Title Short-term hypoxic hypobaria transiently decreases internal ethylene levels and increases sensitivity of tomato fruit to subsequent 1-methylcyclopropene treatments

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Citation Postharvest Biology and Technology, Volume 56, Issue 2, May 2010, Pages 131-137

Keywords Ethylene; Hypoxic hypobaria; 1-Methylcyclopropene; Ripening; Softening; Tomato

Abstract

Brief treatment of ripening tomato fruit with ethylene transiently negates or reduces sensitivity to subsequent treatments with 1-methylcyclopropene (1-MCP), indicating that internal ethylene levels can modulate responses to 1-MCP. The present study further tested this model by applying 1-MCP to tomato fruit following treatments that transiently decreased internal ethylene concentration (IEC). The hypothesis was that decreases in IEC would result in enhanced sensitivity to the ethylene antagonist. Breaker and pink 'Florida 47' tomato fruit were subjected to hypoxic hypobaria (HH) (1.7 kPa O_2, 8 kPa) for 6 h, followed by treatment at ambient pressure with aqueous 1-MCP at a sub-saturating dose (0.93 mmol m^{-3}, 50 $\mu g\ L^{-1}$) and exposure duration (1 min). Immediately following HH, breaker fruit had a 76% lower IEC and enhanced sensitivity to 1-MCP compared with fruit not receiving HH. Increased sensitivity to 1-MCP was evident in further suppression of fruit firmness and hue angle declines, and delayed peak ethylene production. Within 3 h of removal of fruit from HH, IEC had returned to pre-HH values and responses to 1-MCP were comparable with those of fruit receiving 1-MCP without prior HH. Decreased IEC and increased sensitivity to 1-MCP in response to HH were also observed for fruit at more advanced ripening. We addressed whether increased sensitivity to 1-MCP following exposure to HH was a response to reduced pO_2. Breaker and pink fruit were exposed to hypoxic (4.5 kPa O_2) or normoxic (21.3 kPa O_2) hypobaria (21.3 kPa) for 6 h prior to treatment with 0.93 mmol m^{-3} aqueous 1-MCP. Immediately following HH, IEC was reduced about 61 and 49% in breaker and pink fruit, respectively, accompanied by increased sensitivity to 1-MCP. By contrast, IEC and responsiveness to 1-MCP were unaffected in fruit following exposure to normoxic hypobaria (NH). The results indicate that enhanced sensitivity to 1-MCP following HH is a result of low pO_2-mediated reductions in IEC. The data are consistent with the model that IEC at the time of 1-MCP treatment can modulate response intensity and explain the divergent responsiveness of different climacteric fruits to 1-MCP applied after ripening initiation.