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Impact of Color on Perceived Wine Flavor

Jeannine F. Delwiche

Department of Food Science and Technology, The Ohio State University
2015 Fyffe Road, Columbus, OH 43210, USA

Summary

While taste and smell are important aspects of flavor, multiple lines of evidence indicate that color can alter the perception of taste, smell and flavor. This has been demonstrated under laboratory conditions many times with model solutions, but only recently was it shown that the phenomenon also occurs under a more casual setting with a complex stimulus such as wine.

「味」と「香り」は「風味」の重要な側面であるが、複数の根拠により、「色」もまた「味」、「香り」、「風味」の感じ方を左右しうることが示されている。このことは実験室条件下ではモデルを用いることにより何度も証明されてきたことであるが、最近になってようやく、ワインのような人に複雑な刺激を与える飲食物について、より日常に近い条件下でもこういった現象が起こることが示された。

1. Introduction

The impact of color on the perception of taste and smell has been well demonstrated in the laboratory. Several studies have shown that color greatly impacts the ability of subjects to identify food and beverages, with uncolored and miscolored noncarbonated, fruit-flavored beverages being identified correctly less frequently than appropriately colored samples (DuBose, Cardello and Maller 1980; Philipsen, Clydesdale, Griffin and Stern 1995; Stillman 1993). This phenomenon also has been found for table jellies (Moir 1936), sherbet (Hall 1958), and wine gums (Teerling 1992). These findings suggest that individuals associate certain flavors with specific colors and when colors are altered, identification is decreased.

Generally, taste and/or flavor intensity tends to increase as the color level increases in sucrose solutions (DuBose *et al.* 1980; Johnson and Clydesdale 1982), yoghurt (Norton and Johnson 1987; Teerling 1992), and cakes (DuBose *et al.* 1980). It is possible that consumers, familiar with beverages made from powders or concentrates, have learned that taste and/or flavor tend to increase as color increases.

Additional evidence has demonstrated that color-taste associations also have other subtle impacts on perceived taste, smell and flavor. Pangborn, Berg and Hansen (1963) found that additions of food coloring impacted the sweetness ratings of a white wine that had been colored to look like a rosé, sauterne, sherry, burgundy, and claret. Morrot, Brochet, and Dubourdieu (2001) found that when white wine was colored red with food coloring, people described the wine with more red wine odor terms (which tended to describe red or dark objects). In contrast, when the wine color was left unaltered, people described the wine with more white wine odor terms (which tended to describe yellow or clear objects). However, both these latter two studies and the studies mentioned earlier were

conducted in a laboratory setting, leaving the question of the impact of color on complex stimuli presented in a more casual setting unanswered.

2. Methods

At the Monell Chemical Senses Center, an annual event, called the "Annual Review for Sponsors", takes place to inform sponsoring organizations of the recent findings of the center. In order to welcome them, on the night preceding the oral reports, a wine and cheese event was held. This investigation took advantage of this casual, low pressure setting in order to see if color had an influence on the ratings of wines.

Participants in the voluntary wine-judging event were asked to rate the intensity of a variety of wine attributes for three different colored wines. They were told that the impact of presentation order was being investigated. General wisdom says that when tasting a series of wines, it is important to begin with sweeter wines and progress to drier wines. This typically means one first taste pink wines, then white wines, and then finally red wines. If dessert wines are to be tasted, they are tasted last, due to both their high sweetness and high alcohol content. However, this was the cover story. In reality, the wine samples only differed in the amount of food color that was added, and despite color, did not differ sat all in sweetness or alcohol content.

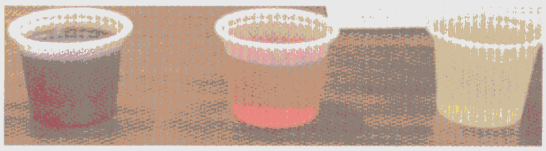

Figure 1. Colored wine samples

Attribute	White	Pink	Red
Sweetness			
Bitterness			
Acidity			
Dryness/Astringency			
Fruitiness			
Oakiness			
Fullness/Body			
Complexity			
Maturity			
Balance			

Figure 2. Subject ballot

For the stimuli, a California Chardonnay (Clos Julien Chardonnay, San Luis Obispo County, 1999) was colored to look like a white wine, a rosé, or a red wine with combinations of red, blue and green food coloring. These samples are shown in Figure 1. Approximately 15 ml samples were presented to the participants in one-ounce (30 ml) plastic medicine cups. People were asked to rate, on a scale from 0 - 15, the intensity of sweetness, bitterness, acidity, dryness/astringency, fruitiness, oakiness, fullness/body, maturity, complexity, and balance. The ballot is show in Figure 2, and the overall set up is shown in Figures 3 and 4.

The first six attributes were chosen because they are typical of the first attributes learned by wine drinkers and

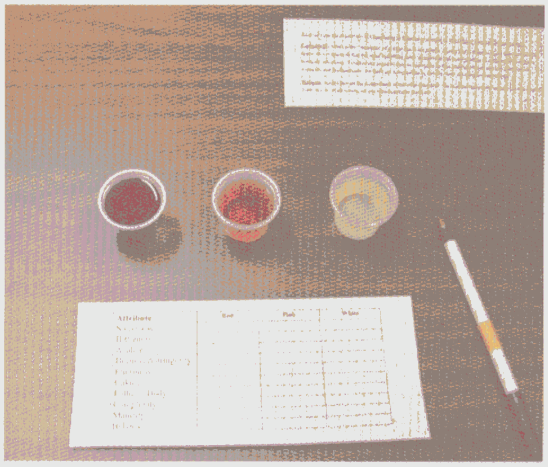

Figure 3. Sample presentation

Figure 4. Subject tasting samples

are thus the best understood. The last four attributes were selected because they are terms that are typically used to differentiate between red, white and pink wines. Because pilot studies showed that many subjects were confused by the meaning of the last two terms. Definitions (Bernstein 1982) were available for the subjects who were less certain about the meaning of these two terms (see Figure 5).

