A SPECIAL SUPPLEMENT TO WINEMAKER

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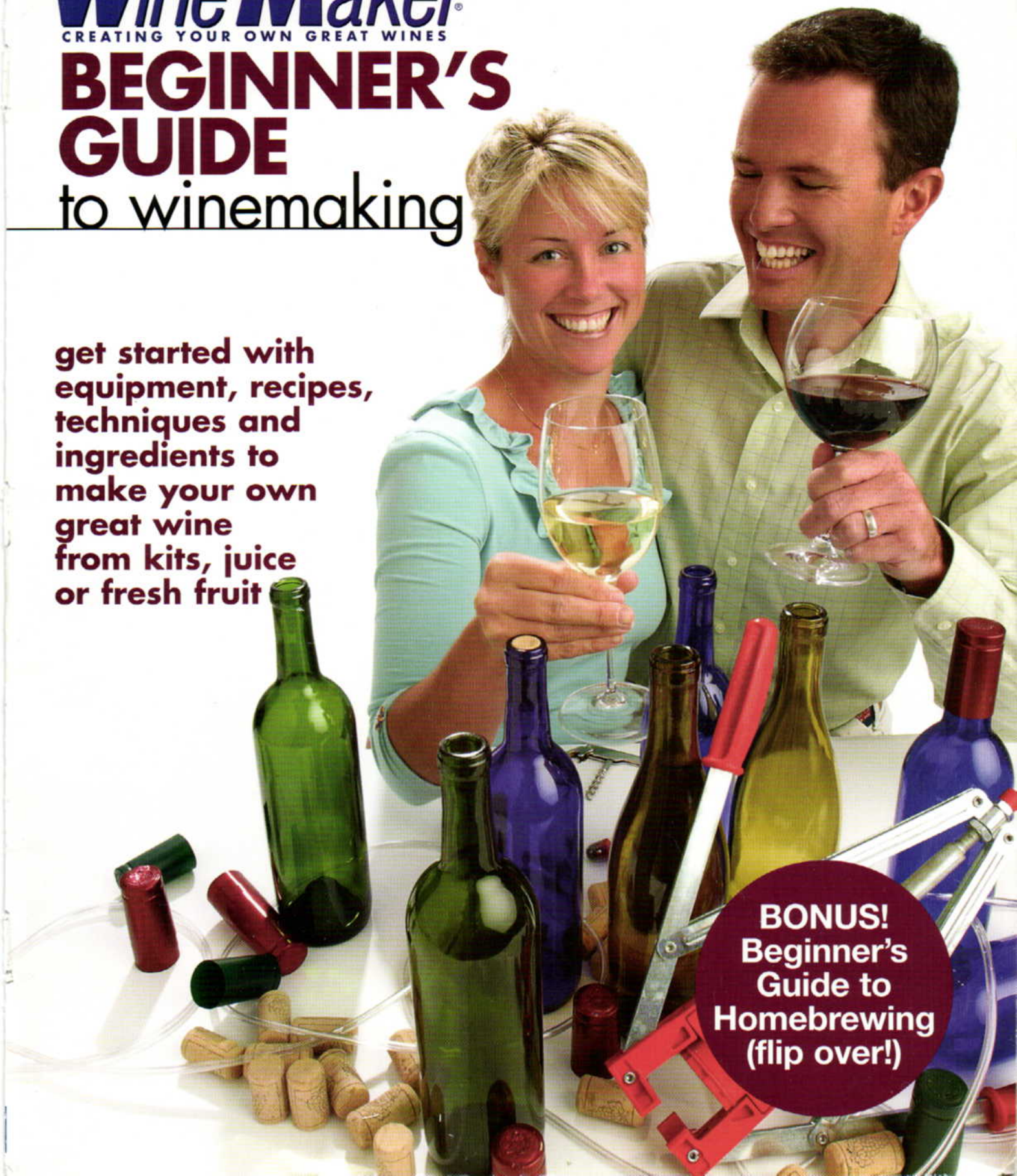
BEGINNER'S GUIDE to winemaking

get started with equipment, recipes, techniques and ingredients to make your own great wine from kits, juice or fresh fruit



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**A total of 240 medals were awarded to wines made from kits.

COVER PHOTOGRAPHY: Charles A. Parker

WineMaker BEGINNER'S GUIDE

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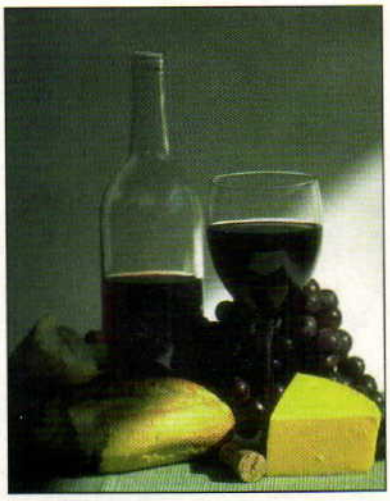

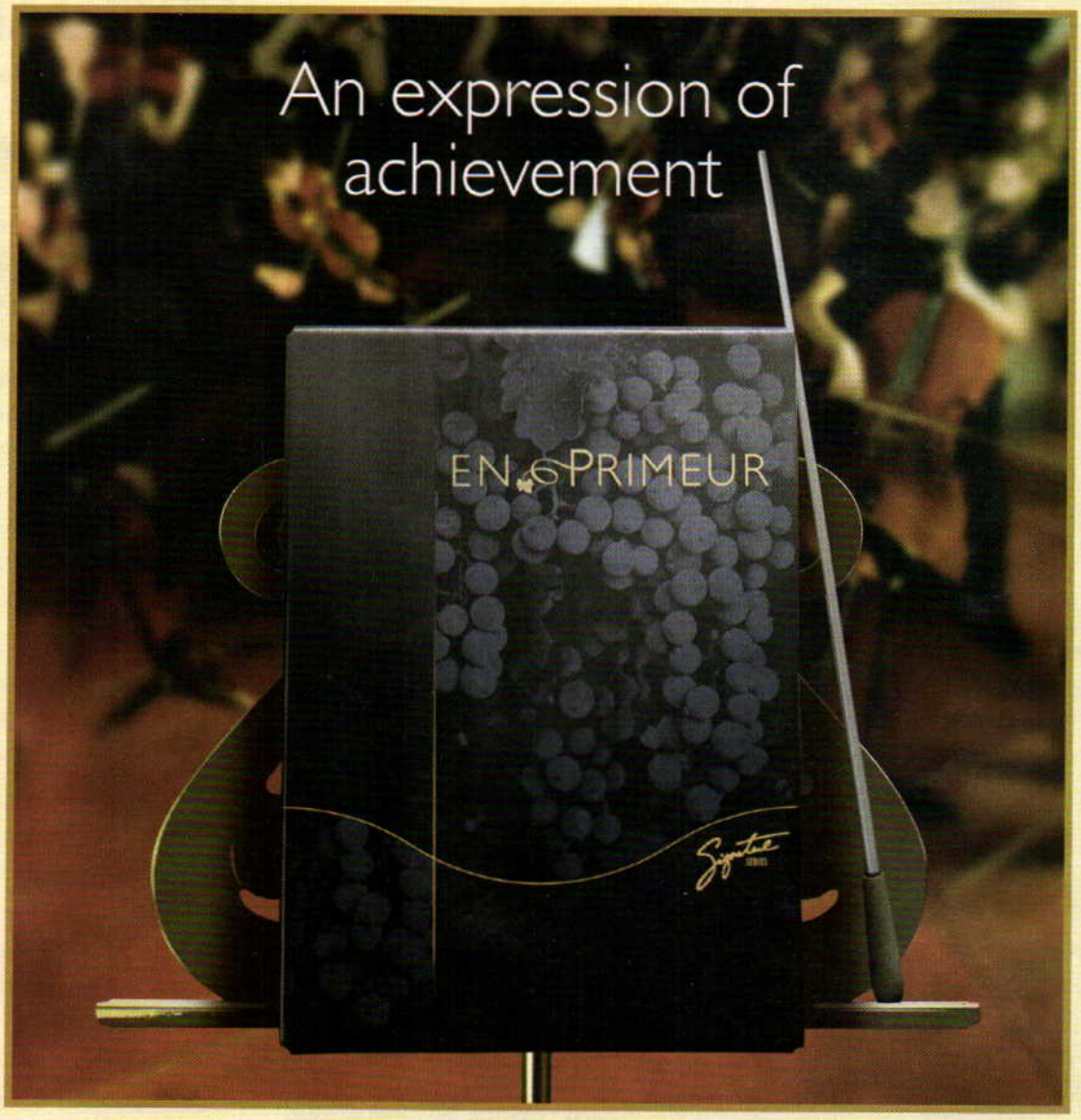

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WELCOME WINEMAKERS!

Although this publication is labeled a "Beginner's Guide," we purposely designed it to incorporate the essential skills and knowledge that successful winemakers of all levels must possess. To make things simple, we began with an overview of the equipment and the most elementary skills to get you started. Armed with this, we introduce you to the simple practice of making wine from wine kits. Kits are convenient as they virtually guarantee to anybody capable of following simple directions and practicing sound sanitation a successful batch of wine.

Before advancing to the traditional process of making wine from fresh grapes, it is important that a winemaker understands the science involved in the hobby. "Winemaking Science" the second section of this guide will get you acquainted with the chemistry that goes into making wine. Sure it seems like magic, but thanks to years of research, we can now identify, measure and adjust wine components such as acidity, pH and sulfites. This scientific knowledge has caused an increase in wine quality over the years and we believe it will help you as a home winemaker as well.

When you have a grasp on the science end of the hobby, you are ready to begin making wine either directly from grapes or with purchased juice. We'll walk you through the techniques and equipment you'll need as well as offer you step-by-step recipes for two of the most popular wine styles in the world: Cabernet Sauvignon and Chardonnay. Finally, in the "Country Winemaking" section, we explore the world of making wine from everything but grapes and give you a raspberry wine recipe to get you started right.

From all of us here at *WineMaker*: We wish you good luck and welcome you to the hobby. Enjoy!

– Garrett Heaney

Basic Equipment

To make homemade wine from kits or fresh fruit, the first thing you should do is acquire the appropriate equipment. The simplest way to accumulate your gear is to buy a complete winemaking equipment set from your favorite home winemaking retail shop. Here's a piece-by-piece overview of the equipment that you will need.

Primary Fermenter

The basic wine fermenter is a 7.5–12 gallon (30–46 L) food-grade plastic container. It should come with a cover that allows you to attach an airlock. Even though the volume of wine made in a kit is only 6 gallons (23 L), you will need the extra fermenter volume to deal with foaming during primary fermentation. Only use food-grade plastic containers.

Carboy

A carboy is a six-gallon (23-L) bottle-shaped container made of glass or food-grade plastic. This is where your wine goes after primary fermentation. As with choosing a primary fermenter, getting the right size carboy is crucial. Get a carboy that holds the entire volume of your wine with little or no space left over. The 6.5-gallon carboys — widely available at homebrew shops — are unsuitable for kits. They leave too much headspace above the wine, which leads to oxidation and spoilage.

Airlock and Rubber Bung

A bung is a slightly-tapered rubber stopper with a hole in it. The airlock fits into it and helps to form a valve that seals the carboy. The airlock prevents oxygen and spoilage organisms from entering, while allowing fermentation gas to escape. For the most part, glass carboys take a #6.5 bung while plastic fermenters use a #11. Before purchasing a bung, check to make sure it will fit your fermenter. The airlock must be half-filled with water and attached to the carboy. As an alternative, some people fill the lock with sanitizing solution.

Siphon Hose

A siphon hose is six feet (1.8 m) of food-grade tubing attached to a rigid acrylic rod, with a spacing tip on the end. The siphon hose is used for transferring wine from one container to another while leaving the sediment behind. The rigid rod prevents the tubing from collapsing when draped over the edge of the pail or carboy. The spacing tip on the end of the rod prevents the siphon action from sucking sediment up off the bottom of the pail or carboy. When the hose gets stained from repeated use, throw it away and get a new one. The soft vinyl is difficult to clean properly, and hoses are cheap to replace.

Siphon Bottle Filler

While it's possible to fill bottles by pinching the end of the hose to stop the flow, a siphon filler makes this a much neater, faster operation. A siphon filler is an acrylic tube with a needle valve on one end; this slips over the end of the siphon hose. The wine will only flow when the valve is pressed against the bottom of the bottle. You can then withdraw the filler and spill only a few drops of wine before moving on to fill the next bottle.

Floating Thermometer

Good thermometers are essential for ensuring that your must is at the right temperature for fermentation. They're also useful for checking the temperature of your fermentation room. The most convenient floating thermometers feature a plastic cap with a ring on top. This allows you to tie a string to them and drop them into the carboy to check the temperature of the fermenting must. The thermometer can then be hauled out by the string. Winemaking thermometers don't contain mercury, but they do contain volatile chemicals, like toluene. If you break one into your must, discard the batch immediately. Probe-type metallic thermometers don't break easily, but tend to be less accurate.

Hydrometer

Looking much like a glass thermometer, a hydrometer measures specific gravity and is used to monitor the progress of fermentation. A hydrometer consists of a glass tube with some steel shot sealed in the base, and a strip of marked paper on the inside. As the yeast eats the sugar and makes alcohol, the hydrometer will sink lower and lower. By measuring the progression of this sinking, you can accurately track your fermentation. The test jar is a clear, tall, footed tube. Fill it with a wine sample, drop in your hydrometer and read the results.

Wine Thief

No, a wine thief is not your thirsty brother-in-law. A wine thief is a hollow glass or plastic tube with a hole in each end. It is used for removing samples from the carboy. Poke the pointy end below the surface of the wine, and allow the tube to fill. Once it reaches the desired level, place your finger over the top and keep the thief upright as you transfer it.

Spoon

Your winemaking spoon should be stainless steel or food-grade plastic, approximately 28 inches (70 cm) long so it can reach all the way to the bottom of the carboy and fermenter.

Brushes

Carboy and bottle brushes are good for scrubbing goo out of narrow-necked vessels. Sturdy brushes are essential for cleaning chores.

Corker

There are a few different corkers available. The twin-handle, hand-operated units work well, but the larger floor corkers are better. They have interlocking jaws that "iris" shut to compress the corks and insert them.

KITwine

A typical wine kit contains only a few ingredients: a bag of preserved grape concentrate, yeast and the additives you need to make wine. Not all kits include the same additives, but common additive packs include Bentonite, oak chips, stabilizers and a fining agent. Some white wine kits, such as Gewürztraminer, even include a non-fermentable sweetener to add just before bottling.

Kits also contain complete and easily followed instructions that tell you exactly how to make the wine. Kit instructions are simple; you don't need a science degree. All the pH, acid and sugar levels have been adjusted for you in advance. Red wines have already been adjusted for color as well. All you need is some basic equipment, suitable water and a bit of space.

Modern kit technology is producing wines that are winning awards in the same categories as fresh grape wines at high-end competitions. Just about any vinifera varietal or blend is available as a kit. Kits vary in the amount of juice or concentrate they contain, but on average, a kit produces about 6 gallons (23 L) of wine, enough to yield about 30 750-mL bottles.

Kit wines have shorter fermentation and aging timelines. Many kits are designed to be ready to bottle within a month and only need about three months of aging to be drinkable. High-end kits can be ready to bottle in six to eight weeks and well-aged in six to nine months. Kit wine concentrates can be stored at room temperature and purchased any time of year. Winemakers no longer have to wait for harvest or worry about a vintage. For the beginning winemaker this is the perfect primer. You are virtually guaranteed excellent results as long as you follow the enclosed instructions carefully.

By Jeff Chorniak

before you get started with KITS

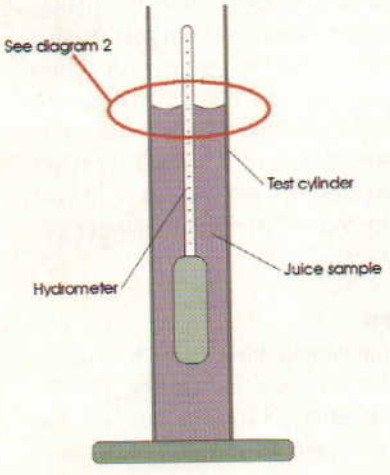


Diagram 1

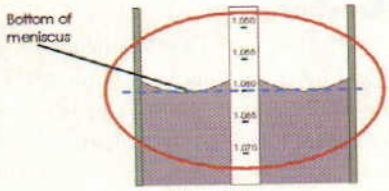


Diagram 2

Diagram 1 displays a test cylinder filled with juice and a hydrometer. Diagram 2 shows a close-up of the meniscus bottom.

Before you jump in and get started with your kit, there are three skills you'll need to become acquainted with and be able to administer. The first is simple: You'll need to learn how to not only clean your equipment, but make it free of germs and bacteria. This is the all important process of **sanitation**. Home winemakers use a variety of solutions for sanitizing, but most use potassium metabisulfite. It serves a dual purpose as it sanitizes and stabilizes simultaneously. When diluted with water, potassium metabisulfite releases sulfur dioxide (SO_2) gas that is a highly potent bacteria killer. For more details on cleaning and sanitation, see page 14. It is perfect for sanitizing clean utensils, bottles, carboys and hydrometers, which brings us to our second winemaking skill: **Measuring specific gravity**. Modern technology makes this easy with a device called a hydrometer (illustrated to the left). The specific gravity of your must (or concentrate) tellls you how much sugar it contains, and in turn, what your potential alcohol will be. For a full description of what a hydrometer is and exactly how it works, see the equipment rundown on page five. To use a hydrometer, insert it into a test cylinder (or test jar) and with a sanitized basting bulb or wine thief add a sample of your must, concentrate or wine. Continue to add your must until the hydrometer begins to float, then give it a spin to clear it of bubbles and solids. After it is still, you will notice that the surface tension of the your liquid creates a curve around the hydrometer stem (this is called the meniscus). Take your reading from the lower end of the meniscus to help ensure accuracy.

The third skill you'll need to learn is **racking**. Racking is the process of moving juice from one container (typically a carboy) to another. Winemakers need to transfer the fermenting wine away from its sediment. This entails inserting a half-inch diameter hose (or a racking cane) into the fermenter and siphoning the clear wine into another sanitized container. After you do this, top it off and fit it with a sanitized bung and fermentation lock. This can be a delicate operation and it's important to go slowly. You don't want to stir up the sediment, but you don't want to lose your siphon suction. When you're done, you should have a full carboy of wine that is virtually solid-free.

