Antibiotic-eating bug unearthed in soil

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It's well known how bacteria exposed to antibiotics for long periods will find ways to resist the drugs—by quickly pumping them out of their cells, for instance, or modifying the compounds so they're no longer toxic.

Now new research has uncovered another possible mechanism of antibiotic "resistance" in soil. In a paper published on Dec. 6 in the Journal of Environmental Quality, a group of Canadian and French scientists report on a soil bacterium that breaks down the common veterinary antibiotic, sulfamethazine, and uses it for growth.

Certain soil bacteria are already known to live off, or "eat," agricultural pesticides and herbicides, says the study's leader, Ed Topp, a soil microbiologist with Agriculture and Agri-Food Canada in London, Ontario. In fact, the microbes' presence in farm fields can cause these agrichemicals to fail.

But to Topp's knowledge, this is the first report of a soil microorganism that degrades an antibiotic both to protect itself and get nutrition.

"I think it's kind of a game changer in terms of how we think about our environment and antibiotic resistance," he says.

Concerns about widespread antibiotic resistance are what led Topp and his collaborators to set up an experiment 14 years ago, in which they dosed soils annually with environmentally relevant concentrations of three veterinary antibiotics: sulfamethazine, tylosin, and chlortetracycline. Commonly fed to pigs and other livestock, antibiotics are thought to keep animals healthier. But they're also excreted in manure, which is then spread once a year as fertilizer in countless North American farm fields.

The researchers first wanted to know whether these yearly applications were promoting higher levels of antibiotic resistance in soil bacteria. But a few years ago, they also decided to compare the persistence of the drugs in soil plots that had been repeatedly dosed, versus fresh soils where antibiotics were never applied.

They did this experiment, Topp explains, because of previous work indicating that pesticides often break down more quickly in soils with a long history of exposure, indicating that pesticide-degrading microbes have been selected for over time.

Still, it came as a surprise when they saw antibiotics also degrading much faster in long-term, treated plots than in fresh, control soils, he says. In particular, sulfamethazine—a member of the antibiotic class called sulfonamides—disappeared up to five times faster.

The researchers subsequently cultured from the treated plots a new strain of *Microbacterium*, an actinomycete that uses sulfamethazine as a nitrogen and carbon source. Extremely common in soil, actinomycete bacteria are known to degrade a wide range of organic compounds. And now at least two other sulfanomide-degrading *Microbacterium* strains have been reported, Topp says: one from soil and another from a sewage treatment plant.

Taken together, the findings suggest that the capability to break down sulfanomides could be widespread. And if it's indeed true that "the microbiology in the environment is learning to break these drugs down more rapidly when exposed to them, this would effectively reduce the amount of time that the environment is exposed to these drugs and therefore possibly attenuate the impacts," Topp says.

Not that negative impacts aren't still occurring, he cautions. In particular, long-term exposure to antibiotics puts significant pressure on soil bacteria to evolve resistance, which they typically do by giving and receiving genes that let them detoxify drugs, or keep the compounds out of their cells.

What the new research suggests, though, is that soil bacteria could be swapping genes for breaking down antibiotics at the same time.

"My guess is that's probably what's happening, but it remains to be determined," Topp says. "It's actually extremely fascinating."

More information: dl.sciencesocieties.org/public … cts/0/0/jeq2012.0162

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