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Predictability of Food and Wine Pairing using a Sensory Approach

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ABSTRACT

The purpose of this study was to explore significant differences in perception of match for a variety of food and wine styles; evaluate the impacts of wine sweetness level, wine acidity level, and wine tannin level on perception of match; and to investigate the impact of food and wine expertise on perceived level of match. A field research design was used to explore expert recommendations of food and wine combinations to obtain broader feedback on consumer perceptions. The population consisted of a convenience sample of 248 students enrolled in a continuing education course in food and wine pairing at George Brown College in Canada. Participants evaluated their perceived competency in food and wine pairing experience; sweetness, acidity and tannin levels for each wine; and perception of match with each food and wine combination using a survey instrument that employed 0 – 10 line scales for each evaluation. Participants were separated into expert and novice groups based on their self-evaluation of food and wine pairing experience in order to explore differences in perception between experts and novices. The highest perceived wine matches for each food item were: Sauvignon Blanc and chêvre (*mean* = 5.69; *SD* = 2.32), Chardonnay and brie (*mean* = 4.08; *SD* = 2.36), Cabernet Sauvignon and spicy Italian salami (*mean* = 5.09; *SD* = 2.45), and Port and milk chocolate (*mean* = 5.46; *SD* = 2.87). Wine sweetness, acidity and tannin levels all significantly impacted the level of match with certain food items. Food and wine expertise also significantly impacted the level of match, and differences between the expert and novice groups were found in regard to perception of match for select food and wine combinations and the impact sweetness, acidity, and tannin had on level of match.

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DEDICATION

This thesis is dedicated to my wonderful, loving family, and my very own synergistic match. Without your encouragement and support I would never have completed this project! Thank you for believing in me and never giving up on me. I love you all.

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Chapter 1

Introduction

People have been enjoying and experimenting with food and wine combinations for years, and research has shown that consuming the two together can increase satisfaction of both the food and the wine (Bastian, Collins & Johnson, 2010; Harrington, 2005; Harrington & Hammond, 2005, 2006; Madrigal-Galan & Heymann, 2006; Nygren, Gutafsson, & Johansson, 2002, 2003a, 2003b). As consumers are becoming more adventurous, they are seeking more knowledge of food and drink combinations in order to reap the full benefits of gastronomy (Van Westering, 1996). Therefore, the findings of this study can benefit food service and wine professionals by providing more knowledge of wine and food matches that consumers perceive as ideal, and this knowledge can aid restaurateurs, service staff, and wine sellers in improving the overall customer experience through pairing suggestions. Also, with a greater knowledge of food and wine pairing, everyday consumers will feel more comfortable choosing food and wine combinations in more personal settings such as family gatherings and dinners at home.

The overall goal of this research was to evaluate a variety of sensory relationships in the interaction of wine and food when tasted sequentially and then together. Differences in perceived level of match were explored to evaluate a variety of food and wine style combinations. The perceived level of match refers to how well an individual believes the food and wine pair together. Authors of food and wine pairing literature have generated several match levels that range from no match to synergistic match (Harrington, 2008; Immer, 2000; Rosengarten & Wesson, 1989).

The effects of certain wine characteristics (component and texture elements) were also examined to determine their impact on perceived level of match, and this study specifically

explored sweetness, acidity and tannin. Components relate to basic taste perceptions (sweet, sour, salty, bitter) on the tongue. Sweetness, a wine component, is determined by the amount of residual sugars that remain after fermentation, and wines range from dry (lack of residual sugars) to sweet. Acidity, another wine component, in wine often relates to a sour taste, and acids are inherent in grapes and are often formed during fermentation. Texture elements relate to the tactile sensation of wines in the mouth. Tannin, a wine texture, is perceived as a roughening and drying sensation in the mouth (Harrington, 2008; Immer, 2002; Jackson, 1994, 2002; Rosengarten & Wesson, 1989; Simon, 1996).

This study also explored the impact food and wine pairing expertise had on the perceived level of match. Food and wine pairing expertise relates to the experience and knowledge one has regarding food tasting, wine tasting and food and wine pairing. Expert and novice groups were used to explore any significant differences in perception of match for selected food and wine combinations as well as any differences regarding which key wine elements impacted perceived level of match. The novice group ranged from novice to average in food and wine pairing, and the expert group ranged from average to expert in food and wine pairing.

This research project examined the potential of predicting food and wine match levels using a scoring approach. Four wines specifically (Chardonnay, Sauvignon Blanc, Cabernet Sauvignon, and Port) were considered, and the perception of match with each wine when paired with chêvre, brie, spicy Italian salami and milk chocolate was evaluated. Wine sweetness, acidity and tannin levels for each wine were also evaluated. The following research questions were addressed to explore these food and wine pairing issues:

RQ_1: Are there significant differences in perceived level of match for a variety of different food and wine styles?

RQ_2: Do certain wine characteristics impact the perceived level of food and wine match?

RQ_3: Does food and wine pairing expertise level impact the perceived level of food and wine match?

RQ_4: Are there significant differences in perception of match between experts and novices for selected food and wine combinations?

RQ_5: Are there significant differences between experts and novices regarding which key wine characteristics impact the perceived level of food and wine match?

Numerous publications exist in the mainstream press exploring food and wine pairing combinations, but the views projected are mainly subjective and merely offer guidelines to follow to achieve successful food and wine matches instead of providing definite rules for pairing (Harrington, 2008). Also, previously published articles in scholarly publications researching food and wine pairing generally used a small sample size with the largest sample size being 76 participants (Bastian et al., 2010), and most of these studies used trained or expert panelists (Harrington & Hammond, 2005, 2006; Harrington, McCarthy, & Gozzi, 2010; King & Cliff, 2005; Madrigal-Galan & Heymann, 2006; Nygren, Haglund, Johansson, & Noble, 2001; Nygren et al., 2002, 2003a, 2003b). Not only do these studies have limited sample sizes and types, but their food selection has been limited mostly to cheeses. Therefore, these studies have neglected to explore different component, texture and flavor elements that a larger variety of foods could provide, because the cheeses used in previous research share similar characteristics in regards to acidity, fat and salt levels (Bastian, Payne, Perrenoud, Joscelyne, & Johnson, 2009;

Bastian et al., 2010; Harrington & Hammond, 2005; Harrington et. al., 2010; King & Cliff, 2005; Madrigal-Galan & Heymann, 2006; Nygren et al., 2002, 2003a, 2003b).

A key purpose of this study was to determine which food and wine combinations result in the perception of an ideal match using a large sample size (N = 248) consisting of individuals ranging from novices to experts in food and wine pairing as well as adding other types of foods in addition to cheeses.

Chapter 2

Literature Review

Background

Eating and drinking are life sustaining activities that not only provide nourishment but enjoyment and pleasure. Consumers enjoy food and wine together because the combination increases satisfaction of both the wine and the food (Bastian et al., 2010; Harrington, 2005; Harrington & Hammond, 2005, 2006; Harrington et al., 2010; Madrigal-Galan & Heymann, 2006). In addition to experiencing more sophisticated taste combinations, individuals also enjoy the combination for other reasons. Research has shown that consumers believe wine is a situational accompaniment to food and prefer not to drink wine alone to avoid any social stigmas (Pettigrew & Charters, 2006).

The goal of many when pairing wine and food is to create a match that brings out the best qualities of the food and wine when enjoyed together. With a variety of wine styles, brands and types to choose from, consumers are prepared to find and purchase products that meet these sensory expectations (Lattey, Bramley, & Francis, 2010). While an absolutely perfect marriage of food and wine is rare, it is not impossible to achieve other acceptable and enjoyable combinations. When selecting food and wine combinations, there is always the chance that *no match* will be created between the two. Some combinations produce a negative effect when tasted together often when the food is overly acidic, salty, bitter or spicy. Wine and food combinations can be created where the wine plays a supporting role in the relationship. This match, whose purpose is refreshment, requires only that the wine act as a simple, pleasant beverage that accompanies the food choice. A *refreshment match* is often appropriate when certain characteristics of the food may make it difficult to pair with certain wines, and cold reds

and whites often serve the purpose of refreshment. For example, any food that is highly seasoned or spiced will pair nicely with a cool, refreshing wine to cleanse the palate. A *neutral match* is created when nothing turns more acidic, harsh, bitter, or sweet when wines and foods are tasted together. People may set their food and wine pairing goals no higher than a neutral match at gatherings such as Thanksgiving so that the wines selected will accompany the different types and styles of foods served without significantly altering the characteristics of either. At times, some combinations can bring about great changes in the wine or the food. Certain elements in either a wine or a food in a *transformation match* remain unchanged while others completely change bringing about a great, average or bad match depending on the circumstances. Often, the basic components of foods and wines are similar enough to create a good match. A *good match* may not only consist of matching food and wine flavors, but important characteristics such as overall body style of the food and wine will also match. When components, overall body and flavor match, a *synergistic match* is achieved. Here, the combination of food and wine creates an effect that is superior to the food and wine tasted individually. Synergy is often achieved when a third flavor is created that is not tasted in either the food or the wine. This dynamic match is the ultimate goal of most food and wine marriages (Harrington, 2008; Immer, 2000; Rosengarten & Wesson, 1989).

Food and Wine Pairing Considerations

Experts have generated several "rules" to act as guidelines when pairing wine and food. These rules have expanded upon the old suggestion of "red wine with meat, white wine with fish" to take into consideration the many factors influencing a food and wine match such as gastronomy and the important elements of food and wine components, textures and flavors. (Harrington, 2008; Immer, 2002; Rosengarten & Wesson, 1989; Simon, 1996).

Gastronomy. Food and wine characteristics that influence the level of match are often dependent on an area's gastronomic identity since it can impact the components, textures and flavors of foods and wines. Norms and rules with respect to eating and drinking are referred to as gastronomy. Any advice or guidance regarding what, when, where, why and how much to eat and drink and in what form and combination all lies within the scope of gastronomy (Santich, 2004). Gastronomy draws on social, economic and cultural situations as well as environmental conditions, and these influences impact certain characteristics of foods and wines. Environmental conditions, such as latitude location and soil quality, affect how ripe grapes will become and determine harvest time, nutrients the vine receives, and water uptake conditions. Culturally, certain factors such as the socio-economic conditions of the growing area, wine making traditions, technology used, grower's classification (cooperatives vs. independents) and farming techniques can also influence a wine's final composition. An area's gastronomic identity can provide clues to a wine's overall components, textures and flavors and this information can be helpful to consumers when selecting wines to pair with certain foods (Ferguson, 2000; Harrington, 2008; Immer, 2000; Leeuwen & Seguin, 2006; Preston, 2008).

Because components, textures and flavors of wines and foods greatly affect the success of a food and wine combination, they should not only be considered in the context of gastronomic identity. These important elements of food and wine can determine whether a food and wine match is merely neutral or achieves synergistic status.

Key wine characteristics. Categorizing food and wine elements into three groups (components, textures, flavors) makes it easier to determine what specifically drives a successful food and wine match (Harrington, 2008). Authors and experts disagree on which elements are most important in determining the success of a food and wine pairing, but they agree that these

are important elements to consider when pairing food and wine. Harrington (2008) considers components to be the most *basic* elements that impact a match, while Rosengarten and Wesson (1989) believe they matter *most* in food and wine pairing. Immer (2002) and Simon (1996) found that in their experiences that body style/weight is the most important element that determines the best food and wine marriages.

Components are often measurable and correspond to the basic sense perceptions of sweet, salty, bitter and sour on the tongue. These sensations supply the initial impression for food and wine tastes and even when textures and flavors are perceived their opening mark remains. Textures are perceived in every corner of the mouth and correspond to touch and temperature sensations. Food and wine with similar or contrasting textures can be successfully paired as some combinations reinforce each other texturally and others create interest with striking texture differences. Flavors are experienced through an interaction of the nose and palate, and they give food and wine their distinct tastes. However, food and wine flavors generally come from different sources, and adjectival descriptions of flavors are not always indications of potential food and wine matches. (Harrington, 2008; Rosengarten & Wesson, 1989; Simon, 1996). The following sections outline sweetness, acidity and tannin as they are important elements in determining the perception of match between wines and foods, and they are the key characteristics explored in this study.

Sweetness. Sweetness, or "dryness" in wine-tasting terminology, comes from residual sugars left after fermentation and levels vary depending on grape variety and other factors. Glucose and fructose are the primary grape sugars, and they are essential for fermentation as yeast needs these sugars for energy. As grapes ripen their acidity level decreases and their sugar level increases; therefore, the grapes' ripeness at harvest time greatly affects the amount of sugar

perceived in a wine. Sweetness is perceived by sensitive tasters at concentration levels of 0.2% or higher, but most individuals cannot taste sweetness unless the sugar content is greater than 1%. In a finished wine product, a hydrometer can be used to determine the percentage of sugar content by weight which is expressed in degrees of Brix. High sugar levels can create a sense of body and can also diminish acidic, bitter and astringent aspects of wine (Clarke & Bakker, 2004; Grainger, & Tattersall, 2005; Harrington, 2008; Jackson, 1994, 2002).

