Cronobacter sakazakii

Odds and Ends from the 2010 General Meeting

- Cronobacter sakazakii (formerly Enterobacter sakazakii) and other species in this genus are foodborne pathogens that can cause rare but serious and often fatal infections among premature and newborn infants, according to Angelika Lehner of the University of Zurich in Switzerland and her collaborators; she spoke during the symposium, “Persistence of Foodborne Pathogens from Farm to Fork.” Curiously, this desiccation-resistant and biofilm-forming opportunistic pathogen produces cellulose, which she considers a “virulence factor,” mainly because it renders these bacteria resistant to chloride-containing cleaning agents. These bacteria contaminate powdered milk, likely through additions of plant-derived supplements and fortifiers. The bacteria may persist in such dried milk products for several years before they are reconstituted with water and given to premature infants via feeding tubes, she says. Infections typically cause severe inflammation of the intestinal tract and, less often, meningitis or sepsis.
- Mice fed with live Mycobacterium vaccae, a soil bacterium, navigated mazes more efficiently, according to Dorothy Matthews of the Sage Colleges in Troy, N.Y., and her collaborators, who reported their findings during the session “Microbial Interactions with Plants or Animals.” That exposure, which apparently also reduces anxiety levels among mice, seems to be “temporary,” and could be due to the bacteria stimulating serotonin production in the central nervous system of the animals, she says.
- Bacteria in the gastrointestinal (GI) tracts of obese children living in Switzerland produce higher levels of short-chain fatty acids than do the otherwise indistinguishable GI-dwelling microorganisms of their leaner classmates, according to Amanda Payne of the Institute of Food, Health, and Nutrition, ETH Zurich, Switzerland and her collaborators; she spoke during a “Microbial Sciences” session. Among a genetically “closed” population of Old-World Amish in Pennsylvania, there is little or no correlation in terms of GI microbiome differences with obesity, adds Margaret Zupancic of the University of Maryland Medical School in Baltimore, who spoke during the same session. However, when host obesity-pre-disposing genetic factors are taken into account, “intriguing patterns” in GI bacterial population composition begin to emerge, she says. Although the analysis is at an early stage, those patterns “hold up” and those correlations may make it possible to determine who is more “at risk” for becoming obese. Both studies point to the “multifactorial” character underlying epidemic obesity, both researchers point out.

Jeffrey L. Fox

Peroxisomes Mount First-Line Antiviral Defense

In addition to metabolizing fatty acids and ridding cells of toxic substances, peroxisomes help cells fend off viruses, acting alone and in concert with mitochondria. Both cases involve the antiviral signaling (MAVS) protein, which induces both peroxisomes and mitochondria to release other antiviral agents, according to Jonathan Kang of Harvard Medical School in Boston, Mass., and his collaborators. “This is the first demonstration that peroxisomes are involved in innate immunity,” he says. Thus, peroxisomes are more than metabolic organelles within cells. Details appear in the May 14, 2010 Cell.

Discovered about five years ago, the MAVS protein, also called interferon-β promoter stimulator (IPS)-1, was thought to act solely on mitochondria. However, after reovirus infects various types of mouse cells, including embryonic fibroblasts and macrophages, or human hepatocytes, MAVS attaches to membranes of peroxisomes and then induces antiviral signaling, Kang and his collaborators report.
Meanwhile, cells infected with influenza virus respond similarly, whereas cells infected with vesicular stomatitis virus (VSV), which interferes with type I interferon signals, apparently respond only through the peroxisomal antiviral pathway.

Within a few hours, MAVS induces a signaling pathway that leads to expression of the gene encoding viperin along with other antiviral genes, including those encoding type I interferons, Kagan says. These agents act together to block replication of reovirus. The immediate immune response launched with viperin deters viral invaders until mitochondrial MAVS kicks in with interferons to halt viral replication.

Viperin specifically targets viruses, whereas interferons are toxic to viruses and other cells. “It may be possible to create treatments to selectively activate some antiviral substance like viperin and avoid the side effects of interferons,” Kagan says.

Hepatitis C, other viruses, and some bacteria also stimulate protective responses via the peroxisomes. These responses likely occur throughout the body because peroxisomes are present in most cell types, according to Kagan. “This is unique, considering all other innate immunity networks operate in a cell-specific manner,” he says. “Every bacterial and viral pathogen may be subject to peroxisomal detection.”

MAVS usually operates via the RIG-1-like receptor protein family, which detects viruses and induces type I interferons, Kagan continues. However, the peroxisomal MAVS acts at an independent site.

“This study clearly demonstrates that IPS-1 [MAVS] is both localized to and signals from peroxisomes, and suggests that spatial and temporal compartmentalization of antiviral signaling events is necessary for a timely and appropriate antiviral response,” says immunologist Michael Gale from the University of Washington, Seattle. Which viruses trigger peroxisomal MAVS signaling and at what stages of viral replication these events occur await further studies, he adds.

These findings might help to explain Zellweger syndrome, a rare but often fatal condition in which peroxisomes fail to develop properly. Although viewed as a metabolic disorder, infants with Zellweger syndrome are highly vulnerable to lung infections. Perhaps such patients succumb to infections because they are lacking an essential peroxisome-dependent immune response, Kagan suggests.

Carol Potera