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Wine Making Basics – The Next Step for the Home Grower

You've established your vineyard and want to make wine. The cultivars you have selected will give you a general time for maturity indicating when to harvest.

Determine Readiness to Harvest

Test the fruit before harvest. Determine if the sugar levels are optimum for producing wine. Use a refractometer to get your brix levels (optimum is 20 and above) and if possible test the pH and TA as explained below.

Getting Started

There are many sources in books and on the web for making wine. The following should be considered a guideline. Once you become comfortable making wine, you will develop your own strategies.

Equipment needed:

De-stemmer/crusher, (unless destemming by hand)	Yeast
Container to ferment must ¹ with a loose lid	Sugar
Refractometer or hydrometer	Litmus paper
Tubing for syphoning juice to carboys.	Carboy and airlock bubbler
Cleaning and sanitizing chemicals	Malolactic bacteria
Measuring cups, scale, measuring spoons	Clarifying agent
Fruit Press	Racking Cane

Do you have enough fresh fruit to make wine? How many grapes are needed for a bottle of wine? A general figure is 15-16 pounds of fruit per finished gallon of wine.

Cleaning and Sanitation

It is important that your wine making tools and working area be clean. Yeasts are always in the air, so it is a good idea to clean and sanitize old equipment or equipment you have borrowed. Bottles should be clean and sanitized prior to being filled and corked. These two procedures are

¹ Must – destemmed and crushed grapes, from the Latin term meaning “young wine”

different. **Cleaning** is the process of removing all dirt and residue and is done first. **Sanitizing** is the chemical treatment of your bottles and equipment to kill foreign yeasts, bacteria, and molds and is performed after cleaning. The list of products to use for each process is listed below.

A few of the common products used for cleaning include: percarbonates (combination of sodium carbonate and hydrogen peroxide), PBW (Powder Brewery Wash)², Straight-A®, One-Step®, B-Brite®, Sparkle Brite (Diversol)®, and Pro-Zyme®. It is NOT suggested to use chlorine bleach, as it is difficult to get rid of residues. Do not use cleaners such as bathroom cleaners. Tools and equipment should be scrubbed or soaked for at least 20 minutes.

The following are used for sanitizing: Campden® tablets - pill form of sodium or potassium metabisulfite, (preferably use potassium metabisulfite - powder is better), Iodophor®, and Sparkle Brite (Diversol) ®.

If you keep your equipment clean, use good grapes, use SO2, ferment to at least 12% alcohol, and keep your containers topped off you should have no problem with preventing your wine from turning to vinegar. Vinegar forms from bacteria found in poor grapes and can also be transferred by fruit flies.

Table 1. Sugar additions (Source: Culter 1996)

Sugar Additions (if necessary)			
Existing Brix	Add per gallon for 12% alcohol	Add per gallon for 13% alcohol	Add per gallon for 14% alcohol
16	.58 lb./gal.	.68 lb./gal.	.78 lb./gal.
17	.49	.59	.69
18	.39	.49	.59
19	.30	.39	.49
20	.20	.30	.39
21	.10	.20	.30
22	0	.10	.20
23	0	0	.10
24	0	0	.05

Note: 1 degree Brix produces approximately 0.575 percent alcohol

Harvest

Harvest the fruit on a dry day to prevent damp berries (individual grapes) from getting mildew. It is preferable to wait a few days to harvest if it has just rained so the sugars can level off and the fruit can dry. Generally, the sooner you crush the berries after harvest, the better. If under a crunch for time, white grapes can be harvested earlier than red grapes.

Brix (also known as **Balling**) is the measurement of sugar content represented as grams of sugar per 100 grams of juice. It can be measured using a hand held refractometer in the field or a floating hydrometer in the winery. If your grapes have a reading under 20 Brix the sugar levels are too low and they may not be ripe enough for harvest. Adding sugar to juice that is 20 Brix or above is not necessary to obtain a nice wine and to provide enough sugar for proper fermentation. If you have already harvested and your Brix reading was under 20, then you will

² Mention of a product is not an endorsement by the Connecticut Agricultural Experiment Station nor the author.

probably need to add sugar to the must for wine making. The figures in **Table 1** are indicators for ripe fruit, and sugar additions if needed.

A **pH** below 3.6 is desired for wine grape juice. Higher pH levels can influence the keeping quality of produced wines. As the pH increases, all molecular SO₂ is lost along with its effectiveness as a preservative. Proper measurement techniques for the pH of grape juice are essential for wine quality and microbial control when adding sulfites. pH readings can be accomplished easily with litmus paper for the home vintner. You can obtain more precise readings with a pH meter. **Table 2** shows the ideal SO₂ levels.

