Utilizing a Systematic Approach for Tasting Wine to Build Taste Memory

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Abstract

Tasting wine is believed to be complex and requiring of comprehensive understandings of grapes, regions, wines, and laws. By following a repeatable, systematic method to tasting, tasters of all experience levels can begin to develop a deeper understanding of wine and to develop their taste memory. Each element of the tasting approach is broken into components that describe how to record tasting notes, as well as describe the impacts of winemaking on specific visual, chemical, aroma, and flavor attributes.

Introduction

A holistic approach to wine tasting and development of a perspective on wine styles, varietals, countries of origin, and regions is critical to building taste memory. The imperative with this approach is about building a wine knowledge base that can be utilized for practices such as tasting wines blind.

When approaching wine tasting in this way, it is essential to record perceptions and thoughts about the wine while tasting. This can easily be achieved by bringing a small notebook to the tasting event and taking notes during each wine experience. The benefit of note taking is the ability to revisit thoughts at the completion of the tasting event or at any time in the future. Tastings generally include multiple wines and the mind's ability to recall and distinguish between sets of tasting memories is limited by its working memory (Lim et. al., 2022). This means that characteristics of wines may be intermixed, resulting in confabulation rather than accurate recall of individual wines. Tasting notes, however, provide an unchanging reflection of the experience.

No matter the experience level of the taster, understanding how to record notes and how to evaluate wines is integral to building a taste memory.

Recording notes

A myriad of wine journal options exists, many of which are organized for tasting whites, reds, rosés, sparkling, fortified, et cetera. Others will have rubrics on each page to dictate what to write and where to write it. This format may be helpful for the nascent taster who is intimidated by a blank page and may be an effective training guide for those who are easing into recording tasting notes. However, the specificity of these books locks the taster into a specialized framework and often provides little space to record the true reflections of the wines from the tasting. Therefore, a simple, spiral-bound notebook is more than sufficient for tasting notes.

When looking for a tasting note repository, three rules apply: find something that has lined pages, is bound, and is portable. While the lack of lined pages is not a hard requirement, it will provide the minimum amount of structure to organize thoughts and will make it easier to review the notes in the future. Having a bound notebook is important because it keeps the notes organized, in one place, and maintains them in chronological order. Not that an anachronistic review of tasting notes is inherently bad, rather, reviewing notes chronologically will show the evolution of the taster's note taking style and may elucidate a change in taste preferences over time. Additionally, loose pieces of paper are more apt to be misplaced, decreasing the ability to refer to old tasting notes. Portability is key because it allows for easy transportation to tastings outside of the home (e.g., wine shop, winery, friend's house) without being incumbered by an inconvenient, large, or heavy note repository.

There are apps and online note repositories (e.g., Vivino, CellarTracker, Wine-Searcher) that are great alternatives to physical notebooks. Digital alternatives give the taster the freedom to take notes in almost any setting and do not require the foresight to remember to bring a physical notebook to tastings.

Evaluating the Wine

There are many methods for evaluating wines. This article expands on the salient elements of a wine's evaluation and utilizes the general framework established by the Wine & Spirit Education Trust (WSET). This organization provides several free wine evaluation rubrics that can be referenced during tasting events (WSET, 2016). Other organizations have developed methodologies for evaluating wines that are aligned to their certification programs (e.g., Advanced Certificate from the Wine & Spirit Education Trust, Advanced Wine Certificate from the International Sommelier Guild, Certified Specialist of Wine from the Society of Wine Educators). It is advised that tasters pursuing specific certifications adhere to the organization's standards.

Staring at a glass or a flight of glasses of wine can be intimidating. The systematic approach to evaluating wine mitigates the taster's anxiety by breaking down tasting notes into 4 sections: appearance, nose, palate, and overall impression.

Appearance

Within the category of appearance, focus on color, clarity, and presence of dissolved gas (e.g., bubbles). In addition to the above categories, wine drinkers may refer to the "legs" of a wine as a heuristic of quality. The phenomenon of legs is explained by the Marangoni Effect and is related to the evaporation of alcohol and evaporative cooling (Venerus & Nieto Simavilla, 2015). Plateau-Rayleigh instability, the explanation of a liquid's proclivity to bead up due to surface tension (Rapp, 2017), further describes the beading formations observed in the glass. Rather than indicating wine quality, slowly streaking legs observed on the bowl of the glass indicates higher levels of alcohol, glycerol, or higher levels of sugar.

