

# Classifying South African Chenin blanc wine styles

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by

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## Declaration

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## Summary

South African Chenin blanc wine is characterised by its style diversity and has been receiving more industry limelight over the past few years. Three dry Chenin blanc wine styles are currently described by the wine industry as Fresh and Fruity (FF), Rich and Ripe unwooded (RR-unwooded) and, Rich and Ripe wooded (RR-wooded). According to the South African wine industry, however, consumers seem to be somewhat confused by these various Chenin blanc wine styles, which have not yet been clearly defined and classified. During this study we investigated the following perspectives of this wine style classification confusion:

Currently, no specified sensory method is being used to differentiate between wine styles of a single wine cultivar, such as Chenin blanc. The sorting method can be used as a more cost and time effective classification and profiling method than general quantitative descriptive analysis (QDA). It was therefore investigated whether both uninstructed and instructed sorting, with consumers and wine experts, can be used to classify and describe the Chenin blanc wine styles similarly to QDA. The increase in young wine consumers, Generation Y, introduces new wine marketing opportunities for the wine industry which need to be investigated. Young consumers are not aware of the various Chenin blanc wine styles, which may influence their wine preferences. The influence of wine style knowledge on these consumers' wine style preferences were investigated during blind and wine style informed preference test. Any segmentation within this Generation Y group was also investigated with regards to their Chenin blanc wine style preferences and/or exploratory data. The following scientific and industrial findings were made:

QDA was successfully substituted by instructed and uninstructed sorting tasks. Although the sorting tasks easily differentiated between wooded and unwooded wines, QDA differentiated more successfully between the unwooded wines. Wine tasting experience did not significantly influence the sorting results of the consumers versus the wine experts, but more experienced panellists consistently used fewer descriptors than untrained consumers. All panellists sorted products slightly better when they were provided with wine style sorting instructions. However, there were no significant differences between the instructed and uninstructed sorting task results, i.e. a wine style descriptor list did not improve panellists' abilities to describe their sorted wine groups.

South African Chenin blanc wines can definitely be divided into wooded and unwooded wine styles, i.e. two wine style groups, but the unwooded Chenin blanc wine spectrum formed a wine-style-continuum. This finding is apparent from both the sorting and QDA methods. The unwooded continuum wines can further be differentiated from one another with the use of a fresh-to-mature scale and/or a light-to-full body scale during QDA.

Generation Y wine consumers preferred all the Chenin blanc wine styles equally and moderately during the blind tasting, but their knowledge of the wine style concepts significantly increased their preferences for the wines during the informed wine style tasting. The cognitive influence of wine style knowledge is therefore powerful in terms of influencing a consumer's wine preferences. Other interesting correlations were also made between Generation Y consumers' wine style preferences and their exploratory data.

## Opsomming

Suid-Afrikaanse Chenin blanc wyn word gekarakteriseer deur styl diversiteit en is die afgelope paar jaar meer in die kollig. Drie droë Chenin blanc wynstyle word tans deur die wynbedryf beskryf as: Vars en Vrugtig, Ryk en Ryp ongehout en, Ryk en Ryp gehout. Volgens die Suid-Afrikaanse wynbedryf is daar heelwat verwarring is tussen hierdie Chenin blanc wynstyle weens die feit dat hierdie wynstyle nog nie duidelik gedefinieer en geklassifiseer is nie. Tydens die huidige studie het ons die volgende perspektiewe van hierdie wynstyl-verwarring ondersoek:

Huidiglik word daar geen gespesifiseerde sensoriese metode gebruik om te onderskei tussen verskillende wynstyle van 'n enkele wyn kultivar, soos Chenin blanc, nie. Die sorteringsmetode kan gebruik word, in stede van kwantitatiewe beskrywende analise, as 'n meer koste- en tyd-effektiewe produk klassifikasie en profileringsmetode. Dit was dus ondersoek of beide geïnstrukteerde en ongeïnstrukteerde sorteringstake, met verbruikers en wynkundiges, gebruik kan word om die verskeie Chenin blanc wynstyle kan profileer en klassifiseer soortgelyk soos kwantitatiewe beskrywende analise. Die toename in jong verbruikers, Generasie Y, skep nuwe wynebemarkingsgeleenthede wat ondersoek moet word. Jong verbruikers se onbewustheid van die verskeidenheid Chenin blanc wynstyle mag hulle voorkeure vir hierdie wyne beïnvloed. Die invloed van wynstyl kennis op hierdie jong verbruikers se wynstyl voorkeure was ook ondersoek gedurende 'n blinde en 'n wynstyl-ingeligte voorkeur toets. Enige segmentasie binne hierdie Generasie Y verbruikersgroep was ook ondersoek in verband met hul Chenin blanc wynstyl voorkeure en/of verkennende data. Die volgende wetenskaplike en industriële bevindings is gemaak:

Kwantitatiewe beskrywende analise kan suksesvol vervang word deur beide geïnstrukteerde en ongeïnstrukteerde sorteringsmetodes. Alhoewel die sorteringsmetodes maklik gebruik kon word om te onderskei tussen gehoute en ongehoute wyne, kan kwantitatiewe beskrywende analise fyner onderskeid tref tussen die individuele ongehoute wyne. Die wynproe-ervaringsvlak het geen invloed op die sorteringsresultate gehad nie, maar meer ervare paneellede het konsekwent gebruik gemaak van minder beskrywende terme as onopgeleide verbruikers wat baie meer en verskillende soorte terme gebruik het. Beide panele het effens beter gesorteer wanneer hulle spesifieke wynstyl sorteringsinstruksies ontvang het. Daar was egter geen beduidende verskille tussen die geïnstrukteerde en ongeïnstrukteerde sorteringsresultate nie, wat daarop dui dat sorteringsinstruksies en 'n lys van wynstyl beskrywings nie die paneellede se wyse van sortering verander het nie.

Suid-Afrikaanse Chenin blanc wyne kan definitief verdeel word in gehoute en ongehoute wynstyle, d.w.s twee wynstyl groepe, maar die ongehoute Chenin blanc wyn spektrum vorm 'n wynstyl-kontinuum. Laasgenoemde is bevind tydens beide die sorteringstake asook kwantitatiewe beskrywende analise. Die ongehoute kontinuum wyne kan verder van mekaar onderskei word met behulp van 'n vars-tot-volryp en/of 'n ligte-tot-volmond skaal tydens kwantitatiewe beskrywende analise.

Alle jong wyn verbruikers het ewe veel van al die wynstyle gehou tydens die blinde wynstyl voorkeur toets, maar tydens die wynstyl-ingeligte voorkeur toets het hulle voorkeure vir al die wynstyle drasties verbeter. Die kognitiewe invloed van Chenin blanc wynstyl kennis kan dus lei tot hoër voorkeure vir die wynstyle. Ander interessante korrelasies is ook bevind tussen hierdie Generasie Y wyn verbruikersgroep se wynstyl voorkeure en hul verkennende data.

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## Biographical sketch

Inneke Bester was born in George, South Africa on the 17<sup>th</sup> of October 1986. She attended Outeniqua Primary School and Matriculated at Outeniqua High School in 2004. Inneke obtained a BScAgric degree in Oenology and Viticulture in 2008 at the Stellenbosch University. In 2009 she completed a harvest season and a sensory internship in the Quality Management and Research department at Distell, Adam Tas cellar in Stellenbosch. In 2010 Inneke obtained a diploma in Postgraduate Marketing. And in 2011 Inneke enrolled for an MSc in Wine Biotechnology at the Institute for Wine Biotechnology, Stellenbosch University.

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## Preface

This thesis is presented as a compilation of six chapters as indicated below.

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# Chapter 1

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## **INTRODUCTION AND PROJECT AIMS**

# INTRODUCTION, PROBLEM STATEMENT AND AIMS

## 1.1 General Introduction

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Chenin blanc wines have been produced in South Africa for centuries; however, it has received more industry limelight during the past few years thanks to the dedication and proactive work of organisations within the South African wine industry such as the Chenin Blanc Association (CBA). According to the Ina Smith, manager of the CBA, six different styles of Chenin blanc wines can be identified in South Africa: Fresh and Fruity, Rich and Ripe unwooded, Rich and Ripe wooded, Rich and Ripe slightly sweet, Sweet and Sparkling (Smith, 2010).

However, there seems to be some confusion amongst consumers in terms of their ability to identify and relate their preferences to these various wine styles. The issue seemed to be that there are so many different styles of Chenin that we seem to be confusing the customer and also don't tell them what is in the bottle (Brower, 2009). This state of confusion is not clear as it can refer to the fact that consumers are confused about the various wine styles or they are confused in terms of their preferences for the wine styles. The South African wine industry is not yet using the various wine style identities as marketing tools, i.e. it is not printed on the bottle label. It is possible that consumers are therefore not be aware that they possibly select different wine styles during repeated Chenin blanc wine purchases which may confuse them, because they expect these Chenin blanc wines to be similar to one another. During this study it was important to investigate this state of confusion, in terms of classifying Chenin blanc wine styles, from various perspectives: by identifying whether there truly are three Chenin blanc wine styles or whether there are more or less wine styles; by identifying the most suitable sensory technique able to classify wines into the various Chenin blanc wine styles; by establishing how consumer preferences are influenced when consumers are not aware of the wines' style identities versus when they are informed of the wine style identities.

No specific sensory method is currently used to classify and describe Chenin blanc wine styles; and the differentiation between these wine styles also still need to be defined. Furthermore, some of the wine styles seem to overlap with one another with regards to their sensory characteristics. One of the main challenges for the wine industry of South Africa is to identify a method that can be used to describe and classify the various Chenin blanc styles that will suit specific consumer target market preferences.

Sensory research plays an important role during product development, marketing research, competitive product comparisons and during quality control (Chollet *et al.*, 2011). Sensory science and sensory profiling techniques are becoming increasingly important in terms of understanding consumer perceptions and linking product development effectively with consumer insights and their product preferences (Delarue and Sieffermann, 2004). The most important purpose of sensory profiling is to describe and quantify the sensory attribute differences between a set of product samples in order to position the products in a multivariate projection (Delarue and Sieffermann, 2004). Sensory research can therefore be used to investigate the following aspects of a product sample set: similarities within the group of products; precise sensory profiles of individual products within a sample set and; consumer preference drivers for specific products or sensory attributes. Generally sensory research is not specifically focused on identifying and describing the sensory attributes of a group of products, but is rather focused on profiling individual products especially during QDA.

According to Lawless and Heymann (2010:5), there are three major types of sensory tests: classification tests, description tests and affective tests. Two types of analytical sensory research methodologies can be used to investigate products in terms of their sensorial



properties: descriptive profiling tests and classification tests (Næs *et al.*, 2010:19-21). Two methods that demonstrate these tests on wines are quantitative descriptive analysis (QDA) (Mirarefi, Menke and Lee, 2004) and the free sorting method (Parr *et al.*, 2007). Recently both these tests have been used as describe and discriminate between products (Faye *et al.*, 2004; Lim and Lawless, 2005; Cartier *et al.*, 2006; Chollet *et al.*, 2011), however, QDA is typically used as a descriptive method and sorting is used as a discriminating test (Næs *et al.*, 2010:19-21). QDA will typically deliver qualitative as well as quantitative data (Næs *et al.*, 2010:19-21) whereas the free sorting task delivers qualitative data, although it can be combined with a sequential attribute intensity scaling task to obtain quantitative data (Chollet *et al.*, 2011). However, the problem with this extra step is that consumer panellists are not normally used to quantify their perceptions, because they are often biased by their preferences for or against certain products. Sorting and QDA have been repeatedly compared with one another (Chollet *et al.*, 2011), however, it is yet to be established whether these methods can be used to distinguish between different wine styles and consumers' wine style preferences.

With the creation of different Chenin blanc wine styles it is not only important to profile the wine style sensory characteristics, but also to classify wines according to the appropriate wine styles. QDA has been used extensively to specify the nature and the intensity of the sensory characteristics (Stone *et al.*, 1974) and it remains to be the best sensory profiling method with regards to obtaining highly reliable, precise and repeatable results (Chollet *et al.*, 2011; Rodrigue *et al.*, 2000). This method does, however, require a trained panel to profile products. Although trained descriptive panels are effective in terms of providing reliable data, the training period is often time consuming and expensive (Chollet *et al.*, 2011). It may take anywhere between a few weeks to several months to complete the language development and calibration phases of QDA (Chollet *et al.*, 2011). For each new sample set the panel must either be retrained or a different panel must be trained to profile the new sample set (Bitnes *et al.*, 2007; Chollet *et al.*, 2011). This does not only limit QDA's versatility in terms of being used across different wine sample sets, but it also increases financial and time expenses for the wine industry. The question therefore arises whether QDA can effectively be used to describe the sensory profile of different wine styles and whether the method can also be used to effectively identify the various wine style clusters.

The discriminative sensory technique called free sorting was developed in the late 1960's and early 1970's and generally used for studies of word meanings by Rosenberg and Kim (1975) and Rosenberg *et al.* (1968). Sorting has been used over the past few years by researchers to successfully classify various food and non-food product classes within a sample set: odorants (Lawless, 1989; MacRae, Howgate, and Geelhoed, 1990; MacRae *et al.*, 1992; Heymann, 1994), basic taste and salts (Lim and Lawless, 2005; Yang and Lawless, 2005) drinking waters (Falahee and MacRae, 1997), beers (Chollet and Valentin, 2001), cheese (Lawless, Sheng, and Knoops, 1995), jellies (Tang and Heymann, 2002), yogurts (Saint Eve, Paci-Kora and Martin, 2004), red wine (Gawel, Iland, and Francis, 2001), plastic pieces (Faye *et al.*, 2004), tactile surface texture (Hollins, Faldowski, and Rao, 1993) and fabrics (Giboreau *et al.*, 2001) and musical timbres (McAdams *et al.*, 1995). The sorting technique is described by researchers as a simple, time saving and practical technique to describe the sensory characteristics of a product sample set and to identify various similarity groups within the product sample set (Chollet *et al.*, 2011). The sorting task is often combined with a verbalisation phase to create a perceptual map that can thereafter be statistically investigated to explain the underlying map dimensions in a similar manner than the principal component analysis (PCA) map, obtained during QDA (Popper and Heymann, 1996). The inclusion of a verbalisation phase will result in comprehensive and consistent product spatial positioning maps (Cartier *et*

*al.*, 2006). Panellists do not require any training other than the primary sorting instructions and this method also limits the level of sensory fatigue or boredom (Bijmolt and Wedel, 1995). Previous research on the sorting task versus QDA found that both trained and untrained panellists can create similar perceptual product maps, therefore sorting results were independent of the level of panellist training or experience (Cartier *et al.*, 2006). The sorting method can also be used for much larger product sample sets than QDA (Piombino *et al.*, 2004). The principal of the sorting task is to collect similarity data: i.e. each assessor groups products together based on perceived similarities (Chollet *et al.*, 2011). In other words this method will generally profile groups of similar products and not individual products such as QDA. Product spatial positioning maps of sorting data can be obtained via statistical analysis such as multidimensional scaling (MDS) or DISTATIS which are similar to the PCA map obtained from QDA (Chollet *et al.*, 2011). These maps can be used similarly to the PCA map to identify and interpret the underlying dimensions that explains the product positions (Chollet *et al.*, 2011). To the researchers' knowledge, no research has been conducted to investigate the use of the sorting method to classify various wine styles within a single wine cultivar.

Previous studies investigated the use of various trained and novice panels in order to sort products (see Chollet *et al.*, 2011; Cartier *et al.*, 2006). However, industry expert panellists have not frequently been compared with untrained consumer panels. Due to the fact that wine industry experts are responsible for the creation and description of the various Chenin blanc wine styles, it is important to investigate whether untrained consumers can sort and describe wines similarly to them. According to Moskowitz *et al.* (2006:310), there are different arguments in terms of which panel should be used for sensory profiling. The first view is that experts should be used during early stage product development as they are often aware of consumer preferences and able to communicate the consumer desires to product developers. However, there is no evidence in research supporting this claim. The second view is that consumers should be used for almost all tasks in the early phases of product development due to the argument that a carefully selected and instructed consumer panel can describe products similarly to experts (Moskowitz, Munoz, and Gracula, 2003). However, the majority of companies still rely on the use of a trained panel for product profiling (Moskowitz *et al.*, 2006:310). As a result of intensive training, trained panellists have a better descriptive vocabulary and ability to describe products in comparison to consumer panels and expert panels. Lawless and Heymann (2010) warned not to rely on consumer panels for accurate descriptive information about a product set, because consumers are often influenced by individual preference bias and should only be used to capture preference data. However, Moskowitz *et al.* (2003) argue that the progress of sensory science can be advanced by using consumers during the early stages of product development instead of routinely relying on trained panellists. It is clear that there are different schools of thought with regards to the type of panel that should be used for sensory profiling. One of the aims of this current study is to evaluate which panel, wine experts or wine consumers, can be used during the sorting task and how do their sorting results differ from one another?

Furthermore, it is important to establish how these panellists', consumers and wine experts, knowledge of the various wine styles will influence their sorting results. Wine style instructed sorting must therefore be compared with uninstructed wine style sorting. During their research Chollet *et al.* (2011) and Cartier *et al.* (2006) obtained similar results from both instructed and uninstructed sorting tasks. Due to the fact that wine experts are responsible for the production and classification of these Chenin blanc wine styles, it is important to investigate how their wine style classification perceptions compare to those of the wine consumers. During a blind wine tasting, experts will generally use their wine cultivar knowledge to predetermine the

expected sensorial dimensions of a specific wine (Green *et al.*, 2011). This is called a top-down evaluation (Green *et al.*, 2011). On the other hand, consumers will generally evaluate a wine from bottom-up during a blind tasting, according to their own perceptions of the sensorial characteristics and global perceptions of the products (Green *et al.*, 2011). However, during an instructed wine tasting, where the wine style concept or wine category is defined beforehand, novice consumers would also make use of a similar top-down evaluation method. In other words consumers will try to match perceived product characteristics to their expectations, which are created by their knowledge of the defined product concept. Trained panellists, on the other hand, also use the bottom-up evaluation technique as they are trained to identify and scale the individual sensory attribute intensities (Green *et al.*, 2011).

The South African wine industry is however, not only interested in the sensorial profile or differences between various Chenin blanc wine styles, but they are also interested in the consumer preferences for these wine styles. This information is critical in order to identify consumer target markets for specific wine styles. Currently there is a major increase in the number of young wine consumers, Generation Y, who are born between the years 1977 to 2000 (Wolf, Carpenter and Qenani-Petrela, 2005). It is therefore important to focus on this new wine consumer generation due to the fact that this generation has not yet been researched in terms of their preferences for different Chenin blanc wine styles. In order to establish the degree of liking for products, hedonic or affective tests are conducted with a large group of 100 to 150 representative panellists of a targeted consumer population (Næs *et al.*, 2010:15). Traditionally QDA descriptive data are used to explain drivers of liking (Kleef, Trijip and Luning, 2006) however, sorting data has also recently been used to explain consumer preferences for various products within a sample set (Faye *et al.*, 2006). External preference maps (PREFMAPS) can be obtained by regressing consumer preference data on the PCA data obtained from QDA (Helgesen, Solhiem, and Næs, 1997; Moskowitz *et al.*, 2006:285-286). However, it is possible to investigate how the descriptive product positioning of sorting methods can be used, instead of QDA, to explain consumer preference drivers (Faye *et al.*, 2006). Faye *et al.* (2006) found that similar preference maps can successfully be obtained when utilising the sorting technique than the PREFMAPS obtained from QDA. In their study Faye *et al.* (2006) used a relatively large consumer panel of 207 people to conduct both a sorting task and preference scaling for a set of leather samples. Even though they eliminated the use of a trained panel to explain the drivers of liking for consumers, they still used a large consumer sample which becomes too unpractical and expensive for the wine industry to perform on a regular basis. The following questions therefore arise: can sorting, with the use of a small consumer panel or wine experts, be used instead of QDA to explain the drivers of liking similarly than the PREFMAPS? Therefore, which combination of sensory profiling data, i.e. sorting data or QDA data, can be combined with Generation Y consumers' preference ratings to effectively explain these young wine consumers' Chenin blanc wine style preferences?

Not only may different consumers prefer different Chenin blanc wine styles, but their knowledge of the particular wine style group might also influence their preference for the specific wine style. Similarly to the uninstructed and instructed sorting tasks, consumers might use more top-down cognitive analyses (Green *et al.*, 2011) when they are aware of a particular wine's style identity versus when they taste wines blindly and have to rely on bottom-up cognitive analyses (Green *et al.*, 2011). Therefore, the knowledge of the various wine style identities might create strong expectations in the minds of the consumers before they even sample the wines. Due to the fact that the South African wine industry is not currently using these wine style definitions or names as marketing tools on the wine labels, it is important to

establish how Generation Y consumers' knowledge of these wine style concepts will influence their preferences for the various wines.

It is therefore clear that there is much confusion with regards to: the various Chenin blanc wine styles and their separate style group identities, the methods that can be used to effectively identify them, the existence of different wine style preference groups amongst the Generation Y consumer market and the influence that wine style knowledge has on panellists classify wine style classifying results and on consumers' preferences for these wine styles.

## **1.2 Problem statement and research questions**

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The current study has two focus points for which specific aims have been formulated: a scientific focus area and an industry focus area. These project aims have been formulated to effectively guide the decisions made during the experimental design of the project.

### **1.2.1 Scientific problem statement**

With the development of new wine styles within a single wine cultivar such as Chenin blanc it is important to establish a good sensory profiling technique that can be used to profile the wines individually and classify various wine styles effectively. The sorting technique could possibly be used to substitute QDA when profiling various Chenin blanc wine styles and establishing whether there are only three definite dry Chenin blanc wine styles. However, the use of sorting to identify and profile various wine styles for a specific wine cultivar, such as Chenin blanc, with the use of untrained panellists, either wine experts or consumers, is yet to be established.

No drivers of liking have yet been identified for the different Chenin blanc wine styles. This is the first study to investigate the drivers of liking for the Chenin blanc dry wine styles. In terms of preference mapping techniques it needs to be investigated whether the sorting data combined with consumer preference data can be used as a substitute for QDA descriptive data to explain the drivers of liking. Sorting is less expensive and less time consuming than QDA. The preference means for the various wine style groups, obtained from sorting tasks, can first be calculated and thereafter ANOVA can be used to establish whether there are any significant differences between the different wine style groups in terms of consumer preferences. If the same answers are obtained by using this method than those obtained by standard PREFMAPS, financial and time costs can be reduced.

This scientific problem statement therefore generates the following research questions:

- Should QDA or the sorting technique be used to classify and profile the Chenin blanc wine styles effectively?
- Should wine experts or wine consumers be used during sorting to classify wine styles?
- Should sorting tasks be uninstructed or wine style instructed?
- Are there specific drivers of liking for these Chenin blanc wine styles?
- Can QDA or the sorting technique be used to explain consumer preferences effectively?

### **1.2.2 Industrial problem statement**

The first obvious question for the industry is whether or not the South African Chenin blanc wines can be divided into three defined style groups that can be identified similarly by young wine consumers and wine experts. The pressing question for the industry is whether they should start marketing Chenin blanc wines as different defined wine styles in order to reach and

satisfy consumers, especially the new Generation Y consumers. Therefore they have to know what the effect of the wine style concepts are on the wine consumers' preferences.

It is furthermore uncertain whether wine industry experts and consumers perceive wine style classifications similarly. Due to the fact that wine industry experts, such as winemakers, are responsible for the creation and positioning of the wines so as to satisfy consumers, it is important that consumers must perceive these wines similarly to the wine experts.

It is also important to investigate how the new generation of wine drinkers, Generation Y born between years 1977 to 2000 (Wolf, Carpenter and Qenani-Petrela, 2005), perceive these various Chenin blanc wine styles. It is not yet clear whether there are different consumer preference clusters within this generation for different Chenin blanc wine styles and whether their exploratory data, i.e. socio-demographics, wine purchase and consumption behaviour, wine beliefs and subjective wine knowledge, are associated to their wine preferences.

Furthermore, the effect of Chenin blanc wine style concepts, i.e. knowledge of the particular wine style definition, on consumer preference ratings is unknown. This will give an indication as to how advantageous the use of Chenin blanc wine style definition and marketing will be in terms of consumer preference of the wine.

This industrial problem statement therefore generates the following research questions:

- Can South African Chenin blanc wines be divided into different wine style groups and how many wine styles groups are there?
- Can young wine consumers perceive the various Chenin blanc wine styles similarly to industry wine experts?
- Can different consumer wine style preference groups be identified in the Generation Y wine consumer market?
- Are there any correlations between the Generation Y consumers' wine style preferences and their exploratory data?

### **1.3 Project aims**

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The current study aims to achieve both scientific output as well as industry output. For clarity it is necessary to define the aims needed to reach these research outputs.

#### **1.3.1 Scientific aims**

##### **1.3.1.1 Scientific platform: Classification of Chenin blanc wine styles during sorting (Chapter 3 and 4)**

- a) Comparing QDA versus sorting, with wine experts and consumers, to establish which sensory technique can be used in the future to classify various Chenin blanc wines according to their style identities and profiles.
- b) Comparing uninstructed sorting with wine style instructed sorting to establish which type of sorting task should be used to effectively classify wines according to wine style identities.

##### **1.3.1.2 Scientific platform: Classification of Chenin blanc wine styles during QDA (Chapter 4)**

- a) Obtaining a descriptive list of Chenin blanc wine style attributes, sensory lexicon and aroma standards which can be used to illustrate the wine style concepts and to formulate the wine style definitions.

- b) Establishing whether there are associations between wine style sensorial attributes and the various Chenin blanc wine sample positions on the PCA projections.
- c) Obtaining possible segmentation of wine samples on the basis of wine style sensorial characteristics.

#### **1.3.1.3 Scientific platform: Identifying drivers of liking during the use of preference tests combined with QDA and sorting descriptive data (Chapter 5)**

- a) Combining QDA profiling data with consumer preference data to create internal and external preference maps to establish drivers of liking for the various wine styles.
- b) Compare use of sorting data with the use of QDA descriptive data to explain possible drivers of liking for the various Chenin blanc wine styles. For sorting data, ANOVA can be used to indicate whether there are significant differences between group mean preferences. For QDA descriptive data, PREFMAPS can be used to indicate drivers of liking.

### **1.3.2 Industry aims**

#### **1.3.2.1 Industry platform: Investigating the practicality of using the sorting technique to classify Chenin blanc wine styles (Chapter 3)**

- a) Establish consumers' and experts' natural perceptions of possible wine styles by investigating their descriptions for their sorted wine groups during uninstructed sorting.
- b) Establish if consumers and experts identify only the three industry-classified wine styles or more/less wine styles, during instructed sorting and how they describe these wine styles.
- c) Compare consumers' sorting data with wine experts' sorting data to establish whether they sorted and described wine styles similarly.

#### **1.3.2.2 Industry platform: Investigating the influence of wine style concepts on Generation Y consumer preferences for the Chenin blanc wine styles and investigating South African Generation Y consumer insights (Chapter 5)**

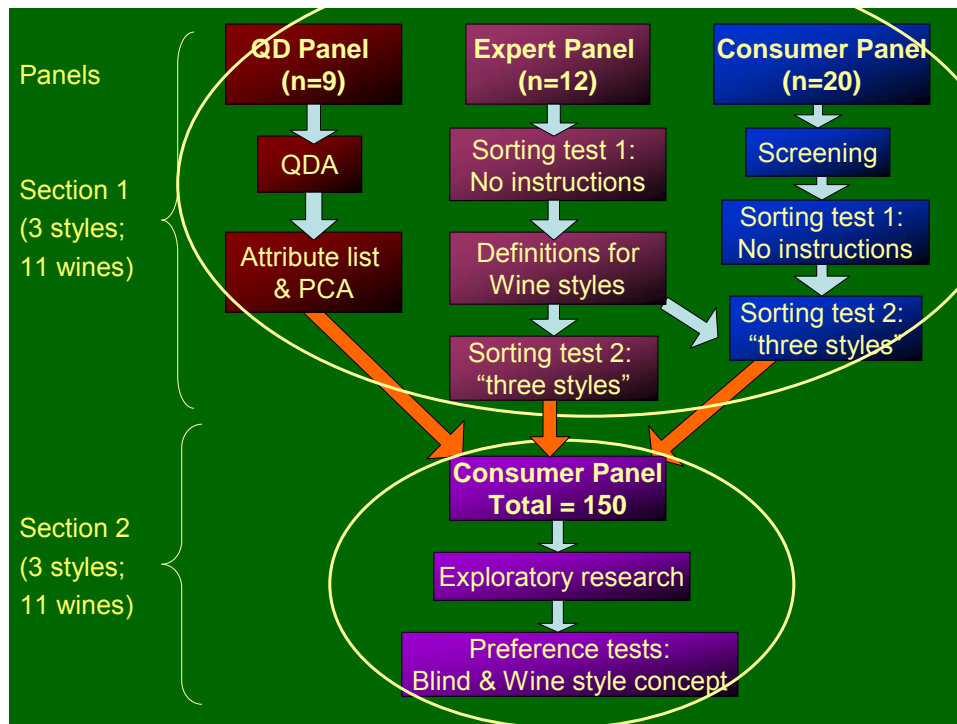
- a) Obtain preference maps by regressing wine attribute intensities onto consumer preference data in order to indicate which wine styles Generation Y consumers preferred the most.
- b) Investigate how Generation Y consumers' blind preference ratings differ from their wine style concept preference ratings for the various Chenin blanc wines, to determine what the effect of wine style information is on consumers' wine style preferences.
- c) Investigate Generation Y consumers' exploratory data, combined with their preference data, for possible relationships or correlations.

## **1.4 Experimental design summary**

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The entire experimental design for this study is illustrated in Fig. 1. In total, six different experiments were conducted. The order in which the tests took place was as follows:

Firstly the uninstructed and instructed sorting and verbalisation tasks were completed by twelve Chenin blanc wine experts. Thereafter uninstructed and instructed sorting and verbalisation tasks were also completed by twenty young wine consumers (see Chapter 3). Quantitative descriptive analysis (QDA) was performed by nine trained panellists and the results were compared to the sorting task results (Chapter 4). Lastly Chenin blanc preference data and exploratory data were captured from Generation Y wine consumers (Chapter 5).



**Figure 1:** A summary of the project's experimental design: Section 1 entails QDA with a trained panel of nine judges as well as instructed and uninstructed sorting tasks with twelve wine experts and twenty young wine consumers. These tests aim to classify the various wine styles and to identify which method-panel combination can be optimally used to classify and describe these Chenin blanc wine styles. Section 2 entails blind and wine style informed preference tests as well as exploratory research with 150 Generation Y wine consumers. These test aim to classify the Generation Y consumer market segment in terms of their Chenin Blanc wine style preferences and to classify their wine style preferences according to their exploratory data. In order to do so the QDA and sorting descriptive datasets are utilised during preference statistical analyses methods (see orange arrows).

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# Chapter 2

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## LITERATURE REVIEW

## LITERATURE REVIEW

### INTRODUCTION

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The South African wine industry is a competitive environment. Not only is the industry currently overcrowded with a large number of small scale wineries competing with one another for market share, but it is mainly dominated by a few corporate companies that threaten the survival of these small scale wineries. Various external factors contribute to the level of success of the domestic wine industry. These factors include the country's economic situation, the political disposition and the environmental changes due to climate fluctuations.

South Africa has come a long way in the process to create high quality Chenin blanc wines, previously renowned as the workhorse cultivar. It was mainly used as a base-wine for brandy production or for mass production of low quality wines. Today South African Chenin blanc wines are not only used in high quality white wine blends, but carefully cultivated Chenin blanc grapes are also used to produce award-winning single cultivar wines which are comparable with the world's best Chenin blanc wines. Due to the fact that that Chenin blanc grapes have a neutral sensory profile, the wine aroma and flavour profile can be manipulated during the wine-making and maturation process in order to create a wide variety of different wine styles.

There seems to be some confusion amongst consumers with regards to the various wine styles and consumers are often not even aware of the various Chenin blanc wine styles that are available on the market. The differences between these wine style profiles may cause consumers to doubt what they can expect from any purchased bottle of Chenin blanc wine. It is yet to be established whether there is some merit in separately categorising these various Chenin blanc wine styles and marketing them to appropriate consumer target markets with preferences for specific wine styles. Even though this approach might seem plausible, there is the possibility that classifying Chenin blanc wines into various style groups becomes complicated due to the presence of some between-style wines.

Furthermore, South Africa is one of the countries with the lowest per capita consumption of wine (Foxcroft, 2009) and is therefore not considered a wine drinking nation in comparison to the rest of the world. The substantial growth of wine exports after the trade restrictions had been lifted in 1994, created an outlet for producers who previously relied on domestic market wine sales (Foxcroft, 2009), providing that they had enough financial support to export their wines. Little effort has therefore been made during the last decade to develop the domestic market which ultimately led to a decline in wine consumption per capita (Foxcroft, 2009).

Even though the country is not considered a wine-drinking nation, many other alcoholic beverages are consumed by South Africans including beer, ciders, mixed alcoholic beverages etc. The popularity of these beverages and the loyalty of consumers towards drinking only certain alcoholic beverages also threaten the success of the domestic wine industry.

However, a new consumer generation born between the years 1977 to 2000 (Wolf, Carpenter and Qenani-Petrela, 2005) is currently entering the wine industry, as well as all other consumer related industries, and presents great opportunities for wineries. Not only are Generation Y consumers eager to try new products and to establish their preferences for specific brands or products (Resnick, 2008), but this is the largest growing consumer generation since the Baby Boomer generation (Hammond, 2010), born between the years 1946 to 1964 (Martin and Tulgan, 2003). The Generation Y wine consumer is therefore categorised between the ages of 21 and 32 years old.

Generation Y consumers' wine purchases are influenced by extrinsic (physical product aspects) and intrinsic factors (sensorial aspects). Wine consumers' personal characteristics can

also influence their perceptions, preferences and purchase behaviour. In order to establish and grow the success of the various Chenin blanc wine styles amongst this new consumer generation, it is important to be aware of their various needs, preferences, purchase behaviours and consumption behaviours. Consideration should be given to whether this Generation Y consumer population has a preference for Chenin blanc wines in general and whether they have specific wine style preferences within the Chenin blanc range.

Sensory science came about in the late 1940's during a time when consumer food companies expanded their product developments significantly (Skinner, 1989). It rapidly developed over the last few years with the expansion of foods and other consumer products. Today sensory science connects product research and development, marketing efforts and the consumer market (Kotler and Keller, 2009:9). Various statistical univariate and multivariate analysis methods are used during sensory science, depending on the situation and nature of the sensory investigation. Some of the most commonly used univariate statistics are normality, variation, means, analysis of variance and regression analysis. Multivariate statistical methods that are often used for more complex sensory datasets are principal component analysis (PCA), multidimensional scaling (MDS), DISTATIS, correspondence analysis (CA), partial least squares regression (PLS) and preference mapping.

There are three different mainstream categorised sensory methods and techniques that can be utilised to solve various problems. Firstly, there are profiling or descriptive tests (Kotler and Keller, 2009:6) which mainly focus on individual sensory components of a product, and aims to identify, describe and also quantify the intensities of these various individual sensory components for each product within a sample set. Secondly, classification or difference tests (Kotler and Keller, 2009:5) can be used to identify and describe sensorial differences and also similarities between various products within a sample set. Lastly hedonic or preference tests (Kotler and Keller, 2009:7) are used in order to establish the degree to which a consumer will accept a single product and whether he or she will prefer one product over the other.

All these techniques have been developed over the years in order to optimally resolve sensory problems or marketing questions. However, there are various disadvantages to each technique and, the appropriate technique for a specific study will depend on the researcher, the financial support, the market demand and the available time. A sensory classification method called the sorting technique is an easier, faster and less expensive substitute for QDA. In order to reach specific research aims it is important to use the most effective sensory method, the correct sensory panel, as well as appropriate statistical analyses. Not only does sensory evaluation function as a quality control and research measure, but it also supports product development teams to design a product that will optimally satisfy a specific consumer target market (Kotler and Keller, 2009:17). The univariate and multivariate statistics in this chapter have been described in standard sensory statistical textbooks and software packages (Lawless and Heymann, 2010; Næs, Brockhoff and Tomic, 2010; Statsoft. Inc., 2010).

This Chapter will review the Chenin blanc history in South Africa as well as the research findings and general aspects of the new Generation Y wine consumer. Furthermore, a review is provided of the general sensorial techniques which are used to investigate product differences and similarities and to explain consumer preferences for specific products.

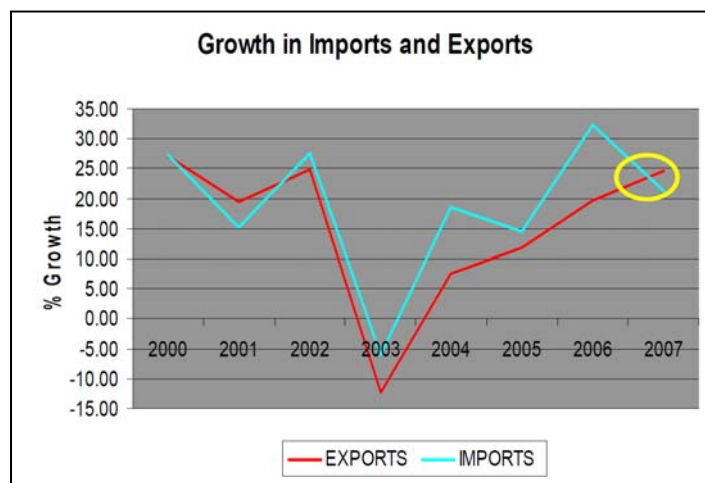
## SECTION 1. An overview of South African Chenin blanc wines

### 1.1 South African wine industry: past and present

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The Cape winegrowing areas receive Mediterranean climate and is situated in the southern hemisphere. This factor together with the existence of various different soil types; mountain slopes and valleys, creates a vast variety of different terroirs for the wine grape, *Vitis vinifera*. Summers are long and hot and the winter months become mild and wet (Toerien, 2000:7). These annual weather conditions are ideal for viticulture in the Western Cape of South Africa. According to Toerien (2000:7), South African (S.A.) wine land soils can mainly be classified as granite; shale and sandstone. Due to the fact that valley-floors and river-side soils are not ideal for vineyard production because deep and organic rich soils result in overproduction, viticulture experts have learned to make use of the excellent foothill terroirs in order to produce high quality wine grapes (Toerien, 2000:7). These areas are rich in deep and well-drained soils such as Tukululu, Hutton, Clovelly and Glenrosa soils (Toerien, 2000:7).

South Africa is considered to be one of the New World wine-producing countries. In 2009 the South African Wine Industry celebrated 350 years of wine-making. The first wine was produced in the Cape in 1659 under the command of Jan van Riebeeck. He visited the Cape in 1652 on behalf of the Dutch East India Company and established a settlement here (South African Wine Industry – 320 years old, 2010). According to Toerien (2000:6), even though South Africa is one of the oldest New World wine-producing countries, it has suffered years of political turmoil and difficult economical times which lead to the country's slow development in all industries. During this period, the wine production activities and raw materials required for vineyard cultivation and wine production were strictly regulated and mainly controlled by co-operate companies such as KWV (*Kooperatiewe Wijnbouers Vereniging van Zuid-Afrika Beperkt*); Stellenbosch Farmers' Winery and Distillers (Toerien, 2000:6; Theron, 2005:121). The two afore-mentioned companies have merged and are now known as Distell. A dramatic increase in of exported wine volumes occurred after 1994 when the first democratic elections took place in South Africa and sanctions were lifted (Theron, 2005:121). According to Toerien (2000:6), export volumes increased by almost 600% from 20m litres to 116 million litres over a period of six years (from 1992 to 1998) which accounted for 25% of the total wine production in South Africa. More than 250 000 people are employed (directly and indirectly) in the wine industry (WOSA Coping with Crisis, 2008). Nearly 4000 farmers are cultivating approximately 101 957 ha of land under vines (WOSA Coping with Crisis, 2008). The estimated annual harvest in 2009 amounted to 1330 357 tons (1 015.4 million litres), of which 77% was used for wine (WOSA Coping with Crisis, 2008). In 2005 the international wine production figures were estimated as follows: Italy leads with 19.1% of globally produced wine; France was second with 18.5%; Spain third with 12.8%; and South Africa ranked ninth with 3.0% (WOSA Coping with Crisis, 2008). The following plot (Fig. 2.1) indicates how exports are still increasing after 2007 whereas imports are decreasing dramatically. Export growth in 2006 was approximately 19.6% and in 2007 it increased to 24.6% whereas import growth in 2006 was approximately 32.3% and in 2007 it decreased to 21.16% (WOSA Coping with Crisis, 2008).



**Figure 2.1:** Growth in Imports and Exports in the S.A. wine market (Adapted from: WOSA Coping with Crisis, 2008)

Since the establishment of vineyards and winemaking procedures in the Cape, South African wine producers have dramatically increased the production of high quality wines, and are focused on continuously improving environmentally friendly cultivation and production methods. South Africa has become a wine producing country to be reckoned with on a global scale. Latest figures from market analysts AC Nielsen indicates that South African wine sales are currently overtaking French wine in the United Kingdom. South African wine sales grew with 20% volume in 2010 compared to a decline in French wine sales of 12%; South Africa is now the fourth largest wine selling country in the United Kingdom (WOSA, 2010a).

Today, the South African wine producers consist mainly of co-operative wineries, independent cellars and wholesalers. Co-operatives are the main contributors to South Africa's wine production volumes annually pressing approximately 80% of the country's total wine harvest. These wine producers will typically process grapes which they obtain from shareholder farms (WOSA, 2010b). The independent cellars and wholesalers will often buy grapes and wine for wine production or they will rely completely on their own cultivated grapes for production purposes. They will thereafter bottle the final product under their own brand names (WOSA, 2010b). Co-operate wine producers are however, not equipped to produce the level of wine quality needed for sustainable business and market growth as they are often not able to adapt fast and effectively enough to sudden market changes (WOSA Marketing plan, 2010). Whilst eliminating some, these changes will increase the competition for producers who struggle to adapt to new trends.

Various factors impact the competitiveness in the wine industry. A healthy competitive atmosphere within an industry promotes the product quality as well as innovation and improved market offerings. However, if competition within the wine industry becomes too strong, it will eliminate some producers completely who are not able to adapt. According to Heijbroek (2007), these factors can be described as follows:

- General and basic production factors such as raw materials, climate, unskilled labour and capital resources that can influence cost price of wine production directly.
- Infrastructure, skilled labour, research, education, information and communications are also critical in order to improve wine production efficiency and the resulting wine quality. The level of industry consolidation or fragmentation will influence the degree of dependency within the wine industry, which can ultimately influence competitiveness between producers.
- Well structured marketing strategies, branding strategies and product styles can increase competitive advantages for producers.

- Development in a specific industry, i.e. such as the improvement of South African wine quality, will not only increase international demand but also domestic demand which will increase competitiveness amongst domestic wine producers.
- Any industry competitiveness may be encouraged or reduced/curbed by Government authorities.
- Economic variables including entrepreneurial spirit, international orientation, ability to co-operate and management culture can influence the strength of the wine industry. Exchange rates and political decisions are major influential factors. On the other hand entrepreneurial spirit will improve the response to opportunities and challenges as created by unforeseen industry environmental changes.

Foxcroft (2009) used the guidelines described by Heijbroek (2007) to grade the South African wine industry in terms of its competitiveness. According to Foxcroft (2009), the South African wine industry structure is fragmented and a high level of competition exists. Even though some competitiveness is desirable, it ultimately results in a lack of overall trust and co-operation (Foxcroft, 2009). Secondly, he found that the domestic demand is declining and that no change is expected in this trend due to the fact that there is no dominant association or organisation which can drive domestic demand for wine. Thirdly, Foxcroft (2009) found that the exchange rate risk and implications of political decisions are major challenges for South Africa. At the start of 2011 it was announced that the legal drinking age would be revised and changed from 18 to 21 years in order to curb alcohol abuse to some extent. Difficulties arising from these mentioned factors will increase the level of competition within the industry and curb efficient response from wine producers to opportunities such as the emerging wine consumer market (Foxcroft, 2009), i.e. the Generation Y wine market. According to Foxcroft (2009), industry structure, domestic demand as well as economic variables and interactions between them must be advanced in order to improve the competitive nature of the S.A. wine industry. There is good potential for wine consumption to increase domestically in South Africa when one considers the improved socio-economic status of the nation due to steadily growing gross domestic product (GDP), and the growth of the middle class consumers who are generally status and lifestyle-oriented (Foxcroft, 2009). The majority of South Africans do not drink wine and this fact needs to be addressed urgently by the industry (Foxcroft, 2009). The declining wine consumption trend is also partly as a result of competition from beer, the ready-to-drink category (ciders) and brandy. It was reported that 63% of all South Africans have never consumed wine before (Loubser, 2008).

Both domestic and global wine consumption is growing at a slower rate than before (Foxcroft, 2009). This can result in wine overproduction and cause financial losses for the domestic wine industry. The four major factors hindering these consumption trends are political, economical, marketing and social factors (Foxcroft, 2009). Furthermore, consumers' perceptual change of wine being a habitual consumption product to a lifestyle product (Lunardo and Guerinet, 2007) as well as consumers' health concerns associated with alcohol and alcohol abuse (Foxcroft, 2009) prevent the growth of wine consumption in South Africa. One of the most significant hurdles for the domestic wine industry is that younger consumers seem to be replacing older, traditional and frequent wine drinking consumers. This new generation of consumers, Generation Y (Wolf, Carpenter and Qenani-Petrela, 2005), is less liberal in terms of their wine consumption behaviours and also less likely to select wine as their beverage of choice, given the widening variety of drinks such as RTD's (Ready-To-Drink beverages) currently available on the market (Lunardo and Guerinet, 2007). However, these consumers are more adventurous and loyal towards specific consumer brands (Hammond, 2010), especially

their alcoholic beverages of choice, than previous generations which open new marketing opportunities and challenges for the S.A. wine industry.

It is therefore important for wineries to create a strong consumer following at an early age when consumers are still in the process of forming their own product preferences. When the wine industry understands and anticipates these young consumers' wine preferences and purchase behaviours, wines can be created and positioned more effectively to ensure and promote the future sustainability of the domestic wine market.

## **1.2 Chenin blanc wines of South Africa**

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### **1.2.1 Chenin blanc's history in South Africa**

Chenin blanc, also known as Steen, is a neutral white wine cultivar (Marais, 2011) as it contains relatively few primary grape flavours. The wine sensory profile of this particular cultivar can therefore be dramatically modified during vinification and maturation phases. Aromatic and flavour profiles of a wine are the result of the formation and extraction of primary grape compounds such as mercaptanes during viticulture processes, secondary fermentation compounds such as esters during vinification and tertiary ageing compounds such as dimethyl-sulphide during wine maturation (Marais, 2011). Terrior, i.e. the soil, climate and elevation where the grapevine is situated, also influences the expression of grape specific compounds that will contribute to the wine aroma and flavour profile (Loubser, 2008).

According to Marais (2011), approximately 20% of all South African wine grapes are Chenin blanc grapes. Over the past few years a group of dedicated producers began producing high quality wines from Chenin blanc grapes (O'Kennedy, 2009). Garret (1997) found that a small percentage of wine farms replaced mass wine production with the creation of high quality Chenin blanc wines instead. Jamie Goodie, a renowned wine journalist based in the United Kingdom, found that the South African wines have a uniquely South African character and that the Chenin blanc wine styles vary between classical new world and old world styles, i.e. this cultivar has a broad sensorial appeal. Asimov (2007) found that the success of high quality South African Chenin blanc wines has grown over the last 20 years and that these wines have the potential to compete against the Loire wine region in the South of France's wines. Due to the versatility of Chenin blanc it can not only be used to create various high quality single cultivar (Chenin blanc) wine styles, but can also be used to create wine blends, sherries and brandies (Marais, 2011). Not only is Chenin blanc versatile in terms of vinification processes, but its viticulture adaptability makes it perfect for all the climatic regions in South Africa (Marais, 2011).

In the past South African Chenin blanc wine was mainly used during mass production of bulk wine (Goodie, 2011; Marais, 2011; Loubser, 2008). More recently the variety has made a great progress and there is a recognisable improvement in the quality of Chenin blanc table wines from South Africa (Loubser, 2008). According to Loubser (2008), the following three aspects are important factors that will ultimately determine Chenin blanc wine quality: terrior, viticulture as well as oenology. Terrior is the combined effect of all natural forces on the vineyard. The viticultural factors or cultivation procedures with regards to the wine vineyards refer to: clone type, trellising system, vine spacing, row orientation, canopy management, fertilisation, irrigation, vine age, yield, maturity indices, harvesting method as well as the presence of *Botrytis cinerea* (Loubser, 2008). The oenological or wine production aspects refer to the following: juice pressing, grape skin contact pre-fermentation and/or during fermentation,



juice oxidation, juice clarification, yeast nutrition additions, yeast strains, fermentation temperature, wood, blending, bottling and lastly bottle or barrel maturation (Loubser, 2008). Even though Chenin blanc wine quality has improved significantly in South Africa, more vineyards are being replaced today by varieties such as Chardonnay and Sauvignon blanc as well as Cabernet Sauvignon, Merlot and Shiraz (Asimov, 2007). It is therefore important to improve the image of Chenin blanc, not only for the consumer market, but also for the producers who need to be convinced that this varietal can help create a sustainable future. Not only are South African wine producers creating top quality Chenin blanc wines that can compete with the world's best, but, the wine quality is consistent throughout vintages (Asimov, 2007).

When looking at the South African Wine Industry Statistics (SAWIS 2009) the following interesting trends can be observed with regards to the South African wine industry for 2009:

- Chenin blanc has the highest total hectare coverage across South African wine regions with a total of 18 668ha. However, the largest section is distributed in the warmer climate areas such as Paarl, Malmesbury, Olifantsriver, Bredekloof and Worcester.
- Chenin blanc is also the variety utilised the most for total wine making purposes: during 2009 wine production was a total of 282 206 tons. From this total 88.1% of Chenin blanc grapes was crushed by producer cellars; 9.4% was crushed by private wine cellars and the remaining 2.5 % was crushed by producing wholesalers.
- In terms of sales, it is interesting to note that Chenin blanc bottle sales (750ml glass containers) were lower than other natural white wine bottles in 2009. A total of 2 690 998 Chenin blanc bottles were sold in 2009 in comparison to 3 072 756 bottles of Chardonnay and 9 084 215 bottles of Sauvignon blanc. However, there was an increase in Chenin blanc sales from 2008 (2 680 921 bottles) to 2009 of 150.4%. It is therefore clear that there is a growing interest in Chenin blanc amongst consumers.

Not only do Chenin blanc cultivation and wine production form one of the largest portions of wine production in South Africa, but these wines are also relatively low in price in relation to other noble varieties which suggests the possibility for price increases (Loubser, 2008). This could ultimately result in increased national revenue for the wine industry. Chenin blanc wine quality improvements will also justify a price increase. However, in order to ensure that price increases are justified, it must be investigated how favourable target market consumers perceive such high quality Chenin blanc wines from different wine style segments. It is ineffective if a top quality wine is produced with a high price, but the market does not have a significant preference for these wines and their various wine styles.

### **1.2.2 Chenin blanc viticultural aspects**

Efficient acidity content in Chenin blanc grapes is important in order to promote gradual and balanced ripening (Asimov, 2007). Cooler regions will typically promote the formation of optimal grape acidity. The most important area for vineyard cultivation in South African is situated around Cape Town, the most Southern point of the country, which is directly next to both the Atlantic and Indian oceans. During summer season November to April, the cold Antarctic current flows up to South Africa causing sea breezes to travel inland and cool the vines (Asimov, 2007). Due to the fact that ideal cultivation areas are constantly being discovered for the production of high quality wine grapes, it can be expected that South African wines will continue to improve in the future. The future of Chenin blanc wines in South Africa can be summarised as follows, "The hope is that Chenin blanc will continue to be part of the South African wine equation. It was the dominant grape in an era characterised by bad wines, and it may only be natural for the industry

to equate improvement with different grapes rather than with making better Chenin blancs” (Asimov, 2007).

### 1.2.3 Different South African Chenin blanc wine styles

A specific wine cultivar such as Chenin blanc, can have various wine styles which are created due to subtle differences in ethanol content, the presence of a few inorganic substances and also due to the presence of specific acids and phenols. These small components and the ratios in which they occur in a wine, will all play a role in determining and differentiating specific cultivar wine styles (Arakoon Wines, 2011). Chenin blanc wines are mainly characterised by a neutral wine fermentation bouquet, which is not stable and is replaced with a bottle maturation bouquet which mainly consists of esters (Marais, 2011). Even though Chenin blanc grapes are fairly neutral in terms of primary grape flavour compounds, a wide variety of different and prominent Chenin blanc styles can be found in South Africa due to various specific fermentation processes, wood content (or not) and bottle or barrel maturation.

