RED WINE PRODUCTION CONSIDERATIONS

Section 3.

Cap Management

Pomace contact influences color, body, flavor, astringency, and the evolution and life of the wine. A great deal of research has been directed to better understanding the effects of fermentation and cap temperatures, cap mixing, and maceration period.

Cap management systems include the following:

- pump over
- punch down by hand or mechanically
- sprinklers
- rototanks or other special tanks
- variation of submerged cap
- thermovinification
- gas (air or nitrogen) systems such as pulsed air

Management of phenols frequently involves attempts to extract maximum color, and processing methodologies consistent with the maintenance of that color. The perception of color depth is a signal of strength of character, and is therefore highly important to the consumer. Wines lacking deep, rich color are frequently presumed to lack other desirable attributes.

The ratio of solids to liquid is an important quality parameter. A high percentage of solid phase (as occurs with small berry varieties) increases the color and phenolic content of the resultant wine. Dejuicing approximately 10% of the juice from the fermentor, prior to fermentation, is an age-old method of increasing the overall character and quality of some red wines. This concept is worth considering in our region, particularly with young vines.

The rate of extraction of phenols is strongly influenced by such factors as fermentation temperature and fruit maturity. There is a linear increase in color extraction by increasing the temperature from 15°C to 33°C (Lee et al., 1977). Most West Coast producers of Cabernet Sauvignon ferment in the range of 28°C to 35°C. Such temperatures are considered necessary for obtaining a wine with sufficient tannins for aging.

Relatively low fermentation temperatures (20-25°C) are used to produce light, fruity wines, since such temperatures favor fermentation aroma. Perhaps a greater emphasis is now being placed on monitoring cap, as well as juice, temperature to assure sufficient extraction.

In the past, interventions during the cuvaison were generally limited to pumping over, for highly colored varieties. This was adequate to overcome the main flaw of pump-over, namely, uneven leaching of the skins. Traditional pumping over tended to cause juice to infiltrate through fissures in the cap, leaving much of the pomace untouched.

Therefore, many vintners now use sprinklers or splash plates, and an even greater number punch down and pump over, or simply punch down. Some winemakers follow “Bordeaux tradition” and simply pour a couple of buckets full of must over the top to moisten the surface of the cap.

Cap management techniques continue to receive a lot of attention. For many vintners, cap management from fermentor to press has evolved to using the gentlest methods possible. Harsh must treatment is believed to increase the solids level (and phenols), which can detrimentally affect wine quality.

Fire hose spraying has given rise to sprinkler and splash plates, with many producers not pumping over at all, but simply punching down. Many believe that gently punching the cap twice daily achieves a complete extraction of flavors without picking up unpleasant, bitter phenols. Mechanical cap punches are not uncommon. Pumping over is frequently done once or twice at the start of fermentation to aerate the must.

However, too much pumping over can be detrimental, due to problems caused by excessive extraction. As such, many use gentle to very-gentle methods of cap mixing, after about mid-way through the fermentation.

Specialty tanks, such as Rototanks, were popular on the West Coast years ago. These can provide more character, flavor, and 20-30% greater phenolic extraction, due to a thinner cap. Wines produced from these systems, however, frequently have rather short lives because of shortened cuvaison, resulting from the vintner's need to increase output through such expensive systems.

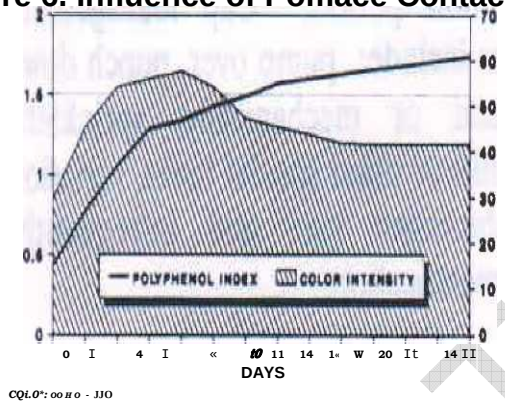
Maceration Period

Another important factor influencing color and style is the length of the cuvaison. Maximum color extraction is reached about half-way through the fermentation (Berg and Akiyoshi, 1956). Anthocyanins are rather easily extracted, while other phenols, such as tannins, are extracted more slowly (see Figure 6). This is a principal reason why dejuicing prior to dryness, particularly with mature fruit,

produces wines with good initial color, little astringency, low total phenols, and which are generally floral, light in body, complexity and depth.

