A microscopic view of burnt cranberry wine crystals. The image shows several large, irregular, golden-brown crystals with complex internal structures and sharp edges, set against a dark background. The crystals are illuminated from below, creating a strong glow and highlighting their translucent, glass-like texture.

Cooking Alcohol

:The Sweet Wines of New York
and the Crystals they Create

Article and Images by Emily Cali

Burnt cranberry wine,
10x objective, 3x ocular
lens



Star burst shaped
crystals, blueberry wine,
20x objective, 3x ocular
lens

Wine was first created many centuries ago and has been used as a beverage, a ceremonial liquid, a food enhancer and a joyous drink for numerous years. It has also had a long history of usage in religion as sacramental wine and vines that have been planted across the globe were initially germinated to be used by churches for religious ceremonies. Wine is generally characterized into two types: Old World and New World.

Wines that come from Europe and the Mediterranean are typically referred to as Old World wine and are created under strict guidelines that define what grapes can be grown where, when they can be harvested and how they are fermented. The majority of Old World Wine is dry and complex, reds are typically earthy and dark while whites are light and citrusy with a lot of acid to clean the palate. The wines of Europe are meant to go with food; the culture of most of the world involves drinking wine with meals and during the day whereas, in newer wine producing

countries, wine is more of a celebratory item used for special occasions.

New World Wine is brighter than the rich flavors of the Old World noble grapes, reds are jammy and filled with fruit flavors while whites tend to be sweet and crisp. These New World wines sell well because they are tasty and can usually be enjoyed on their own without lacking depth (Old World wines are enhanced by and enhance the flavors of food).

There are seven noble grapes used in wine making, these grapes can be found all over the world but are considered to have originated from France. The noble grapes used to create white wines are Chardonnay, Sauvignon Blanc, and Riesling. The noble grapes used to make red wines are Cabernet Sauvignon, Pinot Noir, Merlot, and Syrah. These noble grapes are known as *vitis vinifera*, the original or best grapes for wine making. Other varietal grapes that have ancestry traced to the noble grapes are Chenin Blanc, Gewurztraminer, Muscat, Pinot Gris (or Grigio), and Semillon (whites) and Cabernet Franc, Zinfandel, Gamay, Grenache, Mourvedre Tempranillo, Sangiovese, and Nebbiolo (reds).

These varietal grapes can be attributed to certain places that retain unique soils, weather, climate, seasonal differences, sun exposure and even diurnal swings (the difference in temperature between day and night). This environmental impact on the vines is called *terroir* (teh- wahr) and translates from French to "sense of place". The origin of some wines, which goes back to the grape vines themselves, can directly identify where the wine was made. Vines take years to mature and in most cases only the best grapes are harvested (moldy or small grapes are sometimes cut from the vines to allow the plant to direct its growth to the better grapes). The growing of grapes and wine is known as viticulture, the wine making itself is known as viniculture. These two terms are most commonly in reference to grapes but wines can also be made from other fruits. This is less popular due to the low amounts of sugars in other fruits which don't allow proper fermentation into an alcoholic beverage.

New York State and its Vine Growing Areas



AVAs

Other Growing
Areas

map made using reference
at <http://www.newyorkwines.eu/#!regions-terroirs/c11a2>

diagram of grape made
using reference of illustration
by Mariana Ruiz Villarreal at
winemakersacademy.com

New York State is home to four American Viticultural Areas or AVAs, these areas are recognized by their terroir and the types of grapes grown in them. By Lake Erie is the Erie AVA Region, east of that is the Finger Lakes Region, toward the southern tip is the Hudson River Region and Long Island has its own region on the northern tip (Long Island Region). There are also multiple other vineyards outside of these regions are scattered across the state. New York State grows grapes including Riesling, Seyval blanc, Chardonnay, Pinot Noir, Cabernet Sauvignon (nobles, less than 10% of production in the state), Catawba, Delaware, Niagara, Elvira, Ives, Isabella (American hybrids), Aurore, Baco Noir, De Chaunac, Seyval blanc, Cayuga, Vidal and Vignoles (French hybrids). Many wineries also utilize local fruits such as blueberries, cranberries, blackberries, apples and currants. Mead or honey wine is also made in the state.