Acidity. The perception of sourness comes from acidity levels in wines and foods. Acidity gives wine refreshing, crisp, and fresh qualities. Acids originate in the grape (tartaric and malic) and are generated during fermentation (lactic and succinic). Since different grape varieties have different acidity levels, the finished wines vary in their acid taste. Also, the growing region's climate also plays a role in the amount of acid a wine will have. Cooler climate growing regions usually produce wines that are more crisp and tart. Wines made in warmer climates can often be flat and bland (Clarke & Bakker, 2004; Grainger & Tattersall, 2005; Harrington, 2008; Immer, 2002; Rosengarten & Wesson, 1989).

Tannin. Astringency is the sensation most synonymous with tannins. Increasing with ripeness, tannin comes from the grape skins, stems, and seeds; and wines made from grapes with thick skins usually have the most tannin. Often confused with bitterness, tannins create a rough, drying and puckering sensation in the mouth especially when grapes are unripe or have been improperly handled. Tannin is more notable in red wines since during the wine making process the grapes soak up not only the red color but also the tannin. The longer the grapes soak, the more tannin the wine will have. Also, as wines age, the tannins settle out as a deposit and become softer (Clarke & Bakker, 2004; Gawel, Oberholster & Francis, 2000; Grainger, &

Tattersall, 2005; Harrington, 2008; Immer, 2000, 2002; Rosengarten & Wesson, 1989; Turner & Roycroft, 1979).

Wine Styles and Key Differences

Wines are complex and their unique tastes are derived from many sources such as grape varietal, volatiles formed during yeast fermentation, microbial germentations and post-fermentation treatments. Nonvolatile compounds such as sugars and polyphenols contribute greatly to the wine's major components and textures of sweetness and tannin level (Ebeler, 2001). Wines are categorized as white, red, rose, fortified or sparkling. Red wines have been fermented with the skins left on the grapes increasing the amount of tannin in the final wine product. When making white wines, the juice is separated from the skins before the fermentation process creating a lighter colored, less tannic wine. Rose wines are generally pink in color because the grapes have had limited contact with their skins during fermentation and maintains only some of the tannin. Extra alcohol is added to wines to fortify them, and the alcohol content of fortified wines is generally greater than 14%. Champagne or sparkling wines are effervescent and are easily distinguished by their bubbly nature (Harrington, 2008; Immer, 2000, 2002; Rosengarten & Wesson, 1989; Simon, 1996). The following sections provide a brief background on the four wines used in the study to highlight certain elements that have the potential to affect the perception of match when tasted with foods.

Sauvignon Blanc. As one of the most recognizable grape varieties, Sauvignon Blanc is best enjoyed within a year of purchase as freshness decreases and complexity does not increase with age. Sauvignon Blanc is generally highly acidic and the acid levels impart tangy, tart, and zesty characteristics to the wine. Warmer climates create wines with asparagus and green bean characteristics and often produce wines that lack the vivid, brisk qualities found in most

Sauvignon Blanc wines. Better suited for cooler climates, Sauvignon Blanc maintains its fresh and crisp characteristics when grown in cooler regions. If grapes lack sun exposure or are harvested unripe, the final wine can possess an aggressive cat urine aroma and if exposed to more sunlight, the wine has a more melon like aroma.

Sauvignon Blanc can grow quite vigorously and unrestrained growth as well as over-cropping can lead to uninteresting wines with neutral tastes. The importance of canopy management, pruning, and leaf and shoot thinning allows the plant to use its energy to properly ripen the grapes (Immer, 2000; LaMar, 2002c; Simon, 1996). Sauvignon Blanc is often blended with Semillion to soften the aroma and add additional richness and flavor. Not as common is the practice of barrel fermentation to modify aroma and increase the wine's complexity. These practices and production differences lead to little consistency in different Sauvignon Blanc styles, and consumers are often confused about the nature of this wine as a result (LaMar, 2002c).

Chardonnay. Chardonnay is also one of the most recognizable, noble white grape varieties, and its final composition ranges from medium to full-bodied. Chardonnay is so delicate that its aroma and flavor can be completely dominated when blended with a small percentage of another varietal. This 'blank canvas quality' allows differences in soil, climates, and vineyard practices to greatly affect its final composition. Cooler climates yield light, lean, appley, and slightly acidic wines. Warmer climates create filled-out wines with butterscotch or butter flavor. Different wine making techniques can also create wide variances in Chardonnay's characteristics. Fermentation in oak barrels can impart oakey aromas and flavors to the finished product.

Researchers from the University of California at Davis determined through DNA profiling that Chardonnay originated from the nearly extinct grape variety, *gouais blanc.* While this variety is a member of the pinot family, Chardonnay is not considered to be a member of this variety family. Chardonnay is more difficult to handle from harvest to bottling and is relatively more sensitive to winemaking techniques since the berries oxidize easily and are fragile due to their small size and thin skin (LaMar, 2002b; Simon, 1996; Yildirim, Yildirim, Yucel, Ova & Altug, 2007).

Cabernet Sauvignon. Cabernet Sauvignon can be grown just about everywhere and its growth characteristics and flavor appeal have made Cabernet Sauvignon a popular wine around the world. Cabernet Sauvignon is generally well suited for aging as the bouquet develops and tannins soften and smooth. According to LaMar (2002a), U.C. Davis University researchers have determined that Cabernet Sauvignon is a hybrid offspring of Sauvignon Blanc and Cabernet Franc. Since Cabernet Sauvignon berries are relatively disease resistant because of their rough skins, grapes can be left to ripen late into the season. Moderately warm, semi-arid areas with long growing seasons and well-drained soil are the ideal place to cultivate grapes for Cabernet Sauvignon wines. Climates that are too warm or too cool with inadequate sun exposure can cause the finished wine to be more vegetal and less fruity (LaMar, 2002a; Simon, 1996).

Port. Port wines are fortified sweet wines made from the Maurisco grape and shipped out of Oporto, Portugal. A fortified wine made using the same techniques is not officially considered Port unless it dons a seal of authenticity of the Portuguese Government. Ports are made through the addition of fortified spirits that halt the fermentation process which leaves higher sugar levels in the final product. In order to produce a consistent product, winemakers often blend sweet and dry wines to achieve the desired sweetness. Ruby Port, like the one used

in this study, is the most common wood port and is made from blending wines from several different vintages. Typically, Ruby Ports are aged two or three years before bottling (Fletcher, 1981; Harrington, 2008; Jackson, 2002).

Food Characteristics

Knowledge of certain food qualities and characteristics can also aid in determining which wines to match with certain food dishes or what foods to prepare based on wine selection. The components, textures and flavors of foods can impact the potential success or failure of a food and wine marriage. The foods used in the study are briefly described below.

Chêvre is a fresh cheese made from goat's milk. It has a lower fat content and is generally mild, creamy and sometimes tangy. Since Chêvre is not cooked or ripened it maintains a higher moisture content and overall is not overly bitter. The texture of Chêvre is moist and creamy and often comes coated in leaves, herbs or pepper (Harrington, 2008; Herbst, 1995).

Brie is a soft-ripened cheese made from cow's milk, and it usually has a higher fat content and a smooth rich texture. Brie is ripened from the outside in and has a firm and edible rind and a soft, creamy and buttery center (Harrington, 2008; Herbst, 1995; Simon, 1996).

Salami is a type of sausage that is air-dried, and the meat does not have to be cooked before eating because the curing process preserves the meat. Typically made from a mixture of beef and pork, salamis are often heavily seasoned, and Italian varieties are often rich, fatty and studded with black or white peppercorns (Herbst, 1995).

Milk chocolate has a gluey mouth coating texture that often blocks the taste buds and deadens the palate due to its richness and sweetness. Milk chocolate is made through the addition of dry milk to sweetened chocolate. With less chocolate liquor than dark chocolate, the taste of chocolate flavor is not as pronounced (Harrington, 2008; Herbst, 1995; Simon, 1996).

Food and Wine Research

While food and wine pairing "rules" and suggestions are abundant in popular literature, only a small amount of empirical studies have been published in peer-reviewed journals on the subject of food and wine pairing (Harrington et al., 2010; Harrington & Hammond, 2006; Nygren et al., 2001; Pettigrew & Charters, 2006). A slightly larger number of wine and cheese pairing studies have been conducted (Bastian et al., 2009, 2010; Harrington & Hammond, 2005; King & Cliff, 2005; Madrigal-Galan & Heymann, 2006; Nygren et al., 2002, 2003a, 2003b).

Nygren et al. (2001) explored the change in flavor produced by food and wine combinations by measuring interactions of wine and hollandaise sauce. It was found that the hollandaise sauces decreased the perception of sourness and bitterness of the wines and increased the butter flavor, but none of the wines had a significant effect on the creamy mouthfeel of the sauces. The effect of the sauce on the wine flavor was greater than the effect of wines on sauce flavor; however, the effect of the sauce on the wine flavor was not statistically significant.

The impact of blue mold cheese on sensory perceptions in white wine was considered by Nygren et al. (2002). The sequential tasting approach (wine-cheese-wine) found that many wine flavors such as sourness decreased but others such as sweetness remained the same.
Nygren et al. (2003a) studied how the prior tasting of dry white wine affected the sensory perception of blue mold cheese. Using another sequential tasting approach (cheese-wine-cheese) some of the flavors such as butter and wooly and tastes of saltiness and sour of the cheeses declined.

Comparing a mixed tasting approach (tasting the wine and cheese together) with the previously used approaches (sequential), Nygren et al. (2003b) evaluated white wines and blue mold cheeses and found that generally flavor and taste intensities of wine and cheese decreased

by means of mixed tasting. Nygren et al. (2003b) suggested that using a mixed approach in wine and cheese research would be most appropriate since this technique resembles how people normally eat.

King and Cliff (2005) evaluated wine and cheese pairings with the use of a scale to measure ideal matches, and relatively small deviations-from-ideal confirmed that wine and cheese were compatible. The study found that between white, red and specialty wines, white wines paired best with the cheeses. It was also noted that stronger flavored cheeses tended to be better matched with stronger flavored wines. Since there was a relatively high deviation for each cheese across all wines, this indicated that the judges were not in agreement on their evaluation of matches due to personal preferences and individual differences in tastes.

Harrington and Hammond (2005) also found a substantial amount of variation in perceived level of match across the panel of judges when the direct impact of food and wine elements on the level of perceived food and wine match was measured. It was found that sweetness level in wine was a predictor of perceived level of match with two out of the four cheeses used in the study, and overall wine body was a significant predictor of match with one of the cheeses. No support was found for wine acidity or spiciness; food saltiness, bitterness, or spiciness, or the importance of wine or food flavor intensity as predictors of level of match. In 2006, Harrington and Hammond studied the impact of body or texture elements on perception of food and wine match. Through the use of sequential evaluations of foods and wines, it was proven that perceived level of match can be predicted. The study found that body matches (as well as food fattiness to tannin matches) create successful pairings between food and wine.

Madrigal-Galan and Heymann (2006) studied how red wine impacted flavor perceptions of certain cheeses. The overall observed trend was that the tasting of cheese previous to the

evaluation of wine decreased the perception of certain wine attributes, such as astringency and oak and berry flavor and aroma, but the perception of butter did not decrease. This research aligned with Nygren et al. (2001) research indicating the mixture effects not only cause some attributes to be suppressed but others enhanced.

Bastian et al. (2009) studied consumers' evaluations of ideal food and wine pairings recommended by experts. Using a mixed tasting method, it was found that the majority of pairs suggested by experts were rated to be close to ideal by the consumers. Red table wines proved to be better accompaniments to cheeses than white wines as they were more versatile. Bastian et al. (2010) explored preference of pairs of different red wines with the same cheddar cheese. This research found that eating cheddar cheese before drinking Shiraz reduced some of the negative characteristics of the wine and enhanced the preference for the wine. This indicates that consuming food and wine together can minimize some of the less desirable flavors of both.

Harrington et al. (2010) considered the addition of specific food items to wine and cheese pairings to increase the overall match sensation. The study found substantial differences in perceptions across participants, but overall, the addition of other food items increased the overall sensation of the wine and cheese match and indicated an enhancement in the overall experience for the consumer.

