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Wine Making for the Home Gardener

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Introduction

Wine making has increased in popularity as a hobby for home gardeners who have taken the science and craft beyond the grape vineyard to the bramble patch, vegetable garden, and flower garden. The American Homebrewers Association estimates that more than one million Americans brew beer or make wine at home at least once a year.

The grape has long been considered the perfect base for winemaking because of its natural mix of ingredients. However, with a little extra effort to balance ingredients, great wines can be made from many other fruits as well as vegetables, grains, leaves and flowers grown in the home garden.

This article describes the basic steps used in making wine from fruits or vegetables grown in the home garden. The term "fruit" is used generically to refer to whatever fruit or vegetable is being used as the base for the wine. Whether using peaches, beets, cactus or parsley, the process is similar and the outcome can be delectable.

There are two principles that guide every step in the home winemaking process:

1. Sanitation is essential. While absolute sterility is not required, all equipment must be sanitized to reduce bacteria and fungi. Fungi and bacteria found on most garden produce, on kitchen counters and tools, or even in the air can spoil the wine. Two solutions commonly used for sanitizing equipment are: (1) 14 crushed Campden tablets (a form of potassium metabisulfite) dissolved in one gallon of water, or (2) potassium metabisulfite powder. Read the directions on the product carefully for amounts since recommendations from the literature vary considerably for a sanitizing solution. Products used by the author recommend four Campden tablets per quart of water, or ¼ teaspoon of potassium metabisulfite powder per quart of water. Citric acid added to the potassium metabisulfite increases its antimicrobial effect. There are also proprietary formulations developed for winemaking such as "B-Brite" (an active oxygen sanitizer and "Star San" (an acid-based sanitizer) which work without use of sulfite. Chlorine bleach is not recommended to sanitize wine equipment as it can impart an unpleasant taste to the wine.

2. Oxygen (after active fermentation stage) is "an enemy of wine." (Quote attributed to Louis Pasteur). Exposure to oxygen can lead to oxidation which can have a negative impact on color and taste of wine.

Steps in the Wine Making Process

While wine can simply 'happen' if fruit is left to sit and ferment, a palatable wine takes a bit more effort in preparation of the fruit and equipment. The type of equipment needed to make wine at home depends in part on how much wine is being made. Table 1

summarizes the basic equipment needed for making one gallon of wine.

Table 1. Basic Equipment Needed for Making One Gallon of Wine
Primary fermenter: *plastic bucket, crock, or other container that holds 2 or more gallons*
Secondary fermenter (carboy): *1-gallon glass or plastic jug with a small opening*
Rubber cork (bung): *with hole in center for the airlock*
Airlock (bubbler): *"S" type plastic tube*
Hydrometer: *scale to measure specific gravity and potential alcohol*
Siphon tube: *6 feet of ½ inch clear plastic tubing*
Nylon straining bag: *sanitized panty hose works well*

Step One: Prepare fruit.

*The fruit is prepared and placed into a nylon bag in a clean **primary fermenter**.*

Figure 1. Fresh, ripe blackberries

This article describes using fresh fruit to make wine, however, it is possible to use frozen fruit, or even fruit juice. Several different fruits can be mixed together to make a 'fruit' wine.

The quality of the finished wine is dependent on the quality of the fruit. Choose the ripest fruit available. Rinse it with water, as if it is going to be eaten. Remove insects, sticks, molded or bruised fruit. Prepare the fruit by chopping, crushing, pressing, heating, or soaking to make more pieces accessible to extract flavors, color and aromas.

The method used to extract flavor and aroma from the fruit is determined by the type of fruit. For most fruits the method is fermentation extraction, where the flavors and aromas are extracted as part of the fermentation process. Some vegetables, such as beets require heat extraction, heating the vegetable in water to aid extraction of color and flavors. Herbs, flowers, leaves, and bark, may be steeped in cold water to preserve their color and aroma. The prepared fruit is referred to as ***must***.

Figure 2. Chopping blueberries for wine.

