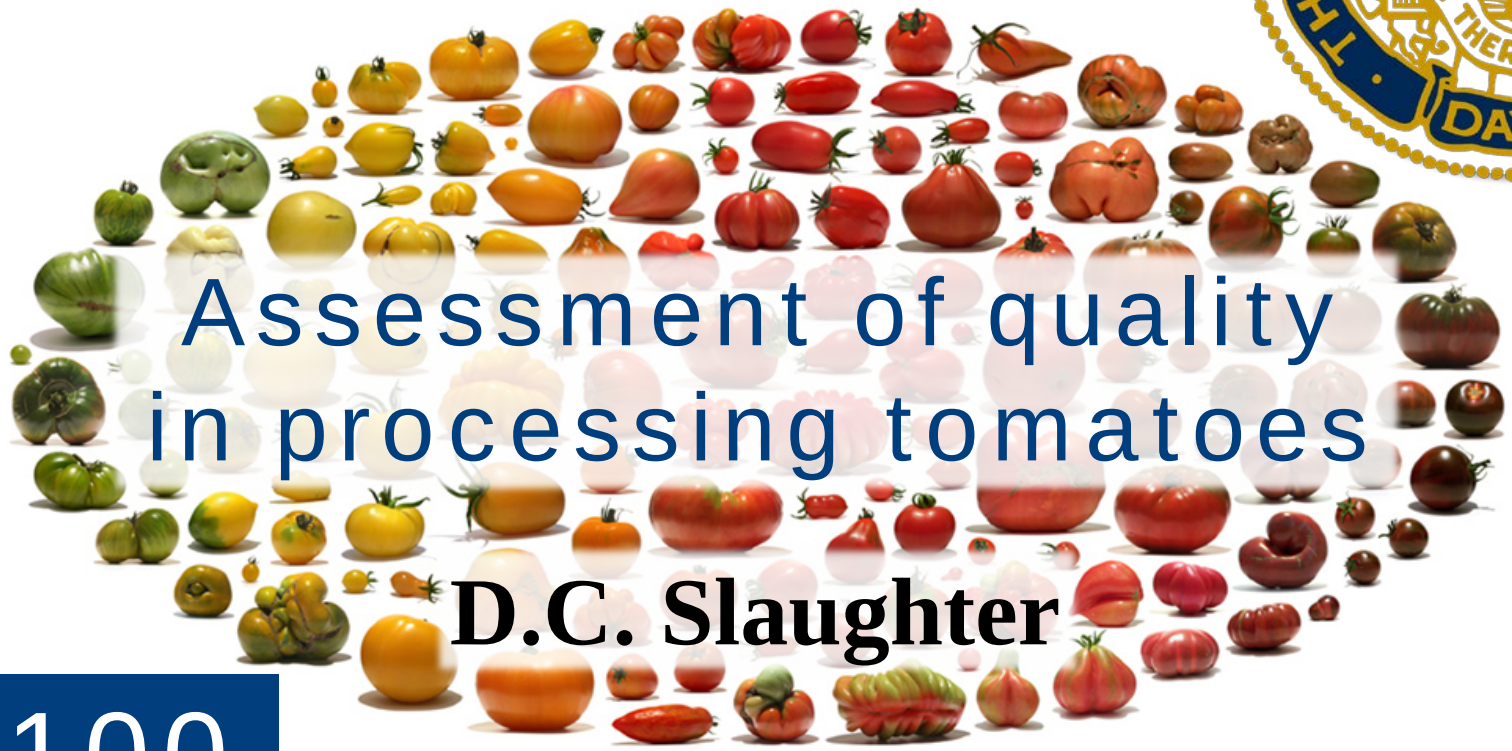
UCDAVIS



Assessment of quality in processing tomatoes

D.C. Slaughter

100 YEARS 1915-2015

BIOLOGICAL AND AGRICULTURAL ENGINEERING

http://www.uliwestphal.de/lycopersicum-content.html

Assessment of Tomato Quality

Mechanized Harvest

California Processing Tomato Inspection Program

Random Sampling

Inspection

Tomato Maturity and Ripeness

- Kader et al. 1977 & 1978
  - Tomatoes harvested at early ripeness stages were:
    - less sweet,
    - had less tomato-like flavor and
    - more off-flavor

  than tomatoes harvested a later ripeness stages.

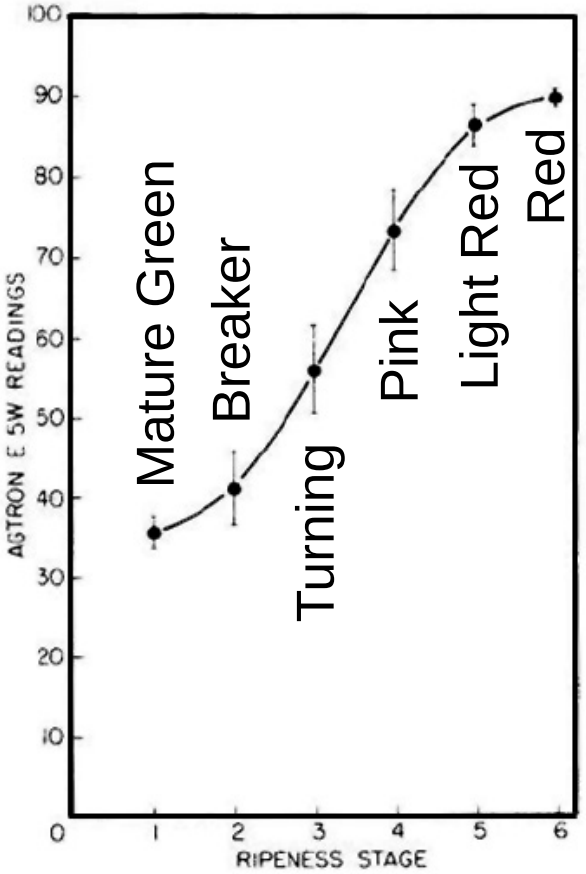
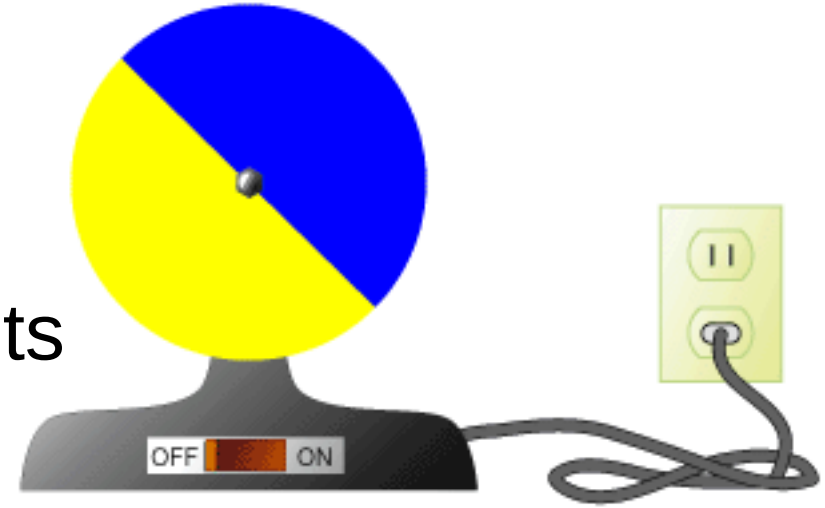


Fig. 1. Agtron E5-W reflectance readings vs ripeness classes of 'Ace 55' fruits. Each point represents a mean for 50 fruits and vertical lines indicate standard deviation.

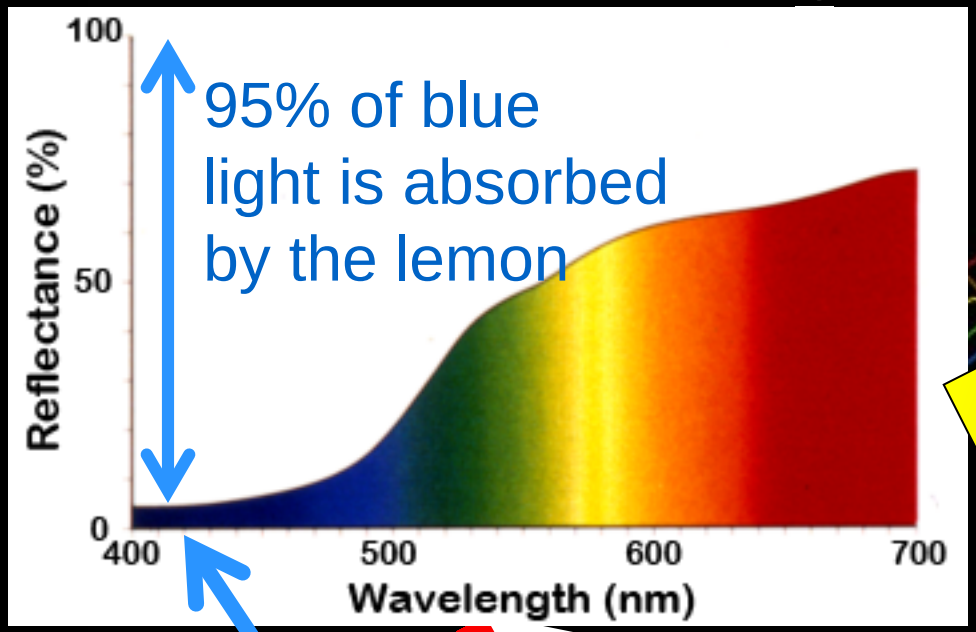
Brief History of Tomato Maturity Assessment

