

**Title** Cell wall-modifying enzymes and firmness loss in ripening ‘Golden Reinders’ apples: A comparison between calcium dips and ULO storage

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### Abstract

Calcium treatment and storage under ultra-low oxygen (ULO) conditions are common post-harvest practices aimed at delaying ripening-related softening of apple (*Malus × domestica* Borkh.) fruit, but the biochemical mechanisms underlying these effects have not been determined conclusively to date. In this study, commercially mature ‘Golden Reinders’ apples were dipped in 2% calcium chloride prior to storage at 1 °C and 92% RH under either regular air or ultra-low oxygen (ULO; 1kPa O<sub>2</sub>:2kPa CO<sub>2</sub>) for 19 or 31 weeks, and kept thereafter at 20 °C for 0, 7 or 14 days in order to simulate the usual marketing time. Cell wall composition and cell wall-modifying enzyme activities were determined in relation to fruit firmness. ULO-storage and calcium dips were effective for firmness preservation, seemingly due to decreased pectin solubilisation.  $\beta$ -Galactosidase,  $\alpha$ -l-arabinofuranosidase and pectate lyase activities were correlated positively with firmness loss of ‘Golden Reinders’ fruit after storage.