Figure 3. Putting blackberries into nylon bag in primary fermenter

The must is placed in a nylon bag (panty hose work well) in a clean primary fermenter, which is a glass or plastic container that is larger than the amount of wine being made. For example, use a two gallon container if making one gallon of wine. The extra room is needed during the vigorous first phase of fermentation. The nylon bag makes it easier to remove the must from the fermenting juice once extraction has occurred. The primary fermenter is covered with a clean cloth which will permit air exchange during the first phase of fermentation.

Figure 4. Covered primary

The fruit is further prepared by adding ***sulfites***. This is critical for several reasons. Sulfites protect against

bacteria and mold formation; prevent oxidation (replacing oxygen with sulfur dioxide gas); inhibit growth and competition of most wild yeasts; and help to preserve good color in the wine. The sulfite is usually in the form of powdered potassium metabisulfite, or ***Campden*** tablets (one tablet, crushed and dissolved in water, for one gallon of wine). Note that this is the same substance that can be used in sanitizing equipment, just a much smaller concentration.

Figure 5. Campden (bottle, tab)

Step Two: Add Ingredients.

Water, sugar and other ingredients needed for fermentation and to enhance flavor are added to the must

Additives used in wine making will vary with the specific fruit being used. For example, fruits that are naturally low in acid will benefit from addition of an acid blend. Table 2 provides a summary of ingredients typically used and discussed in this article.

Table 2. Ingredients Typically Used in Wine Making
Acid blend: *a blend of tartaric, malic and citric acid; used with fruits low in acid*
Pectic enzyme: *used to break down pectin*
Campden tablets: *for sanitizing equipment and/or sulfiting the must*
Potassium Metabisulfite: *for sanitizing equipment and/or sulfating the must*
Yeast Nutrient: *food for the yeast*
Grape Tannin: *antioxidant and preservative adds astringency to wine*
Potassium Sorbate: *for stabilizing wine*
Wine yeast: *converts sugar to alcohol through fermentation*

Water is usually added to berry, vegetable and most fruit wines because, unlike grapes, they are often too strong in flavor, too low in water, and/or too high in acid to produce a good tasting wine without being diluted. The amount of water added depends on how much juice is produced when the fruit is prepared and on whether water was added in preparing the fruit. For example, when making one gallon of beet wine, if one quart of water is used in cooking the beets, it is added to the must and an additional three quarts of water is added to bring the volume up to four quarts, or one gallon. In another example, when making berry wine, if one quart of juice is produced in crushing the berries, an additional three quarts of water is added to bring the volume up to four quarts, or one gallon. Distilled water is not recommended, as it does not contain trace elements useful in fermentation.

Sugar is needed to produce alcohol. The amount of sugar present at the start of fermentation determines the percent of alcohol at the end of fermentation, minus any sugars that didn't ferment. While most fruits contain some sugar the amount is generally not sufficient to produce a quality wine. The amount of sugar present in the fruit juice determines how much to add. A ***hydrometer***, a glass tube with one or more scales, provides information that can be used to estimate how much sugar to add. One scale on the hydrometer measures ***specific gravity*** (S.G.), which is the weight or density of the liquid. When the hydrometer is placed in the liquid in the fermenter, it will float up to a level on the glass tube indicating the S.G. If there is no sugar in the liquid, the hydrometer will float to the 1.000 level (the S.G. of water). Sugar is added to the juice/must in the fermenter to raise the S.G. to about 1.090. This S.G. ensures that there is enough sugar to produce an alcohol level of about 12%. The sanitized hydrometer can be placed directly into the liquid in the fermenter, or some of the liquid can be dipped out and placed into a tall thin plastic or glass container deep enough to float the hydrometer.


