A transcriptomic analysis unravels key factors in the regulation of stay-green disorder in peel of banana fruit (Fenjiao) caused by treatment with 1-MCP

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Abstract

1-Methylcyclopropene (1-MCP) has been widely used to manipulate fruit ripening. However, inappropriate treatment with 1-MCP may cause ripening disorders. In this study, we observed that the appropriate concentration of 1-MCP (400 nl L^{-1}, 6 h) (1-MCP400) significantly delayed the ripening of Fenjiao banana. However, a high concentration of 1-MCP (3200 nl L^{-1}, 6 h) (1-MCP3200) resulted in abnormal Fenjiao banana that ripened with softened fruit that had a green peel. An RNA sequencing analysis showed that a large number of differentially expressed genes (DEGs) in the fruit peel and pulp were screened out from fruit that were ripened as controls. A KEGG analysis revealed that the metabolic pathways of plant hormone signal transduction, starch and sucrose metabolism, phenylpropanoid biosynthesis, photosynthesis and biosynthesis of amino acids were significantly enriched during fruit ripening. The fruit transcript level of fruit was markedly altered by 1-MCP treatment. Large numbers of DEGs were also detected between high and appropriate concentrations of 1-MCP in the peel and pulp. A comprehensive functional enrichment analysis showed that most of the DEGs involved in photosynthesis, cysteine and methionine metabolism, phenylpropanoid biosynthesis, amino sugar and nucleotide sugar metabolism, plant hormone signal transduction, starch and sucrose metabolism were enriched. RT-qPCR verified the RNA-Seq results, which indicated that 1-MCP3200 severely repressed the expression of genes involved in ethylene (*MaACS1*, *MaACO1*, *MaETR2-like*, *MaERF003*, *MaERF012* and *MaERF113*), auxin (*MaARF19-like*, *MaSAUR71-like* and *MaSAUR72-like*) and abscisic acid (*MaPYL3-like* and *MaABI5-like*) signaling pathways, chlorophyll and cell wall degradation, and starch and sucrose metabolism but induced the expression of genes in lignin synthesis. These

genes were consistently expressed in the pulp and peel following control and 1-MCP400 treatment, but their expression was inconsistent following 1-MCP3200 treatment, which may result in the failure of the peel to turn yellow in the 1-MCP3200 group.