PhD Project Advertisement

Project title: ***Exploring the North Ronaldsay Sheep Microbiome: Unlocking Enzymes for Sustainable Agriculture and Biotechnology***

Project No: FBS25-37-Oyama-qa

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Project description: Microalgae or seaweed-based livestock feed has shown promise in reducing greenhouse gas emissions. However, efficient utilization of seaweed as a feed ingredient is hindered by the lack of effective enzymes needed to break down complex marine carbohydrates like ulvan, a unique polysaccharide found in green macroalgae (Ulva spp). Ulvan is a valuable renewable resource containing rare sugars and nutrients, but its industrial and agricultural use is limited due to the high cost and scarcity of enzymes capable of degrading it.

The North Ronaldsay sheep, an ancient breed uniquely adapted to a diet of seaweed, offer an exceptional opportunity to address this challenge. These sheep harbour a microbiome that may contain enzymes specifically evolved to digest marine polysaccharides, presenting an untapped resource for advancing livestock nutrition and sustainable bioeconomy solutions.

In this project, we aim to uncover and characterise novel enzymes from the microbiome of North Ronaldsay sheep, focusing on their potential to improve livestock feed digestibility, reduce emissions, and enable the production of value-added products. The research will combine microbiology, molecular biology, biochemistry, bioinformatics, and livestock nutrition to achieve the following objectives:

1. Identify and Characterise Enzymes: Screen bacteria from sheep microbiomes for ulvan-degrading enzymes using selective media and genomic analysis.

2. Clone and Optimize Enzyme Activity: Use molecular techniques to produce identified enzymes and test their functionality under industrially relevant conditions (e.g., varying salinity, pH).

3. Explore Applications: Evaluate enzyme supplementation in livestock feed for improved digestibility and reduced emissions in vitro and, time permitting, through live animal trials.

4. Bioproduct Development: Investigate enzyme-treated seaweed for bioconversion into sustainable, high-value products.

The student will have access to extensive resources, including pre-isolated bacterial strains and genomic data, and will develop expertise in anaerobic microbiology, enzymology, bioinformatics, and livestock nutrition. This interdisciplinary training will prepare them for careers in biotechnology, animal health, and sustainable agriculture, equipping them to contribute to innovative solutions for a low-carbon economy.

Training opportunities: The student will gain expertise in anaerobic microbiology, molecular biology, enzymology, bioinformatics, and livestock nutrition and clean energy. The student will receive training in the following techniques: Anaerobic microbiology: bacteria culture and anaerobic media preparation. Molecular biology and genomic techniques: sample collection, nucleic acid extraction and quantification, sequencing library preparation, computational analysis of sequencing data and use of in silico tools to enzyme identification. Biochemistry and chemical analysis: enzyme characterisation assays, protein purification and fractionation, mass spectrometry and NMR structural characterisation.

Anaerobic fermentation and emissions: feed supplementation experimental design, greenhouse gas measurements and nutritional analysis. They will also enhance translational skills through involvement of interested industry partners as part of the QUB-AFBI Alliance and the Co-Centers (Climate+ and SureFood) at the Institute for Global Food Security at QUB, and the Belfast Region City deal innovation hubs (e.g. Momentum OneZero). Time spent at Aberystwyth will provide experience in a secondary institute.

Project supervision style: We offer a structured supervision plan with the supervisory team providing regular one-on-one and team meetings fortnightly in the first instance including timely feedback, and tailored guidance to ensure project success. The student will also have access beyond these meetings to the supervisory team via email or by arranging separate meetings as required. On a day-to-day basis the student can access advise and support from the large teams run by the supervisory teams' including experienced postdoctoral researchers and skilled technicians who can provide practical laboratory help with any questions whilst the student is in the laboratory. Student progress is also reviewed yearly by assigned progress monitors and an independent mentor outside the supervisory team.

Student profile: Although not a pre-requisite, laboratory skills in microbiology, biochemistry, chemistry, animal science or nutrition and bioinformatics will be valuable

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.