Cornell University
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Residual/Reducing Sugar 3 Ways

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Why to run it: To assess fermentation completion or residual sugar concentration (g/L)
What it measures: The percent reducing sugar in wine

Residual or reducing sugar? Reducing sugars are the fermentable sugars present in must or wine--namely, glucose and fructose. Residual sugars include all forms of sugar in the wine, including nonfermentable pentoses. In most cases, the non-fermentable sugars remaining in a wine are negligible, so that the residual sugar concentration consists primarily of the reducing sugars glucose and fructose. One notable exception occurs when wines have been back-sweetened with sucrose post fermentation. Because sucrose breaks down much more slowly in finished wine than in juice or fermenting must the sucrose remains relatively intact during trials and cannot be accurately measured using the methods below without additional pretreatment steps.

Basic bench-top: Clinitest®
Materials:

- Clinitest® copper sulfate tablets
- Test tubes and rack
- Forceps
- Dropper
- Conversion chart
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Analysis time: 5 minutes

Accuracy: reported as ± 0.05% for wines from 0-1% sugar

Hazards: Tablets are caustic and should be not be touched with bare fingers; use forceps. Test tubes get very hot during the reaction and may cause burns if handled.

Cost: $20 for 100 tablets

Theory and Practice: Each tablet contains NaOH, citric acid, and copper sulfate; the first two reagents undergo an exothermic neutralization reaction to provide the heat necessary to drive a reaction of copper sulfate with the sugars in a dilute wine sample. The copper sulfate reaction produces a colored reaction product which is compared to a color chart to determine approximate residual sugar. This method is useful for rapid determination of dryness, but it should not be used to determine the concentration of residual sugar.

Advanced bench-top: Reblein or Gold Coast Titrametric method
Materials:

- 200mL Erlenmeyer flasks
- 10mL volumetric pipettes
- Volumetric flasks for solution preparation
- Titration apparatus
- Reagents: sodium potassium tartrate, sodium hydroxide, copper sulfate, potassium iodide, sodium thiosulfate, soluble starch, potassium iodide, sulfuric acid, and deionized water

Accuracy: good

Hazards: Several of the reagents are hazardous, requiring appropriate handling and disposal.

Cost: $200 for glassware and reagent purchase

Theory and Practice: In this procedure, copper sulfate reacts with residual sugar; the copper remaining after the reaction is then reduced to iodine, which is titrated with sodium thiosulfate. Titration concentrations are then compared to a deionized water blank to calculate the residual sugar. While this multi-step reaction takes some time and skill to run, it isn't necessarily difficult and is the cheapest way to accurately calculate residual sugar.

Blue is not a sad color if you're trying to get a fermentation to finish.

Chemistry geek: Enzymatic analysis with a Spectrophotometer
Materials:

- Spectrophotometer
- UV cuvettes
- Micro pipettes and tip
- Enzyme test reagent kits

Analysis time: 30 minutes

Accuracy: very good

Hazards: None

Cost: $5,000+ for spectrophotometer purchase; $90 for 30 enzyme tests

Theory and Practice: Enzymatic analysis provides individual measurements for glucose and fructose concentration rather than the total concentration of reducing sugar. In a series of reactions, fructose and glucose ultimately produce gluconic acid-6-phosphate and nicotinamide-adenine dinucleotide phosphate (NADPH) in stoichiometric (quantitative) concentrations. Unlike glucose, the light absorbance of NADPH can be measured spectrophotometrically at a wavelength of 340 nm, and this measurement and the known quantitative relationship between NADPH and glucose concentration is used to calculate the amounts of glucose and fructose in the sample. Accurate micro-scale measurements are necessary for successful application of this analysis.

The ChemWell multi-analyzer at the extension enology lab is a like a big spectrophotometer and can perform any enzyme assay. A small winery can use a more standard spec and accomplish all of the same things, however.