Table 2 Ideal free SO₂ levels (Source: Culter 1996)

Ideal Free SO ₂ Levels		
pH	White Wines	Red Wines
3.00	13 ppm	8 ppm
3.10	16	10
3.20	21	13
3.30	26	16
3.40	32	20
3.50	40	25
3.60	50	31

Rough Equivalents: 1 gram SO₂ = 150 ppm in 1 gallon

1 gram SO₂ = 30 ppm in 5 gallons

¼ tsp. = 1.3 g. ½ tsp. = 2.7 g. 1 tsp. = 5.5 g.

TA, also known as Titratable Acids, is not a test most home grape growers perform because they lack the required materials. If you are interested, it can be measured using the following procedure: 1) fifteen ml of must is placed into a clear tube; 2) three drops of phenolphthalein indicating solution is added to the tube and swirled to mix; 3) ten ml of sodium hydroxide is added to the test tube 0.5 ml at a time, the phenolphthalein changes color when the pH reaches 8.2. When the color change is permanent, each ml of added reagent will equal 0.1% TA. You can then compare your readings to **Table 3** to see if they fall into the range for harvest.

De-stem

Some people take the berries off the rachises (stems) before crushing. The crushing process is faster without the interfering stems. Stems can also increase tannins in the juice. This is less noticeable on red grapes that often are oaked during the aging process to increase tannins.

Crush

The berries, with or without rachises, are then put into a crusher. This is a V shaped hopper with a crank handle. When cranked, the fingers in the center of the crusher gather the berries and crush them while dropping the juice, seeds, skins, and berry flesh pulp, (and rachises if you didn't previously remove them) into a pail placed beneath the hopper. Various grape cultivars contain pectin in different levels. The pectin level can be determined by the stickiness of the crushed berry. High viscosity (the stickier the crushed fruit) indicates higher pectin levels. If you are using fruit high in pectin, this is the time to add pectinase, an enzyme that breaks down the pectin in the fruit. Pectinase makes the pulp release more of its juice and helps prevent or reduce

cloudiness in the wine. However, the use of pectinase can speed up the maturation of a finished wine, making them appear flat or past their prime. Slower maturation is better for making higher quality wines, but lack of cloudiness is also preferred. With experience, you will learn if your cultivars are high in pectin and determine if you will need to add pectinase. The resulting material after the grapes have been destemmed and crushed is called the “Must”.

Table 3 Juice harvest indicator levels. (Source: Boulton et al. 1977 in van Schalkwyk and Archer 2000)

Recommended Sugar and Acid Levels for Wine Grapes			
Wine Type	Brix	TA	pH
Sparkling	18.0-20.0	0.70-0.90	2.8-3.2
White Table	19.5-23.0	0.70-0.80	3.0-3.3
Red Table	20.5-23.5	0.65-0.75	3.2-3.4
Sweet	22.0-25.0	0.65-0.80	3.2-3.4
Dessert	23.0-26.0	0.50-0.75	3.3-3.7

Hydrometer use

At this point you should get a reading of the must with a hydrometer. Measurements are taken by suspending the hydrometer in the must to determine the Brix, potential alcohol level, and specific gravity. This can be done while it is in the collection pail after crushing or by pouring juice without pulp into a tall slender glass column. The hydrometer is carefully placed into the column so as not to touch the bottom or sides. It must be free floating. Record your measurement as read at the liquid surface line (meniscus). Decide if you want to make sweet, semi-sweet, semi-dry or dry wine. Do you want the alcohol levels to be low, high, or very high? Most table wines have alcohol levels between 11-13%. Refer to **Table 1** for the amount of sugar you may need to add to achieve the desired alcohol level.

Fermentation

Start your fermentation process in a container that is food safe and capable of allowing increased volume without overflowing. A 6” head space is adequate. A loose cover should be used to prevent fruit flies and bacteria organisms from contaminating the must. This can be a tarp or piece of plastic tied over the top. At this point you may take a hydrometer reading to get Brix, potential alcohol and specific gravity readings. Generally, if the Brix reading is less than twenty, two cups of sugar should be mixed in per five gallons of must.

