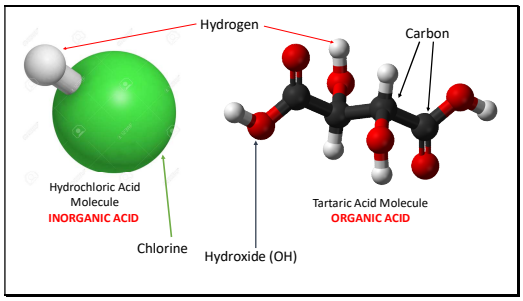
1) Introduction
    a. We will look at what an acid is
    b. We will look at easy ways to measure acids in wine
    c. We'll clarify the reason that TA and pH are necessary and why they are both needed
    d. Going to look at ways to increase or decrease acid in wines

2) What is acid? (**Slide 2**)
    a. Basic acid… Hydrochloric Acid (**Slide 3**)

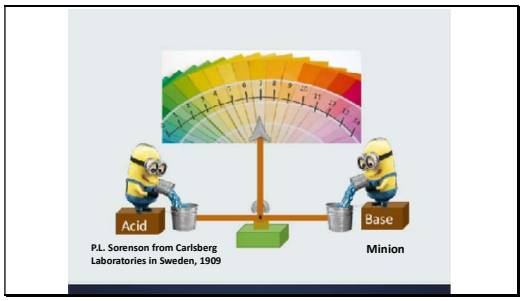


    b. Tartaric acid is more complex.
    c. What makes it acid?
        i. Free hydrogen creates acid
        ii. Higher the amount of free hydrogen, the stronger the acid
    d. There are two kinds of acids.
        i. Inorganic acids
        ii. Organic acids… differentiated by having a Carbon molecule attached to them

3) What are two measures of acid? (**Slide 4**)
    a. pH is a common term for measuring the amount of free Hydrogen ions that float in solution (The strength of the acid)
    b. Titratable Acidity is the measure of how much total acid exists in solution

4) POUR Apple 2016
    a. First wine is apple and won the 2017 Apple Trophy.
        i. Significant for reasons I will point out in a few minutes.
        ii. Focus on the acidity of the wine

5) What is pH? (**Slide 5**)



   a. Invented by head of Carlsberg Laboratory, P.L. Sorenson, a Danish Chemist, in 1909. He was said to be frustrated by the descriptors used in identifying acidity.
      i. Previously, acid was described as 'tart', 'not tart', etc. without any actual measurement
   b. Logarithmic scale that shows amount of Hydrogen on one side and Hydroxide on the other. The middle of the scale is 7.0.
   c. Above pH 7 and we have a Base. Below pH 7 and we have Acid
   d. What is water? Equal amounts of Hydrogen (H^+) and Hydroxide (OH^-) in solution. It is used to identify the neutral pH of 7 by a really long calculation that we won't look at.

6) Measuring pH (**slide 6**)
   a. pH of acids is measured at levels below 7. The Lower the number, the stronger the acid, meaning more free Hydrogen ions in solution.
   b. Wine usually measures between pH 3.0 and pH 3.7, depending on the wine and the color.
      i. pH 3.0 – 3.4 is the usual range for white wines.
      ii. pH 3.3 - 3.7 is the range for red wines.
         1. Fruit (non-grape) wines are normally in the low pH range!
   c. We use a pH meter to find the pH of wine. It is a quick test and it is accurate if the meter is properly calibrated and stored correctly.
   d. pH is a measure of the ageability of the wine. A high pH supports a lot more spoilage bacteria and will allow for faster oxygenation.

7) Preservation… A short aside
   a. Normally we use Potassium Metabisulfite to preserve wine.

