A Review of Cork Sensory Assessment Methods

PETER LESKE, NICK BRUER and MARK SEFTON
 Respectively, Manager—Technical Services Group, Technical Services Specialist and Research Chemist, The Australian Wine Research Institute

Introduction

In response to a perceived increase in the incidence of wines affected by cork taint, many Australian winemakers have undertaken sensory analysis of corks prior to use. Some, however, have recently questioned the effectiveness of this approach, and have consulted The Australian Wine Research Institute for advice.

Corks are not inert, and it should be accepted that there may be some sensory effect associated with these closures. The challenge facing users of these products is to establish acceptable limits for such modification, and to distinguish it from ‘taint’. Flavour and aroma modification due to the presence of 2,4,6-trichloroanisole (TCA) is only one form of ‘cork taint’. TCA is the compound most often responsible for the tainting of wines by corks, but several other compounds may also contribute to such taint (Lee and Simpson 1993).

The true incidence of cork taint is unknown, as is the value of assessing corks before use in an attempt to exclude those that are tainted. Conclusive data are unavailable, but products from all companies appear to be affected to some extent. The screening of corks is evidently not totally effective.

In excess of 400 samples of corks and/or wines with suspected taint problems were submitted to the Institute during the 4 years to September 1994. This figure excludes those samples submitted for investigations into other aspects of cork quality, such as seepage, leakage, poor adhesion in the neck of the bottle, and the shedding of treatment materials or dust into the wine, of which 121 samples have been received. Cork-related investigations comprised 30% of all samples with problems submitted to the Institute in this period. A mong the cases submitted with a suspected taint problem, the proportion of affected wines was as high as approximately 40%.

The incidence of taint in bottled wines was recorded during two Advanced Wine Assessment Short Courses conducted in 1994. Wines of various style and quality were purchased from wholesale and retail sources, and presented to a panel of 33 judges. This approach differed from wine show judging due to the difficulty in obtaining a sample that is representative of the whole batch of corks. Additionally, the sample may be taken by either the supplier or customer, depending on the relevance of the results of the screening test to commercially-packaged wines.

Table 1 summarises the proportion of affected wines. The data show that, even when experienced tasters are judging wines as carefully as possible, differences in perception exist.

Of the approximately 720 bottles opened during the courses, 40 were concluded by at least 25% of the tasters to be tainted. The average number of wines affected by cork taint is, therefore, 5.5%. This average is slightly high, because one full-bodied white wine, sealed with a composite cork, was presented to the participants several times. On every occasion, it was judged to be affected by a dusty, musty, mouldy taint. While there was general agreement that the wine was negatively affected, not all judges considered that the character was typical of cork taint.

If a wine which is submitted to the Institute is considered by an experienced panel to be tainted, it and an extract of the cork are usually subjected to confirmatory analysis for chloroanisoles by gas chromatography/mass spectrometry. In most cases, a correlation exists between the perceived taint in the wine and the concentration of TCA in the cork. This suggests that corks can contribute taint compounds to wine, and screening to eliminate the use of tainted corks should therefore reduce the incidence of affected wines.

Review of sensory assessment methods

A survey of cork assessment methods was initiated following a meeting held at the Institute at which wine industry members discussed cork taint, and at which it was noted that a wide range of methods were used. Information was gathered from wineries, cork supply companies, and research papers in the form of a survey of the procedures used.

Many Australian winemakers utilise methods based on that developed at the Institute, although several winemakers indicated that better results had been achieved with methods developed under their own conditions.

Limitations of cork assessment

There are several limitations in any cork screening method, largely due to the difficulty in obtaining a sample that is representative of the whole batch of corks. Additionally, the relevance of the results of the screening test to commercially-packaged wines is questionable. The following factors must be considered:

Timing of sampling and cork assessment
Wine industry personnel suggested in the meeting that raw, untreated cork is more likely to cause flavour modification than treated material. Most samples are therefore taken as late as possible in the cork production process. The sample may be taken by either the supplier or customer, depending on the relationship between the two. The rejection of corks branded with the identity of the purchaser causes specific problems for the supplier, as the corks are more highly processed and valuable.

Cork batches are often sampled and assessed on repeated occasions, which increases the probability of detecting a tainted batch. If the moisture content of the cork is below 7–8%, there should be no generation of taint compounds due to mould growth (Amon and Simpson 1986), but the potential for cross-contamination by shipping materials remains. It
is recommended that corks be re-evaluated, regardless of any previous screening, as soon as practical before use.

Size of the assessed sample
Several international standards detail statistically valid sampling techniques. Many sampling regimes used by suppliers and their customers do not provide statistically significant results, as the assessment of large, statistically valid samples represents a prohibitive amount of work.

