Using a Refractometer to Discern Fruit Quality

by Kostja Makarovič, D. Sci.
http://www.kostja.si

I went to a supermarket and found very nice Spanish nectarines that were almost black. I smelled the fruit, and its softness convinced me to buy a box. However, I wasn't sure if I was purchasing high quality fruit or not and wished that I had a method to be more certain.

Consumers can be misled about the quality of fruit. While many use these commonly-used techniques to select their fruit, they do not necessarily result in making good selections: appearance, fragrance, softness, organically/commercially grown label.

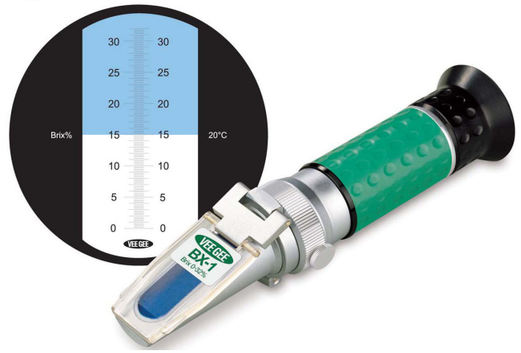
These factors affect flavor and quality, yet the consumer will be in the dark about them:

• The addition of excessive minerals in the soil.

• Watering the plants at specific time intervals.

• Exposing plants to artificial drought, controlled temperature and humidity during growth.

• Freshness and ripening condition controls such as storage at distinct temperature, humidity and atmosphere.



• Chemical methods such as exposing fruits to different gases to induce coloring for transforming ugly fruits to pretty, sellable ones.

Some, but not all, of those agricultural and processing techniques are acceptable practices for organically grown fruits.

Although our senses are designed to recognize fresh ripe fruits, we can be fooled. We cannot easily discern the difference between artificially ripened fruits from really high-quality fruits which are fully ripened on a tree. Shopping for high-quality ripe fruit at a market is a game of chance.

Fruits become sweeter and develop peak nutrition as they ripen naturally. Some fruits, such as bananas, begin to develop with a high starch content. As they ripen to maturity, the starch is converted to simple, easily-assimilated sugars. Other fruits develop sugars at the outset via photosynthesis in the leaves of the plants.

Fruits can be divided in two major groups: 1. fruits that can ripen after harvesting (climacteric), and 2. fruits that cannot ripen after the harvesting (non-climacteric). Refer to the table at the end of this article for lists of some of some common varieties.

Our Senses Cannot Discern the Truth

In this day of food technology, high-tech science can dim or even fool our senses when it comes to recognizing high-quality fruits and vegetables. Sugar content is the primary indicator of fruit ripeness. The sweetness of the fruits can be analyzed in several ways. The easiest method is using our tongue, but this method can be problematic if we have never experienced truly ripe, high-quality fruits of the varieties we are testing. Furthermore, our tongue can be fooled when fruits that should be high in acid become lower in acid (and thus sweeter) as they get stored over time.

Happily, there is a very simple, fast, accurate and cheap method for checking if the fruits and vegetables of our choice are really high quality.

Refractometry to the Rescue!

Refractometry, as it applies to fruits and vegetables, measures the refractive index of juice of those foods. At the low nutrient end if the refractometry scale is pure water. You have probably observed the refractometry phenomenon when a straw in a glass of water appears to be bent at the surface of the water. (See the figure to the left.) Reflected light is refracted (i.e., changes direction) at the point where it passes through a medium with a lower refractive index (air) into the medium with higher refractive index (water). Water has a low refractive index because it does not contain dissolved constituents/nutrients. The refractive index of water will increase with the addition of dissolved solids, such as minerals and other nutrients.

For many substances, the refractive index of the solution linearly increases with the increasing concentration of the solute (the substance that is dissolved in a solvent). This principle is also valid for sugars.

The widely-accepted unit of measurement for sugar content in the water is called BRIX. One BRIX represents 1 gram of dissolved sucrose in 100 grams of water. Sucrose--commonly known as table sugar--is a disaccharide bonded to one glucose and one fructose molecule by the glycoside bond. Of course, in fruits there is always present a mixture of simple sugars: glucose, fructose and some sucrose. The ratio of sugar components varies depending on the variety, place of growth and even stage of ripeness of each fruit.

