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Using °Brix as an Indicator of Vegetable Quality

A Summary of the Measurement Method

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Farmers, as well as produce managers and handlers need straightforward, reliable, proven, and inexpensive criteria, tools, and techniques to gauge the potential quality of their fresh fruits and vegetables. The level of soluble solids in a fruit or vegetable is often used as an indicator of the sugars present in it. Soluble solids levels are usually reported in values of °Brix. °Brix values can be measured easily and reliably in the field, shop, or shed using a relatively inexpensive piece of equipment able to fit in most pockets: a refractometer. When obtained and applied correctly, objective and accurate °Brix values can aid in variety selection, harvest scheduling, and other aspects of crop production including irrigation, fertility, and post-harvest management. These values can also give a rough estimate of how sweet a product may taste to some consumers. At best, °Brix values also appear to be indirect estimates of the general health of some crops and their potential sensory appeal to people. However, there is little scientific evidence to support the use of °Brix values as anything more than an indication of the soluble solids content—and potential sweetness—of fruit and vegetable samples.

Four fact sheets have been prepared to guide farmers and produce buyers and handlers in using °Brix as an indicator of vegetable quality. This *Summary* fact sheet is a general description of the tools and techniques used to measure °Brix. The *Overview* fact sheet provides important background information on °Brix, outlines its application in horticultural crop production, and describes the benefits and limitations of measuring °Brix during vegetable production and marketing. Other fact

sheets provide specific instructions for the taking of °Brix readings in five vegetable crops and guidance in making the best use of the values obtained.

Equipment, Material, and Sample Considerations

Soluble solids (°Brix) values are obtained using refractometers. These instruments measure the degree to which light is bent as it passes through a sample (i.e., the refractive index). Refractometers vary in design. Expensive, bench-top models are common in laboratories and QA/QC facilities. Inexpensive, portable (small-size, handheld), analog and digital versions are preferred by growers and produce managers and handlers. Analog and digital refer primarily to whether the °Brix value is read on a scale resembling an old-style thermometer or displayed digitally.

The refractive index is affected by the temperature of the solution. The °Brix scale is currently based on a reference temperature of 20°C (68°F). Therefore, samples with identical amounts of soluble solids but different temperatures can give different °Brix readings if the refractometer does not correct for temperature. Many modern refractometers correct for temperature but this feature should be confirmed at purchase.

Light must pass through a solution to measure its °Brix. Understandably, the reliability of the reading is influenced by the light source. Some handheld refractometers rely exclusively on sunlight. These units can provide very accurate readings but special attention is needed during the process due to variation in natural light. Other handheld units have built-in light sources (small bulbs)

that increase reliability and consistency but also require their own version of special care. Both types of units are common throughout the industry.



Bench-top refractometer



Digital handheld refractometer



Analog handheld refractometer

This publication summarizes the major steps required to obtain a °Brix reading using a handheld digital refractometer. Steps shown here apply to other refractometers and most vegetable crops. However, specific instructions for measuring °Brix in tomato, watermelon, cucumber, sweet corn, and leafy crops are given in the *Crop Instructions* fact sheet.

This *Summary* publication also depicts the measurement of °Brix on single-fruit samples. In laboratory and research settings, blenders are often used to prepare bulk samples consisting of many fruit or leaves. However, if chosen carefully, single fruit or leaf samples taken from various locations in the field can provide reliable estimates of overall crop soluble solids contents. Single leaf or fruit samples also require less time to prepare and reduce loss of saleable produce.

°Brix readings can be taken on root vegetables; however, the standard sample press shown in this document may not be suitable to extract the required liquid. Instead, for root vegetables, a blender or small food processor may be needed to “pulp” the sample and extract a bead of juice from it. A representative collection of the equipment and materials needed to measure °Brix in most leaf and fruiting vegetable crops is shown in the following figure.



Materials needed for °Brix measurement:

- knives and cutting board for sample preparation
- dish for sample collection after pressing
- sample press or blender
- wash bottle
- refractometer
- delicate task wipe to filter samples and clean refractometer without scratching
- datasheet

Helpful hint:

Measurements can be taken in the field. However, it may be easier to collect samples in the field and then take measurements in a workshop or kitchen with water nearby.

Refractometer Operation

The following images depict the Atago PAL-1™ refractometer. Although the methods and instructions shown here are likely to apply to other handheld digital refractometers, consult your instrument’s instruction manual before proceeding.

The Atago PAL-1™ handheld refractometer has a range of 0 to 53% soluble solids. This range should be appropriate for any vegetable crop. Also, this refractometer can compensate for sample temperature and light conditions if used properly (the sample must be left in the measuring well to allow the unit to adjust to the sample temperature). For best results and greater efficiency, we suggest allowing samples to reach room temperature before measuring them. Also, very bright outdoor conditions can disrupt measurements. So, we suggest taking measurements indoors or in the shade when outdoors.

Calibration

Handheld digital and analog refractometers must be calibrated before each use. Room temperature *distilled* water is all that is needed for calibration of these handheld units. To calibrate them, fill the measurement well leaving just a little of its metal rim showing. Then, press the zero button. The screen will read 000 when calibration is complete. You are now ready to take readings. To check

the calibration, fill the well with clear water and press start. The display should read 0.0. If it does not, repeat the calibration procedure outlined above.

