2012 PQA Meeting: Part 1 Wine Aroma and Sensory by Alain Razungles

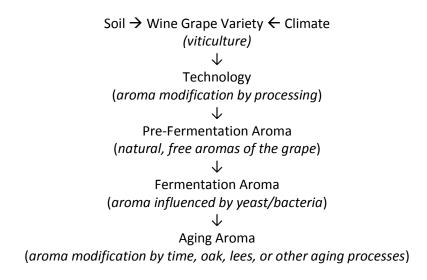
This is part one of a two-part series. Part one will focus on specific points and studies that Alain discussed during his visit to the eastern U.S. Part two will emphasize practical applications of those points and how to utilize the information from Alain's talk in a vineyard or winery.

Summary of Wine Aroma Compounds and Descriptors

Wine aroma is a term used to describe what we smell through our nasal passageway in the nose. Wine flavor, in comparison, is made up of those aromas that are sensed through the nasal passageway in the mouth (retronasal sensation). Wine aroma and flavor can come from four different parts of the winemaking process:

- 1) The variety (grapes)
- 2) The fermentation (yeast/bacterial conversion of aroma compounds)
- 3) The aging process
- 4) Wine defects

Each stage in the winemaking process can alter the wine's aroma. A single decision (i.e. whole cluster pressing vs. crushing/destemming followed by pressing) has the potential to change the aroma composition, as well as the wine's chemistry. This point is emphasized in the following flow chart:



To date, there are approximately 850 aroma compounds identified in wine. Some of these compounds are present in all wines, but at varying concentrations. These are classified as "non-specific aromas." However, other compounds are classified as "specific aromas" because they contribute to the varietal aroma/flavor of that variety and/or are specifically found in only that variety. An example of this includes certain methoxypryazines (bell pepper aroma) found regularly in Cabernet Sauvignon, Cabernet Franc, and Sauvignon Blanc or methyl anthranilate (grape aroma) found in Concord.

If this is not confusing enough, aroma compounds can work synergistically, creating a third and unique aroma all together. This synergism causes great confusion in wine aroma analysis, interpretation, and communication, and is illustrated below:

Prune/Jam Aroma (from fruit ripeness) + Woody Aroma (from oak) =

3rd Unique Aroma Sensation Not Like its Individual Parts

The aroma compounds make up a very small percent of the wine: less than one percent. However, it is the aroma of the wine that determines the wine's quality, and can hence be argued to be one of the most important parts of the wine.

In addition to the free-volatile aromas that humans or animals can actively smell, a non-aromatic class of compounds exists that can affect wine aroma as time progresses. These non-aromatic compounds are often generically referred to as "precursors:" they have no aroma, but when chemically changed, give rise to free-aroma compounds that people can smell. These precursors are available in the grapes and are extracted during harvest and throughout fermentation. Some are converted during fermentation, which gives rise to new aromas that were not associated with the grapes.



Alain Teach Aroma Class Designations

The Muscat Variety and its Aroma

There are about 41 varieties of Muscat in the world (Versini et al. 1993). Its aroma consists primarily of three monoterpenes (a class of aroma compounds) in varying concentrations: linalool, geraniol, and nerol. Total concentration of these compounds in Muscat varieties usually exists around 1000 - 1400 ppb. Above this concentration, the aroma can be uncharacteristic of Muscat varieties and/or considered flawed.

Several viticultural treatments were found to reduce Muscat [wine] aroma including the presence of *Botrytis* at harvest or shading of the berries during the growing season. These viticultural practices, however, did not show changes in aroma precursor concentrations.

Monoterpenes are prevalent in young, aromatic wines. After about 5 years, the terpenes found in young Muscat wines are oxidized and a reduction in their concentration is noticed. However, after 10 to 15 years, the same Muscat wine will begin to exhibit unique citrus characters that were not originally associated with the wine in its younger years. These aromas are developed through the long-term aging of the Muscat wine and the chemical transformation of the original terpene compounds. Here, one can see that aroma compounds are not stable and can give rise to new compounds over time.

