Title Ripening delay of mid-climacteric avocado fruit in response to elevated doses of 1-methylcyclopropene and hypoxia-mediated reduction in internal ethylene concentration

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Abstract

In previous reports, 1-MCP responsiveness of tomatofruit was shown to be strongly decreased or increased by treatments increasing or decreasing internal ethylene concentration (IEC), respectively. In the present study, the role of IEC in modulating 1-MCP responsiveness was further tested using avocado, a fruit that accumulates markedly higher IEC compared with tomatofruit. Preclimacteric (1 d after harvest, firmness 190 N, ethylene production <0.05 ng kg^{-1} s^{-1}) 'Booth 7' avocado fruit were treated for 1 min with aqueous 1-MCP at 1.86 and 9.3 mmol m^{-3} (100 and 500 μg L^{-1}). Both concentrations strongly suppressed softening, and delayed climacteric ethylene production and respiration maxima. Mid-climacteric fruit (7 d after harvest, firmness 65 N, ethylene production ≈65% of maximum) showed complete loss of or diminished sensitivity to 1-MCP at 1.86 mmol m^{-3} or 9.3 mmol m^{-3}, respectively. Application of higher dose of aqueous 1-MCP (46.5 mmol m^{-3}, 2500 μg L^{-1}) revealed that softening, respiration and ethylene production of mid-climacteric avocado remained highly sensitive to inhibition of ethylene perception. In experiments testing the effects of reducing IEC on 1-MCP responses, mid-climacteric avocado were exposed to hypoxia (2 kPa O_2) for 12 h, followed by exposure to aqueous 1-MCP at 18.6 mmol m^{-3} (1000 μg L^{-1}). IEC prior to hypoxia averaged about 38.6 μL L^{-1}. IEC following exposure to air or hypoxia for 12 h averaged around 54 and 16 μL L^{-1}, respectively. Fruit treated with 18.6 mmol m^{-3}1-MCP following hypoxia showed greater suppression of fruit softening, and further delays in peak ethylene production and respiration compared with fruit treated with 1-MCP alone. 1-MCP applied to mid-climacteric fruit also delayed PG accumulation and depolymerization of water-soluble pectin, indicating that cell wall metabolism in avocado fruit remains ethylene sensitive through advanced ripening. Suppression of PG accumulation and pectin depolymerization was greater in fruit exposed to hypoxia prior to 1-MCP. The improved efficacy of 1-MCP at elevated doses and following reduction of IEC in suppressing ripening of mid-climacteric avocado fruit is consistent with the model that IEC strongly influences 1-MCP sensitivity in ripening-initiated climacteric fruits. Possible mechanisms by which 1-MCP sensitivity is modulated by ethylene are discussed.