Metabolic Engineering of Antioxidative Mechanism in Chloroplasts

Sang-Soo Kwak, Suk-Yoon Kwon

Laboratory of Environmrntal Biotechnology, Korea Research Institute of Bioscience and Biotechnology (KRIBB), Oun-dong 52, Yusong, Daejeon 305-806, Korea

TEL: +82-42-860-4432, FAX: +82-42-860-4608, E-mail: sskwak@kribb.re.kr

In order to develop transgenic plants with enhanced tolerance to multiple stress, we are attempting to manipulate the antioxidative mechanism in chloroplasts by metabolic engineering. In addition, we are trying to isolate novel stress-inducible plant promoters. Transgenic tobacco (*Nicotiana tabacum* cv. Xanthi) plants were developed that overexpress both superoxide dismutase (SOD) and ascorbate peroxidase (APX) in chloroplasts and were evaluated for protection against methyl viologen (MV, paraquat)-mediated oxidative damage both in leaf discs and whole plants.[1)] The expression of both CuZnSOD and APX provided the strongly enhanced protection against membrane damage in leaf discs and visual symptoms in whole plants. Transgenic tobacco plants expressing a human dehydroascorbate reductase (DHAR) catalyzing the reduction of DHA to ascorbate in chloroplasts were also developed and were tested for responses to various stresses.[2)] DHAR transgenic plants showed an enhanced tolerance to low temperature and NaCl compared to non-transformed plants. Recently, we developed a novel oxidative stress-inducible peroxidase (*SWPA2*) promoter from sweetpotato (*Ipomoea batatas*) and analyzed its characters in transgenic tobacco plants and cultured cells in terms of environmental stress.[3)] We anticipate that *SWPA2* promoter will be biotechnologically useful for the development of transgenic plants with enhanced tolerance to environmental stress. Transgenic crops expressing CuZnSOD, APX and DHAR under the control of *SWPA2* promoter are under developing. The further metabolic engineering of antioxidative mechanism in chloroplasts will be discussed.

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3. Kim K. Y., Kwon S. Y., Lee H. S., Hur Y. K., Bang J. W., Kwak S. S. (2003), A novel oxidative stress-inducible peroxidase promoter from sweet potato: molecular cloning and characterization in transgenic tobacco plants and cultured cells, *Plant Molecular Biology* **51**, 831-838.