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Different commercial yeast strains affecting the volatile and sensory profile of cava base wine

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Abstract

36 semi-industrial fermentations were carried out with 6 different yeast strains in order to assess differences in the wines' chemical and volatile profile. Two of the tested strains (Y3 and Y6) showed the fastest fermentation rates throughout 3 harvests and on 2 grape varieties. The wines fermented by three of the tested strains (Y5, Y3 and Y4) stand out for their high amounts of esters and possessed the highest fruity character. Wines from strains producing low amounts of esters and high concentrations of medium chain fatty acids, higher alcohols and six-carbon alcohols were the least appreciated at the sensory analysis. The data obtained in the present study show how the yeast strain quantitatively affects the final chemical and volatile composition of cava base wines and have repercussions on their sensory profile, independently of must variety and harvest year.

Keywords: Yeast; Sparkling wine; Base wine; Volatile; Profile; Sensory properties

1. Introduction

Cava (Certified Brand of Origin) is a natural sparkling wine elaborated by the Champenoise or Traditional method in which a base wine is refermented in a sealed bottle (EC Regulation 1493/1999). The method consists in two stages: the preparation of the base wine, and the settling of the sparkle. Therefore, the base wine stage could be considered as a decisive point for obtaining the best quality sparkling wines.

In the main, the sensorial quality of any wine is based on its colour and flavour. The flavour characteristics, especially in white wine, are the result of complex interactions among three factors: grape variety, yeast strain and technical conditions of wine-making (Lilly et al., 2000; Ubeda et al., 2000). Also, the effect of yeast strain on volatile compounds differs according to the original grape must, as the same yeast strain could produce different results (Romano et al., 2003). Although a number of flavour components are found in the original grape, the dominant and major compounds contributing to white wine aroma are formed during yeast fermentation (Patel and Shibamoto, 2003; Estévez et al., 2004) and are mainly higher alcohols, fatty acids, acetates, ethyl esters, ketones and aldehydes (Lilly et al., 2000; Vianna and Ebeler, 2001; Mingorance-Cazorla et al., 2003; Estévez et al., 2004).

The capacity to form aroma depends not only on yeast species but also on the particular strain of the individual species (Antonelli et al., 1999; Patel and Shibamoto 2002; Patel and Shibamoto, 2003; Romano et al., 2003). Modern wine makers prefer to employ selected yeast strain for certain advantageous and particular characteristics so as to ensure a reproducible product, reduce the risk of wine spoilage and allow a more predictable control of fermentation and quality (Romano et al.,

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2003). For the production of young white wine, the wineries select the yeast strains that are high producers of esters and acetates responsible for the desirable fruity taste and low producers of higher alcohols that contribute negatively to white wine aroma (Pérez-Coello et al., 1999; Ubeda Iranzo et al., 2000; Mingorance-Cazorla et al., 2003). Moreover, it's important to use a negative Phenolic Off-Flavour (POF) yeast, that is, one that does not produce volatile phenols, which, when found in high quantities, negatively affect wine by giving it unpleasant olfactory connotations reminiscent of paint, or of horsy, medicinal, or spicy odours (Estévez et al., 2004; Chassagne, et al., 2005).

Various *Saccharomyces cerevisiae* yeast strains have usually been used in white wine manufacture (Antonelli et al., 1999; Ubeda Iranzo et al., 2000; Patel and Shibamoto, 2003). It's important to know the potential differences in volatile production by various yeast strains in order to select the best one to produce the wine desired. There is extensive literature about the use of different yeast strains, but little of this research assesses other influencing factors, such as grape variety and harvest. Therefore, the aim of the present study is to compare the volatile profile obtained with six different yeast strains applied to two different varieties of the same must for three consecutive harvests, in order to evaluate at semi-industrial scale which strain yields the cava base wine with volatile optimum characteristics. For this reason, the commercial yeast strains selected were among the most often employed for the first fermentation in white sparkling wines obtained by the traditional method.