- 1931: MacGillivray spinning color disk

- 1950s: Analog Electronic Instruments



Physics of Light



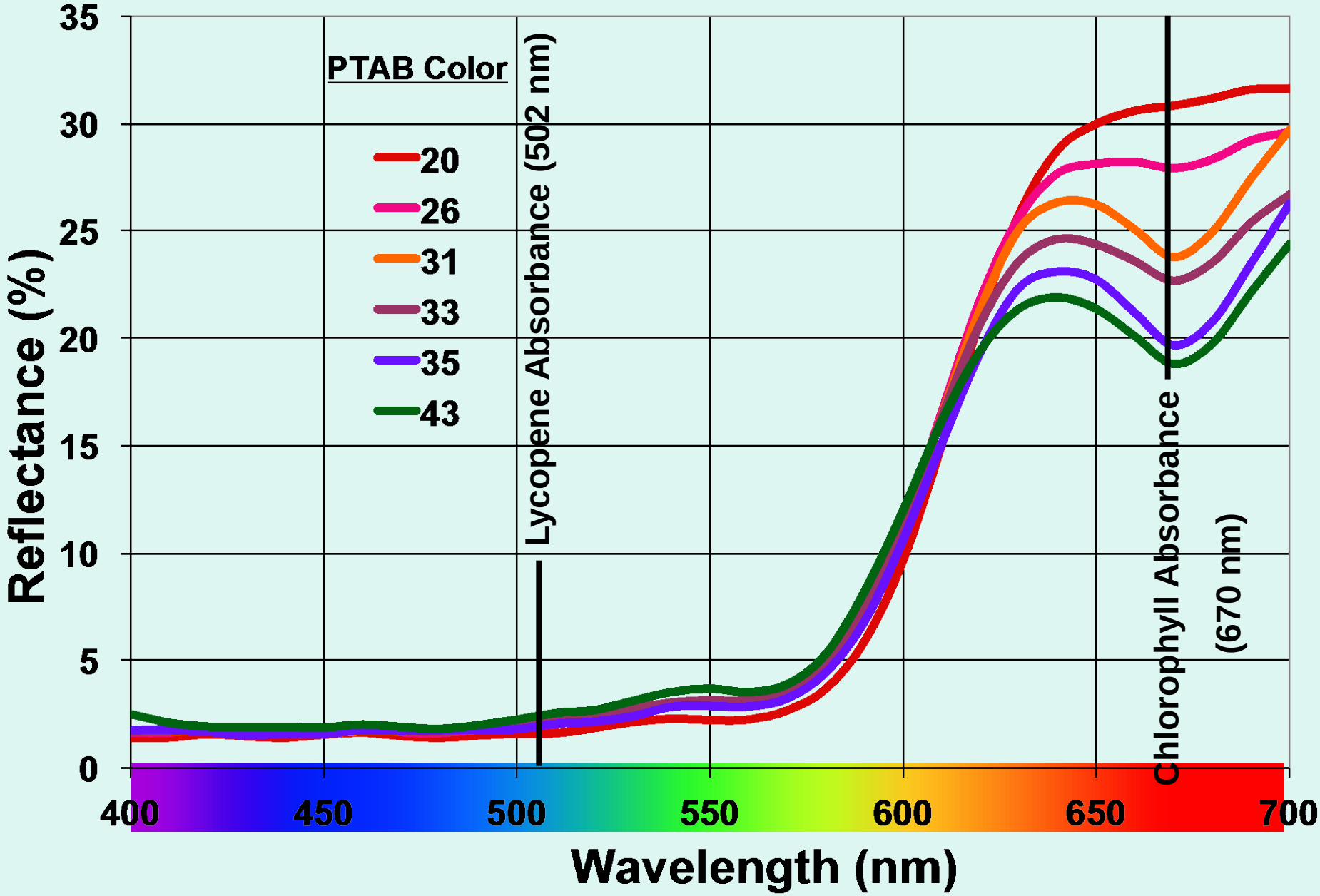
- Light is a wave.
- When light strikes an object, some of its frequencies are absorbed,

- rather, select frequencies of light are absorbed.

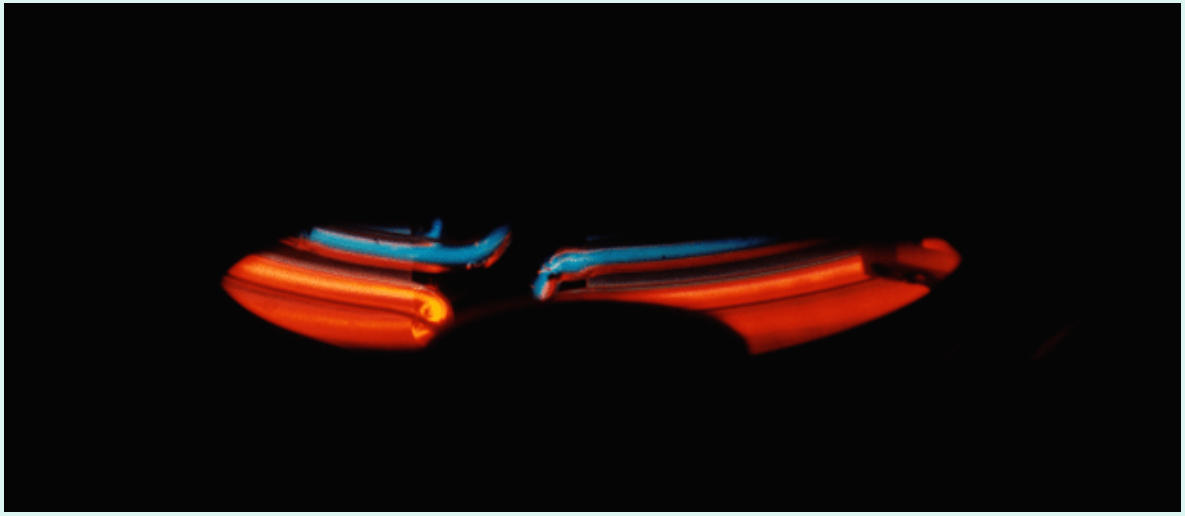
5% of blue light is reflected

White light is the combination of all components of the visible spectrum

Tomato Juice Reflectance

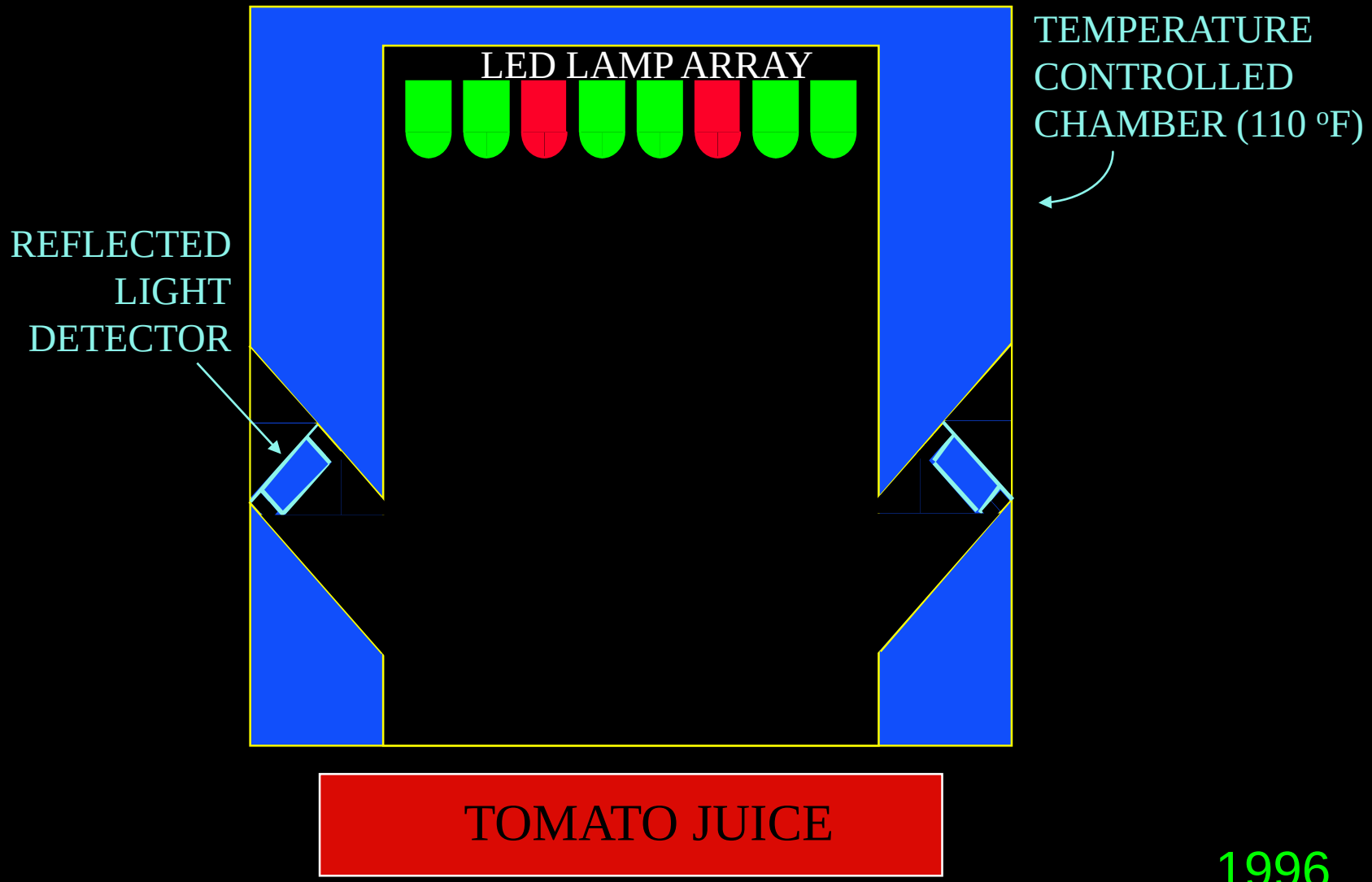


Agtron E5-M
Color in Processing Tomato Inspection



Red Neon &
Green Mercury
Lamps

UC Davis LED Tomato Color Meter



1996

Tomato Inspection Modernization

Concern:

