New PTAB Color Score in 2018

Beginning in 2017, PTAB began a transition to a new color scale, one that will standardize scores with the rest of the nation.

The previous PTAB scale gave a 20 for fully mature, red fruit and 40 for orange fruit. While the scale has been used across PTAB stations for many years, we are introducing a new method of color assessment.

The new method uses a Minolta CR-410 color measurement instrument which produces a new color score called the **Hunter Hue Angle**.

The Hue Angle distinguishes between colors using the angle along a color wheel with values going from 0 to 360 degrees, as shown in Figure 1.

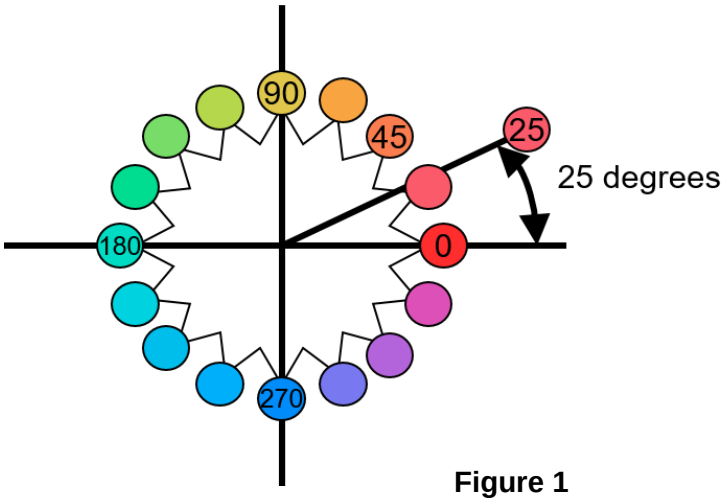


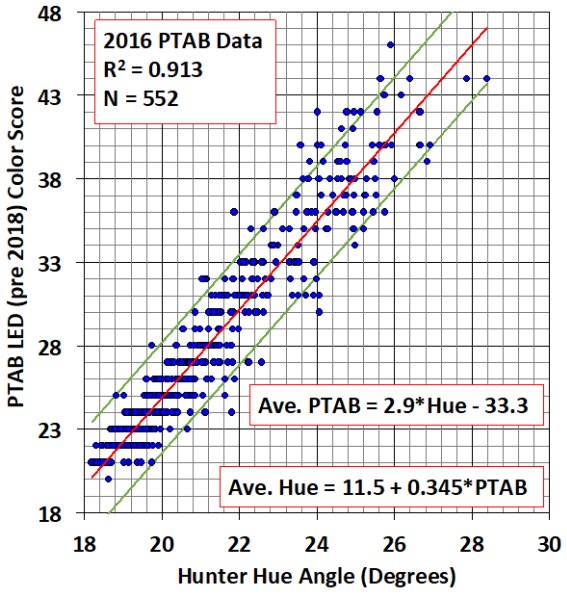
Figure 1

The Hue Angle of processing tomatoes typically ranges from 17 to 25.

While not a perfect conversion, it is possible to estimate an **average** PTAB color score from the Hue Angle score using mathematical formulas. The 95% lower and upper range for predicting PTAB color for individual truckloads is also shown

Range Estimates Based on 2016 PTAB Data

HUNTER HUE ANGLE (DEGREES)	LOWER 95% SINGLE TRUCK PTAB	AVERAGE PTAB COLOR SCORE	UPPER 95% SINGLE TRUCK PTAB
17.5	15.0	~17.5	21.6
18	16.3	~18.9	22.9
19	18.9	~21.8	25.6
20	21.6	~24.7	28.2
21	24.2	~27.6	30.8
22	26.9	~30.5	33.5
23	29.5	~33.4	36.1
24	32.2	~36.3	38.8
25	34.8	~39.2	41.4
26	37.4	~42.1	44.1



Measuring Tomato Color with Minolta

Color is an important indicator of maturity in tomatoes and is an important tool to managing product quality in the processing tomato industry.

The Hue Angle allows for an objective grading of color. It is a part of a larger measurement method, the **Hunter Lab Color Space**.

The Hunter Lab color score uses a combination of Hue, Lightness, and Saturation to describe a color.

Hue is what forms the base of the colors we can name, represented by the color wheel in Figure 1. Lightness is an added modifier that determines how bright or dark the color is. Saturation is an additional modifier that indicates how vivid or dull the color is.