Retention of reference samples
It is not uncommon that samples of winemaking materials are required for analysis after use, to establish the cause of a problem observed some time after bottling. Many materials are, however, unstable in storage.

The provision of reference samples would assist in the evaluation of a problem detected after bottling. It is difficult, for example, to quantify the amount of treatment material originally applied to a cork, particularly if some has been shed into the wine and the cork has been extracted from the bottle neck for testing. Storage of at least 100 corks from each batch in an inert, airtight container for an appropriate period would assist in the analysis of the original condition of the corks in question.

Retrospective sampling to confirm suspected taint
In order to investigate and confirm the incidence of a suspected taint problem, a large sample of corks should be assessed. It is difficult to determine if the supplier or customer should bear the associated cost in such cases. The relationship between the two parties is critical.

Many fundamental questions remain to be answered. These include the mechanism and speed with which taint compounds are transferred from cork into wine, and the effects of other cork compounds, such as tannins and other aroma and flavour compounds. It is probable that some compounds extracted from cork mask others, while additive effects may also exist. Further, the perception of taint compounds depends on their concentration.

It is important for manufacturers and customers to understand the extent of variation between corks and the implications of such variation for aspects of screening tests, such as the time of cork-wine contact, and the relationship between taint observed during testing and that in a bottled product after a period of storage.

Results of the survey of methods
All of the participants in the survey of assessment methods used some form of test, whereby corks are soaked or incubated in contact with an extraction medium for a period, after which the medium is assessed for taint aromas and/or flavours by a panel of judges.

Table 2 summarises the key parameters of these tests. Several companies arrived at different test protocols, despite pursuing a common goal and adhering to comparable development work.

All companies except one immersed more than one cork per vessel, presumably to reduce the amount of work involved in assessing large samples of corks. The range in the number of corks per vessel was large. Most commonly, 5 corks were used. The protocol employing single corks used 100 mL bottles.

One test, employing 48 corks/L, involved a two-stage process, where the original extract was used to characterise and describe the aroma, prior to dilution in unaffected wine to a concentration that simulated the contact of one cork in 750 mL. The intensity and nature of any characters were then assessed in this solution. Data from both assessments were used in the acceptance/rejection decision.

If a taint is detected in an extract of several corks, it is impossible to determine the number of those that are contributing to the taint. The nature of the test generally precludes further work to establish the actual number of affected corks.

The volume of the vessel is important from a practical viewpoint. The vessels should be easy to handle, yet hold enough wine for the necessary number of tasters to individually appraise the extracts. A approximately 40 mL is required per taster. If several tasters are to assess the samples, the minimum vessel volume is 250 mL, depending on the number of corks per vessel.

The five-fold difference noted between the highest and lowest number of corks/L was greater than that expected. This variation probably has a substantial effect on the amount of material which is extracted into the wine, possibly affecting the perception of flavour and aroma. Furthermore, experience has shown that one may not abbreviate the test by shortening the incubation time and using more corks/L; the incubation of a small number of corks for a long time is not comparable to that of a larger number for a short time. Further investigation of the rate of extraction of various taint compounds is required.

Variation was also evident in the scoring system used. For example, six companies required that assessors score the intensity of perceived taints from 0 – 4, one from 0 – 2, and another from 3 – 0. Four required panelists to respond yes/no in assessing the acceptability of samples. A further requirement was to describe any taint perceived, without the application of a numerical score.

The extraction medium is important. All respondents except one used ‘neutral’ dry white wine, probably because it is generally believed that highly aromatic compounds in wine may interfere with the perception of taint. The use of a wine which displays evident fruit characters may be justified on the basis that the lowest level of taint is often perceived as a dulling of these characters. Cork taint may be confused by some with oak characters, so the Institute method utilises wine that has not been treated with oak.

Some cask wines contain a relatively high concentration of free sulphur dioxide (SO₂) which can interfere with the perception of other aromas. These wines and those with intense ‘off-characters’ should be avoided.

The use of water as an extraction medium was proposed by Brunner (1989) and Casey (1990). Growth of mould during testing is more likely in an aqueous medium than in wine, however, because of the composition of the latter. Research is required to establish if chloroanisoles may develop in corks during incubation in an aqueous medium. If so, the assessment may
be of the potential for the cork to develop taint, rather than the presence of taint compounds in the cork.

