FEATURE ARTICLE

America (Country Appellation)

Getting Closure
The continuing search for the best way to seal the bottle

Does the threat of cork taint raise the possibility that wine corks are goners? The research continues with interesting results about consumers' sensory observations of aroma, taste, and mouthfeel.

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Have you noticed that more people today are using the word closure? Everybody, it seems, wants closure to something. In the wine industry, closure is a pet word, but with a different meaning. Two APPELLATION AMERICA postings, Are screw cap wine bottles sensible or not? and To cork or not to cork? elicited a number of thoughtful comments from readers. One, in particular, from George Vare, proprietor of Napa Valley's Vare Vineyards, inspired us to follow up on the topic. Perhaps the most pressing concern about finding the perfect closure is the problem with cork taint or TCA. Let George Vare explain:

"A **worse issue** with TCA [the chief cause of cork taint is the presence of 2,4,6-trichloroanisole or TCA] is that the compound may exist in a wine at a subliminal level, such that the fruit character of the wine is killed, resulting in a 'dull' wine that has no redeeming graces," Vare notes. "In this case, the consumer does not recognize the 'corked' issue but instead blames the producer. Enter Vare Vineyards. As a brand new winery offering a variety of wines [such as] Ribolla Gialla - that few people have heard of, let alone tried - we cannot afford the exposure to TCA in a subliminal situation."

Vare explained that he wants consumers to enjoy this new varietal wine and not be put off by a matter beyond his control. He took charge by choosing to use a synthetic closure made by Nomacorc. "In truth," he continued, "we could have used a screw cap, but the glass companies have been slow to produce a variety of glass-accepting screw caps, especially in the 500ml size which we use."

Now, there's an issue not brought to light in the earlier postings. Vare suggests that the Nomacorc closures have worked well and he's had no consumer or wine trade kickback. If you've read the earlier APPELLATION AMERICA postings on the topic of wine bottle closures, you also know that winemakers have remarked that screw cap closures do not allow oxygen to reach red wines as they age.

Thus, the question begs: what research has Nomacorc done to lead them to offer a satisfactory closure?

PROJECT BROOMSTICK

After opening several wines ruined by cork taint in 1993, Belgian businessman and wine aficionado Gert Noël and his son Marc started Project Broomstick, in order to create a closure based on foam extrusion technology. After six years in R&D, they introduced the first Nomacorc closure.

Using the company's patented co-extrusion manufacturing process, each closure consists of a foamed inner core layer and a flexible outer skin. This method creates uniform closures that yield consistent oxygen (O2) transfer rates. Nomacorc closures look and feel like natural cork and address the problems of cork taint, breakage, crumbling and inconsistent wine preservation.

Nomacorc's research study was conducted world wide to ensure fair and optimum results.

As a result of Nomacorc's post-bottling chemistry research, its product line has been expanded to include a portfolio of wine closures, each one designed for different winemaking styles, oxygen management requirements and shelf-life prospects.

In May 2007, during a company-hosted interactive seminar at the London International Wine & Spirits Fair, Nomacorc released results of its post-bottling chemistry research illustrating how closures affect wine development. The study [Click here *to read how the research was conducted.*] relates to O2 impact on aroma, taste and mouthfeel and allows winemakers to better judge optimum **oxygen transfer rates** (OTR) for closures and the impact of O2 on bottled wine evolution.

Sensory panelists rated aroma, taste, and mouthfeel perceptions. From this, researchers concluded that each closure type (low, medium or high OTR) led to differences in wine development.

Sauvignon Blanc, with a low OTR closure, had the highest degree of fruit preservation but this was accompanied by the presence of reduced characteristics. The bottle with higher OTR was less fruity but free of reduced character defect. Shiraz with a low OTR closure had both bitter and astringent characteristics. The medium OTR closure was the best balanced and least bitter and also had rounder tannins. The wine with the high OTR was found to have more bitterness yet had the lowest astringency.

CONTROLLING WINE DEVELOPMENT

Winemakers can now use these research results to effectively control wine development in the bottle. No, no, we didn't say 'manipulate'. The operative word is 'control' for positive development and the best showcasing of appellation-identifiable characteristics. These are not wine's dirty little secrets as they have been referenced in some consumer-oriented articles. The closure initiative, which is ongoing in today's wine industry can only lead to better wine experiences for consumers now and in the future.

Aroma descriptors can be traced to specific molecules, which, when identified, can be further linked to their O2 sensitivity and thus it can be determined which closure OTR optimizes desired wine development. Because some aromas are oxygen sensitive and others are not, Nomacorc created a classification system, which groups various aroma classes in relation to their O2 sensitivity, such as (common descriptors in parentheses):

--Mercaptans (passion fruit, grapefruit, gooseberries, cat pee, burned rubber, or even rotten eggs).
--Terpenes (citrus, lime, geranium, lychee, rose, pine or coconut).
--Norisoprenoids (flowery, tobacco, violet, petrol or earthy).
--Esters (candy, tropical fruit, peach, banana or melon).
--Higher alcohols (herbaceous, cranberry, mushroom, vegetal, or malt).
--Volatile Phenols (horse, band-aid, smoky, vanilla, oak or bread).
--Pyrazines (bell pepper, grassy, chocolate, roasted nuts, potato and earthy).

--Anisoles (cardboard, corked and musty).

