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How Hosts Control Their Microbiomes

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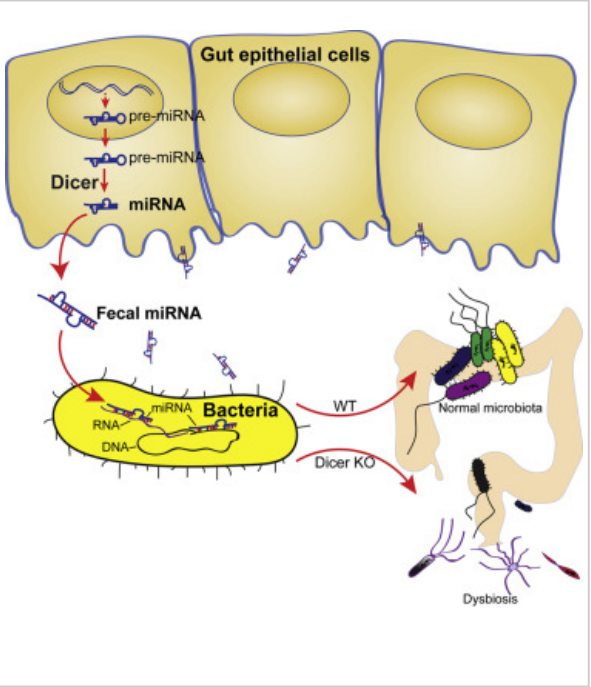
Our microbiomes affect everything from cardiac health to asthma. But do we have any influence on these communities? New research shows how hosts control what microbes live within. Read more...

Recent research has connected gut microbes to nearly every element of human health, raising the hope of fighting diseases by manipulating the assortment of bacteria we carry around with us. But so far, efforts to reshape these microbial populations have seen limited success; altered bacterial populations bounce back to their original compositions and remain relatively stable over time.

"Since gut microbes play an important role in host metabolism and immunity as well as in disease, it is important to understand the mechanisms by which the microbiota is regulated by the host and to identify ways in which to manipulate the microbiome," said Howard Weiner from Harvard Medical School.



Previous studies showed that gut microbes transplanted from fish into germ free mice soon resemble normal mouse microbiota, indicating that the host shapes the composition of gut bacteria. Weiner and his colleagues set out to discover how this was accomplished and now report what they found in the journal *Cell Host and Microbe*. "Our findings reveal a host defense mechanism and highlight microRNAs as a strategy for manipulations of the microbiome for the health of the host," he said.

After confirming the presence of functional microRNAs in the stool, Weiner's team compared microRNA profiles between mice and humans and in different parts of the intestine. Seventeen out of 50 identified microRNAs were shared, and more microRNA was present in the ileal lumen than the colon. This differs from the distribution of microbes, which are more abundant in the colon. The team determined that the microRNAs were made by intestinal epithelial cells and goblet cells and then secreted into the intestinal lumen in extracellular vesicles.

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- Not All DNA is Synthesized During S-Phase

The researchers next looked for an association between the microRNAs and bacteria normally found in the intestine, determining that fecal microRNAs could enter bacteria, co-localize with nucleic acids, and regulate specific bacterial gene transcripts. Oddly, the interactions did not always result in destruction of bacterial mRNA, as is common for microRNA; instead microRNAs also increased the presence of some transcripts and promoted bacterial growth.

To further explore the roles of fecal microRNA in shaping the intestinal bacterial population, the team turned to a mouse model that could not process microRNA. These mice showed uncontrolled gut microbiota and exacerbated colitis. Transplanting wild type fecal microRNA into the mice improved colitis symptoms and returned gut microbes to normal levels.

"Our study suggests that the ability of the host to control gut microbes likely provided organisms with an evolutionary advantage—that is, the prevention of diseases such as colitis and colorectal cancer," Weiner said. "We are optimistic that it will one day be possible to harness this natural host defense mechanism by administering microRNAs as therapeutic compounds to improve health and treat disease."

Reference

Liu S, da Cunha AP, Rezende RM, Cialic R, Wei Z, Bry L, Comstock LE, Gandhi R, Weiner HL. The Host Shapes the Gut Microbiota via Fecal MicroRNA. Cell Host Microbe. 2016 Jan 13;19(1):32-43.

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