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Tannin profile of different Monastrell wines and its relation to projected market prices

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ABSTRACT

This study focuses on the differences or similarities in tannin composition and concentration in Monastrell wines from different wineries from the same geographic area and, within each winery, from wines elaborated based on different projected market prices, to determine whether there is any relationship between the wine tannin composition and the projected price. The tannin composition of the different wines, all of them analyzed at the same point during winemaking, indicated that those elaborated as premium wines presented higher phenol and tannin contents. The mean degree of polymerization of these wines was also positively related with the projected price, which agreed with the results obtained by size exclusion chromatography, that showed that wines with high projected prices had a higher proportion of polymeric tannins, suggesting that techniques favoring the extraction of skin tannins were mostly used in those wines projected as premium wines, probably looking for greater mouthfeel complexity.

1. Introduction

Wines are a complex matrix, appreciated for their stylistic variation and complexity. Their composition depend on grape variety and production area but also on the winemaking techniques used.

In commercial wineries, the vinification process for wines intended for different market prices varies, from using different quality grapes to different enological processes, such as the number of pump-overs, the use of prefermentative additives such as the maceration enzymes, the duration of the skin maceration process and also differences in the aging systems such as the use of wood in the form of barrels, staves or chips (Cadot, Caillé, Samson, Barbeau, & Cheynier, 2012; Cáceres et al., 2012). The objective is to obtain wines sufficiently different as regards quality parameters to justify their allocation to different categories.

The different enological practices prior to aging will cause the differential extraction of compounds from grapes, which will influence the concentration and composition of phenolic compounds in the wines (Sacchi, Bisson, & Adams, 2005). Among phenolic compounds, tannins are responsible for wine mouthfeel, body and astringency, while they also have a role in stabilizing wine color. Studies have shown that overall intensity and persistence are positively correlated with astringency, and therefore to tannin content. A relationship between tannin content and allocation grade has also been described (Mercurio, Dambergs, Cozzolino, Herderich, & Smith, 2010).

Monastrell (Mourvedre in France, Mataro in Australia and California) is a black-skinned variety that has been grown in vineyards all around the western Mediterranean countries for centuries. It is now grown extensively throughout Spain and southern France, as well as in California and South Australia. It is well adapted to warm, dry climates and has small, thick-skinned berries which are high in phenolics and have the potential to produce deeply colored tannic wines.

Under Spanish wine law, Monastrell is one of the primary red wine grape varieties in the Denomination of Origin of Jumilla, Bullas, Yecla, Valencia, Almansa and Alicante (all located in the southeastern Spain), where there is a high production of monovarietal Monastrell wines. Most wineries in these areas market several Monastrell monovarietal wines with different prices, to cover a wide range of consumers. Since all these wineries share quite the same geographic area, with similar soil and climate conditions (although we cannot rule out the existence of some areas presenting quite particular agroclimatic conditions) and the main variety, differences among wines from different wineries and among wines with different projected prices within each winery mainly arise from the agronomical grape management and different enological techniques used during winemaking, as also stated by Cáceres et al. (2012).

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This study will focused on the analysis of the differences and similarities of the concentration and composition of tannins in Monastrell monovarietal wines elaborated in different wineries from the same geographical area to determine whether their concentration and characteristics change according to the wine projected price.

2. Material and methods

Five different wineries, all of them located in Murcia Region (wineries 1 to 4 were located in the D.O. Jumilla and winery 5 in D.O. Bullas) were asked to supply three different Monastrell wines vinified for low (less than 3€), medium (4–10€) and high (10–20€, even higher prices in some icon wines) final allocation objectives. The wines were provided just after malolactic fermentation was finished (end of 2013–beginning 2014) and before any wood treatment was implemented enabling to compare the wine tannin content and composition at the same moment and with no interference from wood tannins or other changes due to the aging system.

2.1. General composition

General composition was determined using the Official Methods of Wine and Must analysis (O.I.V., 2015).

2.2. Determination of anthocyanins

Anthocyanins were determined by direct injection of wine samples following the method already described by Busse-Valverde, Gómez-Plaza, López-Roca, Gil-Muñoz, and Bautista-Ortín (2011). The analysis was performed at room temperature using a flow rate of 0.8 mL/min and 20 μL of sample was injected. The solvents used were water plus 4.5% formic acid (solvent A) and HPLC grade acetonitrile (solvent B). The elution conditions were those described by Busse-Valverde et al. (2011).

