

# How do flavor and quality of a wine relate?

Leslie Norris<sup>1</sup> and Terry Lee<sup>2</sup>

<sup>1</sup> FlavorSense, 139 Nantucket Cove, San Rafael, California 94901, USA; <sup>2</sup>E. & J. Gallo Winery, PO Box 1130, Modesto, California 95353, USA

## Synopsis

If the premise is accepted that we can make any wine that we wish, then the question becomes how do we define/determine the wine styles that are created? This talk will focus on a technique for defining wine styles at various price points, and will illustrate how such a technique can impact wine sales. Furthermore, we will show that current wine measurements are unable to distinguish between successful and unsuccessful wines in the marketplace. Further research is required chemically to predict success in the marketplace.

Gehen wir davon aus, dass jeder Wein, den wir machen wollen, auch gemacht werden kann, so stellt sich die Frage, wie wir die Weinstile definieren/bestimmen, die kreiert werden. Dieser Vortrag befasst sich in erster Linie mit Methoden zur Definition von Weinstilen an verschiedenen Preispunkten und führt Beispiele an, wie sich solche Methoden auf den Verkauf auswirken können. Darüber hinaus zeigen wir auf, dass derzeitige Weinmesswerte und Erkenntnisse über Weingeschmack nicht ausreichen, um zwischen erfolgreichen und nicht so erfolgreichen Weinen am Markt differenzieren zu können. Es werden Anregungen gegeben, wie Weinstile und Weinchemie in Zusammenhang gebracht werden können

## Introduction

The title of this session, Winemaking in the 21<sup>st</sup> Century, is fairly innocuous; we have safely migrated into the 21<sup>st</sup> century and many of us are still making wine, and I would claim that the wines we are making and delivering to the consumer today are consistently better than at any time in the history of wine. The original narrative that was attached to the title of the session was, however, not so innocuous. It was suggested that *Now that the role of bacteria is well understood and fermentation is subject to control, are there any limits to the scope of the winemaker? Can we make any wine we wish?* This narrative is bound to stir up discussion between those who think that wine should make itself with little intervention from man and those who believe that the modern consumer is benefiting from the melding of science and ancient art.

We have chosen to discuss this challenge of *Can we make any wine we wish?* by presenting:

- an overview of what we know about the chemistry of wine flavor, and
- some thoughts on defining wine 'quality' by means of targeted consumer and chemical analyses.

Flavor is the summation of sensory attributes formed by complex interactions of the volatile and non-volatile compounds created as a result of the ripening of the grape and of the winemaking process. Complex interactions can result in the formation of simple attributes. For example, ethyl butyrate (from the grape) with diacetyl (malolactic fermentation) yields a butterscotch attribute in a wine. Chemicals may be synergistic, for

example, a small amount of  $\beta$ -damascenone (apple, fruity) will lift other fruity notes (such as  $\alpha$ -ionone) in a wine. Conversely, a high concentration of methionol will decrease fruity perception resulting in antagonistic interactions. Although we can chemically measure odor active chemicals in wines, it is difficult to create a model that will predict the interactions of the chemicals that lead to flavor perception. This is especially true for wine given the large number of volatile and non-volatile compounds that exist in wine.

Wine quality has traditionally been defined by the perception of flavor by experts or by simple analytical measurements, such as volatile acidity and alcohol. Since it is unlikely that everyone will have the same wine preferences, it becomes advantageous to define quality as the flavor perceived by the targeted consumer population. Thus quality is based on 'fit for purpose', i.e. the development of wine styles for a targeted population.

Preference Mapping is a technique that allows a mapping of wines in a chosen category, with the determination of the sensory profile that is optimal for each consumer. By using statistical analysis, consumers having similar preferences may be grouped, yielding preferred wine styles for given consumer groups within a targeted population. An example of preference mapping follows.

#### **A case study — defining and targeting US consumer preferences for chardonnay wines**

Chardonnay is the leading varietal in the white wine category sold in the USA. Many styles of chardonnay are available on the market, ranging from a simple, slightly sweet, lightly fruity style to a more complex style based on winemaking techniques, such as barrel fermentation, lees contact, malolactic fermentation and further oak contact.

To explore the sensory attributes of chardonnay wines that drive consumer preference we chose an external preference mapping technique [similar to the one described by Kälviäinen et al. (2000)]. More complete details of this study and similar studies are provided in Lesschaeve (2001) and Lesschaeve *et al.* (2002) and further information on preference mapping may be found in Greenhof and MacFie (1994).

