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WSU WINE AND GRAPE RESEARCH AND EXTENSION NEWSLETTER

EDITORS: Dr. Mercy Olmstead and Dr. James Harbertson

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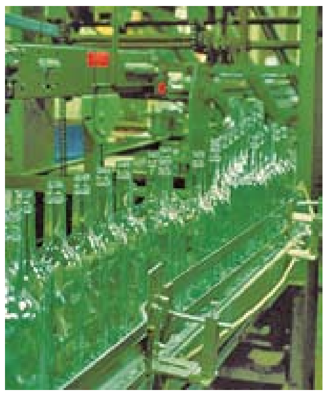
SPECIAL POINTS OF INTEREST:

- What does micro-, meso-, macro - climate mean to you?
- Details of the Horse Heaven Hills AVA
- Fining agents are abundant in the industry, but what is right for your wine?

SPECIAL SEMINAR: HOW THE FOOD BIOTERRORISM ACT IMPACTS WINERIES



On August 26, between 1 to 3 pm, ***Allan Bennet*** from the Food and Drug Administration will be giving a seminar and question and answer session discussing how the new Federal Regulations under the new Food Bioterrorism Act will impact the wine industry. The seminar will be held in the Large Conference Room at the Prosser IAREC. It is recommended that winery employees that deal with recordkeeping should attend the seminar. Please send reservations via email to: **saraspayd@wsu.edu** or **jfharbertson@wsu.edu** to ensure adequate seating. More information at the subject can be found at the following URL: **http://www.cfsan.fda.gov/~dms/fsbtac23.html**

FIELD GRAFTING WORKSHOP A SUCCESS

We held our second field grafting workshop on June 8, 2005, and it was a great success! Growers came to learn about grapevine propagation, grafting techniques, and experiments currently being conducted at WSU-IAREC in Prosser, WA. About 25 people attended and represented both small and large grape growers in the Columbia, Yakima, and Walla Walla Valleys.

Participants who brought their own grafting knives were able to try their hand at removing grape buds off of stored cuttings (including some skin!), making cuts onto green shoots and matching buds to those cuts, and wrapping. Many of the participants felt that they would use some of the information gathered at the workshop in their own vineyards and most walked away with some new knowledge (and a few fingers wrapped in bandages).

This workshop was a wonderful opportunity for all those involved, and I want to thank those that helped during the day!

Dr. Mercy Olmstead,
Extension Viticulturist

A CLIMATOLOGY REFRESHER FOR VINEYARD MANAGERS AND WINEMAKERS

DR. JULIE TARARA • USDA-ARS, PROSSER, WA

We all recognize the tremendous influence that climate exerts on vineyards so it is important for growers and winemakers to use a common set of terms and definitions to describe climate. Listed below are classical, or generally accepted scientific definitions, and useful operational interpretations for the grape & wine industry.

Meteorology vs. climatology, or weather vs. climate.

These terms differ on the basis of time. Meteorology addresses short-term variations in the four primary variables of the physical environment: temperature, humidity (includes precipitation), wind, and radiation (primarily solar radiation). Meteorology is concerned with the current weather from the order of a few seconds if you are studying wind gusts, to about 7 to 10 days if you are trying to pick the best window for the next cutting of alfalfa.

Climatology is concerned with the aggregate of weather conditions over a long period, typically 30 years or more. Temperature and precipitation are the most important elements of a climatic description. In the U.S. we are served by a fairly dense network of recording stations from which databases are built and used to describe climate. Agricultural weather station networks like WSU's PAWS (http://www.paws2.wsu.edu) and the new AgWeatherNet of the Center for Precision Agricultural Systems (coming soon!) provide records that are more useful to growers than are airport and other urban stations.

Meteorology gives you information for deciding on your spray interval for powdery mildew. Climatology gives you information for selecting a varietal mix or a vineyard site. The difference in time scales between meteorology and climatology does not cause too many people headaches.

Macro - climate vs. meso - climate vs. micro - climate.

