Allelic variations in the tomato carotenoid pathway lead to pleiotropic effects on fruit ripening and nutritional quality

Bruna Orsi, Ivan Sestari, Ana Paula Preczenhak, Magda Andréia Tessmer, Mayara Adjada Silva Souza, Neuza Mariko Aymoto Hassimotto and Ricardo Alfredo Kluge

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Abstract

The accumulation of carotenoids is one of the main factors that determine the quality of tomato fruit. Variations in carotenoid biosynthesis genes found in some known tomato mutants such as *yellow flesh* (*r*), *tangerine* (*t*), *Beta carotene* (*B*) and *Delta carotene* (*Del*) alter the accumulation of carotenoids and lead to fruits with colors other than red at the end of ripening. Here, we used near-isogenic tomato lines carrying these allelic variations with the aim to compare their effect on fruit ripening and on the main quality parameters in a single genetic background (Micro Tom). Fruits were harvest in the mature green stage and monitored until the red ripe stage at 23 °C. Interestingly, besides the alteration of the carotenoid profile we also observed pleiotropic effects on fruit ripening. Fruit with loss of function of the PSY1 enzyme (*r*) had earlier and enhanced ethylene production, as well as accelerated fruit pigmentation. Another loss of function mutant, with reduced activity of the CRTISO enzyme (*t*), led to reduced ascorbic acid content and delayed fruit pigmentation. Fruit carrying gain of function in the activity of β-cyclase (*B*) and ε-cyclase (*Del*) enzymes showed thicker cuticle and enhanced ethylene production, respectively. We also observed that the presence of lycopene isomers and other carotenoid isoforms increased the antioxidant capacity of fruit to a higher extent when compared to the accumulation of a single major carotenoid. Together, these results suggest the involvement of carotenoids in events that regulate ripening and tomato fruit quality, and provide bases for the modification of their accumulation to obtain fruits with different quality and nutritional composition.