Color

Color is evaluated with regards to the hue and the level of concentration or intensity. To evaluate color, pour wine into a glass, tilt the glass to disperse the wine and increase the surface area, and put the glass in front of a white or light-colored background. Placing a white piece of paper behind the glass neutralizes the background and allows for the eyes to focus on the color of the wine. Color can be a great indicator of a wine's age. As a wine ages, the color will transition into a golden, brickish, or brown hue. This is true for all wines, apart from wines that endure heavy levels of oxidation during their production and prior to bottling (e.g., Madeira, Oloroso Sherry). A common example of this color change phenomena is a white wine's shift from a pale lemon color to a golden hue over a period of years (Figure 1). Additionally, a red wine may begin its life with a bright ruby color but develop a browning rim or tawny color. These color shifts are attributed to oxidation and to the agglomeration of the pigments (e.g., anthocyanins) and tannins (i.e., the compounds that provide bitterness and drying sensations) in the wine (Jackson, 2020). As these compounds combine, the wine's color will change, and some agglomerates will precipitate out of solution. That is why old bottles of wine will have sediment on the bottom or along the side of the bottle. If a wine is young (e.g., 1-2 years old) and showing premature color change, it can be due to an array of reasons, including a bad closure (i.e., corks are natural products and some have faults that allow for higher-than-normal amounts of oxygen transfer), barrel ageing (i.e., aging in wooden barrels allows for more oxygen contact during maturation and imparts color from the oak), or bad winemaking practices (i.e., not protecting the wine from oxidation through interventions like the addition of sulfur in the form of potassium metabisulfite).

How the agglomeration of molecules results in color change

Human eyes perceive color based on the wavelengths of light that are reflected from an object (Mukamal, 2017). For example, objects that are perceived as green reflect green light wavelengths (495-570 nm). This means that as molecular shape or orientation change, the wavelengths of light that are reflected change. When pigments and tannins agglomerate, the color changes because wavelengths of light are scattered and reflected at different rates (Ustin & Jacquemoud, 2020), resulting in the change in perceived color.

Figure 1: Color change in white wines due to oxidation and aging (Jackson, 2020)

There is an expansive lexicon used by tasters when describing the color of wines. Aligning to a set of colors that are broken down by hue and intensity (Table 1) allows for tasters to communicate characteristics more efficiently. Intensity is categorized as pale, medium, and deep, with pale being the most translucent and deep being close to opaque. However, color intensity has no empirical measure. The color and translucency of water can be used as a close analog of the pale categorization. White and rosé wines are commonly characterized by this color intensity, whereas red wines rarely meet this criterion. Medium intensity tends to be the catch-all for most red wines. When evaluating red wines, if the stem of the wine glass is visible through the wine, then it is generally considered medium color intensity. Deep color intensity is used for red wines that are nearly opaque (e.g., Petite Sirah) and white wines with a significant amount of color (e.g., Sauternes, Trockenbeerenauslese Riesling).

Clarity

Clarity is recorded as clear or hazy and should be measured separately from color intensity. As mentioned above, a wine may have such a high concentration of color that it appears opaque but is still recorded as clear because it is not opaque due to the presence of suspended solids. Suspended solids (e.g., dead yeast cells) are anything that is not dissolved into solution and causes light to be refracted. A wine containing precipitated tartrates (also called "wine diamonds"), sediment in aged wines, or pieces of the cork that broke into the wine during the opening of the bottle would not cause a taster to record the wine as hazy. The majority of wines that are encountered by the public in the market or at wineries will be characterized as clear. The two exception categories are wines that are unfiltered and wines that have some type of microbial spoilage (e.g., Pediococcus, Brettanomyces).

Dissolved Gas

Carbon dioxide is produced during the fermentation of all wines. While sparkling wines have highly visible bubbles, all wines will have some level of dissolved gas. Oxygen, nitrogen, and other gases may also be dissolved in the wine. However, carbon dioxide is the primary focus during tastings due to its higher concentration and contribution to the appearance and taste of the wine. In "still" wines (i.e., wines that are not considered sparkling wines), tiny bubbles may be visible on the rim of the glass. In French, this is referred to as pétillance. This indicates that there are barely perceptible levels of dissolved carbon dioxide in the wine and that the wine is likely to be freshly bottled (i.e., within the last few months) or young (e.g., 1-2 years old). Varying levels of dissolved carbon dioxide in a wine will alter the organoleptic qualities of the wine, namely impacting texture and perception of brightness. However, this section of the wine evaluation is only interested in the visual perception of dissolved gas. For enthusiasts, a carbodoseur is a fast and simple way to determine the concentration of dissolved gas in a wine.

