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Options available to a winemaker who wants to make dry wine with lower alcohol content

INTRODUCTION

The level of alcohol in modern wines is growing every year. This is directly related to climate change, namely global warming. However, although initially an increase in alcohol gave wines a little more body, a further increase has

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led to wines beginning to lose balance and elegance due to “generous” alcohol. Not every consumer appreciates such high alcohol content, preferring lighter wines. There is now a tendency in the market for people to prefer lower-alcohol wines. Many winemakers have set themselves the goal of improving the wine’s balance. And this is especially true for dry wines, as they represent the most popular wine category on the market. Dry wine refers to wines with no sweetness and with a sugar content corresponding to a norm of 4 grams or less of sugar per litre. There are various techniques a winemaker can use to lower the level of alcohol in the finished product, resulting in a balanced wine with a lower level of ethanol – the desired result. There are four stages during which a winemaker can influence the final alcohol content in the finished product: in the vineyard (selection of terroir, selection of grape varieties, direct work with the grape vine in the vegetative period, changing the timing of the harvest), before fermentation (enzymatic effects on the carbohydrates in the must and must filtration), during fermentation (the use of special yeast strains and a combination of different yeast genera) and after fermentation (membrane filtration, fractional vacuum separation). This essay will examine the basic techniques available to a winemaker who wants to produce dry wine with lower alcohol.

Relocating vineyards to cooler climates is one way to reduce sugar accumulation in the grape berry. According to the American Association of Wine Economists (USA), the planet’s average annual temperature has risen by 1.2°C since 1850. As a result, in 2019, temperatures in those German regions producing ice wine did not fall low enough for the berries to freeze on the vine. At the same time, record temperatures were recorded in classic winemaking regions. In France, in the suburbs of Montpellier, a national

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temperature record of 46°C was set on 28 June 2019. These facts point to sugar accumulation increasing further in many wine regions. Hence, it can be concluded that viticulture should be relocated to cooler areas in order to produce wine with lower alcohol. The climate in more northerly regions can be conducive to grapes accumulating less sugar during the vegetative period, thus ultimately affecting the wine's final alcohol content. For example, 20 years ago, the UK climate was too cold for viticulture, but by 2019, the country already boasted 658 vineyards. The Taittinger winery (France) in particular has planted vineyards in the UK to produce sparkling wines. Another option is to plant on northern slopes and at higher altitude. Cultivating vines on northern slopes means that they can profit from darker, cooler conditions, which also leads to lower sugar accumulation. However, this solution necessitates planting new vineyards and requires suitable land to be available. There is also a risk of severe winter frosts and late spring frosts, which may destroy buds or even kill the vine itself.

An important factor determining a wine's final alcohol level is the ability of individual grape varieties to accumulate sugar. Varieties such as Cabernet Sauvignon, Merlot and Chardonnay can accumulate high levels of sugar, thus can produce high alcohol wines. However, it should be noted that each variety has a number of clones. For example, the French nursery Entav-Inra includes the sugar accumulation ability of each Cabernet Sauvignon clone in its description. Accordingly, if you wish to produce a wine with a lower alcohol level, you should choose a clone that is characterised by low sugar accumulation. For example, clone No. 219 produces the lowest sugar content, while clone No. 191 accumulates sugars better and is thus not suitable for this purpose.

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It is also possible to solve the problem by choosing varieties which, regardless of choice of clone, have low sugar accumulation rates, such as Colombard or Semillon. These varieties are less commonly cultivated around the world and are more likely to be found in specific regions, thus also giving the winemaker an additional opportunity to produce a unique wine. However, it is worth noting, for example, that it is impossible to produce a wine from the autochthonous variety Aramon with the organoleptic characteristics of Cabernet Sauvignon. Moreover, there are laws, such as the appellation system in France, which limit the varieties that can be planted in a particular region. Selecting grape varieties and clones which accumulate less sugar will aid the winemaker in achieving his goal.

Yield and time of harvest also play an important role in producing wines with lower alcohol. The amount of accumulated phenolic compounds in the berry also varies depending on yield per vine. Thus, the lower the vine yield and the lower the number of clusters left on the vine during “green harvest”, the higher the concentration of phenolic substances in the remaining clusters and the higher the sugar level. Obviously, the opposite, i.e. increasing the vine yield, will give the desired result – lower sugar content of grapes and, hence, alcohol in the finished wine. However, it should be noted that this will also lead to lower concentration of flavour compounds in the berry, which will affect the finished product, resulting in more dilute wine with less concentrated aromas and flavours. The accumulation of carbohydrates in the berry also depends on the leaf surface area per 1 kg of berries. Thus, the average optimal size of the leaf surface area is 0.8–1.2 m² per kg of berries, with a decrease in area to 0.8–0.5 m²/kg giving an optimal reduction in sugar content with minimal losses of flavour components. Another option is to

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harvest the grapes before phenolic maturity. So, the technique of early harvest with subsequent acidity reduction is used by “Kuban-Vino” (Russia) to produce a range of low alcohol wines. The required sugar content of the berry at harvest time is calculated based on the desired final alcohol content of the wine. This results in fairly accurate alcohol levels in the wine and does not require any further operations, other than acidity reduction. This is necessary as the grapes are not fully ripe and thus have excessively high acidity, which has a negative impact on the wine’s flavour. From the point of view of wine production, it should be noted that this is one of the easiest ways to achieve the goal of producing wines with lower alcohol.