A review of the small number of food and wine studies revealed that regardless of the tasting method (mixed, sequential, or both) the combination of wine and food can bring about not only attribute suppression but also enhancement. Also, there appeared to be a level of variance in food elements, wine elements and perceived level of match among participants in all studies which highlights the individual differences, such as taste preferences and food and wine pairing expertise levels, between subjects.

Experts versus Novices

The majority of food and wine studies conducted used expert or trained sensory panels (Harrington & Hammond, 2005, 2006; Harrington et al., 2010; King & Cliff, 2005; Madrigal-Galan & Heymann, 2006; Nygren et al., 2001; Nygren et al., 2002, 2003a, 2003b) and few studies used novices to study preferences for food and wine combinations (Bastian et al., 2009, 2010). Research has highlighted some performance differences between experts and novices in sensory study environments.

Lawless (1984) found that experts are more disciplined tasters than novices as they systematically inspect wines for appearance, aroma in the glass and flavor in the mouth. Experts have mechanical strategies to enhance the release of (and increase the concentration of) volatile molecules reaching the olfactory receptors such as swirling wine in a glass and sipping the wines. Often, novices only elicited a simple hedonic reaction since wine makes its way from the glass to the palate to the stomach in little time. Experts also have the advantages of accessibility of experiences for aroma description and are knowledgeable about what to expect concerning the probable attributes of different wine styles and origins. Experts were found to match descriptions more accurately than non-experts and used more concrete terms when describing wines whereas consumers used more abstract terms.

McBride and Finlay (1989) studied the differences between experienced and novice assessors when tasting mixtures. The subjects tasted solutions of sucrose and citric acid, and both groups perceived the total intensity of taste mixtures the same way. Novice assessors tended to overestimate sweetness at low intensity levels and underestimate sweetness at high intensity levels. The perception of acidity by novices appears to have been more affected by

sucrose than it was for the assessors, and this judgment of acidity was the only substantive difference between experienced and novice assessors.

Solomon (1990) conducted four studies in which expert and novice tasters matched descriptions of wines written by other experts and novices. Overall, experts were better than the novices in the following ways: matching the wine descriptions written by other experts to the respective wines, performing better on a test of wine discrimination and agreeing on the ranking of wines based on tannin, balance and sweetness as the novices could only rank the wines according to sweetness.

The literature revealed that the main difference between experts and novice consumers has proven to be the quality of the vocabulary used to describe food and wine elements (Chollet & Valentin, 2001; Gawel, 1997; Lawless, 1984; Solomon, 1990). In addition to superior and consistent vocabulary, experts posses a more conceptual knowledge about wines and their expertise developed on the basis of experience with wine related compounds rather than superior sensory ability. Experts are able to identify major attributes of wines and are often categorized as chemists who make wine, wine wholesalers and professors of enology (Lehrer, 1975). Experts should be skilled enough to produce consistent descriptions for the same wine in terms of detectable elements or configural terms (Hughson & Boakes, 2001). For the purposes of this study, experts are defined as individuals who possess explicit knowledge of wines, grape varieties and wine production and enjoy wine on a regular basis, and novices are defined as individuals who rarely drink wine and know very little about it or its production (Hughson & Boakes, 2001).

Value of Food and Wine Pairing Knowledge

Better understanding of food and wine pairing knowledge, and the ability to predict successful food and wine matches can be beneficial for the average person, food and wine professionals and educators. Harrington (2005) and Pettigrew and Charters (2006) suggest that consuming food and wine together can enhance the overall dining experience and the social setting. Individuals seeking to enjoy food and wine combinations can greatly increase their satisfaction by using this information to make more informed decisions regarding food and wine selection.

Food and wine professionals, with food and wine pairing knowledge, are better equipped to recommend food and wine combinations that meet and exceed customer expectations (Harrington & Hammond, 2006). Stanich (2004) suggests that increased gastronomic satisfaction leads to a higher level of overall customer satisfaction. This increased level of customer satisfaction can help businesses increase not only their average check size but their overall profits (Van Westering, 1996).

In an educational setting, this information can be beneficial to educators so that they can provide a more well rounded knowledge that addresses more in depth information about why certain food and wine combinations succeed or fail. Responding to the growing consumer interest in food and wine and other aspects of gastronomy, educators can also provide their students with valuable information that expands upon the traditional curriculum of basic business issues and other introductory courses (Harrington & Hammond, 2005).

Chapter 3

Methods

This study utilized survey instrument to explore a variety of sensory relationships in the interaction of food and wine. A field experiment research design guided this study and was appropriate because the experiment was not conducted in a laboratory setting. One criticism of previous food and wine studies is that the majority of experiments conducted used small groups of experts or trained panelists in labs (Harrington & Hammond, 2005, 2006; Harrington, McCarthy, & Gozzi, 2010; King & Cliff, 2005; Madrigal-Galan & Heymann, 2006; Nygren et al., 2001; Nygren et al., 2002, 2003a, 2003b). The highly controlled and artificial environment in laboratory settings results in a less accurate reflection of the general population. Therefore, this study increased the sample size and explored these food and wine pairing relationships in a more natural environment to obtain broader feedback on consumer perceptions. Also, the larger sample size increased the external validity of the findings by minimizing the negative effects of a less controlled environment (larger standard deviation, decreased accuracy, etc.). The following sections explain the research methodology used to address the following research questions:

RQ1: Are there significant differences in perceived level of match for a variety of different food and wine styles?

RQ2: Do certain wine characteristics impact the perceived level of food and wine match?

RQ3: Does food and wine pairing expertise level impact the perceived level of food and wine match?

RQ4: Are there significant differences in perception of match between experts and novices for selected food and wine combinations?

RQ5: Are there significant differences between experts and novices regarding which key wine characteristics impact the perceived level of food and wine match?

Hypotheses

To address the research questions, several hypotheses were formulated to explore certain food and wine pairing relationships. The literature on food and wine implies numerous potential interactions based on taste components, texture elements and flavors in food and wine products, and studies have found that certain wines pair better with certain foods (Bastian et al., 2009; Harrington et al., 2010; King & Cliff, 2005). Authors in popular literature also propose food and wine combinations that they suggest will be successful based on personal experience and age old adages (Immer, 2000, 2002; Rosengarten & Wesson, 1989; Simon, 1996). Also, literature exploring food and wine match level suggests that certain foods and wines are simply better than others (Harrington, 2008; Immer, 2000; Rosengarten & Wesson, 1989). For the first hypothesis, we suggest that the perceived level of match between certain food and wine combinations will be significantly greater than others. Formally stated:

H_1: Certain food and wine combinations will be perceived as significantly better than others.

Certain key wine characteristics potentially determine the level of match between certain wines and foods. According to the relevant literature that tests the affects of the three wine characteristics (sweetness, acidity and tannin) used in this study, only sweetness level and tannin level have been identified to be significant predictors of ideal food and wine match. No support has been found for acidity level as a significant predictor of level of match (Harrington & Hammond, 2005, 2006). Harrington and Hammond (2005) found that sweetness significantly impacted the level of match with two out of four cheeses used in the study, and in 2006, Harrington and Hammond found that a match of food fattiness and wine tannin levels strongly

impacted the level of perceived food and wine match. While no empirical studies have found acidity levels in wine to have a significant impact on level of match, authors do speculate that acidity levels can have a great impact on food and wine combinations (Harrington, 2008; Immer, 2002; Rosengarten & Wesson, 1989; Simon, 1996). Based on the findings of empirical studies and suggestions made in food and wine pairing literature, the following relationships are predicted:

H_{2a}: Wine sweetness level will significantly impact perceived level of food and wine match.

H_{2b}: Wine acidity level will significantly impact perceived level of food and wine match.

H_{2c}: Wine tannin level will significantly impact perceived level of food and wine match.

The food and wine relationship appears to be further complicated by individual differences, experience levels and other factors (Amerine & Roessler, 1976; Gilbert, 2005; Goode, 2005). The majority of the literature exploring differences between experts and consumers is centered on performance differences in sensory study environments and does not compare expert and consumer perceptions of match for certain food and wine combinations. Only two food and wine pairing studies exploring perception of match have been conducted using consumers (Bastian et al. 2009, 2010). Bastian (2009) had consumers rank eight different wine and cheese pairs suggested by four industry experts. Overall, the consumers agreed with the experts on six of the eight matches. In 2010, Bastian et al. found that when a group of consumers and experts tasted ten Shiraz wines with the same cheddar cheese, the consumers had similar wine preferences to the experts'.

Based on these findings it is predicted that experience or expertise in food and wine pairing will not significantly impact the level of food and wine match, and it will not cause a

significant difference between experts' and consumers' perception of match for selected food and wine combinations. Formally stated:

H_{3a}: Food and wine expertise will not significantly affect the perceived level of food and wine match.

H_{3b}: Food and wine expertise will not result in significant differences in perceived level of food and wine match between the expert and novice groups.

Only two studies have been conducted exploring the impact of key wine characteristics on perceived level of match (Harrington & Hammond, 2005, 2006). In 2005, Harrington and Hammond recognized a level of variance in scoring wine elements as well as in the perceived level of match. This aligns with other studies that noticed a high deviation among responses and substantial differences in perceptions when exploring food and wine matches (King & Cliff, 2005; Harrington et al., 2010). These studies only used experts, but due to the lack of literature comparing consumers and experts, this variation in responses is expected to apply to consumers as well. Therefore it is predicted that the deviation in responses within both groups regarding their perception of which key wine elements predict level of match will not lead to a significant difference between the expert and consumer groups. Formally stated:

H_4: Food and wine expertise will not significantly affect the impact of key wine elements on perception of match.

Sample and Procedures

Several earlier studies in food and wine have used relatively small panels or samples (Bastian et al., 2009; Harrington & Hammond, 2005, 2006; Harrington et al., 2001, Nygren et al., 2002, 2003a, 2003b). As Meilgaard, Civille, and Carr (2007) point out there is an enormous range shown by earlier research for thresholds for different compounds and substantial

differences across individuals. Therefore, this study utilized a larger sample to increase the validity of its findings for the general population. The study utilized a convenience sample of culinary students in a degree program and trade professionals participating in a continuing education program on wine and food at George Brown College in Toronto. Participants ranged in expertise levels and in industry experience outside of this training program. The study was part of a semester long course on food and wine pairing, and the resulting sample consisted of 248 participants (91 females and 157 males).

Data collection process. Participation in the study was voluntary. Participants were given an information letter and consent form prior to participation in the project, and copies are provided in Appendix A and B. The data collection procedures were as follows:

1. Participants went through a one-time sensory training and evaluation session lasting approximately 60 minutes in duration, which included the following:
    - A 15 minute sensory training session introducing the sensory evaluation survey form and providing definitions of terms used in the sensory evaluation survey form.
    - A 45 minute sensory evaluation exercise where participants were asked to identify their perceived level of competency in wine tasting and wine and food matching. Using the sensory evaluation survey form participants were instructed to determine the primary taste components and texture elements. As part of this process, they were also asked to assess the level of perceived match among several types of food and wines. Wine elements of interest in this study included level of sweetness, acidity, and tannin (astringency). The levels of these food and wine elements were not beyond the levels that participants might normally consume. Participants were required to spit out the majority of wine being sampled to minimize palate fatigue.

2. Participants were asked not to wear excessive perfume or cologne and to refrain from smoking tobacco directly prior to tasting or during the tasting sessions.
3. Every effort was made to ensure confidentiality of any identifying information that was obtained in connection with this study. The names of members in this study were kept confidential during data analysis and subsequent publication of study results. Sensory evaluation survey forms were given an ID code prior to statistical analysis.
4. The data collection was conducted by the lead instructor of the course.
5. Participants were not reimbursed or compensated in any way.
6. Participants who were unable or not interested in participating in one or more components of this study were told they were free to do so.

