Title Monitoring the postharvest ripening of tomato fruit using quantitative MRI and NMR relaxometry

Author Maja Musse , Stéphane Quellec, Mireille Cambert, Marie-Françoise Devaux, Marc Lahaye and François Mariette

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Abstract

Magnetic Resonance Imaging (MRI) was performed on tomato fruit during two 3-week periods of postharvest ripening. Different image types were acquired to study macroscopic and microscopic structural changes. Air spaces were identified close to seeds and their shrinkage during the ripening period was estimated from the spin echo images. The development of the bubbles in the outer pericarp during ripening was estimated from the ratio of the long- and short-echo time gradient echo MRI images and supported by the macrovision imaging. Variations in the transverse (T_2) and longitudinal (T_1) relaxation times were determined from quantitative MRI images. They depended on the tissue type and matched fairly well between fruit. In the core, placenta, radial and outer pericarp, T_2 decreased by about 25% from the initial values and T_1 by about 25–30% from the initial values during postharvest ripening. In the locular tissue the relaxation times had less marked trends than in other tissues: both T_2 and T_1 increased slightly until the eighth or ninth measurement day and after that it returned to its approximate initial value. Multi-component characteristics of T_2 and T_1 decay were investigated by Nuclear Magnetic Resonance (NMR) relaxometry. They provided information about all major sub-cellular compartments and showed there was water redistribution among compartments during ripening. In addition to the relaxometry measurements, water content, weight loss and concentration of neutral sugars and acids were measured on some of the tomato fruit. Cell size and organization were investigated by macrovision experiments. Although the overall dependence of the relaxation time on tissue type was to some extent explained by chemical composition and cell dimension, no relationships between trends in MR data and tissue properties were established.