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Is Your Wine Breathing Too Much?

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**Methods:**
- 8 different stoppers: 3 natural corks (varying lengths, 29mm, 33mm, 49mm), 2 technical corks, 2 synthetic stoppers (one was estrusted & one was molded), 1 metal screw cap with a multilayered liner (Kontoudakis et al.)
- All bottles were filled to the same level with the same wine and capped randomly with each of the 8 stoppers being tested (Kontoudakis et al.)
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- After 24 hours sealed bottles were analyzed to determine the amount of dissolved oxygen. Bottles were tested with agitation, on all the bottles in the headspace would be dissolved and without agitation for each stopper type (Kontoudakis et al.)
- Samples of the wine were titrated using the Winkler method to determine concentration of dissolved oxygen ex: 1 N HCl, NaCl, KCl, NaNO₂, Na₂SO₃. 2 M Na₂CO₃, Na₂S₂O₃, NaOH. 3 M H₂SO₄, H₂SO₃, H₂O, H₂O₂ (Kontoudakis et al.)

**Results:**
- Oxygen concentration in the headspace was lower for the natural cork that was longest in length (49mm) (Kontoudakis et al.)
- Differences in the concentration of dissolved oxygen after bottle agitation is directly related to the amount of oxygen that is present in the headspace (Kontoudakis et al.)
- Natural oxygen concentration in the headspace, which we have found in the 49mm natural cork is equivalent to oxygen entrance in a natural cork during the first 3-5 months of aging. In the worst case scenario, the oxygen concentration in the synthetic stoppers and the screw cap is equivalent to the oxygen entrance in a natural cork during its first 3-5 months (Kontoudakis et al.)
- The type of stopper chosen to seal a bottle of wine plays a huge role in the amount of oxygen able to dissolve in the wine when vacuum pumps or inert gas are unavailable (Kontoudakis et al.)

**Background:**
- The amount of oxygen (O₂) absorbed in a wine during storage is one of the main components affecting the quality (color and flavor) of the wine (Kontoudakis et al.)
- Oxidation can initially lead to positive effects in red wines, such as enhanced color and aroma, but can be detrimental to white wines (Kontoudakis et al.)
- There are certain agents in wines (phenolic acids, flavanols, anthocyanins, acetaldehyde, etc.) that can bind with oxygen and produce color changes [browning] and negatively impact the flavor and aroma of the wine (Lambri et al.)
- Wine oxidation can be greatly manipulated by the type of closure used to seal the bottle (Lambri et al.)
- The amount of oxygen remaining in the headspace [volume between fill-level of wine and stopper] will influence wine oxidation (Jung et al.)
- Using a vacuum pump or inserting inert gas (CO₂ or N₂) in the headspace will greatly reduce the original quantity [before storage] of oxygen that will be dissolved in the wine (Jung et al.)

**Results:**
- The type of stopper used to seal the wine was significant when measuring the absorbance at 420nm; this test mainly studied the browning of the wine, meaning the onset of browning varies with different types of stoppers (Lambri et al.)
- The natural cork stopper, N, and the cork-based technical stopper, SI, displayed regular networks of cells with diameters smaller than 100μm and the slowest browning kinetics. The stoppers made of plastic materials had wide cellularity ranges and gave rise to faster browning (Lambri et al.)
- A more regular cellular structure and smaller cell size, with a minimum range of cell diameters, will increase the instance of slower browning rates during storage (Lambri et al.)