3D pore structure analysis of intact ‘Braeburn’ apples using X-ray micro-CT

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Abstract

Fruit tissue microstructure affects gas diffusivity, and, therefore, also hypoxia related physiological disorders such as browning disorders in pome fruit stored in controlled atmosphere conditions. Recent results have shown that the microstructure is quite heterogeneous across the fruit. To enhance our understanding of gas exchange during storage of fruit, methods are required to better understand the spatial distribution of the microstructure of the whole fruit. The aim of this work is to visualize an digitize the spatial network of the pores in intact apples as a basis to help the understanding and modelling of gas exchange. High resolution X-ray CT is used as a non-destructive technique to visualize in 3D the pores inside apple fruit of ‘Braeburn’ apples (*Malus* × *domestica* Borkh.). Reconstruction and segmentation protocols are optimized and validated, resulting in unique 3D digital models of fruit. Porosity analysis shows considerable variation between different apples, as well as within an apple. The results also show a distinct pore structure for different apple tissues, based on the 3D connectivity of the pores. Apple cortex tissue can be divided into a low and high porous region, where the average porosity is 13.2% and 30.4% respectively. Two gas diffusion barriers are identified, namely the skin region and the region where the exocarp and the main vascular bundles are situated. All this leads to large spatial gradients regarding porous parameters inside the apples, especially in the radial direction.