Early gut bacteria shape intestinal ecosystem

November 21 2018, by Scott Schrage

Credit: icon0 com from Pexels

Beating their brethren to the gut can help bacteria make a lasting impression, says new research from the University of Nebraska-Lincoln.

The study suggests that the order in which bacterial species stake out unclaimed territory in the gut can shape an intestinal ecosystem for a lifetime, potentially shifting the odds of certain health outcomes in the process.

Though timing wasn't everything, multiple experiments showed that species given early access to the intestinal tracts of germ-free mice—before the prime real estate had been seized by others—generally took advantage. Over several months, the biodiversity of those burgeoning gut ecosystems often came to be dominated by, or at least resemble, the species that got there first.

"These early colonizers, even when they didn't persist, affected the trajectory of the eventual community composition," said Amanda Ramer-Tait, a study co-author and associate professor of food science and technology at Nebraska. "These early exposure events can have long-term implications for how the community assembles."

Multiple factors are known to influence the gut's ecosystem, which in adult humans usually consists of about 100 trillion bacteria from several hundred species. Diet, genetics and environment seem to hold the greatest sway, yet those factors combine to explain less than 30 percent of the variation in gut communities, which are fingerprint-distinct even from an early age.

The perceived importance of that biodiversity has risen considerably since the early 2000s, when research began establishing stronger links between the presence or absence of gut bacteria and the health of their hosts. According to that research, the makeup of bacterial communities may affect the risk of developing chronic maladies that range from obesity and Type 2 diabetes to heart disease and neurological disorders.

And if a gut's first residents really do influence who comes, stays and goes, then early-life factors that may contribute those microbes—cesarean sections, antibiotics, baby formula—could have prominent health consequences years later, researchers said.

"Knowing when to introduce (micro-)organisms, and which organisms we should introduce, and whether that will (affect) you—we've got to learn how to do that," said co-author Andrew Benson, director of the Nebraska Food for Health Center. "We just made another step in that direction."

That step began with plastic bubbles and mouse scat. The team, co-led by former Nebraska researchers now at the University of Alberta, received fecal samples of mice whose recent ancestors had been living in the wilds of France and Scotland.

In an initial experiment, the team fed bacterial communities derived from those samples to mouse pups living in the plastic bubbles, which shielded them from all other outside bacteria. Roughly 100 species of bacteria were exclusive to each location, with another 200 species residing in both. One group of mouse pups was fed the French-style bacteria and then, about a month later, the Scottish party. Another group received the Scottish brew before the French.

The team found that the French descendants tended to fare about the same regardless of whether they arrived first or second. But the Scottish species had a measurably better survival rate when they were given first dibs rather than forced to encroach on French-held tracts. And after just 78 days, the composition of the bacterial community in a mouse's gut was generally more similar to whichever community—French or Scottish—was introduced first.

Ramer-Tait and Benson said the findings suggest that evolutionarily fitter bacteria—in this case, the French—can overcome a home-field advantage. Yet those findings also support the idea that less-fit species stand a better chance of compensating for their weaknesses if given the opportunity to entrench themselves, the researchers said.

"There've been no other studies that have as systematically and comprehensively tested these hypotheses, and applied ecological theories, as has been done with this work," Ramer-Tait said. "In a study where diet, genetics and other environmental exposures aren't controlled, you would never see the impact that these early organisms can have. That's the beauty of our experimental system – you can control all of these factors."

With conditional support for its first-gets-fed hypotheses, the team designed a second experiment that put a more select group of bacteria—just four strains—to the test. In one treatment, the researchers introduced the four-strain group to mouse pups about a week before adding the full French and Scottish communities from the first experiment. In two other treatments, the team introduced the larger colonies either a few days or nearly a month before the four-strain group.

Two of the four strains survived the 78-day trial-by-gut only when they entered ahead of the French and Scottish invasions, whereas the other two strains managed to thrive regardless of their arrival time. Why the disparity? The two time-dependent strains shared genetic similarities with members of the larger bacterial communities, indicating that they require the same resources and fill similar niches in a gut ecosystem.

A head start may have given those two strains the advantage they needed to survive, but they apparently lacked the fitness to overcome the handicap of arriving late.

"It depends on when you show up to the weight room and what type of lifting you want to do," said Benson, professor of food science and technology. "If you're really good at the bench press, but you come in and the bigger guys are (already) on it, you might not go over there. You might just go, 'Eh, I'll go over to this other machine.' But if you get there first, you have the whole weight room (to yourself), and you can have whatever you want."

Provided by University of Nebraska-Lincoln

Citation: Early gut bacteria shape intestinal ecosystem (2018, November 21) retrieved 17 July 2024 from https://phys.org/news/2018-11-early-gut-bacteria-intestinal-ecosystem.html