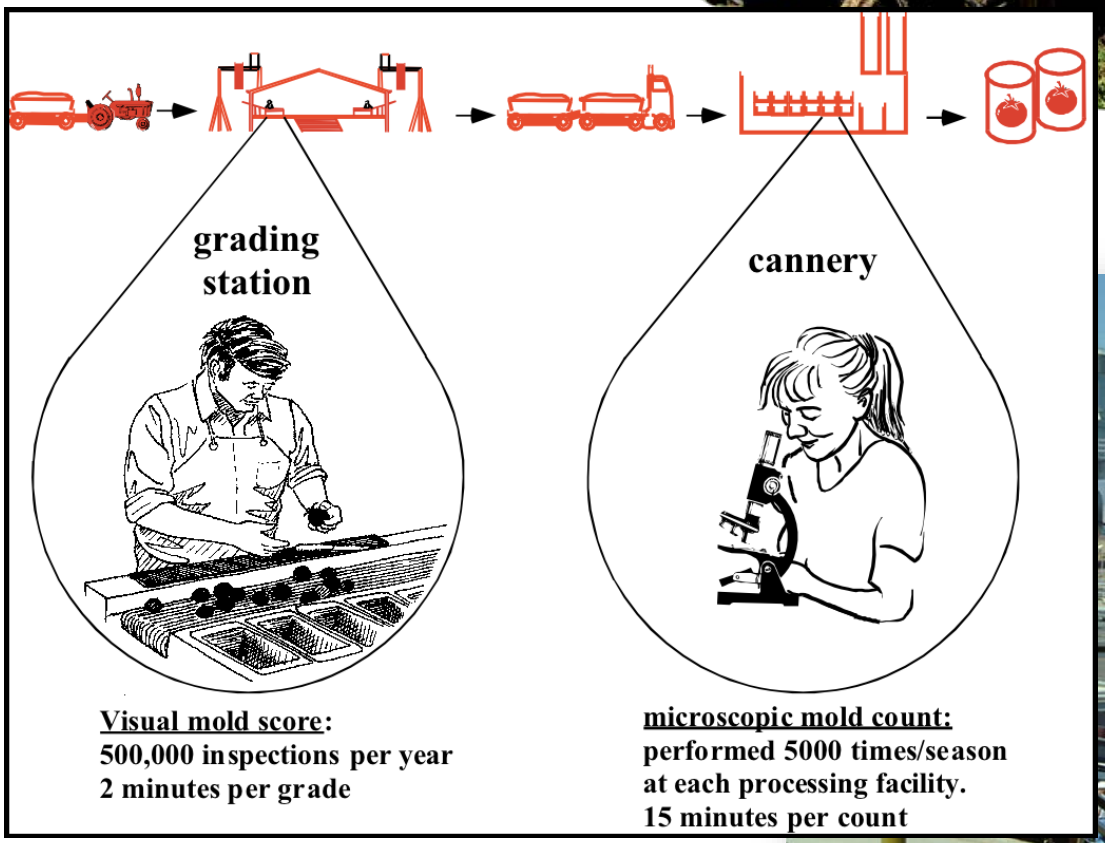
- Existing LED color systems were first deployed in 1996.
  - After 21 years of service, maintenance costs are an increasing concern.

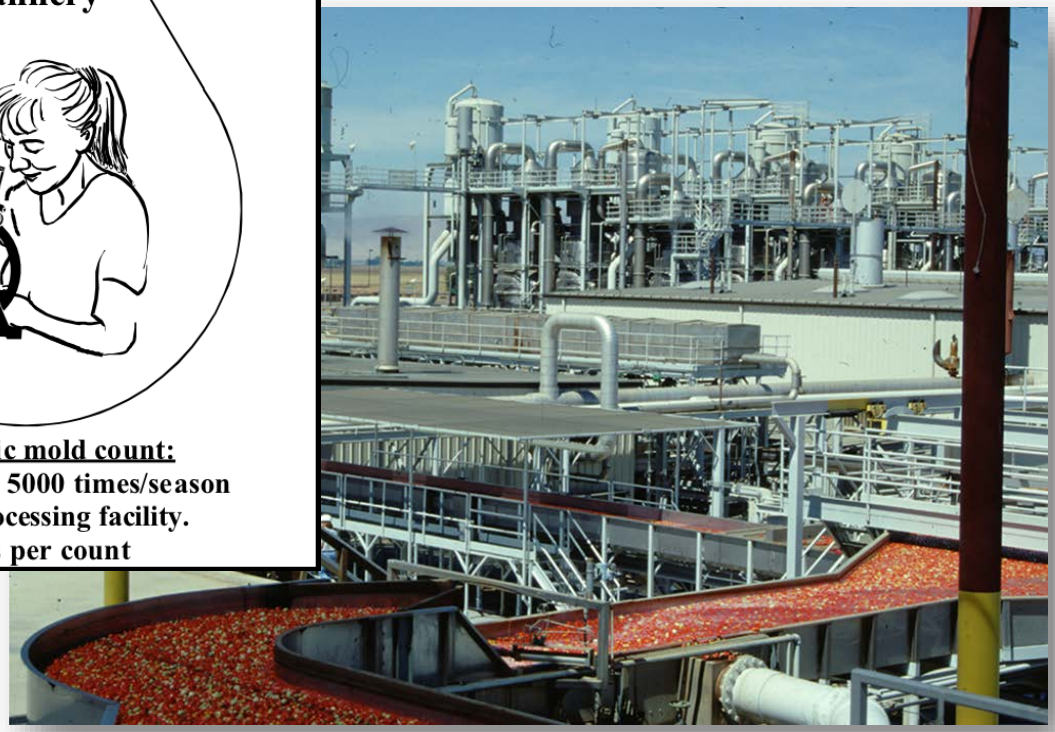
LED-Based Colorimeter Designed at UC Davis in 1996

Modernization Effort:

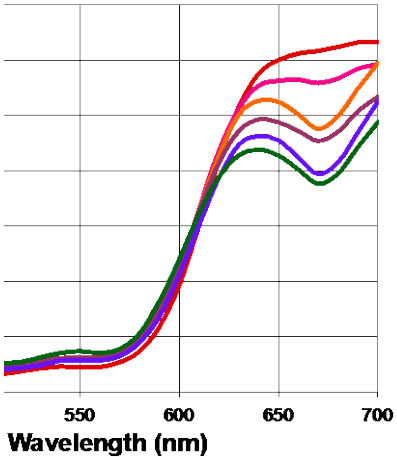
- To develop a fully automatic system for measuring color, pH and soluble solids content.

