BIOFILMS

A little help from a phage friend

Publishing in *The ISME Journal* Rice and colleagues reveal that a filamentous phage helps *Pseudomonas aeruginosa* form a mature biofilm.

Biofilm formation is a well-described process: it starts when a bacterium adheres to a surface, and then a microcolony forms that grows both horizontally and vertically to form a complex three-dimensional structure that can harbour physiologically distinct cell types. During the course of biofilm development, some regions of the biofilm die, which allows progeny bacteria to disperse.

Filamentous phage Pf4 had previously been isolated during the release of bacteria from a *P. aeruginosa* biofilm. To test if Pf4 plays a part in biofilm formation, the authors produced a strain in which the prophage was deleted (ΔPf4). Although this strain grew as well as the parent lysogen during planktonic growth, it had a reduced ability to form biofilms. At each time point examined, the microcolonies of the ΔPf4 mutant were smaller than those of the parental strain, and they never developed the distinct morphology or zones of dead cells that are characteristic of the wild-type biofilm.

Adding purified Pf4 phages to the mutant biofilms restored wild-type features of the biofilm, including zones of dead cells. Based on this finding, the authors proposed an essential role for Pf4 in biofilm development. An important phenotype of a mature *P. aeruginosa* biofilm is resistance to SDS treatment. Although mature wild-type biofilms are not affected by SDS, the ΔPf4 mutant formed biofilms that were as sensitive to SDS as the well-characterized *lasR rhlR* biofilm double mutant, providing further evidence for the absence of true biofilm development in the mutant that lacked the prophage.

The formation of small-colony variants is typical of *P. aeruginosa* and has been linked to its virulence. When the effluent of mutant and wild-type biofilms was cultured on solid media, small-colony variants were only formed by the wild-type strain. The ΔPf4 mutant was also significantly less virulent than the wild type in a mouse model of infection. It is unclear if reduced virulence results from a lack of Pf4 prophage or the inability to form biofilms.

How this phage-dependent bacterial phenotype evolved and what components of the phage are needed for mature biofilm formation remain to be investigated.

Christiaan van Ooij

> “The ΔPf4 mutant was also significantly less virulent than the wild type in a mouse model of infection.”

ORIGINAL RESEARCH PAPER Rice, S. A. *et al.* The biofilm life cycle and virulence of *Pseudomonas aeruginosa* are dependent on a filamentous prophage. *ISME J.* 13 Nov 2008 (doi: 10.1038/ismej.2008.109)