VALIDATION OF THE VITICULTURE ZONING METHODOLOGY APPLIED TO DETERMINE THE HOMOGENOUS SOIL UNITS PRESENT ON D.O. RIBERA DEL DUERO REGION

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ABSTRACT

The methodology to viticulture zoning developed and proposed by Gómez-Miguel and Sotés (1992) has been studied in order to validate it. This was the main aim of this work, which shows only partial results because data from more vintages will be collected during the next vintages.

The proposed validation is based on the comparison of quality levels of the viticulture products (grapes) grown in different Homogeneous Soil Units (HSU) but classified as the same level of quality. HSUs classified as optimum in Ribera del Duero Denomination of Origin (D.O.) region were chosen for this validation study. The three more important Optimum Units were selected. They represented around of 50% of the global surface of vineyards on the Ribera del Duero viticulture D.O. zone. Five different vineyards in each Unit were chosen. Trying to select the most similar vineyards to reduce variability factors, other selection criteria applied were grape variety, clone, rootstocks, age, training systems and cultural practices.

Three grape samples were collected around of each selected vineyards at the "Technological maturity" stage of the grapes. Different oenological quality parameters were analysed on the collected grapes. After the statistical treatment of the whole analytical data, obtained from grapes collected during two consecutive vintages, some significant results can be pointed out. Among them, it is interesting to note that, in general, variability due to vintage was stronger than that due to the HSU. In a similar way, variability due to vineyards was also significant, and in general, it was bigger than variability due to Units. Furthermore, the whole data showed similar levels of quality after comparing grapes from each HSU studied.

These results seem to validate the proposed methodology. That is, the methodology is valid to determine HSU which can produce grape of a similar quality, and then it can be applied to the correct or appropriate use of the agriculture medium.

KEYWORD

Viticulture zoning methodology – validation – grape – quality

INTRODUCTION

Nowadays, it is undisputable the relationships among soil, climate, landscape and other factors of the agriculture medium, with the characteristics of the wine grapes as composition, colour, astringency, and so on. In fact, a lot researcher groups all over the world have been

studying these influences and relationships for decades. To sum up all the precedent studies, now it is totally accepted that the interaction "terroir"-vine-viticulture is the base to obtain quality grapes from which make quality wine. Furthermore, this multiple interaction is the base to obtain wines with personality and with particularly expression of the medium in which grapes grown.

During the last 90's, Gómez-Miguel and Sotés developed and proposed a methodology to viticulture zoning (Sotés y Gómes-Miguel, 1992; Gómez-Miguel and Sotés, 2003). This methodology has been applied in the most significant and important Spanish Viticultural and Oenological Denomination of Origin (D.O.) regions, such as Ribera del Duero, Rioja, Toro, among others. Cited authors indicated this methodology is useful to determine Homogeneous Soil Units (HSU) even if these co-exit in the same vineyard. So, cited authors said that this methodology is an appropriate method to the correct ordering and exploitation of the medium according to its viticulture and oenological use.

The validation of this methodology has not been carried out completely yet, and this is the main aim of this works. The proposed validation is based on the comparison of quality levels of the viticulture products (grapes) grown in different HSU classified as the same level of quality. The study is being carried out in vineyards of Ribera del Duero D.O. region. HSUs, classified as optimum, were chosen for this validation study. The three more important Optimum Units were selected. They represented around of 50% of the global surface of vineyards in the Ribera del Duero D.O. region.

MATERIALS AND METHODS

The three more important and extensive HSUs selected for this study were defined from the zoning study of Ribera del Duero Denomination of Origin carried out by Sotés and Gómez-Miguel (1992). They were the Units 6, 11 and 14. For more information about this Units consult (González-Sanjosé et al., 2008). As it is described in the previous cited work, five different vineyards in each Unit were chosen. Trying to select the most similar vineyards to reduce variability factors, other selection criteria applied were grape variety, clone, rootstocks, age, training systems and other cultural practices

Three grape samples were collected, around each selected vineyard, at the "Technological maturity" stage of the grapes, which are correlated with adequate levels of sugar, acidity, phenolic content (nowadays named phenolic maturity), so that good sanitary stages and even with good levels of aroma precursor compounds (González-Sanjosé *et al*. 1991). The harvesting periods were around the middle of October, and in general time between the first and the last sampling was around two weeks. Depending on the vintage, time sampling difference was large, 16 days in the first vintages, or short, tree days in the second one.

Three lots of 25 Kg of grapes 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. Grapes were transported in plastic boxes to the laboratory as soon as possible after their collection. From each sampled lot, groups of single grapes were obtained separating manually two o three grapes of each cluster. Then, three groups of 100 single grapes were randomly formed and they were used to analyse the composition of the grapes. Grapes were manually peeled, skins were used to evaluate phenolic composition, pulps were pressed to obtain the respective must where parameters related to sugars and acidity were measured. Titrable acidity (TA) expressed as g/L of tartaric acid, pH, conductivity (Cnd), K and Cl measurements so as reducing sugars (RS) were determined according to OIV methods (1990). ºBrix was evaluated by direct measured on refractometer. Malic Acid content was evaluated by enzymatic methodology. Phenolic extracts were obtained by maceration of skins with

methanol acidulate with formic acid, 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, ACYpH, 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 phenolic-tartaric-ester contents (E-TH2) were analysed according to Mazza et al., (1999) and Total Flavonol levels (FLA Neu) by Neu reactions. The Glories colour parameters, colour intensity (CIntensity), tonality (To) and percentage of red, yellow (Ye) and Blue were measured on methanol extract of the skins.

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 $\alpha = 0.05$ was used. Multivariante analysis were also applied, Factorial Analysis were applied to the global analysis of the data. All statistical analyses were carried out using the statistics package Statgraphics Plus 4.0 (1999, Manugistics Inc.).

RESULTS AND DISCUSSION

Firstly to comment the obtained results, authors want to note that this paper present partial results (from two vintages) which will be completed and corroborated, with data from new vintages. Secondly, it is important to comment that the climatology on the viticultural region under study was very unfortunate in different aspect during the year under study. So, the meteorology of the first year was very adverse, 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. During the second vintage meteorology was loss adverse, however a strong hail storm during spring and a frost at the beginning of the autumn, damaged largely two of the vineyards selected for this study. For that reason, at in the first year of study, even if samples were collected from the 15 selected vineyards, only data from 13 of them have been included in this study.

The diverse factors of variability on the composition of the grapes are well known. Some of them are: the intra vineyard variability, due to own metabolism of each vine and cluster; the inter variability due to vineyards even if these are close, due to soil units, cultural practice and so on and the inter variability due to the vintages, especially associate to climatic conditions. The experimental design applied in this study try to consider all of them. So, the three lots collected around each selected vineyard try to collect the intra-vineyard-variability and the five vineyards selected form each HSU try to collect the inter-vineyard-variability. Obviously the extension of this study to different vinatge tries to collect also the inter-annual-variability. The two last types of variability are showed in figure 1, which showed, as example, the results from two of the parameters studied. Similar results were observed in the other studied oenological characteristics.

The results showed large variability due to vineyards, but this was also dependent on the year or vintage. So, the inter-vineyards variability can be very important (large vertical lines) or insignificant (short vertical lines).

Global results also showed a clear effect of the year, as it can be observed in the figure 2. Factorial Component Analysis showed how data of the grapes from each vintage were well separated on the left and the right of the figure, respectively. The multivariante analysis also

showed the intra-vineyards variability of the vineyards, which is showed by the dispersion of the points. Very close points correspond with grape-lots from the vineyards with a small intra-variability and disperse points correspond with vineyards with a large intra-variability.

