

WHY SPARKLING WINE HAS BUBBLES. HOW BUBBLES FORM, GROW AND BURST

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The production of sparkling wine starts with a base wine to which a mixture of sugars and yeasts (*liqueur d'expédition*) is added. In the presence of sugars, yeasts are activated by transforming them into alcohol and carbon dioxide, which is the source of the effervescence. Fermentation takes place inside a pressure tank or in the bottle, depending on whether the production method is Charmat or Classic.

The carbon dioxide produced remains trapped in the form of molecules dissolved in the liquid in the corked bottle or in the pressure tank. When wine is in the glass, carbon dioxide is dispersed in two ways: through the surface of the liquid or through the formation of bubbles.

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When and how bubbles are created

Bubbles are formed when the gas molecules dissolved in the liquid join together and make their way up to the surface through the other molecules of which the liquid itself is composed. The formation of bubbles is therefore limited by an energy barrier intrinsic to the liquid.

While the creation of bubbles initially requires a large amount of energy, once they are formed and expand less energy is required.

According to scholars, bubbles are formed in two ways: they either come from gas pockets already found on the walls of the glass (heterogeneous nucleation), or they appear in the liquid without the help of pre-existing nucleation sites, i.e. from pockets of gas (homogeneous nucleation).

The pockets of gas must be of a certain size in order for bubbles to form in the sparkling

wine; in this way the carbon dioxide molecules cross the energy barrier of nucleation, naturally assuming the appearance of bubbles.

Where are the nucleation sites located?

The nucleation sites of the bubbles are found in the impurities attached to the surface of the glass; they consist of elongated cellulose fibres from fabric or paper that come to rest on the glass from the surrounding air or are left on the glass after it has been washed and dried.

Each fibre contains a cavity, called a lumen, whose geometric characteristics prevent it from becoming completely dampened by the sparkling wine poured into the glass. Consequently, small amounts of air remain trapped even if the glass is full.

In fact, a sparkling wine poured into a perfectly clean glass, that is, with walls free of any impurities, would not be effervescent at all. Any excess carbon dioxide molecules would escape from the free surface of the liquid.

The pockets of gas trapped in the lumen increase in size with the continued accumulation of carbon dioxide molecules. As a result, a small bubble comes out from one end of the fibre or from both ends.

However, a small pocket of gas remains trapped, and it is precisely here that new bubbles are formed at the nucleation sites and then break away.

As long as there are carbon dioxide molecules dissolved in the sparkling wine, new bubbles will continue to form.

Once the bubbles have formed and been released from their sites, they rise towards the surface of the sparkling wine in a line, increasing in size during ascent as further carbon dioxide molecules enter the bubbles.

The frequency of bubble production

The production frequency of the bubbles is the number of bubbles produced in a second.

The frequency of formation at a given nucleation site progressively decreases with the passing of time and with the decreased content of carbon dioxide dissolved in the liquid; we in fact know that this progressively escapes from the wine when it is poured into the glass. Particles of different shapes and sizes normally adhere to the side of the glass, which is why different frequencies of bubble formation can be observed in the same glass and at the same time.

You may have noticed that vintage sparkling wine has a greater number of small bubbles than a young sparkling wine. This happens because the caps and wire muzzles do not seal the bottle hermetically, and small amounts of carbon dioxide slowly escape during the aging process in the cellars. Bubble growth is therefore lower than in a younger sparkling wine.

“Archimedes’ thrust”

Bubbles, then, form and grow when they rise in the glass of sparkling wine. But what causes the bubbles to rise to the surface? The force behind the rise of the bubbles in sparkling wine is known as “Archimedes’ thrust”. Archimedes’ thrust basically causes bubbles to detach themselves from the side of the glass, and then to make their way towards the surface through the molecules of the liquid. But bubbles are also subject to the force of attraction and cohesion of the molecules present in the liquid that surround them. This force holds back the bubbles and slows their rise.

The bubbles burst and disappear

A few seconds after their creation, the bubbles reach the free surface of the glass, but emerge only partially above the surface of the sparkling wine. Most of the volume of the bubble is in fact immersed below.

The portion of the bubble that presses against the surface is a spherical liquid film that becomes increasingly thin and fragile, sensitive to every slightest variation in pressure and temperature. When it reaches a critical thickness, a small hole appears in the envelope of the bubble which gradually widens, pushed by the forces of surface tension, and bursts. The bubble bursting process takes only tens of microseconds.



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