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Perceived Match of Wine and Cheese and the Impact of Additional Food Elements: A Preliminary Study

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Very little empirical work has been done on the assessment of the impact of additional food items on match perception. The addition of specific food items to wine and cheese pairings added an increase in the overall sensation of match. This finding highlights the value of layering flavors, fruit, acid, sweet contrasts, and spice to improve wine and cheese relationships. This study found substantial differences in perceptions across the participants, supporting current arguments on individual differences in sensory perception. Limited statistical differences were found for the separation in match levels based on flavor intensity and body-to-body relationships. The descriptive statistic differences, however, may have practical significance based on consumer sensory perceptions.

KEYWORDS wine and cheese pairing, Canadian wine, artisan cheeses, food element match impact

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INTRODUCTION

While the enjoyment of wine and cheese cannot be denied, few scientific studies have been completed to assess the relationship among cheese type, wine type, and the impact on the sensation of match. At the time of this study, only a handful of empirical studies have been published across a variety of related literature streams on the topic of wine and cheese pairing (Bastian, Payne, Perrenoud, Joscelyne, & Johnson, 2009; Harrington & Hammond, 2005; King & Cliff, 2005; Madrigal-Galan & Heymann, 2006; Nygren, Gustafsson, & Johansson, 2002, 2003a, 2003b). Although, there are a growing number of books in the mainstream press on food and wine pairing (e.g., Dorenburg & Page, 2006; Immer, 2004; MacNeil, 2006), this mainly anecdotal literature provides no hard rules for pairing but instead provides guidelines for increasing the likelihood of a good match (Harrington, 2008). In addition to empirical studies specific to wine and cheese pairing, the more general scientific study of wine and food pairing relationships is limited in scope with very few empirical studies published in peer-reviewed journals (e.g., Harrington & Hammond, 2006b; Harrington, Miszczak, & Ottenbacher, 2008; Pettigrew & Charters, 2006).

While the number of studies in general food and wine or cheese and wine are limited, an even more limited analysis has been provided considering the change in perceived match of cheese and wine when other food elements are added to the mix with no studies published. Therefore, the main objectives of this exploratory study are to generate greater scientific knowledge regarding wine and cheese pairing as well as the potential impact of additional food items to the wine and cheese combination. The results of this research will provide valuable information for wine and food-service professionals in the selection of ideal matches in cheese, wine, and other food elements that can be used to enhance a cheese and wine combination.

BACKGROUND

Wine and Cheese

In 2000, Werlin provided several general suggestions for cheese and wine pairing: (1) pairing light white wines with light cheeses (such as goat's or sheep's milk cheeses with a Chenin Blanc), (2) pairing high-acid white wines with high-acid cheeses (such as an aged chèvre with a cool-climate Sauvignon Blanc), (3) pairing low-acid wines with lower-acid cheeses (such as a gouda with a California Chardonnay), (4) pairing strong wines with strong cheeses (such as aged cheddar and Syrah or Rhone reds), and (5) pairing dessert wines with strong, salty cheeses (such as blue-veined cheeses and Sauternes or Port). Further, the author suggested that white

wines are more versatile with cheeses than red wines. These basic ideas provide guidance for wine and cheese pairing but appear to be derived from personal experience and anecdotal methods.

Nygren et al. (2002) considered the impact of blue mold cheeses on flavors in white wine. In this study, it was found that blue mold cheeses have a substantial impact on wine flavor attributes. Specifically, most of the white wine flavor attributes decreased (i.e., citrus, apple, oak, and sour taste), while others remained unchanged (i.e., mineral, spicy, bitter taste, sweet taste). The study provides evidence for the use of sensory analytical methods to describe profiles of wine and cheese combinations. While the study (2002) used a sequential approach (i.e., first wine-spit-evaluate, cheese-spit-evaluate, second wine-spit-evaluate), Nygren et al. (2003a) considered using a mixed approach to cheese and wine evaluation (i.e., mixed tasting of cheese and wine, spit, evaluation of cheese and wine). In the study, the overall finding was that a mixed tasting approach provided greater decreasing changes in wine attributes than did the sequential approach. This finding indicates the importance of utilizing the mixed approach in wine and cheese pairing experiments with results likely to more closely resemble those in a realistic dining experience.

King and Cliff (2005) considered wine and cheese recommendations using an "ideal pair" approach. Participants were asked to define wine and cheese combinations based on a bipolar line scale. Specifically, the midpoint of the scale indicated an "ideal pair," defined as "a wine and cheese combination where neither the wine nor the cheese dominated" (2005, p. 245). Wine and cheese combinations used 9 Canadian cheeses and 18 British Columbian (Canada) wines (six white, six red, and six specialty [e.g., late harvest, ice wine, port style, etc.]). Study findings indicated that white wines scored closer to the ideal than did red or specialty wines. Thus, findings inferred that white wines were easier to pair with a variety of cheeses, but considerable individual differences across judges were apparent.

