Carotenoid and tocopherol fortification of zucchini fruits using a viral RNA vector

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Abstract

Carotenoids and tocopherols are health-promoting metabolites in livestock and human diets. Some important crops have been genetically modified to increase their content. Although the usefulness of transgenic plants to alleviate nutritional deficiencies is obvious, their social acceptance has been controversial. Here, we demonstrate an alternative biotechnological strategy for carotenoid and tocopherol fortification of edible fruits in which no transgenic DNA is involved. A viral RNA vector derived from Zucchini yellow mosaic virus (ZYMV) was modified to express a bacterial phytoene synthase (crtB), and inoculated in zucchini (Cucurbita pepo L.) leaves nurturing pollinated flowers. After the viral vector moved to the developing fruit and expressed crtB, the rind and flesh of the fruits developed yellow-orange rather than green color. Metabolite analyses showed a substantial enrichment in health-promoting carotenoids, such as α- and β-carotene (pro-vitamin A), lutein and phytoene, in both rind and flesh. Considerably higher accumulation of α- and γ-tocopherol was also detected, particularly in fruit rind. Although this strategy is perhaps not free from controversy due to the use of genetically modified viral RNA, our work does demonstrate the possibility of metabolically fortifying edible fruits using an approach in which no transgenes are involved.

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