Composition of grape grown on different homogenous terroir units (HTU)

Composition des raisins cultivés sur différentes unités de terroir homogènes (UTH)

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Summary

This paper was based on the soil maps units from Ribera de Duero viticulture and wine Denomination of Origin that defined different Homogeneous "Terroir" Units (HTU) with potentially diverse oenological qualities. The main aim of this study was the study of possible correlations between HTU categories and the development and quality of the wine grapes cultivated on specified HTUs. Five vineyards from three different optimum HTUs were selected for this study. Selection criteria were grape variety, clone, rootstocks, age, training systems and cultural practices, trying to select the most similar vineyards.
Samples of 25Kg were manually harvested, from each one of the 15 selected vineyards. The grapes were harvest at the degree of technological maturity as similar as it was possible. Technological maturity is correlated with adequate levels of sugar, acidity and phenolic content, so that good sanitary stages and even good levels of aroma precursor compounds. So, composition of grapes was evaluated considering all these parameters, however this paper showed only partial results, showing levels of sugar, acidity variables (pH, titrable or total acidity and content of malic acid), and phenolic compounds (several phenolic families were considered: total polyphenols, anthocyanins, catechin and flavanol levels). This work will be completed with future studies that will be carried out in future vintages.
Obtained data showed that, even having a large variance among vineyards of the studied Homogeneous Terroir Units, was possible to detect significant differences on the composition and oenological quality of the grapes of each UHT.

Key words: Terroir, zoning, grape quality, soil units.

Introduction

Gómez-Miguel and Sotés (2003) described the general methodology for terroir zoning and characterization that takes into account the specific conditions in Spain, such as land use, vineyard distribution, and occupation index of the designation regulations. The methodology is based on the integrated spatial analysis of environmental variables (i.e.: climate, vegetation, geology, geomorphology, soils, etc.), landscape variables (derived from photo-interpretation and a digital elevation model), and viticulture variables (training systems, varieties, phenology, productivity, quality, etc.). The resulting database is integrated in a Geographic Information System (GIS) that allows the spatial and statistical analysis of all variables and the results are presented in maps, in which it is possible to observe the distribution of each Homogeneous Terroir Units (HTU) defined by the model. Furthermore, each HTU is classified according to their viticulture and oenological potential.
Nowadays, it is undisputable the relationships among soil, climate, landscape, etc. and the characteristics of wine grapes (composition, color, astringency, etc). In fact, a lot scientific groups all over the world coutries, where the vine is cultivated, have been studying this fact for decades. A recently recompilation of all these researches was published by Fregoni et al., (2003).To sum up, nowadays it is totally accepted that the interaction "terroir"-vine-viticulture is the base to obtain quality grapes from which make quality wine.

This paper is focused in the last part of the zoning methodology proposed by Gomez-Miguel and Sotés (2003), it said it is focused in the study of the integration of the Homogeneous Land or Terroir Unit with the vine (considering variety, rootstock and other factor of variance) and its products, the grapes.

Materials and Methods

The UHT have already been defined in previous zoning works in three steps, and also the qualification and quantification of the soil series and UHT are included in original report of the zoning study of Ribera del Duero Appellation of Origin (AO) Sotés and Gómez-Miguel (1992). Resulting of this study, different Homogeneous Terroir Units (HTU) were defined. These units were classified in five different levels: optimum, suitable, unfavourable, unfit and excluded. Based on this classification, the three HTUs classified as optimum (labelled as 6, 11 and 14) which content the biggest quantities of vines were chosen. These HTUs represented the 42,2 % of the total vineyard surface. The soil taxonomy unic (USDA, 1994 and 2006) of each respective selected HTU was: Calcixerollic xerochrept, fine-loamy, mesic, mixed (USDA, 1994) with tentative translation to Typic calcixerept, fine-loamy, mesic, mixed (USDA, 2006); Typic haploxeralf, fine-loamy, mesic, mixed, and Calcic haploxeralf, clayey, mesic, mixed with lithologic materials formed over sandy clays of the Miocene period.

The selection of vineyards was carried out considering diverse cultural and varietal factors, in order to reduce as much as it was possible the variance due to all of them. Vineyards of Tempranillo vines of 8 to 10 years were located. Among them, it was looked for vineyards of the same rootstock (110R), similar training system (vertical shoot-positioned trellis with two pairs of movable foliage wires, cordon trained and spur pruned, and 130 or 150 x 300), sited in hillside with slight slopes lower than 10%. Finally, it was tested the HTU of each vineyard, and five of them sited on each studied HTU were selected.

