Color Measurement of Meat and Meat Products

Melvin Hunt, Donald Kropf
and Brad Morgan, Coordinator

Introduction

An infinite number of colors surround us in our everyday lives. We all take color pretty much for granted, but it has a wide range of roles in our daily activities: not only does it influence our taste in food and other purchases, the color of a person's face can also tell us about their health. Even though colors affect us so much and their importance continues to grow, our knowledge of color and its control is often insufficient, leading to a variety of problems in deciding product color or in business transactions involving color. Since judgement is often performed according to a person's impression or experience, it is difficult for everyone to control color accurately using common, uniform standards. With these thoughts in mind, this paper is designed to provide suggestions for researchers needing to measure color of muscle foods. Hopefully, these suggestions will allow meat color to be determined — via visual and instrumental methods — smoothly as well as accurately.

Visual Appraisal

Visual appraisals of color are closely related to consumer evaluations and set the benchmark for instrumental measurement comparison. They are not easy to conduct with either trained or consumer panels, since human judgements may not be repeatable from day to day and are influenced by many factors (personal preference, lighting, appearance characteristics other than color, etc.).

Various scoring scales have been utilized for panel training and evaluation. Pictorial color and three-dimensional color standards, meat treated with various compounds or having been exposed to display, and descriptive word scales are examples of color scales or guides commonly used for visual training and/or reference for panels. Many of these are descriptive and imply averaging the color over the entire meat surface area. Others utilize a "worst-point" color score for a single discolored area of at least 2 cm in diameter.

Visual Appraisal Guidelines

1. Standardize as many sample variables as possible (i.e., animal nutrition regimen, carcass chill rate, muscle, sample location within a muscle, fiber orientation, muscle pH, time and temperature).
2. Conduct pretrials to determine the spectrum of colors and discoloration patterns unique to the study.
3. It is vitally important to match the scoring scale descriptions to the objectives of the study and color variations anticipated.
4. Conduct acceptance appraisals under conditions (i.e., retail cases, lighting, temperature, defrost cycling, packaging) that simulate the conditions under which consumers make their selections.
5. Overwrap with the type of film most commonly used in merchandising the specific product, unless film variables are being studied.
6. Keep panelist viewing angle constant relative to the light source, about 45° to view mainly diffuse reflectance.
7. Whenever possible, use colored pictures or three-dimensional aids for panel training; and to minimize variation due to day or replication, provide color standards for panel reference. It's important to store pictorial standards in the dark, because most are subject to light-induced color changes.
8. Evaluate areas of normal color and discoloration color separately, using an averaging approach for areas of normal color and a "worst-point" approach for discoloration. If percentage discoloration is scored by panelists, be sure the percentage breaks in the scale are realistic and reflect consumer discrimination.
9. Rotate packages from front to back and side to side to help minimize variations in temperature, air movement and lighting intensity in display cases.
10. Standardize case display temperature. If cases have a defrost cycle, those also must be controlled. Be aware that case temperature usually is not the same as product temperature. The latter can be determined by placing a thermometer 1 mm below the surface of the meat.
11. Standardize the type of lighting used for color evaluations and display studies. If fluorescent, state the specific lamp used. Recommended fluorescent lamps for meat (fresh or cured; oxygen permeable or impermeable packaging films) display studies include: SPX-30 (a high efficiency lamp, General Electric Co.), Color-Gard 32 (Duro-Test Co.), Deluxe Cool White, Deluxe Warm White, Soft White, Natural White or Natural (most available from General Electric, Phillips and Sylvania). Do NOT use Cool White, Daylight or Standard Grulux lamps because their color balance of wavelengths do not complement meat color and appearance.
Instrumental Color Methodology

Sample preparation is critical for instrumental color measurement regardless of whether one is using extraction or reflectance techniques. The same sample restraints and considerations given for visual color also apply to instrumental evaluations.

One of the greatest problems in sample presentation involves uneven color or variable discoloration. Due to differences in chill rate, pH decline and/or muscle fiber type, different areas within a given muscle can vary in color and specific areas can be severely discolored. When such a problem occurs, it is prudent to determine the proportion of the surface each section represents and to measure them separately.

Researchers have several options when deciding to measure meat color, to follow meat color changes and to quantitate myoglobin forms. The overriding issues in selection of methodology are project objectives and the anticipated use for the color data (Kropf, Olson and West, 1984). With this information in mind, the major decision regarding methodology concerns is whether to extract pigments and measure transmission or absorbance or to determine the reflectance of the intact sample. A major advantage of reflectance is that repeated measurements can be made on the same location of individual packaged samples.

Instrumental Measurement Guidelines

1. Standardize as many sample variables as possible.
2. Because pH can have a major effect on meat color dynamics, the pH of the color sample should be known and reported.
3. Use samples at least 12 to 15 mm thick. If wafer-thin slices are being measured, stack them to a similar thickness. For translucent samples, a standardized white background is recommended.
4. Generally, meat will be packaged and scanned through the packaging film. However, depending on the study objectives, samples may be evaluated unpackaged and thus eliminate package film effects. A spectrally pure glass over the aperture will guard against meat pieces and juice entering the reflectance port. The glass must be kept clean.
5. Carefully prepare the standardizing tile for instrument standardization. Standards may be packaged in the packaging film to prevent the packaging film from affecting reflectance at certain wavelengths.
6. Know the aperture size and the area of illumination that is being scanned by the instrument. For some studies, measuring the same sample area or areas is critical. Some instruments may have multiple viewing port sizes; select the largest port when "average" surface color determination is most important and use the smaller port when trying to measure color of small, localized areas.
7. Some instruments are capable of averaging values for several sample areas. The number of scans needed per sample to get a representative color evaluation is dependent upon the variation between and within treatments. Often meat samples vary within treatments, thus increasing number of observations is more beneficial than making several scans of each sample.

Conclusion

Several excellent literature reviews of meat color measurements are available. The information incorporated into this paper was primarily compiled from those reviews.

References