Analog refractometers are also calibrated using a few drops of room temperature, distilled water placed on the sample plate. Looking through the viewfinder should reveal a blue line at exactly 0 °Brix. The calibration screw on the unit can be used to adjust the zero baseline as needed. Further information on refractometer use and calibration can be found in the article by Vasquez and Mueller in the References section.



Taking a °Brix Reading

Fill the measuring well of the digital handheld refractometer nearly full; a small amount of the metal rim should be visible. And there should be no bubbles in the sample. If the sample is at room temperature, simply press the start button. The °Brix reading will be displayed in about 3 seconds. If the sample is cool or warm, wait for the refractometer to adjust before measuring. If you are using a handheld analog or benchtop refractometer, place a few drops of liquid on the plate then close the cover. Some analog and benchtop refractometers do not have a temperature compensating function. If that is the case, samples should be measured at 20°C (68°F) to avoid the need to adjust °Brix readings for temperature.

Step 1. Select

Select samples at regular intervals throughout the growing season and choose a consistent time of day to do so. Collect several healthy, representative plants from around the growing area to include potential variability in soil type, moisture, fertility, etc. Select mature and saleable vegetables and ones of the same age or position on the plant.

Step 2. Prepare

Take samples that represent all tissues and regions within a fruit or vegetable when possible (i.e., a tomato wedge vs. a slice). Select samples from a consistent location within the fruit or vegetable when necessary (i.e., 3rd mature leaf in a lettuce head or center slice from

cucumber or zucchini). And extract multiple samples from within each fruit or vegetable to represent the variability within a fruit.

Step 3. Press

Use a hand press or electric blender to prepare samples that are well mixed and representative of the larger vegetable from which they were sampled. Consider a garlic press for extracting juice from fruit and leaf samples—it is an inexpensive, simple, and quick tool.

Step 4. Filter

Filter the pressed or blended sample with cheesecloth or a delicate task wipe to prevent larger pieces of the sample from contaminating the sample well. Pieces of tissue in the well will cause inaccurate readings.

Step 5. Read

Prior to each sampling period, calibrate refractometers with water. Take measurements on room temperature samples soon after harvest to obtain the most accurate and consistent readings throughout the growing season.

Step 6. Clean

Clean the refractometer and press with water and dry the well and the press between each measurement. Use only a delicate, non-scratching wipe to clean the refractometer. The lens contains glass and should not be damaged. Drying the well between readings reduces measurement error by eliminating sample carryover or excess water which dilutes the next sample, lowering its reading.

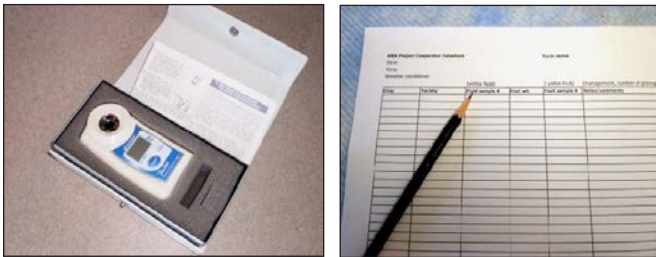


Step 7. Record

°Brix values can be important in your operation. These values represent a snapshot of one key aspect of crop quality and, potentially, buyer or consumer liking. Like other information important in your operation, °Brix readings should be recorded, not discarded or “committed to memory.” A record of °Brix values can become a useful reference; however, for that to happen, other information must be recorded alongside the °Brix reading. This additional information will give the °Brix values meaning going forward. Consider recording the following information along with each °Brix value.

- date and time of harvest and measurement
- crop species and variety name
- identity and location of samples within the growing area (number samples gathered from a single crop field and their location in the field)
- identity of samples within the fruit (number samples from within a single fruit)
- fruit weight prior to preparation for measurement
- crop management including planting date, number of pickings, watering and fertilization regime, etc., and recent weather conditions.

When done taking °Brix readings for the day, clean and put away the refractometer. It is best to store refractometers in a location without large variation in temperature. And, make sure all information has been recorded in the notebook or log and place it with your crop records.



Measuring °Brix—A Recap

°Brix values can be measured reliably on location using a self-correcting (for temperature) digital handheld refractometer, one of several types available. Care must be

taken, however, in selecting samples and calibrating the unit. Once a fresh vegetable leaf or fruit sample and other items are in hand and the refractometer is calibrated, obtaining and recording a reading using a seven-step process may require about one minute. °Brix values correlate much more strongly with how sweet a product may taste than how nutritious it may be.

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Making the best use of °Brix measurements requires time, patience, and practice. A solid record of °Brix values obtained on multiple crops (varieties, years, growing conditions) is needed to use °Brix values in decision-making.

References

- Boulton, R. B., V. L. Singleton, L. F. Bisson, and R. E. Kunkee. 1996. *Principles and practices of winemaking*. Chapman and Hall, NY.
- Vasquez, S., and S. Mueller. *Refractometer calibration, use and maintenance*. <http://ucanr.org/sites/viticulture-fresno/files/115503.pdf>

Fact sheets in this series:

Using °Brix as an Indicator of Vegetable Quality: An Overview of the Practice, HYG-1650-12

Using °Brix as an Indicator of Vegetable Quality: Linking Measured Values to Crop Management, HYG-1651-12

Using °Brix as an Indicator of Vegetable Quality: A Summary of the Measurement Method, HYG-1652-12

Using °Brix as an Indicator of Vegetable Quality: Instructions for Measuring °Brix in Cucumber, Leafy Greens, Sweet Corn, Tomato, and Watermelon, HYG-1653-12

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