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Winemaking processes

NEW TECHNOLOGY FOR REDUCING THE ALCOHOLIC CONTENT IN WINE

Today's wine market, especially the Anglo-Saxon, values, above all, wines of great harmony and aromatic intensity, especially in the case of red wines. However, in order to obtain both complex and harmonious wines, it is essential to have a grape with a high degree of aromatic and phenolic ripeness. Unfortunately, given the meteorological conditions that we are currently experiencing, many Spanish wine producers must aim for a certain degree of over-ripening of the grapes in order to produce the type of wines described above, which entails the disadvantage of obtaining elevated alcohol levels. It is for this reason that most high expression red wines have an actual alcoholic strength of more than 14 %. It is evident that wines with a higher alcoholic strength are more difficult to market and may present some issues and/or problems associated with their production [1].

Given these circumstances, the application of techniques designed to reduce the concentration of sugars in the must and/or of alcohol in the wine would be very useful for the wine industry. In light of this, the International Organisation of Vine and Wine (OIV) implemented its resolution OENO 10/200 which authorises the partial dealcoholisation of wines by no more than 2% alc. vol. The dealcoholisation techniques most commonly used in the market are reverse osmosis and partial vacuum evaporation using distillation columns such as the *spinning cone column*. Both procedures are effective even though they present drawbacks such as the high energy consumption associated with the working conditions required in each case [2, 3].

VITEC has spent the last two years optimising and perfecting a new dealcoholisation technology. This work forms part of the project "*Reduction of dissolved oxygen and dealcoholisation of wine using hydrophobic membranes*" within the INNPACTO 2010 programme, which is funded by the Ministry of Economy and Competitiveness. The companies Inoxpa and Freixenet are collaborating with VITEC in the development of this project.

Figure 1. Alcoholic strength reduction system.

Membrane technology, also known as osmotic distillation, is regarded as an innovative and promising process to adjust the alcohol content of wine. The dealcoholisation unit operates at room temperature and atmospheric pressure, which means that the wine does not undergo pressurisation (as in the case of reverse osmosis) or heating (as in the case of vacuum evaporation). Therefore, this would presumably be a strong candidate for a technique that causes less deterioration of the wine being treated, in addition to a lower energy consumption. The alcohol adjustment system consists of a porous and hydrophobic cylindrical membrane. The wine flows parallel to the outer side of this membrane, while water flows counter-currently through the hollow fibres of the membrane. The membrane's hydrophobic characteristics prevent the passage of water to the wine, and in addition, only substances in the gaseous phase are able to pass. The driving force that enables the transfer of alcohol from the wine phase to the water phase is the difference in concentrations between the two phases separated by the membrane. Several authors point out that, along with the alcohol, some aromatic compounds are also transferred through the membrane [4, 5].

In view of the above, one of the project's main objectives is to investigate the behaviour of the alcohol and the transfer of the aromatic fraction of wines during the alcohol removal process. For this reason, a mathematical model was developed in collaboration with the Advanced Separation Processes group of the University of Cantabria. This empirical model allows us to predict the behaviour of the alcohol and the aromatic compounds during this process with an error of less than 10%. However, it is necessary to introduce the liquid-vapour equilibrium data of various aromatic compounds representative of each grape variety into the mathematical model. The liquid-vapour equilibrium data are obtained experimentally by the determination of the partition coefficients, that is, the distribution of a compound between a liquid phase and gas phase [6]. By optimising the mathematical model it is possible to obtain the ideal working and operating conditions required to adjust the alcohol content in wine by means of this dealcoholisation technology.

The process is currently being validated on an industrial scale using grape varieties which have a tendency to produce high alcohol contents. The preliminary results of the chemical and sensory analyses of wines obtained by dealcoholisation through osmotic distillation are presented below. The wine used for these tests was a red wine from the vintage of 2011 (DOQ Priorat): 50% Grenache Noir, 30% Carignan, 10% Cabernet Sauvignon and 10% Syrah. The wines were characterized analytically and analysed using sensory methods by VITEC's panel of 10 tasters.

Table 1. Analytical characteristics of dealcoholised wines and untreated wine.

Wine	Untreated	Dealcoholised 1	Dealcoholised 2
Alcoholic strength by (% vol.)	15,5	14,5	13,5
pH	3,44	3,42	3,41
TTA (g/L)	5,38	5,40	5,40
AA (g/L)	0,74	0,74	0,73
TPI	73,7	73,7	74,5

* TTA = total tartaric acid, AA = acetic acid, TPI = total polyphenol index

The objective of this test was to obtain a wine with less alcoholic perception and an alcoholic strength by volume of 14.5%. The alcohol content was nevertheless reduced by a further degree in order to study the effect of dealcoholisation on the wine properties. Table 1 shows the pH, TTA, AA and TPI values obtained for an untreated wine and for the same wine after alcohol removal. These values show that there are no notable differences with respect to the basic properties of the wine analysed.

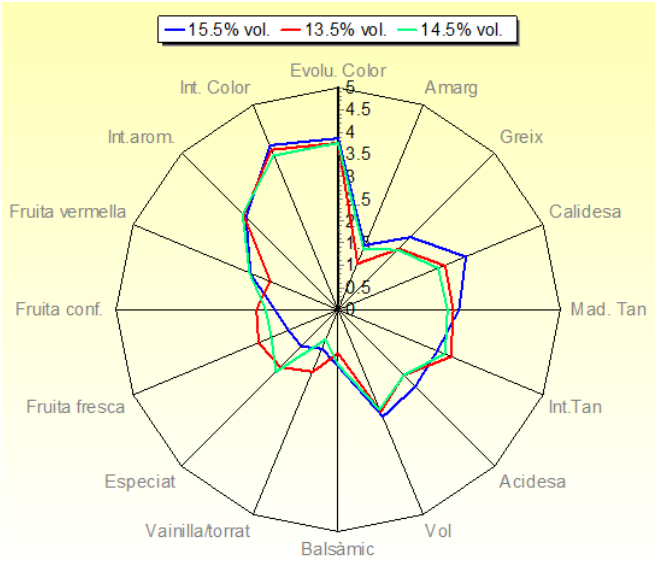

Figure 2. Sensory analysis diagram

Figure 2 shows that the wines with an alcoholic strength of 15.5% and 14.5% have a similar sensory profile. However, they differ in warmth and body, as was expected. Furthermore, the wine with an alcoholic strength by volume of 14.5% stands out in the flavour descriptors of candied fruit, fresh fruit and spicy notes compared with the 15.5% wine. In this case, the acidity decreases slightly when the alcoholic strength is reduced from 15.5% to 14.5%. With regard to the reduction of the alcoholic strength by 2 degrees, there are variations in terms of warmth, body, bitterness and acidity, although these differences are not substantial. In terms of aromas, the reduction in red fruit is compensated by the emergence of a greater intensity in fresh fruit, candied fruit, spicy and vanilla/toasty aromas. Parameters such as colour and aromatic intensity do not change after alcohol removal.

SUMMARY

Osmotic distillation can be considered an alternative technology to vacuum evaporation and reverse osmosis for the purpose of adjusting the alcohol content of red wines. VITEC is in the final stages of developing a wine dealcoholisation system based on this new technology. Further industrial tests are planned with varietal wines and blends which have high alcohol contents or produce a marked sensation of warmth during tasting.

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