

PhD Project Advertisement

Project title: *TB or not TB – developing the next generation technology for rapid bovine tuberculosis detection*

Project No: FBS25-56-Cramer-ra

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Project description: This project will investigate and validate a novel method for rapid and cost-effective analysis of animal (livestock) diseases, focused on bovine tuberculosis. Mass spectrometry (MS), which is one of the most powerful molecular analysis techniques, will be employed. MS is already well-established in clinical (NHS) laboratory for the diagnosis of infectious diseases (biotyping) and metabolic diseases of newborns. Here, we will use ‘LAP-MALDI’ MS, which has been developed in our labs, and exploit its advances in sample classification for the detection of bovine diseases and characterising/validating disease biomarkers that have been identified by this new analytical method.

Bovine tuberculosis (bTB) is a world-wide disease with serious economic impact for dairy farming and significant risks to the human population through zoonotic transmission. bTB costs the UK ~£100 million per year, with over 27,000 cattle being slaughtered for disease control in 2021. In 2013, the UK Government launched various bTB eradication strategies, with the aim of declaring the UK bTB-free by 2038, showing the importance for UK agriculture and one health.

There are currently two bTB diagnostic tests approved for use in the UK. The primary test is the tuberculin skin test and the secondary test is the interferon (IFN)- γ blood test. The IFN- γ test is used to supplement the tuberculin skin test to detect bTB infections that may not have been detected simply with the skin test. Both tests are invasive, time-consuming and depend on specific reagents. Therefore, there is the need for faster, less invasive and more cost-effective tests at the same or higher level of detection accuracy.

Our earlier BBSRC-funded research demonstrated that LAP-MALDI MS analysis of cow milk allowed rapid detection of mastitis two days before clinical manifestation (<https://doi.org/10.1039/D1SC05171G>). Recent DEFRA-funded research showed that nasal swab samples from bTB cattle can be distinguished from samples of healthy cattle and cows with mastitis. Samples were collected non-invasively, prepared within 4 hours and analysed by LAP-MALDI MS within minutes. The class prediction model based on this data was highly accurate and identified the protein S100-A12 as a potential biomarker for bTB-specific detection (<https://doi.org/10.1021/acs.jafc.3c01879>).

The main work packages will be:

- Sample collection from farms and collaborators.
- Optimisation of LAP-MALDI MS profiling for bTB detection.
- Multiplexed LAP-MALDI MS profiling analysis.
- Validation of S100-A12 as a bTB-specific disease marker.
- Identification of novel bovine disease markers.

In summary, this project will develop new MS-based technology for a potential step-change in veterinary diagnostics through faster, cost-effective and less invasive tests.

Training opportunities:

Experimental methods:

- LAP-MALDI MS and analytical sample preparation for MS analysis;
- Assaying liquid biopsies using ELISA-based methods;

- Biomolecular characterization using MS data;
- Collection, handling and preparation of farm animal samples, including CL-2/3 lab work, GLP and containment procedures;
- Laser safety training;
- Prediction model building using machine learning and multi-omics bioinformatics.

General Training:

- Lab training: The successful candidate will be trained in lab-based analytical and microbiological research, including SOPs, instrument training, H&S (risk assessments) and research ethics;
- Research/data analysis: Mandatory attendance of weekly group meetings, discussing day-to-day running of research labs and work data with journal club presentations. Weekly 1-2-1 meetings with the lead supervisor, discussing data and learning relevant data mining techniques by using their own data;
- Non-academic agri-food innovation training: Understanding policy-facing research and advice through a 3-months placement at the Agri-Food & Biosciences Institute;
- Transferable skills: A wide range of transferable skills courses are available in teaching, leadership, mathematical/statistical skills, science communication/writing and management courses, e.g. >50 RRDP courses run by the Doctoral and Researcher College. The successful candidate is also required to further their studies by attending some taught UG courses.

Project supervision style: The student will have weekly 1-2-1 meetings with RC to review data, receive direct feedback (there and then) and learn relevant data mining techniques using the student's own data. The student will also attend weekly group meetings, discussing day-to-day running of research labs (including H&S) and research/work data with journal club presentations. In addition, quarterly meetings with all supervisors will be arranged by video-conferencing and all supervisor have "open door" policies for further help/supervision. Feedback for all written output can be expected within two weeks, which is particularly important for poster presentations and article submissions. Practice presentation with supervisor-led peer-review in group meetings will complement feedback in presentation skills for conferences talks etc. Other supervisory/mentoring arrangements, as required by the Doctoral and Researcher College, are report submissions based on prior discussion with the supervisors at 1, 3, 9 months before the confirmation of registration and then every 6 months until thesis submission.

Student profile: Applicants should have a background in the physical, life or medical/veterinary sciences and have good analytical skills. Hands-on experience in the field of mass spectrometry (e.g. through a final year project) is desirable but not essential as is basic knowledge in animal sciences or microbiology.

Other information: This is a CASE studentship with AFBI, Northern Ireland and the project includes a 3-month placement at AFBI, Northern Ireland where accommodation will be provided at no cost to the student.

Stipend (Salary):

FoodBioSystems DTP students receive an annual tax-free stipend (salary) that is paid in instalments throughout the year. For 2024/25 this is £19,237 (£21,237 at Brunel University) and it will increase slightly each year at a rate set by UKRI.

Equity Diversity and Inclusion:

The FoodBioSystems DTP is committed to equity, diversity and inclusion (EDI), to building a doctoral researcher (DR) and staff body that reflects the diversity of society, and to encourage applications from under-represented and disadvantaged groups. Our actions to promote diversity and inclusion are detailed on the [FoodBioSystems DTP website](#) and include:

- Offering reasonable adjustments at interview for shortlisted candidates who have disclosed a disability or specific learning difference.
- [Guaranteed interview](#) and [applicant mentoring](#) schemes for applicants, with UK home fees status, from eligible under-represented ethnic groups.

These are opt-in processes.

Our studentships are offered on a part-time basis in addition to full time registration. The minimum registration is 50% FT and the studentship end date will be extended to reflect the part-time registration.

For up to date information on funding eligibility, studentship rates and part time registration, please visit the [FoodBioSystems website](#).