Testing instrument. The testing instrument was adapted from previous food and drink research (Bastian et al., 2009; Harrington et al., 2010). Because this study used a previously developed scale with slight modifications, the content for the wine attributes, level of match, and food and wine expertise were considered to be validated by previous research and theoretical grounding (Bastian et al., 2009; Harrington et al., 2010). The Cronbach's alpha reliability coefficient was calculated to verify the reliability of the testing instrument and the value was determined to be .72. An alpha $\geq .70$ is an acceptable reliability coefficient and indicates acceptable internal consistency (Nunnally & Bernstein, 1994). The instrument included five sections and a copy is included in Appendices C - G: (1) Tasting instructions, (2) Wine and food expertise self-evaluation, (3) Value bands and food/wine level descriptions, (4) Evaluation of wine sweetness, acidity and tannin levels, and (5) Food and wine level of match. The tasting steps in this study were as follows:

1. Prior to tasting, participants were instructed to complete a self-evaluation regarding levels of competence in food tasting, wine tasting, and food and wine matching. These scales used a continuous 0 to 10 line scale with anchors of novice, average and expert (0 = novice, 5 = average, 10 = expert). Participants also indicated if they were male or female on this form.
2. The second step was for participants to evaluate each wine for level of sweetness, acidity and tannin using a 0 to 10 line scale. Participants were provided with and instructed on value bands with descriptor terms for each following value band level and descriptions of the perception for each value band.
3. Wines were evaluated with each food in order of lightest to fullest style (Sauvignon Blanc, Chardonnay, Cabernet Sauvignon and Port). The wines were served in 25cl INAO tasting glasses, and participants were provided with 1 ounce of wine for each evaluation. The wine temperatures were as follows: 9 degrees Celsius for the Sauvignon Blanc and Chardonnay and 16-17 degrees Celsius for the Cabernet Sauvignon and Port. The Sauvignon Blanc and Chardonnay wines were produced in Canada, the Cabernet Sauvignon in Argentina and the Port in Portugal. The wines ranged in price from $13.95 to $16.95 and their alcohol levels ranged from 12.7% to 20%. All wine bottles were 750 ml. Complete descriptions of the wines are provided in Table 1.

Table 1

Wine Identification and Sensory Descriptions

Wine Style	Vintage	Origin	Price	Composition	Sensory Description
Sauvignon Blanc	2009	Dan Aykroyd Lakeview Winery Niagara, ON Canada	$14.95 750ml	Alcohol: 12.7% Dryness: 1	Pale straw color; aromas of citrus, peach, and flinty mineral notes; dry, light-bodied, and refreshing, with peach and grapefruit flavors on the finish.
Chardonnay	2008	Angels Gate Winery Niagara, ON Canada	$13.95 750ml	Alcohol: 13.5% Dryness	Yellow gold in color; aromas & flavors of pineapple, pears & melon; off-dry, soft with a warm finish.
Cabernet Sauvignon	2007	La casa del Rey Argentina	$14.95 750ml	Alcohol: 14% Dryness: 1	Aged in 50% American and 50% French oak for one year, imparting toasty coconut and vanilla notes to the ripe blackcurrant and black cherry fruit.
Port	LBV	Taylor, Fladgate & Yeatman Douro Portugal	$16.95 750ml	Alcohol: 20% Sweetness: 10	Deep purple/black velvet color; plum, raisin, dried fig & spice nose; sweet, full bodied, rich and ripe palate; milk chocolate, dried fruit, mincemeat, fig & plum flavors; balanced with some wood tannins and a warm finish.

4. After evaluating each wine, the participants were instructed to complete a mixed food and wine tasting and evaluation addressing the basic question: What is your perception of match sensation? The match level used a 0 to 10 line scale that included descriptive anchors (0 = no match, 5-6 = average match level, 10 = synergistic or ideal match). Instructions for the food and wine tasting included: “Take a small bite of food and then a sip of wine. Slowly chew

the food and wine combination, savoring the flavors and evaluating level of match. Repeat for each food and wine combination. Please reserve comments on perception of match until all of the participants have completed their evaluations". Participants were asked to cleanse their palate with water, crackers and were given a short break between pairings.

5. The foods were evaluated with each wine in the following order: (1) chêvre (fresh goat's milk cheese), (2) brie (soft cow's milk cheese), (3) spicy Italian salami, and (4) milk chocolate. Both the chêvre and brie cheeses came from Saputo of Canada, the spicy Italian salami from Santa Maria Foods, Inc. of Canada, and the milk chocolate from Lindt and Sprungli, Inc. Complete descriptions of the foods are provided in Table 2.

Table 2

Food Identifications and Sensory Descriptions

Food	Producer	Food Name	Nutrition Summary	Sensory Description
Chêvre	Saputo of Canada	Caprini	Serving Size: 3 cm cube Calories: 80 Fat: 6g Carbs: 1g	Plain goat cheese, soft and creamy, slightly acidulous.
Brie	Saputo of Canada	Brie de Portneuf	Serving Size: 3 cm cube Calories: 90 Fat: 7g Carbs: 2g Protein: 6g	Regular Brie with a white, bloomy rind; supple body; slightly fruity.
Spicy Italian Salami	Mastro; Santa Maria Foods, Inc.	Calabrese Salami Hot	Serving Size: 5 slices Calories: 100 Fat: 7g Carbs: 1g Protein: 7g	Dry-cured, spicy-hot salami; generously seasoned with a selection of bold spices and hot peppers.
Milk Chocolate	Lindt and Sprungli, Inc.	Classic Milk Chocolate	Serving Size: 4.4oz Calories: 230 Fat: 13g Carbs: 24g Protein: 3g	Classic smooth, creamy, milk chocolate.

Data Analysis

The data collected was analyzed with t-tests and regression by using the Statistical Package for Social Sciences, Version 19.0 (SPSS, 2010) to explore the previously stated research questions. Because the line scales used were assumed to provide equally spaced numerical values, t-tests and regression was appropriate for analysis (Meilgaard et al., 2007). For data requiring regression, stepwise regression was utilized. Stepwise regression is a technique that "instructs a computer to find the 'best' equation by entering independent variables in various combinations and orders" (Vogt, 1999, p. 280). Because there was no clear empirical or theoretical basis driving the entry order of the wine elements of interest in this study, it was determined that a stepwise approach was more appropriate than hierarchical regression analysis.

Paired t-tests were conducted to assess if significant differences existed among perception of match with each food item across the four wines in the study. Next, stepwise regression was conducted to identify key wine characteristics that significantly impacted the perception of food and wine match with all four food items used in the study. Finally, linear regression was conducted to test the impact of food and wine expertise on selected levels of food and wine match.

The participants were separated into two groups based on their reported values on the food and wine matching scale (0 – 10) for food and wine pairing expertise. These groups were formed to further explore the impact of food and wine expertise. Group 1, the low food and wine expertise group, included participants whose food and wine matching expertise ranged from 0-4. Group 2, the high food and wine expertise group, included those who ranked their food and wine matching expertise from 5-10. From this point, Group 1 will be referred to as "novices", and Group 2 will be referred to as "experts".

ANOVA (analysis of variance) was conducted to further explore the differences in perception of selected food and wine match levels between experts and novices, and stepwise regression was conducted with both the expert and novice groups to investigate any significant differences between groups regarding the impact key wine characteristics had on perception of food and wine match with all four foods used in the study.

The means, standard deviations and the number of participants for key wine elements (sweetness, acidity and tannin) are depicted in Tables 3a – 3c. The highest means for each variable are shown in bold. The means for the wine elements assessed supported typical characteristics of each wine type as discussed in the literature review.

Table 3a

Perceived Wine Sweetness Levels (N = 248)

Sweetness	*Mean*	*SD*	*n*
Sauvignon Blanc	4.43	2.01	247
Chardonnay	4.13	1.99	247
Cabernet Sauvignon	3.43	1.82	245
Port	**7.98**	1.67	247

Note: 1 = bone dry, 10 = very sweet.

Table 3a illustrates the perceived levels of sweetness for each wine. The participants perceived the Port to be the sweetest wine. The mean sweetness level for the Port was 7.98 (*SD* = 1.67) which aligns with the production process. The sweetness level increases since the fermentation process is halted by the fortification of the wine resulting in a product with higher sugar levels.

Table 3b

Perceived Wine Acidity Levels (N = 248)

Acidity	*Mean*	*SD*	*n*
Sauvignon Blanc	**5.30**	1.87	246
Chardonnay	5.15	2.01	245
Cabernet Sauvignon	5.06	1.81	245
Port	4.19	2.17	244

Note: 1 = imperceptible, 10 = highly perceived.

Table 3b depicts the perceived acidity levels for each wine. The Sauvignon Blanc was the wine with the highest perceived acidity. The means for the Sauvignon Blanc and Chardonnay were over 5.0. According to the Value Band Scale given to participants, the acidity level is "perceived in a recognizable way". As both wines are from a fairly cool growing region in Canada, the acidity levels of these wines were likely to be high and more detectable.

Table 3c

Perceived Wine Tannin Levels (N = 248)

Tannin	*Mean*	*SD*	*n*
Sauvignon Blanc	.20	.90	247
Chardonnay	.26	1.15	247
Cabernet Sauvignon	**5.81**	1.98	242
Port	4.52	2.12	248

Note: 1 = imperceptible, 10 = highly perceived.

Table 3c shows the perceived tannin levels for each wine, and the tannin level was the highest for the Cabernet Sauvignon. The mean of perceived tannin level of the Cabernet Sauvignon was 5.81 (*SD* = 1.98), and according to the Value Band Scale, it was "significantly perceived". This is consistent with the winemaking process since the grapes are soaked with the skins, stems and seeds intact. Cabernet Sauvignon grapes tend to have thick, rough skins which produce higher tannin levels in the final wine product. Tannin levels in the Sauvignon Blanc and Chardonnay were both perceived under 1.0 qualifying the perception of tannin to be

"imperceptible". As white wines, both the Sauvignon Blanc and the Chardonnay were fermented without seeds and stems so the source of tannins was eliminated.

The wines with the highest mean when combined with each food item were also identified. The highest rated combinations are as follows and are depicted in bold in Table 4: Sauvignon Blanc (SB) and Chêvre, Chardonnay (CD) and Brie, Cabernet Sauvignon (CS) and spicy Italian salami, and Port (PT) and milk chocolate.

Table 4

Perceived Level of Food and Wine Match for Each Food and Wine Combination (N = 248)

Variable	*Mean*	*SD*	*n*
SB and Chêvre Match	**5.69**	2.32	248
CD and Chêvre Match	5.13	2.29	247
CS and Chêvre Match	4.21	2.42	248
PT and Chêvre Match	3.44	2.97	245
SB and Brie Match	3.96	2.35	245
CD and Brie Match	**4.08**	2.36	245
CS and Brie Match	3.87	2.38	245
PT and Brie Match	3.36	2.57	247
SB and Salami Match	4.05	2.63	247
CD and Salami Match	3.86	2.41	247
CS and Salami Match	**5.09**	2.45	247
PT and Salami Match	3.70	2.70	246
SB and Chocolate Match	4.60	2.60	247
CD and Chocolate Match	4.37	2.47	246
CS and Chocolate Match	4.27	2.49	246
PT and Chocolate Match	**5.46**	2.87	246

Note: 1 = no match, 10 = synergistic match.

The wine that ranked the highest with the chêvre was the Sauvignon Blanc. This combination had a mean of 5.69 (*SD* = 2.32). According to the Food and Wine Level of Match scale, the participants considered this match to be slightly above average. The wine that ranked the highest with the brie was the Chardonnay. The mean of the perceived level of match for this combination was 4.08 (*SD* = 2.36). According to the scale, the participants perceived this match as being slightly below average. The wine with the highest perceived match with the spicy

Italian salami was the Cabernet Sauvignon. This combination had a mean of 5.09 (*SD* = 2.45), and this was an average match according to the scale. The wine that ranked the highest with the milk chocolate was the Port. This match was also slightly above average since the mean was 5.46 (*SD* = 2.87).

Chapter 4

Results and Findings

Data was imported in the Statistical Package for Social Sciences, Version 19.0 (SPSS, 2010) to explore the perception of match of certain food and wine combinations; the impact sweetness, acidity and tannin had on perceived level of food and wine match; and the impact food and wine expertise had on perceived level of food and wine match. Five statistical tests were conducted to explore the hypothesized relationships, and the results of each test are presented in this chapter in the following order:

1. Paired t-tests – to determine if significant differences existed among perception of match with each food item across all four wines
2. Stepwise regression – to identify if key wine characteristics had a significant impact on the perception of food and wine match
3. Linear regression – to explore the significance food and wine expertise had on level of match
4. ANOVA – to further explore any significant differences in perception of food and wine match between experts and novices.
5. Stepwise regression – to determine if the impact of certain wine characteristics on level of match was significantly different between the expert and novice groups.

Upon completion of the statistical analysis, statistical evidence was found to support H_1, H_{2a}, H_{2b} and H_{2c}. No statistical evidence was found to support H_{3a} and H_{3b} or H_4. The results of the statistical analysis are discussed in detail in the following sections in relation to the research questions and their corresponding hypotheses.

Differences in Food and Wine Match Perception

RQ_1 asked: Are there significant differences in perceived level of match for a variety of different food and wine styles? To answer this question, paired t-tests were used to determine if significant differences existed among perceived level of match with each food item across the four wines used in this study. It was found that *yes*; there are significant differences in perceived level of match for a variety of food and wine styles. The results are shown in Tables 5a – 5d.