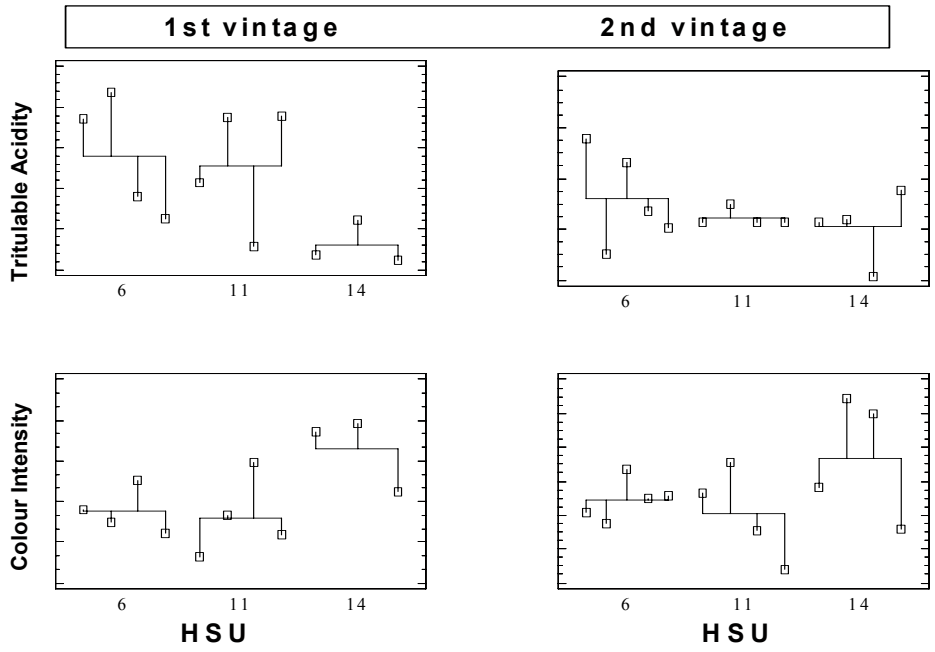

Figure 1. Scatter-plots of Variance Components Analysis. Solid horizontal lines are drawn at the means of the data for each factor level (HTU). Points are drawn at the average values for each vineyard of each HTU, vertical lines indicate the difference among means of each vineyard and the means of its respective HTU.

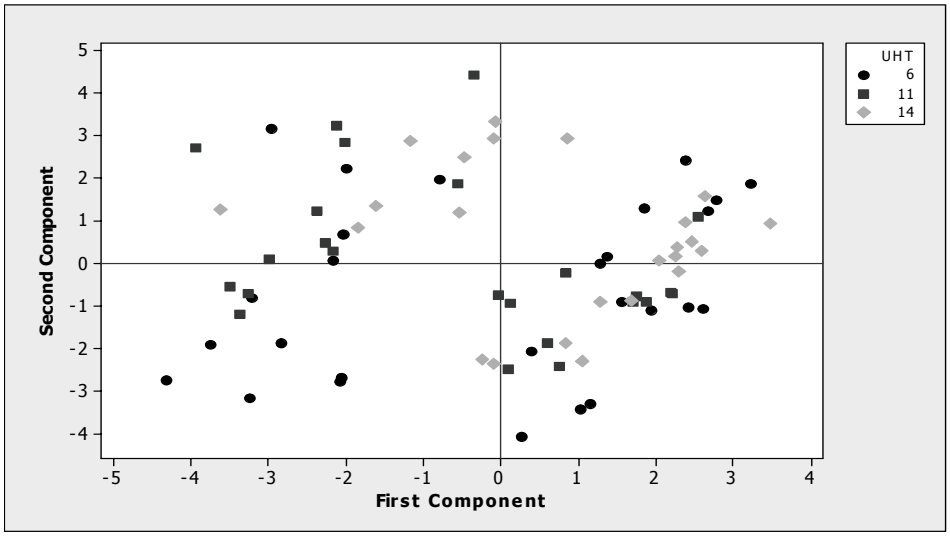

Figure 2. Distribution, on the plane defined by the two main Factor Components, of the grapes from each lot analysed on the two studied vintages. Each point is the score of each lot after a multi-data analyse. Point on the left/right: grapes from 1st and 2nd vintage respectively.

Furthermore, multivariante analysis showed that the grapes from the different studied units were very similar in composition among them, although this similitude depends also on the vintage. So, data from second vintage are globally more aggregated than those from the first one and no intra grouping were glimpsed. However, data from the first vintage allow glimpsing a slight aggregation of the data by units. This fact is also observed by invariant analysis of the studies variables (table 1) which showed that data from the first vintage showed more statistical significant differences among HSU than data from the second one.

Table 1. Mean values and deviation of each indicated parameter and HSU obtained at each studied vintages. Letters indicate significant differences among values for each vintage. LSD (Fisher's least significant difference) method to $\alpha = 0,05$ was applied.