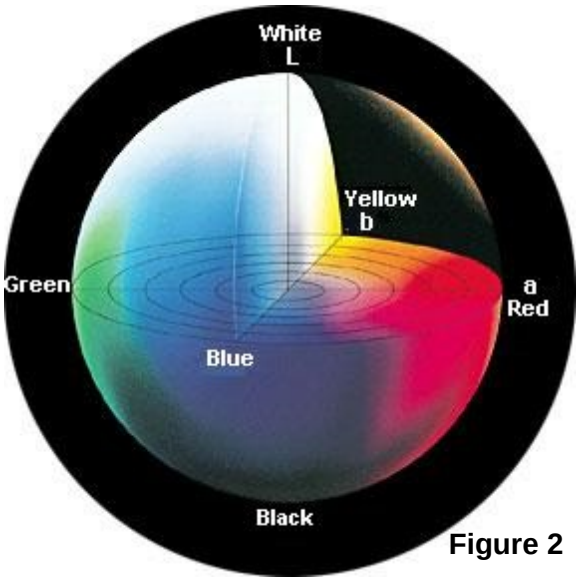


Figure 2

While all three characteristics are used in the Hunter Lab color score, the maturity of tomatoes in characterized by hue angle moving from green to yellow to red. This is why it is used as the official grade of maturity in the new color assessment system.

As an alternative form of expression to hue, saturation, and lightness, color can also be expressed as in a rectilinear coordinate system. The x-axis is represented by a, the y-axis is represented by b, and the z-axis is represented by L, as shown in Figure 2.

L is the lightness of the color in the vertical direction. a and b values indicate color directions towards red, blue, yellow, and green.

The Lab color space is widely used in modern food production systems. By adopting this notation, we are able to standardize scores across quality control labs in tomato processing facilities.

If you would like to learn more about Hue Angle or the Lab Color Space, visit this link: https://www.konicaminolta.com/instruments/knowledge/color/pdf/color_communication.pdf

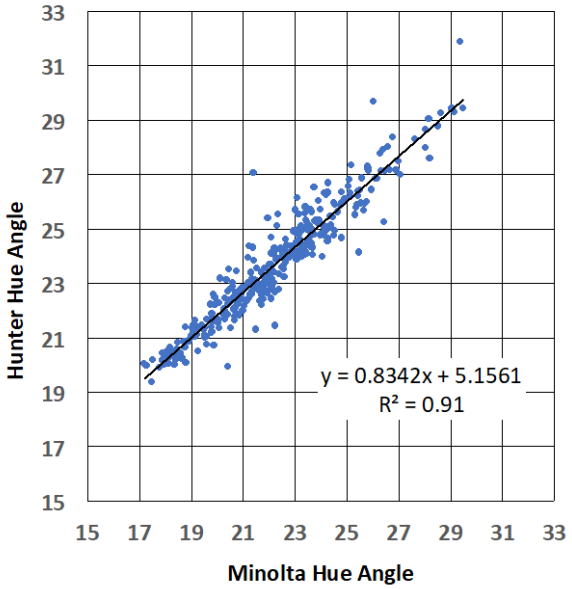
PTAB uses the Konica Minolta model CR-410 colorimeter at the processing tomato inspection stations to measure the Hunter Hue Angle as well as the Hunter a/b ratio of vacuum de-aerated tomato juice samples.

The whole tomato is used in the measurement (i.e. no seeds or skin is removed) and the tomato juice is prepared by blending the sample under high vacuum (27 inches of Hg or higher) to remove air bubbles.

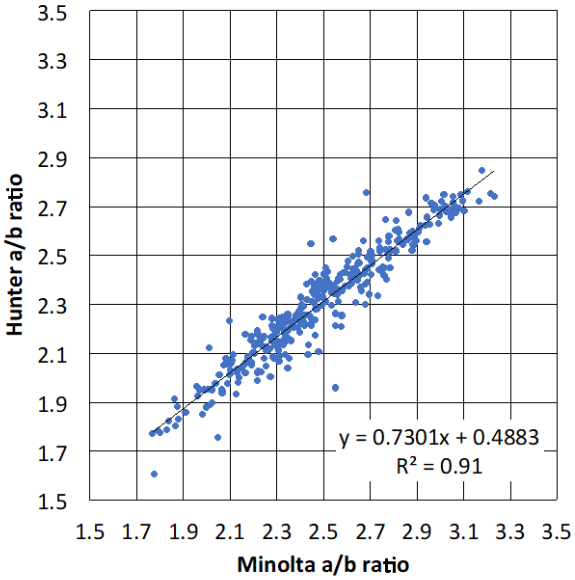
The CR-410 uses diffuse illumination and a 0º viewing angle geometry (specular component included) to make color measurements.