Anatomy of **KIT ADDITIVES**

A typical wine kit includes the concentrated grape juice in a sterile bag, and a collection of stabilizers and additives. These include sulfite powder, oak chips and sweeteners.

Stabilizers and preservatives

Stabilizers and preservatives prepare wine for aging by killing off unwanted yeast that can spoil wine over time.

Potassium or sodium metabisulfite

Used as a source of sulfite in winemaking, metabisulfite prevents oxidation, which causes browning of the must. Metabisulfite also suppresses bacteria and wild yeast. Typical concentrations used in kits range from 15 to 50 parts per million (ppm) at bottling. Sulfite comes in sodium and potassium form. Sodium metabisulfite is slightly more active than the potassium form, but this has no bearing on its flavor or preservative effect.

Potassium sorbate (sorbic acid)

Potassium sorbate, usually just called sorbate, prevents renewed fermentation in sweet wines and inhibits reproduction of mold and yeast. Combined with the sulfite in the kit, it helps to ensure that the wine remains stable during storage and cellaring. Sorbate prevents yeast and bacteria from reproducing to the point where they could affect the appearance, flavor or long-term stability of the wine.

Fining agents

Fining agents are used to clear wine of cloudiness and particles before bottling.

Bentonite (montmorillonite)

Bentonite is a type of clay — a naturally occurring hydrated aluminosilicate of sodium, calcium, magnesium and iron. It is a primary fining agent for wine, but can also be added to clear juice or must prior to pitching the yeast to speed the onset of fermentation.

Colloidal silica (kieselsol)

A solution of silicon dioxide in water suspension, colloidal silica was invented to replace tannin, which used to be a popular fining agent. Colloidal silica can be used alone, but is more commonly used in conjunction with gelatin.

Gelatin

A positively-charged fining agent, it can be used alone or in conjunction with colloidal silica and is usually found in liquid form (with kits). The most powerful of the organic finings, gelatin can also remove tannins (polyphenolics) and coloring particles (melanoidins) from wine. Don't exceed the recommended dosage, or you may lighten your wine.

Isinglass (icthyocolle, fish glue)

A positively charged fining agent like gelatin, isinglass is extremely gentle and usually won't strip wine of color and aroma. Derived from the powdered swim bladder of fish, it's usually dissolved in liquid suspension.

Oaking alternatives

Oak introduces desirable flavors and aromas into wine, including vanilla, smoke and wood-like flavors, all associated with high-quality, barrel-aged wines.

In kits, powdered oak is usually added to the beginning of a fermentation and gives a smooth oak character and a subtle vanilla finish. Chipped oak is often added after fermentation is complete, and lends a more aggressive "woody" character.

step-by-step WINE KIT

Note: Kit instructions will vary with each manufacturer. Below is a synopsis of the common steps most kits require.

Primary fermentation— day 1–5:

1. Sanitize all equipment.
2. The additive pack of the kit may include Bentonite. Mix the Bentonite in a few cups of water (some instructions will suggest using a blender). Add the mixture to the primary fermenter.
3. Empty the grape concentrate into the primary fermenter, rinse the bag with warm water and add to the pail.
4. Add room temperature water (70–80 °F/20–25 °C) to the primary. Fill it to the 6-gallon (23-L) mark. Many primary pails have a ledge or graduated line. Stir it well.
5. Draw a sample of must to your test cylinder and take a specific gravity reading (SG). It will probably read 1.080 to 1.090. Noting an SG reading before fermentation helps you calculate your alcohol after fermentation is complete.
6. If your kit includes oak chips, stir them in.
7. Pitch your yeast (rehydrate as explained above, and stir it in). Note: check your must temperature to know if it is optimum for fermentation.
8. Place the lid on your primary. DO NOT SEAL THE LID. The pressure of the carbon dioxide gas will create an explosion and a terrible mess.
9. Put your primary in a warm area (70-75 °F/20-24 °C), undisturbed, for about five to seven days. Check the temperature occasionally until the SG has dropped to about 1.020.

Secondary fermentation — day 6–10:

10. Siphon wine from the primary pail into the carboy, leaving behind the sediment (dead yeast, Bentonite, etc.).
11. Seal the carboy with an airlock and bung, and let the wine finish fermenting for another 5 to 10 days (70–75 °F/20–24 °C) until your specific gravity consistently reads the same value over two or three days (ideally at 0.995 or less). Your wine has finished. At this point, you can use your starting SG and your finished SG to calculate potential alcohol.

Stabilizing and clearing — day 17–22:

12. With your basting bulb or wine thief, draw a half cup of wine from the carboy, stir in your pack of potassium metabisulfite and potassium sorbate, slowly pour it back into your carboy and stir it vigorously with your stirring stick and replace the airlock.
13. Do the same for the fining agent and pour it back into the carboy. Stir the wine vigorously three times a day for the next three days to release trapped gasses. Let it sit for another 14 to 20 days until your wine has cleared. Before bottling you may choose to rack off the sediment once more. You can bulk age it for months in a cool area or lay it down in bottles.

seven HABITS of successful KIT WINEMAKERS

By Tim Vandergrift

Tips

If you want your kit wine to turn out great every time, and avoid the pitfalls that crop up time and again, here are the seven highly fermentative habits you need to follow.

Illustration by jim woodward

Habit 1: Read the instructions

Manufacturers don't randomly change the process of winemaking for their kits. However, when faced with a changed technology — such as new fining agents, different strains of yeast or a different level of solids in the raw materials — they have to alter the procedures to ensure the wine turns out correctly. Even if you're an experienced winemaker, and you made the very same kit a short time ago, always read the instructions again — they may have changed without your notice. This is especially important in regards to racking, stirring and fining procedures, which are the aspects most likely to change.

Habit 2: Keep it clean

Wine is food. When you're preparing food at home, you use a clean cutting board, wipe the counter, wash your hands and use clean plates and cutlery. Now imagine your dinner had to sit a month, or even six weeks, before it was ready to eat. Unless your clean-up and preparation was intensely sanitary, your food would be spoiled long before you could eat. The same goes for wine. Unless your winemaking equipment is spotless and sanitized, you're giving environmental bacteria up to a month and a half to chow down on your wine!

Remember, cleaning and sanitation are two different things. Cleaning is removing visible dirt and residue from your equipment. Sanitizing is treating that equipment with a chemical that will prevent the growth of spoilage organisms. Everything that comes in contact with your wine must be clean, and properly sanitized, from the thermometer to the carboy, from the siphon hose to the bung and airlock.

Habit 3: Write it down

Winemaking is like any other hobby — you'll be better able to duplicate your successes and avoid your failures by keeping records of both. You can either jot these in the spaces provided right on the instruction sheets, or get a notebook that you can keep in your winemaking area. Ideally, you should record: the date and time you started your fermentation and the type of kit, your measurements (specific gravity, temperature) and the temperature of your fermentation area.

Habit 4: Be full of it

One thing that is crucial to the success of a wine kit is starting it out at the correct volume. Virtually all dry table wine kits start off at six gallons (23 L). Dessert wines are usually three (11.5 L). On day one, you need to add the correct amount of water to make that full, 6-gallon (23-L) volume. The consequences of over-diluting are weak-tasting, low-alcohol wine that may not keep well. The potential consequences of under-diluting are subtler and potentially more harmful.

First, unless corrected, under-dilution will make a harsh, unbalanced wine. It will have a high alcohol content, but no finesse. Certainly the wine will not taste the way it is described in the manufacturer's literature.

The wine will also take longer to ferment and may not clear well.

Starting off at the correct volume requires the use of a primary fermenter with at least an 8-gallon (30-L) capacity. This is to allow room for foaming, which in a wine kit can be astonishingly vigorous.

Habit 5: Stir the pot

Wine kits generally contain the admonition "stir vigorously" somewhere in the text of the instructions. Vigorous stirring is needed on day one. This is because the juice and concentrate are viscous and don't mix easily with water. Even if it seems that dumping the contents of the bag into the primary with the water has done the job, it hasn't. The juice lies on the bottom of the pail with a layer of water on top. This not only throws off any gravity readings, it also overworks the yeast. It may get through the diluted top layer all right, but underneath it can't ferment the high-sugar, unmixed juices. It might quit early, leaving underfermented wine.

Vigorous stirring is also needed when it comes time to stabilize and fine the wine. The stirring has to drive off all of the CO_2 the wine accumulated during fermentation. This is because the dissolved gas will attach to the

fining agents, preventing them from settling out. You need to stir hard enough to make the wine foam and keep stirring until it stops foaming.

Habit 6: Temperature control

One thing that frequently messes up wine kits is the wrong temperature, or varying temperature ranges during fermentation or fining. Kit instructions tell you to ferment your wine within a specific temperature range, typically 68–78 °F (18–24 °C). Kit yeast prefer this temperature range as it provides a good compromise between optimum growth and ester (flavor compound) production. Yeast certainly does not like temperature fluctuations.

This is another situation where kit instructions are different from grape winemaking techniques. In commercial wineries, some white wines are fermented cooler than this, sometimes below 55 °F (12 °C). Again, commercial wineries have the luxury of taking a year or so before they bottle their wines. For the home winemaker though, if the fermentation area is too cool, the wine will ferment very slowly and you'll be stuck with fizzy, unfineable wine.

Temperature range is one thing, but temperature fluctuations are another kettle of oysters. Winemaking yeast is actually a fussy little milquetoast of a fungus. Too many cycles of hot and cold and it will decide that the environment is too hostile and it will go dormant. This will extend your fermentation and may stop it altogether.

Habit 7: Magic ingredient

Ever wondered if there was a magic ingredient you could add to your wine? The truth is, there is time. You see, wine kits are ready to bottle in 28 or 45 days — they're not ready to drink! For most whites, and virtually all reds, at least six months is needed to smooth out the wine and allow it to express mature character. Heavy reds will continue to improve for at least a year, rewarding your patience with a delicious bouquet. So, the old kit winemaker's secret to making great wines: Add the magic ingredient of time and let it do its work!

KIT first aid

By Tim Vandergrift

illustration by don martin

Your wine won't ferment. It ferments too quickly. It ferments too slowly. It won't quit fermenting at all! The wine won't clear in the carboy. No, wait: It's clear in the carboy but goes cloudy in the bottle! There are lumps of yeast floating in your fermenter and it's the wrong color. Goodness gracious, what is that smell? These are some of the problems associated with kit wines gone awry. What follows is a high-threat troubleshooting guide for those times when good wine kits take a bad turn.

Before you do anything, you need to carefully re-read your kit instructions. Wine kits sometimes have instructions and procedures that contradict accepted techniques for typical winemaking and the instructions of other kits. There are many good reasons for these non-intuitive procedures, but they all boil down to the same thing: Wine kit manufacturers have tested their instructions and administered lab trials to ensure the best possible fermentation, clearing and stabilizing for each kit — so follow these instructions to a T! Any departure from these instructions is the number two cause of kit wine failure (the leading cause being inadequate sanitation). If you've sanitized correctly, followed your kit's instructions and still have a problem: It's time for kit first aid!

These fixes, while applicable to almost all wines, are specifically designed to work with kits. Kits, as I am fond of pointing out, are not the same things as fresh grapes and fresh juice. Not only do you need to follow the right directions for the kits, you also have to apply the correct fixes!

Fermentation Follies

Wine Won't Ferment

1. The Gravity of the Situation

When yeast is pitched according to kit instructions, you should see activity within 48 hours, or at least a nice, healthy scum of developing yeast on top of the must. If not, the first step is to take a specific gravity reading. If it shows a drop from the original, you're experiencing "secret yeast." For several and complex reasons, sometimes yeast like to hide, quietly getting to work without too much foaming or fizzing. In this case the immediate solution is to relax and to take another specific gravity reading a day later.

2. Cool Things Down

If you know you added yeast, check the temperature of the must. Kit wines are all designed to ferment at room temperature, generally a range of 65 to 78° F (18–26 °C). If it's much above 90 °F (32 °C), you may have added too much hot water to the must and your yeast is likely dead. Cool the must by freezing a couple of bottles of water, sanitizing the outside and dropping them into the fermenter. Alternately, you can drape a wet towel or T-shirt around the fermenter and direct a fan at it. When the temperature is below the recommended maximum in your instructions, pitch a fresh package of yeast.

3. Or Heat Things Up

If the temperature of the must is below 65 °F (18 °C), warm the must by wrapping it with a heating belt (available through your supply shop). Most of the time the yeast will begin fermenting within 24 hours, but if not, double-check the temperature of the must and pitch another package of yeast.

Wine is Fermenting too Quickly or Slowly

1. Is it Hot in Here?

If your wine ferments to dryness in less than half the time required in the instructions, your temperatures may be too high. Try the wet towel trick described above to cool it down. The trouble with hot fermentation is that yeast tends to generate its own heat after a certain point and you could have a heat-related yeast die-off and a stuck fermentation later.

2. Timing is Everything

If your wine ferments to dryness in less time than specified in the kit instructions, wait the minimum amount of days indicated in the instructions before racking to the secondary fermenter. For example, if the instructions say to wait 5 to 7 days, until the gravity is below 1.020, and you achieve 1.020 on the third day, cool the fermentation down to the temperature specified in your instructions and wait until day 5 before racking. This will ensure that an appropriate amount of sediment is left behind in the primary, and could prevent problems with fining and clearing later.

Wine Won't Quit Fermenting

1. Zero In On Gravity

Sometimes a carboy will continue to bubble, long after it should have stopped. First things first: Check your specific gravity. If it's high, give the wine a good stir, making sure the temperature is at the high end of the specified range and practice patience.

2. Fake Fermentation

If it's in the right range, as listed in the instructions, you may be experiencing a common phenomenon. Your wine may actually be finished fermenting, but due to changes in temperature or barometric pressure it is

out-gassing carbon dioxide at a rate that looks like active fermentation. This could be exacerbated if your wine fermented quite slowly (as in a cool fermentation) and is saturated with CO_2.

My wine doesn't look right!

The Wine Won't Clear

First, don't bottle cloudy wine. It won't clear in the bottle, and any extra treatment to clear it up will require you to dump out all the bottles, process it and re-bottle.

1. Steer Clear of Filtering

Second, don't filter the wine to clear it. Filtering is only good for clearing wines that are already almost completely clear. Fining agents still in suspension will sail straight into your filter pads, blocking them up quickly, and the ones that make it through will show up as sediment later on!

2. Fining: Stir Things Up

First go back to the instructions and make sure you followed the fining procedures exactly. The instructions regarding fining all contain the same phrase: "Stir vigorously," which actually means really, really vigorously. In order for the finings to have the proper effect on the wine, it needs to be free of carbon dioxide. If it's not, the bubbles of CO_2 will float the fining particles back into suspension, over and over again and nothing will settle out. Be sure to stir the wine until it stops fizzing.

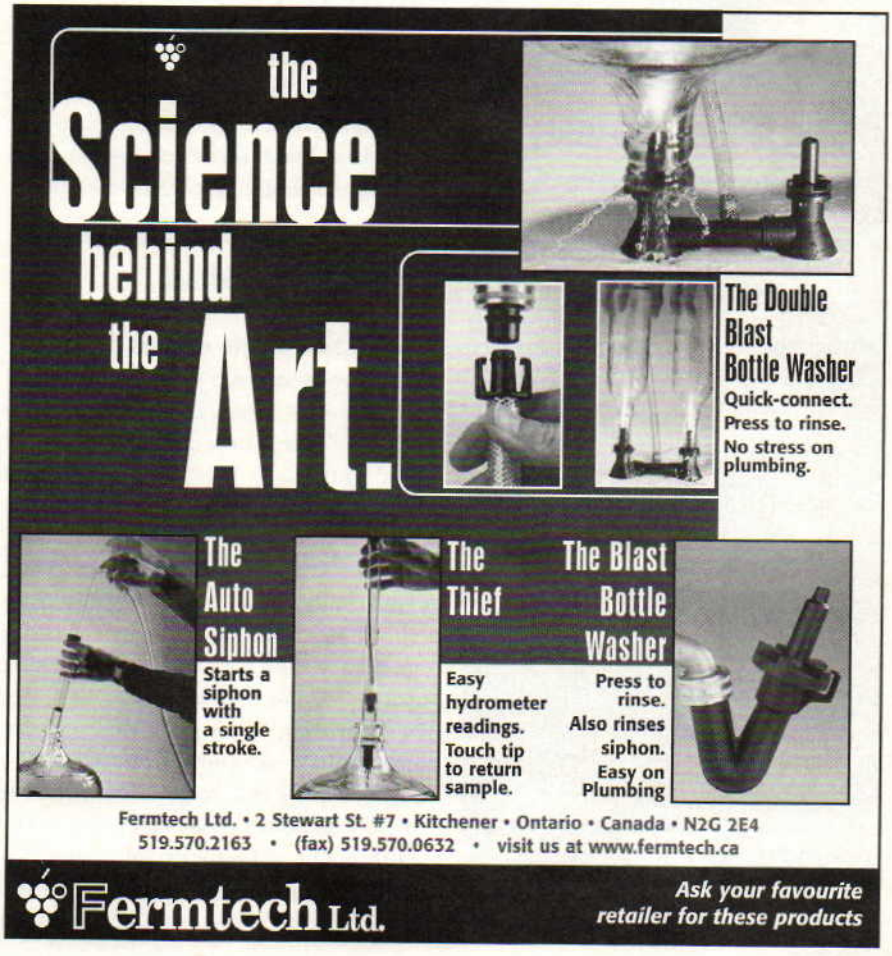
Clear Wine Goes Cloudy in the Bottle

1. Fermentation Not Finished

You can determine if the wine is continuing to ferment in the bottle by taking a sample and checking both the specific gravity and the level of CO_2. If the specific gravity is higher than that recommended in your instructions for bottling, and it has a significant amount of CO_2, you will need to un-bottle all of it and let it finish fermenting.

2. Fermentation Contamination

If the specific gravity is at or below



the levels recommended in your instructions, but the wine is fizzy with CO_2 and hazy, you may have a microbial infection. There are thousands of potential culprits, from lactic acid bacteria (spontaneous malolactic) to Acetobacter (vinegar) to air-breathing mutant yeast: All will ferment your wine after it has achieved what should be your terminal specific gravity. In this case you will need to un-bottle it, re-stabilize it with more sulfite and filter it. It will need to remain in the carboy until you are completely sure it will not ferment again in the bottle.