Grapes were manual harvested. Harvesting date was determine trying to collect grapes at “technological maturity” stage (González-Sanjosé et al 1991), which are correlated with adequate levels of sugar, acidity, phenolic content (nowadays named phenolic maturity), so that good sanitary stages and even good levels of precursors of the final aroma of the wines. The harvesting period was around the middle of October, and time between the first and the last sampling was lower than one week.

Three lots of 25 Kg were picked up from each selected vineyard. One cluster by vine was taken, and sampled vines were randomly chosen with a Z distribution around the vineyard. Grape were transported in plastic boxes to the laboratory. From each sampled lot, groups of single grapes were obtained separating manually two o three grape of each cluster content in each lot. Then, three groups of 100 single grapes were randomly formed and they were used to analyse the composition of the grapes of each vineyards.

Grape of each group were manually peeled, skins were used to evaluate phenolic composition, pulp were pressed to obtain the respective must where parameters related to sugars and acidity were measured.

Titrable acidity (TAc) expressed as g/L of tartaric acid, pH measurements and reducing sugars were determined according to OIV methods (1990). ºBrix was evaluated by direct measured on refractometer. Acid Malic content was evaluated by enzymatic methodology.

Phenolic extract were obtained by maceration of skins with methanol acidulate with acid formic, according to the procedure described by Izcara and González-Sanjosé, (2001). Global phenolic content (total polyphenols, TP, expressed as mg/L of gallic acid), so as some phenolic families (total anthocyanins, T ACY, expressed as mg/L of malvidin-3-glucoside, and catechins (CAT) quantified as mg/L of D-catechin) were evaluated by classical spectrophotometric methodologies, all of them

described in García-Barcelo (1990). Furthermore, total flavanol contents (T Flvols) were analysed according to Mazza et al., (1999).
The analysis of the variance (ANOVA) and the Least Significant Difference test (LSD) were used to detect differences and to establish which data could be considered statistically different. A significance level of = 0.05 was used. All statistical analyses were carried out using the statistics package Statgraphics Plus 4.0 (1999, Manugistics Inc.).

Results and discussion

The vineyards selected for this study were distributed around the demarcation of the Ribera de Duero Appellation of Origine (figure 1). Trying to have an adequate representation of each of the three homogeneous terroir units under consideration, selected vineyards were also located around the global surface of each HTU (table 1).

