

Title Time-resolved reflectance spectroscopy: a non-destructive method for the measurement of internal quality of fruit

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Abstract

Non-destructive optical techniques which employ continuous wave light in the near infrared spectral region are well known for fruit quality measurement. However these techniques measure the diffusely remitted intensity which depends also on the colour of the skin and is determined by both absorption and scattering properties of the sample. Light absorption is determined by chemical compounds in the pulp producing characteristic spectral features. Light scattering is due to microscopic changes in refractive index caused by membranes, air, vacuoles, or organelles which deviate the photon paths and cause light diffusion. A discrimination of these effects would allow a proper assessment of the optical properties of fruit. Time-Resolved Reflectance Spectroscopy (TRS) is a technique based on the measurement of the temporal delay and broadening experienced by a short laser pulse while traveling through a turbid medium. By using an appropriate theoretical model for the analysis of experimental data, it is possible to accurately measure both the absorption coefficient (m_a) and the reduced scattering coefficient (m_s) of the probed medium at a depth of 1-2 cm. Measurements probe the bulk properties, not the superficial ones, and can provide useful information on internal quality. Scattering is related to translucency of tissue and can detect internal bruises and water core. Firmness and pectin composition of apples were also related to scattering. Absorption coefficient at different wavelengths can detect internal defects such as brown heart. Absorption in the 600-700 nm regions can be related to chlorophyll content, hence to maturity, which is of paramount importance for postharvest quality of fruit. Being non-destructive, TRS measurements can be repeated on the same fruit, following development and changes occurring with ripening or storage. Major results indicating different applications in fruit and vegetables are reviewed.