3. A Good Source of Protein

Protein haze is by far the most common of the three scenarios. Sometimes a fining agent will fail to clear all of the big proteins in a wine kit, or in some cases, traces of a protein-based fining agent (gelatin, isinglass) will stay in solution. When the temperature of the wine changes, these proteins become visible as a haze. As it warms up again, the haze disappears. Proteins are usually taken care of with the bentonite included in kits, but if you do have a protein haze, a small addition of bentonite should take care of it. Try adding 15 grams per six gallons (three teaspoons). Wait two weeks and check for cold stability.

That's not the Right Color!

Kit is too dark or too light

1. Inconsistent Kit Color

Wine kit manufacturers are in an odd position: They make a packaged food out of a variable agricultural product. In this respect they are like producers of bread or pasta, who face harvest differences from year to year. They both blend raw materials from different areas to achieve consistent quality — kit manufacturers using grapes, rather than wheat, in this case.

However, even when all of the grapes in a kit come from a specific area, it may not be possible to completely blend away the color and flavor differences. Commercial wineries acknowledge this, and celebrate the different harvests by doing vintage tastings. Kits, however, are going to vary a bit from year to year, and unless the color change is marked by some other change (such as a loss of aroma or bouquet) you may not want to do anything to change it.

2. If You Want to Change

There are coloring products on the market, such as Grapeskin Extract and Exberry, which can be used to darken a red wine. If you must use them, follow the package directions, but keep in mind that they are not very stable colors, and could combine with any proteins or melanoidins in the wine and fall out of suspension later on.

What's that awful smell?

Wine Smells like Matches

1. Mega-bisulfite

Your wine may have too much sulfite, which is characterized by a "burnt match" smell, often accompanied by a tickling in the nose. However, the true level of sulfite can't really be determined without a proper test. Until you've had your wine accurately tested, don't attempt any correction of the sulfite level. Consult your instructions for the correct sulfite level in the kit.

2. Aerating

Minor excesses of sulfite (an extra 10 or 25 PPM) can be driven off by stirring small amounts of oxygen into the wine, effectively oxidizing the free sulfite into bound sulfite, taking it out of action. You can stir air into the wine with a spoon, rack it with plenty of splashing, or bubble air into it with a brand-new, sanitized fish tank aerator for a short period of time. As always, test, adjust and test again.

3. Peroxide

Larger amounts of sulfite (up to an extra 50 to 100 PPM) can sometimes be treated with a hydrogen peroxide addition. Hydrogen peroxide is a very potent oxidizer. In high concentration it is used as part of the fuel mixture in rocket engines, oxidizing the fuel so rapidly as to resemble an explosion. It does the same thing in wine, oxidizing the sulfite, taking it out of action. For

every 10 PPM of sulfite to be removed in 6 gallons of wine, add 4.2 ml of regular drug-store hydrogen peroxide. You must use a brand-new bottle of 3% USP-grade hydrogen peroxide, measure with a syringe to get accurate results, and above all, test before and after your adjustment.

Wine Smells like Rotten Eggs

1. Your Strain

Most yeast produces a small amount of hydrogen sulfide (H_2S) during fermentation, producing a whiff of rotten egg. Certain yeast are famous for producing large amounts of this aroma, the Montrachet strain being particularly prone. However, this is rare in wine kits, as excess H_2S is usually a symptom of low nutrients in the must, or too many grape solids — conditions that don't apply to wine kits.

2. Air, Not Copper

If you do get this problem it can sometimes be cured by aeration, like the treatment for small amounts of excess sulfite. If it's worse than a whiff, the fix used to be to treat the wine with copper, either in the form of metallic copper (a handful of sanitized pennies tossed in the carboy) or with a product called Cufex, which is a copper sulfate compound. The problem with this is that even in small amounts, copper is toxic to humans.

The Sunny Side of the Street

The good news in all of this is that most of these problems are actually very rare. Of the hundreds of thousands of wine kits sold every year, we see very few cases of real defects in processing. It turns out that kit winemakers are pretty savvy for the most part. With good sanitation, accurate measurements of temperature and gravity, and detailed record-keeping, you should never see most of these problems. But if you do, don't panic: Most of the common conditions are easily fixed. Check out your options, and if you get stuck, call your retailer. Most winemaking stores have been in business a long time, and like me they've seen it all. They'll help you get back on the right track, pronto.

Using **JUICES**

Once you have some experience with kit wines, you may decide to experiment with grape juices. Rather than jumping straight into the vineyard and picking or purchasing wine grapes in need of crushing, winemakers can purchase a variety of sterile and fresh juices.

Making wine from juice requires a bit more hands on attention than making wines from kits. Unlike kits, fresh juices often have no additive pack or instructions. Those details are left up to you to obtain and follow. Likely, no pH, acid or sugar balancing has been administered on the juice. Using juice does not need to be intimidating. The learning curve is actually more gentle than that of fresh grape winemaking. Pure, untouched juices open the door for creativity. It is a great way to begin experimenting.

Juice usually comes in a 5 or 6-gallon (19 or 23 L) pail. Juices are either sold sterile or fresh. Sterile juices are preserved with sulfite to prevent spoilage or premature fermentation. The acid, pH and sugar may already be adjusted. Even the color should be correct per varietal or blend.

With fresh juices, the quality of the unpreserved juice is dependent on the year and location it was harvested. Fresh juice is sold as-is, while quantities last. Without preservatives, it might have little or no shelf life.

Some juices are put in cold storage. The almost freezing temperatures stifle spoilage and fermentation of natural yeasts in the must. But before you are ready to jump into juice winemaking, you'll need to master some basic skills that require a little know-how in the science department. You'll need to learn how to test acid and pH levels and how to manage sulfites and yeast. The "Winemaking Science" section starting on the next page is a general overview to prepare you.

SCIENCE wine

a brief glossary: some key terms

Brix: a scale of measuring sugar concentration in grapes, juice, must and wine. Instruments such as refractometers and hydrometers are used to measure degrees Brix in the above mediums.

fermentation: the process that a wine (or any alcoholic beverage) undergoes where sugar is converted into ethyl alcohol. Yeast is the key component to fermentation, when it reacts with or "eats" the sugar, leaving behind ethanol and carbon dioxide.

lactic acid: a mild acid found in wine. Malolactic fermentation transforms malic acid (a harsh acid) into lactic acid. This translates into a favorable flavor in most red wines.

malic acid: an organic acid found in grapes and wine. As malic acid is decomposed in a grape or other fruit, the fruit becomes more ripe. This acid is a "harsh" acid and is sometimes unfavorable for particular wine styles, including many red wines.

malolactic fermentation (MLF): A process that transforms the harsh malic acid into the more mild lactic acid. This process follows the alcoholic fermentation and is usually only administered in red wines.

oxidation: this is one of the main causes of spoilage in wines and is caused by over-exposure to oxidation. Although some controlled exposure (aeration) is necessary, too much can cause problems.

pH: the scale of measurement for acidity. pH is measured in all phases of vine growth, grape ripening and throughout the winemaking process. At times, winemakers find it necessary to adjust the pH in their wines through a process called acidification.

potential alcohol: a measurement of a must or wine that suggests what the total possible alcohol percentage would be should all the available sugar within the solution get converted into alcohol. The potential alcohol is therefore more than the actual alcohol content should residual (unconverted) remain in solution.

tartaric acid: an organic acid found in grapes that is highly important to a wines flavor, color and overall acidity. Tartaric acid is not fully soluble in wine and the remaining "tartrates" should be left out of the bottle, as they resemble shards of glass.

total acidity (TA or titratable acidity): a measurement of the acid (both fixed and volatile) that a must or wine contains. It is one of the most common measurements used to analyze a wine and is typically expressed in grams per liter.

specific gravity: the ratio of the weight of a volume of a wine (or any liquid) to that of an equal amount of water. It is a density measurement used to determine sugar content in wine and is often found as the corresponding equivalent of degrees Brix.

yeast: the critical component to fermentation of wine (or any alcoholic beverage). Yeast are single-celled organisms that consume or "eat" sugar as a source of energy and leave behind the bi-product of ethyl alcohol and carbon dioxide.

cleaning/sanitizing

The skills and procedures winemakers use vary substantially. However, there are two skills that every winemaker needs, no matter the size of their winery: cleaning and sanitizing. Your equipment needs to be as clean and as free from biological growth as possible. The only organism you want growing in your fermenter is yeast. Growth of other organisms in unfermented wine (called must) can spoil the resulting wine.

For both cleaning and sanitation, you can use household products — dish soap for cleaning and bleach for sanitizing — or you can use cleaners and sanitizers designed for brewing and winemaking. You can buy these at any homebrew shop.

Cleaning

When cleaning your equipment, you can use dish soap and water, but this has drawbacks. Unless rinsed thoroughly, soap residue can interfere with your wine. Some popular cleaning products that work better for cleaning winemaking equipment are TSP (tri-sodium phosphate), PBW (Powder Brewery Wash), One-Step and Straight-A. Use 2 tsp. of TSP per gallon (~2 grams/L) of warm water. Use 1–2 oz. (28–56 grams) of PBW per gallon of hot water. Use 1 tablespoon per gallon of warm water of One-Step and Straight-A. These cleaners can be used safely on stainless steel, plastic and other materials.

Sanitizing

Bleach is a cheap and effective sanitizer. 2-½ tablespoons of bleach in 5 gallons (19 L) of water makes a working solution that sanitizes with a 30-minute contact time. However, bleach can corrode stainless steel and can be absorbed by plastic, leading to off-flavors. If you use bleach on glass or plastic fermenters, as many winemakers do, empty any plastic containers immediately after the sanitizing period and rinse thoroughly.

Two specific sanitizers are iodophor and Star San. Just 1 ounce (30 mL) of iodophor or Star San mixed with 5 gallons (19 L) of water makes an effective sanitizing solution.

Finally, some winemakers uses potassium metabisulfite powder to sanitize their equipment using 8 teaspoons (50 grams) dissolved in 1 gallon (4 L) water with 5 minutes contact time needed to sanitize.

For more details on cleaning and sanitation, see "Keep it Clean" in the Summer 2001 issue of *WineMaker*.

SUGARS

By Jeff Chorniak

illustration by jim woodward

As a guide, the level of alcohol you might want to strive for in a dry red wine is 12 to 12.5%. The average bottle you pick up at your local wine store hovers in this range. The alcohol level of a dry white averages about 11 to 11.5%. But for the sake of simplicity, let's focus our demonstration on a dry red of about 12% alcohol, and conclude that the level of sugar you want to find in your must to get that should be about 22° Brix.

How to Measure Sugar in Must

What does 22° Brix actually tell you? The degrees Brix is the approximate percentage of sugar that exists in your must. Quite simply, every degree of Brix that your must registers is the same as saying that for every 100 grams of grape juice, about 1 gram of it is sugar; or, 1% sugar. So, if your grape must is 22° Brix, approximately 22% of your must is sugar. Once the yeast start eating it, they will convert some of it to carbon dioxide, and approximately 55% of it to ethyl alcohol. So, once you know the percentage of sugar in your must, you can estimate the potential alcohol it will produce. Simply multiply your Brix reading by 0.55. Now, because yeasts differ and their living conditions vary, the exact amount of alcohol produced will waver, more or less. But this is the general picture: Brix X 0.55 = % alcohol.

If you grow your own grapes, an excellent field tool for measuring Brix is the hand refractometer, a small device about 4 inches long that measures sugar by the way it refracts light. By putting the grape juice from a crushed berry onto the glass prism at one end and reading the scale through the lens at the opposite end, you can determine the °Brix of your grapes.

But if you buy your grapes from the local vineyard, and the vineyard owner doesn't give you the sugar level of the grapes, the tool you would be using to measure this yourself is a hydrometer. The hydrometer is a sealed glass tube containing a scale used to measure the specific gravity of a fluid. It looks and floats upright like a thermometer. In water the specific gravity scale would read 1.000. The thicker the fluid, the higher the tube floats, and the higher the reading. The amount of dissolved sugar in your grape juice will determine its thickness. More sugar, more thickness. Once you know the specific gravity of your unfermented juice, you will know the sugar level — and can calculate if more is needed. For details on using a hydrometer, see page 6.

ACIDITY

By Daniel Pambianchi

illustration by jim woodward

Grapes contain a good deal of naturally-occurring (organic or fixed) acids, three of which are of enological significance: tartaric, malic and citric acids. Lactic acid is present in trace amounts.

Total acidity, the concentration of all acids, is relatively high when grapes first start ripening and then subsides during maturation on the vines as the hard malic acid decreases. Grapes are harvested when the acidity level, established by the viticulturist and winemaker, is typically between 6 and 9 grams per liter. (You'll sometimes see this expressed as a percentage, for example, 0.6% and 0.9%). This represents the acid concentration in grape juice at picking and must be balanced with the sugar content, typically in the range of 21 to 23 Brix degrees (or a specific gravity between 1.085 and 1.095).

The amount of sun exposure and rainfall during grape ripening and harvest affect the acid concentration, as well as the concentration of sugars, aromas, and eventually flavors in the final wine. Failure to harvest at the desired acidity and sugar levels can result in an unbalanced wine.

During vinification and winemaking, the acids change: Tartaric and malic acid concentrations decrease slightly while lactic acid is formed. There are other acids in wine, but they exist in trace amounts only — including citric acid.

So the three acids of enological significance in wine are: tartaric, malic and lactic. Tartaric acid is the most significant and the strongest of these

acids in both grapes and wine, and is responsible for making a wine lively and fresh. Malic acid imparts a sharp, green-apple sensation. Many winemakers find malic acid undesirable and thus convert it to lactic acid, a much softer acid.

Total acidity (TA) is used to quantify a wine's acidity and represents the concentration of all organic acids in the wine. TA is expressed in grams per liter (g/L) or, quite often, as a percentage of weight to volume. For example, a wine with a TA of 7.0 g/L is said to contain 0.70 percent total acidity.

Since all acids are factored into the TA measurement and not all have the same chemical properties, a reference point is used to qualify the measurement. In North America, tartaric acid is used as the reference. This means that the TA value represents acid concentration as if it were only tartaric acid.

Measuring acidity

Measuring acidity in wines and musts is simple, quick and fun. A simple process known as titration is used to measure acid concentration. Titration involves neutralizing the acid content of the wine with a base solution, referred to as the titrate solution or simply as the titrate. The amount of titrate used determines the acid concentration.

Adjusting acidity

The processes of increasing and decreasing acidity are referred to as acidification and deacidification respectively. The most widely used methods for increasing TA are the addition of acid (or acid blend) and the blending of musts or wines. For acid reduction, methods include: the blending of musts or wines, the addition of an acid-reducing solution, malolactic fermentation, cold stabilization and the addition of water.

Although these methods increase or decrease TA, each method acts on different acids and therefore yields different results in the final acid composition of wine. Selection of an acidification or acid-reduction method should therefore be based on the desired acid to be increased or decreased. For a full overview and specific directions on measuring and adjusting acidity, read Daniel Pambianchi's "Acidity," in Spring 2001's issue of *WineMaker*.

pH

By Daniel Pambianchi

pH is a close relative of acidity, specifically, the total titratable acidity (TA) for wines. TA measures the acid concentration in musts and wines while pH measures the relative strength of those acids. The pH of wines depends on the pH of the unfermented grape juice (also called the must), which in turn depends on such factors as grape variety, type of soil, viticultural practices such as irrigation, the climate during grape ripening and the timing of the harvest. For example, soils rich in potassium or grapes harvested during heavy rainfalls will tend to have a higher pH.

Why should winemakers care about pH?

Two wines with similar TA measurements but different pH will be quite different and evolve differently. A wine with lower pH may show a redder color (in the case of red wines) with greater stability during aging, and will have more fruit, less complexity and less body than the higher-pH wine. The lower pH wine will also mature more slowly — and therefore age longer — and will be less susceptible to spoilage. With that in mind, TA is not sufficient when evaluating a wine. We also need to understand the relative strength of the acid components, or its pH.

illustration by jim woodward

It is imperative then to always monitor and control a wine's pH to ensure that it does not fall below or rise above critical thresholds. Solutions (such as wine) can have a pH in the range 0 to 14. A pH of 0 represents a strong acid solution, while a pH of 14 represents a strong alkaline solution. Distilled water has a theoretical pH of 7, and wines are in the range of 3 to 4.

Measuring pH

A crude approximation of a wine's pH can be measured using pH paper. To determine the pH of musts or wines, a strip of pH paper is immersed in a sample of the must or wine, and then the color of the paper is matched to a standard set of colors that comes with the kit. Each color corresponds to a specific pH level. Inexpensive pH paper can provide inaccurate results — typically varying plus or minus 1 pH unit — and is therefore not a recommended method for precise analysis.

The recommended method is to use a pH meter with a minimum resolution of 0.1 and accuracy of ±0.1 pH unit. A digital stick pH meter with this accuracy costs approximately $50 (U.S.). It is a worthwhile investment for people who make wine from fresh juice or grapes, when pH control is imperative. Similar to TA, the pH level should be measured before the start of fermentation, following malolactic fermentation, at the end of fermentation and following any pH correction procedures. You can also monitor the pH during alcoholic fermentation since pH is more accurate than TA measurements during this phase. For more details, read "pHiguring out pH," in Summer 2001's issue of *WineMaker*.

SULFITES

By Daniel Pambianchi

Sulfite is the most effective and widely used preservative in winemaking. It safeguards musts and wines against premature oxidation and microbes that could otherwise spoil wine. It preserves the wine's freshness, helps maintain its color and is essential for aging wines. Another common use is in inhibiting wild yeasts to allow cultured wine yeasts to carry out the alcoholic fermentation.

SO_2 gas can be condensed to a colorless liquid to produce a sulfite solution with excellent antiseptic properties. These properties result from the dissipation of active SO_2 to produce "free SO_2," and from some free SO_2 combining with aldehyde compounds (responsible for oxidation in wines) to form "bound SO_2" when sulfite is added to wine. Free SO_2 is also found in musts from crushed grapes that have been sprayed in the vineyards with sulfur-based pesticides. It is also a byproduct of alcoholic fermentation, albeit in small concentration.

