Fundamental Physics for Food Technology and Innovation (4011106)

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Physics of Light in Food Technology and Innovation

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Overview of topics to be covered:

A. Understanding Light - Basic Concepts
B. The Electromagnetic Spectrum
C. Light Interaction with Food Materials
E. Color in Foods
F. Measuring Light Properties in Food
G. Applications in Food Quality Assessment
H. Light-Based Food Processing
I. Advanced Applications
J. Safety Considerations
K. Future Trends

Understanding Light - Basic Concepts

- Light as electromagnetic radiation
- Wave-particle duality
- Visible spectrum (380-700 nm)
- Key parameters: *wavelength*, *frequency*, *Speed*
- Equation: $c = \lambda f$

where:

- c = speed of light (3×10^8 m/s) λ = wavelength (m) f = frequency (Hz)

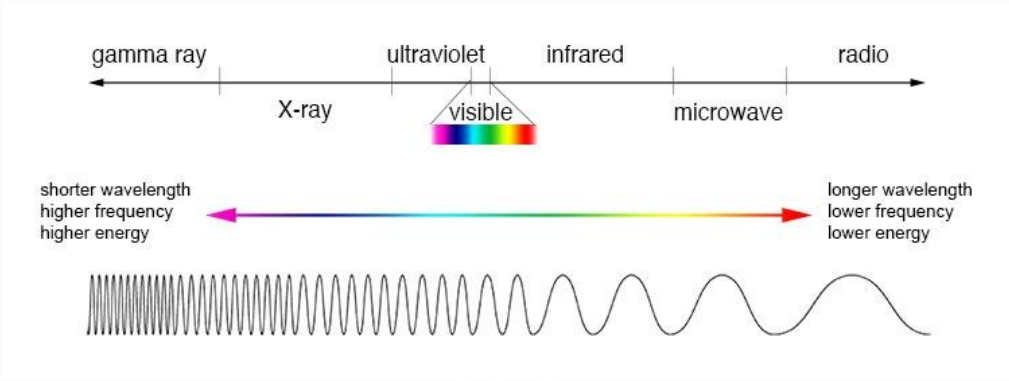

Figure 1: Light wave characteristics diagram

Light Interaction with Food Materials

- Reflection
- Transmission
- Absorption
- Scattering

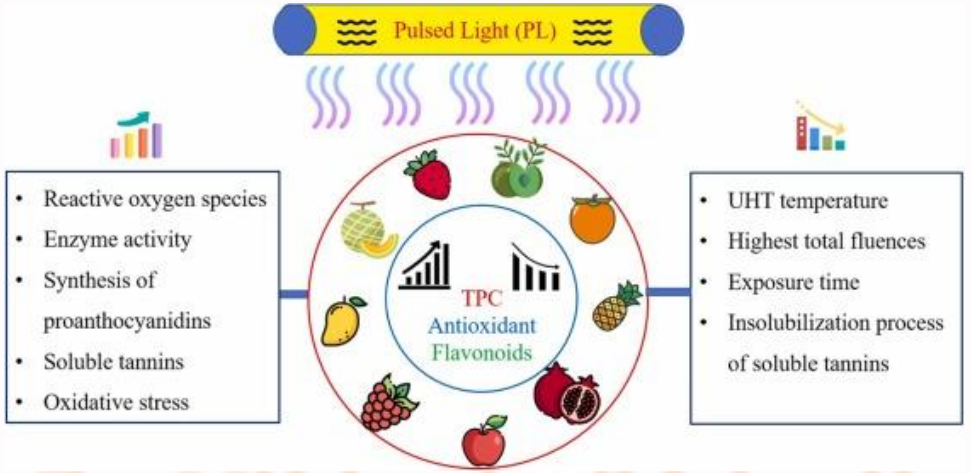

Figure 2: Light interaction with food materials

Color in Foods

- Physical basis of color
- Primary and secondary colors
- Role of pigments
- Color spaces (RGB, Lab*)