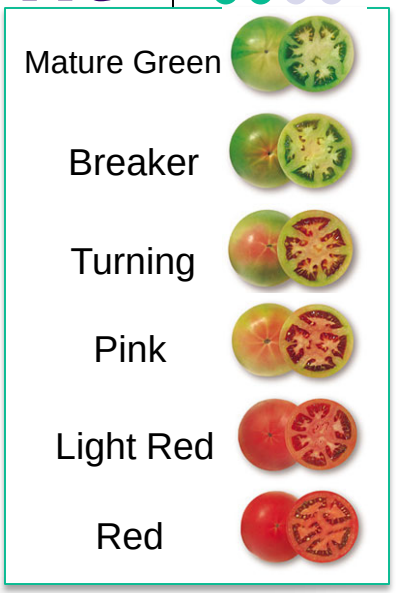
and in Processing

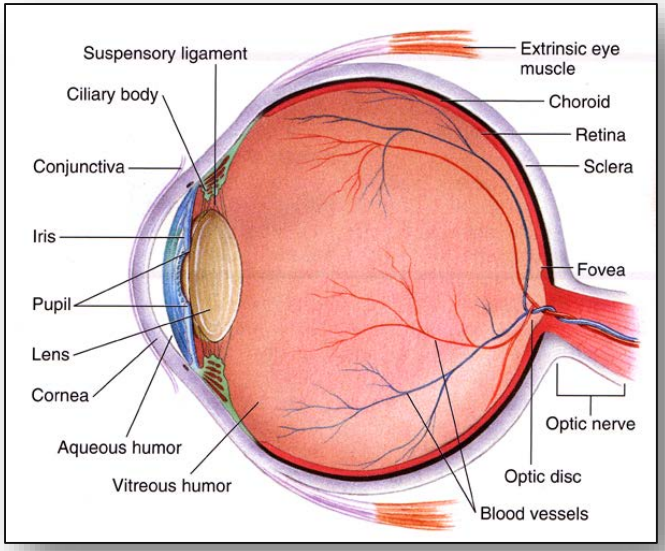




Tomato Appearance vs. Maturity Assessment

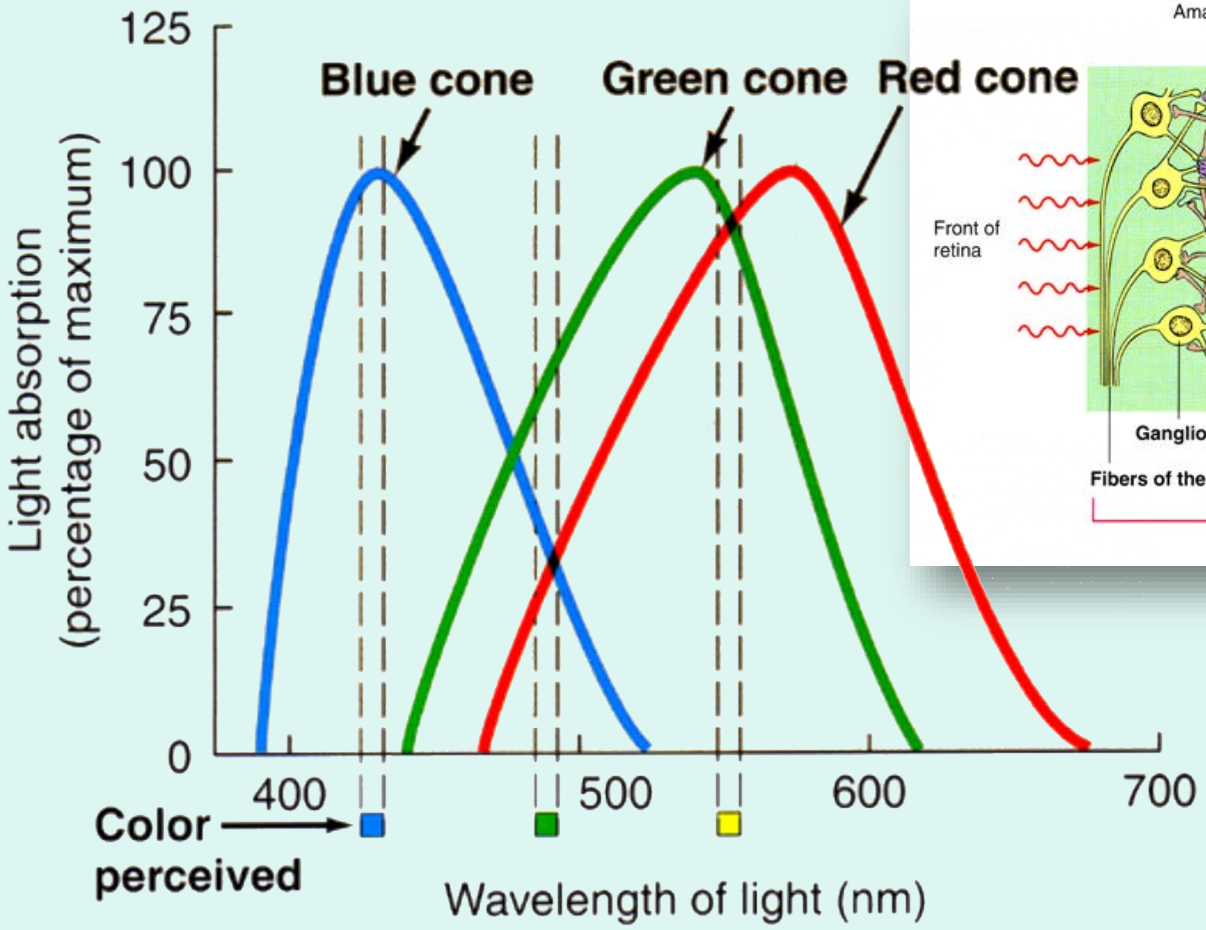


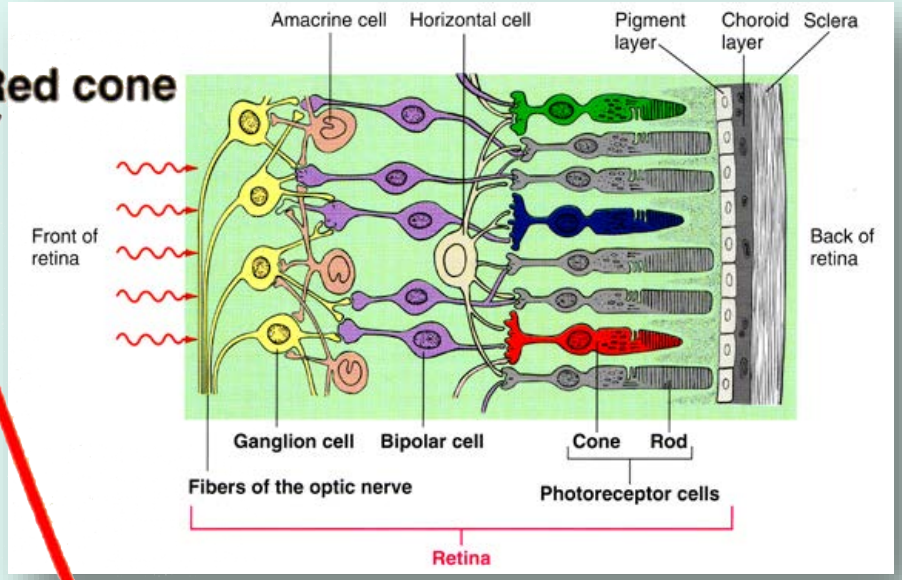




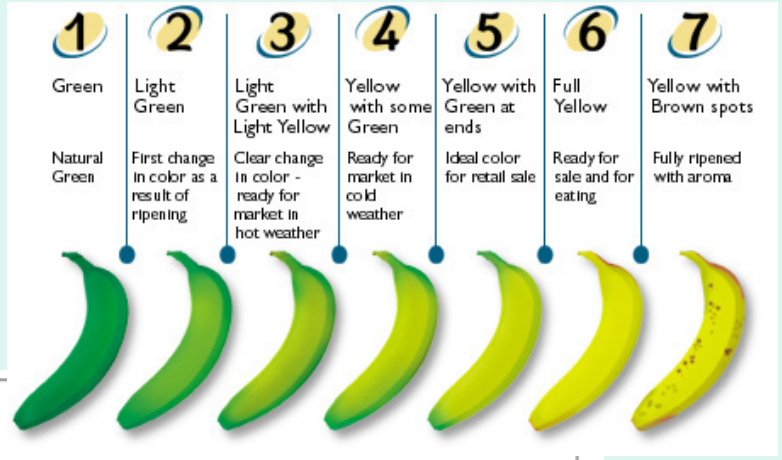
Human Eye

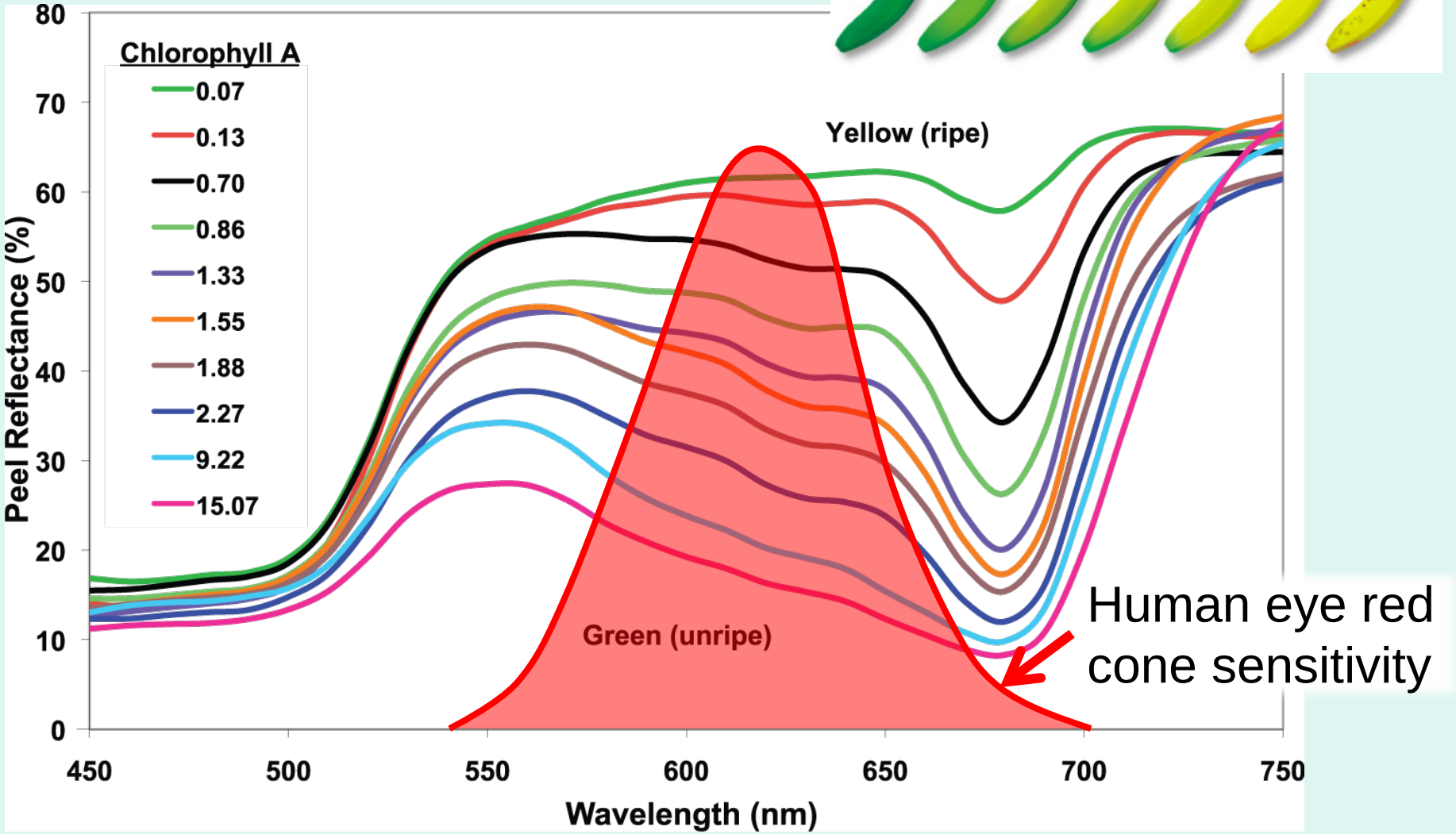
- Each cone in the human eye integrates the information across a wide (~33%) portion of the visible spectrum.





