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Crystal Structures and Evolution of RNA Processing Enzymes. Rumana Rashid, Mohamed Aittaleb, Fanming Xu, Hong Li, Dept. of Chemistry and Biochemistry, Florida State Univ., Tallahassee, FL.

Crystal structures of two RNA processing enzymes are determined. The first enzyme processes and modifies ribosomal RNAs. The second is responsible for recognition and excision of tRNA introns. In both cases, crystal structures of archaeal enzymes and biochemical studies of their eukaryotic counterparts illustrate a common evolutionary principle to enhance RNA substrate diversity. Ribosomal RNAs are processed and modified in nucleolus by box C/D small nucleolar ribonucleoprotein particles (snoRNPs). The core components of box C/D snoRNPs include fibrillarin, Nop58p, Nop56p, a Snu13p-like proteins, and box C/D RNA. Fibrillarin binds to both Nop56p and Nop58p and the resulting complex interacts with the box C/D RNA. The two Nop proteins in Eukarya have a single homolog in Archaea, Nop58/56p, suggesting a gene duplication event and diversification of the function of the Nop proteins. A crystal structure of an archaeal fibrillarin-Nop56/58p complex at 3.1 Å is obtained. This core protein complex structure exhibits a symmetric architecture that coincides with the bipartite feature of box C/D RNAs. This model clearly predicts a pseudosymmetric assembly of the eukaryotic fibrillarin-Nop56p-Nop58p complex that is verified through protein-protein interaction studies. RNA splicing endonuclease is the second RNA processing enzyme where the same evolutionary principle is observed. The yeast splicing endonuclease is an $\alpha\beta\gamma\delta$ heterotetramer while all archaeal organisms contain a single endonuclease gene homolog. Crystal structures of two archaeal endonucleases reveal that archaeal enzymes are either homotetramers or homodimers of four equivalent endonuclease domains. Biochemical studies show that while all splicing endonucleases can cleave a minimal RNA motif, the yeast endonuclease recognizes much broader range of RNAs than its archaeal homologs. We propose that the transition from “homomultimer” to “heteromultimer” structures through gene duplication is an important strategy to modulate RNA substrate specificity of all RNA processing enzymes.