METABOLIC ENGINEERING OF CAROTENOID BIOSYNTHESIS IN POTATO
(SOLANUM TUBEROSUM) TUBERS

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Carotenoids are a class of pigments which are essential for photosynthesis and function as attractants in
some higher plant organs. In humans and animals, the health benefits of dietary carotenoids are becoming
increasingly apparent: they have, in fact, different beneficial effects, although the mechanisms of action
remain unclear. For example, lycopene appears to have a protective effect against prostate cancer while
Lutein and zeaxanthin intake appear to provide protection against age-related macular degeneration. The
widespread occurrence of vitamin A deficiency is well documented.

In order to increase beta-carotene (pro-vitamin A) and total carotenoid content in potato tubers we
produced transgenic plants with the antisense fragment of lycopene epsilon-cyclase (ε-lcy) cloned
between the tuber-specific Potato promoter and the Nos terminator. Transgenic plants (selected by pcr
assay) were characterized through HPLC analysis, which revealed in different lines, an increase of 2-9
fold of β carotene and important modifications of xanthophyll content. Real-time PCR experiments
proved endogenous e-lcy gene silencing as well as perturbations of transcript levels of several carotenoid
pathway genes. Furthermore, we transformed potato plants with bacterial genes, encoding for phytoene
synthase (crtB), phytoene desaturase (crtI) and lycopene cyclase (crtY) introduced in sense orientation
under the control of constitutive (CAMV 35S) or tuber-specific promoter (Potato) promoter. Preliminary
spectrophotometric analyses revealed, in several transgenic lines, increases in total carotenoids. Further
analyses (HPLC, real-time pcr, microarray) are in progress to characterize these transgenic plants and to
identify genes which are regulated by carotenoids.

References