Metabolic profiling of transgenic lines silenced for an MDHAR gene and impact on ascorbate redox state and carbon metabolism

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Ascorbate is a key molecule involved in numerous cellular processes in plants and is an essential antioxidant protecting the cell from reactive oxygen species (ROS) damage in case of environmental stress. The cellular concentration of ascorbate depends on its biosynthesis, recycling and degradation: these are under genetic control and closely related to environmental conditions.

The recycling pathway controls the redox state of the ascorbate pool and is especially important during stress responses. Recycling of oxidized ascorbate to the reduced form occurs via two enzymes monodehydroascorbate reductase (MDHAR) and dehydroascorbate reductase (DHAR). Transgenic lines silenced for an MDHAR gene in a cherry tomato cultivar have been generated. Our previous results have shown that the activity of MDHAR is correlated with reduced ascorbate and fruit firmness in tomatoes. The objective of this study was to determine whether limiting turnover of the ascorbate pool may affect central metabolism of tomato plantlets and fruits.

MDHAR modified plantlets showed a slower early growth and fruit size was also affected. Silencing MDHAR induced a modification of carbohydrate metabolism affecting particularly sugar concentrations. The ascorbate pool and ascorbate degradation products were also modified. Transgenic lines showed other strong variations of metabolites compared to wild type.

Ascorbate concentration was measured by spectrophotometry. Metabolite profiling of transgenic lines was provided by a GC-MS based survey of tomato metabolites. Results are discussed and shed light on the impact of a modified recycling pathway on metabolism in plantlets and fruits of tomato.

Keywords: ascorbate-recycling, metabolic profiling, redox state