One Legionella rarely comes alone

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Numerous microorganisms, including Legionella, live in biofilms in shower hoses. A team from the aquatic research institute Eawag has now investigated and characterised such microbial communities and analysed their interaction with this pathogen. The results may contribute to a better understanding of the ecology of Legionella and support the possible development of a probiotic approach for the control of Legionella.

Legionella is responsible for the notorious Legionnaires' disease and a flu-like illness called Pontiac fever. The bacterium occurs naturally in building plumbing systems. Inhalation of contaminated water droplets can lead to infection and health problems in humans. Legionella feel especially at home in the biofilms of shower hoses, which provide a particularly ideal environment for their growth. These conditions include high temperatures and longer periods during which the water stagnates.

In order to prevent infection with Legionella through drinking water or shower water, methods and approaches are needed to contain their proliferation. Most of the research on the bacterium has so far been carried out on pure cultures. However, a biofilm, which also contains Legionella, is full of a wide variety of microorganisms that are constantly interacting with each other. It is now known how important these microbial interactions are and how they influence the occurrence and behaviour of different species within a biofilm. This interaction can also have an impact on the persistence and proliferation of Legionella.

The biofilms from different shower hoses differ in colour and consistency, as well as in the microbial communities, which were examined through molecular analysis (Photo: Eawag, Frederik Hammes).

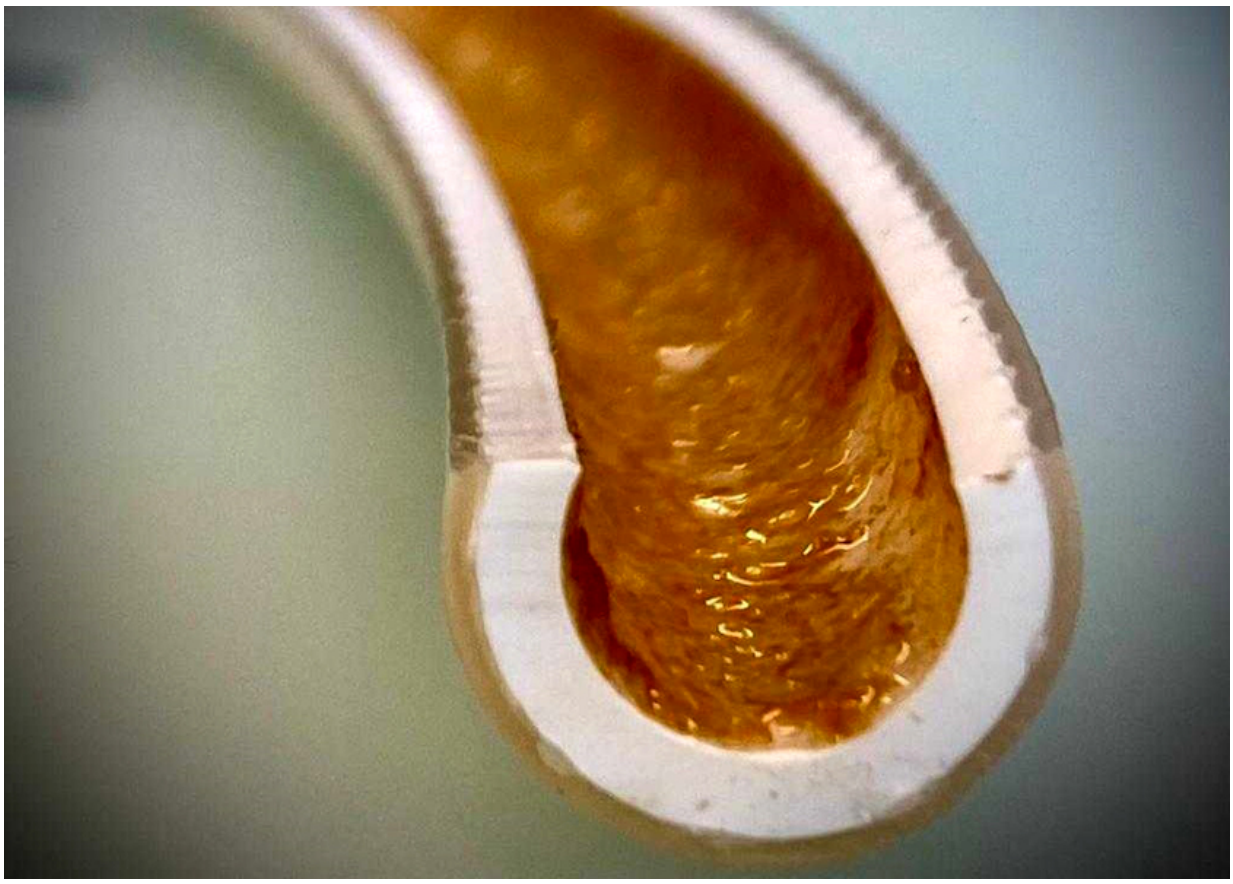
Friend or foe?

