Title Biotechnology to improve tomato aroma and flavor

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Abstract

Although more than 400 different volatiles have been found in tomato and its products, only a few of them have a marked impact on its organoleptic properties. Thus, metabolic engineering offers a solution for improving the taste and aroma of tomato. Nevertheless, this technique has thus far had only limited practical impact. Previous attempts to modify the aroma of tomato using metabolic engineering of the fatty acid, amino acid and terpenoid pathways had only had a limited success. To test the potential of metabolic engineering to effectively modify aroma and taste properties of fruits, we chose to divert the terpenoid pathway by overexpression of the lemon basil geraniol synthase (GES) gene. GES encodes the enzyme responsible for the production of geraniol from GDP. Geraniol, an acyclic monoterpene alcohol has an intense odor evocative of roses, and is also a key precursor to other scented volatiles such as geranial, citronellol and geranyl acetate. The gene was over-expressed under the control of the strong fruit-ripening-specific tomato polygalacturonase promoter (PG). Overexpression of GES produced elevated levels of geraniol and about ten other geraniol derivatives, which resulted in dramatic changes in the aroma and overall flavor of the transgenic fruits, as judged by a panel of untrained taste panelists. Monoterpene accumulation was at the expense of ~50% decrease in lycopene accumulation. Our data clearly indicate that improvement of fruit aroma and taste by genetic engineering is feasible for tomato and that this approach has the potential for modifying the aroma and taste of other carotenoid-accumulating species of agricultural and horticultural importance.