Harrington and Hammond (2005) tested the relationship between the wine elements of six wines (Riesling, Sauvignon Blanc, Chardonnay, Pinot Noir, Merlot, and Cabernet) with the food elements of four types of cheeses (soft, firm, hard, and blue veined). In their study, Pinot Noir was shown to be the easiest red wine to pair with a variety of cheeses; an off-dry Riesling was shown to be the easiest white wine to pair. The hard cheese (Gruyère) was the most versatile of the four cheese types (i.e., creating the highest level of perceived match across all wines and cheeses). A consistent finding with other studies was a substantial amount of variation in perceived level of match across the panel of trained judges.

Madrigal-Galan and Heymann (2006) considered how red wine impacted flavor perceptions in a variety of cheeses. The red wines included Cabernet Sauvignon, Merlot, Pinot Noir, and Syrah. The cheeses included soft styles (mozzarella and teleme), medium hard (cheddar), hard (emmental

and Gruyère), and blue (gorgonzola and stilton). In general, the study found little difference in flavor perceptions across cheeses and across red wines. The wine and cheese interactions decreased the perception of sourness in the wines, decreased the flavor intensity perception of the wines, and increased the perception of butter (as a wine attribute) across all cheeses. As a whole, the results indicated to the researchers that "[c]ontrary to common perception, the cheese and wine pairing translates into wine character suppression more than enhancement" (Madrigal-Galan & Heymann, 2006, p. 21).

Bastian et al. (2009) looked at the level of agreement between wine and cheese consumers with suggested matches by experts for ideal pairings. As a whole, the consumers agreed with the experts for six of the eight pairings. In this study, red wine (Sangiovese, Shiraz, and Cabernet Sauvignon) was found to be more versatile than the whites (sparkling, Sauvignon Blanc, oaked Chardonnay, and Gewürztraminer) with the cheeses (soft-ripened, fresh goat, Gruyère, parmesan, cheddar, and gorgonzola). In terms of specific wines, the Gewürztraminer and Sangiovese seemed to be the most complementary with the cheeses, while the Sauvignon Blanc and botrytis dessert wine were the most difficult to match from a consumer perspective. A weakness in this study was that the assessment of match was based on a general assessment and did not ask participants to differentiate among match type, such as flavor intensity differences, body-to-body differences, etc. Earlier findings in more general food and wine pairing indicate these differences may provide important indicators or predictors of match (Harrington & Hammond, 2006a).

In summary, a review of the limited literature on wine and cheese pairing provides several consistencies and several contradictions. One thing apparent across all studies was the impact of individual differences and preferences across both trained judges and consumers on wine and cheese match levels. Second, in the lab setting and in both mixed and sequential tastings, it appears that cheese combined with wine (generally) decreases many flavor attributes and sourness perceptions of wine. The main exception is that cheeses consumed with wines appear to increase the perception of butter aromas in wine.

The studies to date provide conflicting evidence on the versatility of red wines versus white wines when paired with a variety of cheeses. In general, the combined results seem to indicate a greater versatility of firm or hard cheeses (e.g., Gruyère) across wine types and the greater versatility of off-dry style white wines (e.g., Riesling and Gewürztraminer) when paired with a variety of cheeses. The value of theoretical pairing preferences in regards to acidity levels (wine and cheese), body matching, intensity levels, and salty–sweet contrast matches (e.g., Port and stilton, botrytis dessert wines and blue-veined cheeses) have received mixed results. Therefore, further research is needed to determine red wine versus white wine matches

based on specific wine and cheese styles, dessert wine and cheese match perceptions, and (from a realistic dining experience perspective) the impact of other elements (e.g., other items that might be served on a cheese plate or cheese board) on the perception of match between wine and cheese.

MATERIALS AND METHODS

Industry Experts and Proposed Matches

Five wine and cheese experts provided suggestions for the wine and cheese combinations used in the current study. The wine and cheese experts included (1) two professional sommeliers, (2) two artisanal cheese makers, and (3) a food and wine pairing author. The suggestions resulted in six wine and cheese pairing combinations.

The basic rationale for each pairing suggestion is as follows:

1. Feta cheese and sparkling wine—the fresh style of the selected feta should match body-to-body with a predominately Pinot Noir-based sparkling wine; the acidity and effervescence in the sparkling wine should cleanse the palate of the salty/briny character inherent in this cheese style.
2. Soft-ripened, cow's milk, triple cream cheese with oaked, cool-climate Chardonnay—the creamy texture of the cheese will match with the fuller body and creamy texture of this oaky Chardonnay; the cool-climate Chardonnay will retain sufficient acidity to compliment the lactic acid in the cheese as well as to create a cleansing effect.
3. Semi-soft, aged cow's milk cheese with Pinot Noir—the creamy, buttery, and medium body of the cheese will match with the lighter, smoother tannin red wine from a cool climate.
4. Firm, Italian-style cheese with full-bodied Meritage red (Bordeaux-style blend)—sharper and firmer (hard) cheese with a nutty character will pair with this full-bodied Bordeaux blend due to a body-to-body match.
5. Soft-ripened, aged goat's milk with ash and Vidal ice wine—the intensity of the aged goat's cheese matches with the intensity of the ice wine; good acidity in the ice wine balances with the higher-acid goat's milk cheese.
6. Soft-ripened, aged goat's milk with ash and Riesling ice wine—the intensity of the aged goat's cheese matches with the intensity of the ice wine; good acidity in the ice wine balances with the higher-acid goat's milk cheese.

