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Poster #67: Need for speed: early lysogen formation following rapid lysis drives temperate phage persistence

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Infection by temperate phages leads bacteria down different evolutionary routes, each with specific fitness trade-offs. Lysogeny provides immunity against similar phages through superinfection exclusion but comes with costs such as genomic maintenance of the prophage and risk of future cell lysis. In contrast, lytic activity favours surface receptor modifications that confer phage resistance at the expense of receptor function. To investigate which phage traits favour the evolutionary preference for lysogeny over resistance, we tracked the dynamics of naïve *E. coli* K-12 populations when exposed to either of four temperate phages. Populations rapidly diversified into lysogens and non-lysogens, with non-lysogens almost entirely outcompeting lysogens in half the cases. Whole-genome sequencing and phenotypic screening confirmed that non-lysogens acquired phage resistance via receptor modifications. We initially hypothesised that prophages only persist when costs associated with receptor modifications outweigh those of prophage maintenance. Contrary to expectation, lysogens are as fit as or fitter than resistant mutants in competition assays and growth rate measurements, with no significant differences across phages. To identify the underlying viral drivers, we quantified differences in latent period, burst size, spontaneous induction rate, and adsorption rate. We demonstrate that significantly faster lysis times and higher burst sizes favour lysogen formation and persistence. Using mathematical modelling, we integrate how these empirical parameters predict long-term bacterial population dynamics in the presence of temperate phages. Our study highlights how early phage infection dynamics shape long-term bacterial population structure, underscoring how initial epidemiological parameters dictate the trajectory of bacteria-phage co-evolution.

Reference #1

Reference #2

Reference #3

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