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Influence of the yeast autolysates addition on the volatile compounds of sparkling white wines

Silvia Pérez-Magariño[1], Marta Bueno-Herrera[1], Carlos González-Huerta[1], Pedro López de la Cuesta[1], Leticia Martínez-Lapuente[2], Zenaida Guadalupe[2], and Belén Ayestarán[2]

[1]Instituto Tecnológico Agrario de Castilla y León (ITACyL), Consejería de Agricultura y Ganadería, Ctra. Burgos Km. 119, 47071 Valladolid, Spain
[2]Instituto de Ciencias de la Vid y del Vino (Universidad de la Rioja, Gobierno de La Rioja y CSIC), Madre de Dios 51, 26006 Logroño, Spain

Abstract. During sparkling wine aging, different compounds such as polysaccharides can be released due to yeast autolysis that can cause important changes in wine composition. Yeast autolysis is a slow natural process that takes long time, and the addition of some products could improve the quality of these wines. The aim of this work was to study the effect of the addition of several commercial yeast autolysates on the volatile composition of white sparkling wines (*Godello* and *Verdejo*), and aged on lees for 9 months. The discriminant analyses indicated that the sparkling wines treated with PCP2 showed the highest differences in the volatile composition of both sparkling wines studied, being the ethyl esters, terpenes, decanoic acid and some alcohols, the compounds that were affected in a greater extent. This fact could be due to PCP2 presenting the highest mannoprotein percentage that can interact with volatile compounds, modulating their volatility and perception.

1. Introduction

Natural sparkling wines are obtained after a second fermentation in closed bottles, and they remain in contact with the yeast lees for at least 9 months (EC Regulation N°606/2009). During sparkling wine aging, different compounds such as mannoproteins and polysaccharides can be released due to yeast autolysis. These compounds can interact with phenolic compounds and/or volatile compounds [1–4] and can cause important changes in wine composition, affecting the quality of sparkling wines [5].

The changes in the volatile compounds could have a great effect on the final quality of these wines [6,7]. During this process, different volatile compounds can be released, formed or degraded [8,9], modifying the aroma profile of sparkling wines. In addition, some volatile compounds can be adsorbed on the yeast lees, reducing their concentration in sparkling aged wines, mainly the most hydrophobic ones [10,11].

However, yeast autolysis is a slow natural process that takes long time, and large periods of time are necessary for the release of mannoproteins and polysaccharides. Therefore, many suppliers of enological products offer several preparations rich in mannoproteins and polysaccharides obtained from *Saccharomyces cerevisiae* cell walls by different ways. Besides, in the last years, some products have been developed more specifically to sparkling wines in order to improve the quality characteristics of these wines.

2. Objectives

The aim of this work was to study the effect of the addition of several commercial yeast autolysated on the volatile composition of white sparkling wines elaborated from two white grape varieties (*Godello* and *Verdejo*), and aged on lees for 9 months.

3. Materials and methods

3.1. Sparkling wine elaboration

The base wines were elaborated following the traditional white winemaking process in stainless steel tanks. The studied varieties were: *Verdejo* from the Rueda Designation of Origin (DO), and *Godello* from the Bierzo DO.

The sparkling wines were elaborated following the traditional or "champenoise" method. In the tirage phase, tirage liquor and the different polysaccharide commercial product in the doses indicated in Table 1 was added. The doses applied were the maximum indicated by the supplier. After that, the bottles were kept in a cellar at temperature and relative humidity controlled for 9 months.

All wine production was carried out in the experimental winery of the Enological Station (ITACyL) sited in Rueda (Valladolid).

Wines were analysed after 3, 6 and 9 months of aging on lees, and before the analyses, the wines were riddled and disgorged. Brut Nature sparkling wines were obtained,

Table 1. Characteristics of the different polysaccharide products (PCP) used given by the commercial supplier and the doses applied.

