Citrus Scores

Background

Color is often used as an indication of quality and freshness for food products. This is the case for orange juice, where a red-orange color is preferred. Originally, orange juice manufacturers used subjective methods for measuring color. The subjective method used involved the visual comparison of orange juice in a standard glass tube to a set of United States Department of Agriculture (USDA) plastic comparators, also in glass tubes. As with any subjective method, the results were inconsistent.

In the 1950s and 60s, research was done by a number of companies in the hopes that they could produce an instrument for objective measurement of the color of orange juice. HunterLab developed the D45 Citrus Meter which is still used in the industry today although it is no longer manufactured. The current HunterLab instrument meant for measurement of orange juice is the ColorFlex 45/0. This is a compact spectrocolorimeter that can be used to measure the color of fresh and concentrated orange, grapefruit, and lemon juice contained in the same kind of glass tube that was used for the visual comparison method. It can show citrus score values in accordance with the USDA D45 Citrus Meter through hitch standardization with a USDA OJ4 plastic standard.

Conditions for Measurement

Instrumental: ColorFlex 45/0 with EasyMatch QC (EZMQC-Citrus/CFLX option), ColorFlex Citrus, D45

Illuminant: C

Standard Observer Function: 2 degree

Transmittance and/or Reflectance: Reflectance only.

Formulas

ColorFlex 45/0

$$\text{Citrus Red} = -469.800 + 542.475\left(\frac{X}{Y}\right) - 54.707\left(\frac{Z}{Y}\right) + \frac{75.447}{Y}$$

The world's true measure of color
HunterLab

$$\text{Citrus Yellow} = 134.900 - 28.329\left(\frac{X}{Y}\right) - 117.722\left(\frac{Z}{Y}\right) - \frac{19.163}{Y}$$

$$\text{Citrus Number} = -40.600 + 86.597\left(\frac{X}{Y}\right) - 22.073\left(\frac{Z}{Y}\right) + \frac{18.309}{Y}$$

where X, Y, and Z are the CIE Tristimulus Values.

Because there is a translucency difference between genuine citrus juice samples and the plastic OJ standard tubes, slightly different formulas are used for calculating the citrus values of standards. Those formulas are as follows:

$$\text{Citrus Red} = -471.000 + 542.475\left(\frac{X}{Y}\right) - 54.707\left(\frac{Z}{Y}\right) + \frac{75.447}{Y}$$

$$\text{Citrus Yellow} = 133.600 - 28.329\left(\frac{X}{Y}\right) - 117.722\left(\frac{Z}{Y}\right) - \frac{19.163}{Y}$$

$$\text{Citrus Number} = -41.000 + 86.597\left(\frac{X}{Y}\right) - 22.073\left(\frac{Z}{Y}\right) + \frac{18.309}{Y}$$

where X, Y, and Z are the CIE Tristimulus Values.

D45

$$\text{Citrus Redness} = CR = 200\left(\frac{A}{Y-1}\right)$$

where

A = amber portion of X tristimulus value.

$$\text{Citrus Yellowness} = CY = \left(\frac{1-Z}{Y}\right)$$

Typical Applications

The citrus scores are employed by citrus growers and processors. The scales are most commonly used for measuring orange juice, but they may also be used on grapefruit, lemons, and other citrus fruits.

For Additional Information Contact:

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