The steps required for the creation of a PrefMap are:

- the establishment of a cross-functional team, in this case representing Winemaking, Marketing, and Research and Technical Services,
- the selection of the wines to go into the study,
- the conduct of consumer like/dislike testing,
- the conduct of descriptive analysis of the wines, and
- data analysis.

The team selected 23 wines from around the world as the best representatives of the following chardonnay style categories as defined by the Winemaking Department:

- neutral with natural flavors
- neutral, easy to drink, unoaked
- neutral, easy-to-drink, with some oak
- not fruity, some oxidation, ‘European style’
- extra fruity
- simple fruit with spicy oak
- oak dominated
- integrated fruit and oak, slightly sweet
- barrel fermented, Burgundian style
- oaky, buttery, ‘full blown’
- elegant, cold climate fruit, subdued fruit
- fruit driven
- Burgundian with balanced fruit and oak
- Burgundian with nutty-toasty, sulfide derived complexity

The selection of the wines for the study is a critical step in the process, as essentially the wines chosen define the sensory space to be tested.

An external preference mapping technique [similar to the one described by Kälviäinen et al. (2000)] was applied to correlate consumer preference with the sensory attributes of each wine. The analysis enables the determination of the sensory profile of a chardonnay wine that is optimal for each consumer, i.e. that he/she would like the best). Results of the analysis are displayed on a map (preference map).

The position of the ideal wine of each consumer is displayed according to their sensory profiles. There are as many ideal wines as consumers. The actual wines tasted by the consumers are displayed as well on the map according to the same principle. The sensory attributes are then projected on the map to label the main characteristics differentiating the wines from each other.

Since we have seen previously that consumers are unlikely to have the same wine preferences, the next step is to look for groups of consumers who may have similar preferences. On one hand, the characterization of the consumers belonging to a group (demographics, attitudes toward wine, etc.) enables Marketing to define which group is a potential target in their strategy. On the other hand, the sensory profiles of the ideal wines of the consumers are valuable information for winemakers to refine their wine styles. The data gained from the consumer testing and descriptive analysis are displayed on a two-dimensional map as shown in Figure 1 (see below). The optimal chardonnay wine for each consumer is displayed by a solid circle; the twenty-three wines tested both by the consumer and the sensory panel are displayed as solid squares and labeled ‘A’ to ‘W’. The left side of the map has a high density of consumers relative to the other parts of the map.

The first preference dimension (horizontal axis) splits the consumers who like sweet and smooth chardonnay wines (on the left) and the consumers who like wines that are more complex in sensory attributes with a high intensity of alcohol aroma, a lingering after-

taste and an intense oak aroma (toasted oak to smoky-bacon) (on the right). The second preference dimension (vertical axis) splits the consumers who like moderately sweet to sour wines, with low flavor intensity (bottom) from consumers who like wines with a high flavor intensity (but not lingering) and an intense flavor of vanilla-oak and of apple and stone fruit.

Through a segmentation study, it was possible to identify four groups or segments of consumers of unequal size.

### **How to use this information in winemaking?**

Wine is not a formulated product such as mayonnaise or a cola beverage. Therefore, it is not obvious how the intensity of the sensory attributes is related to either the ingredient (grapes) that wine is made from or to the winemaking practices applied during production.

The optimal sensory profile for each segment, however, can be valuable for guiding winemaking or the blending processes during preparation of the wine for bottling. If the objective is to reposition the sensory profile of an existing wine with the optimal profile as determined for a given consumer segment, the sensory scientist can provide a differential profile of the two wines showing the sensory attributes that need to be softened and those that need to be reinforced. The science of winemaking and the skill of the winemaker make these adjustments feasible by blending wine legs, by treating the wine appropriately, or by adjusting winemaking practices during the next vintage. One significant challenge in the application of preference maps is to make the sensory vocabulary understandable to the winemakers, who tend to use their own vocabulary (jargon) to describe the sensory attributes of wines. To overcome this difficulty at the winery, the Sensory and Flavor science staff have worked closely to produce flavor standards that illustrated the sensory attributes used in this particular project. By smelling or tasting these standards in a wine, most of the winemakers were able to understand what the consumers liked or did not like in chardonnay wines. However, identifying winemaking practices that can be manipulated in order to change the attributes of the wine are not identified by the preference map, unless process data are collected and included in the statistical analysis of each wine.