These terms differ on the basis of spatial scale. There is some overlap between scales (see Figure 1) when we consider the classical definitions of these terms. Workable operational boundaries between micro- and meso-, and between meso- and macro- follow their classical definitions.

Macro-climate

Macro-climate is the general climate or average weather of a large area that can extend on the small end from a region (for example 'the upper Midwest' or 'the Inland Northwest' macro-climates) up to the globe on the large end, if you happen to be a global climate modeler. Region is a geographic, and not a political delineation in this discussion, so think less about state borders and more about natural boundaries. For practical purposes of vineyard management and wine marketing, region is the upper boundary of macro- climate and we need not consider larger scales like 'west of the Mississippi' or 'Europe'. The general term climate implies macro-climate unless otherwise specified.

Climates are classified into broad groups based principally on average monthly and annual values for temperature and for precipitation. Boundaries between climates have been drawn largely based on the natural geographic limits of certain plants. The climate classification system, like that of botanical classification, starts with broad descriptors (for example: tropical & rainy; dry; mild & humid; cold & snowy) and adds progressively narrower descriptors or limits based on the degree of temperature extremes or pattern of rainfall, to more accurately draw a useful climate map.

Example:

Dry climates are those in which annual precipitation (water in) is less than potential evaporation (water out) and can occur at any latitude. Within this category, climates vary by degree of humidity and are either arid (conventional deserts like the Gobi) or semi-arid (for example, the northern Plains in Colorado). In the mid-latitudes (away from the equator or either pole), semi-arid and arid climates exist primarily because of their interior position on a continent and isolation from large bodies of water (oceans and seas), or because of their location in the rain shadow of a mountain range (for example, east of the Cascades is a semi-arid climate).

Example:

Climates in the mid-latitudes with mild winters are defined by the average temperature of the coldest month of the year (not higher than 64°F and not lower than 27°F), but within this broad boundary, there is quite a bit of variation on the basis of annual rainfall distribution. A marine climate with cool summers extends in a narrow band along the West Coast from southern Alaska to northern Washington State. A dry-summer climate receives little to no precipitation during the summer, which may be hot in one category (for example, Central Coast, California) or warm in another category (for example, Willamette Valley).

"I heard that I can change my macro-climate by using irrigation… is that true?"

Anonymous Curious Student

Meso-climate

Meso-climate extends on the small end of the scale from an extensive vineyard area (a few vineyard blocks to a few square miles) up to the large end of the scale at a region. Yes, there is overlap between meso- and macro-. And yes, you will notice a bit of overlap between meso- and micro-. Some meteorology/climatology texts define meso-scale as ranging from about a mile to about 50 or 100 miles, so as to include the weather phenomena of tornadoes, thunderstorms, and valley winds. For our purposes in the grape & wine industry, meso-climate extends from an area of vineyard production (for example, Alder Ridge or Red Mountain meso-climates) up to areas that are smaller than our boundary for macro-climate (for example, the Puget Sound or the Umpqua Valley meso-climates). Compare meso-climates within a single macro-climate.

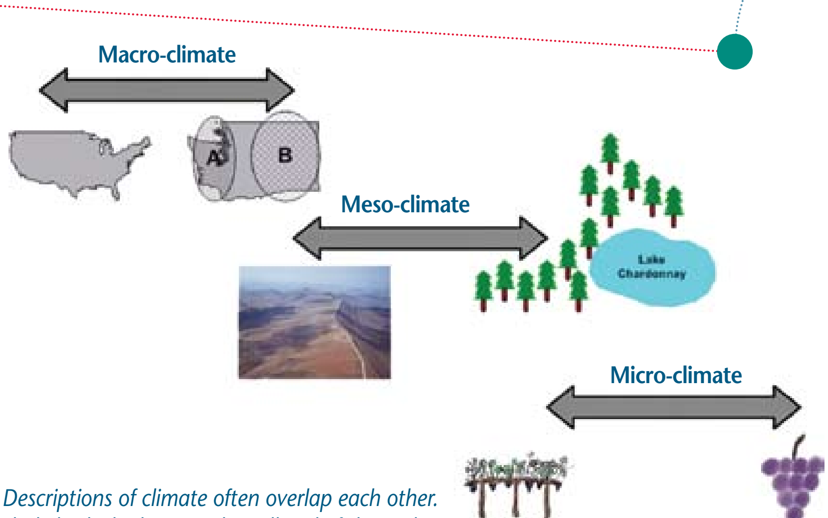


Figure1. Descriptions of climate often overlap each other. Definitions include both the large and small end of the scales.

