# THE INFLUENCE OF NATIVE FLORA ON ARGENTINE WHITE WINE TERROIR *cv.* TORRONTES RIOJANO

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## ABSTRACT

The main objective of this paper is to establish considerable differences between wines from three wine areas or terroir, made with *cv* Torrontes Riojano.

Seventy-one volatile components were used as variables, obtained by means of solid-liquid extraction, quantification by Gas Chromatography with Flame Ionization Detector (FID), and the use of a multivariate statistical model of classification.

We have been able to conclude that the components which differentiate geographical areas in wines come from native flora which is near the vineyards, either owing to cross-pollination, dispersion both of resin and of pollen of the Larrea genus (*jarilla*), the wind or the solubility of the volatile components found in the soil.

**Key words:** Torrontes, terroir, native flora, *jarillas*, Larrea, aromas.

## INTRODUCTION

"Terroir" is a descriptive study of a place in the grape growing and winemaking area, which persists through the effects of fermentation and ageing of a wine. Given that the term "Terroir" is strongly associated to the geographical origin, it is difficult to quantify its influence on the finished product. That is to say, wines of a same variety but coming from diverse geographical areas express themselves differently, also having their quality affected.

According to the definition in the Draft Resolution stage 5 OIV/VITI/CLIMA/07/3330 St. 5[(1)], "Terroir is a peculiar delimited geographic space ……..." That is to say, "Terroir" means that the wines from an area in particular are unique and it is impossible for them to be reproduced in another place, even if the variety and production techniques are accurately repeated. The "Terroir" makes up the landscape characteristics and is part of the values of the territory.

That is, "Terroir" means that wines from a particular area are unique, and unable to be reproduced elsewhere, although the variety and processing technology to accurately repeated. The "Terroir" integrates the landscape characteristics and shape part of the values of the territory.There are several publications about weather and edaphologic variables, altitude, agricultural practices like vineyard management, irrigation and pruning type which have an influence on the differentiation and typification of "Terroir" [(2, 3, 4,5 6)]. However, there are no publications that objectively state the influence of the landscape, that is, native flora over "Terroir".

The analytical characterization of the aromatic profile of wines enables the determination of the principal volatile components which influence directly on the perception of wine aromas, and those which are under the perception threshold [(7, 8, 9, 10,

[11]. It is not known to what extent those components under the perception threshold influence on the global perception of wine aromas, or whether they have any direct or indirect relation with the native flora.

As a hypothesis, we expect to establish considerable differences between the geographical areas, the composition and concentration of the volatile components related to the aromas, by means of gas chromatography analysis and the identification of the compounds that influence on the "Terroir" and its origin.

Since the concentration and nature of the aromas depends on varietal, environmental and agronomic factors and on the technological process of vinification[7] , connected to the complex enzymatic activity of the yeasts and bacteria and to the corresponding substrates found in must, we expect to find and identify volatile compounds in wines, which are related to the native vegetation that surrounds the vineyards and which allows, by means of a statistical system, to predict the origin of its "Terroir". To that end, we worked on the same variety planted in different geographical areas. The variety we chose was *cv.* Torrontes Riojano, as it is considered the only native Argentine vine. It produces white wines and is cultivated in all of the wine regions, from the province of Salta to Rio Negro.

The Argentine area par excellence for this vine is the Riojan valleys, a soil in which it expresses outstanding characteristics.

Its extension in Argentina is 8,106 hectares, according to the information provided by the National Institute of Vitiviniculture (INV).

Very aromatic, Torrontes is a floral, herbaceous wine, with reminiscences of rose and a tinge of tea. Some are characterized by a touch of rue or nutmeg. There may also appear citric and honey aromas, but they do not minimize the typical muscatel grape aroma, which still remains in the bottle. Its most usual colour is pale yellow, with slight greenish sparkles. In the mouth, it is usually defined as a rustic wine. It is a wine with character and a bitter aftertaste, but with a fresh, light nature.

In the Argentine market, there are Torrontes Riojano wines from the Province of La Rioja and Torrontes Riojano from other Argentine geographical areas, which develop different sensory characteristics possibly related to the "terroir". In order to verify this, Torrontes Riojano wines were micro-vinified in standardized conditions. They underwent a discriminant statistical study, from which 19 volatile components that separate geographical areas were obtained. 5 of them do not have a defined metabolic pathway and might therefore come from external sources.

A cross-validation was carried out to minimize the different cultural and oenological practices with commercial wines of different qualities.

Based on these studies, a descriptive statistical research of the Argentine geographical wine areas was carried out. In those areas, the vineyards which are planted between 900 and 1,500 metres of altitude coincide with the distribution of the predominant shrub vegetation of the family Zygophyllaceae, especially the Larrea genus (*jarilla*) [12, 13, 14].

From the Patagonia to the Province of Salta there are three species of *jarilla*: Larrea cuneifolia, which grows in thin texture soils; Larrea divaricata, which has adapted to sandy, deep soils; and less frequently Larrea nitida. In general, the *jarilla* grows in sandy soils, sandy-clayey soils or with a chalky layer, but it does not tolerate high salt contents.