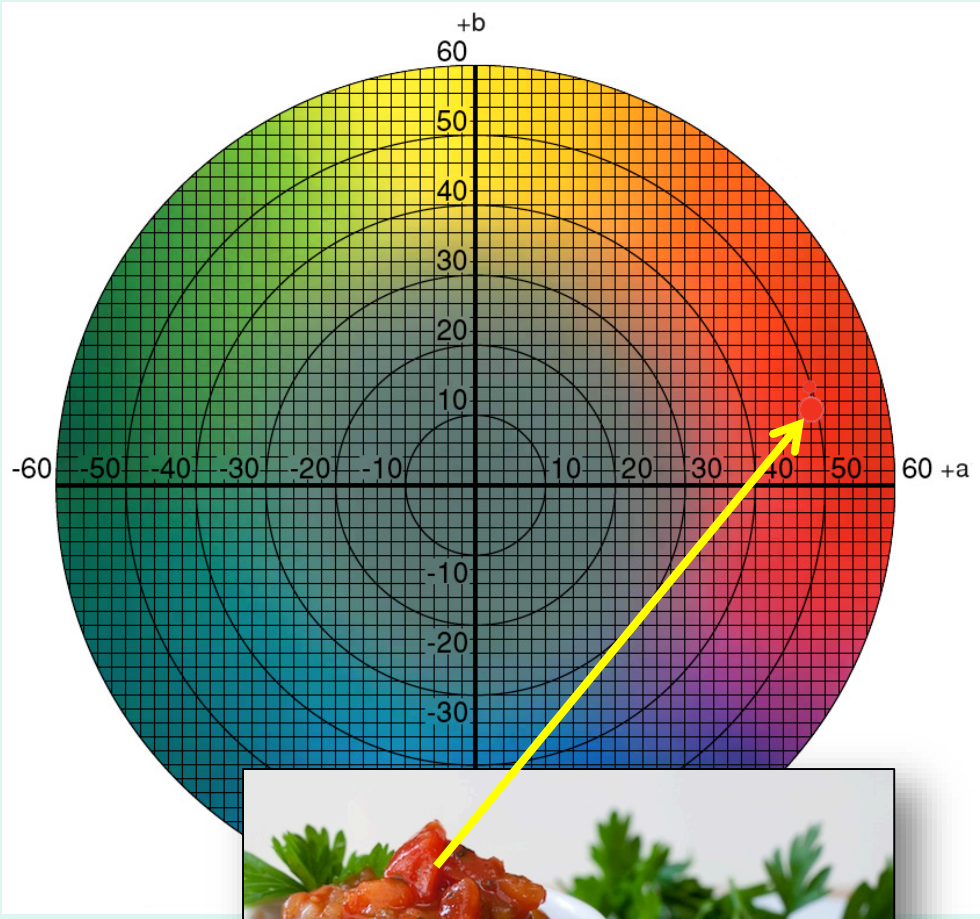
Example Quantifying Color





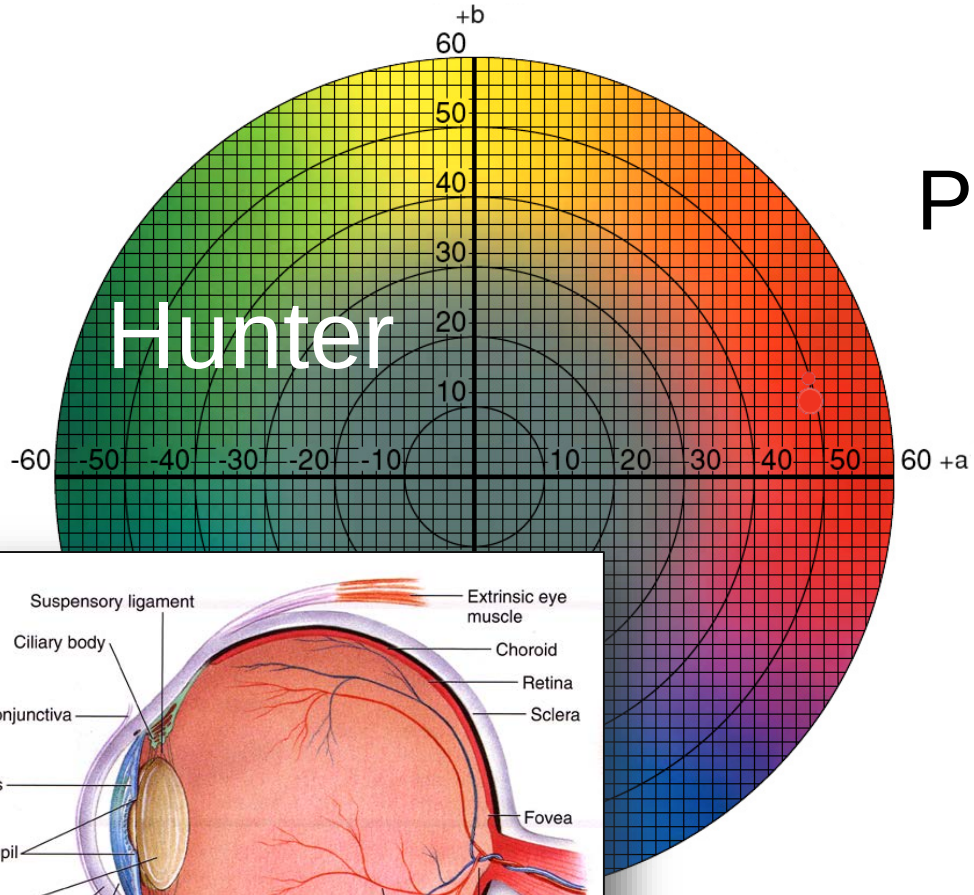
Hunter L, a, b color space

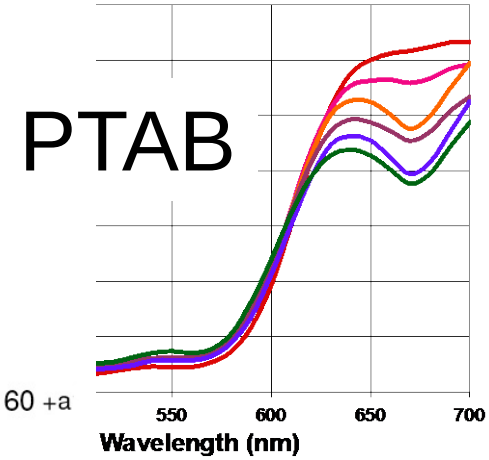
- Hunter a & b color scores have been adopted for quality assessment of processed foods by USDA.

