Patterns of sweetness preference in red wine according to consumer characterisation

Maria Madalena Sena-Esteves, Mariana Mota, Manuel Malfeito-Ferreira*

Linking Landscape, Environment, Agriculture and Food Research Center (LEAF), Instituto Superior de Agronomia (ISA), University of Lisbon (UL), Tapada da Ajuda, 1349-017 Lisboa, Portugal

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ABSTRACT

The preference for sweet taste in red wine was examined according to consumer categories of age, gender, drinking experience and personality type (Big-5 personality-test). A total of 114 subjects revealed their preferences for sweetness after tasting dry red wine spiked with equal concentrations of glucose and fructose at 2 g/L, 4 g/L, 8 g/L, 16 g/L and 32 g/L, following an ascending forced choice paired comparison method (2-AFC).

The overall preference for sweetness was shown within the range of 4.8 to 21.9 g/L, with maximal liking at 8 g/L. Three patterns of response to sweetness were observed (sweet dislikers, sweet likers and indifferent to sweet) according to the different categories of consumers. Differences ($p > 0.05$) were not found in sweetness preference among the categories up to 16 g/L sugar except for the trait extraversion at 8 g/L, where low extraverts showed a higher proportion of responses preferring the sweeter sample. Most significant differences were found only under the highest tasted concentration (32 g/L). Females and novices preferred sweeter samples ($p < 0.05$) when compared with the response of males and experienced consumers, respectively.

1. Introduction

The sensory properties of a wine are a major element that will determine its success among consumers (Francis & Williamson, 2015). These authors provided an overview of the current knowledge of the sensory attributes that have been found to be important to consumer preference and liking. The relationships between consumer hedonic response and wine sensory attributes, as quantified by a trained sensory panel, help enable the understanding of the sensory characteristics that drive acceptance. A common finding is the importance for many consumers of the appropriate balance among acidity (sourness) (Francis et al., 2010; Lésschaeve, Bowen, & Bruwer, 2012), bitterness and sweetness (Francis et al., 2010), and astringency (Lattey, Bramley, & Francis, 2010). These mouthfeel properties are complemented by aromatic features, where fruity, floral and oak flavours are particularly appreciated (Lund et al., 2007, Marchal, Pons, Lavigne, & Dubourdieu, 2013). Comparatively, studies concerning preferences for sweet mouthfeel are fewer and present knowledge is mostly based on early research (Amerine & Ough, 1967; Duitschaever, Buteau, & Ashton, 1980; Filipello, Berg, Hinreiner, & Webb, 1955; Kielhöfer, 1955). More recently, Blackman, Saliba, and Schmidtke (2010) reported the preference for sweetness in two Australian Semillon wines with different acidity levels. International wine challenges also tend rate sweeter samples more highly (Loureiro, Brasil, & Malfeito-Ferreira, 2016). Therefore, either from controlled experiments with wines spiked with different sugar levels or from overall consumer preferences, it seems that a "sweet tooth" observed in other foods (Wansink, Bascoul, & Che, 2006) may also be applied for wine drinkers.

Preference for sweet foods has been studied associated with the perception of sweetness intensity revealing several patterns of sweet liking (Drewnowski, Henderson, Shore, & Barratt-Fornell, 1997; Kim, Prescott, & Kim, 2014; Thompson, Moskovitz, & Campbell, 1976 and Whiterly, Pangborn, & Stern, 1980). Intensity ratings of sweetness show that consumers with different sweet liking status have similar intensity ratings either in water (Drewnowski et al., 1997; Kim et al., 2014) or in foods and beverages (Drewnowski et al., 1997; Kim et al., 2014; Methven, Xiao, Cai, & Prescott, 2016). Therefore, sweet perception appears to be independent from the pleasantness of sweetened foods, although a recent report stated otherwise (Jayasinghe et al., 2017). The former authors established sugar preference or acceptance dose-response curves with several shapes, yielding 3 or 4 types of hedonic responses, which may be reduced to 2, gathering sweet/sucrose likers in opposition to sweet/sucrose dislikers (Drewnowski et al., 1997, Methven et al., 2016, Yeomans, Prescott, & Gould, 2009, Yeomans, Tepper, Riestzschel, & Prescott, 2007). The establishment of individual sweet liking status may be obtained across multiple sugar

concentrations using hedonic Likert scales (Drewnowski et al., 1997), visual analogue scales (Kim et al., 2014; Methven et al., 2016; Yeomans et al., 2007), labeled magnitude scales (Jayasinghe et al., 2017; Yeomans et al., 2007) or paired comparison tests (Blackman et al., 2010). Yeomans et al. (2009) used two concentrations of sucrose and two concentrations of saccharin to classify sweet liking. Hedonic responses to one concentration of sugar (Kim et al., 2014; Saliba, Wragg, & Richardson, 2009) failed to reveal some features of liking patterns when compared to ratings across increasing concentrations (Kim et al., 2014). However, for rapid screening tests a single concentration may be used to separate between sweet likers and sweet dislikers (Asao et al., 2015).

