

Oak wood offers a wide range of tools for wine aging, which one to choose?

Sourced from the research article “Impact of oak wood modalities on the (non)-volatile composition and sensory attributes of red wines” (OENO One, 2021)¹.

>>> The phenolic, aromatic and sensory evolution of a red wine under different oak aging conditions was evaluated. Neither phenolic nor fruity aromatic contents and profiles were impacted by the aging container or the derived oak products used. Meanwhile, a different woody aroma content was observed depending on the exposed wood area to wine volume ratio. From a sensory point of view, higher smoky, vanilla and/or spicy flavours were identified for all oak-aged wines when compared to the control (stainless steel tank), but they were all perceived as being as fruity as the control. <<<

Nowadays, the use of oak wood during wine production is widespread. Cooperages not only provide barrels or casks, but also derived oak products in different forms (chips, blocks, winewoods, tankstaves, etc), all available for different toasting levels. Such a supply of oak products allows customers to obtain wines with the desired aromatic profile, adding structure and the demanded balance between fruity and woody characters.

How do these different treatments using oak products affect the volatile and non-volatile composition of wines? To answer this question, a full-scale experiment was conducted with oak wood products from a single cooperage (same manufacture, species and origin of wood, Nadalié Cooperage, Ludon-Médoc, France) for a reliable comparison of aging treatments.

Materials and methods

Merlot grapes (2018 vintage) were vinified in Château Pierre de Montignac (AOC Médoc Cru Bourgeois). Both alcoholic and malolactic fermentations were performed in stainless steel tanks with oak wood blocks (2/3 MT+ and 1/3 MT toasting, dose 4 g/L, 5 weeks maceration in total). The blocks were removed at the end of the malolactic fermentation (MLF) and the wine was then distributed into different containers for aging: casks (30 hL, with/without winewoods MT toasting), diamond concrete vats (20 hL, with/without winewoods MT toasting), tronconic concrete vats (50 hL, with winewoods or tankstaves, 50 % MT and 50 % MT+ toasting), 225 L barrel with woody heads (MT toasting), 225 L barrel with plexi heads (LMTAA toasting, light medium toasting with watering), 500 L barrel (MT toasting) and stainless steel tank (control).

The goal of the present study was to evaluate the impact of the aging container (with or without derived oak products) on the phenolic, aromatic and organoleptic red wine quality. Wine was sampled after 9 months of aging.

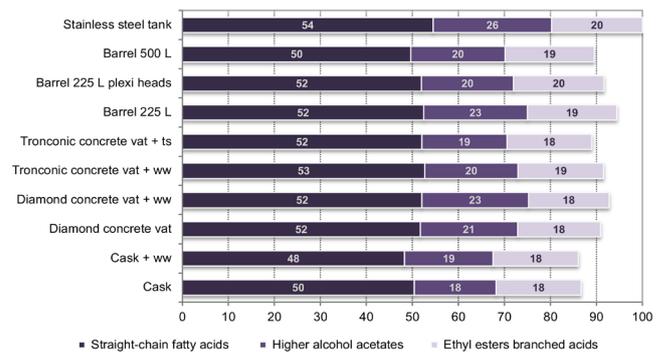


Figure 1. Relative ester concentration in wine from different aging treatments compared to control wine (stainless steel tank, 100 %) after 9-months aging. ww, winewoods; ts, tankstaves.

Impact on chemical composition

Classical oenological parameters, wine colour and total tannin content were not impacted by the aging treatment. After 9 months of aging, all wines had significantly lower total phenolic (7-15 % decline) and total anthocyanin (39-62 % decline) content in comparison to the values at the end of the MLF. Wines from all aging treatments presented similar total phenolic values to the control, but a higher total anthocyanin content.

Esters are mainly responsible for the fruity character of red wines. In this research, wines from all aging treatments showed a total ester content of around 1600 µg/L during the whole aging period. The relative total ester concentration of all wines was calculated to better compare with control wine (considered the benchmark; 100 %) (Figure 1). Certainly, the different aging treatments led to total ester contents slightly lower than that of the control, but they all had at least 86 % of the total fruity volatile content of the control wine. It should be noted that the 225 L barrel differed the least from the stainless steel tank (it kept 94 % total ester content of the control wine), followed by the diamond concrete vat with winewoods and the 225 L barrel with plexi heads (keeping 93 % and 92 % total ester content of the control wine respectively). According to the aromatic profile, the compounds responsible for the slight diminution of total esters content are ethyl decanoate (floral hints) and isoamyl acetate (banana notes). These volatile compounds were present, respectively, at subthreshold levels and at concentrations well above their perception threshold in all wines. Therefore, the reduction in their content is expected to have little or no sensory impact on the final fruity character of wines.