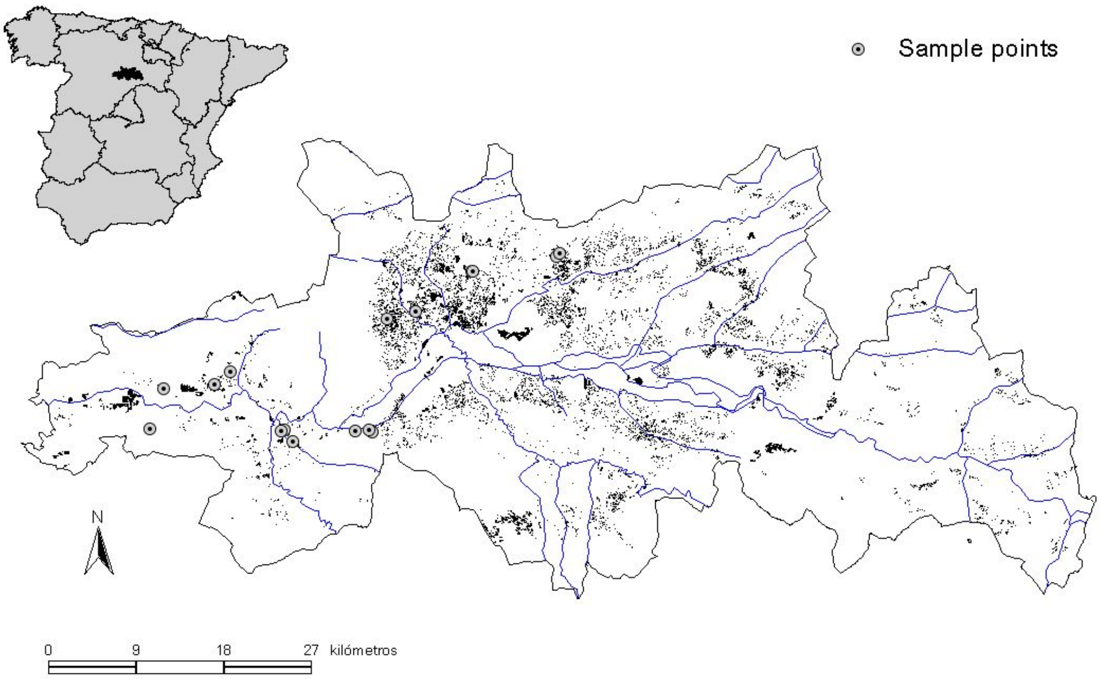

Figure 1 Distribution of the vineyards selected for this study around the surface of Ribera de Duero Apellation of Origin.

Vineyd	11	31	41	61	81	51	21	32	42	71	12	22	52	62	72
HTU	6	6	6	6	6	11	11	11	11	11	14	14	14	14	14
X	394472	402776	436258	418845	415551	409137	417339	401146	436618	427590	395939	417025	407928	421741	427662
Y	4606798	4612731	4624532	4618111	4606592	4605531	4606484	4611388	4624918	4622970	4610909	4606701	4606636	4618941	4623016
Z	830	775	866	823	774	770	783	788	876	834	780	787	764	813	828

Table 1Localization of each vineyard used for this study and their respective HTUs.
Vineyd = vineyard; HTU = Homogeneous Terroir Units; X = longitude, Y = latitude; Z = altitude.

First to comment the obtained results, it is important to note that this paper present partial results, which will be completed and corroborated, in next vintages. Secondly, it is also important to note that the last vintage was very atypical in the viticulture region under study. Last year, the meteorology was very adverse in "Ribera de Duero" viticulture region, affecting notably to the development of clusters and grapes so as the ripening process. Important Spring frost, strong hails during May, so as a warm summer, not hot enough, caused that some of the selected vineyards did not show the best conditions to produce adequate quality grapes. According to these comments, even if grapes were harvested from the 15 vineyards under study only data from 11 of them will be showed and commented in this work. Only data from grapes with an adequate level of technological quality will be considered. The grapes, of the four vineyards eliminated from the results discussion, showed or a bad sanitary stage (especially damage by *Botrytis cinerea*) or they did not show good level of sugars and phenols.

The results of ANOVA analysis, of the data corresponding to the analysed parameters, showed significant differences for the majority of the studied parameters, with the exception of sugars and total anthocyanins levels, which showed p values of the F-test over 0,05 (0,1252 and 0,0662, respectively). In these two last cases, the variance within-group was higher than the variance among groups, so that significant difference among HTU were not detected. Analysing with detail the results (figure 2 and table 2) it was easy to note the high variance detected among vineyards of the HTU labelled as 11. It is important to remember the anomalous climatic conditions of the last vintage that clearly affected the synthesis and accumulation the metabolites, and which could produce these notable differences.

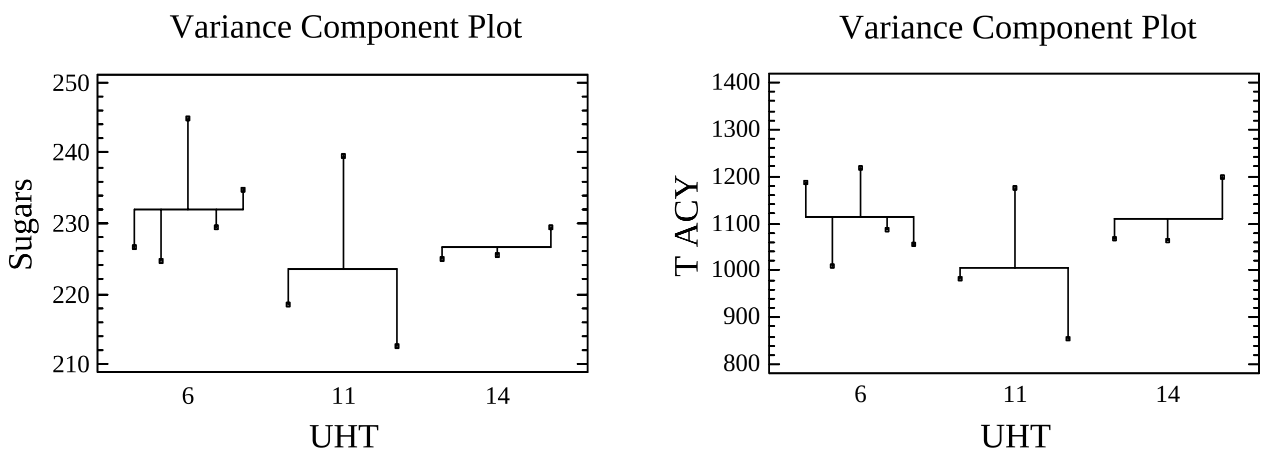

Figure 2 Scatter plots of Variance Components Analysis. Solid horizontal lines are drawn at the means of the data for each factor level (HTU). Points are drawn at the average values for each vineyard of each HTU, vertical lines indicate the difference among means of each vineyards and the means of its respective HTU.

