POPULAR SCIENCE ABSTRACT

The vast majority of infectious diseases are caused by pathogens that live in social systems called biofilms. These complex structures are composed of different species of bacteria that interact with each other both directly and indirectly via metabolic products or their virulence factors. In addition, the extracellular matrix also plays a crucial role in bacterial biofilm, and it is composed of organic and inorganic components. This bacterial ecosystem is very challenging for medicine because it protects bacteria from the host's immune system and limits the penetration of therapeutics such as antibiotics. Bacterial biofilm makes it difficult, for example, to heal wounds or integrate implants into tissues.

Dental plaque is also an example of a complex system of many interacting bacterial species. Depending on the composition of bacteria in dental plaque, it can contribute to the development of periodontitis and lead to tooth loss and bone resorption. Furthermore, growing number of reports indicate a connection between periodontal diseases and life-threatening disorders such as cardiovascular or neurodegenerative diseases including Alzheimer's disease. However, little is known about the mechanism by which the infection spreads. One possibility is the importance of small microcolonies, which may detach from the growing biofilm and enter the bloodstream.

The aim of this project is to investigate how different biofilm species composition influences pathogenic potential and host response. In this project, we will focus on the reaction of immune cells (macrophages and neutrophils) to biofilm infections. We will determine whether these cells are able to engulf bacteria present in the form of biofilm and how the infection affects their activity. Subsequently, we will investigate the effect of bacteria and/or bacteria-activated macrophages and neutrophils on vascular damage, which may be a potential mechanism for the bacterial spreading. In addition to this, we will verify whether the bacteria themselves can directly affect the blood vessels.
Biofilm composition will also be examined to check for any changes during the infection, such as the most dominant bacterial species and most susceptible to removal by the host. Importantly, we will test biomaterials in the form of nanoparticles with anti-biofilm properties and immunomodulatory factors to observe their ability to fight infections.

The research will be conducted on zebrafish larvae (*Danio rerio*) - a small aquarium fish, commonly used in biomedical research due to numerous advantages such as, transparency of the larvae, external fertilization, and availability of various transgenic fish lines with specifically labelled cell types e.g., neutrophils, macrophages, or endothelial cells lining the blood vessels. This allows direct microscopic observation of the interaction between pathogens and host cells in real time.

In the future, the results of this project may contribute to the development of alternative methods of combating infectious diseases caused by bacteria present in the biofilm form, which significantly weakens or even prevents effective treatment.