

PhD Project Advertisement

Project title: *Unravelling Bovine Tuberculosis: Novel Biomarker Discovery and Host-Pathogen Interaction Insights through Transcriptomic Analysis*

Project No: FBS25-65-Gibson-as

Lead supervisor: Dr Amanda Gibson, Centre of Excellence for Bovine Tuberculosis, Aberystwyth University

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Co-supervisors:

Dr Suzie Hingley-Wilson, School of Biosciences, University of Surrey

Dr Martin Swain, Department of Life Sciences, Aberystwyth University

Dr Otar Akanyeti, Computer Science, Aberystwyth University

Project description: Bovine tuberculosis (bTB) is a chronic infectious disease of livestock of global socioeconomic, animal welfare and zoonotic importance. Economic losses worldwide have been estimated at \$3 billion annually. In the UK bTB control is estimated to cost around £150 million per year. The Godfrey 2018 review for government of the TB Eradication Programme in England highlighted that better understanding of host-pathogen interactions and tests with improved sensitivity for the detection of bTB are crucial in developing tools to combat bTB.

Our main hypothesis is that through large scale transcriptome data analysis we will (1) define novel diagnostic biomarkers of tuberculosis in cattle and (2) discover novel host-pathogen interactions. Together these will maximise the overall detection of infected animals and thus contribute to the eradication of bTB in Great Britain.

Objectives

1a. Discover and define biomarker signatures associated with infection and disease progression.

Initial validation of a training dataset identified enrichment of key cytokine signalling and the migration of leukocytes, lymphocytes and granulocytes pathways. Within this project, the student will perform a comprehensive analysis, including the identification of minimal sets of differentially expressed immune system genes that characterise vaccination and disease status, to be used as biomarkers in future tests.

1b. Prediction using biomarkers and their validation

Identified biomarkers will be used to predict the vaccination and protection status of the calves within a wider blinded dataset; to perform innovative predictions. In collaboration with APHA, the dataset will be unblinded to complete and refine the validation cycle through the application of molecular techniques (such as quantitative PCR). Both training and blinded datasets may then be combined, to apply machine learning models to gain deeper predictive insights.

2. Validation of robust biomarker using in vitro models

Using migration genes previously identified within the training dataset, the student will employ a series of in vitro cell based assays using cells from naïve and vaccinated individuals to verify key findings and cellular interactions, using techniques such as multiparameter flow cytometry, Luminex technology, and microscopy

The overall goal of the project is to define a robust set of biomarkers that differentiate between vaccinated calves that are protected, partially protected or not protected. With such rich and comprehensive data sets, there will be excellent opportunities for publication and for the student to develop their own ideas.

Training opportunities: To support development in immunology, the student will be encouraged to attend the British Society for Immunology Summer School designed for trainees to build knowledge and scientific networks. In parallel the student will be fully trained in safe and effective work within a CL2 environment in Dr Gibson's group, including the use of innovative cell-based assays, multiparameter flow cytometry, Luminex technology, and microscopy. Complementary

innate immunology skills will be developed in Dr Hingley-Wilson's group at UoS. Bioinformatics involves a wide range of disciplines, and it is normal for Life Science PhD students to lack these skills. We provide training via specific courses, but ongoing supervision and numerous events to build a community of peer support for scientific computing are also important. Dr Swain provides a course in bioinformatics via the Graduate School. Drs Akanyeti and Swain are members of the Artificial Intelligence Hub, which organises monthly "hacky hours" to provide support in scientific computing, and an annual week-long summer school where the student can work on their data alongside data science experts. We also organise twice yearly bioinformatics workshops and a weekly bioinformatics coffee morning. A variety of online training courses are also available from Cardiff University via Supercomputing Wales

Project supervision style: At minimum the student will attend monthly meetings with the AU supervisors, with Hingley-Wilson joining as required. The Gibson group holds a fortnightly lab meeting for presentation of work to celebrate progress, help overcome barriers and provide support from across the research team. All supervisors have "open door" policies welcoming frequent informal interaction as required by the student. Swain runs weekly coffee mornings for bioinformatics students and PhD supervisors; and biannual university-wide bioinformatics workshops where students present work. The student will be welcome to contact any supervisor at any point. Feedback on drafts (e.g. literature review, manuscripts, presentations) will be provided as mutually agreed, and thesis writing closely supported throughout the project with early drafts encouraged. A project initiation meeting (within first month) with all supervisors will take place, with expectations and responsibilities confirmed for all concerned as regards working patterns, leave, meetings, feedback, authorship, data management, group citizenship etc.

Student profile:

The project would be suitable for ambitious students with interests in cross-disciplinary research relating to agri-food biosystems. We are open to applicants from diverse backgrounds, including those with strong academic records in a numerate, biological, or otherwise relevant sciences. A clear interest in combining scientific computing with laboratory experiments will be important, and we expect to provide training to help the student develop these skills. The ability and motivation to learn quickly would be highly advantageous.

Other information:

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 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](#).