Figure 6. Hydrometer

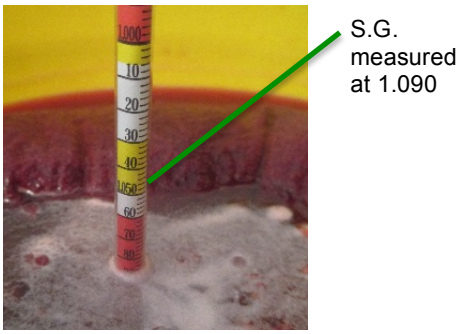

Figure 7. Hydrometer measuring S.G. fermentation

Another scale on the hydrometer measures ***predicted alcohol*** (P.A.) which is the percentage of alcohol expected in the finished wine. Using this scale to determine how much sugar is needed, add sugar to the liquid until it raises the hydrometer in the liquid to the desired alcohol level, usually 12%. When reading the hydrometer, note that the liquid rises around the hydrometer and at the edges of the container. The measurement (S.G. or P.A.) is taken at the meniscus, or bottom flat area of the liquid, not the raised area around the hydrometer edges of the

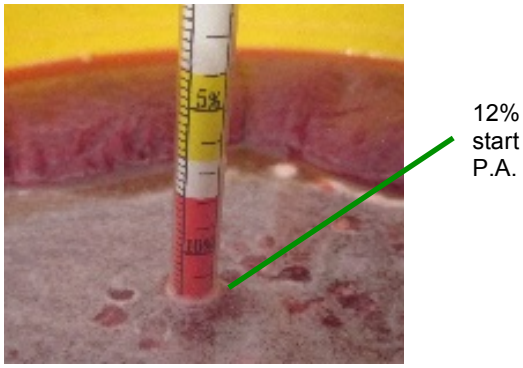

Figure 8. Hydrometer measuring P.A. at start of fermentation

container. For more information about reading a hydrometer, check the American homebrewers Association and E.C. Kraus websites listed in the references.

Several substances, some of which naturally occur in grapes, need to be added to most other fruits and vegetables to produce a good tasting wine. These include acids, pectic enzyme, tannin, and yeast nutrient.

Acids give wines their characteristic crisp, slightly tart taste and aid in fermentation. The amount of acid desired in a wine is very subjective because of the difference in tastes. If a wine has too much acid, it tastes sharp/sour/bitter. If a wine doesn't have enough acid, it tastes flat or bland. Most fruit juices/musts benefit from addition of acid. This can be accomplished by adding ***acid blend*** (a mixture of citric, malic and tartaric acid). Tannin, a naturally occurring polyphenol found in grape seeds and skins, may be added to add astringency and complexity to a dry red wine. Care needs to be used in adding tannin to a white wine because it can easily overwhelm the fruit flavor. The acidity level of the must can be checked using titration kits or pH testing strips (litmus paper). However, measured acid levels and the way the acid tastes to each person may have no relationship. Because of this, many wine makers use tested recipes initially, then experiment with the recipe to suit their personal tastes. Keep in mind that each different batch of fruit can have different amounts of acids present.

Figure 9. Acid blend, tannin, pectic, enzyme, yeast nutrient.

Pectic enzyme as an additive serves two purposes. It breaks down natural pectin and breaks down the pulp and skins, making it easier to extract flavor, aromas, acids, tannins and other components that add to the complexity of wine. Natural pectin, present in many fruits, can create a haze in wines. Apples, blueberries and blackberries contain natural pectin, so will benefit from addition of pectic enzyme in the winemaking process.

Yeast nutrients are useful additives for yeast to produce a good fermentation. Most fruit and vegetable musts, do not have all the nutrients needed. Recipes will indicate how much yeast nutrient to add based on the fruit/vegetable base.

Yeast is the last ingredient added to the must, being added 12 to 24 hours after the must is prepared and other ingredients are added. The reason for the 24

hour delay is to allow the sulfite, which was added to the prepared fruit, to kill the natural yeast, then break down, so it will not kill the cultured wine yeast. Fresh fruits, berries, and vegetables contain natural yeast, not suitable for wine making since these natural yeasts may produce off-flavors and odors and may produce very small amounts of alcohol. Use only wine yeasts, which have been developed specifically for wine making. Yeasts used for bread making are not suitable for wine making. It takes only a small amount of wine yeast to start fermentation.

Step Three: Primary Fermentation

Figure 10. Wine Yeast

For about three to ten days the juice/must should sit in a dark room at a temperature of about 70 degrees Fahrenheit for red wines or 50-60 degrees Fahrenheit for white wines. The yeast will multiply rapidly and begin to convert the sugar to alcohol and carbon dioxide. The liquid is stirred and the nylon bag of fruit is gently squeezed daily until the S.G. reaches about 1.030 or lower.