A CLIMATOLOGY REFRESHER

Example:

The Walla Walla Valley and the Yakima Valley share the same semi-arid macro-climate, but differ in meso-climate. Typically, in winter, the Walla Walla Valley experiences larger temperature swings between day and night. Let's say that the average temperature on December 20 was 17 °F in Walla Walla and 10 °F in Prosser, implying higher risk of cold injury for sites around Prosser. However, Walla Walla had a high of 38 °F and a low of -4 °F that day, whereas Prosser had a high of only 24 °F and a low of -4 °F. More bud damage may have occurred among Walla Walla vineyards than Prosser vineyards because of the more extreme change from well above freezing during the day to below zero at night.

Example:

The Columbia River Gorge is home to the windsurfing capital of the world. Vineyards at the eastern end of the Gorge, say along the banks of the Columbia in the vicinity of Alderdale or Canoe Ridge or Paterson, share the same macro-climate as those that are say, in the foothills of the Rattlesnake mountains, but they differ in meso-climate related to persistent and high winds. Let's say that during spring and summer the average daytime wind speed across the south-facing slope of Canoe Ridge is 10 mph, with frequent gusts to 30 mph, whereas, at the base of the Rattlesnakes, also facing south, the average wind speed is 6 mph with many fewer gusts to 30 mph. Identically trained and managed vineyards in these two areas would display different canopy appearances by midseason (one might see somewhat shorter shoots at Canoe Ridge and a more windblown look). Even under similar annual rainfall and summer ET, vineyards in the two areas would have required different fine-tuning of irrigation because wind can cause the double wallop of stomatal closure and an added heat load to the vines from their dry surroundings (advection).

Micro-climate

Micro-climate extends from the scale of inches to the scale of a few hundred yards, or alternatively, from the scale of a leaf to the scale of a vineyard. Some overlap between meso- and micro- exists based on the size of the vineyard in question. To build an operational definition, micro-climate demands the most mental flexibility from us because vineyard management decisions involve a continuum of scales within this category. It is the smallest scale of interaction between plants & animals and their environment. Crop micro-climate can and has been manipulated by agricultural producers for millennia, even in the days before we knew enough to call it micro-climate. The scenarios below illustrate how your favorite scale within micro-climate will vary with perspective:

Example:

The temperature of the air in the loose bark on the south side of a vine trunk may be several degrees warmer than that at the thermometer mounted on a mast 6 feet above the ground, even though the mast is adjacent to that very vine. If you are a cutworm, the micro-climate of the trunk may be such that you decide to venture out to the cordon and slurp up a few juicy buds, unbeknownst to the pest scout whose temperature readings suggest that cutworms won't be frolicking on the spurs for a few more days. Obviously, the cutworm's preferred scale for micro-climate is that of a few inches, preferably the inches of loose bark and the inches of cordon and spurs.

Example:

On a similar scale to that favored by the juvenile delinquent the cutworm, if you're a powdery mildew spore, the humidity in the hundredth of an inch nearest the leaf surface is the scale of micro-climate that gets you excited about infecting Gary Grove's favorite Lemberger block. Of course, we all know that plant pathologists display a perverse sense of excitement upon seeing diseased plants, so Gary might be as thrilled as the powdery mildew spores.

Example:

On the other end of our micro-climate scale, let's say that an old circle vineyard is being managed with center-pivot irrigation and a cover crop. We'd expect this center-pivot block to have a slightly lower average air temperature and slightly higher average humidity than the clean-tilled, drip-irrigated block next door. In late August, there might be a three-degree difference in air temperature between blocks, particularly while the overhead irrigation is running, and this could be sufficient to promote slower acid metabolism in the ripening fruit. The two adjacent blocks share one meso-climate, but they have distinct micro-climates due to management practices.

