

Argentinean Commercial Malbec Wines: Regional Sensory Profiles

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Abstract: Sensory evaluation was performed on 32 commercial Malbec wines (2008 and 2009 vintages) produced in five provinces of Argentina. Wines from different areas in Mendoza (the most important producer of Malbec) were also included to test possible differences within this province. Ten key attributes were first recognized by descriptive analyses and then carefully evaluated by a trained sensory panel composed of 10 judges. Among the aroma and flavour attributes the analyses focused on plum, red fruits, white pepper, bell pepper, and floral. Three attributes of taste (acidity, astringency, and bitterness) and two attributes of color (red and blue-purple hues) were also analyzed. Statistical differences and similarities in sensory data were tested using analysis of variance (ANOVA), multiple means comparisons by least significant difference test (Fisher LSD), and principal component analysis (PCA). ANOVA and Fisher LSD tests of sensory data showed significant differences ($P < 0.05$) for 6 out of 10 wine attributes: plum, floral, red fruits, astringency, red and blue- purple hues.

Key words: Malbec red wines, commercial wines, sensory analysis, Argentina, Mendoza.

1. Introduction

Argentina is the fifth largest producer of wines, and is among the top ten countries with the largest area planted with vines. The wine industry plays an important role in the country's regional economies. The commercial competitiveness, the development of an image, and the search for typicity contributed to recognition of the importance of having a representative grape variety of a region [1]. The "typicity" of wines has been the focus of recent research in several viticultural regions. Next to the international varieties, the search for local qualitative varieties is becoming more common, thanks to research and trials done in many different environments [2-8]. The term "typicity" is used to convey those wine qualities and flavour characteristics that can be expected from a region, which is defined

as a broad geographic area distinguished by similar features [6, 8]. The character of wines, will depend on the grape variety, the winemaking process used, the territory-climate, soil, within other factors, so that the final product can be clearly seen to belong to the singular place and made with a singular winemaking tradition. Bringing out typicity in wines is particularly difficult in a moment when viticultural and oenological techniques have become strongly invasive and widespread in their use. Therefore enhancing typicity is, in fact, a great challenge.

Vitis vinifera L. (cv.) Malbec is the main red variety cultivated in Argentina [9], and has been given far greater respect and attention, hence is now considered to be Argentina's signature grape variety, as well as its greatest hope for export markets. Although Malbec's great reputation, little is known about its sensory characteristics of the wines produced in different viticultural regions. In Argentina Malbec is cultivated in the majority of the wine regions which cover a

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lengthy territory at the foot of the Andes. This area ranges from the province of Salta located at 21° south latitude, to the province of Chubut, located at 42° south latitude, being Mendoza the “birthplace of Malbec”.

In terms of legal inspection, the Instituto Nacional de Vitivinicultura (INV) has been implementing an analytical system in commercial wines for their varietal characterization with the purpose of authenticity, designation of origin and traceability control [10], through the determination of anthocyanin profile with HPLC. In addition, professionals at the INV as well as Goldner and Zamora [5] did an important investigation on “non-commercial” Malbec wines. Their work presented clear sensory differences among wines produced from grapes cultivated in different viticultural regions.

The present study has the intention to contribute to the previous paper works, emphasizing the regional characteristics of “commercial” Malbec wines in order to provide additional information for a wide range of future studies: from those related to legal control, consumer preferences, and also concerning the correct application of viticultural and oenological techniques capable to maintain the wine’s sensory characteristics in the bottle. Sensory characteristics of commercial wines are subject to a higher number of variables, since from the same raw material cultivated under the same climatic and soil conditions, different wine styles may be produced. These variables are related to a cultural factor, but also to the manipulation of the grapes during the wine-making process, including those stages concerning packaging, transport, and conservation of the wine until reached by the consumers. In this context, maintaining the typical sensory characteristics of Malbec wines on a commercial basis demands great abilities.

2. Applicability of the Research

- Optimize the regulatory framework of the appellation systems—DOC, IG, etc., by establishing

the authenticity and control of geographic origin of the wines, complementing the sensory characteristics with the compositional profile of wines.

