Determining the molecular mode of action of Home and Personal Care (HPC) product preservatives and characterising antimicrobial resistance in problematic bacterial contaminants

Supervisory team:
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Host institution: Cardiff University
CASE partner: Unilever Research and Development, Port Sunlight

Project description:
Each year, millions of tonnes of home and personal care (HPC) products, including cleaning products, cosmetics and toiletries are manufacturer globally. To keep these products free from microorganisms, industrial manufacturers add antimicrobial preservatives. However, products occasionally become contaminated with microorganisms, the most common of which are antimicrobial resistant bacteria which can also cause human infections.

The HPC industry is undergoing considerable change, needing to reduce the use of environmentally toxic preservatives, consumer pressure to use natural and milder but less effective preservatives, and the urgent requirement to reduce single-use plastic packaging. The changes are conducive to increased HPC product contamination, and a potential rise in antimicrobial resistant (AMR) bacteria causing outbreaks of infection.

We have teamed up with Unilever Research & Development (Port Sunlight, UK) to offer a CASE PhD studentship aimed at filling multiple knowledge gaps in relation to the use of preservatives and new multifunctional product ingredients. Past collaborative PhD training between Cardiff University and Unilever has investigated a range of problematic antimicrobial resistant bacteria including Burkholderia, Pseudomonas and Enterobacteriaceae. These species are considered priorities in relation to the development of new HPC preservation strategies.

The proposed PhD will examine the mechanisms behind preservative mode of action and resistance in the priority bacterial contaminants. This knowledge will provide industrial manufacturers with solutions to improve HPC preservation and preventing the development of further antimicrobial resistance.

The project will specifically:
1. Use molecular and genomic techniques to understand how preservatives and multifunctional ingredients work to suppress or kill bacteria, as well as how the industrial contaminant resist these important antimicrobials.
2. Monitor and identify priority contaminants causing manufacturing incidents using molecular methods including PCR, whole genome sequencing and sequencing the entire DNA content of the industrial products (metagenomic analysis).
3. Understand how large plasmids (called megaplasmids) specifically help priority contaminants survive the harsh antimicrobial-rich conditions in HPC products.

A common feature of the Burkholderia, Pseudomonas and Enterobacteriaceae bacteria found within industrial products is that they have acquired megaplasmid DNA. With a variety of known and unknown genes present on these megaplasmids, we do not know which may play a role in mediating antimicrobial resistance and the ability of the bacteria to survive industrial preservation.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.