WINE AGEING IN CONTROLLED PERMEABILITY HDPE TANKS

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Introduction

Wine industry uses different vessel for winemaking or storing, stainless steel, wood, fiberglass, etc. In recent years, many innovations in plastic tanks have been available for the wine industry, and especially for small and medium wine cellars, which employ tanks from 2hL to 22hL. The employment of plastic tanks has increased because the problems arising from the use of plastics for wine storage has been solved (transfer of odors, employment of suitable plastic…). Furthermore, these porous tanks are permeable to oxygen due to the material with which they are manufactured (polymers) and they may have a controlled permeability, which makes their use more attractive for the cellars. They are used for conservation and aging wines, because with the addition of wood pieces it can be produced wines similar to those aged in barrels. It is a system of aging cheaper than barrels, takes up less space (they can be stacked up easily in 5 heights) and is very versatile (because there are in the market tanks of different volumes to respond to the needs of cellar). On the other hand, these tanks allow to the winemaker control the amount of oxygen that the wine receives. These tanks can be used as an auto-micro-oxygenator system and it is necessary to know the oxygen transfer rate in order to management the aging process. The HDPE tanks let to add the type of wood desired, even mixing different origins and toast levels of oak, and allows the winemaker "to develop" an aging process appropriate for every type of wine, ensuring the individuality and potential for each wine.

In this work it has been analyzed the Oxygen Transfer Rate (OTR) in a controlled permeability 190L HDPE wine tank (Flextank, Australia) by an analysis of the uniformity of the dissolved oxygen (DO) distribution. Non-invasive and non-oxygen consume opto-luminescence technology has been used for the analysis of the spatial distribution of the DO concentration, as it is essential to know and control the process. It has been done the control of the same red wine aged in HDPE tanks and in barrels simultaneously, to analyze and compare the differences between the two aging systems.

Keywords: ageing, barrel, chips, control, oxygen, permeability HDPE tanks, Spanish oak wood, wine.

Materials and methods

Oxygen distribution throughout the HDPE tank. In order to know how the oxygen is distributed throughout the HDPE tank, it is necessary to guarantee that no wine compounds are consuming it. By this way, to avoid oxygen-wine interaction a fluid different from wine to work with was chosen and to check the formation and evolution of gradients in the dissolved oxygen concentration. Thus, the tests related to gradients were carried out in a synthetic wine (pure water and ethanol at 15% volume with a 3.5 pH value). During the tests with the synthetic wine, the temperature was kept at 16ºC. A total of eight independent channels were used. They were placed in three heights and at three different distances from the wall of the tank. The luminescent systems selected for this work were of the series Oxy-trace (PreSens GmbH, Germany) working with the trace oxygen sensor coating type PSt6 (detection limit 1 ppb, 0 – 4.2 % oxygen) (Del Alamo Sanza & Nevares 2010). To know the real mean value of dissolved oxygen concentration in the fluid of the studied tank, the average weighted with the volume given the influence area of each measuring point (volumetric mean, VM) was calculated according previous works (Nevares, del Alamo, & Gonzalez-Muñoz, 2010). An arithmetic mean was also carried out (mean).

Wine and wood. Four 190L HDPE tanks were used with the same red wine and with oak cubes or staves and also two 225L barrels. A dissolved oxygen measuring point was monitored in four tanks and in two barrels during four months of aging. The oak products were made from Spanish oak wood (Quercus petraea) provided by Tonelería Intona, SA (Navarra, Spain).

Wine analysis. A group of 10 people with previous experience in wine analysis were trained in recognizing aromatic characteristics from wine. Judges assessed the aroma using a tasting evaluation sheet that included different sensory descriptors: color intensity, red, blue and brownish, aromatic intensity, aromatic complexity, fruit, reduction, lactic, woody-like, toast, balsamic, sweet (vanillin and coconut), spicy (pepper and clove), cinnamon, balsamic, cacao, smoke/tobacco, coffee, volume, acidity, tannic intensity, sweet tannin, green tannin, astringency, reduction, oxidation, animal, wood-green and global parameters (harmony, post-taste and final point). The different terms were evaluated in a scale from 1 to 10 (1, null; 10, very strong). The average of all the panelists was calculated to build the prediction models. All the sensory evaluations were realized under Spanish Standardization Rules (UNE).

Results and discussion

HDPE mapping. The final objective of the first part of the trial was to test the oxygen transfer rate (OTR) of the tank in order to check its performances according with the promised OTR values. By this way, the OTR was monitored and an oxygen distribution map was elaborated and its variation along the time is represented in few selected times in figure 1. An animation with this evolution has been also done.

OTR of these HDPE tanks was 2.15 mg/L.month or 26.2 mg/L.year a little bit higher than those proposed by other authors in barrels and quite similar to usual micro-oxygenation (MOX) dosage in red wines along ageing processes with alternative oak products. Figure 1 shows the oxygen distribution in the volume in this "barrel volume" HDPE tanks. It can be seen that the management of these tanks must be quite similar to barrels and don't suppose an accelerated ageing process since the dosage procedure is quite similar to barrels, by a diffusivity process instead of a dissolution process like with MOX devices. The diffusivity surface is the wall of the tanks, and it may be produced in a similar way to that of staves in a barrel, and in this manner DO distribution is similar to barrels and quite different to classic stainless steel MOX tanks.

