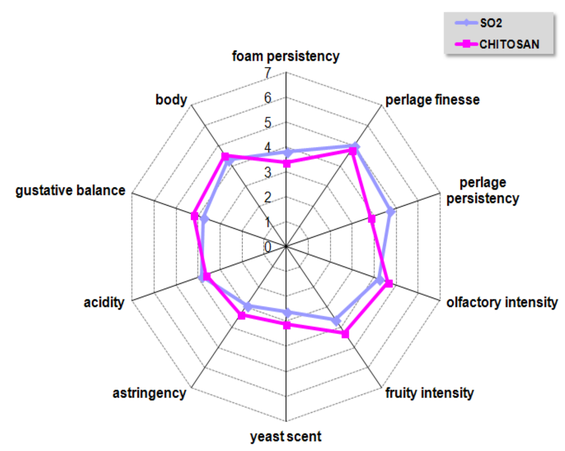

Figure 5. Spider diagram depicting the results from descriptive test on final wines

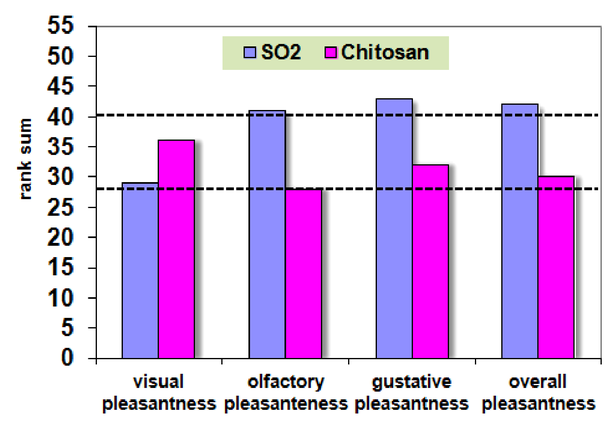

Figure 6. Ranking test results for final wines

Conclusions

Results suggested that chitosan positively affected the aromatic profile of sparkling wines obtained by the "tradition method", reinforcing their fruity character and overall pleasantness. Foam and perlage were, however, less persistent with respect to control (SO2) wines. During the Prise de mousse, chitosan absorbed a portion of the constitutive phenolic compounds in this way reducing the browning of the final product. Fermentation rate and fixed composition of wines were only affected to a minor extent, mainly due to a little reduction in tartaric acid content and a generally slower lag phase which did not impede the completion of the fermentation .

References

[1] International Organisation of vine and wine, Resolution OIV/OENO 338/A 2009.
[2] Chinnici, F. et al. *J. Agric. Food Chem.*, **2014**, 62, 9868
[3] Castro, A. et al. *LWT*, **2018,** 93, 174.
[4] Spagna, G. et al. *Food Res Int*, **2016,** 29(3–4), 241–248, 87