

Title Effects of the combined application of 1-MCP + low O₂ on ripening of apple fruits
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Abstract

For the past two years we have been studying the effects of the combined application of 2 ppm 1-MCP + 1.5% O₂ on apple (*Malus ×domestica* Borkh.) fruit ripening at 1°C and 6.5°C. In fruits stored at 6.5°C, the onset of the C₂H₄ climacteric occurred 10, 55, and 95 days. For the controls, 1.5% O₂, and 2 ppm 1-MCP, respectively, whereas in fruits treated with 1-MCP and kept under 1.5% O₂, the onset of the ethylene climacteric did not occur for 200 d, the duration of the experiment. The retardation of the climacteric rise was attended by a complete suppression of the ACC synthase 1 (*ACS1*) and ethylene response sensor 1 (*ERS1*) genes. The promoters of both genes contain C₂H₄-responsive elements. Thus, once *ACS1* is induced, it can sustain the auto-catalytic increase in C₂H₄ evolution. The dependence of mRNA accumulation in both genes on C₂H₄ was also demonstrated by treating climacteric fruits with 1.5% O₂, 2 ppm 1-MCP, and 2 ppm 1-MCP + low O₂. The degree of decrease in C₂H₄ evolution differed with the treatments, being stronger in the combined 1-MCP + low O₂ treatment. This was reflected in the amounts of the accumulated transcripts. At present the developmental changes that precede the induction of *ACS1* are unknown. At 1°C, the climacteric rise in C₂H₄ evolution was also retarded by the combined treatment for 250 days. However, when the fruits were transferred after 250 d to 18°C, ripening occurred normally, as could be judged by the rise in C₂H₄ evolution, softening and induction of the expression of C₂H₄-dependent genes, e.g., polygalacturonase. The data thus show that apples treated with 1-MCP + 1.5% O₂ can be successfully stored at relatively high temperatures. The expression of the alcohol dehydrogenase (*ADH*) gene that is induced by 1.5% O₂ is not affected by 1-MCP.