A village of bacteria to help frogs fight disease

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The naturally occurring bacteria on a frog's skin could be the most important tool for helping the animal fight off a deadly skin disease. Credit: Virginia Tech

The naturally occurring bacteria on a frog's skin could be the most important tool for helping the animal fight off a deadly skin disease, according to an experiment conducted by Virginia Tech researchers.

Antibiotics to get rid of the normal bacteria don't significantly alter the rate of fungal infection, but they did cause the frogs to lose weight, suggesting that having their normal bacteria is important for frog health. In addition, treatment with probiotic bacteria did not decrease fungal infection as expected.

However, naturally occurring skin bacteria can respond to infection and adjust structure and function to compensate for it, according to the team.

"It turned out that in this experiment, it wasn't about a single bacterium being protective, but rather the structure of the whole community was important in infection and frog health," said Jeni Walke, a postdoctoral associate in Biological Sciences at Virginia Tech.

The results were published Wednesday (Oct. 7) in the journal *PLOS ONE.*

Because bacterial communities are unique to each frog species, the trick will be determining which environmental and biological factors cause some frogs to develop protective communities while others do not, according to Lisa Belden, an associate professor of biological sciences in the College of Science and Fralin Life Science Institute affiliate.

Belden's team has long been interested in how a frog's skin microbiome, or the collection of bacteria on its skin, helps it survive chytrid fungus exposure.

Chytrid fungus causes a disease called chytridiomycosis, which is rapidly spreading across the world and already threatens about 500 amphibian species. The disease disrupts amphibian skin, potentially resulting in death.

Scientists believe chytrid fungus may be the greatest disease-caused loss of biodiversity in recorded history. Many factors are at play, including amphibian behavior, biological defenses, and environmental conditions. Human-driven changes such as climate change, invasive species, pollution, and habitat degradation further complicate the problem.

For this latest experiment, Belden's team collected bullfrogs from a pond

in Giles County, Virginia. About half of the frogs were already infected with the fungus that can cause disease in some amphibian species.

The team divided them into six experimental groups to explore the infection rate differences between those treated with antibiotics, which reduced the normal bacteria, those treated with an anti-chytrid probiotic bacterium and those not treated at all. These treatments resulted in differences in microbial structure on the frogs' skin, which in turn influenced infection levels and frog growth.

Because some frogs were infected with the fungus and others weren't, the scientists were also able to demonstrate that the fungus affects the microbial structure of the bacteria living on frog skin.

In this experiment, it wasn't a single probiotic bacterium that was protective, but rather the structure of the whole community that was important for frog health.

The next step is to further explore the capabilities of other naturally occurring bacteria, and which environmental factors allow some frogs' bacteria to successfully fight off the fungus.

"Factors that contribute to microbial community assembly and maintenance on amphibian skin, including host factors, habitat, diet, and the available microbial species pool, may ultimate influence disease dynamics," said Belden, who is also an affiliated faculty member with Virginia Tech's new Global Change Center.

The research was funded by the National Science Foundation.

"Chytrid disease is devastating large numbers of amphibian communities in many parts of the world," said Simon Malcomber, program director in the National Science Foundation's Division of Environmental Biology,

which funded the research. "The study shows the importance of amphibian microbiomes in mediating the effects of chytrid disease, and offers hope of limiting the infection."

Provided by Virginia Tech