Portland Winemakers Club

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January 2017

President's Monthly Rant

In case you have been wondering about how much the very rich are having to spend to get a decent bottle of wine, I'm here to help with the results of some of 2017's top wine auctions. Seems the price keeps going up up up, appreciating even more the diamonds, art and classic cars.

Christies
1 Case of Domaine de la Romanée-Conti 1988 $280,000 (that's only $23,333 per bottle, about $4000 a glass)
1 Case of Château Cheval-Blanc 1947 $227,200
1 Bottle of Château Lafite-Rothschild 1806 $61,670
1 Case of Petrus 1947 $49,000

Sotheby's
1 Case of Domaine de la Romanée-Conti 2013 $55,350 (invest now!)
1 Case of Vosne Romanée, Cros Parantoux 1990 $157,051
1 Case of Hermitage, La Chapelle 1961 $157,051

California was not to be left out however, at New York's "Finest and Rarest" October sale the highest lot was:
A 43 bottle vertical of Screaming Eagle Cabernet Sauvignon $149,007

So if you balk at paying $30-$50 for a decent bottle of juice at your favorite wine shop or at the winery itself, just remember when you pour it for your friends how lucky you are to be able to impress them with your generosity and at the same time save from $5000 to $20,000 per cork. Next time buy 2…

Phil

Drink Responsibly.
Drive Responsibly.

Scheduled Meetings

January 13, 2018
Annual Gala – Oak Knoll Winery; 5-9 PM

January 17, 2018 Crush Talk / Planning

February 21, 2018
Bordeaux Tasting

March 21, 2018
PWC women winemakers pouring their own creations.

April 18, 2018
Barrel / Carboy Sample Tasting

April, 2018
Tour:

May 16, 2018
Speaker.

June, 20, 2018
Speaker:

July, 14 2018
Annual Picnic at Oak Knoll Winery, 1 till 4 (no regular meeting in July)

August 15, 2018
All Whites Tasting

September 19, 2018
Other Reds Tasting

October 17, 2018
Pinot Noir Tasting

November 2018
No Meeting

December 5, 2018
Planning, Tours, Speakers, Events, Elections

Misc. Information

• Winery releases THC-infused wine

Rebel Coast Winery in Sonoma unveiled a dealcoholized Sauvignon Blanc wine that has been infused with psychoactive THC compounds derived from cannabis. The winery launched the new product in conjunction with the legalization of recreational cannabis in California. The wine delivers 4 milligrams of THC per glass, providing effects in less than 15 minutes, according to the winery. Grapes for the wine are sourced from Sonoma County and undergo traditional winemaking before the wine is dealcoholized and then infused at a rate that delivers 16 milligrams of THC per bottle. The wine will retail for $59.99 and be distributed to 500 dispensaries through Green Reef Distributing.

• New academic research correlating a link between unhealthy behaviors and political ideology does not bode well for liberals. A pair of Duquesne University economists conducted an exhaustive study comparing the statistical demand for alcohol with regional political persuasions in all 50 states between 1952-2010.
“In this study, we show that liberal ideology has a statistically significant positive association with the consumption of alcohol in the United States even after controlling for economic, demographic, and geographic differences across states. Holding everything else constant, we find that as states become more liberal over time, they experience higher consumption of beer and spirits per capita,” write Pavel A. Yakovlev and Walter P. Guessford.

Note: The annual Gala will be held on Saturday January 13th, 2018 at Oak Knoll Winery. The next regular meeting will be Wednesday, January 17th at 7:00 PM at Oak knoll Winery (See page 3). January agenda: Crush talk, how did the 2017 crush go for you, planning for 2018 tours; speakers; events etc. Come with a bottle of wine to share and your ideas for what we should be doing in 2018.

The regular meeting will be a potluck, bring a small snack to share. Also bring a wine glass for tasting.
The club meeting will begin at 7 pm and end by 9 pm. If you can, get there a little early to help set up. Please help put away chairs and tables at the end of the meeting.

Website: http://portlandwinemakersclub.com/

The December meeting minutes were listed in the December newsletter but are re-printed here in case you missed them.
(Present: 20)

• Phil introduced three new members, Doug Schenk, Gillian Wildfire & Paul Sowray.
• Annual elections were held:
President - Phil Bard (says it’s his last year?); Secretary - Ken Stinger; Treasurer - Barb Thomson; Grape Purchase Program - Bob Hatt; Club Tastings - Bill Brown; Club Tours - Damon Lopez; External Competitions – Paul Boyechko; Club Speakers - Barb Stinger; Social Events – Marilyn
Brown & Alice Bonham; Web Design - Alice Bonham.

• Bill Brown suggested we use measured pour spouts for our club tastings.
• Marj offered to let us use one ounce pourers from Oak Knoll to see if we can get by using only one bottle when attendance is low.
• It was agreed that we should continue holding the club women’s tasting event in March and the barrel / carboy sample event in April.
• The rest of the evening was devoted to discussions around member winemaker problems and experiences.

‘He toppled over after his eighth glass’

— PORTLAND WINEMAKERS CLUB —

2018 Gala

Join us for another auspicious evening:

Saturday, January 13th, 2018

5pm – 9pm

Oak Knoll Winery

❄ ❄ ❄

PWC members, please bring a salad, side dish or dessert to contribute to the evening's meal. And be sure to bring your own wines & wine glasses for tasting!

