‘Passe Crassane’ pear fruit (*Pyrus communis* L.) ripening: Revisiting the role of low temperature via integrated physiological and transcriptome analysis

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Abstract

European pear fruit (*Pyrus communis* L.) respond to low temperature (LT) treatments by inducing ethylene production and fruit ripening. However, it is unclear to what extent this response is the result of LT alone or LT-induced ethylene production. In this study, we followed the physiological and molecular responses of ‘Passe Crassane’ pears to LT and the ethylene analogue, propylene, at various storage temperatures. Fruit at 20 °C treated with propylene softened to eating firmness (13–21 N) within 9–10 d, with little changes in endogenous ethylene production (< 0.03 μg kg^{-1} s^{-1}). By contrast, LT-treated fruit (0 °C and 5 °C for 42 d) produced large amounts of ethylene (1–2 μg kg^{-1} s^{-1}), and rapidly softened to < 5 N after being transferred to 20 °C. From transcriptomic analyses, we identified 437 differentially expressed genes (DEGs) between propylene-treated and control fruit, which were further augmented by LT treatment. On the other hand, the expression patterns of 763 DEGs between 5 °C vs. 20 °C was not significantly affected by propylene treatment in non-chilled fruit. To examine LT-induced and ethylene-induced pathways separately during chilling, the responses of LT-induced DEGs to 1-methylcyclopropene (1-MCP), an ethylene action inhibitor, were assessed. Among the 763 LT-induced DEGs, 1-MCP treatment disrupted the expression of 390 DEGs, indicating that they were regulated by LT-induced ethylene. Intriguingly, 373 DEGs including transcription factor-related genes such as *PcERF98-like*, *PcATL65*, *PcMYB6-like*, *PcGRP2-like*, *PcTCP7* and *PcMBF1c* were unaffected by 1-MCP treatment, and thus, likely to be influenced by LT alone. Based on these results, the potential role of these LT-specific genes/pathways as a key factor modulating changes in ethylene production and responsiveness leading to fruit ripening in European pears is discussed.