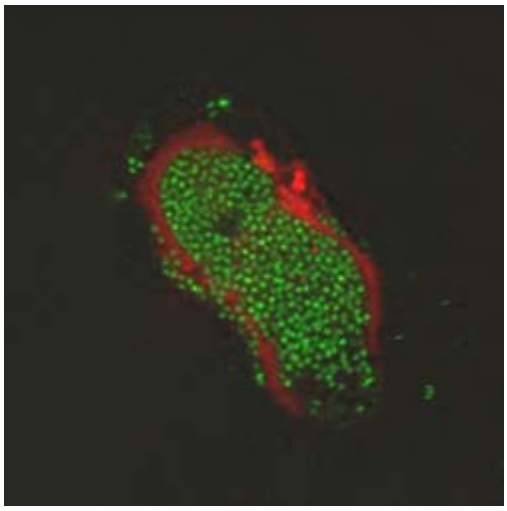
Science News –
August 9, 2006

What lurks in cooling towers?

Amoebas infected with pathogenic bacteria are more prevalent in cooling towers than in natural environments.

Legionella pneumophila, the bacterium responsible for Legionnaires' disease, is just one of many related bacteria that use amoebas as a host, according to a study published today on *ES&T*'s Research ASAP website (DOI: 10.1021/es0604257). The results have implications for human health, because high numbers of infected amoebas inhabit the cooling towers on top of many commercial buildings.



Mary Farone
An amoeba is infected with a novel bacterium, CC99. Numerous coccoid bacteria fill the nucleus of the amoeba 48 hours after infection as it begins to rupture.

In the new study, Sharon Berk of Tennessee Technological University and colleagues sampled 40 cooling towers and 40 natural aquatic environments—rivers, lakes, creeks, and ponds. All samples contained amoebas, but infected amoebas were found in 22 of the cooling towers and 3 of the natural samples. Surprisingly, just 3 of the cooling towers contained *L. pneumophila*. Some of the other bacteria may also be human pathogens, but the only way to know, according to Berk, is to test sera from patients, because many of these bacteria cannot be cultured outside of amoebas and are not detected by conventional methods.

People regularly get pneumonia after inhaling *Legionella*, and possibly other amoeba-associated microorganisms, in aerosol drifts from cooling towers. The most famous, defining outbreak occurred in 1976, when 221 people were sickened and 31 died while attending a convention of the American Legion at a hotel in Philadelphia. After an intensive investigation, the hotel's cooling tower was identified as the source of the epidemic. Even 30 years later, *Legionella* remains a problem. In 2000, >100 people were infected when they inhaled cooling-tower drift while standing in line outside a new aquarium in Melbourne, Australia.

Amoebas routinely feed on bacteria, but *Legionella* can hijack the amoeba's cellular machinery and then multiply profusely. Eventually the amoeba swells and bursts like a balloon, releasing a horde of bacteria, which swim away in search of another host. Some of these bacteria can survive outside the amoebas for weeks, whereas others survive only for short periods, explains Berk.

Richard Miller, a microbiologist at the University of Louisville, says that the process is similar when *Legionella* infects a human alveolar macrophage, a cell that scavenges the surface of the lung and engulfs pathogens. Using a molecular "needle and syringe", *Legionella* injects the macrophage with proteins that prevent digestion of the bacteria, says Miller. Like the amoeba, the macrophage eventually fills up with bacteria and bursts.

According to Jeffrey Cirillo, a microbial pathogeneticist at the Texas A&M University System Health Science Center, many pathogens have evolved to protect themselves against single-celled organisms, such as amoebas. The same mechanisms that turn the tables on amoebas are what also make the bacteria dangerous to humans. *Legionella*, he says, is not spread from person to person. This suggests that, as a host, mammals are an evolutionary dead end for *Legionella*, he adds.

"Some of the cooling-tower-related outbreaks worldwide have been horrendous," says Australian cooling-tower maven Clive Broadbent of Clive Broadbent & Associates. He emphasizes that Berk's study presents important research findings, raising questions about the role of cooling towers in disease causation, especially the "startling observation" that most of the infecting bacteria were not *Legionella*, the species invariably targeted in laboratory isolation methods. —BARBARA BOOTH