MINITOPIC

Recent High-Tech Developments in Synthetic Biology and Other Realms of Microbiology

Recent developments in synthetic biology or in other high-technology areas involving microbiology include the following:

- Two recently developed synthetic gene circuits, called deadman and passcode, efficiently can control or kill genetically engineered cells of *Escherichia coli* containing them, according to James Collins of Massachusetts Institute of Technology, in Cambridge, Mass., and his collaborators. The former needs an external chemical to prevent a continuously expressed toxin from killing the cell, while the latter uses hybrid transcription factors to control host cells. Details appeared 7 December 2015 in *Nature Chemical Biology* (doi:10.1038/nchembio.1979).
- A molecular confinement mechanism that separates guide RNA from the Cas9 protein that inserts an artificial sequence into a targeted gene can prevent CRISPR-based gene drives from operating in the wild, according to George Church, Keven Esvelt, and their collaborators at Harvard University and Harvard Medical School in Cambridge and Boston, Mass., respectively. Details appeared 16 November 2015 in *Nature Biotechnology* (doi:10.1038/nbt.3412).
- Ribonuclease H powers a rolling, DNA-based motor that is built onto a 1-μm-sized glass sphere, and that moves 1,000 times faster and is more stable than other two- or multi-legged synthetic nanomotors, according to Khalid Salaita of Emory University in Atlanta, Ga., and his collaborators. Details appeared 14 December 2015 in *Nature Nanotechnology* (doi:10.1038/nnano.2015.259).
- A prototype device that couples acoustic tweezers with reusable microfluidic platforms can soon be used to sort cells to determine how they respond to drug candidates or, instead, for diagnosing various infectious diseases, according to Tony Jun Huang of Pennsylvania State University in University Park and his collaborators. Details appeared 28 October 2015 in *Lab on a Chip* (doi:10.1039/C5LC01049G).
- Properly harnessed, electricity provides an effective way for killing bacteria, and it works best when it is releasing low but constant amounts of hydrogen peroxide in the immediate vicinity of the targeted microorganisms, including those in biofilms, according to Sujala T. Sultana, Haluk Beyenal, and their collaborators at Washington State University, Pullman. Details appeared 14 October 2015 in *Nature Scientific Reports* (doi:10.1038/srep14908).
- A new mass-spectral imaging system enables scientists to map the contents of cells in three dimensions on a nanoscale, according to Carmen Menoni, Dean Crick, and their collaborators at Colorado State University in Fort Collins. Details appeared 14 December 2015 in *Optics & Photonics News* (http://www.osa-opn.org/home/articles/volume_26/december_2015/).

resistance genes to formerly drug-susceptible strains.

Despite the multitude of virulence and drug resistance genes that some bacterial strains amass, commensal enterococci tend to outcompete and replace these clinical pathogens when pitted against each other in the mouse gastrointestinal (GI) tract, according to Maria Montealegre, a graduate student working with Murray. "This may explain the vast predominance of clade B commensal strains in humans in the community, and why antibiotic-resistant *E. faecium* strains are often replaced once patients leave the hospital," Montealegre says.

Remarkably, commensal strains actively kill some of those pathogenic strains by turning their mobile elements against them, says Murray, citing research by Michael Gilmore of Harvard Medical School in Boston and his collaborators.

"We unexpectedly observed that the prototype clinical isolate strain V583 was actively killed by GI tract flora, whereas commensal enterococci flourished," says Gilmore. Commensal strains secrete a heptapeptide pheromone, cOB1, that triggers virulent strains to self-destruct. This pheromone activates plasmid-based mobile elements, which are prevalent in virulent strains but not commensals, ultimately causing chromosomal genome instability that can prove lethal. "The accretion of mobile elements in *E. faecalis* V583 renders it incompatible with commensal strains," he says. Thus, these critical mobile elements are responsible for both the rise and the downfall of this opportunistic pathogen.

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RESEARCH ADVANCES

By Consuming Glycine, Gut Microbiota Control Glutathione Synthesis

Carol Potera

The gut microbiota in mice consumes glycine, one of three amino acids needed by host animals to make the powerful antioxidant peptide glutathione, according to Adil Mardinoglu at the Royal Institute of Technology in Stockholm and Chalmers University of Technology, Gothenburg, both in Sweden, and his collaborators in Sweden and Denmark. He calls this