Table 5a

Paired t*-tests for Wine Match Levels with Chêvre (N = 248)*

Paired Comparisons	*n*	*Mean Difference*	*SD*	*Significance (2-tailed)*
SB-CD	248	.55	2.90	.003
SB-CS	247	1.48	3.36	<.001
SB-PT	248	2.25	3.91	<.001
CD-CS	247	.93	3.16	<.001
CD-PT	248	1.69	3.77	<.001
CS-PT	247	.79	3.28	<.001

Table 5a shows that there were significant differences with all wine match levels for the chêvre. The Sauvignon Blanc was a significantly better match than the Chardonnay ($p < .01$), Cabernet Sauvignon ($p < .001$), and the Port ($p < 001$). The Chardonnay was significantly better than the Cabernet Sauvignon ($p < .001$) and the Port ($p < .001$), and the Cabernet Sauvignon was significantly better than the Port ($p < .001$).

Table 5b

Paired t*-tests for Wine Match Levels with Brie (N = 248)*

Paired Comparisons	*n*	*Mean Difference*	*SD*	*Significance (2-tailed)*
SB-CD	245	-.40	5.33	.24
SB-CS	245	.09	3.08	.63
SB-PT	245	.60	3.50	.007
CD-CS	245	.50	5.61	.17
CD-PT	245	1.01	5.66	.006
CS-PT	245	.51	3.02	.009

Table 5b shows that the only significant differences ($p < .01$) with the brie were that the Sauvignon Blanc ($p = .007$), Chardonnay ($p = .006$), and Cabernet Sauvignon ($p = .009$) ranked higher than the Port. While the Chardonnay proved to be the best match with the brie, it was not significantly better than the Sauvignon Blanc ($p = .24$) or the Cabernet Sauvignon ($p = .17$).

Table 5c

Paired t*-tests for Wine Match Level with Spicy Italian Salami (N = 248)*

Paired Comparisons	*n*	*Mean Difference*	*SD*	*Significance (2-tailed)*
SB-CD	247	.19	2.55	.25
SB-CS	247	-1.04	3.38	<.001
SB-PT	246	.35	3.85	.16
CD-CS	247	-1.23	3.02	<.001
CD-PT	246	.18	3.30	.41
CS-PT	246	1.38	3.28	<.001

Table 5c shows that the Cabernet Sauvignon match with spicy Italian salami was significantly greater than the Sauvignon Blanc ($p < .001$), Chardonnay ($p < .001$), and the Port ($p < .001$). The Sauvignon Blanc match was higher than the Chardonnay ($p = .25$) and Port ($p = .16$), and the Chardonnay ranked higher than the Port ($p = .41$). None of these differences were significant however.

Table 5d

Paired t-*tests for Wine Match with Milk Chocolate (N = 248)*

Paired Comparisons	*n*	*Mean Difference*	*SD*	*Significance (2-tailed)*
SB-CD	246	.22	2.42	.15
SB-CS	246	.33	3.37	.13
SB-PT	246	-.86	4.16	.001
CD-CS	246	.10	2.94	.59
CD-PT	246	-1.09	3.92	<.001
CS-PT	246	-1.19	3.41	<.001

Table 5d shows that the perception of match between the Port and the milk chocolate was significantly higher than with the Sauvignon Blanc ($p < .001$), Chardonnay ($p < .001$), and Cabernet Sauvignon ($p < .001$). The Sauvignon Blanc was rated higher than the Chardonnay ($p = .15$) and Cabernet Sauvignon ($p = .13$), and the Chardonnay was higher than the Cabernet Sauvignon ($p = .59$). The differences between these rankings were not significant.

Hypothesis 1. Hypothesis 1 predicted that certain food and wine combinations would be perceived as better than others. The results of the paired t-tests support Hypothesis 1, because significant differences were found between perceived level of match for certain food and wine combinations.

Impact of Key Wine Elements on Match Perception

RQ_2 asked: Do certain wine characteristics impact the perceived level of food and wine match? Sweetness, acidity and tannin were all explored to determine whether or not they impacted the perceived level of food and wine match. To investigate RQ_2, stepwise regression was conducted to determine which key wine elements, if any, impacted the perceived level of match with all four foods used in the study. The analysis showed that certain wine characteristics *do* impact the level of perceived match, and the results are depicted in Tables 6a – 6d.

Table 6a

Chêvre Match Level Regressed on Wine Attributes

Variable	Acidity	Tannin	Sweetness
Chêvre Match	.09**	-.21***	X
R	.23	.23	X
R^2	.05	.05	X
F (df)	**23.27*****(2, 887)	**23.27*****(2, 887)	X

Note: All Betas are standardized; X = variable excluded in stepwise regression.
*** $p < .001$; ** $p < 0.01$; * $p < 0.05$; + $p < 0.10$ (2-tailed).

Table 6a shows the impacts sweetness, acidity and tannin had on the perceived level of match with chêvre. Tannin and acidity both had significant effects on the perception of match while sweetness was excluded as a key characteristic that would predict level of match. Tannin had a highly significant negative relationship with the chêvre (β = -.21, $p < .001$) since a higher tannin level lowered the perceived level of match. The relationship between acidity and the chêvre was positive (β = .09, $p < .01$) as higher levels of acidity increased the perception of match.

Table 6b

Brie Match Level Regressed on Wine Attributes

Variable	Acidity	Sweetness	Tannin
Brie Match	.07*	X	X
R	.07	X	X
R^2	.01	X	X
F (df)	**4.53***(1, 868)	X	X

Note: All Betas are standardized; X = variable excluded in stepwise regression.
*** $p < .001$; ** $p < 0.01$; * $p < 0.05$; + $p < 0.10$ (2-tailed).

Table 6b shows the impacts sweetness, acidity and tannin had on the perceived level of match with brie. Acidity had a significant positive relationship with the brie (β = .07, $p < .05$) since higher acidity levels increased the perception of match. Tannin and sweetness were excluded as a key characteristic that would predict level of match.

Table 6c

Spicy Italian Salami Match Level Regressed on Wine Attributes

Variable	Tannin	Acidity	Sweetness
Salami Match	**.13*** **	X	X
R	.13	X	X
R^2	.02	X	X
F (df)	**15.02*** **(1, 877)	X	X

Note: All Betas are standardized; X = variable excluded in stepwise regression.
*** $p < .001$; ** $p < 0.01$; * $p < 0.05$; + $p < 0.10$ (2-tailed).

Table 6c shows the impacts sweetness, acidity and tannin had on the perceived level of match with spicy Italian salami. Tannin had a highly significant positive relationship with the salami ($\beta = .13$, $p < .001$) since higher perceived levels of tannin increased the perception of match. Acidity and sweetness were excluded as a key characteristic that would predict level of match.

Table 6d

Milk Chocolate Match Level Regressed on Wine Attributes

Variable	Sweetness	Acidity	Tannin
Chocolate Match	**.14*** **	X	X
R	.14	X	X
R^2	.02	X	X
F (df)	**18.47*** **(1, 872)	X	X

Note: All Betas are standardized; X = variable excluded in stepwise regression.
*** $p < .001$; ** $p < 0.01$; * $p < 0.05$; + $p < 0.10$ (2-tailed).

Table 6d shows the impacts sweetness, acidity and tannin had on the perceived level of match with milk chocolate. Sweetness had a highly significant positive relationship with the milk chocolate ($\beta = .14$, $p < .001$) since higher sweetness levels increased the perception of match. Tannin and acidity were excluded as a key characteristic that would predict level of match.

Hypothesis 2a. Hypothesis 2a predicted that sweetness would significantly affect the perceived level of food and wine match. Support was found for hypothesis 2a because sweetness impacted the perceived level of match with the milk chocolate. The impact sweetness had on the perceived level of match was positive and highly significant ($p = .00$). Higher perceived sweetness levels resulted in a higher level of perceived match.

Hypothesis 2b. Hypothesis 2b predicted that acidity would significantly affect the perceived level of food and wine match. Support was found for hypothesis 2b because acidity impacted the perceived level of match with the chêvre and the brie. Acidity had a positive relationship with both cheeses as higher acidity levels resulted in higher perceived level of food and wine match. The impact acidity had on the match with the chêvre ($p = .01$) was greater than the impact it had on the brie ($p = .03$).

Hypothesis 2c. Hypothesis 2c predicted that tannin would significantly affect the perceived level of food and wine match. Support was found for hypothesis 2c with the perceived level of match with the chêvre and the salami. The impact tannin had on the chêvre was negative as higher levels of tannin resulted in a lower perceived level of match. The relationship between tannin and the chêvre was highly significant ($p = .00$). The impact tannin had on the perceived level of match with the salami was positive; higher tannin levels resulted in a higher perceived level of match. The relationship between tannin and salami was also highly significant ($p = .00$).

Impact of Food and Wine Expertise on Match Level

RQ_3 asked: Does food and wine pairing expertise affect the perceived level of food and wine match? The food and wine combinations selected for this analysis were the wines that resulted in the highest mean match with each food item. Table 7 depicts the results of the linear

regression conducted to determine if food and wine expertise impacted selected levels of food and wine match, and the results show that expertise *did* affect the perceived level match.

Table 7

Selected Levels of Food and Wine Match Regressed on Food and Wine Experience Level

Variable	Chêvre/SB	Brie/CD	Salami/CS	Chocolate/PT
FWE β	.11^{+}	**.15***	**.15***	**.30****
R	.11	.15	.15	.30
R^2	.01	.02	.02	.09
F (df)	3.11^{+} (1, 242)	**5.41***(1, 239)	**5.33***(1, 241)	**23.09****(1, 240)

Note: FWE=Food and wine experience.
* All Betas are standardized.
*** $p < .001$; **$p < 0.01$; *$p < 0.05$; +$p < 0.10$ (2-tailed).

Food and wine expertise level impacted the perception of match between all food and wine combinations. Overall, higher food and wine expertise resulted in higher perceived level of match across all selected food and wine combinations. The Chardonnay and brie combination ($p = .02$) and the Cabernet Sauvignon and spicy Italian salami combination ($p = .02$) were significantly impacted by food and wine expertise as the significance levels were $p < .05$. The impact food and wine expertise level had on the Port and milk chocolate match level was highly significant ($p < .01$). For the chêvre and Sauvignon Blanc match, 1% ($R^2 = .01$) of the variance in match perception can be explained by food and wine expertise; 2% ($R^2 = .02$) of the variance in match perception for both the brie and Chardonnay match and the spicy Italian salami and Cabernet Sauvignon match is explained by food and wine expertise level, and 9% ($R^2 = .09$) of the variance in match perception for the Port and milk chocolate match can be explained by food and wine expertise levels.

Hypothesis 3a. Hypothesis 3a predicted that food and wine expertise would not impact the perceived level of food and wine match. Hypothesis 3a was not supported, because the results of linear regression showed that food and wine expertise did impact the perceived level of

match with all selected food and wine combinations. Food and wine expertise had a positive relationship with the perceived level of match. Higher food and wine expertise resulted in higher perceived level of match for the selected food and wine combinations.

Perception of Match: Experts versus Novices

RQ_4 asked: Are there significant differences in perception of match between experts and novices for selected food and wine combinations? To answer this question, ANOVA was conducted to determine if there were significant differences between the expert and novice groups in regard to their perception of match for selected food and wine combinations. There *were* significant differences between the expert and novice groups, and Table 8 displays these results.

Table 8

Differences in Perception of Selected Food and Wine Match Levels based on Expertise

Variable	Mean square between groups	Mean square within groups	*F*	*(df)*	*Significance (2 tailed)*
Chêvre/SB	14.82	5.30	2.80	(1, 242)	.10
Brie/CD	6.34	5.48	1.16	(1, 239)	.28
Salami/CS	2.46	6.09	.40	(1, 241)	.53
Chocolate/PT	86.12	7.83	**11.00*** **	(1, 240)	**.00**

Note: All Betas are standardized.
*** p < .001; **p <0.01; *p < 0.05; +p < 0.10 (2-tailed).

The only highly significant difference in food and wine match perception between the expert and novice groups was the milk chocolate and Port match ($p < .001$). The chêvre and Sauvignon Blanc match was notable at the $p < .10$ level, but the difference between groups was not highly significant. The means, standard deviations, number of participants, and range of responses (0 – 10 line scale) for the selected food and wine matches are depicted below in Table 9 for the expert and novice groups.

