Title Cellular approach to understand bitter pit development in apple fruit

Author Sergio T. de Freitas, Cassandro V.T. do Amarante, John M. Labavitch and Elizabeth J. Mitcham

Citation Postharvest Biology and Technology, Volume 57, Issue 1, July 2010, Pages 6-13

Keywords Calcium; Cell wall; Homeostasis; Pectin; Pectin methylesterase; Vacuole

Abstract

Bitter pit (BP), a Ca^{2+} deficiency disorder of apple fruit (*Malus domestica*), is a complex process that involves not only the total input of Ca^{2+} into the fruit, but also a proper Ca^{2+} homeostasis at the cellular level. The objective of this study was to test the hypothesis that Ca^{2+} accumulation into storage organelles and binding to the cell wall is associated with BP development in apple fruit. The experiment was carried out on 'Granny Smith' apples stored at 0 °C for 60 d. After storage, fruit were segregated into two lots for analysis, apples with the water-soaked initial visual symptoms of BP and those not showing this symptom. Cytochemical and ultrastructural observations showed an accumulation of Ca^{2+} in the vacuole of individual outer cortical cells of pitted fruit. We also observed an increase in the expression of genes encoding four pectin methylesterases, a greater degree of pectin deesterification and therefore more Ca^{2+} binding sites in the cell wall, and a higher fraction of the total cortical tissue Ca^{2+} content that was bound to the cell wall in pitted fruit compared with non-pitted fruit. Cells of the outer cortical tissue of pitted fruit consistently had higher membrane permeability than outer cortical cells of non-pitted fruit. The results provide evidence that Ca^{2+} accumulation into storage organelles and Ca^{2+} binding to the cell wall represent important contributors to BP development in apple fruit.