Products	Doses (g/L)	Characteristics
PCP-1	0.30	Product with autolysated yeast enriched in polysaccharides
PCP-2	0.30	Cell wall autolysated yeast enriched in polysaccharides and with 20–22% of soluble mannoproteins
PCP-3	0.15	Inactivate yeast with high content in parietal polysaccharides
PCP-4	0.15	Product with polysaccharides from the yeast cell walls, highly purified and with high content in free mannoproteins

Table 2. Polysaccharide composition of the commercial products (PCP).

Products	Percentage of mannoproteins	Percentage of glucans
PCP-1	52.9	47.1
PCP-2	85.9	14.1
PCP-3	77.1	22.9
PCP-4	62.3	37.7

i.e. no expedition liqueur was added. Three bottles of each experience at each sampling time were analysed.

3.2. Analysis of volatile compounds

The volatile compounds were extracted by liquid-liquid extraction following the method developed by Rodríguez-Bencomo et al. [12]. The chromatographic analyses were performed with a HP-6890N GC coupled to a HP-5973 inert MS detector equipped with a Quadrex 007CWBTR capillary column, following the chromatographic conditions established by Rodríguez-Bencomo et al. [12].

3.3. Analysis of polysaccharide composition of commercial products

In order to characterize the different polysaccharide commercial products, the polysaccharide and monosaccharide composition of the commercial preparations was determined by gas chromatography coupled to a mass detector of their trimethylsilyl-ester-O-methyl glycosyl residues obtained after acidic methanolysis and derivatization [13].

The content of mannoproteins was estimated by the mannose concentrations and glucans by the concentrations of glucose.

3.4. Statistical analysis

The statistical analysis of the data was carried out by stepwise discriminant analysis, using the Statgraphics statistical package. The forward method was used to determine the variables most useful for differentiating the wines by treatment. The F-statistical function was used as the criterion for variable selection.

4. Results and discussion

The results of the polysaccharide composition of the commercial products are shown in Table 2. The percentage

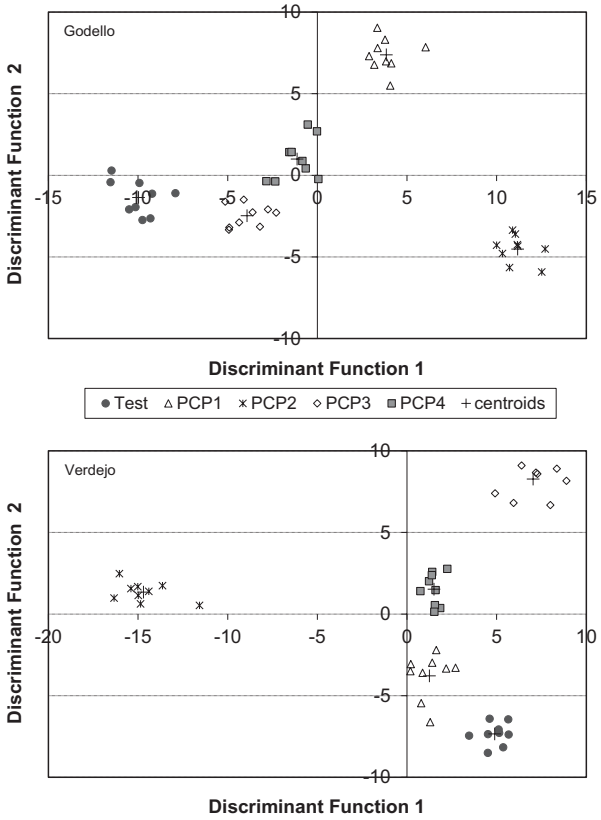

Figure 1. Distribution of *Godello* and *Verdejo* wines in the plane defined by the first two discriminant functions of the model obtained with all the variables. Test: control wines; PCP: wines treated with polysaccharide commercial products.

of mannoproteins of the different commercial products, estimated by the mannose concentrations, was between 53–83%. The percentage of glucans, estimated by the concentrations of glucose, was between 14–47%. Therefore these results indicate that these products presented in general higher amounts of mannoproteins than of glucans. PCP2 was the product with the highest percentage of mannoproteins.

