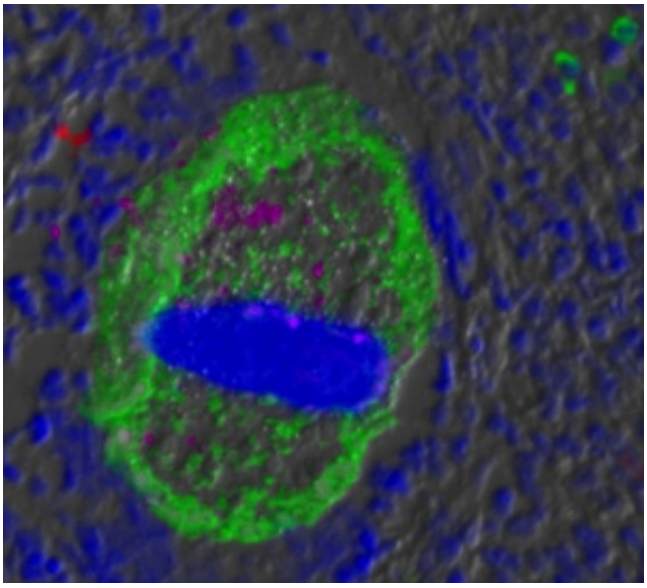
Study reveals how fish control microbes through their gills

February 18 2016, by Katherine Unger Baillie



A parasite in a trout gill is coated with IgT, labeled green.

Oriol Sunyer, a professor at the University of Pennsylvania School of Veterinary Medicine, has described fish as "an open gut swimming." Their mucosal surfaces—their skin, digestive tract and gills—are in constant contact with water, including any pathogens that the water may contain.

In aquaculture facilities, this exposure is a risk, as diseases can quickly tear through populations. In hopes of improving vaccines that keep fish healthy, researchers are therefore very interested in learning how fish

detect and respond to pathogens through their mucosal surfaces. There is also great interest in learning how fish control the community of "friendly" microbes, the microbiota, that dwell in and on their respiratory surfaces.

In a new study published in the journal *Nature Communications*, Sunyer and colleagues made headway in this understanding. Their work reveals that fish induce production of a particular antibody in their gills in response to pathogen exposure. In addition, the researchers found that the gills' microbiota is coated with this same antibody, an immunoglobulin called IgT, the function of which was first discovered by Sunyer's lab in 2010. Prior to this study, it was thought that only mammals had such a refined local mucosal immune response.

"Our work is the first to show that fish can mount a local antibody response to pathogens and microbiota within a mucosal respiratory surface," Sunyer said. "We might expect that mucosal immunoglobulins play a key role in controlling the microbiota in mammals' lungs as well, which is something that has yet to be explored."

In addition to Sunyer, the research team included first author Zhen Xu, Fumio Takizawa and Daniela Gomez of Penn Vet, David Parra of the Universitat Autonoma de Barcelona, Louise von Gersdorff Jorgensen of the University of Copenhagen and Scott E. LaPatra of Clear Springs Foods Inc.

In previous work, Sunyer and colleagues found that IgT is the the primary immunoglobulin involved in pathogen responses in fish guts and skin, and they showed that IgT also coats the commensal bacteria living on these surfaces, likely helping prevent these microbes from getting out of control and causing illness.

Because gills are respiratory organs that are considered a mucosal

surface, the researchers wanted to see if similar immune defense mechanisms were present there. To investigate, they first examined the gill mucus of rainbow trout and found IgT was abundant, though other immunoglobulins, IgD and IgM, were also present. Examining the gill microbiota, they found that IgT was the primary antibody coating bacteria in the gills, consistent with the team's earlier findings in fish skin and gut.

To see if this prevalence indicated a role for IgT in responding to pathogens in the gills, the researchers exposed the trout to a parasite that causes white spot disease, a common infection in farmed, pet and wild fish that particularly targets the skin and gills.

A few weeks after the infection, the team surveyed parasites left in the gills and found them overwhelmingly coated with IgT; only a few had some IgM coating them, and no IgD-coated parasites could be detected. Fish that survived infection also had a significant increase in IgT-producing B cells in their gills, an additional sign that the IgT response was a key to fighting the parasite.

Sunyer's team observed a similar response after fish were exposed to a different pathogen, the bacterium Flavobacterium columnare, which affects the skin and gills and is a leading cause of death in farmed and wild freshwater fish.

Further experiments confirmed that these increases in IgT and IgT-producing B cells were specific to the gills and not the result of a systemic, or serum, increase in production, showing for the first time that a non-mammalian species can locally induce a dedicated mucosal immune response.

From an evolutionary perspective, the findings reveal that sophisticated immune defense mechanisms in respiratory surfaces came about very

early in vertebrate evolution.

"Our study reveals in fish an ancient partnership between mucosal immunoglobulins and respiratory surfaces , thus showing that the basic principles by which respiratory surfaces are controlled from an immunological perspective are conserved in all jawed vertebrates," Sunyer said.

And, on a practical level, the work continues to inform strategies to design better, cheaper vaccines for fish, a crucial step to making fish a safe and affordable source of food protein for the world.

"There's a huge amount of effort directed to developing vaccines for fish," he added, including so-called "bath vaccines" that are simply dropped in the water and absorbed by the animals' gills and skin. "Therefore, by understanding how gill mucosal immunity works, we hope to find better ways to deliver vaccines into the gills of these animals and induce protective immunity to infectious diseases."

Provided by University of Pennsylvania

Citation: Study reveals how fish control microbes through their gills (2016, February 18) retrieved 19 April 2024 from https://phys.org/news/2016-02-reveals-fish-microbes-gills.html