Concentrate – This Is Serious!

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Introduction

Australian winemakers commonly use two scales to measure "sugar" content in grape juices. They are:

1. Degrees Brix, and
2. Degrees Baume. (1.8 Brix = 1 Baume).

Both Baume and Brix scales give us a measure of soluble solids in grape juice. Soluble solids measurements are also used to monitor the progress of fermentation. However, we need to understand just what it is that we are measuring when we drop our hydrometers into juice or ferment.

The Baume scale is convenient because we believe that it gives an estimate of finished alcohol levels, i.e. we say that a 12.0 Baume juice will have a final alcohol level after fermentation of approximately 12.0%.

The conversions mentioned above can be handy rules of thumb, but just how accurate are they? Have you ever wondered why your 13.5 Baume Chardonnay juice can end up with a finished alcohol level of over 14%?

Soluble Solids

Degrees Brix is defined as soluble solids per 100g of juice (not per 100ml of juice!) and is a measure of all soluble solids including pigments, acids, glycerol and sugar. Generally, the fermentable sugar content of grape juice is between 90 and 95% of the total soluble solids. The remainder can be classified as dry extract. Note however that we make our grape sugar measurements as liquid—we do not weigh the juice.

Most winemakers use the Brix measurement (or Baume) to provide an approximate measurement of sugar levels, although other scales such as Oechsle do exist.

How many of us remember that our soluble solids measurements are really only telling us the ratio of sugar to water and do not take into account the specific gravity of the juice? If we really want to know how much sugar is in our juice, we should use the following formula:

Weight (in g/L) = Brix x Specific gravity x 10

This is because soluble solids measurements are not simply related to density or concentration. A simple linear relationship does not exist for sugar concentration in liquids. The specific gravity of a sugar solution increases as the concentration of sugar in the solution increases.

As apparent soluble solids increase, actual sugar concentration is increasing even more *because of the increasing specific gravity* (refer to the above equation). In other words, the specific gravity increase means more sugar per unit volume is in solution.

Table 1 shows a sugar solution of **4 Brix** has **41 g/L** of sugar while one of **24 Brix** has **264 g/l**. Increasing the Brix level 6-fold has increased the sugar level 6.44 –fold! This has significant implications.

Table 1.

Brix	Baume	Specific Gravity 20/20	Sugar g/L	Probable Alcohol in finished wine v/v
0	0	1	0	
2	1.1	1.0078	20	
4	2.2	1.0157	41	
10	5.6	1.04	104	4.6
16	8.9	1.0653	170	8.6
18	10	1.074	193	10
20	11.1	1.0829	216	11.4
22	12.2	1.0918	240	12.7
24	13.3	1.1009	264	14.1
26	14.4	1.1101	288	15.2
40	21.9	1.178	470	
60	32.4	1.285	771	
68	36.5	1.336	908	

(adapted from "Wine Analysis and Production" by Zoecklein et al.)

There are two important issues relating to sugar concentration:

1. The actual amount or percentage of fermentable sugar in juices. This is important for estimating the potential alcohol in finished wine. For a more accurate prediction, refer to the table above.

   Alternatively, at typical harvest sugar levels, use a factor of 0.58 to multiply from Brix readings. You can also use a factor of 1.045 instead of 1.0 when using the Baume scale. In other words, 22.0 Brix x 0.58 = 12.8% alcohol. Remember though that the higher the sugar concentration, the less accurate this will be.

2. The actual amount or percentage of sugar in grape juice concentrate. This is important for calculating the amount of concentrate required to raise ferments to a certain alcohol level or when adding to finished wines as sweetening or as dosage in sparkling wine.

> Grape juice concentrate is generally at 65-68 Brix, this being close to the limit of solubility of glucose and fructose in water. There is a misconception amongst some winemakers that 68 Brix concentrate contains 680 g/L sugar. IN FACT, IT CONTAINS 908 g/L!
>
> The specific gravity of this concentrate is 1.336 so according to the formula above,
>
> Weight of sugar(g/L) = 68 x 1.336 x 10 = 908

Again, this has important implications for concentrate additions. If you have a low sugar ferment that you think needs concentrate addition to increase final alcohol content, you should know the actual amount of sugar in your concentrate before you add it.

Assume 10,000 litres of 10 Baume (or 18 Brix) juice that you want to increase to 11 Baume or 19.8 Brix.

1.8 degree Brix increase equals 18 g/l:

10,000 x 18 g/L = 180,000 gms of sugar required.

If the grape concentrate is 68 Brix, it contains, from above, 908 g/L of sugar.

Therefore, volume of concentrate required = 180,000/908 = 198 litres

(Strictly speaking, you need a little more concentrate to make up for the fact that your juice is now 10,198 litres in volume).

Super Yeasts

Also important here is the belief that some yeasts are “super-efficient” and can convert an identical amount of sugar into more alcohol than other yeasts. While there may be some small differences between species, it is unlikely that different strains of the same species will vary greatly in their “efficiency”. There are several useful research papers on this topic.

Conclusion

So, the moral is not to be surprised if you pick your Chardonnay at optimum flavour development, with a Baume reading of 13.3, and you end up with over 14.0% alcohol in the finished wine. Note that in red wines some of the alcohol produced is lost to the atmosphere because of warmer ferment temperatures, more open fermenters and so on. Thus, reds generally don’t show this apparent “increase” in alcohol.

Of course, you could be getting higher alcohols levels than you expected because your hydrometers are not correctly calibrated! This is surprisingly common and it is worth checking your hydrometers with those of any sympathetic wineries nearby if possible. You may be disturbed at what you find.

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Reference

Zoecklein, Fugelsang, Gump and Nury (1995), *Wine Analysis and Production,* Chapman and Hall, New York.