Structural studies of a mitochondrial RNA importer

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Mitochondria are membrane bound organelles of endosymbiotic origin with limited protein coding capacity. Consequently, the continual import of nuclear-encoded protein and nucleic acids such as DNA and small non-coding RNA is required and essential for maintaining organelle mass, number and activity. As plant mitochondria do not contain all the necessary tRNA types required, the import of cytosolic tRNA is vital for organelle maintenance.

In Arabidopsis thaliana, plant specific outer membrane proteins named Tric1 and Tric2, (tRNA import component) were shown to be involved in the import of cytosolic tRNA [1]. Tric1/2 binds tRNA\textsubscript{AL\textsubscript{A}} via conserved residues in the C-terminal Sterile Alpha Motif (SAM) domain. We have determined the X-ray crystal structure of the Tric1 SAM domain to 1.5Å resolution showing an oligomeric helical superstructure with three molecules per asymmetric unit (Fig. 1). Key amino acid residues have been identified to be responsible for the oligomeric formation. Using site directed mutagenesis, in combination with crystallographic analyses and RNA electrophoretic shift assays we have determined that the oligomerization of Tric1 SAM domain is essential for protein function associated with RNA binding capability.

Furthermore, complementation of Arabidopsis thaliana Tric1/2 deletion mutant lines with a mutated Tric1 failed to restore the defective plant phenotype suggesting the superstructure is essential for function in planta. Our results highlight the importance of oligomerization of Tric proteins for their biological function.

Figure 1. The helical superstructure of Tric1 SAM domain. Each of the three chains in the asymmetric unit of the crystal structure are coloured in magenta, green and blue. The crystal lattice forms the superstructure.