Scientists discover that the immune system affects gut bacteria evolution

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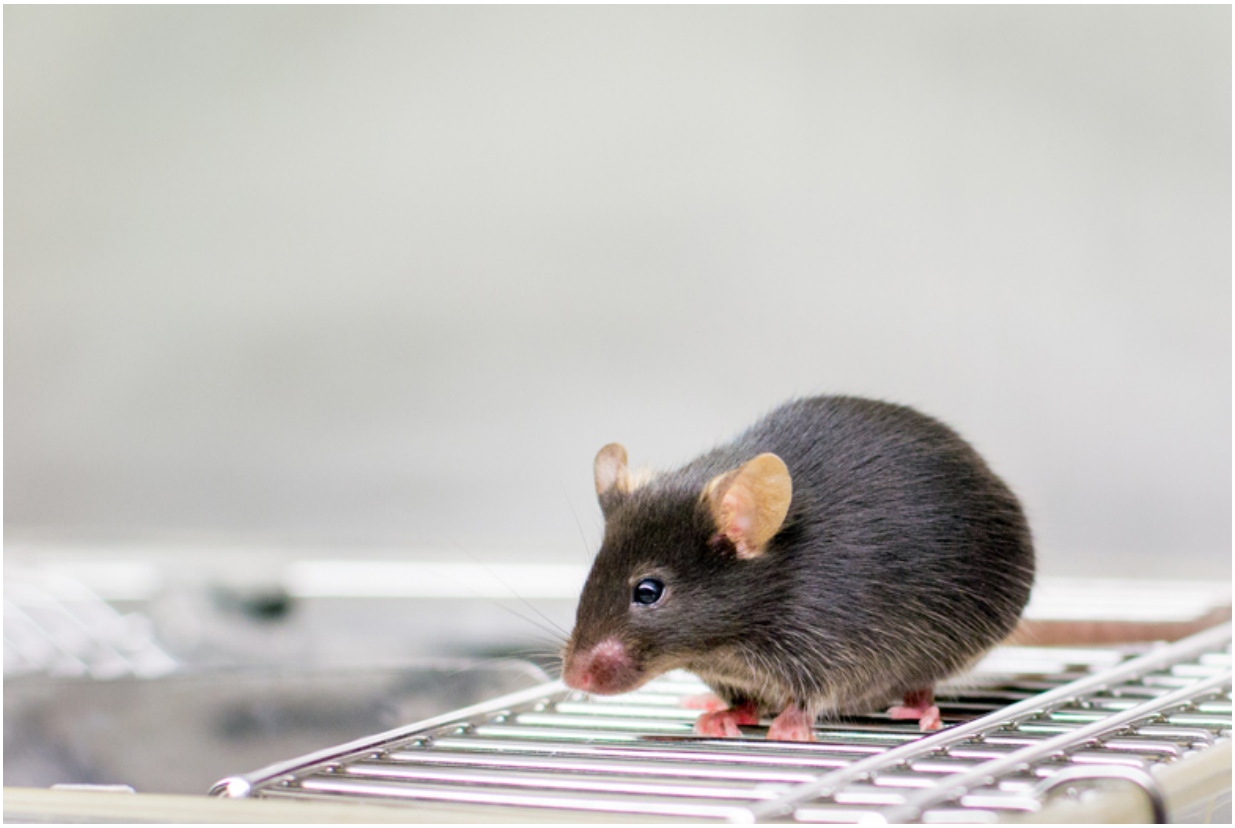

The adaptation process of gut bacteria is affected by the immune system of the host. Credit: Roberto Keller (IGC).

Our health is strongly dependent on the diversity of bacteria that inhabits our intestinal tract and on how the immune system tolerates it or

responds to the pathogenic bacteria to prevent disease. In a study published this week in *Nature Communications*, researchers from the Instituto Gulbenkian de Ciencia (IGC, Portugal) discovered that when the immune system of the host is compromised, the composition of the gut bacteria changes, and the pace and predictability of the process of adaptation of these bacteria are affected. This study suggests that the treatment of intestine pathologies that result from impaired immune system, such as the inflammatory bowel disease, may require therapies based on personalized medicine taking into account the individual composition of gut bacteria.

This research led by Isabel Gordo and Jocelyne Demengeot is the first experimental work that proves the hypothesis that the immune system influences the evolution of gut bacteria. The intestine is a highly complex environment, and gut bacteria need to adapt and evolve to efficiently cope with different stimuli, including the diversified diet that is ingested every day. This originates more and more diversity of bacteria in the intestine that needs to be checked by our surveillance mechanism, the immune system, in order to prevent diseases. It was known that pathologies arise when the immune system fails and there is disruption in the community of gut bacteria. But a direct or indirect link between the immune system and the evolution of bacteria had not been proven yet.

The research team investigated how Escherichia coli (E. coli), one of the first bacteria to colonize the intestine at birth, evolved in healthy mice and in mice that did not have lymphocytes, cells of the immune system. While in healthy animals rapid metabolic adaptations to the diet could be observed, in immune compromised mice the changes were slower. The researchers observed that the same sort of beneficial adaptations occurred across the several healthy mice that were studied. However, large inter individual variations were observed in those animals that lack lymphocytes, making difficult to predict the course of bacteria evolution

in those animals. Joao Batista, PhD student and first author of this study, explains: "We observed that this feature is due to changes in the composition of the community of bacteria in the intestine, which is more similar across individuals with a healthy immune system, and is quite diverse in animals with an immune compromised system."

Jocelyne Demengeot comments: "This research was possible due to the collaborative spirit that exists in the IGC, that brings together research groups from different fields. Hence, we merged our expertise in evolutionary biology and immunology to study the complex interactions between the vertebrate immune system, composed of a myriad of different cells, and the gut microbiota, composed of another myriad of different bacteria. We learned that the immune system acts as a normalizer of the gut microbiota composition."

Isabel Gordo adds: "Our work shows that it is possible to predict the evolution of commensal bacteria in healthy organisms, but the same is not true in organisms with problems in their immune system. Therefore, the use of generalist therapies to treat people suffering from intestine pathologies that result from an impaired immune system, such as inflammatory bowel disease, may not be the best approach. Instead, therapies based on personalized medicine should be considered, accordingly to the composition of gut bacteria of each person."

More information: João Barroso-Batista et al. Adaptive immunity increases the pace and predictability of evolutionary change in commensal gut bacteria, *Nature Communications* (2015). DOI: 10.1038/ncomms9945

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