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Comparison of aromatic composition of an endangered variety ('Albilla Dorada') with other recognized aromatic varieties

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Summary

'Albilla Dorada' is a local and endangered grape variety. It was correctly identified beforehand by analysing six microsatellite regions recommended by the GENRES 081 project plus six other additional regions, resulting in one new genotype not described for any variety according to the literature consulted. The object of this paper is to characterize the aromatic composition of this grape vine genotype not previously described. The minority volatile compounds in the grapes were analysed by gas chromatography-mass spectroscopy (GC-MS) and compared with those of eight known aromatic cultivars: 'Albillo Real', 'Macabeo', 'Malvasía Aromática', 'Gewürztraminer', 'Viognier', 'Malvasía Riojana', 'Riesling' and 'Moscatel de Grano Menudo'. Statistically significant differences between varieties were found as regards the different fractions making up the aromatic composition. 'Albilla Dorada' differed from the rest in that it had higher proportions of alcohols, benzene alcohols and norisoprenoids. In the case of the terpene fraction, it was the variety with the highest proportions of citronellol and terpene hydroxides. Results of this work point out 'Albilla Dorada' is a variety with a singular aromatic identity and highlight the necessity of recovering it before its total disappearance.

Key words: 'Albilla Dorada', genotype, grapes, volatile compounds.

Introduction

The designation 'Albillo' or 'Albilla' (*Vitis vinifera* L.) is a generic term which includes a large group of minority white grape varieties grown in Spain under the same name. One of these is 'Albilla Dorada'. Recent studies have shown that this cultivar has a different genotype from all other previously-described 'Albillos' (Fernández-González *et al.* 2007).

'Albilla Dorada' is a local and endangered grape variety. It has been grown in the central Iberian Peninsula for many years and is in fact located exclusively in the municipal territory of Villamalea (La Mancha region). Its grapes are small and thin-skinned and acquire orange-pink tints upon ripening, which occurs in mid-August. The varietal aroma is distinctive in every variety and is what contributes most to a wine's personality ('Moscatel', 'Chardonnay', 'Sauvignon Blanc', 'Riesling' …). This is due essentially to the minority volatile compounds from the grape.

The object of this study is to determine the aromatic composition of 'Albilla Dorada' and see in what way it differs from that of other internationally-known aromatic varieties.

Material and Methods

Plant material: This study was carried out in 2010. All grapes came from the same multivarietal vineyard, located in Tomelloso (La Mancha region-Spain). The following varieties were analysed: 'Albilla Dorada', 'Albillo Real', 'Macabeo', 'Malvasía Aromática', 'Gewürztraminer', 'Viognier', 'Malvasía Riojana', 'Riesling' and 'Moscatel de Grano Menudo' (or 'Muscat of Frontignan'). Varietal identity of the cultivars was established by analysing the twelve microsatellite regions: VVS2, VVMD5, VVMD7, VVMD27, VrZAG62, VrZAG79, VrZAG64, VrZAG67, VrZAG83, VVMD21, VVMD28 and VVMD36.

Sample preparation and GC-MS analysis: The GC-MS analytical method used was published by García *et al.* (2003) and Romero *et al.* (2006). Samples were analysed in a TraceGCUltra gas chromatograph coupled to a DSQ mass spectrometer with an electron impact ionization source and a quadrupole analyser. For data processing, the minority volatile compounds were grouped into families by their chemical structure. To determine the concentrations of the minority volatile compounds, three samples of grapes of each variety were taken and processed separately.

Results and Discussion

The genetic analysis showed 9 different profiles, eight of which belonged to known varieties. The genetic profile corresponding to 'Albilla Dorada' did not match the one proposed for any cultivar according to the data bases and literature consulted (Fernández-González *et al.* 2007, Santana *et al.* 2008).

Forty-six compounds were identified in the grapes: 8 C6 compounds, 4 linear alcohols, 18 terpene compounds (subdivided in terpenes, terpene oxides and terpene hy-

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droxides), 4 norisoprenoids, 7 phenols, 3 benzene aldehydes and alcohols and 2 furanones. There were enormous inter-variety differences in concentration. The total concentration of minority volatile compounds ranged from 14.61 mg·kg^{-1} in the 'Moscatel de Grano Menudo' variety to 2.58 mg·kg^{-1} in 'Albilla Dorada'.

As was to be expected, the 'Moscatel de Grano Menudo' grapes contained the highest concentrations in all fractions, except for C6 compounds, citronellol and geraniol and phenols, where concentrations were higher in 'Albilla Real', 'Gewürztraminer' and 'Riesling', respectively. There was little variability between varieties in the concentration of some groups of compounds, such as norisoprenoids (7-45 µg·kg^{-1}), linear alcohols (36-100 µg·kg^{-1}), benzene alcohols and aldehydes (40-300 µg·kg^{-1}) and C6 compounds (2-10 mg·kg^{-1}). In the terpene group, however, the range was much larger (e.g. linalol ranged from 0.18 to 1,600 µg·kg^{-1}).

