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Does UV-B radiation modify gene expression?

Frequently the harsh environmental conditions, such as, high temperatures, low freezing conditions, high levels of PAR and UV-B sun radiation induce remarkable adaptive reactions in plants. These responses suggest that plants may possess genes associated with defence mechanisms that allow them to survive under natural hostile environments. Plants must adapt to these extreme conditions so they can complete their biological cycle. In this context, *Deschampsia antarctica* É. which grows naturally in Antarctica but also inhabits the Austral zone of Chile and Tierra del Fuego (Moore, 1983) has naturally been exposed to low freezing temperatures and to the increase in UV-B radiation levels occurring in the southernmost part of South America. This combination of low freezing temperatures and high intensities of PAR and UV-B radiation has induced effective defence mechanisms in this plant species. One of these mechanisms is the biosynthesis of secondary metabolites like phenolic compounds (e.g. flavonoids and phenylpropanoids) which can soak up UV-B radiation as a result of their absorptive properties and their role as antioxidants.

The increase in flavonoids and anthocyanins as a plant response to UV-B radiation has been reported and it has been assumed that plants can use phytochemical defences to avoid this harmful radiation. Flavonoids are synthesized by the phenylpropanoid and acetate metabolic pathways. Their biosynthesis has broadly been studied. However, in *D. antarctica* this pathway has only been partially elucidated. CHS is often considered the rate-limiting enzyme in the flavonoid pathway. It belongs to the multigene family and was the first key gene to be identified. In this brief paper we report the effect of UV-B radiation on its transcription levels. In addition, the molecular characterization of *D. antarctica* CHS is reported. Similarly, some flavonoid end products -which might be involved in UV-B adaptive responses-were identified.

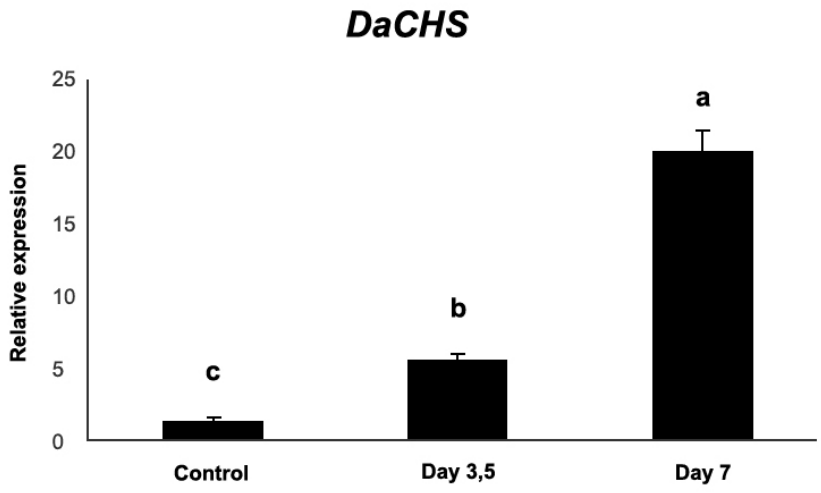

Fig. 1. Effect of UV-B radiation on DaCHS gene. Control plants were maintained in a growth chamber with a PAR regime (16/8 h). Treated plants underwent the same PAR regime daily, supplemented with UV-B radiation for 9 h. Measurements were made at 3.5 and 7 days. One-way ANOVA from Statistica 4.0 software was used for statistical analysis. Bars indicate standard deviation and letters indicate statistical difference ($p \leq 0.05$).

UV-B treatments

Accumulation of transcripts was determined on UV-B irradiated plants. Non-irradiated plants were used as controls. After 3.5 days of UV-B irradiation the accumulation of transcripts was higher in the treated group compared to non-irradiated plants. The maximum difference between both groups was reached after 7 days of treatment (Fig. 1).

