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Population Dynamics of Multiple Compatible Plasmids

Bacteria often carry more than one type of plasmid, with as many as 13 found in a single strain, but there has been little work on the dynamics of multiple plasmids. I developed theoretical models and did laboratory studies on the dynamics of multiple plasmids. For experiments, I used 3 plasmids from different compatibility groups: R100-1drd (inc FII), R390 (incN), and S-a (incW). I studied segregation and conjugation in strains carrying pairs of the 3 plasmids:

1. There was no sign of surface exclusion between plasmids in different groups, which supports dogma regarding compatible plasmids.
2. There was, however, evidence for incompatibility between pairs of "compatible" plasmids. The S-a plasmid suffered a significantly higher segregation rate from a strain carrying R100 than when by itself, and there was a non-significant tendency for R100 to expel R390 as well.
3. Finally, there was evidence for plasmid interaction in matings where donor cells carried two different plasmid types. Comparison to theoretical models showed that plasmid-free cells simultaneously acquired two plasmids at a rate higher than expected if the plasmids transferred independently. Moreover, when transconjugants carrying both plasmids were used as donors in a secondary mating, the two plasmids co-transferred completely.

These results suggest that even supposedly distantly related plasmids will interact when they co-exist in bacterial populations. Exchange of DNA and competition between unrelated plasmids may be common. Both processes should enhance the evolution of new plasmid types as chimaeras of existing plasmids.