Controlling Ethylene and Ripening Avocados

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Introduction

The avocado industry struggles with making the growth and storage of avocados more efficient. Controlling ethylene levels has been used to control avocado ripening. As avocados ripen, they develop an index of dry matter, which is regulated in the market. It is inconvenient to analytically determine dry matter of avocados, so I worked to help develop instruments that easily measure ethylene and dry matter, which gives avocado farmers greater efficiency in their avocado production.

Materials and Methods

F-901B

- Firmware was uploaded to PCBs, then communication from the PCBs to a computer with the PyModbus protocol was verified
- Using a code in Python, PCB environmental sensors were tested
- Devices were assembled with a PCB, gas input/output, pump, cleansing mechanism, and gas sensors which were calibrated and verified with a span

Figure 1. A completed assembly of the F-901B Gas Analyzer

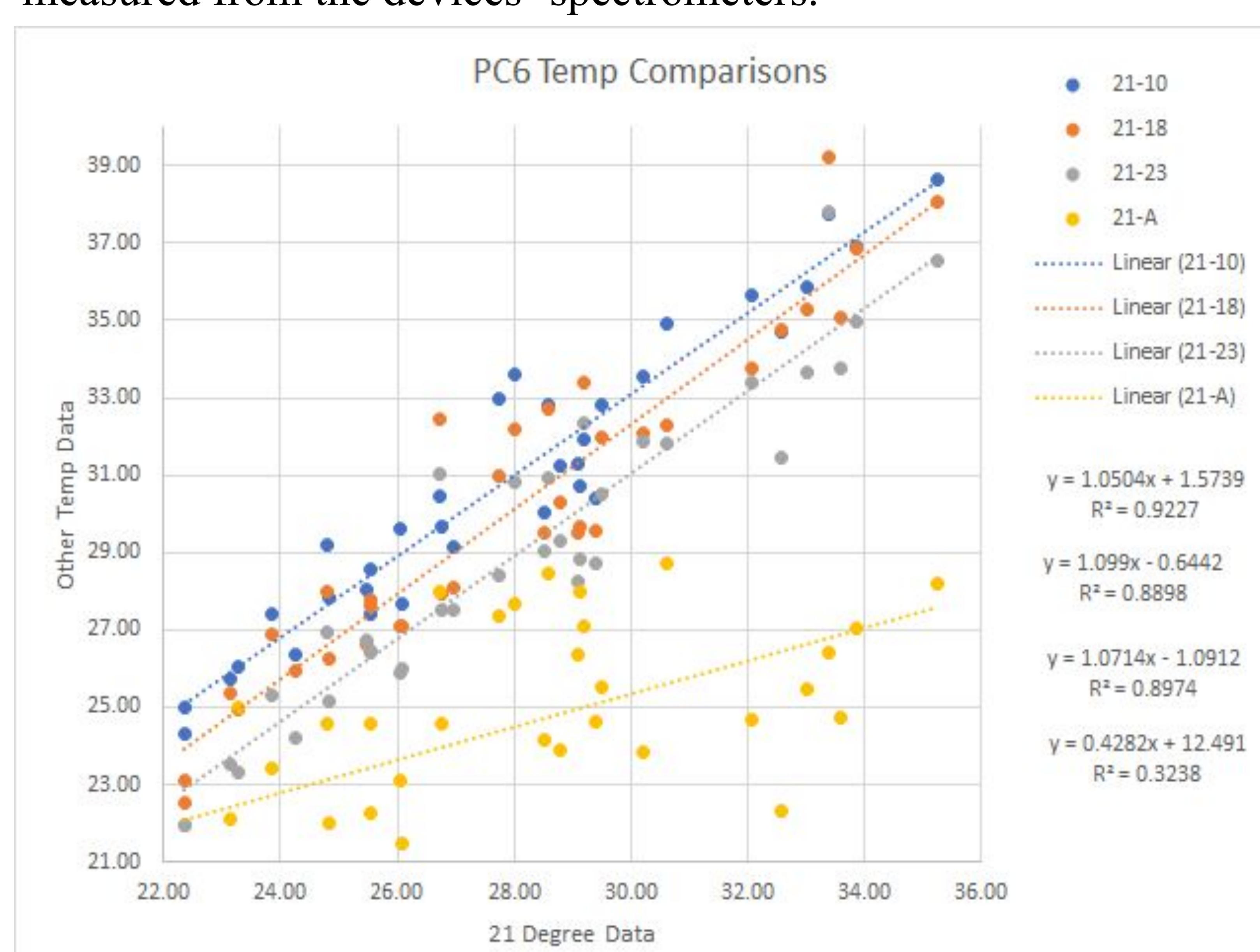
F-750/751

- Dry matter testing
  - Avocados were labeled and scanned on both devices to gather dry matter predictions
  - Small chunks of the avocados on each scanning site were cut, weight, and dehydrated for two days
  - After two days, the chunks were reweighed to find the actual dry matter
- Temperature verification/adjustment
  - Avocados were placed in an environmental chamber ranged from 10-50℃
  - Dry matter predictions were made with the devices, then analytical dry matter data was taken
  - Device predictions at various temperatures were calibrated to align with analytical data

Figure 2 (top left). Sample scanning of an avocado with the F-750 and F-751. Figure 3 (top right). Avocado samples in the dehydrator. Figure 4 (left). Dry matter testing setup.

Results

