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The Evolution and Mechanisms of Type 1 CRISPR Systems

Bacteria and Archaea have adaptive RNA-guided immune systems called CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats)-Cas (CRISPR associated) that provide protection against invading genetic elements. There are currently five reported CRISPR types comprised of at least nineteen subtypes that encode for a different crRNA-guided surveillance complex. The Type 1-E system of Escherichia coli relies on a surveillance complex called Cascade (CRISPR-Associated Complex for Antiviral Defense) and a nuclease/helicase, Cas3. Similarly, the Type 1-F system of Pseudomonas aeruginosa relies on a surveillance complex called Csy (CRISPR system yersinia) and the trans-acting nuclease, Cas2/3. The Type 1-F system is unique, because it contains a fusion of the Cas2 and Cas3 proteins into a single polypeptide. In most Type 1 systems, Cas2 and Cas3 are separate proteins that are involved in adaptation and interference, respectively. When the surveillance complex of a Type 1 system binds to target DNA, it recruits the nuclease to degrade the invader DNA. My aim is to determine if the Cas2/3 protein from P. aeruginosa can complement the activity of Cas3 from E. coli.