Bacterial brawls mark life in the gut's microbiome

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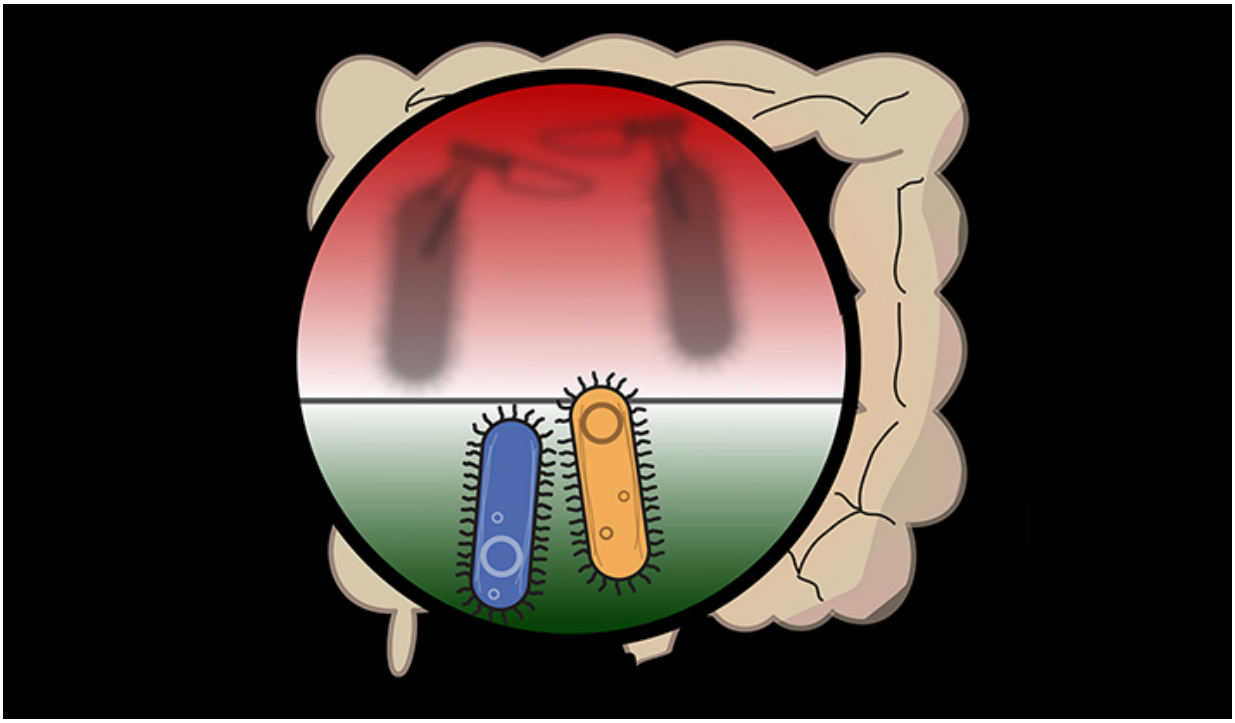

Bacterially speaking, it gets very crowded in the human gut, with trillions of cells jostling for a position to carry out a host of specialized and often crucial tasks. A new Yale study, published the week of March 7 in the journal of the *Proceedings of the National Academy of Sciences* suggests these "friendly" bacteria aggressively stake out their territory, injecting

lethal toxins into any other cells that dare bump into them.

"These bacteria are friendly to us, but possess an elaborate arsenal to protect their space," said Aaron Wexler of the Department of Microbial Pathogenesis at the Microbial Sciences Institute at West Campus and lead author of the study. "We've come to view this as a way bacteria check up on their neighbors—as if asking 'Are you the same as me?'"

Gut bacteria have co-evolved in mammals to take on many tasks crucial to health. While we provide the bacteria with nutrients and a warm place to live, they harvest indigestible parts of our diet, produce vitamins we can't make, fend off dangerous pathogens, and fine-tune our immune systems. Bacteria also help each other—for instance some have evolved to consume byproducts of other species.

Wexler and senior author Andrew Goodman wanted to explore how these cells manage to function together packed into such close proximity. To their surprise, they found bacteria were in almost constant warfare with each other.

They found members of the phylum Bacteroidetes—one of the major groups of bacteria in the gut—have developed mechanisms to "hand-deliver" toxins into neighboring cells and to defend against toxins injected by similar cells. Immunity proteins produced within the bacteria provide defenses against these toxins and ensure co-existence with similar cells. For reasons not well understood, only a subset of members within a given species possesses these defenses.

"Even in the same species the arsenals can be different," Goodman said. "They are defining who is who at a much finer level than species. It seems to be a way to keep competitors at arm's length."

Understanding how these toxins work may one day have clinical

relevance, the authors say, given increased understanding of how the disruption of the microbiome can play a role in cancer, obesity, and autoimmune diseases.

More information: Human symbionts inject and neutralize antibacterial toxins to persist in the gut, *Proceedings of the National Academy of Sciences* , www.pnas.org/cgi/doi/10.1073/pnas.1525637113

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