Anatomy of a Wine Making Grape

Peripheral Zone (third pressing)- contains sugar acids and other components that affect the wine flavor

Intermediate Zone- contains sugar and tartaric acid (first pressing)

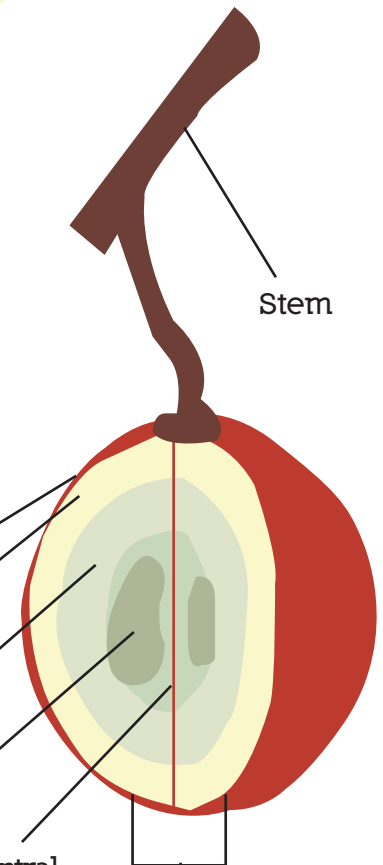
Seed

Central Zone- contains malic acid and sugar (second pressing)

