Title Chilling and heating may regulate C6 volatile aroma production by different mechanisms in tomato (*Solanum lycopersicum*) fruit

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Abstract

Hexanal, *Z*-3-hexenal, *E*-2-hexenal, hexanol, and *Z*-3-hexenol are major tomato (*Solanum lycopersicum* L.) volatile aroma compounds derived from oxygenation of unsaturated fatty acids. Chilling and heating may suppress production of these C6 volatiles. The objective of this research was to determine the effects of chilling or heating on gene expression and enzyme activity of lipoxygenase (LOX), hydroperoxide lyase (HPL), and alcohol dehydrogenase (ADH), which catalyze key steps in C6 volatile production via the oxylipin pathway. 'Tasti-Lee' and 'Sanibel' tomatoes, harvested at different stages of fruit development, were ripened to full (red) ripe stage at 20 °C. Fruit were then treated by either chilling (5 °C for 5 d) or heating (52 °C hot water for 15 min), then cooled with 23 °C tap water to 25 °C and placed at 20 °C for 4 d, or held continuously at 20 °C as the control. Both chilling and heating reduced C6 aldehyde and alcohol aroma volatiles immediately after treatment, and the levels of aldehydes did not fully recover after 4 d at 20 °C. Chilling down-regulated expression of *TomloxA*, *B*, and *C*, but not *D*; however, it increased total LOX activity. Chilling also down-regulated *HPL* and *ADH* expression immediately after treatment, but, after 4 d at 20 °C, both genes were up-regulated compared to the control. HPL activity in chilled tomatoes was reduced, but recovered to control levels after 4 d at 20 °C. ADH activity in chilled fruit decreased after 4 d at 20 °C. On the other hand, heating greatly up-regulated *TomloxB* and *C* expression, even after 4 d at 20 °C, and slightly down-regulated *TomloxA* and *D*, while increasing overall LOX activity. Heating up-regulated both *HPL* and *ADH*, and that effect persisted for 4 d at 20 °C. However, heating reduced the activities of HPL for 4 d at 20 °C and ADH immediately after treatment. The results indicate that heating and chilling regulate C6 volatile production by different mechanisms. Chilling-induced inhibition of C6 volatile production may be due to down-regulation of gene expression, and subsequent reduction of HPL and ADH enzyme activities in the oxylipin pathway. Heating-inhibition of C6 volatile production, however, does not appear to be due to down-regulation of gene expression, but HPL and ADH activities were briefly suppressed.