According to Loubser (2008), the production of a wide variety of different wine styles is applicable to Chenin blanc due to the cultivar’s exceptional versatility (Marais, 2003). With regards to Chenin blanc wine styles, the following factors are responsible for variations amongst different styles: region of origin and therefore also terrior, yield and ripeness (Loubser, 2008; Carstens, Burger and Kriel, 1981) as well as the use of oak, the inclusion of noble rot grapes, *Botrytis cinerea*, or wine and the level of residual sugar (Loubser, 2008). Furthermore, the use of various wine yeasts will also alter the wine sensorial profile creating specific wine styles. Currently the Chenin Blanc Association (CBA, 2011) of South Africa recognises six different Chenin blanc wine styles (see Table 2.1) from which three can be classified as dry wine styles with a residual sugar < 9 g/L (Loubser, 2008).

**Table 2.1:** The Chenin Blanc Association's six recognised styles (Adapted from: Smith, 2010).

Chenin blanc Style	Description (Res. sugar content)
Fresh and fruity	less than 9 g/l residual sugar
Rich and ripe – unwooded	less than 9 g/l residual sugar
Rich and ripe – wooded	less than 9 g/l residual sugar
Rich and ripe – slightly sweet	between 9 and 30 g/l residual sugar
Sweet	more than 30 g/l residual sugar
Sparkling	Tank fermented or Cap Classique

For the purpose of this study researchers only focused on the dry Chenin blanc styles, i.e. Fresh and Fruity (FF), Rich and Ripe unwooded (RR-unwooded) and, Rich and Ripe wooded (RR-wooded) wine styles. A summary has been made in Table 2.2 of the various Chenin blanc wine styles and how they are treated during the production process. This information was obtained from research done by O’Kennedy (2011) from Anchor Yeast.

According to O’Kennedy (2011), the FF styles are usually harvested at grape sugar levels between 21 to 23 °Balling whereas the RR styles are harvested at 23 to 27 °Balling. After grapes have been harvested and crushed winemakers often adjust the acid-level by adding tartaric acid to the must before the onset of fermentation. The amount of total acid adjustment is determined by the wine cultivar and the climate where the grapes were grown. Ascorbic acid is usually added during production of FF and RR-unwooded Chenin blanc wine styles. Ascorbic acid enhances the extraction of mercaptan from grape precursors to form guava and passion fruit aromas/flavours. However, the incorrect use of ascorbic acid may cause unwanted sulphur-like off flavours as well as wine oxidation. Residual sugars between 3 to 7g/L (dry wines) can be

obtained by one of four methods which are: intended stuck fermentation when fermentation of the grape must via yeast cells stops due to stress; dry fermentation followed by adding concentrate; dry fermentation followed by addition of Chenin blanc noble late harvest; or by utilizing natural fermentations. The final two methods must be done with great care due to the fact that natural yeast fermentations may result in unwanted aroma profiles or even unwanted stuck fermentation and Botrytis-character can also dominate the wine profile too much if present in uncontrolled quantities in the wine (O’Kennedy, 2009).

**Table 2.2:** Summary of Dry Chenin blanc style production methods (Adapted from: O’Kennedy, 2009)

	Chenin blanc wine style (Dry: RS < 9g/L)		
	FF	RR-unwooded	RR-wooded
<b>Aroma/Flavour compounds</b>	Mercaptanes (guava; passion fruit; grapefruit; black currants) Esters (pineapple, pear, apple, tropical fruit salad, peach, melon and papaya)		
<b>Common style descriptors</b> (Smith, 2010.)	<ul style="list-style-type: none"> <li>- For drinking early</li> <li>- Light and juicy</li> <li>- Light textured</li> <li>- Fresh and Fruity</li> <li>- Delicate</li> <li>- Easy and uncomplicated</li> <li>- Outgoing and easy to please</li> <li>- Easy appeal</li> <li>- Easy drinking style</li> <li>- Undemanding</li> <li>- Light and crisp</li> <li>- Accessible</li> <li>- Succulent acid</li> <li>- Vibrant freshness</li> </ul>	<ul style="list-style-type: none"> <li>- Smoothly textured</li> <li>- Ripe tropical notes</li> <li>- Fruit forward and rounded</li> <li>- Alluring texture</li> <li>- Body plumped by (6 months) lees contact</li> <li>- Concentrated fruit</li> </ul>	<ul style="list-style-type: none"> <li>- Spicy, herbal aromas</li> <li>- Subtle caramel tone</li> <li>- Concentrated fruit</li> <li>- Bold and integrated fruit flavours</li> <li>- Well-rounded and plump</li> <li>- Alluring texture</li> <li>- Mouth filling</li> <li>- Full and complex</li> <li>- Well balanced</li> <li>- Big boned</li> <li>- Mocha overlay</li> <li>- Well spiced by oak</li> <li>- Vanilla spiciness</li> <li>- Spicy hints from light oaking</li> <li>- Subtle oaking</li> <li>- Harmonious oaking</li> <li>- Attractive creaminess</li> </ul>
<b>Grape sugars at harvest</b>	21 – 23 °Balling	23 – 27 °Balling	23 – 27 °Balling
<b>TA adjustment</b>	Tartaric acid and Ascorbic acid	Tartaric acid and Ascorbic acid	Tartaric acid
<b>Yeasts</b>	VIN 7 (mercaptan release) and Ester forming yeasts	Ester forming: VIN 13 (tropical, floral, blossom flavours); NT 116 (tropical and citrus) NT 45 (complexity and mouth feel)	French Chardonnay yeasts: Collection C�page Chardonnay (promotes citrus character); VIN 13 and VIN 7 (needs good temp. control)
<b>MFL (Malolactic Fermentation)</b>	No MFL	No MFL	MFL: 30 – 70% promotes complexity and mouth feel
<b>Wood</b>	No wood	No wood	Little new wood; French oak 300L barrels; OR staves in stainless steel tanks.
<b>Fermentation temperature</b>	12 to 13°C (lower temp.= formation of fruity acetate esters)	12 to 16°C (lower temp. = formation of fruity acetate esters)	16 to 24°C (higher temp. = formation of higher molecular weight ethyl esters)
<b>Optimum bottle maturation time</b>	12 to 18 months	2 to 10 years	2 to 10 years
<b>Current turnover</b>	Fast (desired)	Too fast (not reach full potential)	Too fast (not reach full potential)

The presence of mercaptans, sulphur containing flavours, is the main cause of the aromatic characteristics of Chenin blanc wines (O'Kennedy, 2009). Examples of flavours that can be expected from Chenin blanc wines due to the presence of mercaptans are: guava (often the most prominent characteristic), passion fruit, grapefruit and blackcurrant (O'Kennedy, 2009). Furthermore, these flavour compounds are not all equally as stable and some will disappear over time. The guava flavour will only remain stable for a period of between 12 to 18 months in the wine, thereafter it will break down or be converted into another compound which is less aromatic (Smith, 2010). Not only does the structure of the grape flavour compounds influence the perceived wine flavour, but the concentration in which these compounds are present in a wine will severely affect the quality of the wine and the perception of wine flavours. Whilst a flavour compound can contribute significantly to produce a fine wine, higher concentrations of that specific compound could result in negative consumer perceptions and preferences, such as the mercaptan guava aroma that can be perceived as Sweaty Armpit at high concentrations in the wine (Smith, 2010). Prolonged skin contact prior to fermentation can increase various grape-specific component extractions from the grape skins which will increase their concentrations in the wines. Not all component extractions will improve wine quality (O'Kennedy, 2009). Excessive skin-contact can lead to over-extraction of some components. Overall, Chenin blanc grapes do not contain as much grape-derived flavour components as Sauvignon blanc where methoxypirazines play a major role in creating the typical fruity and green or unripe wine sensory characteristics. For this reason, it is not necessary to use skin contact during the production of Chenin blanc wines because no significant compounds need to be extracted like with Sauvignon blanc. Some producers might however, introduce Chenin blanc skin contact prior to fermentation when raisin-type grapes are present in the batch that have to be hydrated before it can be pressed, in order to maximise the flavour dimension from raisin-grapes and juice volume (O'Kennedy, 2009).

Secondary Chenin blanc aromas are formed during the fermentation process when the yeast cells form esters contributing to the wine's aroma and flavour profile (O'Kennedy, 2009). Flavours that are associated with ester-formation during fermentation are: pineapple, pear, apple, tropical fruit salad, peach, melon and papaya (O'Kennedy, 2009). The presence of specific esters is also related to the age of the wine. According to Smith (2010), some esters are specifically prominent in young Chenin blanc wines whilst others appear more frequently in older wines. This trend can be explained due to the fact that some esters which are more dominant in older wines due to the fact that they are more stable than other esters which will disintegrate during bottle maturation. Smith (2010) continued by stating that one should however, keep in mind that different perceptions of flavours can be caused due to mere variations in the concentration of one specific ester in the wine. Different yeast types are used when aiming to create different specific Chenin blanc wine styles due to the fact that they all attribute differently to wine flavour and aroma profiles. Yeasts that are typically used during the production of FF wines are VIN 7 which tends to release mercaptan flavours such as guava, passion fruit and grapefruit; as well as other ester-forming yeasts such as tropical fruit salad-like esters. For RR-unwooded styles ester-forming yeasts are usually utilised in order to obtain more complex aroma and flavour profiles for example VIN 13 which adds tropical, floral, blossom flavours; NT 116 which adds tropical and citrus flavours and NT 45 which adds complexity and mouth feel to the wine. For RR-wooded styles winemakers typically use French Chardonnay yeasts. This is due to the moderate fermentation speed these yeasts have at 16 to 24°C. An example of this yeast type is Collection Cepage Chardonnay (DSM) which has a moderate fermentation tempo in barrels and promotes the Chenin blanc citrus character. Alternatively winemakers use VIN 13 or VIN 7 for barrel fermentation only if they can sustain temperature

control. The RR-wooded Chenin blanc styles are the only styles that will be allowed to have between 30 to 70 % malolactic fermentation (MLF) as it is more difficult to inhibit MLF in barrels than with the FF and RR-unwooded wines. MLF will however, improve complexity and mouth feel of wooded Chenin blanc styles but must be controlled in order not to dominate the subtle grape characteristics. Very little new wood is used during preparation of RR-wooded styles as excessive use of wood can dominate subtle Chenin flavours. The use of French oak 300L barrels is most common. Few producers use American oak. Good results can also be obtained by fermenting Chenin blanc juice with wooden staves in stainless steel tanks (O’Kennedy, 2009).

Fermentation temperatures for FF styles are 12 to 13°C whereas for RR styles it can be higher: 12 to 16°C. The RR-wooded style wines with French Chardonnay yeasts will typically ferment between 16 to 24°C (O’Kennedy, 2009).

During Chenin blanc bottle maturation some aromatic compounds will typically be formed whilst others (such as esters) tend to break down over time. This process creates a complex and rounded flavour profile to the wine. The compound mainly responsible for a bottle maturation bouquet is referred to as Dimethyl-sulphide which tends to create a molasses, straw type character in the wine. The concentration of this compound is therefore also depended on the storage time and temperature (Smith, 2010). The average ageing potential for these various wine styles are as follows: FF (using VIN 7) 12 to 18 months due to the instability of the guava flavour; and RR 2 to 10 years. However, the relatively fast market turnover for RR styles often prevents these wines from reaching their maximum flavour profile potential (O’Kennedy, 2009). Consumers need to be educated about these Chenin blanc wines and the importance of maturing some of the styles in order to obtain maximum wine quality.

Not only are the various wine styles confusing to consumers, but competition panellists also find it challenging to grade different Chenin blanc wine styles in the same tasting session. Competition tasting panels are currently avoiding this problem by only comparing similar Chenin blanc wines with one another (Loubser, 2008). According to the CBA, there has been a drastic shift to produce more RR Chenin blanc wine styles (with some degree of wood influence) than the easy-drinking FF wine styles (Loubser, 2008). According to Naude (2007), more wine producers are recognising that Chenin blanc grapes reach optimal ripeness at a slightly higher ripeness level than other white wine cultivars.

## SECTION 2. The new wine consumer Generation: Generation Y

### 2.1 Consumer markets in the South African wine industry: opportunities and trends

Various new trends are emerging in the South African (S.A.) consumer market which creates new opportunities. The following section describes S.A. consumer market trends and opportunities.

#### 2.1.1 South African population statistics

The distribution of the South African population in terms of their socio-demographic information indicates the following trends: African females dominate the S.A. market with 79.4% of the population (20 368 150 females) in the female sector (SAS, 2010). The African male sector dominates the male market with an estimated 79.4% of the population (19 314 500). Thereafter, the white sector follows with white males at 9.2% (2 243 000) of the total S.A. male population and white females at 9.1% (2 341 700) of the total S.A. female population (Table 2.3).

When comparing the population of the Western Cape in relation to the rest of S.A. (Table 2.4) it is clear that a significant percentage of the total S.A. population reside here. The Western Cape is currently positioned as the 5<sup>th</sup> highest populated province in South Africa (at a population estimate of 5 223 900 and a total of 10.4% of the total population). The highest populated province in S.A. currently is the Gauteng province at 22.4% of the total population of 11 191 700 people.

**Table 2.3:** Mid-year population estimates for South Africa by population group and sex (Adapted from: SAS, 2010)

Population group	Male		Female		Total	
	Number	% of total population	Number	% of total population	Number	% of total population
African	19 314 500	79.4	20 368 100	79.4	39 682 600	79.4
Coloured	2 124 900	8.7	2 299 200	9.0	4 424 100	8.8
Asian/Indian	646 600	2.7	653 300	2.5	1 299 900	2.6
White	2 243 000	9.2	2 341 700	9.1	4 584 700	9.2
Total	24 329 000	100.0	25 662 300	100.0	49 991 300	100.0

**Table 2.4:** Mid-year population estimates by province, 2010 (Adapted from: SAS, 2010)

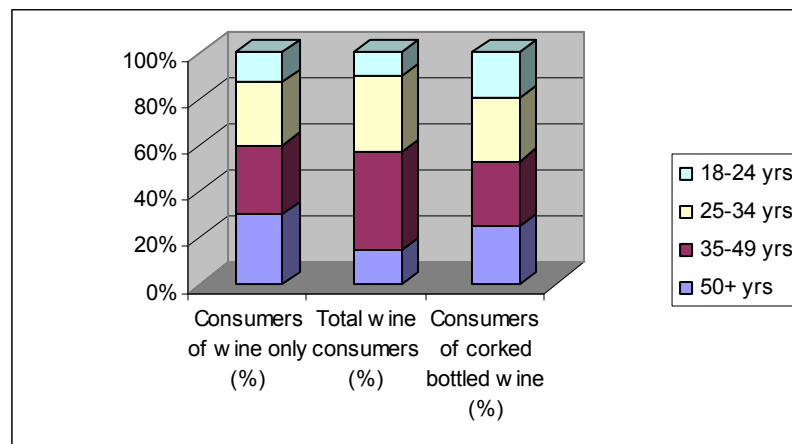
Provinces	Population estimate	Percentage share of the total population
Eastern Cape	6 743 800	13.5
Free State	2 824 500	5.7
Gauteng	11 191 700	22.4
KwaZulu-Natal	10 645 400	21.3
Limpopo	5 439 600	10.9
Mpumalanga	3 617 600	7.2
Northern Cape	1 103 900	2.2
North West	3 200 900	6.4
Western Cape	5 223 900	10.4
Total	49 991 300	100.0

The current distribution in the Western Cape for the age group between 20 to 34 years old is as follows (SAS, 2010): males are a total of 657 400 (26.14% of the total male population in the Western Cape); females are a total of 712 400 (26.30% of the total female population in the Western Cape); and the total age population of 20 to 34 years in the Western Cape is 1 369 800 (26.22% of the total population in the Western Cape). This is a significant segment of the entire S.A. Western Cape population and this young consumer generation, Generation Y, will continue to grow even more in the near future.

### 2.1.2 Different consumer segments in the S.A. wine industry

According to an interview held with Debra Savage, Marketing and Sales Manager, Rupert and Rothschild Vignerons, by Green (2010), wine is all about image to the consumer market in South Africa. The different wine segments can be classified by different wine price brackets as well as different wine-styles. According to Green (2010), the South African wine consumer market can be divided into three main categories according to the prices that consumers are willing to pay for a bottle of wine. Low prices of < R25 per bottle: Consumers from any age category who generally pay for low priced wines. Medium prices of R26 to R49 per bottle: Consumers with an average income and a preference towards affordable wine in any age category. Premium sector of > R50 per bottle: The wine connoisseur who is more concerned about what he or she serves to guests and, of course, consumes themselves. These consumers are especially amongst the younger up-and-coming as well as the more mature age groups.

In her article, Green (2010) quoted Savage who said that, “At the end of the day it is all about image in today’s society and therefore this sets the trend for the different categories of wine lifestyle.” Furthermore, Green (2010) found that consumers older than 25 years are the predominant wine drinkers in South Africa (see: Fig. 2.2). It is therefore clear that wine appeals to the slightly more sophisticated consumer market section to whom image and status is important (Green, 2010).



**Figure 2.2:** South African wine consumers categorised by age in 2010 (Adapted from: Green, 2010)

Currently, Gauteng has the largest share of total number of South African wine consumers of approximately 35 to 40% (Green, 2010). Cape Town follows with a large percentage of approximately 30% of the S.A. wine consumer market (Green, 2010). This area also has a great share of the 18 to 24 year old target market which is still latent in terms of wine purchase and wine drinking habits (SAS, 2010).

What do these consumer markets drink? According to Green (2010), beer remains the most popular drink of choice especially in the metropolitan areas. According to Green (2010)’s

estimations out of 11 million consumers a total of 69% of the metro population of 7.6 million people drink beer regularly, while only 16%, 1.8 million people, regularly consumes wine. Green (2010) proposed that the way to increase the wine drinking consumer segment would be to create new initiatives aimed at converting the beer drinkers into wine drinkers. However, this is not easy to achieve. Hardened beer drinkers would unlikely trade their love for beer for wine. Personal preferences for specific product categories are constructed over years of exposure (Pliner, 1982). Consumption of new products can even become habitual to consumers who initially reacted negatively towards it and over time, consumers become less reluctant to try new substitute products (Pliner, 1982). Such an example can be seen with the introduction of wine screw-cap closures that started to replace cork closures. At first, almost all wine consumers were strongly opposed against the closure change but after about 1 to 2 years most consumers became accustomed to screw-caps and some even prefer it over cork closures. Over time, consumers recognised the storage and environmental advantages of the new closures, such as the fact that it reduces the number of trees destroyed for their cork, and it limits the possibility of wine cork-taint (TCA).

A simple and effective manner to increase the South African wine consumer segment would be to start at the entry level consumers. These are Generation Y wine consumers who are experimenting with all kinds of alcoholic beverages in a quest to establish their own preferences, to which they often become loyal. By obtaining a strong following of young consumers for a wine brand, a producer will be able to win their loyalty, and also convert their preferences for syplistic wines to more complex wines over time as these consumers mature with the winery and its brands.

## **2.2 Segmentation, target markets and product positioning**

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Segmentation of consumer markets and the selection of target markets for specific products, such as white wines (Chenin blanc), are extremely important for the success of the wine industry. Wine consumers often differ in terms of their wine preferences, attitudes, consumption behaviour and lifestyles. Furthermore, they also differ significantly in terms of personal desires, needs and individual personality traits (Hammond, 2010) which will influence their purchase decisions. According to Yuan *et al.* (2005), a one-bottle-fits-all marketing effort which aims to cater to all wine consumers is not an effective strategy. The goal with segmentation is that the company can select and research appropriate target markets in order to comprehend their needs, wants, beliefs and desires. This enables the company to create products that it will satisfy and even delight the targeted consumer market.

### **2.2.1 The role of market research**

It is important to research the main consumer target market thoroughly in order to gain an in-depth understanding of their preferences, perceptions, needs and wants. Thereafter, a specific wine or wine style can be positioned in such a manner that it will satisfy consumers. Only when a consumer is satisfied with his wine purchase and consumption experience will he or she consider re-purchasing the wine in the future. However, if the wine does not meet consumer expectations, they will be disappointed and often resist purchasing the same in the future.

### **2.2.2 Market segmentation**

Market segmentation is defined by Schiffman *et al.* (2001:54) as follows, “the process of dividing a market into distinct subsets of consumers with common needs or characteristics and selecting



one or more segments to target with a distinct marketing mix.” If no differences existed between consumers only mass marketing strategies would have been necessary, i.e. marketing a product to all consumers instead of only selected consumer target market(s) (Blackwell *et al.*, 2001). According to Bruwer *et al.* (2002), geographic, socio-demographic, behavioural and psychological variables can typically be used in order to segment the market into various target markets. Some researchers separate attitudes, needs and benefits from behavioural characteristics (Wyner, 1995), whilst others include them under the general banner of behavioural characteristics, along with usage occasion, usage rate, benefits sought and loyalty status (Kotler *et al.*, 2001).

Wyner (1992:39) noted that socio-demographical consumer data does not relate directly to a product category and also does not give the researcher any indication of the specific consumer market's unfulfilled needs. Instead socio-demographical data consists of personal details about the consumer but does not explain the underlying motivations that drive that consumer's purchase behaviours (Wyner, 1992:39). Researchers therefore agree that socio-demographical data alone are less useful when trying to explain or predict consumer behaviour (Grunert *et al.*, 1997; Wedel and Kamakura, 2000). According to Bruwer *et al.* (2002), wine consumers with similar socio-demographical information will often differ significantly in terms of their attitudes towards wine, wine consumption behaviour, and lifestyle differences, but not necessarily in terms of their wine preferences or purchase behaviour.

Segmentation can therefore be defined as the “identification and profiling of distinct groups of buyers who might prefer or require varying product and service mixes by examining socio-demographic, psychological, and behavioural differences among buyers” (Kotler and Keller, 2009:53). According to Lesschaeve (2011), consumers are traditionally characterised based on their socio-demographic profiles, the wine brands they purchase, and the wine styles they consume; but these factors do not necessarily correlate with consumer preferences. Consumer liking, according to Lesschaeve (2011), for any sensory attribute can be illustrated by an inversed bell curve that demonstrates how consumer liking will change as a function of that specific attribute's intensity. Typically, consumer liking will increase with an increase in a specific attribute up to an “ideal point” and thereafter decrease as the intensity of the attribute increases even more (Lesschaeve, 2011). The ideal points for wine sensory attributes vary among consumers and those consumers can be categorised based on their sensory preference (Lesschaeve *et al.*, 2002). The market can therefore be segmented according to the various consumer preference ratings for a specific product.

### **2.2.3 Target market identification**

It is not possible to satisfy all consumers in the same manner. Therefore the marketers need to identify the main consumer segments that they want to focus on (Kotler and Keller, 2009:53). A target market is defined as “the part of the qualified available market the company decides to pursue” (Kotler and Keller, 2009:790). Companies must be able to segment consumer markets and select the segments that present the most potential for them. Thereafter products can be designed to specifically suit the needs of the targeted consumers.

The completion of market segmentation will support the second step of marketing: i.e. target market selection where the marketer decides which market segment presents the greatest opportunities for the company (Kotler and Keller, 2009:53). A company will typically aim at satisfying a consumer segment that shows the best potential in terms of sustained future relationships with the company and that will promote higher turnovers for the company.

## **2.2.4 Product positioning**

After segmenting and selecting the target market(s) the company can develop special market offerings and position it in such a way that it captures the attention of the intended buyers (Kotler and Keller, 2009:53). Today the marketing and production viewpoints in all industries have shifted from a product concept, which proposes that consumers favour products that offer the best quality performance or innovative features, to a marketing concept, a philosophy of creating products that suits the consumers (Kotler and Keller, 2009:53). These two perspectives can therefore be understood alternatively as top-down marketing or the product concept and bottom-up marketing or the marketing concept. Today, this marketing concept has been extended and more companies are realising the importance of maintaining a holistic marketing concept during all their operations. The holistic marketing concept is based on the development, design, and implementation of marketing programs, processes, and activities that are interdependent of one another, i.e. a broad, integrated marketing perspective (Kotler and Keller, 2009:53-54).

## **2.3 The rapidly growing Generation Y consumer market**

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### **2.3.1 Generation segmentation strategies in the wine industry**

According to Hammond (2010), using socio-demographic information as a basis for consumer market segmentation is common as these aspects are easily measurable. However, the use of generation classification as a consumer market segmentation method seems to deliver more promising results. Generational aspects such as age and era relate to purchase behaviour and preferences. According to Kotler and Keller (2009:259), each generation's or cohort (Kotler and Keller, 2009:259) consumers have been exposed to the same environmental, political, social, cultural and economical conditions and have therefore grown up sharing the same or similar values and outlooks on life. The marketplace is generally responsive to the different needs and wants of each generation based on the following three factors according to Smith and Clurman (1997): formative cohort experiences, age and lifestyle and current social and economic conditions. These factors will shape an individual's values, attitudes, beliefs and behaviours so that consumers can be classified into various groups according to their shared experiences (Ryder, 1965). Due to the fact that the attitudes, preferences and consumption trends of generations are relatively consistent throughout consumers' lives (Rentz and Reynolds, 1991; Rentz, Reynolds, and Stout, 1983; Schewe and Meredith, 1994; Schewe and Noble, 2000), generational classification is an effective segmentation variable. It makes sense to analyse different generations for wine market segmentation and target marketing efforts, as wine is a product for which consumer preferences are shaped over time, i.e. with more wine tasting experience. Younger generations are typically exposed to the wide variety of different wine cultivars and styles for the first time; and it will take some time for novice wine drinkers to appreciate the entire spectrum of available red and white wine varieties. Older, more experienced wine generations are typically more set in terms of their wine preferences and do not experiment as much as younger, novice wine drinkers. Generally, less complex white wine varieties are preferred in the beginning and thereafter the preferences of novice consumers will advance to the more complex red wine and wooded white wine varieties as they start to experiment with these more complex wines.

It is becoming increasingly important to understand consumers within the wine market of South Africa and how they perceive different wines and/or wine styles. The youngest generation

of wine consumers, Generation Y, can be classified as the most promising market segment. This segment consists of large and increasing numbers of consumers who were born between the years 1977 to 2000 (Wolf, Carpenter and Qenani-Petrela, 2005) which implies that these consumers are today between the ages of 11 to 34 years old. However, Generation Y wine consumers are classified approximately between the ages of 21 to 32 years old.

The 21 to 32 year old market segment consists of loyal supporters of various alcoholic beverages that compete against wine for market share. These consumers will often spend substantial amounts of money on other alcoholic beverages (that are less complex than wine) such as beer and ciders (Foxcroft, 2009). In addition, subjects are influenced by various factors in terms of their preferences and their decisions to buy a wine.

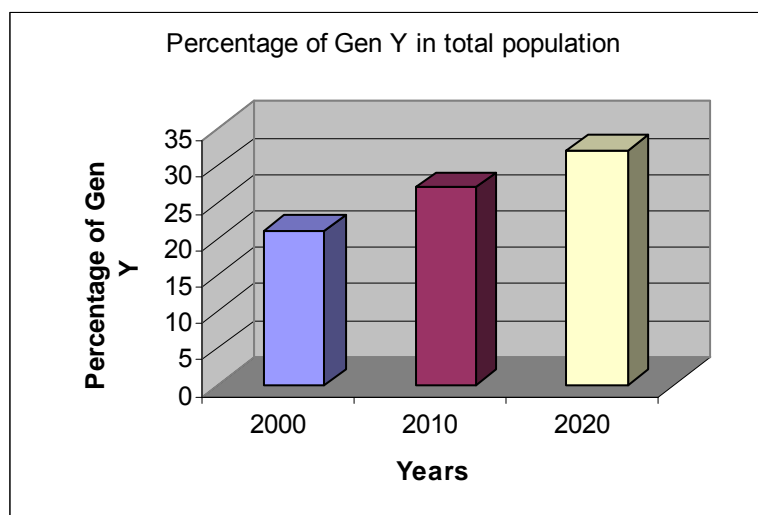
According to Hammond (2010), it is important that the wine industry should focus their efforts on understanding these consumers' wants, needs, desires and preferences. According to Hammond (2010), the Generation Y consumer group is prematurely prosperous and they control their own finances at an earlier age than any of the previous generations did. They possess strong purchasing power which creates opportunities for many consumer industries (Nielsen, 2007; BizCommunity.com, 2002). In his research Hammond (2010) discovered the following characteristics about Generation Y consumers:

- Nielsen's (2007) indicated that Generation Y consumers perceive wine to be both a relaxing and sophisticated product as well as being somewhat formal at times.
- Generation Y consumers generally consider themselves to be wine novices or slightly wine knowledgeable, however, one-third of them want to increase their wine knowledge suggesting an excellent educational opportunity for the wine industry (Nielsen, 2007).
- Generation Y consumers are diverse with various subgroups that have different tastes.
- According to Thach (2005), they are optimistic and think more practically.
- Their electronic skills are outstanding and they are internet-savvy.
- Generation Y is environmentally- and cause orientated and socially conscious.
- They are the most highly educated generation (Brand Amplitude, 2008).
- They demand choice and personalised offerings (Engauge, 2008).
- Generation Y consumers are experientially oriented.

In South Africa Generation Y accounts for nearly a quarter of the population (Resnick, 2008). These consumers will also continue to increase in their numbers over the next twenty years (BizCommunity.com, 2002). He also found that these consumers are expected to increase with twice the rate of the overall population (Smith, 2010). Table 2.5 indicates the increase of Generation Y consumers from 2010 to 2020 in comparison to the previous generations namely Generation X, Baby Boomers and Before-1945's. It is clear that this generation will dominate every industry over the next 10 years. Figure 2.3 Indicates the growth of the Generation Y market from the current (year = 2010) approximate of 27% of the total population to the future (year = 2020) approximate value of 32% of the total population.

**Table 2.5:** Audience Pool and Generation Y (Adapted from: Smith, 2010)

	1998			2010			2020		
	Total	Growth	Ages	Total	Growth	Ages	Total	Growth	Ages
Before 1945	62.5M	31	53+	39.4M	17	65+	21.8M	9	75+
Boomers 1945-64	77.8M	39	34-52	74.5M	33	46-64	69M	28	56-74
Gen X 1965-76	44.4M	22	22-33	46.3M	21	34-45	45.4M	19	44-55
Gen Y 1977-95	15M	8	18-21	64.8M	29	18-33	78.9M	32	25-43



**Figure 2.3:** Future South African Generation Y population projection (Adapted from: Smith, 2010)

Students (ages 18 to 24) as well as young working adults (ages 25 to 32) have much more information and options at their disposal which can influence their decisions. It is predicted that Generation Y will have access to even more information in the future. And “they will have both the confidence and the power to use this information to build or destroy brands” (Smith, 2010).

### 2.3.2 Consumer usage (target market)

One of the problems in the South African wine industry is that there is no wine culture amongst consumers. This prevents the growth of domestic wine sales (Green, 2010). Consumers need to perceive wine as a lifestyle product or else producers will be forced to turn to opportunities outside the country where they can sell their wines and obtain long term business stability and loyalty from consumers (Green, 2010).

### 2.3.3 Opportunities

There is a clear gap in the market for consumers between the ages of 21 to 32 years old who definitely drink alcoholic beverages, but not necessarily wine. As indicated before, this is the fastest growing Generation in the history of consumer markets and it presents new opportunities for all businesses. The majority of young consumers are however, loyal to other alcoholic drinks that compete directly with wine such as beers and ciders (Foxcroft, 2009) and it is critical for marketers to create innovative strategies that will convert these consumers into wine drinkers. Sixty-three percent of consumers in South Africa have never drunk wine before (Loubser, 2008). This clearly indicates a market gap which needs to be penetrated by the wine industry.

## 2.4 Consumer decision making process: what influences S.A. wine consumers?

The factors that a consumer considers before purchasing a wine can vary from the simple brand defined by colour (red or white); to more complex indicators such as country or region of origin, wine style flavour description, grape cultivar and vinification method (Halstead, 2002). Halstead (2002) also mentions that the most common factors used to describe the wine market are as follows: price differentiation within a single product category and product differentiation within the wine category in terms of quality, style and labelling (Halstead, 2002). The following section explores various factors (price, brands, packaging and Word-of-Mouth) that have a significant impact on the wine consumer’s decision making process.

### 2.4.1 Price versus quality

Zeithaml (1988) defined a consumer's perceived quality as "the consumer's judgment about a product's overall excellence or superiority". According to a study done by the American Association of Wine Economists (AAWE), both connoisseurs and non-connoisseurs will typically use factors such as price, umbrella branding, goodwill and past consumption experience in order to evaluate the quality of wines, however, most influential factor is price (Gergaud and Livat, 2007). The study found that connoisseurs do not typically associate price with wine quality whereas novice consumers will tend to rely more on price as an indication of wine quality. The researchers Gergaud and Livat (2007) also make the interesting statement that wines that are not easy to evaluate by consumers, especially by novice consumers, will lose market share in favour of those wines with well established and easily recognisable brands. Novice consumers prefer to rely on individual signals such as price rather than collective signals such as umbrella branding.

### 2.4.2 Brands: lack of large, dominant brands in the wine market

In another study Lulie Halstead (2002) also investigated the key factors that influences the decision making process of consumers in the wine category by analysing the effects of product cues, product information, packaging, purchase location, consumption occasion and the role of the consumers' self when he or she purchases a wine. She found that there are usually a number of highly defined and dominant brands in any Fast Moving Consumer Goods (FMCG) market such as the wine market. South Africa has a major need of these strong market leader wine brands which would capture a large share of market and induce repeat purchases. These dominant wine brands will improve the market share for all wines by convincing consumers of, and ultimately dedicating them to, wine. This could eventually motivate consumers to experiment more with other, less iconic brands, as well. There is therefore an opportunity to build more single dominant wine brands in the South African wine market, which would be targeted towards specific promising markets such as the Generation Y consumers.

### 2.4.3 Packaging

Packaging plays an important role in defining the wine brand positioning in the consumer's mind, especially if he or she is not familiar with the specific brand. Consumers, especially those who are still relatively naïve, are often confused when it comes to choosing a wine from the hundreds of bottles displayed on retail market shelves. With a dramatic increase in competition between South African wine brands in domestic retail stores, producers are attempting to attract extra consumer market attention by changing extrinsic factors such as packaging and labelling in a dramatic manner. A current trend in the wine industry is the creation of arty wine label designs in an attempt to catch the eye of browsing wine consumers. Wine brands such as *Fat Ladies*, *Juno* and *Murati Melck's Red* are good examples of these arty and light-hearted label designs which. The younger consumer market segment finds these labels attractive and it enhances the enjoyment of wine drinking for them (Green, 2010). However, a mere label change needs to be dramatic in order to attract a significant amount of attention. One should also carefully consider the type of consumer that the wine is targeted at in order for that change to resonate with the preferences and perceptions of that specific target market.

#### **2.4.4 Word-of-Mouth**

Word-of-mouth referencing by friends, family, media, critics and opinion leaders is the most influential source when it comes to consumer behaviour as it is constantly used and trusted by consumers more than any other traditional advertising format. Not only does it increase the consumer's trust in the product but it is also the most inexpensive and most effective advertising medium. Different people are considered to be good spokespersons for a product for instance reference groups, which are increasingly being used by consumers in order to assist them during their decision making process (Halstead, 2002). The advantages of word-of-mouth marketing is multiple: not only do consumers trust the opinion of their peer groups more than the conventional advertising messages with which they are bombarded daily, but it is a less expensive method of marketing especially when company marketing budgets are limited, for example during the recession period in 2008. According to Green (2010), word-of-mouth marketing for wines can be leveraged by not only conducting wine tastings at the individual wine farms or at local wine festivals, but also by promoting the use of in-store tastings and wine clubs. Not only will this improve the consumers' own experience with specific wine brands, but it will enhance the social and pleasant atmosphere that is often associated with enjoying wine. These tactics will therefore not only sell wine as an FMCG, but it will also sell an experience with the wine that the consumers can refer to again during future wine purchasing decision making processes.

### **2.5 Description of the target market: Generation Y**

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A market is defined as a collection of various consumer groups excluding the sellers (Kotler and Keller, 2009:49). The industry on the other hand is defined as "a group of firms that offer a product or class of products that are close substitutes for one another" (Kotler and Keller, 2009:786). The target market of consumers between ages 21 to 32 years old, Generation Y, will be described in the following section in terms of their characteristics, market size, growth rate and trends.

#### **2.5.1 Characteristics, size, growth rate and trends of Generation Y**

The members of this target market segment are relatively homogenous in comparison to other generations and they are also considered as the most brand-conscious generation (Smith, 2010). Dominating trends are as follows:

- 1 These consumers grew up with the internet and therefore expect everyday-life activities to be easy and fast; and they want personalised products and services (Codrington, 2007).
- 2 They want a wide range of different options (Codrington, 2007).
- 3 They are globally connected and interactive (Codrington, 2007).
- 4 They embrace diversity more than any previous generation. This trend can also be observed in their choices of retail products, social groups etc. This is a result of their strong belief that "everyone has the right to his or her own opinion" (Codrington, 2007).
- 5 They believe in the concept of a "united-Generation" instead of "me-Generation". They value group work and team spirit. This decrease in individuality and self-expressionism will simplify the task of identifying target markets too (Codrington, 2007).
- 6 These S.A. Generation Y consumers often support Proudly South African branded products as a result of their united love for the country (Bizcommunity.com, 2010).

- 7 This generation is committed to their work and some work more than 30 hours a week. This hard-working attitude is evident in the 18 to 20 years and 21 to 24 years age groups (Bizcommunity.com, 2010) due to the following reasons:
  - They embrace life-long learning.
  - They believe that perseverance is vital in order to be successful.
  - It is important to S.A. Generation Y consumers to be well informed.
  - They seek to reach the top positions in their careers.
  - They aspire to run their own business one day, i.e. to be independent.
  - They pursue a life filled with challenges, novelty and changes.
- 8 Important values of this young generation are (Smith, 2010): optimism, confidence, idealism, equality, ambition, passion, commitment, tradition and empowerment.

### **2.5.2 Target market needs and wants: Generation Y**

In order to create a product that will satisfy a target market, the difference between consumer wants and needs must be defined. Consumers' wants are specifically associated with emotional aspects whereas consumers' needs are closely linked to functional attributes.

This new generation of wine drinkers is different from any preceding generations. Wine brands that aim to penetrate this market will have to appeal to this market by fulfilling this generation's needs and wants. Generation Y consumers are constantly looking for products that can enrich the following specific needs (Fields, 2008): connection, diversity, time with friends, civic activities, environmental preservation, authenticity, quality, inspirational experiences, access to information and ongoing learning. In terms of purchasing behaviour they often consider the following factors (Fields, 2008): affordable price, good quality, fast service and most importantly a unique experience.

### **2.5.3 Accessibility, education and measurability of Generation Y**

This consumer target market is measurable and accessible. According to Media Literacy Clearinghouse (MLC, 2010), social networking through use of social websites like *Facebook*®, *Twitter*® and *LinkedIn*® will dominate this generation's communication and connectivity means. According to Nielsen, *Facebook*® has recently reached more than 500 million users making this social networking platform the world's most popular form of social networking (MLC, 2010).

In terms of age group education 58.8% of the 20 to 24 age section had completed secondary school. Thereafter 45.7% in the 25 to 49 age group and 14.2% in the 50 plus age group had completed secondary school. Tertiary education was completed by 6.9% of the 20 to 24 year old group compared to 4.3% of consumers who are over the age of 24. The opposite is reflected in terms of uneducation consumers: 21.6% of the over 50 year olds who had never been to school and 14.5% of them who had not completed primary education, as opposed to 2.5% of the under 50 year olds who had never been to school and 3.3% of these under 50 year olds who had not completed primary education (Gillwald *et al.*, 2005).

## **2.6 Variants that influence consumer behaviour, preference and purchase decisions**

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Consumer behaviour can be defined as "the study of how individuals, groups and organisations select, buy, use and dispose of goods, services, ideas or experiences to satisfy their needs and wants" (Kotler and Keller, 2009:190). It is therefore important to investigate and comprehend the consumer behaviour parameters of a specific target market thoroughly in order to successfully

reach this market segment with a specific product or product category. According to Lesschaeve (2011), few taste preferences are instinctive and will rather be developed over time together with a child's development and his experimentation with various intensities of different flavours and tastes. Furthermore, she also found that a consumer's preference for a specific food type or flavour often correlates with his or her familiarity with that food type or flavour. Therefore it can be suggested that repeated exposure to, and satisfaction by, a specific product type or flavour will increase the consumer's preference for that specific product or flavour. Furthermore, researchers have shown that consumers tend to reject new flavours during their first exposure, so-called *neophobia phenomenon*, however, they can develop a preference for this new flavour over repeated exposures according to the theory of mere exposure (Pliner, 1982). Food flavour complexity also impacts preference development, as some consumers prefer simple flavours whilst others prefer more complex food and drink flavours (Lesschaeve, 2011).

According to literature the independent variables that can influence consumers' decision to purchase a wine can be grouped into two main influential factors namely consumer factors and product factors.

Consumer factors that influence consumer decision making and preferences used for market segmentation: Consumer's experience with the wine (Thomas and Pickering, 2003) and wine quality (McKinna, 1986; Hall and Winchester, 1999; Bruwer and Reid, 2002); consumer's knowledge of wine (Thomas and Pickering, 2003; Lockshin *et al.*, 1997; Quester and Smart, 1996; Bruwer and Reid, 2002); type of situation or occasion consumer faces, i.e. occasion-based segmentation (Thomas and Pickering, 2003; Dubow, 1992; Hall *et al.*, 2001; Bruwer and Reid, 2002); level of self-confidence (Lockshin *et al.*, 2006); gender differences (Spawton, 1991; Barber *et al.*, 2007); income level (Kolyesnikova *et al.*, 2008); wine involvement levels (Lockshin *et al.*, 1997; Quester and Smart, 1996; Bruwer and Reid, 2002); ethnical or cross-cultural background (Hall *et al.*, 1997; Bruwer and Reid, 2002); lifestyle differences (Bruwer and Reid, 2002); risk reduction strategies (Hammond, 2010); consumption and purchase behavioural factors (Geraghty and Torres, 2009); and geographical factors (Sanchez and Gill, 1998; Bruwer and Reid, 2002).

Wine product factors that can influence consumer decisions and preferences: elaborate taste descriptions (Mueller *et al.*, 2010); bottle shape (Thomas and Pickering, 2003); bottle and label colours (Thomas and Pickering, 2003); label design (Thomas and Pickering, 2003); back-labels (Charters *et al.*, 2000); price of wine (Mueller *et al.*, 2010); wine ratings from the store (Mueller *et al.*, 2010); wine critics' scores (Mueller *et al.*, 2010); medals from wine shows (Mueller *et al.*, 2010); promotional materials (Mueller *et al.*, 2010); and neck hangers (Mueller *et al.*, 2010).

Some of these factors are inter-dependent and can therefore collectively influence the final purchase decision. All these factors have previously been investigated for their influential roles during decision making and purchase behaviours and a few of these factors showed significant influences on consumer preference and purchase behaviour.

### **2.6.1 Consumer factors that influences wine preference and purchase behaviour**

For the purpose of this study we shall explore the effects of these consumer factors of interest in terms of how each factor influences wine purchase behaviour and preference. These factors are: experience, context or occasion that the consumer is faced with, confidence level, gender differences, involvement level in wine and lifestyle.



### 2.6.1.1 Wine experience and wine knowledge

Consumer experience in terms of a specific product category will generally also increase consumer knowledge with regards to the product category. This knowledge can be used as a risk reducing agent which will ultimately help to encourage consumers in purchasing a specific product. All consumers experience risk at some point when evaluating and deciding on a product to purchase (Kotler and Keller, 2009:213). There are five different types of risks that can be perceived by wine purchasing consumers. These are: functional risks where expectations are not met by the product's performance, physical risks where the product threatens the consumer's health and well-being, financial risks where consumers waste money because the product quality does not justify its price, social risks where consumers are embarrassed in front of peers due their inappropriate product purchase decisions, and time risks where the consumer wastes time on an unsatisfactory purchase.

One method of reducing these perceived risks is by gathering information about the product before making a purchase decision (Kotler and Keller, 2009:213; Murray, 1991). Obtained information about a product will minimise the uncertainty involved during the decision making process by increasing the consumer's knowledge and self-confidence (Olsen, Thompson and Clarke, 2003). Findings of previous research (Lacey *et al.*, 2009; Mitchell and Greatorex, 1989; Mitchell and McGoldrick, 1996; Spawton, 1991) also suggested that consumers acquire information as a risk reduction strategy. The problem with wine, according to Chaney (2000) and Unwin (1999), is that its quality characteristics cannot be assessed without purchasing and tasting the wine first. Inexperienced wine consumers will therefore often rely on descriptions from labels, friends, wine menus, journalists and restaurant wine steward recommendations in order to make their choice (Hammond, 2010). In addition, consumers often rely on their own information sources i.e. their own wine knowledge, preferences, and usage experience (Dodd *et al.*, 2005; Lockshin and Hall, 2003). Choices are, however, often made without an adequate amount of information (Hammond, 2010). This could lead to dissatisfaction which leads to negative word-of-mouth about the product. This can affect the image of the product detrimentally.

Highly involved and experienced wine drinkers understand interactions between various wine factors such as the wine regions, producers and grape varieties and how it influences wine quality, but novice consumers are oblivious to these specific interactions (Lockshin *et al.*, 2006). According to Lelièvre *et al.* (2009), there are two different experienced panellists: professional panellists and sensory experts. Not only do professional experts have technical knowledge of wine and wine making but they often have in depth chemosensory knowledge as well which could significantly influence their wine perceptions (Lelièvre *et al.*, 2009). In another study McKinna (1986) proposed that the wine market can be segmented according to expertise level into the following segments. The segments are: wine knowledgeable or connoisseur, wine pretentious or aspiring, young bottle wine drinkers, average cask wine drinker and new wine drinker. Thereafter, Spawton (1991) simplified these five segments into four major segments, stating that the segmentation bases were consumer expectations and risk reduction: connoisseurs, aspiring drinkers, beverage wine consumers and new wine drinkers. Finally Hall and Winchester (1999) identified the following wine experienced consumer segments: connoisseurs, image concerned, risk averse and enjoyment segments.

Not only does experience influence consumer purchase decisions but it is also positively related to objective knowledge as well as to subjective knowledge (Brucks, 1985). According to Brucks (1985), we can differentiate between three different types of product knowledge: subjective i.e. self-perceived knowledge level, objective knowledge i.e. the information that has been stored in an individual's memory, and usage experience i.e. the amount of times that a product has been purchased or used. Subjective wine knowledge will directly influence

consumer self-confidence which will also influence the consumer's purchase behaviour (Olsen, Thompson and Clarke, 2003). The higher the subjective knowledge level, the more confident the consumer will be in making a purchase decision. Interestingly Barber *et al.* (2008) found that Generation X'ers have higher levels of subjective wine knowledge in comparison to Generation Y consumers, indicating that Generation Y consumers are not yet familiar enough with wine.

#### **2.6.1.2 Purchase occasion**

Occasion or context can be described as the situation for which a wine is purchased by a consumer. Typically consumers will consider different aspects of the product more carefully for different occasions such as a birthday gift, formal dinner or a casual gathering with friends. The occasion for which a wine is purchased can also influence the perceived risk of the purchase decision. Hall *et al.* (2001) found that the dominant attributes relating to wine choice are wine price, wine taste and wine type (red or white) and the importance of each of these factors for the consumer differed for different consumption occasions.

#### **2.6.1.3 Confidence level**

Confidence is seldom classified as an isolated consumer behaviour characteristic. According to Alba and Hutchinson (1987), product experience strengthens a consumer's objective knowledge about the specific product which, in turn, will strengthen consumer confidence (Park and Lessig, 1981). Consequently consumers with high self-confidence do not fear the social risks of making wrong purchase decisions and will use less external informational sources, than consumers with low self-confidence, and rely more on their own judgements when deciding on a bottle of wine to purchase (Hammond, 2010).

Consumers often struggle to identify wine aromas, as described on the back-label, which could also decrease their confidence in purchasing wine and consequently influence their wine preferences. Most consumers can rate their subjective liking for a wine; however, most do not have the confidence and knowledge needed to objectively assess a wine's quality (Mueller *et al.*, 2010). Therefore, consumer panels are generally used during preference or hedonic tests in sensory science whilst trained or expert panels are used for descriptive or profiling tests. Descriptions of wine attributes on a back-label are often created by wine experts in the industry such as the winemakers. It is therefore important to assess how these consumers relate to experts in their ability to identify various wine attributes that constitutes to the overall wine profile as well as their descriptions for the various Chenin blanc styles. Wine is an extremely complex product and younger consumers often lack self-confidence to select wines for specific occasions. It also appears that self-confidence and wine involvement levels might be related, because involved consumers tend to have more confidence in their purchase decisions than uninvolved consumers (Mueller *et al.*, 2010).

#### **2.6.1.4 Gender differences**

Gender differences seem to play an important role in terms of preference and purchase behaviour in wine (Lelièvre *et al.*, 2009). In a wine consumer study Saad (2005), found that nearly half of the females in the sample prefer wine over other alcoholic beverages, while a quarter of males prefer wine. Since a decade ago these amounts have increased with approximately 16% until today, therefore wine loyalty is increasing amongst South African consumers. Social risks are also considered differently by different genders as males tend to place more value on social and psychological factors than females in relation to their perceived value of wine purchasing and consumption (Hall *et al.*, 2000). As more females are often wine

consumers than males, females contribute to the largest percentage of the wine consumer market (Barber *et al.*, 2007).

#### **2.6.1.5 Involvement level**

A consumer's product involvement level is closely related to his level of experience and knowledge about the product, but it also refers to the level of excitement and interest that the consumer has for a product class such as wine. The more interested one is in a product, the more willing one is to learn more and gather more information about that specific product (Lelièvre *et al.*, 2009). There are different definitions for consumer involvement in literature. Kotler and Keller (2009:784) define consumer involvement as "the level of engagement and active processing undertaken by the consumer in responding to a marketing stimulus." According to Zaichkowsky (1985), consumer involvement can be defined as "the consumer's perceived importance or relevance for an 'object' based on his or her needs, values, and interests." In the case of the wine consumer: involvement is a goal oriented and emotional state of interest. However, when the consumer is not so much involved in wine, he or she will minimise all wine purchase procedures. For example they will minimise information sources and focus on less complex information to make a purchase decision such as price and popular or familiar brand. This also reduces their perceived purchase risks (Park and Lessig, 1981).

Research showed that product involvement is closely related to consumer decisions and purchase behaviour (Flynn and Goldsmith, 1993; Mittal and Lee, 1989; Slama and Tashchian, 1985; Lockshin, Spawton and Macintosh, 1997, Quester and Smart, 1996). Consumers with high product involvement levels will therefore react differently to marketing efforts than consumers with low product involvement levels. According to Lockshin, Spawton and Macintosh (1997), it is therefore possible to effectively segment a wine consumer market with the use of involvement as a segmentation variable. These segments include: choosy buyers, brand conscious but hate to shop, uninvolved shopper, interested shopper and the lazy involved shopper.

The level of wine involvement will indicate the consumer's rating of the wine importance (Yuan *et al.*, 2005) and it will also reflect consumers' level of wine interest. Highly involved wine consumers, so-called wine enthusiasts, will often utilise more complex information cues, buy more wine and spend more money per bottle than low involvement buyers (Lelièvre *et al.*, 2009). Low involvement consumers often use risk reduction strategies in order to simplify their purchase decisions (Yuan *et al.*, 2005).

Wine involvement might also be directly related to consumer age. Not only does product involvement influence interest level in a specific product category but it has been suggested that product interest can also increase with age until the above-55 age group and therefore age influences the consumer behaviour in the purchase of wine (Quester and Smart, 1996).

The specific aspect of wine that makes it such a complex product is the fact that one cultivar, like Chenin blanc, can have a wide variety of different wine styles. Some of these wine styles are more difficult to identify than others. Wollan (1996) found that that highly involved consumers place more importance on style, as it takes more experience and interest to identify various wine styles, than lesser involved consumers who are often unable to differentiate between various wine styles due to their lack of interest and experience.

#### **2.6.1.6 Lifestyle**

Another aspect that plays an important role in consumers' purchase and decision behaviours is their lifestyle. According to Kotler and Keller (2009:786), lifestyle can be defined as "a person's pattern of living in the world as expressed in activities, interests and opinions."

The socio-demographic characteristics of consumers refer to population characteristics that are identifiable and measurable (Schiffman *et al.*, 2001). On the other hand, lifestyle characteristics are defined as being “linked to values and the processes by which people seek to achieve their values through various modes of expression, including the consumption of wine” (Bruwer and Reid, 2002). According to Bruwer and Reid (2002), wine consumers can be socio-demographical similar to one another, but have different attitudes towards wine, wine consumption behaviours and lifestyles.

Various wine lifestyle segments have been identified in the Australian wine consumer market and lifestyle classifications has been used to segment five groups as follows: purposeful inconspicuous premium wine drinkers, ritual oriented conspicuous wine enthusiasts, enjoyment seeking social wine drinkers, image oriented wine drinkers and basic wine drinkers (Bruwer and Reid, 2002).

## **2.6.2 Wine factors that influences wine preference and purchase behaviour**

Not only is sensory profiling and sensory evaluations important from a research and development perspective or a scientific perspective, but it is vitally important in order to establish how consumers value the sensory properties of food and drink. By understanding a consumer market’s preferences one can provide them with an array of products that will satisfy their sensory preferences. Today there is a lot of focus on improving existing products that will satisfy consumer needs and preferences more effectively than before (Næs *et al.*, 2010:15). Various intrinsic and extrinsic product factors can influence consumer preferences. This is a particularly complex process to understand as so many unforeseen or uncontrollable factors might influence consumer preference and purchase intentions due to the interaction effect that intrinsic and extrinsic product cues have on consumer preference. Intrinsic product factors are those aspects that can not be seen by the consumer whereas extrinsic factors are all the visual and physical factors of a product that a consumer can evaluate.

### **2.6.2.1 Intrinsic wine factors**

Wine intrinsic cues can be defined as the sensory characteristics (Mueller, Osidacz, Francis and Lockshin, 2001) such as taste, smell, sight, mouth feel and style of the wine. Intrinsic cues play an important role in terms of wine profile perception and consumer preferences. As stated by Lesschaeve (2011), “Exposure to wines from novel varieties and to different wine styles can impact consumer preference and consumer purchase behaviour.” Extrinsic wine factors such as label design, brand name, cultivar type etc. might strongly influence initial product purchase decisions. Intrinsic wine factors on the other hand will influence the ultimate consumer satisfaction and the chances of repurchases. Consumers will almost always consume wine whilst being informed about its identity after purchasing a bottle of wine (i.e. they will be aware of the brand, region, packaging and price of a wine whilst consuming it). After being able to evaluate both the intrinsic and extrinsic factors of the wine the consumer will subconsciously decide whether he or she would repurchase the same wine during future occasions (Mueller *et al.*, 2001). It is therefore extremely important that the intrinsic factors, which are mostly evaluated after extrinsic factors, confirm and enhance the consumer’s evaluations of the extrinsic factors in order to strengthen satisfaction with the wine.

The key drivers of a repurchase for a specific wine are consumers’ previous purchase decisions as well as several wine sensory attributes (Mueller *et al.*, 2001). It is therefore especially important to firstly identify which wine intrinsic characteristics satisfies a specific consumer segment in order to ensure that a bottle of wine will achieve long term market

success by being repurchased. A well designed label or attractive descriptions which can motivate a consumer to try a bottle of wine must therefore have an equally satisfying sensory profile. If the sensory profile disappoints the consumer's expectations he or she will seldom repurchase the wine in the future. Disappointed consumers will most probably also spread negative word-of-mouth about the specific wine which might demotivate others to buy the wine, as discussed in 2.4.4.

Humans have a poor ability to distinguish between individual odours in a complex mixture (such as wine) regardless of the level of training and experience (Livermore *et al.*, 1996). This problem is furthermore, complicated by the fact that consumers may differ in terms of perceptual awareness, due to physiological differences (Cain, 1979). It is becoming increasingly difficult for novice consumers to distinguish between various wines and their distinct characteristics as there are such a wide variety of different wines and wine styles commercially available. This could result in wine becoming a commodity product which would have a negative impact on price and profitability (Jennings and Wood, 1994).

Wine quality is generally defined by chemical measures via analytical apparatus, however, these measures, are not fully appreciated by consumers, who generally rely on their own perceptions of product quality. Sensory characteristics are also not easily measurable as one cannot use analytical tools to evaluate a wine's sensory profile but have to rely on human perception. It is difficult to describe the complex sensory attributes of wine in such a way that novice consumers can relate to it and perceive it. It is therefore important to investigate whether consumers and experts see eye-to-eye with regards to wine quality ratings. Due to the fact that many wine consumers will often buy wine on the basis of wine expert recommendations, it is important to ensure that the method utilised to classify and describe wines and wine styles provides results that are in line with the perception and preferences of the target consumer market.

### **2.6.2.2 Extrinsic wine factors**

The extrinsic wine cues can be defined as every aspect of the wine that does not involve sensory characteristics such as price, region of origin, packaging, closures, brand and labels (Mueller *et al.*, 2001). In today's competitive wine industry marketers and producers are pushing all boundaries in order to catch the attention of new consumers. Retail shelving spaces are dominated by differentiated brand designs all aiming to stand out more than the others for the browsing consumer to see. Instead of simplifying the purchase decision this might become a complicated situation for a novice consumer (Cohen and Lowengart, 2003). The S.A. grocery stores are filled with a vast variety of wines and a simple wine purchase decision can therefore become intimidating for a novice wine consumer.

### **2.6.3 How do consumers perceive wine?**

Perception can be defined as "the process by which an individual selects, organises and interprets information inputs to create a meaningful picture of the world" (Kotler and Keller, 2009:788). It is clear that various independent and dependent consumer and product variables can influence consumer perception, decision making and/or preference. However, it is likely a combination of these variables, and the interaction between them, that causes a consumer's ultimate preference for a specific wine and also influences his or her purchase and repurchase decisions. It is therefore important to investigate how consumer behaviour can be influenced not only by the intrinsic and extrinsic wine cues, but also due to the consumer's personal factors.

According to Mueller *et al.* (2010), one can distinguish between search, experience and credence attributes in terms of how consumers perceive wine. Search characteristics can be assessed in the store prior to purchasing the product such as producer, brand, region, grape variety and packaging. Experience characteristics can be assessed only after the product has been purchased and consumed such as taste, aroma, flavour, mouth-feel, overall sensorial perception. This will influence the ultimate preference for the product and the memorability of the product. Credence attributes can not be assessed during consumption of the wine such as health effects, environmental benefits, ingredients or production methods.

The experience characteristics are typically described on the back-label of the bottle which actually forms a part of the search characteristics. This creates a problem as consumers struggle to imagine these sensory descriptors which they can only experience when consuming the wine. Consequently, consumers often only use back-label sensory descriptions to assist them in making the right choice of wine. It seems that elaborate taste descriptions are more appealing to consumers when they are choosing a wine than when they taste the wine (Mueller *et al.*, 2010). Elaborate wine taste descriptions are often confusing to consumers when they try to detect separate aroma characteristics.

## **SECTION 3. Sensory science: the link between the consumer market and the wine industry**

### **3.1 Difference between concept and blind sensory perceptions**

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According to Kotler and Keller (2009:203), perception can be defined as follows: “the process by which we select, organise, and interpret information inputs to create a meaningful picture of the world.” Consumer perceptions are important as it becomes their own reality therefore; it also influences the consumer’s actual behaviour (Kotler and Keller, 2009:203). A specific product concept can influence the consumer expectancy of the product at hand before he or she even had the opportunity to experience the product. In their research Ballester *et al.* (2005) aimed to determine whether Chardonnay wine concept is a result of perceptual similarities between different wines or whether it is due to a concept structure about Chardonnay in the minds of the panellists (experts). According to Lindsay and Norman (1977), novice consumers mainly use bottom-up evaluation processes and therefore evaluate whether their perceptions of the individual sensory characteristics are similar or not between different products. Experts however, have an extensive knowledge of wine cultivar sensory characteristics and they will generally search for the sensory attributes that they expect to find in a specific cultivar wine (Brochet and Dubourdiou, 2001). This method of evaluation, often used by expert panellists, is called top–down evaluation. It is possible that the specific wine or wine style descriptions may similarly influence consumers’ expectations and also perception of a specific wine. Consequently their perceptions of the wine could change their preferences for the specific wine as well. A novice will look to any guidance that he or she can get when they do not know how to approach a specific product during evaluation. It is therefore important that the concept of the wine style, in this instance Chenin blanc wine styles, are clearly defined and that consumers can identify with these industry defined wine style concepts. Not only do these concepts serve a classification purpose, but it also creates helpful references for consumers to use when trying to identify a wine that they prefer most.

### **3.2 Type of panel: consumers versus experts versus trained professionals**

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During sensorial tests one of three panels can typically be used by the sensory analyst: a trained professional panel for descriptive tests such as quantitative descriptive analysis; an industry expert panel for example wine makers or expert wine tasters; or a novice consumer panel for classification tests and hedonic tests Næs *et al.*, (2010:15). However, these panels have different advantages and disadvantages when used during sensory research.

Sensory science and sensory profiling techniques are becoming increasingly important in terms of understanding consumer market perceptions and linking product development effectively with consumer insights. Sensory profiling is viewed as a way to explain and possibly anticipate consumer preferences (Delarue and Sieffermann, 2004). It can thus be found that the most important purpose of sensory profiling is to describe and quantify individual product sensory differences and it aims to position sample set products in a multivariate projection as defined by these products’ relevant sensory attributes (Delarue and Sieffermann, 2004).

According to Næs *et al.*, (2010:15), two different panels are usually utilised for sensory profiling procedures: trained panels and consumer panels. The trained panel is typically used for sensory profiling to identify and rate the sensory attributes of a product and for sensory difference testing to identify sensory differences between products. During quantitative

descriptive analysis (QDA) a trained panel will be used to describe the product set as objectively as possible (Næs *et al.*, 2010:15).

In order to establish product preference, a consumer panel will be used. Consumers will naturally evaluate their preference for or against a product first and they typically focus more on the global perception of a product than on the individual sensorial characteristics of the product. Here, the panellists are selected in order to be representative of the population of targeted consumers. These tests are often called hedonic or affective tests (Næs *et al.*, 2010:15). The number of consumers used to participate in a hedonic test must be more than the number of trained assessors in a sensory panel in order to obtain useful and reliable information. Typically consumer panels will be between 100 to 150 consumers (Næs *et al.*, 2010:15). Trained panellist analyses are expected to function like similar analytical tools (i.e. with little or no variance between panellists), but consumers are expected to show more variance between their answers and between replications of their own tests. It is therefore necessary to include larger numbers of consumers in order to improve precision and reliability of the preference data. This precaution acts as an automatic internal quality control measure of the panel. Individual differences can also be detected and analysed within such a large panel (Næs *et al.*, 2010:20) for example to evaluate how the scale was utilised. Table 2.6 summarises the differences between trained sensory panels and consumer panels.

**Table 2.6:** Trained sensory panellists versus expert panellists versus consumer panellists

QDA	Sorting Technique		Preference scaling
Trained	Experts	Consumers	Consumers
Sensory profiling (Næs <i>et al.</i> , 2010:15).	Sensory profiling	Sensory profiling (Næs <i>et al.</i> , 2010:15)	Degree of liking and Acceptance tests
QDA: PCA plots	Similar perceptual spatial plots (MDS) (Cartier <i>et al.</i> , 2006)		Preference maps or PLS
Analytical tools (Nestrud and Lawless, 2008)	Slight variance	More variance exp. (Chollet <i>et al.</i> , 2011)	
N = 6-12 (Chollet <i>et al.</i> , 2011)	N = 12-15 (Chollet <i>et al.</i> , 2011)	N = 20 (Chollet <i>et al.</i> , 2011)	N = 100-150 (Næs <i>et al.</i> , 2010:15)
Bottom-up (Ballester <i>et al.</i> , 2005)	Top-down (Green <i>et al.</i> , 2011) (Ballester <i>et al.</i> , 2005); (Brochet and Dubourdieu, 2001)	Bottom-up (Ballester <i>et al.</i> , 2005); (Lindsay and Norman, 1977)	Conceptual versus blind preference
Time consuming	Fast		

Both panels are often used in order to explain consumer preference drivers. Therefore by combining the two panels and the tests used for each, the researcher is able to establish the product or attribute drivers of liking for consumers. This information is especially important for product development, marketing strategies, understanding various consumer segments in terms of their needs and trends in the market (Næs *et al.*, 2010:16).

Due to the fact that consumers are not trained to act as analytical instruments such as trained descriptive analysis panellists (Nestrud and Lawless, 2008), it becomes more complex to understand how they perceive various products. Differences between trained panel member perceptions is prescribed due to mere noise occurrence within the data set (Lawless and Heymann, 2010), however, it might be insightful to investigate the differences between individual consumer members. Due to the fact that human subjects are not equally sensitive to sensory stimuli, a panel of trained judges is used in order to stabilise the generated description



(Delarue and Sieffermann, 2004). It is therefore important to understand heterogeneity within a consumer group in order to segment the group according to sensory perception or sensory preferences.

In the past the majority of product similarity studies have all utilised trained panels to create product perceptual maps through the use of descriptive analysis techniques. However, it has been proven that similar perceptual maps can be obtained from untrained consumer panellists both from projective mapping (Napping®) and from a trained panel during QDA (Kennedy and Heymann, 2009). These two sensory methods are in fact two different tests: Napping® is essentially a classification tests whereas QDA is traditionally a descriptive or profiling test. The use of untrained judges for Napping® provided similar product spaces as those obtained by descriptive analysis for the same set of milk and dark chocolates and individual panellists perceived the chocolates similarly (Kennedy and Heymann, 2009). It is therefore clear that there might be some merit in using untrained panellists to describe product differences and sensory factors contributing to specific product perceptions in a sample set. When additional tests such as liking and purchase intent for the various products is also measured, the projective map can further be enriched with information indicating the drivers of liking and purchase intent as well as the different product segmentations within a product set, as perceived by the consumers.

With both trained panels and consumers, there will always be some variations between the individual panellist maps reflecting differences in the overall perception of products (Risvik *et al.*, 1997) due to the fact that two people will almost never have exactly the same preferences and perceptions for all products. While training may reduce the variation between individual judge maps, this may not be desirable. One advantage of projective mapping is that it can be used to evaluate the importance of product attributes to consumers. Training the judges may change the information obtained from the projective maps, thus not providing insight on how consumers perceive the product differences in terms of latent sensory differences (Kennedy and Heymann, 2009). This could lead to loss of latent sensory information which could be valuable for creating niche market products or to resolve quality control problems.

Traditionally sensory profiling is performed with a group of trained assessors who objectively provide a quantitative description of the sensory characteristics of food or drink products (Stone and Sidel, 2004). One of the main disadvantages of QDA is that this conventional profiling method is time-consuming. This is due to the fact that the vocabulary and associated training must be adapted to each product category specifically (Ares *et al.*, 2010). In terms of applicability to general market perception of the product there is a possibility that trained panellists will describe the product(s) differently than consumer panellist or consider attributes that are irrelevant for consumers (ten Kleij and Musters, 2003). Products must suit the targeted consumer segment preferences in order to ensure that these consumers are able to identify the various organoleptic characteristics of the product which will in turn satisfy them and increase the chances of a possible product repurchase in the future. In order to design food products that meet consumer sensory expectations, food companies need information about how consumers perceive the sensory characteristics of the product. The best way to understand consumer preferences (especially for a specific consumer segment group) is through the use of consumer data (Risvik *et al.*, 1997) generated by consumer panels. It is therefore important to investigate techniques that could possibly exclude the need for panellist training and improve the process of obtaining effective consumer insights (Faye *et al.*, 2006).

As mentioned earlier, one can typically use three different panel groups during sensory research: a trained panel, expert panel and consumer panel. These panels can be used to profile a sample set but only a consumer panel can be used to perform preference tests on a sample set such as “degree of liking”. The outcome of this preference data can thereafter be

regressed on descriptive data which is usually obtained from conventional profiling methods such as QDA to obtain a partial least squares referred to as PLS or an external preference map or PREFMAP that will explain the drivers of liking for the individual products. More variance is expected especially with consumers as they are less experienced than trained and expert panels. A large group number of participants are also needed (N = 100 to 150) when performing preference tests with consumers in order to reduce the variance in their preference data. These different panels, trained panels, experts and novice consumers, also evaluate a product sample set such as wine differently from one another via bottom-up or top-down analysis (Lelièvre *et al.*, 2009).

Bottom-up analysis refers to the process of evaluating the basic product sensorial characteristics without knowing what the classifying cultivar or wine style is and which characteristics are typically associated with it. In other words this cognitive process emphasises properties of the wine sample such as intensity of latent characteristics (Parr *et al.*, 2007). This method is generally used by trained panellists during QDA as they are trained to identify and to scale separate product characteristic intensities. It is also often used by novice consumers who are given blind tastings. Due to the fact that these consumers do not know what to expect from the product, they focus on their first global impression of the product and the most dominant characteristics of the product.

On the other hand top-down analysis refers to the way that wine industry experts typically evaluate wine samples or the way that consumers evaluate a wine with their knowledge of the wine price, brand, description etc. (Green *et al.*, 2011). Firstly, experts generally identify the type of wine cultivar; and thereafter they look for the various characteristics that can often be associated with that specific wine style identity or wine cultivar. Wine experts often know exactly what to expect in terms of the sensorial characteristics of a specific cultivar and they are also able to link a typical cultivar sensorial characteristic with a wine cultivar or wine style. Top-down analysis can also refer to the use of similarity classifications methods which are often used by consumers in their everyday tasks. Consumers will generally use classification definitions in order to evaluate a product such as wine style, brand, price or region of origin. For each of these classification types the consumer has already created a specific expectancy of how the product will be perceived, i.e. before evaluating the product, due to previous experience or simply his or her own concept of the product. Therefore top-down cognitive processes includes the panellist's mental representations of a specific wine cultivar due to previous experience with this specific variety (Hughson and Boakes, 2002; Green *et al.*, 2011); as well as the panellist's expectations (Parr, White and Heatherbell 2004). Lelièvre *et al.* (2009) describe these two evaluation methods as memory representation i.e. top-down analysis; and perceptual or surface characteristics i.e. bottom-up analysis.

It is therefore clear that these three panellist groups use different cognitive processes during informed and uninformed situations in order to evaluate the sensorial properties. Consumers are influential and they will utilise both methods but in different situations: i.e. during a blind tasting it is expected that they will utilise bottom-up evaluation techniques more and during an informed concept tasting they will typically utilise top-down analysis techniques to evaluate a product. This is supported by the research of Solomon (1997) who found that, during blind tasting tests, wine experts will typically organise a sample set of wines according to cultivar type; whereas the novice consumers would rather use one or two salient perceptual characteristics such as sweetness or fruitiness to organise wines into similarity groups. In their research Lelièvre *et al.* (2009) found that wine experts have a strong knowledge structures in their memory due to repeated experiences with similar wines in the past which will dominate the way that they evaluate and describe products.

How does the level of wine expertise influence the way the wines are memorised? Different expertise levels will influence the categorisation process of wines (Maitre *et al.*, 2010). According to Lelièvre *et al.* (2009), “Beer or wine experts in sensory evaluation are assessors trained to evaluate the intensity of different attributes of the products and to detect and identify flavours and defects.” Thus these assessors’ expertise level relies mainly on their level of sensory expertise in terms of a specific product category such as wine/beer. In this paper, professional experts will be called experts and experts in sensory evaluation will be called trained panellists. Researchers also concluded that people can gain experience while working with the product, in tasting the product, in tasting the products just for pleasure and in tasting the product for pleasure and for getting expertise (Maitre *et al.*, 2010). According to Lelièvre *et al.* (2009), industry experts have a more commonly shared knowledge and experience level in terms of evaluating specific products such as beer which differentiates them from novice consumers.

In their study on the relationship between expertise level and memory for beers Valentin *et al.* (2007) found that the beer expert panel, which consisted out of intensively trained novice consumers, outperformed the novice consumers in an identification task as well a recognition memory task. They found that this advantage in identification tests were due to the fact that the expert panel formed stronger memory codes that could be recalled more easily than the novice panel who did not receive any beer evaluation training. Experts therefore do not necessarily have better perceptual abilities, but better memory structures for specific aromas or products. Experience in evaluating a specific product category will therefore significantly influence the way one categorises those products (Lelièvre, 2009). According to Lelièvre (2009), two approaches in perceptual categorisation can be distinguished: those based on similarity and those based on knowledge. According to the theory of similarity, “categorisation of products in the mind is based upon a comparison between one sample and an abstraction of the category or one or several examples of the category” (Thibaut, 1997). The abstraction is memorised and is therefore the result of all previous tasting experiences of samples from the same category (Maitre *et al.*, 2010).

Generally, it is expected that trained panellists will outperform untrained, novice panels during classification tasks and in terms of their data reproducibility; however, this accepted idea has not yet received sufficient support in literature (Chollet and Valentin, 2001). These researchers found that both trained and untrained panellists have similar perceptions (in terms of beer), but their verbalisation abilities differ for the same product sample set. Experts (and trained panellists) tend to use more terms, however, these terms tend to be more concrete and shared amongst the panellists whereas consumer panellists generally tend to use hedonic and ambiguous terms that are not often shared with other panellists within the group (Clapperton and Piggott, 1979; Lawless, 1984; Gains and Thomson, 1990; Gawel, 1997).

Even when consumer panellists are provided with a lexicon, a description list of possible aroma characteristics, experts still managed to outperform these novices (Solomon, 1990). It therefore seems that a description list does not improve novice panellists’ ability to discriminate or describe various products within a sample set. Research conducted by Challot *et al.*, (2011) supported this finding when they confirmed that providing a list of descriptors to consumers during the verbalisation process of the sorting tasks did not improve their ability to describe products. This finding can be explained by the fact that a long list of descriptions may often confuse consumers. When evaluating a sensorial complex product such as wine, it is difficult to measure to which degree the panel members’ true perceptions or the product concepts influenced their perceptions of specific aroma and flavour characteristics.

Even though some researchers found similar results when using both a trained panel and an untrained consumer panel to do the same sensory test, other researchers found opposing results. According to Chollet and Valentin (2001), similar performance from both trained and untrained panellists is determined by the type of sensory task performed by the panels. It is therefore important that the sensory researcher is aware of the problems and uses of various panels and always consider the product type as well as the project aims when deciding upon the use of a specific panel during a specific sensory test on a specific product category.

### **3.3 Using wine style definitions and attribute descriptions as extrinsic training tools**

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Mueller *et al.* (2010) found that one can distinguish between search, experience and credence attributes in terms of how consumers perceive wine. The search attributes are available on the retail shelves and will help to eradicate some of the consumer's perceived risks but will not overcome all perceived risks, as consumers are restricted to only the product's appearance at this point (Mueller *et al.*, 2010). Due to the fact that consumers generally can not taste or smell a wine in a retail shop, they can not experience its sensorial, which will have a major influence on their wine preferences. The question arises, how can wine experiential characteristics be included with the extrinsic wine cues so as to positively influence consumer perception and preference thereof?

According to Shaw *et al.* (1999), one will win more confidence and preferences from consumers when the wines are positioned according to specific product attributes for example the wine's style descriptions such as the appearance, smell and flavour of the wine (Shaw *et al.*, 1999). Here, the term attributes specifically refer to features or benefits of the wine. Thomas and Pickering (2003) found that one of the most important back-label elements is the wine attribute description as it plays a significant role in influencing the respondents' decisions on purchasing.

Research on the impact of a back-label wine sensory description was conducted by Mueller *et al.* (2010) found that the presence of a taste description on a wine bottle always increased the choice of that particular bottle of wine by between 3.9% to 15.1% (Mueller *et al.*, 2010). Nevertheless, some consumers still found it hard to identify the aroma characteristics in the wine itself, described on a wine's back-label. Consequently the back-label description is often only utilised as a guidance tool during the consumer's purchasing decision making process. The purchase risk perceived by the consumer was significantly reduced by the presence of meaningful and understandable sensory back-label descriptions (Mueller *et al.*, 2010). If used wisely, it can also motivate consumers to try wines brands or wine cultivars that are new or unknown to them.

It was also found that training may be more important than experience in order to improve the ability of people to rate the intensity of descriptive sensory factors. Research shows that training does indeed improve the ability of consumers to identify the odour quality of individual odorants (Cain, 1979). The question therefore arises during the present study: can non-trained consumers be used in order to identify Chenin blanc aroma characteristics and various Chenin blanc wine styles? To answer this question, it is primarily important to investigate how consumers compare to trained panellists as well as industry experts, who are responsible for the production and marketing of Chenin blanc wines. It is important that wine experts understand the behaviour choices and preferences of consumers, as well as their limitations in order to provide consumers with an understandable, attractive and unique extrinsic appearance relating to the intrinsic Chenin blanc styles and attribute characteristics. This may improve consumers' preferences and self-confidence, as well as trust in specific wine styles.

It has been found by previous research studies that novice consumer panellists can be used to obtain similar results than those obtained from a trained panel or expert panellists (Chollet and Valetin, 2001; Cartier *et al.*, 2006). This is supported by the finding that the olfactory sensitivity of experts is similar to those of novice consumers (Bende and Nordin, 1997). However, it was also found that the sensorial classification abilities of experts often exceed those of novices for a specific product as they have more product experience and a better vocabulary (Chollet and Valetin, 2001; Cartier *et al.*, 2006; Bende and Nordin, 1997). Experts are also more efficient in generating verbal descriptions during sensory profiling or classification methods.

### **3.4 Research methods for wine sensory data and consumer insight evaluation**

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“Human perceptions of foods and consumer products are the results of complex sensory and interpretation processes” (Lawless and Heymann, 2010:10). The distinctive *Vitis vinifera* grape flavour and aroma characteristics are expressed as a result of the physical and cultural environment (Parr *et al.*, 2007). Within each cultivar, one can furthermore identify different wine styles that are the results of specific cultivation and harvest methods e.g. sugar level during harvest; the wine production process e.g. type of yeast used during fermentation, maturation specifications e.g. type and duration of wood maturation, to name but a few. Recently, the South African wine industry started to investigate the opportunity for classifying different Chenin blanc wines according to different wine styles and to market these wine styles to the consumer target markets. It is therefore important to investigate the sensory methods that could possibly be used to classify and describe various wine styles within a specific cultivar type as well as to investigate the target market consumer preferences for these wine styles and establish which product factors are responsible for driving these preferences. Even though the most accurate results are obtained from using human senses instead of instrumental tests (Lawless and Heymann, 2010:10), one has to keep in mind that human testing automatically includes vast amounts of uncertainty and biasness into the data as different people perceive and prefer various sensorial factors differently. It is therefore important to reduce the amount of data variance; however, no answer in sensory science will ever be without any uncertainty (Lawless and Heymann, 2010:11). The researcher therefore has to strive to obtain the answer with the least uncertainty. In other words: which answer or result can be considered as relevant and significant in the specific situation.

According to Lawless and Heymann (2010:5), there are three different test methods in sensory evaluation: classification tests, descriptive tests and affective tests. All these tests are used to reach specific objectives. Discrimination tests are typically classified as analytical tests where the aim is to investigate whether various products in a sample set is different to one another in some way. The type of panellists used here can be either trained or untrained. Descriptive tests on the other hand focuses on quantifying the specific sensorial differences between two products in a sample set. Only highly trained panellists are used to conduct this analytical test. Lastly the affective tests aim to establish how well the products within a specific sample set is liked or preferred with regards to one another. This is classified as a hedonic test where the sensory analyst will only make use of untrained users of the product, i.e. consumers. Two types of sensory research methodologies are commonly used in sensory research: Sensory descriptive tests and classification tests (Næs *et al.*, 2010:19-21). Two methods that demonstrate each of these tests are QDA, a profiling method, and the sorting task, a classification method. Under normal conditions both these tests can be used as descriptive and classification tests, however, QDA is typically used as a descriptive method and sorting is used

as a discriminating test. In the past these tests have been repeatedly compared with one another, QDA versus sorting, especially on beers (Chollet *et al.*, 2011); however, it is yet to be established which method is the best to use in order to investigate wine style differences and to explain consumer preference.

These two methodologies will force the panellists to use different cognitive processes during sensory evaluation. Sensory profiling tests, such as QDA, is assumed to be a bottom-up cognitive evaluation process, as panellists are trained to make analytical judgements about the intensities of the product's sensorial characteristics (Parr *et al.*, 2010). On the other hand the classification method, such as a sorting task, enhances the panellists focus on the holistic or global perception for a group of similar products (Parr *et al.*, 2010) and according to Dalton (2000) and Parr *et al.* (2003), this implicates higher-order cognitive processes, i.e. top-down evaluations, which will reflect a panellist's level of experience or expertise. Which of these two methods is therefore most important to investigate? Due to the fact that consumers are the end-users of wine it is important to evaluate the method that they use during cognitive assessment of the wines. Consumers often sort products together according to similarity and seldom focus on individual aspects of a product. The sorting task is a natural and everyday exercise for consumers as it does not require a quantitative response (Lelièvre *et al.*, 2008), which is associated with bottom-up cognitive processes such as used during conventional profiling.

Various sensory research and product profiling methods are therefore available for researchers in order to investigate product sensory profiles, product similarities, as well as panel perceptual comparisons for example experts versus consumers versus trained assessors, and to determine consumer preferences and explain drivers of liking for specific products.

### **3.5 Introductory review of analysis techniques relating to the profiling, classification and preference drivers of Chenin blanc wine styles**

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The following section explores the various analysis techniques, univariate and multivariate statistics, relating to the profiling, classification and preference drivers of the various Chenin blanc wine styles. Specific attention is given to techniques used during QDA and sorting method as well as the preference analysis methods.

#### **3.5.1 Univariate statistics (descriptive analyses)**

##### **3.5.1.1 Mean, median and mode parameters**

The mean; median and mode values of a dataset are also important during sensory statistical analysis (Lawless and Heymann, 2010:475). The mean of the dataset, i.e. average, represents the data set's central value and is often referred to in data sets that follow a normal distribution, i.e. for symmetrical data distributions. The median or 50<sup>th</sup> percentile, on the other hand, is used to represent the centre of non-symmetrical data distributions and is therefore often used in non-parametric tests. The median is simply the value right in the middle between the highest and the lowest values of the data set. In terms of categorical data, the mode is the most frequently observed value in the entire dataset.

##### **3.5.1.2 Standard deviation and variation**

Another way to describe the dataset is to evaluate what the amount of difference or variability is between observations over the entire dataset. The amount of difference between an observed

value and the central value (which is often the mean) of the dataset is known as the standard error or the standard deviation (Eq 1).

$$s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}} \quad (1)$$

Where  $s$  = standard deviation/error;  $n$  = number of samples;  $x_i$  = sample number  $i$ ;  $\bar{x}$  = the sample mean value.

The variance of a specific sample can therefore be expressed as the square of the standard deviation ( $s^2$ ). The coefficient of variation (CV), which is expressed as a percentage value, is a useful statistical parameter that can be used to indicate how accurate the measurements were between various replication measurements of a specific sample (Eq 2).

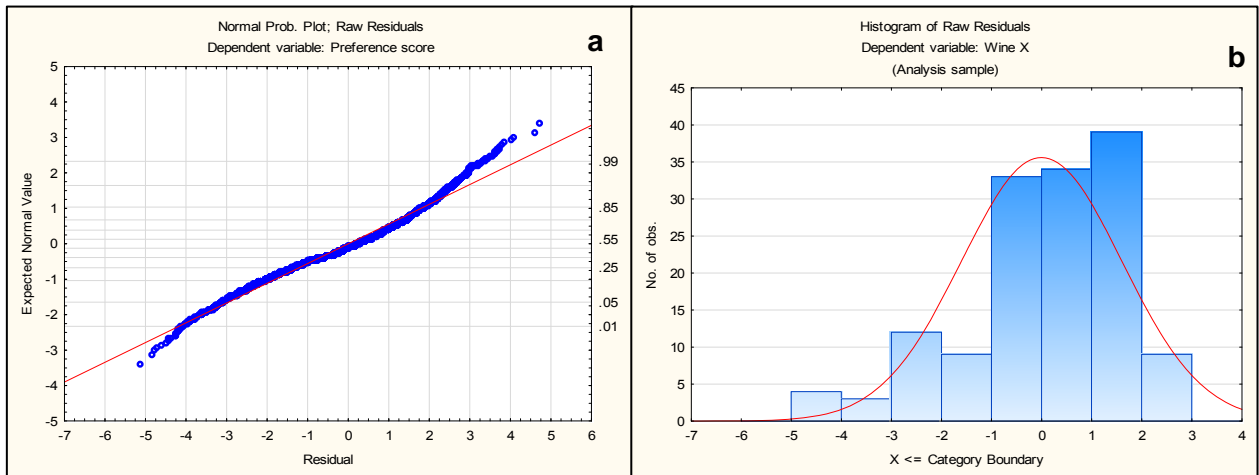
$$CV(\%) = 100 \frac{s}{\bar{x}} \quad (2)$$

Where  $CV$  = the coefficient of variation;  $s$  = the standard deviation/error;  $\bar{x}$  = the sample mean value.

Often assumptions of homogeneous variances are made in terms of the variances within each level of treatment or group. Therefore the null hypothesis states that the variances within each treatment level or group are the same. In order to test this assumption, Levine's test for homogeneity is used. When a probability value of larger than 5% is obtained for this test ( $p > 0.05$ ) the null hypothesis can be accepted that the variances in each treatment level or group are homogeneous.

### 3.5.1.3 Data distribution (population statistics)

A data distribution can be described as set of data points that range between a maximum and a minimum value. The data distribution obtained from a sample set used during an experiment is typically expected to resemble the true population data distribution; however, due to uncontrollable conditions a certain amount of error can result in the experimental data distribution which causes variations in the data (Lawless and Heymann, 2010:475). Most statistical analyses (parametric tests) are conducted with the assumption that the data follows a normal distribution. The normal distribution can be described as a bell-shaped curve, i.e. the normal distribution curve, (see Fig. 2.4) and is often illustrated by histograms which represent the number of observations for each value interval of a data set around a central, mean value (Lawless and Heymann, 2010:476). The normal distribution curve can also be described by the standard deviations from the central mean value of the dataset (Lawless and Heymann, 2010:477). Normal probability plots of the raw residuals can also be used to inspect whether a sample distribution is normal. Normality on these plots is typically observed when data points form a straight line on the plot (see Fig. 2.4). One can also easily identify possible outliers on a normal probability plot. Due to the fact that that wine sensory data are complex, one often do not obtain a normal distribution of the data and can therefore make use of non-parametric tests which do not require normal data distributions.



**Figure 2.4:** Normal data distributions as indicated by (a) a straight line on a normal probability plot or (b) a symmetric bell-curved shape on a histogram (Own data).

### 3.5.1.4 Analysis of variance (ANOVA)

Analysis of variance (ANOVA) is generally used for a data set follows a normal distribution, in order to determine whether there is a significant difference between two or more products/product groups (Lawless and Heymann, 2010:508). When only two products/samples are compared to one another the student t-test can be used to determine if there is any difference between the two products/samples (O'Mahoney, 1986). Two-way ANOVA is used for a complete block experiment data analysis, i.e. when all panellists evaluate and rate all products during all of the replication tests (Lawless and Heymann, 2010:516). This means that each score value is a function of the treatment effect, the panellist effect, the replication effect, the error in the data and also the interactions (Lawless and Heymann, 2010:517). ANOVA is therefore used to investigate the null-hypothesis that there is no difference between means of the various groups, i.e. that all the group means are the same. Generally an F-test (see Eq 8) is used to investigate whether there is a significant difference between two or more groups. This is done by comparing the means of two or more products when scaled data are obtained (Lawless and Heymann, 2010:507). Typically in QDA this is univariate statistical method is used when investigating what the effects of different treatments are on the sensorial perceptions of the product as perceived by a panel of judges. In this particular study it is important to investigate if there are any perceived sensorial differences between various Chenin blanc wine styles which could also influence different preference ratings of a group of consumers. The total amount of variance ( $SS^2_{total}$ ) consists out of variance between groups ( $SS^2_{Between}$ ) and the variance within groups or the error variance ( $SS^2_{Within}$ ) (Eq 3-7).

$$SS^2_{total} = SS^2_{Between} - SS^2_{Within} \quad (3)$$

$$SS^2_{total} = \sum_{j=1}^q \sum_{i=1}^{n_j} (y_{ij} - \bar{y}_{total})^2 \quad (4)$$

$$SS^2_{Between} = \sum_{j=1}^q n_j (\bar{y}_j - \bar{y}_{total})^2 \quad \text{and} \quad \bar{y}_j = \frac{1}{n_j} \sum_{i=1}^{n_j} y_{ij} \quad (5)$$



$$SS_{Within}^2 = \sum_{j=1}^q \sum_{i=1}^{n_j} (y_{ij} - \bar{y}_j)^2 \tag{6}$$

$$\bar{y}_{total} = \frac{1}{n} \sum_{j=1}^q \sum_{i=1}^{n_j} y_{ij} \tag{7}$$

Where  $q$  = number of groups;  $n_j$  = the number of replications per group  $j$ ;  $n$  = total number of measurements.

$$F = \frac{\frac{SS_{fact}^2}{(q-1)}}{\frac{SS_{Within}^2}{(n-q)}} \tag{8}$$

In the F-test the estimated F-value is compared to the critical F-value (i.e.  $F_{crit}$ ) at a specific significance level of 5%. When the estimated F-value is larger than the  $F_{crit}$  (i.e.  $>1$ ) the null hypothesis that the group means are the same can be rejected. In other words, there is a significant difference between the groups. The probability test which accompanies the F-test is usually conducted at a 95% confidence level, therefore when the chances that the F-test is false are more than 5% ( $p > 0.05$ ) the results of the F-test will be rejected (i.e. there is no difference between the groups).

**Table 2.7:** Example of a one-way ANOVA: difference between male and female preferences for a specific wine style (Own data)

	dF <sup>a</sup>	SS <sup>b</sup>	MS <sup>c</sup>	F	p
Intercept	1	4991.752	4991.752	1917.861	0.000000
A1 gender	1	2.563	2.563	0.985	0.322677
Error	146	380.005	2.603		
Total	147	382.568			

<sup>a</sup>Degrees of freedom; <sup>b</sup>Sum of squares; <sup>c</sup>Mean sum of squares

After ANOVA is completed and a significant difference is found between the groups, i.e. the null hypotheses is rejected, the researcher can further investigate which groups are different and how much different are they from one another. These investigation tests are called multi-comparison tests or post-hoc tests and they are therefore used for planned comparisons between various group means after ANOVA. Examples of post-hoc tests are the Fisher LSD test, the Tukey test and the Bonferroni test. Out of all these tests the Tukey test is the most lenient and the Bonferroni test is the most conservative. Even though the Bonferroni test can be used to obtain reliable results with a small group of two to three groups/treatments, it will often not regard the differences between a large number of groups as significant enough which makes the use of this test often less practical. The Tukey test on the other hand can easily be used to obtain reliable results with a large number of groups; however, there is the risk that false significant differences might be included when a post-hoc test is too lenient. The Fisher LSD test (Eq 9) is quite popular as it can easily be calculated. Unfortunately it should also be used with caution seeing it can include too many comparisons. The means of the groups are then compared with one another and those that differ more than the amount represented by the Fisher LSD value are considered to be significantly different from one another.

$$LSD = t \sqrt{\frac{2MS_{error}}{N}} \quad (9)$$

Where  $MS_{error}$  = error term obtained from the ANOVA;  $n$  = number of panellists;  $t$  = t-value for a two tailed test with the degrees of freedom for the error term.

When a dataset does not, however, follow a normal distribution, certain non-parametric statistics can be used to investigate the differences between different groups or sample means such as the Kruskal-Wallis test. This test transforms the numeric data into ordinal data and is therefore free of conservative assumptions, such as those of the Bonferroni test. However, this method of statistical analysis can also fail to identify some important information due to the data transformation.

### 3.5.1.5 Nonparametric statistics: Pearson's correlation coefficient

In more complex data sets (or with more complex products such as wine) one will often observe that two variables might be related to one another. A change in one of these variables will therefore be accompanied by a change in the other variable at the same time. When the data are not standardised, covariance can be evaluated which indicates the difference in change of both variables in the same manner, i.e. they change together. However, when the datasets of both variables are standardised the Pearson correlation coefficient measure (Blalock, 1979) can be used in order to investigate the association between the two variables (Eq 10). This technique assumes that both variables have at least been measured on interval scales and can be used to evaluate the ratios between the values of the two variables which are independent of specific measurement units. A strong correlation is indicated when the Pearson correlation value ( $r$ ) is closer to 1 or -1; whereas a weak correlation will have an  $r$  which is closer to 0. A positive correlation indicates that both variable values will increase at the same time, whereas a negative correlation indicates that the one variable will increase at the same time that another variable increases. According to Bastian, Collins and Johnson (2010), a medium to large positive correlation can be 0.41 to 0.49 for consumer preferences in terms of their wine and cheese pair preferences.

$$r = \frac{\sum xy - \frac{\sum x \sum y}{n}}{\sqrt{\left[ \sum x^2 - \frac{(\sum x)^2}{n} \right] \left[ \sum y^2 - \frac{(\sum y)^2}{n} \right]}} \quad (10)$$

Where  $r$  = Pearson's correlation coefficient;  $x$  = series of independent variable data points;  $y$  = series of dependent variable data points;  $n$  = total number of data points for the dataset.

## 3.5.2 Multivariate statistics

### 3.5.2.1 Principal component analysis (PCA)

According to Lawless and Heymann (2010:434), PCA can be described as "a multivariate technique that simplifies and describes interrelationships among multiple dependent variables and among objects" (Anderson, 2003; Tabachnik and Fidell, 2006). The main goal of principal component analysis is to reduce the dimensionality of a set of variables, often from three

dimensions to two dimensions, without losing too much information, i.e. variance explained by the data. PCA can be used firstly to determine which dimensions, or principal components, are the most important in a set of variables and thereafter other variables of interest can be plotted into these dominant dimensions. Thereafter one can evaluate the PCA plot for observation clusters which are similar to one another in relation to the dominant dimensions of the PCA plot. PCA can be obtained by using the mean data that the researcher obtained for all the sample set products as measured by all the panellists over all replications. The dataset is then compressed without compromising or losing the information that it contains. PCA typically results in a bi-plot which indicates the various interrelationships between variables and products (Lawless and Heymann, 2010:435). This plot consists out of several principal components (PC's) which represents the linear function of each variable in the dataset. The original data matrix is changed to a score matrix which contains the samples loaded on the PC plane, as well as a loading matrix which contains the transposed dataset's variables which is also projected on the PC plane. Both these matrixes can be presented in scores plots and loadings plots which are two-dimensional plots. When scores are grouped together on the scores plot during QDA with a trained panel, it indicates that these samples appear similar to the trained panel and therefore they have the same sensory properties. When loadings are grouped together on the loading plot during QDA it indicates that these sensorial attributes are closely related to one another. This technique is therefore effective when investigating correlations between various descriptions for a sample set of products (Lawless and Heymann, 2010:435) as well as evaluating how similar or different the products are to one another according to their sensorial properties. When any two variables are located in the same direction as one another they are possibly strongly correlated with one another which means that they refer to the same sensory characteristic (Heymann and Noble, 1989).

### **3.5.2.2 Multidimensional scaling (MDS)**

It was stated by Kohli and Leuthesser (1993) that MDS and its consequential product positioning plots/maps can be used in the place of PCA. MDS can be described as a multivariate statistical technique that analyses the similarity relationships among stimuli or samples in a product set by representing these stimuli as points on a map (Schiffman, Reynolds and Young, 1981; Abdi, 2007). Generally, MDS is performed on the global similarity matrix, i.e. sum of all the individual panellist distance matrices. The distance between two points on the MDS map therefore represents the sensorial difference perceived by the panellists between these two products. In other words if two products were often sorted together their two points will be closer to one another on the MDS map but if they were rarely grouped together they will be situated far from one another on the map. The dimensions of the MDS map explain the difference between the stimuli. This is the first statistical analysis method used to investigate the free sorting task data; however, it does have one serious disadvantage. MDS does not take individual differences or error variations into account for individual panel members as it is constructed on the mean values of the panel group. Therefore one runs the risk of constructing an average map representation that is not similar to each of the individual panellist representations (Lawless *et al.*, 1995).

### **3.5.2.3 DISTATIS**

Even though MDS is effective in terms of indicating how products within a single sample set differ from one another, this technique still does not take into consideration individual panellist variances. A similar data analysis method to MDS called DISTATIS has recently been developed which aimed to resolve this disadvantage of MDS. DISTATIS is derived from STATIS

which is often used to analyse multivariate data (Abdi *et al.*, 2007). Contrarily to the MDS method, DISTATIS takes the individual panellists' sorting data configurations and their individual error variances into account as well, as it is not constructed from a mean configuration that represents the entire panel's individual configurations. Furthermore, DISTATIS can be performed directly on individual distance matrices instead of the global similarity matrix (Abdi *et al.*, 2005, 2007) which also simplifies the analysis process, i.e. a global similarity matrix does not have to be constructed first in order to obtain the MDS map. According to Chollet *et al.* (2011), DISTATIS can be defined as a three-way generalisation of classical multidimensional scaling and like MDS it provides a map of the products. This compromise map therefore manages to integrate the individual panellists' distance matrices in the most efficient way in order to eliminate the effect of individual panellist error variance. Similar to MDS the obtained compromise map from DISTATIS also indicates the similarity between two product points in terms of their proximity relative to one another. DISTATIS has an additional advantage as it can be used to effectively analyse and compare various panels with one another in terms of their sorting data in order to inspect whether there is any consensus between various panels for the same product sample set.

#### **3.5.2.4 Correspondence analysis (CA)**

This multivariate analysis method is commonly used as an exploratory technique to represent complex frequency tables, often two-way frequency crosstabulation tables, in simplified, low-dimensional plots. CA can therefore be described as analyses of two-way or multi-way tables with the correspondence measures between rows and columns of the tables. This is done by firstly standardising the frequencies in the crosstabulation table, i.e. the sum of all relative frequencies in the cells adds up to 1. Ultimately these relative frequencies are represented in a low-dimensional space in terms of the distances between the individual rows and/or columns. Care must however, be taken when interpreting the results of this plot as it is merely an exploratory technique and no statistical significance tests can be used appropriately to report the associations between row and column variables. However, these CA plots can be used to give a general view of the general associations that can be expected between various selected variables. The CA plot can be interpreted as a typical bi-plot. The first dimension of the CA plot will explain the largest percentage of inertia, i.e. this dimension explains the majority of variations observed between the relative frequencies' patterns in the rows and the columns of the crosstabulation table. It can be established how the various row and column variables characterise both dimensions in order to establish the relative associations that can be expected between column and row variables according to their positions in the first dimension. The table of columns' and rows' relative frequencies can also be used, together with the CA plot to interpret the results.

#### **3.5.2.5 Preference mapping**

Preference mapping is often used to investigate the drivers of liking for a specific sample set. The preference map is therefore a single plot which often contains both consumer hedonic information as well as the descriptive sensory information of the products, often obtained from QDA, and it illustrates the relationships between these two datasets.

There are generally two types of preference mapping techniques: internal preference mapping and external preference mapping. Both these techniques are based on the same raw data although they offer different perspectives in terms of the result interpretation. In essence the internal preference map is a PCA on the consumer preference data and regressions are made of the first two PC's on the descriptive data obtained from QDA. During external

preference mapping a PCA is obtained of the descriptive data and the first two PC's of the consumer preference data are then regressed on the descriptive data. In principal, both these preference mapping techniques can be considered as PCA regressions. During internal preference analysis one only has to use preference data for a sample set gathered from a group of consumers which will therefore capture more of the consumer understanding (Kleef, Trijp and Luning, 2006). According to Greenhoff and MacFie (1994), internal preference mapping only reflects preference data for a specific sample set of products and can be associated to specific consumer segments. However, during external preference analysis one typically regress descriptive data onto the preference data obtained from consumer groups and therefore captures more of the product understanding. External preference mapping, or PREFMAP, consists of numerous regression models: regressing the consumer preferences unto the first two principal components of a PCA plot of the product sensory characteristics, which is typically obtained from QDA. Therefore the main aim of preference mapping is to comprehend and describe how the sensory characteristics of a product sample set can influence a consumer's preference. Both these analysis methods will therefore give an indication as to what the drivers of liking for consumers where in terms of the various products, but the external preference map (PREFMAP) can indicate the identities of the sensory characteristics that seem to drive consumer liking for various products within a specific sample set. Both these techniques can therefore be used in order to investigate underlying dimensions that are believed to drive consumer preferences and choices (Kleef, Trijp and Luning, 2006). The relevance of preference analysis is two-fold, according to Kleef, Trijp and Luning (2006), who suggests that food technologists will often be the end-users of external analysis results for product development, whereas internal preference analysis results are important for marketers in terms of competitive product positioning and new product creativity.

#### **3.5.2.6 Partial least squares regression (PLS)**

Another method to investigate the consumer preferences for a specific product sample set is to make use of PLS otherwise known as projection to latent structure. This multivariate analysis method, which is constructed in a similar method than PCA, can be regarded as a substitute for multiple regressions, particularly when the data set contains large number of predictor variables. This method can be used to create a plot which is similar to the external preference map (PREFMAP) as it combines the product matrix with the consumer matrix, which relates to the specific product matrix (Lawless and Heymann, 2010:445). Internal PLS can also be obtained, similar to the internal preference maps by conducting a PLS on the consumer preference data and thereafter regressing the descriptive data, usually obtained from QDA, on to the preference data. The PLS method therefore finds the correlation between a set of x-variables for example descriptive sensorial data of a sample set obtained from QDA, and a set of y-variables for example preferences scores for the sample set obtained from a consumer panel. If a strong correlation is found between these two variable sets the PLS can be used to predict y values, preference scores, observed for specific x values, descriptive sensorial data, for unknown samples.

#### **3.5.2.7 Consensus analyses: Rv-coefficient analyses**

It is often necessary to compare two different configurations with one another in order to identify whether they both deliver the same results (i.e. to measure the level of agreement or consensus between them). According to Escoufier (1970, 1973), the Rv-coefficient can be used to measure this level of similarity between two different configurations. Escoufier (1973) defined the Rv-coefficient to be "a similarity coefficient between positive semi-definite matrices". The stronger

the Rv-coefficient, closer to 1, obtained between two linear multivariate configurations, the more similar the results are from these two configurations. A weak Rv-coefficient, closer to 0, indicates that two configurations are less similar to one another and therefore there is less confidence that they can both be used to obtain the same information/results. According Faye *et al.* (2004) an Rv-value of 0.77 can be considered as good agreement between two configurations, however, Tang and Heymann (2002) found that Rv = 0.68 is a good agreement indicator. As a basis of comparison an Rv-value of 0.7 is considered to be a good level of agreement between two configurations (Cartier *et al.*, 2006). The Rv-coefficient therefore compares two configuration matrices with one another (Eq 11).

$$RV(X, Y) = \frac{tr(S_{XY}S_{YX})}{\sqrt{tr(S_{XX}^2)tr(S_{YY}^2)}} \quad (11)$$

Where  $W_X$  and  $W_Y$  = the matrices of the inner products of respectively X and Y;  $S_{XX}$  and  $S_{YY}$  = the empirical covariance matrices of respectively X and Y; and  $S_{XY}$  = the empirical covariance between X and Y.

### **3.6 Descriptive analyses: quantitative descriptive analyses (QDA)**

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Descriptive analysis tests involve the processes of identifying, describing and quantifying the sensory differences between various samples within a sample set with the use of a professional trained panel. This technique known as QDA is typically used for describing products and differences between products with the advantage that it describes the properties of a product in a language that is directly relevant for people's perception (Næs *et al.*, 2010:20). A small panel of between 8 to 12 people (Lawless and Heymann, 2010:227) are intensively trained for a specific product category and they are expected to work like analytical instruments (Næs *et al.*, 2010:20; Nestrud and Lawless, 2008). These panellists are only used to obtain objective qualitative and/or quantitative sensory information about a specific product or sample set; and they are not used to obtain preference information (Lawless and Heymann, 2010:227). This standard sensory profiling method has been used for years (since 1974) to define the sensory attributes for a specific product set and has proven to deliver reliable and precise results (Chollet *et al.*, 2011).

There are various descriptive analysis tests such as the Flavor Profile® method (Caul, 1957); the Texture Profile method (Brandt *et al.*, 1963, Szczesniak *et al.*, 1975); Quantitative Descriptive Analysis® or QDA® (Stone and Sidel, 2004); the Spectrum Method® (Meilgaard, Civille and Carr, 2006) and other hybrid versions of these aforementioned descriptive analysis techniques can also be used by researchers (Einstein, 1991). These techniques are classified as the most comprehensive and informative sensory methods in the history of sensory science (Lawless and Heymann, 2010:7). Due to the fact that the small panel are so well trained to function like an analytical unit, the researcher can expect much less variance between their individual results which justifies this use of fewer panellists for the test. The intensive training period will therefore significantly lower the error variance which is expected when using so few panellists, whilst maintaining the statistical power and test sensitivity (Lawless and Heymann, 2010:7). The opposite is true for preference tests where consumers, who are often naïve, are used to obtain liking scales for a product sample set. Due to the fact that that these consumers seldom provide similar data a large number of consumers (75 to 150) must be used which will consequently minimise the amount of error variance in the data.

### 3.6.1 The QDA procedure

The QDA panellists are typically recruited for their sensorial classification abilities prior to the training phase of QDA. Even though the number of panel members is relatively small, they are required to commit to the training procedures which could take months. In particular, language development and calibration are likely to require a long time to develop. In fact, these two steps can last from a few weeks to several months (Chollet *et al.*, 2011). This factor is a major disadvantage of QDA not only because panellist commitment might be troublesome over a long period of time, but generally this is an expensive sensory profiling method as it requires many training sessions as well as large wine volumes needed for training; and finally time also needs to be included for the data capturing phases. A list of attributes is firstly generated for the specific product set. Thereafter physical or chemical reference standards are selected which acts as the protocols for the selected attribute terms during the training period. Concept formation is a critical step during QDA training where the panellists are all trained to identify a specific sensory attribute and they must be able to ultimately associate this sensory attribute with a single word or phrase. According to Lawless and Heymann (2010:228), it is extremely important that the panellists are exposed to a large variety of standards in order for them to resolve any perceptual uncertainties and to reach an agreement with regards to the specific attributes that are appropriate for the selected product sample set. After the concept formation and verbalisation training, assessors are trained to rate all the applicable attribute intensities on an intensity line scale (Chollet *et al.*, 2011). The panel is thereafter intensely trained to profile the specific product sample set according to the generated descriptive list, via the use of the intensity scales. Panellists' performance can thereafter be checked regularly in terms of their repeatability, classification ability and agreement between each other. The intensity scales can either be represented as various numberings with an upper and a lower limit or as a structured or unstructured line scale which can be presented on a computer screen or on paper ballots (Næs *et al.*, 2010:21). The order of the products in the final profiling test phase is randomised per panellist in order to prevent any first-order effect to influence the panellist's perception of a specific sample.

Even though QDA is the most trusted sensory profiling technique and has been used since 1974, it is unfortunately quite expensive and time-consuming. Consequently most industries can not routinely use this technique (Kemp, Hollowood and Hort, 2009; Meilgaard, Civille and Carr, 2006; Stone and Sidel, 2004). Researchers often use QDA to describe wine attributes and the intensities at which these attributes can be perceived in specific wine samples. Various new methods have been developed during the past few years aimed to replace QDA as the industry often needs results fast and at a more cost-efficient manner (Guinard *et al.*, 2001).

### 3.6.2 Statistical analysis of QDA data

The quantitative data obtained by QDA for each attribute of each product are generally analysed using parametric statistics such as analysis of variance (2-way ANOVA: panellist, product), whereas the relationships between attributes are often described with multivariate methods such as PCA. For further detail see sections 3.5.1.5 Analysis of variance (ANOVA); and 3.5.2.1 Principal component analysis (PCA).

The final PCA plot can be used to indicate possible various clusters of the products within the sample set. Furthermore, one can use QDA descriptive data in combination with consumer preference data in order to explain the drivers of liking for specific products within the sample set via external preference mapping. Even though the QDA panel is highly trained and expected to act as an analytical unit, panellists may commonly make use of various parts of the intensity

scales when quantifying the various sensory descriptors for a sample. According to Lawless and Heymann (2010:235), this is already taken into consideration by sensory analysts who will mainly focus on the relative distances among product ratings per attribute in order to determine whether there are significant differences. Statistical tests such as the t-test or ANOVA can be used to analyse these relative differences in measurements for a specific attribute between different products as obtained from the panellists (Lawless and Heymann, 2010:235). However, Lawless and Heymann (2010:235) caution against the use of QDA intensity ratings as absolute measurements as it indicates relative differences between samples in terms of specific attributes. The PCA plot should therefore be evaluated with caution. The use of more than one sample and more than one reference product can therefore help panellists during their quantification of descriptors (Lawless and Heymann, 2010:236). In the current study two reference products will be included, during QDA, with their quantified descriptor details as well as maximum intensities for each descriptor in order to standardise panellists' scaling methods.

### **3.6.3 Advantages of QDA**

According to Lawless and Heymann, 2010:227, descriptive analysis methods such as QDA are considered to be the most sophisticated tools in sensory science. Not only does QDA enable a sensory researcher to obtain objective, quantified and qualified intensity information which can easily be statistically analysed, but it can be used both in food and non-food fields of research (Lawless and Heymann, 2010:228). For marketing and strategic product positioning purposes, QDA can be used to view the competitive positioning of other products in the same market segment than a specific product to review where new development opportunities might be found. Furthermore, it can be used to optimise ingredients or product development purposes in order to suit a specific target market segment's sensory preferences. It can also be used for quality control purposes to rate the index of undesirable sensorial factors; to investigate consumer complaints about a specific product; or to investigate what the sensory components are that contribute to a product failure (Lawless and Heymann, 2010:228). Furthermore, the QDA method remains to be one of the most reliable and consistent sensory tools (Lawless and Heymann, 2010:227) which have been used in countless of studies on a wide variety of different food as well as non-food products. Due to the fact that panellists are intensively trained to identify differences in specific sensorial attribute intensities, one can easily use QDA on a product sample set that are similar to one another. Furthermore, this technique is relatively easy to adapt in order to fit a specific study's objectives (Lawless and Heymann, 2010:236). Lawless and Heymann (2010:236) continued to mention the following advantages of QDA: independent judgements are formed by panellists during testing, statistical analysis and representation of data are relatively easy and product descriptions are generally based on consumer language descriptions.

### **3.6.4 Disadvantages of QDA**

Aside from the fact that QDA takes a long time and it is expensive for industries to apply on a regular basis, there are other disadvantages that make the use of QDA as a sensory profiling method for product sample sets less desirable. Firstly as the vocabulary generated by the panel for a given product type is specific to the sample set one cannot generalise the findings to other products which falls outside of the specific product sample set. Therefore different panels must be trained for different product types and this process can easily become too financially strenuous for many companies to commit to (Bitnes *et al.*, 2007). Another way to generalise to other products is to re-train the same panel on a different product sample set. However, once



again a lot of training time and equipment is needed to re-train a panel which will also result in a long time-delay and high costs (Chollet *et al.*, 2011). Secondly, this method is completely based on language and this creates potential comprehension and agreement problems within the panel (Chollet *et al.*, 2011). Lawless and Heymann (2010:237) also cited a common disadvantage namely the fact that panellists generally use the attribute intensity scales differently which results in relative differences between products instead of absolute differences. This can be corrected by continuously checking the panel for consistency and consensus during the training phase with the use of specific software packages such as *PanelCheck®*, V1.4.0, *NOFIMA*, Norway which is a freeware R-based program (Lawless and Heymann, 2010:244). This program can be downloaded free of charge from <http://www.panelcheck.com/> (Tomic *et al.*, 2007).

In an attempt to sidestep the time-consuming, labour intensive and expensive method of conventional profiling (QDA) some other profiling methods have been developed to replace this technique such as: free choice profiling. In 1984, Williams and Langron formulated a completely new and different method that aims to substitute QDA. This new technique (i.e. free choice profiling) does not require the assessors to be screened or trained as they are free to describe and evaluate the products in their own way (Marshall and Kirby, 1988; Oreskovich, Klein and Sutherland, 1991). Flash profiling was thereafter also invented (Dairou and Sieffermann, 2002) which is a combination of free choice profiling and a comparative evaluation of the whole product set. Projective mapping (or Napping®) was also developed. Risvik *et al.* (1994; 1997) described the use of projective mapping which they developed in parallel with Napping® in the 1980's and 1990's (Kennedy and Heymann, 2009; Risvik, McEwan and Rødbotten, 1997; Risvik *et al.*, 1994; Pagès, 2005). Finally a cost and time efficient method called the free sorting task was also developed in the late 1960's and early 1970's and was generally used for studies of word meanings by Rosenberg and Kim (1975) and Rosenberg *et al.* (1968).

The question therefore arises whether QDA is an effective method to describe the sensory profile of different wine styles, such as the various Chenin blanc wine styles, and whether the method can also be used to effectively identify these various wine style clusters.

### **3.7 Classification testing: the sorting task**

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As opposed to profiling sensory methods such as QDA there are also classification sensory methods. The sorting method can be used as a classification test to detect small differences between products in a sample set. Discrimination tests are suitable for testing with either consumers or trained sensory panellists (Næs *et al.*, 2010:21). According to Lawless and Heymann (2010:5), this is the simplest of tests as it aims to answer the question whether there is any significant difference between the perceptions for two different samples/products. Examples of classification tests are the triangle test (Helm and Trolle, 1946; Peryam and Swartz, 1950); duo-trio (Peryam and Swartz, 1950) and the paired comparison tests (Lawless and Heymann, 2010:5). These classification tests all generally make use of 25 to 40 participants who passed pre-screening tests to ensure that they have a satisfying level of sensory acuity. Not only are these tests generally simplistic in terms of practicality, but the data analysis techniques (i.e. statistics on frequencies and/or proportions) are fairly simple to conduct and to interpret.

The traditional sorting tests involves a panel of about 20 participants (Chollet *et al.*, 2011; Lawless and Heymann, 2010:459) who receive all the samples in a test set at once and they are asked to discriminate between these samples in terms of their similarities by sorting the samples into two groups (Lawless and Heymann, 2010:87). According to last-mentioned

authors two different sorting tasks have often been used in the past to discriminate between various samples: the Two-Out-of-Five test and the Harris-Kalmus test. However, a new sorting method was developed in the 1970's for perception word meaning studies (Lawless and Heymann, 2010:459) which is known as the free sorting task. In sensory science this sorting method has proved to be an efficient and economical sensory classification method (Abdi *et al.*, 2007) which has been used quite extensively for various product types such as: basic tastes and salts (Lim and Lawless, 2005); fragrances/odorants (Lawless, 1989); vanilla beans (Heymann, 1994); oxidation odors (MacRae *et al.*, 1992); cheeses (Lawless, Sheng, and Knoop, 1995); mouth feel words (Bertino and Lawless, 1993); ice cream (Wright, 1995); drinking waters (Falahee and MacRae, 1995; Falahee and MacRae, 1997); grape jellies (Tang and Heymann, 2002), snack bars (King *et al.*, 1998) beers (Chollet and Valentin, 2001); red and white wines (Ballester *et al.*, 2005; Piombino *et al.*, 2004; Green *et al.*, 2011); and yoghurts (Saint-Eve, Paa`i Kora, and Martin, 2004). Not only has this method been used on food products in order to determinate sensory differences but it was also used on non-food products such as automotive fabrics (Giboreau *et al.*, 2001; Picard *et al.*, 2003); cloth fabrics (Soufflet, Calonniera, and Dacremont, 2004); plastic pieces (Faye *et al.*, 2004); tactile surface texture (Hollins *et al.*, 1993); and musical timbres (McAdams *et al.*, 1995). The sorting task can therefore substitute QDA in order to profile products which save the industry more time and money in the long run. Consumer panels were also proven to execute the sorting technique well in comparison to other trained panels.

The sorting methodology is the most recognised discriminating sensory technique and can be defined as a global sensory evaluation approach which assesses the main sensory dimensions of a specific product sample set (Maitre *et al.*, 2010). According to Chollet *et al.* (2011), this method is based on categorisation which is a natural cognitive process routinely used in everyday life by all consumers and it does not require a quantitative response, in relation to conventional profiling which requires quantitative data to be generated by the trained panel. Traditionally the sorting task is a free method which means that the panellists are free to use their own similarity classification criteria in order to separate products into groups as they perceive them to be similar. The only instruction is then that the sorting must be done in such a way that the products placed within the same group are homogeneous. During this process the type of panel used will usually conduct the sorting process differently according to the expertise level: i.e. professionals use their technical knowledge and often use grape variety as their main criterion (Ballester *et al.*, 2008). Consumers can be expected to focus more simplistically on obvious differences between samples and sort according to clear similarities. However, one can also use the sorting method to investigate differences within the same grape variety. According to Perrin (2008), these investigations can be linked to perceived typicality ratings. Not only can sorting dimensions be linked to typicality assessment, but it can also be correlated to sensory dimensions (Parr *et al.*, 2010) by adding a verbalisation process to the task which aims to describe the various sorted groups according to perceived sensory characteristics.

Recently the sorting task has been evaluated numerous times in terms of how it compares to QDA and whether it can successfully replace this method (Lelièvre *et al.*, 2008, 2009; blancher *et al.*, 2007; Cartier *et al.*, 2006; Faye *et al.*, 2004, 2006; Saint-Eve *et al.*, 2004; Soufflet, Calonnier and Dacremont, 2004; Tang and Heymann, 2002).

It has also been found that the sorting task can be used to successfully compare different panel expertise levels with one another and to investigate what the impact is of expertise on the ability to discriminate between various products within a specific sample set. According to literature the sorting task was successfully used to compare the olfactory perception abilities of experts versus novices of perfume (Beguin, 1993) and of wine (Chollet and Valentin, 2001).

Several other researchers also found that they could successfully use untrained panellists, similarly to trained panellists, to obtain accurate MDS maps which are similar to the PCA maps obtained during conventional profiling, in order to interpret the product positions relative to the descriptors associated to them (during the verbalisation process) (Lawless and Glatter, 1990; Chollet *et al.*, 2011; Faye *et al.*, 2004; Lim and Lawless, 2005). The only difference between trained and untrained panellists is that untrained panellists typically generates less accurate and precise descriptive terms than trained panellists (Chollet and Valentin, 2001; Chollet *et al.*, 2011). In their research to investigate the impact of expertise/training on sorting results, Cartier *et al.* (2006) found that similar product spatial maps can be obtained from trained and untrained panellists during the sorting task. These maps also compared well to PCA maps (from QDA).

### 3.7.1 The free sorting procedure

One of the most important advantages of the free sorting procedure is the fact that it is simple to be conducted by the analyst and to be understood by the panellists. During this procedure panellists will receive all the product samples within the sample set at once, in randomised order (to prevent first-order biasness or a carry-over effect). Thereafter they are only asked to group those products together that they perceive to be similar (Lawless and Heymann, 2010:459). The groups should therefore be homogenous and coherent (Chollet *et al.*, 2011). An additional step can thereafter be added by asking the panellists to describe each group of products that they have sorted together. It is important that provision is made to prevent a carry-over effect due to some stronger wines that diminishes the perception of more delicate wines. This is prevented by allowing enough rest-periods between tastings and by cleansing pallets with water/biscuits before tasting a following product.

Assessors are instructed to taste and evaluate each sample one at a time and to arrange the products in terms of their perceived similarities/dissimilarities into various groups (Chollet *et al.*, 2011). Chollet *et al.*, (2011) did not give the assessors any criteria to perform the sorting task. Assessors were free to make as many groups as they wanted and to put as many beers as they wanted in each group. One of the aspects of the sorting task that needs to be investigated is the effect of sorting instructions on the panel's classification results. Do the definitions and concepts of a specific sorting groups influence the way that panellists perceive and sort the products differently from when they are not aware of the classes or concepts?

According to literature one can obtain similar product maps with the sorting task and the conventional profile (QDA) (Chollet *et al.*, 2011). This result is consistent with the works of Blancher *et al.*, 2007; Cartier *et al.*, 2006; Faye *et al.*, 2004, 2006; Saint-Eve *et al.*, 2004; Tang and Heymann, 2002. However, when evaluating the captured descriptive information of each method it has been found that QDA tends to provide more precise and more easily interpretable descriptions than those obtained from the sorting task's verbalisation phase (Chollet *et al.*, 2011). The sorting task provides global information about basic, salient and common characteristics Chollet *et al.* (2011).

The addition of a descriptor list has no significant influence on the sorting outcome (Chollet *et al.*, 2011) which means that the outcome is independent from a guidance list. These results are similar to those sorting results obtained from different product types (Blancher *et al.*, 2007; Cartier *et al.*, 2006; Faye *et al.*, 2004, 2006; Saint Eve, Paci-Kora and Martin, 2004; Tang and Heymann, 2002 ).

In summary Chollet *et al.* (2011) found the following in their research on the sorting technique: untrained assessors were able to perform the sorting task as well as trained assessors but trained assessors tended to use more groups than novices. Furthermore, they

found that all the different novice (consumer) panels provided similar results, which proved that the sorting task with novices can provide stable results. They also found that instructions on the number of groups that should be made did not influence the sorting results. These researchers therefore proved that various trained and untrained assessors can spontaneously form the expected types of groupings (Chollet *et al.*, 2011). This means that the differences within their specific set of beer samples were obvious enough for both panels to identify correctly without being briefed on how their groups should be sorted. However, results of Lelièvre (2010) showed that when assessors were asked to perform a free sorting task and a binary sorting task (where one group had to be sorted according to Trappist beers and another group had to be sorted according to non-Trappist beers) different results were obtained than Chollet *et al.* (2011). In the free sorting task, trained and untrained participants tended to split the Trappist and non-Trappist beers whereas no such separation was observed in the binary sorting task (Lelièvre, 2010). These results suggest that, in the free sorting task, assessors relied mostly on what they truly perceived in the products whereas during the binary sorting they relied heavily on the concepts of Trappist versus non-Trappist beers which seemed to be somewhat fuzzy for these assessors (Chollet *et al.*, 2011). When providing the panel with sorting instructions, it is therefore important that clear definitions for the grouping concepts are created. Furthermore, Chollet *et al.* (2011) found that even though trained assessors outperformed untrained assessors in discriminative and memory tasks it did not prevent untrained assessors from performing the sorting tasks efficiently. Finally they also found that individual panellist agreement (especially the trained panel) was relatively high for the sorting task. Chollet *et al.* (2011) therefore proved that the sorting task is a robust sensory tool similar to findings of other researchers who used different products.

Different studies contradict one another in terms of being able to use consumers to perform the sorting and verbalisation task similarly to experts or trained panellists (Lelièvre *et al.*, 2008 with beer versus Faye *et al.*, 2006, 2008 with leather and plastic pieces). This contradiction is mainly due to the fact that the samples have different sensorial complexities. Non-food products such as plastic pieces and leather can only be evaluated on sight and touch and little evaluation can be done in terms of aroma. On the other hand, food-products such as beer and wine contain complex compositions of various aroma and flavour properties that can also influence one another in terms of how they are perceived by the panellists. Furthermore, wine attributes also change over time. It might still be easy to classify such complex products into various groups according to their global sensorial properties, however, it is much more difficult to specifically describe the individual ortho-nasal and flavour characteristics that contribute to the global flavour and aroma perceptions for the various groupings. Being able to identify and describe individual aroma and flavour properties from a complex mixture of numerous sensorial characteristics requires some experience or training and it can therefore be expected that wine industry experts as well as trained panellists will fair well in the descriptive phase of the sorting task. On the other hand it is expected that untrained or novice wine consumers might have more difficulty in terms of describing their various groupings even though they are able to create similar groupings than expert or trained panellists.

### **3.7.2 The number of products and panellists to be used for sorting task**

In sensory science methods it is extremely important to estimate how many samples can be evaluated by panellists in a single tasting session without causing sensory-fatigue. Wine is a complex and sensorial demanding product and a lot of concentration is needed to evaluate individual sensorial characteristics of the wine's global sensory profile. Due to the fact that that

wine experts are experienced with regards to tasting large numbers of wines on an almost daily basis, they are more suited to evaluate larger sample sets during sensory tests such as sorting. However, novice panellists such as consumers will often become fatigued easily when evaluating too many products in one session or have numerous sessions in one day. The more complex the specific product category is, such as wine and beer, and more similar the products are to one another in the sample set, the less the number of samples should be. According to Chollet *et al.* (2011), the efficiency of the sorting task decreases as the number of beers increases with 20 beers as the maximum number that can be efficiently sorted in one session. However, too few samples seem to decrease the sorting task efficiency as well: sorting tasks performed with 8 beers gave poor results compared to a similar task carried out with 12 beers (Nava Guerra *et al.*, 2004).

As a guideline Chollet *et al.* (2011) advised to use between 9 to 20 products with an optimum number being around 12, depending on the type of product; their degree of similarities; and the alcohol content. In their study on commercial cereals Cartier *et al.* (2006) recommended using between 6 to 15 samples per sorting task to prevent undesirable changes of the cereal's physio-chemical properties such as humidity and structure which can influence the sensory properties. In the case of a single cultivar wine sample set, the differences between the various wine styles need to be carefully considered. The larger the differences between these various wine styles, the larger the product sample set of wines can be, however, if the styles are too close to one another it is wiser to consider using a smaller sample set of wines. As a guideline approximately 10 to 20 products can be used depending on the product type, its stability and its general sensorial complexity in order to obtain effective results (Lawless and Heymann, 2010:459).

With regards to the number of panellists required to perform a successful sorting task Lawless and Heymann (2010:459) and Chollet *et al.* (2011) recommended using 20 untrained panellists. In their study on commercial cereals Cartier *et al.* (2006) used 24 panellists to obtain stable product spatial maps, however, they found that further investigation is needed in terms of how many panellists are optimally needed during the sorting procedure. The use of more panellists than the required will increase research costs unnecessarily.

### 3.7.3 Comparing QDA with sorting

Various researchers evaluated the sorting task in comparison to conventional profiling methods in order to establish whether the same results can be obtained from the sorting method than QDA, which is relatively expensive and takes a long period of time to execute. According to Heymann, (1994); Tang and Heymann, (2002); Faye *et al.*, (2004, 2006); and Saint-Eve *et al.*, (2004), the sorting task results are comparable with those results obtained from QDA or free profiling. The sorting task is also reproducible (Falahee and MacRae, 1997; and Chollet, 2011). In other words MDS configurations obtained from sorting (from panels with various expertise levels) can be easily compared to PCA configurations obtained from QDA (Cartier *et al.*, 2006). However, the descriptions for the product groups were not the same, especially in the case of the untrained consumer panellists. Cartier *et al.* (2006) also found that consistent configurations can be obtained using untrained or trained panellists and that familiarisation with the products did not induce any significant change. In another study, comparing QDA with the sorting task using jellies, Blancher *et al.* (2007) found that a Flash profile (description phase) and the sorting task together provided sensory maps that were similar to those of QDA.

When comparing the sorting method with QDA in Table 2.8 the most obvious difference is that the sorting method obtains global sensory evaluation data (Green *et al.*, 2011) from similar

products (i.e. indicates similarities among wines), while QDA is better suited to identify specific attributes of wines and profiling each product separately in detail (i.e. quantify attribute intensities as well). According to some authors (Saint-Eve *et al.*, 2004; Bárcenas, Pérez Elortondo and Albisu, 2003; Chauhan and Harper, 1986), QDA cannot reveal sensorial interactions. Saint Eve, Paci-Kora and Martin, 2004 also found that one of the major downfalls of QDA is that it does not account for complex perceptions or sensory attribute interactions like the sorting method. It mainly accounts for high impact odorants whereas sorting can include the influence of both overall wine aroma and sub-threshold odorants (Green *et al.*, 2011).

**Table 2.8:** Comparison between the conventional profiling method (QDA) and the free sorting task

QDA (Stone <i>et al.</i> , 1974)	Sorting (Chollet <i>et al.</i> , 2011)
ANOVA and PCA plots	MDS/DISTATIS and CA plot
Trained panel (6-12)	Expert/Consumer (20)
Time Consuming	Fast
High costs	Low costs (cost effective)
Training required	No training needed
Complex	Simple/easy to understand
Individual sample sensory description	Group (global) sensory description
Possible groups/classes	Indicates groups/classes
Used to indicate drivers of liking	Not used to indicate drivers of liking
Criteria provided (set descriptive list)	No criteria (use own similarity criteria)

QDA on the other hand is the most commonly used profiling method in sensory science due to its reliability and consistent results (Rodrigue *et al.*, 2000). However, it does have a number of obstacles which caused researchers to question its practicality. The application of QDA is a time-consuming process due to panellist training and the fact that vocabulary development must take place for a specific product sample set. In addition the entire panel must first reach consensus with regards to the meaning of each descriptor and they have to use these descriptors consistently to describe samples (Cartier *et al.*, 2006). This method also forces panellists to come to an agreement which is not a natural when evaluating any product. This could lead to false agreements made amongst panel members and latent attributes go unnoticed. QDA is also a costly procedure as most trained panels are employed and the project's success relies on their commitment. To profile a new product sample set, the panel must be retrained or an entirely new panel must be trained in order to successfully profile the new sample set. Both these solutions will increase the time and cost of the research study.

The sorting method overcomes all of the obstacles presented by traditional QDA (Cartier *et al.*, 2006). It does not require any training of panellists, nor do they have to agree on their verbalisation methods and it also produces little fatigue or boredom (Bijmot and Wedel, 1995). According to Cartier *et al.* (2006), the fact that sorting does not, in comparison to QDA, require any preselection or determination of attributes to be used for sample description will prevent the method from biasing panellists or from overwhelming them with a tedious attribute list. The fact that each panellist is given free reign to decide which criteria to use in order to discriminate between samples (Lawless and Heymann (2010:459) also creates the opportunity for salient discriminating attributes to be discovered which would have been lost during the establishment of attributes and the training phase that forms the basis for QDA procedures. The technique is furthermore suited to be carried out by untrained consumers as well as industry experts as

some studies found that the level of experience or training does not have a significant effect on the groupings made by the panellists (Lawless and Glatter, 1990; Lawless *et al.*, 1995). This technique is therefore not influenced by higher cognitive considerations by panellist of the product sample set (Lawless and Heymann, 2010:460). It is also one of the few sensory evaluation methods that can be used on a large sample set (Piombino *et al.*, 2004) of up to 20 products at a time (Chollet *et al.*, 2011).

Even though the sorting task seems like the ideal substitute for QDA (Cartier *et al.*, 2006), it also has a number of downfalls. It has been suggested that the sorting task, followed by a description, is not well adapted for a precise and reliable description of complex products such as beers but may be an interesting tool to probe assessors' perceptions (Lelièvre *et al.*, 2008). In this aspect QDA still remains the best sensory technique when the analyst wishes to capture precise measures of attribute intensities in various products. Even though consumer panels can be utilised to classify groups of complex food products (such as beer or wine) similarly than an expert panel; it is expected that consumers or novice panellists will tend to under perform in terms of describing their various product groupings. Here the expert panellists' experience will give them the advantage of being able to identify and describe individual sensorial characteristics more easily from the complex global sensory profile of these products. In addition to these shortcomings of the sorting task, the verbalisation phase only takes place after sorting is completed which means that the sorting method can not be primarily viewed as a sensory profiling method. This is due to the fact that the descriptions which have been formulated by the panellists refer to groups of products instead of each individual product. In other words the descriptors were associated directly to a group of similar products instead of associating each attribute to individual products in terms of its perceived intensity. It is therefore clear that the sorting method is specifically formulated for the use to identify homogeneous groups of products within a product sample set and to profile the groups of products instead of individual products itself. Furthermore, one of the great advantages of QDA is its versatility. Apart from profiling individual products in a sample set, it is also regularly used to explain drivers of liking for various wines as a function of the various attributes and their intensity incidences. This is traditionally done by regressing preference data, obtained from a large consumer panel, onto the descriptive data obtained from QDA to create external preference maps (or PREFMAPS). Generally the sorting task is not used to indicate drivers of liking. It might, however, be possible to explain the drivers of liking for various sorted groups in the instructed sorting using analysis of variance (ANOVA) to compare the preference means of the various sorted product groups with one another.

#### **3.7.4 Statistical analyses of sorting data**

For the analysis of sorting data a sensory researcher will typically make use of multi-dimensional scaling (MDS) in order to obtain product positioning maps that are defined according to the consumer panellists' perceptions of similarity and differences between samples in a sample set. The ultimate goal with the sorting task is to use statistical analysis techniques such as MDS or DISTATIS to obtain the structure of the product space and to interpret the underlying dimensions (Chollet *et al.*, 2011). For further details see sections 3.5.2.2 Multidimensional scaling (MDS) and 3.5.2.1 DISTATIS.

MDS analyses the frequency data obtained from the sorting task, i.e. the amount of times two products are grouped together by the panel. Frequency data based on the amount of times products were grouped together according to certain perceived similarities is called derived measures of similarity (Lawless and Heymann, 2010:458). Derived measures of similarity are

generally used to obtain the relative distances between products on a dimensional product positioning map or projection (Lawless and Heymann, 2010:458). The sorting data are captured as distance matrices, indicating which products are different from one another, which can be converted into covariance matrices, indicating which products are grouped together (Abdi and Valentin, 2007). The sum of all the panellists' individual covariance matrixes is a compromise matrix which can be analysed by one of two methods: map representations or the use of clustering/tree representation techniques. The first method namely map representations includes the following methods of analyses: multidimensional scaling analysis (MDS: Schiffman, Reynolds and Young, 1981), DISTATIS (Abdi *et al.*, 2007; Abdi *et al.*, 2005), multiple correspondence analysis (MCA: Takane 1981, 1982; Cadoret, Lê and Pagès, 2009), common components and specific weights analysis (Qannari *et al.*, 2009). The second method consists of clustering methods (Miller, 1969) as well as additive trees (Abdi, 1990).

The two techniques which shall be used specifically in this study are MDS and DISTATIS. These two statistical analysis methods produce projections which are similar to PCA plots, derived from QDA. The sensory analyst can therefore easily compare these various maps to one another. Correspondence analysis or CA plots can also be used evaluate how often one can expect the various significant descriptors to be grouped together with specific wine groups as formed during sorting. Furthermore, the Rv-coefficient can be used to quantify the similarity between two matrices, i.e. to compare two individual panellists' data or two panels' data sets with one another in terms of similarity.

Consumer preference data can also be used in combination with the sorting data in order to investigate possible drivers of liking for specific wine styles. As mentioned, this can be done by establishing the preference means for each of the sorted wine style groups, obtained from DISTATIS, and comparing these means with one another via ANOVA to establish if there are any significant consumer preferences for some of the styles.

There are, however, some precautions that need to be considered when evaluating and interpreting the sorting data. When interpreting MDS plots, there is a risk of oversimplifying the results as some level of subjectivity is included when a sensory analyst interprets the configurations (Lawless and Heymann, 2010:460). According to Lawless and Heymann (2010:460), the researcher can use several methods to improve the reliability of the MDS projections and therefore also the interpretations made by the researcher. Firstly one can make use of various panels and compare their MDS maps to see if similar groups are obtained for the same product sample set. Secondly one can also make use of clustering techniques to identify various groups or categories of products. Furthermore, one can use both MDS and DISTATIS analysis and compare these methods' configurations to see if they are similar to one another which will also improve the reliability and repeatability of the grouping results.

During data encoding the rows and the columns of the individual distance matrices for each panellist are the products. When a panellist grouped two products together a 0 is used to indicate this on the distance matrix. Conversely a 1 on the distance matrix indicates that a panellist did not group two products together (Chollet *et al.*, 2011). Even though the sorting task is a simple and easy-to-perform sensory discriminating method, it also raises several practical and methodological issues that must be explored in terms of classifying and describing various wine styles within a single wine cultivar such as Chenin blanc.

Due to the fact that the current experiment will also compare different groups of panellists (experts versus novice consumers) in terms of how they sort a set of wines; the DISTATIS method will primarily be utilised for this experimental procedure. However, as the additional evaluation the MDS maps can be used to validation the DISTATIS results, these MDS maps will also be investigated in the current study which will improve the reliability of the results.



### 3.8 Affective testing: preference mapping

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Consumer judgement is extremely important and nowadays it is considered in the product's life cycle phases. These phases are product development, market positioning, advertising and communications (Faye *et al.*, 2006). This third type of sensory test, known as affective testing, is aimed at quantifying the degree to which a consumer sample group likes or dislikes a specific product or product group, generally known as hedonic or affective sensory tests (Lawless and Heymann, 2010:7). As stated by Guinard, Uotani and Schlich (2001) the consumer population for any given product is often heterogeneous with regards to their preference ratings. According to Van Trijp and Schifferstein (1995), the main difference between consumer sensory testing and marketing research is that consumer sensory tests primarily focuses on the consumer's degree of liking/disliking of a product due to specific sensory factors alone. Affective testing is generally conducted with the use of blind codes for sensory research. During marketing research the focus shifts to the perception of products with the inclusion of a consumer's knowledge of the brands, price, packaging and so forth. Lawless and Heymann (2010:304) found that the researcher is primarily interested in the liking or acceptability of the product based on sensory aspects of the product in sensory science whereas in marketing research the researcher is typically interested in the purchase intent, cost impact, branding effect, niche market descriptions etc. The ideal will therefore be to combine both sensory and marketing research as a product that is liked will not necessarily be feasible or marketable in the industry. On the other hand, a product with an attractive marketing appeal will not necessarily be liked by the consumer when evaluating its sensorial attributes. Therefore he or she runs the risk of purchase the product due to excellent marketing strategies but ultimately he or she might be disappointed by the sensory profile of the product as it did not meet consumer expectations which can ultimately lead to product failure.

Traditionally there are two types of typical consumer tests: acceptance tests and liking tests (Lawless and Heymann, 2010:304). The difference between these two tests is that liking tests are typically comparison tests, where one product can be liked more than another, whereas acceptance tests can be conducted on single products and the product can either be accepted by the consumer or rejected due to faults or his or her personal dislikes.

The development of the hedonic scale (Jones *et al.*, 1955) insured that one could indicate the degree of liking or disliking for a specific product instead of simply stating whether the consumer liked the product or not. Hedonic in this concept refers to pleasure and it refers to the immediate reaction of consumer due to his or her perception of appearance, taste, aroma, flavour, mouth-feel and texture (Lawless and Heymann, 2010:304). The hedonic scale is a balanced 9-point scale with adverb point labels for liking with a neutral point in the centre of the scale which provides consumers with the option to give a neutral answer, i.e. it prevents a forced choice. According to Lawless and Heymann (2010:7), the adverbs connected to the scale point labels are chosen as such that it represents equal distances between points on the scale (similar to an interval scale) which makes statistical analysis and comparison possible.

Not only is it important to assess which products consumers prefer more and which sensorial characteristics drive consumer likings; but it is important to identify various groups of consumers that have similar product and sensorial preferences. The identification and separation of these various consumer preference groups can be used to identify and define target markets for a specific product. Some researchers such as Clark (1998) indicated that "it is possible to separate respondents into particular segments, defined by similarities in response. These segments can then be further defined by information on socio-demographics, attitudes and behaviour, depending on what data has been collected." Therefore consumer exploratory

data can be used in order to investigate various sub-groups within the consumer group according to their exploratory data categories.

Data from both consumer panels in preference tests and trained panels in conventional profiling can often be used effectively in order to establish the reason for consumer liking. By combining the two data sets the researcher is able to establish the product or attribute drivers of liking. This information is especially important for product development purposes, marketing strategies and understanding various consumer segments in terms of their needs and trends in the market (Næs *et al.*, 2010:16). Typically large, carefully selected consumer groups are used during preference tests and they assess products under controlled conditions (Lattey *et al.*, 2007). This evaluation is critical in terms of connecting perception of the targeted consumer market with the production process of the product that is created for the specific market. According to Lattey *et al.* (2007), any attribute has an optimal intensity level where it is most liked by consumers but higher intensities than this point will result in negative preference reaction from most consumers. The most widely used techniques for assessing preference drivers are internal and external preference mapping (Arditti, 1997; Dalliant-Spinnler *et al.*, 1996; Greenhoff and MacFie, 1994; Hough and Sanchez, 1998; Jaeger *et al.*, 1998; Mc Ewan, 1996; Monteleone *et al.*, 1998; Murray and Delahunty, 2000; Schlich, 1995), multiple factor analysis (Belin-Batard, Huon de Keradec, and Barthélémy, 1996; Escofier and Pagès, 1990) and partial least square regression (Huon de Keradec, Durand, and Sabatier, 1997; Murray and Delahunty, 2000). For more details see section 3.5.2.4 Preference mapping.

One of the most important factors that must be kept into consideration when conducting preference studies is whether or not consumers should evaluate the products in a blind or informed context. In their research study on internal and external preference mapping for commercial lager beers Guinard, Uotani and Schlich (2001) compared consumer hedonic ratings of a blind condition versus an informed condition with regards to the brand and price of the lager beers. They found that there is a significant change in hedonic ratings from a blind to an informed tasting condition. This suggests that the two conditions, blind versus informed preference testing, stimulate the use of different cognitive processes. When consumers are informed in terms of the specific product that they are about to taste, expectations are created before they consume the product. During their evaluation of the product they will therefore compare their perception of the product with their expected perception of the product. However, during a blind taste consumers will not have predisposition expectations in terms of their preferences for the products. Here their preferences are the pure result of the product profile characteristics. Interestingly Guinard, Uotani and Schlich (2001) found that this particular difference in preferences between informed and blind tastings was the strongest for consumers who are between 20 to 30 years old, i.e. the young Generation Y consumer market segment. It is advisable to segment the consumer market before-hand and select a specific target market group for the product sample set at hand in order to obtain their preference data which will consequently have less variation in the data. Using consumers that do not like the specific sample set will create too much variance in the preference data.

In the case of external preference mapping (PREFMAP), a vector model (Carroll, 1972) is often used which enables the sensory or perceptive dimensions of a product sample set to explain the mean consumer preferences, i.e. to indicate the drivers of liking for specific sensory or perceptive dimensions (Greenhoff and MacFie, 1994; Mc Ewan, 1996; Schiffman, Reynolds and Young, 1981). According to Faye *et al.* (2006), these sensory dimensions can either be the principal components in the case of QDA or it could be the MDS dimensions in the case of the sorting task.

The traditional external preference mapping techniques uses two different panels: to obtain descriptive data and preference data. Faye *et al.* (2006) focused on obtaining a new method of preference mapping by utilising consumers instead of training a panel to profile all the sample set products before using the same consumers to complete preference scaling for the products as well. Their main goal was therefore to substitute the long process of training a profiling panel by using consumers in a sorting task. In their study Faye *et al.* (2006) found that free sorting can be associated with a classical hedonic test with naïve consumers and that this global sensory method (i.e. sorting) can therefore be used effectively to explain consumer preferences as well. However, these researchers used a large number of consumers (207) to complete both the sorting tasks well as the preference scaling. In reality this is an expensive and impractical approach as many wine glasses and wines are needed when using such a large consumer panel to taste all the sample set wines twice for both tests. Even though they succeeded in creating a method that will deliver results faster, it is more labour intensive and expensive to use 207 consumers to profile a wine even with the use of the sorting task. Due to the fact that recent studies (Chollet *et al.*, 2011) indicated that one can obtain the same information from consumers than from a trained panel, with a consumer panel of 20 people, the question therefore arises whether one will be able to use a smaller sorting group of consumers or experts to obtain perceptual data which can be used together with preference data obtained from a larger consumer sample group of between 75 to 150 consumers (Lawless and Heymann, 2010:7) to obtain an accurate preference map. Even though most sensory practitioners do not believe that consumers can be used to describe their perceptions accurately enough, the sorting task enables the sensory analyst to capture this data fairly accurately as it focuses on global perceptions rather than individual product perception (Lawless, Sheng, and Knoop, 1995; Popper and Heymann, 1996; Tang and Heymann, 2002).

### 3.9 Abbreviations used

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ANOVA: Analysis of variance

CBA: Chenin Blanc Association

DISTATIS: multi-variate analysis method (combination of STATIS and MDS)

Fisher LSD-test: Fisher least significant difference test

FF: Fresh and Fruity

RR-unwooded: Rich and Ripe unwooded

RR-wooded: Rich and Ripe wooded

IWBT: Institute for Wine Biotechnology

LS Means: Least significant means

MDS: Multidimensional scaling

PCA: Principle component analysis

PLS: Partial least squares regression

PREFMAP: External preference mapping

QDA: Quantitative descriptive analysis

RV-coefficient analysis: Regression vector coefficient analysis

S.A.: South Africa

## CONCLUSION

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Domestic wine sales are overall still low in comparison to earlier years. This could be explained due to a combination of increased competition as well as the economic downturn that forced consumers to rethink their spending patterns. After the 2008 recession consumers will likely remain weary of spending too much money. Wine producers who are able to win the hearts and minds of consumers during this post-recession period will reap the rewards in the years to follow. The wine-producers with the largest share of voice amongst consumers in the market will also stand a better chance of claiming the largest consumer market share in the end.

Today the South African wine industry is breaking away from the historic Chenin blanc workhorse image by improving the wine quality and creating various outstanding Chenin blanc wine styles. However, the unique wine style characteristics of this diverse cultivar still need to be defined. Focus is now placed on improving the consumers' comprehension of the various Chenin blanc wine styles and to effectively marketing these wine styles to the correct consumer target markets. However, more effort is still needed in order to classify these various styles and position them according to consumer preferences.

The difficulty with classifying wines into various wine style groups is that it requires all wines within the same style group to be representative of that specific wine style. Representiveness is an important factor that needs to be defined precisely in order to categorise products (Ballester *et al.*, 2005). Products that can be categorised together in a single group, such as a wine style group, typically share many common attributes with other products in the same category, but have common attributes with products from other categories (Rosch and Mervis, 1975). The problem with categorisation is the fact that items which are categorised together will typically share some of the key attributes, but not necessarily all attributes. Therefore it is difficult to clearly classify and categorise products such as wine styles as many general attributes are shared by all of the wines but they might differ independently in a specific manner that qualifies them to form part of a specific wine style category. A product category can be viewed as a type of a continuum of representiveness as some products will always be more typical examples of the product category but they are still classified into the same group as other less typical products (Mervis and Rosch, 1981). Concept representiveness (such as for wine styles) is often determined by experts in the case of wine (Martin *et al.*, 1992). These wine experts possess both theoretical and perceptual wine knowledge which forms due to regular sample tasting of wines or formal wine tasting training (Ballester *et al.*, 2005). However, the way that experts and novice wine consumers evaluate wines is different. Experts use different cognitive processes due to a specific level of wine knowledge and experience. Consumers would therefore not necessarily classify a wine sample set similarly to wine experts. This could result in confusion and frustration on the consumer's behalf when he or she can not relate to the specific wine style. It is therefore important to evaluate how these two panels will assess and classify the same wines, representing various wine styles within a single wine cultivar group. Not only will this identify whether such wines are classified similarly by both experts and consumers, but it will give a clear indication as to whether wine styles should be defined as separate categories with typical attributes associated to each style; or whether these wines rather form part of a continuum between various wine style categories.

Another factor that needs to be investigated is whether this style classification method is due to conceptual classification or perceptual classification techniques. This is reflected in the way that the products are evaluated cognitively via either a bottom-up approach signifying a conceptual classification or a top-down approach signifying a perceptual classification.

Furthermore, it is important to evaluate all aspects of consumer sample groups when trying to establish trends/relationships with regard to wine style preferences. Consumer involvement, experience level, lifestyle, gender, context and self-confidence levels are important factors that can influence wine purchase behaviours as well as preferences for various wine styles.

The following aspects were included in this current study in order to ensure that a representative sample of Generation Y consumers were sourced which will cover a wide range of income, education, wine knowledge, wine involvement, equal numbers of men and women as well as a defined context for example social dinner with friends. These aspects could possibly influence consumer behaviour and preferences and researchers can use these influences during sensory data analysis to explain preference drivers.

For the purpose of this research study the focus was placed on investigating the interaction of personal factors with wine intrinsic factors and how these factors influence consumer purchase/decision making behaviour. Even though the product extrinsic factors play an important role in consumer decision making, it was decided to focus on the effect of intrinsic factors on consumers especially as these factors mainly influence the possibility of a repurchase. It is not only important to investigate what influences a consumer to purchase a bottle of wine, but it is even more important to investigate what will promote a repurchase decision and possible long-term consumer loyalty. Due to the fact that there is much confusion about the various new Chenin blanc style classifications in South Africa and whether it influences consumer behaviour or their preferences, it is important to evaluate what the influences of various wine style intrinsic effects are on consumer preferences and perceptions. Another important factor to investigate is whether these consumers can relate to the various Chenin blanc wine styles similarly as wine experts in the industry who are responsible for the classification of these wine styles. Due to the fact that wine experts are responsible for the production and marketing of the wine to the consumers, it is important to ensure that consumers can relate to these expert perceptions. Too much confusion in wine marketing will negatively influence consumer purchase behaviour and consumers will resolve to purchase wine cultivars and wine brands that they are familiar with and that will consistently satisfy them.

Sensory science has provided researchers and the wine industry with a wide variety of methods and techniques to connect the consumer market, scientific departments and the wine producers in the wine industry with one another. This will not only enhance communications between the various industry sectors, but it will also support the production and marketing of wines that are optimally positioned for specific consumer target markets.

The recently developed sorting tasks and the corresponding DISTATIS statistical analysis method has shown some good potential in terms of being able to substitute the elaborate and expensive QDA. Even though there are many advantages of the sorting task for classification purposes it is still unclear whether this task will be able to perform equally as well as the QDA method product profiling. Ultimately previous research has shown that the sorting task can be successfully in the place of QDA for various product types with the use of either trained or untrained panellists. Similar product positioning maps, MDS and DISTATIS maps, can be obtained as the PCA maps from QDA. Depending on the product complexity and similarity degree it was also found that even though QDA provides more detailed descriptive and quantifying information, the sorting task is able to provide generally similar descriptors for products. However, these sorting descriptors are related to global perception of the various sorting groups/classifications rather than individual product perceptions as in QDA. The sorting task can therefore be used to effectively obtain a general overview of a specific product sample set with particular focus on the common similarities and differences between the products instead of individual, in-depth quantification of descriptions for each product within the sample

set (like in the case of QDA). As a result, the choice between the use of QDA and the sorting task will depend on the main purpose of the investigation. According to Cartier *et al.* (2006), the sorting task can not be used satisfactory when the aim is to investigate the precise attribute differences between various products in a sample set. Here, QDA is more suitable.

A wide variety of different South African Chenin blanc wine styles are commercially available today, however, it seems to be problematic for consumers who are often uncertain of their expectations of a specific Chenin blanc wine due to the fact that they are not aware of the various Chenin blanc wine style varieties that are available. No method has yet been established for the classification of various wine styles within a single cultivar. It is therefore important to investigate which method, QDA versus the sorting method, should be used to investigate whether various Chenin blanc wines can be classified into different, definite wine style groups. It is also important to investigate how these wine style groups influence the preferences of a target consumer market group and whether different consumers will have a higher preference for specific wine styles.

The sorting task is therefore an ideal, time-saving and cost efficient sensory classification method to use when aiming to compare various products within a single product sample set, which can be rather large, in terms of their general similarities and differences. This technique is well suited for marketing research purposes, competitive product positioning investigations, general sensorial comparisons for product developers, as well as product screening purposes before more in-depth sensorial methods such as QDA by researchers (Chollet *et al.*, 2011).

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# Chapter 3

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## RESEARCH RESULTS

**Utilizing the sorting technique to classify and profile Chenin blanc dry wine styles**

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## RESEARCH RESULTS

### Abstract

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The vast variety of South African Chenin blanc wine styles is causing confusion amongst wine consumers who often struggle to distinguish between these wine styles. The question arises whether these different wine styles can be classified and profiled as separate style groups. The classification of these wine styles can furthermore, be used during marketing efforts. A new classification method called the sorting method, have been used to classify and profile different foods and beverages with the use of both trained and untrained panellists. Panellist training is, however, both expensive and elaborate. This study aimed to establish whether the sorting method can be used to identify, classify and profile Chenin blanc wine styles with the use of untrained experts or with untrained novice consumers. The influence of wine style sorting instructions on the sorting results was also explored in this study. It was found that the sorting method can be successfully used both with a novice consumer and a wine expert panel to classify and profile the different Chenin blanc wine styles. However, experts exceeded consumers in terms of their descriptive data as they used fewer descriptors that were more often used by all experts. Wine style sorting instructions did not significantly influence the results; however, the instructed wine style sorting task slightly reduced the number and accuracy of the descriptors used by both panels to describe the styles. Even though the sorting task with untrained panellists can be used to classify various wine styles, finer differences between unwooded wine styles should be investigated with the use of qualitative descriptive analysis.

### 3.1 Introduction

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With the increase in the development of high quality Chenin blanc single cultivar wines, South African wine producers also started to create different Chenin blanc wine styles (Smith, 2010). The result is a wide variety of various Chenin blanc wine styles with contrasting sensorial profiles. These commercially available wines are confusing wine consumers who are not aware of the various Chenin blanc wine styles. Currently there are three dry Chenin blanc wine styles, according to the South African Chenin Blanc Association namely Fresh and Fruity, Rich and Ripe unwooded and Rich and Ripe wooded (Smith, 2010). Due to the fact that that the Chenin blanc wine profile can range from a fresh character, similar to Sauvignon blanc wines, to a rich and rounded character, similar to wooded Chardonnay wines, it is important to investigate whether Chenin blanc wines can be classified in to separate wine style groups or whether the wine styles forms a continuum.

The sensory classification method known as free sorting (Lawless and Heymann, 2010:459) has been developed along with the DISTATIS statistical analysis technique. DISTATIS is generated from the multidimensional scaling method (MDS) and is used to optimally analyse sorting data (Abdi *et al.*, 2007). This new sensory method has shown great potential, in various studies, terms of grouping similar products within a sample set; but especially as it is more cost and time effective than traditional profiling methods such as quantitative descriptive analysis (QDA) (Chollet *et al.*, 2011). Even though there are many advantages in terms of using the sorting method for classification purposes, it is still unclear whether this method can profile a wine sample set as well as the QDA method.

No sensory method is yet being used by the South African wine industry to classify various wine styles within a single cultivar. It is therefore important to investigate whether this classification method, namely sorting, can be used to obtain similar results than QDA, which will be evaluated later as well. Finer details such as the effect of the sorting task instructions and the panellists' wine expertise will be investigated in this Chapter. Furthermore, it also needs to be established whether there truly are three Chenin blanc wine styles and whether they can be identified both by industry experts and consumers. Due to the fact that the wine industry needs a viable method that is not too expensive or elaborate, to classify the various Chenin blanc wine styles, the sorting method will merit their production and marketing procedures as well. The main problem areas of this Chapter reside in both the *industrial* and the *scientific* fields.

The first obvious question for the *industry* is focused on whether or not South African Chenin blanc wines can be divided into defined style groups that can be identified by consumers as well as wine experts in the same manner. It is important to establish whether the wine industry should market Chenin blanc wines in terms of various wine style classifications that can satisfy the needs of consumer target markets; or whether all Chenin blanc wines should rather be viewed as part of a wine style continuum. Due to the fact that that wine industry experts are responsible for the production and positioning of the wines according to consumer preferences, it is important to investigate whether wine industry experts and consumers perceive and classify various wine styles similarly. The influence of training or experience on wine evaluation abilities and perception of various wine styles will therefore be investigated.

Even though the sorting method might be able to classify various Chenin blanc wines according to their different wine styles, it is also important that the *scientific* and technical aspects of this wine style classification method are evaluated. Previous studies have made use of both trained panels and consumer panels to conduct sorting tasks (Chollet *et al.*, 2011; Lelièvre *et al.*, 2008; Faye *et al.*, 2006; Beguin, 1993; Chollet and Valentin, 2001). For the purpose of this study however, it needs to be established whether both wine industry experts and untrained wine consumers can be used to conduct the wine style sorting tasks. Furthermore, it also needs to be established whether the sorting task should be uninstructed, i.e. not give the panel any sorting group guidelines, or instructed, i.e. providing the panel with the definitions for the various wine style groups according to which they must sort the product sample set. During uninstructed sorting, panellists are expected to focus more on their actual sensorial perceptions of the wines and their first impressions of which wines are similar to one another (Chollet *et al.*, 2011). On the other hand these panellists are expected to focus more on the concept of the various wine styles during instructed sorting tasks which may lead them to make use of a matching procedure in order to sort the wines into the correct wine style group. Due to the fact that that each of these two sorting methods may provoke the panellists to focus on the wines in a different manner than during the other sorting method, different sorting results might be obtained from the instructed than from uninstructed sorting.

### **3.2 Materials and methods**

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In total four different sorting experiments were conducted. The order in which the tests took place was as follows: twelve Chenin blanc wine industry experts completed both uninstructed sorting and instructed sorting tasks. Thereafter the same uninstructed sorting and instructed sorting tasks were conducted by twenty young wine consumers. These tests were constructed in such a way to establish whether consumers and wine experts can classify and profile wines similarly. Results will therefore indicate the level of agreement between young wine consumers and wine experts with regard to the industry-defined Chenin blanc dry wine styles. Therefore:

are these wine style concepts Fresh and Fruity, Rich and Ripe unwooded and Rich and Ripe wooded descriptive enough for consumers to group these wines together during instructed sorting? Do they do so in the same manner as experts? And do experts classify these wines in a similar manner than the wine industry, i.e. according to the wines' current wine style identities?

### 3.2.1 Wines

Twelve Chenin blanc wines have been selected for the purpose of this study to represent the three industry classified dry Chenin blanc wine styles (FF, RR-unwooded and RR-wooded). A list of all the possible wine sources were constructed with the use of the 2011 John Platter (Platter and Van Zyl, 2011) as well as the 2010 top 12 Chenin blanc wines (Wine Info, 2011). These two wine award lists were used as these wines have been thoroughly assessed for high wine quality. The reasons why high quality Chenin blanc wines were used in this study are as follows: selecting wines with equal levels of wine quality prevents wine quality differences from influencing panellists' perceptions of the wines. Using a uniform wine quality selection process also decreased the possibility of including selection biasness. Only wines with three to four John Platter stars or a position on the top twelve Chenin blanc wines were used. The final selection procedure was conducted on the bases of wines being conveniently available and due to financial restrictions and the ideal sample size limit for the sorting method (12 products, Chollet *et al.*, 2011) only 12 wines were sourced. Therefore each one of the three Chenin blanc styles was represented by four out of the twelve wines. One RR-unwooded wine was, however, not available and the sample set was reduced to 11 wines instead of 12 wines.

In order to test for sensory fatigue and to ensure that the selected wines had enough sensorial variation between them, a sorting pre-test with eight internal Institute for Winebiotechnology (IWBT) members was conducted with the selected eleven wines. Sensory fatigue will severely diminish an assessor's ability to identify and evaluate wine intrinsic characteristics. Ultimately panellists may lose interest during the sorting task. Results from the sorting pre-test showed that panellists did not experience sensory fatigue when evaluating the eleven wines. However, as two sorting tasks, each with eleven wines, will be allocated to the consumer and expert panels in the study, it was decided to include a break between the two sorting tasks. Both panels received the same eleven wines during the instructed sorting task, but they were informed that it was different wine samples.

These 11 wines (Table 3.1) will therefore represent each of the three different dry Chenin blanc wine styles as identified by the Chenin Blanc Association (i.e. FF, RR-unwooded, RR-wooded). Information about the technical analysis for each wine was obtained from the wine bottle label, wineries itself, and the internet. During all experimental procedures the same 11 selected Chenin blanc wines were used which represented the three different dry Chenin blanc wine styles (FF, RR-unwooded and RR-wooded). All samples were tasted in air-conditioned rooms of 21°C under normal lighting (white lights).

**Table 3.1:** Wines used to represent the industry classified three dry Chenin blanc wine styles

Wine nr.	Wine style	Technical Analysis				Origin	Vintage	Quality	Price/ bottle
		Alc (%)	Acidity (g/L)	pH	RS (g/L)				
W1	FF	14	6.3	3.37	3.0	Stellenbosch	2010	Top12*	R33
W2	FF	14	6.48	3.39	7.55	Stellenbosch	2009	Top12*	R35
W3	FF	13.50	6.8	3.2	1.9	Stellenbosch	2010	Top12*	R35
W4	FF	13.50	6.1	3.45	4	Stellenbosch	2010	3.5stars <sup>#</sup>	R80
W5	RR-unwooded	14	6.5	3.24	1.05	Stellenbosch	2010	3.5stars <sup>#</sup>	R50
W6	RR-unwooded	13.81	5.6	3.37	3.3	Stellenbosch	2010	4stars <sup>#</sup>	R50
W7	RR-unwooded	14	6.5	3.24	1.05	Stellenbosch	2010	3.5stars <sup>#</sup>	R50
W8	RR-wooded	14.20	6.0	3.35	4.5	Stellenbosch	2009	Top12*	R127
W9	RR-wooded	14.24	7.0	3.27	6.3	Paarl	2008	Top12*	R180
W10	RR-wooded	14.50	5.7	3.43	3.7	Stellenbosch	2009	Top12*	R72
W11	RR-wooded	14.16	6.88	3.31	4.45	Franchhoek	2009	Top12*	R95

\* wines are from top 12 Chenin blanc competition of 2010, South Africa (Wine Info, 2011)

<sup>#</sup> wines that received John Platter star ratings in 2011, South Africa (Platter and Van Zyl, 2011)

### 3.2.2 Chenin blanc wine expert sorting panel

The expert Chenin blanc panellists were recruited with the help of the Chenin Blanc Association, South Africa. The panel of twelve judges consisted of nine males and three females. The age distribution of the expert panel was broad as it includes a significant number of relatively young experts from 29 to 35 yrs old, as well as relatively old experts from 60 to 65 yrs old.

### 3.2.3 Untrained wine consumer sorting panel

The consumer sorting panel (N = 20) that was selected consisted of four males and sixteen females. These 20 non-smokers were all between the ages of 21 to 32 yrs old and drink white wine at least once a month. Fifty percent of the panel have tasted Chenin blanc wines sometimes whilst eight of the panellists often drink Chenin blanc wines. Only two consumers seldom drink Chenin blanc wines. This indicates that the panel had some experience with Chenin blanc wines.

### 3.2.4 Sorting pre-test

As mentioned, a pilot study (pre-test) was conducted, with an internal panel of eight members from the IWBT, on the proposed experimental sorting task design to ensure its functionality and to improve any practical or technical difficulties. Furthermore, the pre-test screened the selected eleven wines in order to ensure that they are good representatives of the various Chenin blanc wine styles before proceeding with the actual data capturing processes.

### 3.2.5 Sorting task designs and procedures

Each of the two sorting panels completed two sorting tasks. An uninstructed sorting task was first conducted where panellists used their own similarity criteria to group the wines. During the instructed sorting task both panels were instructed to sort wines according to the three industry-

defined Chenin blanc dry wine styles: FF, RR-unwooded and RR-wooded. Complete sample order randomisation was not necessary as the panellists were allowed to evaluate the wines in any order and they could take as much time as they needed. Nonetheless all wines were marked with three-digit numbers and each panellist received the wines in a different order. Only the wine sample aromas were evaluated in order to prevent carry-over effects and sensory fatigue. Both panels were informed that they would not necessarily all receive the same Chenin blanc wines so as to prevent them from being tempted to compare their wine preferences with other panellists. No discussions were allowed during the sorting procedures.

The expert panel (N = 12) sorted the eleven wines relative to one another in various groups according to their similarities. They were allowed to create as many groups as needed. The only restriction was that each group must appear homogeneous and that a single wine can not be placed in two groups. Thereafter panellists described their global perceptions of the wine groups with no more than five descriptors per group (Chollet *et al.*, 2011). The untrained panellists (N = 20) completed the same procedures.

The expert panel was thereafter consulted, in a discussion group format, to define the FF, RR-unwooded and RR-wooded Chenin blanc wine style concepts. These dry Chenin blanc wine style definitions were thereafter explained to the untrained consumer panel to ensure that they understand the meaning of these wine style concepts.

After a resting period the expert panel members completed instructed sorting where they had to sort the eleven wines into the three defined wine style groups (FF, RR-unwooded and RR-wooded). They were allowed to create more groups if they felt that some of the wine samples do not fall within these three defined wine style groups. Assessors were not aware that they were evaluating the same eleven wines than during uninstructed sorting. Thereafter the experts described each wine style group with no more than five terms. All other sorting procedures were similar to uninstructed sorting. The untrained consumer panel also sorted and provided descriptors for the eleven wines during instructed sorting.

### 3.2.6 Statistical analyses

All sorting data were captured using *Microsoft Excel 2007*. Each participant's data were captured in a distance matrix where the columns and rows represented the wine samples. If two samples were grouped together a 0 was given to the matrix position where the column wine and row wine meet one another. Similarly a 1 was used to indicate when two wine samples were not sorted together. Each panellist's distance matrix was converted into a covariance matrix which compares the pattern for each product directly with all the other products in the sample set. Data analyses were conducted using *StatSoft STATISTICA 10®*. The individual distance matrices were used to perform MDS as well as DISTATIS (Abdi *et al.*, 2005, 2007). MDS analysis is a multivariate statistical technique typically performed on a global similarity matrix of a panel (Chollet *et al.*, 2011). DISTATIS, on the other hand, accounts for the individual sorting data of the panellists and can be defined as a three-way generalisation of MDS which integrates assessors' distance matrices efficiently (Chollet *et al.*, 2011). For DISTATIS a compromise covariance matrix is firstly obtained from the individual panellist covariance matrices and thereafter used in a principal component analysis to obtain a projection map that is similar to the MDS plots (Lilievre *et al.*, 2009). MDS and DISTATIS therefore create product positioning maps where the points on the map represent the sample set products. The distance between two points on the plot therefore illustrates the degree of similarity between two products (Chollet *et al.*, 2011). If two products are positioned far from one another, they were perceived as different

from one another. However, the closer two products are positioned on the plot, the more similar they were perceived by the panellists.

The descriptive data of the sorted wine groups were analysed using correspondence analysis (CA). The descriptive data were assigned to all wines within a panellist's wine group and thereafter a descriptor list for each wine could be captured. Synonyms were grouped together and given a collective descriptor name which increased the statistical power of a single descriptor. When the descriptor is positioned on the same side of the origin as a particular wine it is expected that the descriptor will be grouped together more often with the specific wine. The further the descriptor lies in this specific direction from the origin the more often it will be expected that this descriptor will be grouped together with the wine as well. However, if the descriptor is positioned opposite the origin of a specific wine, it is expected that this specific wine will seldom be grouped together with the specific descriptor.

Rv-coefficient analyses were conducted to investigate the consensus between different DISTATIS configurations obtained from the expert panel and the untrained consumer panel during the two sorting tasks. An Rv-coefficient close to 1 indicates a strong level of agreement between two configurations (i.e. they are similar to one another). As a basis of comparison an Rv-value of 0.68 is considered to be a good level of agreement between two configurations (Tang and Heymann, 2002).

The inclusion of replications was considered in order to eliminate individual variations of panellists. According to Moskowitz *et al.* (2006:305), a replication test is when the researcher repeats the same test with the same panel of judges multiple times. The mean values of the replication runs are then used during final statistical analysis in order to reduce individual panellist variations over the different replication tests. This will result in lower variation error and the results will be more reliable and consistent. Sylvie Chollet (sensory researcher, Department of Food and Biotechnology, ISA Lille, France) and Wendy Parr (senior research officer, Wine Sensory Science, Lincoln University, New Zealand) found that it is not necessary to use repetitions when performing the sorting task. According to these researchers the sorting task is a repeatable sensory evaluation tool. Chollet *et al.* (2011) were able to obtain similar maps with different sorting groups on the same set of beers. Chollet (2011) also mentioned that it is troublesome to analyse sorting repetition data as one can not obtain average measurements with a distance matrix. If sorting repetitions were used, a single configuration would be obtained per repetition, which must be compared to each of the other repetitions' configurations (Chollet, 2011). According to Parr (2011), a reason for not using repetitions in the sorting task is that other methodologies/ procedures involving the same wines, such QDA, can provide further data on whether the same configurations can be obtained.

### **3.3 Results and discussion**

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The following section describes the results and discussion for the two sorting tasks namely uninstructed sorting and instructed sorting as performed by both the untrained wine consumer panel and the Chenin blanc wine expert panel. For both MDS and DISTATIS statistical analysis methods the first two dimensions were chosen to obtain the configurations. The MDS plots are not shown here, because they were all similar to the corresponding DISTATIS plots. DISTATIS plots provided more concise wine groupings and are therefore shown.



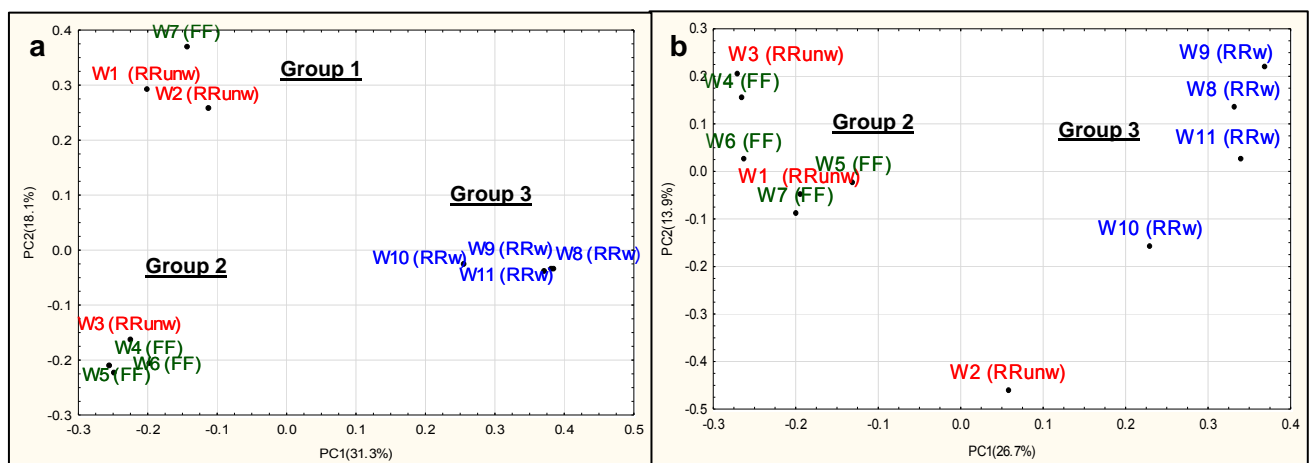
### 3.3.1 Comparing the results obtained from a wine expert panel versus an untrained consumer panel during uninstructed sorting

The expert panel's uninstructed sorting data were analysed via DISTATIS and MDS. If the MDS and DISTATIS plots are similar, it indicates that the panellists similarly sorted the products (i.e. less inter-panellist variations). The DISTATIS plot (Fig. 3.1.a) indicates three wine groups similar to the MDS plot's wine groups (data not shown). Two groups contained either RR-unwooded or FF wines, whereas all the wooded wines were grouped together in a third group.

The first two principal components explain almost 50% of the data variance. The first component, explaining 31.3% of the data variance, separates wooded wine character (on right-hand side) from unwooded wine character (on left-hand side). Whereas the second component, explaining only 18.1% of the data variance, distinguishes Fresh wine character from the Ripe wine character more clearly (Groups 1 and 2).

The majority of the experts were able to identify the various wine styles. In general, the RR-unwooded wines were less often sorted within the correct wine style group (RR-unwooded) whereas the RR-wooded wines were almost always correctly identified. This indicates a high consensus level between the wine experts in terms of their wine style classifications. Furthermore, it suggests that these experts have the same perception of the wine style concepts than the Chenin Blanc Association, who classified the wines according to these wine styles.

The DISTATIS plot (Fig. 3.1.b) was also used to evaluate the untrained wine consumers' uninstructed sorting data. The first two principal components (PC's) explain a total of 36.7% of the variance in the data which is less than the 50% explained by the first two PC's of the expert panel DISTATIS plot. Only two major groups are apparent in Fig. 3.1b namely Group 3, RR-wooded wines, and Group 2, which mostly consists of FF wines with the exception of W3 and W1 which are RR-unwooded wines. Only one other RR-unwooded wine (W2) remained in a group of its own far removed from Groups 2 and 3.



**Figure 3.1:** DISTATIS plots, calculated from individual similarity matrices, representing the product similarities as perceived by (a) wine experts and (b) untrained consumers during uninstructed sorting (obtained from *StatSoft STATISTICA 10®*). Where FF are Fresh and Fruity wines, RRUnw are Rich and Ripe unwooded wines and RRw are Rich and Ripe wooded wines.

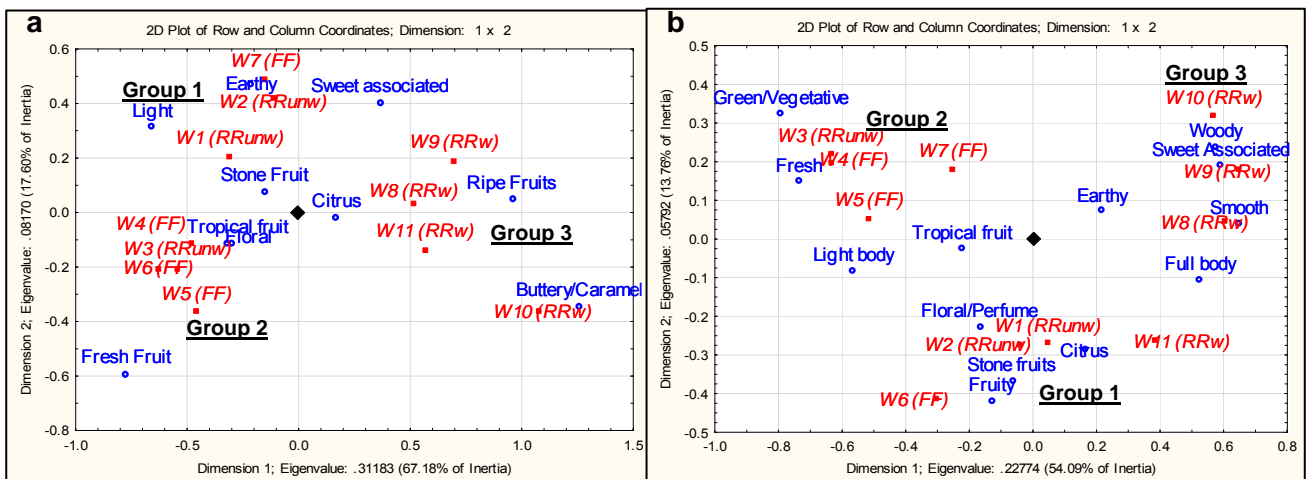
### 3.3.2 Comparing the wine style descriptions obtained from wine experts' versus untrained wine consumers' during uninstructed sorting

Verbalisation data obtained from the wine expert panel and the untrained wine consumer panel, during uninstructed sorting, were evaluated with the use of CA plots (Fig. 3.2). The first two dimensions of both the expert panel plot account for a large percentage of data variance

(84.78%). It is clear that the three groups in Fig. 3.2.a generally correspond with the actual wine style identities of the samples. Group 1 and 2 alternatively contains mostly RR-unwooded wines and FF wines, whilst only RR-wooded wines are found in Group 3.

At first 127 different types of descriptors and a total of 502 descriptors were used by the experts to describe the wines. After grouping synonymous descriptors a total of ten main descriptors were used to perform CA namely: Light, Earthy, Sweet Associated, Ripe Fruits, Buttery/Caramel, Fresh Fruit, Floral, Tropical Fruit, Citrus, and Stone Fruits. These descriptors were grouped together with the sorted wine style groups in the following manner: Group 1 associate with Earthy and Light and is often grouped with the RR-unwooded wines. It is also grouped together with Stone fruits but not as often as Earthy. Group 2 associate with Fresh fruit, Tropical and Floral, and the last two descriptors were less often grouped with Group 2 wines. Group 2 consists mostly of FF wines. Group 3 associate with Buttery/Caramel and Ripe Fruits to a lesser degree also Citrus which consists of the RR-wooded wines. The Sweet associated descriptor is seldom associated with Group 2 (FF) but equally associated to both Group 1 (RR-unwooded) and Group 3 (RR-wooded).

During uninstructed sorting the consumer panel used a total of 569 descriptors to describe all the wines in the sample set. After reducing synonyms a total of thirteen main descriptors were generated. These descriptors divide the wine sample set into three distinct groups which are relatively similar to the true wine styles (Fig. 3.2.a). The left-hand side of the CA plot illustrates the FF wines grouped together, except for W3 which is RR-unwooded, whilst a group of only RR-wooded wines is found on the right-hand side. A third group of wines is positioned on the bottom part of the plot which generally consists of RR-unwooded wines, except for 195a which is an FF wine. The following summary indicates which descriptors are often expected to be grouped together with specific wine style groups. Group 1: Floral/Perfume, Stone Fruits, Citrus, and Fruity strongly associate with mostly RR-unwooded wines. Group 2: Green/Vegetative, Fresh and some degree of Light body and Tropical fruit associate to this wine group. The wines within this group are usually FF wines. Group 3: The RR-wooded wines are more complex and is often grouped with Woody, Sweet Associated, Smooth, Full body and to a lesser degree also Earthy.



**Figure 3.2:** Correspondence analyses plots of uninstructed sorting: (a) wine experts' and (b) untrained wine consumers' descriptor relation to specific wines within the sample set (obtained from StatSoft STATISTICA 10®). Where FF are Fresh and Fruity wines, RRUnw are Rich and Ripe unwooded wines and RRw are Rich and Ripe wooded wines.

### 3.3.3 Comparing the results obtained from a wine expert panel versus an untrained consumer panel during instructed wine style sorting

Definitions for the Chenin blanc wine style terms namely FF, RR-unwooded and RR-wooded were generated from the expert panel (see Table 3.2). During instructed sorting the expert panel sorted the wine set into the three defined Chenin blanc wine style groups. A consensus analysis revealed that the expert panel did not have any trouble identifying and classifying the correct wines as RR-wooded (100% correct classification). However, the FF wines (Group 1) were classified correctly 75% of the time as FF but 25% of the time, these wines were classified as RR-unwooded. The RR-unwooded wines (Group 2) were only 33% correctly classified as RR-unwooded wines and more often classified as FF wines.

**Table 3.2:** Wine style definitions as generated by Chenin blanc wine experts

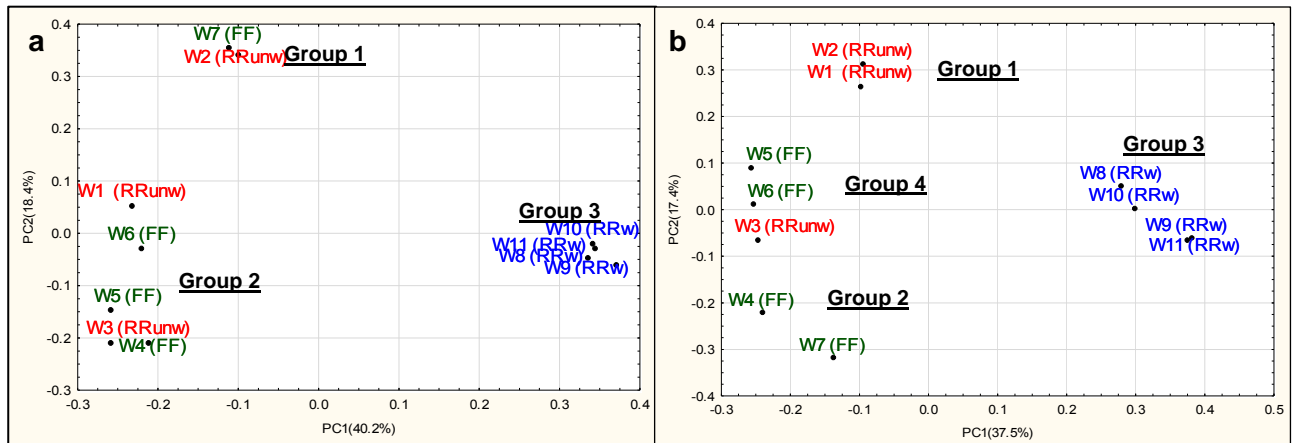
FF	RR-unwooded	RR-wooded
Fresh Fruit	Ripe Fruit	Cooked Fruit
Perfume/Floral	Pineapple	Bee Wax
No Wood	Yellow stone fruits	Wood/ Cedar wood
Crispy/Fresh	Honey	Resinous
Sharp	Citrus	Baked apple/quince
Value	Layered/Rich Texture	Pine nuts/ nutty
Easy Drinkable	Viscose	Botrytis
Lime	Raisins	Orange Peel
Tropical	Expressive	Fat
Guava	Med. Body	Toasty
Crispy Apple	Fig Jam	Butterscotch
Linear	Tropical	Dried fruit
	Broad	Vanilla
	Pear	Yellow straw
	Marmalade	
	Honey	
	Ripe Papaya	

When evaluating the instructed sorting DISTATIS plot (Fig. 3.3.a) for the expert panel it is clear that the groupings are well consolidated. Group 3 is generally defined by RR-wooded wines and the three unwooded wine groups from the MDS plot (not shown) are now simplified into two groups. W1 (RR-unwooded) which has previously appeared on its own in the MDS plot (not shown), is now classified together with the rest of Group 2, which mostly consists of FF wines, and Group 1 still consists of W7 and W2. Instructing panellists to sort wines according to the Chenin blanc wine styles did not improve their wine style sorting abilities.

After completing the uninstructed sorting task the untrained consumer panel also completed the wine style instructed sorting task. Panellists were provided the three wine style definitions, obtained from the wine expert panel, and sorted the wines according to these wine styles.

Similarly to the Chenin blanc wine expert panel the consumer panellists were also able to sort the RR-wooded wines 100% correctly in the RR-wooded Chenin blanc wine style category. Furthermore, they identified 75% of the FF wines correctly but 25% of these wines were wrongly classified as RR-unwooded wines. The group that seemed to confuse these consumers the most was the RR-unwooded wine style group. Consumers correctly identified RR-unwooded wines 50% of the time, but 50% of the time they mistook these wines for FF wines. Untrained consumers were therefore, like the wine experts, easily able to correctly identify RR-wooded wines, but they struggled to distinguish between FF and RR-unwooded Chenin blanc wines.

When evaluating the untrained panellists' DISTATIS plot (Fig. 3.3.b) four different groups are clearly visible. Once again the same RR-wooded group is formed (similar to expert panel, Fig. 3.3.a), but three other groups with different Freshness and Rich/Ripeness levels are also shown. It is clear that PC1 of the DISTATIS plot divides wines according to the wood content. RR-wooded wines are grouped together in Group 3 on the right-hand side of the plot, whereas the unwooded wines are located on the left-hand side. The vertical axis (PC2) divides the rest of the wines into three groups: Freshness (Group 2) opposing Rich/Ripeness (Group 1) and in the middle a mixture of these two groups forms Group 4 which contains both FF wines as well as RR-unwooded wines.



**Figure 3.3:** DISTATIS plots, calculated from individual similarity matrices, representing the product similarities as perceived by (a) wine experts and (b) untrained consumers during instructed wine style sorting (obtained from *StatSoft STATISTICA 10®*). Where FF are Fresh and Fruity wines, RRunw are Rich and Ripe unwooded wines and RRw are Rich and Ripe wooded wines.

### 3.3.4 Comparing the wine style descriptions obtained from wine experts' versus untrained wine consumers' during wine style instructed sorting

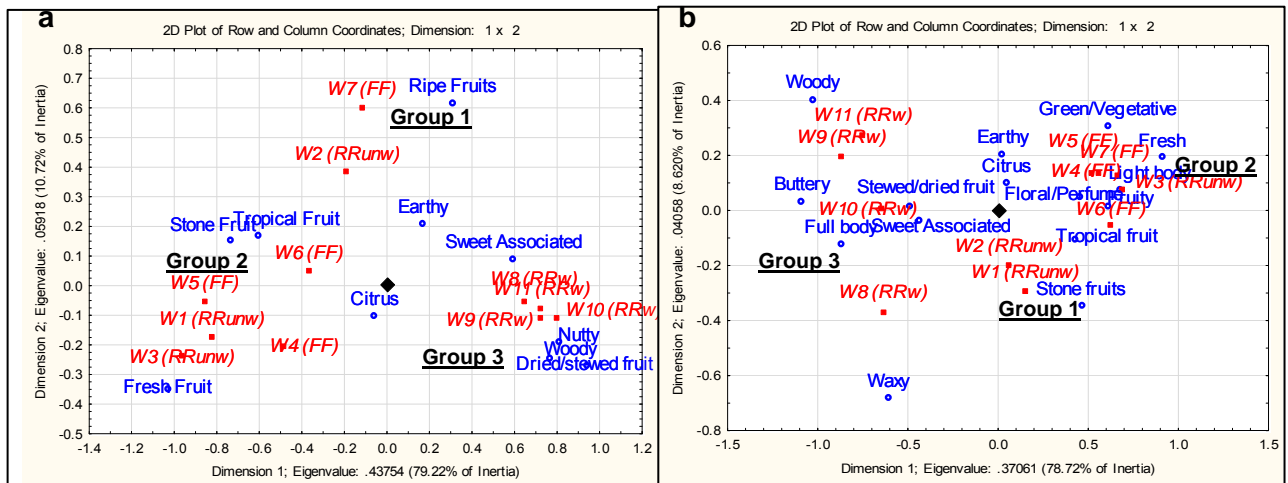
It is clear from the expert panel CA plot of instructed sorting description data (Fig. 3.4.a) that some descriptors are slightly different than those used during uninstructed sorting (Fig. 3.2.a). During instructed sorting these experts used 85 different types of descriptors and a total of 449 descriptors to describe the eleven wines in comparison to the 127 different descriptors and total of 502 descriptors used during uninstructed sorting. The wine style sorting instruction clearly decreased the total number and variety of descriptors used by the wine expert panel. The ten important descriptors here are: Ripe Fruits, Earthy, Tropical Fruit, Stone Fruit, Citrus, Fresh Fruit, Nutty, Woody, Dried/stewed fruit and Sweet Associated. Instead of Light, Floral, Buttery/Caramel descriptors during uninstructed sorting, the following descriptors Nutty, Woody and Dried/Stewed Fruit were used during instructed wine style sorting.

In Fig. 3.4.a the three wine groups that associate with various descriptors are clearly visible. Group 1 associated with Ripe Fruits and somewhat also with Earthy and Tropical Fruit. Group 2 associated with Fresh Fruit and to a lesser degree also Stone Fruit. Group 3 associated with Nutty, Woody, Dried/Stewed Fruit and somewhat also with Sweet Associated. The descriptor Citrus is almost equally associated in some extent to both Groups 2 and 3 whereas Tropical Fruit is almost equally associated to both Groups 1 and 2.

After investigating the untrained wine consumers' groups made during instructed sorting the descriptor associations with the wines and wine groups were also evaluated via CA (Fig. 3.4.b).

Initially a total of 688 descriptors were used by the consumers to describe the wines, but after grouping the synonyms, fifteen attributes were obtained.

The RR-wooded wine style Group 3 was often grouped with Woody, Buttery, Full body, Sweet Associated, Stewed/Dried Fruit. One of the RR-wooded wines (W8) was often grouped with Waxy. However, this style group is seldom described with Green/Vegetative, Fresh, Light body, Floral/Perfume and Fruity characteristics. The FF wine style Group 2 was often grouped with Green/Vegetative, Fresh, Light body, Floral/Perfume, Fruity and sometimes also with Tropical fruit, Citrus and Earthy. But this style group was seldom grouped with Woody, Buttery, Stewed/dried Fruit, Full body and Sweet Associated. The RR-unwooded wine style Group 1 was often grouped with Stone fruits, Waxy and sometimes Tropical fruit, but seldom grouped with Earthy and Citrus attributes.



**Figure 3.4:** Correspondence analyses plots of instructed wine style sorting: (a) wine experts' and (b) untrained wine consumers' descriptor relation to specific wines within the sample set (obtained from *StatSoft STATISTICA 10®*). Where FF are Fresh and Fruity wines, RRUnw are Rich and Ripe unwooded wines and RRw are Rich and Ripe wooded wines.

### 3.3.5 Comparison between the sorting groups' descriptors

Similar descriptors were obtained from the expert panel and the consumer panel during both instructed and uninstructed sorting tasks. Table 3.3 indicates which descriptions were derived for the various wine groups from both sorting tasks (via experts and consumers).

It is clear that some of the descriptors overlap especially between Groups 1 and 2 (which contains the FF and the RR-unwooded wines) such as Floral/Perfume, Stone fruits, Citrus, Fruity, Tropical fruit and Light/Light body. Group 3 on the other hand, which contains all the wooded Chenin blanc wines have specific and unique characteristics that is consistently associated to this wine group such as Woody, Buttery, Sweet Associated, Full body, Nutty and Dried/stewed fruit. Some of the descriptors (Table 3.3) are the same for both the experts and the consumers in terms of a specific wine style group. This indicates that both panels described the wine style groups similarly.

**Table 3.3:** Sorting task(s) descriptions that associate strongly with the three wine style groups as obtained from wine experts and untrained wine consumers.

Groups	Sorting panels		
	Sorting task	Expert descriptions	Consumer descriptions
Group 1 (RR-unwooded)	uninstructed sorting	<b>Sweet Associated</b> <b>Stone Fruit</b> Light Earthy	<b>Floral/Perfume</b> <b>Stone Fruits</b> Citrus Fruity
	instructed sorting	<b>Ripe Fruits</b> <b>(Earthy, Tropical fruit)</b>	<b>Stone Fruits</b> <b>Waxy</b> <b>Tropical fruit</b>
Group 2 (FF wines)	uninstructed sorting	<b>Fresh fruit</b> <b>Tropical</b> Floral	<b>Fresh</b> <b>Tropical fruit</b> Light body Green/Vegetative
	instructed sorting	<b>Fresh fruit</b> <b>Citrus</b> <b>Tropical fruit</b> (Stone Fruit)	<b>Fresh</b> <b>Fruity</b> Light body Floral/Perfume Green/Vegetative ( <b>Tropical fruit</b> , earthy, <b>citrus</b> )
Group 3 (RR-wooded)	uninstructed sorting	<b>Buttery/Caramel</b> <b>Sweet Associated</b> Ripe Fruits Citrus	<b>Smooth</b> <b>Full body</b> <b>Sweet Associated</b> Woody Earthy
	instructed sorting	<b>Woody</b> <b>Dried/Stewed fruit</b> Citrus Nutty ( <b>Sweet Associated</b> )	<b>Woody</b> <b>Sweet Associated</b> <b>Dried/Stewed fruit</b> Buttery Full body

### 3.3.6 Comparison of uninstructed and instructed sorting tasks as conducted by wine experts and untrained wine consumers

Solomon (1997) found that, during blind tasting tests, wine experts will typically organise a sample set of wines according to cultivar type; whereas the novice consumers would rather use one or two salient perceptual characteristics such as sweetness or fruitiness to organise wines into similarity groups. In their research Lelièvre *et al.* (2009) found that wine experts have a strong memory knowledge structures due to repeated experiences with similar wines in the past which will dominate the way that they evaluate and describe products. In order to statistically compare two configurations the Rv-coefficients were calculated between the product coordinates of each configuration (see Table 3.4). Relatively high Rv-coefficient values were obtained between the expert and the consumer panels during both uninstructed sorting (Rv = 0.78) and instructed sorting (Rv = 0.79). Therefore, both panels strongly agreed in terms of their sorting data output for each sorting task. However, the expert panel have the highest level of agreement between their two sorting tasks (Rv = 0.93) indicating that they were the most consistent. The consumer panel's instructed and uninstructed sorting data were also similar (Rv = 0.87). This result is consistent with previous research findings that the addition of a descriptor list has no significant influence on the sorting outcome (Chollet *et al.*, 2011). These results are also similar to those sorting results obtained from different product types (Blancher *et al.*, 2007;

Cartier *et al.*, 2006; Faye *et al.*, 2004, 2006; Saint Eve, Paci-Kora and Martin, 2004; Tang and Heymann, 2002 ).

**Table 3.4:** Consensus between wine expert and untrained consumer panels in terms of their different sorting tasks (Rv-coefficient analysis) (obtained from *StatSoft STATISTICA 10®*). Where 1 indicates uninstructed sorting and 2 indicates instructed sorting.

Panel*sorting session	Rv-coefficient value	Confidence level
Expert 1 vs expert 2	RV=0.93	p<0.01
Consumer 1 vs consumer 2	RV=0.87	p<0.01
Expert 1 vs consumer 1	RV=0.78	p<0.01
Expert 2 vs consumer 2	RV=0.79	p<0.01

In essence, it was found that either a wine expert or a young wine consumer panel can be used to effectively sort wine styles and that sorting instructions does not significantly influence the obtained results. These results might, however, be misleading. The wood-attribute, due to its obvious presence or absence, could be driving the high level of agreement between panels and between sorting tasks. Different panels namely trained panels, experts and novice consumers evaluate a product sample set such as wine differently from one another via bottom-up or top-down analysis (Lelièvre *et al.*, 2009). In their research Ballester *et al.* (2005) aimed to determine whether Chardonnay wine concept is a result of perceptual similarities (bottom-up analysis) between different wines or whether it is due to a concept structure (top-down) about Chardonnay. They found that the Chardonnay wine concept amongst wine experts is mainly a consensual one, but that top-down analysis was also evident. In the current study, all panellists could easily identify the wooded Chenin blanc wines which stood out from the unwooded wines, in other words they also made use of sensory similarity to identify these wines (bottom-up). However, the sensory differentiation between the RR-unwooded and FF wines were not clearly observed by either the wine experts, who mainly use top-down analysis (Brochet and Dubourdieu, 2001), or consumers, who mainly use bottom-up analysis and similarity perceptions (Brochet and Dubourdieu, 2001). This indicates that the wine industry experts are not yet familiar enough with the differentiations between RR-unwooded and FF Chenin blanc wines to use top-down analysis in order to discriminate between these wine styles. Alternatively, these two wine styles are too similar to merit the establishment of separate wine style groups.

Furthermore, the wine experts' DISTATIS plot for instructed sorting explains a higher amount of variance (58.7%, Fig. 3.3.a) than uninstructed sorting (49.4%, Fig. 3.1.a). The wine positions in the instructed sorting DISTATIS plot therefore explain more variance. The first two CA plot dimensions of experts' instructed sorting task (89.94%, Fig. 3.4.a) also explained slightly more variance than uninstructed sorting (84.78%, Fig. 3.2.a). Similarly the first two dimensions of consumers' instructed sorting DISTATIS plot explained the highest amount of variance. The amount of variance explained by the consumer CA plot during instructed sorting (87.34%, Fig. 3.4.b) is higher than uninstructed sorting (67.85%, Fig. 3.2.b). The consumer DISTATIS plot from instructed sorting also explains a larger amount of variance (54.9%, Fig. 3.3.b) than the uninstructed sorting DISTATIS plot (40.6%, Fig. 3.1.b). It is clear that instructed wine style sorting results consistently explained more variance than the uninstructed sorting results and expert panel projections consistently explained more variance than the untrained consumer panel projections. Generally it is expected that trained panellists will outperform untrained, novice panels during classification tasks and in terms of their data reproducibility, however, this accepted idea has not yet received sufficient support in literature (Chollet and Valentin, 2001). Even though some researchers found similar results when using both a trained panel and an untrained consumer panel to do the same sensory test, other researchers found

opposing results. According to Chollet and Valentin (2001), similar performance from both trained and untrained panellists is determined by the type of sensory task performed by these panels. The sorting task was previously successfully used to compare the olfactory perception abilities of experts versus novices of perfume (Beguín, 1993) and of wine (Chollet and Valentin, 2001). Untrained panellists typically generates less accurate and precise descriptive terms than trained or expert panellists (Chollet and Valentin, 2001; Chollet *et al.*, 2011). Cartier *et al.* (2006) found that similar sorting product spatial maps can be obtained from trained and untrained panellists. These maps also compared well with PCA maps (from QDA).

All data outputs during the current research study (MDS, DISTATIS and CA plots) indicate that there is a definite RR-wooded Chenin blanc wine style opposed to an FF wine style, however, some RR-unwooded wines were perceived as FF wines. The complex RR-unwooded therefore forms part of a wine-style-continuum between the FF and RR-wooded wines.

The consumer panel consistently grouped wines together with specific attributes during both sorting tasks (Fig's. 3.2.b and 3.4.b). A specific group of FF wines associated strongly with a Vegetative/Green characteristic which could form the basis for a new FF wine style definition. Apart from the clearly visible RR-wooded group, an RR-unwooded group associated strongly with stone fruits. These RR-unwooded wines seem to be classified according to their wine body descriptions, i.e. RandR full-bodied versus RandR light-bodied wines. Due to the fact that the wooded wines possibly diminished the fine differences between FF and RR-unwooded wine styles to some extent, future research should only compare FF and RR-unwooded wines.

Similar descriptors were obtained from both the expert and the consumer panels during uninstructed and instructed sorting. Some descriptors overlap between Groups 1 and 2, respectively containing FF and RR-unwooded wines, such as Floral/Perfume, Stone fruits, Citrus, Fruity, Tropical fruit and Light body. Group 3 on the other hand, with RR-wooded wines, have unique characteristics such as Woody, Buttery, Sweet Associated, Full body, Nutty and Dried/stewed fruit. Both panels described the wine style groups similarly.

During both sorting tasks consumers used more terms to describe their groupings than the wine experts. The number of descriptors used by consumers increased from uninstructed to instructed sorting whereas the number of descriptors used by wine experts decreased from uninstructed to instructed sorting. Consumers relied on their own descriptors during uninstructed sorting whereas the wine style definitions (Table 3.2), during instructed sorting, influenced them to use more new descriptors. However, the various wine style definitions standardised the experts' vocabulary and therefore they used similar and fewer descriptors in total during instructed sorting.

Overall, there is a clear difference between the wooded and unwooded Chenin blanc wine style characters. Two correlating scales were identified, i.e. the Fresh-Mature and the Light-full body scales, which captures the wine style difference well in terms of a wine-style-continuum. The wooded wines were rated as being more Mature and Full-bodied whereas the unwooded wines contained more Fresh and Light-bodied characteristics. On the other hand, the two wine style groups namely RR-wooded and FF wines are well associated with two different wine style description groups. The rest of the RR-unwooded wines could be represented by a wine-style-continuum between these two main wine styles.

### **3.4 Conclusions**

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It can be reported that this group of South African Chenin blanc wines can be divided according to wooded and unwooded wine styles (i.e. RR-wooded versus FF wines); however, the rest of the Chenin blanc wine spectrum formed a continuum of wine styles that can be positioned



between these two extremes. These continuum wines can possibly be differentiated from one another according to their freshness/maturity and/or light-bodiness/full-bodiness. This factor can further be researched in more detail using QDA.

There is no influence of wine tasting experience or training on the outcome of Chenin blanc wine style sorting. Therefore, either consumers or wine industry experts can be used to conduct a wine sorting task; however, the wine expert panel is expected to outperform the consumers in terms of describing the various wine groupings as a result of their high level of wine tasting experience. Some differences are, however, observed in terms of the descriptions of various wine styles. The higher the experience or training level, the more precise and consistent the panel used wine descriptors. Novices tend to use a lot more descriptors. Furthermore, expert panellists naturally have a higher level of consensus between one another in terms of the specific attributes that they will use to describe a wine style group than novice wine consumers.

In terms of the sorting instructions, both panels sorted products slightly better when they were instructed in terms of how they should sort products as more variance was explained by the DISTATIS plots. However, results from both sorting tasks and the level of consensus between the two methods indicated that providing a list of descriptions that define the sorted wine style concepts did not change the panellists' abilities to describe and sort the wine style groups (i.e. instructed and uninstructed sorting tasks both delivered the same results).

The DISTATIS statistical analysis method delivers reliable configurations that are similar to those obtained from MDS, but as it incorporates the individual panellist variances as well it creates much more concise groupings.

No statistical differences (Rv-coefficient analysis) were found between the configurations of any of the sorting configurations. This indicates that the same sorting structures can be obtained from consumer and expert panels, and also during instructed and uninstructed sorting methods. The level of wine tasting experience and sorting instructions therefore did not have a statistically significant effect on the manner in which the sorting tasks were conducted.

Even though similar results were obtained from all sorting tasks, descriptive data differed somewhat between instructed and uninstructed sorting tasks for the two panels. It is suggested that instructed sorting should be used in the case of a wine expert panel to classify the various wine styles. The experts must therefore first reach consensus about the various wine style definitions before the uninstructed sorting and description task. This ensures that all panellists use the same reference framework to sort and describe the wine groups.

When using a consumer panel to perform wine style sorting tasks, it is suggested that uninstructed sorting should rather be used as a description list only motivates the panellists to use too many different descriptions which complicates the data analysis procedure. Due to the fact that that young, novice wine consumers often have a limited vocabulary for describing Chenin blanc aroma characteristics, it is expected that they generally use less and similar descriptors for the wines in uninstructed sorting.

The sorting technique can therefore be used successfully both in the wine industry, as well as in research institutions to identify various wine styles within a specific sample set. It can also be used to identify where problem areas reside, i.e. when some wine styles seem to be amalgamated with one another which may cause confusion amongst consumers in the market. Intensive conventional sensory profiling such as QDA could be used in order to investigate these finer differences between wine styles, which will be evaluated later by the researchers as well. Overall the sorting task is an easy, simplistic, effective, time saving and economical sensory classification and profiling method in terms of the identification and description of various wine styles of a specific wine cultivar group.

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# Chapter 4

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## RESEARCH RESULTS

### QDA versus sorting: profiling and classifying Chenin blanc wine styles

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### Abstract

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The vast variety of South African Chenin blanc wine styles is causing confusion amongst wine consumers who often struggle to distinguish between these wine styles. The question arises whether these different wine styles can be classified and profiled as separate style groups. The classification of these wine styles can furthermore, be used during marketing efforts. Quantitative descriptive analysis (QDA) is renowned as one of the most accurate and reliable sensory profiling techniques, however, it is often impractical for industry usage due to the cost and time that it requires. A discriminating method, the free sorting task, has been developed in order to substitute QDA as it is much less costly and more time-efficient. To the researchers' knowledge it has not yet been established whether the sorting task can be adapted to effectively classify and profile the various Chenin blanc dry wine styles similarly than QDA. The purpose of this research was to compare QDA with an uninstructed sorting task and a wine style instructed sorting task in terms of the methods abilities to classify and profile a sample set of Chenin blanc dry wines. Some degree of wine style classification was found, especially in terms of wooded and unwooded Chenin blanc wines. The more complex unwooded Chenin blanc wines formed a continuum between the wooded and fresh, unwooded wines. Neither the sorting instructions nor the level of panelist wine expertise influenced the sorting results. Similar results were obtained from the sorting tasks and QDA; however, QDA is more effective in terms of discriminating between the complex unwooded Chenin blanc wines on a continuum.

### 4.1 Introduction

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In the sensory research field one of the most often used conventional profiling methods is quantitative descriptive analysis (QDA) known for its excellent ability to deliver reliable, precise and consistent quantitative and qualitative results (Lawless and Heymann, 2010:227). According to Lawless and Heymann, 2010:227, descriptive analysis methods such as QDA are considered to be the most sophisticated tools in sensory science. Not only does QDA enable a sensory researcher to obtain objective, quantified and qualified intensity information which can easily be statistically analysed, but it can be used in both food and non-food fields (Lawless and Heymann, 2010:228). However, this technique has a fair number of disadvantages as well, especially in terms of its practicality during scientific research projects. QDA requires a substantial amount of time for the training phase and it is also quite expensive. Therefore QDA is not well suited for frequent conduction (Kemp, Hollowood and Hort, 2009; Meilgaard, Civille and Carr, 2006; Stone and Sidel, 2004). Researchers often use QDA to describe wine attributes and the intensities at which these attributes can be perceived in specific wine samples.

Various new methods have been developed over the past few years to obtain results faster and in a more cost-efficient manner (Guinard *et al.*, 2001). In 1984, Williams and Langron formulated a completely new and different method that aims to substitute QDA. This new technique (i.e. free choice profiling) does not require the assessors to be screened or trained as they are free to describe and evaluate the products in their own way (Marshall and Kirby, 1988; Oreskovich, Klein and Sutherland, 1991). Flash profiling was thereafter also invented (Dairou and Sieffermann, 2002) which is a combination of free choice profiling and a comparative evaluation of the whole product set. Projective mapping (or Napping®) was also developed. Risvik *et al.* (1994; 1997) described the use of projective mapping which they developed in

parallel with Napping® in the 1980's and 1990's (Kennedy and Heymann, 2009; Risvik, McEwan and Rødbotten, 1997; Risvik *et al.*, 1994; Pagès, 2005). Finally a cost and time efficient method called the free sorting task was also developed in the late 1960's and early 1970's and was generally used for studies of word meanings by Rosenberg and Kim (1975) and Rosenberg *et al.* (1968).

Secondly, as the vocabulary generated by the trained panel is specific to the sample set used during QDA one cannot generalise the findings to other products. Therefore different panels must be trained for different product types and this process can easily become too financially strenuous for some companies to commit to (Bitnes *et al.*, 2007). Another way to generalise to other products is to re-train the same panel on a different product sample set. This re-training process will also result in a long time-delay and high costs (Chollet *et al.*, 2011). Another common disadvantage is that panellists generally use the attribute intensity scales differently which results in relative differences between products instead of absolute differences (Lawless and Heymann, 2010:237). This can be corrected by continuously checking the panel for consistency and consensus during the training phase with the use of specific software packages such as *PanelCheck®*, V1.4.0, NOFIMA, Norway which is a freeware R-based program (Lawless and Heymann, 2010:244).

The sorting task is a cost efficient and time saving method (Rosenberg and Kim, 1975; Rosenberg *et al.*, 1968; Lawless and Heymann, 2010:459). The sorting method and corresponding DISTATIS, used to analyse sorting data, has shown good potential in terms of being used as a Chenin blanc wine style classification and profiling tool (see Chapter 3).

The main problem area in this Chapter resides in the *scientific* field with regards to the comparison between profiling and classification methods i.e. QDA versus the sorting method. A wide variety of different South African Chenin blanc wine styles are commercially available today, however, no sensory method is yet used to classify and profile the wine styles of a single cultivar. In the past QDA has been extensively used to produce reliable and accurate sensory profiles for individual wines, however, it is not generally used as a wine style classification method. The sorting method was developed in order to classify products according to perceived similarities and to substitute the use of QDA. It is therefore important to investigate which method, QDA versus sorting, should be used to investigate whether there are different Chenin blanc wine style groups. The question therefore arises: how does sorting compare to QDA in terms of profiling and classifying wines according to various wine style groups?

## 4.2 Materials and methods

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In total five different experiments were conducted (four of which has already been described in Chapter 3). Uninstructed and instructed sorting tasks were completed by both wine experts and untrained wine consumers (see Chapter 3). Thereafter QDA was conducted by nine trained panellists and the general descriptions obtained from the sorting tasks were used in order to train the QDA panel. This was done to ensure that the final projections could easily be compared with one another. In this Chapter the focus is therefore placed on QDA.

For the QDA sensory method a randomised complete block design (RCBD) was used, i.e. each wine sample was randomly assigned to each panellist within each block or session (Lawless and Heymann, 2010:70). There were thus three blocks for QDA which represents each replication test session. The reason for randomised product orders was to prevent any carry-over effects from distorting the final data (Lawless and Heymann, 2010:72).

The main aim of this study was to investigate how the sorting technique compares to the conventional QDA method in terms of profiling and classifying the wines of different wine styles.

Furthermore, this study investigates the use of three sensory profiling panels that differ in terms of their training or wine tasting experience levels during the uninstructed sorting and QDA.

#### **4.2.1 Wines**

Eleven commercial wines, selected from the 2010 John Platter (Platter and Van Zyl, 2011) and the top 12 Chenin blanc Challenge wines (Wine Info, 2011), were used during all experimental procedures to represent the three dry Chenin blanc wine styles namely four Fresh and Fruity wines (FF), three Rich and Ripe wooded wines (RR-wooded) and four Rich and Ripe unwooded wines (RR-unwooded). See Chapter 3, Table 3.1 for wines' details and the wine selection process. All samples were tasted in air-conditioned rooms of 21°C with normal lighting (white lights).

#### **4.2.2 Sensory evaluation panel composition for QDA and sorting tasks**

Three different panels were used during this study for various sensory tasks. These panels all differ from one another in terms of their training or experience level with regards to wine tasting and evaluation. Two sorting task panels were used namely a Chenin blanc wine expert panel (N = 12), as well as an untrained wine consumer panel (N = 20) to perform instructed and uninstructed sorting tasks (see Chapter 3 for more details).

A trained panel of nine women, between the ages of 25 to 65 years old, was used to profile the eleven Chenin blanc wines during QDA. They are all permanently employed panellists of the Department of Food Science, Stellenbosch University. They all have at least three years experience of wine-QDA projects and they have been profiling dry Chenin blanc wines a month before this project. The total training time could be reduced, because panellists were familiar with both the QDA procedures, as well as the Canadian data capturing program (*Compusense Five®*, *CompuSense, Canada*).

#### **4.2.3 Sorting task designs and procedures**

For detailed descriptions of the sorting task designs and procedures refer to Chapter 3. Two sorting tasks, uninstructed and wine style instructed sorting, were conducted by both the untrained wine consumers and the wine experts to obtain similarity groups and descriptions of the Chenin blanc wines. During uninstructed sorting, panellists used their own similarity criteria to sort the wines. Wine experts defined the wine style concepts namely: FF, Rich and Ripe (unwooded) and Rich and Ripe (wooded) (see Chapter 3, Table 3.2). Thereafter panellists from both groups used these wine style definitions to sort wines according to the three Chenin blanc dry wine styles. They could also create other groups if they needed to do so.

#### **4.2.4 QDA design and procedures**

The first section of QDA involved product familiarisation and establishing suitable attributes and aroma standards for the sample set. Panellists were calibrated to correctly identify and scale the wine attribute intensities. Unstructured intensity scales (0-100) were used to rate the attribute intensities of the eleven selected wines. A 0 represented nothing present and 100 represented intense. The panel was trained per Chenin blanc wine style, first all four FF wines, then all three RR-unwooded wines and finally the four RR-wooded wines, to effectively compare the different wine styles with one another. The wine descriptors obtained during sorting were used to train the panel in order to simplify the training procedure and also improved the comparability of QDA and sorting data. Main tier descriptors were used from the Chenin Blanc Association's Chenin

blanc wine aroma wheel (Smith, 2010), rather than primary descriptors. Descriptors therefore had a high communication value for industry end-users (winemakers and consumers) because it was obtained from both wine consumers and wine experts (Lawless and Heymann, 2010:231).

The number of synonym descriptors obtained during the sorting tasks was simplified with the use of the Chenin blanc aroma wheel (see Addendum C). Various attributes such as pineapple, guava, melon and passion fruit were grouped under the main tier Tropical fruits. During QDA aroma identification and concept training a number of aroma standards, associated with the Tropical fruits descriptor, such as guava, tropical, melon and passion fruit were used (see Addendum C, Table C.1). Aroma standards were created either by spiking a Chenin blanc wine base with a concentrated aroma flavour or by using the raw product. A wine attribute definition list, sensory lexicon, was also used to clarify the difference between attribute descriptions (see Addendum C, Table C.2).

During the training phase the panellists scaled attribute intensities on paper ballots. However, during the test phase they quantified the sensory attribute intensities on a computer line scale of 10 cm long ranging from values 0 to 100. Reference points were added to each of the computer intensity line scales which the panellists could use as a baseline measurement for a specific attribute (Lawless and Heymann, 2010:155). Two control samples representing two extreme wine styles (FF and RR-wooded) were used both during training and data capturing sessions to standardise panellists to some extent. The panel received three training days (aroma, palate and final training); one rest day before data capturing and three consecutive replication tests on the final test day.

During the aroma training period, the panel was exposed to 20 aroma standards representing the 14 main tier aroma descriptors used to profile the wines. The descriptive panel agreed on the final descriptive list for the eleven wines. Two additional aroma intensity scales were added namely a Fresh-Mature scale as well as a Light-Full Body scale. The Fresh and Light Body interval labels were positioned at the 0 point of the computer line scales; whereas the Mature and Full Body labels were positioned at the 100 point. These scales were included in QDA as sorting panels could differentiate between light and heavy wines as well as fresh versus mature/ripe wines (see Chapter 3, Table 3.3). These two scales could potentially discriminate between Chenin blanc wine styles on a continuum basis instead of separate wine style groups. The following aroma descriptor intensities were evaluated for each of the eleven wines: Freshness or Maturity, Light Body or Full Body, Tropical Aroma, Citrus Aroma, Fresh Peach/Apricot Aroma, Dried apples/pears Aroma, Mixed dried fruit Aroma, Rich/Stewed fruit Aroma, Floral/Perfume Aroma, Sweet Associated Aroma, Vegetative/Green Aroma, Woody Aroma, Nutty Aroma, Spicy Aroma, Buttery Aroma and also Earthy (Hay and Wax) Aroma.

During the palate training sessions the panel had to score each wine according to the following flavour characteristics: Fresh Fruit Flavour, Stewed/Ripe Fruit Flavour, Vegetative/Green Flavour, Woody Flavour, Sweetness, Acidity, Bitter Taste and Astringency.

During the final training session the panellists compared wines with maximum intensities versus wines with minimum intensities of each flavour and aroma attribute in order to ensure that everyone agreed on the attribute intensity scores.

#### **4.2.5 Statistical analyses**

For descriptions of the sorting statistical analyses methods, refer to Chapter 3, section 3.6.2. Three QDA replicate tests were completed by the trained panel. A randomised complete block design (RCBD) was used, i.e. each wine sample was randomly assigned to each panellist within each block or session (Lawless and Heymann, 2010:70). The QDA data capturing was



conducted with the use of *Compusense five*®, *CompuSense, Canada* which is compatible with Norwegian panel monitor software *PanelCheck*®, *V1.4.0, NOFIMA, Norway*. QDA data were exported directly into *StatSoft STATISTICA 10*® for further statistical analysis. PCA was conducted on the QDA data to investigate the underlying principal components that define the product positions. ANOVA's and Pearson's correlation analyses were conducted to investigate possible relationships between descriptors and differences between the wine styles.

Rv-coefficient analyses were conducted to investigate the consensus between different DISTATIS configurations obtained from the expert panel and the untrained panel during the two sorting tasks. An Rv-coefficient close to 1 indicates a strong level of agreement between two configurations, i.e. they are similar to one another. Rv-coefficient analyses were also used to investigate the consensus between DISTATIS and PCA configurations. Where necessary all decimal numbers were rounded up to two decimals. As a basis of comparison an Rv-value of 0.68 is considered to be a good level of agreement between two configurations (Tang and Heymann, 2002).

### 4.3 Results and discussions

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The following section will mainly discuss QDA results and give a brief overview of the sorting results. For a detailed discussion of the sorting results refer to Chapter 3.

#### 4.3.1 Sorting results

With regards to the sorting method, it was found that both the Chenin blanc expert panel and the novice consumer panel could be used successfully to sort the various wines into different wine style groups. Both panels agreed in terms of the RR-wooded category classification, whilst the differentiation between FF and RR-unwooded wines seems to be less certain.

In terms of the two different sorting techniques, the specific wine style sorting instructions did not influence the way that these panels sorted wines. In other words similar sorting groups were obtained from both panels during both instructed and uninstructed sorting procedures.

The consumers consistently used more descriptors than the experts during both sorting tasks. However, the number of descriptors used by consumers increased from uninstructed to instructed sorting whereas the number of descriptors used by the experts decreased from uninstructed to instructed sorting. The consumer panel, that used their own descriptors during uninstructed sorting, were possibly encouraged to use more of the new terminologies provided to them during instructed wine style sorting. In the case of the experts it is possible that the wine style definition standardised their vocabulary and therefore they used more similar and fewer descriptors during instructed sorting.

It is therefore suggested that instructed sorting should be used in the case of a wine expert panel to classify the various wine styles. The experts must therefore first reach consensus about the various wine style definitions which ensures that they all use the same reference framework to sort and describe the wine groups. When using a consumer panel to perform wine style sorting tasks, it is suggested that uninstructed sorting should rather be used as a description list only motivates the panellists to use too many different descriptions which complicates the data analysis procedure. Due to the fact that that young, novice wine consumers often have a limited vocabulary for describing Chenin blanc aroma characteristics, it is expected that they generally use less and similar descriptors for the wines in uninstructed sorting.

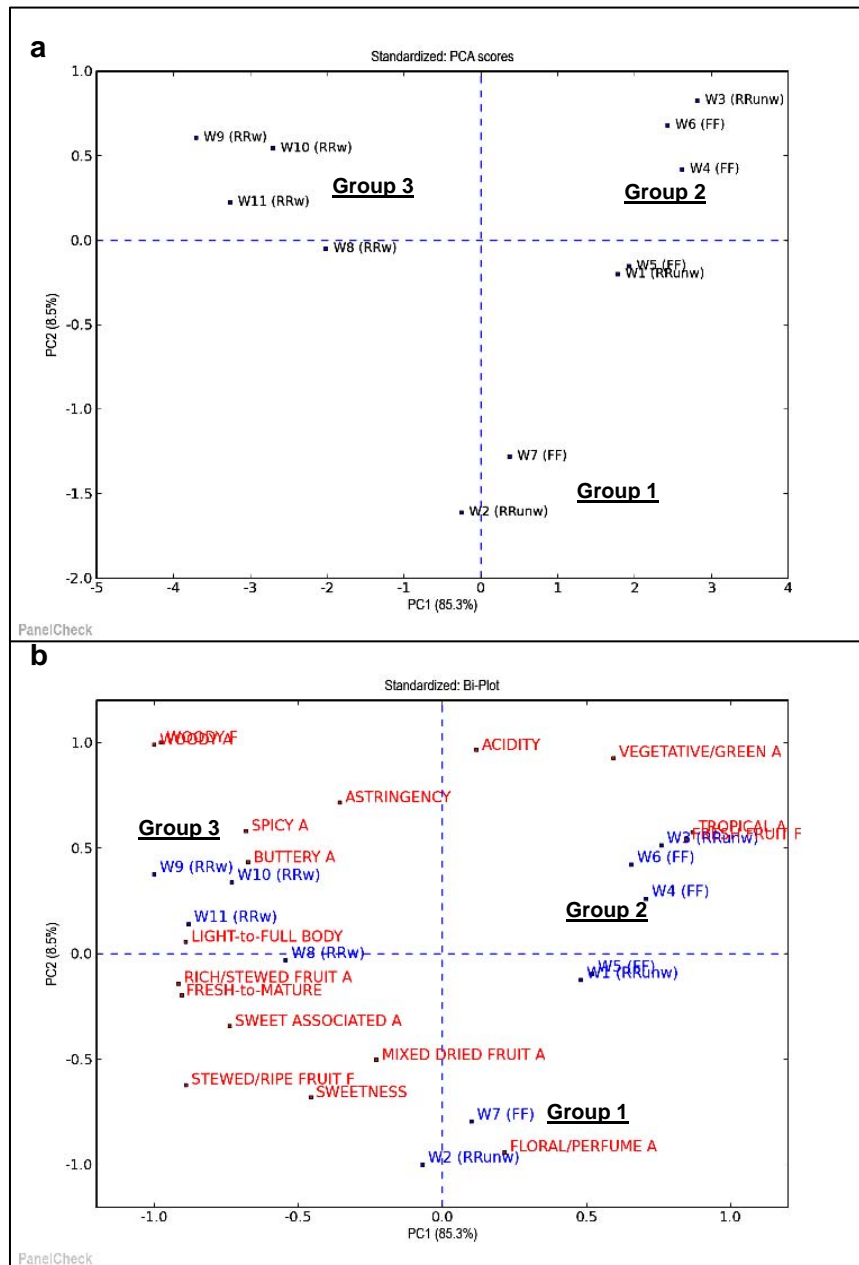
### 4.3.2 QDA results

Standardised Tucker plots from *PanelCheck®*, V1.4.0, *NOFIMA*, Norway indicated that the panellists were homogeneous in terms of their wine profiling data and well trained. Tuckerplots were also used to identify which attributes significantly contributed to the sensory profiles of the wines (refer to Addendum B). The following attribute intensities were all scaled similarly by the panellists: Fresh-to-Mature scale, Light-to-Full body scale, Tropical Aroma, Rich Stewed Fruit Aroma, Floral/Perfume Aroma, Sweet Associated Aroma, Vegetative/Green Aroma, Woody Aroma, Spicy Aroma, Buttery Aroma, Fresh Fruit Flavour, Stewed/Ripe Fruit Flavour, Woody Flavour, Sweetness, Acidity and Astringency.

The PCA plot in Fig. 4.1.a (obtained from *PanelCheck®*, V1.4.0, *NOFIMA*, Norway) was constructed on the first two principal components (PC's) which explained a total of 93.8% variance in the data. This plot indicates how the product samples can be positioned relative to one another according to their various aroma and flavour intensities (Fig. 4.1.a). The plot captures a large amount of variance in the first PC (85.3%) which means that there is a significant level of confidence in the product sample positions relative to one another. All the wooded wines were similarly perceived as they are clearly grouped together on the PCA (Group 3). On the other hand a large, but less concise, group was formed opposite the wooded wine style group which mostly contains FF wines (Group 2). These wines are not wooded and their sensory characteristic intensities are directly the opposite of the wooded wines' sensory characteristic intensities. Due to the fact that that PC1 clearly separates wooded wines from unwooded wines it is therefore mostly explained by the wines' wood index. A third unwooded group of wines is also visible between these two groups (Group 1).

A PCA plot, explaining 94.6% of the data variation in the first two PC's, was also investigated which contains both the descriptors as well as the various Chenin blanc wine sample groupings (Fig. 4.1.b). When evaluating this plot it is clear that certain descriptors associate with specific wine style groups more intensely than other wine style groups.

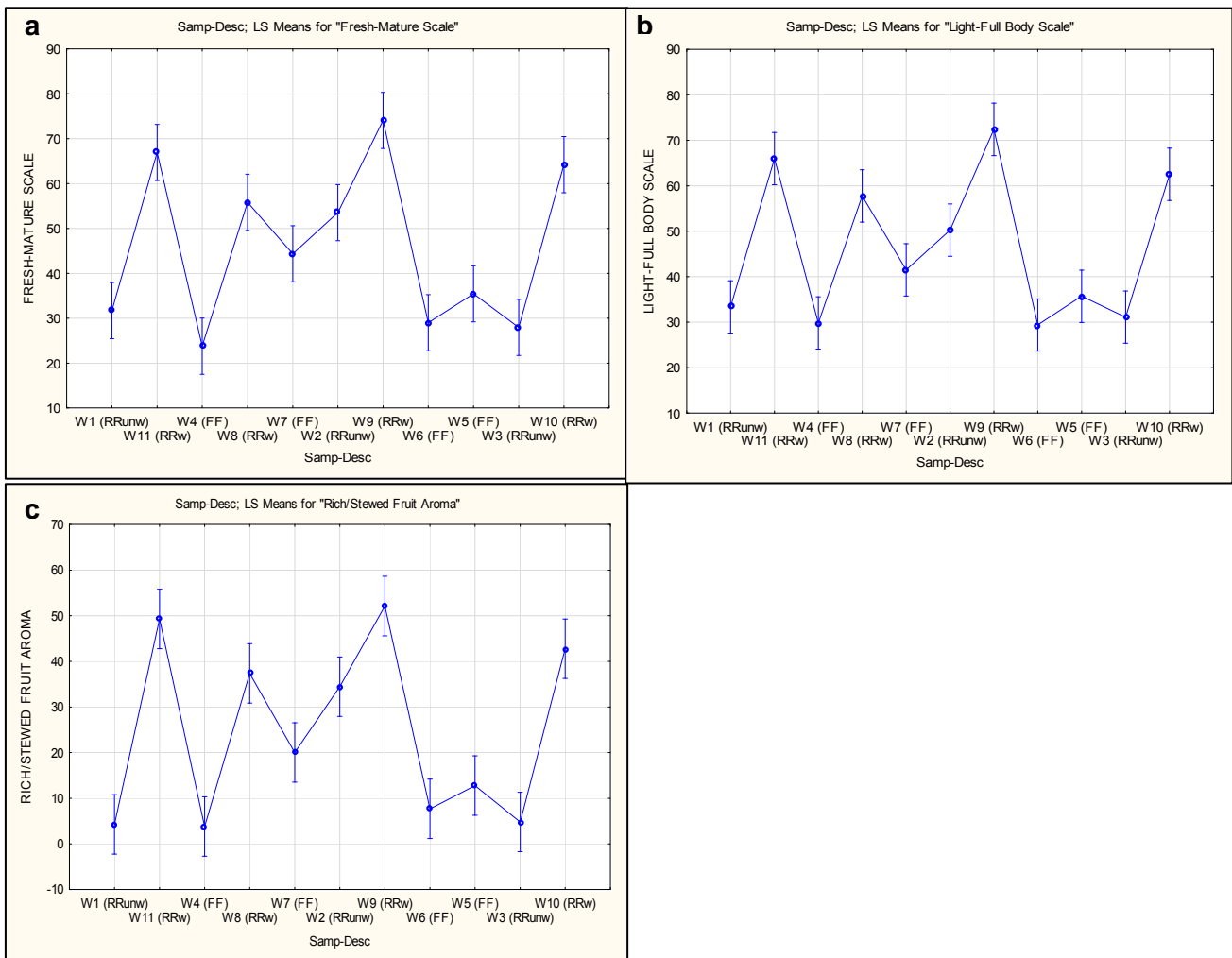
The RR-wooded wine group (Group 3) is associated with: Buttery Aroma, Woody Aroma, Woody Flavour, Spicy Aroma, Astringency, Full body, Maturity, Rich/stewed fruit Aroma, Sweet Associated Aroma and Stewed/ripe fruit Flavour. The general FF wine style group (Group 2) is associated with: Tropical Aroma, Fresh Fruit Flavour and also Vegetative/Green Aroma. Due to the fact that that this group opposes the Fresh-Mature indicator this group is strongly associated with the Fresh scale section. Similarly the Light-Full Body indicator is also directly opposite to Group 2 on the other side of the origin which indicates that the Light Body characteristic can strongly be associated to this group. Group 1 consist of two wine samples (a FF and a RR-unwooded wine) which strongly associate with Floral/Perfume Aromas and Sweetness. It also shares some of Group 3's characteristics such as Stewed/Ripe Fruit Flavour and Sweet associated Aroma.



**Figure 4.1:** The trained panel's (a) standardised principal component analysis plot of Chenin blanc wine style samples and (b) plot indicating Chenin blanc wine sample positions relative to the descriptors (aroma and flavour) (Obtained from *PanelCheck*®, V1.4.0, *NOFIMA*, Norway). Where F+F are Fresh and Fruity wines, R+R unw are Rich and Ripe unwooded wines and R+R w are Rich and Ripe wooded wines.

When evaluating Fig. 4.1b it is clear that there is a relationship between Woody Flavour and Woody Aroma as well as between Fresh Fruit Flavour and Tropical Aroma. There also seems to be a relationship between the Light-Full Body Scale and the Fresh-Mature Scale ratings (Fig. 4.1.b). When evaluating the least significant means plots (LS Means) for each of these two scale ratings for each of the eleven wines (Fig's. 4.2.a and 4.2.b) it is clear that the two plots are similar to one another. Therefore the more Mature a wine is perceived, the more Full Bodied it will also be perceived, whereas a Fresher wine sample will be perceived as being light bodied. The Mature section of the Fresh-Mature Scale might also be related to the Stewed/Ripe Fruit Flavour and Rich/Stewed Fruit Aroma scales. In relation to the Mature section of the Fresh-Mature scale it seems that the Fresh side of this scale is strongly represented by descriptors that appear directly opposite from the Fresh-Mature scale, through the origin of the

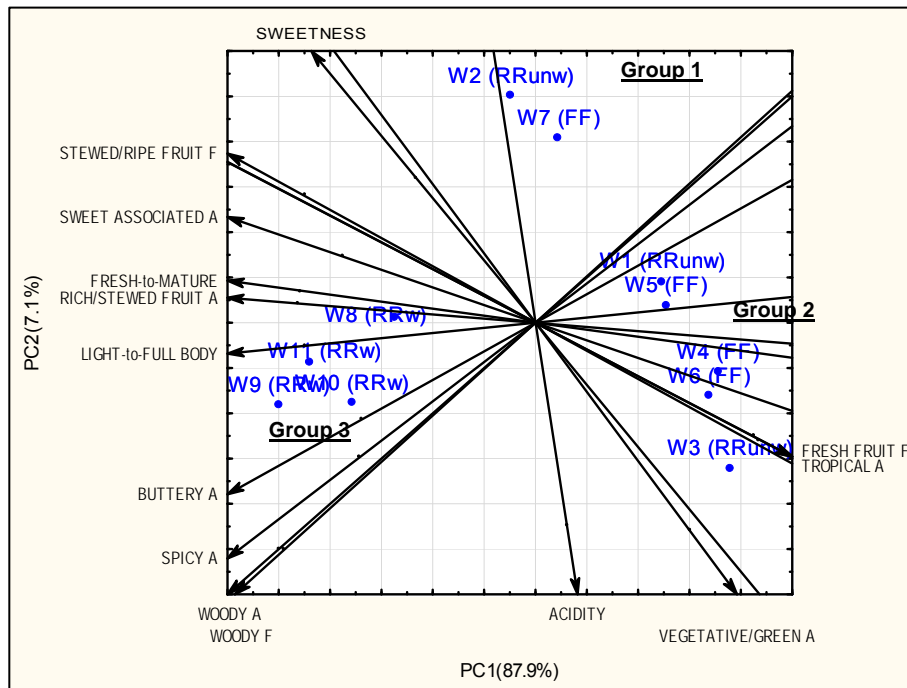
plot, such as Fresh Fruit Flavour, Tropical Aroma and Vegetative/Green Aroma. When investigating the least significant means plot for Rich/Stewed Fruit Aroma (Fig. 4.2.c) it is similar to the Fresh-Mature scale LS means plot (Fig. 4.2.a) which indicates a possible relationship.



**Figure 4.2:** Least significant means plots of the (a) Fresh-Mature Scale, (b) Light-Full Body Scale, and (c) Rich/Stewed Fruit Aroma for the eleven wine samples (obtained from *StatSoft STATISTICA 10®*). Where FF are Fresh and Fruity wines, RandR unw are Rich and Ripe unwooded wines and RandR w are Rich and Ripe wooded wines.

After evaluating the tuckerplots, obtained from *PanelCheck®, V1.4.0, NOFIMA, Norway* (data not shown), the individual significant wine descriptors were identified ( $p < 0.05$ ). For the purpose of this study only these descriptors with intensities that significantly correlated with the wine samples ( $p < 0.05$ ) in the tuckerplots, were used for further statistical analysis. These attributes formed the main descriptors that will classify wines in the wine set: Fresh-Mature scale, Light-Full body scale, Tropical aroma, Rich/Stewed Fruit aroma, Sweet Associated aroma, Vegetative/Green aroma, Woody aroma, Spicy aroma, Buttery aroma, Fresh Fruit flavour, Stewed/Ripe Fruit flavour, Woody flavour, Sweetness and Acidity.

The PCA scatterplot (Fig. 4.3), conducted on these fourteen significant attributes, illustrates the wine sample positions as a function of the samples' descriptor intensities. Three different product groups are clear: (1) wooded wine group, (2) relatively large group containing both FF and RR-unwooded wines and lastly (3) a FF and a RR-unwooded wine are grouped together.



**Figure 4.3:** Principal component analysis scatterplot of eleven Chenin blanc wines according to all the significant descriptors (obtained from *StatSoft STATISTICA 10®*). Where FF are Fresh and Fruity wines, RRunw are Rich and Ripe unwooded wines and RRw are Rich and Ripe wooded wines. A is Aroma and F is Flavour.

The first important point is the fact that PC1 in Fig. 4.3 explains the highest amount of variance between the wine positions (87.9%) whilst PC2 only explains 7.1% of the variance, but combined these two principal components explain a total of 95% of the variance observed in the data set. This is a strong representation of the amount of variance explained in the data. It is important to note that the Fresh-Mature scale and the Light-Full Body scale have two opposite extremes. The Fresh-Mature scale indicates high intensity of the Fresh characteristic in wines versus high intensity of Mature characteristic; and the Light-Full Body scale opposes high intensity of Light Body characteristic versus the high intensity of Full Body characteristic. The arrow section of the vector indicates intense Maturity or intense Full-Body characteristics. On the other hand the tail-end of the vector indicates high intensity of Freshness or high intensity of Light-Body characteristics.

The various groupings in Fig. 4.3 can therefore be associated with the descriptors as follows: The unwooded wine group on the right-hand side of PC1 is strongly associated with: Fresh Fruit Flavour, Freshness, Light-Body and also Tropical Aroma. However, this wine group has low intensities of Stewed/Ripe Fruit Flavour, Sweet Associated Aroma, Rich/Stewed Fruit Aroma, Buttery Aroma, Wood Aroma, Wood Flavour and Spicy Aroma. On the other hand the wooded wine group on the left-hand side of PC1 is strongly associated with high intensities of Stewed/Ripe Fruit Flavour, Sweet Associated Aroma, Rich/Stewed Fruit Aroma, Buttery Aroma, Wood Aroma, Wood Flavour and Spicy Aroma. Furthermore, they are also described as Mature and Full bodied wines with little Fresh Fruit Flavour and Tropical Aroma. The wooded wines are also poorly rated in terms of Vegetative/Green characteristic intensity, however, these wines associate fairly well with high intensities of Sweetness. The remaining group with only two wines (W2 and W7) is generally defined by PC2 and contains low acidity and Vegetative/Green aroma intensities but high intensities of Sweetness.

In an effort to investigate the possible relationships between the QDA descriptors used to profile the wines, non-parametric correlation analyses were conducted namely Pearson's

correlation coefficient analyses, which indicate all the possible correlations in the data set (see red correlation values in Addendum B, Table B.1). Correlation values with  $p < 0.05$  indicate significant correlations between two descriptors. A large variety of correlations was found in this descriptor dataset and it appears that only Acidity has slightly lower correlations than the rest of the descriptors. A factor analysis, conducted with only one factor, explain 83% of the variance which indicates strong inter-correlations between the fourteen product descriptions. Two groups of descriptors were identified which are negatively related to one another but there is a strong relationship between the various descriptions within each group.

In the one group the following descriptors are strongly and positively related: Maturity, Full-body, Sweet Associated Aroma, Rich/Stewed Fruit Aroma, Woody Aroma, Spicy Aroma, Buttery Aroma, Stewed/Ripe Fruit Flavour, Woody Flavour, Sweetness ( $r > 0.65$ ,  $p < 0.05$ ). In this instance we accept that a correlation of  $r = 0.5$  is relatively strong considering that there are many factors, such as human error, that can influence the data output. Spicy Aroma was not significantly correlated with either Sweetness or Sweet Associated Aroma ( $p > 0.05$ ). The Fresh-to-Mature scale and the Light-to-Full body scale had the highest correlation value ( $r = 0.97$ ,  $p < 0.05$ ) together with Rich/Stewed Fruit Aroma and the Fresh-to-Mature scale (i.e. maturity) which also had  $r = 0.97$ ,  $p < 0.05$  (also see Fig. 4.2). Wine Freshness will thus increase as Light-body characteristic increases and *visa versa*. Similarly Maturity will increase as the wine's Full-body characteristic increases. Rich/Stewed Fruit Aroma will also increase as wine Maturity increase and *visa versa*. The other group of correlating descriptors are: Tropical Aroma, Fresh Fruit Flavour and Vegetative/Green Aroma. The Freshness and Light-body characteristics of the Fresh-to-Mature and Light-to-Full body scales are strongly correlated with this group's descriptors. The odd descriptor, Acidity, which does not seem to fit into any of the two groups, is strongly correlated with Vegetative/Green Aroma ( $r = 0.76$ ,  $p < 0.05$ ); but Acidity is also strongly negatively correlated with Sweetness ( $r = -0.75$ ,  $p < 0.05$ ) and Stewed/Ripe Fruit Flavour ( $r = -0.68$ ,  $p < 0.05$ ). The Acidity descriptor and correlating descriptors are explained by PC2, whereas the previously mentioned two descriptor groups are explained by PC1.

These two main groups of descriptors correlate negatively with one another indicating that these two wine groups may represent different Chenin blanc wine styles. In Figures 4.1b and 4.3 the RR-wooded wines are closely associated with the first group of correlating descriptors. On the other hand the unwooded wines (FF and RR-unwooded) are strongly related to the descriptors in the second group. Two correlated attribute intensity scales, the Fresh-to-Mature and the Light-to-Full body scales, effectively captured the wine style differences in the form of a wine-style-continuum. Therefore wooded wines are Mature and Full-bodied whereas the unwooded wines are Fresh and Light-bodied.

### **4.3.3 Comparison between sorting method(s) and QDA in terms of the various obtained Chenin blanc wine style groupings**

According to Tang and Heymann (2002); Faye *et al.* (2004, 2006); and Saint-Eve *et al.* (2004), the sorting task results are comparable with those results obtained from QDA. In other words MDS configurations obtained from sorting, from panels with various expertise levels, can easily be compared to PCA configurations obtained from QDA (Cartier *et al.*, 2006). In another study, comparing QDA with the sorting task using jellies, Blancher *et al.* (2007) found that an additional description phase provided sorting maps that were similar to those of QDA. When comparing the current sorting methods with QDA it is clear that these techniques deliver similar results in terms of Chenin blanc wine style groupings. Similar wooded wine style groups were found, but there was some confusion with regards to the classification of the unwooded wines (FF and RR-

unwooded) during both QDA and sorting methods. All the MDS, DISTATIS and PCA plots clearly indicated that the RR-unwooded wines are not consistently grouped together and often migrates into the FF wine style group. Although there were no significant differences between the sorting configurations obtained from both panels, the expert panel's instructed sorting DISTATIS configuration explained the most variance and is therefore the most valid panel-sorting-method combination. The three prominent groupings on the PCA plot (Fig. 4.1.a) are similar to the expert panel's groupings during instructed sorting (Chapter 3, Fig. 3.3.a). Similar descriptive data, obtained from both QDA and expert instructed sorting, were often grouped together with similar wine style groups (Chapter 4, Fig. 4.1b and Chapter 3, Fig. 3.3.b).

High consensus levels were found between the DISTATIS plots of both sorting tasks (from both the expert and consumer panels) versus the PCA plot (from the QDA trained panel) (see Table 4.1). Several other researchers also found that they could successfully use untrained panellists to obtain MDS maps that are similar to the PCA maps obtained during conventional profiling (Chollet *et al.*, 2011; Faye *et al.*, 2004; Lim and Lawless, 2005). This indicates that QDA and the sorting techniques delivered the same results in terms of the groupings of the various Chenin blanc wine styles. Furthermore, there were no differences between the various panels in terms of their data output (all Rv-values were larger than 0.75, see Table 4.1). However, the DISTATIS plot obtained from the expert panel during instructed sorting had the highest level of agreement with the PCA plot obtained from the trained panel during QDA (Rv = 0.93).

In essence the sorting task (with or without sorting instructions) and the QDA method can be used to sort various Chenin blanc wine styles. There was no difference in terms of the consensus between the Chenin blanc expert panel; the young wine consumer panel; or the trained panel, which means that they can all be used to sort wines according to their various Chenin blanc wine styles. Thus neither the sorting instructions nor the level of panellist wine tasting experience influenced the wine style groupings significantly. Even though these Rv-values are high it might be somewhat misleading as the wooded wine attribute could be responsible for driving the high level of agreement between panels and between sensory methods. The fact that wooded wines were consistently grouped together by both the consumer sorting panel; the expert sorting panel; as well as the QDA trained panel could possibly be the dominant factor that drives high consensus levels between panels and tasks. This is also a clear indication that the Chenin blanc wines can definitely be well sorted according to wooded styles and unwooded styles.

**Table 4.1:** Consensus between expert panel, untrained consumer panel of the two sorting tasks (instructed and uninstructed) and the trained panel of the QDA method (Rv-coefficient analysis) (obtained from StatSoft STATISTICA 10®)

Panel*sorting session	Rv-coefficient value	Confidence level
Expert 1 vs QDA	RV=0.86	p<0.01
Expert 2 vs QDA	RV=0.93	p<0.01
Consumer 1 vs QDA	RV=0.78	p<0.01
Consumer 2 vs QDA	RV=0.76	p<0.01

#### **4.3.4 Comparison between sorting method(s) and QDA in terms of the various Chenin blanc wine style descriptions**

According to literature one can obtain similar product maps with the sorting task and QDA (Chollet *et al.*, 2011). This result is consistent with the works of Blancher *et al.* (2007); Cartier *et al.* (2006); Faye *et al.* (2004, 2006); Saint-Eve *et al.* (2004); Tang and Heymann (2002). However, QDA tends to provide more precise and easily interpretable descriptions than those obtained from the sorting task (Chollet *et al.*, 2011). The sorting task provides global information about basic, salient and common characteristics. According to some researchers, QDA cannot reveal latent sensorial interactions (Saint-Eve *et al.*, 2004; Bárcenas, Pérez Elortondo and Albisu, 2003). Saint Eve, Paà-Kora and Martin (2004) also found that QDA does not account for complex perceptions or sensory attribute interactions like the sorting method. It mainly accounts for high impact odorants whereas sorting can include the influence of both overall wine aroma and sub-threshold odorants (Green *et al.*, 2011).

The raw descriptive data obtained, during this research study, from the consumer panel during both sorting tasks required more data clean-up, i.e. identifying and grouping synonyms, than those obtained from the wine experts. Experts are generally more familiar with specific terminologies than the consumers who tend to use their own vocabulary to describe specific characteristics. Fewer descriptors were obtained from the expert panel during instructed sorting as their vocabulary was standardised. However, untrained consumers used more different descriptors during instructed sorting, possibly because they were overwhelmed with the descriptor list and used more descriptors than necessary. Due to the fact that consumers are not trained to act as analytical instruments (Nestrud and Lawless, 2008) it becomes more complex to understand how they perceive various products. Training the judges may change the information obtained from the projective maps, but does not provide insight on how consumers perceive the product differences in terms of latent differences (Kennedy and Heymann, 2009). In order to design food products that meet consumer sensory expectations, food companies need information about how consumers perceive the sensory characteristics of the product. It is therefore important to investigate techniques that exclude the need for panellist training, or experts, to obtain effective consumer insights (Faye *et al.*, 2006). Overall, wine style groups were fairly similarly described during both sorting tasks and QDA (Table 4.2).



**Table 4.2:** Sorting task(s) and QDA descriptions that associate strongly with the three wine style groups

Groups	Sorting panel descriptions for wine style groups			QDA panel descriptions for wine style groups
	Sorting task	Wine experts	Untrained consumers	Trained panellists
Group 1 (RR-unwooded)	Uninstructed sorting	<b>Sweet Associated</b> <b>Stone Fruit</b> Light Earthy	<b>Floral/Perfume</b> <b>Stone Fruits</b> Citrus Fruity	<b>Floral/Perfume Aroma</b> Sweetness (Stewed/Ripe Fruit Flavour; <b>Sweet associated Aroma</b> )
	Instructed sorting	<b>Ripe Fruits</b> <b>(Earthy, Tropical fruit)</b>	<b>Stone Fruits</b> <b>Waxy</b> <b>Tropical fruit</b>	
Group 2 (FF wines)	Uninstructed sorting	<b>Fresh fruit</b> <b>Tropical</b> Floral	<b>Fresh</b> <b>Tropical fruit</b> Light body Green/Vegetative	<b>Tropical Aroma</b> <b>Fresh Fruit Flavour</b> <b>Vegetative/Green Aroma</b> <b>Fresh Aroma</b> <b>Light Body</b>
	Instructed sorting	<b>Fresh fruit</b> <b>Citrus</b> <b>Tropical fruit</b> (Stone Fruit)	<b>Fresh</b> <b>Fruity</b> Light body Floral/Perfume Green/Vegetative <b>(Tropical fruit, earthy, citrus)</b>	
Group 3 (RR-wooded)	Uninstructed sorting	<b>Buttery/Caramel</b> <b>Sweet Associated</b> Ripe Fruits Citrus	<b>Smooth</b> <b>Full body</b> <b>Sweet Associated</b> Woody Earthy	<b>Buttery Aroma</b> <b>Woody Aroma</b> Woody Flavour Spicy Aroma Astringency <b>Full Body</b> Mature Aroma <b>Sweet Associated Aroma</b> <b>Stewed/Ripe fruit Flavour</b>
	Instructed sorting	<b>Woody</b> <b>Dried/Stewed fruit</b> Citrus Nutty <b>(Sweet Associated)</b>	<b>Woody</b> <b>Sweet Associated</b> <b>Dried/Stewed fruit</b> Buttery Full body	

#### 4.4 Conclusions

South African Chenin blanc wines can be divided into RR-wooded versus FF unwooded wines; however, the rest of the Chenin blanc wine spectrum form a wine-style-continuum between these two extreme wine styles. The continuum wines can be differentiated from one another according to their level of Freshness/Maturity and their Light-body/Full-body characteristics.

Panellists' wine tasting experience or training does not significantly influence the Chenin blanc wine style sorting results. Therefore, either consumers or wine industry experts can be used to conduct a wine sorting task; however, the wine expert panel is expected to outperform the consumer panel in terms of describing the various wine groupings. The more wine tasting experience a panellist has (e.g. wine experts), the more precise and consistent the panel will use certain wine attribute descriptors. Untrained wine consumers tend to use many descriptors, whereas wine experts naturally have a higher level of consensus in terms of the specific attributes that they use to describe a wine style group.

In terms of sorting instructions, both panels sorted slightly better when they were provided with wine style sorting instructions. However, providing panellists with a list of descriptions, defining the wine style concepts, does not significantly influence the panellists' abilities to sort the wines. Similar results were obtained from informed and uninformed sorting tasks.

However, the descriptive data differed somewhat between uninstructed and instructed sorting for both panels. Instructed sorting should be used in the case of a wine expert panel to classify the various wine styles. The experts must first reach consensus about the various wine style definitions before sorting and describing the wines. When using an untrained consumer panel, we suggest that uninstructed sorting should be used, because a description list often motivates consumers to use too many different descriptions which lead to laborious data analysis procedures.

This study proved that similar wine style classifications can be obtained from the sorting task and QDA. Untrained consumers or wine expert panellists during a sorting task can deliver similar results than a QDA trained panel. However, the QDA method remains the best in terms of identifying and quantifying finer wine style differences. Although sorting tasks can easily be used to differentiate between wooded and unwooded wines, the QDA method provided more detail in terms of the unwooded wines' Maturity/Freshness and/or Body description variations.

Even though the sorting task seems like the ideal substitute for QDA (Cartier *et al.*, 2006), it also has a number of downfalls. It has been suggested that the sorting task, followed by a description, is not well adapted for precise descriptions of complex products, but is an interesting tool to probe assessors' perceptions (Lelièvre *et al.*, 2008). In this aspect QDA still remains the best sensory technique to capture precise attribute intensities in various products. Even though consumer panels can be utilised to group wines similarly than wine experts, it is expected that experts will always tend to slightly outperform consumers in terms of describing the various wine groupings. In addition, the description phase only takes place after sorting is completed which means that it can not primarily be viewed as a sensory profiling method. This is due to the fact that the descriptions formulated by panellists refer to groups of products instead of individual products. It is clear that the sorting method is specifically formulated to identify homogeneous products within a product sample set and to profile these product groups.

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# Chapter 5

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## RESEARCH RESULTS

### Investigating Chenin blanc wine style preference drivers and Generation Y wine consumer insights

An excerpt of this manuscript is under preparation for submission of publication in  
**FOOD QUALITY AND PREFERENCE JOURNAL**

## RESEARCH RESULTS

### Abstract

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In South African the production of a wide variety, high quality Chenin blanc wine styles have drastically increased over the last years. The growth of the new Generation Y wine consumer market is demanding more attention from the industry. These young wine consumers often experiment with various wines in order to establish their wine preferences. It has not yet been established whether there are definite drivers of liking for specific Chenin blanc wine styles and whether these Generation Y consumers have a preference for these wines. The purpose of this research was to establish whether Generation Y consumers prefer specific Chenin blanc wine styles and whether their wine preferences are correlated with exploratory data, such as socio-demographics, gender, consumption frequency, purchase behaviour, wine knowledge and purchase occasion. Furthermore, it was also investigated whether the sorting method can be used instead of quantitative descriptive analysis (QDA) to investigate the consumers' various Chenin blanc wine style preferences. QDA is often used together with wine preference data to obtain external preference maps or partial least squares maps which can be used to explain the preference drivers. However, the sorting task can also be used together with preference data to establish whether there are significant differences between consumers' wine style preferences via ANOVA. Generation Y consumers had significantly higher preferences for the wines during an informed wine style preference tasting than during a blind preference tasting. Some interesting correlations were also found in terms of Generation Y consumers' exploratory data and wine style preferences. Both QDA and sorting methods were successfully used to indicate that there are no specific wine style preference drivers for this consumer group. However, QDA remains to be the superior method to investigate preference drivers, because it contains quantitative descriptive data whereas the sorting tasks deliver frequency descriptive data.

### 5.1 Introduction

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A new consumer Generation born between the years 1977 to 2000 (Wolf, Carpenter and Qenani-Petrela, 2005; Thach and Olsen, 2006) is entering the wine industry and presents great potential opportunities. Not only are Generation Y consumers eager to try new products and to establish their preferences for specific brands (Resnick, 2008), but this is the largest growing consumer generation since the Baby Boomer generation (Hammond, 2010), born between the years 1946-1964 (Martin and Tulgan, 2003). The Generation Y wine consumer is therefore approximately categorised between the ages of 21 to 32 years old in South Africa, because the legal drinking age of 18 years old might be readjusted to 21 years by the government in the near future. Various factors influence the wine preferences and purchase decisions of Generation Y consumers such as specific physical product aspects, known as extrinsic factors as well as sensorial aspects, known as intrinsic factors. Personal characteristics of the Generation Y wine consumers can also influence their wine perceptions, preferences and purchase behaviour.

Various types of Chenin blanc wine styles are available today in South Africa (Loubser, 2008). Due to the fact that these young consumers are often not aware of the various Chenin blanc wine styles, they are confused with these commercially available wines namely: Fresh and Fruity (FF), Rich and Ripe unwooded (RR-unwooded) and Rich and Ripe wooded (RR-wooded). In order to understand these consumers' wine style preferences it is important be

aware of their needs, preferences, beliefs and behaviours. It must also be established whether there are Generation Y subsections with specific Chenin blanc wine style preferences. For the purpose of the current study the effects of Generation Y wine consumer exploratory data were investigated in terms of how it influences their wine purchase behaviour and wine style preferences. The exploratory data comprise of: level of wine experience, occasion that the consumer is faced with, self-confidence, gender, wine involvement and lifestyle.

Apart from establishing whether Chenin blanc wines can be separated into different wine style groups (Chapter 3 and Chapter 4) it is also important to investigate the preferences of the new Generation Y wine consumer market for the various Chenin blanc wine styles. Data obtained from trained panels during QDA is generally used to explain consumer preferences obtained during preference tests. This information is important for product development, marketing strategies and to comprehend consumer segments in terms of their needs (Næs *et al.*, 2010:16). Large, carefully selected consumer groups are typically used during preference tests (Lattey *et al.*, 2007). The most widely used techniques for preference assessment are internal and external preference mapping (Arditti, 1997; Dalliant-Spinnler *et al.*, 1996; Greenhoff and MacFie, 1994; Hough and Sanchez, 1998; Jaeger *et al.*, 1998; Mc Ewan, 1996; Monteleone *et al.*, 1998; Murray and Delahunty, 2000; Schlich, 1995), multiple factor analysis (Belin-Batard, Huon de Keradec, and Barthélémy, 1996; Escofier and Pagès, 1990) and partial least square regression (Huon de Kermadec, Durand, and Sabatier, 1997; Murray and Delahunty, 2000). The sorting technique may be used instead of QDA to evaluate the preferences for the various sorted groups (Faye *et al.*, 2006). The specific problem areas addressed in this Chapter relate to both the *industrial* and *scientific* fields.

From an *industrial* perspective it is important to investigate how the new generation of wine drinkers perceive various Chenin blanc wine styles. Generation Y is currently the largest, growing generation and all industries are actively focussing their attentions on this promising market segment. One aim is to investigate if there are consumer clusters with different wine style preferences and how their wine preferences correspond with their exploratory data such as: socio-demographic data, purchase and consumption behaviour, attitudes and beliefs and their subjective wine knowledge. The influence that the consumers' knowledge of the Chenin blanc wine style concepts has on their preferences for the wines was also investigated. This will indicate the potential of Chenin blanc wine style concept marketing to be advantageous in terms of consumer preferences for specific wines.

From a *scientific* perspective no drivers of liking have yet been identified for the different Chenin blanc dry wine styles. This study aims to establish whether sorting data, instead of QDA descriptive data, can be used to explain the drivers of liking for various wine styles. It is not only important to investigate whether the sorting method can describe and classify wine styles similarly to QDA (see Chapter 3 and Chapter 4), but also whether the sorting method can explain consumer preferences. Substituting QDA with sorting will reduce the required research time and financial costs.

## 5.2 Materials and methods

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This Chapter follows on Chapters 3 and 4 which evaluated the use of the sorting task and QDA during Chenin blanc wine style profiling and classification. Generation Y wine consumers' preference and exploratory data were captured in this Chapter.

A blind and informed wine style preference test was conducted. A completely randomised design (CRD) was used where the panellist receive all the samples in random orders to prevent the possibility of carry-over effects (Lawless and Heymann, 2010:72).

## **5.2.1 Wines**

For the purpose of this research study the same wine sample set was used as during the sorting tasks and QDA (see Chapter 3 for details). Eleven Chenin blanc wines were selected from the 2010 John Platter (Platter and Van Zyl, 2011) and the top 12 Chenin blanc Challenge wines (Wine Info, 2011), to represent three of the industry classified Chenin blanc wine styles: four FF wines, three RR-unwooded wines and four RR-wooded wines.

## **5.2.2 Sorting and QDA**

### **5.2.2.1 Sorting and QDA panels**

During a previous study two sorting task panels were used to complete both an uninstructed and an instructed sorting task. These panels were a Chenin blanc wine expert panel (N = 12) as well as an untrained consumer panel (N = 20). A trained panel (N = 9) was also used for QDA. For more detail on these two panels please refer to Chapter 3 and Chapter 4.

### **5.2.2.2 Sorting and QDA designs and procedures**

The eleven Chenin blanc wine samples, representing three Chenin blanc wine styles, were first classified and profiled during sorting tasks and QDA. Uninstructed sorting and wine style instructed sorting tasks were performed by both an expert and a consumer panel. The wine expert panel was also used to define the three Chenin blanc dry wine style concepts. A trained panel identified and quantified the relevant wine attributes of this wine set during QDA. For more details on the sorting tasks and QDA procedures refer to Chapters 3 and 4. Quantitative and qualitative sensory data were therefore obtained from these sensory methods.

## **5.2.3 Preference tests and exploratory research**

### **5.2.3.1 Generation Y wine consumer panel**

During this current study a Generation Y wine consumer panel was used during this study to conduct the two Chenin blanc wine style preference tests and for exploratory research. All consumers were selected from the Stellenbosch and near-Cape Town areas, such as Tygerberg, in the Western Cape, South Africa. The consumer sample group was between the ages of 21 to 32 years old. In order to obtain reliable preference and exploratory data it was important to test a large panel consumer group of between 75 to 150 people (Lawless and Heymann, 2010:7), therefore 150 consumers were tested during this study. Consumers were sourced with the use of a stratified snowball sourcing technique (Lamb *et al.*, 2004:153). This non-probability snowball sampling method reduced sourcing costs and widened the sourcing reach (Statsoft, 2011). Young working consumers, youth societies, church groups, sports clubs, academic departments and university hostels in Stellenbosch and the Tygerberg areas were contacted. They were encouraged to source others who fit the following requirements: consumers between ages 21 to 32 years old, who drink white wine regularly i.e. once a month (Meuller, Francis and Lockshin, 2009). A total of 715 Generation Y consumers were initially sourced. After screening (see Addendum A) all respondents a total of 150 Generation Y consumers were approved and they completed blind and informed Chenin blanc wine style preference tests. Thereafter they also completed exploratory questionnaires (see Addendum A) capturing their socio-demographics, consumption behaviour, attitudes, wine preferences as well as their subjective wine knowledge.



### 5.2.3.2 Blind and informed wine style preference test designs and procedures

Preference tests were conducted over a series of 3 days and 5 sessions in order to accommodate all the selected panellists. In the end a total of 150 consumers attended the wine tasting sessions. All wine samples were served in air-conditioned rooms of 21°C and the sample size was 25ml. Wines were tasted under normal lighting. First these consumers rated their preferences for the eleven wines, on a 9-point hedonic scale, during a blind test where they were unaware of the wine style identities of the samples. Random sample order presentation was used to prevent any carry-over effects.

Thereafter they were provided with the three Chenin blanc dry wine style definitions (FF, RR-unwooded and RR-wooded) obtained from the expert sorting panel. They rated their preferences for three Chenin blanc wines, each representing one of the wine styles. These three wines were also part of blind preference test, but consumers were not aware of this.

### 5.2.3.3 Exploratory research design and procedure

After the preference tests, consumers completed an exploratory research questionnaire (see Addendum A). This questionnaire captured the consumer socio-demographics to validate that they were indeed representative of the Western Cape Generation Y wine consumer market. Furthermore, data about their beliefs towards wine, wine consumption and purchase behaviour, wine preferences and subjective wine knowledge were also captured. The exploratory data were used to identify consumer segment preferences for specific wine styles. Correlations within the consumer exploratory data were also investigated. Exploratory data were combined with the sensory descriptive data to investigate trends within this Generation Y wine consumer group.

## 5.2.4 Statistical analyses

For information about the sorting and QDA statistics refer to Chapters 3 and 4. All preference and exploratory research data were captured with *Microsoft Excel 2007®* and *StatSoft STATISTICA 10®* was used for data analyses. Data was checked for normality and all statistical analyses were conducted at a 5% significance level. All answers in the exploratory research questionnaire were coded prior to data capturing. Various statistical analyses were conducted on the preference data and exploratory research data. Significant differences between wine style group preferences were investigated with the use of analysis of variance (ANOVA) and least significant mean analyses (LS Means). Possible relationships and associations within the exploratory data were analysed via Pearson's correlation coefficient analyses and correspondence analyses (CA). According to Bastian, Collins and Johnson (2010), a medium to large positive correlation can be 0.41 to 0.49 for consumer preferences. Preference maps were created by regressing the preference data (obtained from preference tests) onto the descriptive data (obtained from QDA, refer to Chapter 4). Partial least squares (PLS) internal preference mapping as well as external preference mapping (PREFMAP) was used. The PREFMAP is used to explain any drivers of liking for specific wine attributes and their intensities in the wines. Where necessary all decimal numbers were rounded up to two decimals.

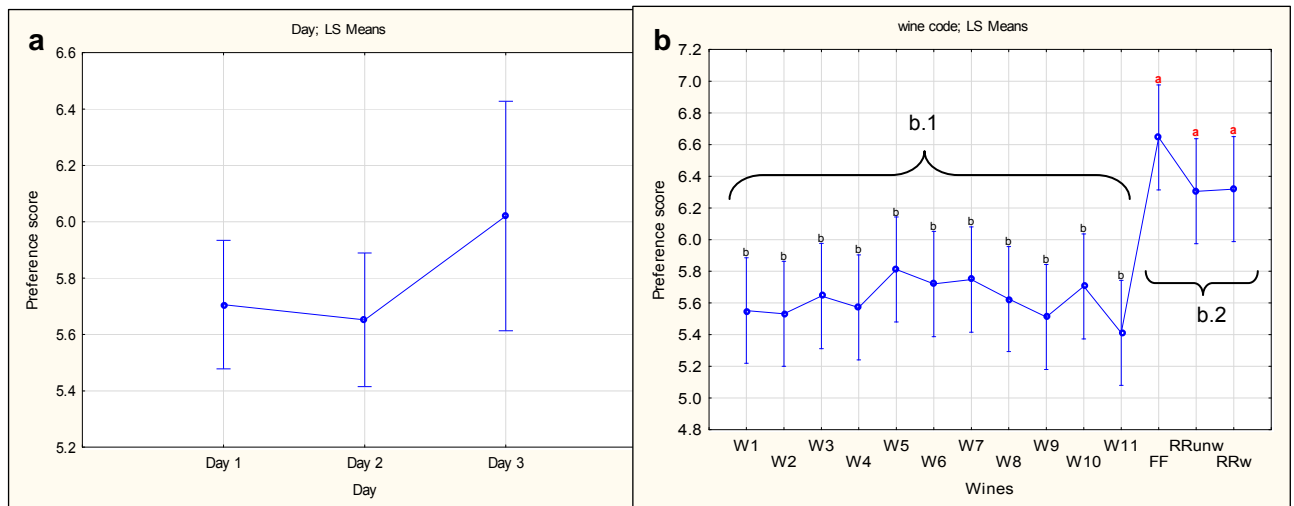
## 5.3 Results and discussion

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### 5.3.1 General preference results for different Chenin blanc wine styles

ANOVA and least significant mean analysis were used to evaluate whether there were any significant preference differences between the various tasting days (Fig. 5.1.a). The fixed effects

test for preference scores indicated that the specific test day did not have a significant effect on the consumers' preference scores ( $p=0.3$ ). Even though it seems that day 3 had a slightly higher mean ( $y = 6.02$ ) than the other two days ( $y = 5.65$ ;  $y = 5.71$ ), this can be explained by the fact that only 21 consumers tasted on Saturday in relation to the 67 consumers who participated on day 1 and the 62 consumers on day 2. Both days 1 and 2 had a morning and an afternoon tasting. It is therefore understandable that the variance for day 3 will be somewhat larger than for the previous two days and the mean might also be slightly different (Fig. 5.1.a). However, there is no significant difference between the preference scores obtained from these different sessions ( $p > 0.05$ ).



**Figure 5.1:** Least significant preference mean analyses for any significant difference in preference score of 150 Generation Y wine consumers (a) per day and (b) during the (b.1) blind and (b.2) informed wine style preference tests (obtained from *StatSoft STATISTICA 10*®).

When investigating the wine preference means (LS means) during the blind tasting versus the wine style concept tasting (Fig. 5.1.b) an interesting discovery was made. No significant differences were found between the various wines, and different wine styles, during the blind tasting. However, a large increase in preference scores ( $p < 0.01$ ) in the wine style informed tasting indicated that the three wines representing FF, RR-unwooded and RR-wooded wine styles were significantly more preferred than the wines in the blind tasting. Therefore, although consumers already tasted the three wines during the blind tasting they liked these wines more when they were informed of the wines' style identities. The mean preference scores for all the blind wines varied between 5.4 to 5.8 whereas the preference scores for the three informed wine styles were significantly higher: FF = 6.65, RR-unwooded = 6.31 and RR-wooded = 6.32 (Fig. 5.1.b). Although all three wine styles were equally liked by Generation Y consumers, the FF wine had a slightly higher mean preference score than the other two wine styles (RR-unwooded and RR-wooded). This indicates that a wine style name and definition can significantly improve Generation Y consumers' preferences for a specific wine. In their research study on internal and external preference mapping for commercial lager beers Guinard, Uotani and Schlich (2001) compared consumer hedonic ratings of a blind condition versus an informed condition with regards to the brand and price of the lager beers. They found that there is a significant change in preference ratings from a blind to an informed tasting condition. This suggests that the two conditions (blind versus informed) stimulate the use of different cognitive processes. When consumers are informed in terms of the specific product that they are about to taste, expectations are created before they consume the product and they will compare their product perceptions with their expected product perceptions. However, during a blind taste

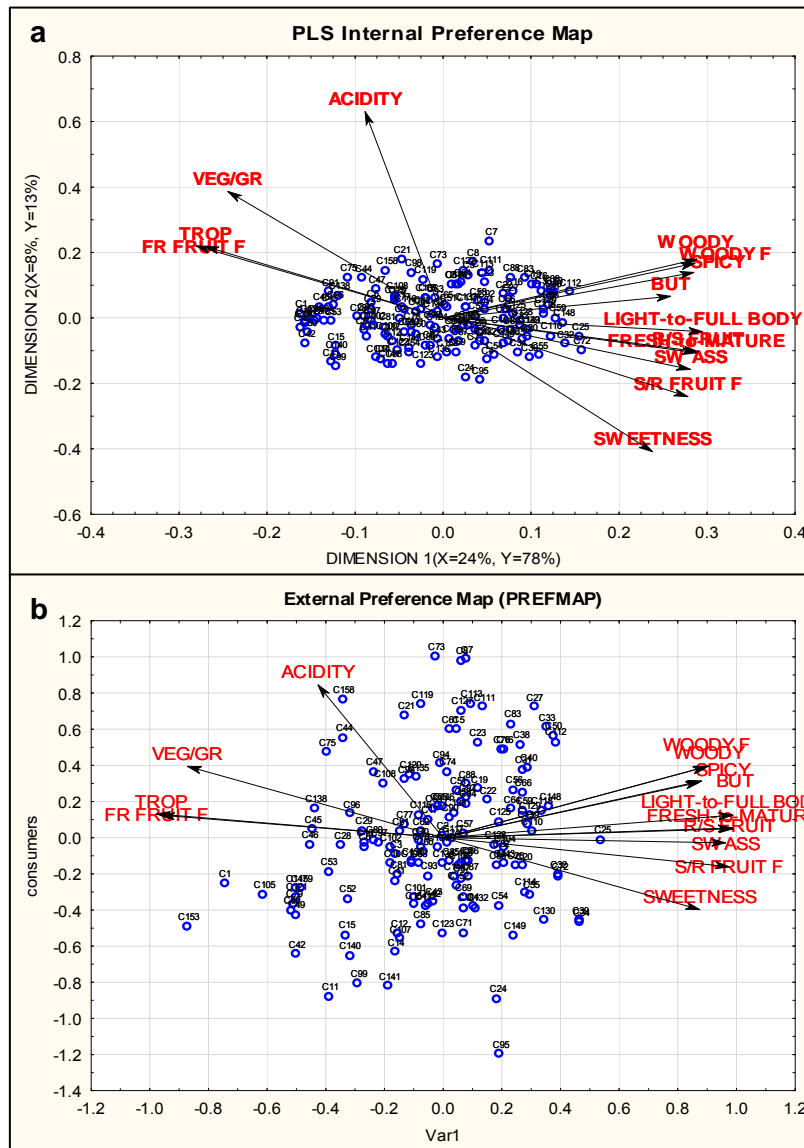
consumers will not have predisposition expectations in terms of their preferences for the products. Here their preferences are the pure result of the product profile characteristics. Interestingly Guinard, Uotani and Schlich (2001) found that this particular difference in preferences between informed and blind tastings was the strongest for consumers who are between 20 to 30 years old (i.e. the Generation Y consumer market).

