MINITOPIC
First Set for 2016 of Microbiota Studies Involving the Gut or Other Anatomic Sites

Here in brief are findings from several recent reports of efforts to understand how microorganisms in the gut or elsewhere in the body affect the host:

- Depleting the gut microbiota helps to enhance type 2-cytokine signaling and convert M1 into M2 macrophages in host mice—in turn, stimulating development of beige from white fat, helping to keep such animals lean regardless of their food intake, according to Mirko Trajkovski of the University of Geneva, Switzerland, and his collaborators. Details appeared 16 November 2015 in Nature Medicine (doi:10.1038/nm.3994).
- Proteins produced by Escherichia coli in the gut of rodents may signal “fullness” to the host by activating “satiety pathways,” releasing hormones from the gut and also modulating sensory pathways in the brain, according to Serguei Fetissov of Rouen University in France and his collaborators at several French institutions and in England. Details appeared 24 November 2015 in Cell Metabolism (doi:10.1016/j.cmet.2015.10.017).
- Bacteria in the gut of German cockroaches release pheromones, including volatile carboxylic acids that play a major role in how the cockroaches socialize and communicate, according to Ayako Wada-Katsumata of North Carolina State University in Raleigh and her collaborators. Details appeared 7 December 2015 in Proceedings of the National Academy of Sciences (doi:10.1073/pnas.1504031112).
- In mice lacking lymphocytes, the adaptation of E. coli to the gut environment is slowed compared to those bacteria in hosts with intact immune systems, according to Isabel Gordo and Jocelyne Demengeot of Instituto Gulbenkian de Ciencia in Oeiras, Portugal, and their collaborators. Details appeared 30 November 2015 in Nature Communications (doi:10.1038/ncomms9945).
- Analyses of the gut microbiomes of American Indians of Cheyenne and Arapaho ancestry indicate a reduced abundance of the anti-inflammatory bacterial genus Faecalibacterium and a fecal metabolite profile consistent with dysbiosis and metabolic disorders, according to Cecil M. Lewis, Jr., of the University of Oklahoma, Norman, and his collaborators. Details appeared 6 December 2015 in Current Biology (doi:http://dx.doi.org/10.1016/j.cub.2015.10.060).
- The gut microbial populations in patients with enteric infections change in similar ways regardless of the specific pathogen responsible for causing their disease, according to Shannon Manning of Michigan State University, Lansing, and her collaborators. Moreover, blocking increases in E. coli may be important for preventing those bouts of disease. Details appeared 22 September 2015 in Microbiome (doi:10.1186/s40168-015-0109-2).
- Microbes in the gut convert polyphenols in pomegranate juice into urolithins (6H-dibenzo[b,d]pyran-6-one derivatives), which can protect against Alzheimer’s disease, according to Navendra Seeram of the University of Rhode Island, Kingston, and his collaborators. Details appeared 11 November 2015 in ACS Chemical Neuroscience (doi:10.1021/acscnem.5b00260).

Identification of this clade raises the possibility of using the genomic information to search for candidate genes implicated in this higher transmission phenotype.”

The surprising degree of genetic plasticity within these emergent S. pyogenes clades could prove important for those designing diagnostic tests and vaccines to detect and control the infections that this pathogen is causing, note Claire Turner, Shiranee Sriskandan, and their collaborators of Imperial College London in the UK in the same issue of mBio. "The changes [this clade] had undergone are likely to impact on transmission and ability to spread through the population,” says Turner. “I would think that this is likely to happen with other bacteria as it is a fundamental part of the pathogen life cycle and is an important area for future research focus.”

David C. Holzman, who writes from Lexington Mass., is a contributing writer for Microbe.

RESEARCH ADVANCES
Genetically “Tuned” Viruses Enhance Transfer of Harvested Light Energy

Barry E. DiGregorio

A genetically modified virus, suitably equipped with properly ordered light-harvesting molecules, can markedly enhance the efficiency with which that energy can be transported, according to Angela M. Belcher of the Massachusetts Institute of Technology in Cambridge, Mass., Petra F. Scudo from Istituto eni Donegani in Novara, Italy, and their collaborators. This research not only helps to elucidate the physics governing light collection, but also might lead to designing improved solar cells as well as diagnostic devices, they note. Details appeared 12 October 2015 in Nature Materials (doi.org/10.1038/nmat4448).

