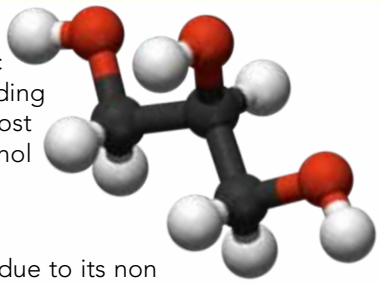
The Wine EXPERT
Practical Winemaking Information

GLYCEROL AND WINEMAKING

What is glycerol:

Glycerol ($C_3H_8O_3$) is a non-volatile compound which has no aromatic properties, but which significantly contributes to wine quality by providing sweetness and fullness (Ribereau-Gayon *et al*. 1972). It is the most import by-product of alcoholic fermentation in quantity after ethanol and carbon dioxide (CO_2).



Why is it important in wine?

Glycerol has a favorable impact on wine quality. It is non aromatic due to its non volatile nature but can contribute to the sensory properties of wine depending on the concentration. Wines lacking in body can benefit from an increased glycerol production to improve the sensory characteristics. The production of glycerol is also very important to maintain the redox potential of the yeast which is vital during fermentation.

How to influence glycerol production:

Yeast have the greatest influence on glycerol production which is influenced by many growth and environmental factors (Scanes *et al*. 1998). Several studies have described the effect of yeast strain on glycerol production (Lopez de Lerma and Peinado, 2011; Remize *et al*., 2000) and it appears to be one of the key factors impacting glycerol production.

The amount of glycerol produced varies with the type of yeast used, with sugar content and the grape variety. It has been reported to vary according to the available nitrogen source and, in particular, the nitrogen composition as it depends on the nature of the amino acids used as nitrogen source. n must with a nitrogen deficiency, it has been shown that adding complex nutrients, like those in the Fermaid range, can help increase the glycerol level from 0.5 to 1.5 g/L depending on the yeast strain (Trioli, 1996). Several studies have shown that an increase in temperature resulted in greater glycerol production (Rankine and Bridson, 1971; Ough *et al*., 1972; Gardner *et al*., 1993).

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A WORD FROM OUR EXPERT

During the fermentation of the sugars in the must, the yeast synthesizes – in addition to ethanol and CO_2 – various other by-products, of which the most abundant is glycerol. Once the glucose has entered the cell, it is converted into dihydroxyacetone.

The production of glycerol has **two important functions for yeast: to combat osmotic stress and to maintain the oxidation-reduction balance**. When the yeast is in a hyperosmotic medium, such as a very high-sugar grape must, the water quickly moves from the cell to the extracellular medium. The production of glycerol allows the yeast to balance the osmotic pressure difference between the interior and the exterior of the cell (figure 1). Glycerol synthesis leads to the oxidation of NADH into NAD+ (figure 1), which maintains the intracellular oxidation-reduction balance. The formation of the biomass and other by-products generates a surplus of NADH, which, in the absence of oxygen, cannot be reoxidized by mitochondrial respiration. What's more, as the alcoholic fermentation of glucose is in itself a neutral process from the viewpoint of oxidation-reduction, the excess NADH formed cannot be reoxidized during the formation of ethanol. Therefore, it is the synthesis of glycerol that allows the NAD(H) homeostasis Therefore, it is the synthesis of glycerol that al-

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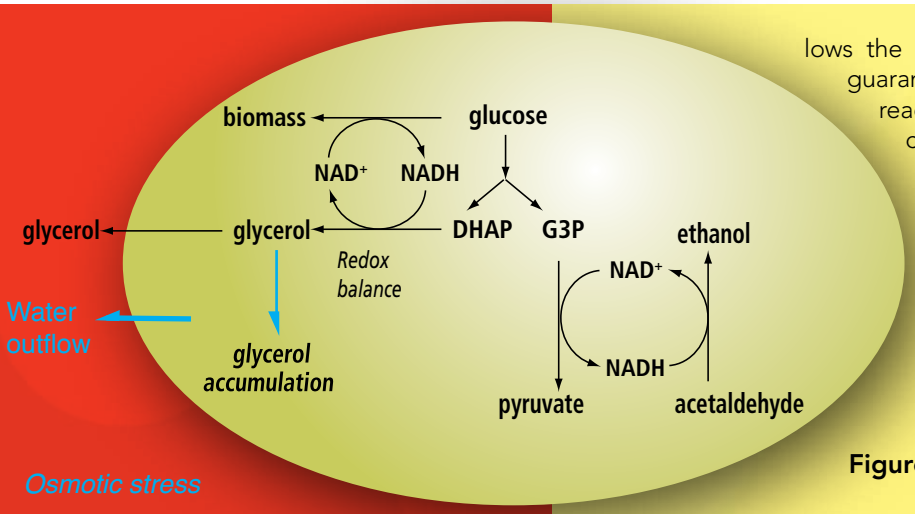


