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Superbugs abound in soil: Survey of bacteria reveals an array of antibiotic-resistance.

Helen Pearson



Some soil bacteria were found to be naturally resistant to up to 15 antibiotics.

Bacteria that live in soil have been found to harbour an astonishing armoury of natural weapons to fight off antibiotics. The discovery could help researchers anticipate the next wave of drug-resistant 'superbugs'.

Researchers have long known that soil-dwelling bacteria make natural antibiotics, and that they have inbuilt ways to survive their own and other bugs' toxins; in some cases, the genes that help them dodge antibiotics have transferred into infectious bugs that plague humans.

Microbiologists have identified a few of the ways that soil microbes neutralize antibiotics. But Gerard Wright and his team at McMaster University in Ontario, Canada, have shown that soil microbes carry a hidden trove of such arms.

The team collected handfuls of dirt from towns and forests across Canada, and grew the bacteria contained within them. They isolated 480 different strains of the common soil bacteria *Streptomyces*, which are known to synthesize a large number of antibiotics, and so are expected to have natural defenses against them. They then threw 21 different antibiotics (some natural, some synthetic), at the bugs to see if they could survive.

Hard to beat

The strains were impervious to seven or eight antibiotics on average, the researchers report in *Science*¹, and two hardy ones were resistant to 15 drugs.

Many of the bacterial strains were immune to antibiotics that they have probably never been exposed to before. And the crafty creatures used some previously unknown ways to detoxify some drugs, such as adding a sugar molecule on to the drug telithromycin, which prevents it from crippling a cell.

Being able to disable so many antibiotics so easily may help the underground bacteria survive the cocktail of chemicals released by other microbes, fungi and plants in the underground, Wright suggests.

Out of the dirt

The discovery raises fears that the genes underlying this glut of drug-resistance could jump into bacteria such as *Staphylococcus aureus*, which causes hospital infections and is already resistant to almost everything on the pharmacy shelf.

"The chances that these genes will end up in a disease-causing organism at some future point is high," says microbiologist Abigail Salyers, who studies microbe gene transfer at the University of Illinois at Urbana-Champaign.

Antibiotic resistance genes have escaped from the dirt before. Researchers think that the genes that allowed superbugs to resist vancomycin, one of the last lines of antibiotic defence prescribed by doctors, originally came from soil-dwelling bugs.

Forewarned is forearmed

On the flip side, the findings could help doctors arm themselves against future superbugs. Drug companies seeking new antibiotics, for example, could test a prototype product on an array of soil bacteria to find organisms that are naturally resistant, and figure out how they manage to disable the drug.

Armed with this knowledge, scientists could tweak the drug to avoid resistance before it even occurs: they might sculpt the antibiotic's chemical shape, for example, or design a second medication that would stop the bacteria from degrading the antibiotic or pumping it out of the cell.

But because the team looked at only a tiny fraction of the soil bacteria, there are probably many more ways of fighting antibiotics that have yet to be discovered, says Jo Handelsman who studies soil microbes at the University of Wisconsin, Madison. "We have an enormous task ahead of us," she says.

References

- 1 D'Costa V., *et al. Science*, **311**. 374 - 377 (2006).