Competition between phage-resistance mechanisms determines the outcome of bacterial co-existence

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Résumé

Many bacterial species carry multiple prophages, and despite the potential cost, which includes cell death upon phage induction, prophages can also provide the host multiple fitness advantages, such as infection of direct competitors. However, the long-term efficiency of displacing conspecifics through prophage induction has received little attention. We experimentally coevolved a polylysogenic *Klebsiella pneumoniae*strain (ST14) with a phage-sensitive strain, BJ1, in several environments resulting in different phage infection regimes. We then followed the adaptation process and the emergence of resistance. After 30 days, population yield remained stable, and although BJ1 was present in all conditions, its frequency was higher when phage pressure was stronger. Resistance to phages emerged fast through mutations interrupting the capsule biosynthesis. In contrast to our expectation, lysogenic conversion was rare and costly because new BJ1 lysogens exhibited exacerbated death rates and were easily outcompeted. Unexpectedly, the adaptation process changed at longer time scales, where BJ1 populations adapted by fine-tuning the production of capsule, reducing the ability of phage to absorb, while remaining capsulated. These resistant clones are pan-resistant to a large panel of phages. Most intriguingly, some clones exhibited transient non-genetic resistance to phages. Our experimental and modelling results highlight the diversity, dynamics and competition between phage-resistance mechanisms during coevolution and how these are driven by phage density.

Mots-Clés: coevolution, polylysogeny, phage resistance

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