COMPARATIVE ANALYSIS OF ETHYLENE-DEPENDENT RIPENING AND LOW-TEMPERATURE-MODULATED RIPENING IN KIWIFRUIT

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Abstract
Three different types of ripening characteristics in kiwifruit, ethylene-induced, low-temperature-modulated, and on the vine, were investigated. When fruit were stored as a batch at room temperature, a typical climacteric ethylene increase was observed simultaneously in all the individual fruit in the same container within a short period. When fruit were stored spatially separated at room temperature to avoid the effects of disease-induced ethylene, more than 50% of the fruit did not initiate ethylene production, even after two months, suggesting that healthy fruit remained in the pre-climacteric stage. Fruit stored at 5°C ripened faster than fruit stored at 20°C in terms of fruit softening, an increase in soluble solid content, and decrease in titratable acid without detectable ethylene, and a 1-methylcyclopropene treatment failed to suppress low–temperature-modulated ripening. Fruit ripening without detectable ethylene was also observed in fruit left on the vine until late autumn. RNA sequencing and real-time PCR analyses in 'Sanuki Gold' fruit revealed that ripening-associated genes were divided into three categories; ethylene responsive only, as shown in AcACS, AcAAT, AcERF4,6, and AcNAC1; dual responsive, as shown in AcPG, AcEXP1, AcbAMY1, AcERF10,14, and AcMADS1; and low temperature responsive only, as shown in AcNAC4 and AcMADS2. The expression profile of the vine-ripened fruit was similar to that in fruit ripened at low temperature. These results indicate that a low-temperature signaling pathway regulates fruit ripening at low temperatures in both off and on the vine in an ethylene-independent manner, but sharing some ripening-associated genes with the ethylene signaling pathway.

Key words: Kiwifruit, ripening, ethylene, temperature-induced