Flesh or Meat

Skin

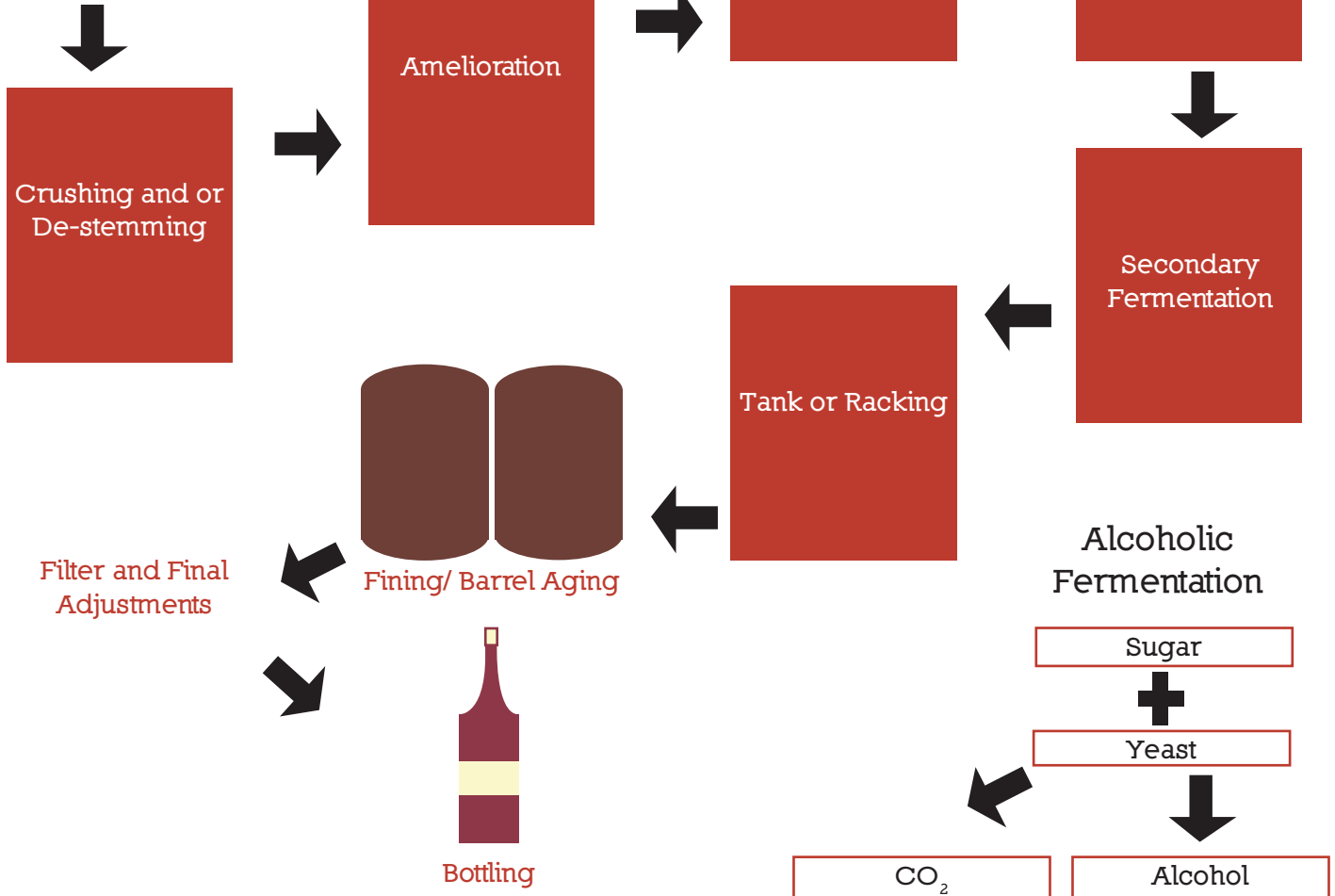
Stem





Viniculture

Whole Fruit



Wine Grapes or other fruits are brought whole from harvest. The fruit is then de-stemmed and then crushed by machine (in the past it was crushed by manually stepping on the grapes). The mash that results from this is called a must. Depending on the wine stems could be added back in after crushing (red) or stems and seeds could be removed completely (white). Amelioration means "to make better" in the case of wine this is the addition of water to the must in order to alter the amount of acid or sugar in the wine. Grapes are 70%-90% water and so is wine. The newly formed must undergoes primary fermentation for a period of time. The natural yeasts and proteins in the fruit allow alcohol production. Many companies add yeast to have more control of the wine quality and flavor.

The must is pressed to remove the skins and other materials that are not going to be in the final product. The juice is then allowed to go through a secondary fermentation in which more yeast or sugar can be added. If more sugar is added along with yeast the wine will have a higher alcohol content. This is also the time when malolactic fermentation can occur which can create a buttery or nutty aroma. It can also sometimes smells like bubble gum. The wine is then tanked to let rest. It may stay tanked or is put in barrels to age. Before it is stored it is fined or filtered to remove such things as dead yeast and other particles. It is filtered and adjusted as the wine maker sees fit. The final stage is bottling.

Cool or cold climate leads to high acid in wines and low sugar and low alcohol, lighter body; warm and hot climates lead to full wines with high alcohol and low acid, these are hard to pair with food. When a wine is called flabby it means it is unbalanced. New York State is mostly a continental climate area meaning that it has a wide range of temperature differences between summer and winter as well as day and night due to a lack of influence from large bodies of water. Most of the 300 or so wineries in New York are located in the western part of the state by lakes. The lakes create warm air currents that cause a more maritime climate, or even distribution of temperatures between coldest and hottest.

White wines are pressed and typically do not have skins, red wines are kept with the skin, rose wines are fermented with the skin just long enough to create a pink color, natural yeasts in the grapes are used for fermentation but often times commercial yeasts are used to have a more predictable outcome the amount of sugar during fermentation is measured with a saccharometer (calibrated hydrometer) it is let float in the wine solution and it has measurements on it, malolactic fermentation is caused by bacteria after the initial or primary fermentation and it converts malic acid into lactic acid this created a nutty and buttery taste the must has to be pressed and transferred for secondary fermentation secondary fermentation either happens in steel vessels or oaken barrels which may or may not be toasted.

There are there types of toasting and they are usually at the head of the barrel. The vessels are kept airtight to prevent oxidation which can make wine very dry and unflavored. During fermentation proteins are broken down and particles settle, yeast and other faults are usually removed but sometimes



tartaric acid crystals can still be found in bottles, in the US these are typically removed but some wines will still have them. They will not harm you and are in fact used to create cream of tartar for baking.