All grapes have wild yeasts on their skins. Fermenting with wild yeasts is known as Spontaneous Fermentation. Wild yeasts can vary from location to location and may not necessarily be a desirable strain. Some are not good for wine making. Fermentation with wild yeasts can be unpredictable and doesn’t always produce a consistent wine as there are many variables that may fall into play. Grapes will ferment, but the fermentation can be slower to establish, allowing other organisms to take over. Having the proper acidity and pH in your grapes at harvest, reduces possible contamination while waiting for fermentation to begin. When you first begin making wine, it is recommended to use a known yeast strain. To do this you need to kill off any wild yeasts, spoilage organisms and bacteria in the juice. This can be done with Campden® tablets (pill form of potassium metabisulfite) or powder at the rate of ½ tsp. dissolved in one cup of

warm water per six gallons of must, (read directions on package). Killing off wild yeasts is done 24 hours before introducing your desired yeast strain and directly after you have crushed. Wait and follow directions on the package for timing and dosages. Then add your desired yeast. The type of grape you are using will influence the strain of yeast you buy. Specific strains of yeast can encourage certain flavors and aromas. After introducing yeast, the grapes sit on the skins to ferment, usually about 4-5 days. This is more common with red and purple grapes than with white.

Fermentation is the process where sugars are turned into alcohol. While waiting for fermentation to start, resist the urge to look in on its progress for a few days. This is the time when there is a greater chance of introduced contamination and subsequent spoilage. You will see the lid lifting up slightly once fermentation has definitely started. Punch down the must cap and stir the solids back into the mix. Do this every few days. When fermentation starts to slow after approximately one week, you can rack off the juice to a carboy and press the solids to remove any extra liquid (see the pressing information below). It is advisable to transfer the juice to a carboy before the complete fermentation has finished. Only a tablespoon of sugar is needed if the Brix reading was twenty or above. This additional sugar isn't added to increase alcohol content, but to generate CO₂ from fermentation to force oxygen out from the head space. The carboy should be filled to within a few inches of the top to minimize head space which reduces chances of contamination and oxidation. White wines tend to oxidize more readily than red wines so an airlock should be added immediately after the carboy is filled.

The next stage of fermentation is changing the remaining sugars in the juice to alcohol. When the bubbling seems to have stopped, typically about 10 days, take another hydrometer reading. The potential alcohol should be about 1/3 of the first reading. This happens by the natural process of yeast consuming the sugars and giving off carbon dioxide. Cool fermentation temperatures, (50°-60° Fahrenheit.) are preferable. Warmer temperatures result in more complex wines and increase the difficulty in controlling the fermentation rate. Fermentation can last anywhere from 1 week to 4 weeks. After fermentation has completed, take another reading with the hydrometer. Using your initial potential alcohol reading, subtract your ending potential alcohol reading. You will get your actual alcohol percentage by volume.

There is always a chance for a stuck fermentation, (incomplete fermentation) or spoilage, but this is more common when using wild yeasts. Common causes include:

- Overly ripe grapes at harvest. They produce too much alcohol killing off most yeast, and the surviving yeast is too weak to finish converting the remaining sugar to alcohol.
- The must may be lacking nutrients that are important to yeast growth. This can allow a wine to spoil more easily and decrease its longevity. You could end up with off flavors and unwanted aromas. The addition of diammonium phosphate (DAP) to the must might help.
- The wild yeast may not be a desirable *Saccharomyces cerevisiae* strain. Since you don't know what strain of yeast you are working with, it takes more knowledge to control fermentation. You need to know what is going on with the fermentation.

- Even when you have used an introduced yeast strain, it is possible to get stuck fermentations. Higher must temperatures (fermenting must can near 104 degrees) can cause a stuck fermentation by killing off the yeast. Read the directions on the package.

Some experienced wine makers using wild yeasts will take regular hydrometer readings. When the alcohol levels have reached 3 or 4%, they then inoculate the must with the desired strain of *Saccharomyces* yeast to finish the job. You can get the best of both worlds by first fermenting with wild yeasts that can create greater body, color, and character; and then using introduced strains to get higher alcohol levels. Wild yeasts have been used to make wines for thousands of years. It has only been within the last century that introduced yeasts were used.

Pressing

Some wine makers prefer to press their must before fermentation. This is common with delicate white wines, but whites can also be fermented on their skins to increase character. Red wines benefit from fermenting on the skins to gain color and increase tannins. Pressing the must after fermentation allows the tannins and aromas to mix with the juice and gives a hardier fuller body juice. Pressing can be accomplished by “hand squeezing” on a small scale, or with a wine press. To use a wine press, the grape must is poured into the press basket. This barrel shaped apparatus has narrow open slatted sides with an inside disk that presses down on the must to force the liquid out through the open slats into a collection pan that drains into a bucket. The juice that flows off the must without pressure is called “Free Flow” and is the juice that produces the highest quality wine. The juice that is obtained by putting pressure on the must will tend to be lower quality and will have more tannins and phenols extracted from the stems, skins, and other materials in the must. Some presses are very elaborate and can ratchet down putting extra pressure on the must making the process easier and permitting more juice to be extracted.

