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Use of a plastic film to eliminate the cork taint of a contaminated wine – improvement of organoleptic quality

Sourced from the research article "Use of alimentary film for selective sorption of haloanisoles from contaminated red wine" (Food Chemistry, 2020)[1].

>>> Cork taint, generally recognized by a musty or moldy off-flavor, is a serious problem facing the industry today when putting wines on the market. To assess the effectiveness of a food-grade plastic film in removing the compounds concerned, trials were carried out under real conditions. It was found that enological parameters as well as color are maintained, and there is no absorption of phenolic compounds or oak aromas. The plastic film improves the organoleptic quality of wines contaminated with haloanisoles, by reducing the concentration of compounds that give the cork taint and mask oaky and/or fruity aromas. <<<

While several preventive measures have been taken to try to reduce the appearance of cork taint in wine in recent years (banning halophenols, use of chlorine-free cleaning products...), cellars and cooperages affected by haloanisoles (HAs) contamination crop up every year. Certain procedures for decontamination of wine have been considered (yeast hulls, plastic films, filter pads...)[2, 3, 4], but legislators have remained cautious regarding authorizing treatments for contaminated wines before bottling. Today, the development of a solution that respects the wine, effectively eliminating HAs without harming the organoleptic potential of the product, is more than necessary and eagerly awaited by the sector.
In this study, a red wine from the 2013 vintage (70 % Cabernet Sauvignon, 30 % Merlot), naturally contaminated with different HAs levels after 24 months' aging in barrels (225 L, medium plus toast), was subjected to treatment with a food-grade plastic film (dose: 20 m²/hL) over 48 h. Wine samples were taken before treatment and after 8 h, 24 h and 48 h of treatment. The effectiveness of the film was assessed by comparing HAs levels before and after treatment. To evaluate the impact of the treatment on both wines' chemical parameters and organoleptic quality, analysis concerning color, classic enological parameters, phenolic and aromatic composition as well as sensory evaluation were carried out.

Treatment effectiveness

The plastic film allowed a significant and progressive reduction in the concentration of TCA (2,4,6-trichloroanisole) present in the initial wine. The effectiveness of the treatment is still more remarkable as wine-film contact times increases (Figure 1). For barrels B and C, immersion of the plastic film in the wine for 8 h resulted in a TCA reduction of 47 to 57 %. After 24 h and 48 h of treatment, reductions of ~74 % and ~82 % in the initial TCA concentration were observed, respectively. For barrel A, the decontamination rate could not be quantified (TCA levels below the limit of quantification). However, it should be pointed out that TCA levels fell below the limit of detection after 48 h of treatment.

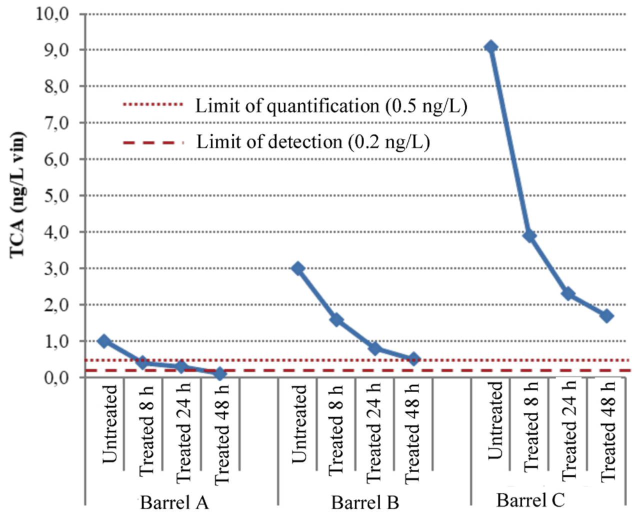

Figure 1. Reduction in TCA content in a red wine by treatment with a plastic film.

The perception threshold for TCA varies between 1.5 and 3.0 ng/L, depending on the sensitivity and expertise of the taster, as well as the matrix and style of the contaminated wine. In our study, the TCA levels in the wines at the end of treatment appear below or around the lower value of the perception thresholds published in the literature.
The haloanisoles PCA (pentachloroanisole) and TBA (2,4,6-tribromoanisole) were not detected in the wines analyzed. However, all showed traces of TeCA (2,3,4,6-tetrachloroanisole), which were eliminated during the first 8 h of treatment.