The three species of *jarilla* are distributed according to the elevation above sea level: Larrea cuneifolia up to 1,200 masl; Larrea divaricata up to 1,500 masl; and Larrea nitida from 1,500 masl[13,14]. The blooming of the *jarilla* takes place between October and November, in coincidence with the inflorescence period of the vine, which may imply

the existence of cross-pollination, that is to say, the volatile compounds of the *jarilla* pollen might be adsorbed on the surface of the pruine of the berries, or the volatile compounds might be adsorbed through the ground via the vine roots. The *jarilla* specimens are very resinous and perfumed. Therefore, it is possible that there exists an interrelation between the *jarillas* and the vines which can explain why the same variety of wine expresses itself differently depending on its geographical origin, bestowing on it the typical characteristics of a "Terroir".

## MATERIALS AND METHODS

### MATERIALS

**Reference grapes and wines**: cv Torrontes Riojano micro-vinified in identical conditions of cold maceration and alcoholic fermentation.
**Geographical areas**: Central area, Uco Valley and Eastern area of the Province of Mendoza; and Vichigasta, Villa Unión, Guandacol and Centre of the Province of La Rioja.
**Commercial wines**: 25 commercial samples of different varieties and geographical areas mentioned on their labels.
**Jarillas:** leaves, stems, primary and secondary roots, flowers and pollen.
**Soil**: soil surrounding the Vitis vinifera specimens and soil surrounding the *jarilla* specimens.

### METHODS

**Sample collection**

Expert members of the National Institute of Vitiviniculture (INV) collected the samples from the aforementioned cultivars in the geographical areas mentioned above, certifying the varietal origin by means of ampelography and collection of samples from cultivars genetically certified.

**Micro-vinifications**

They were done in order to produce wines made up by their natural components, without undergoing aggressive practices like the excessive pressing which gives wines herbaceous aromas which are considered a flaw.

Certain guidelines were set for making the reference wines by means of micro-vinification: 1) the amount of grape used, 2) de-stemming by hand, 3) pressing under controlled conditions, 4) alcoholic fermentation done with a pool of selected Saccharomyces cerevisiae yeasts, 5) cold maceration, and 6) cold stabilization and preservation of the wines in cold store.

**Jarillas**

We collected samples from the leaves, flowers, pollen, stems and roots, whose volatile components were extracted by means of the Kuderna-Danish concentration system with azeotropic mixture of pentane-dichloromethane solvents and identified by gas chromatography with mass detector.

**soils**

Following the same extraction and concentration methodology, the volatile components of the soils near the vines and the *jarillas* were analyzed by means of gas chromatography so as to make comparisons.

We checked whether any of the volatile components which had previously differentiated geographical areas in the wines, coincided with those found in *jarillas*.

**Vitis vinifera**

On two specimens of *Cereza* Vitis vinifera, which is considered neutral in the production of aromas, at ten- metre distance one from the other, the following test was carried out in order to verify the possible absorption through the roots and the transfer of the volatile components which had previously discriminated geographical areas to the berries. One of the specimens was provided with a solution with the abovementioned volatile components in a concentration of 0.20 $mg.l^{-1}$ and was watered every seven days with ten litres of water. A blind experiment was carried out on the other specimen.

The absorption monitoring was done from sprouting up to berry formation.

## ANALYTICAL METHOD

The volatile fraction of the wines was extracted from 100ml of wine previously treated with 20 µl of R-octanol as internal standard and separated by means of solid-liquid extraction with Amberlite XAD-2 resin and pentane-dichloromethane solvents in equal parts. Then, the samples were made concentrated in Kuderna Danish until a drop of essential oil was obtained. A microlitre of this oil was injected in split mode in a Hewlett Packard HP-6890 Chromatographer with FID detector, equipped with capillary column HP-Innowax (50m x 0,25 mm i.d., 0,25 mm film thickness).

For the quantification, the "Internal Standard Method" is used and the result is expressed in a concentration of $mg.L^{-1}$

With this analytical method 71 components have been extracted, identified and quantified. **Tab. 1** shows the volatile components analyzed.

**Tab. 1**

| Volatil components | |
|---|---|
| Alcohol crotylico | Butanol |
| 2-pentanol | Ethyl propionate |
| 2-methylbutanol | 3-methylbutanol |
| 4-methyl-2-pentanol | 1-pentanol |
| Isobutyl Acetate | Hexanal |
| Damascenona | E-3-hexenol |
| Z-3-hexenol + Furfurilic | Cis-2-hexenol |
| E-2-hexenol | Hexanol |
| Gammabutirolactona | Alfa-pinene + dipentene |
| Dipentene | 2-phenylethanol |
| Hexyl acetate | D-Limonene |
| Cineole | Benzyl alcohol |
| 1-phenylethanol | Gamma terpinene |
| Guaiacol | 2-isopropyl-3-methoxipirazina |
| Linalool + ethyl heptanoate | Nonanal |
| Alpha terpinene | E-ox.limonene +1- phenyl-2-propanol |

