

Lutz Kasper · Patrik Vogt

Uncorking the Physics of Wine

A Wine Tasting
in 50 Experiments



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Preface

Wine and physics—how do they go together? Where one is based solely on pleasure, the other may be associated with school trauma for some. Fine aromas and very relaxed situations on the one hand, chalk-dusty formulas and exam stress on the other. At least that’s a widely held stereotype. But those who engage with it can also enjoy physics. With this book, we want to encourage our readers to rediscover the physics “behind things” or to see it from a new perspective and to enjoy it in a relaxed manner. We have chosen the topic complex “wine” because it offers a variety of connections to the world of physical phenomena in its richness of facets and not least because we appreciate the grape juice itself very much.

With this, we bring two ancient cultures together: the culture of wine with its several thousand-year-old history and the culture of physics, which can look back on over 2000 years, at least in its ancient philosophical roots and mechanical-practical origins. We are not the first to have seen such a connection. Already in the first century AD, Heron of Alexandria dedicated a significant part of his mechanical and pneumatic inventions to the decanting and refilling, portioning, and automated mixing of wine. We will discuss this later in the book. Some of the ideas compiled here are good old acquaintances from experimental physics lectures, while others are our own developments from our long-standing efforts to teach physics in real-life contexts at schools and universities.

The sequence of all the experiments presented here follows less the physical subject structure known from textbooks, such as mechanics, thermodynamics, etc. Instead, we try to orient ourselves on the course of a wine tasting or a successful evening with friends and good drinks. So we start

with the opening of wine bottles in an astonishing methodical variety. Keep your corkscrew, but rest assured that in case of need, it can also be done with trees, kitchen torc, or bicycle pumps!

Once the bottle is opened, it often comes down to the correct aeration. Of course, one can make a meditative ceremony out of it. And some wines certainly deserve it. But what do you do when the guests arrive unexpectedly early? Decanting in under 60 s and emptying the bottle in 2 s could be a solution here. Aeration is usually followed by pouring, and should a drop spill, we have a scientifically proven excuse for you here.

We devote a larger part of the experiments to the complex gustatory perceptions that are obvious—or rather on the palate—in addition to the acoustic and optical phenomena. These are mainly offered to us by the “accessories”, the glasses and bottles. We make them ring, sing and vibrate in resonance. We look in and through the glass, put on a red wine glasses and also show which tricks turn red wine into Blanc de Noirs or even water.

In a predominantly mechanical department, we become acrobatic and seemingly defy gravity. Floating corkscrews and glasses, or even the brimful spritzer glass in the somersault swing, will encounter you here. Or you can let Pythagoras himself teach you modesty.

At the end of the wine tasting, we may have run out of wine, but not the physical attention. We can still experiment with the remnants, the empty glasses and bottles, the candles, and the tablecloth.

You will see, a wine tasting is above all one thing: applied physics! Let yourself be inspired to experiment, to ask questions and give answers. And all this without any exam stress. All the experiments presented here have been successfully carried out by us several times. The vast majority of them can be carried out without special equipment. As a rule, just what is found on the table during a convivial evening is sufficient. For some measurements, we have used smartphone apps, which are available free of charge with few exceptions. However, as authors, we take no responsibility for any broken favorite glasses, unpredictable champagne corks, or red wine stains on clothing and furniture! In any case, we wish you an unclouded and significantly elevated wine enjoyment through physics and agree with Charles Darwin at this point: Only a fool doesn't experiment!

We thank Dr. Susanne Ihringer and Kevin Kärcher from PH Schwäbisch Gmünd for their helpful advice and experimental support on chemical issues.

Above all, we would like to finally thank our families and especially Kathrin and Diana for patiently enduring resonating bottles, singing glasses, cracking wooden slats, shattered glasses, and some strange arrangements on

domestic tables, as well as for their great support in experimenting and for valuable feedback on texts or illustrations. The book would not have become what it is now without you, or not at all.

in March 2022 / May 2024

Lutz Kasper
Patrik Vogt

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1

In the Beginning is the Cork: Physics of Bottle Opening

Before we can begin—both with the wine tasting and with the experimenting—we have a sealed wine bottle in front of us. Usually, this poses no challenge and without paying much attention to the process, the cork is pulled out. But even this beginning of a wine tasting has its physical intricacies. Why is the cork stuck so tightly (we will not pay attention to bottles with screw caps in this chapter)? What causes the familiar sound when uncorking? What to do if no corkscrew is at hand? What pressure is actually in a champagne bottle? We will find answers to these questions in the first eight experiments and also take a look at the corkscrew as a force-saving machine.

Uncorking Wine and Champagne Bottles

Experiment 1: “Pop”—How Fast is Sound?

A still sealed wine bottle, a corkscrew and a smartphone are undoubtedly a promising combination. Notify good friends with one device and pull the cork out of the bottle with the other—what more could you want? But perhaps in addition to the throat, the “mind” is also thirsty and it should not be neglected here. So physical mindfulness is practiced right from the start, namely when opening the bottle. The characteristic pop sound when opening the bottle can give us information about the speed of sound (Kasper & Vogt, 2020). This is where the smartphone comes into play again. But first: