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Wine consumers' subjective responses to wine mouthfeel and understanding of wine body

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ABSTRACT

Wine mouthfeel is considered important for wine quality by experts, while consumers understanding of mouthfeel and the role of wine body in their wine choice is unknown. One experiment determined the influence of intrinsic wine mouthfeel on consumers' wine liking and emotions, and the other, how consumers understand the term wine body. The first experiment used a 2 astringency level \times 2 body level experimental design. The samples were base wine with; nothing added (control), added xanthan gum (for increased body), added grape seed extract (GSE, for increased astringency), and with both added xanthan gum and GSE. The consumer taste trial ($n = 112$) indicated that wine with increased body did not influence wine liking and emotions; while increased astringency decreased liking and elicited more intense negative emotions. The second experiment examined consumers' knowledge of wine body through an online survey ($n = 136$). Consumers described wine body most frequently using words such as flavour, fullness, and strength. Wine body was therefore understood by consumers predominantly as a holistic multi-sensory perception of flavour. Wine flavour was indicated by consumers to be the most important factor driving purchase decisions followed by balance of flavours and wine body. It is crucial that wine professionals carefully communicate wine characteristics to consumers to prevent possible misunderstandings such as the meaning of wine body and as a result better meet consumer expectations. In future, the term body may benefit from a clearer definition for academic research as well as industry.

1. Introduction

Mouthfeel is a major contributor to the sensory perception of wine (Gawel, Oberholster, & Francis, 2000; Pickering & DeMiglio, 2008) and is a tactile sensation in the oral cavity during consumption (DeMiglio, Pickering, & Reynolds, 2002). In wine, mouthfeel sensations include "perceptions such as astringency, burning, prickling, viscosity, body, and temperature" (Jackson, 2009). The chemical constituents that elicit these perceptions have been extensively studied; astringency, the puckering and drying sensation, is caused by polyphenolic compounds that are predominantly extracted from the skins and seeds as well as acids (Payne, Bowyer, Herderich, & Bastian, 2009; Pickering & DeMiglio, 2008; Vidal et al., 2004), and viscosity from either sugar, polysaccharides, and to some extent ethanol (DeMiglio et al., 2002; Gawel et al., 2014; Runnebaum, Boulton, Powell, & Heymann, 2011). Control of wine mouthfeel during production has important consequences to consumer's acceptance and preferences of wine (Bastian, Collins, & Johnson, 2010; Lattey, Bramley, & Francis, 2010; Stokes, Boehm, & Baier, 2013). The challenge

for winemakers is to produce wine with appropriately balanced mouthfeel characteristics tailored to specific market segments, as liking of wine by mouthfeel is not homogeneous within a population (Biasoto, Netto, Marques, & Da Silva, 2014).

Wine body is another important sensory characteristic that is often used to describe wines in the wine industry as well as in the scientific community. Most frequently, wine body is mentioned on labels for consumer appeal, so as to broadly categorise wines into light, medium, and full bodied. This particular character however has been challenging to study and little has been reported on its influence on consumers' hedonic evaluation of wines. Wine body is commonly used to describe mouthfeel in literature, suggesting that the sensation is of no exception to other mouthfeel characters; tactile characteristics in the oral cavity not including sapid characters (Guinard & Mazzucchelli, 1996; Laguna, Bartolom e, & Moreno-Arribas, 2017). As wines are reported to elicit complex mouthfeel sensations, a mouthfeel wheel was developed specifically for red wine (Gawel et al., 2000) and later white wine (Pickering & DeMiglio, 2008). The number of descriptions that relate to the category of wine body within the mouthfeel wheels in contrast to

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astringency is comparatively meagre, as well as being less specific. Clear definitions of wine body do not exist in literature despite being regularly used in definitions for other mouthfeel attributes. Wine body has been holistically described as the weight of wine on the palate resulting from the combined perception of alcohol, sugar, tannins, acid, flavour, and glycerol (Iland, Gago, Caillard, & Dry, 2009), though the role of glycerol in wine has been reported as a minimal contributor at levels found in table wine (Noble & Bursick, 1984). The word body was ambiguously used together with flavour to define “watery” and “thin” under the category of “weight” in the red wine mouthfeel wheel (Gawel et al., 2000). It was again used in the white wine mouthfeel wheel to define “weight”, distinct from “viscosity”, yet the reference standard for both these attributes was carboxymethyl cellulose (Pickering & DeMiglio, 2008). Thus, confusion remains around the precise meaning of wine body as researchers still lack the understanding of what it constitutes and whether it is the same as viscosity/thickness (Laguna et al., 2017). To add to this, such terms are specifically used by experts and are not necessarily appropriate for communication with regular wine consumers. Consumers are often unfamiliar with technical terms used by experts to describe wine, a finding that was reported between two French cohorts (experts vs. consumers) (Le Fur et al., 2011). Regular wine consumers generally tend to use more holistic, abstract, allusive and hedonic terms than experts, who are more attuned to using technical, concrete and precise terms (Chollet & Valentin, 2001; Eric & Solomon, 1990; Gawel, 1997; Lawless, 1984; Valentin, Chollet, & Abdi, 2003). Further, consumers do not always understand jargon and may not find them useful to describe wine (Clapperton & Piggot, 1979). Attribute descriptions within the mouthfeel wheels have been pronounced as perhaps too technical for consumers (Vidal, Giménez, Medina, Boido, & Ares, 2015). Therefore, the question arises; how do consumers describe wine body if jargon does not apply?