Malolactic Fermentation is the secondary fermentation that occurs with red wines and some white wines. This fermentation occurs when bacteria consume the malic acid, naturally found in grapes, and change it to lactic acid and CO₂ gas. The wine becomes more mellow, when malolactic fermentation converts the stronger malic acid into the less harsh lactic acid. Since no filtration is used for home winemaking, malolactic fermentation must be completed before bottling to assure the stability of the bottled wine. If it is not complete, and you bottle your wine, you run the risk of the malolactic fermentation in the bottle. The wine will turn cloudy, create sediment, and it can cause the wine to leak through the corks and even cause them to shoot out of the bottles. Some wine makers inoculate their wine with malolactic bacteria to encourage this secondary fermentation before bottling. Malolactic bacteria prefer temperatures above 60° Fahrenheit, grow better if in contact with the lees (sediment) in your carboy, and prefer a pH above 3.3.

Racking

This is the process of pulling the clear juice off of the dead yeast cells known as the lees. The juice should be returned to a clean carboy to allow more settling. After fermentation is complete, add ¼ tsp. metabisulfite per each five gallons to prevent spoilage. This will help if you are not allowing malolactic fermentation. If the juice is cloudy, you can add a clarifying agent such as bentonite (a type of clay). The bentonite should be hydrated with water for at least three hours before adding to the carboy. This addition will cause any additional solids (proteins) to settle to

the bottom and then the juice can be racked again. There are other types of fining agents on the market in addition to bentonite. Wait at least three days after adding bentonite until you begin cold stabilization.

Cold Stabilization

Next, the cleared wine should be stored at temperatures below or near freezing (32°-38° Fahrenheit) for several weeks. pH readings can be taken prior to stabilization to provide an idea of how quickly and whether salts will completely precipitate. A pH greater than 3.6 will precipitate salts more efficiently, therefore shortening time needed in cold stabilization. If you are still using a bubbler air lock, vodka or other high alcohol liquid should be substituted for water or the water in the bubbler will freeze in the cold temperatures. Optionally, carboys can be stoppered without a bubbler when cold stabilizing. Cold stabilization will further clarify the wine by preventing tartaric salts from forming after the bottling process. This is generally only done for white wines, as they are bottled earlier than reds, usually served cold, and crystals are more noticeable in white wines. Red wines are bottled later which allows the crystals to precipitate on their own before the wine is bottled. If a wine does not go through cold stabilization and is later chilled to a low temperature in a homeowner's refrigerator, crystals may precipitate out and settle to the bottom of the bottle. These are known as "wine diamonds" because they have a shine similar to diamonds. They are harmless but consumers do not like it as they look like glass fragments.

Oak softens the character of the wine. Tannins are extracted from the oak chips, and over time, combine with proteins in the wine and settle to the bottom. Oak can be added to red wines in many ways but for the home owner the use of chips is the easiest. Red wines can have toasted oak chips added to the carboy. You will not need to add chips if aging in oak barrels. Aging with oak for the home wine maker ranges in time from a month to several months. The rate of toasted chips to add to a 5-gallon carboy ranges from one to two ounces. It can bring out different flavors in the wine. White wines such as Chardonnay and Sauvignon blanc can also be oaked but it is more common with reds. Never use oak wood from firewood you may have. Use oak chips meant for wine making.

Bottling

Bottling is done when the wine is stable. This means the fermentation is complete, malolactic fermentation is complete, proteins are stable through pectinase enzyme use, wines are fined (clarified) using bentonite or other agent, wines have been cold stabilized, and residual sugars have been converted to alcohol. If you are maintaining higher sugar levels and don't filter before bottling, then adjusting the SO₂ levels is about all you can do. Finished white wines generally require more free SO₂ to achieve the same anti-bacterial effectiveness as red wines.

Oxidation occurs when wine has insufficient SO₂ levels and has been exposed to too much air. It is more noticeable with white wines as a slightly brown color. This can happen more readily if your carboys are not topped off with wine.

When corking your bottles, the wine should fill the bottle to within ¼" of the bottom of the cork. If you are using a racking cane to fill your bottles, allow the wine to fill to the rim of the bottle. The level will be correct when you quickly lift the cane and remove it from the bottle.

Storage

As a general rule, filled corked wine bottles should be stored upright for a few days after bottling, then on their side to keep the corks moist. Screw cap bottles can be stored upright.

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