Study reveals classic symbiotic relationship between ants, bacteria

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Ants that tend and harvest gardens of fungus have a secret weapon against the parasites that invade their crops: antibiotic-producing bacteria that the insects harbor on their bodies.

Writing today in the journal *Science*, an international team led by UW-Madison bacteriologist Cameron Currie illustrates the intricate and ancient nature of this mutualistic relationship. The researchers found that the ants house the bacteria in specialized, highly adapted cavities and nourish them with glandular secretions-an indication that the ants, bacteria, fungus and parasites have likely been evolving together for tens of millions of years.

"Every ant species [that we have examined] has different, highly modified structures to support different types of bacteria," says Currie. "This indicates the ants have rapidly adapted to maintain the bacteria. It also indicates that the co-evolution between the bacteria and the ants, as well as the fungus and parasites, has been occurring since very early on, apparently for tens of millions of years."

Furthermore, Currie says, the fact that the species have coexisted for so long means there might be a mechanism in place to decrease the rate of antibiotic resistance - which could help address a significant problem facing modern medicine. "We can learn a lot about our own use of antibiotics from this system," he says.

Currie studies the intricate relationships between certain species of ants in central and South America, the fungus they cultivate for food, the parasite that invades the fungus, and the bacteria that the ants harbor to fight the parasite. The phenomenon is a classic example of mutually beneficial symbiosis, and Currie views it as a model system with the potential to shed light on the way other organisms interact.

Although the ants and their fungus gardens had been closely studied for dozens of years, Currie was the first scientist to identify the crucial role of bacteria and the antibiotics they produce. He made a key insight that white spots on the ants, which were previously dismissed as "waxy blooms," were actually colonies of bacteria.

In the latest phase of his research, Currie, who began this study when he was at the University of Kansas, and his team removed the external blooms of bacteria from two ant species in the genus Cyphomyrmex and examined the exoskeleton beneath with a high-powered microscope. Their investigation revealed crypts attached to endocrine glands, both of which were previously unnoticed by scientists.

In fact, the crypts are specially adapted to the type of bacteria each species harbors - evidence that the ants are capable of rapidly changing to maintain their bacterial residents.

"These two species of ants are very difficult to differentiate other than through molecular analysis," says Currie. "There are almost no morphological, or physical, differences between the two. However, the crypts in the exoskeleton are distinguishable. We can actually use them to tell the two species apart."

The degree of specialization indicates that the association between the ants and the bacteria is ancient, says Currie, and likely vital to the species' survival. The phenomenon extends beyond the two species of Cyphomyrmex to about 210 species of fungus-growing ants, which harbor many different species of a specific group of bacteria.

"For me, it shows us how little we know about natural systems and microbes in nature. Fungus-growing ants are very well studied, yet this morphological characteristic went unnoticed until now. What other organisms might be taking advantage of this type of association? What don't we know about other systems that are not as closely studied as these ants?"

Source: University of Wisconsin