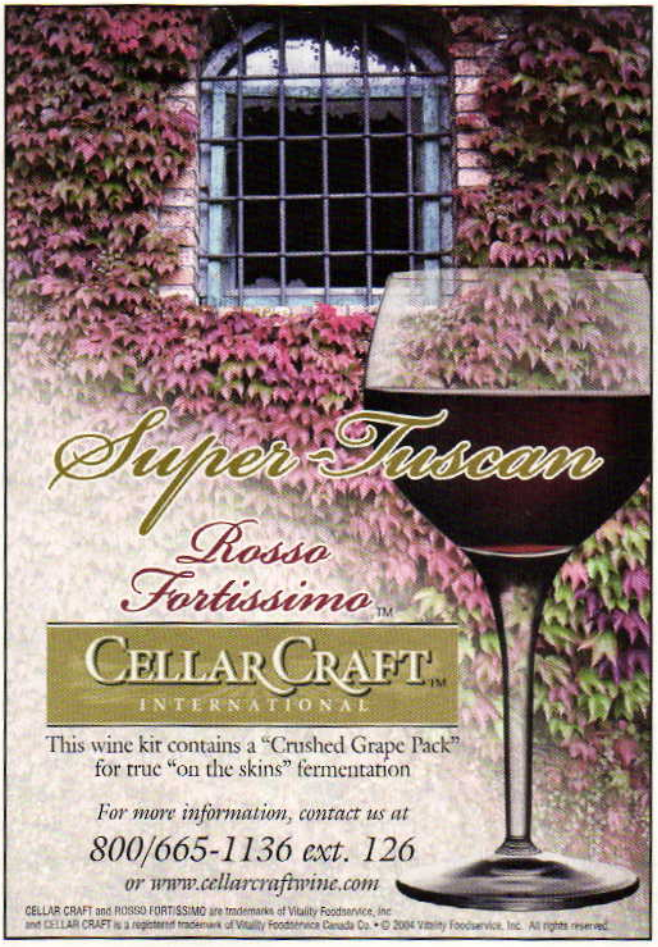
Two measurements widely used in commercial winemaking are free SO_2 and total SO_2 — the sum of free and bound SO_2. Only free SO_2 provides antiseptic and oxidative protection to wines and is therefore the prime consideration for home winemakers. SO_2 concentrations are expressed in milligrams per liter. One mg/L is equivalent to 1 part per million (ppm).

Measuring Free SO_2

Measuring the all-important free SO_2 concentration is the home winemaker's challenge. CHEMetrics manufactures Ripper-method titration cells, sold under the brand name Titrets and available at most home winemaking supply shops. This product is meant for measuring free SO_2 concentration in the 0 to 100 mg/L range. Results are acceptable for dry white wines although they can have an error margin of up to 10 mg/L. Results are not as reliable for red wines or white wines containing ascorbic acid or tannin, but they are satisfactory for home winemaking purposes.

illustration by jim woodward

In certain instances, winemakers may need to add sulfite to their wine or must. The most effective way to do this is to make a 10% sulfite solution and add the required amount — determined by a sulfiting chart. One of these charts, along with more information on measuring and adjusting sulfite levels can be found at www.winemakermag.com/feature/21.html. The 10% solution is prepared by dissolving 10 grams of potassium metabisulfite in warm water and then topping up with cool water to the 100 mL level. Use a scale to measure your sulfite powder to the right amount. To help you determine sulfite additions, there is a handy online calculator at www.winemakermag.com/sulfitecalculator/index.html.



FERMENTATION

By Jeff Chorniak

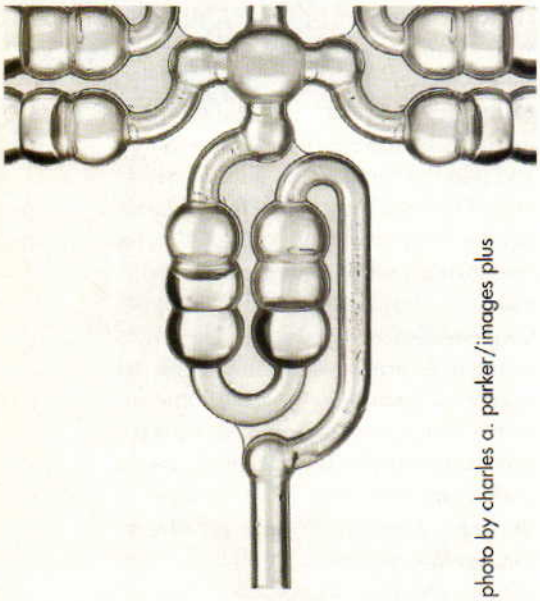


photo by charles a. parker/images plus

Fermentation is a chemical reaction that takes place when yeast turns sugar into carbon dioxide and alcohol. Obviously, this is a critical part of the entire process. A yeast cell will turn 51 to 55% of the sugar it eats into ethyl alcohol, and the remaining 45 to 49% into carbon dioxide gas. The proportion is not exact since some sugar is consumed by the yeast, and some converted to acids, esters and aldehydes. You can ferment just about anything on this planet, if sugar is present. But all fermentation, including what takes place in your must, requires yeast: a one-celled living organism. It eats, reproduces and gives your wine life.

Fermenting the wine

Now that we've covered the vital elements, we can walk through a chronological model of the entire process from pitching yeast to aging.

Day 1: grapes and fresh juice

The first time I bought grapes I was surprised at all the extra stuff that came with my purchase: spiders, twigs, leaves, flies and other no-see-um single-celled creatures. Fruit flies carry acetobacter bacteria. This bacteria converts alcohol to acetic acid, giving wine acetic astringency, or a vinegar taste. Another enemy is oxygen. Ever bite an apple and leave it sitting? Notice how it turns brown? Enzymes in fruit, once activated in air, turn fruit brown. The trick is to remove oxygen. The solution: potassium metabisulfite. Potassium metabisulfite produces sulfur dioxide in your must (free SO_2). When used in correct proportions it stuns indigenous yeasts, kills bacteria and prevents grapes from oxidizing.

Now that you've subdued the three enemies of wine, take a specific gravity reading with your sanitized hydrometer to determine your sugar level and potential alcohol. Hopefully, your specific gravity will be around 1.090. That's about 12.2% potential alcohol. If the SG is less than 1.090 you might want to consider chaptalization (adding sugar) to give your yeast more to eat, and therefore produce more alcohol. (Check out the August-September 2002 issue of *WineMaker* for a detailed explanation of chaptalization.) If you find that the Brix level of your must is too high (say up around 1.100), consider diluting it. Add water a bit at a time, taking readings.

Sterile juice, unlike crushed grapes, does not need to be sulfited; the supplier will have done all that for you. Some proprietors will even give you the SG, pH and Brix reading for your crushed grapes or juice. Even so, double-check it at home to determine if adjustments are needed. The ideal is 0.6 to 0.8% acid for reds, and 0.65 to 0.85% for whites. With a pH meter, look for a pH of 3.1 to 3.2 in reds and 3.4 for whites.

Pitching yeast

There are various ways to pitch yeast, depending on whether it is dry or liquid. Dry yeast offers two ways. One: Lift the lid, sprinkle the yeast on top of your must, lower the lid and walk away. As long as the must temperature is in the low 70s °F (low 20s °C), it works.

Two: (the most reliable method) is rehydration. Sprinkle the yeast into a quarter cup of water warmed to 95 °F (no higher); in 10 minutes you'll see the rehydrating yeast swell to a paste. Mix it into your batch. Rehydration guarantees your yeast is alive and when you pour it into your must it hits the ground running. Don't let the yeast-water stand longer than 15 minutes; without sugar it will starve.

Instructions for preparing liquid yeast vary according to the manufacturer. Some cultures need to be incubated from 1 to 5 days before pitching. Other liquid cultures come in vials that can be added immediately.

For the first 12–24 hours after pitching the yeast, you may notice zero activity. Not to fret. Your little yeast buddies are in there, multiplying like there's no tomorrow. Monitor your must temperature and give it a day.

Yeast nutrients

Besides sugar, yeast needs potassium, iron, calcium, vitamin B, B1, copper, lead, zinc and other minerals. If your must lacks nutrients, you might consider adding them. *Winemakermag.com* offers a plethora of information on the subject. Just type "yeast nutrient" into the search engine.

Day 2–5

With juice wines, day five is a good time to rack your fermenting wine off the sediment into carboys. Racking when the SG drops to 1.020 and the vigor of fermentation has subsided is a suggested practice. This is usually around day five. Note: Keep the end of your racking tube submerged to retain a protective layer of carbon dioxide on your wine.

Batch sizes and carboys

The right size and type of carboy is key. After primary fermentation, fresh or sterile juice that's sold in 5-gallon (20-L) pails should be racked to a

5-gallon carboy. During fermentation the layer of CO_2 on your wine will protect it. When fermentation is complete, top up within 2 inches of the bung. A sulfite solution in the airlock will block fruit flies and other organisms.

Day 10–17

The airlock will work regularly, releasing carbon dioxide gas as fermentation slows over the next days or weeks. When the SG bottoms out between 0.095 and 0.090 and remains there for about three days you can conclude that fermentation is over.

Fining

Fining is the act of adding protein that will stick to suspended particles in your wine and pull it to the bottom. Whether you prefer to filter or fine your wine is a personal preference. The vast majority of wines you buy are filtered or fined. If you choose not to filter or fine your wine, aged bottles will gather sediment over time. If you don't mind decanting your wine before serving it, then this is an acceptable alternative. For wines from juice or grapes there are various types of fining agents on the market: Isinglass (made from the bladder of fish, in liquid or powder); bentonite (clay); Sparkolloid (powdered protein extracted from kelp), and Kieselsol (a liquid in which small silica particles are suspended). For more information on fining see articles in the Spring 2000 and December 2002–January 2003 issues of *WineMaker*.

Stabilizing

Stabilizing ensures that no fermentation will happen again. It also protects your wine against spoilage organisms and oxidation. Some home winemakers prefer not to stabilize. This also is a personal preference. While new, unstabilized wine can be enjoyable, your wine will have no immune system and will not last long.

The method of stabilizing your wine will probably be during your second (or third) racking after fermentation is complete. There are two ingredients to stabilize wine.

One is potassium metabisulfite. For healthy wine, it is recommended you maintain 30 ppm of free SO_2. For this you need to measure how much free SO_2 you already have. To stabilize, draw a cup of wine from your carboy, dissolve your potassium metabisulfite crystals (or crushed tablets) and add it to your wine. If stabilizing during racking, pour the dissolved solution on the bottom of the receiving carboy so that the wine will immediately enter an oxygen-free environment. Keep the end of your racking tube submerged.

The second ingredient is potassium sorbate. Potassium sorbate prevents residual yeast cells from multiplying. Sorbate is not typically necessary in dry wines. If, however, there is residual sugar above 0.995, sorbate is recommended. Two teaspoons of potassium sorbate for every 5 gallons will work.

MALOLACTIC fermentation

By Daniel Pambianchi

photo courtesy of Lallemand

This is a microscopic view of some typical malolactic bacteria chains. Learn how to convert these into softer lactic acid and you can give certain wine styles the "supple" or "buttery" flavor you desire.

Malolactic fermentation (MLF) is a secondary fermentation occurring when malolactic (ML) bacteria become active in the presence of malic acid. Bacteria may be present naturally in fresh grape juice or wines. It could also be acquired from oak barrels previously used for MLF or a winemaker can add them from a commercial culture. MLF cannot occur in concentrates and sterilized juices because the bacteria have been eradicated during the concentration or sterilization procedures. It is also not recommended in concentrates because most are tartrate-stabilized during production and therefore contain a high proportion of malic acid. MLF would convert the malic into lactic acid, leaving the wine with little acidity, and a pH above 3.8, resulting in a flabby wine that is susceptible to bacterial infections. Indigenous bacteria will provoke MLF naturally, but results are unpredictable because the type of bacteria cannot be ascertained. Some wild ML strains may impart off-flavors and may cause spoilage at low free sulfur dioxide (SO_2) levels.

Relying on bacteria from a previous MLF in oak barrels or adding a selected culture will yield reliable and predictable results. These methods give winemakers more control and therefore reduce the risks of unsuccessful MLF or microbial infection. Although carrying out MLF is not difficult, the wine must provide a suitable environment for the bacteria to have its effect, and you need to closely monitor the progress.

Selecting an ML Culture

Leuconostoc oenos species are the most common ML cultures used in home winemaking and are available in either liquid or freeze-dried format. Liquid cultures are normally added directly to wine, while freeze-dried cultures first need to be rehydrated in distilled water.

Liquid cultures are less stable and therefore have a shorter shelf life. Freeze-dried cultures can be stored up to one year in a refrigerator or 18 months in a deep freezer.

Preparing for MLF

An important consideration before doing a MLF is that this fermentation will cause a reduction in total acidity in wine. Therefore, if you do not want to reduce acidity in a low-acid wine (below 6.0 grams per liter), you should forego MLF. A wine with very low acidity will become flabby and unbalanced.

If you need to increase the acidity of a batch in anticipation of conducting MLF, do so before the start of alcoholic fermentation by using tartaric acid.

For the alcoholic fermentation, select a *S. cerevisiae* yeast strain that is compatible with MLF, such as Lalvin's ICV/D-47, for a higher probability of a successful MLF. Inoculate the juice with yeast and conduct the alcoholic fermentation as usual, until the specific gravity drops to 1.000 or lower, prior to starting the MLF.

MLF is usually carried out immediately following the alcoholic fermentation so that they do not interfere with each other, although some ML cultures allow both fermentations to occur simultaneously. What is most important is that you observe the culture's environmental conditions — conditions that would otherwise inhibit ML bacteria. Let's examine these conditions.

First: The wine's free SO_2 content should be less than the maximum (typically between 5 and 15 mg/L) prescribed by the ML culture manufacturer because ML bacteria are very sensitive to free SO_2. Be sure to only sulfite the wine lightly for any batch that you plan to take through MLF.

Second: The pH should be higher than the prescribed minimum (typically 3.2) because ML bacteria are also sensitive to low pH.

Third: The wine should be above 64° F (18° C) throughout MLF for the bacteria to become active. Either warm up a cool cellar, or move the wine to a warmer room without exceeding 77° F (25° C).

Fourth: ML bacteria need to feed on nutrients, which can be found in the lees — the deposits formed during alcoholic fermentation. Therefore, do not rack your wine before initiating MLF. And make sure you observe oxygenic requirements of the selected culture. Most ML bacteria used in home winemaking are sensitive to air, and can become easily inhibited if exposed. Try to avoid operations such as racking and vigorous stirrings during MLF.

A word of caution! Many of the above conditions favor growth of spoilage organisms. Use extra sanitary precautions to avoid potential problems. Ask your supplier for the full set of manufacturer's instructions when buying ML culture, and strictly follow these instructions.

Conducting the MLF

When ready to start the MLF, inoculate the wine with an ML culture, making sure all environmental conditions are maintained favorably throughout this phase. If you expect to conduct the MLF under a more difficult environment, first condition the hydrated culture by adding it to an equivalent volume of commercial apple juice, containing no preservatives. Apple juice has a high malic acid concentration, which will "jump-start" the bacteria. Loosely cover the container, making sure there is little air space between the culture and the cover. Keep the culture at room temperature for two to four days and then add it to the wine. Be sure to stir very gently.

To inoculate several batches, withdraw a 5 percent volume of wine actively undergoing MLF and inoculate another batch with this sample. For example, withdraw approximately ¼ gallon (1 L) to inoculate a five-gallon (20 L) batch. Be sure to minimize the culture's exposure to air.

Oak barrels used for MLF will become heavily populated with ML bacteria. Successive vintages can be ML-fermented in the same barrels without adding any bacteria. Simply transfer the wine to barrels and MLF will start on its own. When MLF has completed, sulfite the wine to 50 mg/L, top up containers and return the wine to the cellar for aging at a cooler temperature.

Measuring MLF Progress

MLF takes one to three months to complete — the point when malic acid is totally converted into lactic acid — if the wine is held above 64 °F (18 °C). Always closely monitor and control MLF. Paper chromatography, an analytical procedure used to detect the presence of malic and lactic acids in wines, is the most reliable method to monitor progress.

Monitor the pH as well to avoid spoilage problems. MLF causes the pH to increase. If it is allowed to progresses to an unusually high level, the wine will oxidize prematurely and become more prone to bacterial infections and spoilage.

Paper Chromatography

Paper chromatography uses a special cellulose paper immersed in a solvent containing a color indicator. Kits costing approximately $45 U.S. are conveniently packaged and sold with all the necessary equipment and chemicals and include: 30 sheets of chromatography paper, large jar with a wide opening and lid, disposable micropipets, chromatography solvent (bright orange color) and 0.3 percent reference solutions of each of malic, lactic, tartaric and citric acid. Use the solvent in a well-ventilated area because it has a very strong and irritating smell.

Using a lead pencil (ink will run when absorbed by the solvent), trace a horizontal line 1¼ inches (3 cm) from the bottom of the paper, across the long side. On the line, mark and label a reference dot for each reference solution and sample to be tested as T, C, M, and L for tartaric acid, citric acid, malic acid and lactic acid, and WS for each wine sample. The dots should be spaced at least 1 inch (2.5 cm) apart and from either edge of the paper.

Using different micropipets, "spot" each dot with a single drop of the corresponding reference acid solution or wine sample to be analyzed. Spot each dot three or four times, making sure to let each spot dry for approximately 15 minutes before re-applying (use a hair dryer to accelerate this process).

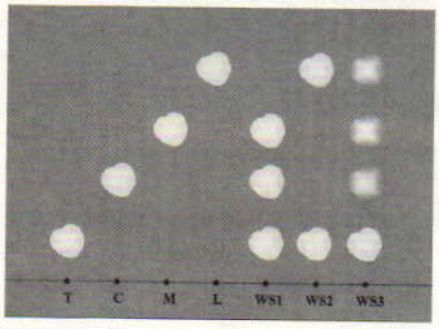
Curl the paper into a cylindrical shape around the vertical (short) axis without overlapping the edges, and staple the two ends at the top, middle and bottom. Pour enough solvent in the jar so that it is about 1 inch deep. Insert the paper in the jar and immerse it in the solvent, making sure that it stands upright, and then close the jar with the lid.

The solvent will start traveling up the chromatography paper and will cause acid components to "separate." Allow the solvent to reach the top of the paper, which can take up to six hours. When completed, take the paper out of the jar, remove the staples from the paper and uncurl it. Hang it to dry in a warm, well-ventilated area to volatilize the solvent. Pour the leftover solvent back in its original container for other chromatography tests. After approximately three hours, yellowish spots will start appearing on the paper.