Example:

Evaporative cooling is an excellent example of deliberate micro-climate modification. Small drops in air temperature inside the vine canopy can be measured following short bursts of water from overhead micro-sprinklers during hot afternoons. In an experiment in a commercial Riesling block, these small drops in temperature were enough to reduce the amount of sunscald on the berries, a boon to fruit & wine quality.

Example:

Following our wind & meso-climate example, we can conjure up a wind & micro-climate example. Say at one particularly windy site in the Columbia Basin, a 10-acre vineyard block is bordered on the upwind side by a windbreak of mature poplars. The vines on either edge of that block share one meso-climate, but differ in micro-climate with distance from the wind break. Closer to the windbreak the air is warmer. Closer to the windbreak

A CLIMATOLOGY REFRESHER

there might be less mechanical damage to the leaves, leading to varied capacity of the canopy for photosynthesis or different sunlight exposure on the fruit than in the rows farthest downwind. Rows that are too close to the windbreak may be shaded, a less-than-desirable micro-climate modification. There is no distinct border between "windbreak" and "non-windbreak" rows, only a continuum of micro-climate with distance from the trees.

Example:

Our frosty meso-climate example also has a micro-climate companion. Cold air is denser than warm air, so cold air drains downslope, settling at the base of a slope or in draws. A block at the base of a slope may suffer more spring frosts than an identical block planted at mid-slope simply because of cold air drainage. The two blocks share a meso-climate but differ in micro-climate. The few dozen or few hundred vines in a swale may suffer the same consequence, rendering shoot growth or fruit maturation uneven across a single block. Both scales comprise micro-climate.

Dr. Julie Tarara, USDA-ARS Research Horticulturist

Take home points:

Do describe an appellation in terms of meso-climate. Please do not describe this scale as micro-climate. **With reasonable effort, we can alter vineyard microclimates via farm and vineyard management practices.** The same cannot be said of meso-climate.

Do describe a vineyard block as having a different micro-climate from a nearby block because of local topography, in-block vine growth, vineyard floor cover, or other management practices.

Do describe your vines as having a certain canopy micro-climate, or the fruit clusters on the west side of the canopy as experiencing a different micro-climate from those on the east side of the canopy.

Do remember correct practical definitions for micro-, meso-, and macro-climate in the context of vineyards, and do enjoy yet another bottle of Washington wine tonight!

***Dr. Sara Spayd**, Extension Food Scientist*
Department of Food Science
and Human Nutrition
WSU Prosser IAREC

RESEARCHER SPOTLIGHT: DR. SARA SPAYD

This newsletter edition highlights ***Dr. Sara Spayd***, Extension Food Scientist with the Department of Food Science and Human Nutrition, located at WSU IAREC in Prosser.

Sara hails from a small town in North Carolina, about 15 miles NNE of Wilmington between Currie and Montague. As she describes it, "they were both merely wide spots in the road." Montague, as a town, collapsed in the late 1800's when the postmaster and the lady who ran the boarding house ran off with the mail. The other claim to fame of Montague is having the smallest national military park in the United States where the patriots defeated the Scottish loyalists, led by Flora McDonald. Sara's family owned a diversified farm, primarily planted to highbush blueberries in addition to peaches, strawberries, sweet potatoes, soybean, corn, muscadine grapes, and very briefly, hogs.

Sara completed her undergraduate degree in Horticulture at NC State University and received graduate degrees in Food Science at the University of Arkansas, Fayetteville. She became interested in grapes because her father met Dr. Justin Morris who encouraged her to apply for graduate school at the University of Arkansas. She applied at WSU and was offered the Prosser position about three weeks after defending her Ph.D. and has been at the IAREC since August 1, 1980. Sara was recently recognized for 25 years of service with WSU Extension.

