Differential expression and co-regulation of carrot *AOX* genes (*Daucus carota*)

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ABSTRACT

Alternative oxidase (AOX) is a mitochondrial protein encoded by the nuclear genome. In higher plants *AOX* genes form a small multigene family mostly consisting of the two subfamilies *AOX1* and *AOX2*. *Daucus carota* L. is characterized by a unique extension pattern of *AOX* genes. Different from other plant species studied so far it contains two genes in both subfamilies. Therefore, carrot was recently highlighted as an important model in *AOX* stress research to understand the evolutionary importance of both *AOX* subfamilies. Here we report on the expression patterns of *DcAOX1a*, *DcAOX1b* and *DcAOX2a* and *DcAOX2b*. Our results demonstrate that all of the four carrot *AOX* genes are expressed. Differential expression was observed in organs, tissues and during de novo induction of secondary root phloem explants to growth and development. *DcAOX1a* and *DcAOX2a* indicated a differential transcript accumulation but a similar co-expression pattern. The genes of each carrot *AOX* sub-family revealed a differential regulation and responsiveness. *DcAOX2a* indicated high inducibility in contrast to *DcAOX2b,* which generally revealed low transcript abundance and rather weak responses. In search for within-gene sequence differences between both genes as a potential reason for the differential expression patterns, the structural organization of the two genes was compared. *DcAOX2a* and *DcAOX2b* showed high sequence similarity in their open reading frames (ORFs). However, length variability was observed in the N-terminal exon1 region. The predicted cleavage site of the mitochondrial targeting sequence in this locus is untypical small for both genes and consists of 35 amino acids for *DcAOX2a* and of 21 amino acids for *DcAOX2b*. The importance of structural gene organization and the relevancy of within-gene sequence variations are discussed. Our results strengthen the value of carrot as a model plant for future studies on the importance of AOX sub family evolution.

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