Discriminating terroirs by combination of phenolics and sensory profiles of Malbec wines from Mendoza

Roy Urvieta, his PhD Adviser Ariel Fontana, Fernando Buscema, Beatriz Coste and Rubén Bottini, published in Food Chemistry a paper that compared parcels in the three most important winemaking regions of Mendoza, Argentina, using phenolic and sensory profiles. Twenty-seven parcels from 6 different locations: Luján de Cuyo, Maipú, Rivadavia, Tupungato, Tunuyán and San Carlos were selected to provide a representative sample of Malbec grapes in each location. Individual parcel has homogeneous soil texture (that is, soil texture diverged amongst parcels), planted with Malbec vines obtained from mass selection, own-rooted, of more than 5 years old and managed with the same cultural practices (without leaf removal and cluster thinning).

The parcels were compared in the most rigorous way possible. The grapes were harvested between March 14th and April 21st, 2016. Winemaking was carried out at the CIW pilot-winery using 800-L vessels in triplicate for each parcel. Four out of the 27 parcels were vinified only in duplicate due to the small size of the parcels. The phenolic composition and sensory descriptive analysis were carried out in Grupo de Bioquímica Vegetal-IBAM-CONICET and FAUBA-UBA, respectively. Phenolics have been proposed as chemical markers to establish cultivar authenticity and geographical origin of grapes. Anthocyanins are the main compounds responsible for color in grapes and wines. Flavanols are found in different tissues of the vine (leaves and stems) and in the most solid parts of the berry (skin and seed), forming polymers and oligomers known as pro-anthocyanidines or condensed tannins. These compounds are essential for the wines sensory characteristics, such as color, astringency and bitterness, as well as aging ability; all of them are strongly related to quality perception of wines.

All wines were characterized in a descriptive sensory analysis by a trained panel of 8 volunteers (two men and 6 women) between 25 and 66 years old. The training consisted of 18 h for introduction in wine sensory analysis, attribute generation, discussion, consensus in reference standards and practice in scale use. In the period of training sessions, the panelist used the same sample of the project to create, refine and gain consensus on the attributes. The panelists evaluated 27 parcels of Malbec wines in duplicate over 11 sessions, equating to 4-5 wines per session presented in randomized block design. Prior to each evaluation session, the reference standards were available if the panelist needed to refresh the memory. The panel rated 11 aromas, three tastes and two mouthfeel descriptors. For each of the descriptors, panelists were directed to rate the intensity of each wine on a 15 cm unstructured line scale anchored with the terms “low” and “high” at either end of the scale.

With the results obtained, chemometrics and sensometrics tools were used, such as MANOVA (multivariate analysis of variance), PCA (principal component analysis), CVA (canonical variate analysis) and cluster analysis to examine these profiles and afterwards compared for the geographical discrimination.

Tupungato showed the maximum levels of anthocyanins, while Rivadavia had the minimum levels amongst all departments. Also, the results of the present study demonstrated that warm areas such as Rivadavia (1833-1903 GDD, 635-671 m a.s.l) had a decrease of approximately ~53% in total anthocyanins as compared to cooler zones with higher altitudes like Tupungato (1171-1633 GDD, 1240-1510 m a.s.l.). Wines from Rivadavia (the Eastern and warmer region) had higher amounts of caffeic acid, while Tupungato and Tunuyán (cooler

zones on the Andes Piedmont) had higher amounts of tyrosol and *trans*-revesratrol. The Quercetin compound was higher in departments at a high altitude such as Tupungato, while considerable lower concentrations in Rivadavia were observed. This may be purportedly due to the differences in altitude, where at higher altitudes the sun exposure (and by consequence the UV-B irradiance) is higher and may increase the concentration of quercetin. The *trans*-resveratrol showed significant differences between locations, where higher and colder areas had higher concentrations. The increase in the concentration of anthocyanins and resveratrol may be due to higher UV-B exposure of the plants located at high altitudes.

In this study, the application of CVA to phenolic profile of Malbec shows a good discrimination among wines from different regions (Figure 1). That is, Rivadavia, which is located in the East with low altitude and warmer temperatures was separated from Tupungato and Tunuyán that have higher altitudes and cooler temperatures. This finding might suggest that Tupungato and Tunuyán wines would exhibit a more intense color, as anthocyanins are responsible for this property. Additionally, wines with higher concentrations of phenolic compounds may be associated with wines with greater antioxidant capacity and superior storage potential, both associated with high quality and consumer's preference.