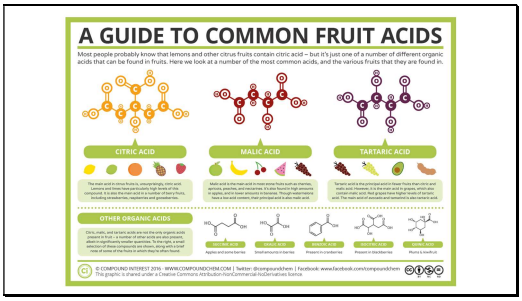
i. The Metabisulfite portion helps to reduce spoilage bacteria and oxidation in the wine.
ii. The less we need to add, the better and this is controlled by pH.

b. Additions chart (**Slide 7**)
c. Not going to delve into the why on this. That is another discussion.
d. Enough to say that the pH determines the amount required to allow for a longer aging wine, especially as a red.

8) Recording your measurements (an aside)
   a. Serve Apple 2017
   b. Remember the best wine you ever made? Maybe it was the bottle that you opened three years after making it and it was incredible!
   c. Ever try to duplicate it?
   d. Records!
      i. Pass out the book.
   e. 2017 wine was based on pH and TA of 2016 wine.

9) Titratable Acidity (TA)
   a. Calculation of the AMOUNT of acid in a wine
   b. Differs from pH in one VERY SIGNIFICANT WAY… (**slide 8**)
   c. pH represents how strong the acid is in a wine, regardless of how strong it tastes, whereas a titration measures how strong that acid tastes.
      i. You can't taste pH. You CAN taste acid
      ii. One does not determine the other
         1. Titratable (total) acid can vary due to differing amounts of the different acids but the pH depends on the STRENGTH of those acids.
         2. An acidic tasting wine does not necessarily have a low pH. Acids all taste differently and their flavor does not depend on the pH of the liquid.
   d. More complicated to find but not that difficult!

e. TA is a measure of the amount of acid in a wine
    i. Most wines have 3 primary acids (**Slide 9**)



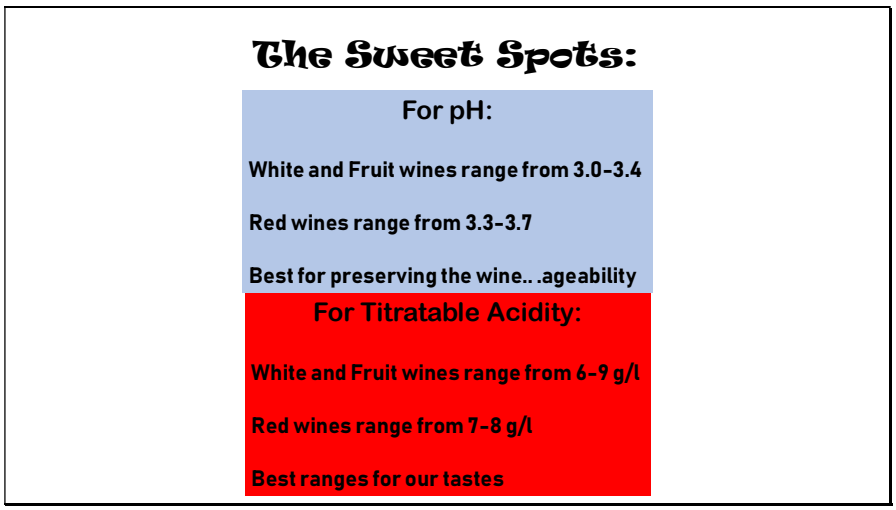
        1. Tartaric (stronger, most prevalent in grapes)
        2. Malic (less strong, prevalent in many other fruits)
        3. Citric (Weaker than Malic, also prevalent in many fruits)
    ii. Each has a different taste and tartness.
        1. Important because the measure of the Titratable Acid will provide a taste profile while **pH measures the preservability of the wine**

10) Buffers, pH and TA
    a. Wine is more than just acid, water and alcohol. (**Slide 10**)
        i. Food coloring… woops, no
        ii. Complex compounds provide flavor, texture, tannins, nose and all of the appealing characteristics that make it Wine.
        iii. Most of these compounds are affected by the acid
        iv. Many of these compounds contain elements or chemicals that bond with acid
    b. Buffers are the name of chemicals or elements that bond with the negative sides of acids (**Slide 11**)
        i. This Neutralizes acids so that they are not available any more in a liquid.
            1. Gas chromatography is required to measure them, so we can't really do it.
            2. Naturally occurring in wine
            3. AND we add them with chemicals like Potassium Metabisulfite
        ii. Potassium (K) is a buffer commonly found in grapes.