Subjects

A group of industry professionals attending a wine educators' conference participated in this study. Specifically, the group attended a wine and cheese

seminar as part of a three-day conference ($N = 14$). Participants included sommeliers, wine distribution representatives, and wine educators. For this study, participants used both sequential and mixed tasting assessments ([1] wine only; [2] cheese only; [3] wine and cheese combined; and [4] wine, cheese, and additional food item; e.g., Harrington et al., 2008).

Wines and Cheeses

Six Canadian wines were selected for this preliminary study. Table 1 provides a description of each wine by wine style, origin, vintage, price, and sensory description. While Canada does not have a longstanding reputation for production of world-class wines, internationally, it has been acknowledged that quality wines are produced. Tastings of quality Canadian producers by knowledgeable experts provides support for the wine quality in its two main regions: British Columbia and Niagara (e.g., Robinson, 2007). Several earlier studies have considered Canadian wine characteristics and pairing relationships with cheeses.

In a study of ice wine characteristics, Cliff, Yuksel, Girard, and King (2002) found that Ontario ice wines (Niagara region) had more fruity and floral aromas than British Columbia and German ice wines in their sample. While German ice wines had the lowest viscosity, total sugar, and ethanol, British Columbian ice wines had the highest titratable acidity, the highest viscosity, and total sugar in the group. The findings indicated a clear separation among Canadian and German ice wines when using a trained panel of judges.

King and Cliff (2005) found that Canadian white wines were easiest to match with cheeses. Pinot Noir was the most versatile Canadian red wine (more versatile than BC Merlot, Meritage, or Foch). Tests of matches among Canadian cheeses and Canadian specialty wines (sparkling, blush, late harvest, ice wines, and port style) provided inconsistent results across the panel of judges.

In a study on the effectiveness of the "mouth-feel wheel," King, Cliff, and Hall (2003) used British Columbian red wines to determine whether the fabric descriptions used in the "wheel" resulted in a continuous scale as described in earlier research (Gawel, Oberrholster, & Francis, 2000). While the concept of the mouth-feel wheel encompasses several elements, the primary idea is the use of mental fabric descriptions as a continuum (e.g., silk, velvet, suede, corduroy, burlap) for varying levels of tannin or astringency (e.g., smooth to rough). In their study, while the judges could differentiate levels of astringency, the researchers found that the descriptors in the wheel needed to be simplified to be effective.

In summary, these studies indicate differences based on location (terroir) for sweet dessert wines (ice wines) and reinforce the impact of

TABLE 1 Wine Identification and Sensory Descriptions

Wine style	Vintage	Origin	Price	Wine composition	Sensory description
Sparkling wine	2004	Sumac Ridge, Steller's Jay Brut, British Columbia	$25 (750 ml)	Alcohol: 13.1% pH: 3.5 Dryness: 1 Residual sugar: 12.1 g/L TA: 5.7 g/L Oak aging: No	Ripe strawberry, fresh toast, and crisp lively acidity; the mousse is fine and the palate is full of citrus and fresh strawberries
Oaked Chardonnay	2005	Jackson-Triggs Delaine Vineyard	$25 (750 ml)	Alcohol: 13% Dryness: 0 Residual sugar: 4 g/L TA: 6 g/L Oak aging: 8 months Full malolactic	Gold in color, hints of tropical aromas of ripe grapefruits, green apples, citrus, and nuances of oak; creamy, biscuity finish
Pinot Noir	2004	Inniskillin Founders' Series	$35 (750 ml)	Alcohol: 12.5% pH: 3.53 Dryness: 0 Residual sugar: 4.5 g/L TA: 6.2 g/L Oak aging: Yes	Ripe aromas of black cherry and red plum; notes of clove, black pepper, and black licorice; finish of firm tannins
Meritage (Bordeaux-type blend)	2005	Osoyoos Larose, Le Grand Vin	$40 (750 ml)	Alcohol: 13.8% pH: 3.83 Residual sugar: 1.4 g/L TA: 6.5 g/L Oak aging: 16 months	Dark-hued wine with red fruit aromas and flavors of plum, black cherry, and chocolate; balanced oak flavors and long and supple tannins; excellent concentration on the palate
Vidal ice wine	2006	Jackson-Triggs Proprietors' Reserve	$38 (375 ml)	Alcohol: 10.5% Dryness: 23 Residual sugar: 228 g/L TA: 11 g/L Oak aging: No	Richly textured with tropical aromas; bold fruit flavors balanced with fine acidity and silky finish
Riesling ice wine	2006	Inniskillin	$80 (375 ml)	Alcohol: 9.5% pH: 3.33 Dryness: 22 Residual sugar: 220 g/L TA: 10.4 g/L Oak aging: No	Aromatics of lime, apricot, grapefruit, and peach blossom with a slight mineral edge; racy interplay of sweet and tart

TA = titratable acidity.

individual differences in perceptions for wine judges. Additionally, these studies support the general idea that white wines and lighter reds from Canada are more versatile when paired with a variety of cheeses than are full-bodied reds or specialty wines.