- Determine those site variables directly related to wine sensory characteristics: climate, soil, slope, irrigation, trellis system, etc..
- Understand the profiling factors that drive consumers’ buying decisions and preferences at regional and international levels.
- Know in more detail the regional-differential Malbec attributes in order to develop techniques and technology that enhance typicality by improving and keeping those key attributes in the bottle for the consumer.
- Allow to advice vine growers and winemakers to take into consideration the effects and interactions between grape and site, reaching the enological potential of the Malbec grapes.
- Contribute to a deeper knowledge of the signature grape varieties of the most important viticultural areas of the world.

3. Materials and Methods

3.1 Wines

Thirty-two commercially available 2008-2009 Malbec wines were obtained from 8 Argentinean winemaking regions to 4 wines per region: Salta, La Rioja, San Juan, Río Negro, and within Mendoza: Luján (Centre of Mendoza), San Martín (East Mendoza), Valle de Uco (West Mendoza), and San Rafael (South Mendoza). The wines were selected on the basis of being 100% Malbec grape. All the wines were tank-fermented, with no oak aging.

3.2 Trained Panelists

Ten panelists were trained during 15 sessions of 3 hours each, before performing descriptive analysis. None of the panelists had prior experience in wine assessment. The pre-selection of the panel was based on the high degree of interest on Oenology and Viticulture, great interest in learning, self-motivation,

and time availability. The panelists were screened for their ability to assess odour and taste, as well as for their cognitive (flavour memory), and descriptive language skills [11, 12]. Ten people were selected for the final panel based on their performance for providing correct answers in screening tests. The final panel consisted in four males and six females, ranging in age 22 to 47 years. All of them completed 45 h of training and 16 h of sensory evaluation of Malbec wines.

3.3 Descriptive Analysis

The description of 32 commercial Malbec wines was determined using descriptive analysis [13-15]. Before the evaluation of Malbecs, a representative collection of 8 Malbec wines (one of each from the 8 regions under study), was bench-tested to identify relevant aroma, flavour, and taste attributes. By round-table discussion and consensus, the panel selected and refined the attributes that best described their perceptions. During the round-table discussion, 10 final attributes were selected and evaluated by a trained sensor panel of 10 judges. Reference standards were available to define descriptors. Judges rated the references, discussed and clarified the meaning of the attributes, and practiced with sample wines. Finally 10 characteristics were identified and measured: plum, white pepper, red fruits, bell pepper, floral, acidity, astringency, bitterness, red hue, and blue-purple hues.

3.4 Evaluations of Malbecs Commercial Wines

Evaluations were conducted in the sensory tasting room at the Departamento de Estudios Enológicos y Sensoriales (DEES), at the Instituto Nacional de Vitivinicultura (INV). An incomplete randomized block design with two repetitions was applied in order to manage the challenge of evaluating 32 wines per panelist. Each judge assessed all the wines in eight sessions of two hours each (16 h of evaluation in total). Each session was duplicated with a break of fifteen minutes between the evaluations. All samples were

poured from a single bottle (750 mL), and judges were given 50 mL samples to evaluate for the sensory (color, aroma, flavour, and taste) attributes (Table 1). Between evaluations, judges rinsed with water and unsalted crackers. Judges assessed the magnitude of each attribute on a 10-cm unstructured line scale, where 0 and 10 were anchored with the labels “absent” and “high,” respectively [16]. Sensory scores were quantified by measuring the distance of the judge’s mark (assessment) from the origin of the line. The evaluation took approximate 1 h and the extra hour was intended to promote and improved motivation among judges: by socializing, playing wine sensory evaluation “games”, making oral presentations on behalf of the panelist related to Oenology and Viticulture topics, discussing current articles related to sensory analysis of wine, among other tasks.

4. Results and Discussion

4.1 ANOVA: Three Way Interactions

Analysis of Variance has been one of the most often employed statistical tools to study differences between products [17]. In this study ANOVA of sensory data showed significant differences ($P < 0.05$) for 6 out of 10 wine attributes (Tables 2 and 3) corresponding to the most remarkable Malbec variety sensory characteristic: plum, red fruits, floral, astringency, red and blue-purple hues [5, 18, 19].