The anthocyanins were quantified as malvidin-3-glucoside at 520 nm, using malvidin-3-glucoside chloride as an external standard (Extrasynthèse, Genay, France).

2.3. Chromatic parameters

Absorbance measurements were made in a Helios Alpha (Thermospectronic, Whaltam, MA, USA) spectrophotometer with 0.2 cm path length glass cells. Color density (CI) was calculated as the sum of absorbance at 620, 520, and 420 nm and tint was calculated as the ration between absorbance at 420 nm and at 520 nm (15). The total phenol content (TPwine) and total anthocyanins were measuring as described in Ribéreau-Gayon, Glories, Maujean, and Dubourdieu (1998).

2.4. Analysis of tannins by acid hydrolysis

The proanthocyanidin content was estimated spectrophotometrically following the method of Ribéreau-Gayon et al. (1998) after acid hydrolysis of the samples.

2.5. Determination of tannins by phloroglucinolysis

Proanthocyanidins were determined according to the method described by Kennedy and Jones (2001) and Pastor del Rio and Kennedy (2006) with some modifications, as follows: 100 μL methanolic extract was reacted with 100 μL phloroglucinolysis reagent (100 g/L phloroglucinol and 20 g/L ascorbic acid in 0.2 N HCl with methanol) in a water bath for 20 min at 50 °C. Then, 200 μL of 200 mM aqueous sodium acetate were added to stop reaction.

A little amount of wine (4 mL) was evaporated in a centrivap concentrator (Labconco, USA), redissolved in 2 mL of water and then passed through a C18-SPE column (1 g, Waters, Milford, MA), which was previously activated with 10 mL of methanol followed by 20 mL of water. Compounds of interest were eluted with 10 mL of methanol after the cartridge was washed with 20 mL of water, and evaporated, and then dissolved in 0.8 mL of methanol. Phloroglucinolysis was then carried out as described above.

HPLC analysis followed the conditions described by Busse-Valverde et al. (2010). Proanthocyanidin cleavage products were estimated at 280 nm using their response factors relative to (+)-catechin, which was used as the quantitative standard. Total proanthocyanidin content, the apparent mean degree of polymerization (mDP) calculated as the sum of all subunits (flavan-3-ol monomer and phloroglucinol adducts, in moles) divided by the sum of all flavan-3-ol monomers (in moles) and the percentage of each constitutive unit were determined with these analyses.

2.6. Size exclusion chromatography

An adaptation of the method described by Kennedy and Taylor (2003) and proposed by Bautista-Ortín et al. (2015) was used for size exclusion chromatography (SEC). Briefly, two PLgel (300 × 7.5 mm, 5 μm, 500 (effective molecular mass range of up to 4000 using polystyrene standards) by 100 Å (effective molecular mass range of 500–30,000 using polystyrene standards) columns, connected in series and protected by a guard column containing the same material (50 × 7.5 mm, 5 μm), all purchased from Polymer Labs (Amherst, MA, USA) were used. The isocratic method used a mobile phase consisting of N,N-dimethylformamide containing 1% glacial acetic acid, 5% water and 0.15 M lithium chloride. The sample injection volume was of 10 μL, the flow rate of 1 mL/min, oven temperature of 60 °C and elution was monitored at 280 nm.

2.7. Statistical analysis

All the statistical analyses were made using Statgraphics Centurion XVI (Statpoint Technologies Inc., Warrenton, VA, USA).

3. Results and discussion

Wines were selected from five different wineries located in Murcia region and the enologists were asked to provide us with monovarietal wines being elaborated for allocation to different price segments. We avoid to use the term "high or low quality wine" since, in each market price segment, high quality wines can be found, from high quality young wines to high quality premium wood aged wines, but it is clear that differences in chemical composition between these wines are expected. For this reason we shall refer to segment of prices or, more precisely (since the wines were sampled and analyzed before they were finished, just after malolactic fermentation, to eliminate possible blending and to avoid the differences introduce by the aging systems), to projected prices.

Table 1 shows the results of the general chemical composition of the different wines. As previously stated in the Material and Method section, all wines were made only from Monastrell grapes, with no blending with any other grape variety. The percentage of alcohol increased with the projected price, probably because for wines for the higher segment, only well-ripen grapes are used. However, only one sample presented an alcohol percentage lower than 13%. Monastrell grapes must be harvested mature to avoid