Using this classification system, Sauvignon Blanc aromas are in the O2-sensitive category (mercaptans) and thus benefit from low O2 exposure. Sauvignon Blanc's reduced characters (volatile sulfur compounds) are found under anaerobic conditions and contact with O2 lowers the concentration. Thus, a winemaking style influences closure choice. For a reductive winemaking style, which maximizes fruity notes, yet at the risk of producing reductive characters, a winemaker can use a closure with higher OTR to lower the risk of reduced notes while still preserving a wine's fruity character.

In the Shiraz experiment, O2 influences the taste and mouthfeel sensations of bitterness and astringency. Bitterness is associated with smaller tannin molecules (monomers and oligomers) in a wine. Astringency is linked to longer-chain molecules (polymers). Tannin molecules are reactive and constantly changing in size, often breaking into smaller molecular structures or inter-reacting to form longer molecules.

This depolymerize-repolymerize tannin tendency leads to a broad range of molecules of differing sizes, all of which influence a wine's perceived bitterness and astringency. Mediated by acetaldehyde (detected as ripe fruit aromas) in a wine, tannins can undergo cross-polymerization reactions. Interaction with O2 can rapidly lead to both increased bitterness as well as tannin softening.

"Acetaldehyde," Olav Aagaard, Ph.D., and Director of Nomacorc's Global Research explained further, "is the oxidation product of alcohol. Indeed, it smells like ripe fruit, but it is also very reactive and binds to many phenolic structures in wine. Via this reaction, they contribute to the change in taste, astringency and wine color."

All this "chemistry-speak" explains the reaction of Shiraz to various types of OTR closures. In the case of wine with the low OTR, both bitterness and astringency were noted. With medium OTR, adequate O2 was available, resulting in lower wine astringency. Bitterness, although still present, was noted as being far less than in the low-OTR example. The high-OTR Shiraz presented the least amount of astringency, but the wine was higher in bitterness because of small-bridged tannin structures, which are low molecular weight tannin structures (dimers, trimers), in which the individual tannin molecules are connected to each other via a condensation reaction with acetaldehyde. "This leads," says Aagaard, "to 'ethyl bridges' between the tannin molecules. It has been proven by sensory research that ethyl-bridged tannin structures are more bitter than their corresponding unbridged tannin counterparts."

Nomacorc will continue to explore post-bottling chemistry and oxygen transfer topics through its state-of-the-art, proprietary, advanced sensory research laboratories. The company has initiated a comprehensive, multiyear project with the University of California, Davis Department of Viticulture and Enology. The study will focus on collecting technical data to demonstrate how O2 transfer through closures influences the evolution of wine after bottling.

The wine industry as a whole has not yet arrived at perfect closure but what seems evident is that there will no longer be a single closure. Wineries producing more than one varietal wine or wines from multiple appellations will be able to choose a closure that controls the wine's best development and expression in the bottle.

HOW THE RESEARCH WAS CONDUCTED

Using a Bordeaux region Sauvignon Blanc (bottled without sparging but with vacuum filling at the Chambre d'Agriculture 33 in Bordeaux) and a Barossa Valley Shiraz (bottled with nitrogen sparging of both bottle and headspace at Provisor in Adelaide, Australia), Nomacorc's research team analyzed the performance of each wine type using three different closures that allowed low, medium and high OTR. Experiment constants included storing wines for a year under identical controlled conditions and measuring OTR values using a Mocon Oxtran analyzer, according to ASTM F1307-02, a standard industry method.

We questioned Olav Aagaard, Ph.D., and Director of Nomacorc's Global Research on "a standard industry method," because we were unaware that there was one. He responded: The ASTM F1307-02 is a standardized test to measure the O2 permeability for dry film packaging. Indeed the way we measure the O2 permeability for closures is not a standardized test because there are many variables which are usually not specified (bottle neck, temperature, and humidity to name a few).


Olav Aagaard, Ph.D., and Director of Nomacorc's Global Research.

"However, the test is using the same principles, setup and hardware (Mocon Oxtrans) to determine the OTR. So, in absolute terms, we cannot say that our values are correct because we should first determine and agree as an industry what the correct measure should be. Yet, we can measure the closures relatively from each other, if we use the same method for the individual measurements. That is what we did; all the closures were measured in the same timed period with the same equipment and with the same protocol. So the OTR values of the closures are relatively comparable."

We also questioned whether the amount of dissolved O2 (DO) in the wines was measured at the time of bottling. Aagaard indicated that it was for the Shiraz and was found to be 1.55, 1.67 and 1.55ppm for the low, medium and high OTR closures respectively. He considers that all DO levels were statistically the same at the start. Unfortunately, the DO for the Sauvignon Blanc was not measured.

If the amount of DO was not measured at time of bottling, then does that invalidate the findings? "The DO difference can have an effect on the initial development of the wine," Aagaard said. "However, in the case of the Shiraz, the DO levels were not statistically different, so they couldn't be responsible for the organoleptic and taste differences observed after one year.

In the case of the Sauvignon Blanc, we don't have the DO levels after bottling, but the three different bottles lost the same amount of Free and Total SO2 in the first couple of months (the so called bottle-shock period). Because the drop in Free and Total SO2 is strongly correlated to the initial amount of DO in the bottle, one can assume that the initial levels of DO after bottling were the same and were not responsible for the change in organoleptic properties. So any changes which took place after one year cannot derive from the initial DO and hence need to come from the additional amount of O2 which entered after bottling. This O2 ingress is reflected by the OTR of the closure."

Further among constants were color analysis of free and total SO2.

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