Table 1: Colors used for describing wines

Wine Type	Color	Description	Example Wine
White/ Sparkling	Lemon-Green	Not very common. Contains yellow and green hues.	Hunter Valley Semillon
White/ Sparkling	Lemon	The most common color used for characterizing white wines. Often referred to as yellow.	Sancerre
White/ Sparkling	Gold	Common for older wines, and wines with barrel maturation or skin contact. The intensity of yellow is greater and color is transitioning from yellow to include low concentrations of brown.	Barrel aged high-quality White Burgundy
White/ Sparkling	Amber	Mainly used to describe dessert wines, fortified wines, or wines with significant bottle age. Browning is present.	Amontillado Sherry
Rosé	Pink	The lightest of the rosé colors. Small amounts of color extraction during fermentation.	Provençal Rosé
Rosé	Salmon	Indicative of longer extraction times during the fermentation process. A combination of pink and orange hues.	Tavel Rosé
Rosé	Orange	Typically a result of extended skin contact with white grapes. Little to no hues of pink or red.	Skin contact Georgian wine
Red	Purple	Dark and intense with little to no hues of red or brown.	Petite Sirah
Red	Ruby	High levels of red hue. This should look like the color of the gemstone.	Red Bordeaux
Red	Garnet	Mostly red with elements of brown.	Pinot Noir
Red	Tawny	Brown hues dominate. Small amounts of red or purple may be present. Like the amber color for white wines but used for describing red wines.	Tawny Port

Nose

There is a lot of wine specific terminology used during tastings and thus it is necessary to clarify the difference between nose, aroma, and bouquet. Nose is a general term used to describe everything that can be smelled from the wine. Aroma is more specific and is characterized as the scents related to the grape and grape derivatives (e.g., fruit, floral, herbal, vegetal). The bouquet relates to smells that come from the winemaking and aging processes (e.g., bread, spice, torrefaction).

Furthermore, some tasting paradigms, including the WSET (2016), break wine into primary, secondary, and tertiary aroma categories. With this categorization, the term bouquet is omitted, and aroma is used to cover all descriptors. Primary aroma accounts for the grape characteristics mentioned above for aroma

and is typified by fresh qualities (i.e., fresh fruit qualities versus dried fruit qualities). Secondary aroma is specific to the scents derived from the winemaking process (e.g., yeast, bread, butter). This also includes aromas that come from aging wine in barrels (e.g., spice, vanilla, dill, butterscotch). Tertiary aromas are defined as scents that develop due to aging (e.g., dried fruit, leather, nuts). An example of tertiary aromas in aged Riesling is the development of diesel or petrol aromas due to the degradation of carotenoids and formation of 1,1,6-trimethyl-1,2-dihydronaphthalene (TDN) (Black et. al., 2012).

The determination of specific scents is difficult for many tasters (e.g., raspberry, blueberry, pink peppercorn). A good starting point for evaluating the aromatics on the noes is to use smell and flavor groupings. In practice, this means bucketing aromas into categories, like red fruit or blue fruit, rather than calling out specific types of fruit. This methodology can be employed with primary, secondary, and tertiary characteristic descriptors. The evaluation rubrics linked at the end of this article provide a comprehensive list of aroma and flavor groupings.

In addition to recording the characteristics of the wine's aroma, it is important to record the intensity of the aromas. Intensity is measured as light, medium (-), medium, medium (+), and pronounced. A wine described as light on the nose requires the taster to place their nose fully in the glass and necessitates labor to identify the aromatics. A pronounced wine can be smelled inches from the glass and the aromatics are unambiguously present.

The evaluation of a wine's aromas is not limited to positive qualities and an element of a wine's evaluation includes determining if the nose is clean or faulty. Not every commercial wine will taste will be fault free. Four of the most common wine faults are cork taint, volatile acidity (VA), reduction, and "Brett".

Cork Taint

Cork taint is caused by the compound 2,4,6-Trichloroanisole (TCA), which is created when mold interacts with chlorinated phenolic compounds. Phenolic compounds, which are naturally occurring in wine, and chlorine, which can be used in the wine production process, will readily attach to these phenolic compounds through a process known as electrophilic aromatic substitution (Wade, 2006). While the exact chemical process in which chlorine substitutes with hydrogen atoms to form chloroanisoles is less relevant to tasting, what is important is that chlorine and phenols undergo the process naturally and readily, without the need of special conditions. Therefore, areas in wineries where grapes, juice, or wine are handled will be devoid of chlorine containing compounds or cleaners. Mold is the other component required to produce TCA and can be found in many locations, including wineries. However, with regards to cork taint, it has historically been associated with cork and cork production.

Although TCA was not identified until the 1980s, wine contamination due to cork taint has been found in the literature dating back to the early 20th century (Jung &

Schaefer, 2010). Cork is a natural product and mold spores are often present when the cork tree bark is harvested. Up until the 1990s, the washing and cleaning processes used in the production of wine corks utilized bleach. The modernization of the wine cork manufacturing process has replaced bleach with peroxides and utilizes ovens to kill the molds found in freshly harvested cork bark. Even with these process improvements, it is estimated that 3-5% of wines under cork closure are still subject to TCA contamination (Robinson & Harding, 2015).