Concentrations were expressed in percentages to compare varieties. The procedure using percentage data to compare varieties has been used very successfully in the study and characterization of the phenolic and anthocyanine composition of different varieties of red grape (Mattivi *et al.* 2006, Rodríguez *et al.* 2006).

The Table shows the average value and the standard deviation of the percentages of different groups of compounds and significant differences between varieties. The dominant fraction of the varietal aroma in all cultivars was that of the C6 compounds, comprising aldehydes and alcohols with 6 carbon atoms. This fraction accounted for over 90 % of the total varietal aroma in most of the varieties considered, except for 'Moscatel de Grano Menudo' and 'Gewürztraminer', where the fraction of terpene compounds accounted for a relatively high proportion. In 'Albilla Dorada' also, this fraction was less than 90 % owing to the high proportion of benzene alcohols that the grapes contain.

The principal constituent fraction of the varietal aroma in the 'Albilla Dorada' variety was C6 aldehydes and alcohols, the volatile compounds present in grapes in the highest concentrations (Gómez *et al.* 1995). The grapes of this variety differ from the rest in that they contain a high percentage of benzene alcohols and aldehydes (Benzyl alcohol, 2-Phenylethanol and Phenylacetaldehyde).

Unlike the rest, 'Albilla Dorada' samples also exhibited high percentages of alcohols and norisoprenoid compounds. The norisoprenoid and furanone fractions were less than 1 % in all varieties.

In the case of the fraction of terpene compounds, the grapes of 'Albilla Dorada' differ from the rest in that they contain a high proportion of citronellol and terpene hydroxides.

Principal component analysis (PCA) of the different fractions comprising the varietal aroma identified two principal components accounting for 34.3 % and 32 % of variance. Loadings for principal component 1 (CP1) were 0.941 for norisoprenoids, 0.831 for alcohols and 0.800 for benzene alcohols and aldehydes, and for principal component 2 (CP2) the loadings were -0.975 for C6 compounds and 0.960 for terpene compounds. The Figure shows a pro-

Table

Average percentages of the different varietal aroma constituent fractions in grapes from different varieties of vine. Letters indicate homogeneous groups in the columns according to Duncan's test with a level of significance P=0.01) (ns: not significant) ADO: 'Albilla Dorada'; ARE: 'Albillo Real'; MAC: 'Macabeo'; MVA: 'Malvasía Aromática'; MGM: 'Moscatel de Grano Menudo'; RIE: 'Riesling'; MVR: 'Malvasía Riojana'; GEW: 'Gewurztraminer'; VIO: 'Viognier'

Fraction (%)	ADO mean ± sd	ARE mean ± sd	MAC mean ± sd	MVA mean ± sd	MGM mean ± sd	RIE mean ± sd	MVR mean ± sd	GEW mean ± sd	VIO mean ± sd
C6 Compounds	83.34^{bc}±0.67	95.53^{d}±0.49	92.40^{cd}±2.48	93.71^{cd}±1.59	57.72^{a}±11.78	90.02^{cd}±0.18	91.60^{cd}±1.28	75.28^{b}±3.70	95.12^{d}±1.18
L. Alcohols	3.13^{ef}±0.15	0.72^{ab}±0.04	1.48^{bc}±0.49	1.00^{ab}±0.47	0.69^{a}±0.03	0.73^{ab}±0.30	1.85^{c}±0.40	1.15^{abc}±0.22	0.46^{a}±0.17
B. Ald and Alc.	7.59^{e}±0.36	2.36^{b}±0.26	2.58^{b}±0.55	0.49^{a}±0.11	2.23^{b}±0.69	1.94^{b}±0.26	2.50^{b}±0.36	2.11^{b}±0.18	1.70^{b}±0.31
Phenols	2.04±0.14	0.80±0.16	2.68±0.98	0.32±0.11	0.43±0.11	2.11±0.42	2.95±1.30	0.99±0.47	0.22±0.06
Norisoprenoids	0.90^{e}±0.04	0.21^{ab}±0.01	0.45^{b}±0.26	0.32^{ab}±0.14	0.30^{ab}±0.03	0.53^{b}±0.02	0.55^{b}±0.25	0.26^{ab}±0.10	0.08^{a}±0.01
Furanones	0.09±0.01	0.07±0.03	0.09±0.03	0.05±0.01	0.12±0.03	0.06±0.01	0.13±0.06	0.13±0.05	0.03±0.01
Terpene Comp.	2.92^{a}±0.29	0.31^{a}±0.05	0.32^{a}±0.18	4.12^{a}±0.88	38.55^{c}±11.01	4.62^{a}±0.38	0.43^{a}±0.22	20.08^{b}±4.44	2.40^{a}±0.72
Terpenes	22.96^{a}±2.31	71.34^{cd}±1.86	63.29^{bc}±8.64	90.49^{ef}±1.13	78.48^{de}±1.40	89.46^{ef}±0.44	69.44^{cd}±9.87	93.99^{f}±1.45	55.17^{b}±3.92
T. Oxides	1.55^{a}±0.20	9.96^{ab}±2.69	18.63^{b}±9.37	7.10^{ab}±0.44	12.15^{ab}±2.44	6.99^{ab}±1.03	13.12^{ab}±3.74	0.71^{a}±0.28	39.20^{c}±5.03
T. Hydroxides	75.49^{d}±2.49	18.69^{c}±2.34	18.08^{c}±3.30	2.41^{a}±0.89	9.36^{b}±1.95	3.56^{ab}±0.58	17.44^{c}±4.68	5.30^{ab}±1.07	5.62^{ab}±1.30
Linalool	1.13^{a}±0.39	3.73^{a}±0.89	6.47^{ab}±1.37	47.32^{d}±7.51	74.04^{e}±2.62	15.48^{c}±2.32	6.22^{ab}±2.74	1.33^{a}±0.31	14.51^{bc}±3.57
α-Terpineol	2.44^{ab}±0.14	5.95^{abc}±1.77	16.95^{d}±5.58	14.92^{cd}±3.64	1.02^{a}±0.03	4.94^{ab}±0.55	11.39^{bcd}±3.46	0.12^{a}±0.04	2.78^{ab}±0.60
Citronellol	14.96^{c}±1.65	6.06^{ab}±2.66	11.01^{bc}±2.48	6.32^{ab}±1.62	0.66^{a}±0.05	1.74^{a}±0.72	10.91^{bc}±2.35	2.33^{a}±0.56	2.08^{a}±0.32
Nerol	7.80^{abc}±1.42	9.46^{abc}±3.66	11.27^{c}±2.90	4.20^{ab}±1.24	7.02^{abc}±0.89	3.57^{a}±0.84	9.62^{abc}±2.78	10.20^{bc}±1.38	3.51^{a}±0.68
Geraniol	73.66^{cd}±3.40	74.79^{cd}±7.42	54.29^{b}±6.73	27.25^{a}±2.29	17.25^{a}±2.77	74.26^{bc}±3.45	61.85^{bc}±8.74	86.02^{d}±1.92	77.12^{cd}±6.56