Red wines and wines that are aged with wood or wood chips will have tannin, tannin is the woody smoky dry nutty flavor that can cause mouth drying and a gritty texture on the tongue when consuming a wine that contains it. Tannin can also be a product of fermentation if the wine was fermented with the skins seeds and even stems of the grapes. Sometimes tannin is artificially added.

Wine can be blended with reserve juice or other wines before it is bottled. Adding reserve juice, or saved fruit juice that was removed from the must, before fermentation, adds sweetness and fruitiness, adding other wines can create more complexity and flavor mixtures. Adding water balances out high acid or high sugar in the must before it ferments, this is a process known as amelioration. When more alcohol is added it is called chaptalization. Wines that have had alcohol added to them are known as fortified wines.

There are several types of bottles that wine can be stored in to be sold. Typically clear bottles are meant to be enjoyed in a short period of time (within the next couple months after purchase). Clear bottles say that the wine should not be aged and it will get light pollution which causes an off taste and sometimes unpleasant smell in the wine (think skunked beer). More opaque bottles are for aging and keeping the wine from light and heat, the glass on these also tends to be thicker. Champagne or sparkling wine comes in very thick bottles and the bottom has a dome called

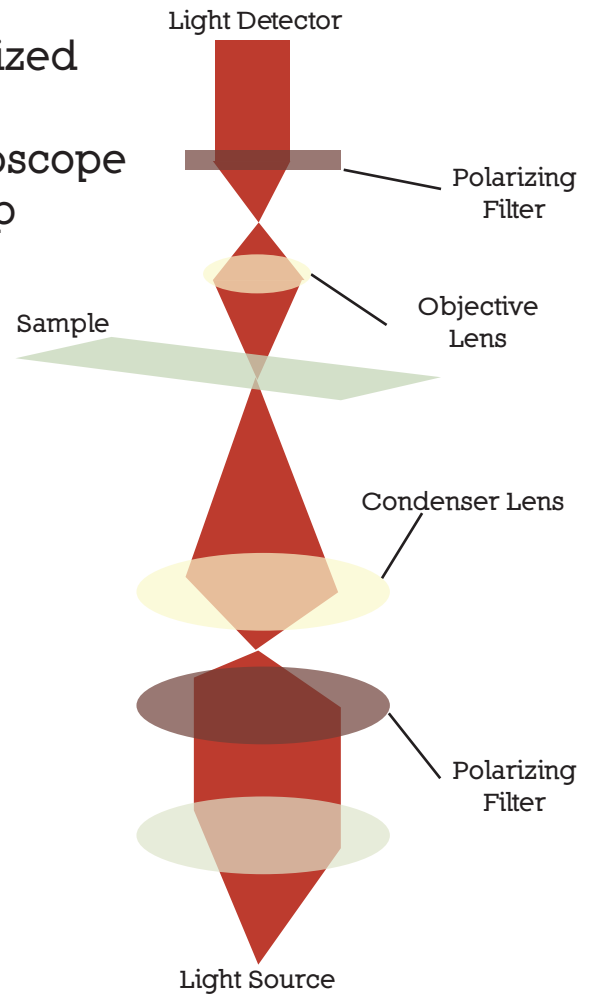
a punt to help keep the bottle from shattering under the stress of the pressure inside.

Polarization of light occurs when light that normally moves in all directions in waves is forced to move in one direction. In a polarized light microscope set up there is one polarizing filter set between the light and the subject (here that would be the microscope slide with wine on it) and one set at a 90 degree angle after the subject but before the camera lens. The filters, when set at a 90 degree angle to each other, block light completely if it's not a crystal or a birefringent (polarizing) object. Birefringence is caused by light being bent through a complex structure.

Crystals are birefringent and form for many reasons including heat, pressure and cold. In wine, as mentioned above, tartaric acid crystals tend to grow as the grapes and juices ferment with yeast, some vineyards remove these impurities and others let them stay and be bottled with the wine. Wine also contains sugars, which crystallize, and multiple other components that can alter the shape or arrangement of crystal formation.