We'll see you there!

Gala Entry: $15 per person ❄ ❄ ❄ *Annual Dues:* $15 per person

2018 WineMaker International Amateur WINE COMPETITION

ENTER YOUR **BEST HOMEMADE WINES**
IN THE WORLD'S **LARGEST COMPETITION**
FOR HOBBY WINEMAKERS!

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Enter your wines and compete for gold, silver and bronze medals in 50 categories awarded by a panel of experienced wine judges. You can gain international recognition for your winemaking skills and get valuable feedback on your wines from the competition's judging panel.

Entry Deadline: March 16, 2018 5515 Main Street • Manchester Center, VT 05255 ph: (802) 362-3981 ext. 106 fax: (802) 362-2377. http://www.winemakercompetition.com/

Amateur Wine Contest | Corrado's Family Affair

www.corradosmarket.com
Corrado's Market - Headquarters 1578 Main Avenue Clifton, NJ 07011
Phone:973.340.0628 Fax: 973.340.2052
Competition info at:
http://corradosmarket.com/wine-contest/

Newport Seafood & Wine Competition

This is an early reminder that the Newport Seafood & Wine competition is coming up soon. Each entry must have a completed registration form. All entries must be received by the Greater Newport Chamber of Commerce no later than January 26, 2018 or to a drop site (F.H. Steinbart) no later than January 19, 2018. Details at: http://seafoodandwine.com/

Winemaking: More Secrets of Fermentation

More on the magical microbes that play a vital part in turning grapes into wine; this time it's the turn of the lactic acid bacteria.
Caroline Gilby.

Beaujolais Nouveau epitomizes the carbonic maceration style.

There are two more winemaking processes to look at to demystify the facts behind those technical words that so often get bandied about in the wine world. First of all, I will attempt to cut through the rubbish that is often talked about carbonic maceration (or macération carbonique as it is commonly called because it is so associated with Beaujolais in France). Then, I will go onto the 'malolactic fermentation', (often abbreviated to 'malo') another fermentation process in winemaking where bacteria take center stage.

Carbonic maceration

Carbonic maceration has almost certainly happened by accident since grapes were first turned into wine but was more formally 'invented' in 1934. The process depends on having intact berries - which usually means hand harvested whole bunches.

Both machine harvesting and destemming bunches cause too much damage and therefore leakage of juice for this process to work. The bunches are then put into an oxygen-free atmosphere in an enclosed fermentation tank, and this forces the grape cells to respire in an anaerobic way as there is no oxygen to fuel normal respiration.

Normal respiration (or breathing to you and me) uses oxygen to completely break down sugar to provide energy and producing carbon dioxide and water as by-products, but when there's not enough oxygen, cells have a metabolic shortcut so that they can still produce energy.

Anaerobic breathing - what's that?

To use a human analogy, when you are sitting at your desk reading this, you are breathing in enough oxygen to sit there comfortably, sustaining all your energy needs. However if you get up and sprint for a train, you quickly run out of energy and get muscle pains and maybe a stitch. This is because you aren't getting enough oxygen for this higher energy demand so your body goes into shortcut mode or anaerobic respiration. The by-product of this is lactic acid which collects in your muscles giving that heavy leg feeling and that stitch (though but luckily this can be broken down later on).

Plant cells have a similar metabolic short cut, but instead of lactic acid, they produce ethanol as a by-product and it is this phenomenon that carbonic maceration relies upon. In practical terms, what happens is that the winemaker fills the vat up with carbon dioxide to exclude all oxygen before adding the whole bunches, or with so-called 'semi-carbonic maceration' the weight of the bunches crushes some of the berries at the bottom of the tank.

These then start to ferment normally creating an atmosphere of carbon dioxide in the tank and thus anaerobic conditions. (Just in case you didn't know, carbon dioxide is a suffocating gas that suppresses the breathing reflex and, as it is denser than air, it will collect in winery vats and low corners of wine cellars. It can be fatal too - a young winemaker died in Spain a few weeks ago).

The grape cells are thus forced into anaerobic respiration and alcohol is produced within the whole berries. Unfortunately, alcohol is toxic to plant cells, and once it accumulates to about 1.5 to 2%, the grape cells start to die and the berries eventually collapse. In the meantime, color pigments (or anthocyanins) dissolve out of the skins into the pulp, but very little tannin, and various fruity esters (particular ones that give flavors of cherry, raspberry and even banana) are produced.

…enter the yeasts

Finally as the berries collapse, or are crushed deliberately by the winemaker, yeast take over and finish the fermentation as normal. The end result is typically bright fruity wines with relatively low tannin levels that are easy to drink young - Beaujolais Nouveau is the epitome of this style, but many producers in and out of Beaujolais use a semi-carbonic maceration to increase levels of fruitiness and drinkability. A good example is Duboeuf's Gamay Vin de Pays de L'Ardeche.

Malolactic magic

Once upon a time, winemakers noticed that bubbles appeared in their wine in springtime and thought that this was simply the young wine reacting 'in sympathy' to the rising of the sap as the vines came back into growth after lying dormant through the winter. Now we know that it is caused by a type of fermentation that needs warmer conditions to take place - such as warmer weather in springtime.

