Mice fed more fiber have less severe food allergies

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The development of food allergies in mice can be linked to what their gut bacteria are being fed, reports a study published June 21 in *Cell Reports*. Rodents that received a diet with average calories, sugar, and fiber content from birth were shown to have more severe peanut allergies than those that received a high-fiber diet. The researchers show that gut bacteria release a specific fatty acid in response to fiber intake, which eventually impacts allergic responses via changes to the immune system.

"We felt that the increased incidence of food allergies in the past ten years had to relate back to our diet and our own microbiome rather than a lack of exposure to environmental microbes—the so-called 'Hygiene Hypothesis'," says Laurence Macia, co-senior author on the study with Charles Mackay, both immunologists at Monash University in Australia. "Most researchers in this field look at excess fat as the problem—we were one of the first looking specifically at fiber deficiency in the gut."

Gut bacteria are known to break down dietary fiber into their byproducts—primarily short-chain fatty acids. Macia and Mackay take this a step forward and show that these fatty acids support the immune system by binding onto specific receptors on T regulatory cells—immune cells known to suppress the immune response. This binding promotes a cascade of events that regulate inflammation in the gut—something that can be out of flux during an allergic reaction to food.

In the study, mice that were bred to have an artificially-induced peanut allergy were fed a high-fiber diet to produce a healthy population of gut bacteria. The bacteria were then given to a group of "germ-free" mice that had no gut microbes of their own. Despite not having consumed any fiber themselves, this second group of mice was protected against allergy, showing a less severe response when exposed to peanuts. In short, their microbiota was "reshaped" by having this transplant, says Mackay, adding that these mice clearly evolved mechanisms for responding to fiber and its byproducts. "It's almost an essential component of their nutritional health," he says.

"My theory is that the beneficial bacteria that predominate under consumption of fiber promotes the development of regulatory T cells, which ensures the bacteria have a healthy, anti-inflammatory system to thrive in," says Macia. "So it's a win-win for everybody."

This anti-inflammatory effect was even seen with an artificial administration of these fatty acid byproducts. When the researchers gave groups of allergy-induced mice a water supply that was enriched with short-chain fatty acids for three weeks prior to exposure to peanuts, the mice had a reduced allergic response, even in the absence of a "protected" microbiota.

Both researchers expressed cautious optimism that their results can be effective in humans, and further preclinical trials would be required before studying the fiber-allergy relationship in people. "Right now, we need to identify what form of fiber to give," says Macia. "That's the main limitation at this stage."

"It's likely that compared to our ancestors, we're eating unbelievable amounts of fat and sugar, and just not enough fiber" says Mackay, "And these findings may be telling us that we need that high-fiber intake, not just to prevent food allergy, but possibly other inflammatory conditions as well."

More information: *Cell Reports*, Tan et al.: "Dietary fiber and bacterial SCFA enhance oral tolerance and protect against food allergy through diverse cellular pathways." www.cell.com/cell-reports/full … 2211-1247(16)30630-1 . DOI: 10.1016/j.celrep.2016.05.047

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