The effects of heat and light on wine during storage

Scope

The following is a brief review of the literature on the topic of the effect of heat on wine.

The AWRI often receives enquiries regarding the effects of heat and light on bottled wine during storage, and it was considered worthwhile to provide a brief summary of our findings and recommendations in this area.

Heat

Excessive storage temperatures will have a marked effect on the shelf life of bottled wine. Marais (1986) observed the development of faulty flavours and decreasing overall quality after 12 months' storage of wine at 30°C. Temperatures in excess of 40°C will induce visual and sensory changes to a wine in only a matter of days (Ough 1986). In general, any storage place where the temperature exceeds 25°C for long periods and 40°C for short periods can affect wine quality (Ough 1992). Amon and Simpson (1986) recommend that bottled wine be stored with the cork in contact with the wine in a cool (15–20°C), dry location.

Leakage of wine and/or movement of cork stoppers due to thermal expansion of wine may result following exposure to temperatures which are significantly greater than ambient temperature. Such physical damage does not necessarily imply that the quality of the wine has also been affected, but will obviously affect the appearance, and therefore the marketability, of the wine.

Physical, chemical and sensory tests are required to establish whether any damage has occurred to wine following exposure to extremes of temperature during storage. It is necessary to compare test results of bottles exposed to excessively high temperatures with those for bottles of the same wine which have not had such exposure, although this may not always be possible.

It is believed that prolonged storage of wine in a refrigerator could also adversely affect wine quality; it has been argued that the vibrations from the refrigerator's compressor are detrimental during wine storage. The AWRI has been unable to find any literature on this subject, however.

Light

The deleterious effects of light on beer flavour have been known to brewers for many years. Other research has also shown that wines may also develop off flavours upon exposure to light. Maujean and Seguin (1983) demonstrated that 'lightstruck' flavour (goûts de lumière) is due to the formation of volatile sulfur compounds, which are believed to be derived from the sulfur-containing amino acids, methionine and cysteine. Riboflavin (vitamin B2), which is present in low levels in musts and wines, undergoes photo-activation and subsequent reduction when exposed to light at wavelengths of 370 nm and 440 nm. The sulfur-containing amino acids may in turn be oxidised, and subsequent reactions result in the formation of the sulfur compounds responsible for the sensory off character.

Dozon and Noble (1989) found that exposure of still and sparkling white wines, bottled in green glass, to light emitted from fluorescent lamps resulted in the production of the lightstruck flavour. The intensity of the flavour was statistically significant in the still and sparkling wines after exposure for 31.1 hours and 18 hours, respectively. In comparison, the same wines stored in clear glass developed a statistically significant level of the off flavour after exposure for only 3.3 hours and 3.4 hours, respectively. Sensory assessment of the affected wines using descriptive analysis indicated a decrease in 'citrus' aromas and an increase in 'cooked cabbage', 'corn', 'wet wool/wet dog' and 'soy/marmite' aromas.

The trials described above involved placement of wines a distance of 35 cm from two 40 watt fluorescent lamps. Illuminance decreases proportionally with the square of the distance from the light source, and as wine is likely to be stored considerably further from light sources in most winery storage and retail display situations, the amount of light incident on bottled wine will be significantly less than in the trials described by Dozon and Noble.

The intensity of fluorescent lamps relative to the illuminance of the sun should also be considered. A 36 W fluorescent lamp with an illuminance of 400 lux will provide approximately 14 mW/m^2 of UV-A radiation[1], while UV-A radiation in full sunlight will be 60,000 mW/m^2 (Gordon Watson, Gordon Watson and Associates, *pers. comm.*). In other words, direct sunlight provides 4286 times the amount of UV-A radiation as fluorescent lamps. Further, the spectrum of light emitted from fluorescent lamps will contain discrete peaks, the wavelengths of which are dependent on the phosphors used to coat the inside of the tube, whereas sunlight provides a relatively continuous distribution across the entire visible and ultra-violet spectrum. It is likely that exposure of bottled wine to sunlight, as may be the case in retail window displays, will be more deleterious to wine quality than exposure to electric lighting systems.

The role of light in copper instability

Another negative aspect of the exposure of wine to light is the potential for such exposure to exacerbate copper instability in susceptible white wines. The Institute has in the past investigated several cases of haze in white wine in which it has been observed that bottles of wine stored on the uppermost layer of bins have developed a haze, while underlying bottles have yet to display any precipitation. In such cases it is invariably found that the haze in the wine is attributable to copper instability. The Institute recommends that white wines containing a concentration of copper greater than approximately 0.5 mg/L are likely to be susceptible to copper haze, and if the level is greater than this arbitrary limit, protection from exposure to light will only delay the inevitable.

What are the ideal storage conditions for bottled wine?

In view of the effects described above, it is recommended that wine be stored under insulated and/or temperature-controlled storage conditions, which minimise fluctuations in both temperature and humidity. The use of miniature temperature logging devices which record temperatures at regular intervals is suggested as a means for the monitoring of temperature fluctuations during storage and transport. The data from these temperature loggers can be downloaded to a computer for subsequent perusal.

The careful selection of glass colour can assist in the prevention of problems associated with exposure of bottled wines to light. Rankine (1989) indicates that amber glass is most effective in excluding wavelengths below about 450 nm. Sadly, the colour of the glass selected is likely to be dictated more by marketing concerns than by technical concerns, however. Of the investigations conducted at the Institute in recent years which have identified copper instability

[1]UV-A radiation generally refers to that part of the spectrum in the range 320–400 nm (Salisbury and Ross 1992).

as a cause of haze in white wines, a disproportionately high number involved wines in clear glass bottles.

Some potential solutions for the minimisation of lightstruck flavour involve the manipulation of wine composition, in order to prevent the formation of the compounds responsible. Minimisation of the concentration of sulfur-containing amino acids might assist, but would be difficult to achieve in practice. Similarly, minimisation of the concentration of riboflavin might prevent the problem from occurring. Pichler (1997) suggests the selection of yeast strains which have decreased ability to biosynthesize riboflavin, or the adsorption of riboflavin by adsorption on bentonite. Maujean and Seguin (1983) described trials using a range of treatments to eliminate the problem; addition of copper ions provided a means for treatment of the sulfur compounds responsible for the off aroma; dithionate ions to reduce riboflavin and thus prevent its photoactivation; and the addition of tannins to reduce the speed with which the sulfur compounds are formed.

It is important to note that some wines may be significantly more susceptible to the problem than others. For example, the liberation of amino acids from yeast cells during autolysis, as occurs during the tirage process in the manufacture of *methode champenoise* wines, may result in an increase in the concentration of sulfur containing amino acids compared with that in the base wine prior to tirage.

The Institute welcomes comments or contributions from winemakers with regard to the effects of heat and light on wines during storage, as these may help us to learn more about how best to store wine.

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