Konica Minolta
CR-410 Colorimeter

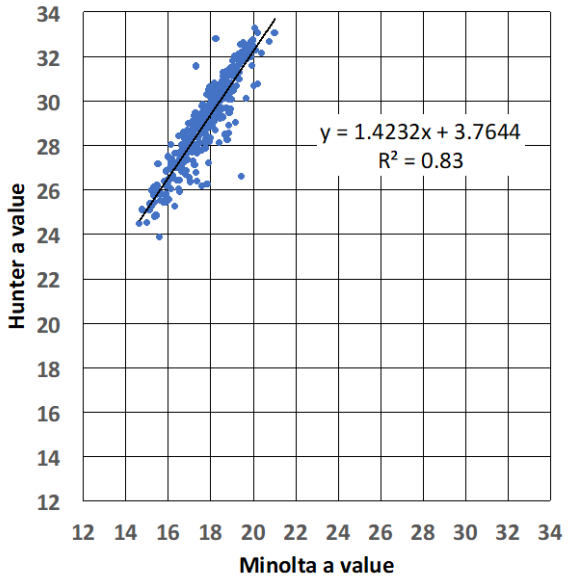
In 2006, UC Davis conducted a research study on raw processing tomato juice samples prepared using the standard PTAB method to compare the Hue angle, a/b ratio, and L, a, b color values produced by the Konica Minolta CR-410 to those produced by a HunterLab brand instrument (HunterLab uses direct 45-degree illumination). The results showing the relationships observed in the 2006 study are shown page 4. In general, ratiometric-based measurements, such as the Hunter Hue Angle and the Hunter a/b ratio show good agreement between the two types of instruments. Comparison plots for L, a, and b values are also shown on pages 4 and 5 for reference. While the correlation between instrument types for all color measurements are high, the illumination method affects the L, a, and b values more strongly than the ratio-based measurements. Thus a conversion equation is needed for converting the Minolta L, a, and b values to HunterLab L, a, and b values.



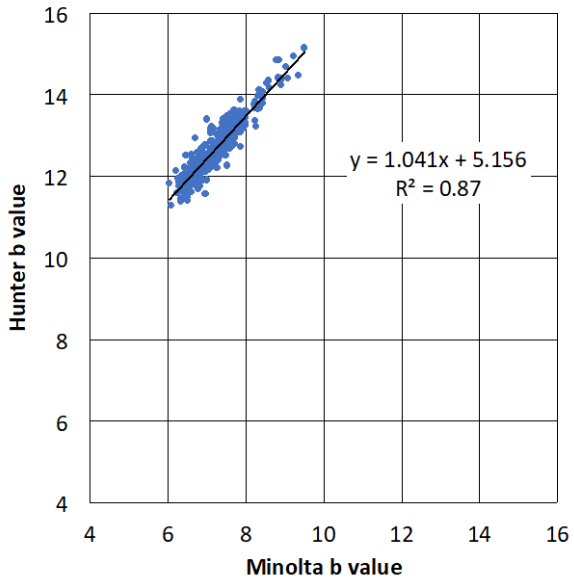
Comparison of Minolta and HunterLab Hue angles for raw processing tomato juice samples prepared using PTAB methods from 350 truckloads in 2006.



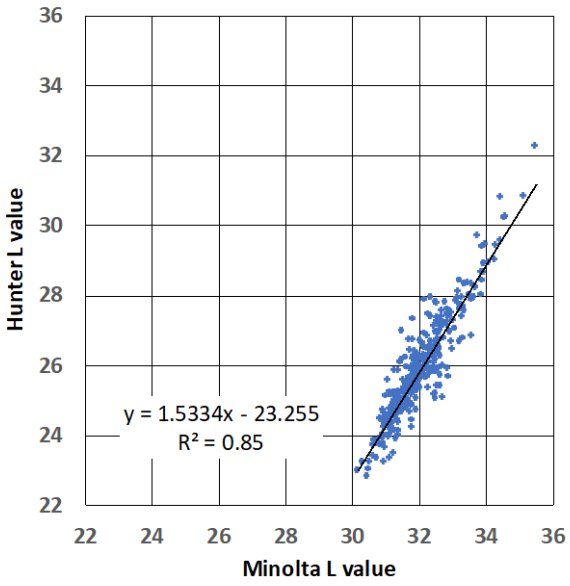
Comparison of Minolta and HunterLab a/b ratios for raw processing tomato juice samples prepared using PTAB methods from 350 truckloads in 2006.



Comparison of Minolta and HunterLab a values for raw processing tomato juice samples prepared using PTAB methods from 350 truckloads in 2006.



Comparison of Minolta and HunterLab b values for raw processing tomato juice samples prepared using PTAB methods from 350 truckloads in 2006.



Comparison of Minolta and HunterLab L values for raw processing tomato juice samples prepared using PTAB methods from 350 truckloads in 2006.