### **5.3.2 Evaluating consumer preferences via the use of QDA descriptive data**

No consumer preference clusters were found during investigation of the blind preference data on the PLS internal preference map (Fig. 5.2.a). This indicates that the entire group of sourced Generation Y wine consumers, from the Western Cape, can be considered as a single preference group that has an equal moderate preference for these Chenin blanc wines. This finding supports the ANOVA results in Fig. 5.1b of the LS Mean preferences for the eleven wines which were tasted in a blind condition.

There is also a clear separation between two wine style groups in the first dimension (Fig. 5.2.a). On the left-hand side the dominating wine attributes are Fresh Fruit Flavour, Tropical Aroma and Vegetative/Green Aroma. The Acidity attribute is also positioned more to the left of dimension 1. The right-hand side of dimension one is dominated by Stewed/Ripe Fruit Flavour, Sweet Associated Aroma, Rich/Stewed Fruit Aroma, Maturity, Full body, Buttery Aroma, Spicy Aroma, Woody Flavour, Wood Aroma and Sweetness. This supports the findings obtained from the sorting method (CA plots, refer to Chapter 3) and also QDA (PCA plot, refer to Chapter 4). There is a definite distinction between fresh, fruity Chenin blanc wines (FF style) and the rich, wooded Chenin blanc wines (RR-wooded style).

An external preference map (PREFMAP) was obtained by regressing the Generation Y consumers' preference scores for the blindly tasted Chenin blanc wines on the descriptive data obtained from QDA (refer to Chapter 4). Therefore the actual preference scores were regressed on the first and second principal components of the PCA obtained during QDA. No significant drivers of liking were found as all consumer preferences are consolidated in the middle of the plot (Fig. 5.2.b). In other words all the Chenin blanc wine attributes contributed to equal, moderate consumer preferences for these wines.

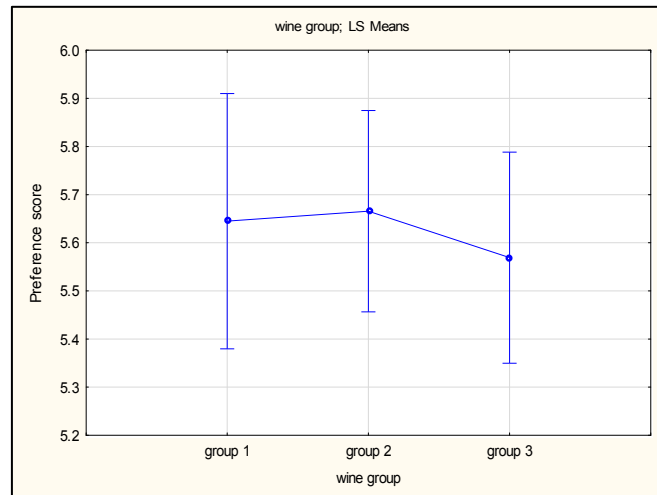


**Figure 5.2:** Preference analyses of 150 Generation Y consumers for the eleven Chenin blanc wines via (a) a partial least squares internal preference map and (b) an external preference map (PREFMAP). The arrows indicate intensity increase of relevant wine sensory attributes and the dots indicate the 150 consumer distributions in relation to the wine sensory attributes (obtained from *StatSoft STATISTICA 10®*). Where: FRESH-to-MATURE = Fresh-to-Mature scale; LIGHT-to-FULL BODY = Light-to-Full Body scale; TROP = Tropical aroma; R/S FRUIT = Rich/Stewed Fruit aroma; SW ASS = Sweet Associated aroma; VEG/GR = Vegetative/Green aroma; WOODY = Woody aroma; SPICY = Spicy aroma; BUT = Buttery aroma; FR FRUIT F = Fresh Fruit flavour; S/R FRUIT F = Stewed/Ripe Fruit flavour; WOODY F = Woody flavour; SWEETNESS = Sweetness; ACIDITY = Acidity.

### 5.3.3 Evaluating consumer preferences via the use of sorting group data

The sorting groups can also be used to investigate the preference differences for the various sorted wine style groups. The average preference scores were determined for the various wine style groups formed during instructed sorting which in turn was obtained from the expert panel's DISTATIS plots (refer to Chapter 3). ANOVA was then conducted on the group means to investigate if wine style preference results are similar to those obtained from the PREFMAP and PLS internal preference map results. In Fig. 5.3 it is clear that there are no significant differences between the preference means for the various wine style groups (refer to Chapter 3) which is similar to the preference map results. Preference maps could, however, not be created

when using the sorting task to investigate the preferences for the various wine style groups, because the sorting descriptive data were not scaled. The reason why the consumer panels are not generally used to obtain quantitative descriptive data are that they do not validly scale descriptive data as well as trained panellists. Consumers are not trained to act as analytical instruments (Nestrud and Lawless, 2008), therefore it is difficult to understand how they perceive various products. However, it has been found that experts outperform consumers during sorting tasks (Valentin *et al.*, 2007)



**Figure 5.3:** Least significant preference means per sorted wine style group obtained from expert panel's DISTATIS plot during instructed wine style sorting (obtained from *StatSoft STATISTICA 10®*). Where Group 1 mostly contained RR unwooded wines, Group 2 mostly contained FF wines and Group 3 only contained RR wooded wines.

### 5.3.4 Generation Y perception and opinion research results and discussion

#### 5.3.4.1 Generation Y consumers' socio-demographics, wine purchase and consumption behaviours

The main socio-demographic data such as gender, age, wine consumption behaviour, smoking habits, income, education and residence of Generation Y consumers were captured in Table 5.1. These results indicate that the selected consumers were all representative of the population of Western Cape Generation Y wine consumers.

These Generation Y consumers generally purchase wine from various stores. Forty-eight percent often purchase wine from general retail stores and 47% purchase wine from liquor stores. Thirty-seven percent of consumers sometimes purchase wine from wine estates, but almost none of them purchase wine from warehouses or convenience outlets. These wine purchase findings also support Nguyen (2009) who found that a large percentage of Generation Y wine consumers are also wine purchasers.

The histogram in Fig. 5.4.a illustrates the wine consumption frequency of these young consumers. It is clear that all wine consumers can be classified as regular wine consumer with 61% reporting to drink wine 1-2 times/week. Only 20% indicated that they occasionally drink wine whilst 15% indicated that they drink wine almost every day.

Generation Y consumers generally view wine as a lifestyle product as they mostly buy wine for dinner (67%) and social events with friends (34%). Interestingly 25% often buy wine to enjoy on their own. Wine is therefore not only associated with social events but some young consumers also enjoy wine on their own. In their research Thach and Olsen (2006) found that

Generation Y consumers perceive wine as a relaxing beverage, to be enjoyed with food and during social occasions with family and friends, but some of these consumers also perceive it to be an elite, classy product which is more reserved for formal occasions

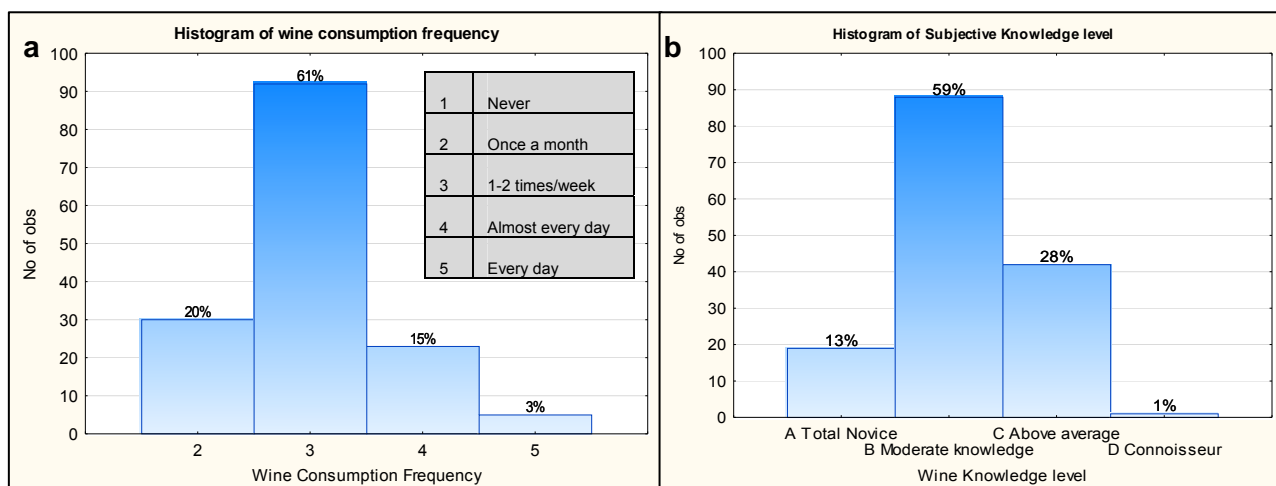
When asked how often they identify the described wine aromas on a wine's back-label 63% found that they can sometimes identify these characteristics in the wine whilst 15% reckoned they can identify described back-label wine aroma descriptions almost always. Sixteen percent indicated that they are seldom able to identify these descriptors in a wine. It is therefore clear that this is a relatively novice sample group of consumers, however, they all drink wine. In their research Nelson, Almanza and Donovan (2006) found that wine consumers, especially females, often perceive the wine back-label to be confusing and the overload of information provided by the back-label makes it difficult to read. This can ultimately contribute to these consumers' fear of making the wrong wine purchase decision.

The majority of the young wine consumers learned to drink wine during their university years (57%). Thirty-eight percent learned to enjoy wine with their parents and 16% are self-taught wine consumers, whilst only 7% learned how to enjoy wine by studying a wine course.

The majority (88%) of Generation Y consumers indicated that they mostly drink wine with their friends and 32% indicated that they enjoy wine with their relationship partner. Thirty-two percent often drink wine with their parents and 26% also enjoy wine with other family members.

**Table 5.1:** Generation Y wine consumers socio-demographic data summary

<b>Gender</b>	Female 73%	Male 27%	<b>Previous sensory participation</b>	Yes 33%	No 67%
<b>Smoking habits</b>	Non-smokers 93%	Smokers 7%	<b>Wine evaluation qualifications</b>	Yes 6%	No 94%
<b>Age</b>	21-23 yrs 53%	24-26 yrs 25%	27-29 yrs 17%	30-32 yrs 5%	
<b>Monthly income</b>	<R2 000 49%	R2 000 – R4 999 21%	R5 000 – R9 999 16%	R10 000 – R14 999 7%	≥ R15 000 8%
<b>Highest education</b>	High School/ Grade 12 21%	Tech/ Some secondary 4%	Diploma or Degree 44%	Postgraduate qualification 31%	
<b>Residence (past 5 yrs)</b>	Western Cape 93%	Gauteng 3%	Eastern Cape 1%	Kwazulu Natal 1%	Northern Cape 0
	Limpopo 0	Mpumalanga 0	North West 0	Free-State 0	Other 2%
<b>Freq. wine consumption</b>	< 1/month 1%	1/month 11%	2-3/month 32%	4-5/month 11%	> 6/month 26%
<b>Only willing to drink</b>	White wine 10%	Red wine 1%	Red and White wine 89%		
<b>Preferred wine</b>	White wine 21%	Red wine 35%	Red and White wine 54%		



**Figure 5.4:** Histograms of 150 Generation Y consumers' (a) wine consumption frequency and (b) subjective wine knowledge levels (obtained from *StatSoft STATISTICA 10®*)

### 5.3.4.2 Generation Y consumers' subjective wine knowledge levels

A histogram of Generation Y consumers' subjective wine knowledge (Fig. 5.4.b) confirms that they are novice to moderately wine knowledgeable. The largest proportion (59%) consider themselves to have a moderate wine knowledge level and 13% of consumers thought themselves to be complete wine novices. Only 28% indicated to have above average wine knowledge. This consumer segment has some wine knowledge but is by no means wine knowledgeable or wine experts.

### 5.3.4.3 Generation Y consumers' wine involvement levels

This sample of young wine consumers rated the importance of following wine and packaging aspects: Quite important characteristics were price (70%), wine cultivar identity (77%) and wine aroma (70%). Sometimes important wine characteristics were wine region (60%), vintage (58%), label design (52%) and brand name (58%). Wine characteristics rated as rarely important to unimportant were wine closure type and bottle shape. The back-label descriptions are quite important for some consumers (44%) and 35% indicated that it is rarely important to them. This indicates that wine bottle back-label descriptions have good marketing potential; however, it must be used wisely by wine marketers in order to attract the attention of Generation Y consumers. Interestingly wine aroma is equally important to these young wine consumers than wine price. Cultivar is even more important than price and wine aroma. Research by Wolf, Carpenter and Qenani-Petrela (2005) shows that Generation Y consumers have a high preference for inexpensive wines and they tend to purchase wines that they believe to represent good value, whereas their Generation X parents are more concerned with the specific wine quality and they will spend more money on wines. In relation to the Baby Boomers, Generation Y also perceive New World wines to be less expensive and of a higher quality (Wolf, Carpenter and Qenani-Petrela, 2005). Thach and Olsen (2006) also found that Generation Y consumers favour wine brands that will deliver consistent quality at a reasonable price to which they can become loyal.

The most important information source for Generation Y consumers, which they use during wine purchase decisions, is their own previous experience with a wine (93%). Secondly they often refer to word-of-mouth from their family and friends (68%). Both the opinions of expert wine critics as well as shelf information and wine label information are only important to 26% of the consumers. Regular advertising methods (13%) and a salesperson's advice (13%) are not important to these consumers. It seems that these young consumers do not always trust

conventional advertising and sales methods. They much rather rely on their own experience and advice from friends and family members when making a wine purchase decision.

Furthermore, these consumers are fairly interested in Chenin blanc wines. There is potential for the wine industry to encourage this interest level even more. A total of 44% and 26% are respectively moderately interested and fairly interested in Chenin blanc wines. The more interested one is in a product, the more willing one is to learn more and gather more information about that specific product (Lelièvre *et al.*, 2009). According to Mueller *et al.* (2010), self-confidence and wine involvement levels might be related, because involved consumers tend to have more confidence in their purchase decisions than uninvolved consumers.

When evaluating the young wine consumers' preferences for other alcoholic beverages the following findings were made: as expected almost all consumers indicated a high preference for wine. In total 71% consumers like wine much (71%). Interestingly it seems that this pattern is reversed in terms of their preference level for brandy: 60 % either strongly dislikes brandy. On the other hand whiskey was either liked or disliked by Generation Y consumers, whereas relatively equal numbers of consumers either like beer much, dislike beer or indicated that they feel neutral towards beer. In terms of ciders there is quite a large Generation Y segment that like ciders much (32%), but a large proportion also indicated that they moderately liked ciders (27%). There was also a consumer segment that did not care for Vodka (28%) and quite a large segment also indicating that they do not like Vodka at all (25%). Ciders, beers and whiskey are therefore the strongest competitors of wine in this Generation Y consumer market. According to Green (2010), beer remains the most popular drink of choice especially in the metropolitan areas. According to her estimations out of 11 million consumers a total of 69% of the metro population (7.6 million people) drink beer regularly, while only 16% (1.8 million people) regularly consume wine. The majority of young consumers are however, also loyal to other alcoholic drinks that compete directly with wine such as beers and ciders (Foxcroft, 2009) and it is critical for marketers to create innovative strategies that will convert these consumers into wine drinkers. Sixty-three percent of consumers in South Africa have never drunk wine (Loubser, 2008). This clearly indicates that there is a market gap which needs to be penetrated by the wine industry.

#### **5.3.4.4 Generation Y consumers' wine attitudes and beliefs**

A total of 61% of consumers strongly agreed with the statement I like the taste of wine and an additional 33% simply agreed with this statement (total agreement is 94%). Similarly 65% of consumers indicated that they strongly agreed that Wine goes well with meals and 32% simply agreed with this statement. Seventy-one percent like to know and evaluate the wine quality whereas 24% were neutral in terms of this statement. Furthermore, 61% indicated that they prefer wine to any other drink whilst 28% expressed a neutral opinion. A total of 85% also indicated that wine helps me to relax.

When asked if they agreed with the statement wine is cheap the majority (46%) were neutral, whereas 42% disagreed. Two opposite opinions were found with regards to the statement enjoying wine is a factor of social status: 36% of this young consumer group agreed but 33% disagreed with this statement. The rest (34%) were neutral in terms of their opinions about this statement. When asked whether they agree that moderate wine consumption is good for health 80% responded positively and the rest remained neutral. Furthermore, 73% of young consumers indicated that drinking wine interferes with their driving abilities and 17% were neutral with regards to this statement. In terms of lifestyle these consumers generally do not believe that wine is crucial for their lifestyles, because 41% disagreed and 33% expressed no opinion. However, a certain percentage of the sample (17%) agreed that wine is crucial for their



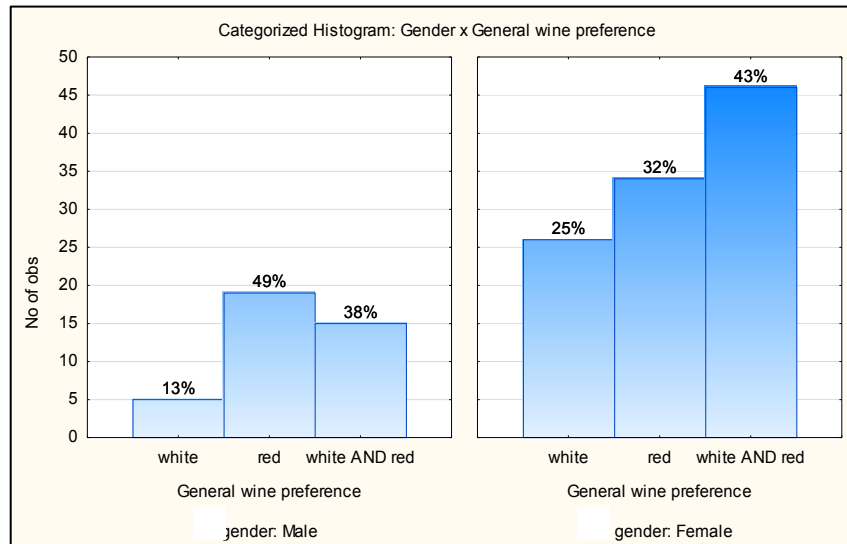
lifestyles. The majority of consumers (62%) also indicated that wine consumption favours a festive atmosphere.

### 5.3.5 Consumer preference and exploratory data correlations and correspondences

#### 5.3.5.1 The effect of gender and smoking habits on Chenin blanc wine style preference

No relationships were found, after conducting ANOVA's, between gender or smoking habits and preferences for various Chenin blanc wine styles: FF, RR-unwooded or RR-wooded ( $p > 0.05$ ). All consumers equally liked these wine style concepts when they had the opportunity to taste the various wines. The mean preference values were all between 6 and 7 which indicate that they generally liked these wine styles.

It was also investigated whether males and females have significant different preferences for various wines (white wine, red wine, both red and white wine). As can be seen in histogram of the cross-tabulation table results (Fig. 5.5) there is no significant relationship between gender and the type of wine that the consumer prefers as  $\text{Chi}(X^2 = 4.23 \text{ at } df = 2, p = 0.120)$ . However, it is interesting to note that in both gender groups white wine is preferred by less people than red wine.



**Figure 5.5:** Relationship between gender and type of wine preferred by young wine consumers (obtained from StatSoft STATISTICA 10®).

#### 5.3.5.2 The effect of consumption frequency, purchase frequency, involvement level and subjective wine knowledge on Chenin blanc wine style preference

During an ANOVA a significant, positive relationship was found between the frequency of times that a Generation Y consumer would purchase/drink a wine and the consumer's preference for the wooded Chenin blanc wine style ( $r = 0.22, p < 0.01$ ). This suggests that the preference of a young wine consumer for wooded Chenin blanc wine will increase with an increased frequency of times that he or she purchases or drinks wine. A consumer's wine preferences are generally acquired over time after being exposed to different wines and gaining more experience. Generally speaking, novice consumers will start with less complex wines such as white wines (unwooded), light/unwooded red wines and Rosé wines. Thereafter they will gradually experiment with wooded wine styles and become accustomed with more complex sensorial spectrums of these wines. Due to the fact that that wooded white wines generally have a more complex palette and bouquet than the unwooded white wines, it is expected that more

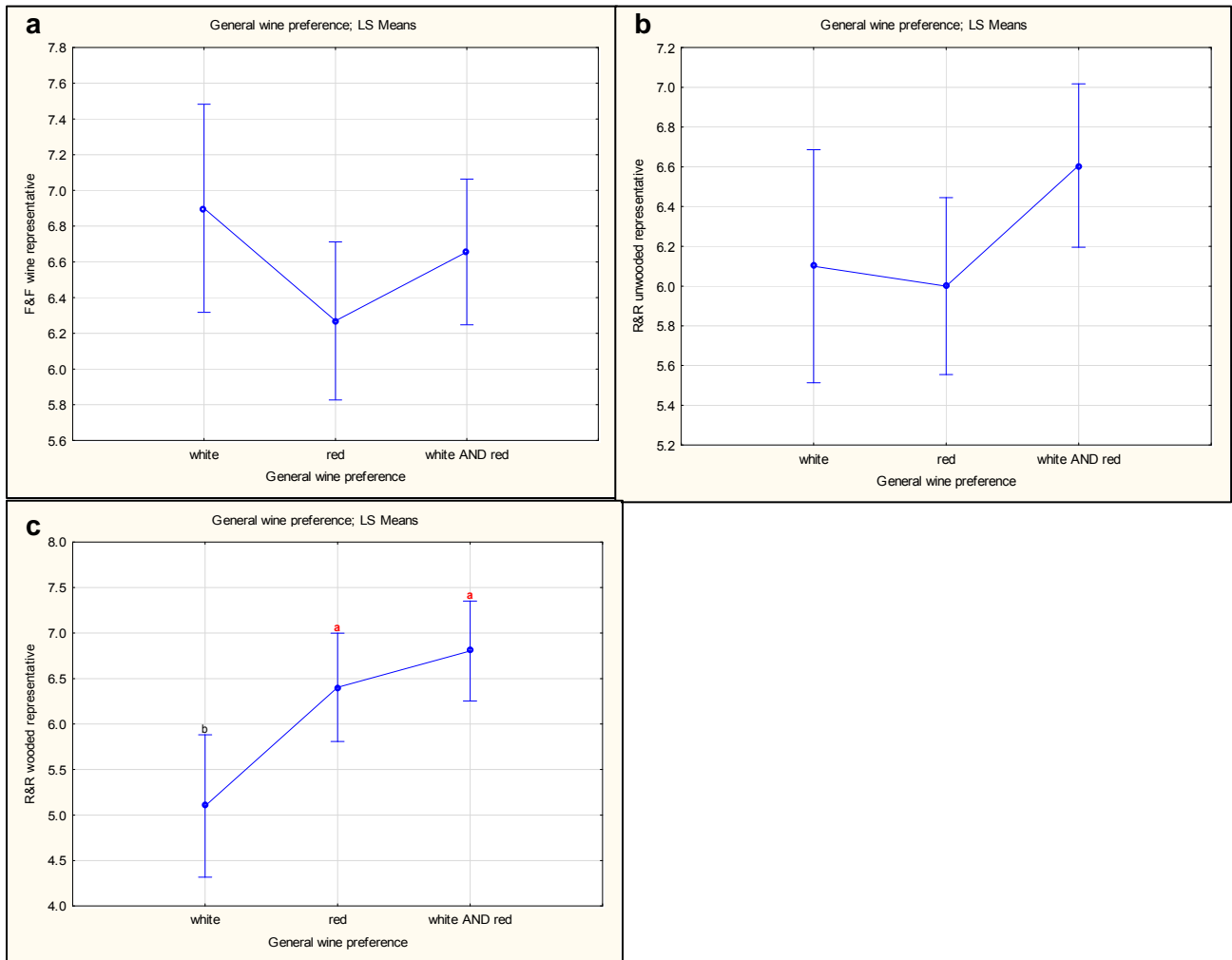
experienced wine drinkers will become accustomed to this wine style and their preference thereof will also increase. Another wine consumption question was also asked later in the questionnaire to see whether consumers are consistent in terms of their answers. Similarly there is a significant relationship between the wine consumption frequency and preferences for wooded Chenin blanc wines ( $r = 0.18$ ,  $p = 0.03$ ). The moderate, positive relationship means that preference for wooded Chenin blanc wines will increase an increase in wine consumption frequency. This also indicates that the panel of Generation Y consumers were generally consistent in their answers and the results are therefore reliable.

It was investigated whether consumers with strong preferences for only white wines, or only red wines or both red and white wines differed in terms of their preferences for the different Chenin blanc wine styles. These three predetermined preference groups will be referred to as consumer groups. Significant differences ( $p \leq 0.05$ ) indicate that consumers with different wine preferences also differed with regards to their Chenin blanc wine style preferences. When reviewing the mean preference scores it is clear which consumer group preferred which specific Chenin blanc wine style group. For the FF Chenin blanc wine style there was no significant difference between these consumer groups ( $F(2, 140) = 1.62$ ,  $p = 0.20$ ). All the different consumer groups had similar relatively high liking scores for the FF style (Fig. 5.6.a).

When evaluating the RR-unwooded wine style preference scores (Fig. 5.6.b) no significant differences were found between the consumer groups' mean preferences for this specific wine style ( $F(2,140) = 2.19$ ,  $p = 0.12$ ). However, when the LSD test was conducted it was found that consumers with a preference for both red and white wine significantly differed from those who only drink red wine in terms of their preference ratings for RR-unwooded Chenin blanc wine (Between MS = 2.64 at  $df = 140$ ,  $p = 0.05$ ). Even though  $p$  is equal to the cut-off point of 0.05 there is still a tendency for a significant result. These findings suggest that young wine consumers who prefer both red and white wine also generally prefer RR-unwooded Chenin blanc wine significantly more than those who only drink/prefer red wine. And white wine consumers will generally like RR-unwooded Chenin blanc wine styles similarly than those consumers who prefer to drink both red and white wines ( $p = 0.79$ ).

An interesting finding was made when evaluating the mean preference scores for the RR-wooded Chenin blanc wine style in terms of different young consumer wine preference groups. At  $F(2, 140) = 6.29$ ,  $p < 0.01$  was found (Fig. 5.6.c) which indicates a strong significant difference between the various consumer groups in terms of their preferences for the RR-wooded wine style. When evaluating Fisher's LSD multiple comparison test (Between MS = 4.7061,  $df = 140$ ,  $p = 0.01$ ) a significant preference difference for RR-wooded wines was found between the consumer group that prefers white wine and the consumer group that prefers red wine. Similarly, a significant difference for the wooded Chenin blanc wine style was found between consumers who prefer white wine and those who prefer both red and white wine ( $p < 0.01$ ). This suggests that young consumers who prefer red wine and those who prefer both red and white wine both equally like the RR-wooded Chenin blanc wine style more than consumers who generally prefer only white wines (white wine preference =  $b = 5.1$  versus red wine preference =  $a = 6.4038$  and preference for both red and white wines =  $a = 6.8033$ ). This illustrates that the more a consumer experiments with more complex wines (such as red wine) their repeated exposures will ultimately increase their preferences for more complex wines as well (theory of mere exposure, see Pliner, 1982). New wine consumers will generally start with less complex and easy-drinking wines and will only build a preference for more complex wines after repeated exposure to those wines. In terms of marketing it is therefore important that the wooded Chenin blanc wines should be targeted towards Generation Y consumers with a red

wine preference. On the other hand, the FF wines suit the preferences of consumers with a dominating white wine preference.



**Figure 5.6:** Least significant preference mean analyses for (a) the Fresh and Fruity Chenin blanc wine style, (b) Rich and Ripe unwooded Chenin blanc wine style and (c) Rich and Ripe wooded Chenin blanc wine style by young consumers with predominant white wine, red wine, both red and white wine preferences (obtained from *StatSoft STATISTICA 10®*).

Pearson's correlation coefficient analyses were furthermore conducted to investigate possible correlations between consumers' Chenin blanc wine interest level and their wine style preferences. An increase in their interest level for Chenin blanc wines lead to a considerable increase in their preferences for both RR-unwooded Chenin blanc wine styles ( $r = 0.18$ ,  $p = 0.03$ ) and also for RR-wooded Chenin blanc wine styles ( $r = 0.26$ ,  $p < 0.01$ ). However, the Pearson correlation coefficients for these two correlations indicates that a stronger and positive relationship is present between the RR-wooded preferences and the interest level in Chenin blanc wines, than between the RR-unwooded preferences and Chenin blanc wine interests. Therefore, preference for the RR-wooded Chenin blanc wine style is expected to increase even more than the preference level for the RR-unwooded Chenin blanc wine style as a result of an increase in the consumer's general interest level in Chenin blanc wines. An increased interest level in wine encourages consumers to experiment more with different types of wines. Liem and de Graaf (2004) found that repeated exposure of young children and adults to orangeades higher sucrose concentrations caused an increase in their preferences for sweeter orangeades.

After repeated exposures to more complex wines, a consumer's preferences for these wines may thus increase.

Even though it seems that Chenin blanc interest level influenced their preferences for specific wine styles, no relationships were found between the young consumers' subjective knowledge level of wines and their preferences for various Chenin blanc wine styles ( $p > 0.05$ ). Thompson (2010) found that Generation Y consumers who purchased wine in restaurants not only felt more sophisticated, but they perceived this purchase decision as an opportunity to improve their general wine knowledge as well. Highly involved wine consumers (so-called wine enthusiasts) will often utilise more complex information cues, buy more wine and spend more money per bottle than low involvement buyers (Lelièvre *et al.*, 2009). Low involvement consumers often use risk reduction strategies in order to simplify their purchase decisions (Yuan *et al.*, 2005).

It was also found that wine consumption frequency of young wine consumers is significantly related to their subjective wine knowledge level ( $r = 0.35$ ,  $p < 0.01$ ). The relatively strong and positive Pearson correlation coefficient indicates that a young consumer's wine consumption frequency will increase as his or her subjective wine knowledge increases. Conversely their subjective wine knowledge level will increase with an increase in wine consumption frequency.

Pearson's correlation coefficient analyses were also used to evaluate how consumer knowledge level influenced their importance opinions of wine aspects such as brand, cultivar etc. There is a significant correlation between subjective wine knowledge level and the importance of a wine brand to a young consumer ( $p = 0.05$ ). Even though the probability value parameter for significance testing is classified as  $p \leq 0.05$ , a value of 0.05 still indicates a tendency for a significant test result. There was also strong, positive correlations between subjective wine knowledge and the importance of the wine's cultivar or blend identity ( $r = 0.28$ ,  $p < 0.01$ ), vintage ( $r = 0.25$ ,  $p < 0.01$ ), origin ( $r = 0.24$ ,  $p < 0.01$ ), brand name ( $r = 0.16$ ,  $p = 0.05$ ) and aroma characteristics ( $r = 0.31$ ,  $p < 0.01$ ). In their research Hall *et al.* (2001) found that the dominant attributes relating to wine choice are wine price, wine taste and wine type (red or white). No correlations were found for subjective wine knowledge of these Generation Y consumers with the wine brand, label design and colour, bottle shape, price, wine closure (cork or screw-cap) or back-label wine descriptions ( $p > 0.05$ ).

### **5.3.5.3 The correlations between Generation Y consumers' wine preferences and their preferences for other beverages**

The following findings were made during Pearson correlation coefficient analyses in order to determine which alcoholic beverages consumers, with a high wine preference, will also prefer. An interesting negative correlation was made between Generation Y consumers' preferences for brandy and wine which suggests that consumers with a higher preference for brandy will have a lower preference for wines ( $r = -0.21$ ,  $p = 0.01$ ). This is also true for the inverse statement: consumers with low preference ratings for brandy generally have high preferences for wines.

### **5.3.5.4 The effect of subjective wine knowledge and wine consumption frequency on the preferred occasion for which a wine is purchased and on the information sources used**

The consumers' subjective wine knowledge levels were investigated in terms of its ability to influence the wine purchase occasion. The standard deviation (std. dev.) values were estimated and a subsequent CA plot was obtained (Fig. 5.7.a). The closer a specific standardised deviation value is to 1, the stronger the association between a specific information source and a specific subjective wine knowledge level. There seems to be an association between the

occasions that a young consumer would purchase a wine for and his or her subjective wine knowledge level. The two purchase occasions that are often associated with total novices are for a special occasion (std. dev. = 0.64) and for a 'bring-en-braai' (std. dev. = 0.79). This trend suggests that novice wine consumers often associate wine with various social gatherings (formal and informal) and not as an everyday lifestyle product. However, this group of novice wine consumers does not often buy wine for dinner (std. dev. = -0.71), suggesting that they are not experienced enough to know which wine-and-food pairings will be suitable. From all the knowledge groups, these consumers also often purchase wines as birthday gifts (std. dev. = 0.18). On the other hand, young consumers who reported to have a moderate level of subjective wine knowledge are expected to purchase wine to enjoy on their own (std. dev. = 0.54). This could suggest that consumers are still experimenting with various wines on their own in order to discover which varieties and brands they prefer best. Furthermore, the percentage of young wine consumers with above average level of objective wine knowledge are often associated with purchasing wine for dinner (std. dev. = 0.50). This can possibly be explained due to the fact that consumers with a fairly good level of wine knowledge know, from experience, which wines pair well with which meals. They can appreciate a good combination of food and wine and will often purchase wine for these occasions. Interestingly these consumers do not generally purchase wine to enjoy on their own (std. dev. = -0.49) which indicate that they would rather share wine with others during a meal (i.e. dinner) than drink alone.

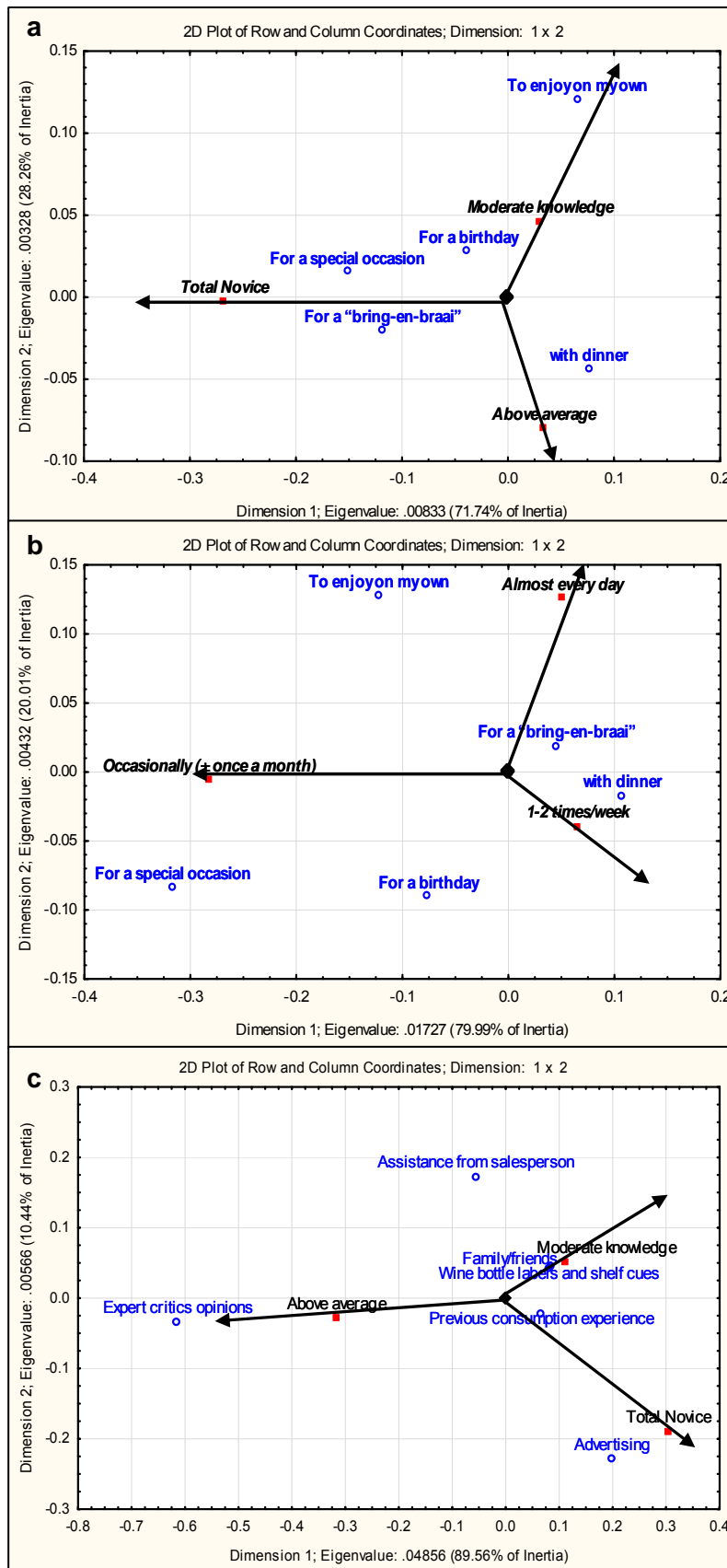
A different CA plot (Fig. 5.7.b) indicates associations between these consumers' wine consumption frequencies and the occasions for which they generally purchase wine. There seems to be a strong association between consumers who occasionally consume wine and special occasions (std. dev. = 1.30). A strong association was also found between consumers who drink wine 1-2 times per week and purchasing wine for dinner. However, the consumers who occasionally drink wine will seldom or never purchase a bottle of wine to enjoy with dinner (std. dev. = -0.95). Furthermore, there is a relatively strong association between consumers who drink wine 1-2 times per week and wine purchases for dinner (std. dev. = 0.49). However, this group of consumers rarely purchase a wine to enjoy on their own (std. dev. = -0.66). Finally, consumers who drink wine almost every day will often purchase wine to enjoy on their own (std. dev. = 0.54). These consumers, however, seldom associate with purchasing a wine for a special occasion (std. dev. = -0.58).

A third CA plot (Fig. 5.7.c) was conducted in order to investigate how consumers with different subjective wine knowledge levels use different information sources during purchase decisions. Different consumer wine knowledge groups also make use of different information tools when making a wine purchase decision. The problem with wine, according to Chaney (2000) and Unwin (1999), is that its quality characteristics cannot be assessed without purchasing and tasting the wine first. Inexperienced wine consumers will therefore often rely on descriptions from labels, friends, wine menus, journalists and restaurant wine steward recommendations in order to make their choice (Hammond, 2010). In addition, consumers often rely on their own information sources i.e. their own wine knowledge, -preferences, and -usage experience (Dodd *et al.*, 2005; Lockshin and Hall, 2003). It is clear that total novices often use impersonal advertising information source (std. dev. = 1.26) and also to their own previous consumption experience (std. dev. = 0.59) during wine purchase decisions. These consumers are also hesitant to make use of personal information sources such as sales assistants (std. dev. = -0.72) and expert critic opinions (std. dev. = -1.561). They will also rather rely on their own experience and therefore purchase a wine that they have tasted before than purchase a different wine. Those Generation Y consumers with a moderate wine knowledge level often make use of advice from family or friends (std. dev. = 0.57) to guide their wine purchase

decisions. They are also eager to use the wine bottle labels and shelf cues (std. dev. = 0.33) as well as assistance from a salesperson (std. dev. = 0.29) in order to make a wine purchase decision. The young consumers with above average wine knowledge levels often use expert critic opinions (std. dev. = 3.11) before they make a wine purchase decision. However, these consumers seldom make use of advertising, wine bottle labels and shelf cues, family and friends as information sources. Subjective wine knowledge will directly influence consumer self-confidence which will also influence the consumer's purchase behaviour (Olsen, Thompson and Clarke, 2003). I.e. the higher the subjective knowledge level, the more confident the consumer will be in making a wine purchase decision. Findings of previous research (Lacey *et al.*, 2009; Mitchell and Greatorex, 1989; Mitchell and McGoldrick, 1996; Spawton, 1991) also suggested that consumers acquire information as a risk reduction strategy.

In conclusion it seems that novice consumers would rather keep to themselves and refer to impersonal information sources such as advertisements on the television, flyers, newspaper etc. than to consult any others (friends, relatives or experts) possibly due to the fear of being perceived by others as incompetent when it comes to choosing the right bottle of wine. All of these consumers also referred to their own past experiences as an information source to some degree. Dodd *et al.* (2005) established that consumers with a higher subjective wine knowledge level will refer to both impersonal information sources and their own past experience, but refrain from asking others for their opinions. Thomas (2000) and Dodd *et al.* (2005) found that the use of the self as an information source is the most convenient method. According to Dodd *et al.* (2005), regardless of context, it is likely that self will be the most important source because it is more readily available and likely to be salient. Personal and impersonal sources are also likely to be important depending on the situation. Those with moderate wine knowledge are not concerned about what their peers or family members might think and they will openly discuss wines before making a decision to purchase one. They will also make more use of in-store information sources such as bottle labels and shelf cues as well as available salespersons to guide them in choosing a wine that suits their needs. Those young wine consumers who reported to have above average wine knowledge will rather refer to wine expert opinions when deciding on purchasing a specific bottle of wine, possibly due to the fact that they trust others who also have high wine knowledge levels to guide their wine choices. According to Hammond (2010), an increase in self-confidence decreases the fear of social risk and therefore consumers might be more willing to use personal information sources. Consumers need the correct information sources to guide their wine purchase decisions and, as stated by Nelson, Almanza and Donovan (2006), it may be as simple as how dry or sweet is the wine, what the grape varietal is and what foods will pair well with the wine.

Pearson correlation coefficient analyses was also used to investigate whether the subjective wine knowledge levels of a Generation Y wine consumers correlate with their ability to identify wine aromas described on the back-label. A strong correlation was found ( $r = -0.54$ ,  $p < 0.01$ ) at 5% significance level. The responses for this question were reverse-coded, therefore a negative correlation was found, 5 was associated with Never, whilst 1 was associated with Always. Young consumers' ability to identify wine aromas, described on a wine bottle back-label, will thus increase with an increase in their subjective wine knowledge level. Highly involved and experienced wine drinkers understand interactions between various wine factors such as the wine regions, producers and grape varieties and how it influences wine quality, but novice consumers are oblivious to these specific interactions (Lockshin *et al.*, 2006). Wine knowledge is related to experience (Brucks, 1985) therefore more wine knowledgeable consumers will often consume different types of wines and their preferences consequently may become stronger for more complex wines.



**Figure 5.7:** Correspondence analyses plots of Generation Y consumers' (a) subjective wine knowledge level in association to consumers' preferred wine purchase occasion, (b) wine purchase occasions in association with different wine consumption frequencies and (c) subjective wine knowledge level in association with their preferred information sources that they consult to make a wine purchase decision (obtained from StatSoft STATISTICA 10®).

### 5.3.5.5 The effect of subjective wine knowledge on the attitudes and beliefs of Generation Y wine consumers

Subjective wine knowledge is also defined as self-perceived knowledge (Brucks, 1985). It is therefore the individual's own perception of the level of knowledge that he or she possesses with regards to a specific matter (such as wine). It was found that the subjective wine knowledge level of consumers not only influenced the information sources used during wine purchases (Fig. 5.7.c, section 5.5.3.4) but it is also influenced by the consumption frequency of wines (Fig. 5.7.b, section 5.5.3.4) as well as the different wine purchase occasions (Fig. 5.7.a, section 5.5.3.4). A consumers' experience level has a much stronger correlation with subjective wine knowledge than with objective wine knowledge which ultimately leads to the consumers relying more on themselves when making purchase decisions (Dodd *et al.*, 2005).

This study also indicated that there are strong correlations between subjective wine knowledge levels of Generation Y wine consumers and some of their beliefs and attitudes with regards to wine and wine consumption. Positive correlations were found between subjective wine knowledge and their level of agreement with the following statements: I like the taste of wine ( $r = 0.26$ ,  $p < 0.01$ ). Wine goes well with meals ( $r = 0.24$ ,  $p < 0.01$ ). Moderate consumption is good for health ( $r = 0.24$ ,  $p < 0.01$ ). Wine consumption favours conviviality (festivity) ( $r = 0.23$ ,  $p < 0.01$ ). Wine helps me to relax ( $r = 0.22$ ,  $p < 0.01$ ). Those beliefs that correlated the strongest with consumers' subjective wine knowledge were: to be able to know and evaluate wine quality ( $r = 0.44$ ,  $p < 0.01$ ), wine is crucial for the consumer's lifestyle ( $r = 0.38$ ,  $p < 0.01$ ) and the fact that they prefer wine more than other drinks ( $r = 0.37$ ,  $p < 0.01$ ). According to Nguyen (2009), Generation Y consumers in South Africa regard wine as an alcoholic drink that you need to have knowledge about and it is also important for them to know how to drink and enjoy wine, as it enhances their life experience. Wine is becoming an important lifestyle product to most of these young wine consumers (Nguyen, 2009).

## 5.4 Conclusions

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With regards to the Generation Y consumer group no significant consumer preference clusters were found. Therefore the entire group of consumers selected for this study, i.e. Western Cape consumers aged between 21 to 32 years old that drink white wine at least once a month, can be viewed as one target market group that generally likes all the Chenin blanc wine styles equally.

Even though there were no drivers of liking for specific wine style(s), the informed wine style tasting's wines were significantly more preferred than the blindly tasted wines. Therefore strong Generation Y preferences are linked with the knowledge of wine style concepts during wine tasting. The focus shifts to concept preferences compared to these consumers' perceived sensorial preferences for the wines during the blind tasting. It is therefore clear that the cognitive influence of wine style knowledge can effectively improve the wine drinker's preference for a particular wine. These wine style definitions clearly have valuable marketing qualities which can optimally position Chenin blanc wines for the Generation Y consumer target market.

This study also proved that sorting data can be used to determine whether the preference ratings for different Chenin blanc wine styles differ significantly. This can be done with the use of ANOVA and comparing the mean preference scores of the sorted wine groups with one another. However, QDA qualitative and quantitative data can explain the consumers' preferences more effectively via internal or external preference maps.

Generation Y consumers who prefer red wine also prefer the wooded Chenin blanc wines as well as the complex RR-unwooded wines. Only consumers who prefer to drink white wine



preferred the FF Chenin blanc wines. Effective marketing strategies must therefore be used to target these various wine styles to the correct wine consumer preference segments that will favour these wine styles. This study also found that consumers with a higher subjective wine knowledge found it easier to identify the back-label described sensorial wine characteristics in a wine. Furthermore, the higher the consumers' interest level in Chenin blanc wines are, the stronger their general preference are for more complex Chenin blanc wine styles. Wine education must be encouraged even more amongst these young wine consumers in order to improve their perceptions and preferences for wine. Generation Y wine consumers with different subjective wine knowledge levels will generally purchase wines for different events. Novice wine drinkers generally associate wine with various types of social gatherings, both formal and informal. Generation Y consumers with moderate subjective wine knowledge generally purchase wine to enjoy alone possibly because they are still experimenting with various wines in order to discover which varieties and brands they prefer most. Lastly, consumers with above average wine knowledge often purchase wine for dinner occasions as they understand and appreciate food and wine pairing. Similarly, consumers that occasionally drink wine generally purchase wine for special occasions or to enjoy on their own, moderate wine drinkers often buy wine to drink with dinner and frequent wine consumers will also purchase wine to enjoy on their own.

The current study found that the use of previous consumption experience as an information source was also important to almost all consumers. They generally rely on themselves to some extent when making a wine purchase decision. Furthermore, the current study indicate that young wine consumers with higher subjective wine knowledge levels also generally used personal information sources and those with low subjective wine knowledge levels made use of impersonal information sources, which contradicts Dodd *et al.* (2005)'s findings. This can be explained due to the fact that these young consumers are more susceptible to social pressure and young wine novices would rather use impersonal information sources than asking others due to fear of feeling embarrassed. On the other hand young consumers with relatively high subjective wine knowledge associate more with others whom they perceive to be wine knowledgeable, such as wine experts, and they will refer to these people instead of impersonal information sources. Generation Y consumers with high subjective wine knowledge levels believed: that it is important to know and evaluate wine quality; that wine is crucial for their lifestyles; and they prefer wine more than other drinks.

Wine marketing managers can therefore achieve long-term success by embracing the new Generation Y wine consumer market. In-store marketing efforts, label designs, wine style classifications, wine sales personnel etc. must be used to equip browsing consumers with suitable information which they can use during their wine purchase decisions. Retail store and restaurant personnel who are able to detect consumers' general wine knowledge level can provide them with the most suitable information tools for their wine purchase decision. Marketers can therefore create marketing strategies that are tailored to attract and retain Generation Y wine consumers with different subjective wine knowledge levels.

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# Chapter 6

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## General discussion and conclusions

## GENERAL DISCUSSION AND CONCLUSIONS

South African Chenin blanc wine styles include the following three industry-defined dry wine styles: FF, RR-unwooded and RR-wooded. Consumers are, however, confused by the diversity of Chenin blanc wine styles and consequently they often struggle to identify Chenin blanc wines that suit their preferences (Brower, 2009; Smith, 2010). No specified sensory method is yet used to classify and describe the various Chenin blanc wine styles. The scientific field can assist the wine industry by providing them with valuable tools and information to optimise their Chenin blanc wine style production and marketing efforts. It is increasingly important to understand consumers within the wine market of South Africa and how they perceive different wines and wine styles. The youngest generation of wine consumers, Generation Y, can be classified as the most important new market segment due to the fact that it consists of large and increasing number of consumers, born between the years 1977 to 2000 (Wolf, Carpenter and Qenani-Petrela, 2005), who are different from any other preceding consumer generation. This promising Generation Y consumer group not only differs from previous generations in terms of age, lifestyle and size, but they also react differently towards modern technology, products and traditional marketing efforts. The Generation Y consumer group is providing new opportunities for the South African wine industry and it is important to investigate these consumers' wine related insights.

The motivation for this research study was to investigate different classifying perspectives for South African Chenin blanc wines so as to resolve this confusion with regards to the various Chenin blanc wine styles. These perspectives are the classification of Chenin blanc wines: into their various wine style groups according to sensorial similarities, with the use of either the sorting method or QDA; into the various consumer preference groups during blind and informed wine style preference tests; and into various preference groups according to the consumers' exploratory data similarities.

The main aims of this research project were therefore three-fold. (1) Various sensory classification techniques, uninstructed and instructed sorting techniques and QDA, were investigated in terms of classifying different South African Chenin Blanc wine styles. The various panels, wine experts, trained panellists and young wine consumers, used during these aforementioned sensory methods were also investigated in order to determine which method-and-panel combination is able to effectively classify and describe the existing three Chenin Blanc dry wine styles. (2) Sensory profiling of Chenin blanc wine styles was also used to extend the Chenin blanc wine style lexicon and to identify other wine styles that might not have been recognised before as well as how these wine styles can be classified into separate groups or as part of a wine style continuum. (3) The drivers of liking for Chenin blanc wine styles have been investigated during blind and wine style concept informed conditions in order to establish how the various wine style concepts or definitions may influence Generation Y consumer preferences for specific wines. This Chapter provides an overview of the findings obtained for both the scientific and industrial fields.

This research study delivered the following *scientific outcomes*: (1) sensory attributes of three major dry Chenin blanc wine styles, FF, RR-unwooded and RR-wooded, and identified the definite number of Chenin blanc wine style classification groups; (2) comparisons between experienced wine panellists and unexperienced consumer panellists with regards to their sorting data; (3) and interactions between consumers' exploratory data and their wine style preferences.

