Title Braeburn browning disorder characterized by means of X-Ray micro-Ct

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Abstract

During ULO storage, apple fruit can develop undesirable internal disorders such as browning. The occurrence of browning often develops into cavities. This means that cells are destroyed and water is removed from the affected tissues. Up to date, no knowledge is available about the microstructural changes during browning of tissue. Such information will be useful, to better understand to the process of disorder development in relation to gas and water exchange in tissues. The aim of this work was to develop a method for *in vivo* 3-D visualization of the changes in the microstructure of Braebum apple fruit during the development of internal browning disorder caused by unfavorable gas conditions during storage. Braeburn apples were grown in Belgium and were examined at regular times during storage under controlled atmosphere. 3-D visualization of the tissue morphology was performed by X-ray CT without the need for sample preparation. Another advantage is that this technology can be used to examine both millimeter-sized samples and entire fruits, presenting a unique view on the disorder from tissue to fruit level. The small samples were scanned at 4,8 flm pixel resolution (Skyscan 1172, Skyscan, Kontich, Belgium) while the entire fruit was scanned at 70 flm resolution (Tomohawk HOMX, MTM KULeuven, Leuven, Belgium). Image analysis was perfomed with Avizo Fire 7 (VSG, Bordeaux, France). Morphological parameters (porosity, connectivity, surface area) were extracted from micro-CT images revealing drastic changes in the microstructure during storage, with the porosity of affected tissue dropping from 14.6 % immediately after harvest to values as low as 3.1 % after 1 month of storage under browninginducing conditions. This coincided with clear loss of cellular integrity and filling of pore spaces. The formation of cavities with few intact cells and loosened cell walls could be visualized as well, resulting in an increased porosity up to 41.2%. Significant differences were found for different sample positions along the fruit radius. Obtained datasets on sound and disordered fruit tissues can be used to construct 3-D geometric models in which fluid transport is simulated, revealing critical metabolic imbalances and pathways for water movement in the sound and disordered tissues. X-ray CT data on intact fruit were collected and correlated with the micro-CT images of the samples. Microstructural characteristics obtained from high-resolution scans were related to

greyscale values in CT images. The results have shown that browning is associated with cell leakage. The images are used to develop a fast scan protocol and decision algorithm based on internal fruit quality, with potential applications in the fruit sorting industry.