## Estimation of %Alcohol using Combined Refractometer & Hydrometer Data

For the amateur winemaker, ebulliometery and distillation/hydrometry represent the most accurate methods for assessing the volume of alcohol in wine. However, both of these techniques are very time consuming and require a considerable investment in laboratory apparatus and supplies. Although less accurate, a reasonable "ballpark" estimate of the percent alcohol in a wine can be arrived at by measuring its refractometer brix and hydrometer-based specific gravity; and, subsequently plugging these measurements into a regression equation (see Eq. H-1 below).

Prior to the start of fermentation, the amount of sugar in grape juice or must can be accurately estimated using either a hydrometer of a refractometer. The refractive index of must lawfully increases with the quantity of sugar dissolved in the grape juice. A refractometer measures this effect using light passing through the juice/must to generate an estimate of the proportion of sugar by weight. However, once the level of alcohol begins to increase due to fermentation, independent refractometer assessments no longer yield an unambiguous proxy measure of sugar content. This is because alcohol also contributed to the refractive index of the wine. That is: many different combinations of %sugar vs. %alcohol can lead to the same refractometer Brix value. Hence, without additional information, a refractometer Brix reading of a wine is ambiguous with respect to either the %sugar or %alcohol of the wine under consideration. While increasing levels of alcohol in wine are accompanied by increases in refractometer Brix, these same increases in %alcohol yield moderate decreases in its specific gravity. The nature of these differential effects of changing %alcohol level are depicted in Figure H-1.

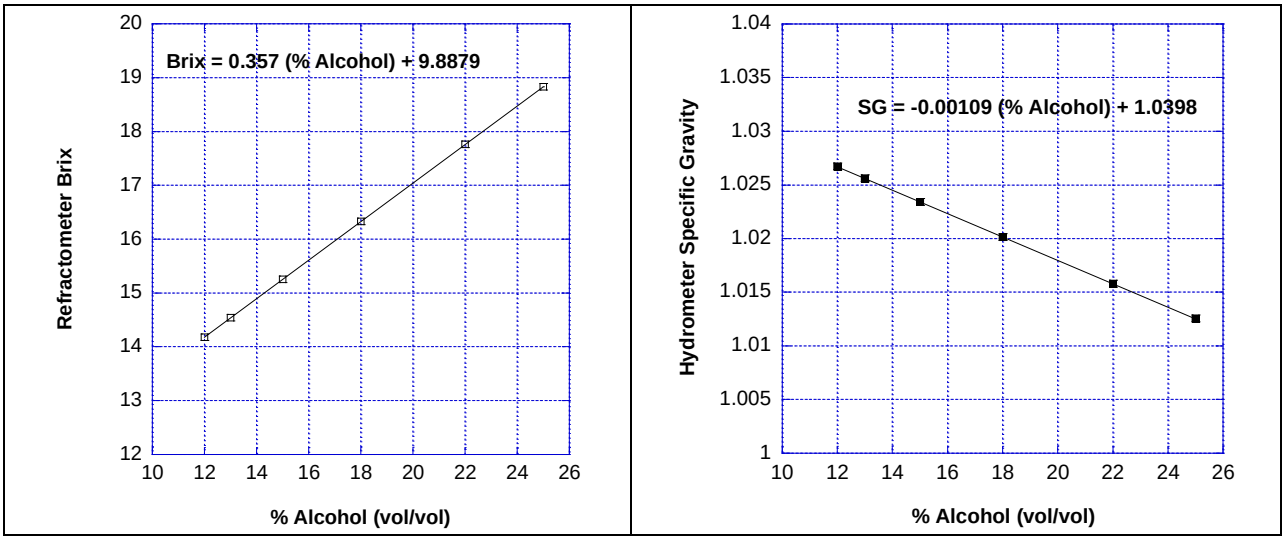


**Figure H-1.**
**Increasing levels of %alcohol cause refractometer measures of Brix to increase linearly while hydrometry-based specific gravity measures demonstrate a systematic linear decline**
( Data based upon Rogerson & Symington, 2006).

Rogerson and Symington (2006) have combined the linear relationships depicted in Figure H-1 to derive an equation which yields reasonably accurate estimates of the percent alcohol (by volume) in wine. Their original equation was expressed using refractometer °Brix and hydrometer measurements expressed in °Baumé. Because most hydrometers used by home winemakers use the specific gravity scale, their equation has been reformulated to accommodate this situation as follows:

**% Alcohol (vol/vol) = (1.646 * RBRIX) – (2.703 * (145 – 145/SG)) – 1.794 [Eq. H-1]**

Where: **RBRIX** = °Brix measured with a winemaking refractometer
**SG** = specific gravity measured with a short-range hydrometer

## Procedure

1. Pour approximately 150 mL of your wine into a hydrometer sample tube/jar.
2. Allow the wine sample and hydrometer to reach the ambient room temperature. The closer the temperature is to your hydrometer's calibration temperature (typically 20° C) the more accurate your measurement.
3. Use your hydrometer to measure the specific gravity of the wine sample.
4. Place a few drops of the wine sample on your refractometer, allow 30 seconds for the temperature of the sample to equilibrate to the instrument and then read the Brix value.
5. Plug the refractometer Brix and hydrometer specific gravity readings into Eq. H-1 to calculate the estimate of %alcohol in the wine sample.

## Notes

Typical results yield values that are within 1 %alcohol units of the true value (e.g., 14 ±1% alcohol (v/v)). More recently, Son et al. (2009) have published another regression model for estimating %alcohol using a refractometer and hydrometer. Preliminary experiments performed by *MoundTop MicroVinification* appear to suggest that the Rogerson & Symington approach (i.e., Eq. H-1 above) yields results more closely matching "gold standard" distillation estimates of %alcohol in wine samples.

## References

Rogerson, F. & Symington, C. (2006). A method for the estimation of alcohol in fortified wines using hydrometer Baumé and refractometer Brix. *American Journal of Enology and Viticulture*, *57*, 486-490.

Son, H.S., Hong, Y.S., Park, W.M., Yu, M.A. & Lee, C.H. (2009). A novel approach for estimating sugar and alcohol concentrations in wines using refractometer and hydrometer. *Journal of Food Science*, *74*, C106-C111.