

Altruism plasticity and byproduct-service exchange in the evolution of reciprocal cooperation in *Escherichia coli*

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Abstract

Explaining how cooperative individuals positively assort into a cohesive community is one of the greatest challenges for evolutionary biology. Here, we show that in antibiotic culture, many and even all of *Escherichia coli* bacteria cells will plastically mutate to be antibiotic resistant with the increase of antibiotic concentration and then altruistically protect antibiotic-sensitive individuals from the attack of antibiotics. A further experiment showed that antibiotic-sensitive *E. coli* strain could in turn help reduce the indole produced by the resistant strain; whilst this metabolic product is harmful to the growth of the antibiotic-resistant strain but benefits the antibiotic-sensitive strain by helping turn on the multi-drug exporter to discharge the antibiotic. A reciprocal cooperation can therefore evolve via a non-positive exchange between the metabolism byproduct indole of antibiotic-resistant cells and the indole-aborting service of antibiotic sensitive cells as unconscious help in nullifying indole side effect of antibiotic resistant strain.

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