lows the NAD(H) homeostasis to be maintained, thereby guaranteeing the functioning of numerous metabolic reactions utilizing this cofactor. This role of glycerol, considered to be the "redox safety valve," is vital during fermentation. So, if we were to stop the formation of glycerol, the cell could not survive in the absence of oxygen!

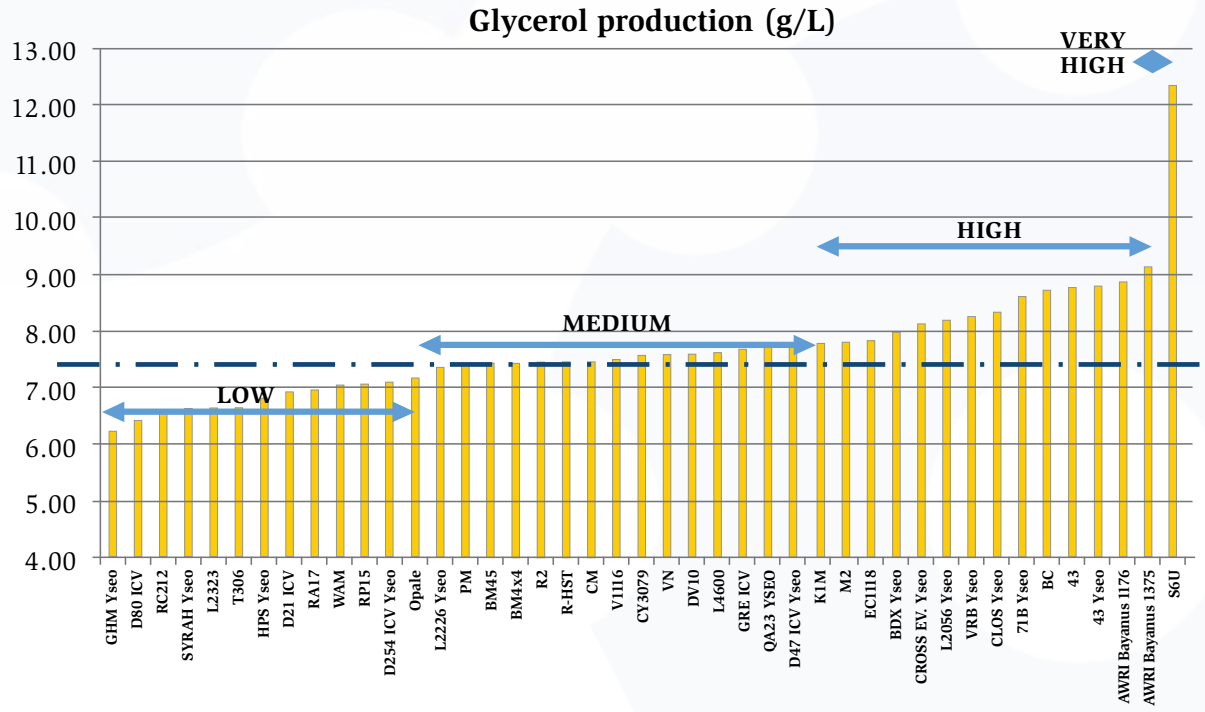
Figure 1: Synthesis of glycerol in *Saccharomyces cerevisiae*

THE RESULTS

The amount of glycerol usually formed by *Saccharomyces cerevisiae* in wine varies between 2–11 g /L but normal concentrations are in the range 4–9 g/L.