### **Conclusion**

Wine flavor is the result of complex interactions of non-volatile and volatile compounds as perceived in the mouth. The quality of a wine is in part a reflection of what is perceived whether it is by a winemaker, by an expert, or by a consumer. Wine quality can, therefore, be defined as that wine style that is 'liked/preferred' by a defined population of consumers. The technique of sensory preference mapping can be utilized to visualize the similarities and differences between wines in the marketplace and identify groups of consumers who have similar likes/dislikes of wines, and what sensory characteristics those wines possess. Winemakers can then be given guidance on wine styles for drinkers within the targeted population. Unlike consumer/sensory analyses, the chemical analysis of wine has not been able to predict the 'liking/disliking'/quality of a

wine. The complexity of perception is not yet understood in terms of the wine chemistry that is currently being measured.

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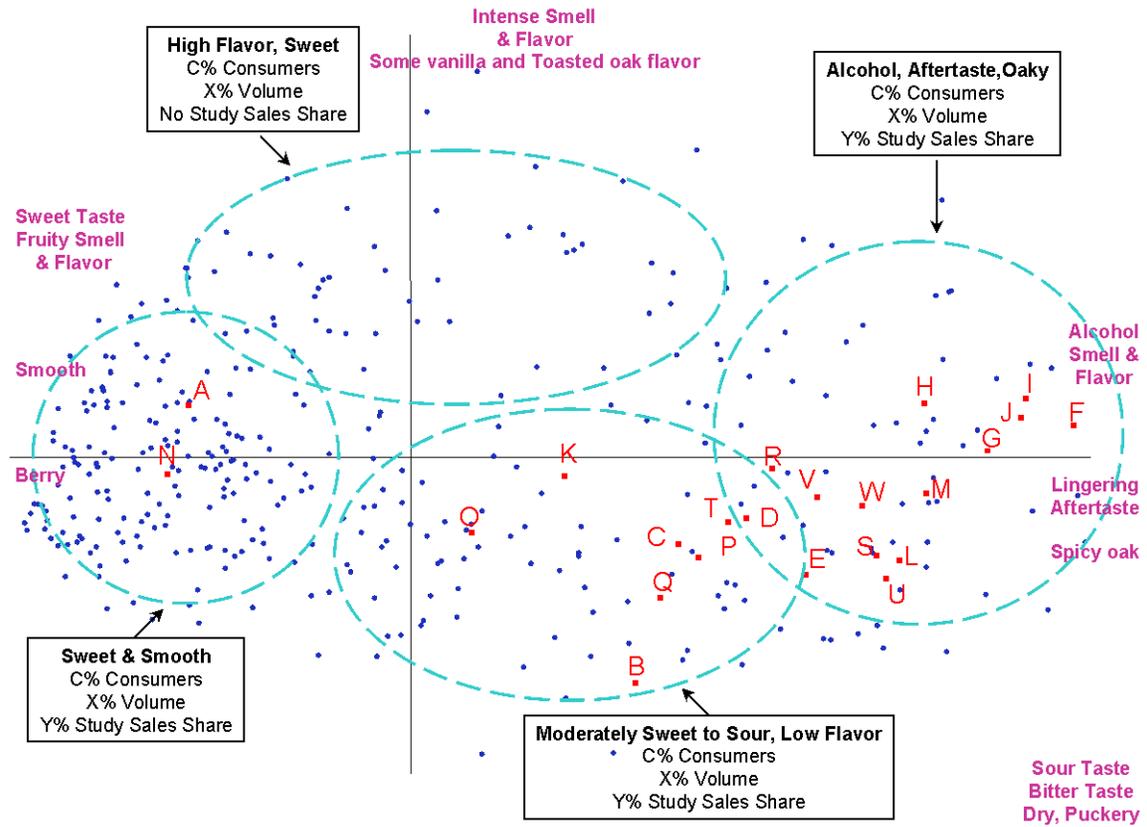
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**Figure 1. Preference map describing the optimal sensory profiles of Chardonnay wine for the 361 surveyed consumers**

The ellipses are established at 80% confidence level and they cluster the consumers in 4 segments.  
 The sensory descriptors are overlapped which enables description of the sensory properties driving the consumers' preference.  
 The preference drivers of each consumer segment are written in bigger letters.