Comparison of Carotenoid Content, Gene Expression and Enzyme Levels in Tomato (*Lycopersicon esculentum*) Leaves

Andrew J. Simkin[a,c], Anne-Marie Labouré[a], Marcel Kuntz[a,*], and Gerhard Sandmann[b]

[a] Génétique Moléculaire des Plantes, Université, J. Fourier and CNRS (UMR5575), BP53, F-38041 Grenoble cedex 9, France. E-mail: marcel.kuntz@ujf-grenoble
[b] Address: Botanisches Institut, J. W. Goethe Universität, D-60054 Frankfurt, Germany
[c] Present address: Horticultural Sciences Department, PO Box 110690, University of Florida, Gainesville, Florida 32611-0690, USA

* Author for correspondence and reprint requests

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Physiological conditions which lead to changes in total carotenoid content in tomato plantlets were identified. Carotenoid levels were found to increase after the onset of a dark period during a normal 24h cycle. This rapid initial increase is followed by a steady decrease in carotenoid content throughout the night. A decrease in the expression of several carotenogenic genes, namely *pds*, *zds* (carotenoid desaturases) and *ptox* (plastid terminal oxidase), was observed following the removal of the light (when carotenoid content is at its highest). An increase in gene expression was observed before the return to light for *pds* and *zds* (when carotenoid levels were at their lowest), or following the return to light for *ptox*. The phytoene desaturation inhibitor norflurazon leads to a decrease coloured carotenoid content and, in the light, this correlated with *pds* and *zds* gene induction. In the dark, norflurazon treatment led to only a weak decrease in carotenoid content and only a small increase in *pds* and *zds* gene expression. The striking absence of phytoene accumulation under norflurazon treatment in the dark suggests a down-regulation of carotenoid formation in darkness. However, prolonged dark conditions, or treatment with photosynthetic inhibitors, surprisingly led to higher carotenoid levels, which correlated with decreased expression of most examined genes. In addition to light, which acts in a complex way on carotenoid accumulation and gene expression, our results are best explained by a regulatory effect of carotenoid levels on the expression of several biosynthetic genes. In addition, monitoring of protein amounts for phytoene desaturase and plastid terminal oxidase (which sometimes do not correlate with gene expression) indicate an even more complex regulatory pattern.

Key words: Carotenoid Desaturation, Photooxidation, Norflurazon