Fruitiness is generally inversely proportional to the phenol level. Some producers dejuice before or at dryness, deliberately avoiding extended maceration, because it reduces the “fruit” character they wish to showcase.

Figure 6. Influence of Pomace Contact Time on Color and Phenols



Extended cuvaison affects the evolution of tannins, and creates more body, complexity, depth of character, and enhanced color stability. In contrast to anthocyanins, tannin phenols are extracted throughout the skin contact period. This extraction has a significant effect on astringency, color and, particularly, color stability. Tannins derived from extended skin contact appear to stabilize anthocyanins by combining to form larger polymeric complexes with pigments. This pigment-tannin complex formation is important for color stabilization and mouthfeel (see module on Redox Potential and Reductive Strength).

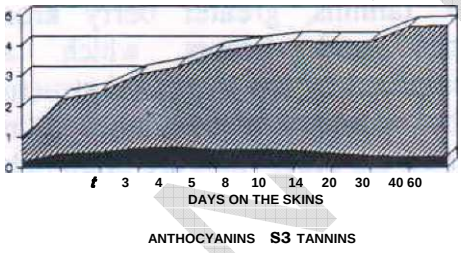
The binding of pigments with tannins to form stable color complexes involves both oxidative and non-oxidative mechanisms. It is believed that acetaldehyde produced by coupled oxidation of ethanol forms the bridge between tannins and

pigments. Sulfur dioxide can inhibit or slow the formation of tannin-pigment complexes by binding free acetaldehyde.

Extended cuvaison seems to create more-complex wines as a result of phenolic condensation and polymerization reactions (Sterns 1987). As maceration time increases, so does the extraction and polymerization of phenols to form higher molecular weight tannins.

This is reflected in the sensory analysis of the wine, e.g., less, yet stable color, less bitterness, and more tannins, yet “soft” tannins (see Figure 7). The increased phenols extracted, and the polymerization of those phenols, allows extended maceration to produce wines which are “round” and “firm” in the palate, often with considerable aging potential.

Figure 7. Effect of Skin Contact Time on Cabernet Sauvignon Phenols



Cellarmasters in Bordeaux sometimes continue pump-overs after the end of the alcoholic fermentation, but more often they button up the tank and wait for the cap to “fall” into the wine. This post-fermentation pomace contact is a time-honored tradition in Bordeaux, and is frequently used in the US. For “Grand Vin,” the average total skin contact lasts from 20 to 25 days. In the US, wines are often pressed ten or fifteen days post-fermentation. This is frequently done by filling the tank completely full, or by CO_2-gassing the headspace of a partially-full tank.

The length of maceration is determined by a host of factors, including fruit maturity (perceived presence of “ripe” tannins), age of the vine, source of fruit and history of wines produced from those grapes, stylistic goals and, of course, taste. A key concept is suppleness.

Unripe fruit with “immature” tannins will likely not benefit from extended skin contact. Generally, wines produced from young vines (less than 10 years old) do not appear to benefit from extended maceration in the same way as do older vines. Tannins from immature vines are believed to be “immature” and aggressive.

Young vines produce a higher intensity of vegetative aromas and flavors (particularly if the fruit is shaded) that may be muted by limiting the cuvaison. Older vines, on the other hand, produce fruit with more “mature” tannins, and greater berry aroma intensities and flavors which are complemented by the increased structure given by extended maceration.