Five artisanal cheeses were selected for the tasting in this study. The cheeses came from three different regional cheese makers, were of high quality, and represented five different cheese styles. Table 2 provides a description of each cheese by cheese type, milk type, origin, price, and cheese description. These cheeses were selected to maximize differences in cheese style as well as to insure high-quality and consistent cheeses for the study.

Additional Elements

A further objective of this study was to consider the impact of additional food elements to the recommended wine and cheese matches. These additional food elements were included in this study with the specific research question in mind: Will the addition of these elements have a positive or negative impact on match perception? To evaluate the impact, the study used three food items as additional elements for four of the six wine and cheese pairings. Due to time limitations and to minimize the potential for palate fatigue, key food items of interest were limited to four of the wine and cheese combinations. The three food items included the following: wild quince and pear chutney, Arkansas beaten "biscuits" with black pepper, and

TABLE 2 Identification of Cheeses

Cheese type	Milk type	Origin	Price/lb	Description
Feta cheese	Fresh/soft, goat's milk	Bittersweet Plantation Dairy (Louisiana)	$15	Tangy soft cheese brined in a salty whey
Fleur de lis fromage	Soft-ripened, cow's milk, triple cream	Bittersweet Plantation Dairy (Louisiana)	$70	Triple cream Guernsey milk blend characterized by a slightly firm rind and buttery, creamy interior
Thomasville tomme	Semi-soft, cow's milk	Sweet Grass Dairy (Georgia)	$15	Golden yellow color with mellow and buttery characteristics and soft texture
Montabella, Italian-style cheese	Firm, sharp, cow's milk	Sweet Home Farm (Alabama)	$15	Yellow color with a black rind; sharp and slightly nutty; grating style cheese
Lumiere	Soft-ripened with ash, goat's milk	Sweet Grass Dairy (Georgia)	$30	Pure white interior divided and surrounded by thin line of grapevine ash; thin to medium white, bloomy rind and clean taste and soft texture

spiced Cajun pecans. Theoretical differences in food and wine relationships have been suggested for three general spice types: sweet, pungent, and hot spice categories (Harrington, 2008). Therefore, the current study incorporated these three spice categories in the additional food items used in this study.

The wild quince and pear chutney is a product made by Chef John Folse & Co. It is made using quince, pears, sugar, white vinegar, water, and ground sweet spices (i.e., cinnamon, nutmeg, ginger, and cloves). This food item was included to assess the impact of sugar, acid, and sweet spices on wine and cheese matches. The chutney was served during the tasting of the oaked Chardonnay and the soft-ripened, triple cream cheese.

Arkansas beaten "biscuits" utilize a traditional technique of beating the dough for 20–30 minutes with a piece of stove wood or mallet (or in a mixer with a paddle) (Engelhardt, 2005). Beaten biscuits are different from other kinds of biscuits. Rather than traditional light and fluffy biscuits, beaten biscuits have a smooth, firm, fine-grained texture. The finished product resembles a homemade cracker. The version in this study included the additions of coarse ground black pepper and sorghum molasses. The ingredients for the beaten biscuits include flour, salt, black pepper, lard, water, sorghum molasses, and milk. This food item was included to assess the impact of black pepper and a slight sweetness on wine and cheese matches. The beaten biscuits were included in the tasting sequence with the Pinot Noir and the semi-soft cheese (Thomasville tomme).

The third food item (spiced Cajun pecans) was part of the tasting sequence for both ice wines (Vidal and Riesling). This item was included in the tasting sequence to assess the impact of nuttiness and hot spice when matching sweet wines with cheeses. Ingredients for the spicy pecans include butter, garlic, hot pepper sauce, salt, and pecan halves. The spicy Cajun pecans and ice wines were sequenced with the soft-ripened, aged goat's milk cheese with ash. The pairing of this food item with both cheeses was done to determine if the resulting sweet–spicy match relationship was consistent across ice wines regardless of varietal.

Tasting Procedure

Using an adapted deviation-from-match-type scale (e.g., Bastian et al., 2009; King & Cliff, 2005), the subjects in this study evaluated six wines, five cheeses (a total of six wine and cheese pairings), and the impact of food items on four of six of these pairings.

Prior to the evaluation of these pairings, all participants (1) received instruction on how to taste the wine, cheese, and other food items (both in verbal and written format); (2) were instructed on how to use the evaluation scales by way of a computer-based presentation; and (3) were

provided instruction and definitions on tasting for flavor intensity match, body-to-body match, and whether the additional item decreased, had no impact, or increased the sensation of match (instructions/definitions were provided as part of a computer-based presentation and in written form to all participants).