From a wine aroma perspective, cork taint is often described as smelling like wet cardboard, a dank basement, or a wet dog. While the characteristics of TCA's smell are true, the more significant effect is a muting of the prominent aromas that would be found in a different bottle of the same wine, leaving little to no smell at all. The easiest way to test if a bottle of wine has cork taint is to open a second bottle of the same wine and compare the aromatics. If opening a second bottle is not an option, inserting plastic wrap into the bottle and allowing the wine to contact the surface of the wrap (i.e., a surface phenomenon where TCA and other phenolic compounds are attracted to the surface of the plastic wrap and removed from the wine) before pouring another glass will mitigate the impact of the TCA contamination (González-Centeno et. al., 2021). Increased contact time (i.e., 48 hours of contact time has shown maximum effects) with the plastic wrap will continue to reduce the TCA impact and in some cases reduce the impact below typical sensory thresholds. However, since TCA poses no health risk, contaminated wines can still be consumed.

Why a restaurant pours a taste before leaving the customer with the bottle

When a bottle of wine is ordered at a restaurant, a server or a sommelier will pour a small amount of wine into a glass for the customer to taste. The common misconception is that this is done to allow the customer to ensure that they like the wine. However, this is done to make certain that the wine has no faults. Namely, if the wine is corked (TCA). Some restaurants may let a customer send the wine back if they do not like it, but that is generally frowned upon.

Volatile Acidity

Volatile acidity (VA) is a term used for scents associated with vinegar (acetic acid) and nail polish remover (ethyl acetate). Common causes of VA accumulation in wines are fermenting damaged or botrytized grapes, bacterial spoilage (e.g., *Acetobacter, Gluconobactor*) from high levels of oxygen contact wine the wine, and making wines with high pH levels (Hudelson, 2011). Naturally occurring yeasts and bacteria that produce VA are found in vineyards, on grapes, in winery facilities, and in the pores of the wood used to ferment and age wines. This means that fruit that has been damaged by weather, bees, birds, or other pests are prone to higher levels of VA. Managing the above risk categories by sorting out compromised fruit, protecting wines from oxygen contact (e.g., blanketing wines with inert gas, minimizing tank and barrel ullage), and acidulating grape must or wine (i.e., reducing the pH of wine through the addition of tartaric acid) will reduce the concentration of VA found in the final wine.

From a sensory perspective, low concentrations of VA can give a desirable sweetness to the nose of a wine. As the concentration of acetic acid increases, the sweetness will change to vinegar or other "chemical" aromas. Likewise, low levels of ethyl acetate can give a wine a green apple candy nose, whereas high concentrations create an unpleasant nail polish remover (ethyl acetate) aroma.

Reduction

Reduction is a term for wines that show aromatics of matchstick, rubber, rotten eggs, cabbage, garlic, et cetera. Chemistry defines reduction as a chemical reaction where a compound receives electrons from another compound. However, congruent with the wine industry's alternative use of the word oxidation, the wine term reduction differs from the chemistry definition. Rather, reduction represents a wine with high concentrations of sulfur containing compounds (e.g., hydrogen sulfide, mercaptans) (Robinson & Harding, 2015). For the purposes of this article, the wine industry's definitions of reduction and oxidation will be utilized.

If a wine is reduced, there are techniques that a winemaker can employ to remove the compounds or reduce their sensory impact. During the fermentation process, yeasts lacking proper nutrients, namely assimilable nitrogen, will utilize biosynthetic pathways that produce volatile sulfur containing compounds (De Guidi et. al., 2021). This process can be mitigated by adding nutrients (e.g., Fermaid K, GoFerm, BSG Superfood) or aerating the fermentation tank (e.g., breaking up the cap of grape skins on the top of the fermenter via punch down, mixing the wine by pulling juice from the bottom of the tank and spraying it onto the top of the tank, pulsing the tank with filtered compressed air or inert gas). Common techniques for reducing low levels of reduction during the aging process include racking the wine off the lees (the settled yeast cells) and incorporating oxygen into the wine (i.e., by stirring barrels or pulsing tanks of wine with filtered compressed air). While some sulfur containing compounds can be volatized by aerating the wine, others require chemical intervention. Wines that continue to show reduction can be treated with ascorbic acid (vitamin C) and copper sulfate. Ascorbic acid breaks disulfide bonds (sulfur-sulfur bonds) and copper sulfate binds to the resulting sulfur compounds and precipitates out of solution (Osborne, 2013). There is a low legal limit to adding copper sulfate to wines (e.g., 6.0 mg/L in the USA and variable by country), meaning that this intervention is viewed as a last effort to resolving reduction in a wine. Additionally, fining agents, like copper sulfate, are nonselective and remove more than just the targeted compounds. This means that desirable compounds will also be removed by the process.

