SPECTRAL ENGINES

APPLICATION NOTE

SMART FARMING

Non-destructive Brix measurement of strawberries with NIRONE™ Spectral Sensors

Introduction

When sweet fruit reach their peak ripeness, they will usually contain the highest possible amount of sugar. Measuring the amount of dry matter or simply the amount of sugar in a fruit would be highly advantageous in a number of businesses, from the production at orchards and farms to fruit processing, and even at the store where consumers could have the quality of their chosen fruit tested before purchase. Brix measurements are most ideal for monitoring a food product or a process for measuring the degree of maturity of a particular crop.

The degrees Brix is a simple scientific measure of the total soluble solids (TSS) contained in a liquid. 1 °Brix equals 1 gram of dissolved sucrose sugar in 100 grams of water. The typical degrees Brix measurement can be done with a refractometer, which are available as both classic mechanical versions and modern digital versions. The major disadvantage of the refractometers is that the sample, namely the fruits to be tested, need to be destroyed to have the fruit juices on the refractometer. With near-infrared spectroscopy the destructive sampling of the fruits can be bypassed, and the quality of the fruit can be tested without waste or harmful chemicals.

Spectral sensors enable fast collection and interpretation of data in many material sensing applications. With Spectral Engines' NIRONE™ solutions, these measurements and analysis can be carried outside of laboratories at a fraction of the cost of typical, much larger laboratory equipment. NIR spectroscopy does not require any sample preparation as such, it is easy and fast to use.

The benefits of Spectral Engines' solutions are:

- Fast and accurate measurements in the field
- Real-time measurement data realized with compact spectral sensors
- True NIR wavelengths above the 1100 nm region increase the sensitivity and selectivity of the measurement
- No sample preparation

USE CASE

We tested our NIRONE Sensor S1.4, against a classic refractometer results on a store-bought box of strawberries. The new NIRONE Sensor S1.4 covers wavelengths 1100 – 1350nm and generates chemical information from 2nd overtone vibrations making the NIRONE S1.4 the ideal sensor for smart agriculture applications. For example, it can be used to measure protein and moisture levels in grains, solid foods and animal feed.

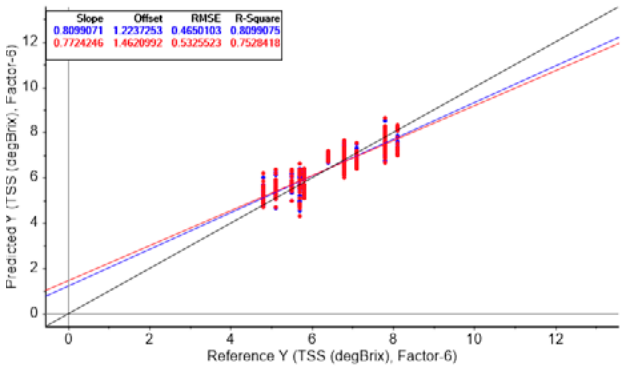
Sample preparations and measurements

We simply measured all the individual strawberries through the peels without any sample preparation with the S1.4 sensor.. After spectra had been measured from the strawberries, the juices from the strawberries were pressed with a simple hand press out of the berries, and some of the juice was placed on the measurement spot of the reference device, a digital refractometer.

The refractometer gave highly repeatable results, even after stirring and replacing of the samples from the same berries, all results were within it's given error margin. The °Brix of the chosen 12 strawberries, a rather limited set, was well varied from 5.1 to 8.1 °Brix, which is a rather low range for strawberries but typical for late spring / early summer production of strawberries (some of the strawberries were slightly raw).

Calibration results and analysis

A simple spectral pretreatment was applied to the data and then analyzed using PLS (Partial least squares) regression algorithm. Without omitting any data, the 1sigma measurement error for the range from 5.1 to 8.1 was determined to be +/-0.53 °Brix. There was a clear correlation between the refractometer results from the juices and the reflectance spectra measured from the strawberries.



Example Predicted vs Reference plot of the TSS in °Brix for the 12 strawberry samples. The root mean square error of cross-validation tells that the 1sigma error is +/- 0.53 °Brix for each sample.

Conclusion

This test of the newest NIRONE Sensor S1.4 it was shown that it is possible to determine the sugar content or total soluble solids content of the fruit non-destructively and with very good accuracy. The method is both simple and quick. The same sensor should also work well in the simple dry matter or moisture content determination of different kinds of produce. In the case of TSS or sugar content measurement a simple refractometer could serve as an adequate reference analysis method.

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