Impact on the chemical composition of the treated wines

The use of plastic film had no significant effect on conventional enological parameters (pH, density, alcohol,

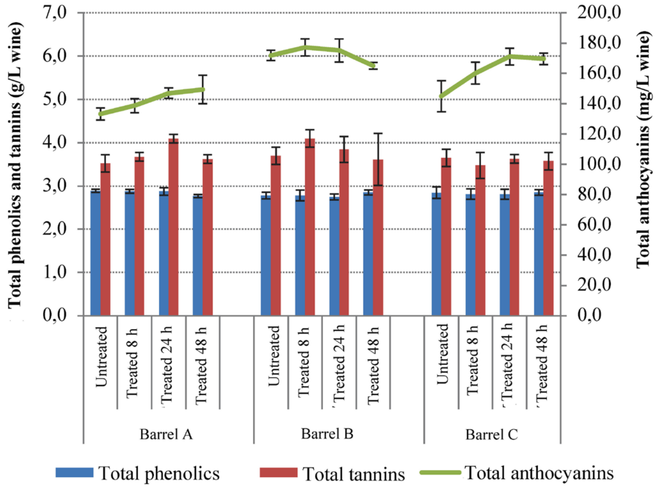

Figure 2. Changes in levels of total phenolic compounds, total tannins and total anthocyanins during plastic film treatment of red wine contaminated with haloanisoles.

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total and volatile acidity, glucose/fructose ratio, malic, lactic and tartaric acid contents), nor on the color or the content of total phenolic compounds and total tannins in the treated wines, regardless of the duration of the treatment (Figure 2).

However, a slight increase in the initial total anthocyanin level was observed for barrels A and C after 24 h of treatment. Since anthocyanins play a decisive role in the color of red wines, it would be interesting to monitor levels throughout bottle aging, to find out whether or not this slight increase has an impact on the final product.

The plastic film does not seem to have any effect on oak aromas: their concentration remained constant throughout treatment. Only the vanillin content was reduced following treatment for the wine from barrel B (≤ 28 %). However, it remained well above its perception threshold (320 µg/L), regardless of the wine-film contact time. In any case, the plastic film had no impact on whiskey-lactone levels, responsible for oaky and coconut aromatic notes, or on eugenol, a compound linked to spicy and smoky aromas. Among the volatile compounds that contribute to the fruity character of red wine, the plastic film seems to selectively absorb certain markers for ethyl esters, and this progressively as the wine-film contact time increases (Table 1). At the end of treatment (48 h), a reduction in the concentration of these compounds of up to 82 % was observed. The higher hydrophobicity of these esters, and therefore their greater affinity for non-polar plastic films such as that used in this study, would explain their absorption.

■ Impact on the organoleptic quality of the treated wines

Triangular tests showed significant differences ($p \leq 0.05$) compared with untreated wine after 8 h of treatment for Barrel A wine, after 48 h of treatment for Barrel B wine and after 24 h of treatment for Barrel C wine (Figure 3). In the case of Barrel A, these differences could not be explained by any of the suggested descriptors. They were however associated with fruity, oaky and corked descriptors in the case of Barrel B, and fruity, corked, astringency and bitterness descriptors in the case of Barrel C. Thus, according to sensory analysis, the wines treated with the plastic film were perceived as less corked and more fruity and/or oaky than the corresponding untreated wines, and this regardless of the wine-film contact time. This behavior is directly linked to the sharp decrease in the concentration of HAs in the wine following treatment with the plastic film (Figure 1). The cork taint had clearly been acting as a powerful masking agent[5]. Although a reduction in the content of certain fruity compounds was

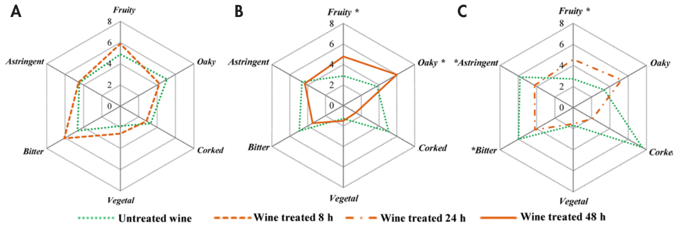

Figure 3. Sensory profile of untreated wine and wine treated with the film which was perceived as significantly different in the triangular test: after 8 h of treatment for barrel A (A), after 48 h of treatment for barrel B (B), and after 24 h of treatment for barrel C (C). * Significant difference at $p < 0.05$.

observed in the treated wines, an improvement in the fruity perception of these wines has been confirmed.

