

黑莓果实发育过程中黄酮和花色苷积累的作用机制研究

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摘要:【目的】重点研究第三代新兴的小浆果类果树黄酮和花色苷积累的动态变化, 明确黑莓果实发育过程中黄酮和花色苷合成相关代谢物的变化规律, 探究其果实成熟过程中颜色变化和花色苷积累的作用机制, 以为蔷薇科悬钩子属高效利用花色苷等药用成分提供参考依据。【方法】以黑莓'Chester'品种不同发育阶段的果实为植物材料, 对果实发育过程中颜色和代谢物的变化进行观察和测定, 同时分析相应时期关键基因和转录因子在转录层面的表达情况。【结果】研究表明, 在黑莓果实发育过程中, 未成熟的黑莓果实颜色亮于成熟黑莓果实颜色, 糖类、氨基酸和黄酮类物质不断变化和累积, 关于黄酮和花色苷合成代谢物和相关基因通常显著富集, 黄酮和花色苷合成通路中存在 18 个差异表达的基因和 25 个差异代谢物质。此外, 465 个差异表达的转录因子可进一步分为 47 个家族, 3 个差异表达的基因 (CHI、LAR 和 SAT) 与 MYB 和 bHLH 呈高度相关关系。【结论】综合各项指标可知, 黑莓'Chester'品种果实在发育过程中, 果实颜色呈现出由青色—红色—紫黑色的转变, 且不同发育阶段果实的花色苷合成相关基因表达和代谢物质存在显著差异, 后期黄酮和花色苷合成通路存在显著富集现象。该研究结果对探索调控黑莓果实成熟过程中黄酮和花色苷合成和积累作用机制奠定基础。

关键词: 黑莓; 黄酮; 花色苷; 果实; 代谢物

Study on the mechanism of flavonoids and anthocyanins accumulation during blackberry fruit development

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Abstract: [Objective] This study focused on the dynamic changes of flavonoid and anthocyanin accumulation in the third generation of small berry fruit trees, to clarify the changes of flavonoid and anthocyanin synthesis related metabolites during fruit development of blackberry, and to explore the mechanism of color change and anthocyanin accumulation during fruit ripening, to provide reference for the efficient utilization of anthocyanins and other medicinal components in Rubus of Rosaceae. [Methods] The fruits of blackberry 'Chester' at different developmental stages were used as plant materials to observe and determine the changes of color and metabolites during fruit development, and to analyze the expression of key genes and transcription factors at the transcriptional level. [Results] The results showed that during the development of blackberry fruit, the color of immature blackberry fruit was brighter than that of mature blackberry fruit, sugar, amino acids and flavonoids were constantly changing and accumulating, flavonoids and anthocyanin biosynthetic metabolites and related genes were generally significantly enriched. There were 18 differentially expressed genes and 25 differentially expressed metabolites in flavonoids and anthocyanin biosynthetic pathway. In addition, 465 differentially expressed transcription factors can be further divided into 47 families. Three differentially expressed genes (CHI, LAR and SAT) were highly correlated with MYB and bHLH transcription factor. [Conclusion] The results showed that the fruit color of blackberry

'Chester' changed from green to red to purple-black during fruit development, and there were significant differences in gene expression and metabolites related to anthocyanin biosynthesis at different developmental stages, and significant enrichment of flavonoids and anthocyanin biosynthesis pathway at later stage. This study will lay a foundation for exploring the mechanism of regulating the synthesis and accumulation of flavonoids and anthocyanins during blackberry fruit ripening.

Key words: Blackberry; Flavonoid; Anthocyanin; Fruit; Metabolite