In 2009 an e-commerce site was set up by Lester Hutt (who licensed the name and products) to support the Florida State University Science Department Laboratories through a project called BevShots. This site sells multiple products from

Polarized Light Microscope Set Up



fashion accessories to prints that display images taken of crystallized alcoholic beverages from hard liquor and mixed drinks to beer and wine. These images were captured by photomicroscopist/ photomicrographer Michael Davidson by thinly spreading alcoholic drinks on microscope slides and allowing them to set and evaporate forming crystals that were then placed under a polarizing microscope and photographed.

I was inspired by BevShots to try photographing crystals formed from alcoholic beverages. I noticed that on BevShots' site, they displayed pictures for both white wine and red wine and rose and sparkling but there was no specification as to what sort of grapes were in the wine or where it came from and I was curious to see if the grapes and fruits would make a difference in the crystal formation. I also wanted to explore the possibility that how the crystals were formed may change their looks as well. I selected six wines from Montezuma Winery in Upstate New York, Cranberry Bog (100% cranberry wine), Blue Moon (100% blueberry wine), Dragonfly (apple and black currant wine), Diamond (white wine), Fat Frog Red (red wine) and a honey mead.

I put these wines on microscope slides with an eyedropper, I used two drops per slide without a glass cover and one drop on slides with a glass cover. For each wine I had one slide that I put on the stove top to rapidly remove the moisture from the wine and hopefully form crystals faster and possibly in a different structure than natural drying. After burning the sugars on several slides I figured out the right amount of time and heat to give each wine so that it wouldn't turn into a black sticky smelly smoking mess (roughly a minute on low). Unfortunately the wines on the uncovered slides were too thick and though I waited over a month almost no crystals formed and the sugars became very sticky, and dust adhered to



the surface of the samples. They were just overall very messy. The slides that I made with the coverslips worked out a lot better, I think that the weight of the glass coverslips allowed an even and thin spread of the wine and this enabled a quicker evaporation time although the cover slip itself prevented air flow to the liquid beneath it. Seeing that the covered slides were yielding more results I tested heating covered slides on the stove. This seemed like the best way to create crystals quickly, but since the wine was so thinly spread under the cover slips on the slides it was hard to tell if I was overheating it. I used this sort of short cut to crystallize the Dragonfly Montezuma Wine, the Fat Frog Red, Diamond White and the Honey Mead. I used the stove top in my apartment and set it to low with the slides laid directly on it. There was a lot of hissing and cracking and bubbles sliding out from under the cover slips, I wasn't sure what to expect. I waited two days after I had cooked the specimens and went in to shoot. The method was so much better than just waiting around for the other slides to crystallize. The crystals that formed on the cooked covered slides were very small but also very numerous. They weren't what I wanted (I

wanted the images to contain crystals corner to corner) but it was a lot better than what I had been imaging. After observing these samples I noticed some patterns.

Observed Patterns of Crystallized Wines

1. The crystals were all the same colors in polarized light.
2. Most of the crystals were sort of pinwheel shaped, all the small ones typically contained three-four distinct points.
3. Mead seemed to have a lot more sugar than any of the other wines (crystals were more numerous and quicker to form).
4. The black currant apple wine formed segmented crystals.
5. The blueberry wine seemed to have the largest crystals and they were star burst shaped.
6. The crystals were not very bright, they were not faceted enough to shoot at a medium light or camera settings.

Shooting Technique

All pictures were captured with a tethered Canon Mark II camera mounted on a copy stand with a canon microscope mount attached. The microscope used was an Olympus with a beam splitter for viewing through the eye piece and camera. The ocular lens had a 3X magnification. The light was set to maximum and the condenser was opened all the way. The majority of the images were taken at ISOs higher than 1000, f/stop between 4 and 5 and the shutter speed at 1/30 sec. Pictures were then edited in Lightroom with some background clean up done in Photoshop to remove noise and visible dust that had stuck to the samples.

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Crystals that formed along the coil on the stove top burner, mead, 20x objective, 3x ocular lens

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