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Editors

Water Stress in Biological, Chemical, Pharmaceutical and Food Systems

Springer

Water and Food Appearance

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Abbreviations

CVS	Computer vision system
ESEM	Electron microscope by environmental mode
K	Attenuation coefficient
N	Refraction indexes
R_∞	Reflectance of an infinitely thick layer of the material
RH	Relative humidity
S	Dispersion coefficient
SEM	Scanning electron microscopy
T_g	Glass transition temperature

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G.F. Gutiérrez-López et al. (eds.), *Water Stress in Biological, Chemical, Pharmaceutical and Food Systems*, Food Engineering Series,
DOI 10.1007/978-1-4939-2578-0_3

1 Introduction

Food appearance depends not only on its chromatic characteristics (hue, saturation) and luminosity but also on the spatial distribution of light inside the food material, which determines appearance aspects such as transparency and gloss.

The perception of food color is based on visual sensations, which depend on the spectral distribution of light. This aspect has been widely analyzed in food science.

The modes of appearance produced by different spatial distributions of light were denoted as "cesia" by the architect Cesar Janello in 1965. An atlas of *cesia* was later developed, which found application mainly in relation to paintings, architecture, and ambient illumination materials (Caivano 1991, 1994, 1996; Caivano et al. 2004).

Because chromatic properties define the color of a given material by means of three variables (hue, saturation and luminosity), the three variables proposed for *cesia* are perceived permeability (or its opposite, opacity), darkness (or its opposite, lightness or luminosity, which is shared with the color properties), and diffusivity (or its opposite, regularity), related to the distinctness of image and referring to the sharpness of images produced by reflection and by transmission (Caivano et al. 2004).

Permeability ranges from opaque samples to transparent samples, passing through samples with different degrees of perceived transparency. The variation of darkness can be perceived by reflectance or transmittance, while the variation of diffusivity involves perceptions from matte or translucent to glossy. Both reflection and transmission may occur regularly (specularly) or diffusely, and any intermediate combination may also appear.

In foods, the defined *cesia* characteristics represent important physical aspects of food quality which are perceived by human vision. Nevertheless, these characteristics have received little attention by food researchers in comparison with chromatic attributes, possibly because of the difficulty of easily and adequately measuring and specifying the stimuli that generate those phenomena.

During processing or storage of foods, many structural changes occur, which can induce changes in color, gloss, transparency, and luminosity. While stimuli for color can be produced by primary sources (objects that emit light) or by secondary sources (objects that reflect or transmit the light coming from another source), the variations of *cesia* only occur in secondary sources, that is to say, in objects that produce changes in the spatial distribution of the light they receive. These changes are mainly due to microtextural variations on the surface or in the volume of the object. If these textural variations are of a rather small size, then visual texture changes are not perceived, while the effect produced on light is noticed (Caivano et al. 2004).

Translucent materials are those that both transmit and scatter light. The degree to which an object is translucent depends on the extent to which the light entering a sample is reflected, scattered, or absorbed. As a phenomenon, translucency occurs between the extremes of transparency and opaqueness (Hutchings 1999).

Many changes produced during food processing involve the destruction or generation of interfaces and affect the way in which light interacts with the sample matrix. The extension of most of those changes is defined by water content. An integral approach that takes into account color, pigment concentration, as well as the effect of water on the microstructure and the effect of water on the physical changes is important in order to understand visual color perception of foods.

6 Future Work

The mathematical development of *cesia* solids, such as those available for the chromatic aspects of appearance, will allow better analysis and prediction of the integrated aspects affecting sample visual characteristics. Such development will provide tools for innovative product development and for process control and will necessarily require multidisciplinary interactions, involving concepts from physics, mathematics, chemistry, engineering, photography, imaging, and architecture.

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