Affective measures from consumers give an important indication of the potential performance of wine products and typically liking is measured. An additional measure to hedonics is consumer emotions. The study of emotions that are experienced throughout food and beverage consumption is considered a relatively new area of research. These measures become an important point of difference between similarly liked products (Jiang, Niimi, Ristic, & Bastian, 2016; Porcherot et al., 2012). A range of consumer emotions can be elicited by wines, and emotions (either positive or negative) can change upon the consumption of wines as well as by the consumption context (Danner et al., 2016; Ferrarini et al., 2010; Jiang et al., 2016). Recently, it has been shown that consumer emotions can change depending on the flavours added to red wine, where positive emotions were elicited by a floral flavour while negative emotions were elicited by green flavour (Jiang et al., 2016). However, the effects of wine mouthfeel on wine consumers' emotions are poorly understood and little researched. This lack of understanding stems out to other food products also.

The work presented here had two main objectives: 1) to determine the effects of the intrinsic wine mouthfeel sensations of astringency and wine body on consumers' wine liking and wine-evoked emotions, and 2) examine consumers' understanding of the term wine body. The first and second objectives were achieved by means of consumer wine tastings and an online consumer survey, respectively.

2. Materials and methods

2.1. Study 1 – consumer tasting of wines varying in body and astringency

2.1.1. Experimental design

To determine the effect of mouthfeel on consumers' wine liking and elicited emotions, a factorial design with two grape seed extract levels (GSE) × two gum levels was used. This gave four different types of wines; the control (no added GSE or gum), a wine with added xanthan gum (0.5 g/L) (The Melbourne Food Ingredient Depot, East Brunswick,

VIC, Australia), a wine with added GSE (2 g/L) (Tarac Technologies, Nuriootpa, SA, Australia), and a wine with both added gum (0.5 g/L) and GSE (2 g/L).

2.1.2. Sample preparation

A range of base wines were considered for the consumer trial, as model wines are often disliked by consumers and thus inappropriate for consumer studies. Ultimately a commercial bottled of unoaked Semillon wine was used for its neutral flavour characters, as determined through bench top tasting of a series of wines with oenology staff members. To minimise the influence of olfaction on wine mouthfeel during tasting, the volatile aroma of the wine was reduced as much as possible by the addition of activated carbon (2 g/L) followed by filtration with a 0.45 µm polycarbonate membrane. As bench top tests determined the wine to have a slight bitterness; sucrose (1.5 g/L) was added to mask the bitter taste. The commercial Semillon wine after carbon treatment and sucrose addition acted as the control, as well as the base wine to which mouthfeel agents were later added. Semillon with minimal mouthfeel was used as a “model” wine instead of red wine to allow for subsequent manipulation of mouthfeel character and thus to better understand the influence of changes in mouthfeel to consumers' subjective responses.

Although there is no general acceptance of the term wine body in the academic literature, an assumption was made for this study that wine body was related to viscosity, as the wine industry use the word frequently and consistently in such a way. To achieve a fuller bodied wine, six gums were initially compared in base wine by oenology staff in informal bench top tastings, however xanthan gum was selected for its solubility and low astringent character, the latter of which some of the other gums possessed. To determine and confirm the levels of xanthan gum and GSE for addition, a directional paired-comparison test was performed using experienced volunteers (n = 30) recruited from oenology staff and students at the University of Adelaide Waite Campus. These volunteers were educated in oenology and/or have worked in the wine industry, were all trained wine tasters and also had previous experience with descriptive analysis of wines. Accordingly, the volunteers were well aware of the meaning of body and astringency mouthfeel characters. The wines with additions of gum only (0.35 g/L) and GSE only (1.5 g/L) were compared against the control. Samples were served in black glasses in individual sensory booths under orange sodium light and pairs of samples were presented in a balanced order. Each volunteer was asked “Which of the two wines has more body?” and “Which of the two wines has more astringency?” Correct responses for wine with increased body and astringency tests were 21 and 27 out of 30, respectively. Data analysis by Chi-square test showed that addition of gum and GSE had significantly more body ($p < 0.05$) and more astringency ($p < 0.01$), respectively, than the control. To ensure a better discrimination of body and astringency by consumers, the final concentrations of xanthan gum and GSE for the consumer evaluation was increased to 0.5 g/L and 2 g/L, respectively.

Each wine sample was chemically analysed in triplicate for pH, titratable acidity (TA, g/L), sugar (g/L) by the Rebelein method, volatile acidity (VA, g/L), free and total SO₂ (mg/L) using the Markham still (Iland, Bruer, Edwards, Caloghris, & Willkes, 2013), and alcohol level (% v/v) with the Alcozyzer (Anton Parr, Graz, Austria) (Supplementary Table 1). The pH, free SO₂, sugar and alcohol contents significantly differed ($p < 0.05$, using general linear model analysis of variance (GLM-ANOVA)) across samples however these differences were thought negligible and were most likely too small to be detected by the consumers (Supplementary Table 1).

Prior to consumer testing, the base Semillon wine was carbon filtered a day before each trial and stored in 2 L Schott bottles under nitrogen gas coverage at 4 °C. Wines were equilibrated to room temperature (20 °C) for 3 h before each session. At this point, gum and/or GSE were added according to the experimental design and solubilised with a stick blender.

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