

PhD Project Advertisement

Project title: Investigating the gut parasite *Eimeria* in UK sheep: parasite species diversity and impacts on the gut microbiome

Project No: FBS2024-097-Betson-sa

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Project description:

Food producing animals are infected by many parasite species, which severely compromise their health and productivity. *Eimeria* parasites are single-celled pathogens which are very common infections of farmed animals in the UK and worldwide. They can cause gut disease (called coccidiosis) in young animals including sheep, cattle and poultry, leading to diarrhoea, reduced weight gains and even death. Although *Eimeria* parasites are well-studied in poultry and commercial vaccines are available to control coccidiosis in chickens, research in sheep is much more limited and there are no vaccines. Control in sheep relies on good animal husbandry and use of drugs. However, there are reports of resistance to one drug, toltrazuril, which is often used to control coccidiosis in sheep, posing a threat to sustainable control. A number of different *Eimeria* species infect sheep and some are described as more likely to cause disease than others. Distinguishing between *Eimeria* species is usually done by microscopy, looking at the shape and size of *Eimeria* oocysts (eggs). However, this is not a reliable method of detecting different *Eimeria* species, particularly if sheep are infected by more than one species. DNA-based methods to distinguish between *Eimeria* species have been developed but have not been widely applied in the UK and elsewhere. Another area where further research is needed, is understanding how *Eimeria* infections impact on the gut microbiome of sheep. It is known that the microecology of the gut plays a critical role in animal health and that *Eimeria* infections cause disturbances (dysbiosis) in the gut microbial community of poultry but this has not been to date explored in sheep.

In this PhD project, the student will address current knowledge gaps related to *Eimeria* infections and coccidiosis in sheep in the UK. They will design and carry out a cross-sectional survey to understand the extent of *Eimeria* infection among sheep in the UK, apply cutting-edge molecular approaches to determine which *Eimeria* species are present and epidemiological analysis to investigate risk factors for infection and which *Eimeria* species are associated with disease. This will be followed up by a longitudinal study on sheep farms with a known history of *Eimeria* infection to understand seasonal changes in *Eimeria* species infections. The student will use samples collected during these studies to explore interactions between *Eimeria* infections and the microbial bacterial and eukaryotic communities in the sheep gut.

This project will provide new insights into an often-overlooked but important disease of sheep in the UK and will support the development of evidence-based control approaches. The detailed description of *Eimeria* species and their association with clinical disease is critical information for future development of vaccines against coccidiosis in sheep. An understanding of the impact of *Eimeria* infections on the sheep faecal microbiome will pave the way for new strategies control and treatment of coccidiosis, such as use of pre- and pro-biotics. This will ultimately lead to improved and sustainable control of *Eimeria* parasites, and ultimately improvements in sheep health and productivity.

Training opportunities:

The student will gain experience in technical skills including parasitological diagnosis, molecular biology, next-generation sequencing (NGS), bioinformatics (including microbiome analysis), epidemiology and statistical analysis to understand parasite spread, risk factors for infection and interactions with the microbiome.

The student will learn how to design epidemiological studies and carry out fieldwork and will also gain experience in

writing and presenting work to scientific and lay audiences and engaging with stakeholders.

The student will have access to training and support offered through the Researcher Development Programme at the University of Surrey, including workshops in scientific writing and a mentoring scheme.

Although based at University of Surrey, the student will also have the opportunity to work in the laboratory of the supervisor at Aberystwyth University to learn about NGS and microbiome analysis.

Student profile:

This project would be suitable for students with a veterinary degree or a degree in biological sciences or a related area. The following are desirable skills and/or qualities in prospective candidates:

- Demonstrated interest in the topic, for example through prior experience of working with parasites or related pathogens.
- Some experience of molecular laboratory settings, for example through undergraduate projects or placements.
- Demonstrated ability in bioinformatics and/or statistics and interest in the application of these approaches as the project involves microbiome and epidemiological analysis.

Stipend (Salary):

FoodBioSystems DTP students receive an annual tax free stipend (salary) that is paid in instalments throughout the year. For 2023/24 this is £18,622 and it will increase slightly each year at rate set by UKRI.

Equality Diversity and Inclusion:

The FoodBioSystems DTP is committed to equality, 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](#).

In accordance with UKRI guidelines, 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.

References:

- Bangoura B, Bhuiya MAI, Kilpatrick M. Eimeria infections in domestic and wild ruminants with reference to control options in domestic ruminants. *Parasitol Res.* 2022; 121(8):2207-2232. doi: 10.1007/s00436-022-07564-x.
- Hinsu A T, Thakkar J R, Koringa P. G, Vrba V, Jakhesara SJ, Psifidi A, Guitian J, Tomley FM, Rank DN, Raman M, Joshi CG, Blake DP. Illumina next generation sequencing for the analysis of Eimeria oopulations in commercial broilers and indigenous chickens. *Front Veterinary Sci.* 2018; 5:176. doi: 10.3389/fvets.2018.00176
- Keeton STN, Navarre CB. Coccidiosis in Large and Small Ruminants. *Vet Clin North Am Food Anim Pract.* 2018; 34(1):201-208. doi: 10.1016/j.cvfa.2017.10.009.
- Madlala T, Okpeku M, Adeleke MA. Understanding the interactions between Eimeria infection and gut microbiota, towards the control of chicken coccidiosis: a review. *Parasite.* 2021; 28:48. doi: 10.1051/parasite/2021047.
- Odden A, Denwood MJ, Stuen S, Robertson LJ, Ruiz A, Hamnes IS, Hektoen L, Enemark HL. Field evaluation of anticoccidial efficacy: A novel approach demonstrates reduced efficacy of toltrazuril against ovine Eimeria spp. in Norway. *Int J Parasitol Drugs Drug Resist.* 2018; 8(2):304-311. doi: 10.1016/j.ijpddr.2018.05.002.
- Salamon, D., Zapała, B., Krawczyk, A. et al. Comparison of iSeq and MiSeq as the two platforms for 16S rRNA sequencing in the study of the gut of rat microbiome. *Appl Microbiol Biotechnol.* 2022; 106:7671–7681. doi: 10.1007/s00253-022-12251-z
- Zahedi, A., Liu, D., Yang, R. et al. Next-generation sequencing amplicon analysis of the genetic diversity of Eimeria populations in livestock and wildlife samples from Australia. *Parasitol Res* 2023; 122:615–624. doi: 10.1007/s00436-022-07764-5.

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