

Transcriptome and methylome analysis reveals effects of ripening on and off the vine on flavor quality of tomato fruit

Chi Zhang, Wenyi Duan, Kunsong Chen and Bo Zhang

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Abstract

Current commercial harvest procedures for tomatoes usually involve harvesting the fruit at an early ripening stage with high firmness suitable for storage and transportation followed by ethylene treatment to accelerate fruit ripening. However, harvesting at an immature stage results in reduced flavor quality. Here, we provide major insights into the effect of ethylene-induced ripening of immature fruit on consumer liking, flavor-related compounds, transcriptomes and DNA methylation. Reduced flavor quality of off-vine ripened fruit treated with ethylene is associated with significantly higher content of malic acid, a lower sugar/acid ratio, as well as changes in major volatiles. Altered levels of flavor-related compounds are associated with significant changes in expression of genes encoding key biosynthetic enzymes for malic acid and specific volatiles. Transcripts involved in ethylene formation and signaling are induced by exogenous ethylene treatment. Meanwhile, significant difference in transcript levels of genes related to auxin response are observed between fruit ripened on and off the vine. Differences in transcript levels of volatile synthesis-related genes, including *LOXC*, *BCAT1* and *AADC1A*, are accompanied by major changes in DNA methylation status of their transcriptional promoter regions. Our analysis provides molecular insights into tomato fruit flavor loss caused by artificial ripening using postharvest ethylene treatment.