IN BRIEF

CELLULAR MICROBIOLOGY

c-di-AMP enters the riboswitch realm

Riboswitches are regulatory motifs found in the UTRs of mRNAs that bind cellular ligands and typically block mRNA expression by forming transcription termination stem loops. The identity of primary ligands for several candidate riboswitches has remained elusive, but a study now reveals that the *ydaO* riboswitch, which is widespread in bacteria, selectively responds to the second messenger cyclic di-AMP (c-di-AMP). Previous work suggested that *ydaO* senses ATP; however, Nelson *et al.* found that the binding affinity of c-di-AMP was more than six orders of magnitude greater than that of ATP. Furthermore, c-di-AMP was shown to trigger transcription termination *in vitro*, and this observation was supported by *in vivo* experiments. This is the first riboswitch that has been shown to respond to c-di-AMP and its identification greatly increases the number of genes known to be regulated by this important second messenger.

ORIGINAL RESEARCH PAPER Nelson, J. W. *et al.* Riboswitches in eubacteria sense the second messenger c-di-AMP. *Nature Chem. Bio.* http://dx.doi.org/10.1038/nchembio.1363 (2013)

ANTIMICROBIALS

Resistant bacteria show some sensitivity

Bacterial resistance to single antibiotics often leads to cross-resistance to other antibacterial agents. By evolving independent *Escherichia coli* populations in the presence of one of several different antibiotics *in vitro*, Lázár *et al.* now show that the evolution of resistance to one antibiotic can also be accompanied by hypersensitivity to other antibiotics. Populations that were adapted to aminoglycosides (which target the ribosome) showed increased sensitivity to many other antibiotic classes, including those that target the cell wall and DNA synthesis. Whole-genome sequencing revealed that mutations that disturb the proton motive force (PMF) across the inner membrane were particularly common in the resistant strains, and biochemical assays indicated that these mutations diminish the activity of the PMF-dependent AcrAB multidrug efflux pump, resulting in hypersensitivity to several other antibiotics.

ORIGINAL RESEARCH PAPER Lázár, V. *et al.* Bacterial evolution of antibiotic hypersensitivity. *Mol. Sys. Biol.* http://dx.doi.org/10.1038/msb.2013.57 (2013)

BACTERIAL PATHOGENESIS

Meningococcus warms up to immune evasion

Loh, Kugelberg *et al.* show that a temperature increase triggers immune evasion by *Neisseria meningitidis* owing to the control of gene expression by three independent RNA thermosensors. RNA thermosensors are located in the 5′ UTRs of mRNAs and, at low temperatures, form stable hairpin structures that prevent ribosome binding and thereby inhibit translation. At higher temperatures, the hairpin melts and gene expression is restored. The authors found that these thermosensors are upstream of genes that are involved in capsule biosynthesis, lipopolysaccharide sialylation and factor H-binding protein expression, all of which are required for immune evasion. They conclude that increases in temperature function as an alarm signal for meningococci to upregulate immune defence genes. As temperature increases during the inflammatory response to other pathogens, this adaptive mechanism could provide these bacteria with an advantage during co-infections.

ORIGINAL RESEARCH PAPER Loh, E., Kugelberg, E. *et al.* Temperature triggers immune evasion by *Neisseria meningitidis*. *Nature* **502**, 237–240 (2013)