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Engineering flavonoid metabolism in plants for health-promoting foods

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There is growing evidence that bioactives in the diet play an important role in promoting health. Flavonoids and related phenolics are examples of bioactives from plants that have beneficial influences on a number of important risk factors associated with cardiovascular disease, cancer and age-related degenerative diseases.

Despite increasing knowledge about the link between food and health, changes in diets over the last 50 years have resulted in decreasing numbers of people meeting the recommended dietary intakes of of flavonoid-containing fruit and vegetables and chronic diseases are reaching epidemic proportions in Western societies. Consequently, exploring methods to improve the levels of flavonoids and related phenolics in the fruit and vegetables that people eat is an important strategy to promote health through the production of protective foods.

In tomato, the combination of different types of metabolic strategies (including manipulation of transcription factors) with the availability of natural mutant varieties results in the generation of genetically modified plants with very high levels of different phenolic compounds. These new genetically improved tomatoes provide a unique opportunity to assess within a whole-food context the impact on disease of individual phytonutrients including those (such as resveratrol and isoflavonoids) found at low concentrations in only a limited number of plant species.

Our approach focuses on testing the potential health benefits of functional foods using *in vitro* and animal model systems for different diseases and, eventually, human intervention studies.

As an example of this approach, we present recent data on the effect of flavonoid-enhanced tomatoes on the progression of inflammatory bowel diseases (IBD), a chronic inflammation of the gastrointestinal tract where nutrition interventions play a central role. Our results indicate that, in cell-based assays, flavonoid-rich tomato extracts are able to suppress the secretion of specific pro-inflammatory cytokines by intestinal epithelial cells; preliminary feeding experiments with mice fed a diet enriched with high-flavonoid tomatoes show a reduction in both weight loss and disease activity index.