In this case, M13 bacteriophages were used as scaffolds to which light-harvesting chromophores could be attached. Specifically, the chromophores
were attached to the major coat pVIII protein of the virus. Because this virus can be genetically reprogrammed with slight differences in that protein, those attachment sites can be “tuned” by changing how they are spaced along the viral surface—“multiplying the possibilities for creating intricate chromophore networks and for controlling energy transfer,” the researchers note.

“Our original motivation was to be able to reproduce the quantum-enhanced energy transport occurring in natural photosynthesis by using an artificial, man-made device,” Scudo says. “At first, we did not think of industrial applications of our system. However, probably with a few more changes, these systems could be tested in dye-sensitized solar cells, chemical sensing, or medical diagnostics.”

“Our hypothesis was that we could select the spacing between amino acids to precisely control the distance between attached chromophores,” Belcher adds. “By changing the interaction between the chromophores, we are able to control the energy transport.” The two versions were designed and chosen to demonstrate two representative regimes of energy transport: classical and quantum, she points out. In one version of M13 phage, the chromophores were scattered in a rather diffuse grid, and while collecting light energy they behaved as a classical “hopping network” for energy transport. In the other, the chromophores were spaced closely enough to be “strongly coupled,” behaving more quantum-like in energy transport and thus enhancing by 68% their capacity to transfer the light energy that they collected.

“This [research] represents a new threshold for the development of solar cells,” says So Young Yoo of Pusan National University in Busan, Korea. “The authors proved that genetically engineered phages can be successfully utilized as ‘tunable light harvesting materials.’” This approach, he adds, is “an important energy-transfer design concept.”

What will it take to move from working concept to practical use? Viruses “can boost solar cell efficiency” in dye-sensitized solar cells, according to Belcher. “We are still in the early stages in terms of industry implementation,” she says. “We hope that within the next few years we will test cost-effective materials systems and will conduct research in the detailed implementation for solar cell technology.”

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NEW FROM ASM

Physical Interaction Directs cyclic-di-GMP Signaling in Gram-Negative Bacteria

Second messenger cyclic-di-GMP controls many cellular behaviors in gram-negative bacteria, but it remains a mystery how the cell’s signaling networks, consisting of dozens of proteins that can make, break, or bind the molecule, correctly directs signaling output. Recent work from Dartmouth College in Hanover, N.H., in collaboration with Cornell University in Ithaca, N.Y., highlights physical interaction as one way to direct signaling. First author Kurt Dahlstrom looked at mutations in diguanylate cyclase enzymes that lead to biofilm defects in Pseudomonas fluorescens, focusing on interactions of one, GcbC, with its cyclic-di-GMP responsive protein, LapD. “Signaling specificity occurs at least in part through the ability of the DGC enzyme to physically interact with the protein that binds cyclic-di-GMP,” explains lead scientist George O’Toole. Using genetic, biochemical, and structural approaches, the team identified an alpha helix on the surface of GcbC and an alpha helix on the surface of LapD that interact with each other. “We think this is one mechanism by which specificity is conferred,” concludes O’Toole.

Dahlstrom KM, Giglio KM, Collins AJ, Sondermann H, and O’Toole GA. Contribution of physical interaction to signaling specificity between a diguanylate cyclase and its effector. Published online 15 December 2015; doi: 10.1128/mBio.01978–15

NEW FROM ASM

Whole-Genome Sequencing for Listeria Outbreak Surveillance

Foodborne outbreaks remain a major concern worldwide, and the number of Listeria monocytogenes outbreaks reported increased in the European Union in 2015. New research from the University of Melbourne in Australia suggests that whole-genome sequencing (WGS) may improve surveillance methods. A team lead by Benjamin Howden performed comparative studies of WGS against traditional surveillance methods used to type 423 L. monocytogenes isolates. Their results suggest WGS is not only in agreement with methods such as multilocus sequence typing and PCR-serotyping, but that WGS is able to further refine strain differences that traditional methods aren’t. Prospective studies using 97 additional strains were able to find a match between a human isolate and one found in food-industry surveillance, demonstrating the ability of this method to infer links between potential outbreaks and their source of origin.