IOWA STATE UNIVERSITY
Extension and Outreach

grape maturity series

Estimating Grape Maturity by Total Soluble Solids

What are total soluble solids

The harvest parameter of total soluble solids (TSS) is a measure of the density (mass/volume) of all soluble solids. Freshly pressed grape juice is comprised of about 80% water and many dissolved solids. The solids of most importance include sugars, organic acids, phenolic compounds, nitrogenous compounds, and structural polysaccharides. The sugars (glucose and fructose) in the solution of juice account for 95-99% of the solids, thus TSS is a good estimation of the concentration of sugars. A component in determining ripeness of the berries is the concentration of sugars. This determines the potential alcohol content achievable during fermentation through yeasts consumption of sugars.

The terms TSS and °Brix are used somewhat interchangeably due to the majority of the soluble solids being sugars. The measurement of °Brix is defined as the sucrose (a disaccharide composed of one unit of glucose and one unit of fructose) concentration in aqueous solution (1 °Brix = 1 g sucrose / 100 g solution = 1%). Although the relationship between sugar concentration and alcohol formed is not precise, a general equation to estimate the percent of potential alcohol (v/v) is °Brix * 0.57. Depending on the type of grape and wine style, the factor ranges from 0.55-0.60.

Juiced berry samples ready for analysis of °Brix by digital refractometer.

What happens during grape ripening

Grape ripening begins at véraison when the berries soften, the color changes and sugar begins to accumulate. Sucrose is transported from the leaves into the berry where it is cleaved as glucose and fructose and stored in cell vacuoles. In unripe berries, glucose is the predominant sugar. At the ripening stage glucose and fructose are usually present in equal amounts (1:1 ratio); however, it is somewhat dependent on the variety. The sugar content of the juice of ripe grapes varies between 150-250 g/L. In overripe grapes, the concentration of fructose exceeds that of glucose. At harvest maturity, the degrees ºBrix varies from 16-24 or higher depending on the grape variety and expected wine style.

How to measure total soluble solids

The TSS in juice are commonly measured using a refractometer or a hydrometer. Alternately, density meters can be used as the TSS correspond to the density of all solids. Temperature is an important factor in these measurements and must be accounted for either by temperature compensation built in to the instrument, or by taking the temperature of the sample and applying a compensation. A refractometer uses the refractive index of a solution to interpret the amount of dissolved solids in a sample. The refractive index is a measurement of the light refraction, the total internal reflection of light, or the bending of light. Portable handheld refractometers may be manual or digital and can effectively measure the TSS using a small sample of juice. Hydrometers are made in a range of styles using various scales (ºBrix, Baume, Specific gravity) and may cover the whole scale or may be part of a set containing short scale ranges such as -5-5 ºBrix, 0-8 ºBrix and 14-24 ºBrix. Hydrometers require a much greater sample volume and are usually calibrated at a specific temperature. A temperature correction is required if the temperature of the juice is different than the temperature of calibration.

Total soluble solids by manual and digital refractometer

Materials

- Manual or Digital Refractometer
- Deionized (DI) water
- 5-10 mL juice sample
- Thermometer (if the refractometer does not include a temperature compensation system)
- Disposable Pasteur/transfer pipets
- Lint-free cloth or “Kimwipes”

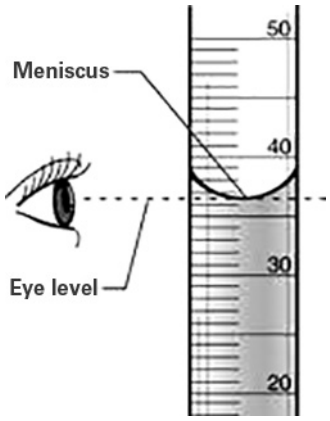
Manual refractometer, digital refractometer and hydrometer.

Manual refractometer procedure

1. Open the lens cover to clean with DI water and dry the surface with a lint-free cloth.
2. Place a few drops of DI water on the lens (cover lens completely), close the lens cover and allow sufficient time for temperature of the sample to equilibrate. Note: If temperature compensation is not built in, measure the temperature of the water used and record.
3. Holding the refractometer toward a light source (natural light is preferred), look through the eyepiece and focus the view by turning the eyepiece. You will see a dark and a light region, separated by a distinct interface (boundary).
4. To calibrate, use the zero-adjust screw to make the interface between the dark and light regions cross the scale at 0 °Brix.
5. Before measuring the °Brix of a juice sample, open the lens cover to clean with DI water and dry the surface with a lint-free cloth.
6. Place a few drops of juice on the lens (cover lens completely), close the lens cover and allow sufficient time for temperature of the sample to equilibrate. Note: If temperature compensation is not built in, measure the temperature of the sample used and record.
7. Hold the refractometer against a light source (natural light is preferred).
8. Read the graduated scale where the dark/light interface crosses and record.
9. If the temperature of the water used for calibration is the same as the temperature of the juice, then the reading is the total soluble solids concentration in °Brix, and no adjustments are needed.
10. If the temperature of the juice is higher than the water, add 0.07 for every °C difference. If the temperature of the juice is lower than the water, subtract 0.07 for every °C difference.
11. Record the result then clean the lens with DI water and dry the surface with a lint-free cloth.

Digital refractometer procedure

1. To calibrate, place a few drops of DI water on the lens (cover lens completely). Temperature compensation should be built in to the digital refractometer so no temperature reading is required.
2. Press the zero button to calibrate as directed by manufacturer's instruction. Remove the DI water and dry the lens with a lint-free cloth.
3. To ensure the calibration was successful, place a few drops of DI water on the lens and press the start/read button to confirm it reads zero. Remove the DI water and dry the lens with a lint-free cloth.
4. Place a few drops of juice on the lens (cover lens completely). Press the start/read button as directed by manufacturer's instruction to obtain the sugar concentration in °Brix.
5. Record the result then clean the lens with DI water and dry with a lint-free cloth.



Reading the meniscus.

Total soluble solids by hydrometer

Materials

- Hydrometer(s) with ºBrix, Baume or Specific Gravity scale
- Graduated or hydrometer cylinder, 250-500 mL
- Thermometer
- 250-300 mL juice sample
- Sucrose solutions of known concentrations

Procedure

1. Prior to sample measurements, calibration can be checked by using sucrose solutions of known concentrations that fit the range of the hydrometers in use. Follow steps 2-5, substituting sucrose solutions for the juice sample.
2. Rinse the hydrometer and the cylinder with the juice sample you wish to analyze.
3. Fill the hydrometer cylinder with enough juice for the hydrometer to float freely. Either use a temperature compensated hydrometer or bring the sample to 20.0 ºC. Alternately, record the temperature and use a temperature correction table to correct the recorded reading.
4. Gently lower the hydrometer into the cylinder filled with juice while giving it a gentle spin as it is released. Make sure the hydrometer does not touch the sides or the bottom and that there are no bubbles on the hydrometer.
5. Record the hydrometer reading at the bottom of the meniscus (see figure, left, for how to read the meniscus accurately). If needed, use any applicable correction tables to adjust the recorded result.

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