iii. Tums are a buffer for stomach acid
iv. Bonds well with acid (**slide 12**)
v. Produces a filtrate.
    1. Like Cream of Tartar (**slide 13**)
    2. Which you find at the bottom of carboys and bottles as a crystal
vi. When you add acid to a wine that contains lots of buffers, it sometimes doesn't change the TA as much as you think it should. The result eventually is that the pH will not change much. This is due to the bonding of buffers with the acid and creates solids at the bottom of your carboy

11) Measuring TA (**Slide 14**)

a. Syringes
b. .1N NaOH
c. Cups
d. Washing water
e. And we'll do a measurement.
f. How it works: (**Slide 15**)
    i. 15 ml of wine
    ii. A syringe of at least 12ml of NaOH
    iii. Drop the pH probe into the wine and start adding NaOH to it. The pH will rise.
    iv. Add the NaOH until the meter hits 8.20
    v. Measure the number of ml's of NaOH that were used and divide by 2. The result is the number of grams/liter of acid that you have
g. Result ideally will be 6-9 g/l for whites and fruits and 7 – 8 for red wines



12) Balancing the wine is critical (**Slide 16**)

a. Two samples of Petit Syrah
    i. 1 has pH of 4.30/ TA of 5.8 g/L. I have no idea how it got that way except to say that it was a combination of buffers released during fermentation and then Malolactic fermentation. It's still fairly high so I assume that there is a lot more Malic (weaker) than Tartaric Acid in the wine.
        1. The worrisome thing is that the wine will spoil due to the very high pH. It's way over the high end.
    ii. 2 is the balanced wine. I added 38 g of Tartaric acid to reduce the pH to 3.90/ TA of 8.
        1. The wine TA is now at the high end. pH is still above the range I want. I won't add more acid, though, because the taste is telling me that there is plenty of acid in the wine. I'll give it some time, taste and measure again and see what is going on.

Adding Acid to wine:

To reduce the pH of a wine by .1, add 1 gram of Tartaric Acid per Liter of wine.

A 5 gallon carboy is approximately 19 Liters. A 6 gallon carboy is approximately 23 Liters

Adding Malic is more difficult because it is not as acidic.

1.0 g/L addition of Malic acid will increase the TA by about 1.12 g/L and will decrease the pH by 0.08 pH units.

1.0 g/L addition of Citric acid will increase the TA by about 1.17 g/L and will decrease the pH by 0.08 pH units

b. Acid addition simplified. (**Slide 17**)
    i. Lower pH: 19 grams of tartaric acid to a 5 gallon carboy will lower pH by .1
        1. Why? Because 5 gallons is approximately 19 Liters. See the relationship?
        2. 6 gallons is 23 Liters. Add 23 grams of tartaric acid to lower pH by .1.
c. Throw away your Acid Blend!!! They don't tell you how much of what is in it. You don't know how much to add. You no longer have control of either pH or TA.

13) Removing acid from wine. (**Slide 18**)
    a. Malolactic fermentation
        i. Red wines (and Chardonnay)!
        ii. Converts Malic acid to Lactic acid which is smaller, less acidic and lowers TA while raising pH
    b. Cold stabilize
        i. Extended cold stabilization will encourage buffering and crystallization of the acids. It will then drop to the bottom of the carboy as a solid.
    c. BLEND
        i. Use different wines with different pH and TA to create something that you will love

d. Addition of buffers.
    i. Calcium carbonate (chalk) will bond with acids and drop them as solids. Not highly recommended… Last resort

14) Now you know everything there is about acid in wine. (**Slide 19**)
    a. Summary
    b. The truth is, make what you like. We, as home winemakers, only are required to drink what we make. Enjoy!