For this reason, Eawag researchers led by Frederik Hammes, head of the Environmental Microbiology department, and his doctoral student Alessio Cavallaro investigated these relationships in more detail. They used 85 shower hoses from a building that has had problems with Legionella contamination in the past. The researchers cut open the hoses, extracted the biofilm and thus obtained the DNA of all the microorganisms living in them. This gave them an overview of the communities within the respective hoses.

The results provide an insight into the microbial environment that favours Legionella. “Bacteria need other friendly bacteria in order to survive,” says Cavallaro. The variety of bacteria found in the biofilm of the shower hoses shows that Legionella also has some “friends” among these microorganisms. The researchers then analysed the samples statistically and could thereby make assumptions as to which of these bacteria promote Legionella and which, on the contrary, do not correlate with the occurrence of Legionella and

are therefore possible antagonists. This knowledge is an important step towards a probiotic solution against Legionella, i.e. using other bacteria against the pathogen. The study also makes it easier to understand the living conditions of the bacterium, which in turn can help the routine monitoring.

Überlandstrasse 133
CH-8600 Dübendorf
T +41 58 765 55 11
F +41 58 765 50 28
info@eawag.ch
www.eawag.ch
eawag aquatic research



The biofilm on the plastic is visible after cutting open the shower hoses (Photo: Eawag, Frederik Hammes)

Different species of Legionella in a biofilm

But not all Legionella are the same. While Legionella pneumophilia is the best researched, as it is the main cause of the disease, there are many other species of Legionella. “The highlight of our results was that we found several species of Legionella in all biofilms,” explains Cavallaro. This has been rarely proven to date. The researchers also discovered that these different species of Legionella also inhabit different environmental niches within a biofilm. “These findings may not only help us to better understand Legionella, but also develop appropriate measures against the pathogen in the future,” says Cavallaro.

The next step for Cavallaro would be to investigate the function of the different inhabitants within a biofilm in connection with the Legionella bacteria. While the previous study focused on the number and distribution of bacteria and possible antagonists of Legionella, it would be interesting to find out in the future why certain bacteria are not compatible with Legionella. This would also provide important information on how biological antagonists could be used to combat Legionella in the future.

Cover picture: Legionella thrive particularly well in biofilms inside shower hoses. Eawag has

analysed the other microorganisms with which they coexist there. The picture shows a biofilm removed from a shower hose (Photo: Eawag, Frederik Hammes)

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Project LeCo

Contact

Frederik Hammes

Group Leader

Tel. +41 58 765 5372

frederik.hammes@eawag.ch

Alessio Cavallaro

Postdoctoral Researcher

Tel. +41 58 765 6682

alessio.cavallaro@eawag.ch

Cornelia Zogg

Science Editor

Tel. +41 58 765 5763

cornelia.zogg@eawag.ch

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