Bacteriophages for Biofilm Eradication


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**Bacteriophages for Biofilm Eradication**

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**Introduction**

Bacteriophages or phages are a unique type of virus that recognize a specific type of bacteria and then infect, replicate and kill the host via cell lysis. The application of phages and their enzymes for treating bacterial biofilms has recently gained significant interest due to a number of significant advantages compared to traditional antibiotics, including high specificity and efficacy, low immunogenicity and production costs.

**Proteus mirabilis**, **Stenotrophomonas maltophilia** and **Pseudomonas aeruginosa** are all clinically relevant microorganisms associated with biofilm formation and thus there is great difficulty treating such infections. With the increasing number of multi-drug resistant strains being reported the time for novel antimicrobial agents is now and thus we propose the use of bacteriophages to treat the said bacterial species’ biofilms.

**Aims**

- To isolate novel bacteriophages which act against **Proteus**, **P. aeruginosa** and **S. maltophilia**
- Obtain high and pure phage titre of isolated phages
- Characterize each phage to determine their novelty
- Assess the ability of phages to degrade bacterial biofilms

**Methodology**

- Environmental enrichment of phages
- Top agar overlay spot test assay
- Top agar plaque assay
- Phenol:chloroform DNA extraction
- Genomic restriction analysis
- MBEC assay

**Results**

To date we have isolated 6 phages against 6 different Proteus bacteria (Fig. 1), with 2 phages lysing all strains. Furthermore, we have 9 phages which act against **P. aeruginosa**. Phage qφNFS (Fig. 2) has shown great preliminary results when attempting to degrade PA01 biofilms and resulted in a clinically significant two log reduction of the biofilm. The Proteus phages are yet to be tested against biofilms, but are expected to have a similar outcome to that of qφNFS. These results so far show the extreme potential of phages to act as biocontrol agents against biofilms in an era of increasing multi-drug-resistance.

**Anti-biofilm assays (MBEC)**

**P. aeruginosa** biofilms grown via the MBEC device (Fig. 3) were exposed to different phage titres of qφNFS phage and incubated for 18-24 h before assessing the ability of the phages to degrade the biofilms. A phage titre of $1 \times 10^7$ showed a 100x reduction of the PA01 biofilm (Fig. 4).

**Planned MiniION nanopore sequencing**

- We plan to sequence all our phages using MiniION nanopore sequencer
- Test runs with **Escherichia coli** phage λ produced 130k reads in 6 h!