Developing a novel approach to improve the welfare of dairy cows: inactivating mastitis-causing bacteria using non-invasive cold atmospheric plasma (CAP)

Supervisory team:
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Collaborators: Dr Dimitrios Lamprou (Queen's University Belfast)

Host institutions: University of Bristol, University of the West of England (UWE)

Submit applications for this project to the University of Bristol

Project description:

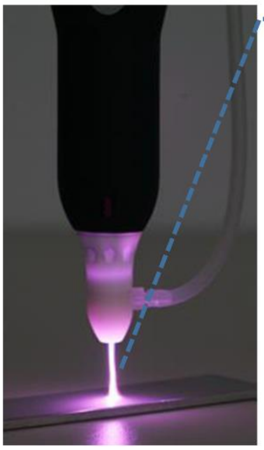

Image 1. Schematic representation of cold atmospheric plasma generation.

Conservative estimates for the dairy industry suggest 300 million cows produce 600 million tons of milk per year globally. In the UK, milk production is worth £8.8b, making up almost 20% of total agricultural output. Mastitis is a highly prevalent disease in dairy cattle affecting the world's dairy industry by reducing milk quality, milk yield, increasing treatment costs, hampering animal reproductive performance and raising greenhouse gas production. It also causes pain, suffering and general stress to the animals. Mastitis is usually caused by bacterial invasion of the teat canal, but also as a result of injury to the cow's udder.

Currently, bovine mastitis is predominantly treated with antibiotics. However, antibiotic use is under scrutiny due to the development of antimicrobial resistance and presence of residues in milk. Therefore, novel strategies for preventing bovine mastitis are urgently needed. Cold atmospheric plasma (CAP) is a novel non-thermal technology shown to have antibacterial properties in a variety of different settings. Plasma describes the state of an ionised gas (4th state of matter), with natural examples including the northern lights, lightening and solar winds. In the lab, we produce CAP by excitation of gas molecules through the use of electrical discharges. CAP has the potential to inhibit bacterial biofilms and promote healing of teat injuries due to the reactive species it contains (e.g. oxygen/nitrogen reactive species). Data from our group have shown that CAP is effective in eliminating bacterial pathogens on different surfaces (steel/polymer, food, model human skin). This project aims to explore the viability of using CAP to prevent mastitis in dairy cows, thereby improving milk quality/production and animal welfare, while also reducing the use of antibiotics. Therefore, for the first time, we will investigate: i) the efficacy of CAP against bacterial biofilms associated with mastitis and ii) the safety of CAP on bovine mammary cells, using 3D printed bovine mammary skin and ex vivo skin models.

The student will join active interdisciplinary research groups with access to world class research facilities at University of Bristol (animal welfare, physiology, regenerative medicine) and University of the West of England-Bristol (cold plasma, microbiology, cell biology and metabolism). The student will receive excellent training and support from their supervisory team, and develop the practical skills and enterprising mindset that employers seek. The student will also benefit from a rich collaboration with Dr Lamprou, expert on 3D-printed artificial skin models (School of Pharmacy-Queen's University Belfast).