Currently, Sara's research program has concentrated on viticultural impacts on wine quality. Her lab, headed by Barb Zimmerman and Maria Mireles, is working on a grape color and phenolic survey throughout the state. And, of course, writing up research from past years is a never-ending task. The initial run of the Enology Certificate Program has been a huge success, with 20 people graduating this year. In January 2006, it will be offered online, expanding opportunities for long distance education. Sara feels that both the research and extension aspects of her job are very important in order to help the Washington industry grow and improve.

Sara enjoys spending time with her two cats, Spooky and Wiley and cross-stitching… though not at the same time. One last note...Sara does enjoy her job. She loves red wine, white wine, and a tall glass of grape juice. Sometimes even with one cat in her arm.

Dr. Mercy Olmstead,
Extension Viticulturist

DROUGHT STILL A CONCERN?

Although many wine grape growers have kept a mindful eye on their irrigation practices this year, the drought will not affect the grape industry as severely as some tree fruit farmers.

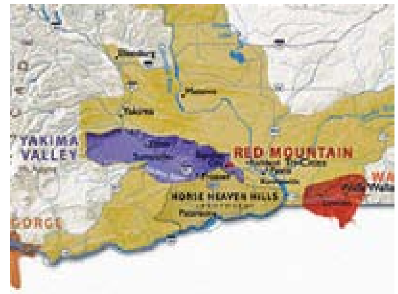
The drought of 2005 has not affected grape growers as much because of the outstanding research that has been previously conducted to more efficiently apply water for optimum grape quality.

The situation for junior water rights holders has improved somewhat, with growers on the Roza irrigation district receiving approximately 38% of their allotment. Those with senior water rights will receive 100% of their allotted water.

The drought is not only affecting agriculture, but cities as well. Some cities in the Pasco, Kennewick, Richland area are beginning rationing of water for landscape irrigation. Even cities on the west side of the state are dealing with the effects of drought with reduced municipal water supplies. With the multiple occurrences of drought, both in the past and predicted for the future, perhaps some homeowners are looking at xeriscaping (landscaping with drought tolerant plants).

Dr. Mercy Olmstead,
Extension Viticulturist

HORSE HEAVEN HILLS: THE NEWEST WASHINGTON AVA



On Monday Aug. 1, 2005, after the United States Tobacco Tax and Trade Bureau (TTB) gave the Horse Heaven Hills its official status as an American Viticultural Area (AVA), Ted Baseler read out the official proclamation from Governor Gregoire's office to a crowd of growers and winemakers at Columbia Crest Winery in Patterson. Robin Pollard the new executive director of the Washington Wine Commission was also in attendance for the official proclamation, as well as Valoria Loveland, the Director of the Washington State Department of Agriculture. Horse Heaven Hills is the newest AVA for Washington and is the first of several proposed AVAs to be approved. Other proposed AVAs that have not yet been approved are the Wahluke Slope, Rattlesnake Hills, and Columbia Gorge.

Horse Heaven Hills Facts

- Officially given status on Aug. 1, 2005 by TTB.
- Total acreage: 570,000 Acres.
- Acres planted: 6,040.
- Varieties planted: Cabernet Sauvignon, Merlot, Syrah, Chardonnay, Riesling, Semillon, and Sauvignon Blanc.
- 20 vineyards.
- Series of south facing slopes.
- Sandy, well drained soil.
- Very windy (up to 30% more wind than other regions).
- Average 2800 annual heat units per growing season.
- Rainfall is only nine inches per year, primarily during the winter months when the vines are dormant. Supplemental irrigation is necessary and allows viticulturists better control of vineyard water status.
- Named by cowboy James Kinney in 1857 after discovering his herd on a hillside eating the native grasses.
- Oldest vineyard planted by Don Mercer in 1972 at Phinny Hill.

Dr. Jim Harbertson, Extension Enologist

CLARIFICATION: FINING TO REDUCE ASTRINGENCY

What is fining? Why do we do it?