I produced, tested, and calibrated 37 units of the F-901B. Using the F-750 and F-751, I scanned avocados under different conditions to create dry matter prediction models. These were based on my analytical dry matter data and the reflectance spectra measured from the devices' spectrometers.



Graph 1. Plot of dry matter predictions at varying temperatures.

Discussion

When I tested firmware on the F-901B, the Modbus protocol would fail and the computer would not be able to accurately read information from the device. The gas sensors also needed to be calibrated several times at different concentrations to ensure that they worked properly.

Based off my dry matter predictions for avocados at different temperatures, I normalized the predictions by adjusting the regression lines to fit the analytical data. This allowed the F-750 and F-751 to make better dry matter predictions under different circumstances. Making a working model was difficult because the avocados changed in ripeness over time, causing dry matter fluctuations. There were also times when no correlation could be found in the predictions between devices, which made normalizing the predictions impossible.

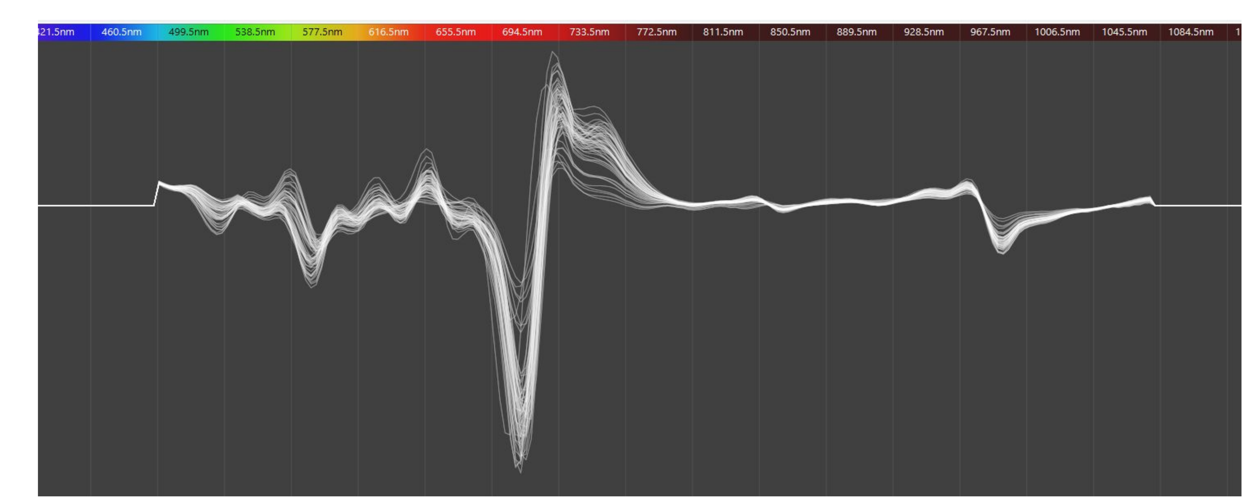


Figure 5. Reflection spectra from the NIR scanner.

Conclusion

I produced a set of F-901B Gas Analyzers and made significant progress in improving the F-751 Avocado Quality Analyzer. By testing how the temperature of avocados affected their dry matter predictions, I made a model that eliminated those wavelengths most affected by temperature and normalized the predictions to match the analytical data and the F-750. In the future, more testing with avocados in different climates and dry matter contents must be made to further develop the F-751. However, the combination of instruments that can measure and control ethylene levels and instruments that can measure the ripeness of avocados are a viable method to increase efficiency in the food industry.

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