Vintage	1rst			2nd		
UHT	6	11	14	6	11	14
SR (g/L)	228,8 ± 7 **a**	226,9 ±17,9 **a**	226,7 ± 6,6 **a**	216,3 ± 13,7 **a**	220,7 ± 11,3 **a**	225,3 ± 19,9 **a**
º Brix	22,2 ± 1,1 **b**	22,2 ± 1,9 **b**	24,4 ± 0,4 **a**	22,4 ± 1,1 **a**	23,2 ± 1,2 **a**	22,9 ± 1 **a**
Malic (g/L)	4,4 ± 1 **a**	3,7 ± 1 **ab**	2,9 ± 0,8 **b**	5,5 ± 1,3 ***a***	3,9 ± 0,5 ***b***	4,2 ± 0,8 ***b***
pH	3,29 ± 0,19 **b**	3,3 ± 0,15 **b**	3,5 ± 0,06 **a**	3,57 ± 0,26 **a**	3,5 ± 0,1 **a**	3,64 ± 0,27 **a**
TA (g/L)	7,18 ± 1,4 **a**	6,96 ± 1,39 **a**	5,01 ± 0,5 **b**	7,01 ± 2,03 **a**	6,16 ± 0,41 **ab**	5,18 ± 1,33 **b**
Cnd (mS)	2,22 ± 0,24 **a**	2,08 ± 0,22 **a**	2,13 ± 0,15 **a**	2,44 ± 0,18 **a**	2,22 ± 0,28 **b**	2,37 ± 0,25 **ab**
K (mg/L)	1353 ± 178 **ab**	1229 ± 67 **b**	1386 ± 225 **a**	1642 ± 176 **a**	1452 ± 84 **b**	1621 ± 281 **a**
Cl (mg/L)	18,5 ± 4,7 **a**	17,2 ± 5,9 **a**	19,2 ± 4,3 **a**	40,5 ± 17,5 **a**	36,5 ± 12,9 **a**	39 ± 18,5 **a**
TP (mg/L)	1678 ± 217 **b**	1734 ± 266 **b**	2104 ± 227 **a**	1857 ± 461 **a**	1760 ± 290 **a**	1863 ± 237 **a**
CAT (mg/L)	316 ± 66 **c**	383 ± 54 **b**	496 ± 110 **a**	516 ± 69 **a**	440 ± 163 **a**	495 ± 98 **a**
ACY pH (mg/L)	1100 ± 85 **a**	1076 ± 179 **a**	1100, ± 57 **a**	964 ± 88 **a**	877 ± 205 **a**	942 ± 123 **a**
FLA N (mg/L)	74,8 ± 9,6 **b**	72,2 ± 11,5 **b**	83,9 ± 6,6 **a**	104,7 ± 7,3 **b**	105,5 ± 21,1 **b**	123 ± 35,4 **a**
E-TH2 (mg/L)	14,3 ± 1,66 **a**	14,4 ± 2,5 **a**	13,9 ± 0,6 **a**	13,8 ± 1,3 **b**	13 ± 2,5 **b**	16,4 ± 3,4 **a**
CIntensity (1mm)	1,38 ± 0,20 **b**	1,43 ± 0,34 **b**	1,89 ± 0,24 **a**	2,18 ± 0,3 **b**	2,41 ± 0,32 **a**	2,39 ± 0,24 **ab**
Tonality	0,47 ± 0,06 **a**	0,45 ± 0,07 **a**	0,43 ± 0,02 **a**	0,22 ± 0,02 **a**	0,23 ± 0,03 **a**	0,22 ± 0,02 **a**
% Yellow	29,4 ± 2,6 **a**	28,7 ± 2,95 **a**	28,3 ± 1 **a**	17,7 ± 0,9 **a**	17,6 ± 1,67 **a**	17,6 ± 1,1 **a**
% Red	63,1 ± 3,3 **a**	64,9 ± 4,2 **a**	65,5 ± 1,2 **a**	79,7 ± 2,2 **a**	76,4 ± 4,2 **b**	78,8 ± 3,5 **ab**
% Blue	7,5 ± 1,87 **a**	5,9 ± 1,14 **b**	6,2 ± 0,6 **b**	2,6 ± 1,56 **b**	4,8 ± 1,81 **a**	3,6 ± 2,5 **ab**

The similitude among grapes of the three studied units will be also clearly observed in the figure 3, which showed the global data summarized on the graphical representation of the average data of grapes from each HSU studied. The general composition profiles showed in this figure were very similar, that means that, in general, grapes showed similar oenological characteristics independent of the soil units in which they were cultivated.