Fining is the addition of an adsorptive compound that is followed by settling or precipitation of partially soluble components from wine (Boulton 1996). Many things can be removed from wine, for example, sulfur compounds, proteins, and tannins. However, I will focus this discussion on the removal of tannin.

The phenolic class, known as tannin, primarily causes astringency. Fining to remove tannin from wine is generally done when a wine is too astringent. Protein fined wines are lower in tannin concentration than the untreated wines, suggesting that the reduction of astringency may be linked to the decrease of tannin concentration in fined wines (Maury et al. 2001).

Obviously, this really only applies to red wines since the amount of tannin in white wines is negligible. Determining whether a wine is too astringent is generally left to the winemaker's judgment. The winemaker's judgment can also be verified or tested with a sensory panel. It all really depends on if the winemaker, or the winery owner is happy with the judgment of an individual or a group of people. Chemically monitoring wine tannin can help to understand the changes in astringency.

The bottom line when considering fining is determining the astringency that consumers are willing to accept. Wine that is to be consumed immediately must have a low level of astringency to match the consumer's expectations. The astringency consumers expect varies by cultivar and wine type. Generally, wines that are meant to age can be fairly astringent at release, as they should become less astringent as they age. However, before this article gets too far, I will remind you of a few basics about astringency before we resume our discussion about fining.

Basics of astringency

A. Astringency has been described by the American Society for Testing Materials Committee E-18 '…the complex of sensations due to the shrinking, drawing, or puckering of the epithelium as a result of exposure to substances as alums or tannins' (ASTM 1989).

B. Astringency is not a flavor; it is a tactile sensation that arises from the reduction of the lubrication of the tissues in the mouth. The lowered coefficient of friction between the tissues in the mouth causes the firing of the mechano-receptors that are found in either the free or encapsulated nerve endings into the cutaneous structures of the oral cavity (Geldhard 1972).

C. Tannins are thought to cause the de-lubrication by binding and precipitating with salivary proteins (Gawel 1998 and Noble 1998).

Now that we understand the basic premise of astringency, it will be simpler to describe how fining for astringent compounds works.

Fining for astringency is similar to how the sensation is caused in your mouth

To reduce the astringency of a wine, you add protein. Just like the salivary protein in your mouth when you add the protein to your wine, the protein will coagulate with the tannin forming an insoluble complex. After time it will settle down to the bottom of your barrel or tank as a precipitant that you can rack away from. Fining with protein will only remove tannins and some polymeric pigments and not other phenolic classes (Sarni-Manchado et al. 1999, Harbertson et al. 2003).

Available proteins

Most of the available proteins are by-products from other food industries (see table 1). The proteins are generally cheap and usually are a mixture. Recently in the United States and Europe, concerns have been raised about the addition of animal proteins to wine due to the disease known as bovine spongiform encephalopathy (Mad Cow disease). It was demonstrated that the conditions used to denature the raw collagen during the manufacture of gelatin were incapable of denaturing the protein that causes bovine spongiform encephalopathy (Shreiber 1997). In 1997, the Food and Drug Administration recommended stricter guidelines to avoid contaminated gelatin (Shreiber 1997). This has led to research into the use of proteins derived from plant sources (Maury et

CLARIFICATION: FINING TO REDUCE ASTRINGENCY

Protein	Range of Application (mg/L)	MW (Daltons)	pI
Casein	60-240	20-30 KD	3.7-6.0
Gelatin	30-240	60 KD	4.8-4.85
Isinglass	30-240	Unknown	4.5, 4.8
Ovalbumin	30-240	46 KD	4.55, 4.9
Conalbumin	30-240	60 KD	6.8, 7.1

Table 1. Commercially available proteins and their chemical characteristics (Boulton et al. 1996).

"Chemically monitoring wine tannin can help to understand the changes in astringency."

J.F. Harbertson
Extension Enologist

al. 2003). The plant proteins that have been tested so far are derived from wheat and from white Lupin. Gluten, a wheat protein, has been demonstrated to be effective as a red and white wine fining and clarification agent (Maury et al. 2003, Marchal 2002). Although not widely commercially available, the plant derived fining agents may prove to be a valuable alternative.