The tasting process utilized the following sequential process:

1. Wine tasting and notes.
2. Cheese tasting and notes.
3. Mixed cheese and wine tasting and evaluation: flavor intensity match, body-to-body match, and descriptions of key elements in the wine or cheese that enhance or decrease a match sensation.
4. Cheese, additional component, and wine, then evaluation (applicable for samples 2, 3, 5, and 6): flavor intensity match, body-to-body match, additional components impact on match, and descriptions of key elements in the wine or cheese that enhance or decrease a match sensation.

Sequential and mixed tasting methods were employed (Nygren et al., 2002). For the mixed tasting of wine and cheese, participants were told to take a small bite of cheese and then a sip of wine. Participants were instructed to slowly chew the cheese and wine combination, savoring the flavors and evaluating level of match for both flavor intensity and body-to-body matches. Participants were instructed to place an **X** on the scale indicating if in this wine and cheese combination the cheese dominates, creates an ideal match, or if the wine dominates in flavor intensity or body-to-body relationship. The general scale used a 12-cm deviation-from-match format (see Figure 1). Each scale was divided into six sections of 2 cm each, using seven anchor descriptors (e.g., cheese dominates excessively, ideal match, wine dominates moderately, etc.). Anchors were placed at 0, 2, 4, 6, 8, 10, and 12 cm with the mid-point (6) representing an "ideal match" (e.g., Bastian et al., 2009). The mixed tastings of cheese and wine included two scales: one for flavor intensity match and one for body-to-body match. Mixed tastings of cheese, wine, and an additional component included three scales: one for flavor intensity match, one for body-to-body match, and one for additional component impact.

Flavor intensity was defined as "the relative level of intensity or force of the characteristic flavor(s) in the wine or food" (Harrington, 2008, p. 314)

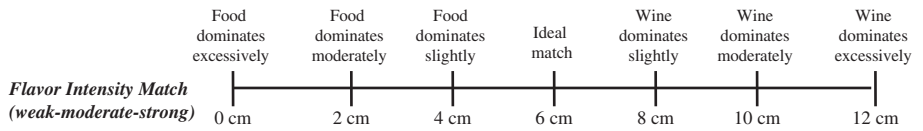

FIGURE 1 Example of scales used to rate wine and food matches.

and described as a continuum ranging from none–weak–moderate–strong–powerful. Body refers to mouth–feel characteristics in food and wine that provide a feeling of weight, texture, or power. In wine, it refers to the consistency or viscosity derived through the tactile sensations in the mouth. The body-to-body relationship was defined as the relative match between the food and wine in regards to the feeling of weight, lightness-to-richness, or smoothness-to-roughness in the wine and food.

Participants were asked to cleanse their palate with water and crackers and were given a short break for instruction between pairings. All participants completed the 10 pairings (6 wine and cheese and 4 wine, cheese, and other food item) in a 90-minute timeframe.

Statistical Analyses

The results shown in Tables 3 through 5 provide descriptive and statistical differences for level of flavor intensity match, level of body-to-body match, and the impact that additional elements had on match perceptions. Statistical tests use paired *t*-tests with a sample size of 14 for each test. The Statistical Package for the Social Sciences (SPSS 15.0) was used to run all tests.

TABLE 3 Mean Scores of Wine and Cheese Pairing: Flavor Intensity versus Body-to-Body ($N = 14$)

	Average perceived match (SD)	
Pairing	Flavor intensity match	Body-to-body match
Sparkling wine and feta cheese	3.25*	4.71
	(2.35)	(1.92)
Chardonnay and fleur de lis (triple cream)	6.01	5.47
	(2.31)	(2.04)
Chardonnay, fleur de lis, and quince chutney	4.74	4.97
	(1.94)	(1.68)
Pinot Noir and semi-soft (Thomasville tomme)	6.24	5.05
	(2.91)	(1.62)
Pinot Noir, semi-soft, and beaten biscuits with pepper	5.08	4.60
	(2.67)	(1.43)
Osoyoos Larose Le Grand Vin and Montabella (firm, Italian cheese)	4.50*	6.12
	(1.78)	(1.40)
Vidal ice wine and Lumiere (soft-ripened goat's cheese)	6.22	5.24
	(2.65)	(2.14)
Vidal ice wine, Lumiere, and Cajun spiced pecans	5.98	5.31
	(1.47)	(0.96)
Riesling ice wine and Lumiere	6.38	5.50
	(3.17)	(1.35)
Riesling ice wine, Lumiere, and Cajun spiced pecans	6.61	5.74
	(2.85)	(1.48)

Note: Significant differences are comparisons of average flavor intensity match versus average body-to-body match for each pairing (paired *t*-tests).
Significance levels are indicated as follows: $*p < 0.05$.