| | |
|---|---|
| Z-limonene oxide | S -R citronellal |
| Menthol | 4-terpineol |
| Alpha Terpineol | 2-isobutyl-3-methoxypirazina |
| Diethyl maleate | R-mirtenol |
| 3,4-dimethylphenol | Ethyl octanoate |
| Citronellol | Nerol |
| Citral | S-mirtanol |
| p-anisaldehido | Geraniol + linalyl Acetate |
| Z-cinnamaldehyde | Citral |
| Transanetol | Wiskey-Lactone |
| Thymol | Carvacrol |
| Wiskey-Lactone | Eugenol |
| Nerilo acetate | Damascenona |
| Genarilo acetate | Ethyl caprate |
| Ethyl anthranilate | ionone alpha |
| Isoeugenol | Gamma decanolactona |
| Dodecanol | Beta ionone |
| R-nerolidol | S-nerolidol |
| Delta undecanolactona | Ethyl + deltaundecanolactona Laureate |
| Delta dodecanolactona | Delta dodecanolactona |
| Ethyl myristate | |

## STATISTICAL METHOD

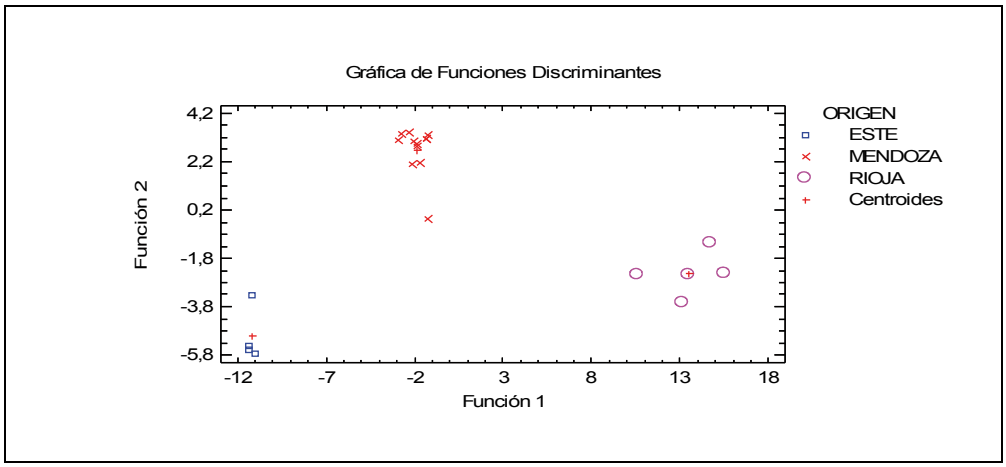
The discriminant statistical analysis was carried out on the obtained data with the Statgraphics Centurion XV software, which entailed the study of the discriminant variables with the individual odoriferous components of each sample, using ORIGIN as classification factor [15, 16].

## RESULTS

The analytical results obtained for the volatile composition of Torrontes Riojano wines coming from La Rioja, Mendoza and Area were grouped according to their geographical origin: Mendoza, East and La Rioja (ORIGIN).

The variables which showed differences between their averages were the following: Carvacrol, Cineol, 4-terpineol, 2-isopropil-3-metilpirazina, Eugenol, E-2-hexenol, Hexanol, Guaiacol, Isoeugenol, Menthol, Nerol,p-anisaldheido, R-mirtenol,R-Nerolidol, S-nerolidol, Transanetol, and Timol. Those volatile components sensorially correspond to herbaceous, spicy, balsamic aromas which are not defined as variety sensory descriptors.

In the discriminant study, 2 discriminant functions were obtained with p-values lower than 0.05, being statistically significant with a 95% confidence level. **Graph 1** of discriminant functions shows the existence of significant differences between the wines coming from the wine areas of La Rioja, Mendoza and East Area of Mendoza. In this study, the 21 observations used to adjust the model to a 100% were correctly classified.




**Graph 1: Discriminant functions of geographical areas**

## RESULTS ON *JARILLAS* AND SOILS

By means of extraction, concentration and chromatographic analysis of *jarillas* and soils, high concentrations of p-anisaldehido, R-mirtenol, Transanetol, Timol, Carvacrol, Eugenol, Isoeugenol and Menthol were found, among other components.

## RESULTS ON VITIS TESTS

90% of the volatile compounds were recovered, except 2-isopropil-3-metilpirazina and Nerol, in the leaves and also in the berries.

## CONCLUSIONS

We conclude that 19 odoriferous components out of the 71 individual compounds analyzed have a discrimination capacity to establish and predict geographical areas. These volatile components sensorially correspond to herbaceous, spicy, balsamic aromas which are not defined as variety sensory descriptors and are found in concentrations which are lower than their perception threshold.

5 out of the 19 components do not have a defined metabolic pathway in grapes. Thus, they might come from an external source like the *jarillas*, since said components were also found in high concentrations in those plants, and it was proved that their absorption through the roots is possible.

Therefore, we can conclude that the landscape, which in this paper refers to the native flora and is part of a geographical area or terroir, interacts with the vineyards by means of exchanges (cross-pollination, resin and pollen dispersion, wind or solubility of the volatile components which are deposited in the soil), contributing among other variables, to obtain wines which are unique even when the variety of origin is the same.

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