Once added to the wine, the proteins coagulate with the large molecular weight tannins that are primarily responsible for astringency in red wine. The degree that the tannin will bind protein has to do with the tannin's size, subunit composition, and the protein's chemistry.

Larger tannins react better with protein than small tannins

Larger tannins will precipitate more readily with protein than smaller tannins. Grape seeds and skin have average polymer lengths of 10 and 32, respectively (Kennedy et al. 2000, Souquet et al. 1996). It has been demonstrated with salivary proteins that the average polymer length, of seed tannin precipitated was 5.8 subunits (Sarni-Manchado et al. 1999b). However, the size of tannin that each of the different enological proteins will precipitate has yet to be defined. The fact that most of the proteins are mixtures helps complicate efforts that target specific molecular weight classes of tannin. However, the overall effect of protein's ability to remove tannin is more than adequate.

Tannin sub-unit composition influences tannin-protein interactions. Tannins containing gallic acid esters have been suggested as interacting easier with protein (Sarni-Manchado et al. 1999a).

Not all proteins interact the same with tannin

As mentioned previously, a general characteristic of protein is that it will co-precipitate with tannin. However, not all proteins interact with tannin to the same degree. Proteins that are rich in the amino acid residue proline are some of the most effective at precipitating tannin (Oh et al. 1980, Hagerman and Butler 1981). Proteins that are rich in proline (PRP) are found in human saliva and the connective tissue of different mammals (Lu and Bennick 1998). The connective tissue in its denatured form can be purchased as gelatin and is one of the most common fining agents. It was first thought that larger proteins were better at precipitating tannin than smaller proteins. Some small proteins that are rich in proline will precipitate tannin as effectively as larger proteins. The proline residues place kinks in the backbone of the protein. The kinked backbone gives the protein a more string-like structure and exposed backbone. The exposed backbone of the protein allows easier access for tannin to bind.

The isoelectric point of the protein matters

The isoelectric point (pI) of the protein is the pH that the net charge of the protein is zero. Proteins have many amino acid residues that make up the protein structure. Each residue has its own charge status. The pH of the solution will generally control the charge status of the residues. Proteins are generally less soluble at their isoelectric point and have been demonstrated to co-precipitate tannin maximally at their isoelectric point. Of the proteins available for commercial scale fining, the milk protein casein has the closest isoelectric point (pI 3.7) to wine pH. Gelatin and albumin proteins are exceptionally soluble at their pI, whereas casein is not.

Which agents are best?

Most protein preparations for fining are mixtures, although you can purchase more pure fractions of proteins from commercial vendors. One of the most well known but least understood fining practices is the use of egg whites. Egg whites contain a mixture of polysaccharide and protein. They are chosen primarily because of availability and ease of use. However, it is often a difficult task to reproduce the same results due to egg volume and variations in consistency. Purified forms of egg white proteins can also be purchased (ovalbumin and conalbumin). Casein is probably the best protein available because its isoelectric point is close to wine pH and it does not leave a residue in the wine (Boulton et al. 1996). Gelatin is a good protein for fining because it is rich in proline and will react quite readily with tannin. The difficulty of gelatin is that it can take a long time to form insoluble complexes with tannin, and a protein residue is left. Gelatin will not react with many protein dyes, making it difficult to detect residual protein in your wine. It also tends to form a gel at lower temperatures and must be added to a wine within a specific temperature range (see manufacture details for exact temperature ranges). However, there are many gelatin preparations available. During the manufacture of gelatin, a combination of chemical processes will alter protein size and purity. The raw proteins undergo both enzymatic (protease) and chemical hydrolysis (boiling). The manufacturers claim that using proteins of different sizes allows the user to remove specific classes of tannin. Recently, a study was performed to test this theory. The researchers tested gelatins that underwent hydrolytic cleavage and confirmed that the proteins were of different molecular weight using gel electrophoresis. The different protein fractions showed small differences in their ability to precipitate tannin, except for the largest protein fraction that did not precipitate as much tannin (Maury et al., 2001). The researchers reasoned that the higher molecular weight proteins may have different structural conformations which lowered their ability to bind tannins.

