

- Color is a perceptual phenomenon that depends on the observer and the conditions in which the color is observed.
- It may be desirable to follow the changes in color of a product during storage, maturation, processing, and so forth.
- Color is often used to determine the ripeness of fruits.
- Color of potato chips is largely controlled by the reducing sugar content, storage conditions of the potatoes, and subsequent processing.
- Color of flour reflects the amount of bran. In addition, freshly milled flour is yellow because of the presence of xanthophylls.
- It is a characteristic of light, which is measurable in terms of intensity and wavelength. Color of a material becomes visible only when light from a luminous object or source illuminates or strikes the surface.

Spectrophotometers

Early instrumental methods for color measurement were based on transmission or reflection spectrophotometry. In spectrophotometers, three projectors each with red, green, or blue filters in front of the lens are required. Red, green, or blue light beams are focused on a screen such that they overlap over half a circle. The other half is illuminated by another projector or by spectrally pure light from a prism or grating. The observer can see both halves of the circle on the screen simultaneously. Each projector is equipped with a rheostat to vary the amount of light from each of the red, green, and blue sources. The observer can determine the amounts of red, green, and blue required to match almost any spectral color by varying the amount of light. Spectral color can be defined in terms of the amounts of red, green, and blue.

Colorimeters

Before the 1950s, calculation of X , Y , Z data from spectra was very common but it required computational work which led to the development of electronic integration. Tristimulus colorimeters were developed since spectrophotometer integration was expensive. A tristimulus colorimeter has three main components:

1. Source of illumination
2. Combination of filters used to modify the energy distribution of the incident/reflected light
3. Photoelectric detector that converts the reflected light into an electrical output. Each color has a fingerprint reflectance pattern in spectrum. The colorimeter measures color through three wide-band filters corresponding to the spectral sensitivity curves. Measurements made on a tristimulus colorimeter are normally comparative. It is necessary to use calibrated standards of similar colors to the materials to be measured to achieve the most accurate measurements.

Each color has its own tristimulus values that distinguish it from any other color. These values can be measured to determine if a color match is accurate. They can also be used to determine the direction and amount of any color difference.

Water Activity

Water activity and sorption properties of foods have been considered as important physical properties in food formulations and processes. Most of the biochemical and microbiological reactions are controlled by the water activity of the system, which is therefore a useful parameter

to predict food stability and shelf life. The rate of moisture transfer in the drying process through the packaging film or edible food coating during storage can be estimated and as a result drying conditions, packaging, or coating material can be selected using water activity and sorption properties of foods. In addition, these properties must be considered in product development.

Instrumental Methods

Measurements Using Hygrometers

In this method, the sample is equilibrated with air in a closed vessel and then the relative humidity of the air is determined by using a hygrometer. Many hygrometric instruments work on the principle of measuring wet and dry bulb temperature, dew point, change in length of material, and electrical resistance or capacitance of salt. The relative humidity can be determined by measuring the wet and dry bulb temperatures of air in equilibrium with food. This method has been used primarily to determine the relative humidity of large storage atmospheres and commercial dehydrators.

Measurements Based on Hygroscopicity of Salts

Each salt has its own characteristic or critical relative humidity transition point. It will remain dry if the relative humidity of the surrounding air is lower than that of the critical. It will show a wet short line that can be seen under a lens if the air relative humidity is higher than the critical. Using this property of salt, it is possible to observe the change in the color of salt enclosed over the sample such as silica gel, which changes color from blue at low humidity through lilac to pink at high humidity. Thus, it gives an approximate estimate of ERH from the color matching against a calibrated series of standard colors.

SIZE AND SHAPE

Size is an important physical attributes of foods used in screening solids to separate foreign materials, grading of fruits and vegetables, and evaluating the quality of food materials. For example particle size of powdered milk must be large enough to prevent agglomeration. Decrease in particle size also increases the steady shear and complex viscosity. The importance of particle size measurement has been widely recognized, especially in the beverage industry, as the distribution and concentration ratio of particulates present in beverages greatly affect their flavor. It is easy to specify size for regular particles. Particle sizes are expressed in different units depending upon the size range involved. *Coarse particles* are measured in millimeters, *fine particles* in terms of screen size, and very fine particles in micrometers and nanometers. *Ultra fine particles* are described in terms of their surface area per unit mass. Particle size of particulate foods can be determined by sieve analysis and settling rate method.

Shape: Shape is also important in heat and mass transfer calculations, screening solids to separate solid materials, grading of fruits and vegetables, and evaluating the quality of food materials. The shape of the food material is usually expressed in terms of its sphericity and aspect ratio. Sphericity is an important parameter used in fluid flow and heat and mass transfer calculations. The aspect ratio is another term used to express the shape of the material. It is calculated using