TABLE 4 Mean Scores of Wine and Cheese Pairing vs. Wine, Cheese, and Other Items ($N = 14$)

	Match level			
	Flavor intensity		Body-to-body	
Pairing	Wine and cheese (SD)	With additional item (SD)	Wine and cheese (SD)	With additional item (SD)
Chardonnay, fleur de lis, and quince chutney	6.01 (2.31)	4.74* (1.94)	5.47 (2.04)	4.97 (1.68)
Pinot Noir, semi-soft, and beaten biscuits with pepper	6.24 (2.91)	5.08 (2.67)	5.05 (1.62)	4.60 (1.43)
Vidal ice wine, Lumiere, and Cajun spiced pecans	6.22 (2.65)	5.98 (1.47)	5.24 (2.14)	5.31 (0.96)
Riesling ice wine, Lumiere, and Cajun spiced pecans	6.38 (3.17)	6.61 (2.85)	5.50 (1.35)	5.74 (1.48)

Note: Significant differences are comparisons of average flavor intensity match (wine and cheese only) versus average flavor intensity match (wine, cheese, and additional food item) and average body-to-body match (wine and cheese only) versus average body-to-body match (wine, cheese, and additional food item) using paired *t*-tests.
Significance levels are indicated as follows: $^{*}p < 0.05$.

TABLE 5 Mean Scores of Additional Item Impact on Pairing ($N = 14$)

	Pairing			
	Chardonnay, fleur de lis, and quince chutney	Pinot Noir, semi-soft, and beaten biscuits with pepper	Vidal ice wine, Lumiere, and Cajun spiced pecans	Riesling ice wine, Lumiere, and Cajun spiced pecans
Mean level of impact (SD)	7.56 (4.33)	6.24^{a} (3.18)	8.12^{a+} (2.16)	7.49 (3.40)

Note: Significant differences are comparisons of average level of impact on wine and cheese match when the additional food item was added to the tasting using independent *t*-tests.
Significance levels are indicated as follows: $^{+}p < 0.10$.
[a]Mean level of impact score differs significantly when pairings share the same letter.

RESULTS

The following provides an overview of the results of the recent Canadian wine, Southern U.S. cheese, and additional component tasting. Table 3 provides the average perceived match for each pairing and provides the standard deviation (SD; in parentheses next to the average level of perceived match). The SD reflects the level of agreement across all participants in the tasting. In many cases, the SD was relatively high, providing support for other studies indicating substantial differences in perceptions by judges in a variety of situations (e.g., Harrington & Hammond, 2005; King & Cliff, 2005; King et al. 2003).

Table 3 provides mean scores for match perceptions of the 10 pairing combinations used in this study (6 wine and cheese and 4 wine, cheese, and other item). Figure 1 provides an example scale for the wine and cheese and wine, cheese, and food pairings with descriptors for each 2-cm increment. Thus, a value near 6 indicates an ideal match; values below 6 indicate food domination in the relationship, and values above 6 indicate a wine domination of the relationship. Unlike other recent studies (e.g., Bastian et al., 2009), this study separated match based on flavor intensity levels and body-to-body levels. Statistical tests were performed to assess if significant differences were apparent based on matching for flavor intensity or body-to-body relationships. Mean scores of these pairing relationships and any statistical differences are discussed in the following sections.

Ideal Wine and Cheese Pairings

In this section, the mean match perceptions are discussed for the six wine and cheese pairings. Table 3 provides two statistically significant findings in regards to flavor intensity match versus body-to-body match for each wine and cheese combination. Specifically, the sparkling wine/feta cheese combination and the Osoyoos Larose/Montabella cheese combination had significantly lower perceived matches for flavor intensity compared to body-to-body relationship within each pairing combination. In other words, the cheeses dominated in match relationship based on flavor intensity.

Sparkling wine and feta cheese

For the assessment of flavor intensity match, participants perceived the feta flavor intensity to dominate the wine ranging from a slight to moderate amount. The mean score was 3.25 (2.35 SD) The body-to-body match provided a closer level of match with a mean of 4.71 (1.92 SD), but the sparkling wine body was perceived as slightly lighter than the feta cheese body.

Chardonnay and fleur de lis (triple cream cheese)

The flavor intensity match for this pairing was near ideal with a mean of 6.01 (2.31 SD). The body-to-body match relationship was also close to ideal with a mean of 5.47 (2.04 SD). In the body-to-body comparison, the triple cream cheese was perceived to slightly dominate this relationship but only by a minor amount (0.53 from ideal). The SD values indicated a moderately good level of agreement for perceived match in both flavor intensity and body-to-body match between the Chardonnay and the triple cream.

Pinot Noir and semi-soft cheese (thomasville tomme)

In this pairing, the flavor intensity match was close to ideal (mean = 6.24), but the variation across participants was a bit higher (2.91 SD). The body-to-body match perception indicates that the cheese slightly dominates in this case (mean = 5.05), but the smaller SD (1.62) provides evidence of more consistency in agreement for the body-to-body match level than for the flavor intensity match level.

Osoyoos Larose Le Grand Vin and Montabella (firm, Italian-style cheese)

The flavor intensity match level for this pairing (mean = 4.50) and a low variation across participants (1.78 SD) provides evidence that the Montabella cheese flavor intensity was slightly to moderately dominant. In terms of the body-to-body match perception, a near-ideal score (mean = 6.12) and low variation (1.40 SD) provides evidence of a near-ideal match for body and good agreement across participants.

