# PhD Project Advertisement

**Project No/title:** FBS2025 38 Kingston-Smith a b / *Understanding control of Rubisco degradation in forage ingested by ruminants*

**Lead supervisor:** Professor Alison Kingston-Smith, IBERS, Aberystwyth University

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**Co-supervisors:**

Dr Alessandro Pandini, Brunel University of London

Dr Russ Morphew, Aberystwyth University

## Project Details

Grass and clover are the main source of nutrition for ruminant livestock in the UK. However, as well as greenhouse gas emissions, livestock are responsible for significant nitrogen pollution. During grazing, ~100kg plant material is consumed per cow per day, but as little as 30% of the plant protein might be retained as milk and meat, the rest lost as waste onto the land. This occurs when there is inefficient capture of plant protein by the rumen microbiota during rumen fermentation. In a grazing system, plants can contribute to this problem through increased activity of plant proteases in response to the rumen environment, which is perceived as a cellular stress. The plant protein Rubisco accounts for ~60% of soluble protein in green cells and is a key target for degradation in the rumen. Increasing the stability of Rubisco in the rumen will therefore help to deliver sustainable grassland-based food systems.

**Research aims**: To understand how Rubisco breakdown is regulated by proteases and intracellular small molecule interactions when plant cells enter the rumen, after being eaten by grazing cattle and sheep.

**What you will do:** This project will operate at the level of the plant protein molecule to explore interactions that have the potential to alter nitrogen dynamics in the rumen. It is based on the hypothesis that Rubisco undergoes a specific stress-responsive degradation pathway in the rumen which is dependent on preservation of plant protein-protein (protease) interactions under anoxia. These interactions have not previously been studied at this scale and resolution. This multidisciplinary project involves discovery biology (particularly novel proteomic cross-linking mass spectrometry) and state of the art techniques in computer science as applied to protein structural modelling. The research will involve in vitro simulations of rumen exposure, cell fractionation, protein analysis, proteomics, bioinformatics and molecular modelling. While this research is at the fundamental level, the results will inform identification of protein targets which can ultimately be exploited by conventional breeding to develop improved forages for sustainable livestock production.

**References:**

1. Kingston-Smith et al., 2008 doi:10.1093/jxb/erm326
2. Beha et al., 2002 https://doi.org/10.1046/j.1365-3040.2002.00908.x
3. Kingston-Smith et al 2003 DOI: 10.1007/s00709-002-0044-5
4. Kingston-Smith et al., 2005 DOI: 10.1079/BJN20041303
5. Hart et al., 2016 doi: 10.1016/j.jprot.2016.04.023
6. Kamau et al., 2020 https://doi.org/10.1002/fes3.209

## Student profile

**Essential for project:** A background in one or more of the following: biology, plant science, biochemistry, animal science, veterinary bioscience.

**Desirable for project:** A background in bioinformatics, biomolecular modelling or AI. Driving licence.

**Minimum requirements for all FoodBioSystems applicants:** An upper 2nd class degree (or equivalent) in a subject relevant to the project. Candidates with a lower class of Bachelors degree, but merit or above at Masters level will also be considered**. D**emonstrable skills in problem-solving, team-working, communication and time management.

## Training

**Project specific training opportunities:** The student will receive tailored support at both Aberystwyth and Brunel Universities. At the start of the project the student and supervisory team will meet and agree on training needs. The student will be based at Aberystwyth and will gain hands on experience of the experimental (wet lab) techniques required through integration into the groups of Prof Kingston-Smith (plant biology, rumen biology) and Dr Morphew (proteomics). It is anticipated that during the studentship the student will make two short visits and one visit of 3 months to Brunel to engage with Dr Pandini's group at Brunel to acquire the necessary dry lab experimental skills in biomolecular modelling and AI to succeed with the project aims

**FoodBioSystems training opportunities:** Throughout their studentship, all FoodBioSystems doctoral researchers participate in cohort training that covers four key themes: food systems, big data (data analytics and modelling), business, and research fundamentals. All doctoral researchers complete a placement: either project-related with a non-academic (CASE) partner, or unrelated to the project and outside the academic environment (PIPS). Details of training are available on the DTP website: https://research.reading.ac.uk/foodbiosystems/training/.

## Project supervision style

The student will be supervised through structured and informal meetings. Monthly, formal supervisory team meetings with all academic supervisors will be in hybrid mode allowing the student to present their progress, challenges, and agree a plan of next steps. At Aberystwyth, day to day supervision will be provided by the supervisor most closely matched to that research area. AKS and RM operate an open-door policy and will meet the student at least weekly in person, more frequently when more support is needed. The student will engage with monthly lab meetings and wider research teams. Opportunity to attend weekly online meetings of the Computational Biology group at Brunel will help onboarding before visits and increase networking with researchers at Brunel. Provision of feedback on completed documents (ie literature review) will follow the Aberystwyth standard of 15 working days. Email correspondence will be answered within the Aberystwyth standard of 3 working days.

## Stipend (Salary)

FoodBioSystems DTP students receive an annual tax-free stipend (salary) that is paid in instalments throughout the year. For 2025/26 this is £20,780 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 who also meet academic eligibility criteria and the student profile essential for the project.

These are opt-in processes**.**

Our studentships can be offered to home students on a part-time basis, and studentship end date and stipend payments will be amended to reflect the part-time registration. The minimum registration for DTP funded part-time students is 0.5 FTE (studying an average of 20 hours per week over 8 years). We regret that part time registration is not available to international students due to complexities of visa restrictions.

## Funding note

We welcome applications from candidates with Home/ROI fees and international fees status. This studentship is funded by UKRI and covers stipend, fees at Home/ROI rate, and research costs. The host university will not charge UKRI funded international students the difference between Home/ROI fees and international fees.
Costs that must be found from other sources or met by the individual student include:
Visa fees, healthcare surcharge, relocation costs and guarantor services.

**For up to date information on funding eligibility, studentship rates and part-time registration, please visit the FoodBioSystems website.**