Glycerol production can be controlled by the choice of the appropriate yeast strain. We have studied the production of glycerol by wine yeast strains, under controlled laboratory conditions (synthetic must 230g/l of sugar (glucose/fructose), no nutritional deficiencies (300 mg/l of YAN) at 24°C) and mimicking winemaking conditions. The results are the following:

1. There is a wide range of different production of glycerol depending on the yeast strain. We can classify selected wine yeast into 3 categories : low, medium and high glycerol producers. At the lowest range, the yeast GHM is at 6.22 g/L and the highest, the S6U at 12.62 g/L. Most selected yeast are found to be medium producers (between 7 and 8 g/L), a few high producers such as Cross Evolution, VRB, CLOS, BC and 43 (between 8.08 and 9.6 g/L). Those with the highest production can be particularly interesting in wines which have lower mouthfeel and structure. It is important to consider the other characteristics of the wine yeast as they might not be suitable for all wines.

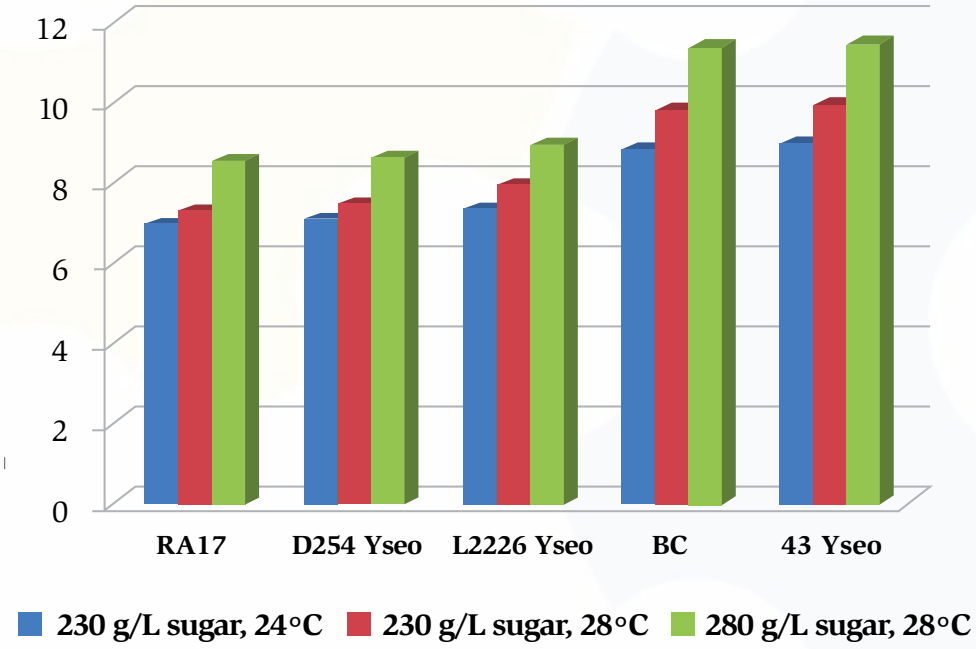


THE RESULTS (cont'd)

2. As the production of glycerol is closely linked to the availability of the fermentable sugars found in musts, it will increase as well when the concentration of sugar increases, as well as the temperature as seen in the figure below. Again, the yeast strain effect is still present and impacts the concentration of glycerol.

Important: acetic acid can become a problem when the sugar concentration is high. It is crucial to perform good fermentation management to reduce this risk such as rehydrating the yeast in Go Ferm Protect and having a proper nutritional regime during fermentation with the Fermaid range of products.

Glycerol production (g/L)
Temperature and sugar concentration impact



A QUICK SUMMARY

When selecting a yeast for winemaking, it is important to base the selection on many parameters, glycerol being one of them. For example, polysaccharides are other compounds produced by selected yeast which can have an important impact on mouthfeel and volume. Winemaking conditions, wine style, the wine yeast performance and characteristics are all important factors to consider. Selected yeast will vary in the capacity to produce different concentration of glycerol, an important by product of alcoholic fermentation. Glycerol may have a positive impact on the mouthfeel and smoothness of the wine. In order to modulate glycerol production and improve complexity, the choice of selected yeast is an important step.

Our next topic: The fructophilic ability of wine yeast

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