Accumulation of tocopherols and transcriptional regulation of their biosynthesis during cold storage of mandarin fruit

Florencia Rey, María Jesús Rodrigo and Lorenzo Zacarias

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Abstract

Tocopherols are plant-derived isoprenoids with potent antioxidant activity, which have been implicated in the tolerance of plants to different stresses. However, tocopherol accumulation and biosynthesis in fruit, and their potential implication in postharvest chilling injury (CI), has been scarcely studied. Therefore, in this work, we have investigated tocopherol accumulation and biosynthesis in the peel of mandarin fruit of three cultivars with contrasting susceptibility to CI during storage at 2 °C ('Fortune'>'Nova'> 'Nadorcott'). α- and γ-tocopherol were the isoforms detected in the flavedo of the fruit, and a direct relationship between tocopherols content and CI-tolerance was found, since CI-tolerant fruit accumulated the highest tocopherol content whereas CI-sensitive fruit the lowest. Moreover, the transcriptional profiling of 14 genes related to the specific steps of tocopherol biosynthesis, and to their precursor's synthesis, were analyzed. Upstream genes *DXS1* and *DXS2* (1-deoxy-d-xylulose-5-phosphate synthase) and *GGDR* (geranylgeranyl diphosphate reductase), involved in the supply of phytyl pyrophosphate, and the *VTE3* (2-methyl-6-phytyl-1,4-benzoquinol methyltransferase) isoforms appear to be key for the differences in total tocopherol content among the cultivars at harvest. During cold storage, most genes involved in the precursors supply were up-regulated, whereas genes of the tocopherol-core pathway were in general repressed. Changes in *VTE4* during cold storage may account for the differences in γ-tocopherol among cultivars. Collectively, results suggest that the concentration of tocopherols at harvest may play a function in the natural tolerance of mandarin fruit to CI, and that changes in the expression of genes during storage appear to be cold-regulated responses, rather than involved in CI tolerance.