Before fermentation, the winemaker can reduce the sugar content of the must using enzymatic and filtration processing methods. Glucose oxidase is used to enzymatically lower the sugar content in the must. The action of this enzyme results in the glucose molecule being oxidised to gluconic acid and hydrogen peroxide. Gluconic acid is colourless and odourless; flavour may also be lacking or slightly acidic. It has an antibacterial effect, which positively affects the must, while hydrogen peroxide is completely soluble in water and alcohol. Therefore, glucose oxidation products will not adversely affect the organoleptic properties of the must and wine. The enzyme’s pH range is 3.5–6.5. Thus, it is necessary to increase the pH level for some varieties with an inherent high acidity; this will then drop with the formation of gluconic acid. It should be noted that the level of titratable acidity will increase with the formation of gluconic acid, but, taking into account preliminary deoxidation, the pH value will remain at the initial level. Nanofiltration is used to remove sugar from the must. The must passes through the membrane under pressure, and filtration is carried out in

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a tangential mode due to separation into two fractions - permeate (must with a lower sugar content) and retentate (concentrated sugar). This filtration enables the sugar content of the must to be reduced by 5-15% with minimal loss of colour and aroma. Theoretically, by increasing the surface area of the filtration and reducing the filtration time, it is possible to increase the sugar content reduction of the must and avoid losses of aroma.

The use of non-classic yeast is the latest approach to solving the problem of high alcohol in wine. Special strains of the yeast Saccharomyces cerevisiae, which are dominant in the wine industry, can result in a slight decrease, of 0.2-0.7%, in the volume of alcohol in wine. However, the American Society for Microbiology (USA) has reported on the development of a technique using a combination of yeasts of different genera. This reduced the final alcohol content from 15% to 13.4% on a pilot sample of Syrah wine material. Since yeast not related to Saccharomyces cannot consume all the sugar in the must and dies at relatively low rates of alcohol, fermentation begins with non-Saccharomyces yeast - Metschnikowia pulcherrima - and is then inoculated with the Saccharomyces. This method has shown greater effectiveness in red wines than in white. Thus, for Chardonnay, the decrease in alcohol was only 0.9% and notes of acetone were observed in the aromas, while Syrah demonstrated no organoleptic deviations. Another possibility is genetically modified (GM) yeast. Research at the Australian Wine Research Institute has shown that the use of GM yeast resulted in a decrease in alcohol content from 15.7% to 12.2%. At the same time, no negative influences on flavour and aroma components were detected. Moreover, such yeast can add aromatic richness to wines. However, the use of GM yeast remains controversial, both in terms of legislation and consumer preferences.

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Ethanol can be removed from wine after fermentation using membrane filtration (reverse osmosis) and vacuum fractional separation of alcohol. The reverse osmosis method has long been used to produce non-alcoholic wines. Similar to nanofiltration, only membranes with small-pore filters are used in reverse osmosis, while the filtration power can also be selected and regulated. The minimum possible alcohol content in wine passing through reverse osmosis is 0.5% ABV. Thus, using reverse osmosis minimises the loss of aromatic compounds, since these compounds cannot penetrate the filter membrane. An additional positive factor is that reverse osmosis filtration occurs at low temperatures, so the wine is not exposed to heat. Another method is the vacuum fractional separation of alcohol from wine. Pressure of approximately 0.04 ATM is created in the apparatus; at this pressure, alcohol begins to boil at 20°C. Fractionation permits the removal of the estimated amount of alcohol from the wine, while preserving other volatile components. If aromatic compounds have evaporated with the alcohol, then separation into fractions means that those compounds that have evaporated but are not alcohol are returned to the wine, and the alcohol is separated. However, such equipment is rather expensive and beyond the means of many companies. The opinions of people who have tasted wine that has passed through reverse osmosis also differ. However, Mariona Gil (PhD in Engineering, Universidad Autónoma De Chile) notes that there is no difference in organoleptic and chemical components between the control sample of Priorat DOC wine and the test sample, except for the difference in alcohol.

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CONCLUSION

Due to global climate change, winemakers are faced with the problem of increasing alcohol levels in wine. High alcohol is not always desirable, as the wine loses balance and harmony. Work is underway to develop and improve affordable techniques. Each technique discussed in this essay, both individually and in combination, can enable you to achieve the goal of lowering the alcohol level. One main limitation for the winemaker is the budget available to implement the technology, in addition to legislative standards. Decreased alcohol levels are in demand. Alcohol levels can affect scores for wines in wine competitions, which, in turn, impacts the marketing and consumer appeal of the product. A balanced wine is more attractive and saleable. When choosing a particular methodology, the winemaker must consider a number of factors, such as climatic conditions, evaluate the pros and cons for each and decide which technology is more affordable and preferable depending on individual circumstances.

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