Interpreting Results

The spotted chromatography paper is referred to as a chromatogram. The figure illustrates a typical chromatogram showing how spots have traveled and formed. For each sample, moving from the bottom edge of the paper towards the upper edge, the tartaric acid spot will have traveled the shortest distance, followed by citric, malic and lactic spots. Use the reference solution spots to help you locate horizontally the corresponding acid components of the wine samples.

When MLF has completed, you will see a clear lactic spot for the wine sample, and a very faint malic spot (a small trace always remains), as well as a tartaric spot. If any citric acid is present, a corresponding spot may be visible depending on the acid concentration.



(Top): The chromatography kit includes everything you need to monitor MLF.

(Bottom): The chromatogram shows that wine sample WS1 hasn't started MLF, sample WS2 has completed MLF and WS3 has begun MLF but is not complete.

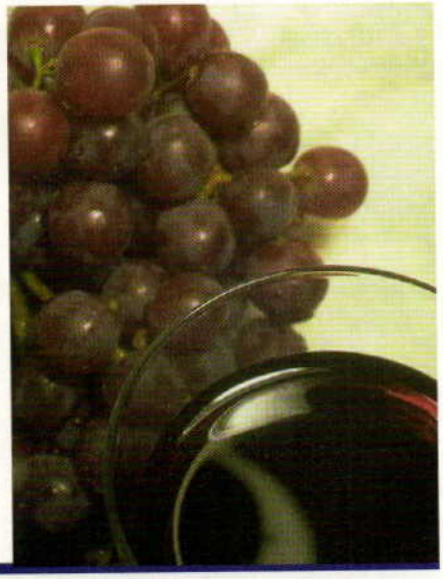
GRAPE wine

Ah yes . . . grapes! Now that we've covered the science behind the winemaking process, you are ready to gather some grapes and start making wine from scratch. Kits and concentrated juices are convenient and capable of making fine wines, but there is a sense of authenticity and tradition in producing wine from the original source: the wine grape. From the gaze of a fruitful vineyard to the pride of a successful harvest, wine grapes bring an element of authenticity to the winemaking process that one cannot find elsewhere. Like any ancient art form, winemaking lacks exact documentation, but evidence as far back as Mesopotamia suggests that viticulture and winemaking existed over 8,000 years ago.

Back then, the world was still flat and people lacked the scientific knowledge that has demystified the world as we know it. To our good fortune, we can now explain the miracle of how a grape is transformed into this fine beverage the world has celebrated for millenia. In fact, Alison Crowe, a contributor to *WineMaker* magazine and former enologist at Bonny Doon Vineyard in Santa Cruz, California has provided a wealth of this information in "From Grape to Glass" below. Following this, techniques in maceration (the process in red winemaking of letting the crushed grape solids soak in the juice) are described. Armed with this knowledge you are ready to jump in foot first and begin making wines from grapes. Special thanks to Gene Spaziani for providing his Cabernet Sauvignon and Chardonnay recipes.

from GRAPE to GLASS

By Alison Crowe



Nothing feels as satisfying and authentic as making your first batch of wine from fresh grapes. And there's no better time to try it than in early autumn, when grapes all over the country are ripening in vineyards and backyard gardens.

There are many kinds of grapes to choose from, depending on where you live. *Vitis vinifera* is the classic choice for flavor, varietal character and historic authenticity. This famous European wine-grape family includes such renowned varieties as Chardonnay, Merlot, Zinfandel and Cabernet Sauvignon. In the United States, to make a sweeping generalization, *v. vinifera* grapes thrive in California and the Pacific Northwest. They also grow well in microclimates scattered from New York to the Great Lakes, to the mid-Atlantic states and beyond.

Those who live in colder, wetter climates may not be able to find *v. vinifera* grapes grown locally. Don't be discouraged. Fine hybrids and *Vitis labrusca* grapes, which are less susceptible to cold and disease, may be growing near your home. Other options include ordering grapes through your favorite local winemaking shop or from a produce wholesaler. (See "Find Amazing Grapes!" Fall 2000 *WineMaker*.) Whatever kind of grapes you use, the general techniques, equipment and ingredients are the same. Here's an overview of some key steps along the way.

Inspecting the Fruit

Winemaking starts with inspecting the grapes. Make sure they are ripe by squishing up a good double handful, straining the juice and measuring the sugar level with a hydrometer. The sugar density should be around 22 °Brix — this equals 1.0982 specific gravity or 11% potential alcohol — and the fruit should taste sweet, ripe and slightly tart. For details on taking hydrometer readings, see page 6.

The grapes must also be clean, sound and free of insects and other vineyard debris. Discard any grapes that look rotten or otherwise suspicious. Also, it's very important that all the stems are removed, since they will make your wine bitter.

Keeping it Clean

Winemaking demands a sanitary environment. Wash all of your equipment thoroughly with hot water, boiling what you can. It's also wise to arm yourself with a strong sulfite solution to rinse any equipment that comes in contact with your wine. To make it, add 3 tablespoons of sulfite powder (potassium metabisulfite) to a gallon of water and mix well (for more on sanitation turn to page 6).

Adjusting the Juice: Acids

Adjusting the juice or "must" of your wine is critical. Luckily, it's also easy. Acid content is measured with a

simple titration kit; you can buy one at a supply shop. The ideal acid level is 6–7 grams per liter for dry reds and 6.5–7.5 grams per liter for dry whites.

Here's an example: If your must measures 5.5 grams per liter, then you need to add 1 gram per liter of tartaric acid to bring it up to 6.5 g/L. Since 0.2642 gallons equals 1 liter, 1 g/L is equivalent to adding 3.8 grams of tartaric acid to your one-gallon batch. Add this powder in one-eighth teaspoon intervals, checking acidity carefully after each addition, until the desired level is reached. You can buy tartaric acid at your supply shop.

You also need to monitor the sugar level with your hydrometer. The must should be about 22° Brix for both reds and whites. To bring the sugar concentration up, make a sugar syrup by dissolving one cup sugar into one-third cup of water. Bring it to a boil in a saucepan and immediately remove from heat. Cool before adding in small amounts, one tablespoon at a time, until the desired degrees Brix and specific gravity is reached. To lower the sugar level, simply dilute your must or juice with water.

The temperature of your must can also be adjusted to provide the perfect environment for yeast cells. Warming up the juice gently (don't cook or boil it!) is an easy way to bring it to pitching temperature without damaging the quality of the wine. Fermentation can sometimes reach into the 80° to 90° F range, though the 70° F range is standard for reds (whites often are fermented at cooler temperatures).

If your grapes have been refrigerated or are too cold, use this unorthodox but quick trick: Heat up a small portion of the juice in the microwave, mix it back into the fermentation pail and re-test the temperature. An electric blanket wrapped around the fermentation pail also works, but takes longer. For cooling, add a re-usable ice pack and stir for a few minutes. Pitch the yeast when the temperature reaches 70° to 75° F for reds and 55° to 65° for whites.

Racking the Wine

"Racking" means transferring the fermenting wine away from sediment. You insert a clear, half-inch diameter plastic hose into the fermenter and siphon the clear wine into another sanitized jug. Then top it off and fit it with a sanitized bung and fermentation lock. This can be a delicate operation and it's important to go slowly. You don't want to stir up the sediment or lose suction in the siphon. For further details, see page 6.

Bottling the Batch

Bottling may sound complicated, but it's really not. To bottle your wine, you simply siphon your finished product into the bottles (leaving about 2 inches of headspace below the rim), insert a cork into the hand corker, position the bottle under the corker and pull the lever. It's always wise to buy some extra corks and practice with an empty bottle before you do it for real.

Wine bottles can be purchased at home winemaking stores, or you can simply wash and recycle your own bottles. These supply stores also rent hand-corkers and sell corks. You should only buy corks that are tightly sealed in plastic bags because exposure to dust and microbes can spoil your wine. Corks can be sterilized just before bottling, with hot water and a teaspoon of sulfite crystals.

A one-gallon batch will yield about five standard-size (750 ml) bottles of wine. If the fifth bottle isn't quite full, then either drink that bottle or use smaller bottles to keep the wine. The key is to have full, sealed containers that are capable of aging. For more information on bottling and aging techniques, turn to page 36.

Now you're ready to make your first batch of fresh-grape wine. Red wines always are fermented with the skins and pulp in the plastic pail; the solids are pressed after fermentation is complete. White wines are always pressed before fermentation, so only the grape juice winds up in the fermenting pail. Good luck!

new EQUIPMENT

Crusher and Press

Crusher-Destemmer

Basket Press

The major difference between winemaking from concentrate or juice and winemaking from fresh grapes is that the latter requires extracting juice by mechanical means, specifically crushing and pressing. The crusher is used to break the grape skins in order to expose the juice in preparation for maceration when making red wines, or to ease pressing and juice extraction in white winemaking. The most basic crusher, the manual crusher, consists of two aluminum fluted rollers, a hopper and a flywheel-crank assembly. A motorized version that greatly simplifies crushing is also available, at a greater cost.

An important drawback of the crusher is that stems are crushed rather than separated from the must. Therefore, stems need to be removed manually, a tedious and messy task. Stems should ideally be removed to avoid imparting harsh tannins or increasing the wine's pH. A crusher-destemmer (often called crusher-stemmer) is another solution. It first crushes grapes and then channels them through a screen that allows grapes to drop into the fermenter, but expels stems out an exit chute for disposal. Both manual and motorized models are available.

The wine press (often called a basket or vertical press) is used to apply pressure on crushed grapes to extract juice. The basket press is the most popular type because it is efficient and well-priced. This press consists of a cylindrical hardwood basket to hold the crushed grapes, as well as a ratchet mechanism and hardwood blocks for exerting pressure. Mechanical bladder presses are also available and use an inflatable device to press out juice.

NEW SKILLS: master MACERATION

By Daniel Pambianchi

Maceration is the process in red winemaking of letting the crushed grape solids soak in the juice. It is during maceration that key compounds are extracted from the grape juice and solids, giving red wine its body, flavors and color. These compounds are known as phenols and mainly comprise tannins, color pigments and flavor compounds. The concentration of phenols in wine depends on maceration techniques, such as cold soaking and cap management.

Effects of maceration

It is during maceration that red wines acquire part of their structure. The amount of phenols extracted during maceration depends on a number of factors that will need to be managed and controlled. These include the maceration period and temperature and cap management (pumping-over and punching-down operations).

As a general rule of thumb, the longer the juice and grape solids are in contact, the more tannin and color will be extracted, and the more full-bodied and colored a red wine will be. The amount of phenol extraction is high in the early days of maceration and continues, albeit at a slower rate, in the final days. Color extraction, on the other hand, happens within the first few days to one week and then subsides. There is very little color extraction after the tenth day or so.

For maximum phenol extraction, you want to prolong the maceration period as much as possible until little or no extraction occurs. The challenge is to retard and slow down fermentation, which would otherwise greatly reduce the maceration period and the level of extraction. The fermentation temperature will rise rapidly up to 90 °F (32 °C) or more, if not controlled, and will cause a rapid fermentation or may cause a stuck fermentation. The solution is cold soak pre-fermentation.

By dropping the temperature of the juice and grape solids down to 46 °F (8 °C) or lower, you effectively prolong maceration and inhibit fermentation. For a full-bodied, deep-colored red wine using grapes which have been cold-shipped to your house, cold soak the juice and grape solids up to two weeks before initiating fermentation by placing sealed freezer bags full of ice into the juice. When using freshly picked grapes, you will need to store the grapes in a cooler — not a practical solution for most home winemakers — or use the freezer-bag method. Be sure to stir the juice and solids during cold soak to distribute the temperature evenly, and add approximately 100 mg/L of sulfite to prevent volatile acidity from forming. Punch down the grapes at least twice a day to prevent microbial spoilage. When ready to start fermentation, inoculate the must with yeast.

During maceration, keep the fermenter covered and properly sealed with a tarp (water-proofed canvas) to prevent bugs from invading the sweet juice. Carbon dioxide (CO_2) gas produced during fermentation will get trapped between the cap (the mass of grape solids above the juice) and the tarpaulin, thereby protecting the juice from oxidation and microbial spoilage. During cold soaking, when no gas is produced, inject CO_2 gas under the tarp from a tank to protect the must from oxidation. Inject enough gas to form a layer above the must, and quickly tie down the tarp to prevent gas from escaping.

During fermentation, the grape skins will form a cap and rise to the top of the must. To prevent spoilage and to maximize phenol extraction, punch down the cap three times a day using a plunger built from a long wooden handle attached perpendicularly, at one end, to a one-square-foot piece of oak. Separately or in addition to punching the cap, pump the juice over the cap.

Pumping over involves using an electric pump to recirculate juice from the bottom of the fermenter to the top (over the grape solids). This has the added benefit of dissipating some heat from the fermenting juice. Don't overdo it to avoid oxidizing the wine. It only takes about 20 seconds for 53 gallons (200 L).

Consult your retailer about choosing a pump. Not any pump will do, since it has to be able to displace the grape solids that enter it. A one-horsepower, positive-displacement impeller pump with 1-½ inch tubing is recommended, as a minimum. If you do not have a pump, collect some juice with a bucket from the bottom of the fermenter and pour it over the cap. A fermenter equipped with a spout will prove practical.

As you will be removing the tarp frequently during punching of the cap and pumping over, the protective CO_2 gas will escape. During the vigorous phase of fermentation, sufficient gas is produced to provide adequate protection. When fermentation subsides, you may need to inject CO_2 gas under the tarpaulin from a tank.

When fermentation is complete and the Brix level has reached 0°, an additional week or 10 days of post-ferment maceration will be beneficial in softening the tannins. Closely monitor the wine during this phase to avoid unpleasant results such as microbial spoilage. Extended maceration is not recommended for high-pH wines, since these do not benefit as much from long extraction and are more prone to microbial spoilage.

To maximize the benefits of phenol extraction, choose a fermenter that provides an adequate ratio of juice surface to volume. A greater surface ratio allows more juice to be in contact with the grape solids, thereby increasing extraction. A 350-liter food-grade plastic fermenter is a good choice. It can hold up to 18 36-pound (16.3-kg) cases of grapes. Be sure to account for volume from the rising of the cap when choosing the size of a fermenter.

When high color and tannin extractions are desired without cold soak or extended maceration, fermentation can be carried out at the high end of the recommended temperature range of 72–86 °F (22–30 °C). This method can be used with low-tannin grapes where extended maceration provides no benefit. It also has the advantage of minimizing the risk of oxidation and microbial spoilage since the duration of must exposure to air is reduced. Many great wines are made using high-temperature fermentation!

Another trick to increase the yield of juice from maceration: Add a small amount of pectic enzymes at crushing time and ferment at the high end of the temperature range. Pectic enzymes are most effective above 80 °F (27 °C). In powder form, pectic enzymes are added at a rate of up to ½ ounce per gallon (4 g/hL). The powder should be dissolved in a small amount of cool water first. In liquid form, add up to 3 drops of pectic enzymes per gallon (4 L) of wine. To avoid extraction of overly harsh tannins don't use pectic enzymes if macerating with stems.

White wines do not benefit from maceration since no color extraction is required and tannins are not desirable. Some winemakers macerate their crushed white grapes for up to 24 hours to give their wines a little more structure and color but the practice is not recommended for home winemakers due to the increased risk of oxidation and phenol over-extraction.

For some more information on grape winemaking techniques, check out the following articles:

"From Grape to Glass"
(Fall 2000)
"Juice Your Fruit"
(August–September 2002)
"Organic Winemaking: Tips from the Pros"
(February–March 2003)
"Punching Down the Cap: Tips from the Pros"
(April–May 2003)
"Master Maceration: Techniques"
(Fall 2001)
"Mastering Malolactic Fermentation: Techniques"
(Winter 2001)
"Your Home Wine Lab"
(Spring 2001)
"Carbonic Maceration"
(August–September 2002)

case study: MAKING CABERNET SAUVIGNON

By Tom Rinaldi

Most winegrowers and connoisseurs consider Cabernet Sauvignon the king of the red wines. The wines made from Cabernet Sauvignon grapes are as diverse as the lands upon which they are grown. Experience has shown that Cabernet can be successfully grown around the world. This produces wines with black cherry, cassis, plum and herbal characteristics.

The grapes have been described as "buckshot on barbed wire" because the berries are relatively small and the stems are lignified (woody) at ripeness. Because of its thick skins and loose clusters, Cabernet Sauvignon can tolerate rain very well.

The wines often have such power and tannin that blending with its cousins, such as Merlot, has been a useful tool. Merlot, Cabernet Franc, Malbec and Petite Verdot all can be used as blending tools to give dimension, structure, softness and elegance to the wine. But wines made from 100 percent Cabernet Sauvignon can do quite well on their own.

Making Cabernet Sauvignon from Fresh Grapes

Ripe Cabernet grapes have brown, lignified seeds, a gummy skin texture and a full flavor development with smooth tannins in the taste. There should be few, if any, green seeds. The sugar content and specific gravity readings at harvest can vary tremendously, but it would be advisable to adjust to approximately 23–24 °Brix. Also, pH should be about 3.15–3.85 and total acidity 0.5 to about 0.9 grams per 100 mL. The grapes you use to make wine should all appear sound and healthy. Be sure to remove overripe, raisined or moldy grapes, and all "MOG" (material other than grapes).

You should make every effort to get grapes from the vine to the fermenter as quickly as possible, and at the coolest possible temperature. The type of equipment can vary greatly, but it is crucial to remove all stems before they get to the fermenter. Beware of tearing skins or breaking seeds throughout the entire process since that will adversely affect the final wine.

The choice of "cold soaking" is up to the winemaker. Basically, cold soaking is the amount of time that grape must is allowed to sit and mix at cool temperatures before the addition of yeast, or before fermentation begins on its own.

Adding sulfur dioxide at the crusher will help avoid bacterial or yeast problems. The recommended amount is usually around 50 parts per million (ppm) — about 2 grams of potassium metabisulfite per five gallons (19 L) of juice, or approximately 1 gram per 40 pounds (18 kg) of fruit.

The type of yeast and the quantity is up to the winemaker, who can determine his ability to control the temperature. Home winemaking shops and yeast manufacturers can also recommend yeast for Cabernet Sauvignon. Wyeast recommends its 3267 Bordeaux Wine Yeast, while White Labs suggests WLP 760 Cabernet Red Wine Yeast. Lallemand's EC1118 *Prise de Mousse* has also shown success in making this wine. Always be sure the must isn't too cold when you inoculate with yeast. This is one of the primary causes of stuck fermentation. The must temperature must be above 55 °F (131 °C) before you add yeast.