CONCLUSIONS

These results seem to validate the proposed methodology. That is to say, the methodology is valid to determine HSU which can produce grapes of the similar quality, and then it can be applied to the correct or appropriate use of the agriculture medium.

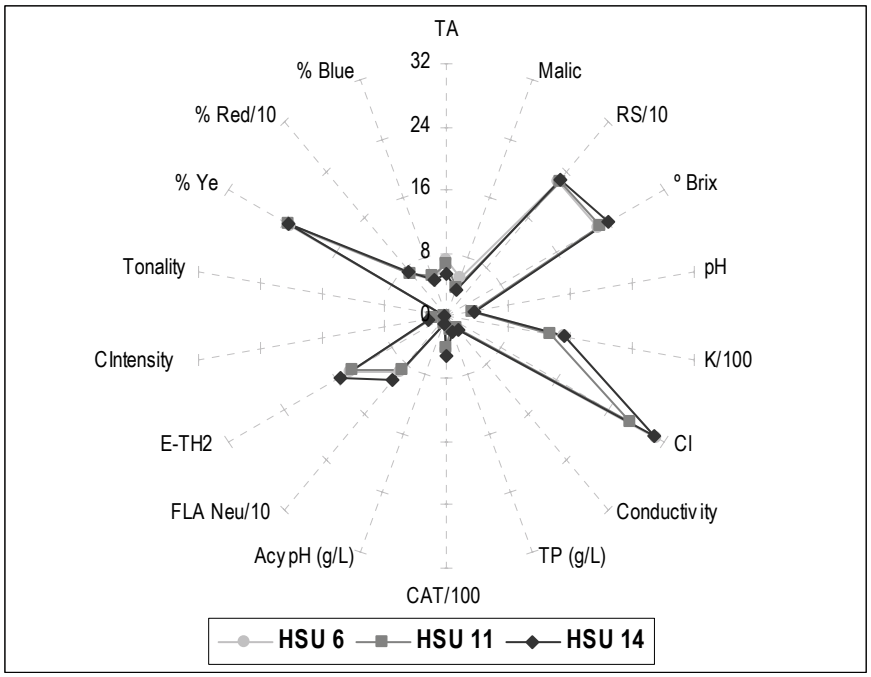

Figure 3. Global oenological characteristic profile of the grapes of each studied HSU. Points showed mean values of grapes by units independent on vineyard and vintage. n= 27, 24 and 21 to HSU 6, 11 and 14, respectively. .

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BIBLIOGRAPHY

García-Barceló J. 1990. Técnicas analíticas para vinos. GAB Ed, Barcelona, Spain.

Gómez-Miguel V. and Sotés V. 2003**.** Zonificación del "terroir" en España**. In: "***Terroir, Zonazione, Viticoltura: trattato internazionale*". Ed. Fregoni M., Schuster D. and Paoletti A. Phytoline, Rivoli Veronese, Italy. pp 187-226

González-Sanjosé M.L., Barrón L.J.R., Junquera B., Robredo L.M. 1991. Application of principal component analysis to ripening indices for wine grapes. *Journal of Food Composition and Analysis*, 4, 245-255.

González-Sanjosé M.L., Rivero M.D., Bleoju M. and Gómez- Miguel, V. 2008. In: *VIIe Congrès International des Terroirs Viticoles 2008 Acta*. ACW Ed. Nyon, Suisse. Vol.2, 641-7.

Izcara E. and González-Sanjosé M.L. 2001. Análisis de métodos rápidos de extracción para seguir la maduración fenólica de la uva. *Enólogos*, 14, 14-18.

OIV. 1990. Recueil des Méthodes Internationales d'Analyse des vins et des moûts. *Office International de la Vigne et du Vin*, París.

Mazza G., Fukumoto L., Delaquis P., Girard B. and Ewert B. 1999. Anthocyanins, phenolics and color of Cabernet Franc, Merlot, and Pinot Noir wines from British Columbia. *Journal of Agriculture and Food Chemistry*, 47, 4009-4017.

Sotés V. and Gómez-Miguel V. 1992. Delimitación de zonas vitícolas en la Denominación de Origen Ribera de Duero. *Informes Técnicos ETSIA*. UPM, Madrid, Spain.