One question about the true impact of the plastic film on the fruity perception in the wine remained unanswered: can the decline of certain fruity compounds, caused by the use of the plastic film, impact red wine fruity character expression and perception in the absence of the masking effect of TCA? To answer this question, a red wine without HAs contamination was also treated with the plastic film for 48 h. The sensory analysis of this wine demonstrates that treatment with the plastic film does not affect the fruity perception, because, regardless of the wine-film contact time and with a reduction of the same fruity markers as in the contaminated wines, tasters did not find a significant difference between treated and untreated wines.

■ Conclusions

The plastic film used is effective in removing HAs in a partially selective manner. The findings demonstrate that there is no significant consequence on wine organoleptic quality. Even if the plastic film retains certain esters, it has been confirmed that their reduction does not influence the fruity perception.

The obtained results are encouraging for the wine sector, as this treatment, effective in reducing cork taint very significantly, is easy to implement, and might help restore an acceptable qualitative organoleptic potential for wines contaminated with HAs. Since the plastic film used is fully food grade, its use poses no risk to the chemical composition of the wine. ■

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Table 1. Changes in levels of volatile fruity markers (µg/L wine) during plastic film treatment of red wine contaminated with haloanisoles.

Volatile compound	Aromatic descriptors	Barrel A: Untreated wine	Barrel A: Wine treated for 8 h	Barrel A: Wine treated for 24 h	Barrel A: Wine treated for 48 h	Barrel B: Untreated wine	Barrel B: Wine treated for 8 h	Barrel B: Wine treated for 24 h	Barrel B: Wine treated for 48 h	Barrel C: Untreated wine	Barrel C: Wine treated for 8 h	Barrel C: Wine treated for 24 h	Barrel C: Wine treated for 48 h
Fruity aromas													
Ethyl propanoate		262.4 ± 15.2	*ns*	*ns*	*ns*	297.0 ± 15.2	*ns*	*ns*	*ns*	283.0 ± 18.5	*ns*	*ns*	*ns*
Ethyl butanoate		123.8 ± 3.6	*ns*	*ns*	*ns*	132.4 ± 8.1	*ns*	*ns*	*ns*	129.3 ± 9.3	*ns*	*ns*	*ns*
Ethyl hexanoate		141.9 ± 5.6	*ns*	- 21%	- 21%	148.4 ± 6.1	- 17%	- 19%	- 26%	148.3 ± 9.9	*ns*	- 19%	- 24%
Ethyl octanoate		115.3 ± 6.5	- 48%	- 69%	- 76%	118.4 ± 10.2	- 54%	- 70%	- 78%	115.9 ± 8.1	- 42%	- 63%	- 73%
Ethyl decanoate		40.3 ± 1.8	- 48%	- 62%	- 80%	32.9 ± 0.2	- 58%	- 77%	- 82%	41.9 ± 0.1	- 51%	- 72%	- 81%
Ethyl dodecanoate		9.5 ± 0.0	- 53%	- 65%	- 81%	7.5 ± 0.0	- 50%	- 64%	- 81%	9.7 ± 0.7	- 31%	- 60%	- 82%
Isobutyl acetate		61.2 ± 1.4	*ns*	*ns*	*ns*	66.2 ± 2.4	*ns*	*ns*	*ns*	60.1 ± 4.6	*ns*	*ns*	*ns*
Isoamyl acetate		267.9 ± 4.0	*ns*	*ns*	*ns*	274.1 ± 10.2	*ns*	*ns*	- 7.7%	252.6 ± 20.4	*ns*	*ns*	*ns*
Propyl acetate	*solvent, fruity*	20.4 ± 1.6	*ns*	*ns*	*ns*	21.8 ± 0.5	*ns*	*ns*	*ns*	19.9 ± 0.9	+ 14%	+ 8%	+ 10%
Butyl acetate	*solvent, fruity*	11.3 ± 0.1	*ns*	*ns*	*ns*	11.7 ± 0.9	*ns*	*ns*	*ns*	11.3 ± 0.2	*ns*	*ns*	*ns*
Ethyl isobutyrate		191.2 ± 7.0	*ns*	*ns*	*ns*	201.8 ± 2.1	*ns*	*ns*	*ns*	214.8 ± 16.6	*ns*	*ns*	*ns*
Ethyl 2-methylbutanoate		23.8 ± 1.1	*ns*	*ns*	*ns*	23.5 ± 0.7	*ns*	*ns*	*ns*	27.2 ± 1.7	*ns*	- 14%	- 16%
Ethyl 3-methylbutanoate		38.3 ± 2.9	*ns*	*ns*	*ns*	35.6 ± 1.5	*ns*	*ns*	*ns*	39.0 ± 1.1	- 11%	- 15%	- 16%

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