Basic Study for Increasing Functional Food Ingredients Content in Tomato Using Genetic Diversity

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Introduction

Functional food ingredients have recently attracted attention because of their contribution to the maintenance and improvement of human health and to the prevention of lifestyle diseases. Tomato, *Solanum lycopersicum*, contains functional food ingredients such as lycopene and ascorbic acid, which have anti-oxidant capacity, and serotonin, which—according to a recent report—may have anti-obesity effects. To increase the content of these useful ingredients via breeding and/or cultivation methods, information on their genetic diversity and their synthesis mechanisms is essential. In this study, we investigated functional food ingredients in a tomato introgression line, IL8-3, in which a chromosomal segment from tomato wild species *S. pennellii* is introgressed into the cultivated tomato *S. lycopersicum* chromosome 8, and we also examined the synthesis mechanism of serotonin at the molecular level.

Materials and Methods

First, we measured the anti-oxidant capacity, which is measured as oxygen radical absorbance capacity (ORAC), ascorbic acid content, and serotonin content in IL8-3 and M82—the parent cultivar of IL8-3—fruit. Second, we focused on serotonin because tomato is comparatively rich in this novel and unique functional food ingredient. Serotonin content was measured during fruit development with mRNA levels of the tomato homolog genes of tryptophan decarboxylase (*SlTDC1* and *SlTDC2*) and tryptamine 5-hydroxylase (*SlT5H*), which may play roles in serotonin synthesis. Transgenic tomato plants overexpressing *SlTDC1* with *35S* promoter of cauliflower mosaic virus were developed and investigated.

Results and Discussion

Because domestication narrows the range of genetic diversity in cultivated tomatoes, wild species are useful for drastically improving fruit traits. ORAC, ascorbic acid content, and serotonin content were higher in IL8-3 fruit than in cv. M82 fruit, although their content is not always stable. Therefore, the chromosome segment form *S. pennellii* can be useful for increasing the functional food ingredients content in fruit. The serotonin content increased with fruit development and the *SlTDC1* and *SlT5H* expression levels were high in developing fruit. *SlTDC1* expression levels corresponded with the serotonin content during fruit development. These results suggested that *SlTDC1* and *SlT5H* play roles in serotonin synthesis in tomato fruit, and that *SlTDC1* is particularly important. Tomato plants overexpressing *SlTDC1* showed increased serotonin content, indicating that *SlTDC1* plays a key role in serotonin synthesis. The diversity in tomato SlTDC genes will be of interest in future studies as one of the determining factors of serotonin content.