Table 9

Perception of Match for Selected Food and Wine Combinations for Experts and Novices

Variable	*Mean*	*Standard Deviation*	*n*	Range Minimum	Range Maximum
SB and Chêvre Match – Novice	5.53	2.33	172	0	10
SB and Chêvre Match – Expert	6.07	2.24	72	1	10
CD and Brie March – Novice	3.99	2.33	170	0	10
CD and Brie Match – Expert	4.34	2.36	71	0	9
CS and Salami Match – Novice	5.05	2.48	172	0	10
CS and Salami Match – Expert	5.27	2.43	71	0	10
PT and Chocolate Match – Novice	5.11	2.91	170	0	10
PT and Chocolate Match - Expert	6.42	2.50	72	0	10

Note: n=number of participants; 0 = no match, 10 = synergistic match.

For each selected food and wine match, the mean level of match for the expert group was higher. The range of responses for each food and wine match on a scale of 0 – 10 was quite broad. All food and wine matches had at least one rating of 0 (no match) except for the Sauvignon Blanc and chêvre match as rated by the experts where the lowest response was a 1, and all matches had a at least one rating of 10 (synergistic match) except for the brie and Chardonnay match as rated by the novices where the highest response was a 9. Overall, the range of responses was very broad.

Hypothesis 3b. Hypothesis 3b predicted that there would be no significant differences in perceived level of match with selected food and wine combinations between the expert and novice groups. Hypothesis 3b was not supported, because the perception of match with the Port and milk chocolate was significantly different between the expert and novice groups ($p = .00$). Also, while the difference between the two groups' perception of the chêvre and Sauvignon Blanc match was not highly significant ($p = .10$), it is still noteworthy.

Impact of Key Wine Elements on Perception of Match: Experts vs. Novices

RQ_5 asked: Are there significant differences between experts and novices regarding which key wine characteristics impact the perceived level of food and wine match? To answer this question, stepwise regression which was run twice (once for the expert group and once for the novice group) for each food item to explore if there were differences in perceptions between groups in regard to which key wine characteristics impacted the level of match. There *were* significant differences between the expert and novice groups and the results are shown in Tables 10a – 10d.

Table 10a

Chêvre Match Level Regressed on Wine Attributes for both Experts and Novices

Variable	Tannin	Acidity	Sweetness
Chêvre Match – Novice	**-.19*** **	**.10***	X
R	.21	.21	X
R^2	.05	.05	X
F (df)	**14.93*** **(2, 621)	**14.93*** **(2, 621)	X
Chêvre Match – Expert	**-.24*** **	X	X
R	.24	X	X
R^2	.06	X	X
F (df)	**15.12*** **(1, 255)	X	X

Note: All Betas are standardized; X = variable excluded in stepwise regression.
*** $p < .001$; ** $p < 0.01$; * $p < 0.05$; + $p < 0.10$ (2-tailed).

Table 10a shows the impacts sweetness, acidity and tannin had on the perceived level of match with chêvre for both the novice and expert groups. Sweetness was excluded as key characteristics that would predict level of match for both groups, and acidity was excluded for the expert group. For the novice group, acidity had a positive significant relationship with the chêvre ($\beta = .10$, $p < .05$; $F = 14.93$, $p < .001$) and tannin had a negative significant relationship with the chêvre ($\beta = -.19$, $p < .001$; $F = 14.93$, $p < .001$). Tannin also had a significant negative relationship with the chêvre for the expert group ($\beta = -.24$, $p < .001$; $F = 15.12$, $p < .001$).

Table 10b

Brie Match Level Regressed on Wine Attributes for both Experts and Novices

Variable	Acidity	Sweetness	Tannin
Brie Match – Novice	**.11**$^{+}$	X	X
R	.11	X	X
R^2	.01	X	X
F (df)	**7.60**$^{+}$ (1, 616)	X	X
Brie Match – Expert	X	X	X
R	X	X	X
R^2	X	X	X
F (df)	X	X	X

Note: All Betas are standardized; X = variable excluded in stepwise regression.
*** $p < .001$; ** $p < 0.01$; * $p < 0.05$; + $p < 0.10$ (2-tailed).

Table 10b shows the impacts sweetness, acidity and tannin had on the perceived level of match with the brie for both the novice and expert groups. Sweetness and tannin were excluded as a key characteristic that would predict level of match for both groups, and acidity was also excluded for the expert group. For the novice group, acidity had a positive significant relationship with the brie ($\beta = .11$, $p < .05$; $F = 7.60$, $p < .05$).

Table 10c

Salami Match Level Regressed on Wine Attributes for both Experts and Novices

Variable	Tannin	Sweetness	Acidity
Salami Match– Novice	**.14****	X	X
R	.14	X	X
R^2	.02	X	X
F (df)	**12.82***(1, 622)	X	X
Salami Match – Expert	X	X	X
R	X	X	X
R^2	X	X	X
F (df)	X	X	X

Note: All Betas are standardized; X = variable excluded in stepwise regression.
*** $p < .001$; ** $p < 0.01$; * $p < 0.05$; + $p < 0.10$ (2-tailed).

Table 10c shows the impacts sweetness, acidity and tannin had on the perceived level of match with spicy Italian salami for both the novice and expert groups. Sweetness and acidity were excluded as a key characteristic that would predict level of match for both groups, and tannin was also excluded for the expert group. For the novice group, tannin had a positive, highly significant relationship with the salami (β = .14, p < .001; F = 12.82, p < .001).

Table 10d

Chocolate Match Level Regressed on Wine Attributes for both Experts and Novices

Variable	Sweetness	Acidity	Tannin
Chocolate Match – Novice	X	X	X
R	X	X	X
R^2	X	X	X
F (df)	X	X	X
Chocolate Match – Expert	**.30*** **	X	X
R	.30	X	X
R^2	.09	X	X
F (df)	**24.29***(1, 255)	X	X

Note: All Betas are standardized; X = variable excluded in stepwise regression.
*** p < .001; **p <0.01; *p < 0.05; +p < 0.10 (2-tailed).

Table 10d shows the impacts sweetness, acidity and tannin had on the perceived level of match with milk chocolate for both the expert and novice groups. Acidity and tannin were excluded as a key characteristic that would predict level of match for both groups, and sweetness was also excluded for the novice group. For the expert group, sweetness had a positive and highly significant relationship with the milk chocolate (β = .30, p < .001; F = 24.29, p < .001).

Hypothesis 4. Hypothesis 4 predicted that there would be no significant differences in the impact that key wine elements had on perceived level of match between the expert and novice groups. Hypothesis 4 was not supported, because the impact key wine elements had on all four foods were different for both groups.

For the chêvre, sweetness was excluded as an element that would impact perceived level of match, and tannin had a negative relationship with the chêvre for both groups. Acidity had a positive relationship with the chêvre for the novice group but was excluded as a variable for the expert group.

Sweetness and tannin were excluded as elements that would impact perceived level of match with the brie for both the expert and novice groups, but acidity was also excluded for the expert group. Acidity had a positive relationship with the brie for the novice group.

For the salami, sweetness, acidity and tannin were all excluded as elements that would impact perceived level of match for the expert group, but only sweetness and acidity were excluded for the novice group. Tannin was found to impact the level of match with the salami for the novice group.

Sweetness had a positive relationship with the milk chocolate for the expert group but not for the novice group. Sweetness, acidity and tannin were excluded as variables that would impact level of match for the novice group whereas only tannin and acidity were excluded as variables for the expert group.

Chapter 5

Discussion

This study evaluated several food and wine combinations to explore the effects that certain wine characteristics and food and wine expertise had on perception of match. The study used a convenience sample of students from George Brown College in Toronto. The students participated in sensory training and an evaluation session, and completed the following evaluation forms in the session: a self evaluation form rating their competency levels in food tasting, wine tasting and food and food and wine matching; a wine evaluation form to access sweetness, acidity and tannin levels in the wines; a mixed food and wine tasting form to access their perception of match with each food and wine combination. The data collected was analyzed to address the research questions and explore the hypotheses generated from a review of the relevant food and wine pairing literature. The larger sample size and the variety of food items used in the study separate this research from previous studies conducted. The key findings of this study provide valuable insight that can be used to better predict successful food and wine combinations.

It was found in this study that certain food and wine combinations are significantly better than others, and that sweetness, acidity and tannin levels in wine impact the level of food and wine match. The perceptions of the expert and novice groups differed slightly in regards to the perceived level of food and wine match as well as which wine characteristics impacted level of match with selected food and wine combinations. The key findings of the study are discussed in the following sections and are followed by a discussion of the study limitations and recommendations for future research.

Highest Level of Perceived Match for Each Food and Wine Pairing

For each food item used in the study, the wine that yielded highest perceived level of match was identified, and the results of the paired t-tests determined whether or not significant differences existed between the four wines with each food. Overall, the highest level of perceived match for each food and wine combination were the Sauvignon Blanc and chêvre, Chardonnay and brie, Cabernet Sauvignon and spicy Italian salami, and Port and milk chocolate.

Sauvignon Blanc and chêvre. The Sauvignon Blanc was the wine with the highest mean when paired with the chêvre, and this combination was the highest ranking match score overall. According to food and wine pairing literature, Sauvignon Blanc and chêvre are a classic match as both the food and wine are acidic, and the acid in the wine helps cut through the fat in the cheese (Harrington, 2008; Immer, 2002; Rosengarten & Wesson, 1989; Simon, 1996). Also, this finding is in line with King and Cliff (2005) because they found overall that while wine and cheese are compatible, the white wines tended to be better with cheese than red or specialty wines. King and Cliff (2005) also found that out of all the wines used in their study, Sauvignon Blanc was the second most cheese friendly wine. The Port and the chêvre had the lowest mean. This result is similar to King and Cliff (2005) since they found Port to be one of the most difficult wines to pair with food.

This finding is in contrast to the results of other previous research. Harrington and Hammond (2005) found Sauvignon Blanc to be one of the least cheese friendly wines used in their study; however, their study did not asses a match with Sauvignon Blanc and goat cheese because goat cheese was not used in their study. Therefore, there is no common ground for comparison. Bastian et al. (2008) found that Sauvignon Blanc was one of the hardest wines to match with cheese, and consumers used in their study did not rank the Sauvignon Blanc and

chêvre combination as close to ideal because the Sauvignon Blanc dominated the chêvre. The researchers did identify that since, "only a single example of a varietal wine was matched with each cheese, it is difficult to conclude that a specific varietal is better matched to a certain cheese type" (Bastian et al., 2008, p. 181). Perhaps the variation in Sauvignon Blanc varietal as well as the type/brand of chêvre used contributes to the inconsistencies in perception of match. In this study, even though the Sauvignon Blanc was significantly better than the Chardonnay, the Chardonnay and chêvre combination ranked as the third best match overall, making both white wines significantly better with the chêvre than the Cabernet Sauvignon and the Port.

Chardonnay and brie. When paired with the brie, the Chardonnay had the highest perception of match, but there were no significant differences in perception of match between the Chardonnay, Sauvignon Blanc and the Cabernet Sauvignon. Harrington (2008) suggested that brie may pair well with high acid wines and some red or dessert wines, therefore one could assume that brie is a wine friendly cheese based on these recommendations and the results found in this study. In contrast, Simon (1996) stated that brie is one of the trickiest cheeses to match with wines, and this could explain why *one* wine was not significantly greater than all others with the brie. King and Cliff (2005) found that consumers did not rate the Chardonnay and brie match to be close to ideal, so even though Chardonnay and brie had the highest perception of match in this study it may not be correct to assume that the pair is an above average match. The only significant relationship was that the Chardonnay, Sauvignon Blanc and the Cabernet Sauvignon were all significantly better than the Port. This confirms, once again, that Port is more difficult to match with cheese (King & Cliff, 2005).

Cabernet Sauvignon and spicy Italian salami. The Cabernet Sauvignon and spicy Italian salami match was the fourth best food and wine match overall. The Cabernet Sauvignon

was significantly greater with the salami than the remaining three wines. There has only been one study conducted to date using meats to assess level of match with wines, and it was found that a fattiness to tannin match had a significant relationship with level of food and wine match (Harrington & Hammond, 2006). Out of the three meats used in this study (chicken, pork loin, and braised beef) the pork loin and the braised beef received average match levels when paired with the Cabernet Sauvignon whereas the chicken and Cabernet Sauvignon match ranked much lower. The results of this study are consistent with this finding (red meats pair well with red wines), and this also aligns with recommendations from popular literature (Immer, 2000, 2002; Rosengarten & Wesson, 1989; Simon, 1996).

Port and milk chocolate. The Port and milk chocolate match was the second highest ranking food and wine combination overall. The Port was significantly better than the Sauvignon Blanc, Chardonnay and Cabernet Sauvignon. Food and wine pairing literature suggests that Port pairs well with sweeter foods, such as desserts, and that milk chocolate pairs well with sweet, full bodied, high alcohol wines (Harrington, 2008; Rosengarten & Wesson, 1989; Simon, 1996). The findings of this study are consistent with these theories. No empirical studies have been conducted to date that evaluate wine compatibility with milk chocolate.