Consumer segmentation is regarded as essential to understand preferences for different types of wine (Francis & Williamson, 2015). In other food and beverage products, it has been shown that the response to sweet taste by consumers is highly segmented (Kim et al., 2014; Moskovitz, Jacobs, & Lazar, 1985). In wines most frequent studied segments or categories include gender, age, level of expertise, consumption habits or culture (Blackman et al., 2010; Lattey et al., 2010; Lésschaeve et al., 2012; Osidacz, Francis, Bramley, & Stevens, 2011; Williamson, Robichaud, & Francis, 2012). Personality traits have also been shown as influencing food choice. The research on this theme relies on the 'Big Five' theory of personality that involves the independent traits of extraversion, neuroticism, openness, conscientiousness and agreeableness (Hogan, Johnson, & Briggs, 1997). Extraversion reflects how much the individual is oriented towards things outside him and derives satisfaction from interacting with other people. Neuroticism is the tendency to experience negative emotions. Openness to experience has been portrayed as a proxy measure of the willingness to explore new and unfamiliar experiences, ideas and feelings, while conscientiousness refers to persistence, perfectionism and self-discipline. Agreeableness means being sympathetic, kind, affectionate and reflects how much an individual likes and tries to please others (Costa Jr. & McCrae, 1992). A preference for sweet and salty tastes in people who score high in the neuroticism trait was found by Kikuchi and Watanabe (2000). In wines, Saliba et al. (2009) found that sweet taste preference was associated with a higher level of impulsiveness but lower openness. A study involving aroma characterization and liking of a set of Italian red wines showed a link between "innovativeness" (related to openness) and consumers who could reliably differentiate samples (Torri et al., 2013).

Wine is a complex matrix with several taste and mouthfeel interactions. In white wine sugar reduces sourness while in reds reduce astringent and bitter sensations (Sáenz-Navajas, Fernandez-Zurbano, & Ferreira, 2012). Therefore, the addition of sugar may result in lowering the perception of these attributes while sweetness remains unnoticeable. According to our empirical experience, the appeal of smooth red wines has led winemakers to increase residual sugar to relatively high levels, far beyond the level of balancing excessive astringency or bitterness. Therefore, it seems relevant to provide wine industry with guidelines on the addition of sugar to increase red wine acceptance in parallel to what has been reported for white wines (Blackman et al., 2010). The research described in this work was based on Blackman et al. (2010) using a larger number of consumers segmented in several traits other than individual expertise. The main objective was to establish a relationship between the preference for sweetness in a red wine and the different consumer age, gender, wine drinking experience and personality type, hoping to help winemakers in tuning up the levels of residual sugar in red wines according to each consumer target.

2. Material and methods

2.1. Consumer categories

One hundred and fourteen participants were recruited from ISA (Instituto Superior de Agronomia, Lisbon, Portugal) and other external

Table 1
Number of subjects in each class of the categories under study.

Categories	Classes	Number of subjects
Age	[18–24]	68
	[25–29]	27
	[30–60]	19
Gender	Females	51
	Males	63
Experience	Novices	85
	Experienced	29
Agreeableness	A high	113
	B low	1
Neuroticism	A high	45
	B low	69
Extraversion	A high	88
	B low	26
Openness	A high	100
	B low	14
Conscientiousness	A high	94
	B low	20

faculties such as medicine, law and engineering. The average age of the participants was 27, ranging from 19 to 56 years old. Consumers were initially asked to answer some questions in order to group them into several classes in the following categories: gender, age, wine drinking experience and personality type (Table 1).

The wine drinking experience included novice and experienced consumers, based on a combination of self-reported consumption, years of experience in drinking wine, wine knowledge, and involvement in the wine industry, consistent with previous research (Blackman et al., 2010; Melcher & Schooler, 1996). Specifically, the definitions provided by Blackman et al. (2010) were followed: i) a novice was an individual who had been a wine consumer for < 10 years, that drank less than three times a week and who did not self-report as being "knowledgeable"; ii) an experienced consumer was an individual who had been a wine consumer for > 10 years, drinking at least several times a week and who self-reported as being "interested" or "knowledgeable"; iii) the respondents who reported being wine consumers for < 10 years and "knowledgeable" were also classified as experienced consumers.

To evaluate personality, subjects took the Big 5 personality-test (Hogan et al., 1997), which consists in 50 questions to be answered online (www.personality-testing.info/tests/IPIP-BFFM/) on the 5 personality traits: openness to experience, conscientiousness, extraversion, neuroticism and agreeableness. These traits were rated from 1 to 5, and arbitrarily grouped in two classes, high scorers (class A) for the scores from 3 to 5 and low scorers (class B) from 1 to 2, to obtain higher number of respondents in each class.

2.2. Wines

The wine was a 2014 blend of Syrah (80%), Touriga Nacional, Cabernet Sauvignon and Trincadeira varieties (20%) produced in the experimental winery of ISA following classical vinification with skin maceration until sugar dryness. The concentrations of residual sugar in wine were 2, 4, 8, 16 and 32 g/L, obtained by the addition of equal amounts of glucose and fructose (Sigma-Aldrich, St. Louis, USA). Wines were analyzed on pH, total acidity, volatile acidity, free and total sulfur dioxide, reducing substances and alcohol strength using standard OIV (International Office of Vine and Wine) methods (OIV, 2010). The characterization of colour and phenolic compounds was performed by evaluating (i) colour intensity, tonality, total pigments, polymeric pigments, pigment polymerization index, total and stained anthocyanins (Somers & Evans, 1977); (ii) tannic power (NTU/mL) (Freitas & Mateus, 2001) and (iii) total phenols (mg/L of gallic acid) (Ribéreau-Gayon, 1970).