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Headwall APPLICATION NOTE

Orange Processing Brix Prediction Using Hyperspectral Imaging



RAPID, NON-DESTRUCTIVE ANALYSIS & IMPROVED PRODUCTIVITY

Approximately 70 million tons of oranges are produced per year worldwide. About a third of the total tonnage is processed, with the rest being consumed as fresh fruit.¹

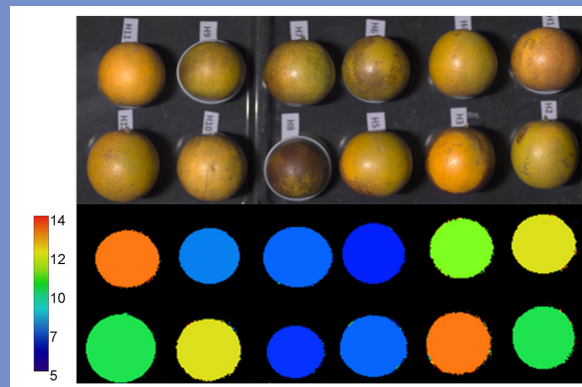
Sweetness, or the concentration of soluble solids is of particular importance

to orange processors. Commonly reported in degrees Brix, it is a key quality factor in assessing the grade of the product delivered into the processing facility. Results are used to calculate the value of the delivered fruit and are directly tied to costs and profitability. The measurement traditionally requires obtaining a representative sample from the delivered load and then juicing and analysis using a laboratory refractometer. However, the process of obtaining results can be slow and labor intensive.

Hyperspectral Imaging (HSI) offers a solution to this challenge. An HSI system can rapidly collect highly resolved spectral data from a load of oranges passing under the sensor. Processing this data in real time and applying statistical analysis algorithms developed by Headwall, the system delivers to the user a predicted °Brix value at the end of the scan.

Value of Spectral Imaging:

- No Sampling
- No Sample Prep
- Real-Time Results
- Optimize Workflows
- Enables Digital Solutions
- Advanced Analytics



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Spectral Imaging, Food Quality

Field boxes or entire truck loads can be scanned in minutes and the results sent to production control stations. Real-time results help speed up receiving operations, optimize decision making and deliver significant ROI.

For the purpose of this study, a Headwall VNIR (400-1000nm) HSI system was used to scan Hamlin oranges from Florida. To obtain the reference values, each of the oranges were juiced, and °Brix was measured using a Cole-Parmer® EW-81150-48 digital refractometer. The refractometer data was employed to train a regression model for prediction of °Brix based on hyperspectral data.

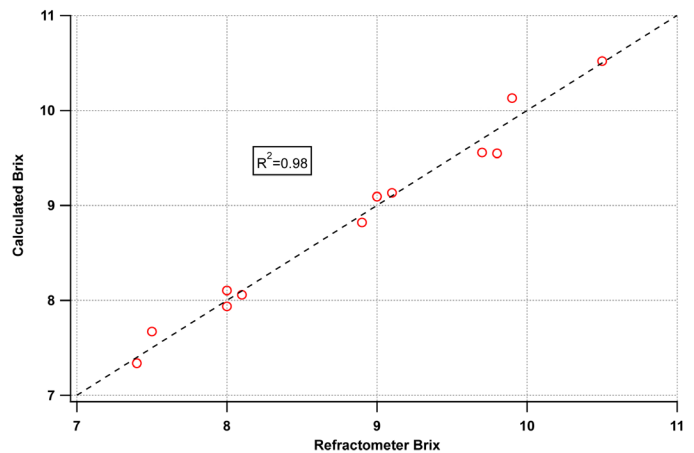
A classification model was created by training the data processing software to recognize the differences between an orange and any foreign areas. Each orange was designated as an object and the oranges were associated with the respective reference °Brix values. A regression analysis model was created and optimized using spectra from the test sample.

Based on this model Headwall's software generated a prediction map where every pixel is assigned a °Brix value. The average of all the pixels in each object resulted in the calculated °Brix for each orange. A plot of the measured versus calculated °Brix demonstrates a good level of agreement between the methods with an $R^2=0.98$.

This example, while based on a small data set and produced in a controlled environment, demonstrates a proof of principle and provides a glimpse into the great potential value of HSI in orange-processing operations.

Headwall's award-winning Hyperspec® MV.X system is designed to streamline the extraction of actionable information from hyperspectral data. Highly intuitive software enables the user to easily create and improve the prediction models and deliver real-time results.

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¹ [The Orange Book](https://orangebook.tetrapak.com/), Tetra Pak, copyright 2023, <https://orangebook.tetrapak.com/>

Want to know more?

Our Headwall Applications Team will work with you to explore how HSI can deliver value to your fruit processing plant or citrus grove!

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