I recommend warm temperatures for maximum extraction of color and flavor, but below 90 °F (194 °C). Maximum punch-down should occur during the prime extraction period from 18 down to 5 °Brix. For a vat, thoroughly submerse the "cap" (the skins and grape particles that float on the must) three times a day for about five to ten minutes. Keep it covered with cloth or wood to avoid bugs, and to protect the carbon dioxide blanket on the surface. Be sure to thoroughly and frequently wet the cap at this time.

Monitor the aromas and flavors throughout the process to get to know the batch and to determine courses of action. For example, you might detect hydrogen sulfide aromas and decide to aerate to rectify the aroma.

Extended maceration is a matter of taste, but for most home winemakers, pressing at dryness is probably the best bet. Throughout the process, it is crucial to avoid any introduction of stems, shearing of skins, any breakage of seeds, wild swings in temperature, unnecessary oxidation and fruit flies.

Pressing is literally a matter of taste. It is advisable to taste the free run and compare it to the press fractions. As the amount of bitterness and high pH "fatness" increase to a perceived objectionable point, either stop pressing or separate the "hard press."

You can identify pH fatness by a soapy, oily texture and taste, along with a color change toward brown and dull. See if the bitter and phenolic portions of this hard press — which usually taste astringent, rough and "puckery" — can be fined to a point at which they taste favorable and can be returned to the main blend. Fining agents vary from gentle (egg whites) to moderate (casein) to harsh (gelatin or activated carbon). Experimentation in small quantities is the only way to decide the best method.

It's generally smart to add malolactic bacteria at pressing. It is important that the culture is pure. To determine an ideal strain, consult with a supplier. You should avoid growing cultures in a high pH concoction to protect the wine from undesirable microbes.

Racking within a few days of pressing is usually a good idea, along with a racking about a week later. At this point, the wine is usually ready to be barreled down and allowed to finish malolactic fermentation. Cabernet Sauvignon is nurtured and allowed to fully evolve with good wood to such a high degree that the importance of high-quality oak cannot be overemphasized. If you use oak chips, the early addition of well-toasted premium oak chips will allow the wood flavor to integrate and develop.

Topping and tasting on a regular basis is crucial and will give indications of the wine's condition and development. Closed-in, reduced, stifled characteristics and completion of malolactic fermentation are common indications that the wine needs racking. At this point, decant the wine from the container as carefully as possible. Rinse out the lees from the original container, adjust the free sulfur dioxide level (usually to minimum of 20 ppm, depending on the pH) and return the wine. This regime is normally carried out about once every three months.

Cabernet Sauvignon wines generally improve in the cellar over a period of 15 to 30 months. When the winemaker believes it to be time, the wine should be bottled. Decisions to fine (two or three egg whites per barrel, for example), to blend or to filter should be weighed carefully because they are irreversible. A large egg white measures about 35 mL; for a typical five-gallon batch at home, you'll want to add about 6 mL of white (keep any particles of yolk out). For small batches, it's possible to dilute the egg white with water and add a portion, but remember to mix the white to a light froth with the addition of a few grains of salt.

One caution: Wines usually go through "bottle shock" a week or so after they are bottled. This can be startling if the winemaker isn't prepared for a disjointed version of a familiar wine. Normally within six to eight weeks the wine will pull out of its awkward phase and begin to give back all the flavors and characteristics the winemaker toiled to preserve.

CABERNET SAUVIGNON RECIPE

by Gene Spaziani

HERE IS A SAMPLE RECIPE for a red wine made with fresh grapes. On average you'll need between 60 and 90 pounds of fresh grapes (still on their stems) to make 5 gallons (19 L) of wine. The basic steps found below are a good template for other red grape wine recipes. This recipe is for Cabernet Sauvignon, the most popular red wine variety in North America. This full flavored, medium-dark red wine offers a clean, well-balanced taste, with a hint of violet in the bouquet. It ages well and improves with oaking.

Yield 5 gallons (19 L)

60–75 pounds (27–34 kg) fresh Cabernet Sauvignon grapes
17–20 Campden tablets or 1.5–2 tsp. potassium metabisulfite powder
1 package (5 g) Red Star Pasteur Red or Wyeast Bordeaux yeast
3 tsp. yeast nutrient
3 tbsp. Oak-Mor
1 pkg. malolactic culture

Step-by-step

1. Sanitize all equipment. Remove any spoiled grapes from the clusters and then crush the grapes. Place them into your fermentation container. Be sure to remove grape stems from the container then add 20 drops of pectic enzyme liquid to the crushed grapes and juice.

2. Add 5 crushed Campden tablets or ½ tsp. potassium metabisulfite powder. Stir the juice and crushed grapes and let sit overnight.

3. On the second day, test for sugar and acid and make appropriate adjustments. Make a yeast starter by pouring 4 oz. grape juice and 4 oz. lukewarm water into a bowl, sprinkle in the yeast and let it proliferate for 30 minutes. Add this yeast starter, the yeast nutrient and the Oak-Mor to the must and stir well. Cover the container loosely with a sheet of plastic.

4. Fermentation will start in two–three days and continue for 7–12 days. The cap (the pulp, skins, etc.) will rise to the top, so twice daily push it down with a sanitized spoon. This allows the color and body to be extracted from the skin and pulp mixture. Between the fourth and sixth day, inoculate the must with malolactic culture (following manufacturer's instructions).

5. Monitor the wine each day with a hydrometer. When the specific gravity reaches 1.000 or lower, it's time to press out the wine and store it in another container.

6. Sanitize a 5-gallon (19-L) glass carboy. Put in 5 crushed Campden tablets or ½ teaspoon potassium metabisulfite powder. Pour in the must and fill up to the top. Insert a rubber bung and an airlock into the jug opening.

7. Let the wine sit for three to four weeks then rack again into a sanitized carboy. Three or four more rackings, four to six weeks apart, should pace the wine to its finish. After the second racking, use just 3 crushed Campden tablets or ¼ tsp. potassium metabisulfite powder.

8. The wine should clear itself. If it doesn't, wait longer and rack until it does clear.

9. When the wine is clear, it's time to bottle. Make adjustments if needed, then bottle the wine and wait at least six months before tasting. Enjoy!

case study: MAKING CHARDONNAY

By Alison Crowe

Chardonnay is one of the world's most-planted grape types. It is of the *Vitis vinifera* species and flourishes anywhere that other members of its family do.

Start With The Best!

As with any wine, the final product is determined largely by the quality of the raw materials. The Chardonnay's flavor should be full of fresh grapes and the acidity should "pop" in your mouth. It should also be relatively free of suspended solids. If you press your juice yourself and you can chill it (or have a beer-lagering fridge), cool the juice to around 40–45 °F (4–7 °C) and let it settle overnight. Rack the juice off the solids in the morning and let the juice warm to 60–65 °F (15–18 °C) in preparation for fermentation. You can also, if you choose, add about 20 mg/L sulfur dioxide to the juice after pressing to discourage oxidation and spoilage organisms. In practical terms, assuming you're working with a five-gallon carboy (19-L), this means adding no more than ⅛ teaspoon of potassium metabisulfite powder to your batch. (For more information, see "Solving the Sulfite Puzzle" in the Winter 2000 issue of *WineMaker*.)

So what characteristics in a juice will determine what you can do with it? Very ripe, flavorful juice that has sufficient acid (at least 6.5 g/L) will be able to stand up to oak and malolactic fermentation, producing an age-worthy wine that will marry well with these enriching, character-highlighting treatments. If your juice is not very flavorful, is under 22 °Brix or is lacking an acidic punch, go for the lean, brisk Chardonnay that is achievable with this kind of fruit, provided that you add enough acid to get the pH below 3.5 and the titratable acidity above 6 g/L. Juices of this nature would just get lost under all of the oak and yeast-autolysis richness associated with the first type of Chardonnay mentioned. Each wine will react to acid additions differently, so use a pH meter or titration kit. Add a little bit, measure, then add again if necessary.

Fermenting for Style

To barrel ferment or not? In order to achieve the rich, full style of Chardonnay, many winemakers choose to ferment their juice in barrels or in glass carboys with a handful of oak chips thrown in. This lets the heat of the fermentation and the increasing alcohol content extract tannins, vanillin and other phenolics from the oak, adding to the wine's complexity. Those who want a crisp style ferment their wines in stainless-steel or glass containers, without adding any oak, which allows the grape's qualities to shine through. No matter which option you choose, if you plan on barrel aging later on, be sure to make enough wine so you will be able to keep your barrels completely full throughout the long-term aging process. Barrel fermentation requires that you leave about 6 inches of headspace in the barrel, which at the end of fermentation will need to be topped up. Always make an extra barrel, a few extra 5-gallon carboys or 1-gallon jugs for topping wine, depending upon the capacity of your cellar. Winemakers also have easier oaking options than barrels. For details see page 7).

Choosing the yeast

With regards to yeast, there are two important considerations to be made. The first is the yeast's ability to ferment to dryness, since Chardonnay table wines are never made sweet. Choose a yeast strain that can motor through the fermentation and not leave any residual sugar behind (*Prise de Mousse* is a good strain, but it tends to inhibit malolactic fermentation, so if you want your wine to undergo MLF, you might choose another strain, like D47 *Cerevisiae*). Secondly, avoid yeasts (like Epernay or QA23) that can contribute aromas not normally associated with Chardonnay, such as lichee, licorice or jasmine. Many yeast-supply companies publish catalogs with valuable information regarding yeast behavior and characteristics. Consulting your local wine shop is also a good way to start. They can help you select a yeast that will complement your wine style.

Yeast nutrients like SuperFood or Fermaid-K are also important as they contain nitrogen, amino acids and vitamins, which are vital to the nutritional health of your yeast. Failing to provide your yeast with nitrogen can lead to stuck fermentations and hydrogen sulfide (rotten egg) odors, among other things.

Managing Fermentation

Pitch your yeast following the manufacturer's directions and mix your starter culture into the nutrient-boosted juice. Cover your primary fermenter with a fermentation lock and get prepared to monitor the fermentation daily. For the "rich" style, especially if you've chosen to barrel ferment, it is wise to ferment in the 60–65 °F (15–18 °C) range in order to let the heat of fermentation extract the complexity from the barrels or oak chips. The temperature may be allowed to rise slightly during the peak of fermentation, but keep the wine from getting above 68 °F (20 °C). At this temperature and starting with juice in our prescribed range, you should reach dryness in about seven days. If you're going for the lean, crisp style, ferment in the 55–60 °F (13–15 °C) range in a glass carboy, a stainless steel keg or other neutral container. Aim for a 10-day fermentation and keep the temperatures below 60 °F (15 °C) at all times. If you've got a beer-lagering fridge or other cooling device, don't let the temperature fall below 50 °F (10 °C) as the

photo by charles a. parker/images plus

yeast may get sluggish and stick. Let the yeast ferment the wine to dryness. Dry is usually around 0.994 SG, or -1° to -1.4 °Brix. Always be sure to use the temperature correction scale that comes with your hydrometer, otherwise your readings will be off.

Post-Fermentation

The decisions you make after the wine is fermented will also help to reinforce your choice of one style or the other. Those who have chosen the rich style will at this point want to embark on a major post-fermentation treatment regimen, while those who have chosen the lean style will use this post-fermentation time to preserve the fruity freshness they were hopefully able to maintain throughout the fermentation process.

Encouraging malolactic fermentation to occur immediately after the primary fermentation is a logical next step for those who want complexity. This is achieved by topping up the barrel or carboy to within an inch or so of the lip and introducing a commercial strain of malolactic bacteria to the dry wine, which is still on its gross lees (dead yeast cells and other settled solids). Be sure not to add any sulfur dioxide to the wine at this time; it will inhibit malolactic fermentation. The bacteria involved are fastidious and are sensitive to even small amounts.

Following the manufacturer's directions (bacteria come in dry-powder or liquid-culture form), inoculate the wine and put the fermentation lock back on. The bacteria will grow and multiply, converting malic to lactic acid and creating desirable flavor and aroma changes in the process.

Once the malolactic fermentation is over (this can be determined by a lack of a crackling noise at the opening of the vessel or, better yet, by a simple chromatographic kit available through most wine supply houses), the vessel should be completely topped up, sealed with a solid closure and left to mature. For details on malolactic fermentation see page 20. You can continue stirring at a biweekly rate for about the next month or so, tasting for developing autolysis flavors as you go. If you fermented in carboys and haven't yet, now is a good time to add a handful of mildly-toasted French oak chips.

Preserving freshness

Those who are going for the fresh, lean style should try to avoid all of the above, though often malolactic fermentation happens spontaneously and is not necessarily precluded for this style. At the end of the primary fermentation, fans of the crisp-style Chardonnay family should immediately rack their wine off the lees into a topped vessel, either another carboy or a neutral barrel, adding about 30 mg/L sulfur dioxide. The key at this point is to keep out oxygen and prevent any further loss of those ephemeral fruit aromas and flavors.

Aging on Oak

Much has been written about using oak barrels for aging wine, and we all know that barrels are an important part of many commercial wine programs. However, the reality for most home winemakers is that barrels can be an expensive adjunct to an already-expensive hobby, and their cost can be prohibitive. A five-gallon American oak barrel can be found for as little as $100, while a five-gallon imported French barrel may cost double that, and prices rise from there.

Depending upon the type, the toast level and the age of the barrel, cooperage can impart varying levels of oak tannins and oak aromatics (hints of vanilla, clove, cinnamon and toast).

If you don't own any cooperage, you can use oak chips, sticks or powder, added in small incremental amounts for flavor and aromatic complexity. The key is to start small. The smaller the "grain size" of your oak adjunct, the less you have to add. Oak powder has a high ratio of surface area to wine, so start with two teaspoons. If you're using chips, try a small palmful; and for oak sticks, which have the lowest ratio of surface area to wine, start with five.

If you don't want an oak note in your wine, feel free to buck current trends and just say no to oak.

Finishing the Wine

With all the lees stirring you might be doing to your wine, you can imagine it'll take you longer to eventually settle your product. Stop weekly lees stirring after malolactic fermentation is complete; after that, continue to stir biweekly for the next two months or until you're satisfied with the flavor development, whichever comes first. With most white wines, you never want to be in the barrel longer than six months. Even with an older barrel, whites can run the risk of pre-mature oxidation, even if they are sitting on their lees and you maintain a rigorous topping program.

Once your wine has seen enough oak and you're ready to bottle, rack out of the aging containers and into carboys or barrels for pre-bottling adjustments (sulfur dioxide levels should be about 25 mg/L).

Filtering is optional and many producers of fine Chardonnay feel it damages their product. As it is a potentially oxidative procedure and may cause spoilage, read all the instructions that come with your filter unit and follow them carefully.

CHARDONNAY RECIPE

by Gene Spaziani

Here is a sample recipe for a white wine made with fresh grapes. On average you'll need between 60 and 90 pounds of fresh grapes (still on their stems) to make 5 gallons (19 L) of wine. The basic steps found below are a good template for other white wine recipes with one exception: Most white wines, outside of Chardonnay, do not traditionally go through malolactic fermentation or utilize oak so these steps can be omitted. This recipe is for Chardonnay, the most popular white variety in North America. The Chardonnay wine grape can be made into a number of styles. The recipe here calls for oak and MLF for buttery notes.

Yield: 5 gallons (19 L)

60–75 pounds (27–34 kg) fresh grapes
⅛ tsp. pectic enzyme
17–20 Campden tablets or 1.5–2 tsp. potassium metabisulfite powder
1 5-gram package of Red Star Montrachet or Lallemand K1-V116 yeast
3 tsp. yeast nutrient
3 tbsp. Oak-Mor
1 package malolactic culture

Step-by-step

1. Sanitize all equipment. Remove any spoiled grapes from the clusters, then crush the grapes. Add ⅛ tsp. pectic enzyme to the crushed grapes. This will maximize the removal of juice from the skins. Let sit for two hours.

2. Press out the grapes and put juice in a fermentation container. Add 5 crushed Campden tablets or ½ tsp. potassium metabisulfite powder to the juice; let sit for at least four hours or overnight.

3. Test the acid and sugar and make adjustments, if necessary. Make a yeast starter by pouring 4 oz. (120 mL) of lukewarm water into a bowl, sprinkle in the yeast and let proliferate for about 30 minutes. Add this yeast starter, the yeast nutrient and the Oak-Mor to the grape juice and swish to help mix.

4. Cover the fermentation container loosely with a sheet of plastic; this allows gases to escape but deters foreign matter from entering. If using a glass carboy, which we recommend, insert a rubber bung and fermentation airlock (filled with clean water) into the carboy.

5. Allow some space in the fermentation container — about 20 percent — for foaming and bubbling. Within 3 days, the fermentation will start. It should continue for 7–12 days. After several days of fermentation, add the malolactic culture, following instructions on the package.

6. When the specific gravity gets below 1.000, fermentation is complete and you can proceed to the next step. If the specific gravity is above 1.000, allow the wine to continue to ferment until it goes below 1.000. Put 5 crushed Campden tablets or ½ tsp. of potassium metabisulfite into a sanitized 5-gallon (19-L) carboy.

7. Siphon the wine into the clean carboy and fill up to the bung and fermentation airlock. If necessary, add water that has been boiled for 15 minutes and cooled to room temperature or a similar wine to fill the new carboy.

8. Place the carboy in a cool place like a garage or root cellar. This will clear out the tartrates and stabilize the wine. Two or three more rackings will be necessary to finalize the process. At each subsequent racking, use just three crushed Campden tablets or 1¼ tsp. of potassium metabisulfite powder.

9. If wine does not clear, use gelatin, kieselsol, or bentonite finings following the manufacturer's instructions and allow an additional three to four weeks for the wine to clear. When the wine is clear, it is time to bottle. If you had to use finings, filter the wine to guarantee complete cleanliness.

Taste the wine and adjust for sweetness; then bottle. After bottling, wait three months before drinking. Enjoy!

COUNTRY wine
NON-GRAPE winemaking

By Alexis Hartung

illustration by don martin

Country wines is the informal term that has been used for years to define fermented beverages made from ingredients other than grapes. This can include fruits, vegetables, flowers and herbs. Wine made with honey is called mead and wine from apples is cider (5 to 7% alcohol).

Every home winemaker should make room in his or her cellar for country wines. They taste fresh and fruity; they reflect the aroma and flavor of ripe fruit. They are inexpensive to make. They are refreshing to drink when the acids are balanced with the other wine components (alcohol, tannin and residual sugars). While most of your grape wines age, country wines can be the "drink now" beverages in your cellar. Country wines can be made in a dry, semi-dry, semi-sweet or sweet styles. A variety of fruits can be fermented separately and blended to make lively libations. There is something to be made for everyone's palate!