4.2 Least Significant Difference

Multiple means comparisons were carry out by Least Significant Difference (LSD) test ($P < 0.05$) on those terms mentioned above, to indicate which means differ significantly across wines [20]. Results from LSD test showed that the red fruits attribute were more remarkable in wines from the south of Mendoza province such as Valle de Uco and San Rafael, and those produced in Río Negro province, being less intense, in areas further North such as the provinces of Salta, La Rioja, San Juan, and East Mendoza (Fig. 1).

Table 1 Sensory attributes used for evaluation of Malbec wines.

Color	Aroma	Flavour	Taste
Red hue***	Plum***	Plum***	Acidity
Blue-purple hues***	White pepper	White pepper	Astringency***
	Red fruits*	Red fruits*	Bitterness
	Bell pepper	Bell pepper	
	Floral*	Floral*	

*: Significance level 5%; **: Significance level 1%; ***: Significance level 0.1%.

Table 2 F-values from ANOVA of mouthfeel, flavour, and color of Malbec wines from the 8 viticultural Argentinean regions.

	Rep (R)	Judge (J)	Wine (W)	R × J	R × W	J × W	
Mouthfeel	Acidity	0.081	2.381*	2.173	0.372	1.784	1.088
	Astringency	5.693*	4.555**	8.322***	0.467	3.404**	0.976
	Bitterness	1.589	3.630**	0.389	0.881	1.387	1.004
Flavour	Plum	1.446	2.581**	5.577***	0.926	2.521**	1.111
	White pepper	0.593	3.290*	0.890	1.506	2.714*	0.702
	Red fruits	0.979	3.746**	2.329*	0.838	2.651*	1.160
	Bell pepper	2.368	2.855*	2.241	0.498	4.392**	1.367
	Floral	12.729**	2.050	2.310*	1.179	2.235	0.701
Color	Red hue	20.24***	3.647**	9.03***	2.660*	12.31***	0.829
	Blue-purple hue	0.431	1.061	9.398***	2.077	23.01***	0.885

*: Significance level 5%; **: Significance level 1%; ***: Significance level 0.1%.

Table 3 F-values from ANOVA for taste, flavour, aroma, and color of Malbec wines from the 8 viticultural Argentinean regions.

Taste	F-value	Flavour and Aroma	F-value	Color	F-value
Acidity	2.173	Plum	5.577***	Red hue	9.03***
Astringency	8.322***	White pepper	0.890	Blue-purple hues	9.398***
Bitterness	0.389	Red fruits	2.329*		
		Bell pepper	2.241		
		Floral	2.310*		

*: Significance level 5%; **: Significance level 1%; ***: Significance level 0.1%.

A similar result occurred with the blue-purple hues and the floral flavour and aroma: wines from the South presented the highest intensity, the opposite occurred in wines from Northern regions, with the exception of East Mendoza—San Martín, where Malbecs were higher in floral aroma and flavour. With regards to plum aroma and flavour, and red hue intensity, Malbecs from the centre and the east Mendoza were described by having the highest intensities compared with Malbecs from southern regions. Wines from west Mendoza—Valle de Uco, were the highest in astringency while Malbecs from San Juan were the lowest.

By comparing the Malbecs from within Mendoza province (Fig. 2), it could be seen that wines from San Rafael had the highest blue-purple hues, wines from West Mendoza had the highest red fruits and astringency, and Malbecs from East Mendoza showed greater violet flower aroma and flavour. In terms of plum, there were no significant differences among Mendocinean Malbecs. The same occurred with the red hue attribute, except for wines from San Rafael which presented the lower value.

