

Measuring Spices on Various Spectrophotometers



Abstract:

Color is an indication of quality and freshness of spices, that is why maintaining color accuracy and consistency in spices is important for appealing and responding to today's customer's needs. Therefore, special spectrophotometers with the right accessories and presentation techniques are essential to ensure uniformity and more repeatable results during measurement.

HunterLab in the past developed ColorFlex EZ as one of the standard instruments to measure the reflectance of spices. However, as spectrophotometric technology has advanced in recent years, and as our customers' needs changes over time, HunterLab developed new innovative spectrophotometers that requires less sample prep and are designed specifically to move the sample under the sensor without touching the sample surface. This increases the measurement area of the sample.

The Instrumentation:

The instruments used in this test were Aeros, Agera, ColorFlex EZ, D25NC and LabscanXE. While the ColorFlexEZ and the LabScan XE both use flash Xenon lighting source, Aeros and Agera use LED technology. A more significant difference is the size of the area of the sample that is measured. A summary of the port size and total area is listed below. The total measured area of Aeros and D25NC is larger due to the rotation of the sample.

| Instrument | Port Size | Illumination | Measured Area |
|----------------------|------------------|---------------------|--|
| Color Flex EZ | 1 inch/25 mm | Flash XE | 0.8 in ² |
| LabScan XE | 1.75 inch/44 mm | Flash XE | 2.4 in ² /1548 |
| Agera | 2 inch/ 50 mm | LED | 3.1 in ² |
| Aeros | N/A | LED | 7.8 in ² / 5100 mm ² |
| D25NC | N/A | LED | 7.8 in ² / 5100 mm ² |



- Sample Holder 145mm and 90mm Petri Dishes (D04-1018-680) and Plastic Petri Dish (L02-1016-781)










Port plate size for Agera, LabScanXE, and ColorFlex EZ

Sample Preparation:

- 1- Pour 50g of your sample in a 90 mm Plastic Petri Dish (L02-1016-781) and tap your sample Petri Dish once on a hard surface to settle the loose spice and add a little of the spice until the dish is filled.
- 2- Scrap the surface of your sample to present a flat uniform surface. Put the petri dish with spice in the petri dish sample holder.
- 3- Take a single-color reading of the sample in all sensors. Make sure that the bottom of your Petri Dish is clean
- 4- Dump the sample in a different cup and refill it with a new batch of the same sample.
- 5- Repeat the measurement 2 times discarding the previous batch and using a different batch of spice each time. You have now three readings of the same sample.
- 1- Average the three-color readings for a single-color measurement representing the color of the batch. Averaging multiple readings minimizes measurement variation associated with non-uniform samples.
- 2- Record the average color values for the sample batch.

Results: The absolute values and Standard Deviation of each sample are shown in the table below.

| | ColorFlex EZ | | | AGERA | | | LabScan XE | | | AEROS | | | D25NC | | |
|---|--------------|-------|-------|-------|-------|-------|------------|-------|-------|-------|-------|-------|-------|-------|-------|
| | L* | a* | b* | L* | a* | b* | L* | a* | b* | L* | a* | b* | L* | a* | b* |
| Sample 1  | 86.70 | -0.49 | 24.13 | 86.79 | -0.51 | 24.30 | 86.09 | -0.68 | 24.06 | 90.27 | -0.80 | 25.21 | 89.86 | -0.68 | 25.52 |
| | 0.29 | 0.07 | 0.74 | 0.29 | 0.06 | 0.65 | 0.29 | 0.06 | 0.58 | 0.19 | 0.06 | 0.59 | 0.16 | 0.05 | 0.29 |
| Sample 2  | 81.93 | -1.08 | 17.19 | 81.95 | -1.36 | 17.46 | 81.24 | -1.15 | 16.84 | 84.62 | -1.12 | 17.88 | 83.99 | -1.06 | 17.93 |
| | 0.28 | 0.03 | 0.26 | 0.25 | 0.03 | 0.23 | 0.23 | 0.02 | 0.19 | 0.31 | 0.02 | 0.08 | 0.21 | 0.04 | 0.04 |
| Sample 3  | 74.55 | 9.28 | 29.64 | 74.55 | 9.14 | 29.64 | 74.05 | 8.91 | 29.67 | 77.84 | 9.77 | 30.68 | 77.37 | 9.94 | 30.55 |
| | 0.52 | 0.15 | 0.20 | 0.32 | 0.13 | 0.21 | 0.34 | 0.15 | 0.20 | 0.09 | 0.06 | 0.07 | 0.07 | 0.06 | 0.08 |
| Sample 4  | 46.80 | 13.33 | 23.90 | 46.70 | 13.22 | 23.93 | 46.41 | 12.93 | 24.39 | 49.91 | 13.46 | 24.85 | 49.41 | 13.54 | 24.61 |
| | 0.58 | 0.03 | 0.10 | 0.60 | 0.01 | 0.08 | 0.59 | 0.02 | 0.07 | 0.09 | 0.04 | 0.07 | 0.11 | 0.07 | 0.12 |
| Sample 5  | 60.07 | 37.22 | 52.24 | 59.94 | 36.85 | 52.36 | 59.88 | 35.95 | 53.39 | 64.20 | 37.43 | 54.19 | 63.72 | 37.53 | 53.87 |
| | 0.16 | 0.32 | 0.33 | 0.07 | 0.20 | 0.21 | 0.12 | 0.19 | 0.20 | 0.23 | 0.13 | 0.27 | 0.31 | 0.07 | 0.20 |
| Sample 6  | 67.37 | 6.84 | 41.72 | 67.40 | 6.46 | 41.87 | 67.36 | 6.60 | 42.19 | 69.76 | 7.33 | 42.98 | 69.18 | 7.41 | 42.50 |
| | 0.05 | 0.05 | 0.43 | 0.01 | 0.05 | 0.47 | 0.07 | 0.03 | 0.45 | 0.16 | 0.04 | 0.09 | 0.24 | 0.03 | 0.13 |
| Sample 7  | 69.10 | 35.26 | 54.08 | 68.92 | 34.92 | 53.94 | 68.79 | 34.08 | 54.61 | 73.23 | 35.19 | 55.75 | 72.91 | 35.68 | 55.64 |
| | 0.04 | 0.13 | 0.20 | 0.06 | 0.11 | 0.15 | 0.06 | 0.12 | 0.19 | 0.04 | 0.08 | 0.12 | 0.08 | 0.04 | 0.07 |

Summary

While all instruments can measure the spices with precision, the larger area of measure of Aeros and D25NC on non-homogeneous samples helps reduce the standard deviation of measurements (i.e more repeatable) without requiring additional amount of sample material.