Apart from sugars in fruits, fruits also contain other nutrients: organic acids, amino acids, fatty acids, minerals, vitamins and fiber. All dissolved matter influences and generally increases the BRIX of the solution. The refractometry numbers commonly associated with fruits are referred to by the term Total Dissolved Solids (TDS). Higher TDS usually correlates with higher quality of fruits and vegetables.

So, how do we measure the refractive index when buying fruits and vegetables at a market? Certainly, the straw in a glass of juice is not practical! Happily, there is tool which makes this easy: a handheld refractometer.

How a Refractometer Works

Handheld BRIX meters can be purchased at agricultural specialty supply stores and online for $15 to $100 apiece. Make sure the BRIX range is specifically designed for fruits, such as those used by vineyard managers for assessing their wine grape crops.

You don't need to make fruit juice in a machine to test BRIX. When shopping, simply ask for a sample slice and squeeze a small amount of juice on the refractometer's glass sensor plate. Or, you can of course test at home. The next step is to compare the BRIX reading to a chart which has data for various fruit varieties. Data tables showing fruit and vegetable quality per their BRIX numbers can be found on the internet. On the next page are some values I have compiled for common foods.

BRIX

Food	Minimum	Average	Highest measured in a temperate region	Highest measured by myself
Apples	12	16	18	18
Apricots	13	16	22	22
Celery	2	3	3	3
Cherimoya	14	18	23	23
Cherries	13	18	28 (32+)	32+
Cherry tomatoes	6	8	10	11
Clementines	10	14	17	17
Cucumbers	2	3	3	3
Feijoa	10	14	14	14
Figs	13	18	26 (32+*)	32+*
Grapes	15	19	27	27
Green lettuce	2	3	5	5
Kiwis	10	12	15	15
Lettuce	2	3	3	3
Mandarins	10	12	14	14
Mangos	12	15	22	22
Melon (Cantaloupe)	8	12	18	18
Melon (Galia)	12	15	18	18
Melon (Piel de Sapo or Honeydew)	10	13	15	15
Mulberries	16	20	26	26
Nectarines	8	11	17	17
Opuntia	12	13	15	15
Oranges (navels)	10	12	15	15
Peaches	10	15	18	18
Pears	12	15	19	15
Persimmons	14	18	23	23
Pineapples	12	14	18	18
Plums	16	18	22	22
Pomegranates	13	15	18	18
Raspberries	10	11	13	13
Red oranges	11	13	15	15
Red peppers	5	8	10	10
Satsumas	9	11	14	14
Sour cherries	10	12	14	14
Strawberries	8	11	15	15
Sweet corns	8	12	15	15
Tomatoes	3	6	9	9
Watermelons	8	10	14	18
Young coconuts	3	5	8	8
Zucchinis	2	4	6	6

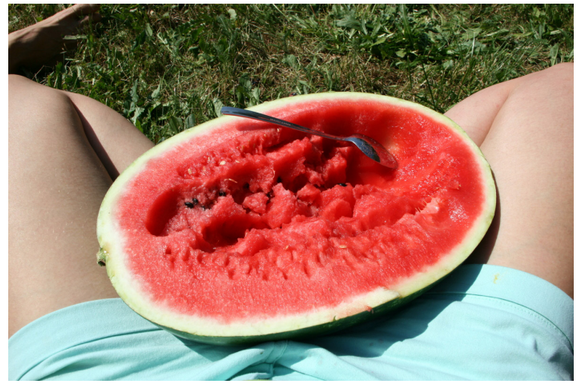
* dried on a tree

Climacteric Fruits

Apples
Apricots
Cherimoya
Cherry tomatoes
Feijoa
Figs
Kiwi
Melon (cantaloupe)
Melon (Galia)
Mango
Melon (Piel de Sapo or honeydew)
Nectarines
Peaches
Pears
Persimmons
Plums
Tomatoes

Non-climacteric Fruits

Cherries
Clementines
Cucumber
Grapes
Mandarins
Mulberries
Opuntia
Oranges (navels)
Pineapple
Pomegranate
Raspberries
Red oranges
Red pepper
Satsumas
Sour cherries
Strawberries
Watermelon
Young coconut
Zucchini



A more advanced table containing actual BRIX measurements of fruits in their optimal tree ripeness as well as their pH values will be published on my web page: www.kostja.si.

Go for the Highest Quality!

In conclusion, I believe that the refractometer is a must for high-quality fruit and vegetable lovers. May you eat the most nutrient-rich foods possible!