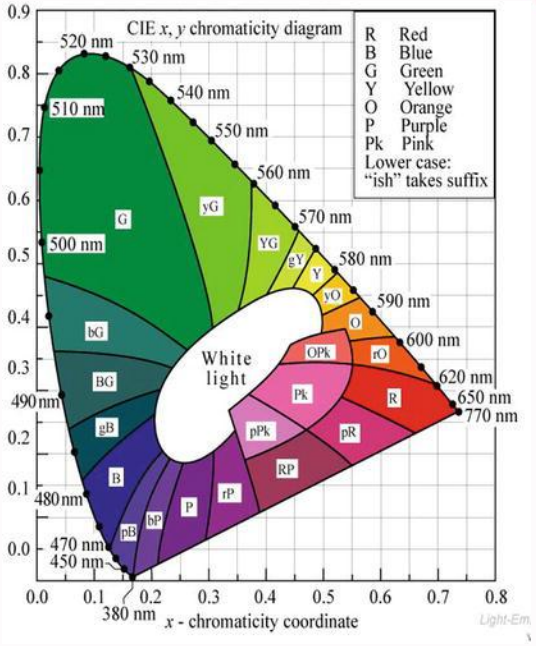

Figure 3: Food color measurement CIE Lab

Measuring Light Properties in Food

- Spectrophotometry basics
- Colorimeters
- Glossmeters
- UV-Vis spectroscopy

Figure 4: Food spectrophotometer measurement

Applications in Food Quality Assessment

- Color measurement
- Freshness determination
- Ripeness assessment
- Defect detection

Figure 5: Optical food quality assessment

Light-Based Food Processing

- UV sterilization
- IR heating
- Photo-oxidation
- Light-induced degradation

Figure 6: UV sterilization food industry

Advanced Applications

- Machine vision systems
- Hyperspectral imaging
- NIR spectroscopy

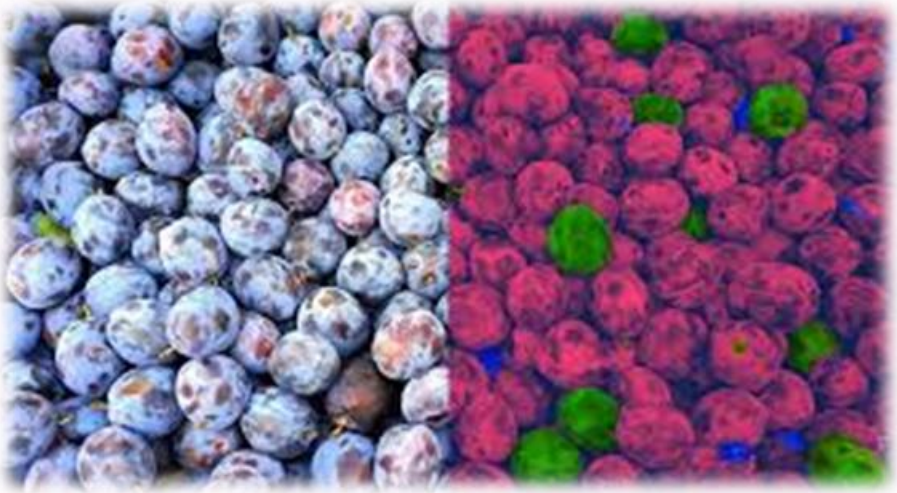

Figure 7: Hyperspectral imaging food quality

Safety Considerations

- UV exposure limits
- Laser safety
- Protection methods
- Regulatory standards

Figure 8: Light safety food processing

Future Trends

- Smart packaging
- Novel sensing technologies
- LED applications
- Artificial intelligence integration

Figure 9: Smart food packaging light indicators

References.

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2. Berns, R. S. (2019). Principles of Color Technology (4th ed.).
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