4.3 Principal Component Analysis

For multivariate tests to identify specificities and

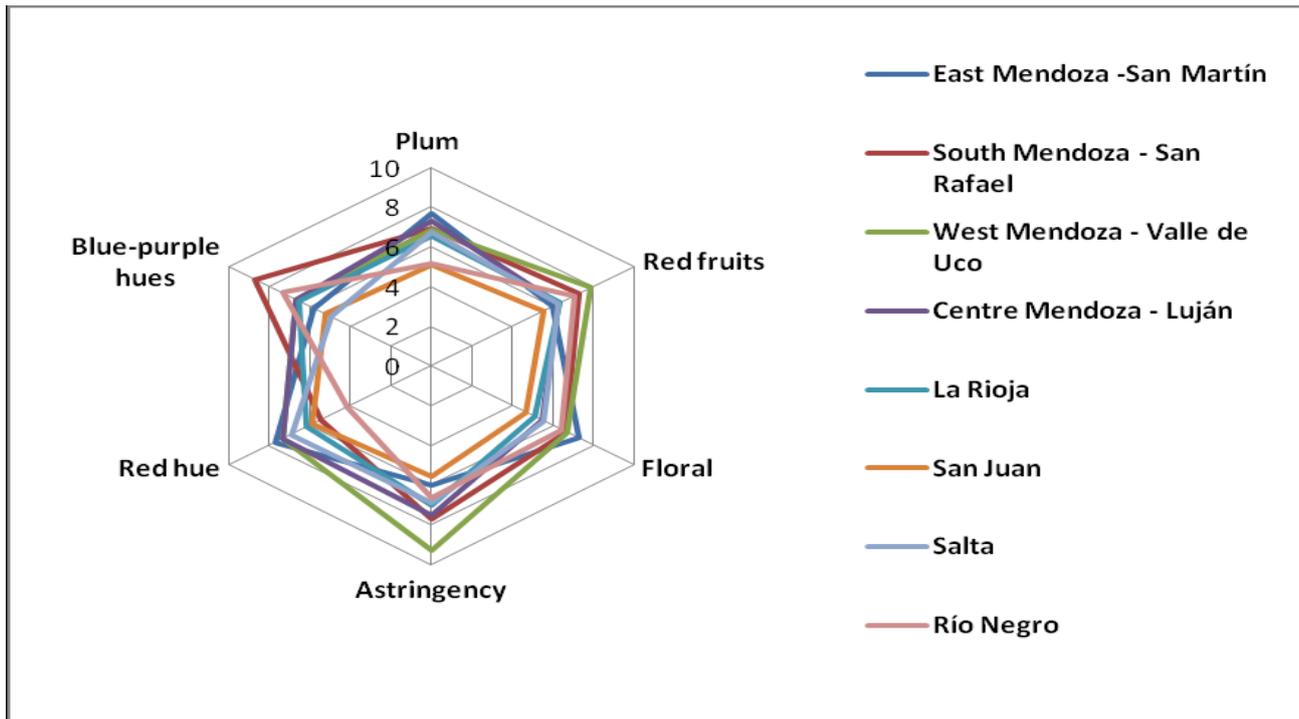


Fig. 1 Cobweb plot of the mean intensity ratings for flavour and color attributes of the Malbec wines from the 8 viticultural regions of Argentina.

