Redox-regulated membrane attachment of ferredoxin-NADP$^+$ oxidoreductase (FNR) is mediated by the Tic62 protein

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Precise management of the regulatory circuits between photosynthetic electron transfer and various downstream processes is required for the optimal fitness of the plant. Since ferredoxin-NADP$^+$ oxidoreductase (FNR) enzyme performs the transfer of electrons from ferredoxin to NADP$^+$, it is an important mediator of reducing power providing the transition from exclusively membrane-bound light reactions to the stromal metabolic pathways. In *Arabidopsis thaliana*, the two chloroplast-targeted FNR isoforms FNR1 and FNR2 can be found attached to the thylakoid and inner envelope membranes, as well as a soluble protein in the stroma (1,2). The physiological role of the different FNR pools and the mode and site of thylakoid membrane attachment has remained enigmatic until now.

In the present study, we provide evidence that FNR is bound to the thylakoid membrane via the Tic62 protein (3), which has been earlier shown to be a 62 kDa subunit of the translocon at the inner envelope of chloroplasts (Tic). Moreover, the FNR1 isoform is a prerequisite for the membrane attachment of FNR2 (1,2). At the thylakoids, Tic62 and both FNR isoforms form high molecular weight complexes that are not involved in photosynthetic electron transfer but are dynamically regulated by light signals and the stromal pH. Structural analyses revealed that Tic62 binds to FNR in a novel binding mode for flavoproteins, with a major contribution from hydrophobic interactions. Furthermore, in the absence of Tic62, membrane binding and stability of FNR are drastically reduced (3).

We conclude that Tic62 represents a major FNR interaction partner not only at the inner envelope membrane and in the stroma, but also at the thylakoids of *Arabidopsis thaliana* and perhaps all flowering plants. We furthermore propose that correct allocation of FNR is used to efficiently regulate Fd-dependent electron partitioning in the chloroplast.

1. Lintala et al (2007) Plant J. 49, 1041-1052.
2. Lintala et al. (2009) Plant J. 57, 1103-1115
3. Benz et al. (2009) Plant Cell 21, 3965-3983.