For the first few days, the fermentation process will be vigorous and foam will collect on top of the liquid. Stirring the liquid daily incorporates air needed for the first part of fermentation and helps keep the nylon fermentation bag wet. Squeezing the bag helps in extraction of color and flavor. During this phase, the yeast is multiplying rapidly. There will be a noticeable odor during this stage of fermentation. After several days, the fermentation process slows. At this stage, check the S.G. every few days. The S.G. will decrease as sugar is converted to alcohol. When the S.G. drops to about 1.030 or lower, it is safe to move to step four.

Figure 11. Foaming primary

Step Four: Continuing Fermentation and Clearing

*The nylon bag with the must is gently squeezed and discarded. The liquid and **lees** (sediment) are transferred to a clean **secondary fermenter** (**carboy**). An **air lock** is fitted into a cork on the fermenter. The liquid will be **racked** multiple times until fermentation is complete and the wine clears.*

Figure 12. Must in nylon bag being removed from primary

When primary fermentation is complete, the flavor, color, and any useful ingredients in the must have been extracted, so the bag of must can be removed from the liquid. The liquid, along with any sediment is transferred to a secondary fermenter to continue fermentation. This can be accomplished by simply pouring the liquid, along with the sediment, into the secondary fermenter. The secondary fermenter is usually a glass jar that permits a clear view of the wine as it clears. The sediment may still contain some live yeast that will be helpful in completing fermentation.

Because this phase of fermentation is anaerobic, (without oxygen), an air lock is put in place. The air lock is a plastic tube filled with the same metabisulfite and citric acid solution used to sanitize equipment. It allows carbon dioxide to escape from the fermenter, and prevents oxygen from getting in to the wine. If there is not enough liquid to completely fill the secondary fermenter, fill the empty space with either a compatible wine or with water. Sterilized marbles can also be added to increase the

Figure 13. Air lock on secondary fermenter

volume, thus decreasing the air space. Some winemaking stores sell small tanks of inert gas that can be used to remove the air from the airspace. It is important that the air space be kept at a minimum to prevent ***oxidation*** (off-colors and tastes). Continuing fermentation and clearing, which may continue for several weeks or months, is best in a dark room at a temperature of 50-60 degrees Fahrenheit. When fermentation appears to have

Figure 14. Hydrometer at finish

stopped (bubbles are no longer coming through the air lock) check the specific gravity. It should be less than 1.000 (alcohol is lighter than water; the sugar has all been converted to alcohol and CO_2).

During continuing fermentation and clearing, the wine will be ***racked*** multiple times over several months. Racking involves siphoning the wine off of the sediment using a plastic tube. The wine filled container is placed higher than the empty secondary container which will receive the siphoned wine. A suction bulb applies suction on the lower end of the tube to start the wine moving from the filled container into the empty container. Keep the top end of the tubing above the level of the sediment in the container to prevent sediment from transferring into the clean secondary. Once the flow has started, keep the lower end of the siphon tube below the fluid in the secondary to help keep oxygen out of the wine as it is being transferred.

Figure 15. Racking wine. Place the filled container higher than the empty one to rack the wine.

If there is sediment in the bottom of the fermenter after one to two more months, rack it again. Continue this process until there is no longer sediment in the bottom. As more sediment is removed, the wine will become clearer. At each racking, some wine will be lost with the sediment in the bottom of the fermenter, so there will be less to put into the clean fermenter. It is important to fill the new fermenter up completely, leaving very little air space. Either use smaller containers, or fill the extra space with a compatible wine or with water. Don't worry about diluting the wine. It is not likely to dilute it more than 1%, which will still produce a very good wine.

Figure 16. The bottom end of the siphon tubing below the fluid level, but above the level of the sediment

At every other racking, one crushed Campden tablet is added to the wine. The Campden added in step one has broken down and needs to be replenished to protect the wine from bacteria. Home winemaking stores sell kits that will provide a rough estimate of free sulfur dioxide in wine. These estimates, along with information about the pH level, can help the winemaker determine the amount of metabisulfite (Campden) to add, thereby preventing overdoing it (ending up with a burnt match smell) or underdoing it (ending up with a spoiled oxide smell). All equipment used in racking should be sanitized.