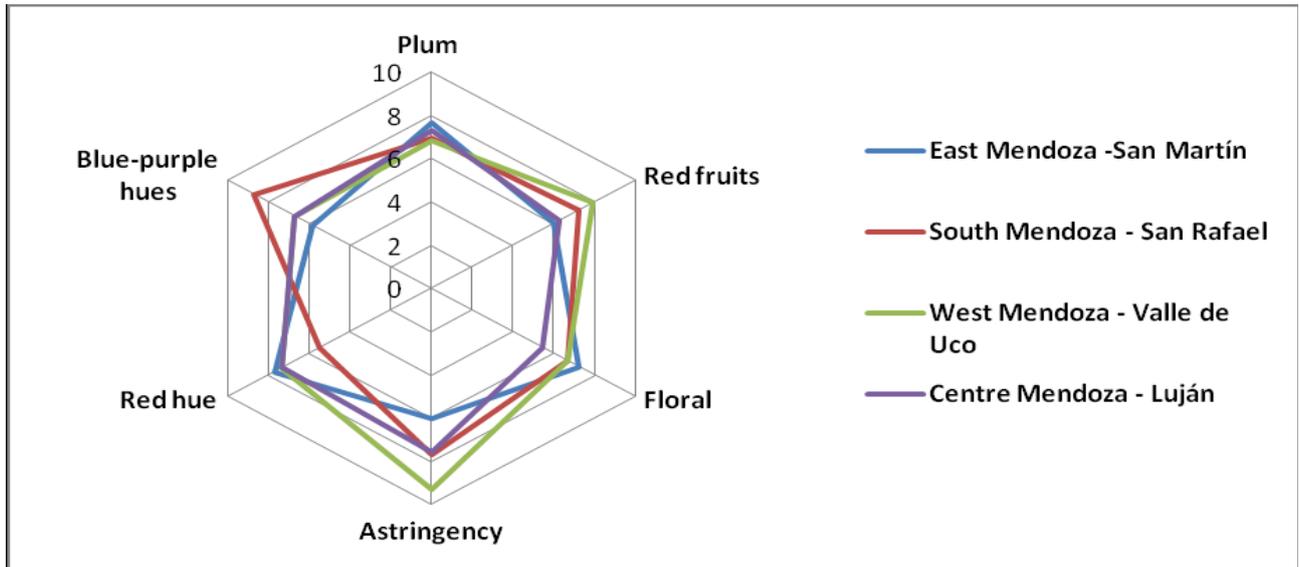


Fig. 2 Cobweb plot of the mean intensity ratings for flavour and color attributes of the Malbec wines from 4 viticultural regions of Mendoza.

possible correlation between the univariate test results, PCA was used [16]. PCA accounted for a total of 80.85% of the variation in the data set using three factors: Factor I (37.58%), Factor II (26.84%), and Factor III (16.43%). Wines were located in all quadrants of the PCA plot indicating a diversity of

wine styles (Fig. 3). The analysis revealed five major groups. Wines located furthest to the right, belonging to the east and centre of Mendoza, were described by higher aromas and flavours of plum, and red hue characteristics. Wines from the west area of Mendoza (Valle de Uco) and the south (San Rafael), had the