My earlier article looked at the primary alcoholic fermentation, which is brought about by the action of yeast, but in many wines there is a second fermentation, this time mediated by certain strains of bacteria. These Lactic Acid Bacteria (from the genera Leuconostoc, Lactobacillus and Pediococcus) use malic acid as an energy source, and produce lactic acid as the main by-product.

Malic acid is sharp and tastes of apples, and it happens to get its name from the apple family (whose Latin name is Malus), though malic acid is also the second most important acid found in grapes, especially when grown in cooler climates. The malolactic fermentation turns this sharp acid into the softer-tasting lactic acid (the gentler acid found in milk) and producing tell-tale bubbles of carbon dioxide as it does so. The result is that the wine becomes softer to taste, and at the same time, any wine undergoing this process, will gain mouth-feel and texture and may sometimes develop creamy buttery characters too.

Once upon a time, this process was rather random, depending on the lucky arrival of the right bacteria, plus the right conditions of temperature and levels of sulfur dioxide in the young wine. Nowadays, winemakers have a much better idea of how to control it and can buy packets of the right bacteria if necessary.
Which wines undergo malolactic fermentation?

Pretty much all red wine undergoes malolactic fermentation (it tastes really odd if it doesn't). However for white wines, winemakers can make a choice depending on the style of the wine they are making. For crisp fresh aromatic wines (sauvignon blanc for instance) usually there will be no malolactic, while rounder, richer creamier (and often oak-fermented) wines (chardonnay for example) may undergo full malolactic fermentation, or even a partial one, with the aim of combining freshness with texture and richness. The Society's Exhibition New Zealand Chardonnay from Kumeu River is a great example of barrel-fermented chardonnay undergoing complete malolactic fermentation (MLF); winemaker Michael Brajkovich explains what he likes about MLF:

'We use 100% MLF for all our chardonnay wines. The species of lactic acid bacteria that is used for just about everyone's MLF is Leuconostoc oenos, which has been renamed Oenococcus oeni. This species has a very good tolerance of low pH, and does not produce very much in the way of spoilage.

'If any Lactobacillus or Pediococcus species grow in your wine, then you have a real problem because of the high volatile acidity. Fortunately they normally will not tolerate low pH, or high SO2. One of the main by-products of MLF is diacetyl, which has a buttery smell. Diacetyl is very important to the flavor and aroma component in milk, butter, cheese and ice-cream. In wine, it can tend to dominate the aroma and mask other characters. These days we prefer to minimize the impact of diacetyl, and we do this by some simple strategies:

'Firstly, we wait for as long as possible after MLF is complete before we add any SO2. This is typically 2-4 weeks, which allows some of the diacetyl to disappear. Secondly, we keep the wine in contact with the yeast lees for as long as possible after the MLF. Yeast cells, even when dead, have a remarkable ability to consume diacetyl, so the longer on lees the less the buttery character.

Most of our chardonnays will have four to five months on lees post MLF, which really cleans them up beautifully, and the fruit can appear again from behind the veil of butter.

'The reason we use 100% MLF is to de-acidify the wine and make it more balanced. Our grapes are harvested at quite a high acid level, typically 8.5 – 9.5 g/l as tartaric. Even though we are a long way north in New Zealand, the proximity of the oceans to the west and the east really keeps the climate cool and the acids high.'

Michael Brajkovich with his homemade 'ear trumpet' used for detecting when the malolactic fermentations start and finish.

Winemaking today involves a lot of science - but for the winemaker there is a real art too, in deciding exactly how to apply all the science to produce the best possible result, and make the most balanced and enjoyable wine.

WINE CHEMISTRY 101 Part A

By Bob Peak

Before we get into the specific chemistry of wine, it's important to review a little bit about the study of chemistry itself. Chemists usually talk about chemical reactions in "equilibrium" terms. That is, we look at what goes into a reaction and what comes out of it, without considering very much the amount of time it takes. We treat it as though the reaction happened instantly, much like adding vinegar to baking soda and getting the immediate acid-base reaction that results. As an analogy, if recipes were written the way chemical reactions usually are, we would bake a cake by telling you the ingredients and baking temperature, but ignoring the time. A cake just comes out. For most chemical reactions most of the time, ignoring time like this has no significant consequences.

Not so for wine chemistry. Many of the important chemical reactions in wine take time to occur. It may take hours for color extraction in a rose, several days for alcoholic fermentation, months to complete the cold stabilization of tartrates, and years to produce the character we call "aged." Whenever we talk about time as a variable in chemical reactions, the field we are studying is "kinetics". Although some chemists devote their research careers to that, I'll mostly treat these chemical reactions of wine as equilibrium situations.

So why chemistry? Without knowing some of the chemistry of wine, a home winemaker may be flying blind—or at least wearing dark glasses with the lights off. Things go in—grapes, yeast, nutrients—and wine comes out. Sort of. With a little chemistry, you can greatly improve your odds of producing excellent wine every vintage. And if you memorize a few of these chemistry facts, you can amaze your friends next time you go wine tasting!

