Current Topics

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Bacterial Diversity Is Dominant Feature in New Tree of Life

Carol Potera

A new rendition of the tree of life includes 92 named bacterial phyla, 26 archaeal phyla, and all five of the eukaryotic supergroups. This tree highlights how bacteria dominate all of biology in terms of diversity. Moreover, although many of the most abundant bacteria have never been seen, they were identified using reconstructed genome sequences. “It was a surprise to see the massive scale of diversity in Domain Bacteria, including many lineages that lack isolated representatives,” says study leader Jill Banfield of the University of California, Berkeley. Details appeared 11 April 2016 in *Nature Microbiology* (doi:10.1038/nmicrobiol.2016.48).

The phylogenetic analysis relied on a set of 16S ribosomal protein sequences, as well as 16S rRNA data, according to Banfield. “A particular strength is that these 16S genes occur consistently in close proximity on the genome,” she says. “It’s fundamentally a genome-resolved approach that uses only high-quality, curated genomes, including some complete genomes.” Meanwhile, this new tree shows animals, plants, and fungi crowded onto two small branches, while bacteria occupy the major branch.

The new tree of life “provides a much needed big picture of what’s known about the phylogenetic diversity of bacterial and archaeal genomes,” says Jonathan Eisen at the University of California, Davis, who was not directly involved in this effort. It has implications for better understanding evolution, the functional diversity of microbes, the biases in many methods used to study microbial diversity, the general requirements of living systems, and where to target new studies of microbial diversity, he says. Eisen also commends Banfield for publishing the data and results in an open access manner.

Banfield and her collaborators “show the relevance of genome-resolved approaches to understand microbial life,” says A. Murat Eren at the University of Chicago, who was not involved in the research. This latest depiction of the tree of life, he adds, “likely is not the...
final one, if there ever will be one. But it shows how much diversity we’ve missed, despite remarkable technology breakthroughs.”

About half the bacteria arrayed along the dominant branch of the new tree belong to the Candidate Phyla Radiation. Little is known about members of this recently described supergroup, whose members characteristically have small genomes and symbiotic lifestyles. Only one member of the group has been isolated, while one other was recently cocultured. Candidate Phyla Radiation is not a formal name, but rather a working title to describe what is now a prominent part of the tree of life, Banfield notes.

Little is known directly about the metabolic lifestyles of bacterial species belonging to the Candidate Phyla Radiation. Their genomes contain recognizable genes consistent with having metabolic pathways for replicating DNA and making proteins. However, species falling within this radiation lack genes to complete the citric acid cycle, respiratory chains, and nucleotide synthesizing capabilities. Thus, they likely rely on fermentation for their metabolic energy and derive some of their basic building blocks from other organisms.

Despite these metabolic shortcomings, there is massive diversity within the Candidate Phyla Radiation—a major new finding that highlights this new depiction of the tree of life, Banfield says. Further analysis of their ecology, evolution, and biochemistry, she adds, “may provide clues about the metabolic platform of early life.”

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RESEARCH ADVANCES

New Synthetic Cell Challenges One-Gene, One-Trait Hypothesis

Marcia Stone

“Life is much more like a symphony orchestra than a piccolo player,” J.

MINITOPIC

Microbiology Policy Bulletin Board

Recent developments involving microbiology and related science policy matters include:

- The White House, through its Office of Science and Technology Policy, in May launched a National Microbiome Initiative (NBI). NBI, which will be comparing microbiomes across different ecosystems, calls for federal agencies to invest more than $121 million in fiscal years 2016 and 2017, in microbiome research. Additional non-federal support for the NBI includes $100 million over four years from the Bill and Melinda Gates Foundation and $10 million over five years from the Juvenile Diabetes Research Foundation.
- At least 30% of antibiotics prescribed in the United States are unnecessary, according to officials from the Centers for Disease Control and Prevention in Atlanta, Ga., and their collaborators from the Pew Charitable Trusts and other public health and medical experts. Details appeared 3 May 2016 in the Journal of the American Medical Association (doi:10.1001/jama.2016.4151).
- Food and Drug Administration (FDA) officials in May recommended that, “unless they lack other treatment options, patients with uncomplicated infections should not receive fluoroquinolones, given the risk for disabling and potentially permanent adverse events.”
- FDA in May revised rules for collecting antibiotic sales data, requiring manufacturers to provide estimates of sales of drugs being used for specific food-producing species—cattle, swine, chickens, and turkeys—in addition to notifying FDA of overall antibiotic sales estimates.
- As part of efforts to eradicate polio, public health officials from 150 countries switched by May from administering a trivalent to a bivalent oral poliovirus vaccine, a change that reflects the loss of wild poliovirus type 2 from circulation—ending a need to vaccinate against it. Removing it from the vaccine eliminates the risk of its reappearing from mutations within the vaccine mix. Meanwhile, in 2015, 74 wild poliovirus (WPV) cases were reported in Afghanistan and Pakistan, a decrease of 79% from the 359 WPV cases reported in 2014 in nine countries, according to the World Health Organization (WHO). As of May, WHO officials note, a mere 12 WPV cases were reported worldwide in 2016.