Figure 17. Sediment and liquid let in secondary after racking

Step Five: Stabilizing, Sweetening, Aging and Bottling

The finished wine is stabilized, sweetened to taste, and then aged to develop the best flavors. It may be bottled or kept in jugs.

A ***stable wine*** is one where all fermentation has stopped because the sugar has been converted to

alcohol and the alcohol level is sufficiently high to kill most remaining yeast. A wine with a S.G. less than 1.000 would be considered very ***dry*** (without sugar). The wine may be sweetened by adding sugar syrup; however, then it would be considered unstable as fermentation could start again.

The most common method of stabilizing wine is through addition of potassium sorbate**, which** kills all active yeast making it impossible for fermentation to start again, even if sugar is added. Note that potassium sorbate only inhibits yeast, not bacteria – another reason for careful sanitization. Filtration systems can be purchased for home winemakers to remove yeast and most bacteria, to increase stability of the wine. There are other methods of stabilizing wine, such as cold stabilization (putting the wine in a 30°F degree temperature for several weeks), however, most of these are not practical for the home wine maker.

Figure 18. Potassium sorbate (stabilizer)

Once a wine is stable, it can be sweetened to taste by adding a simple syrup. A simple syrup is made of equal parts sugar and water which are heated until all the sugar is dissolved, then cooled before being added to the wine. Add a small amount of the sugar syrup at a time and taste to determine the desired sweetness.


Figure 19. Bulk wine aging

Wine may be aged in bulk, before bottling. White wines are best aged at least six months; red wines for nine to twelve months. Aging can be done in a secondary fermenter or another container as long as it is protected from oxygen by an air lock or other air tight seal. Wines age best in a dark room at 50-60 degrees Fahrenheit.

When the wine has cleared, stabilized, and aged (if desired), it can be bottled and corked. Corked bottles should be left upright for 3-5 days, then stored on their sides to keep the cork wet and swollen to prevent oxidation. Some wine makers use bottles with screw tops instead of corked bottles. Store finished wine in a cool place (50-60 degrees Farenheit) and monitor for pushing corks, a sign of fermentation in the bottle, and for carbonation/sediments.

Figure 20. Finished bottle of wine with homemade label

Recipe: Plum Wine

The following is an example of using the wine-making steps with one recipe. The goal is to make one gallon of plum wine. The recipe calls for 4 pounds of ripe plums, 6 pints of water, 2 pounds of sugar, ½-teaspoon acid blend, 1-teaspoon nutrient, 1 crushed Campden tablet, and wine yeast. The exact amount of sugar to be added will depend on how much sugar is present in the plum juice (if any).

1. The plums are weighed, washed, and stems removed. The fruit is chopped into small pieces in a food processor. The chopped fruit is put into a nylon bag and placed into a clean primary fermenter. The amount of water added to blend plus juice produced is measured.
2. The following are added: water to bring the liquid volume up to one gallon; sugar to raise the

P.A. to 12%. (S.G. = 1.090); one crushed Campden tablet; acid blend and yeast nutrient according to recipe. The primary fermenter is covered with a cloth and allowed to sit for 24 hours. The wine yeast is sprinkled on top of the liquid (according to directions on the yeast packet), the fermenter again covered and placed in a room temperature of 70 degrees Fahrenheit. Each day the liquid is stirred and the must in the nylon bag gently squeezed. Fermentation will be vigorous at first, then slow. As fermentation slows, the S.G. is measured. When it reaches 1.030, the nylon bag of must is squeezed and removed and the liquid is poured into a secondary fermenter, fit with an air lock and placed in a dark room at 50-60 degrees Fahrenheit.