There are hundreds of chemical compounds that have been identified in wine, beyond those in grapes to start with. For our chemistry discussion, though, I want to concentrate on a few of the most significant components of wine.

Wine is mostly water. After the 85-90% water, there is some 10-15% alcohol (ethanol), 0.4 –0.7% fixed acids, 1-2% other organic molecules, and less than one-half of one percent minerals, usually reported as "ash".

We will skip over water chemistry for this discussion, and begin with the production of alcohol from grape sugars. This conversion—the one we call "fermentation"—is obviously the most important chemical reaction a hobbyist encounters in pursuing the miracle that is winemaking. First, there is the sugar. Cane sugar, sucrose, is a 12-carbon molecule consisting of two six-carbon rings which are held together by a fairly weak bond. Sucrose is the sugar we most often encounter in daily life and is present in many fruits and vegetables. However, under acid conditions, the weak bond holding the two rings together will break. The two resulting six-carbon molecules are themselves sugars: glucose and fructose. Since each of these contains six carbon atoms, they are collectively called "hexoses" (hex- for six and –ose for sugar). Because wine grapes are high in acid (low in pH), these two are the sugars of grapes, generally in about a 50-50 mix. Both glucose and fructose have the same chemical formula:

C6H12O6

Although the molecules differ in structural details, that feature is not significant for this discussion and we can generally treat them as identical in chemical reactions. One small exception with regard to wine is that most wine yeasts are considered "glucophilic" or glucose-loving. That means a stuck fermentation, with only a little bit of sugar left to ferment out, will contain primarily fructose. So what is left near the end is exactly the sugar that is most difficult to restart.

Ethanol, the alcohol of wine, is a two-carbon compound.

C2H5OH

So for fermentation, we need to take our six-carbon sugar down to a two-carbon alcohol. In basic chemical notation, it is simple and looks like this:

C6H12O6 ⟶ 2 C2H5OH + 2 CO2
(Hexose) (2 Ethanols + 2 Carbon Dioxides)

The reaction products, by weight, are 51.1% ethanol and 48.9% carbon dioxide. The 51.1% by weight would calculate out as 59% by volume, relative to the water in the finished wine. Actual yield of alcohol is a bit lower, due to evaporation during fermentation and conversion of alcohol to other byproducts. We usually use a figure of 55% as a reasonable practical predictor of alcohol in a finished wine. So, degrees brix (percent sugar by weight) times 0.55 (55%) equals alcohol by volume in the finished wine. For example, at 20° Brix, 20 x 0.55 = 11% alcohol by volume.

Of course, real life is never as simple as the chemical equation displayed above and the yeast does not just jump from six-carbon sugars to two-carbon alcohol. The yeast itself is using energy from these chemical reactions to live and reproduce. There are fifty or more enzyme-mediated reactions going on within the yeast cell during the cascade from sugar to alcohol. I will not review them all here, but will cover a few major steps along the way. First, the six-carbon ring is broken into two three

Carbon pyruvates. From there, if oxygen is present, yeast can oxidize the pyruvates all the way down to carbon dioxide and water—no alcohol! That is why fermentation is carried out with little or no oxygen present, after the initial build-up of yeast. The rapid evolution of carbon dioxide—and a fermentation lock on whites and rosés— keeps the environment essentially oxygen-free. Under those conditions, each three-carbon pyruvate is further converted into a two-carbon acetaldehyde. One carbon dioxide molecule is ejected with each acetaldehyde. Then each acetaldehyde is itself reduced to an ethanol molecule. Now we have a solution of alcohol and water, maybe with a little sugar left in it. Sounds like a pretty boring beverage—so what gives wine its zing? In a word -Acid.

WINE CHEMISTRY 101 PART B

The two major organic acid components of grapes and grape juice are tartaric and malic acids, usually starting at about a 50-50 ratio. Together, they create the low pH conditions that help make wine a stable beverage and provide the pleasant tartness we all associate with it. The combined range of these acids in fresh grape juice will usually fall between 3 and 15 grams per liter (or 0.3 to 1.5%). Although this wide range of acid levels—measured as TA or Titratable Acidity—can be seen around the world, most North Coast grape juice comes in between 0.4 and 0.7% TA, with about 0.65% preferred. There is also a trace of citric acid in grapes, but it is not a significant contributor to TA. Together, these acids are the “fixed” acids of grape juice, joined in some wines by lactic acid from malolactic fermentation. The term “fixed” is used to distinguish from the spoilage acids of wine, the volatile acids. Those acids—mostly acetic acid—are the products of vinegar fermentation and will introduce unpleasant aromas to wine at very low levels.

Although malic and tartaric acids begin at near equal levels, it is tartaric that dominates the acid flavor profile in most wines. Like the other fixed acids, it belongs to a chemical class called the carboxylic acids. The structure can be represented as:

HOOC-HCOH-HOCH-COOH

Those “H’s” on each end of the molecule identify this particular acid as a dicarboxylic acid—there are two active “acid” locations (protons) on every molecule. That is twice as much available acid activity as in a like amount of a monocarboxylic acid. Like all the wine acids, tartaric is considered “weak” chemically. It has a native dissociation constant or natural pH level of 4.3 for the first proton and 3.0 for the second one. For an acid, the dissociation constant is written as pKa—the negative logarithm (p) of the constant (K) for dissociation of the acid (a).