This reasearch also provide the South African wine *industry* with relevant sensory and consumer insight *outcomes* in terms of the different Chenin blanc wine styles. It indicates

whether there truly are different Chenin blanc wine styles and whether Generation Y wine consumers have particular preferences for these wine styles. Furthermore, it reports how consumers' knowledge of the wine style concepts influenced their wine style preferences.

## **6.1 Industrial outcomes**

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### **6.1.1 Classifying Chenin blanc wine styles according to their sensorial properties**

In Chapter 3 the sorting method was used in order to identify whether Chenin blanc wines can be classified into various wine style groups. According to the wine industry (Smith, 2011) there are currently three Chenin blanc dry wine styles in South Africa namely FF, RR-unwooded and RR-wooded. However, during this research study we found that South African Chenin blanc wines can be divided into two definite groups: wooded and unwooded wine styles, i.e. RR-wooded versus FF wines. The wooded wine style group was also more concisely grouped together than the unwooded wines which consists of the two integrating wine styles: FF and RR-unwooded. These unwooded Chenin blanc wines therefore formed a continuum positioned between the two extreme wine styles, i.e. FF and RR-wooded. This finding supports the wine industry's notion that some of the wine styles might be too integrated with one another to be clearly separated. With the use of QDA the finer descriptive differences of these continuum wines can be rated with the use of a fresh-to-mature scale and/or a light-to-full body scale in order to differentiate between these individual unwooded wines. The wooded characteristic in the wine may have overshadowed the finer differences between the unwooded wine styles during the current study. We recommend that future Chenin blanc wine style classification research should focus on the unwooded wines separately from the wooded wines and also use a larger number of wine samples in order to discriminate more precisely between the FF and RR-unwooded wine styles.

### **6.1.2 Generation Y consumers' blind and informed Chenin blanc wine style preferences**

In Chapter 5 the various Chenin blanc wine style preferences of South African, Western Cape, Generation Y consumers were investigated in order to identify if there are different consumer preference clusters. One of the main concerns of the wine industry is the fact that they are not currently using wine style concept marketing, because they are not certain whether these consumers are even able to identify the differences between these Chenin blanc wine styles or if they have a preference for these Chenin blanc wines.

No significant differences were observed during this study between Generation Y males and females or between smokers and non-smokers in terms of their preferences for specific Chenin blanc wine styles as they all liked the various wine styles equally. Even though previous studies show that gender differences play a significant role on wine preferences (Lelièvre *et al.*, 2009), these consumers are still relatively novice in terms of wines and they have not yet had enough exposure to show strong gender differences in terms of their preferences for the various Chenin blanc wine styles. Another possibility is the fact that a slight preference bias was possibly included in this study due to the fact that mostly consumers who were interested in wine requested to participate in this study. More females are often wine consumers than males and therefore females contribute to the largest percentage of the wine consumer market (Barber *et al.*, 2007) and they are also more willing to participate in such a wine research study. The female segment was almost twice as large as the male segment in the Generation Y consumer sample group used during the current study.

Even though there were no specific wine style preferences, it is clear that higher preferences are linked to an informed wine style concept tasting instead of a blind wine tasting. Results obtained from an informed wine style preference tasting focused on wine style concepts whereas more focus is placed on the consumers' perceived sensorial preferences during the blind wine tasting. Therefore the consumers' knowledge of the wine style definitions influences their wine preferences differently than when they are not aware of the wines' style identities. These wine style definitions or concepts clearly have valuable marketing potential which can be used to reach and satisfy Generation Y wine consumers. In their research study on internal and external preference mapping for commercial lager beers Guinard, Uotani and Schlich (2001) compared consumer hedonic ratings of a blind condition versus an informed condition with regards to the brand and price of the lager beers. They also found that there is a significant change in consumers' preference ratings from a blind to an informed tasting condition. This suggests that the two conditions, blind versus informed preference testing, stimulate the use of different cognitive processes. When consumers are informed in terms of the specific product that they are about to taste, expectations are created before they consume the product. During their evaluation of the product they will therefore compare their perception of the product with their expected perception of the product, which is typical to top-down cognitive analysis (Green *et al.*, 2011; Lelièvre *et al.*, 2009). However, during a blind tasting consumers will not have predispositioned expectations in terms of their preferences for the products. Here their preferences are the pure result of the product profile characteristics, which are typically associated with bottom-up cognitive analysis (Green *et al.*, 2011; Lelièvre *et al.*, 2009). Interestingly Guinard, Uotani and Schlich (2001) found that this particular difference in preferences between informed and blind tastings was the strongest for consumers who are between 20 to 30 years old, i.e. the young consumer market segment. It is therefore clear that these wine style concepts cannot only be used as effective marketing tools, but it will also have a strong, positive influence on the new and opportunistical Generation Y consumer market segment.

### **6.1.3 Generation Y consumer insights with regards to their preferences for different Chenin blanc wine styles**

Chapter 5 furthermore explored the associations between Generation Y consumers' exploratory data and their preferences for the Chenin blanc wine styles. Even though these consumers have equal preferences for all the wine styles, during the blind wine tasting, those consumers that prefer to drink red wine also preferred the more complex RR-wooded and RR-unwooded wine styles over the FF wine style during the informed wine tasting. Only those consumers who prefer to drink white wine preferred the FF wine style the most. This could be the result of increased exposure to a specific wine style, i.e. the more consumers have experienced complex wines, the more likely they are to cultivate a preference for other complex wines as well. This relates to Pliner's (1982) theory of repeated exposure. In marketing terms, it is therefore important that the wooded Chenin blanc wines must be targeted specifically towards those consumers who prefer to drink red wine, whilst the fresh and unwooded Chenin blanc wines must be targeted to suit the preferences of consumers who prefer to drink white wine.

It was also found that this group of Generation Y consumers with a higher subjective wine knowledge level claimed to identify various back-label wine sensorial descriptions easier in a glass of wine than those consumers with lower levels of subjective wine knowledge. Consumers often struggle to identify wine aromas, as described on the back-label, which could also decrease their confidence in purchasing wine and consequently influence their wine



preferences (Mueller *et al.*, 2010). Most consumers can rate their subjective liking for a wine however, most do not have the confidence or the knowledge needed to assess a wine's quality objectively (Mueller *et al.*, 2010). Therefore consumer panels are also generally used during preference or hedonic tests in sensory science whilst trained or expert panels are used for descriptive or profiling tests. Descriptions of wine attributes on a back-label are often created by wine experts in the industry such as the winemakers. It is therefore important to assess how these consumers relate to experts in their ability to identify various wine attributes that constitutes to the overall wine profile as well as their descriptions for the various Chenin blanc wine styles.

A strong, positive correlation was also found between consumers' relative wine interest level and their preference for RR-unwooded and RR-wooded wines. Consumers with higher Chenin blanc wine interest levels also had higher preferences for more complex wine styles as well. This can be explained due to the fact that interested consumers will typically experiment more with different wines which increases their usage experience level and consequently cultivates a preference for more complex wines as well. Research showed that product involvement is closely related to consumer purchase behaviour (Flynn and Goldsmith, 1993; Mittal and Lee, 1989; Slama and Tashchian, 1985; Lockshin, Spawton and Macintosh, 1997, Quester and Smart, 1996). Consumers with high product involvement levels will therefore react differently than consumers with low product involvement levels to marketing efforts. According to Lockshin, Spawton and Macintosh (1997), it is possible to effectively segment a wine consumer market with the use of involvement as a segmentation variable: choosy buyers, brand conscious but hate to shop, uninvolved shopper, interested shopper and the lazy involved shopper. Furthermore, researchers have shown that consumers tend to reject new flavours during their first exposure (*neophobia phenomenon*), however, they can develop a preference for this new flavour over repeated exposures (theory of mere exposure, see: Pliner, 1982). More involved wine consumers will therefore be more motivated to try both easy-drinking and more complex wines on a more frequent basis than uninvolved wine consumers. Consequently they will also cultivate a stronger preference for these wines than uninvolved wine consumers.

We discovered that young, Generation Y wine consumers with different subjective wine knowledge levels will generally purchase wines for different events. According to Bruwer and Reid (2002), the factors that will influence consumers when they purchase wines include intrinsic and extrinsic wine attributes as well as the occasion for which the wine is purchased. Hall *et al.* (2001) found that the dominant attributes relating to wine choice are wine price, wine taste and wine type (red or white) and the importance of each of these factors for the consumer differed for different consumption occasions. The current study found that novice wine drinkers generally associate wine with different types of social gatherings: both formal such as a special occasion and informal such as a 'bring-and-braai'. Generation Y wine consumers with moderate subjective wine knowledge levels generally purchase wine to enjoy alone, because they are still experimenting with various wines in order to discover which varieties and brands they prefer best. However, consumers with above average subjective wine knowledge often purchase wine for dinner occasions due to the fact that they know and appreciate food and wine pairings. It was also discovered that these consumers with above average wine knowledge seldom/never purchase wine as a birthday gift because they perceive wine as an everyday, lifestyle product and not as a special, gift product.

Consumers who only drink wine occasionally generally purchase wine for special occasions or to enjoy on their own, whilst moderate wine drinkers often buy wine to drink with dinner and frequent wine consumers will also purchase wine to enjoy on their own.

We discovered that different consumer wine knowledge groups also make use of different wine information tools in order to make a wine purchase decision. According to Alba and Hutchinson (1987), product experience strengthens a consumer's objective knowledge about the specific product which, in turn, will strengthen consumer confidence (Park and Lessig, 1981). This current study found that novice consumers would rather keep to themselves and refer to impersonal information sources such as advertisements on the television, flyers and newspapers than consulting other people or personal information sources. This is possibly due to the fear of being perceived by others as incompetent and unknowledgeable when it comes to choosing the right bottle of wine (Hammond, 2010). Those with moderate wine knowledge are not worried about what their peers or family members might think and they will openly discuss wines before making a decision to purchase one. They will also make more use of in-store information sources such as bottle labels and shelf cues as well as available salespersons to guide them in choosing a wine that suits their needs. Those young wine consumers who reported to have above average wine knowledge will rather refer to wine expert opinions when deciding on purchasing a specific bottle of wine, due to the fact that they trust others who also have high wine knowledge levels to guide their wine choices. The problem with wine, according to Chaney (2000) and Unwin (1999), is that its quality characteristics cannot be assessed without purchasing and tasting the wine first. Inexperienced wine consumers will therefore often rely on descriptions from labels, friends, wine menus, journalists and restaurant wine steward recommendations in order to make their choice (Hammond, 2010). In addition, consumers often rely on their own information sources i.e. their own wine knowledge, preferences and usage experience (Dodd *et al.*, 2005; Lockshin and Hall, 2003). Choices are however, often made without an adequate amount of relevant information (Hammond, 2010) and this could lead to dissatisfaction and the consumer could spread negative word-of-mouth about the product which could detrimentally affect the image of the product.

Furthermore, it was also discovered that consumers with various levels of subjective wine knowledge also have different beliefs and attitudes with regards to wine. Those attitudes and beliefs that correlate strongest with high subjective wine knowledge levels were the following: to be able to know and evaluate wine quality; wine is crucial for the consumer's lifestyle; and the fact that they prefer wine more than other drinks.

Even though this Generation Y consumer group could not be segmented into different preference groups according to their Chenin blanc wine style preferences, some of these consumers illustrate different associations and trends between their wine preference and exploratory data. It is clear that wine knowledge is an important influential factor in terms of consumer purchase behaviour and their self-confidence. Subjective wine knowledge will directly influence consumer self-confidence which will also influence the consumer's purchase behaviour (Olsen, Thompson and Clarke, 2003). Therefore, the higher the subjective knowledge level, the more confident the consumer will be in making a purchase decision. Interestingly Barber *et al.* (2008) found that Generation X'ers (1965 to 1976) have higher levels of subjective wine knowledge in comparison to Generation Y consumers (1977 to 2000), indicating that Generation Y consumers are not yet familiar enough with wine. Wine education must be encouraged amongst these young wine consumers in an engaging, non-threatening and insightful manner by providing them with suitable information tools that they can use for wine purchase decisions and to improve their own wine knowledge. Ultimately these new wine consumers will be more motivated to try new and different wine cultivars and wine styles.

## 6.2 Scientific outcomes

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### 6.2.1 Sorting versus QDA in terms of classifying and profiling Chenin blanc wines

In Chapter 3 the sorting method was investigated in terms of its ability to classify Chenin blanc wines into various wine style groups and to describe these wine styles. The following methodological aspects were evaluated with regards to the sorting method: comparisons between novice wine consumers versus wine industry experts to determine which panellists are best suited for the sorting method. The influences of an instructed sorting task versus an uninstructed sorting task on the results obtained from both panels were also investigated. Lastly the practicality of this method was also considered.

We found that there is no difference between wine experts and untrained wine consumers in terms of their sorting results, i.e. they both sorted the wines into similar groups during instructed and uninstructed sorting tasks. Wine tasting experience and panel training did not influence the Chenin blanc wine style sorting outcomes. Therefore, either untrained consumers or wine experts can be used to conduct a wine style sorting task, however, wine experts are expected to outperform consumers in terms of describing the various wine style groupings as a result of their high level of wine tasting experience. Chollet and Valentin (2001) also found that both trained and untrained panellists have similar perceptions in terms of beer, but their verbalisation abilities differ for the same product sample set. Experts and trained panellists tend to use more terms, however, these terms tend to be more concrete and shared amongst the panellists whereas consumer panellists generally tend to use hedonic and ambiguous terms that are not often shared with other panellists within the group (Clapperton and Piggott, 1979; Lawless, 1984; Gains and Thomson, 1990; Gawel, 1997). According to Chollet and Valentin (2001), similar performance from both trained and untrained panellists is determined by the type of sensory task performed by the panels. The higher the level of experience or training, the more precise and consistent the panel will use certain wine attributes to describe wine groups. Highly involved and experienced wine drinkers understand interactions between various wine factors such the wine regions, producers and grape varieties and how it influences wine quality, but novice consumers are oblivious to these specific interactions (Lockshin *et al.*, 2006). According to Lelièvre *et al.* (2009), there are two different expertise types: professional expertise and sensory expertise. Not only do professional experts have technical knowledge of wine and wine making but they often have in-depth chemosensory knowledge as well which could significantly influence their wine perceptions (Lelièvre *et al.*, 2009). We found that the wine consumers tend to use a lot more descriptors than wine expert panellists. During the uninstructed sorting phase they consistently used the same type of descriptors, due to their lack of wine descriptive vocabulary. During instructed wine style sorting these consumers used even more descriptors than during the uninstructed sorting task, due to the fact that the wine style description list or lexicon prompt them to use a wider range of descriptors than those that they are generally familiar with. In terms of the sorting instructions, both panels sorted products slightly better when they were instructed in terms of how they should sort products as more variance was explained by the DISTATIS plots obtained during instructed sorting. However, results from consensus analyses indicated that providing panellists with a list of wine style concept descriptions did not change their sorting results.

It was proved that the DISTATIS statistical analysis method delivers reliable configurations that are similar to those obtained from MDS, but DISTATIS incorporate the individual panellist variance which results in more concise groupings. DISTATIS plots are not only relatively simple

to interpret, but it can easily be compared to PCA plots obtained from QDA. Similar results were obtained from the DISTATIS, MDS and PCA projections during this study.

No statistical differences were found between any of the sorting configurations. This indicates that the same sorting projections can be obtained from untrained consumers or wine experts during either instructed or uninstructed sorting methods. The level of wine tasting experience and sorting instructions therefore did not have a significant influence on the sorting task results. Even though similar results were obtained from all sorting tasks, descriptive data differed somewhat between both sorting tasks for the two panels. It is suggested that instructed sorting should be used in the case of a wine expert panel to classify the various wine styles. The experts must therefore first reach consensus about the various wine style definitions before sorting and describing wines. This ensures that they all use the same reference framework to sort and describe wine groups and reduces the number of descriptors used. When using a consumer panel to perform wine style sorting tasks, it is suggested that uninstructed sorting should rather be used as a description list only motivates the panellists to use too many different descriptions which complicates the data analysis procedure. Due to the fact that untrained wine consumers often have a limited vocabulary to describe Chenin blanc characteristics they generally use fewer descriptors for the wines during uninstructed sorting. In all sorting tasks and description processes the expert panel still slightly exceeded the novice consumer panel, however, both these panels can be used to sort and describe Chenin blanc wine styles. The addition of a descriptor list has no significant influence on the sorting outcome which means that the outcome is independent from a guidance list (Chollet *et al.*, 2011; Blancher *et al.*, 2007; Cartier *et al.*, 2006; Faye *et al.*, 2004, 2006; Saint Eve, Paci-Kora and Martin, 2004; Tang and Heymann, 2002; Solomon, 1990) In other words even when consumers were provided with a description list, experts still managed to outperform these novices. It therefore seems that a description list does not improve novice panellists' ability to discriminate or describe various products within a sample set. Research conducted by Challot *et al.*, (2011) supported this finding when they confirmed that providing a list of descriptors to consumers during the verbalisation process of the sorting tasks did not improve their ability to describe products. This finding can be explained due to the fact that a long list of descriptions may often confuse consumers.

In Chapter 4 the sorting method was compared with QDA in terms of describing and classifying the various Chenin blanc wine styles. Even though QDA is the conventional profiling method trusted to deliver consistent, reliable and accurate results, it is also more expensive and time-consuming than the sorting method. According to literature one can obtain similar product maps with the sorting task and the conventional profile (QDA) (Chollet *et al.*, 2011). This result is consistent with the works of Blancher *et al.* (2007); Cartier *et al.* (2006); Faye *et al.* (2004, 2006); Saint-Eve *et al.* (2004); Tang and Heymann (2002). However, when evaluating the captured descriptive information of each method it has been found that QDA tends to provide more precise and more easily interpretable descriptions than those obtained from the sorting task's verbalisation phase (Chollet *et al.*, 2011). The sorting task provides global information about basic, salient and common characteristics Chollet *et al.* (2011). This current study proved that the traditional QDA method can be substituted by the sorting method. Even though all the sorting panels and methods deliver the same results in Chapter 3, the expert panellists sorting results always slightly exceeded those obtained from the untrained consumer panel. Uninstructed sorting delivered the same results as QDA and instructed sorting, but there is slightly lower consensus level between uninstructed sorting results and QDA results. Therefore one can obtain similar projections from untrained expert or consumer panellists during a sorting task. However, conventional QDA is still the most effective profiling method in terms of

quantifying finer sensorial differences between two products within a sample set as it profiles all the products individually whereas sorting profiles the sorted product groups as separate units. Although the sorting tasks could easily be used to differentiate between wooded and unwooded wines, the QDA method proved more detail in terms of the differences between the unwooded wines which varied according to their degree of Maturity/Freshness and/or Body.

### 6.2.2 Comparison between blind and informed wine style preference tastings

In Chapter 5 the effect of informed versus blind wine style preference tastings were evaluated in terms of the obtained results. It was found that a wine style concept tasting, i.e. informed wine style tasting, had a positive influence on young novice wine consumers' perceptions of a particular wine in comparison to a blind wine tasting, i.e. where they are unaware of the particular wine style identities. It is therefore clear that the cognitive influence of wine style knowledge can effectively improve the wine drinker's preference for a particular wine. During the blind wine style tasting there were no significant differences between the consumers' preferences for the various wine styles.

This study also proved that the sorting task (Chapter 3) can also be used to investigate different preference ratings for different Chenin blanc wine style groups (Chapter 5). This can be done with the use of ANOVA by comparing the mean preference scores for the sorted wine styles groups with one another for significant preference differences. However, QDA data can be used more effectively not only to indicate the preferences for different wine style groups, but also to indicate the preference drivers. No specific wine attribute preference drivers were found.

## 6.3 Conclusion

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The sorting technique can therefore successfully be used by in both the wine industry as well as scientific institutions to identify various wine styles within wine cultivar. Both untrained wine expert or wine consumer panels can be used to perform the sorting task, which can either be instructed or uninstructed, in order to classify and describe various Chenin blanc wine styles.

It can also be used to identify where some wine styles may overlap with one another which is therefore not clearly defined and may ultimately confuse wine consumers. Intensive conventional sensory profiling such as QDA could be used to investigate these finer differences between wine styles. Overall the sorting task is a simplistic, effective, time saving and economical sensory classification and profiling method in terms of the identification and description of various wine styles of a specific wine cultivar group.

Some negative factors about the sorting method were experienced during this study. The sorting method could not be used as effectively as QDA to explain the preferences of consumers. This is due to the fact that the sorting task does not traditionally scale descriptive data like QDA to obtain wine attribute intensity data. Simple attribute intensity scales can be used during the sorting task, however, it would then be wiser to make use of a trained panel or an expert panel as consumers are generally not able to scale wine attribute intensities which will result in too much variance. Nonetheless, ANOVA can be utilised in order to investigate whether there are significant differences between the various wine style group mean preferences and groups were obtained from sorting DISTATIS plots. Furthermore the limited number of wine samples used during sorting, in order to prevent sensory fatigue, also limits the observation of finer differences between the unwooded FF and RR-unwooded wine styles.

The following uses for the sorting task have been suggested by Chollet *et al.*, (2011). It is a useful selection tool before another test such as a profile or consumer test and can be used in

quality control. It can replace a series of triangular tests and be used to determine the general product characteristics from a given group when we know what the groups' relevant sensory characteristics are. The sorting task can assist marketing research by comparing competing products with one another in terms of their sensory profiles.

This project combined the three components surrounding Chenin blanc namely consumer insights, marketing or industry influence as well scientific research skills in order to optimise the classification and description of various South African Chenin blanc wine styles and to understand the consumer behaviours and decisions made by the Generation Y wine consumer target market. Sensory research and consumer insights must be combined today in order to produce and market products that not only satisfy a specific target market, but will support the creation of more effective marketing strategies that will sustain consumer loyalty. The integration of sensory and marketing research is critical to ensure that the production of wine styles fits consumer needs and preferences (Lesschaeve, 2007).

#### **6.4 Possible research difficulties, preventive measures and suggestions for future research**

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Time and funding resources restricted the number of consumers as well as the number of wines that could be included in this study. Care was however, taken to carefully select a representative sample of South African Generation Y consumers in the Western cape between the ages of 21 to 32 years old who drink white wine at least once a month. Both wine sample and panellist selections where restricted to availability. A few other challenges were expected during this study, but measures were taken to prevent these difficulties as follows:

- Consumer research panel size. A maximum number of 150 consumers were used to perform the preference tests as > 150 consumers become too expensive to test. According to Næs *et al.* (2010:15), 100 to 150 consumers provide reliable consumer insights and preference results.
- Total number of wine samples and wine bottles was limited due to financial restraints and to limit the effect of sensory fatigue. No sorting replications were done as sorting is generally a repeatable tool (Chollet, 2011; Parr, 2011). Although only 11 wine samples were used, these wines were evaluated during a pre-sorting test in order to establish that this selection of wines represent a wide variety of Chenin blanc wine style sensorial attributes. It was not possible to include all the different Chenin blanc wine styles from all the different wine regions in the Western Cape as a large wine sample sample set will become too expensive and also cause sensory fatigue during sorting. Wines were therefore sourced from the Stellenbosch, Paarl and Franchhoek according to their wine style classifications via the 2011 John Platter guide (Platter and Van Zyl, 2011) and the top Chenin blanc wines for 2010 (Wine Info, 2011). Future Chenin blanc wine style studies should include a larger number of wine samples from various areas in order to investigate the influence of origin on the wine style classifications.
- Location and facility size. The sensory laboratory could only accomodate a limited amount of people. Two larger lecture rooms were therefore used to accommodate the consumer preference tests and the sorting tests. Even though these rooms are not laboratories, conditions were carefully monitored in order to control these testing environments, such as airconditioned rooms of 21°C and white lights.
- Geographic coverage in Western Cape in terms of wines made it inconvenient for consumers to be transported to Stellenbosch for this study. Sourcing was thus focused on Tygerberg campus, situated in Cape Town which is close to Stellenbosch. It may very

well be that different Geographical areas, such as the Gauteng province, might have Generation Y wine consumers with different Chenin Blanc wine style preferences due to their different lifestyles and perception of wine. Such studies need to be investigated in the future.

- Training and testing procedure of QDA panel. Although some QDA panels are trained for 40 to 120 hours (Meilgaard, Civille and Carr, 2006) it has been proved that successful QDA can be conducted by training the panel for 5 to 10 hours (Zook and Wessman, 1977; Zook and Pearce, 1988; Lawless and Claassen, 1993; Stone and Sidel, 2004). The current QDA panellists all have a minimum experience of three years and already conducted other Chenin blanc wine QDA studies. Therefore they only required 7 hours of training. Stone and Sidel (1993) reported 5 to 7 hours training is sufficient for an experienced panel.

The following measures were taken to prevent difficulties in terms of data accuracy:

- Manual importation of paper ballet data i.e. risk of human error due to typos. A data capturing document was created beforehand to prevent any error entries.
- Bottle faults. Each bottle of wine was checked for wine faults before pouring the wines.
- Smokers cannot perceive wine aroma attributes as accurately as non-smokers. A screening test was used to select twenty non-smoking sorting consumer panellists.

## 6.5 References

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# Addendum A

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**Sorting, consumer screening,  
preference and exploratory  
research questionnaires**

## Addendum A



# Uninstructed sorting



Please follow the instructions as follows:

NOTE: please use the water to desensitise your nose between wines.

### Sorting task:

1. **ONLY SMELL** the wines.
2. Evaluate all 11 wines from left to right one at a time **without sorting in groups**.
3. Now evaluate each wine again in any order and **sort the wines into groups in front of you according to how similar you perceive them to be to one another**.
  - a. NOTE: you may place as many wines into a group if they are all similar to each other.
  - b. You may create as many groups as you want to.
4. **Indicate which wines are grouped together** by writing the number of the wines in a group within one of the blocks as provided in the table below (See table 1).

Break for 3 min

5. Please evaluate the wines that you grouped together and write down the **descriptors (no more than 5 per group)** you perceive to be dominating in that group. See table 1:

**Table 1:** Sorting task

	Group__	Group__	Group__	Group__	Group__	Group__	Group__
(3) Wines per group							
(4) Group descriptors (max 5 descriptors/group)							



# Instructed sorting



Please follow the instructions as follows:

NOTE: please use the water to desensitise your nose between wines.

**Sorting task:**

1. **ONLY SMELL** the wines.
2. Please read the following definitions for the three Chenin blanc wine styles carefully (see last page):  
**“Fresh and Fruity”, “Rich and Ripe Unwooded” and “Rich and Ripe Wooded”**
3. Evaluate all 11 wines from left to right one at a time **without sorting in groups**.
4. Now evaluate each wine again in any order and **sort the wines into 3 wine style groups namely “Fresh and Fruity”; “Rich and Ripe Unwooded” and “Rich and Ripe Wooded” in front of you according to how similar you perceive them to be to one another**.
  - a. You may create more/different groups if you feel there are more.
  - b. NOTE: you may place as many wines into a group if they are all similar to each other.
  - c. You may create as many groups as you want to.
5. **Indicate which wines are grouped together** by writing the number of the wines in a group within one of the blocks as provided in the table below (See table 1).

Break for 3 min

6. Please evaluate the wines that you grouped together and write down the **descriptors (no more than 5 per group)** you perceive to be dominating in that group. See table 1:

**Table 1:** Sorting task

	Fresh and Fruity	Rich and Ripe unw	Rich and Ripe w	Group__	Group__	Group__	Group__
(3) Wines per group							
(4) Group descriptors (max 5 descriptors/group)							



## Screening Questionnaire

### Section A: General

<b>1. Gender:</b>	Male	Female	<b>2. Previous sensory participation?</b>	Yes	No	
	1	2		1	2	
<b>3. Wine evaluation qualifications</b>	Yes	No	<b>4. Do you smoke?</b>	Yes	No	
	1	2		1	2	
<b>5. Age:</b>	< 21 yrs.	21-23 yrs	24-26 yrs	27-29 yrs	30-32 yrs	>32 yrs.
	1	2	3	4	5	6

### 6. Please select one answer for each of the following questions:

<b>6.1. I usually drink/buy wine:</b>	< 1 /month	1 /month	2-3 /month	4-5 /month	>6 /month
	1	2	3	4	5
<b>6.2. Which is true for you?</b>	I only drink white wine	I only drink red wine	I drink both white AND red wine	I do not drink wine at all	
	1	2	3	4	
<b>6.3. Which wine do you PREFER to drink?</b>	I prefer to drink white wine	I prefer drink red wine	I like both white AND red wine equally	I do not like to drink wine at all	
	1	2	3	4	



# Preference test



## Task 1: Receive 11 wines

1. Take a generous sip of each wine from LEFT-to-RIGHT.
2. Please indicate your preference/liking for each wine by making an "X" over the right description on the preference scale for each wine number.

_Nr__	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely
_Nr__	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely
_Nr__	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely
_Nr__	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely
_Nr__	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely
_Nr__	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely
_Nr__	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely
_Nr__	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely
_Nr__	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely
_Nr__	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely
_Nr__	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely

## Task 2: Receive 3 wines

3. Please read the following definitions/descriptions for the three Chenin blanc wine styles carefully: **The 3 Dry**

### Chenin blanc Wine Style Definitions

FF	RR-unwooded	RR-wooded
Fresh Fruit	Ripe Fruit	Cooked Fruit
Perfume/Floral	Pineapple	Bee Wax
No Wood	Yellow stone fruits	Wood/ Cedar wood
Crispy/Fresh	Honey	Resinous
Sharp	Citrus	Baked apple/quince
Value	Layered/Rich Texture/Viscose	Pine nuts/ nutty
Easy Drinkable	Raisins	Botrytis
Lime	Expressive	Orange Peel
Tropical	Med. Body	Fat
Guava	Fig Jam	Toasty
Crispy Apple	Tropical	Butterscotch
Linear	Broad	Dried fruit
	Pear	Vanilla
	Marmalade	Yellow straw
	Honey	
	Ripe Papaya	

4. Smell + taste the following three wines and indicate with an "X" how much you like/dislike the wine sample:

<b>F+F (Wine X)</b>	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely
<b>R+Runw (Wine Y)</b>	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely
<b>R+Rw (Wine Z)</b>	1. Dislike extremely	2. Dislike much	3. Dislike moderately	4. Dislike slightly	5. Neither like nor dislike	6. Like slightly	7. Like moderately	8. Like much	9. Like extremely



# Exploratory Questionnaire

Section A: General							
1. Gender:	Male	Female	2. Previous sensory participation?	Yes	No		
	1	2		1	2		
3. Wine evaluation qualifications	Yes	No	4. Do you smoke?	Yes	No		
	1	2		1	2		
5. Age:	< 21 yrs.	21-23 yrs	24-26 yrs	27-29 yrs	30-32 yrs	>32 yrs.	
	1	2	3	4	5	6	
6. Please select one answer for each of the following questions:							
6.1. I usually drink/buy wine:	< 1 /month	1 /month	2-3 /month	4-5 /month	>6 /month		
	1	2	3	4	5		
6.2. Which is true for you?	I only drink white wine	I only drink red wine	I drink both white AND red wine	I do not drink wine at all			
	1	2	3	4			
6.3. Which wine do you PREFER to drink?	I prefer to drink white wine	I prefer drink red wine	I like both white AND red wine equally	I do not like to drink wine at all			
	1	2	3	4			
Section B: Socio-demographic information							
1. Monthly income level:	<R2 000/month	R2 000-R4 999/month	R5 000-R9 999/month	R10 000-R14 999/month	>R15 000/month		
	1	2	3	4	5		
2. Highest education level:	High School/Grade 12 certificate	Some Secondary education / Tech education	Diploma or Degree	Postgraduate qualification			
	1	2	3	4			
3. Residence (the past 5 yrs)	Western Cape	Gauteng	Eastern Cape	Kwazulu Natal	Northern Cape		
	1	2	3	4	5		
	Limpopo	Mpumalanga	North West	Free-State	Other		
	6	7	8	9	10		
Section C: Consumer behaviour							
1. Retail Outlet	1. Never	2. Seldom	3. Sometimes	4. Often	5. Always		
Grocery store	1	2	3	4	5		
Convenience outlet	1	2	3	4	5		
Wine estate	1	2	3	4	5		
Warehouses	1	2	3	4	5		
Liquor store	1	2	3	4	5		
Wine shop	1	2	3	4	5		
2. Wine consumption frequency:	Never	Rarely/occasionally (± once a month)	1-2 times/week	Almost every day	Every day		
	1	2	3	4	5		
3. For which occasion would you buy wine for the most?	To enjoy on my own	"bring-en-braai"	For a special occasion such as graduation dinner	For a birthday	For sports event	For Dinner	
	1	2	3	4	5	7	
4. Can you identify back label aromas?	Always	Almost always	Sometimes	Seldom	Never		
	1	2	3	4	5		
5. How did you become a wine drinker?	My parents drank wine	At university with friends and wine tours	I experimented with different wines myself	Studied a course in wine	Other		
	1	2	3	4	5		
6. With who do you like to drink wine?	On my own	With friends	With my partner	With work partners/associates	With family members (other than parents)	With my parents	Other
	1	2	3	4	5	6	7
Section D: Consumer Involvement							
1. How important each of the following for you?							
Wine factor	Not at all important	Rarely important	Sometimes important	Quite important	Extremely important		

# **Addendum B**

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**Tucker plots, QDA Pearson  
rank correlations and  
demographic consumer data**

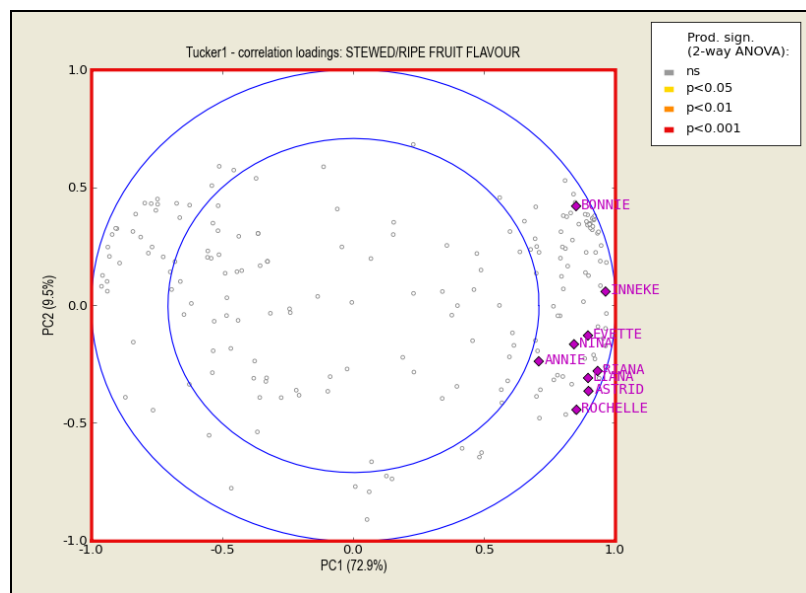


## Addendum B

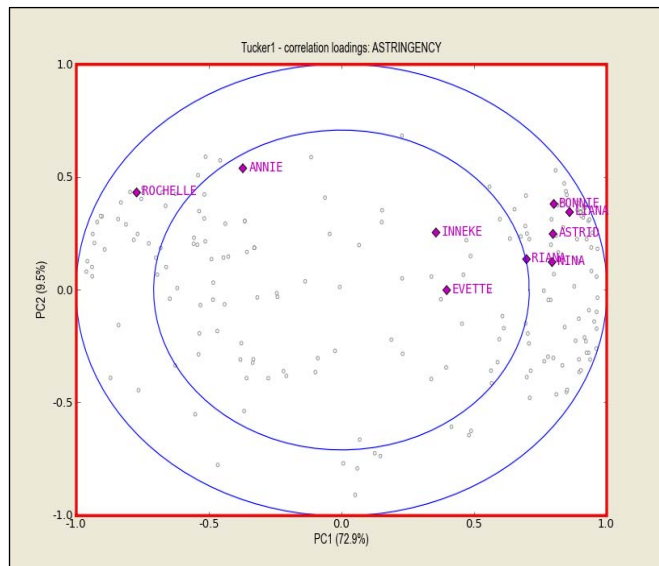
### Tuckerplot evaluations during QDA:

The *PanelCheck*®, V1.4.0, NOFIMA, Norway program was used to evaluate the tuckerplots of the assessors in order to establish their consensus in terms of the intensities of various descriptors in the wines (i.e. how homogeneously the panel scaled). Fig. B.1 illustrates one of these tuckerplots were all assessors used the scale similarly for the specific variable (descriptor intensity) for example Stewed/Ripe Fruit Flavour. When all the assessor evaluation points lie between the outer two circles of the plot in a group ( $p < 0.001$  i.e. there is no difference between the different panellists' attribute intensity ratings for the products) it indicates that this attribute was scaled similarly by all assessors for the same wine samples (i.e. no difference in the manner of sample assessment by the panellists for this particular descriptor). If, however, all the assessor evaluation points lie between the outer two circles, but they are not grouped together (for example, one assessor is placed in the opposite side of the plot than the others) it indicates that even though all assessors perceived the same descriptors in the same samples, some assessors used the scale differently to indicate the specific descriptor intensity.

The Tuckerplot for the descriptor Astringency (Fig. B.2) indicates that a group of assessors on the right of PC1 scaled the descriptor Astringency similarly for all the wines; however, the two assessors on the left-hand side of the plot have used the scale differently to indicate the intensity of astringency in some of the wine samples. Nonetheless all the assessors were consistent in terms of their intensity scaling for this perceived attribute in each wine over the replication tests. Due to the fact that that  $p < 0.001$  there is no difference in the intensity ratings scored for the wines by all panellists for the astringency attribute.

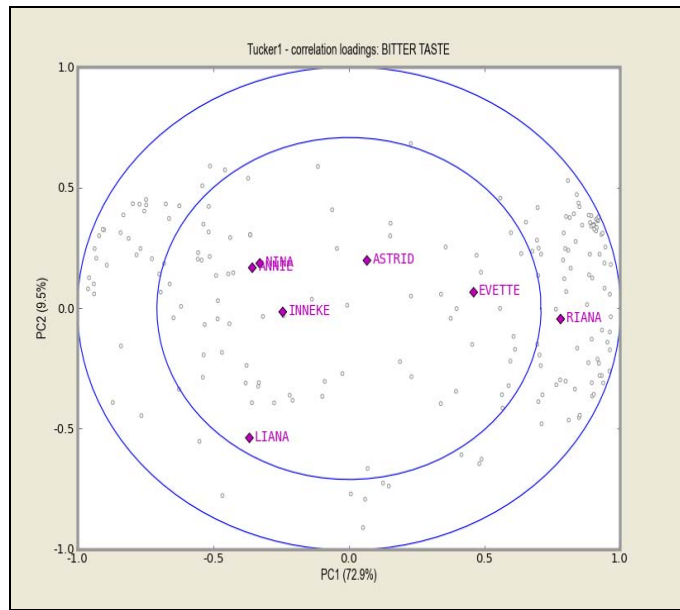


**Figure B.1:** Tuckerplot of the correlation between Stewed/Ripe Fruit Flavour intensity ratings by panellists for 11 wine samples ( $p < 0.001$ ) (obtained from *PanelCheck*®, V1.4.0, NOFIMA, Norway)



**Figure B.2:** Tuckerplot of the correlation between Astringency intensity ratings by panellists for 11 wine samples ( $p < 0.001$ ) (obtained from *PanelCheck®*, V1.4.0, *NOFIMA*, Norway)

When some assessors appear in the middle of the tuckerplot (i.e. in the inner-most circle of the plot) it indicates that they are not consistent in terms of their scores for a specific attribute in the wine samples. This could indicate that these assessors were either not well calibrated with the rest of the panel (i.e. not as well trained as the rest of the panel) or they might not be able to detect the specific attribute accurately due to physiological disabilities. However, when more than one assessor is positioned in the middle of the plot it becomes quite clear that this attribute is not significant enough to form a part of the descriptors for a specific product sample set, as the assessors seemed to be confused about its presence and intensities in the wines. The last situation is illustrated in Fig. B.3: i.e. Bitter Taste was not consistently recognised or scaled by the majority (89%) of the assessors. Due to the fact that there is no significant similarity ( $p = ns.$ ) in terms of the panellists ratings for the Bitter wine attribute of the various wine samples, the Bitter Taste descriptor is not a significant descriptor in terms of this sample set of eleven wines. This descriptor can therefore be eliminated from further investigations. For the purpose of this study only those descriptors with intensity ratings that were significantly correlated with the wine samples (as rated by the assessors) were used for further statistical analysis seeing that these are the main descriptors that can be used to classify wines in the sample set. These descriptors are: Fresh-Mature scale, Light-Full body scale, Tropical aroma, Rich/Stewed Fruit aroma, Sweet Associated aroma, Vegetative/Green aroma, Woody aroma, Spicy aroma, Buttery aroma, Fresh Fruit flavour, Stewed/Ripe Fruit flavour, Woody flavour, Sweetness and Acidity.



**Figure B.3:** Tuckerplot of the correlation between Bitter Taste intensity ratings by panellists for 11 wine samples ( $p =$  not significant) (obtained from *PanelCheck*®, V1.4.0, NOFIMA, Norway)

**Table B.1:** Pearson Rank Correlation values for QDA descriptors of the 11 Chenin blanc wine sample set

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.FRESH-MATURE	1.000	0.973	-0.973	0.973	0.936	-0.873	0.881	0.736	0.955	-0.945	0.927	0.825	0.882	-0.555
2.LIGHT-FULL BODY	0.973	1.000	-0.945	0.936	0.945	-0.873	0.872	0.745	0.927	-0.945	0.927	0.829	0.855	-0.582
3.TROPICAL AR	-0.973	-0.945	1.000	-0.927	-0.891	0.827	-0.853	-0.773	-0.973	0.945	-0.882	-0.884	-0.800	0.555
4.RICH/STEWED FRUIT AR	0.973	0.936	-0.927	1.000	0.909	-0.809	0.927	0.727	0.900	-0.882	0.864	0.765	0.845	-0.464
5.SWEET ASSOCIATED AR	0.936	0.945	-0.891	0.909	1.000	-0.864	0.826	0.555	0.918	-0.936	0.927	0.715	0.891	-0.527
6.VEGETATIVE/ GREEN AR	-0.873	-0.873	0.827	-0.809	-0.864	1.000	-0.771	-0.673	-0.827	0.918	-0.982	-0.733	-0.909	0.755
7.WOODY AR	0.881	0.872	-0.853	0.927	0.826	-0.771	1.000	0.752	0.826	-0.835	0.817	0.837	0.762	-0.459
8.SPICY AR	0.736	0.745	-0.773	0.727	0.555	-0.673	0.752	1.000	0.673	-0.736	0.664	0.829	0.455	-0.382
9.BUTTERY AR	0.955	0.927	-0.973	0.900	0.918	-0.827	0.826	0.673	1.000	-0.945	0.891	0.829	0.836	-0.564
10.FRESH FRUIT FLAV	-0.945	-0.945	0.945	-0.882	-0.936	0.918	-0.835	-0.736	-0.945	1.000	-0.955	-0.852	-0.836	0.600
11.STEWED/RIPE FRUIT FLAV	0.927	0.927	-0.882	0.864	0.927	-0.982	0.817	0.664	0.891	-0.955	1.000	0.788	0.927	-0.682
12.WOODY FLAV	0.825	0.829	-0.884	0.765	0.715	-0.733	0.837	0.829	0.829	-0.852	0.788	1.000	0.601	-0.437
13.SWEET TASTE	0.882	0.855	-0.800	0.845	0.891	-0.909	0.762	0.455	0.836	-0.836	0.927	0.601	1.000	-0.745
14.SOUR TASTE	-0.555	-0.582	0.555	-0.464	-0.527	0.755	-0.459	-0.382	-0.564	0.600	-0.682	-0.437	-0.745	1.000

**Table B.2:** Generation Y wine consumers socio-demographic data summary

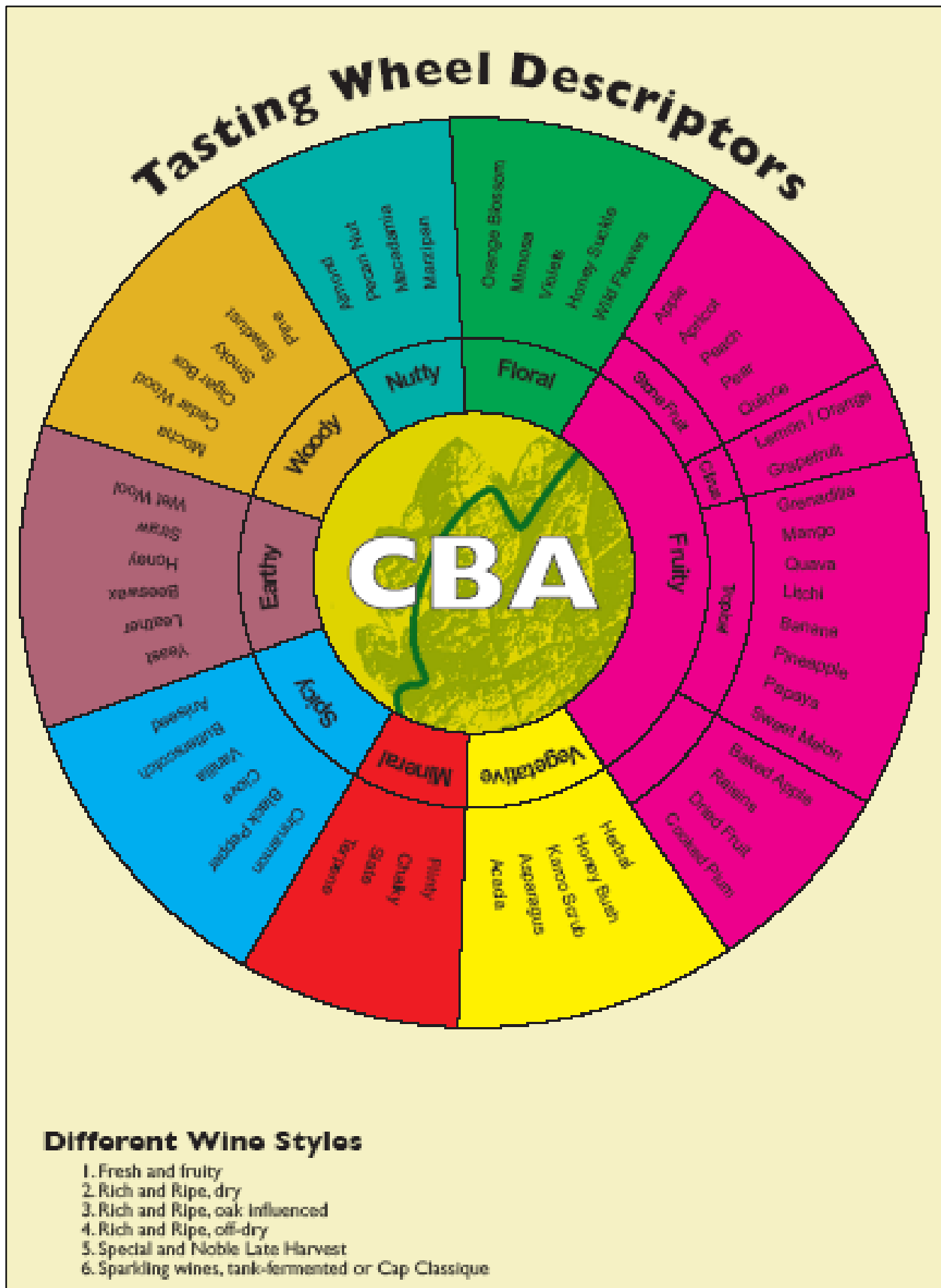
<b>Gender</b>	Female	Male	<b>Previous sensory participation</b>		Yes	No
	109	41			50	100
<b>Smoking habits</b>	Non-smokers	Smokers	<b>Wine evaluation qualifications</b>		Yes	No
	135	11			9	141
<b>Age</b>	21-23 yrs	24-26 yrs	27-29 yrs	30-32 yrs		
	80	37	25	8		
<b>Monthly income</b>	<R2 000	R2 000 – R4 999	R5 000 – R9 999	R10 000 – R14 999	≥ R15 000	
	71	30	23	10	12	
<b>Highest education</b>	High School/ Grade 12	Tech/ Some secondary	Diploma or Degree	Postgraduate qualification		
	31	3	66	46		
<b>Residence (past 5 yrs)</b>	Western Cape	Gauteng	Eastern Cape	Kwazulu Natal	Nothern Cape	
	133	4	2	2	1	
<b>Freq. wine consumption</b>	< 1/month	1/month	2-3/month	4-5/month	> 6/month	
	2	16	48	45	39	
<b>Only willing to drink</b>	White wine	Red wine	Red and White wine			
	12	1	133			
<b>Preferred wine</b>	White wine	Red wine	Red and White wine			
	31	53	62			

# **Addendum C**

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**Chenin blanc wine aroma  
wheel, QDA aroma standards  
and QDA sensory lexicon**

## Addendum C



\*Adapted from Chenin Blanc Association

**Table C.1: Chenin blanc wine aromas (synthetic and natural)**

Main tier	Ref Standard	Chemical name	Supplier	Reference nr.	Dosage/200ml wine
Citrus	Grapefruit	Fresh grapefruit	n.a.	n.a.	24g
	Citrus	Grapefruit	Sensient	C1859	30 µl
Yellow stone fruits	Apricot	Apricot Flavouring	Cargill	F-10922	20µl
	Peach	Peach	Sensient	F9371	33 µl
White stone fruits	Safari dry apples+pears	Dried apples and Pear	Safari	n.a.	Served dry in ramekins
Tropical fruits	Melon	Melon	Sensient	1007873	100 µl
	Tropical	Guava	Firminich	Sample box	33 µl
	Guava	Mango	Firminich	Sample box	30 µl
	Passion fruit	Passion fruit D1556 Liq flav	IFF	108352	100 µl
Sweet associated	Caramel	Butterscotch	Sensient	1043727	33 µl
	Honey	Plain honey	Woolworths	Blue gum Honey	50ml
Floral/Perfume	Honey Blossem	Honey	Firminich	Sample box	50 µl
Woody	Wood	Wood chips (cellar)	n.a.	n.a.	3 g
Nutty	Nutty	Pecan	Firminich	Sample box	25 µl
Spicy	Sweet and savoury spice	Spicy	Robertson spice	Mixed spice and All spice	3 ml (1.5ml each)
Vegetative/Green	Green pepper and canned asparagus juice	diced green pepper and canned asparagus juice	n.a.	n.a.	12 g green pepper and 10 ml asparagus juice
Rich, Stewed fruit	Quince jam	Home-made quince jam	n.a.	n.a.	Served in ramekins
Dried fruit	Safari mixed dry fruit	Dried mixed fruit	Safari	n.a.	Served in ramekins
Buttery	Butter (unsalted)	Unsalted butter	n.a.	n.a.	Served in ramekins
Earthy (hay/wax)	Straw (hay) and wax	Candle wax and farmstead straw	n.a.	n.a.	Served in ramekins

**Table C.2: Descriptions/definitions for Chenin blanc wine aroma descriptors (i.e. Lexicon)**

Wine Attribute	Description/Definition
Citrus	The fresh, zesty, oily, sweet, citrus aroma that is associated with oranges, orange peel, lemons, lime, grapefruit
Tropical	The warm, tropical, sweaty, sweet, fruity aroma that is associated with guava, passion fruit, mango, melons, pineapple
Fresh Apricots and Peaches	The sweet and soft aroma associated with fresh peaches and apricots
Dried apples and Pears	The aroma character associated with various dried apple and dried pear varieties
Mixed dried fruits	The aroma character associated with sweet mixed sun-dried fruit such as dried raisins; apricots; peaches; prunes
Rich/stewed fruit	The sweet; sour; syrupy; sticky aroma associated with cooked/stewed quince; apples; pears
Vegetative/Green	The fresh; herbal; vegetative; green characteristic associated with cut grass; asparagus; green branches; green peppers
Woody	The resinous; dusty; roasted or planky aroma associated with wood or fresh wood shavings
Nutty	The dusty, rich, nutty aroma associated with crushed pecan nuts or freshly ground mixed nuts
Spicy	Complex, pungent, warm, spicy, sweet aroma that is associated with freshly ground and heated spices or mixed dried spice
Sweet associated	The sweet, rich, soft and sticky aroma associated with warm honey; caramel; toffee
Buttery	The smooth, thick, warm, creamy and roasted aroma associated with melted butter
Floral/Perfume	The sweet and floral/rosy aromatic aroma associated with perfume or roses or fresh new blossoms
Earthy (Hay/ Wheat)	The musty; dusty; straw; waxy; dense earthy aroma associated with straw; sand dust; sawdust.
Sweet	The taste gives the impression of covering your whole tongue when intense. Typically on the tip of your tongue.
Sour	The sharp aftertaste stimulated by acid that can cause <b>saliva to flow</b> in the mouth.
Bitter	The aftertaste experienced at the back of the tongue/throat after the product has been expectorated.
Astringent	The <b>dry, puckering or roughing</b> sensation that can be experienced in the mouth cavity after the product has been expectorated.