

The closures debate used to be quite straightforward. Corks were bad because of the high frequency of musty taint, but consumers liked them. In contrast, screwcaps were good because they didn't taint wine, but consumers didn't like them because of their low-rent image. And there was an almighty squabble between the proponents of traditionalists on the one hand and the screwcap crusaders on the other.

Recent developments have made this rather cosy picture appear hopelessly simplistic. An offshoot of the cork wars has been that scientists have begun to look more closely at what happens to different wines sealed with a range of different closures – post-bottling wine chemistry has become the hot topic in the trade.

be balanced out by occasional rogue bottles which are missed by the tasting teams.

Over two weeks in April and May 2005, some 9,450 wines were opened at the IWC and closure type was recorded for 7,375. In the table (see p35), I've included information only from those wines where closure type was noted (this information was supplied by the producers who submitted the wines; again, a potential source of error, but not likely to be a significant one).

The first statistic that stands out is the relative proportions of the different closures now in use. The IWC looks at wines currently on the market or soon to be released. Because many wines only reach market a year or two after vintage, there's a slight time lag here: the proportions of the vari-

ous closures used represents the situation a year or two ago. Since then, things may have changed.

Natural cork is still the predominant closure, sealing 72% of the bottles. Screwcaps and synthetic corks are almost neck and neck, sealing 11.8% and 12.3% of wines respectively; there is still a role for technical corks (cork-based manufactured closures, such as agglomerates, twin tops and branded closures like Altec and Diam), which nestled in just over 4% of all bottle necks. Over the next couple of years, I'd expect to see the proportions of wines sealed with non-cork closures rise.

The most significant data point here concerns the proportions of wines showing musty taint. On the faults clinic report sheet, these are actu-

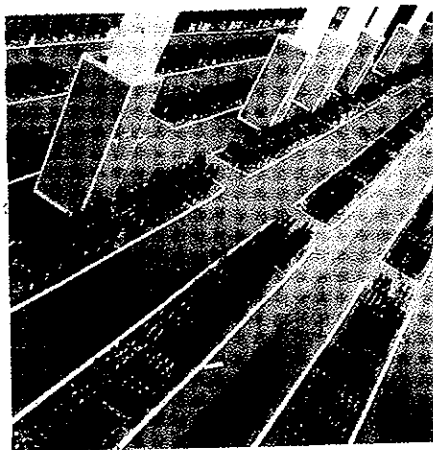
Close call

The pros and cons of corks and screwcaps have been much debated, but it seems the closure issue is much more complex than it first appeared. JAMIE GOODE reports on the latest research and results from the 2005 IWC, and suggests the cork wars are far from over

An encouraging sign has been that the cork debate is increasingly relying on discussions based on data, rather than just on strongly held beliefs, prejudices and anecdotal reports. In this whistle-stop tour of the current state of the closure debate, I'll be focusing on four new chunks of data that have recently appeared: results from a faults clinic, two scientific papers and a consumer survey.

IWC results

The first of these new contributions consists of the results from the faults clinic at *Wine International's* 2005 International Wine Challenge (IWC) for which the red wine results start on p42. This is a useful data-collecting exercise because a lot of wines are being opened at once under controlled conditions. The faults clinic is the destination for any wines that the tasting teams suspect are faulty: they are labelled with a description of the suspected fault, and lined up to be re-tasted by one of the superjurors. The fact that two or three experienced tasters have diagnosed a fault, which is then confirmed by a highly experienced superjuror, presumably reduces any false positives and adds a degree of robustness to the data. It is likely that any false identifications of taint will



It's important to understand that the changes that occur in wine after bottling, which can be attributed to the closure and other bottling variables, are profound.

—Peter Godden, AWRI

ally recorded as 'TCA'. This is the abbreviation for 2,4,6-trichloroanisole, the musty-smelling compound largely responsible for cork taint. However, as journalists attending the recent wine faults clinic – presented by renowned wine scientist Pascal Chatonnet, and sponsored by cork company Amorim – will now know, we can't be sure that musty-smelling wines are tainted by TCA. Chatonnet presented wines doctored with varying concentrations of TCA and TBA (tribromoanisole), and they are just about indistinguishable. TBA, however, isn't a cork-borne contaminant. It is formed from a precursor compound, tribromophenol (TBP), which is widely used as a timber preservative. Many wineries with wood in their construction, or which use wooden pallets (80% of which are treated with TBP), are at risk of contaminating their wines with TBA. TBP use is still widespread, and Chatonnet expects that this sort of environmental contamination of wine will become an increasing problem.