Tartaric acid passes through fermentation and aging mostly unchanged. The main exception is cold stabilization. That is a process by which wine during aging is allowed—or induced—to get very cold (near freezing). The presence of much higher alcohol in wine, as compared with juice, reduces the solubility of tartaric acid. The tartaric acid combines with potassium that is naturally present in the wine, cold temperatures further drive down that solubility, and crystals of potassium bitartrate (KHT) appear on the interior surfaces of the carboy, tank, or barrel. If your wine is too tart when you make it, you can utilize this process to remove some of the tartaric acid and lower the overall acidity, mellowing the flavor. You may occasionally find a commercial wine that has not been adequately cold stabilized. In white wines, after chilling, it may look like there are crystals of glass on the bottom of the bottle. In reds, the crystals usually stick to the cork and are dyed red by the wine. In either case, potassium bitartrate is non-toxic and harmless, although it feels a little gritty on the tongue if you accidentally drink the dregs of the last glass from the bottle!

The other large acid component of grape juice—malic acid—is much more reactive than tartaric during winemaking. Like tartaric, it is a dicarboxylic acid, this time with pKa’s of 5.1 and 3.4. These higher numbers indicate that malic is an even weaker acid than tartaric. Interestingly, though, to human taste malic acid is much sharper than tartaric. If you have teenage children (or have recently been a teenager), you may be aware of Warheads candies or Jones Green Apple soda. Both producers use malic acid for extremely sour food-grade tastes. In nature, malic is the acid of apples and gets its name from malus, the genus name for apple trees.

In most whites and rosés, the malic acid proceeds unchanged through fermentation and is present in the crisp "appley" flavor you sometimes get in these wines. With malic acid accounting for about half of the 0.4 to 0.7% TA, we can express that 0.2 to 0.35% instead as 2,000 to 3,500 milligrams per liter (mg/L) or ppm (parts per million). In wine styles other than these crisp ones, those malic acid levels would taste unpleasantly sour.

For most red wines, as well as big whites like Chardonnay, the malic acid concentration is deliberately lowered during fermentation. The process, malolactic fermentation, is carried out by bacteria, either with or after primary fermentation. The bacteria—oenococcus oeni—convert each molecule of malic acid into a corresponding molecule of lactic acid. Favorable conditions for this fermentation include:

Temperature 65 to 75 degrees F pH above 3.2 (above 3.4 is even easier)
Alcohol below 14%
Total SO2 below 30 ppm
Free SO2 below 10 ppm

The safest way to carry out malolactic fermentation is after primary fermentation, although the conditions for the bacteria are more favorable prior to completion. The safety factor enters because oenococcus oeni, in the presence of sugar, can

produce the volatile acids of vinegar mentioned above. But what about the chemistry?
The reaction is:

$C_4H_6O_5 \longrightarrow C_3H_6O_3 + CO_2$
malic acid lactic acid carbon dioxide

The process is generally considered complete when the residual malic acid level drops below about 30 ppm. At that level, most authorities consider it highly unlikely that spontaneous malolactic fermentation will restart after bottling. (If it did, the wine would turn fizzy and cloudy, also developing off aromas). It is important for home winemakers to note that this is just a "generally accepted" level for commercial wine and is not some absolute barrier. At 30 ppm, a wine that started with 2500 ppm will be 98.8% complete. If instead your wine has 35 or 40 ppm left, it is just a matter of having perhaps 1.3% remaining instead of 1.2%. That is not a very big difference to be concerned about. If you keep your wine under good cellar conditions and bottle with adequate SO_2, there is very little risk of spontaneous re-fermentation of a tiny amount of malic acid.

And what about that lactic acid? You now have just as much of that as you had malic acid to start. Lactic, however, is a monocarboxylic acid:

CH_3-HCOH-COOH

There is just one active proton at one end of the molecule. Since we get one lactic acid molecule for every malic molecule, but it only has half the active protons, it drops the malic acid contribution to TA by half. Effectively, the 0.2 to 0.35% goes to 0.1 to 0.18%. Furthermore, lactic acid has a much milder flavor than malic acid. In contrast to apples, lactic acid is the acid of yogurt and cheese—smooth and creamy! The pKa is 3.08, keeping us in the general pH range of wine. If you submit juice or wine to a laboratory for a complete acid analysis, two more fixed acids may show up. As mentioned before, citric acid is a minor contributor to TA. In grapes affected by the "noble rot" botrytis, however, citric acid can be very high and may contribute to the racy flavors of some late-harvest wines. Succinic acid is also sometimes present as a fermentation product, but generally at levels well below 0.1%.
So that's it for the acids. But several times I have mentioned pH, which everybody knows is somehow related to acid.
I love talking about pH and can go on for hours about it.