Discriminant analysis is a supervised classification technique that was applied to determine the volatile compounds most useful for differentiating the wines according to the treatment. Thirty volatile compounds are included in the discriminant analysis: ethyl esters, alcohols, alcohol acetates, acids, terpenes, lactones and volatile phenols.

Figure 1 shows the distribution of the *Godello* and *Verdejo* sparkling wines in the plane defined by the first two discriminant functions with all the variables,

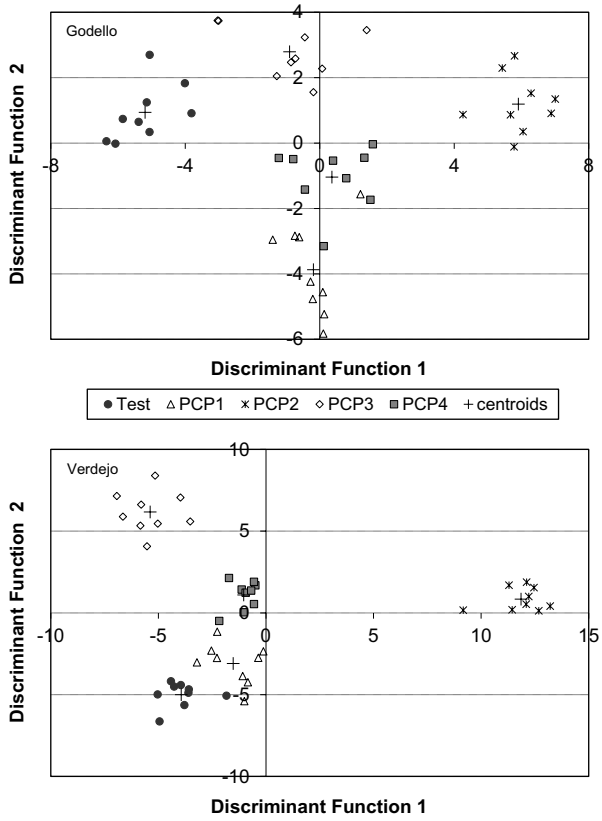

Figure 2. Distribution of *Godello* and *Verdejo* wines in the plane defined by the first two discriminant functions of the stepwise model. Test: control wines; PCP: wines treated with polysaccharide commercial products.

which explained the 80.8% and 94.1% of the total variance, respectively. The wines treated with the different commercial products were well separated, and taking into account that the distance between centroids is proportional to the similarity between groups, the wines treated with PCP2 were the most different, in both type of wines. This fact could be due to PCP2 presented the highest percentage of mannoproteins that can interact with volatile compounds, modulating their volatility and perception [3, 14].

Stepwise discriminant analyses were carried out to determine the volatile compounds most useful for differentiating the wines by treatment. The final model selected 20 and 16 volatile compounds for *Godello* and *Verdejo* sparkling wines, respectively. The variables with the greatest discriminating power were decanoic acid, ethyl hexanoate, ethyl decanoate, citronellol, nonalactone and ethyl butyrate for *Godello* sparkling wines, and ethyl butyrate, decanoic acid, methyl vanillate, terpineol, acetovanillone and isoamyl alcohols for *Verdejo* wines. The differences of the *Godello* and *Verdejo* sparkling wines observed with these models (Fig. 2) were similar than those obtained with the discriminant models carried out with all the variables (Fig. 1).

Although the selected variables were not the same for both models, in general the main variables responsible for the observed distribution of wines were ethyl esters, terpenes, decanoic acid and some alcohols.

All the models were satisfactory with a global classification of 100% of the wines.

In conclusion, the addition of some commercial products rich in mannoproteins in the tirage phase for sparkling wine elaboration can modify the volatile profile of the wines. However, it will be necessary to carry out more studies and analyse other compounds in order to determine the advantages and/or disadvantages to the use of this type of products.

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