The reason for all this rather technical discussion is because the results from the IWC are highly relevant to this debate. Previous large surveys of musty taint have shown that very few non-cork-sealed wines are tainted. This casts doubt on the significance of environmental

sources of taint. If environmental contamination of wines with TCA or TBA is indeed a problem, it will affect wines independent of closure type. Musty taint in wines sealed with alternative closures is environmental in origin: either the wine has been contaminated during the winemaking process, or the closure has picked up TCA from the environment and then transmitted it to the wine. However, in this case, an alarmingly high 2.9% of the wines sealed with synthetic corks and just a few (0.47%) sealed with screwcaps showed musty taint.

Is this really environmental contamination? If so, we might expect it to be affecting both synthetic- and screwcap-sealed bottles alike. There are two explanations for this surprising result. First, tasters were detecting musty taint when none was present (false positives), and the discrepancy between this false-positive rate between the synthetic cork-sealed bottles and the screwcapped ones is explainable by the strong visual cue – even under ‘blind’ tasting conditions, it is possible to differentiate screwcapped bottles from others, and we all know that screwcapped wines are taint-free.

Second, synthetic corks are good at picking up taint compounds, and it is possible that if there is any taint in the winery, this could be absorbed by the closures and thus transmitted to the wine, while the screwcaps haven’t done this. If 2.9% of synthetic cork-sealed bottles suffer from environmental contamination with musty-smelling compounds, a similar proportion of natural cork-sealed bottles are also likely to be suffering from environmental taint. The real rate of cork-borne taint would therefore be around 2%, and not 5%.

Of course, more studies are required before we can draw conclusions, and there’s also the possibility that producers may have submitted cork-sealed wines, yet marked them down as sealed with synthetics on their entry forms: it isn’t possible for the IWC staff to check all 40,000 bottles (four of each wine).

Another interesting statistic revealed by the faults workshop concerns the incidence of taint from natural corks. In 2005, this was 4.8%; how does this compare with previous years? In 2002 it was 4.6%, and in 2003 it was 4.9%. Considering the large sample sizes, these data are remarkably consistent. What they show is that, while cork companies have been busy trying to combat taint, as of the wines on the market now (which, on average, will be sealed with closures manufactured two years ago), the benefits are yet to be realised, and still one in 20 cork-sealed bottles on the market exhibits musty taint – an unacceptably high level.

Finally, it’s interesting to see that very few screwcapped-sealed wines are being identified as showing ‘reduction’ faults. More on this later.

The Australian Closure Fund Study

For a long time, the key question in the closure debate has been whether oxygen transmission through the closure is ever a good thing for wine. Or, to put it another way, is a totally hermetic seal, such as that provided by a glass ampoule, the perfect closure? In February 2005, the publication of a study from Australia claimed to answer this question once and for all. It was sponsored by the Australian Closure Fund (ACF), which had been established in 2003 by Clare Valley winemaker Jeffrey Grosset with a view to supporting scientific attempts to address this complicated topic.

The first press release that accompanied the ACF publication claimed success at first attempt: the results, it stated, proved that oxygen is not needed for ageing of red wines. Wines age just as well under the relatively tight seal provided by screwcaps as they do under



Stopping the gap: a growing number of wine producers now use synthetic corks to seal bottles

corks, which allow more oxygen transmission. However, according to some industry figures with relevant expertise, these conclusions aren’t supported by the data included in this study.

There are three constituent parts to the ACF paper. First, it follows the evolution of a red wine (1996 Penfolds Bin 389) sealed with four different closures: natural cork, a tin-lined screwcap (which has very low oxygen transmission properties) and two synthetic closures. Then it looks at how four different vintages of a sparkling red wine have evolved under crown cap: a slightly tangential bit of information that isn’t relevant to the main point of the paper, in part because we don’t know what pre-bottling treatment the sparkling red was subjected to, and also because crown caps, like screwcaps, have varying levels of oxygen transmission depending on the lining material. Finally, data on the oxygen transmission properties of the closures used in the study are presented.

What do the data show? First, sensory analysis shows that there is no significant difference between the Bin 389 sealed with cork or screw-

cap, with the exception that the screwcapped bottles are significantly higher in ‘reduced’ characters. The synthetic-sealed bottles are more oxidised, more developed, less spicy and show less fruit intensity. Chemical analysis shows that the screwcapped bottles retain the highest levels of free sulphur dioxide, the corks a bit less and the synthetics the lowest. Free sulphur dioxide levels are an established ‘proxy’ measure of how oxidised a wine is, and the logical conclusion from this part of the study is that: (1) synthetics are allowing larger amounts of oxygen into the wine, causing it to age more rapidly; (2) corks are sealing against oxygen entry very nearly as well as screwcaps; and (3) the only consequence of the tighter seal of screwcaps at this stage is the development of reduced aromas.