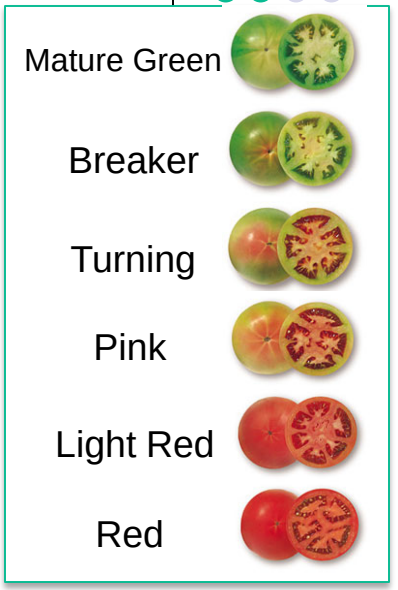


  - USDA Tomato Juice Color Score
    - USDA Color = 25.715 +K_1 * [a –K_2*b]
      - K_1 = 0.956, K_2 = 1.828

Tomato Appearance vs. Maturity Assessment







Traditional PTAB Color =

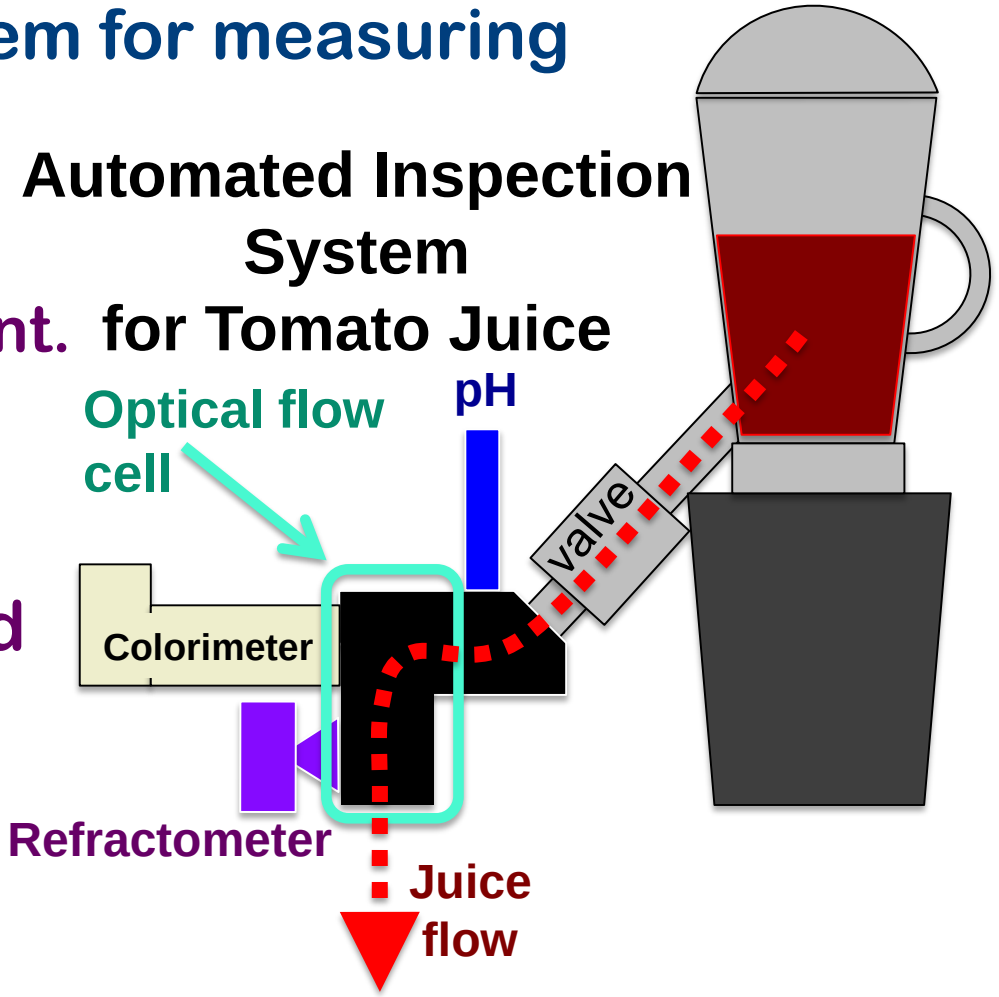
$$\frac{\text{Green Reflectance}}{\text{Red Reflectance}}$$

Hunter a value =
Red Cone – Green Cone

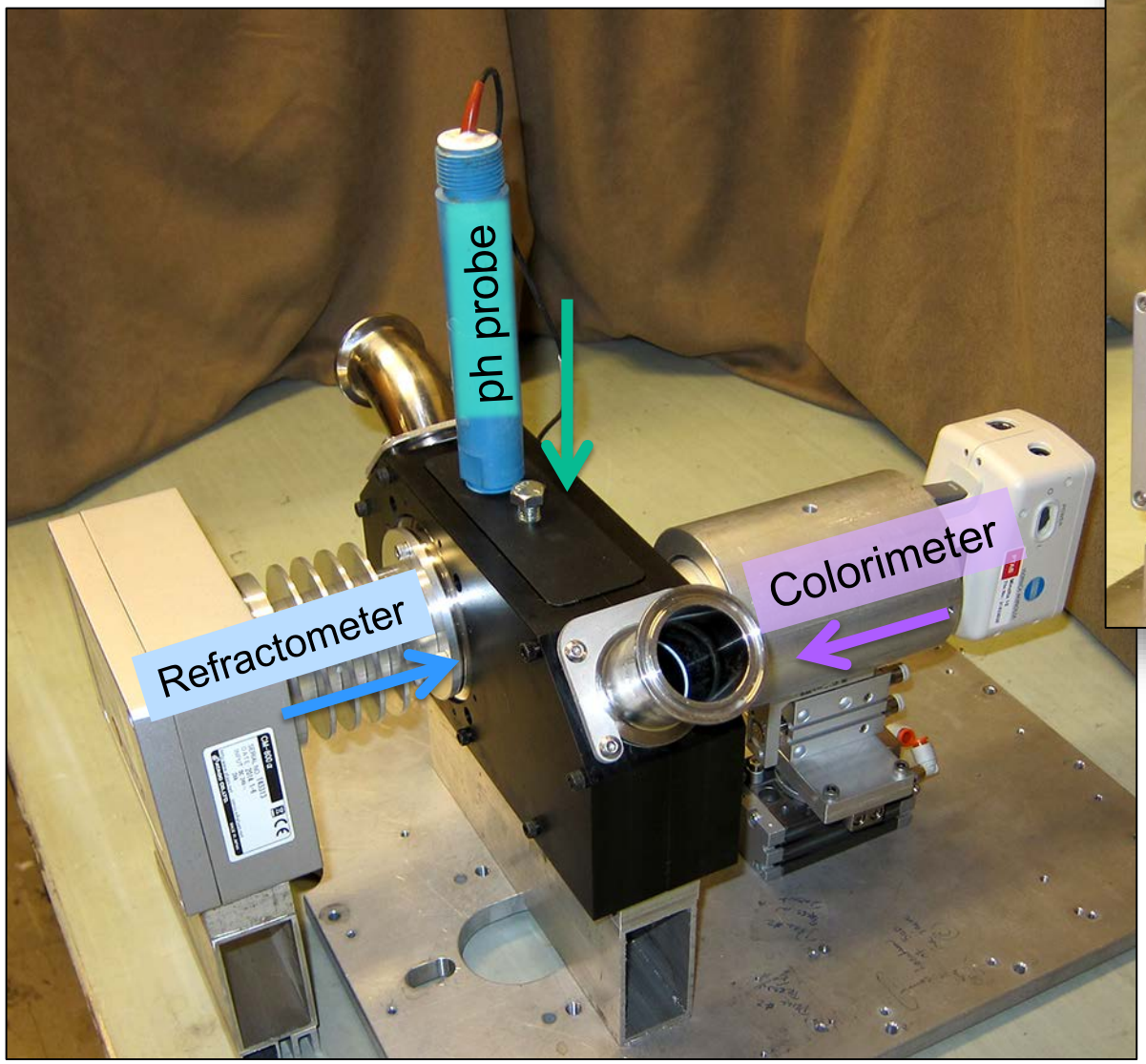
2017
Tomato Juice Inspection

- Fully automatic system for measuring
  - color,
  - pH, and
  - soluble solids content.
- is Self-cleaning.
- can Communicate
  - with the Defect and Sample Scales
  - and Gradestar.