3. When the fermentation has stopped (no bubbles in the air lock); there is sediment on the bottom of the fermenter. The liquid is racked into a clean secondary fermenter and fitted with an air lock. In another two months, the liquid is racked again. This will continue at 1-2 month intervals until the wine is clear. The clear wine is racked into a clean container, stabilized with potassium sorbate and sweetened to the taste of the wine maker. After three days, it is bottled.

Recipes and Recordkeeping

There are many recipes for making wine using a wide variety of fruits, vegetables, flowers and herbs. Table 3 lists a few typical bases used in home wine making. Wine making recipes are good guides to use initially. With experience in and an understanding of the process there is a lot of room to experiment.

Good notes must be kept throughout the wine making process in order to know what ingredients and processes led to such a good wine or what might be changed to make a better wine. Some things that should be recorded include:

Table 3. Examples of Virginia Grown Fruits, Vegetables, and Flowers Used in Wine Making

Fruits	Vegetables	Flowers
Apples	*Beets*	*Bee Balm*
Blackberries	*Broccoli*	*Dandelion*
Blueberries	*Carrots*	*Elderflower*
Elderberries	*Corn*	*Hibiscus*
Grapes	*Cucumber*	*Jasmine*
Melons	*Onion*	*Lavender*
Peaches	*Parsnips*	*Rose Hip*
Pears	*Pea pods*	
Persimmons	*Potatoes*	
Plums	*Pumpkin*	
Pomegranates	*Rhubarb*	
Prickly Pears	*Turnip*	
Strawberries		

1. How much fruit was used. How ripe the fruit was.
2. What ingredients were added and in what amounts.
3. Date started and each date racked along with the specific gravity each time.
4. Notes about the finished product: clarity; color; taste; acidity; flavors.

Summary

Wine making is a preservation method for all those extra fruits and vegetables in the garden. It is a hobby with few rules, lots of possibilities, and an enjoyable outcome. It can be studied from a scientific, chemical, and biological perspective, or simply enjoyed for its outcome. Several of the references at the end of this article include recipes for making country wines. The author and her husband have been making homemade wines and champagnes for over 30 years.

The Law Related to Home Wine Making in Virginia

Virginia laws regarding homemade wine are pursuant to the federal law which states the following:
§ 24.75 Wine for personal or family use.

(a) *General.* Any adult may, without payment of tax, produce wine for personal or family use and not for sale.
(b) *Quantity.* The aggregate amount of wine that may be produced exempt from tax with respect to any household may not exceed:
(1) 200 gallons per calendar year for a household in which two or more adults reside, or
(2) 100 gallons per calendar year if there is only one adult residing in the household.
(Sec. 201, Pub. L. 85-859, 72 Stat. 1331, as amended (26 U.S.C. 5042)

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Photographs

All photographs are by Phyllis Turner.

VOCABULARY

Airlock	**A one-way valve that allows gases released from fermentation to escape while preventing oxygen from the atmosphere from entering the container. Also known as a "bubbler"**
Dry wine	When residual sugar is less than 2.0 g/L. This amount is due to the presence of non-fermentable sugars that the yeast cannot metabolize.
Hydrometer	Weighted glass tubing to measure specific gravity (0.990 to 1.170); some also measure potential alcohol (0% to 22%) and Brix sugar (0%-35%).
Lees	Sediment produced from fermentation
Must	Freshly pressed fruit juice that contains the skins, seeds, and stems of the fruit
Oxidation	The combination of oxygen with the wine resulting in off colors and tastes
Predicted alcohol (P.A.)	Percentage of alcohol expected in the finished wine
Primary fermenter	Food grade container to hold the must and liquid in the first stage of fermentation; will hold 1 ½ to 2 times the volume of the recipe (2 gallon plastic bucket to make 1 gallon of wine).
Rack / racking	Moving wine from one container to another using gravity
Secondary fermenter (Carboy)	Food grade container to hold the liquid during the second stage (anaerobic) of fermentation. Also referred to as a carboy

Specific gravity (S.G.)	Ratio of the density of a liquid compared to water
Stable wine	Completion of fermentation; all sugar has been converted to alcohol
Sulfites	An inclusive term for sulfur dioxide (SO2). a preservative widely used in winemaking because of its antioxidant and antibacterial properties