

# Is it the closure or the wine?



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***Our knowledge of the overall impact of different closures on wine quality has been further boosted with an analysis by the AWRI of the proportion of wines entered in the International Wine Challenge over the past nine years that were rejected for faults. Of particular interest, the analysis suggests that winemaking choices have a much greater role to play in reductive characters than previously thought.***

Few things appear to divide the global wine industry more than the choice of closure used in the final packaged product. The debate over the pros and cons of the various available options has raged for more than two decades in the mainstream industry and shows no real sign of abating. It can be an emotive choice that pits tradition against innovation, marketing against functionality. Surrounding it all are claims and counter-claims about the underlying science of how something as simple as a way to keep the wine in the bottle affects both wine quality and development. The closure, whether cork, screwcap or any of the other alternatives, in many ways has become the de facto culprit for any failure of a wine to live up to the expectations of the winemaker or the consumer. More recent studies, however, are beginning to shine a light on how much more nuanced the impact of the closure can be and how, rather than being the arbiter of the outcome, it is more a bit player in the complex story that presents wine to the consumer.

Some of the first shots fired in this debate came from the landmark Australian Wine Research Institute (AWRI) study that began in 1999 looking at the impact of 14 different closures on the development of a white wine during bottle ageing (Godden *et al.* 2001). This study resulted in arguably one of the iconic images of wine research (Figure 1).

The image clearly shows that the choice of closure can have a fundamental impact on the development of a wine post-packaging, with closures with higher oxygen transfer rates leading to significantly higher risk of the wine showing oxidative characters and premature development. In no small part, the outcomes of this study contributed to much of the Australian

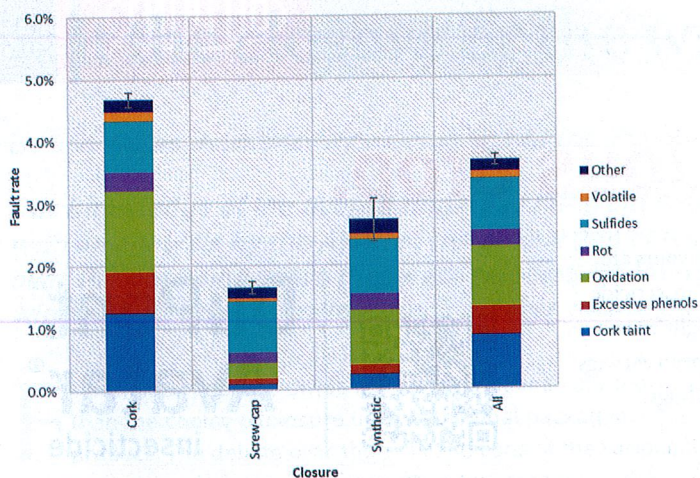
wine industry's confidence to embrace non-traditional closures. Importantly, the study did not dismiss cork as an effective closure, with high quality cork performing well in terms of the freshness of the wine. Rather, it showed that screwcaps were a viable alternative for packaging quality wines. Given the availability of viable alternative closures, the decline of cork in the Australian market was driven by persistent concerns about cork taint and the inconsistency in performance of what is, after all, a natural product.

Another finding from the wine in this study was that while the wine under screwcap tended to have fresher and less developed characters, it also showed signs of characters associated with reduction. This has conceptually been taken to mean, in some quarters, that all wines under screwcap have a tendency towards reduction. The logic would appear simple enough: screwcaps let in less oxygen than the average cork, producing a more reductive environment and, therefore, leading to reductive characters. The natural cork, on the other hand, with its higher levels of oxygen transmission, would allow the wine to 'breathe', preventing or destroying the reductive characters.

Supporting this premise, at least on face value, is some of the scientific research being carried out around the world. In a number of studies, including from the AWRI, it has been seen that wines under screwcaps have higher quantities of the volatile sulfur compounds (VSCs) associated with reductive characters than the same wines sealed under cork. This raises the question, has the rise of the screwcap as a wine closure led to an increase in the occurrence of reductive wines in the market?

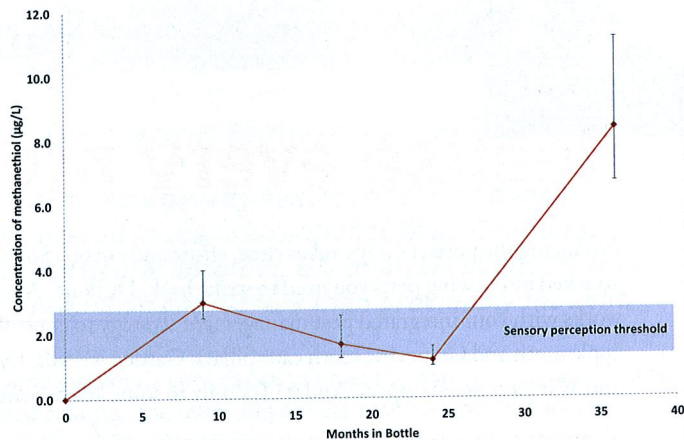


Figure 1. Semillon wine stored for 63 months after bottling under 14 different closures.