Abbreviations: L. Alcohols: linear alcohols; T. Oxides: terpene oxides; T. Hydroxides: terpene hydroxides; B. Ald and Alc: benzene aldehydes and alcohols.

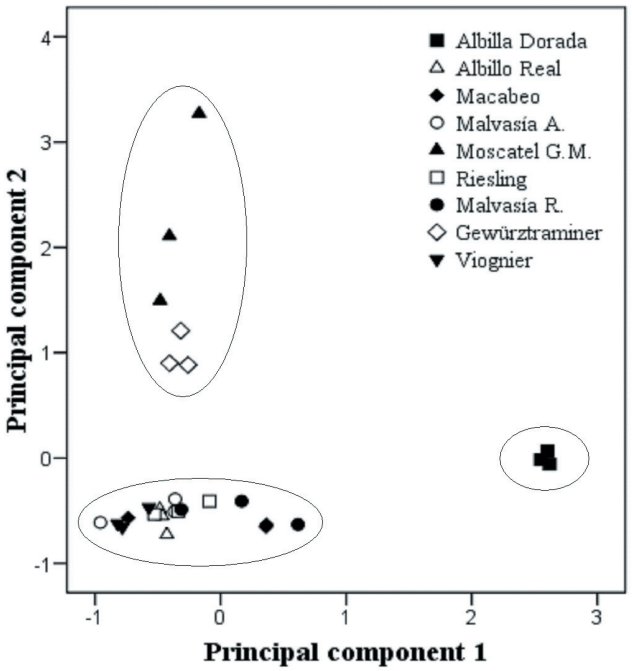

Figure: Projection of analysed samples onto the plane defined by the first two principal components of the percentages of the different volatile fractions.

jection of the samples analysed on to the plane defined by the two cited principal components. It was found that the sample distribution formed 3 groups based on the different percentages of the varietal aroma fractions.

A first group included the 'Moscatel de Grano Menudo' and 'Gewürztraminer' samples. These varieties are characterized first and foremost by a high percentage of terpene compounds and a smaller percentage of C6 compounds than the rest, giving CP2 values greater than zero. The second group, with negative CP2 values and CP1 values between -1 and 1, comprised the 'Albillo Real', 'Macabeo', 'Malvasía Aromática', 'Riesling', 'Malvasía Riojana' and 'Viognier' samples. The last group, consisting solely of 'Albilla Dorada', is substantially different from the others. All values of CP2 are close to 0, and because of the high percentage of norisoprenoids, alcohols and benzene aldehydes and alcohols in this variety, it presents CP1 values of between 2 and 3.

If we take only the terpene fraction, we find that as regards the monoterpenes in the grapes, the 'Albilla Dorada' variety (Table) contained a high percentage of citronellol (14.96 %) and a low percentage of Linalool (1.13 %). The highest proportion of complex forms was found in the form of hydroxides (75.49 %) which were considerably more abundant than in the other varieties.

Passport data on this cultivar can be found under "variety number vivc23429" in the Vitis International Variety Catalogue (http://www.vivc.de).

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