The redox regulation of cysteine biosynthesis in the chloroplast of Arabidopsis thaliana

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Cysteine synthesis is catalyzed by the sequential reaction of two enzymes: serine acetyltransferase (SAT) and O-acetylserine(thiol)lyase (OAS-TL) in plants. Together they form the hetero-oligomeric cysteine synthase complex (CSC). In plants cysteine synthesis takes place in three different cellular compartments: chloroplast, cytosol and mitochondria. In chloroplast SAT1 and OAS-TL B are responsible for cysteine synthesis. The compositions and enzymatic properties of cytosolic and mitochondrial CSC have been well studied, but not in the chloroplast isoform. Recently Cyclophilin 20-3 (CYP20-3) has been shown to interact with SAT1 to enhance cysteine synthesis in stress response. But the mechanism that how CYP20-3 regulates cysteine and glutathione synthesis remains unknown. In my study, it showed that chloroplast OAS-TL B interacts with SAT but less efficiently than cytosolic OAS-TL A. In addition, we obtained the x-ray crystal structure of OAS-TL B from *Arabidopsis thaliana* at 1.76 Å resolution. It indicates that the C-terminus of chloroplast OAS-TL B has a different orientation from cytosolic and mitochondrial OAS-TL isoforms. This different feature in C-terminus of OAS-TL B is associated with its low binding affinity to SAT. It suggests that the formation of chloroplast CSC is not very efficient, which requires CYP20-3 to exert its chaperone function on chloroplast CSC to boost OAS and cysteine production, especially under stressed conditions. This provides us a new redox mechanism on the regulation of chloroplast CSC and might explain how Arabidopsis coordinates the cysteine synthesis in response to stress through redox signals.