Researchers find genetic defences of bacteria don't aid antibiotic resistance

October 7 2015

When bacteria are exposed to antibiotics, they alter the expression of a number of genes within their genome. One of these responses, known as the SOS response, results in an increase in the rate of DNA mutation. Given that DNA mutation is a fundamental trait of evolution, many people have speculated that the stimulation of this response helps contribute to the increased resistance to antibiotics in bacteria over time.

'Antibiotic resistance is a big health problem that's been highlighted

recently by the Prime Minister and the Chief Medical Officer,' points out Professor Craig MacLean from the Department of Zoology, who led the research. 'So it's important that we understand exactly how it's evolving.'

His team has now carried out a series of experiments to investigate the relationship between antibiotics and the SOS pathway, and how it affects the fitness of bacteria and their evolution of antibiotic resistance. Studying two strains of the bacterium Pseudomonas aeruginosa—one normal, the other engineered to never activate the SOS response—the team carried out studies exposing them to non-lethal doses of an antibiotic known as ciprofloxacin.

The team found that, in the presence of the antibiotic, those bacteria that could activate the SOS response have a short-term advantage, reproducing more effectively because some of the genes activated during the defence process act to repair damaged DNA. However, when the researchers came to study the evolution of the bacteria over 200 generations, they found no evidence to suggest that the SOS response accelerated the evolution of resistance, with both the natural and engineered types of bacteria performing equally.

In fact, the team observed that the activation of the SOS response actually became less pronounced from generation to generation as the evolution of antibiotic resistance progressed. 'The stress response pathways provide short-term protection against antibiotics,' explains Professor MacLean. 'But what this shows is that they don't accelerate the evolution of antibiotic resistance. The fairly modest increase in the mutation rate associated with SOS response seems to be offset by a decrease in the effective strength of selection for increased resistance at a population level.'

The team suggests that the finding may change the way people approach

solutions to overcoming antibiotic resistance. 'Many of the antibiotics we use are becoming useless because of bacterial resistance,' explains Professor MacLean. 'One approach to the problem that people have suggested is the development of drugs that block the SOS response, to make it harder for the bacteria to evolve resistance. Our research suggests scepticism towards that approach.'

More information: The SOS response increases bacterial fitness, but not evolvability, under a sub-lethal dose of ciprofloxacin , rspb.royalsocietypublishing.or … .1098/rspb.2015.0885

Provided by Oxford University