

# Measurement of optical properties of fruits and vegetables: A review

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## Abstract

This paper provides an overview of the principles and theory of measuring optical properties of biological materials. It then presents the instrumentation and data analysis procedures for implementing several emerging optical techniques, including spatially resolved, time-resolved, and spatial-frequency domain, along with the standard integrating sphere method. Applications of these techniques for optical property measurement, maturity and quality assessment, and defect detection of fruits and vegetables are then reviewed, followed with discussions on issues and challenges that still need to be addressed for these emerging optical techniques. While these optical techniques are overall more sophisticated in instrumentation and computation, they are based on radiative transfer theory or simplified diffusion approximation theory. Hence, measurement of optical absorption and scattering properties has the potential of providing more useful information for quality evaluation of horticultural products. At present, these techniques are still slow in measurement, and prone to errors due to modeling and instrumentation deficiencies. Further research is therefore needed in using a better mathematical modeling approach, improving data acquisition accuracy and speed, and developing more robust inverse algorithms for optical property estimations.