T ACY		(mg/L)	
HTS	Count	Mean	Homogeneous groups
11	9	1003.4	X
14	9	1108.6	XX
6	15	1111.7	X
SUGARS		(g/L)	
HTS	Count	Mean	Homogeneous groups
11	9	223.6	X
14	9	226.7	X
6	15	232.1	X

Table 2 Multiple range test for Sugars and Total anthocyanins levels of grapes from each HTU. LSD (Fisher's least significant difference) method and p = 0,05

T ACY, total anthocyanins

Within each column, the levels containing X's form a group of means within which there are no statistically significant differences.

In contrast with the cited results, variables correlated with acidity showed all of them factor HTU with p values lower or equal to 0,01 (figure 3), and in consequence the relation between the levels of sugars and titrable or total acidity also showed significant differences among HTUs. Similar results were obtained for no-anthocyanins phenolic families, with significant differences to p values lower than 0,0002 (figure 4). In these cases large variance within-group were also detected, however these were lower than variance among groups, doing possible detect difference among HTUs.

Oenological quality of red grapes for making wine is correlated not only with their levels of phenolic compounds, but also with their equilibrium (Revilla and González-Sanjosé, 2002), for that reason the relationship between levels of total polyphenols and total anthocyanins, so as between total anthocyanins and total catechins levels were also evaluated. Both of them showed statistically significant differences (figure 4). Higher values of these relations are considered positive and indicate better oenological potential, due to the fact that the higher is the proportion of catechins the higher are the possibilities of tanin-anthocyanin condensation, which produce wines with more stable and intense colour (Vivar-Quintana et al., 2002; Revilla and González-Sanjosé, 2003).

