The sensory science behind wine tasting

A succinct look at the fundamentals of what we taste and smell in our wine, and why

Alex Russell

MISCONCEPTIONS ABOUND WHEN it comes to understanding taste and smell perception. One example is the ‘map’ of tastes on the tongue, which presents the idea that the receptors for different tastes are located on different parts of the tongue, e.g. sweetness on the tip of the tongue, or bitterness at the back. Beer tasters have used this as an excuse to swallow samples rather than spit them out, as bitterness is an important component of a beer’s flavour.

Unfortunately for the beer tasters, this simply isn’t the case. While some tongue (and cheek and throat) areas may have higher concentrations of receptor cells for a certain taste, all areas of the tongue seem to be able to pick up all of our primary tastes, including sweet, sour, bitter, salty and umami, referring to savoury or meaty tastes. Besides, bitterness is usually associated with poison, and there wouldn’t be many of us left if we only detected bitterness just before we swallowed.

Taste and smell

Everyone has heard of our primary tastes, but in terms of wine, the most important ones are sweetness (sugar levels) and sourness (acidity).

Wine-tasting is actually a misnomer. When we put a wine in our mouth, we want to know more about it than just the five main tastes. We want to know flavours, too. This brings us to smell.

Our sense of smell comes from receptors in our noses reacting to volatile chemicals. We do not have specific receptors for specific odours – there is no passionfruit receptor, for example. Our brain decodes the complex signals coming from our receptors to tell us what we are smelling. When you think about how many smells there are in the world, you may begin to realise just how much is going on in your brain every time you smell something.

Some smells are due to just one chemical (an odorant), but most are due to combinations of odorants.

For example, tomato contains about 400 volatile odorants, although we can recreate the smell with as few as 16 of them in the right concentrations.

These chemicals can reach the olfactory epithelium via two routes. The first is through our nostrils (orthonasal olfaction) and is what most of us think of when we talk about smell. The other route is through the internal connection between the nose and mouth. Have you ever been drinking something and laughed so hard that it came out of your nose? That’s the passage that odorants take when travelling from your mouth to your olfactory epithelium (retronasal olfaction).

The odours in wine

Wines are complex mixtures of hundreds of chemicals. Some of them have an impact on the flavour of the wine. Others cannot be detected by taste and smell, either because they are not of sufficient concentration, or are outside of our detectable range of chemicals.

We know a bit about the chemicals in wine and which ones are important in wine flavours. For example, Howell and colleagues described 4-mercapto 4-methylpentan-2-one (4MMP) as the main chemical behind box tree (Sauvignon Blanc) or blackcurrant (Cabernet Sauvignon) flavours. The concentration of these chemicals is also critical. At 0.1ng/L, you will perceive box tree or blackcurrant flavours, but when 4MMP reaches 3ng/L, it will instead smell like cat’s urine.

In 2008, Alan Pollnitz and colleagues at The Australian Wine Research Institute wrote about rotundone, a chemical found in pepper. It is also an important odorant in Shiraz, so there is a chemical basis behind describing a Shiraz as being peppery. Shiraz wines from cooler climates are generally thought to be more peppery and, sure enough, generally have higher concentrations of rotundone than those from warmer climates.

Wine flavour

Our perception of the flavour of a wine in our mouth is a combination of taste (sugar levels, acidity, etc) and retronasal olfaction (those pepper notes in that Shiraz, or those passionfruit flavours in that Sauvignon Blanc). There is also an element of touch involved (temperature, viscosity, etc).

Tannin has no smell or taste – it is detected by how the wine feels in your mouth. Despite this, it has an important role in the flavour of a wine.

If seeking to detect more flavour, when you have a mouthful of wine, breathe in through your mouth and out through your nose. More of these odorants will reach the olfactory epithelium via retronasal olfaction. It’s the smell equivalent of turning the volume up on the stereo.

Vision also makes a very important contribution to flavour. The appearance of a wine will give you clues about its flavour. An almost colourless white wine will usually indicate youth and acidity, while an opaque, crimson red wine will often indicate a full-flavoured monster. Once you have these expectations, they can shape your subsequent flavour judgement.

In 2001, Morrot, Brochet and Dubourdieu asked experts to describe white wines that had been coloured red. These experts described them as though they were red wines, because that’s what they expected to taste.

Malika Auvray and Charles Spence argue that perhaps flavour should not be considered a discrete sensory system, since our other senses have an impact on what we perceive. For more on this, Google ‘The multi-sensory perception of flavor’.
Describing a wine

Consider visual perception. It’s relatively easy to describe an object to someone in enough detail that they can imagine it. It’s much harder to do this with smell and taste. Generally, humans are pretty good at odour detection and discrimination, but we’re not very good at odour identification. Raid your pantry and give your friends a few things to smell. They will find it difficult to correctly identify many of them without hints or visual cues. It’s even worse when we mix them together.

University of New South Wales Professor of Neuropsychology David Laing found the limit of elements in a mixture that we can identify is four, even after training. But, when we look at some tasting notes, there are often half-a-dozen or more identified odours and flavours. We know that experts do not have superior noses to novices. It’s all about how the expert thinks about the wine. Expertise is cognitive, not perceptual.

Let’s say that you’re given a red wine at a blind tasting. You know nothing about it apart from what you see, smell, taste and feel. For the experienced wine taster, it will be relatively easy to tell which grape has been used, or if a Shiraz contains a splash of Viognier. Furthermore, an experienced taster can detect flavours that will give a clue as to how the wine was made, such as the type of oak used, or whether malolactic fermentation occurred. And, we haven’t even discussed fault detection.

To the untrained taster, this seems like some sort of witchcraft. The exact same odorants enter their noses and react with their receptors, but they don’t know how to mentally dissect the flavours into meaningful pieces of information. Even with aids, like Ann Noble’s Wine Aroma Wheel, describing a wine is a very difficult task for a novice and something that takes a lot of training to learn. Attempting to identify the grapes used in a wine is well out of reach for most novices.

At first, all of us are novices but, over time, we learn how to locate, isolate and identify elements in wines. Some argue that, instead of identifying pepper and then thinking about Shiraz, experts actually identify Shiraz and then think about pepper.

Another suggestion is that experts know what elements are important and are, therefore, better able to ignore irrelevant information entering their nose. Think about what happens when you taste a Shiraz. You detect rotundone among the hundreds of other odorants that enter your mouth and nose. By contrast, novices don’t know which flavours are important, or where to look for them in the cloud of chemicals that hits their receptors.

There are many questions about exactly how wine experts perceive and dissect wines when they judge them. We are just beginning to scrape the surface.

One thing we have discovered is that novices cannot learn to use just any old word to apply to a smell or taste, at least not in the short term. When learning to use a word to describe an odour, the word needs to be a decent match for the smell. If a wine is not particularly peppery, they cannot learn to describe it as peppery. If you want to teach a novice about what a peppery Shiraz smells and tastes like, you will need some clues.

Smell and taste are remarkable senses that handle these complex chemical analyses with ease. The difficult part is teaching our brains to decode the results. We still have a lot to learn about these processes.

Further reading

The authors suggest The Taste of Wine, by Emile Peynaud, What the Nose Knows, by Avery Gilbert, and The Psychology of Flavour, by Dick Stevenson.

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