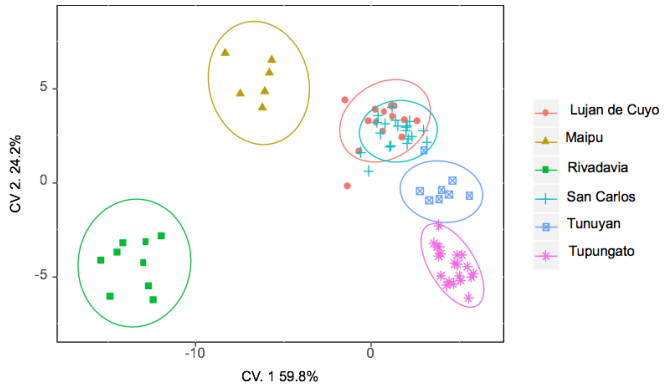

Figure 1: Canonical variate analysis (CVA) plot of combined phenolics measured in individual fermentation replicates of Malbec wines from 6 departments in Mendoza, Argentina. Ellipses that overlap are not significantly different from one another at the 95% level.

The application of PCA to sensory profile explains the 94% of the variance (Figure 2). The first dimension accounted for 55% of the variance and primarily separated Rivadavia, which was positively correlated with herbaceous, tobacco, black pepper and sweet sensory characteristics. The second dimension accounted for 39% of the variance and characterized the difference in locations by red fruits, hot and raisins notes, which were positively associated with Maipú. The first two dimensions show that San Carlos, Luján de Cuyo and Tunuyán are not different from each other, while Tupungato overlaps with Luján de Cuyo. Maipú and Rivadavia are clearly different from the other locations.

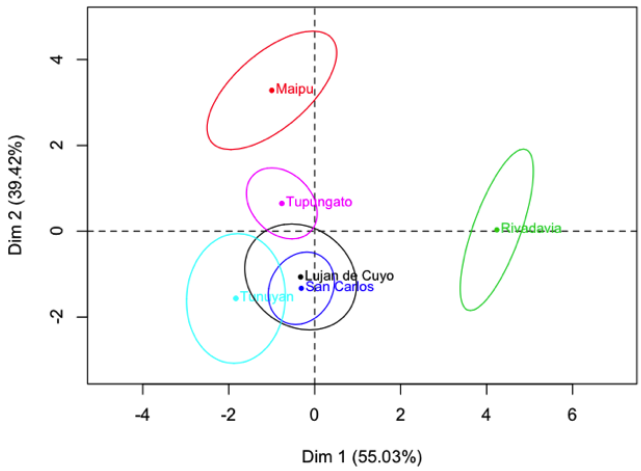

Figure 2: Principal components analysis with descriptive sensory data of Malbec wines evaluated by a trained panel (n = 8): confidence ellipses based on multivariate distribution of Hotelling's test for $p < 0.05$ indicating 95% confidence intervals

The results obtained through the analysis of phenols compouns and sensory profiles show that the locations of San Carlos and Luján de Cuyo are closely associated with each other. The locations of Rivadavia and Maipú, in both analysis, showed that they are different from the rest.

In terms of Mendoza's wine regions, San Carlos, Tunuyán and Tupungato constitute the "Uco Valley". Uco Valley is characterized by vineyards located at high altitudes and cool areas. The locations of Luján de Cuyo and Maipú form the region called "First Zone", located near the Mendoza River, approximately 80 km from Uco Valley. Rivadavia is located in the eastern part of Mendoza at an average altitude of 650 m a.s.l. and is classified as a warm zone called "Este" (East) region. It can be clearly seen that Rivadavia, as per chemical and sensory profiles, was always separated from the rest of the locations since the environmental conditions (altitude and climate) are very different and have different terroir characteristics as compared to places located close to the Andes mountains.

The actual legislation in Argentina define wine geographical areas by historic or political limits. However, the results presented here suggest that geographical indications in Mendoza may not be the proper way to classify wine's origin since a great influence of environment characteristics in each location were observed.

