Iron-sulfur proteins that contain iron-sulfur clusters and are ubiquitously present in various organisms from lower bacteria to higher eukaryotes play important roles in systems such as electron transport and DNA/RNA metabolism. The biosynthesis of iron-sulfur clusters is a highly regulated process involving several proteins. Among them, so-called scaffold proteins play pivotal roles in both the assembly and delivery of iron-sulfur clusters. We have identified two chloroplast-localized NifU-like proteins, AtCnfU-V and AtCnfU-IVb, from Arabidopsis thaliana with high sequence similarity to a cyanobacterial NifU-like protein that was proposed to serve as a molecular scaffold. AtCnfU-V is constitutively expressed in several tissues of Arabidopsis, whereas the expression of AtCnfU-IVb is prominent in the aerial parts. Mutant Arabidopsis lacking AtCnfU-V exhibited a dwarf phenotype with faint pale-green leaves and had drastically impaired photosystem I accumulation. Chloroplasts in the mutants also showed a decrease in both the amount of ferredoxin, a major electron carrier of the stroma that contains a [2Fe-2S] cluster, and the in vitro activity of iron-sulfur cluster insertion into apo-ferredoxin. When expressed in E. coli cells, AtCnfU-V formed a homodimer carrying a [2Fe-2S]-like cluster, and this cluster could be transferred to apo-ferredoxin in vitro to form holo-ferredoxin. We propose that AtCnfU has an important function as a molecular scaffold for iron-sulfur cluster biosynthesis in chloroplasts and thereby is required for biogenesis of ferredoxin and photosystem I.

The Arabidopsis Chloroplastic NifU-Like Protein CnfU, Which Can Act as an Iron-Sulfur Cluster Scaffold Protein, Is Required for Biogenesis of Ferredoxin and Photosystem I

NAKAI Masato*1 and TERASHIMA Ichiro*2

*1(Institute for Protein Research) *2(Graduate School of Science)

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Regulation of Toll/IL-1-Receptor-Mediated Gene Expression by the Inducible Nuclear Protein IκBζ:

YAMAMOTO Masahiro and AKIRA Shizuo
(Research Institute for Microbial Diseases)

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Toll-like receptors (TLRs) recognize microbial components, and trigger the inflammatory and immune responses against pathogens. IκBζ (also known as MAIL and INAP) is a nuclear protein harboring ankyrin repeats and is highly homologous to an IκB family member, Bcl-3. Its transcript is rapidly induced by stimulation with TLR ligands and IL-1. Here we show that IκBζ is indispensable for expression of a subset of genes activated in TLR/IL-1R signaling pathways. IκBζ-deficient cells show severe impairment in IL-6 production in response to a variety of TLR ligands as well as IL-1, but not in response to TNF-α. Endogenous IκBζ selectively associates with the p50 subunit of NF-κB, and is recruited to the NF-κB binding site of the IL-6 promoter upon stimulation. Moreover, NF-κB/p50-deficient mice show similar TLR/IL-1R-mediated responses to IκBζ-deficient mice. Endotoxin-induced expression of other genes such as IL-12 p40 and GM-CSF is also abrogated in IκBζ-deficient macrophages. Given that the LPS induction of IκBζ occurs earlier than that of these genes, some TLR/IL-1R-mediated responses may be regulated in at least a two-step gene expression that requires inducible IκBζ.

Crucial roles of IκBζ in TLR/IL-1R-mediated two-step gene induction and prevention of spontaneous ocular surface inflammation

Wild-type

IκBζ KO