When encountering a wine with reduction, the odors associated with reduction can often be mitigated by decanting the wine or swirling the wine vigorously in the glass. A common tasting adjunct is to drop a penny into a bottle of reduced wine to remove reduction. While it is true that copper reacts with compounds associated with reduction, it will only react with mercaptans, and pennies newer than 1982 only have 2.5% copper plating (Kaiser, 2010). Thus, the effectiveness of this intervention is limited by the amount of copper found in a penny and is considered minimally impactful.

Brettiness

The wine spoilage yeast *Brettanomyces bruxellensis*, colloquially referred to as Brett, is commonly used to produce beers (e.g., Lambic, Gueuze, Belgian) with unique smoke and spice characteristics (Colomer, Funch, & Forster, 2019). However, the sensory qualities resulting from the presence of this yeast in winemaking are attributed to the less desirable qualities of band-aid, sweaty horse, and barnyard. The two compounds, 4-Ethylphenol (4-EP) and 4-Ethylguaiacol (4-EG), contribute these unsavory characteristics to the wine and have a low sensory threshold ranging from 100 to 650 micrograms per liter (AWRI, n.d.; ETS Labs, 2015).

There are some old-world winemaking styles that rely on the sensory characteristics of Brett (e.g., south of France, Rhône valley) and some tasters have come to expect barnyard notes in these wines (Molesworth, 2009). Depending on the concentration of 4-EP and 4-EG, as well as the taster's preferences, these aromas can be viewed as either a flaw or intentional winemaking technique. 4-EG is viewed as the preferable aroma contributor, with clove, smoke, and spice being used as common descriptors. 4-EP provides the more austere medicinal and band-aid aromas.

Brett, specifically the yeast cells, can be removed from the wine through sterile filtration (Duarte, Coimbra, & Baleiras-Couto, 2017), and it is advised to filter a wine with Brett present because it can bloom in the bottle after bottling. The risk of Brett bloom increases drastically once the bottled wine has left the control of the winery. Temperature fluctuations during transportation, storage at distributors, and storage at final sale locations (Malfeito-Ferreira, 2018) exacerbate the risk. In addition to developing aromas from 4-EP and 4-EG, a Brett bloom will make the wine slightly bubbly due to the release of carbon dioxide during the creation of these sensory compounds. Removing 4-EP and 4-EG from wines is possible but will also strip the wine of many other aromas and flavors. In general, wines impacted by Brett will be filtered to reduce further sensory degradation from blooming in bottle, but 4-EP and 4-EG already in the wine will remain unmitigated.

Palate

The tasting portion of the wine evaluation is broken into sweetness, acidity, tannin, alcohol, body, flavor, and finish. When tasters refer to the palate, they are referring to these organoleptic qualities of the wine.

Sweetness

Sweetness is a subjective measure of the perception of sugar in a wine. While some countries may objectively define wine sweetness (Table 2) by the measured residual sugar concentration (e.g., Sparkling wine, German wine, French wine), tasters record perceived sweetness. Acidity plays an integral role in the perception of sweetness because higher levels of acidity result in less perceptible sweetness (Stone, Oliver, & Kloehn, 1969). This phenomenon is commonly observed with Riesling. Due to the naturally high levels of acidity found in Riesling wines, winemakers often halt the fermentation before all the sugars have been

Table 2: Common sweetness level designations

Country or Wine	Designation	Translation	Sugar Range (g/L)
Champagne / Cava	Brut Nature	Dry	0 – 3
Champagne / Cava	Extra Brut	Dry	0 – 6
Champagne / Cava / Prosecco	Brut	Dry	0 – 12
Champagne / Cava / Prosecco	Extra Sec / Extra Seco / Extra-Dry	Off Dry	12 – 17
Champagne / Cava / Prosecco	Sec / Seco / Dry	Off Dry	17 – 32
Champagne / Cava	Demi-Sec / Semi-Sec	Semi-sweet	32 – 50
Champagne / Cava	Doux / Dolce	Sweet	50+
France (non-sparkling)	Sec	Dry	0 – 4
France (non-sparkling)	Demi-Sec	Off Dry	4 – 12
France (non-sparkling)	Moelleux	Semi-Sweet	12 – 45
France (non-sparkling)	Doux	Sweet	45+
Germany (non-sparkling)	Trocken	Dry	0 - 9
Germany (non-sparkling)	Halbtrocken	Off Dry	0 - 18
Germany (non-sparkling)	Lieblich	Semi-Sweet	18 – 45
Germany (non-sparkling)	Süss	Sweet	45+
Sekt	Naturherb	Dry	0 – 3
Sekt	Extra Herb	Dry	0 – 6
Sekt	Herb	Dry	0 – 12
Sekt	Extra Trocken	Off Dry	12 – 17
Sekt	Trocken	Off Dry	17 – 32
Sekt	Halbtrocken	Semi-Sweet	32 – 50
Sekt	Mild / Lieblich	Sweet	50+

(Boiling, 2022; Vinepair, 2016)

consumed by the yeast. The residual sugar balances the sourness brought by the high acidity and may cause the taster to perceive the wine as dry.