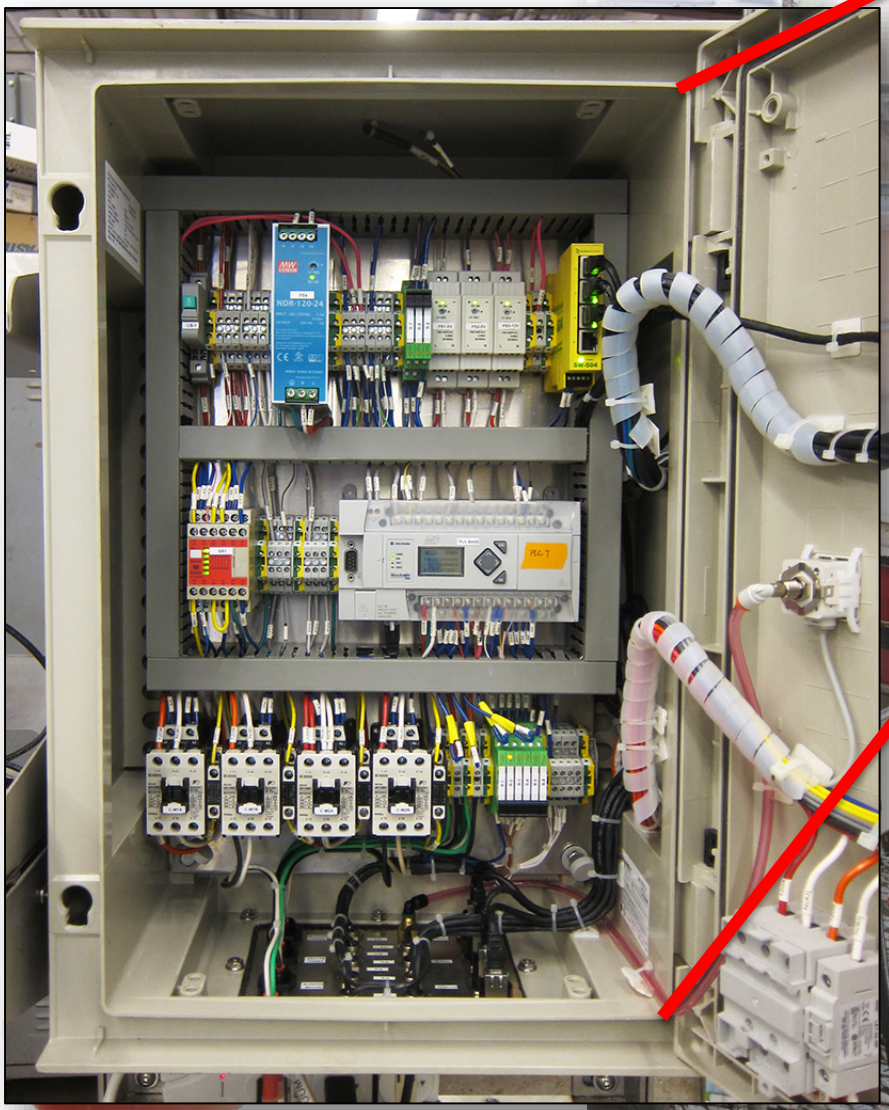
Automated Inspection System for Tomato Juice

