Theanine Improves Salt Stress Tolerance via Modulating Redox Homeostasis in Tea Plants (Camellia sinensis L.)

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Title

Theanine Improves Salt Stress Tolerance via Modulating Redox Homeostasis in Tea Plants (*Camellia sinensis L.*)

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Abstract

Theanine, a unique non-proteinogenic amino acid, is one of the most abundant secondary metabolites in tea. Its content largely determines green tea quality and price. However, its physiological roles in tea plants remain largely unknown. Here, we showed that salt stress significantly increased the accumulation of glutamate, glutamine, alanine, proline, and γ-aminobutyric acid, as well as theanine, in the new shoots of tea plants. We further found that salt stress induced the expression of theanine biosynthetic genes, including CsGOGATs, CsAlaDC, and CsTSI, suggested that salt stress induced theanine biosynthesis. Importantly, applying theanine to the new shoots significantly enhanced the salt stress tolerance. Similar effects were also found in a model plant Arabidopsis. Notably, exogenous theanine application increased the antioxidant activity of the shoots under salt stress, suggested by reduced the reactive oxygen species accumulation and lipid peroxidation, as well as by the increased SOD, CAT, and APX activities and expression of the corresponding genes. Finally, genetic evidence supported that catalase-mediated antioxidant scavenging pathway is required for theanine-induced salt stress tolerance. Taken together, this study suggested that salt stress induces theanine biosynthesize in tea plants to enhance the salt stress tolerance through a CAT-dependent redox homeostasis pathway.