Wine sweetness is divided into four categories: dry, off-dry, semi-sweet, and sweet. Dry wines have no perceptible sweetness (e.g., most red wines, Brut Champagne). Off-dry and semi-sweet designations can seem ambiguous, but the heuristic that off-dry wines are mostly dry with only a slight sweetness, whereas semi-sweet wines have an immediately perceptible sweetness that is balanced by acidity is a common way to distinguish between off-dry and semi-sweet wines. Sweet wines are overtly sweet, often these wines are classified as "dessert" wines (e.g., late harvest wines, icewine, PX sherry). The overall balance of the sweetness of the wine can be noted here. For example, if the sweetness overpowers the other flavors and organoleptic qualities in the wine, then noting that a wine is cloyingly sweet may be warranted.

Acidity

Acidity is the taste sensation of sourness and is broken into five categories: low, medium (-), medium, medium (+), and high. Although this scale is subjective, a good gauge of the acidity level is to note how much saliva is produced after taking a sip of the wine. In general, the higher the degree of salivation, the higher the acidity. This is due to the body's response to acidity and its attempt to use saliva to buffer the low pH levels found in the wine (Obreque-Slier, Espínola-Espínola, & López-Solís, 2016).

Most of the acids found in wine derive from the pulp of the grape, with tartaric acid being the most prominent. Malic acid is also found in grapes in high concentrations but is nominal in most finished wines because it is partially metabolized by yeasts during primary fermentation (Ferreira & Mendes-Faia, 2020) and converted into lactic acid during the secondary fermentation (i.e., most red wines and some white wines undergo this secondary fermentation which results in softened flavors and lower acidity). Lactic acid is less acidic than malic acid and in combination with the secondary fermentation biproduct diacetyl (Bartowsky & Henschke, 2004) provides wines, like Chardonnay, with their buttery character.

It should be noted that there is a difference between acidity and unripe flavors in a wine. Namely, what tasters note as "green" or bitter characteristics in a wine derive from tannins. Bitterness is picked up by G protein-coupled receptors (GPCRs) on the tongue (Soares et. al., 2020). Coupling with receptors is hindered by the size of the compound, meaning that the shorter the tannin complex, the higher the perception of bitterness (Brossaud, Cheynier, & Noble, 2001). Whereas, high acidity provides the sour, mouth puckering characteristics of a wine. An easy way to determine if the wine is bitter or acidic is to add a small amount of base to the wine. To do this, dissolve a small amount of potassium carbonate or sodium bicarbonate (baking soda) in water, then dose the wine with a few milliliters of that solution. If the wine still tastes "acidic", then bitterness is being perceived. Alternatively, if the wine no longer tastes "acidic", then acidity is being perceived. The addition of basic compounds, like potassium carbonate, will neutralize the acids in wine but will have no effect on the organoleptic impacts of tannins.

Tannin

Tannin structure of a wine is categorized as low, medium (-), medium, medium (+), and high. There are two organoleptic impacts of tannins: bitterness and astringency. Astringency is the drying sensation on the tongue caused by the release of salivary proteins (Jackson, 2020). This often feels like chewing on a bar of chalk, which results in the extraction of moisture from the tongue. For seasoned tasters, high tannins are an indicator of specific styles of wine and often associated with drinking young, high-quality Cabernet Sauvignons, Barolo, or Tannat. Wines with low tannins have little or no astringency but may have more bitterness, due to the masking effect of astringency on bitterness (Jackson, 2020). This bitterness is more prevalent in white wines and low tannin red wines (e.g., Grenache).

In a simplified view, grapes are composed of skin, pulp, and seeds. The two major grape derived sources of tannins in wine come from the grape skin and the grape seeds. Grapes with thicker skins (e.g., Cabernet Sauvignon, Petite Sirah) have higher concentrations of extractable tannins, meaning that longer skin contact during primary fermentation will result in a more tannic wine. Seed tannins are considered undesirable because the extractable tannins have the potential to produce more bitterness than grape skins (Brossaud, Cheynier, & Noble, 2001). Grape stems are also tannin contributors but are not used in most wine production (i.e., whole cluster fermentation is a process where the stems are not removed

and are fermented along with the grapes, while common in Beaujolais and some parts of Burgundy, it is less common in large scale winemaking). Wood (e.g., oak barrels, staves, chips, sawdust, oenological tannins) may be used during the fermentation and aging processes. When tannins are incorporated during the fermentation process (i.e., added in an aqueous environment versus an alcoholic environment), there is a different organoleptic impact than when incorporated during wine aging. Corona et. al. (2021) found that tannin additives (oenological tannins) that derived from wood provided no bitterness or astringency, rather it intensified volatile aromatic compounds, increased total acidity, and increased flavor density. This means that tannins added early in the winemaking process have little to no impact on the perception of tannins in the final wine.

