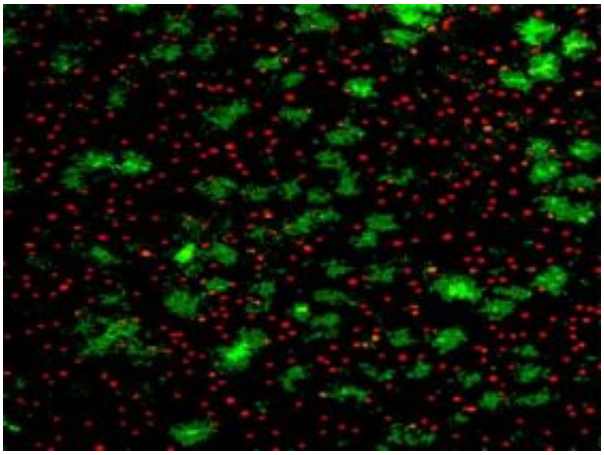
Biofilms use chemical weapons

July 23 2008



Biofilm in green, amoebae in red. Credit: Helmholtz-Zentrum für Infektionsforschung

Bacteria rarely come as loners; more often they grow in crowds and squat on surfaces where they form a community together. These so-called biofilms develop on any surface that bacteria can attach themselves to. The dilemma we face is that neither disinfectants and antibiotics, nor phagocytes and our immune system can destroy these biofilms. This is a particular problem in hospitals if these bacteria form a community on a catheter or implant where they could potentially cause a serious infection.

Scientists at the Helmholtz Centre for Infection Research in Braunschweig have now identified one of the fundamental mechanisms used by the bacteria in biofilms to protect themselves against the

attacking phagocytes. The scientists are now publishing their findings in the renowned specialist publication *PLoS ONE*, together with colleagues from Australia, Great Britain and the USA – the discovery being that biofilm bacteria use chemical weapons to defend themselves.

Until now, scientists have been unable to understand the root of the biofilm problem – the inability of phagocytes to destroy these biofilms. Dr. Carsten Matz decided to investigate this problem. As a model for his investigation, this Braunschweig-based researcher decided to look at marine bacteria. They face constant threats in their habitat from environmental phagocytes, the amoebae, which behave in a similar way in the sea as the immune cells in our body: they seek out and feed on the bacteria.

So long as bacteria are swimming freely and separately in the water, they are easy pickings for these predators. However, if they become attached to a surface and socialize with other bacteria, the amoebae can no longer successfully attack them. "The surprising thing was that the amoebae attacking the biofilms were de-activated or even killed. The bacteria are clearly not just building a fortress, they are also fighting back," says Carsten Matz.

The bacteria utilise chemical weapons to achieve this. A widespread and highly effective molecule used by marine bacteria is the pigment violacein. Once the defence system is ready, the biofilm shimmers a soft purple colour. If the attackers consume just a single cell of the biofilm – and the pigment they contain – this paralyses the attackers momentarily and the violacein triggers a suicide mechanism in the amoebae.

"I feel that these results could offer a change of perspective," says Carsten Matz. "Biofilms may no longer be seen just as a problem; they may also be a source of new bioactive agents. When organized in biofilms, bacteria produce highly effective substances which individual

bacteria alone cannot produce." And the scientists hope to use these molecules to combat a specific group of pathogens: Human parasites that cause devastating infections such as sleeping illness and malaria. Amoeba are ancient relatives of these pathogens and thus biofilm-derived weapons may provide an excellent basis for the design of new parasiticidal drugs.

Source: Helmholtz Association of German Research Centres