**Figure 2.** Percentages of faults seen in wines submitted to the International Wine Challenge over nine years, broken down by wine closure, n=106,627.

A number of studies have investigated this question but, by necessity, they have looked at individual wines or small groups of wines in isolation and have not always put the magnitude of their findings in context for the consumer. An important additional viewpoint, looking at the overall impact of different closure types in the marketplace, comes from results from one of the world's largest wine shows, the International Wine Challenge (IWC). The AWRI worked with the IWC on a review of nine years of its results. More specifically, it looked at the proportions of wines that were rejected each year for a range



**Figure 3.** Development of methanethiol in a white wine under nine different closures. Error bars represent the range of results for the different closure types; the red line represents the average value across the nine closures.

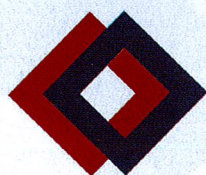
of well-defined faults. Figure 2 presents the relative failure rates for each category of faults for more than 100,000 wine entries under different closure types. This data represents just a small snapshot from a soon-to-be-released IWC report on the prevalence of wine faults in its entries.

The first obvious finding is that the data is consistent with the 1999 AWRI study, with the percentage of wines rejected for oxidation much higher under cork than screwcap. A second, expected finding is the higher percentage of wines under cork being rejected for cork taint, although the fact that there are also wines under screwcap rejected for this fault is an indication that this character can sometimes find its way into wines before packaging. What is surprising, however, given the discussion above, is that the percentage of wines rejected for reductive characters is identical under each closure (0.81% rejection rate for both cork and screwcap), and this is upheld by statistical analysis of the data. In other words, across a very large selection of wines from around the world judged by internationally-recognised experts, there is no difference in the occurrence of wines rejected for reductive characters under screwcap and cork.

So how does this sit with the research results that showed an increase in VSC compounds under screwcaps? One clue may come from the results of the continuing closure trials carried out at the AWRI, some of which are presented in Figure 3.

This graph shows the average amounts of methanethiol developed over 36 months in a white wine bottled under nine different closures, including screwcaps, corks and synthetic closures. The error bars represent the range of values found across the different closures. Methanethiol is a VSC whose odour is often described as 'burnt rubber' or 'rotten cabbage' and has a sensory threshold of about 1.8-3.1 µg/L, as represented on the graph. While this is just one of the VSCs associated with reductive characters, it is an important marker of these characters and similar results are seen for the other common VSCs.

The first feature of the graph that should be noted is the non-linear development of the VSC over time. This is typical of results seen in studies of the development of VSCs during bottle maturation and demonstrates the dynamic and changing nature of the chemistry occurring in wine as it ages in bottle. It is also important to note that the shape of the trend is the same independent of closure.



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The next important feature is the size of the average change between measurement time points compared with the differences seen among the different closures. These average changes are much larger than the differences attributable to the closures themselves. The obvious conclusion, at least in the wine used in this trial, is that a wine's intrinsic nature can play a much greater role in the development of reductive issues, with the closure modulating, but not defining, the outcome. Indeed, after the first two years in bottle the impact of closure is relatively insignificant compared with the average development of methanethiol.

This goes some way to explain the seemingly contradictory results seen from research and wine show results. Closures do have an impact on the levels of VSCs formed in bottle, it is just that factors inherent to the wine also have a role to play and can be a bigger driver of reductive faults. The reductive faults in wines rejected by the judges at the IWC may be the result of issues inherent to the wine rather than the choice of closure. Similar trends have been seen in a range of closure trials carried out at the AWRI using different wines.

These observations are supported by research from around the world which shows that the development of VSCs and their reductive odours is dependent on a wide range of winemaking and viticultural issues. These include: the concentrations of metals such as copper in the wine, both during ferment and after packaging; the nutritional status of the must during fermentation; the choice of yeast used; and the history of oxygen exposure of both the must and the wine all through its life. The effects of many of these factors, which can take place as early as the pressing of the fruit, may not become apparent immediately.

Rather, they may surface much later, even after 12 months in bottle.

Does the closure have an impact? Yes, as was clearly seen in the 1999 AWRI closure study. However, as to the question as to whether low oxygen transfer closures are responsible for the reductive nature of wines, the story would appear to be much more complicated, with winemaking choices having a much greater role to play than has been previously thought by many in the wider industry. It should be remembered that it is not a simple case of one closure allowing oxygen and the other not. All closures commonly used on wine bottles allow ingress of oxygen, it is just the rate at which this happens that varies. High quality cork can exhibit a similar oxygen transmission rate to screwcaps, especially when Saranex liners are used. Indeed, it is probably for this reason that good cork is such an effective closure for wine.

So, the problem of reductive wines may not be solved by the choice of a closure. Rather, it requires continued investigation of the factors that cause reductive characters in wine and considered winemaking choices.

Market perception, however, is a very different issue.

#### ACKNOWLEDGEMENT

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