Sparkling wine gushing: not a cause for celebration

Many consumers have had the experience of opening a bottle of sparkling wine and having the contents spontaneously gush from the bottle. In this column, AWRI Oenologist Ben Cordingley addresses questions asked by sparkling winemakers about why unintentional gushing occurs, the main causes, and what steps can be taken to prevent its occurrence.

What is gushing?

A bottle of sparkling wine can release five litres of gaseous carbon dioxide (CO_2) after opening, ideally in a controlled manner, giving a sparkling wine its distinctive effervescent character. Gushing is the rapid and uncontrolled increase of gas volume that results in the expulsion of foam from a bottle of sparkling wine. Producers can experience substantial economic losses if affected bottles need to be replaced for consumers. Gushing wines can also pose a safety risk, as consumers can be injured by fast-moving corks. Gushing can occur sporadically or across an entire batch, which may require the wine to be reworked.

Positive bubble formation in sparkling wine

The release of gas microbubbles gives rise to the effervescence of a sparkling wine, and the nature of the microbubbles affects quality parameters such as the appearance, mouth-feel and foam behaviour (Cilindre *et al.* 2010). The chemical composition of a wine influences the bubble formation and the positive foaming properties of sparkling wines. Sparkling wines with desirable foam behaviour often contain surface-active grape- and yeast-derived proteins. These 'foam-active' proteins increase the surface tension of the gas/liquid interface of a microbubble, which gives stability to the bubble and leads to a fine persistent foam character.

Which factors influence gushing and what steps can be taken to prevent it occurring?

Excessive carbon dioxide

Australian sparkling wine must contain a minimum of 5 g/L of dissolved CO_2 that is surcharged into the wine from either direct carbonation or secondary fermentation in bottle or tank. Wines with levels of carbon dioxide greater than 12 g/L are more likely to gush, highlighting the importance of correct calculation and addition of tirage liqueur in traditional method sparkling wines.

Inadequate cold stabilisation

Any solid material in a sparkling wine bottle can act as a nucleation site for bubble formation, where its rough surface can store trapped gas and encourage rapid degassing and gushing. The most common solid the AWRI helpdesk has observed in cases of gushing is potassium hydrogen tartrate (KHT) crystals that arise from inadequate cold stabilisation. When checking the stability of a sparkling base wine that will undergo secondary bottle fermentation, the base wine can be fortified with an addition of 1-1.5% ethanol to model the increase in alcohol produced from secondary fermentation, as this alcohol increase will reduce the solubility of KHT and increase the risk of instability. Crystallisation inhibitors are available as sparkling wine specific formulations that may provide additional protection against cold instability. More information on these additives is available from suppliers.

Precipitated pigment, other solids, or poor-quality glass

Sparkling red wines represent a significant number of gushing cases investigated by the AWRI, often due to changes in stability resulting from precipitation of pigment and tannin complexes. Other gushing inducers include calcium tartrate crystals, diatomaceous earth, cork dust and metal hazes. Poor-quality glass with a rough inner bottle wall can also be a source of greater numbers of nucleation sites and an inducer of gushing.

Residual yeast

Any residual yeast lees left in a sparkling wine will also increase the likelihood of gushing. This might occur in pétillant naturel (pét-nat) style wines or if riddling has been ineffective before the disgorgement of traditional method wines.

Nitrogen and oxygen gases

Dissolved oxygen or nitrogen can induce gushing due to the low solubility of these gases in wine, with the nitrogen or oxygen forming gas bubbles upon opening much more rapidly than CO_2. Nitrogen gas can also remain undissolved in wine as small gas bubbles that function as nucleation sites for the explosive evolution of CO_2 bubbles (Loitsch 2000). Headspaces of secondary fermentation tanks should thus be flushed with CO_2 before sealing to remove oxygen and nitrogen. Base wines should not be sparged with nitrogen and aeration should be kept to a minimum.

Botrytis

Fungal diseases can decrease proteins responsible for positive bubble formation and foam stability by producing protein-degrading enzymes (proteases). A recent study by Kupfer *et al.* (2017) demonstrated that wine made from Botrytis-affected fruit had low protein diversity and lower total protein levels, but contained higher levels of hydrophobins, which are proteins that induce gushing. The study proposed that gushing wines often lack balance between hydrophobins that induce gushing and foam-active proteins that protect against gushing.

For further information about sparkling winemaking or other technical winemaking or viticulture questions, contact the AWRI helpdesk on (08) 8313 6600 or helpdesk@awri.com.au.

References

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