'Stressed' bacteria become resistant to antibiotics

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Bacteria become resistant to antibiotics when stressed, finds research published in BioMed Central's open access journal *BMC Evolutionary Biology*. In particular *E. coli* grown at high temperatures become resistant to rifampicin.

It is generally thought that antibiotic resistance is costly to maintain, for example mutations which reduce antibiotic uptake also restrict the amount of nutrients entering the cell. Consequently in the absence of antibiotics non-resistant bacteria will out-compete the resistant ones. However researchers from UC Irvine and Faculté de Médicine Denis Diderot have discovered that by putting bacteria under stress, by growing them at a high temperature, the bacteria could spontaneously develop resistance to the antibiotic rifampicin.

The mutations responsible for rifampicin resistance had different effects in other strains of *E. coli*. In each type of bacteria tested the mutated subunit of the RNA polymerase rpoB allowed them to grow in the presence of rifampicin, but unlike the original test strain they did not necessarily have a growth advantage at high temperature.

Dr Olivier Tenaillon who led this study commented, "Our study shows that antibiotic resistance can occur even in the absence of antibiotics and that, depending on the type of bacteria, and growth conditions, rather than being costly to maintain can be highly beneficial. Given that rifampicin is used to treat serious bacterial infections such as tuberculosis, leprosy, Legionnaire's disease, and for prophylaxis in cases

of meningococcal meningitis, this development has important implications for public health."

These bacteria provide strong evidence that the evolution of antibiotic resistance is governed by two properties of genes, pleiotropy and epistasis. Dr Arjan de Visser from Wageningen University explained, "Pleiotropy describes how the antibiotic resistance mutations affect other functions, hence their fate in other environments. Epistasis describes how well different mutations combine in their effect on resistance, and therefore determines which mutational pathway will be preferred by evolution when several mutations are needed for full resistance."

More information: Evolution of Escherichia coli rifampicin resistance in an antibiotic-free environment during thermal stress, Alejandra Rodríguez-Verdugo, Brandon S Gaut and Olivier Tenaillon, *BMC Evolutionary Biology* (in press)

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