Wine characteristics. Figure 2 shows the aromatic profile of wines aged in the different systems. At the end of aging the wines have very different characteristics according to the aging system. It has been observed that the wines aged in HDPE tanks have fewer red tonality, spicy, coffee, tannic intensity and harmony that wines aged in barrels. They also presented less roasted flavor, cocoa, balsamic, persistence and aromatic complexity, especially these aged with cubes. Therefore it has been seen that wines aged with staves in HDPE are more aromatically complex wines that wines aged with cubes in HDPE, but less than those aged in barrels.

Conclusions

The diffusivity surface in the wall of the tanks behaves in a similar way to the staves in a barrel, and consequently DO distribution is similar in both systems. It has been observed that the wines aged in HDPE tanks with wood pieces have properties quite similar to wines aged in wood barrels.

References

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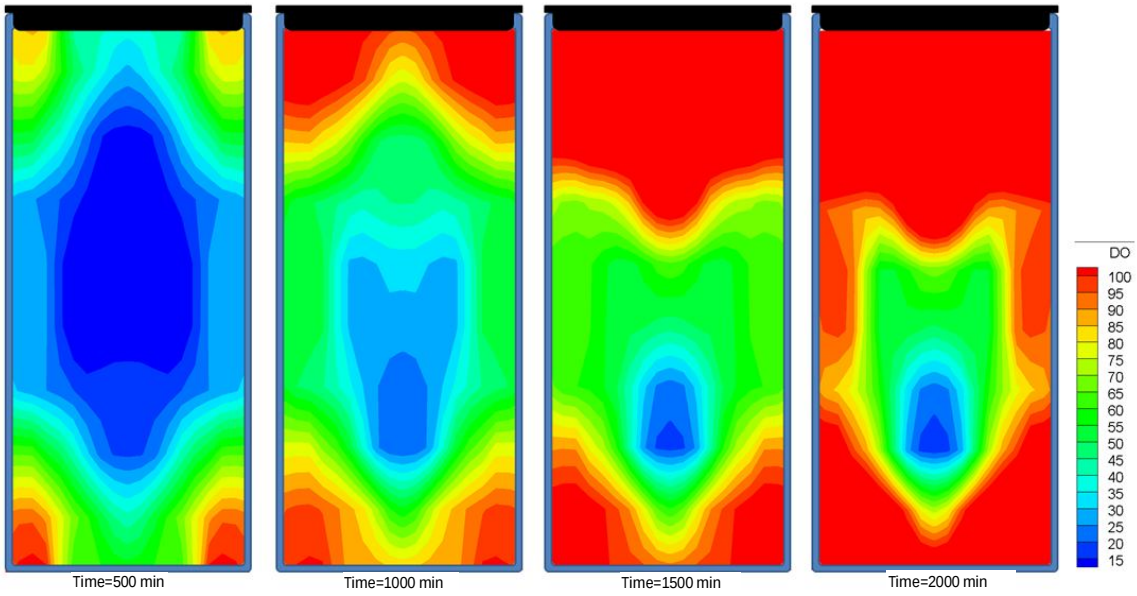

Figure 1. Dissolved oxygen mapping. Evolution DO (µg/L) at different times (500, 1000, 1500 and 2000 minutes).

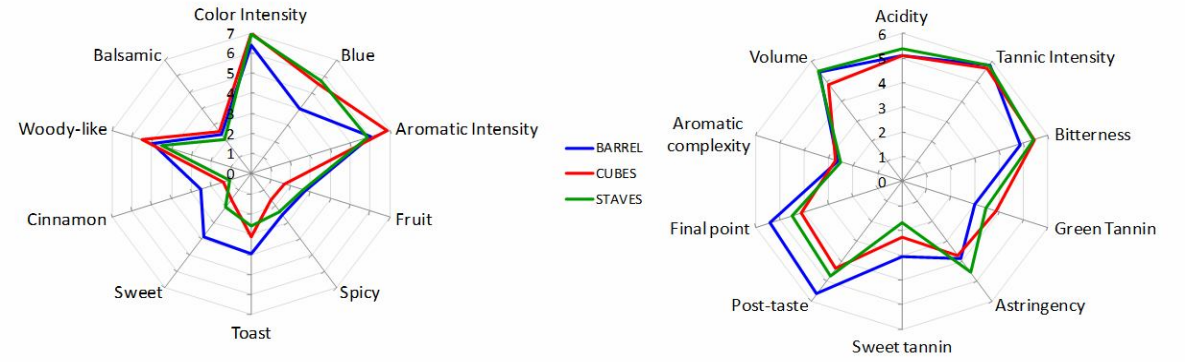

Figure 2. Aromatic profile of wines aged in different systems.