WINE CHEMISTRY 101 PART C

In Part B of this ongoing chemistry lesson, I wrote about wine acids. As usual, I found it impossible to discuss acids without also mentioning pH—they are closely related. However, they do not measure exactly the same thing and must be determined separately if you want a full picture of your wine. While the titratable acid number—TA—is all about taste, the pH number is all about stability. **In particular, wine pH strongly influences the effectiveness of sulfite in preserving wine's freshness and quality. So a sulfite discussion follows this information on pH and wraps up the Wine Chemistry series.**

The range for pH is from 0 to 14. Water, representing neutral, is pH 7.0. Lower numbers (0-6.9) are acidic and higher numbers (7.1 to 14) are basic. The normal range for wine is about 3.0 to 4.0, occasionally going a little higher. pH is named that for good reasons—not just to drive non-chemists crazy! The lower-case "**p**" means "**the negative logarithm of**". The capital **H** represents the **hydrogen ion activity** (concentration, more or less) of the acid solution. All of this is expressed in molar values—a mole of a substance is the gram equivalent of its molecular weight—but don't worry about that. It just puts all chemicals on an equal footing for reaction purposes.

Strong acids, like hydrochloric (muriatic) swimming pool acid, are essentially completely dissociated in water. That is, for every molecule of HCl that comes in contact with water, the H separates as a proton, H^+, and the Cl separates as a chloride ion, Cl^-. The gram equivalent weight of HCl is 36.5 grams. So, if we mix 3.65 grams (one tenth of a mole) in one liter of distilled water, the molar concentration is 0.1. Since all of the molecules dissociate for this strong acid, the hydrogen ion activity is also 0.1 molar. In scientific notation, we can express one-tenth as 10^{-1}. Since the base-ten exponent of that number is –1, the logarithm of that number is also –1. That said, we look at the negative logarithm (**p**) by reversing the sign: 1. A one-tenth molar solution of hydrochloric acid has a theoretical pH of 1. In reality, we would get a measured value very close to that, because this strong acid is so fully dissociated in water.

Not so, however, for the weak acids of wine. Several factors influence pH. First, we have different carboxylic acids participating in the combined pH—primarily tartaric, malic, and lactic, but also possibly citric and succinic. In addition, the potassium salts of the weak acids participate, serving as reservoirs for acid ions as needed in the solution. The wine is "buffered"—it resists changing its pH—by all of these combinations. **So, settled in somewhere between pH 3 and pH 4, it is unlikely to change very much even if the acid level goes up or down significantly. That is why you cannot determine TA by measuring pH, nor the other way around.**

To measure pH in the home wine laboratory, the easiest technique is to use pH indicator "dip sticks". Unfortunately, although easy, they are not usually accurate enough to make good winemaking decisions. Instead, winemakers seriously interested in measuring pH will use a pH meter. Either a portable, hand-held meter or a bench meter is good enough for wine PH, but the portable meters may respond too slowly to be useful for TA measurement if you want to get double-duty out of your meter.

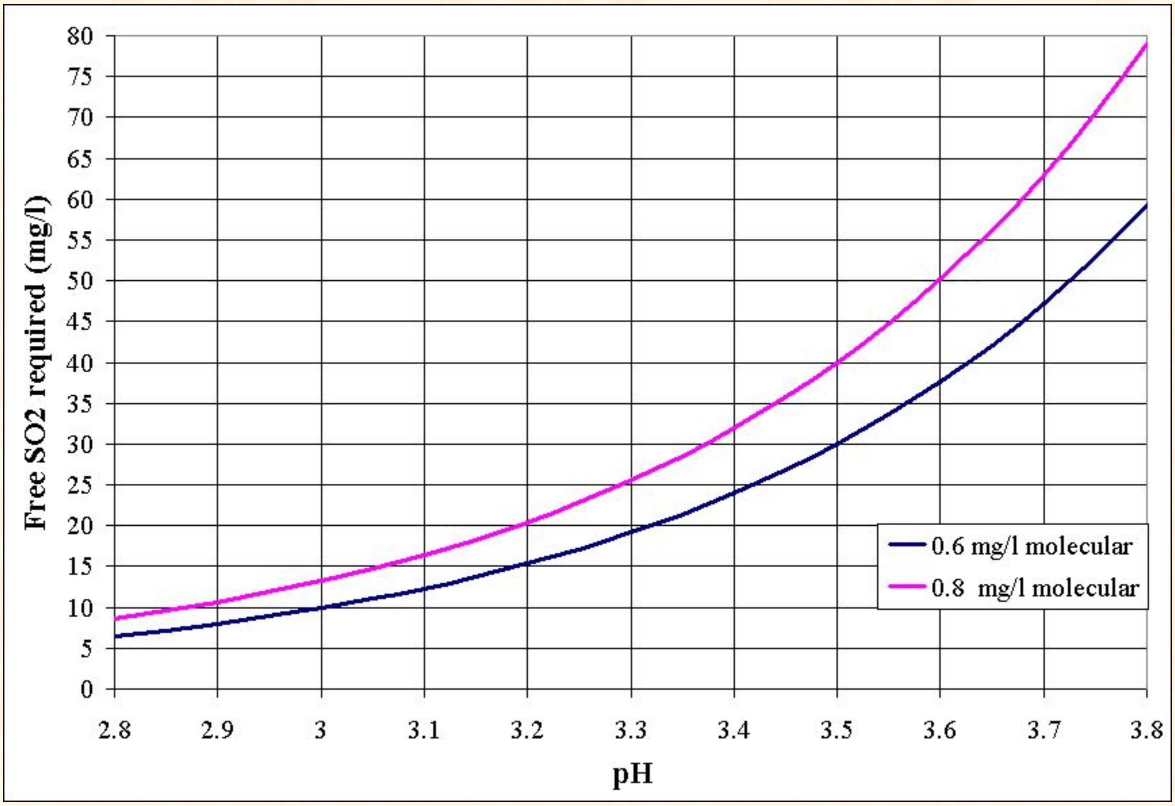
Many years ago, a very skilled Austrian chemist named ***Martha Steinmetz*** told me, ***"everything is pH dependent."*** She said it often, and it is usually true. As noted above, our next chemistry topic is sulfur dioxide, and its behavior in wine is very pH dependent, indeed. **Sulfur dioxide, SO2, is a gas. When dissolved in water, it has a very vigorous reaction, producing dissolved sulfurous acid:**

