Effects of chilling acclimation and methyl jasmonate on sugar metabolism in tomato fruits during cold storage

Jingxiang Zhou, Dedong Min, Zilong Li, Xiaodong Fu, Xiuming Zhao, Jihan Wang, Xinhua Zhang, Fujun Li and Xiaoan Li

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Abstract

Chilling acclimation and methyl jasmonate (MeJA) treatments are effective ways to alleviate chilling injury (CI) in postharvest fruit and vegetables. Soluble sugars can be used as an important energy substance, as well as an osmotic adjustment substance, participating in various stress responses in plants. However, the regulation mechanism of chilling acclimation and MeJA treatments on sugar metabolism remains unclear during the fruit response to chilling stress. In this study, tomato fruits were used to study the regulation of sugar metabolism during chilling resistance induced by 0.05 mM MeJA and 2 °C chilling acclimation treatments for 12 h and recovering at 25 °C for 6 h before being stored at 2 °C for up to 20 days. The results showed that both 2 °C and MeJA significantly induced chilling tolerance in tomato fruit, which was reflected by the decreased CI and malondialdehyde content, as well as the increased fruit color change and total antioxidant capacity. In addition, we found that 2 °C and MeJA promoted starch degradation and sucrose accumulation, but inhibited the increase of glucose and fructose contents. MeJA and 2 °C treatments enhanced the transcription levels of genes encoding amylase (AM), sucrose phosphate synthase (SPS), sucrose synthase (SuS) and neutral invertase (NI), while decreased the transcription level of gene encoding acid invertase (AI) during most of the storage periods. Further correlation analysis suggested that the chilling resistance of three groups of fruit was closely associated with sucrose content (r=−0.824 in control, r=−0.964 in 2 °C-treated fruit and r=−0.838 in MeJA-treated fruit); and the sucrose content of the fruit was positively correlated with *SlSPS3* (r=0.681 in control, r=0.947 in 2 °C-treated fruit and r=0.889 in MeJA-treated fruit) and negatively correlated with *SlAI* (r=−0.954 in control, r=−0.921 in 2 °C-treated fruit and r=−0.637 in MeJA-treated fruit). In addition, in 2 °C-treated fruit, sucrose content

was also correlated with the expression of *a-AM* (r=0.723), while in MeJA-treated fruit sucrose content was correlated with *b-AM* (r=0.694). These results suggested that 2 ℃ and MeJA treatments were both effective measures for enhancing the chilling resistance of tomato fruit by regulating sugar metabolism.