To explore potential relationships guiding successful food and wine combinations, stepwise regression was used once for each food item to determine any key wine elements that impacted the perception of match. When looking at the overall results of which key wine elements impacted the perception of match with each food item, it is notable to acknowledge that the levels of the elements that impacted the match were reflected in the wines that paired the best with each food. For example, the most notable food and wine combination in this regard was the Port and milk chocolate match. The Port was significantly better than the Sauvignon Blanc,

Chardonnay and Cabernet Sauvignon. The Port had the highest perceived sweetness level out of all of the wines, and a higher perceived sweetness in wine resulted in a higher perception of match with the milk chocolate. These relationships provide additional insight as to why certain wines may have paired better with each food.

Key Wine Elements Impact on Perception of Match

When exploring in general which wine elements impacted the level of match with the foods, all three elements (sweetness, acidity and tannin) impacted perceived level of match. The importance of sweetness levels was identified by Harrington and Hammond (2005) as they found that higher wine sweetness increased the perception of match with Danish Blue and Grana Padano cheeses, and overall, when controlling preference for red or white wine, sweetness was the only significant predictor for food and wine match with all cheeses used in the study. This reflects Simon's (1996) as well as Harrington's (2008) recommendation that wine sweetness level should be equal to or greater than food sweetness level. This is consistent with the findings of this study because sweetness had a positive significant relationship with the milk chocolate, which is generally the sweetest type of chocolate. The Port had the highest perceived sweetness out of the wines used in the study, and the mean scores of the remaining wines when paired with the milk chocolate ranked in order of sweetness level (Sauvignon Blanc, Chardonnay, Cabernet Sauvignon). This finding implies that milk chocolate, or sweet foods in general, are better paired with wines that are sweeter than or at least as sweet as the food.

No support to date has been found for the potential of wine acidity to impact level of match. In this study, higher perceived acidity levels impacted the level of match with both the chêvre and the brie in a positive way. The Sauvignon Blanc had the highest perceived acidity levels followed by the Chardonnay. With the chêvre, the wines ranked in order of acidity level

in relation to the overall perception of match. Since chêvre is typically an acidic cheese, this validates many recommendations in food and wine pairing literature that suggest wine acidity levels should be greater than or equal to food acidity levels otherwise the wine will taste flat and dull (Harrington, 2008; Rosengarten & Wesson, 1989; Simon, 1996), and more specifically, chêvre pairs well with higher acid wines. While higher acidity levels also impacted the level of match with the brie, the Chardonnay was perceived as a better match than the Sauvignon Blanc implying that additional food and wine components, textures and flavors played a role in the perceived level of match. Also with the brie it is important to restate that there were no significant differences in perception of match between the Sauvignon Blanc, Chardonnay, or the Cabernet Sauvignon. The participants' evaluation of acidity levels in these three wines were fairly similar suggesting that brie may pair with both slightly acidic white and red wines.

When exploring the impact tannin level had on the perception of match with each food item, it positively impacted the level of match with the spicy Italian salami. The highly rated match between the Cabernet Sauvignon (wine with highest perceived tannin levels) and the spicy Italian salami (a generally fatty meat) mirrors Harrington and Hammond's (2006) finding that a match between food fattiness and wine tannin level strongly impact level of match. Not only is this finding in line with scholarly research, it supports the old adage of "red wine with meat", and it also validates many assumptions made in popular literature. Authors suggest that tannin is meat's major ally because tannins help cut through the fat of the meat and red meats also moderate tannin perception (Harrington, 2008; Rosengarten & Wesson, 1989; Simon, 1996). It is important to note that, with the exception of the Cabernet Sauvignon, the wines did not rank in order of tannin level in regards to their perception of match with the spicy Italian salami; the results were reversed. The wine with the lowest perceived tannin level (Sauvignon Blanc) was

the second best match with the spicy Italian salami, the Chardonnay (third highest tannin level) was next, and then the Port (second highest tannin level) was last. Once again, this implies that additional food and wine components, textures and flavors played a role in the perceived level of match.

Tannin also impacted the level of match with the chêvre. This relationship however was negative as higher perceived levels of tannin decreased the perception of match with the chêvre indicating the need to pair less tannic wines with this type of cheese. With the exception of the Port, the other wines ranked in order with the chêvre according to lower perceived level of tannin. Port had the second highest level of perceived tannin, but it ranked last with the chêvre suggesting once again that Port is more difficult to match with certain foods. This finding does propose that tannin level may not be as important in regards to the level of match with chêvre, because the impact of acidity level was more consistent in regards to overall level of match.

When comparing the perceptions of the expert and novice groups in regards to which wine elements impacted the level of match, it was found that the expert group's perception differed from the overall results. For the expert group, acidity did not impact the level of match with the chêvre or the brie, and tannin did not impact the level of match with the spicy Italian salami. For the novice group, sweetness did not impact the level of match with the milk chocolate. A significant difference between the expert and novice groups in regards to match perception was related to the Port and milk chocolate match. When exploring the impact of food and wine expertise, 9% of the variance in perception of match with the Port and milk chocolate was explained by food and wine expertise. The expert group rated this food and wine combination much higher than the novice group as they did every other selected food and wine combination. Prior exposure to food and wine pairing, in educational or even casual

atmospheres, may account for the higher levels of match for several reasons. Those who evaluated themselves as above average in food and wine pairing competency may have tasted many food and wine combinations and experimented more than those who ranked themselves average; therefore, the expert group may have a more varied comparison base than the novices. For example, those in the expert group more than likely have tasted many more food and wine matches that were unsuccessful and in turn were more likely to rank the selected food and wine matches closer to ideal. Also, the expert group may have more knowledge of expert food and wine pairing recommendations and were more apt to give higher scores to certain combinations such as the Sauvignon Blanc and chêvre match; a classic match according to popular literature. Perhaps experts have a more holistic approach to food and wine pairing, and from experience they may have learned certain strategies such as swirling the wine to release aroma and "chewing" the wine to experience flavors that allow them to better evaluate a food and wine match.

Implications

This study supports many food and wine pairing recommendations as well as similar findings in previous research. The increase in consumer interest in food and wine pairing elevates the need for better understanding of consumer food and wine pairing preferences. Minimal empirical research has been conducted to explore what food and combinations match well together and why. Also, little is known in regard to the likings of individuals with limited food and wine pairing knowledge. This knowledge is crucial so that the relevant industries can better educate and serve the public in a manner that is both enjoyable for the consumer and profitable for the industry. The findings of this study contribute to the gap in relevant food and wine pairing literature as well as illuminate future research ideas and suggestions.

The wines with highest match score with each food item reflect many recommendations in food and wine pairing literature and text books. Any person in the position to recommend, sell or choose food and wine combinations may follow these recommendations, validated by this study, with the comfort of knowing that they will be an average match if not above average. Since individuals with greater food and wine pairing experience rated all of these combinations higher than those with less experience, it may also be assumed, that with more exposure and "practice", that those with limited experience would grow to enjoy these combinations more or be willing to try them as they are highly rated by experts.

The finding that sweetness, acidity and tannin all impact perceived level of match is highly valuable as well. Knowing what wine elements create positive or negative impacts with certain food items can be used to suggest or avoid certain food and wine combinations. These findings can act as guidelines, or a template, in which to base future recommendations upon, or simply to experiment in a non scientific atmosphere to discover other great food and wine matches.

With this knowledge, a desire may blossom in the consumer to become more adventurous with their food and drink selections, and also the likelihood that the frequency in which they choose to enjoy wine with food will amplify. The consumer, as Harrington (2005) and Pettigrew and Charters (2006) suggested, therefore has a more enjoyable experience every time they decide to purposely take part in the decision to enhance their food *and* wine by enjoying them together. Food and wine service professionals may use this knowledge to increase both wine and food sales. Educated bartenders, servers, and managers can, with more accuracy and confidence, recommend certain wines to pair with food selections (or vice versa) and answer questions that customers may have. Impeccable customer service, which includes menu and wine list

knowledge, leads to happy customers and increased customer satisfaction (Harrington & Hammond, 2006; Stanich, 2004). Happy customers return and also provide free advertising through word-of-mouth. More positive experiences lead to more positive word-of-mouth, which leads to more customers. Van Westering (1996) suggested that this increased satisfaction can help businesses boost their revenue. Educators may also use this information to enlighten pupils, in both employment and educational settings, to encourage a more well rounded knowledge of food and wine pairing and better training systems can be developed to enhance the overall program of study (Harrington & Hammond, 2005). Researchers may also benefit from the findings of this study. Expanding upon this research can lead to greater knowledge regarding the effects that certain wine characteristics have on perception of match as well as further exploring the differences between individuals based on food and wine pairing knowledge and individual preferences.

Limitations and Recommendations

Future research is necessary to better understand the relationship between food and wine. The subjects used in the study participated in a 15 minute training session and provided with definitions of terms used in the sensory evaluation forms, they did not receive forms on each aspect of the study. For example, the participants were provided with a wine level value band form so that they could better evaluate sweetness, acidity and tannin levels in the wine, but they were not given a form or definitions for the levels of food and wine expertise or for terms on food and wine match level scale. Further explanation to the participants for these items could have altered response levels and generated more accurate responses. Also, once divided into novice and expert groups, the number of participants in each group was vastly different. The group numbers varied by approximately 100 participants.

Future researchers should take into consideration several additional factors to receive more in depth results. Providing detailed descriptions, like those used in the wine value band form, for food and wine expertise and match level description terms may result in a more accurate view of the participants' knowledge and preferences. Researchers could also gain more knowledge by having participants rank certain food component, texture and flavor elements, such as sweetness, acidity, fattiness, to better understand additional factors that play a role in the success or failure of a food and wine match. Also, additional wine component, texture and flavor elements could be assessed for the same purpose. With an assessment of certain food and wine characteristics, researchers could better predict successful matches based on matching or contrasting elements in food and wine. To date, this is the first study to conduct a food and wine pairing experiment with such a large sample size. In the future, even larger sample sizes could lead to results that can be generalized to a larger population.

For everyday consumers, this knowledge can also be valuable. Simply knowing that certain wines do pair better with certain foods is important information that can enhance the overall dining experience. At the most basic level, this could encourage individuals to be mindful in their selection of wine and food items at home or in a restaurant, and if that is the extent of the individual's knowledge, he will know to ask for recommendations so that the best combination possible is achieved. Knowing what key wine elements create an ideal perception of match is also helpful. Consumers can better understand the impact of sweetness, acidity and tannin so that they do not chose, for example, a high tannin red or high acid white to pair with a sweet dessert. Mindfulness of how the significant component and texture elements play a role in the success of a food and wine match can help guide consumers in selecting proper and enjoyable food and wine combinations.

Conclusion

This study evaluated a variety of sensory relationships in the interaction of food and wine by utilizing four wines: Sauvignon Blanc, Chardonnay, Cabernet Sauvignon, and Port, and four food items: chêvre, brie, spicy Italian salami, and milk chocolate. To address the research questions the differences between a variety of food and wine style combinations was explored. Also, the effects of certain wine characteristics (sweetness, acidity and tannin) were examined to determine their impact on perception of match, and whether or not food and wine expertise impacted the level of food and wine match was evaluated. Many food and wine pairing recommendations are based on anecdotal evidence, and minimal scientific research has been conducted to test these relationships. This study validated some of the claims that food and wine pairing authors have made about the success of certain food and wine combinations and identified some perception differences between novices and experts.

This study produced many important findings related to the impacts of sweetness, acidity and tannin. A major contribution of this study was the finding that acidity levels in wine can significantly impact level of match with certain foods, and that food and wine pairing expertise impacts overall perception of food and wine match as well as the impact certain component and texture elements have on perception of match.

Greater understanding of key wine elements and their potential to influence the success of a food and wine match is important to increase food and wine pairing enjoyment. Also, the role of food and wine pairing expertise in relation to overall perception of match (and which elements help to create a more successful match) is helpful to acknowledge for the purposes of making recommendations that will satisfy the consumer. The findings of this research contribute to the body of food and wine pairing knowledge as well as highlight improvements to be made to

better understand food and wine pairing so that more synergistic matches can be achieved and predicted in the future.

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Appendix A

Chef School,
Center for Hospitality and Culinary Management,
George Brown College
For further information:
Primary Investigator: Robert J. Harrington, PhD, MBA, CEC
Tel: 1 479 575 XXXX
Fax**:** 1 479 575 XXXX
Email: rharring@xxxx

January 11, 2010

Predictability of Wine and Food Pairing using a Sensory Approach
Information Letter

Dear Potential Participant,

You are invited to take part in the research project identified above which is being conducted by the Research Team of Robert J. Harrington at the University of Arkansas, Mario Gozzi at the Chef School, Center for Hospitality and Culinary Arts, George Brown College, and Michelle M. McCarthy at the School of Hospitality, Tourism and Recreation, Humber College and the Canadian Association of Professional Sommeliers.