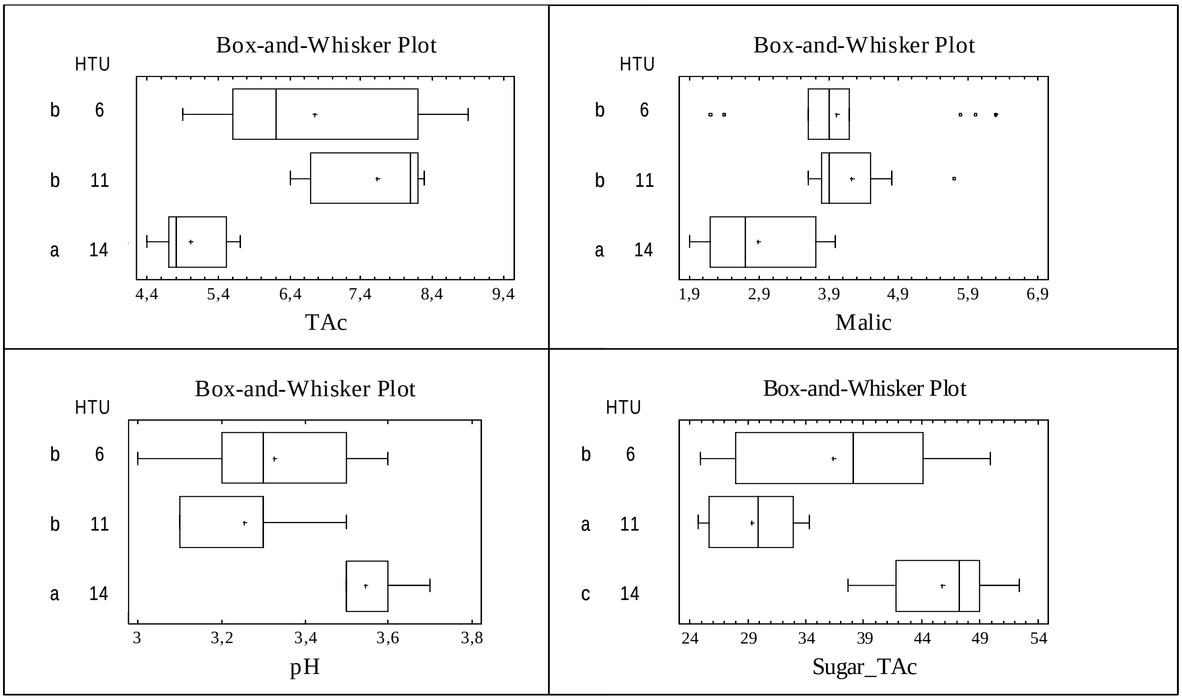

Figure 3 The Box-and-Whisker Plot of the data from studied variables correlated with acid contents. This plot showed the data divided into four equal areas of frequency (quartiles). A box encloses the middle 50 percent, where the median is drawn as a vertical line inside the box. Horizontal lines, known as whiskers, extend from each end of the box. The left (or lower) whisker is drawn from the lower quartile to the smallest point within 1.5 interquartile ranges from the lower quartile. The other whisker is drawn from the upper quartile. Means values of each HTU with the same letter are statistically equals for p values of 0,05.

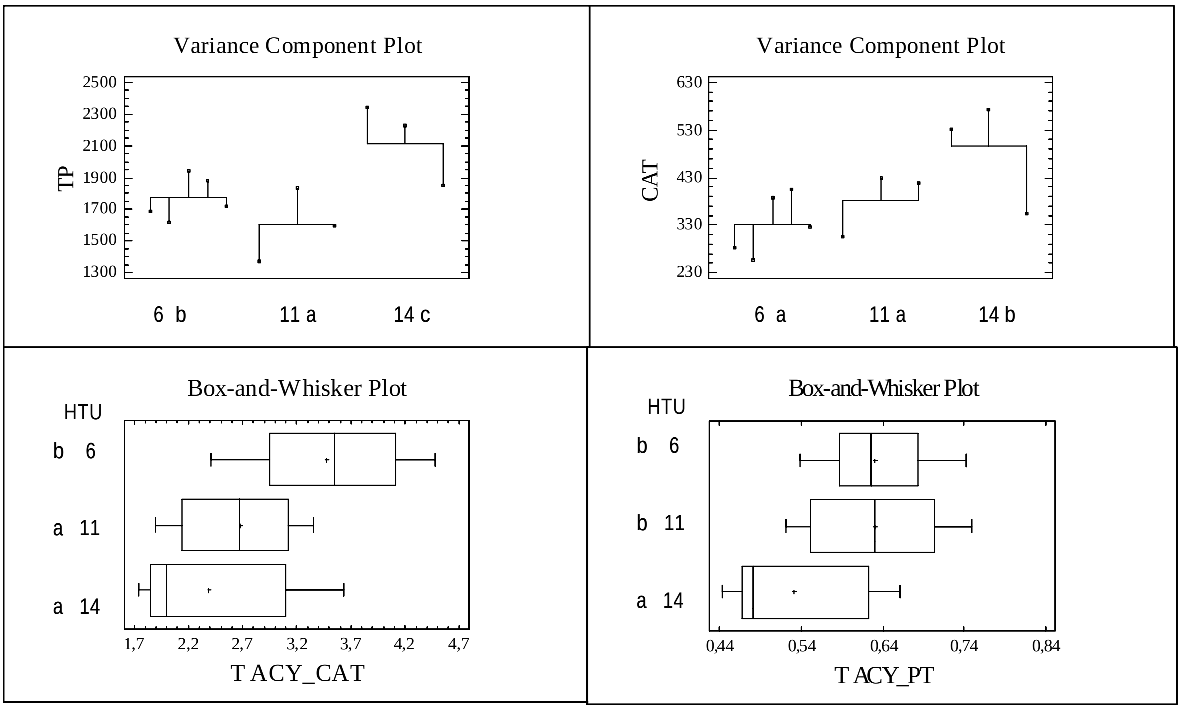

Figure 4 Scatter plots of Variance Components Analysis for Total Polyphenols (TP) and catechins (CAT) levels (TP) and Box-and-Whisker Plot of the relationships between levels of total anthocyanins (T ACY) with catechins and total polyphenols levels. Means values of each HTU with the same letter are statistically equals for p values of 0,05.

Conclusions

These results indicated that grape from each units, even showed all of them good quality, also showed some differences which could increase the quality parameters of the wines obtained from them, giving some special peculiarities.

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