Wines made from fruits such as berries, peaches, pears, apples, rhubarb, tomatoes, watermelon, rosehip and dandelion benefit from the winemaker's decision to control the acids, sugars, nutrients, vitamins and tannin content, as well as the yeast strain, to maximize the fruit flavors.

As a general rule of thumb, country wines have a limited shelf life while most grape wines benefit from at least a bit of aging. Country wines are typically consumed while young, within three months to two years (with a few exceptions, like elderberry) and do not generally improve with bottle aging. The fruit flavor loses its freshness and the color fades. To maximize enjoyment from each of these wines, make sure you test and adjust the acidity and free sulfite levels before bottling.

Most berries are high in acids. The easiest way to control the acids in berries and fruits for winemaking is amelioration (adding water) or limiting the quantity of berries or fruit to the volume of water used per gallon. This is the balancing act for the winemaker. While you want plenty of flavor, you do not want so much tartness that you pucker when you sip! Since acid is the backbone of a wine, titrate the acidity of the must (juice) before fermentation and, again, in the wine before bottling.

The acid range for dry fruit wines will be 0.55 to 0.65 percent. This is, of course, a generalization since there are many memorable fruit wines with acid levels of 0.70 to 0.80 percent. These wines are usually sweetened before bottling to balance the taste of higher acids. **Remember:** If the must (juice) does not have enough acidity during fermentation it can be too slow or may stop fermenting. The resulting wine may also have a medicinal taste. If higher acid levels are desired, consider balancing the acids with sugar after fermentation.

Other country wines — such as banana, dandelion, mead, melon, watermelon, persimmon, pear and tomato — need acid additions to make a wine balanced. The use of a commercial acid blend provides a balance of acids to make a pleasant wine. Old fashioned recipes used oranges and lemons to provide citric acid. These recipes may still be used as long as the citrus peel is not added. The oils in the rinds can actually inhibit a healthy fermentation. The use of a complete yeast nutrient is strongly suggested in all country wines since these fruits and flowers lack sufficient nitrogen, trace minerals and vitamins that are essential for healthy yeast metabolic activity.

All fruits can vary in juice content. Geographical and weather conditions may also contribute to the overall liquid content of the fruit. Fruits benefit from the use of pectic enzymes to release the juice from the fruit before and during pressing. These enzymes need 1–4 hours or overnight contact to break down the pectin in the fruit. Treated juices settle better and filter more easily than untreated juices. Use fresh pectic enzymes and mark the label with a date as it loses strength during storage. In addition to the regular pectic enzymes there are two newer products for fruits. Pearex Adex is a pectic enzyme formulated for pears, apples and quince and other light colored fruits. Adex-G2 may be used for acidic dark fruits such as raspberries, blackberries, currants, blueberries and native American grapes, such as Concord. Follow recommended dosage for fruits.

How much fruit does it take to make a gallon of wine? For guidelines, see the table at lower right. You can use more or less fruit than the recommended quantities. However, less fruit usually means less flavorful wine. More fruit per gallon of water will, in most cases, increase acidity and may make the wine too tart to be pleasurable.

Test the acidity of the must, using an acid test kit. Be sure to follow the guidelines for fruit wines. If using an acid test kit seems intimidating to you, ask your wine hobby supply store for help. They can show you how to do the test. Remember, the hydrometer and acid test kit are to the winemaker as a compass is to a mariner. They show winemakers where they have been and where they are going.

Skill is required to make a good fruit wine. The three cardinal rules for working with fruits are the same as for grapes:

1. Always use ripe, unblemished fruit. You cannot make an excellent wine if you do not start with excellent fruit.

2. Always be clean! Sanitize all equipment before and after use.

3. Always use sulfites to stabilize the fruit and wine to prevent bacterial activity as well as oxidation.

Juice versus Pulp

Preparing the fruit for fermentation is important. Some fruits are soft and are easily mashed or crushed to produce juice. Hard fruits, like apples and pears, need to be cut and pressed to release their juice. Firm berries, like dried elderberries, can be softened by adding boiling water. Freezing berry fruits can release more juice. Stone fruits such as peaches, plums and apricots are fermented on the pulp and benefit from the use of pectic enzyme. Dried fruits can be minced and then treated with warm water to release the sugars and flavors. Citrus fruits, like oranges and lemons, use only the juice; the peels are never used because the oils are bitter tasting and can inhibit fermentation. Rhubarb is cut and sugared to release the juices. Flower wines should be made with only the petals; no stems, no greens.

Note: Some fruits can be prepared by more than one method. Work with the fruit as soon as it is picked or purchased to ensure a quality wine. Remember, superior wines are made using superior quality fruit!

Reasons to Blend Fruit Wines

1. To Achieve Acid Balance: Most fruit wines should have acid levels that are 0.55–0.65% total acidity. Some fruits contain high citric and malic acid. Combining a high-acid fruit wine with a low-acid wine can bring balance and more enjoyable flavors.

2. To Maintain or Add Color: Some country wines tend to brown easily. Blending different wines, concentrated fruit juices or red wine coloring agents can enhance your visual enjoyment and a wine's color stability.

3. To Stretch the Crop Size: Sometimes we do not have enough of one fruit to make a batch of wine. Maybe the crop is small or the market is short of quality fruit. Combining several types of fruit is a practical answer.

For more on country wines...

For further information and more country winemaking recipes, check out the following stories in their respective issues of *WineMaker*.

Back to your Roots
(June–July 2004)
Country Wine Cornucopia
(June–July 2003)
Dandelion Wine: Tips from the Pros
(June–July 2004)
Dandy Dandelion Wine
(June–July 2002)
Elderberry: Varietal Focus
(August–September 2003)
Fruit Port
(June–July 2004)
Making Blueberry Wine: Tips from the Pros
(June–July 2003)
Making Country Wines: Tips from the Pros
(Summer 2001)
Radiant Raspberries
(June–July 2004)
Take a Sip of Strawberries
(Summer 2000)
There's More to Wine Than Just Grapes
(Premier 1998)
Three Cheers for the Red, White and Blueberry!
(Summer 2001)
Tomato Wine: Varietal Focus
(June 2004)

QUANTITIES of FRUIT to USE in MAKING WINE

Fruit	Pounds per Gallon of Water
Apples	7 to 16
Apricots, fresh	3 to 5
Bananas, fresh	3 to 5
Blackberry	4 to 6
Blueberry, fresh or frozen	2 to 4
Cherry, sour	3 to 4
Cherry, sweet	6 to 7
Chokecherry	2.5 to 8
Crab apple	3.5 to 4.5
Cranberry, fresh	3 to 3.5
Elderberry, fresh or frozen	3 to 5
Elderberries, dried	3.5 oz. to 5 oz.
Gooseberries	2.5 to 3.5
Honey	2.5 to 3.5
Melon	3
Peaches, fresh	3 to 6
Pear	4 to 6
Persimmon	3 to 4
Pineapple	3
Plum	4 to 6
Raspberry	4 to 5.5
Rhubarb	3 to 5
Rose hip, fresh	2.5 to 3
Rose hip, dried	10 oz.
Strawberry	3.5 to 5
Tomato	3.5 to 5

Here is a sample country wine recipe that is among the most popular for amateur home winemakers. Raspberry is a plentiful fruit that is available all over North America and around the world.

Country Wine Recipe:
Raspberry Wine

Ingredients

5.0 lbs. (2.3 kg) fully ripened or frozen raspberries placed in a fine mesh straining bag
7 pints (3.3 L) water
2.0 lbs. (0.91 kg) corn sugar or table sugar (Before adding the sugar, use a sugar scale hydrometer to determine the level of sugar in the must. Adjust sugar addition to match the desired potential alcohol level.)
½ tsp. acid blend (Before adding acid blend, use an acid test kit to determine if an acid addition is necessary — target acidity should be 0.65 to 0.80).
10 drops liquid pectic enzyme (or, if using dry pectic enzyme follow manufacturer's directions)
1 tsp. yeast nutrient with energizer
1 Campden tablet, crushed and dissolved

After 24 hours, add:

1 package wine yeast (Red Star Côte des Blancs, Premier Cuvée, Pasteur Champagne, Lalvin K1V-1116, or EC-1118, Fermiblanc or R2)

After fermentation is complete add:

1 Campden tablet, crushed and dissolved fining agent, per package instructions.

One month to six weeks after fermentation is complete, or when racking after fining add:

1 crushed and dissolved Campden tablet.

Step-by-step

1. Pick your raspberries when they are fully ripe. Remove all stems, leaves and foreign matter. Cut and discard any rotten fruit. Wash and drain the berries. To contain pulp and tiny seeds, place fruit in a fine mesh nylon straining bag. If frozen fruit is used, thaw. Lightly mash fresh fruit. Place juice into 2–2.5-gallon (7.6–9.4 L) primary fermenter. To keep all of the pulp in the straining bag, tie the top of the bag. Place the fruit filled bag in the primary fermenter. Fruit should be submerged.

2. Combine water and sugar in a sauce pot and heat to dissolve the sugar. Cool. Pour the sugar solution into primary fermenter. Hydrometer reading will be

21–22 °Brix. Take an acid reading using an acid test kit. Adjust acid levels to 0.65–0.8 (remember, 1 teaspoon of acid blend per gallon (3.8 L) will increase the acid level by approximately 0.15).

3. Stir in acid blend (if needed), pectic enzyme and yeast nutrient and Campden tablet. Cover primary fermenter and let sit 24 hours. In the meantime, make a yeast starter to expand the yeast colony.

Yeast starter recipe: Bring to boil 1 cup orange juice and 2 tablespoons sugar. Let solution cool to 70–80 °F (21–27 °C). Stir in 1/2 teaspoon complete yeast nutrient. To rehydrate yeast, measure 1/4 cup warm water (100–105 °F/37–40 °C), then sprinkle yeast on top. Let yeast sit for 5 to 10 minutes. Stir to dissolve.

4. Add the yeast starter to the cooled orange juice solution. Sanitize a 750 mL wine bottle or pint-size jar. Pour orange juice and yeast solution into clean bottle. Cover with a clean cloth or fit bottle with an air lock and #2 drilled rubber stopper. Yeast starter will be ready in 12 to 24 hours. Stir the yeast into the must (juice). Cover. Stir the must vigorously twice daily. After three days or when hydrometer reading is 8 °Brix (specific gravity 1.030), lightly press juice from bag and transfer to the secondary fermenter. Siphon the remaining wine from the primary container into a glass secondary fermenter. Attach a fermentation lock half filled with water. Discard pulp and clean straining bag.

5. When fermentation is complete (-1.5–0 °Brix (specific gravity 0.994 to 1.000), rack off the sediment into another clean and sterile glass carboy. Stabilize the wine by adding one Campden tablet, crushed and dissolved in a small amount of warm water. Once fermentation is complete, add the fining (clearing) agent according to manufacturer's directions. Let sit 2–3 weeks and siphon the wine away from the sediment. Discard the sediment.

6. Let sit 6 weeks and rack again. Rack a third time after another 6 weeks have elapsed. When clear and stabile, taste the wine. Adjust the sweetness of the wine to suit your preference. If a dry wine is preferred, check the sulfite level and adjust to 35–45 ppm free sulfite, filter, and bottle. To make a sweet wine dissolve 1/2 teaspoon potassium sorbate in a small amount of water. Add to the wine and stir thoroughly.

7. Then perform sugar bench trials to determine the level of sweetness that best enhances the fruit. Compare the aromas, flavors, acid balance, and aftertaste. Taste and determine the residual sugar level that best accents the wine. Do the necessary math by multiplying the amount of sugar needed for the volume of wine to be bottled. Stir thoroughly. Check the sulfite levels, adjust if necessary and filter the wine for a brilliant appearance. Siphon wine in clean, sanitized bottles. *Enjoy!*

FILL it up

By Daniel Pambianchi

A guide to bottling equipment for batches small and large: How to use and choose the right set-up for your home winery.

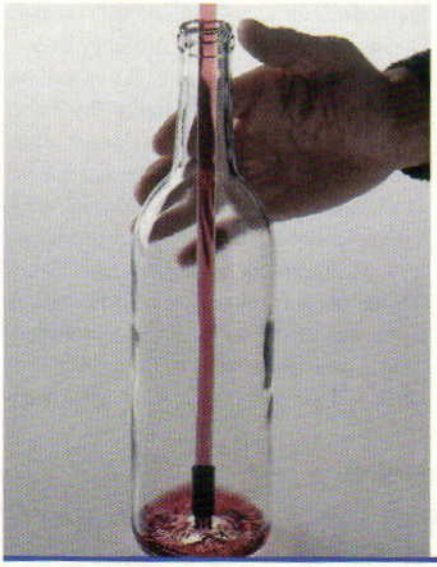
I have always approached bottling, that penultimate step in winemaking before corking, with mixed emotions. On the one hand, there is nothing more satisfying to a home winemaker than to display that perfect bottle of wine, dressed with a colorful label and capsule. On the other hand, bottling can be a tedious, unexciting chore. With all the preparatory work — rinsing, sanitizing and more rinsing — bottling can become overwhelming as one's production increases. An avid home winemaker may produce as much as 50 gallons (200 L) of wine in a given year. That amounts to more than 260 bottles, which can quickly turn into three hours of bottling using a single siphon and racking cane.

Bottle fillers often are described as automatic or semiautomatic to highlight that the equipment has some level of automation, such as fill level or making use of a self-activating pump to transfer wine from a carboy to bottles.

Stem-and-Valve Bottle filler

The most basic bottling apparatus is the stem-and-valve bottle filler, also known as a bottling wand, which is ideal for 5-gallon batches. It typically retails for approximately $5 or less. It can fill 30 standard 750-mL bottles in 20 minutes.

These simple bottle fillers consist of a short plastic tube with a stem attachment. The stem has either a simple or spring-activated valve to control the flow of wine, and uses gravity to displace wine from a carboy to bottles. To fill a bottle, you simply prime the filler, insert it in an empty bottle, and apply pressure by pressing the stem against the bottom of the bottle. Release the pressure when the wine level reaches the top of the bottle. When you remove the filler, the wine level will fall back down to the desired level for inserting standard corks.



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The stem-and-valve bottle filler works well for standard flat-bottom bottles but it is hard to operate when the bottle has a deep punt — an indentation in the bottom of bottles with only an aesthetic purpose. The stem will slide down the punt, and therefore the valve never opens.

Semiautomatic Fillers

There are many types of semiautomatic bottle fillers available, but cost can become an issue. If you're interested, most shop owners should be able to assist you with purchase information.

Corking

After you have your wine in the bottle, it is important to get it sealed up good and tight. The traditional and most popular method is to insert a type of cork into the neck of your bottle. There are several types of corks and corkers. For more information read "Finding Closure," in April–May 2003's issue of *WineMaker*. The sidebar below lists the types of corks and their prices.

CLOSURE TYPE	UNIT PRICE RANGE ($U.S.)
Natural Cork (Good Quality)	0.15–0.30
Natural Cork (High Quality)	0.30–0.40
Natural Cork (Highest Quality)	0.40 and more
Agglomerated Cork	0.09–0.13
Multi-piece Cork	0.14–0.18
Plastic Top Cork	0.11–0.16
Hybrid Cork	0.28–0.32
Non-Cork (not containing natural cork material)	
Synthetic Cork	0.20–0.25
Plastic Screw Cap	0.03–0.05
Crown Cap	less than 0.02

AGING potential

By Daniel Pambianchi

Understanding the lifespan of your wines

For many wine lovers, the subject of a wine's aging potential can be intimidating or seem like artful science that is best left to the wine gurus of the world. Some are often misguided by false myths that all wines can age or that homemade wines cannot age.

We can use our knowledge of the wine's chemistry and organoleptic attributes (color, odor, taste and feel) to evaluate how long a wine can last and when it will be best to drink. With experience, we'll be able to estimate the life of a wine by relying solely on its organoleptic attributes — like the pros who do not have access to analytical data when tasting wine.

Wine is first created in the vineyard as the soil, climate and viticultural practices (e.g. crop thinning, timing of harvest, etc.) dictate the quality and chemistry of the fruit. Only the best fruit coupled with sound winemaking methods will yield age-worthy wines. In general, reds will age better than whites; however, the vast majority of wine produced globally is meant for drinking as soon as it is marketed or within a year or two. Only a small percentage of wine, about 3–5%, is meant for extended cellaring. Homemade wine can be made to last many years.

The wine's chemistry — namely, color, pH, acidity, tannins and alcohol content — plays an important role. Each indicator impacts aging potential, however, they must be considered holistically for a more accurate assessment. If any one indicator is abnormally low or high for a specific style of wine, the wine will be unbalanced and may not age gracefully.

Understanding the indicators will not provide an exact assessment in years, but will give you some clues as to when the wine should be drunk. As you acquire tasting experience and follow a wine's evolution over time, your estimates will greatly improve.

Acidity, pH and color

A wine's pH and color are the most important indicators when assessing aging potential. Lisa Van de Water, of the Wine Lab at Napa, best summarized the effect of pH on wines, as reported by Donald E. Gauntner in the American Wine Society Journal (Winter Issue, 1997).

"At lower pH, red wines are redder, fresher, fruitier, younger tasting for their age, slower to age, slower to mature, less complex, less full-bodied, much slower to spoil, and easier to maintain free of spoilage in the cellar because the SO_2 is more active."

"Higher pH wines, if they are red, are less red (sometimes brown, sometimes purple), less fresh, less fruity, more complex, more full-bodied, faster to age, faster to mature, easier to spoil, and more difficult to manage in the cellar with SO_2."

Wine typically has a pH between 3.2 and 3.6 with whites at the lower end and reds at the higher. Below this range, the wine's high acidity may make it unbalanced, and above this range it will be unstable and dull.

In whites, the color will darken to a gold color and turn to a brownish color if aged too long. In reds, the color will lighten and take on an orangey color, followed by a brownish color, most noticeable at the rim. If color and pH suggest that the wine is in its prime, reassess the wine at least once a year. Keep records of each wine's evolution to understand its aging dynamics.

Acidity has an inverse relationship to pH: A low-pH wine will have a higher acidity and a high-pH wine will have a lower acidity. As such, the refreshing acidity in wine is a good indicator of its aging potential. A flabby or flat wine lacks acidity essential for aging and should be drunk as soon as possible.