2. Material and methods

2.1. Yeast strains

Six different strains of *S. cerevisiae* were tested; five commercial strains were compared with the Y4 strain belonging to the collection of the winery that produces cava sparkling wine (Freixenet, S.A.). The commercial yeasts were: Maurivin Awri 796 (Y1) (Biostar, AB Mauri Ltd., North Ryde, Australia), Enoferm QA 23 (Y2) (Lallemand-Agrovin SAS, Blagnac, France), Fermol Arome Plus Nature (Y3) (Pascal Biotech-AEB Group, Brescia, Italia), Anchor Stellevin NT 116 (Y5) (DSM-Laffort, Heerlen, Netherlands) and Vitilevure 58W3 (Y6) (ALSAFLOR) (Martin Vialatte-Cavatap, Epernay, France). The yeast strains were selected on the basis of commercial suppliers' recommendations. They were recommended for white wines, for increasing the floral and fruity notes of the grape varieties, and for having high resistance to the percentage of alcohol and sulphur dioxide.

2.2. Grape musts

All the autochthonous *Vitis vinifera* varieties of the cava region (Spain) used were traditional white varieties to elaborate cava: each year of the study, six vinifications were realized with Macabeo while the other six were realized with Xarel•lo and Parellada (1:1).

Physical and chemical must parameters within the three harvest years are the following: Macabeo: density 1.062–1.0721, total acidity 3.53–4.25 g/l, pH 3.23–3.27, free SO_2 14–34 mg/l, total SO_2 70–93 mg/l; Xarel•lo-Parellada: density 1.066–1.0753, total acidity 3.12–4.14 g/l, pH 3.09–3.37, free SO_2 16–32 mg/l, total SO_2 55–79 mg/l.

2.3. Semi-industrial scale fermentation

Each of the six yeast strains tested was inoculated in aliquots of 1000 l of must from both Macabeo and Xarel•lo-Parellada grapes. These semi-industrial vinifications were carried out by the same winery through three successive harvest years (2003–2005), for a total of thirty-six vinifications.

Active dried yeasts were prepared according to the specifications of producers, rehydrating 200 g of dried yeast in warm water (38 °C) and 150 ml of base wine with a sucrose concentration of 600 g/l, in order to obtain a final sucrose concentration of 50 g/l. After 15 min, the yeast was diluted into a small aliquot of must and subsequently inoculated in 1000 l of must and incubated at 26 °C.

For the strain belonging to the winery's collection (Y4), a pure culture previously sown in a solid medium was inoculated in a small volume of sterilized must to a final concentration of 10^6 cell/ml, and cultured at 26 °C during 24 h. The starter was progressively diluted with sterilized must to obtain a volume of 5 l and a cellular multiplication sufficient for the first sowing in the winery tank (10^7 cell/ml), where the cellular and volume multiplication was then continued.

In each vinification, the initial yeast populations were similar for the six strains tested. Prior to the cellular multiplication at industrial scale, a control of the yeast strains' mitochondrial and nuclear DNA were performed and compared with a control carried out before inoculating the starters.

Subsequently, 0.6–0.8 g/L of Microcel were added, and amounts of diammonium phosphate between 140 and 180 mg/l were added to the musts of the three harvest years in order to reach EAN (easy assimilable nitrogen) values in musts between 130 and 150 mg/l.

The density, the total acidity, the pH, the NH_4, the SH_2 and the temperature (14 to 16 °C) were the parameters used to control the fermentation. After the fermentation, the tartaric stabilization was performed by reducing the tank temperature to −4 °C.

2.4. Chemicals and reagents

2-octanol and 2-methylhexanoic acid were purchased at Sigma-Aldrich (St Louis, MO) with a purity higher than 98%. They were prepared in a hydro alcoholic solution (11%) and used as internal standards in the concentrations of 0.253 and 0.748 mg/L, respectively. Ethyl isobutyrate, isobutyl acetate, ethyl butyrate, isoamyl acetate, ethyl hexanoate, hexyl acetate, *cis*-3-hexenyl acetate, ethyl lactate, hexanol, *cis*-3-hexenol, ethyl octanoate, octyl acetate, benzaldehyde, ethyl nonanoate, linalool, isobutyl octanoate, isobutyric acid, butyric acid, ethyl decanoate, isoamyl octanoate, isovaleric acid, methionol,