Analysis of CHS gene from D. antarctica

DaCHS full-length cDNA was obtained using 3′-RACE-PCR reactions. A sequence of 1741 bp was obtained, containing 143 bp and 407 bp of 5′- and 3′ -UTR sequences respectively. DaCHS presented an ORF of 1191 bp and a deduced polypeptide sequence of 397 amino acids. The predicted protein showed the typical conserved structural features among CHSs, with an estimated MW of 43.53 kDa (pI 6.44). Residues for the active site (C167, F218, H306 and N339) are present. It has two domains: the N-terminal domain ranges from amino acid 8 to 231 and the C-terminal domain ranges from amino acid 241 to 391. Multiple alignment analysis with fourteen other CHS sequences showed a highly conserved pattern among sequences.

Chalcone synthase was isolated and characterized from the Patagonian hairgrass, *D. antarctica*. DaCHS1 showed a variety of conserved residues in the Chalcone synthase family compared to other monocotyledons. According to phylogenetic analysis, DaCHS can be grouped in the same branch of the phylogenetic tree as HvCHS1.

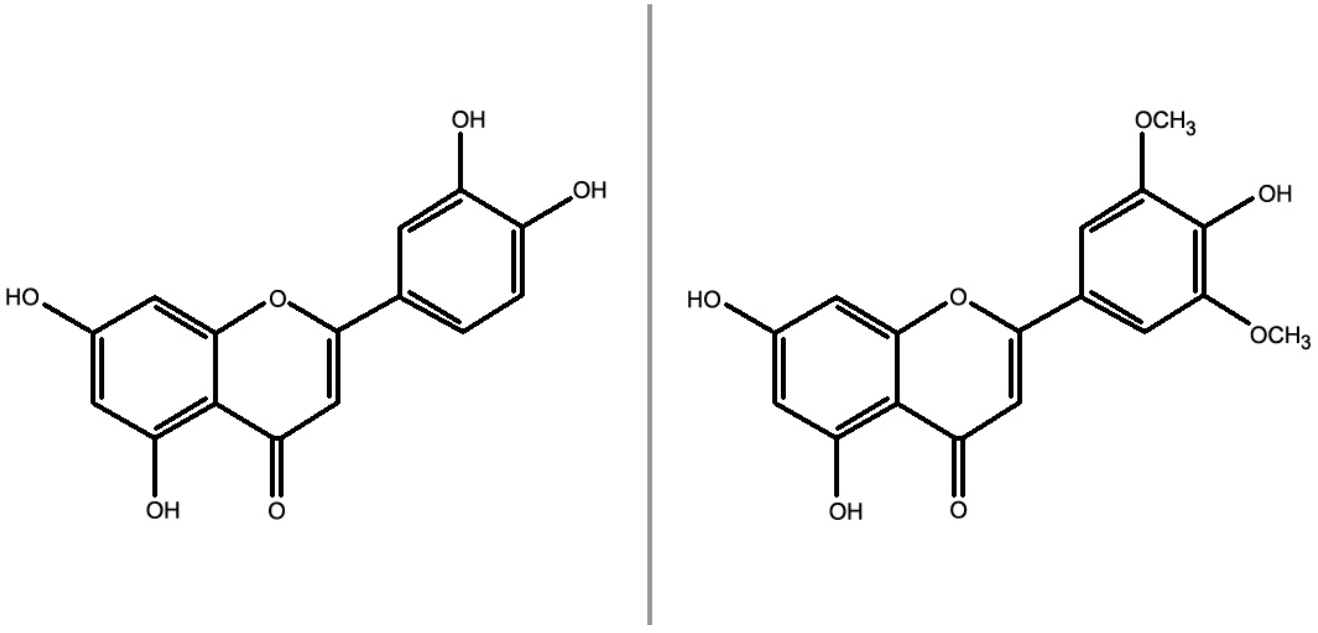

Fig. 2. Flavonoids isolated from the methanolic extract of D. antarctica: luteolin (left); tricin (right).

The observed augment in the CHS transcripts levels after seven days of UV-B treatment suggests that this radiation triggers molecular responses which modify the gene expression of *D. antarctica* making plants capable to deal with high levels of UV-B radiation. Besides, the increased levels of CHS transcripts, a key enzyme for the synthesis of flavonoids and derived compounds, may be correlated with the presence of luteolin and tricin previously isolated in this specie (Fig. 2). These two flavones may play a role in plant protection, acting as UV-B screens.

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