

## Isolation and Characterisation of Novel Environmental Bacteriophages Which Target the Escherichia coli LamB Outer Membrane Protein

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**Abstract :** Bacteriophages are viruses which infect bacteria specifically. Over the past decades, phage  $\lambda$  has been extensively studied, especially its interaction with the Escherichia coli LamB (EcLamB) protein receptor. Nonetheless, despite the enormous numbers and near-ubiquity of environmental phages, aside from phage  $\lambda$ , there is a paucity of information on other phages which target EcLamB as a receptor. In this study, to answer the question of whether there are other EcLamB-targeting phages in the natural environment, a simple and convenient method was developed and used for isolating environmental phages which target a particular surface structure of a particular bacterium; in this case, the EcLamB outer membrane protein. From the enrichments with the engineered bacterial hosts, a collection of EcLamB-targeting phages ( $\Phi$ ZZ phages) were easily isolated. Intriguingly, unlike phage  $\lambda$ , an obligate EcLamB-dependent phage in the Siphoviridae family, the newly isolated  $\Phi$ ZZ phages alternatively recognised EcLamB or E. coli OmpC (EcOmpC) as a receptor when infecting E. coli. Furthermore,  $\Phi$ ZZ phages were suggested to represent new species in the Tequatrovirus genus in the Myoviridae family, based on phage morphology and genomic sequences. Most phages are thought to have a narrow host range due to their exquisite specificity in receptor recognition. With the ability to optionally recognise two receptors,  $\Phi$ ZZ phages were considered relatively promiscuous. Via the heterologous expression of EcLamB on the bacterial cell surface, the host range of  $\Phi$ ZZ phages was further extended to three different enterobacterial genera. Besides, an interesting selection of evolved phage mutants with a broader host range was isolated, and the key mutations involved in their evolution to adapt to new hosts were investigated by genomic analysis. Finally, and importantly, two  $\Phi$ ZZ phages were found to be putative generalised transducers, which could be exploited as tools for DNA manipulations.

**Keywords :** environmental microbiology, phage, microbe-host interactions, microbial ecology

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