Project 3.3 Development of a comprehensive bacteria detection procedure: the creation of a sensor and development of new protocols for sample preparation and deposition

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Background:

Bacterial infections cause a severe socio-economic burden. In 2005 1.8 million people died due to consumption of infected food or water. Only in the USA number of infections and illnesses originating in food reaches 76 million. Among them, 325 000 are admitted to hospitals, and 5200 died. To make the situation even worse, hospitals are a natural place
of occurrence of pathogenic bacteria. The European Centre for Disease Prevention and Control reports that only in Europe, 4.1 million patients are affected by healthcare-associated infection each year. In the USA, nosocomial infections cause around 100 000 deaths per year. The additional costs of treatment of hospital-related infections are enormous. It is estimated to be around 7.5 billion euros in the EU and around $5 billion in the USA. Targeted treatment of infections becomes a must as new bacteria strains, resistant to antibiotics, emerge. Modest estimates ($1.3 billion to $2.7 billion in the USA and $1.5 billion in the EU) were reported.

In the majority of cases, serious repercussions can be avoided thanks to the fast and reliable detection of bacteria. Classical methods, although cheap and straightforward, require up to 72 h to obtain a reliable output. In many cases, this is far too long, not only in the case of healthcare, but also in industry, e.g., food industry, especially of the short expiry date, or security (e.g., anthrax detection). Majority of other utilized detection techniques (e.g., PCR based and mass spectrometry based), share significant drawbacks: they require expensive equipment, trained users and are costly. Therefore, biosensor-based methods are increasingly gaining acceptance. Thus the development of sensitive, specific, and rapid methods for bacteria detection is a must.

Aim:

Within the proposed project, we aim at the development of the whole procedure for bacteria detection utilizing phage-based sensing elements. Bacteriophages (phages for short) are viruses whose host organisms are bacteria. Their natural affinity to host cells can be used to design highly specific tools for bacteria detection. Unlike antibodies, phages can be easily produced cheaply and in large quantities. The work should lead to the development of a novel protocol for bacteria sensing, offering a limit of detection (LOD) below 10 CFU/mL within 1 h.

Requirements:

The project is highly interdisciplinary and combines essential methods of biotechnology, molecular biology, physical chemistry, and nanotechnology. The successful candidate is expected to:
- show scientific initiative,
- perform experiments independently,
- plan the workflow,
- maintain research notes, and participate in the decision-making process.

- He/she will need to build experimental setups, calibrate them, plan and perform control experiments, and analyze the data.
- Contribution through regular reporting and publishing, taking part in, and presenting at group meetings and conferences is mandatory.
- From our experience, the background in biotechnology would be appropriate, as it allows us to adapt to both chemistry and biology tasks. However, applicants with other backgrounds will also be considered based on the possible input to the project (e.g., chemists, biologists, physicists, engineers, or similar).
- Ability to work independently as well as in a group and proficiency in English speaking and writing are required. The successful candidate is expected to contribute to the efficient functioning of the lab by providing help and supervision to junior members of the group and by fulfilling necessary administrative and organizational tasks.