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Isolation and Characterization of Alcohol Dehydrogenase (ADH) Gene from *Panax ginseng*

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Alcohol dehydrogenase (ADH; alcohol:NAD^+ oxidoreductase, EC 1.1.1.1) catalyze the reversible conversion of aldehydes to the corresponding alcohols. The enzyme is presumably required by plants for NADH metabolism, via reduction of acetaldehyde to ethanol, during periods of anaerobic stress. They have been involved in the stress response of plants, mainly in anaerobiosis where they are responsible for the production of ethanol. ADHs have also been implicated in the response to a wide range of other stresses, elicitors and abscisic acid. An alcohol dehydrogenase (*PgADH*) cDNA was isolated and characterized from the leaf of *Panax ginseng* C. A. Meyer. We describe for the first time the isolation and characterization of short-chain ADH gene in *Panax ginseng*. The cDNA was 1106 necleotides long and had an open reading frame of 801 bp with a deduced amino acid sequence of 266 residues. The calculated molecular mass of the matured protein is approximately 29 kDa with a predicated isoelectric point of 6.84. A GenBank BlastX search revealed that the deduced amino acid of *PgADH* shares a high degree homoloy with the short-chain ADH proteins of other plants (68% identity, 85% similarity). To analyze the gene expression of *PgADH* gene against the oxidative and heavy metal stresses, we employed the quantitive RT-PCR and realtime PCR. Our results reveal that *PgADH* is induced by mannitol, sucrose, H2O2, and after exposure to low temperatures. In addition, abscisic acid, salicylic acid and jasmonic acid triggered a significant strong induction (more than ten fold) of *PgADH* within 24 h post-tratment. The positive reponsens of PgADH to the abiotic stimuli suggested that ginseng ADH may help to protect against osmotic-related environmental stresses and that it may also be involved in plant defense system.