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Enhancement of Spermidine Content and Antioxidant Capacity by Modulating Ginseng *Spermidine synthas*e in Response to Abiotic and Biotic Stresses

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Polyamines (putrescine, spermidine and spermine) play pivotal roles in plant defense to different abiotic and biotic stresses. In order to understand the function of ginseng *spermidine synthase* gene, a key gene involved in biosynthesis of polyamines, transgenic plant was generated in *Arabidopsis*. The transgenic plants exhibited high levels of polyamines compared to the untransformed control plants. We investigated the tolerance capacity of transgenic plants to abiotic stresses such as salinity and copper stress. In addition, transgenic plants also showed increased resistance against one of the important fungal pathogens of ginseng, the wilt causing *Fusarium oxysporum* and one of important bacteria, bacterial blight causing *Pseudomonas syringae*. However, an activity of the polyamine catabolic enzyme, diamine oxidase (DAO) was increased significantly in *F. oxysporum* and *P. syringae* infected transgenic plant. Polyamine catabolic enzymes which may trigger the hypersensitive response (HR) by producing hydrogen peroxide (H_2O_2) seem act as an inducer of PR proteins, peroxidase and phenyl ammonium lyase activity. The transgenic plants also contained higher antioxidant enzyme activities, less MDA and H_2O_2 under salt and copper stress than the wild type, implying it suffered from less injury. These results strongly suggest an important role of spermidine as a signaling regulator in stress signaling pathways, leading to build-up of stress tolerance mechanisms.