In conclusion, the data obtained allowed to discriminate the places where grapes are cultivated by using chemometrics and sensometrics methods. Results indicate that geographical origin exert influence on phenolic composition and sensory attributes of Malbec wines, which are influenced also by environmental factors. The results of multivariate analysis showed that Maipú and Rivadavia were clearly separated from the rest. However, chemical data allows a clearer separation of each location much better than those obtained by sensory analysis. By using unsupervised statistical methods, San Carlos and Luján de Cuyo are clearly associated in their sensory profiles and phenolics compounds, and the same results were showed by the CVA and PCA analysis. The overall data, have enological and viticulture impact for winemaking industry, expanding the current knowledge of Malbec wines and its geographical origin.

Reference

Roy Urvieta, Fernando Buscema, Rubén Bottini, Beatriz Coste, Ariel Fontana, Phenolic and sensory profiles discriminate geographical indications for Malbec wines from different regions of Mendoza, Argentina, Food Chemistry, Available online 18 May 2018, ISSN 0308-8146, https://doi.org/10.1016/j.foodchem.2018.05.083

Technical update

Phenolic and sensory profiles discriminate geographical indications for Malbec wines from different regions of Mendoza, Argentina

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Malbec wines from 27 parcels of 6 locations in Mendoza, Argentina (Luján de Cuyo, Maipú, Rivadavia, Tupungato, Tunuyán and San Carlos) were produced under standardized winemaking conditions and analyzed for phenolic composition and sensory descriptive analysis. Different methods of characterization and cluster analysis for each data matrix showed that some locations of Mendoza can be separated from each other. The results indicate that geographical origin exert influence on phenolic composition and sensory attributes of Malbec wines, which are influenced also by environmental factors. The results of multivariate analysis showed that Maipú and Rivadavia were clearly separated from the rest. However, chemical data allowed a clear separation of each location much better than those obtained by sensory data. Using unsupervised statistical methods, San Carlos and Luján de Cuyo are clearly associated in their sensory profiles and phenolics compounds, and the same results were showed by the CVA and PCA analysis. These results have enological and viticulture interest for the winemaking industry as the vineyard site selection for Malbec can considerably affect quality attributes.

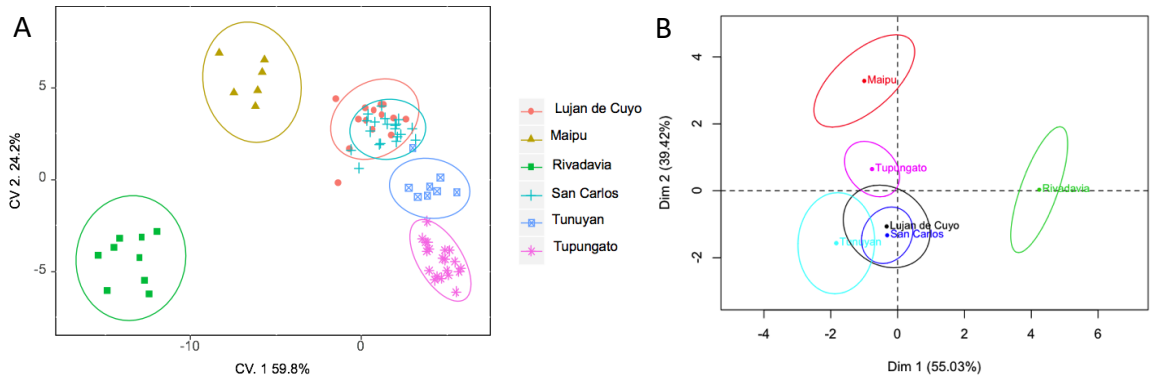

Figure 1. (A) Canonical variate analysis (CVA) plot of combined phenolics measured in individual fermentation replicates. (B) Principal components analysis with descriptive sensory data of Malbec wines evaluated by a trained panel (n = 8). Ellipses that overlap are not significantly different from one another at the 95% level.

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Social media (@catenamalbec)

(A) In conjunction with @CONICETMendoza and @FAUBA_oficial we published in @sciencedirect "Food Chemistry Journal" a paper about the Phenolic and sensory profiling of Malbec.
https://www.sciencedirect.com/science/article/pii/S0308814618308951

(B) Malbec wines from 27 parcels from Mendoza were produced under standardized winemaking conditions, and analyzed for phenolic composition and by means of sensory descriptive analysis

(C) Results indicate that geographical origin exert influence on phenolic composition and sensory attributes of Malbec wines, which are influenced also by environmental factors.

(D) The overall data, have enological and viticulture impact for winemaking industry, expanding the current knowledge of Malbec wines and its geographical origin.