FoodBioSystems DTP - PhD Project Advertisement Text

Project Title: FOODBIOSYSTEMS - What are the mechanisms driving niche specialisation within rumen plant-associated microbiomes?

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Research Group: FOODBIOSYSTEMS BBSRC DTP
Project ID: FBS2020-58

Application Deadline: 6 March 2020

Project Description: Niche specialization is the process by which, through natural selection, a species becomes better adapted to the specific characteristics of a particular habitat. These organisms can be the principal drivers of important processes in the community and therefore are prime targets for researchers looking to engineer microbial communities to achieve desired outcomes. This project aims to identify what drives niche specialization of micro-organisms in the rumen microbiome as they colonize plant material consumed by the host (cows and sheep).

The rumen is a complex ecosystem composed of anaerobic bacteria, protozoa, fungi, methanogenic archaea and phages. These microbes interact closely to breakdown plant material that cannot be digested by humans, whilst providing metabolic energy to the host and, in the case of archaea, producing methane (Huws et al. 2018). Consequently, ruminants produce meat and milk, which are rich in high-quality protein, vitamins and minerals, and therefore contribute to food security. As the world population is predicted to reach approximately 9.7 billion by 2050, an increase in ruminant production to satisfy global protein demand is necessary, despite limited land availability, and whilst ensuring environmental impact is minimized.

Although challenging, these goals can be met, but depend on our understanding of the rumen microbiome. Attempts to manipulate the rumen microbiome to benefit global agricultural challenges have been ongoing for decades with limited success, mostly due to the lack of a detailed understanding of this microbiome. We recently demonstrated evidence of rumen bacterial competitive niche specialisation and ecological plasticity, through possession of numerous isoforms of genes encoding degradative enzymes (Rubino et al. 2017) and through successional colonisation of the ingested plant material (Huws et al. 2016). This project aims to further this knowledge and address the gaps in our knowledge by generating novel genetic data of the actively expressed functions of all the microorganisms in the rumen as they colonize and break down a variety of plant material consumed by the host. The project is primarily computational and will allow the student to learn highly sought-after skills in the analysis and interpretation of genetic data from microbiomes but will also involve some laboratory work involving biochemical characterization of the plant material.

The project will contribute to our understanding of the microbial drivers and interactions that promote effective energy harvesting and resultant feed efficiency in ruminant, allowing models and hypotheses to be generated on how to mitigate the impact of future changes in the climate and resulting extreme weather events.

