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Transcriptome Analysis of Heat Acclimation in *Arabidopsis* Suspension Cells

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Thermotolerance by mild heat acclimation is a genetically controlled manner in plants to overcome transiently temporal heat shock. Recently, this thermotolerance phenomenon have been extensively studied but detail molecular pathways were not well established in plants. Here we report the acclimated thermotolerance in Arabidopsis suspension cells and their transcriptional profiles with cDNA microarrays. Through the analysis, several up and/or down-regulated genes involved with thermotolerance and programmed cell death were classified, interestingly, unreported AP2 domain transcripton factors were dramatically induced in this experiment. By the comparison of up-regulated genes with publicly available microarray data sets at Standford Microarray Database, some genes were involved in various plant developmental stages and stresses, suggesting a multi-functional potency. Furthermore, promoter sequence analysis to find common motifs showed that plant AP2-like motif, which may be involved with thermotolerance, was comparatively high in upstream sequences of up-regulated genes.

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Differential Expression of Catalase Genes in Hot Pepper (*Capsicum annuum* L.)

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Three different catalase cDNA clones(*Cacat1*, *Cacat2* and *Cacat3*) have been isolated from hot pepper(*Capsicum annuum* L.), and their expression patterns have been analyzed. Nucleotide identity of the three genes ranges from 73% to 82%. Northern hybridization showed that *Cacat1* and *Cacat2* transcripts were accumulated with different rhythm under circadian control. Differential expression of three genes was observed in the different organs and during fruit development. Moreover, *In situ* hybridization showed the spatial distribution of *Cacat1* and *Cacat2* transcripts distinct from each other in leaf and stem. In response to wounding and paraquat treatment by which H2O2 level increased at 4-12h after treatments, *Cacat1*mRNA level increased significantly at 4-12h in the paraquat-treated and the systemic leaves. However, wounding hardly affected the expression of catalase genes. Total catalase activity assay also showed the results similar to Northern assay in response to paraquat treatment. In catalase activity level, Ca2+/CaM activated only CAT1 isozyme whereas the catalytic activities of both CAT1 and CAT2 were nonselectively inhibited by SA. The special features of *Cacat1*revealed from our results suggest new perspectives for its possible functional roles related to environmental stresses and possible regulatory mechanism.

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Modulatory Expression of *AtTPS1* under Abiotic Stresses

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Trehalose is known as a stress protectant in microorganisms, but its role in higher plants is yet unknown. We have shown that transgenic tobacco plants producing trehalose exhibited improved tolerance against dehydration and high temperature. But minute amounts of trehalose detected in these transgenic plants suggest that it is not likely to act directly as osmoprotectants. Out of 11 homologs of TPS found in Arabidopsis, *AtTPS1* was the only functional homolog identified so far. To look into the role of trehalose in Arabidopsis, we examined *AtTPS1*expression by Nothern blot, RT-PCR, and histochemical analysis of *AtTPS1::GUS* plants. The results indicate that although of constitutive nature, *AtTPS1* was more strongly expressed in stems and leaves on vascular bundle area. Furthermore, *AtTPS1*was up-regulated by various abiotic stresses including drought, heat, chilling, salt, and wounding stresses. The results, together with exhibition of enhanced tolerance against dehydration, heat and salt stresses in transgenic tobacco plants strongly suggest that trehalose may play a regulatory role under various environmental stresses.

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Trehalose-producing Transgenic Tobacco Plants Exhibit Increased Tolerance to Multiple Abiotic Stresses

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Trehalose-producing transgenic tobacco plants were generated to test their physiological responses to various abiotic stresses. Minute amounts of trehalose (less than 500 g per g leaf tissue) were detected in transgenic plants while no trehalose was detected in nontransformants. All transgenic plants showed enhanced tolerance against dehydration given by blocking water supply or PEG-treatment in maintaining leaf turgidity and showing improved retention in fresh weight. However, negative effect of dehydration on photosynthetic capacity was not relieved in transgenic plants. The initial leaf water potential was observed higher in transgenic plants than nontransformants, but decrease in water potential by dehydration occurred to a comparable degree in both nontransformants and transgenic plants. Trehalose-producing plants also survived better after sustained growth at 45℃ in contrast to nontransformants which underwent extensive leaf chlorosis and necrosis. The photosynthetic capacity and germination efficiency of seed were maintained better after heat-treatment. In addition to dehydration and heat stresses, transgenic plants showed improved tolerance against salinity. When plants were grown under 250 mM NaCl, bleaching and chlorosis initiated significantly earlier in nontransformants. Germination was also less inhibited under salinity in transgenic plants. The results suggest that trehalose confers a protection against multiple abiotic stresses.