Conversely, wood tannins incorporated during the wine aging process (i.e., when the wine is now considered an alcoholic environment) impact perceptible bitterness and astringency. For wooden aging vessels (e.g., barrels, staves, chips), the rate of tannin extraction depends on the surface area of oak in contact with the wine (i.e., wood chips have a higher surface area than a 500 L puncheon barrel), the length of time of contact (e.g., 6 months, 3 years), the toast level (i.e., longer toast times and hotter toast temperatures create higher levels of caramelization of the wood sugars), the type of wood (e.g., American oak, French oak, Acacia), and the age of the wood (i.e., new oak imparts the highest level of tannins and reduces with every use)(Carey, 2009). Extractable wood tannins also vary based on genus (i.e., "American" and "French" oak used for wine barrels come from the genus *Quercus*), species (e.g., *Q. alba*, *Q. petraea*), curing process (i.e., staves are aged at cooperages before assembly to dry the wood, remove sap, and remove bitter tannins), and toast level (e.g., oven toast, fire toast). A review of traditional types of oaks and alternative wood sources indicated highly variable levels of tannins across genus and species (Martínez-Gil et. al., 2020), indicating that extractable tannins could not easily be generalized by wood type.

Alcohol

Alcohol is measured by its level of perception and is categorized as low, medium, or high. In general, wines under 12% alcohol by volume are considered low, 12-14% are considered medium, and above 14% are considered high. Some wine tasting organizations may break alcohol levels into more categories, but this simple categorization is valid for most tasting paradigms. The important thing to note when evaluating a wine's alcohol is its integration with the wine. For example, wines with low levels of alcohol may seem thin and lacking texture, whereas wines with high alcohol may seem hot and unbalanced.

Ethyl alcohol (ethanol) is one of the major products of the fermentation process. In one of many biosynthetic pathways, yeasts convert glucose into ethanol and carbon dioxide. As grapes ripen, the concentration of sugars in the fruit increases, meaning that riper fruit results in higher alcohol wines (i.e., wines from colder regions, like Germany, tend to have lower alcohol levels because of lower grape sugar concentrations at the time of harvest). In the United States, grape sugar concentrations are measured by the unit Brix (France uses Baumé, Germany uses Oechsle, Austria uses KMW, et cetera). 1 Brix is 9.982

Estimation of alcohol percentage based on sugar concentration

1 Brix = 9.982 g/L sugar 18 g/L sugar = 1% abv

↘ ↙

1.803 Brix = 18 g/L sugar = 1% abv

-OR-

1 Brix = 9.982 g/L = 0.5546% abv

g/L of sugar (Laffort, n.d.), however winemakers generally think about sugar in terms of concentration percentage. In practice, 1 Brix is approximated as 1% sugar by concentration and utilized as an easy indicator of sugar accumulation. Ribéreau-Gayon et. al. (2006) report that 18 g/L of sugar converts to 1% of alcohol by volume. Some quick arithmetic shows that multiplying Brix by 55%, will give the winemaker an estimation of the alcohol potential of the resulting wine.

Wines with low alcohol levels have a lighter body and less viscous mouthfeel. The increase in wine viscosity that coincides with the increase of alcohol concentration is due to a compound called glycerol. Glycerol is a non-aromatic and non-volatile byproduct of primary fermentation that is created during the conversion of glucose to ethanol (Dequin, 2014). While the strain of yeast used and other winemaking decisions (e.g., nutrient additions, fermentation temperature) during primary fermentation have been shown to impact the quantity of glycerol produced, the key message is that wines with higher levels of alcohol have more viscous mouthfeels due to higher concentrations of glycerol.

Body

The body of a wine is categorized as light, medium (-), medium, medium (+), and full. Wines characterized as "light" body have a water-like mouthfeel. As the assessment of the body moves towards the "full" categorization, the viscosity of the wine increases. Contributors to a wine's body include alcohol, acidity, and sweetness. The body of low alcohol wines can be balanced by residual sugar. Think of the organoleptic impacts of sugar in a flat soda versus those of water. In addition, high acidity can make light bodied wines seem sharp and less viscous (Jackson, 2020) but full-bodied wines seem more balanced (Burton & Flewellen, 2014).