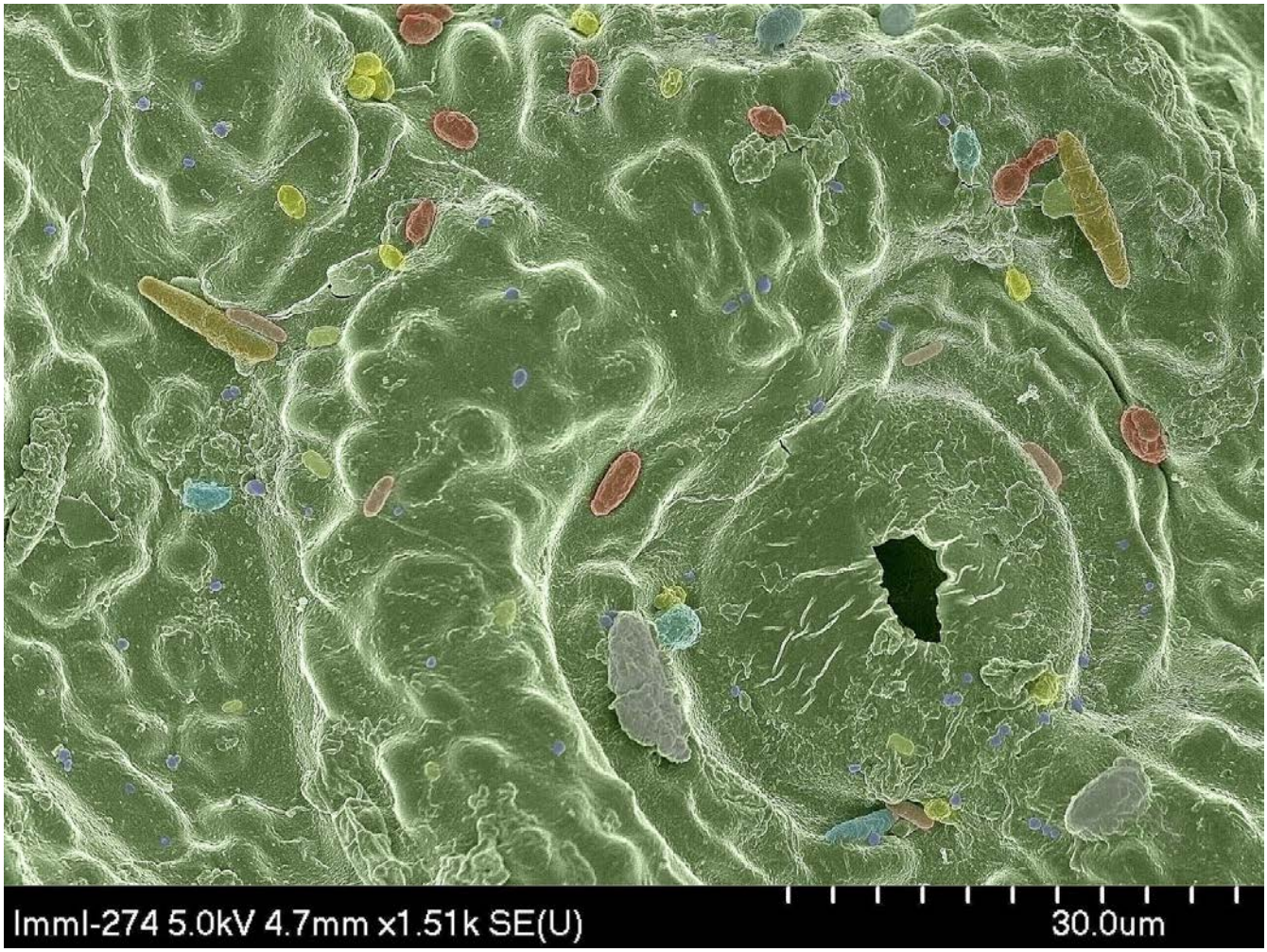

Figure legend: Artificially coloured TM image of rumen microbial cells colonizing fresh perennial rye grass.

Funding Notes: This project is part of the FoodBioSystems BBSRC Doctoral Training Partnership (DTP), it will be funded subject to a competition to identify the strongest applicants. Due to restrictions on the funding, this studentship is only open to UK students and EU students who have lived in the UK for the past three years.

The FoodBioSystems DTP is a collaboration between the University of Reading, Cranfield University, Queen's University Belfast, Aberystwyth University, Surrey University and Brunel University London. Our vision is to develop the next generation of highly skilled UK Agri-Food bioscientists with expertise spanning the entire food value chain. We have over 60 Associate and Affiliate partners. To find out more about us and the training programme we offer all our postgraduate researchers please visit https://research.reading.ac.uk/foodbiosystems/.

Student profile: Candidates should have an upper second-class degree in a related science (e.g. Bioinformatics,

Microbiology, food), and a background interest in -omics technologies and/or bioinformatics. An MSc in relevant science would be advantageous. The ability to learn skills around research conduct/ethics and communication, -omics technologies, and bioinformatics is essential. Good attention to detail, time-management, organisation, teamwork and independent learning, are also required.

References:

Huws, S.A., Creevey, C.J., Oyama, L.B., et al. 2018. Addressing global ruminant agricultural challenges through understanding the rumen microbiome: past, present, and future. Frontiers in microbiology 9, p. 2161.

Huws, S.A., Edwards, J.E., Creevey, C.J., et al. 2016. Temporal dynamics of the metabolically active rumen bacteria colonizing fresh perennial ryegrass. FEMS Microbiology Ecology 92(1).

Rubino, F., Carberry, C., Waters, S.M., Kenny, D., McCabe, M.S. and Creevey, C.J. 2017. Divergent functional isoforms drive niche specialisation for nutrient acquisition and use in rumen microbiome. The ISME Journal 11(6), p. 1510.