Morphology and cell wall composition changes in lignified cells from loquat fruit during postharvest storage

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Abstract

Loquat, as a cold-sensitive fruit, exhibits typical lignification symptoms, such as increased firmness and lignin content, decreased juice yield and loss of fruit flavor when stored at inappropriately low temperatures. Loquat fruit with lignification symptoms contains lignified cells. This work studied the development mechanism of these cells in postharvest loquat fruit. It was found that both the staining area ratios of lignin and the densities of lignified cells had a significant correlation with the firmness and the lignin content of the bulk flesh. These results indicate that the increase of lignified cells might be an important factor in the quality deterioration of postharvest loquat fruit. To understand the mechanism of lignified cell development at the single-cell level, the distribution of lignin, cellulose, and pectin in the cell walls of lignified cells with different morphologies was visualized in a label-free way. In general, the development of the lignified cell was proposed as the thickening of cell walls until the entire intracellular cavity was filled and the cell became total solid. The results of confocal Raman microspectroscopy showed that lignin and cellulose gradually filled the lignified cells during cell development, while pectin was mainly concentrated in the cell wall corner and the middle lamella. The accumulation of lignin and cellulose in the lignified cells was the main cause of the morphological changes in lignified cells during development. The abundant chemical bond information provided by Raman spectra led to further independent distribution imaging of the functional groups of lignin during the development of lignified cells. Besides, in loquat flesh, some lignified cells in the process of development were found alone and surrounded by parenchymal cells; in other cases, some cells around the lignified cells also accumulated lignin and later became lignified cells, eventually forming several clusters of lignified cells. By analyzing the size of lignified cells and their clusters, they might not be the main reason for the rough taste of the loquat flesh with lignification. The

results of this work can be an important complement to the study of the lignification process of loquat fruit during postharvest storage that is mainly carried out at the physicochemical and molecular levels.