Wines produced from older vines are often richer in extract, give more consistent maturity, and produce fruit with more mature tannins, greater aroma intensities and flavors, which are complemented by the increased structure given by extended maceration. This is principally the result of increased reserves in older vines. The wood (roots, trunk, and shoots) contains sugars and starches, many of which are translocated to the ripening fruit.

There is an increasing awareness that some vineyards benefit from extended maceration, but not others. This likely represents qualitative and quantitative differences in grape phenols.

Maceration does not have a predetermined length, but is generally determined by tasting a sample of the young wine from the racking and at the bottom valve. Most reds are dejuiced when the tannins start to soften, and are said to be “well

behaved," better structured, less "green," and less "raw." Maceration affects the evolution of tannins and, for some Cabernet Sauvignons, it can last for 6 weeks.

Controlled Aeration

In addition to management of phenols in the fermentor, winemakers look at controlled aeration of reds as a production tool to help evolve and soften tannins, help lightly-structured wines by providing body, and aid in flavor development.

Controlled aeration is thought to increase the rate of reaction of coloring matter with tannins, resulting in condensation and polymerization, allowing wines to mature as quickly as possible in the barrel. It is now believed that maximum color and color stability can be enhanced through such controlled oxidation. Judgments are based on style, phenolic content, and pH, with air exposure accomplished by controlled aeration during tank racking, barrel to barrel, and/or aging of barrels bung up, and naturally via microoxygenation.

Sulfur dioxide concentrations are usually low until after the malolactic fermentation is complete. Too much sulfur dioxide is believed to slow or inhibit the formation of anthocyanin-tannin complexes by binding with acetaldehydes. Free sulfur dioxide levels are generally kept below 20 mg/L to help facilitate this development. Perhaps what is new is the use of controlled aeration, even on delicate wines, to provide "flesh" and color. Aeration is generally not practiced with Pinot noir or other wines which have a low phenolic concentration.

Many red wine producers are attempting to let the vineyard express itself in the wine. As such, there is perhaps more manipulation occurring in the vineyard than at the winery. There is intense interest in examining quantitative, and particularly qualitative, differences in grape phenols occurring as a result of vineyard and winery management practices.

Red Wine Production Considerations for Virginia

Prior to the harvest, each of the following factors which influence wine structure/texture should be reviewed. The question is “How is each of these influencing your red wine structure/texture, aroma, flavor and overall quality?

- spray residues presence, HACCP certification from grower
- solar exposure of the fruit, degree of leaf shading
- fruit maturity, including tannin maturity
- uniformity of fruit maturity
- berry size
- fruit rot incidence and type of rot
- degree of crushing/destemming, whole cluster pressing
- pre-destemming fruit sorting
- destemming, degree of berry breakage, and non-soluble solids content of juice
- post-destemming fruit sorting
- sulfur dioxide addition, pre- and post-fermentation
- cold soak, time, temperature
- chaptalization and the Brix-to-alcohol conversion rate
- acid addition, pH adjustment
- tannin addition
- barrel/wood fermentation
- yeast assimilable nitrogen (YAN) and micronutrient addition
- enzyme addition
- yeast(s), cultured vs. indigenous
- cultured yeast attributes
- co-inoculation with MLF
- fermentation rate

- fermentation temperature, cap and liquid
- cap management
- bleeding, when, what percentage
- size and shape of fermentor
- pre- and post-fermentation aeration (microoxygenation)
- délestage or rack and return
- alcohol at dejuicing
- extended skin-contact, maceration
- free run and press fractions, segregation of press fractions
- post-fermentation lees storage, primary vs. secondary
- oxidative vs. reductive storage

Study Questions

1. Outline the advantages and disadvantages of open vs. closed tanks.

2. What factors determine the extent of post-fermentation maceration?

3. Why would the height-to-diameter ratio of a tank impact phenol extraction?

4. What is the difference between controlled aeration and microoxygenation?

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