# Mix and match microbes to make probiotics last

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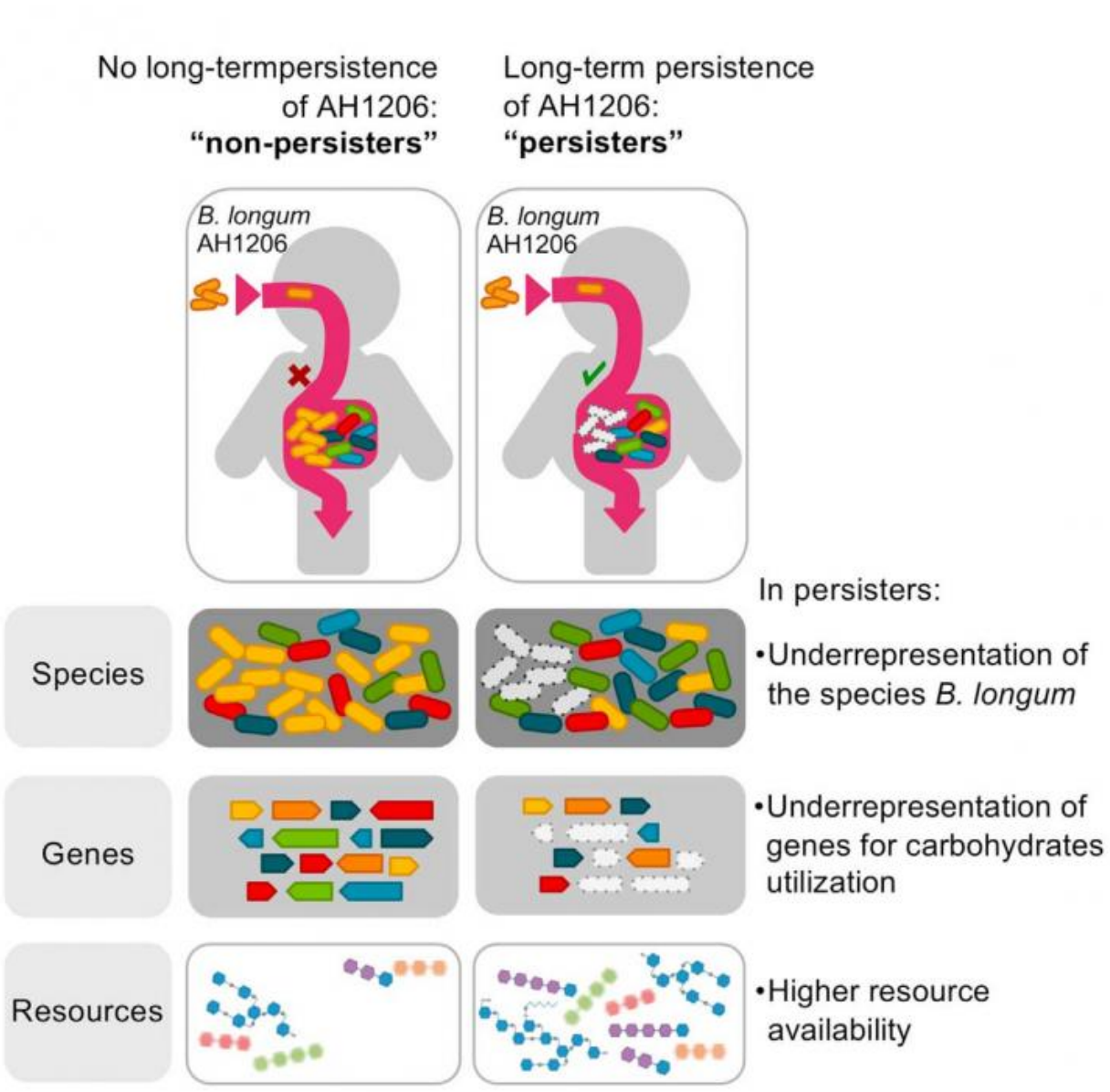

This visual abstract depicts the findings of Maldonado-Gómez et al., who show that an orally administered bacterial strain persists long term in a subset of individuals. Engraftment depended on individualized features of the pretreatment microbiome, likely representing a niche opportunity. Credit: Maldonado-Gómez et al./Cell Host & Microbe 2016

Scientists have tried to alter the human gut microbiota to improve health by introducing beneficial probiotic bacteria. Yet commercially available probiotics do not establish themselves in the gut. A study published September 29 in *Cell Host & Microbe* suggests that it is possible to alter the microbial ecosystem in the human gut for at least 6 months by introducing a single, ecologically appropriate bacterial strain.

The study suggests that matching the right bacterial strain to the gut environment is crucial for making a real change. "If we appreciate the gut microbiota as a complex ecosystem whose composition is governed by strict ecological processes, we can potentially very specifically modulate its composition by introducing a specific strain into it," says senior author Jens Walter, Associate Professor and Chair for Nutrition, Microbes and Gastrointestinal Health at the University of Alberta, Canada. "This opens the possibility of reintroducing a missing bacterium with a health outcome in mind."

An international research team tested the persistence of a bacterial strain called Bifidobacterium longum AH1206 in the human gut. This bacterium is on the human gut hit list. It is one of the top 50 most common among the hundreds of species of bacteria typically found in the human gut. "It is a core member of the human microbiome," Walter says. Bifidobacterium longum is also one of the first dominant bacterial species to establish in the infant gut, especially when infants are breast-fed, which emphasizes the importance and safe intrinsic nature of the

strain.

This differentiates it from the probiotics found in grocery and health stores. The bacteria in these products were selected not for their suitability to live in the human gut, but rather for their ease of production in an industrial setting, according to Walter. Microbes that grow in the human gut are much harder to grow in culture at the scales needed for mass production.

Walter likens attempts to grow these industrial strains of bacteria in the human gut to trying to grow strawberries in a tropical rainforest. "They don't take over because what's already there is a lot better adapted, and therefore fitter. Incoming organisms are simply outcompeted," he says.

"Instead of planting strawberries, we planted a real jungle plant in the rainforest, an organism that is a lot more adapted to that ecosystem," says Walter.

In a double-blind, placebo-controlled trial of 22 people, half of the participants took daily doses of Bifidobacterium longum AH1206 probiotics while the other half took a placebo. After 2 weeks, they switched. Walter and colleagues tracked changes in the gut microbiome over time, looking at the bacterial and genetic composition. 30% of those who took a probiotic with this bacterial strain experienced lasting colonization of the strain and were deemed to be "persisters"; their guts were still colonized by the Bifidobacterium longum AH1206 strain 6 months after they had stopped taking the probiotic.

The data showed that the guts of persisters differed from those who did not have long-lasting affects from the probiotic. Prior to treatment, the persisters had lower levels of the species Bifidobacterium longum or genes found in similar strains. That is, the persisters had an opening in the ecosystem that no existing bacterial strains were vying for.

"Competition in ecosystems is especially harsh amongst closely related species because they have the same resource requirements," says Walter. "It goes back to the theories proposed by Darwin."

The findings suggest that in people who have lost or never acquired a certain valuable strain of gut bacteria due to use of an antibiotic or some other event, it could be possible to repopulate the gut ecosystem. In addition, "since we can differentiate persisters from non-persisters, we could potentially personalize probiotic treatments," Walter says.

**More information:** María X. Maldonado-Gómez et al, Stable Engraftment of Bifidobacterium longum AH1206 in the Human Gut Depends on Individualized Features of the Resident Microbiome, *Cell Host & Microbe* (2016). DOI: 10.1016/j.chom.2016.09.001

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