Study on Salt tolerance in Transgenic Rice with the Gene for Choline Oxidase

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Summary

Development of genetically-engineered crops with enhanced stress tolerance is an important challenge in plant biotechnology. Glycinebetaine, an efficient compatible solute found in a number of halotolerant species of plants and bacteria, is implicated in playing a crucial role on the protection of cellular functions from salt and dehydration stresses.

Cereal crops with agronomical impacts such as rice do not accumulate glycinebetaine and cannot grow in high salt environments. In attempt to enhance salt tolerance in cereal crops, genetically-engineered rice (*Oryza sativa* L.) that acquires the ability to synthesize glycinebetaine has been established by introduction of the *codA* gene that encodes choline oxidase, a glycinebetaine-synthesizing enzyme, from the soil bacterium *Arthrobacter globiformis*. The *codA* gene was successfully inherited to the second generation of transgenic rice and its expression was stably maintained at levels of the mRNA, the protein and the enzyme activity. Levels of glycinebetaine accumulated in leaves were estimated as high as 1 and 5 μmol g^{-1} fresh weight of two types of transgenic plants that targeted choline oxidase into the chloroplasts (ChlCOD plants) and to the cytosol (CytCOD plants), respectively. Inactivation of photosynthesis as a measure of the cellular damage indicated that ChlCOD plants performed better than CytCOD plants against salt and low-temperature photoinhibition, despite the fact that higher accumulation of glycinebetaine was observed in CytCOD plants. These results indicated that subcellular compartmentation of glycinebetaine biosynthesis is a critical element to efficiently enhance stress tolerance of engineered plants.