$$\mathbf{SO2 \longrightarrow (K1)\ H^{+} + HSO3^{-} \longrightarrow (K2)H+ + SO3}$$

As it proceeds through the reaction, two protons are involved, just as with the dicarboxylic acids discussed previously (although this is a simple mineral acid, it just happens to have two active protons). The pKa's (acid dissociation constants) are 1.77 and 7.22, shown as the (K1) and (K2) reactions above. These indicate that half of the "first" protons are dissociated at pH 1.77 and half of the "second" protons at pH 7.22. Since our wine has a pH between 3 and 4, only (K1) plays a significant role, and the dominant form of sulfur dioxide at wine pH is the bisulfite ion, HSO3-. However, it is sulfur dioxide in its molecular form, **SO2, that is strongly antiseptic and antioxidant—protecting your wine from spoilage.**

Reactive, available sulfur dioxide measured in wine is called "free SO2" or "free sulfite". (Note, by the way, that "-ite" ending on sulfite. Sulfate, with an "-ate" ending is a completely different ion and plays no role in protecting your wine.) As we have seen from the pH discussion, most of the free sulfite is actually in the form of the bisulfite ion. Bi- in this case means "one hydrogen atom and one something else" rather than the more common meaning of "two". Potassium bisulfite, for instance, would be KHSO3.

So, how free is it? The amount of molecular SO2 available to protect your wine depends on both the concentration of free sulfite and the pH of the wine. Red wines are generally considered to need 0.6 mg/l of molecular SO2 for protection from oxidation and spoilage, with white wines needing more, about 0.8 mg/l (See table below). And now you know one of the main reasons why low pH wines are more stable than high pH wines!



So far, this discussion has presented sulfite addition as though it came directly from added sulfur dioxide gas. Wineries do that, but sulfur dioxide is a dangerous and reactive chemical not appropriate for home winemaking. Instead, we usually add potassium metabisulfite, a potassium salt of sulfur dioxide. In this application, "meta" is a chemical term meaning "about to become." As above, the "bi" denotes that there is the one proton we have already discussed, plus one potassium ion. Consequently, when potassium metabisulfite is dissolved in water, our old friend the bisulfite ion is produced:

$$\mathbf{K2S2O5 + H2O \longrightarrow 2\ HSO3- + 2\ K+}$$

But, even though this presentation looks as though everything goes to bisulfite, we are still pH dependent. Once the bisulfite ion is in the wine, it can begin going back and forth to the other forms, including molecular sulfur dioxide. **So, how do all these "sulfite" terms add up?**

Potassium metabisulfite weighs 222.32 grams per mole. Sulfur dioxide gas weighs 64.1 grams per mole. For every mole of the salt you dissolve in water (or wine), the yield as sulfur dioxide is as if you added two moles of the gas. As a result, 222.32 grams of potassium metabisulfite introduces the same amount of activity as would 128.2 grams of sulfur dioxide gas (potassium, harmless to the wine, makes up the missing mass). That means that for every 100 ppm of potassium metabisulfite we use in our wine, we have added the equivalent of 57.7 ppm of sulfur dioxide. So, view 100 ppm as "total potassium metabisulfite added." **Does that mean "total SO2" is 57.7 ppm? No. The term "total SO2" is operationally determined in wine testing laboratories.** That is, instead of "total", it means something like "total sulfur dioxide that is recoverable by the recognized analytical method." In that method, a chemist adds strong acid to a wine sample to force the sulfite back over into molecular sulfur dioxide. As that reaction proceeds in a heated flask, air is swept through the sample, removing the sulfur dioxide gas as it forms. At the other end of some glass apparatus, the gas is caught in a basic trapping solution. The chemist measures the amount caught, and that is called "total sulfite." Not surprisingly, in our case, the number would be somewhat less than the theoretical number of 57.7 ppm. From whatever that lower amount is, a still lower amount will be "free"—available to react. And only "free" produces molecular (which protects wine) as noted above. **See Page 10 in this catalog for more information on testing for free SO2.**