The variation in incubation time in the methods described by respondents is large. Experience at the Institute suggests that the perception of 'sound' cork characters, which are generally described as 'woody', 'oaky' or 'sweet', increases with contact time, and obscures taints. It is difficult to define the normal intensity of such characters. They are not regarded as 'taint' at this concentration, but rather as an acceptable flavour/aroma effect of the cork. If, however, they are very intense, they may be considered objectionable, with the corks rated accordingly.

Most participants indicated that TCA is extracted quite quickly into the medium, although extensive trials by one company have led to the incubation of samples for 48 hours. Research is required to establish the location of taint compounds in corks, which might provide an indication of the most appropriate incubation time.

The incubation temperature may be related to time. Several methods required incubation of the samples at 'ambient' temperature, which might vary by 10°C or more over the period of the test, or from one season to another. This variation should be minimised by the use of an incubator or air-conditioned facilities.

The number of tasters is important in all sensory evaluations. A panel that is too large is difficult to manage, and averaging of results can hide extreme scores. Conversely, a panel must be large enough to take account of variation in opinion. Alternatively, the mechanism must exist for one panellist's score to be rejected if it varies substantially from the range. A panel at the Institute normally comprises 4-6 assessors. All scores given by one panellist may be rejected if they are markedly different to those of the panel, but only after careful scrutiny of the comments used to describe any characters. Variation in the perceived intensity of a taint between tasters is common, and is considered less serious than a difference of opinion regarding the nature of the taint.

Most of the respondents used a smaller panel than the Institute, although several regard 3 assessors as the minimum number. At one company, an initial appraisal was performed by one assessor. Samples which were considered to be tainted were then assessed by a larger panel, in order to confirm any taint present.

Only one of the respondents required that panel members undergo formal training involving the determination of individual taint recognition thresholds. A further six used informal methods, such as the inclusion of samples supplemented with TCA. A further six made no attempt to train assessors, and relied on what they describe as tasters with 'experienced palates'.

Assessors should be given the opportunity to appraise samples containing a known concentration of various taint compounds. Ideally, discrimination and recognition thresholds should be established for each assessor. At the Institute, adulterated samples of wine are used to test panelists, and are readily available to wine or cork supply companies which require assistance. A device regarding training is also offered.

It is necessary to include an identified reference control with cork samples in each bottle of wine for assessment. This was not practised by all respondents to the survey. The assessment should be quiet, free from distractions and occlusions, and conducted with clear glasses on suitable benches. Panelists must be given (and take) adequate time for the assessment.

It is desirable that several wines which contain various amounts of added taint compounds are included in the assessment. If several of these are not detected by a panelist, their scores for that session must be carefully scrutinised, and possibly rejected. Repeated samples are also valuable, in order to assess the reliability of each panelist. The assessor should be aware of, and accept, this scrutiny, and be willing to accept variation in their performance. Such techniques have resulted in improved assessment results at the Institute.

The choice of scoring system depends on the requirements of the test. At the Institute, an independent assessment of the incidence and intensity of any taint is often required. A 10-point (0-4) system is therefore appropriate. Variability can be reduced by the use of a simple accept/reject (yes/no) system. This approach is appropriate when a commercial decision of whether or not to use a batch of corks is required.

The selection of appropriate rejection criteria is difficult. The type and intensity of perceived taint may vary, and the relevance of a taint to the bottled product after a period of time must be considered. Samples with obvious TCA, other chloroanisole or chlorophenol taint, should be rejected, but those showing other characters (such as 'plasticine', 'waxy', 'leaky', 'green wood', or 'pyrethrin') may be acceptable.

Characters that have been observed in composite cork products may be attributed to the process of manufacturing. These characters have been described in assessments conducted at the Institute as 'solvent', 'glue' and 'chemical'.

The results of the survey indicate that there is some variation in what is considered 'rejectable' in commercial practice, where the approach is different from that at the Institute. Careful interpretation of the comments made by the panelists is necessary to supplement the information provided by their scores. These comments may be valuable when determining the relevance of test procedures, by comparison with taints observed in bottled wines.

The confirmation of the results of assessments by the analysis of tainted wines from in-house tastings and stock returned from the market is rare but important. Several sets of such analysis are performed each year at the Institute in response to problems. Research is being undertaken to improve the speed of extraction and analysis of such samples, to provide more data.

A revised method could also be used to investigate the location and rate of transfer of taint compounds from cork to wine.

The role of taint compounds other than TCA is under investigation. Interactions, such as synergy or masking of aromas, will be examined. Future research may include the development of a non-destructive test for the appraisal of corks to allow their use and subsequent assessment of both wine and cork. It is important to determine whether taint can develop after insertion of the cork, as the reduction of the incidence of taint by exclusion of tainted corks is based upon the assumption that such corks are the principal source of taint.

References