How much should I add?

Table 1 provides information about the amounts of pure proteins that you can add to your wine. Sometimes when a natural product is being used rather than a commercial product, such as eggs, there are specific Federal guidelines for their addition. Federal guidelines state that you can prepare up to 2 lbs. (907.2 g) egg whites in one gallon of brine solution containing 1 oz. (28.35 grams) of KCl. The maximum dosage of the egg white brine solution is 1.5 gallons per 1000 gallons of wine, or three pounds of egg white per 1000 gallons. Products obtained from different manufacturers generally provide information about how much to add. However, it is advisable to perform trials with your fining agents before scaling up. Small-scale trials with a range of fining agents and different additions allow the winemaker more control and knowledge about how the fining agent(s) are altering the wine. The additions should be varied from low to high and a variety of fining agents should be tested to make an informed decision.

How much tannin can I actually remove?

The relationship between how much tannin is removed by a specific amount of protein is not known because of the factors that influence the tannin protein interaction. However, it is shown that gelatin fining can remove from 10 to 20 percent of tannin (Maury et al. 2001).

How long do I wait?

The reaction time for tannin and protein is quite fast and is completed in about fifteen minutes to an hour. However, the time for the particles, once precipitated, to settle is very slow and can take between two and three days to settle out. The duration of the settling period is dependent on the wine density, volume, temperature, and protein amount added (Boulton et al. 1996).

When do I fine?

It is preferable to fine early rather than later due to the risk of polymeric pigment loss. Polymeric pigment are formed during wine aging and are the source of coloration in aged wines. There is a class of polymeric pigments that will precipitate with protein that is preferentially formed over smaller non-protein precipitable polymeric pigments during wine aging (Harbertson et al. 2003, Adams et al. 2004).

How do I make my addition?

The addition needs to be distributed throughout the wine evenly. This can be achieved by pumping the wine over progressively while slowly adding the fining agent. A dosing valve can be placed between the pump and tank that will allow you to vary the amount of fining agent that is distributed into the wine. Wine is generally filtered after the wine is racked away from the solids. Filtration is done to ensure that there are no protein instability problems during wine aging. Protein concentration and heat stability can also be measured before and after fining to ensure that no later instability problems occur.

Can I monitor my fining trial?

Monitoring your fining trial is recommended, both with sensory and chemical techniques. Measuring tannin can be done directly, or a total phenolics analysis will also work, when under duress. It is better to run a phenolics panel that measures each of the classes so that you can assess the fining agent impact on the phenolic composition of your wine. It is simple to measure total phenolics, tannin, and polymeric pigments during the fining trial and before and after fining. There are many methodologies available for measuring phenolics in wine and several can be performed in a laboratory setting. A complete discussion, along with recommended methodologies, will be available in the proceedings of the 2005 American Society of Viticulture and Enology Phenolics Symposium. Until then, I recommend the use of an assay that combines protein precipitation and bisulfite bleaching to measure tannin and polymeric pigments simultaneously. The method can be accessed online (http://wineserver.ucdavis.edu/adams/tannin/index.htm). If your laboratory does not have the necessary equipment there are outside laboratories that can help. It is also a good idea to measure the heat stability of your wine after fining.

Conclusions:

Reducing the astringency of wine can be achieved by the enological practice known as fining. Fining to reduce astringency involves the use of protein fining agents. The ability of the fining agent to remove tannin is influenced by tannin concentration, size, structure and the protein fining agent's size, composition, and pI. There are many different protein fining agents available, and it is recommended to do small scale experiments to determine which fining agent is suitable for your situation. Monitoring your fining trial can be done by both sensory and chemical methods. Although fining is a useful technique to reduce astringency it is always preferable to reduce astringency by simply not extracting too much tannin during winemaking or blending with less astringent wines.

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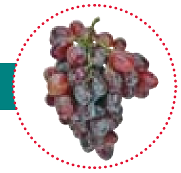

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