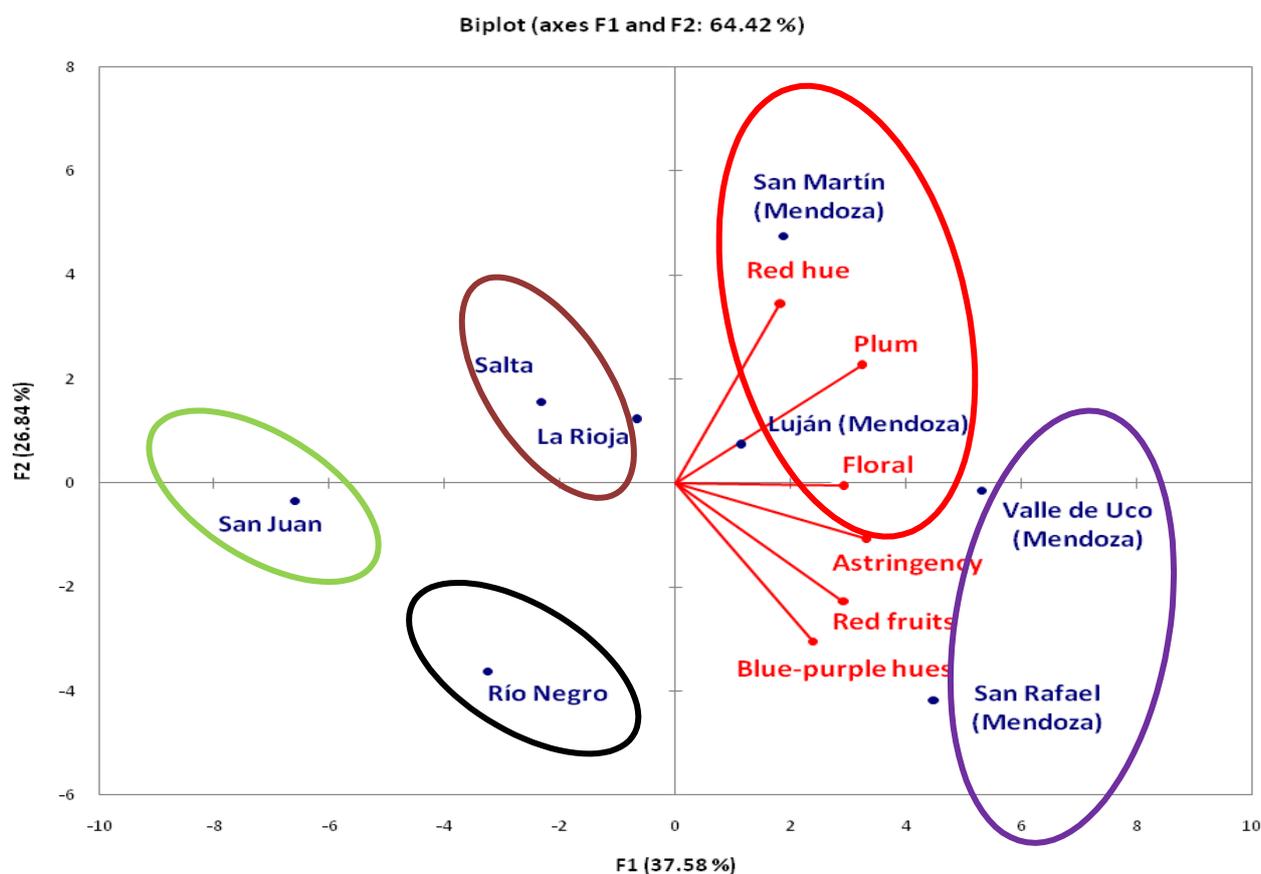


Fig. 3 Principal component analysis of mean sensory attributes for the Malbec wines produced in the 8 viticultural Argentinean regions.

highest floral, red fruits, astringency and blue-purple hues. It is worthy of mention that these results are coincident with Goldner 2006. Wines from provinces of La Rioja and Salta, presented similar characteristics: both are low in floral flavour, in blue-purple hue, although being similar in terms of having medium plum flavour and red hue intensity. Wines from San Juan province were distinctly different presenting the lowest plum, floral flavours, as well as the lowest astringency and blue-purple hues. With regards to Río Negro province, its Malbecs showed low values of plum flavour and red hue. Nevertheless Malbecs from both provinces—Río Negro and San Juan, may possess different attributes that are not described in this research. Therefore it is important to continue investigating about other inherent characteristics of those Malbecs, unintentionally not taken into account in this study.

All statistical analyses were conducted using XLstat 2009 procedures [21].

5. Conclusions

This study showed distinguished differences among commercial Malbec wines cultivated in Argentina. Malbec wines produced in the eight viticultural regions of Argentina presented significant differences in sensory characteristics in 6 out of 10 attributes that correspond to the most remarkable sensory characteristics usually found in this variety: plum, floral, red fruits, astringency, red and blue-purple hues. The PCA results showed five different groups of wines. Some of them correspond to viticultural regions that may have similar climatic conditions and whose locations are close to each other. This could provide important information that may explain the difference among primary distinctive aromas of each

type of wine, regardless the enological techniques applied on each case.

Wines from northern Mendoza varied in character being redder and with more plum aroma and flavour. Malbecs from southern areas were higher in astringency, blue-purple hues, and red fruity and floral aromas and flavours. Malbecs from Salta and La Rioja—northern provinces, were similar in character, showing medium intensities of most of the descriptors.

Curiously, commercial Malbecs from San Juan and Río Negro were distinctly different from the rest, probably due to the absence of differential descriptors not taken into account in this study. These two provinces produced exceptional wines which deserve to be studied in detail, incorporating a higher number of samples and descriptive attributes. This finding may indicate that there is also the likelihood of important sensory differences among Malbecs from these two provinces compared to the rest.

In addition, by comparing results from “non-commercial” [5] vs. “commercial” Argentinean Malbec wines, there were some coincident results. As an example, commercial Malbecs from Valle de Uco showed higher floral and fruity aroma intensities, while wines from Río Negro presented more astringency than the others.