Vidal ice wine and Lumiere (soft-ripened goat's cheese with ash)

The flavor intensity match had a score close to ideal (6.22 = a very slight domination by the ice wine flavor intensity) but with some disagreement (2.65 SD). In terms of a body-to-body match, the mean (5.24) indicates the cheese dominated slightly with a more powerful body (2.14 SD).

Riesling ice wine and Lumiere (soft-ripened goat's cheese with ash)

Here again, the flavor intensity match indicated a slight domination of the ice wine over the cheese (mean = 6.38) but with substantial disagreement in flavor intensity match assessment (3.17 SD). For the body-to-body match, there was strong agreement (1.35 SD) that the cheese and ice wine had a good match with only a slight domination by the cheese (mean = 5.50).

Wine, Cheese, and Additional Element Pairings

In this section, the mean match perceptions for the four wine, cheese, and additional element pairings are discussed (shown in Table 3). A second set of statistical tests are shown in Table 4, assessing comparisons of significant differences among average flavor intensity match (wine and cheese only) versus average flavor intensity match (wine, cheese, and additional

food item) and average body-to-body match (wine and cheese only) versus average body-to-body match (wine, cheese, and additional food item) using paired *t*-tests.

The third set of statistical tests is shown in Table 5. In this table, significant differences were assessed comparing the average level of impact on wine and cheese match when the additional food item was added to the tasting. In other words, as shown in Figure 2, participants were asked to assess any impact of the additional food item on the overall perception of match (no impact, decrease in match perception, or increase in match perception). The example scale in Figure 2 provides descriptions anchoring this assessment in 2-cm increments. Thus, a value near 6 indicates no impact compared to the wine and cheese alone. A value below 6 indicates a decrease in match perception with the addition of the food item, and a value above 6 indicates an increase in match perception with the addition of the food item. The mean values for each pairing indicates a slight increase in perceived match for each wine and cheese relationship once the additional elements were included in the mixed tasting (means ranging from 6.24 to 8.12). The mean match perceptions of flavor intensity and body-to-body for the four wine, cheese, and additional element pairings are discussed below.

Chardonnay, fleur de lis (triple cream), and quince chutney

The mean flavor intensity match (4.74) indicates that the food slightly dominated this relationship with the addition of the fruit chutney. There was good agreement on this match level (1.94 SD). This match relationship was similar for body-to-body perceived match (4.97 mean, 1.68 SD). Overall, with the addition of the fruit chutney, the food items became more dominant but were perceived to improve the match overall (7.56 mean) with substantial disagreement—some members loved it and others did not (4.33 SD).

Pinot Noir, semi-soft (Thomasville tomme), and beaten biscuits

With the peppered beaten biscuits, a relatively good intensity match was created (5.08 mean), but not all agreed (2.67 SD). For the body-to-body match, there was good agreement (1.43 SD) that the food items were

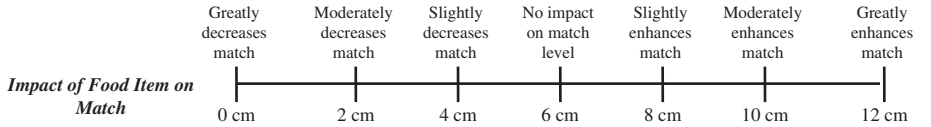

FIGURE 2 Example of scales used to rate impact of additional food item on wine and cheese matches.

moderately dominant in terms of body (4.60 mean). In terms of overall impact, the mean was close to no impact (mean = 6.24), but there was much disagreement (3.18 SD) on whether or not the beaten biscuits increased or decreased the sensation of match.

Vidal ice wine, Lumiere (soft-ripened goat's cheese with ash), and Cajun spiced pecans

With the addition of the pecans, most agreed there was a near ideal match in flavor intensity (5.98 mean, 1.47 SD). The mean for body-to-body match provides strong agreement that there was a slight food body dominance (5.31 mean, 0.96 SD). This hot and nutty effect created the largest positive impact (8.12 mean) with good agreement that the addition of the pecans improved the match relationship (2.16 SD).

Riesling ice wine, lumiere (soft-ripened goat's cheese with ash), and Cajun spiced pecans

With the pecans, most perceived a good flavor intensity match with some disagreement on the effect (6.61 mean, 2.85 SD). The body-to-body match perception was close to ideal with a mean of 5.74. Most participants agreed with this assessment (1.48 SD). While many believed the hot and nutty effect of the pecans greatly increased the match level, several disagreed (3.40 SD). Thus, the overall assessment of impact was slightly positive (7.49 mean).

Summary

There was one significant change for flavor intensity match comparing wine and cheese alone with wine, cheese, and the additional food item (Table 4). The Chardonnay and fleur de lis pairing versus the Chardonnay, fleur de lis, and quince chutney provided this statistically significant difference. In regards to differences comparing the average level of impact on wine and cheese match when the additional food item was added to the tasting (Table 5), the additional food items, generally, improved the sensation of match, but only the Pinot Noir and food combination was statistically lower in this improvement than the Vidal ice wine and food combination. One reason for a lack of significant relationships across pairings may be the large amount of variation in perceptions of the Pinot Noir, semi-soft cheese, and beaten biscuits with black pepper (3.18 SD); Chardonnay, fleur de lis, and quince chutney (4.33 SD); and Riesling ice wine, lumiere, and Cajun spiced pecans (3.40 SD). The pairing of Vidal ice wine, lumiere, and Cajun spiced pecans had the most consistency in impact perception (2.16 SD) and the highest mean score for increase in match perception (8.12).