This research project examines the potential of predicting wine and food match levels using a scoring approach to wine and food element profiles. The research is designed to evaluate a variety of sensory relationships in the interaction of wine and food when tasted sequentially and then together (a mixed tasting). It is anticipated that the findings from this research will contribute to the body of knowledge on wine and food matching and enhancement of curriculum design.

Who can participate in the research?
We are seeking students who are aged 19 and above to participate in this research.

What choice do I have?
Participation is **entirely voluntary**. If you decide to participate, you may withdraw from the project at any time without giving a reason and without any academic penalty. The researcher(s) may also withdraw a participant if it is considered in the participant's best interest or it is appropriate to do so for another reason. If this happens, the research(s) will explain why and advise you about any follow-up procedures or alternative arrangements as appropriate.

All information collected will be confidential. All information collected will be stored securely with the researchers and kept for a period of five years in Hospitality & Restaurant Management, School of Human Environmental Science, College of Agriculture, Food and Life Sciences, Fayetteville, AR 72701. At no time will any individual be identified in any reports resulting from this study.

What will I be asked to do?

- Participate in a one-time only sensory training and evaluation session lasting approximately 60 minutes in duration, which will include the following:
    - Participation in a 15 minute sensory training session where you will be introduced to the sensory evaluation survey form and provided with definitions of terms used in the sensory evaluation survey form. Sensory evaluation is defined as a scientific discipline that is used to induce, quantify, analyze and assess the responses to products based on what is perceived through the senses of sight, smell, taste, touch, and hearing.
    - Participation in a 45 minute sensory evaluation exercise where you will be asked to identify your perceived level of competency in wine tasting and wine and food matching. Using the sensory evaluation survey form you will determine the primary taste components and texture elements. As part of this process, you will also be asked to assess the level of perceived match among several types of food and wines. Wine elements include level of sweetness, acidity, and tannin (astringency). The levels of these food and wine elements will not be beyond the levels that you might normally consume. Participants are required to spit out the majority of wine being sampled to minimize palate fatigue.
- Participants are asked not to wear excessive perfume or cologne and to refrain from smoking tobacco directly prior to tasting or during the tasting sessions.
- Every effort will be made to ensure confidentiality of any identifying information that is obtained in connection with this study. The names of members in this study will be kept confidential during data analysis or subsequent publication of study results. Sensory evaluation survey forms will be given an ID code prior to statistical analysis. No names or identifying information will be included in the written report.
- Analysis of aggregate data from the completed sensory evaluation survey forms will be summarized in a written report.
- It is anticipated that the research will commence the week of January 11th. Your commitment will be for approximately 60 minutes only (as stated above), which will be in scheduled HOSF 2024 class time.
- The research will be conducted by Mario Gozzi, Professor/Chef, Chef School, George Brown College.
- Participants will not be reimbursed or compensated in any way.
- Should a participant not be able to participate in one or more components based on the personal reasons, they may do so.

What are the risks and benefits of participating?

There are no anticipated risks to this research; however, because participants will be tasting food items, the ingredients of all food products will be disclosed prior to tasting. All participants will be required to notify the investigators of any allergies to food items or sulfites (contained in most commercial wines) prior to the sensory tasting session.

While the amount of food and wine ingested at any tasting session will be minimal, participants should evaluate their personal situation prior to consenting to participation in the sensory tasting session.

The benefit received from participation in this study includes increased appreciation for sensory evaluation and greater knoweldge in sensory analysis as applied to food and drink pairing. Your participation benefits society by furthering the knowledge of the interacting effects of food and wine elements on our perceptions of a sensation of match.

How will the information collected be used?
The data provided will be used in the research on wine and food matching, and will form part of a written report. If a participant requests a copy of the report, it will be sent via email.

What do I need to do to participate?
Please read this Information Letter and be sure you understand its contents before you consent to participate. If there is anything you do not understand, or you have any questions, please contact the Principal Investigator or Co-Researcher.

If you would like to participate, please sign the required Consent Form.

Thank you for considering this invitation,

Robert J. Harrington, PhD, MBA, CEC

Mario Gozzi, CCC

Michelle M. McCarthy, MA

Appendix B

Chef School,
Center for Hospitality and Culinary Management,
George Brown College
For further information:
Primary Investigator: Robert J. Harrington, PhD, MBA, CEC
Tel: 1 479 575 XXXX
Fax**:** 1 479 575 XXXX
Email: rharring@xxxx

January 11, 2010

Predictability of Wine and Food Pairing using a Sensory Approach
Consent Form

I, *(please print)*_____ have read and understood the information on the research project ***Predictability of Wine and Food Pairing using a Sensory Approach*** which is to be conducted by Robert J. Harrington and all questions have been answered to my satisfaction.

I agree to voluntarily participate in this research and give my consent freely. I understand that the project will be conducted in accordance with the Information Letter, a copy of which I have retained for my records.

I understand I can withdraw from the project at any time, without any academic penalty, and do not have to give any reason for withdrawal.

I consent to:

- Participate in a one-time only sensory training and evaluation session lasting approximately 60 minutes in duration, which will include the following:
    - Participation in a 15 minute sensory training session where you will be introduced to the sensory evaluation survey form and provided with definitions of terms used in the sensory evaluation survey form. Sensory evaluation is defined as a scientific discipline that is used to induce, quantify, analyze and assess the responses to products based on what is perceived through the senses of sight, smell, taste, touch, and hearing.
    - Participation in a 45 minute sensory evaluation exercise where you will be asked to identify your perceived level of competency in wine tasting and wine and food matching. Using the sensory evaluation survey form you will determine the primary taste components and texture elements. As part of this process, you will also be asked to assess the level of perceived match among several types of food and wines. Wine elements include level of sweetness, acidity, and tannin (astringency). The levels of these food and wine elements will not be beyond the levels that you might normally consume. Participants are required to spit out the majority of wine being sampled to minimize palate fatigue.

- Every effort will be made to ensure confidentiality of any identifying information that is obtained in connection with this study. The names of members in this study will be kept confidential during data analysis or subsequent publication of study results. Sensory evaluation survey forms will be given an ID code prior to statistical analysis. No names or identifying information will be included in the written report.
- Analysis of aggregate data from the completed sensory evaluation survey forms will be summarized in a written report.
- It is anticipated that the research will commence the week of January 11th. Your commitment will be for approximately 60 minutes only (as stated above), which will be in scheduled HOSF 2024 class time.
- The research will be conducted by Mario Gozzi, Professor/Chef, Chef School, George Brown College.
- Participants will not be reimbursed or compensated in any way.
- Should a participant not be able to participate in one or more components based on the personal reasons, they may do so.

Print Name: _____
Signature: _____
Date: _____

Appendix C

Tasting Instructions:

Purpose: Provide an opportunity to taste/evaluate wines, types of foods, and the sensation of match among them.

Steps: Please follow the following sequence during the tasting process:

1. A self-evaluation regarding levels of competence in tasting/matching (Form 1)
2. Wine tasting (Form 2). Rank the wine sweetness, acidity and tannin levels using the 0 to 10 scale following the descriptions in Table 1.
3. Mixed food and wine tasting and evaluation (Form 3): What is your perception of match sensation? Rank the match level using the 0 to 10 scale (0 = no match, 5-6 = average match level, 10 = synergistic or ideal match)
    a. Instructions for the food and wine tasting:

        Take a small bite of food and then a sip of wine. Slowly chew the food and wine combination, savoring the flavors and evaluating level of match. Repeat for each food and wine combination. Please reserve comments on perception of match until all of the participants have completed their evaluations.

Confidentiality: The names of members in this study will be kept confidential during data analysis or subsequent publication of study results. You can choose whether you wish to have your results included in this study or not.

Appendix D

Wine and Food tasting/matching self evaluation: Date: _____

Female_____ Male_____
Circle the level below:

Food tasting	0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10		
	Novice	Average	Expert
Wine tasting	0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10		
	Novice	Average	Expert
Food & Wine matching	0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10		
	Novice	Average	Expert

Appendix E

Sweetness, Acidity and Tannin Value Band Scale

Value Band	Wine Sweetness Description	Wine Acidity Description	Wine Tannins Description
0 **1**	**Bone dry:** The inability to pick up the sensation of sweetness on the tongue. **Brut sparkling Wine**	**Imperceptible:** If the particular sensation is not detectable or if this sensation fades almost immediately. No perception or barely perceptible levels.	**Imperceptible:** Particular sensation is not detectable or if this sensation fades almost immediately. No perception or barely perceptible levels. **White Wines in general**
2 **3**	**Dry:** Any level of sweet characteristics are barely perceived and only with difficulty and hard work on the evaluator's part. **Chardonnay**	**Barely perceptible:** Any level of acidic characteristics are barely perceived and only with difficulty and hard work on the evaluator's part.	**Barely perceptible:** Any level of tannic characteristics are barely perceived and only with difficulty and hard work on the evaluator's part
4 **5**	**Medium dry:** A lightly sweet sensation is identified and perceived at a sufficient level. **Off dry Riesling**	**Little perception:** A taste sensation in which we succeed in identifying or perceiving it in recognizable way, but, the stimulus is not well-defined. The level of perception is still low. **Gewurztraminer**	**Little perception:** A taste sensation in which we succeed in identifying or perceiving it in recognizable way, but, the stimulus is not well-defined. The level of perception is still low. **Granache/Gamay**
6 **7**	**Medium sweet:** A sweet sensation on the tongue that is clearly identifiable and in a very defined way. **Loire Valley Rosé**	**Sufficiently perceived:** A taste sensation in which we succeed in identifying and perceiving it in a sufficient level. **Chardonnay/Merlot**	**Sufficiently perceived:** A taste sensation in which we succeed in identifying and perceiving it in a sufficient level. **Merlot**
8 **9**	**Sweet:** Sugary, full, noticeable glycerin, containing residual sugar but pleasant in taste. **Sauternes**	**Abundant perception:** A taste sensation in which we can clearly identify and perceive in a very defined way. The taste sensation is at an emphasized level. **Sauvignon Blanc** **Dry Riesling**	**Abundant perception:** A taste sensation in which we can clearly identify and perceive in a very defined way. The taste sensation is at an emphasized level. **Cabernet Sauvignon** **Pinot noir**
9 **10**	**Very sweet:** Sweetness is at an unmistakably, high level of perceptibility with a lot of emphasis. **Port Wine/Ice Wine**	**Highly perceived:** Acidity is at an unmistakably, high level of perceptibility with a lot of emphasis. **Brut sparkling Wine**	**Highly perceived:** Tannins are at an unmistakably, high level of perceptibility with a lot of emphasis **Nebbiolo**

Appendix F

Wine sweetness, acidity and tannin levels. Date: _____

Overall feeling (Circle the perceived level below):

Wines:

***Sauvignon Blanc**:*

Sweetness 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

Acidity 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

Tannins 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

Chardonnay:

Sweetness 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

Acidity 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

Tannins 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

Cabernet Sauvignon:

Sweetness 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

Acidity 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

Tannins 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

Port Wine:

Sweetness 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

Acidity 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

Tannins 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10

Appendix G

Food and wine - level of match. Date: _____

Overall feeling of Food & Wine Match (Circle the level of match below):

Chêvre (Fresh goat's milk cheese): _____

Sauvignon Blanc 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Chardonnay 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Cabernet Sauvignon 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Port Wine 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Brie (Soft Cow's milk cheese): _____

Sauvignon Blanc 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Chardonnay 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Cabernet Sauvignon 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Port Wine 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Spicy Italian Salami: _____

Sauvignon Blanc 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Chardonnay 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Cabernet Sauvignon 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Port Wine 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Milk chocolate: _____

Sauvignon Blanc 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Chardonnay 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Cabernet Sauvignon 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Port Wine 0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
No Match Average Match Synergistic Match

Appendix H

November 8, 2012

MEMORANDUM

TO:	Rebeckah Koone Robert Harrington
FROM:	Ro Windwalker IRB Coordinator
RE:	New Protocol Approval
IRB Protocol #:	12-10-200
Protocol Title:	*Predictability of Wine and Food Pairing using a Sensory Approach*
Review Type:	☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB
Approved Project Period:	Start Date: 11/08/2012 Expiration Date: 11/07/2013

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (http://vpred.uark.edu/210.php). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

This protocol has been approved for 248 participants. If you wish to make *any* modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 210 Administration Building, 5-2208, or irb@uark.edu.