

Abstract

Bacteriophages are increasingly considered as alternatives or complements to antibiotics; however, their activity is still evaluated mainly in fast-growing planktonic bacteria cultivated in nutrient-rich media. In natural and clinically relevant environments, bacteria often grow more slowly, are exposed to nutrient limitation, or form biofilms, all of which may substantially affect lytic infection. The aim of dissertation was to quantitatively define the influence of the physiological state of the bacterial host on lytic bacteriophage performance.

In the first part of the study, the T4 – *Escherichia coli*, T7 – *Escherichia coli*, and K – *Staphylococcus capitis* systems were investigated in continuously cultivated bacterial cultures at different specific growth rates. The adsorption constant, eclipse and latent periods, burst size, and phage fitness were determined. The study was further extended by examining phage performance in nutrient-limited bacteria following prior growth at different rates, thereby additionally evaluating the importance of the initial physiological state of the bacteria, which systematically affected all key parameters of the lytic cycle. After normalisation to the maximal growth rate, common relationships emerged between the relative bacterial growth and infection parameters, adsorption showed a non-linear, parabolic response, eclipse and latent periods increased as bacterial growth slowed, whereas burst size and phage fitness decreased linearly. In the second part, a continuous system for reproducible biofilm formation under controlled hydrodynamic conditions was established, and the effects of loading time, washing, and specific growth rate on biofilm formation were evaluated. The activity of phage T4 against *E. coli* biofilm was examined in early and mature stages. Phage retention and efficacy depended on the degree of biofilm development, spatial organisation, and the physiological heterogeneity of bacteria.

The dissertation contributes to the understanding of phage infection as a process tightly dependent on bacterial physiology and establishes an experimental framework for predicting phage performance in planktonic and biofilm systems.

Key words: lytic bacteriophages, physiological state of bacteria, specific growth rate, *Escherichia coli*, *Staphylococcus.capitis*, T4, T7, K, chemostat, phage fitness, bacterial biofilm, mathematical modeling