DISCUSSION

The primary objective of this study was to generate greater scientific knowledge of wine and cheese pairing and the potential impact of additional food items to the wine and cheese combination. Very little empirical work has been done in this regard, and the assessment of the impact of additional food items on match perception represents a new and exploratory area.

The general wine and cheese findings support earlier studies in several areas. For the most part, the expert recommendations for ideal matches of the wine and cheeses matched the perceptions of the sample of industry professionals used in this study. The one exception was the match level of the sparkling wine and the feta cheese. While the match level for this cheese with the sparkling wine may have been the best possible given the group of wines in the study, the salt intensity and body of this cheese overpowered the sparkling wine. The lower level of match perception points to the importance of having an intimate knowledge of the wine and foods as there can be a substantial difference from one producer to the next.

As with earlier studies (e.g., King & Cliff, 2005; King et al., 2003), this study found substantial differences in perceptions across the participants. This finding supports current arguments on individual differences in sensory perception based on sensory sensitivity (McLaughlin, 2008) as well as possible psychological impacts (e.g., Harrington, 2008). The concept of finding an ideal match for the average consumer may need to be based on a conversation about what types of foods or drinks they generally like to determine likely sensitivities and tolerance levels for certain tastes or flavors. Food and drink service professionals with this ability are likely to have a substantial advantage for making a synergistic pairing for individual guests.

The addition of specific food items to wine and cheese pairings added an increase in the overall sensation of match. This finding highlights the value of layering flavors, fruit, acid, sweet contrasts, and spice to improve wine and cheese relationships. Given the exploratory nature of the approach used in the study, this positive finding represents an important gap in the literature requiring additional exploration. Pulling back the veil of wine, cheese, and food relationships may require new approaches to assess important implications for the field. Typical research methods in most lab settings provide better control over a variety of threats to validity, but these results may not be generalizable to field settings. Therefore, the creation of research centers that bridge this gap between the lab and the field appear crucial to move this research stream forward.

This study attempted to separate match levels based on flavor intensity and body-to-body relationships. While limited statistical differences were found, the descriptive statistic differences may have practical significance based on consumer sensory perceptions and appear of likely importance in moving a dining experience from good to ideal based on match. Additional

research is required to further assess match relationships of a variety of taste components, texture elements, and flavor characteristics in wine and cheese pairings.

CONCLUSION

The results of this research provide valuable implications for practitioners and researchers in the field. For wine and foodservice professionals, the study highlights the need to understand both likely wine and cheese matches and individual preferences of consumers. Additionally, the findings point to the potential enhancement of ideal matches in cheese and wine with the addition of other food elements that add layers of flavors and other contrasts.

Limitations and Future Research

This study has several limitations. First, the sample size was relatively small, and the environment did not provide complete control for a variety of factors that might impact sensory perception levels. Future research is needed to substantiate these preliminary findings with a larger sample, repeated measures, and a variety of settings. Second, the initial match selections by the expert panel were done 'blind' (i.e., absent the ability to taste prior to the test). Therefore, this absence of a priori tasting may have impacted wine and cheese match levels.

Additionally, issues related to the internal and external validity of this study cannot totally be ruled out. First, the pairings for this study were predetermined based on a synthesis of the collective input from experts in the field rather than a random test. This method was done due to practicality concerns. Future studies using random wine, cheese, and additional element selections may produce some interesting and valuable results. Due to the background of the participants and experts in this study, the generalizability of these findings to the general public may be limited. Although Bastian et al. (2009) found general agreement between the general consumers and experts for wine and cheese matches in their study, further research is needed to determine levels of difference and agreement across groups with varying degrees of knowledge and involvement with wine and food.

As is evident from the literature review in this study, food and drink pairing using empirical techniques provides a major gap in the food, wine, and foodservice literatures. Future research should consider a variety of food and wine pairing issues, including dessert wines and dessert relationships, the impact of spice in food on wine choices, and other relationships. For

practitioners, empirical research that provides relationships between food, wine, and the holistic dining experience using a more realistic experimental design can also provide value. An assessment of acidity relationships (food and wine) can provide valuable empirical information among a variety of foods, red wine, white wine, and specialty wine products.

Of course, psychological effects in wine and food pairing settings have important implications. Future research on suggestive selling techniques, recommendations versus non-recommendations, lighting effects, regional matches, and blind matches all have important implications for consumer satisfaction and consumer wine selection confidence.

While this study attempted to separate body-to-body match relationships from others match relationships as suggested in the literature (e.g., Harrington & Hammond, 2006a), future research is necessary to determine participants' ability to separate elements in the match relationship and determine other potentially important match elements, such as flavor intensity, sweetness levels, acid levels, flavor types, and umami.

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