Both the total content and profile of fruity volatiles were thus generally maintained throughout aging when compared

to the control, regardless of the aging treatment. Whiskey lactones, vanillin and eugenol were identified as the main contributors to the woody aroma of wine. Since both alcoholic and malolactic fermentations were performed with oak blocks, all aging treatments led to a certain amount of oak woody volatiles. As expected, the aging treatments without oak wood (stainless steel tank and diamond concrete vat) showed the lowest values (Figure 2), corresponding to the woody volatiles

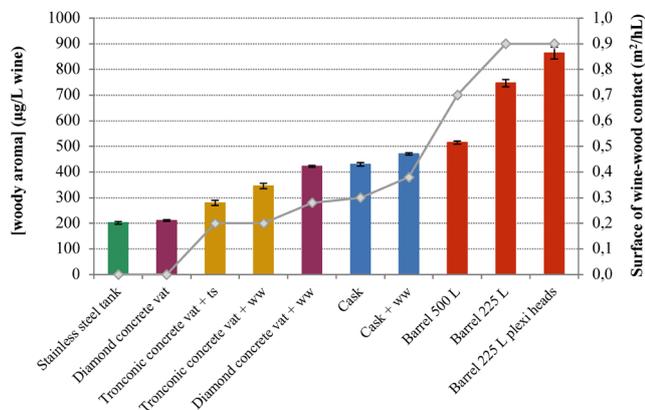


Figure 2. Total woody aromatic volatiles (whiskeylactones, vanillin, eugenol) of wines and surface of wine-wood contact for different aging treatments after 9-months aging. ww, *winewoods*; ts, *tankstaves*. Coloured bars represent woody aroma concentration ($\mu\text{g/L}$ wine), whereas the grey curve correspond to the surface of wine-wood contact (m^2/hL).

extracted during fermentation.

For oak aging treatments, woody aroma extraction is directly defined by the exposed wood area to wine volume ratio: the higher the surface of wine-wood contact per unit of wine volume (Figure 2), the greater the transfer of woody volatiles from wood to wine. Hence, barrel treatments led to wines with the highest content of woody aromatic volatiles, followed by cask treatments. For tronconic concrete vats, even when the wine-wood contact area ($0.2 \text{ m}^2/\text{hL}$) and toasting of both derived oak products were the same, woody volatiles extraction from the winewoods was greater than from the tankstaves.

Impact on organoleptic quality

Fifteen judges participated in sensory analyses using a ten-point scale (0 = 'non-existent', 10 = 'maximum intensity') to score the olfactory (fruity, smoky, vanilla, spicy), gustative (sweetness, bitterness) and in-mouth perception (aromatic persistence, palate volume, astringency) attributes. The sensory profile of wines from the aging treatments in the same container was compared to that of the control wine (stainless steel tank).

. **Cask treatments:** in the presence or not of winewoods, wines aged in a cask were perceived as having significantly stronger vanilla and spicy flavours than the control wine.

. **Diamond concrete vat treatments:** when no derived oak products were added, the wine was perceived in the same way as the control, but the addition of winewoods led to wines being described as more smoky and spicy.

. **Tronconic concrete vat treatments:** the presence of derived oak products, also led to wines being described as more smoky than the control. However, no organoleptic differences were perceived between wines with winewoods and those with tankstaves.

. **Barrel treatments:** higher smoky, vanilla and spicy flavours were highlighted for all barrel-aged wines when compared to the control. In addition, the largest barrel

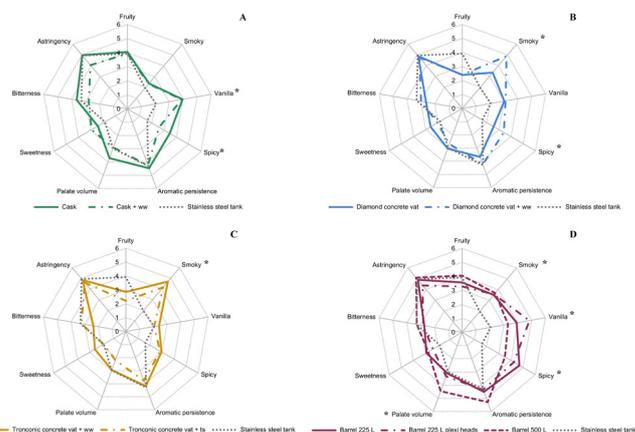


Figure 3. Sensory profiles for wine of different aging treatments compared to the control wine (stainless steel tank) after 9 months of aging: cask treatments (A), diamond concrete vat treatments (B), tronconic concrete vat treatments (C) and barrel treatments (D). *shows significant differences ($p < 0.05$) between certain aging treatments for this organoleptic descriptor. ww, *winewoods*; ts, *tankstaves*.

(500 L) resulted in wines with a greater palate volume. All oak-aged wines were perceived as being similar to the control in terms of fruitiness. Furthermore, the aging treatments did not differ with regard to aromatic persistence, sweetness, bitterness or astringency.

Conclusions

After 9 months of aging, wine from the different aging treatments did not differ from the control (stainless steel tank) in terms of total phenolic and tannin contents. In contrast, total anthocyanins decreased significantly in all wines, with the lowest values in the control wine.

The presence of oak wood during aging did not mask the fruity aroma of wine from any aging treatment, even if the higher the surface of wine-wood contact per unit of wine volume, the greater the woody aroma extraction. According to the sensory analysis, the significant differences between the aging treatments were mainly linked to the descriptors used for the woody character (vanilla, smoky, spicy) of the wine.

Each oak aging treatment led to a wine with a different woody character, without an impact on the perception of the fruitiness. Therefore, the customers' choice of the aging treatment will depend on the targeted aromatic profile of their final wines. ■

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1 González-Centeno, M. R., Teissedre, P.-L., & Chira, K. (2021). Impact of oak wood modalities on the (non)-volatile composition and sensory attributes of red wines. *OENO One*, 55(2), 285–299. <https://doi.org/10.20870/oeno-one.2021.55.2.4673>