Visual Color Evaluation is More Than What Meets the Eye: Building-up Competency on Color Analysis using Trained Sensory Panelists

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INTRODUCTION

Consumers often judge the quality of food by its color and appearance. Color perceived by the eyes is useful in determining food quality. Color can give important information when measured properly. Color of an object depends upon the spectral composition of the incident light and the spectral reflectance of the object. Light waves reflected by an object enter the eye and fall on the retina. The retina contains receptor cells, known as rods and cones, which convert this light energy into neural impulses that travel via the optic nerve to the brain.

Psychologically, brains have short memory retention; our eye can experience strain or fatigue and adaptation and generally, judge’s individual experiences can be the big source of variability in the experiment. These limitations can be improved by establishing standard protocol for using human as instrument in sensory evaluation. The project aimed to build the capability of FNRI Sensory Evaluation Laboratory (SEL) on visual color evaluation.

MATERIALS/METHODS

1. Selection of Panelists
   Candidates were screened for colorblindness using Ishihara plates.

2. Condition for Testing
   Controlled lighting and neutral grey surrounding

3. Practice Protocol for Testing
   Geometric conditions for illumination and viewing were also considered

4. Visual and Instrument Correlation
   CIELab units L*, a* and b* were plotted against the visual ratings

Figure 1. Illustration of how color is perceived
Using samples with spike of quinoline yellow (CAS No. 8004-92-0) and grey color (CAS No. 7782-42-5), the selected panelists were able to rank increasing yellowness in liquid samples and increasing greyness in powder sample. Significant result of ranking test (α=0.05) showed that the panelists have a discriminatory ability with changing concentration of grey and yellow stimuli.

Figure 3 displays color measured by spectrophotometer for a) yellow and b) grey. The CIELAB color units a* b* and L* for increasing intensity of grey and yellow were used to illustrate that visual rating changes as concentration of spike increases and L* a* b* value changes. The color coordinates with good correlation is b* value for yellow (r=0.99), b* value is a measure of yellowness (the higher the b* value, the yellower the specimen), but this is not true for grey. Ratings for grey are strongly correlated with readings of L* or the measure of whiteness.

Comparison of 2016 selected panel and 2017 selected panel is showed in Figure 3a. Both panels agreed with the intensity of yellow color of Y5 sample with a rate of 8.4. However, there is a poor agreement between the panels for the samples Y7 and Y8. The panel consisting of the old selected panelists gave lower scores than the other panel. Compared to the 2016 panel, the newly selected panelists who were trained for color analysis were able to clearly discriminate the samples as seen by the wider spread of scores for each sample.

### RESULTS

#### Pigment Concentration Color Rating and Corresponding Color Difference

<table>
<thead>
<tr>
<th>Grey Color Scale</th>
<th>G3</th>
<th>G4</th>
<th>G5</th>
<th>G6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey Pigment (amount in g per 100 g mixture)</td>
<td>0.25</td>
<td>0.35</td>
<td>0.45</td>
<td>0.55</td>
</tr>
</tbody>
</table>

- Yellow Pigment (amount in 100 ml solution): 3.5 7.0 12.5 16.5
- Color Ratings: 1.03a 1.97b 3.15c 3.85d
- Color Difference, ΔE: 2.10 1.50 1.25 1.65

1. If samples with different superscripts are significantly different from each other at α=0.05
2. Formula used for calculating color difference, ΔE = \((ΔL^2)^{0.5} + (Δa^2)^{0.5} + (Δb^2)^{0.5}\)

### CONCLUSION AND RECOMMENDATION

The experiment was able to establish the conditions for testing, to specify the qualifications of panelists and to verify the performance of panelists using actual food samples. It was inferred that test conditions are in place and sensory panelists were trained, the panel was able to perform as objective instrument in evaluating the color quality of food products.

FNRI-SEL pool of trained panelists and its capability to conduct color analysis were developed and will be beneficial to many studies such as interrelationship between color intensity, flavor, consumer perception and acceptability. It has application in the developments of natural colorants in terms of establishing color specification and establishing stability of colorants.

It is recommended that the result of color analysis to be consistent which will be achieved through programs of training and method verification. The pool of trained panelists can be involved in future studies about the influence of color in consumer perception and decision making. The limitation of spectrophotometer to describe color characteristics maybe supplemented with the use of other instruments.