Finally it is worthy of mention that regardless of the cultural and technological factors applied in the production of each wine, they have reflected and maintained their own inherent characteristics—their primary aromas, which are probably related to the geographical production area.

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References

- [1] L. Corino, A. Caló, Sustainable viticulture: Current practices and future developments, *Agriculturae Conspectus Scientificus* 66 (1) (2001) 3-11.
- [2] M. Cliff, M. Dever, Sensory and compositional profiles of British Columbia Chardonnay and Pinot noir wines, *Food Research International* 29 (3-4) (1996) 317-323.
- [3] M. Cliff, D. Yuksel, B. Girard, M. King, Characterization of Canadian Icewines by sensory and compositional analysis, *Am. J. Enol. Vitic.* 53 (1) (2002) 1675-1684.
- [4] C. Nurgel, G. Pickering, D. Inglis, Sensory and chemical characteristics of Canadian Ice wines, *Journal of the Science of Food and Agriculture* 84 (13) (2004) 1675-1684.
- [5] M. Goldner, M. Zamora, Sensory characterization of *Vitis vinifera* cv. Malbec wines from seven viticulture regions of Argentina, *Journal of Sensory Studies* 22 (2006) 520-532.
- [6] C. Lund, M. Thompson, F. Benkwitz, M. Wohler, C. Triggs, R. Gardner, et al., New Zealand Sauvignon blanc distinct flavour characteristics: Sensory, chemical, and consumer aspects, *Am. J. Enol. Vitic.* 60 (1) (2010) 1-12.
- [7] J. Rezaei, A. Reynolds, Characterization of Niagara Peninsula Cabernet franc wines by sensory analysis, *Am. J. Enol. Vitic.* 61 (1) (2010) 1-14.
- [8] G. Linton, P. Wall, Customer Quality Issues and International Wine Markets, ASVO Oenology Seminar, Quality Management in Viticulture, 1996, pp. 3-4.
- [9] Instituto Nacional de Vitivinicultura, Operativo de Actualización del registro Nacional de Viñedos 2010/2011, Instituto Nacional de Vitivinicultura, 2012, p. 105.
- [10] Instituto Nacional de Vitivinicultura, Resolución C.23/2006, Determinación por HPLC de nueve antocianos principales en vinos tintos y rosados, 2006, www.inv.gov.ar.
- [11] C. Findlay, J.C. Castura, P. Schlich, P.I. Lesschaeve, Use of feedback calibration to reduce the training time for the wine panels, *Food Quality and Preference* 17 (3-4) (2005) 266-276.
- [12] American Society for Testing Materials, Guidelines for Selection and Training of Sensory Panel Members, PCN 04-758000-36, 1981, pp. 1-35.
- [13] H.T. Lawless, H. Heymann, Sensory Evaluation of Food: Principles and Practices, Chapman & Hall, New York, 1998, p. 827.

- [14] M. Meilgaard, G.V. Civille, B.T. Carr, Sensory Evaluation Techniques, CRC Press, 1999, p. 448.
- [15] C.J. Wolters, E.M. Allchurch, Effect of training procedures on the performance of descriptive panel, Food Quality and Preference 5 (1994) 203-214.
- [16] L. Poste, D. Mackie, G. Butler, E. Larmond, Laboratory methods for sensory analysis of food, Research Branch, Agriculture Canada, Publication 1864/E, 1991, pp. 33-35.
- [17] M. Kermit, V. Lengard, Assessing the performance of a sensory panel-panellist monitoring and tracking, Journal of Chemometrics 19 (2005) 154-161.
- [18] G. Choren, El gran libro del Malbec argentino, Editorial Planeta, 2007, p. 200.
- [19] F. Miller, A. Vandome, J. McBrewster, Malbec, VDM Publishing House Ltd., 2010, p. 104.
- [20] M. O'Mahony, Food Science and Technology, M. Dekker, Inc., New York, 1986, p. 487.
- [21] Xlstat, Version 2009, www.xlstat.com/en.