This is where we reach the most controversial part of the paper. The authors have used a machine known as Mocon to measure the oxygen permeability of the different closures used. Bottles are sealed as normal, but then the necks are cut off and the Mocon measures the passage of oxygen through the closure. It needs to be emphasised that we are talking about the passage of tiny, yet significant, amounts of oxygen here. Thirty-five randomly selected natural corks were tested this way, and the data show a range of permeabilities, from just over 1cc to less than 0.001cc oxygen transfer per cork per day. Using the same technique, synthetics showed a consistent permeability of around 0.01cc/day and screwcaps less than 0.001cc/day. From this, the authors conclude that if the screwcapped bottles and cork-sealed bottles taste the same after seven years but have been exposed to widely differing levels of transmitted oxygen, oxygen transmission is not required for wine ageing.

But something is wrong here. If the Mocon measurements are correct, then they don’t fit with the data on free sulphur dioxide levels, which suggest that, on average, the corks seal better than the synthetics used in this study. Richard Gibson, a wine scientist from Australia with expertise in closures, asserts that the Mocon measurements are to blame for this discrepancy. He points out that dry corks, as used in the Mocon machine, are known to be much more permeable than wetted ones, and oxygen transmission is lower and much less variable when wine is in contact with the cork. If we accept this, then the results suddenly fit much better: the screwcapped and cork-sealed bottles taste the same after seven years because the screwcap and cork are doing a pretty similar job. The synthetics are sealing less well, and this is reflected by the results of the sensory analysis where the wines taste oxidised.

What about the 1,000-fold variation in cork



Corked: scientists at Amorim's laboratories (above) use a range of sophisticated techniques to test for wine faults; natural cork (left) is still popular with consumers despite a high incidence of musty taint

Can it be done? It's not possible that there is any fault in the wine. The wine is brilliant and so is the dusting. A brilliant wine is not to be missed.

— Peter Godden, AWRI

performance shown by the Mocon machines? Is this also reliable? Not according to winemaker and chemist Dr Alan Limmer, from Stonecroft in New Zealand's Hawke's Bay. 'If, in fact, we had a variation of 1,000-fold at these levels, individual wines would be unrecognisable. They would reflect the cork more than the wine. And yet, we can generally agree on the character of a particular aged wine.'

The surprising observation in this ACF study was the appearance of reduced characters in the screwcapped bottles. 'Reduction' is a term used

to describe the presence of sulphur-containing compounds formed by reducing conditions (the relative absence of oxygen) in wines. These sulphur compounds are formed by yeasts under stressful fermentation conditions, where they produce hydrogen sulphide. This can later be transformed into thiols (also known as mercaptans), many of which have undesirable smells.

Screwcaps don't cause reduction: it's just that with their super-tight seals, tin-lined screwcaps generate a very low redox potential in wine, and can thus encourage changes in sulphur compound chemistry that encourage the development of reduced aromas. There's currently a heated debate among wine scientists about whether reduction is a winemaking problem or an unavoidable side effect of using tin-lined, tight-sealing screwcaps.

Winemakers can avoid sulphur problems in bottled wines by managing fermentations more carefully (so that fewer sulphur compounds are produced by the yeasts), and by copper fining. But this is easier said than done. While copper removes mercaptans, it doesn't eliminate disulphides, which can hang around unnoticed. Then, given the right redox conditions (in this case lack of oxygen under a super-tight closure), the result further down the road can be more smelly mercaptans.

IWC fault clinic results 2005

	CLOSURE TYPE			
	Cork	Technical cork	Screwcap	Synthetic cork
Total number of wines sealed with each closure	5,304	313	850	908
Number exhibiting musty taint	256 (4.8%)	16 (5.1%)	4 (0.47%)	26 (2.9%)
Oxidised	58 (1.1%)	2 (0.64%)	2 (0.24%)	6 (0.66%)
Reduction	19 (0.36%)	1 (0.32%)	1 (0.12%)	1 (0.11%)
Volatility	9 (0.17%)	1 (0.32%)	0	2 (0.22%)
Unclean	21 (0.4%)	0	1 (0.12%)	2 (0.11%)

PHOTOGRAPHY: courtesy of Amorim

Another problem with copper fining is that it is not selective for bad sulphides. Some sulphur-containing compounds are beneficial for wine aroma. For example, there are some thiols that have recently been implicated in the varietal aroma of Sauvignon Blanc, and you do not really want to strip these out with copper fining.