Adapted from the definitions of **Complexity & Balance**, presented in The Official Guide to Wine Snobbery.

Complexity: refers to the "structure" of a wine that is not simple. A wine that is complex is not easy to taste and appreciate; it demands that the taster contribute some background and understanding. A complex wine is like a complex symphony. Tchaikovsky might be easy to appreciate on first hearing; Mozart requires a little more exposure and concentration. As there are complexities in melody, there are complexities in wine.

Balance: means that all the components of the wine—the fruit, the acid, the tannin, the sugar—are in a state of harmony. In other words, no one note dominates the wine.

Figure 5. Definitions of difficult terms supplied to participants

3. Results and Discussion

Since all participants assessed all wine samples, a repeated-measures analysis of variance was performed upon the ratings. This analysis revealed no significant difference between fruitiness, fullness/body, complexity, and maturity ($p>0.05$). In contrast, significant differences were found between the different colored wines for perceived fruitiness, fullness/body, complexity, and maturity ($p<0.05$) (see Figure 6). These differences generally matched those that would be expected between wines typically associated with the manipulated colors. The rosé-colored wine was rated as being the highest in fruitiness, and the lowest in fullness/body, complexity, and maturity. Similarly, the red-colored wine was rated as the highest in fullness/body, complexity, and maturity.

It is interesting that three of the four terms that showed a significant difference were the most advanced terms. It is possible that the less experienced wine drinkers had only a vague understanding of the words, and thus the color had a more profound impact on them. At the same time, it is

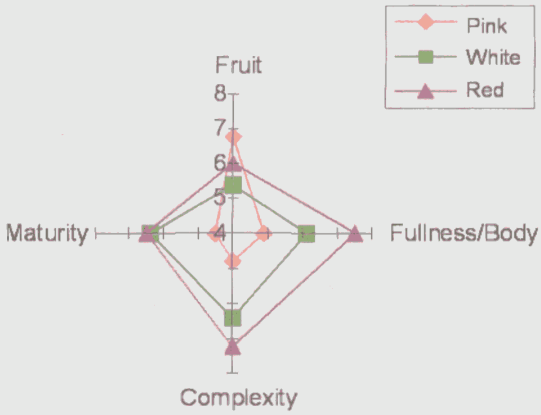

Figure 6. Attributes on which wine color significantly altered intensity ratings

known that more experienced wine drinkers tend to be more heavily influenced by wine color than are novices due to their expectations acquired from their previous experiences (O'Mahony, personal communication). This may mean that while they understood the definitions of the terms, their ratings, too, were strongly influenced by the color differences. It is likely that both the uncertainty of novices and the expectations of experts contributed to the significant differences found.

Before presenting the wines to the participants, some initial investigations were conducted in the laboratory. Of these, one examined the possibility that the amount of food coloring altered the wine flavor. The participant in this pilot study assessed the uncolored wine and the red-colored wine as these two represented the extremes – the lowest amount added food coloring and the highest amount of food coloring. He was aware he would be tasting wines with different amounts of added food coloring. He was blindfolded and handed each wine sample one at a time. After one of each wine had been presented, he was asked to indicate which sample contained the added food coloring. The two wines were presented in random order to the subject four times. His performance indicated that he could not distinguish the samples as half the time he picked the sample with added food coloring and the other half he picked the sample without added food coloring. Furthermore, the subject stated that he was not certain and that he was forced to resort to guessing. This pilot study was interpreted to mean that the food coloring did not alter

the flavor or taste of the wine.

The above findings are in agreement with those conducted in more controlled laboratory settings. As in previous studies, color was shown to alter the perception of a food's taste, smell and flavor, even in a relaxed atmosphere. The findings of Morrot *et al.* (2001) indicate that different colors impact the interpretation of a given wine's taste, smell and flavor, altering what may seem like a citrus aroma to a cherry/plumy aroma, etc. It is likely that this change in interpretation of the stimulus due to the color can explain the findings of this study, and perhaps that of Pangborn *et al.* (1963). It seems certain that color has a profound effect on the perception of foods and drinks, not only in the laboratory but also in more natural settings.

In the past two decades, wine makers have begun using many new techniques to intensify the colors of both red and white wines. Many consumers and experts equate color intensity with color, especially for red wines. Some of the techniques used to intensify red color include aggressive maceration methods, bleeding juice off from the skins, pectin additions, vacuum evaporation, and reverse osmosis (Nesto 2000). However, these techniques to enhance color often distort wine flavor. Yet despite this distortion, color intensity is still one of the key drivers of perceived quality and more intensely colored wines bring a higher price (Nesto 2000). The market seems to recognize that color impacts perceived flavor, even if the mechanism behind this change in perception is not fully understood.

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PROFILE

Jeannine F. Delwiche, Ph. D.

Assistant Professor
Sensory Science Group
Food Science and Technology
The Ohio State University

Ph.D. in Psychology, Cornell University in 1997. M.S. in Food Science &Technology, specializing in Sensory Sciences, UC Davis, CA in 1992. B.S. in Food Science & Technology, Psychology minor, UC Davis, CA, with High Honors in 1990. Professional Member of the Institute of Food Technology (Member-at-Large for the Sensory Evaluation Division; incoming Chair-elect of the Ohio Valley Regional Section). Member of the Journal of Sensory Studies editorial board, the Association of Chemoreception Sciences, the American Chemical Society, and the 5th Sensory Science Symposium Scientific Committee.