Flavor

Gustation (taste) and olfaction (smell) are closely associated, meaning that what is recorded for the characteristics of the nose of the wine is an appropriate starting point for determining flavor characteristics. More specifically, neurons within the olfactory and gustatory cortexes can cross over to respond to taste and smell (Czarnecki & Fontanini, 2019), respectively. In addition, flavor perception is complimented by retronasal olfaction that occurs when some of the volatile aroma compounds travel up the throat and into the nasal cavity when wine is swallowed.

Flavor is recorded in two aspects: intensity and characteristics. The measure of flavor intensity mirrors that of aroma intensity with a range of light, medium (-),

medium, medium (+), and pronounced. The measure of this can be interpreted in two ways, with "pronounced" representing a wine overtly dominant in a few flavors or a wine with many complex and prevalent flavors. It is important to delineate between complex, nuanced flavors and flavor intensity. This evaluation is more about how easily the flavors are recognized, meaning that a wine with a lot of subtle flavors would not be defined as "pronounced".

The method for determining and recording flavor characteristics is the same as the identification of aromas on the nose. This evaluation utilizes flavor clusters, and separates flavors into primary, secondary, and tertiary characteristics. Start by referencing the aromas that were recorded and validate if these characteristics are detected on the palate. Flavors deriving from wine flaws (e.g., Cork taint, VA) should also be recorded at this stage.

Finish

The final element of the tasting portion of the wine's evaluation is recording the finish. Finish is categorized as short, medium, or long, and represents the length of time that the wine's flavor lingers in the mouth after swallowing or spitting out the wine. A wine's finish is considered "short" if the flavor dissipates immediately and "long" if the flavor lingers for a few seconds. One important thing to note is that the length of flavor sustainment should only be measured if it is a positive flavor. This means that if the wine has a lingering bitterness and no other positive qualities, then it would be characterized as "short".

Overall impression

After completing the comprehensive evaluation of the wine's appearance, nose, and palate, it is critical to answer two more questions. Primarily, the taster will determine if they like the wine. Based on this response, the taster will determine if they would purchase this wine again.

The following should be completed before revealing the wines when conducting blind tastings. Assess the wine's age and quality level (e.g., poor, good, very good, excellent).

The determination of a wine's age can be defined by two aspects: the number of years from the harvest date on the bottle and its readiness for consumption. The age of the wine can be recorded in exact years or year ranges (e.g., 1-2 years, 3-5 years, 5+ years). There is more utility in year ranges because it allows the taster to cluster age with characteristics that were recorded for the aromas and flavors (i.e., lots of primary characteristics would indicate a young wine, lots of tertiary characteristics would indicate an older wine).

The wine's readiness for consumption is broken into categories of too young, ready to drink and not suitable for aging, ready to drink and suitable for aging, and, too old (WSET, 2016).

Historically, wines with aggressive tannins (e.g., Barolo, Madiran) were deemed too young to drink at the time of their release for purchase. This holds true for a very select few wines, however the category "too young" is sparsely relevant for contemporary wines that will be encountered during most tastings. More commonly, a wine will be categorized as ready to drink and suitable for aging.

Assuming that the wine is ready to drink now, it is necessary to differentiate between its suitability or unsuitability for aging. Some wines may continue to retain their positive characteristics, but this does not mean that they are suitable for aging. Aging potential indicates that the wine will improve with age (i.e., tannins will soften, sweetness will incorporate with flavors, flavors will become more complex). Port, apart from Vintage Port, is an example of a wine that will not develop further with age. This seems counterintuitive but the maturation of the wine is completed prior to bottling, meaning that the wine is at full development at the time of release. Generally, white wines are not suitable for aging. Chardonnay, Riesling, and dessert wines are some common exceptions.

If a wine has lost its varietal character, the flavors are lost, or the wine is tasting of vinegar, then it is considered "too old".

Conclusion

Understanding how to taste wines and how to record tasting notes are the first steps towards building taste memory. This article has provided a comprehensive overview of the tasting process and has attempted to provide insights into why elements of a wine appear, smell, and taste the way that they do.

In addition to understanding the process of tasting, it is vital to understand why defining elements, like aroma characteristics or acidity levels, are relevant to deciphering wines when tasting. Wines are defined by the environment in which the grapes are grown, the laws that dictate how the wines are made, the choices that winemakers make for aging (e.g., new oak barrels, stainless steel tanks), and an innumerable number of other factors. A strategic and systematic approach to tasting allows tasters to better understand the wine in their glass.

Links to wine evaluation rubrics

WSET Level 2 Systematic Approach to Tasting Wine

WSET Level 3 Systematic Approach to Tasting Wine

WSET Level 4 Systematic Approach to Tasting Wine

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