But how much of a problem is reduction in screwcapped wines? While some critics and wine judges seem to be bumping into screw-capped wines with reduction faults all the time, it isn't a problem according to the IWC fault clinic data, showing up in just 1 of 850 wines sealed this way. The jury is still out.

The Australian Wine Research Institute (AWRI) closure trial

The second important paper to be published contains the latest round of results from the AWRI closure trial. This trial, involving a Semillon wine bottled with a range of different closures, has now been running for five years, and the latest data set is from 63 months post-bottling. Interestingly, in sensory analysis the wines all cluster quite tightly by closure type, leading to the tentative conclusion that the choice of closure is more important than most people have previously realised.

The AWRI's Peter Godden emphasises that, 'the most important outcome of our trials is to demonstrate that by changing the closure one effectively creates "different wines", and that the differences between those wines can be profound'. This leads to a tantalising question:

could it be that the choice of closure is more important than *terroir*? Godden suggests this: 'Changes that occur in wine after bottling can be of far greater magnitude than many vineyard and winemaking variables.'

So in contrast to the conclusions offered by the authors of the ACF study mentioned above, that oxygen isn't needed for wine ageing, the results from the AWRI study indicate that the amount of oxygen transmission by the closure is an important variable, and a glass ampoule, which would allow zero oxygen transfer, is not the ideal closure. The critical question has now become one of just how much oxygen transfer is desirable. 'The future is to use oxygen ingress creatively,' says Godden, 'as small differences can have a big effect on how wine develops. The amount of oxygen required for optimal development will be different for each wine, and understanding this, and other bottling variables, is the next step.'

Wine Intelligence consumer attitudes survey

Late in 2004, Wine Intelligence published a survey of consumer attitudes towards wine bottle closures. This was an independent survey of some 25,000 wine drinkers. Of these, just 1,018 said they were aware of different kinds of closures and thus were eligible for this study.

The conclusions made interesting reading. First of all, consumers still quite like cork: 55% said they liked buying wine with a natural cork closure, 29% said the same for synthetic corks,

whereas only 18% said they actually liked buying wines sealed with a screwcap. When it came to negative responses, only 3% said they didn't like buying natural cork-sealed bottles – despite the taint problem – while more than a third (36%) were opposed to screwcaps.

However, the survey showed that this proportion of anti-screwcap consumers had reduced from 59% the previous year, a significant turn-around. The authors of the report suggest their results indicate that 'closures are losing their impact as a factor in the purchasing decision of UK consumers'. But the fact that of 25,000 wine drinkers only 1,018 claimed to be aware of the closures issue is perhaps more telling; this suggests that consumers are more or less oblivious to what's in the neck (or around and above it) of their wine bottles.

Future steps?

These contributions to the closure debate look set to provoke more discussion. One future step might be for closure manufacturers to brand their products. Then we could see where problem closures originate, and conversely, cork companies doing work to eliminate taint would have some direct reward for their work. This would also allow the trade and consumers to differentiate between different types of screwcap and synthetic cork, for example, all of which will have different properties. Also, there is the prospect of supplying winemakers with closures engineered to have varying permeabilities, which can then be matched with the winemaking goals and the style of wine.

It may be that, soon, closures will be seen as part of the winemaking process itself, and just as winemakers talk about the grape variety, vintage conditions and the type of oak used, they'll be mentioning the closure used to seal the wine. One thing is for certain: the closures debate is more nuanced than just cork versus screwcap, and it looks set to run and run.

JAMIE GOODE has a PhD in plant biology and is publisher of www.wineanorak.com

PHOTOGRAPHY: courtesy of Supremecork

Australian Closure Fund

PO Box 64, Auburn, South Australia 5451.
Tel: +61 (0)8 8849 2175, info@grosset.com.au

Australian Wine Research Institute (AWRI)

PO Box 197, Glen Osmond, South Australia 5064, Tel: +61 (0)8 83 03 66 00 www.awri.com.au, rae.blair@awri.com.au

Wine Intelligence

Erigo House, 93-99 Upper Richmond Road, London SW15 2TG
Tel: +44 (0) 208 785 5515 www.wineintelligence.com,
info@wineintelligence.com

