SOP No: SOP-PHYS-004	SOP Description: Hunter Color Determination
Effective Date:	Version: 1
Author: Sarah Lanning	Replaces Version:
Approval:	Approved Date:

SOP-PHYS-004: Hunter Color Determination

Scope:
Color is an important quality indicator of rice. Consumers generally prefer bright white rice, and lightness, or whiteness, is included in the USDA rice grading criteria. Lower grade rice may be shades of gray or yellow. Instrumental color analysis using the Hunter ColorFlex Colorimeter provides an objective way to quantitatively measure and compare the color of rice samples, by standardizing the elements necessary to view color.

Principle:
Three elements are necessary to see color: a light source, an object, and an observer. A light source emits light that appears white, but when diffracted by a prism, represents all wavelengths in the visible light spectrum (400-700 nm). Colorimeters use illuminants, which are plots of relative energy versus wavelengths, to represent different light sources under standardized and quantifiable conditions. Objects, or samples, modify light differently, depending on the colorants (ex. dyes, pigments) that are present, by selectively absorbing some wavelengths, while reflecting or transmitting others. The amount of light reflected or transmitted can be quantified to form a spectral curve of the object's color characteristics. Finally, observer functions have been established using red, blue, and green glass filters, to simulate the cone-shaped receptors in the human eye, and to quantify numerically the way in which the average human observer perceives color. Three-dimensional scales, such as **CIE L*a*b***, have been developed to objectively quantify color values. This scale defines color as follows:

> L* (lightness) axis: black to white (0 to 100)
> a* (red - green) axis: positive values are red; negative values are green; 0 is neutral
> b* (yellow – blue) axis: positive values are yellow; negative values are blue; 0 is neutral

All visible colors can be quantified within this 3-D rectangular space. In the rice industry, the values of greatest significance are L* (lightness) and b* (yellowness). Color differences may be expressed relative to a standard, such as a color tile, or may be expressed relative to other samples tested under uniform conditions. Sample uniformity is critical to the measurement. Readings may be affected by chalk, hulls or other interferences, and should be minimized when conducting color analysis.

Equipment:

> ColorFlex Colorimeter, Hunter Associates Laboratory, Reston, Virginia
>
> Sample cover
>
> Black and white color calibration tiles
>
> Clear plastic petri dishes (5-cm diameter)
>
> Kimwipes

Procedure:

1. Turn on the colorimeter and computer. Wait 30 min for the instrument to warm up. The instrument will start in "Read" mode.
2. Open the Hunter Lab program: Programs → HunterLab → Universal Software.
3. Calibrate the machine prior to testing samples, at least one time per day.
   a. Select the "Standardize" button from the menu. The instrument will prompt for the black and white tiles in succession.
   b. Install the black tile at the sample port and hit "OK" on prompt.
   c. Repeat step b with the white color tile, as prompted.
   d. A message indicating successful calibration should appear. Using the white color tile, take a reading of the standard by selecting the "Read std" button from the menu.
      i. After the first reading is displayed, select "read" for the 2nd reading.
      ii. If the two readings are similar to each other, select "Accept".
      iii. A sample identification box will appear; enter "standard" as the sample ID and hit "OK". The L*, a*, and b* values will be displayed in the table on the screen.
   e. Compare the values displayed to those provided on the back of the white tile.
      i. Measured values should be within 0.4 units of those provided. If the difference exceeds 0.4 units, clean the standard tiles and re-measure. If the values are still off, standardize the machine according to procedures described in the Hunter ColorFlex User's manual.
4. To analyze a dry sample, fill a small disposable petri dish to level with the sample (rice kernels, flour, etc.).
   a. If analyzing a wet sample, it may be necessary to use a different vessel and cover. Review ColorFlex literature to determine the appropriate sampling equipment.
5. Center the petri dish over the sample port and cover with the black cover that is provided in the accessories kit.
6. Press "Read sam" on the menu to obtain the first of two color readings. Rotate the sample dish approximately 120 - 180°, then press "Read" to obtain the second of two readings. (The instrument is programmed to average the values of the two readings.)
7. Select "Accept" if the replication for the two readings is acceptable.
8. Enter a sample ID for the sample just tested. The colorimeter will save the CIE *L* a* b** values, in addition to other color values related to different scales. (Prompt reads "ASCII Output File: C:\Universe". Click "OK".)
9. Replicate sample measurements as necessary, depending on sample homogeneity.
10. Use Kimwipes to gently clean the lens and the petri dish between samples. When the dish becomes soiled, cracked or scratched, discard and use a new one.
11. Repeat steps 4-8 as necessary for all samples.
12. After analyzing all samples, data may be copied to an Excel file for viewing on any computer, or saved to a file on the hard drive by selecting "File →Save as".
13. When finished, clean the lens and replace the white tile over the sample port on the colorimeter to prevent the lens from getting scratched.