Monitoring for Profit

By Mike Miller

Monitoring is something we are all used to in our daily lives. We get periodic medical checkups to catch problems when they are little and correctable. We get periodic dental checkups to make sure small cavities don't develop into major ones. We go over our children's report cards to make sure they are making satisfactory progress and, if not, work with their teachers to bring them up to standard. Monitoring the winemaking process is similarly a way of avoiding surprises and taking corrective action when problems are small and fixable. Some might ask, though, if the trouble of monitoring is worth the effort. To answer this question, let's look at a cost analysis prepared a few years ago on a wine that was caught unnecessarily in a stuck fermentation.[2] In this analysis, Chardonnay grapes were purchased at $1,500/ton. They yielded 4,000 gallons, a modest size fermentation lot with an investment cost of about $50,000. This wine had a potential return, at $120/case wholesale, of $181,000; however, because of the stuck fermentation and the resultant off-specification wine produced, the actual yield for the wine on the bulk market was $15/gallon, or $51,000. ***The loss of potential earnings was $130,000 for this one lot alone***, a loss that could likely have been avoided with some pre-fermentation testing or some monitoring during the fermentation process. The testing cost would have been under $100.

Not all fermentation lots are as large, but the risks of an unfavorable outcome are the same. To reliably manage the winemaking process in order to prevent surprises and make adjustments as needed to produce desired wines, both commercial and home winemakers should employ a basic monitoring scheme. An example of the types of problems that can occur in winemaking was given in a recent article by wine judges evaluating wines made by home winemakers.[7] The problems were listed as either flaws – a defect that is a minor departure from an acceptable norm and one that causes the wine to be atypical and less than normally enjoyable – or a fault - a character experienced as a major departure from an acceptable norm and one that spoils the wine and causes it to be significantly atypical, usually unpleasant, and often undrinkable. These defects were also categorized as to whether they were caused by poor winemaking practices or not.

Name of Problem	Flaw	Fault	Caused by faulty Winemaking
Presence of Reduced Sulfur Compounds (e.g., H2S)	20%	80%	20%
Presence of Acetaldehyde	5%	95%	100%
MLF in Bottled Wine	40%	60%	80%
Yeast Fermentation in Bottled Wine	50%	50%	100%
Presence of Ethyl Acetate	5%	95%	10%
Inadequate Settling of White Juice	80%	20%	100%
Presence of Tyrene (T.C.A.= corkiness)	20%	80%	0
Presence of 2,3 ethoxy, 3,4 hexadiene (geranium)	5%	95%	90%
Candida-Acetaldehyde	0	100%	100%
Presence of Volatile Acidity – acetic acid	80%	20%	80%
Presence of Volatile Acidity – ethyl acetate	5%	95%	80%
Presence of Diacetyl	90%	10%	50%
Brettanomyces Contamination	80%	20%	0
Additive Overuse (SO2, Sorbate, etc)	90%	10%	100%

Clearly, making wine without knowing the status of the winemaking process can result in production of an unpleasant or undrinkable concoction. We can greatly avoid this undesired outcome by following a plan of **monitoring.**

Harvest Monitoring -- Monitoring in winemaking begins in the vineyard. Starting about 6 weeks after veraison, grape sugars should begin to be checked weekly. When the sugar levels (as °Brix) reach 18, monitoring should be expanded to include pH, titratable acidity, and color/tannins, and the frequency of testing should be increased. As grapes reach physiological maturity, sugars continue to rise, pH starts to rise and can reach levels above the preferred pH 3.4 for white wines and pH 3.6 for red wines, and acidity drops as malic acid metabolism/respiration increases. (In grapes approaching an overripe stage, sugars and acids can both increase as a result of grape dehydration.) Color/tannins continue to rise as well, but harvest decisions regarding this parameter are typically made based on prior history as opposed to achievement of a fixed value. Note that there has been a lot of discussion in the past couple of years about increasing hang time, i.e., delaying a decision to pick, in order to maximize flavor components, and making this flavor decision based on the taste of the grapes. This is an unproven and possibly flawed approach to harvest timing. This process was described recently by the noted viticulture expert Dr. Richard Smart:[1] "Winemakers go into the vineyards and they chew on some grapes, and they look at the seeds and the stems, and they mumble a few things, and then proclaim the harvest date. And curiously, that date is always in the future, never in the past. I never heard a winemaker taste the grapes and say, 'Darn, we got here too late.'"