Carotenoids as Prescurors

Although several different types of precursors exist in grapes and wine, Alain focused most of his initial research on carotenoids. He explained that when he started his research program, there were not many useful or efficient ways to analyze free aroma compounds. Today, instruments like gas chromatography, offer researchers more ways to efficiently and precisely analyzing aroma compounds.

Carotenoids are those compounds that we often associate with things like carrots (what causes the orange color), autumn leaves (the compounds that alter leaf color from green to vibrant shades of yellow or orange) or hot peppers. Grapes are not overly carotenoid-rich in comparison to many other fruits and vegetables (e.g. carrots, tomatoes). However, their carotenoid content appears to influence the aroma concentration of mature wines by acting as precursors to aroma compounds associated with aged wines. In the vineyard, carotenoid synthesis was found to be enhanced in berries with more sun exposure.

Dimethyl Sulfide (DMS)

Alain was one of the first researchers to explain the fickle nature of dimethyl sulfide (DMS). DMS is one of many sulfur compounds commonly associated with "reduced" aromas/flavors. However, at certain concentrations, DMS can enhance the fruity aromas of certain red wines.

In a study comparing Syrah and Grenache, two Rhone varieties, it was found that both varieties contain varying concentrations of DMS as part of their varietal character. About 60 - 70% of the aroma composition of Syrah and Grenache is made up of two other aroma families: norisoprenoids and monoterpenes. What makes these two varieties smell different is the concentration and content of aroma compounds within those two groups.

In an accelerated aging study, Alain's team evaluated the aroma descriptors of several aroma compounds in Syrah and Grenache. This experiment was designed to mimic the role of long-term aging in the two varieties, and evaluate how the aroma composition changed. Alain's research team isolated 46 common descriptors between Grenache and Syrah, and 23 odors that were distinct between the two varieties after the aging process was complete. They found that as the wines aged, two very different

aroma profiles emerged from the once similar aroma profiles between the "young" Syrah and Grenache. Through some analytical evaluation, Syrah appeared to develop its aged aroma through the degradation of glycosidic precursors (aroma precursor compounds that exist with a sugar attachment) while this did not seem to be the case for Grenache. This could help explain the distinction of the two varieties as they age.

Both varieties have also been found to contain concentrations of DMS, although Syrah tends to have greater DMS concentrations compared to Grenache. This could indicate that DMS is specific to the Syrah varietal character. In a sensory experiment, three wine samples of Syrah were spiked with three different concentrations of DMS: 15 μ g/L, 100 μ g/L, and 200 μ g/L respectively. These samples were then evaluated in their aroma description by a sensory panel. In the "first sniff" of each sample, the two higher DMS-spiked samples (100 μ g/L and 200 μ g/L) smelled more of "truffle," "olive," and "undergrowth" compared to the 15 μ g/L DMS concentration sample. However, with some swirling of the glass and a "second sniff," the two higher DMS-spiked samples had significantly higher perceptions of "raspberry" and red fruit aromas. This experiment helped show the fruit enhancing nature of DMS, as well as its ability to rapidly change aroma perception with the ingress of oxygen. [Note: there was a later discussion regarding the possibility that under more reductive conditions, such as in the bottle, DMS can re-stabilize and smell "reductive" or earthy again.]



Alain Razungles, Professor d'Œnologie

Conclusions

These small excerpts were taken from Alain's talk discussing results from his research that focused on aromas in wines. Many of these studies that he talked about can be found in the scientific literature, and are more complete and in depth. [For copies of those publications, please contact Denise at dxg241@psu.edu.] However, the takeaway message from his talks was this: wine aroma can be manipulated at any stage in processing. Compounds like DMS, which has traditionally been classified as

a wine defect, can also affect the wine's aroma on a positive level. Muscats are one class of terpene-rich varieties, but many other varieties (e.g. Riesling, Gewürztraminer, Traminette) can benefit from research associated with terpene degradation and stabilization.

Additionally, there are many precursor compounds in wine that may not be noticeable by smell initially, but over time, may evolve into complex aromas as the wine ages. Concentration and utilization of precursors is being studied today, and was a focus of Bruce Zoecklein's research program (http://www.vtwines.info/).

Please stay tuned for Part 2 of this discussion, which will focus on how to apply some of these points to the vineyard and winemaking processes.

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