Tannins

In red wines, tannins are responsible for body and aging potential, and interact with color pigments to provide color stability. They are essential in making age-worthy wines. Tannins are anti-oxidants and, therefore, mouth-puckering, tannin-rich wines will live longer than low-tannin wines. A wine described as "full-bodied" implies that the tannin content is high while one described as "not approachable in its youth" implies that the tannins are too harsh and require aging to soften.

White wines are very low in tannin concentration and are therefore not meant for aging. The best white wines aged in oak barrels can live longer however, because of the higher tannin content. Similarly, wines (e.g. *Beaujolais Nouveau*) made by carbonic maceration — a technique used to trigger fermentation within whole berries to extract maximum fruit flavors but with no tannin extraction — are not meant for aging being low in tannin content and malic acid.

> "Only the best fruit coupled with sound winemaking methods will yield age-worthy wines."

Alcohol

High alcohol in wine is often (mistakenly) interpreted as "full-bodied." A low-alcohol wine can be full-bodied while a high-alcohol wine can lack body. However, alcohol acts as a preservative, and therefore, higher-alcohol wine will generally outlive lower-alcohol wine.

For example, a tannin-rich, 20%-alcohol port wine can age for decades whereas a fruity, 7%-alcohol Muscat wine should be drunk much earlier. In contrast, a syrupy sweet, 10%-alcohol icewine can be aged ten years or more owing to its higher acidity.

Aroma and Bouquet

A wine's aroma and bouquet can reveal important clues about a wine's aging potential. Wines are often described as "closed in," and therefore requiring cellaring to achieve their full potential. Let's first understand the difference between aroma and bouquet. Émile Peynaud — an authoritative research enologist and teacher of modern winemaking — best describes these terms in "The Taste of Wine: The Art and Science of Wine Appreciation" (Michael Schuster, tr., Macdonald & Co, 1987). Aroma is "the sum of (odor) elements in young wines" and bouquet is "the smells acquired through (aging), which develop gradually over the course of time."

"Defined in this way young wines owe their charm more to their aroma than their bouquet, while the appeal of wines with several years of bottle age will be due entirely to their bouquet."

Young wines will tend to exhibit aromas acquired from the grape varieties used and vinification methods, such as yeast selection. They may lack complexity and therefore seem "closed in" as the aromas have not had a chance to evolve and transform into more flavors as a result of oxidation and complex chemical reactions. Once transformed from aging, the bouquet can exhibit multiple flavors — the more flavors, the more complex.

How can one tell if a wine is past its prime judging from its bouquet? Assuming that the wine has not acquired any faults from poor winemaking or poor cellaring, the wine might well be past its prime if the bouquet seems one-dimensional or has off-odors. The wine is said to be fatigued, having lost much of its fruity aromas and subtle bouquet. Off-odors may include a vinegar smell or a pronounced nutty flavor (usually accompanied by a brownish color).

Free SO_2

Free SO_2 is not a factor when evaluating aging potential; however, it is used as a preservative to ward off microbial spoilage and premature oxidation. Although it helps the wine, sulfite addition should not be mistaken as a means to extend the life of wine. The recommended nominal free SO_2 level is about 10 times the decimal value of the wine's pH. For example, a red wine with a pH of 3.3 requires 30 mg/L; add an extra 10 mg/L for whites.

Cellaring

Remember the three cardinal rules of proper wine cellaring if you intend to age wine.

1. Maintain a constant cool cellar temperature in the 54–59 °F (12–15 °C) range.
2. Maintain relative humidity in the 65–75% range.
3. Protect wine from vibrations, light and odors.

For more on cellaring wine, refer to "Building a Cool Wine Cellar," in the April–May 2002 issue of *WineMaker*.

Bad OXYGEN

By Daniel Pambianchi

The first winemaking principle we all learn when starting out is to protect wine from air. We often read that air (and especially the oxygen it contains) is a wine's worst enemy. Oxidized wine becomes devoid of subtle and fruity aromas that make it seem tired, as if it is well beyond its apogee (even though it is not). Having lost its finesse and intensity, the wine will also take on a brownish color. As oxidation progresses, the wine will take on a deeper brown color with a sherry-like smell and eventually spoil if untreated. When spoiled, the wine will develop a heavy, white film on the surface and possibly a bluish green mold. This primer will help you understand the harmful effects of oxidation, guide you in preventing, or at least reducing the probability of oxidation.

Understanding Oxidation

Simply stated, oxidation is the result of wine being exposed to air during winemaking, at any time from grape or juice handling to bottling and from an inadequate sulfiting regimen. The more technical explanation is that free oxygen in air causes an enzymatic reaction with oxidases — the oxidizable enzymes, such as tyrosinase (polyphenoloxidase) — found in grape juice resulting in oxidation of aromatic and pigmentation compounds.

Fermentation and vinification compounds found in wines — such as alcohol, acidity, tannins and sulfur dioxide by-products — offer better oxidation protection than musts. The world-renowned enologist Emile Peynaud supports this theory in his book "Knowing and Making Wine" (John Wiley & Sons, 1984) by stating that "musts consume on the average two milligrams of oxygen per liter per minute whereas wines take 24 hours to consume the same amount." The susceptibility of must to oxidation underlines the extra care required during grape and juice handling. In general, red wines are less prone to oxidation effects because of their higher concentration of phenolic compounds, which inherently ward off hungry oxygen molecules.

The enzymatic reaction also accelerates as temperature increases, which increases oxidative effects and therefore requiring the wine to be stored at a cool temperature, for example around 55 °F (13 °C). Additionally, as pH increases must and wine become more susceptible to oxidative effects. Therefore, low pH wine is better protected and will tend to age better and longer and exhibit more aromas and a livelier color. And remember, the

effectiveness of free SO_2 from sulfite additions for protecting wine against oxidation (and spoilage organisms) also decreases as pH increases

10 Ways to Ward Off Oxidation

There are two general recommendations that we need to follow diligently during winemaking: 1) minimize the must's and wine's exposure to air, and 2) sulfite judiciously. Following are ten specific recommendations that you should build into your winemaking routine.

1. Transfer whites quickly

White musts are most prone to the effects of oxidation and should therefore be immediately transferred to carboys following crushing and pressing operations. White wine maceration is not recommended; otherwise, the wine will turn a brownish color. Be sure to remove berries and grape bunches affected by mold or rot, which would otherwise hasten oxidation.

2. Adjust the pH

The higher the pH, the more prone wine will be to oxidative effects. If your wine's pH falls in the ideal range of 3.1–3.6, don't play with it. To decrease the pH, add tartaric acid crystals before the start of fermentation at the rate of 1 g/L (0.13 oz./gallon) of juice for every 0.1 unit of pH.

3. Use sulfite

Sulfur dioxide (SO_2) is used in winemaking as a preventative against microbial spoilage, but also to reduce the effects of oxidation. And as pH increases, the effectiveness of free SO_2 decreases. My rule of thumb is to maintain a nominal free SO_2 level in a wine throughout its life until bottling at a value equivalent to 10 times the fraction value of a red wine's pH, and add 10 for white wine. For example, for a red wine with a pH of 3.4, maintain a free SO_2 level of 40 mg/L (ppm). A white wine with the same pH would require 50 mg/L. Use the sulfite calculator at www.winemakermag.com to determine how much sulfite you need to add for the desired free SO_2 level.

4. Top up

One advice that cannot be repeated often enough is to always, always top up your wood barrels or other containers when storing or aging wine. Following the alcoholic fermentation, fill your carboys to leave no more than ¾ inch (1.9 cm) of ullage — the headspace between the surface of the wine and the bung. Then secure the carboy opening with a fermentation lock properly filled half way with water.

Most oxidation problems related to inadequate top up involve barrel aging. Wine breathes through the wood and stave/head joints (i.e. all joints between any wood member) of the barrel. As wine evaporates, it is replaced with air. Check the wine level in all barrels at least twice a month and top up to the bung hole using a reserve wine of similar quality.

5. Rack by gravity

It is often recommended to rack red wine "by splashing." During racking, wine is allowed to splash at the bottom of the container and at the wine's surface as the level rises in the container. This softens the wine and can increase the fruit characteristics. White wines should never be racked with splashing because these are more prone to oxidation. As much as possible, rack wine by gravity, as you first learned when you made that first batch of wine. Other mechanical means, such as pumps, which hasten oxidation should be avoided. Many commercial wineries pride themselves on having a gravity flow system, usually associated with higher quality wines because these have not been subjected to any mechanical processing.

6. Avoid pumps

Unless you handle large volumes of wine where gravity flow is too time-consuming, the use of mechanical pumps should be kept to a minimum, such as in filtering. Mechanical pumps greatly speed up racking or wine transfer operations; however, they tend to dissolve some oxygen in the wine and therefore cause some oxidation. Always look for alternatives. For example, instead of (mechanical) pump over of wine during red wine maceration, punch down the cap. It is much gentler on the wine.

7. Use closed systems

Whenever possible, use a closed system for winemaking operations to minimize wine exposure to air. For example, when filtering, use a vacuum pump to draw air out of the receiving carboy instead of using a normal pump.

8. Use ascorbic acid diligently

Ascorbic acid (vitamin C) is an ingredient often used in home winemaking for its antioxidant properties. However, its use is not well understood. Ascorbic acid only has an extremely transitory antioxidant effect on wines. It fixes to dissolved oxygen in wine and quickly converts it to dehydroascorbic acid, a weak organic acid, within three or four days. Following this oxidation, ascorbic acid is exhausted and serves no further function. It is mainly used to scavenge oxygen in wine before bottling or other operations where the wine will be subjected to little or temporary aeration. Add ascorbic acid at a rate of 2–3 g/hL (approximately ½ tsp. per 25 gallons) of wine just before bottling. Be sure the wine has the minimum recommended level of free SO_2 before adding ascorbic acid; otherwise, it might actually favor oxidation.

9. Store at a cool temperature

The ideal temperature is around 55° F (13° C). Don't go lower than this temperature; otherwise, wine will take much too long to develop gracefully.

10. Inspect your equipment

Winemaking equipment may develop defects over the year from wear and tear. Any defective equipment can easily spoil wine. Inspect all equipment regularly, and particularly any jointed or molded apparatus. For example, check around the valve at the bottom of your stainless steel tank, verify that bungs are not defective and that they form an airtight seal with their vessel and check for leaks in oak barrels.

Good OXYGEN

By Daniel Pambianchi

photo by charles a. parker/images plus

Positive affects of oxidation? How can that be? Winemakers know that oxygen negatively affects wine and they process wine with the utmost care to prevent oxidation. In this article, however, we intend to show how a little oxygen can actually be beneficial to your homemade wine.

Two common winemaking practices that have a positive influence are macroaeration and microoxygenation. Both are used in making some of the best reds and whites, evidenced by the rows and stacks of oak barrels in commercial wineries.

Macroaeration refers to the practice of aerating, or oxygenating, fermenting wine by vigorous racking to produce a softer, less astringent wine that exhibits more fruit character and improved color stability.

Microoxygenation refers to the controlled process of oak-barrel aging where wine is allowed to interact very slowly with a miniscule amount of air penetrating through the barrel. Apart from the flavors and tannins imparted by the wood, wines aged in oak barrels will exhibit more complexity than wines aged in stainless tanks or glass containers primarily because of microoxygenation.

Oxidation reviewed

Simply stated, oxidation is the result of wine being exposed to air during winemaking, at any time from grape or juice handling to bottling. Oxidation can also result from a winemaker's administration of an inadequate sulfiting regimen. The more technical explanation is that free oxygen in air causes an enzymatic reaction with oxidases — the oxidizable enzymes, such as tyrosinase (poly-phenoloxidase) — found in grape juice resulting in the oxidation of the aromatic and pigmentation compounds.

Macroaeration

Macroaeration is only used in red winemaking as it involves vigorous splashing of wine during pump-over or racking operations. Macroaeration has a softening effect on the astringent tannins and enables the winemaker to produce a softer wine.

Wine aerated in this way is approachable much earlier (younger) and has well stabilized color. The high phenolic content and relatively low pH protect the wine from negative oxidation effects. In contrast, white wines have a very low tannin content and typically a higher pH, which makes them more prone to the negative effects of oxidation. Macroaeration therefore is never practiced and not recommended for white winemaking.

Macroaeration can also benefit red winemaking by providing yeast cells with oxygen and ensuring a healthy fermentation. Yeast require oxygen in order to thrive and to convert sugar into alcohol. Such yeasts are said to be aerobic, or living in the presence of oxygen. If oxygen is not sufficiently available, yeasts can become inhibited and a stuck fermentation can result.

Another benefit is reduced hydrogen sulfide (H_2S) production. A common cause of H_2S in wines, detected as a rotten-egg smell, is vinification from grapes that have been overtreated with sulfur-based vineyard mildew and fungus inhibitors. Red wines made from grapes are more prone to H_2S problems because the juice is allowed to macerate with the grape skins (therefore diluting sulfite into the juice).

In white wines from grapes, it is not a problem because the juice is not macerated with the skins. Abundantly aerating the wine by racking it against the wall of the container will reduce the amount of potentially harmful H_2S. If not treated early, H_2S will react in the wine to form first into mercaptans followed by disulfides — both are foul-smelling compounds that cause wine to spoil. The presence of either compound is practically irreversible in home winemaking and the most common result is a lot of spoiled wine being poured down a drain.

Macroaerating wine

There are several ways to macroaerate wine, each having a varying degree of effectiveness. These fall into two main categories: splashing wine and injecting oxygen into wine.

The most common method of splashing used by home winemakers is quite simple — just let the wine splash against the wall of a carboy during racking. Commercial wineries often use delestage fermentation, also known as the rack-and-return method. This method involves fermenting wine that is racked by gravity and flows into a vat, then returned to the tank with a pump. Refer to "Do the Delestage" in the June–July 2003 issue of *WineMaker* for more information on delestage fermentation.

Although these techniques are proven, some industry experts argue that the wine is still too protected by

the layer of carbon dioxide gas that is forming over the wine volume during racking, and therefore the wine does not absorb sufficient air to benefit from macroaeration. It is winemakers of this opinion that turn to the method of injecting oxygen into the wine.

Commercial wineries connect a venturi attachment to their hose when returning wine to the top of the tank during the pump-over operation. The venturi attachment is a simple inverted T-connector that allows air to be drawn into the wine stream when the wine is being pumped over. A check valve may also be used to prevent backflow.

A home winemaker can easily make a T-connector using polyethylene tubing and plastic barb adapters. The T-connector can then be inserted into the racking line by cutting the tube midway and connecting each end to the barb adapter. You will need to test with various lengths of tube on the leg side of the T until the "burping" stops during racking. Alternatively, if you use a pump with a valve on the suction side for pump-over, be sure to open this valve when working the pump.

And remember — do not aerate wine during malolactic fermentation (MLF). ML bacteria are usually very sensitive to oxygen and can become inhibited, which will commonly result in a stuck MLF.

Microoxygenation

A miniscule, controlled amount of oxygen during wine aging can be beneficial for wine to develop and show its full potential. It allows wine to develop and age gracefully while softening tannins, stabilizing phenols and increasing flavor complexity — a phenomenon known as microoxidation, or microoxygenation. This cannot happen in airtight, inert containers such as stainless steel tanks or glass carboys.

Until recently, microoxygenation mainly occurred during barrel and bottle aging where wine breathes through the wood and head and stave joints (the tight space between the pieces of wood forming the heads and walls of a barrel). Wine can also breathe through the cork during the aging process.

New advances in winemaking technology however, now make it possible to microoxygenate wine in controlled fashion at any stage of the process, such as tank aging, for example, and replicate the benefits of barrel-aged wines, albeit in a much shorter time period.

Note: Results are not conclusive as to whether wine should be microoxygenated before or after malolactic fermentation, and therefore that decision remains in the hands of the winemaker.

Microoxygenating wine

In commercial wineries, microoxygenation can be achieved by injecting a continuous, miniscule supply of compressed, industrial-grade oxygen gas

using a stainless steel, microsize diffuser installed inside at the bottom of the tank. The amount of oxygen injected is controlled via an automated control box.

No such microoxygenation equipment is yet available to home winemakers, but if you are a resourceful and handy person, you could find a gas diffuser and assemble it to an oxygen tank using polyethylene tubing.

Be sure to use a regulator on the oxygen tank. Doing this will enable you to run some tests by injecting gas into wine samples in varying amounts and rates. These tests will help you determine what methods yield the best results (since there is no control box).

When barrel-aging wine, no special microoxygenation equipment or process is required; the barrel does all the work. The winemaker only has two tasks: The first is to check the wine level every three to four weeks to ensure that everything is developing as planned according to your desired taste. The only other thing you will need to do is top up the barrel. This will avoid "bad" oxidation, offensive smells and unfavorable tastes in your wine.

For bottle-aging wine, natural or agglomerated corks are recommended. There is much debate about screw caps and synthetic corks because they do not have the long track record of natural corks. Some winemakers maintain that screw caps and synthetic corks provide too much of an airtight seal depriving the wine of the microoxygen that is necessary for it to evolve gracefully. The argument is that airtight seals inhibit microoxygenation and completely stifle the type of evolution required in well-aged wines. If a winemaker prefers to drink young wine, screw caps or synthetic cork closures are certainly a convenient method.

Keeping oxidation in check

If done correctly, home winemakers can develop a means of letting oxygen work for them as opposed to against them and their wines. However, don't forget about the negative effects of oxidation. Oxidized wine becomes devoid of fruity aromas and will spoil if not treated. This can be discouraging for a beginning winemaker, *So beware!*

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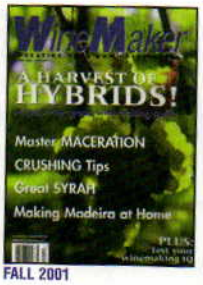

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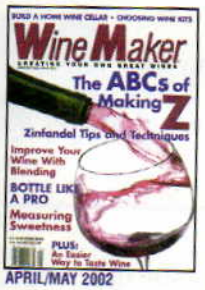

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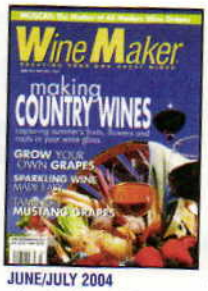

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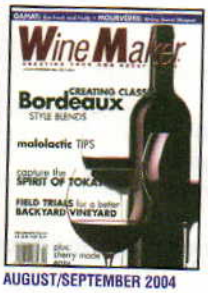

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