Wine Monitoring -- Monitoring in the winery begins with the receipt of grapes, and continues until bottling. Individual monitoring schemes can be developed according to each winemaker's needs and preferences. One sample of a monitoring plan is given below. Some of the key processes in winemaking and the risks associated with those processes are:

- Upon receipt and crushing, measurement of total fermentable sugars will provide an estimate of final alcohol level. Measurement of acidity and adjustment if needed will ensure best extraction of flavors. Measurement and adjustment of pH will ensure best conditions for management of primary fermentation. Measurement of free SO2 levels, if SO2 is added, will indicate if adequate amounts are present to control unwanted lactic acid bacteria. Measurement and addition of yeast assimilable nitrogen will reduce the risk of stuck fermentation while minimizing the likelihood of ethyl carbamate formation.
- During primary fermentation, monitoring of fermentable sugars, pH, acidity, and temperature on a daily basis will confirm adequate fermentation progress, highlight a situation where a fermentation is running too fast, and flag the onset of a sticking fermentation. (A stuck fermentation can result in the production of undesirable hydrogen sulfide, or leave a wine with exceeding high amounts of unfermented sugar.) Also, sugar measurement will determine the proper time for inoculation with malolactic cultures, if desired, or for addition of controlling levels of sulfite. Acid measurement will indicate the need for any adjustments needed for proper wine balance.[5]
- If malolactic fermentation is desired, measuring L-lactic acid levels will confirm the onset of malolactic fermentation, while monitoring the reduction of malic acid levels will confirm the progress of this fermentation. Also, measurement of malic acid levels at the end of malolactic fermentation will indicate the proper time for addition of controlling levels of sulfite so that the wine in not left unnecessarily under protected.
- During storage and racking, measurements of pH, titratable acidity, volatile acidity, and free SO2 will confirm the wine in behaving in a desired and conventional fashion, or highlight the onset of an undesired bacterial contamination. Remember that when volatile acidity is noticeable by taste or smell, the wine will not even be salvageable as bulk wine in the example given above. Without expensive reverse osmosis reprocessing, it will not have any salvage value. Remember also that Free SO2 is not only eliminated over time by oxidation, but that 40 to 90 % of added SO2 can become bound to other wine components and rendered inactive. This is why wine should be monitored every three weeks during aging.[5]

Remember, the key to making the wine you want the way you want is "to monitor how each production activity affects wine palatability and to make adjustments accordingly."[6]

References:

1. D. Berger, ""Water into Wine: the smoking gun," *Wines & Vines.* 86 (3): 52 – 56 **2005.**
2. C. E. Butzke, "A New Idea for Detecting and Preventing Stuck Fermentations," *American Vineyard*, Dec. **1996.**

3. C. S. Ough, V. L. Singleton, “Wine Quality Prediction for Juice Brix/Acid Ratio,” *Am. J. Enol. Vitic.,* 19: 129 – 138 **1968.**
4. C. S. Du Plessis, P. C. Van Rooyen, “Grape Maturity and Wine Quality,” *S. Afr. J. Enol. Vitic.,* 3 (2): 41 – 45 **1982.**
5. P. Iland, A. Ewart, J. Sitters, A. Markides, N. Bruer, “Techniques for Chemical Analysis and Quality Monitoring During Winemaking,” Patrick Iland Wine Promotions, Campbelltown, SA, Australia, **2000.**
6. B. Zoeklein, “Wine Quality Control,” *Vintner’s Corner,*12 (3): 1-2 **1997.**
7. G. Gibson, M. Farkas, “Flaws and Faults in Wine,” *The Grapevine*, The British Columbia Amateur Winemakers Association.

Wine Monitoring Record

Harvest Monitoring: _______________ grapes, _________year

Date	°Brix	pH	Titratable Acidity	Balance	Color/Tannins	Seed Color

Brix method: e.g., refractometer____
pH method: e.g., ACCUVIN Quick Test pH____________________________________
Titratable Acidity method: e.g., ACCUVIN Quick Test TA________________________
Balance = Brix / Titratable Acidity (in g/100 mL)[3, 4]
Color/Tannins method: ____

Wine Process Monitoring, ________________ grapes, started _________, 20_______

initial volume______________

Date	°Brix	pH	Specific gravity	Titratable Acidity	Nitrogen	Color/Tannins	Free SO2

Additives:___________tartaric acid; _______________ yeast nutrient;

Soak Period, if used_________ hours; _____________ temperature

Primary fermentation: start date: ___________, yeast: ____________________

Date	°Brix	pH	Specific gravity	Titratable Acidity	Nitrogen	Temp.

Post fermentation adjustments: sulfite: __________________, tartaric acid: ______________

Secondary fermentation: start date: ________; inoculum: ______________________

Date	L-Lactic acid	Malic Acid
		x
		x
	x	
	x	
	x	

Additions/Adjustments: sulfite: __________________, other: ___________________

Racking/Aging: start date: __________

Date	Fining additive	Racking yes/no	pH	Specific gravity	Titratable Acidity	Free SO2	Volatile Acidity

Bottling

Date	pH	Specific gravity	Titratable Acidity	Free SO2	Volatile Acidity	Alcohol

Comments

Brix method: e.g., refractometer____
pH method: e.g., ACCUVIN Quick Test pH_______________________________________
Titratable Acidity method: e.g., ACCUVIN Quick Test TA__________________________
Nitrogen method: ____
Color/Tannins method: ____
Free SO2 method: e.g., ACCUVIN Quick Test Free SO2___________________________
Residual Sugar method: e.g., ACCUVIN Quick Test RS___________________________
L-Lactic Acid method: e.g., ACCUVIN Quick Test L-Lactic Acid___________________
Malic Acid method: e.g., ACCUVIN Quick Test Malic Acid_________________________
Volatile Acidity method: ____