So, home winemakers always ask, "where did it go?" We have the tiny amount of molecular sulfur dioxide in the wine. We also hope to have a substantial amount of "free" sulfite—maybe up around 30 ppm. Most of that is in the form of the bisulfite ion. In the "total" measured by the appropriate test, we have all of the "free" included, plus some unstable reaction products that loosely link sulfite with other molecules such as sugars and some trace acids. Some of these may return to the "free" side of the ledger as other free sulfite is used up, serving as a sort of reservoir of free sulfite. Other links are not going to come apart, leaving that part of the "total" sulfite bound and unavailable. Those stable sulfite-containing compounds are mostly sulfited aldehydes—oxidation products in the wine that have been safely taken care of by the sulfite, but took the sulfite away with them. So although this sulfite is not coming back, neither are the aldehydes, and that is a good thing. But, as noted earlier, some "added" sulfite is not even in the "total." Those sulfites are gone forever, mostly oxidized to sulfate (it's that –ite and –ate thing again). Sulfate is very common in wine and in the environment, is non-reactive, and is non-toxic. It is what becomes of sulfur dioxide as the wine is exposed to air:

$$2(SO_3'') + O_2 \rightarrow 2(SO_4'')$$

Since that sulfite is gone forever, it helps explain why **you keep that barrel topped up and oxygen out**!
But what about "safe" SO2 levels? The legal maximum for total SO2 in wine is around 350 ppm (and remember, the amount added can be higher still, without hitting the "total" limit, because some of it disappears). Dried fruit is allowed to contain up to 2,000 ppm. When people are adversely affected by sulfites, it is usually reflected as respiratory problems in sensitive individuals, often asthmatics. As I looked for a good illustration for this article, I came across an interesting case study. It seems that an alert emergency room physician noticed that he had six patients who had all consumed the same brand of salsa. Two of the patients had asthma flare-ups, two experienced coughing and tightness of the throat, and two required mechanical ventilation. It was discovered that the offending salsa had a sulfite content of 1,800 ppm—well above the level of 700 ppm found in other brands of salsa. One of the patients, fully aware of her sulfite sensitivity, thought it was safe to eat the salsa because it was improperly labeled as "fresh." **So what does it all mean?** Well, don't add 700, 1,000, or 1,800 ppm of sulfite to your wine. Just don't go there. Keep it to 30 ppm or so, added frequently and measured often. If problems do develop from sulfite in wine, they will likely be respiratory, particularly in sensitive individuals. If one of your friends says they cannot drink your wine because it gives them a headache, it isn't the sulfites. They're drinking too much wine!

We have covered sugar, alcohol, acids, pH and sulfites. **If you keep all of it in mind as you make your next wine, you can envision your ideal wine chemistry: enough sugar to yield a desirable alcohol level; acids in the right range to be pleasant, refreshing, and balanced; pH where it can safely protect the wine from spoilage, and enough sulfur dioxide to get it safely into the bottle.** Chemistry is where science meets art in making fine wine!

NEW from Lallemand: B a c t i l e s s

Acetic acid and lactic acid bacteria control

Bactiless™ is a 100% natural, non-allergenic source of chitinglucan from a non-GMO strain of Aspergillus niger. Bactiless helps protect wine from acetic acid and lactic acid spoilage bacteria, reducing the production of acetic acid and biogenic amines. Bactiless can be used to drastically reduce bacteria populations and to help prevent bacteria growth in wines, especially after malolactic fermentation. It offers an interesting alternative to lysozyme treatment and/or significant amounts of SO2.
The effectiveness of Bactiless can be enhanced with SO2, but it does not replace the use of SO2 since it does not have antioxidant or antifungal properties. Bactiless can help inhibit malolactic fermentation when it is not desired. In wines where malolactic fermentation is desired, Bactiless should not be used until after MLF is complete.
Bactiless is shown to be effective against a broad spectrum of wine bacteria, but does not affect yeast populations.

Portland Winemakers Club
Leadership Team – 2018

President: **Phil Bard** phil@philbard.com
- Set agenda for the year
- Establish leadership team
- Assure that objectives for the year are met
- Set up agenda and run meetings

Treasurer: **Barb Thomson** bt.grapevine@frontier.com
- Collect dues and fees, update membership list with secretary
- Pay bills

Secretary: **Ken Stinger** kbstinger@frontier.com
- Communicate regularly about club activities and issues
- Monthly newsletter
- Keep updated list of members, name tags and other data

Chair of Education: **Barb Stinger** kbstinger@frontier.com
- Arrange speakers for our meetings

Chair for Tastings: **Bill Brown & Barb Stinger** bbgoldieguy@gmail.com kbstinger@frontier.com
- Conduct club tastings
- Review and improve club tasting procedures

Chair of Winery/Vineyard Tours: **Damon Lopez.** dlopez5011@yahoo.com
- Select wineries, vineyards etc. to visit
- Arrange tours
- Cover logistics (food and money)

Chair of Group Purchases: **Bob Hatt** bobhatt2000@yahoo.com
- Makes the arrangements to purchase, collect, and distribute
- Grape purchases
- Supplies – These should be passed to the President for distribution

Chair of Competitions: **Paul Boyechko** labmanpaul@hotmail.com
- Encourage club participation in all amateur competitions available. Make information known through Newsletter, e-mail and Facebook.

Chairs for Social Events **: Marilyn Brown & Alice Bonham** brown.marilynjean@gmail.com alice@alicedesigns.org
- Gala / Picnic / parties

Web Design Editor: **Alice Bonham** alice@alicedesigns.org