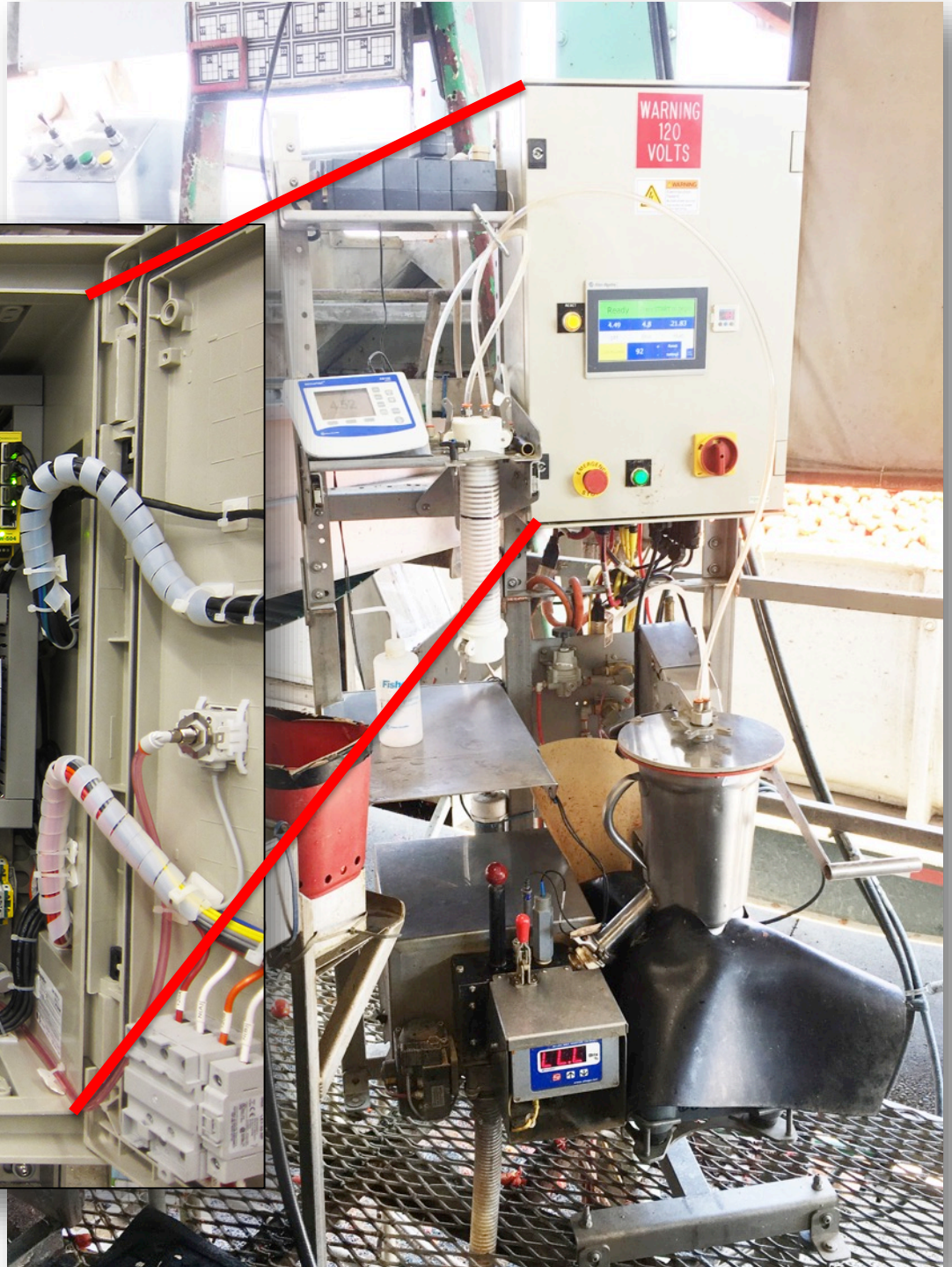


In-line Tomato Juice Flow Cell

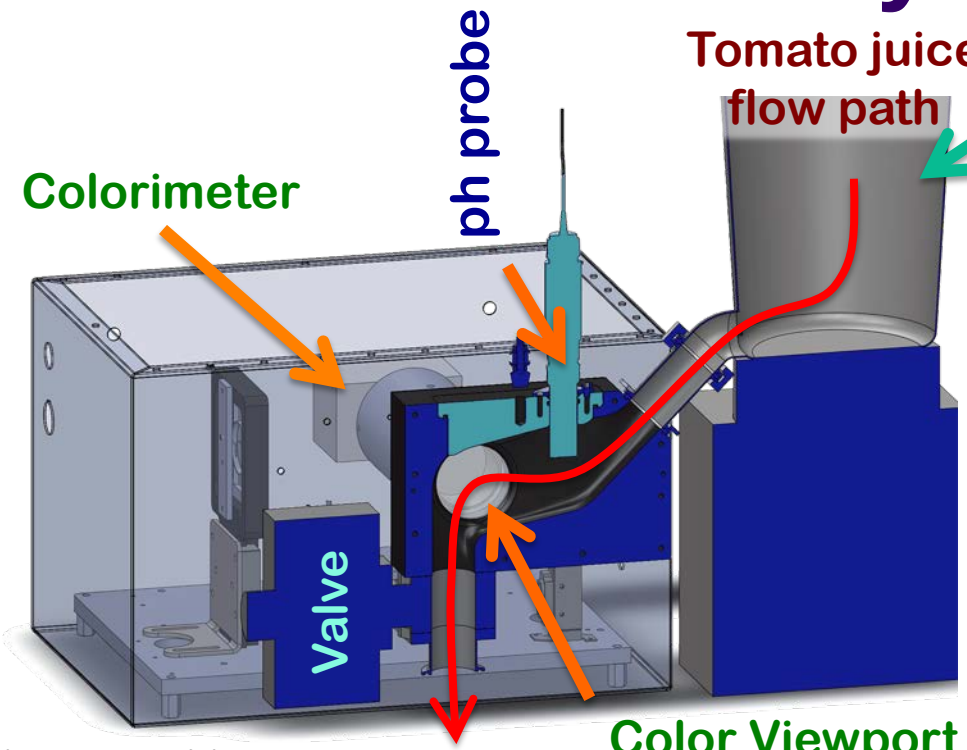


2017 TJIS

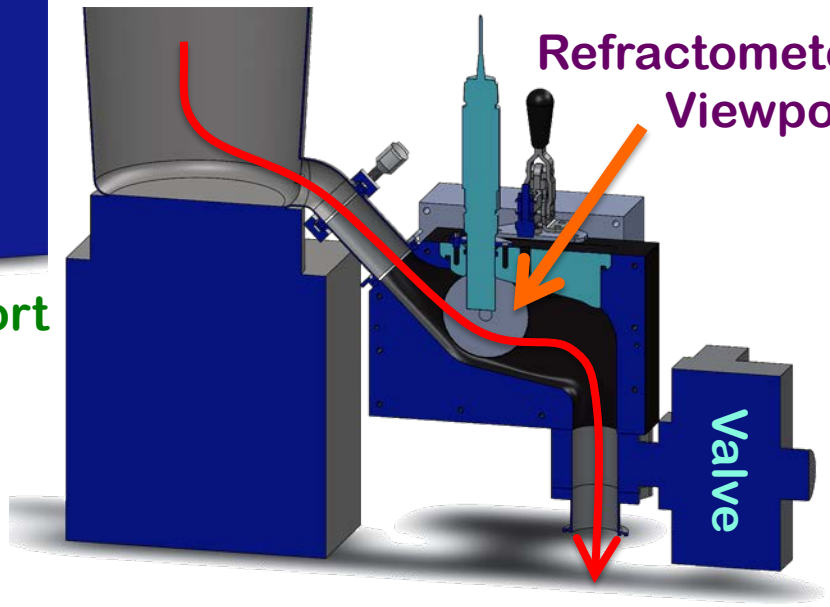




In-line Flow Cell System



Interior View
Looking Backward

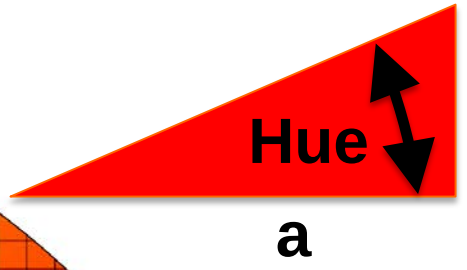


Interior View
Looking Forward

New PTAB Color Score

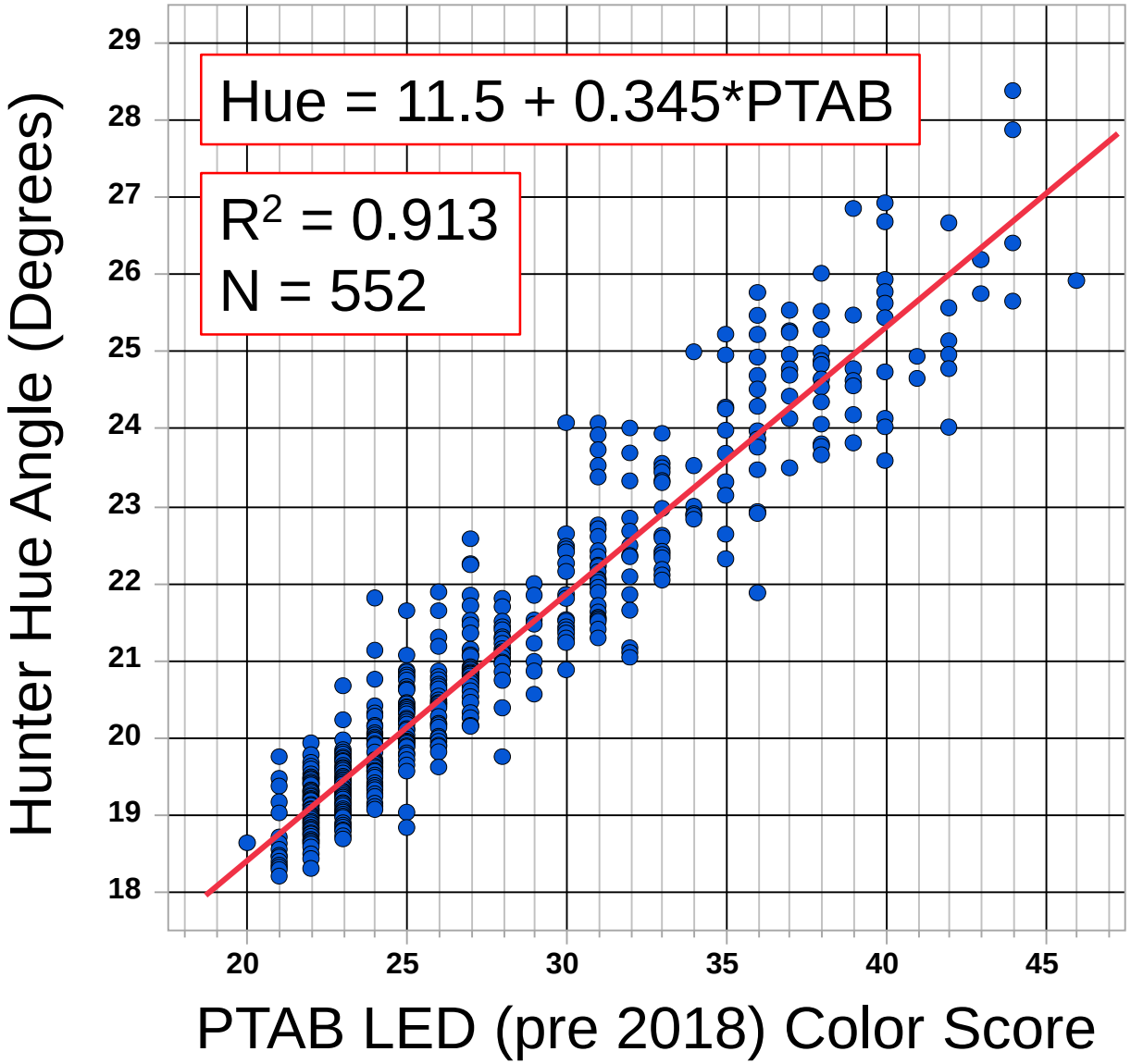
- Hunter Hue Angle will become the official grade in 2018.
- Hunter L, a, b will be provided at no extra cost.

Trigonometry
Hue angle = arc tangent(b/a)



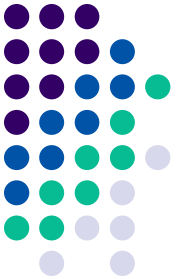
Hunter a, b Chromaticity Diagram

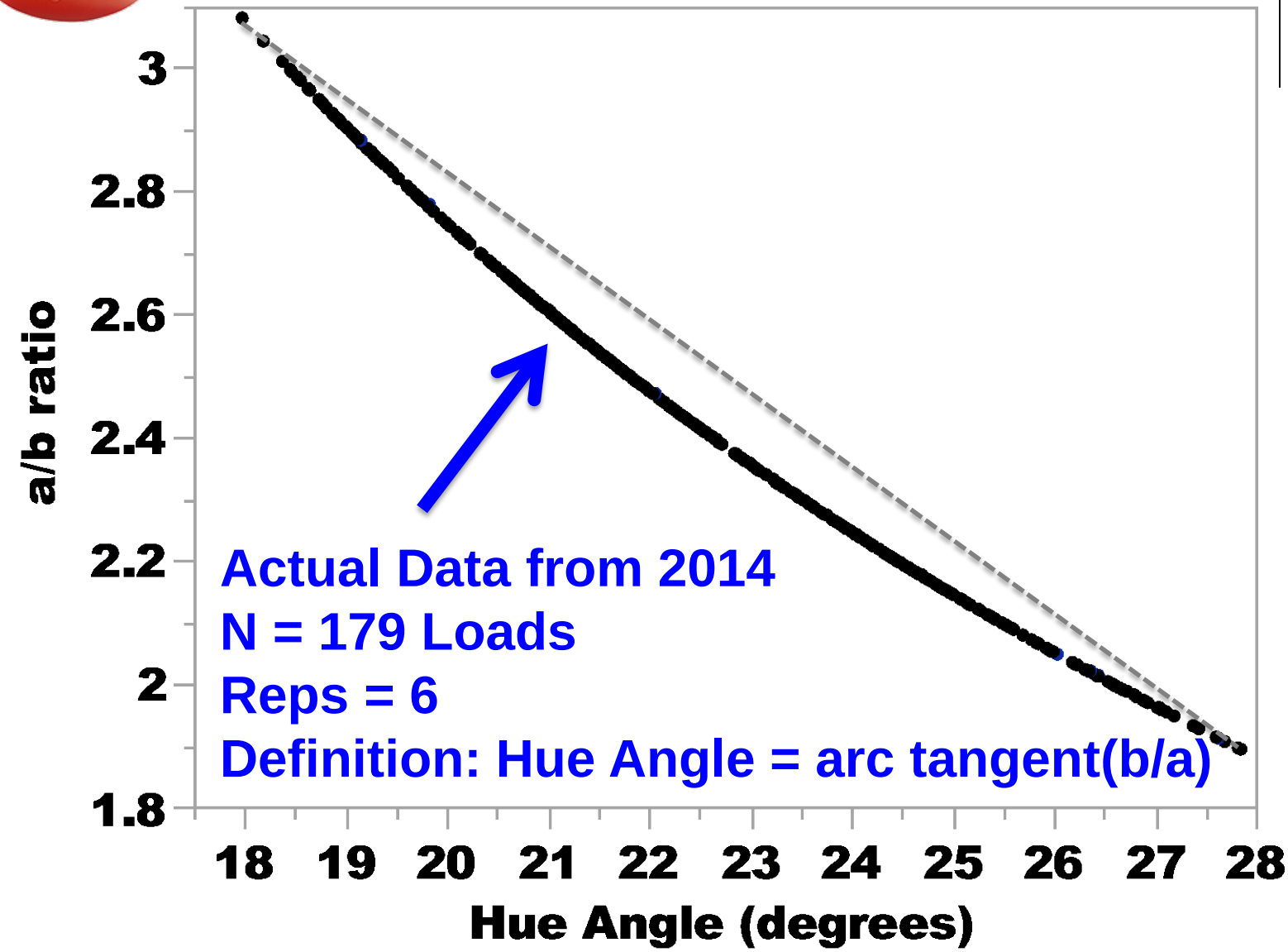
Converting from PTAB Color to Hue Angle



2016 Study Data

2014 Color Results





2018 Color Information

- For an information sheet on the new color score system please contact:
  - Tom Ramme, Manager
  - Processing Tomato Advisory Board
  - Phone: 530.759.7501
  - Email: Tom@PTAB.ORG