FoodBioSystems DTP - PhD Project Advertisement

Project title:

FBS2021-24-Kevei: Exploring the impact of microplastic-bacterial complexes on animal health and the gut microbiome using a bacteriovorous nematode model

Lead supervisor:
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Dr. Glyn Barrett, School of Biological Sciences, University of Reading
Dr. Nandini Vasudevan, School of Biological Sciences, University of Reading

Project description:

Plastic pollution is a global issue and rapidly emerging as a crisis for both environmental and human health. The level of microplastics contamination in the environment has grown exponentially in recent decades, and now it is recognized as a harmful agent, representing a potential yet unexplained risk to human health. While there is evidence for toxic effects of microplastics on animals of aquatic ecosystems, the consequences of microplastic contamination for terrestrial ecosystems and higher trophic level species, including livestock and humans are largely unknown. Exposure to microplastics (MPs) impacts every level of the food chain with MP ingestion causing alteration of feeding activity, decreased food assimilation, stunted animal growth with negative impacts on fertility and reproduction. MPs can serve as carriers of bacteria and also impact bacteria growth and metabolism; therefore MPs can modify bacterial microhabitats within the soil and in the gut of animals. Perturbation of the gut microbiota, which strongly influences host health, by MP ingestion is an increasing concern with direct impacts on the health of wildlife, livestock and humans. Currently there is limited information on how MPs interact with different bacterial species and how bacteria-MP complexes influence animal health.

The aim of this project is to fill an important gap in understanding interactions between the environmental microplastic pollutants and microbial communities of the soil and of the gut of agriculturally important animal species and humans. We propose to build a simple model for investigating these interactions using the bacteria-feeder nematode *Caenorhabditis elegans*, which possesses a high level of conservation of tissue and cellular function and behavioural responses with higher eukaryotes, including humans. We will use this model to obtain insight into whole-animal defects upon exposure to various MP-bacterial complexes, such as healthspan, stress response pathways, behaviour, cognition and aging. Results of this project will be used to gain insight on the interaction of microplastics and bacteria within the context of the terrestrial ecosystem, and the adverse effects of microplastics on the gut microbiota and consequently on the animal health.
This is an exciting opportunity for a highly motivated individual interested in studying the impact of microplastic pollution in the environment and in the Agrifood sector. The student will be exposed to different research environments by joining on this project led by four research groups (Drs Kevei, Gutierrez-Merino, Barrett and Vasudevan) at two locations (University of Reading and University of Surrey).
This project represents a uniquely diverse training opportunity as the successful applicant will experience and learn various complimentary research techniques. The student will develop a cross-disciplinary approach

towards studying the adverse effects of microplastic ingestion on the terrestrial ecosystem, and the gut microbiota of animals, that form interlinked relationships within the agricultural food production. They will develop a greater understanding and gain practical skills in research methodologies of the soil bacteria and bacterivore species, develop advanced molecular biology, physiology, molecular ecology and microbiological skills, with an insight to biomedical sciences. They will also learn and employ spectroscopy and microscopy methods. This research will contribute to fill the gaps in high-level research informed skills that are required to adopt novel, innovation-led strategies.

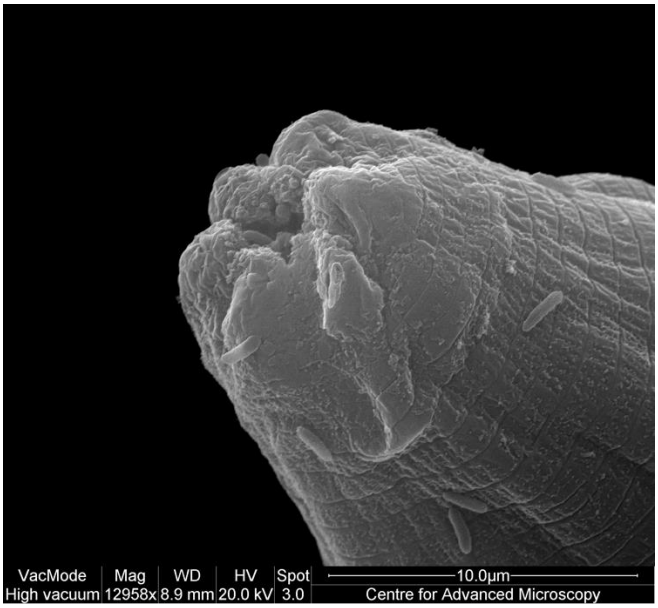

Figure 1 Scanning electron micrograph of C. elegans mouth with adherent bacteria. Bacteriovorous nematodes are common residents of soil ecosystems and are critical in global processes such as nutrient cycling. In the soil complex nematodes can come into contact with and ingest microplastic particles which are increasingly being associated with negative impacts on animal and ecosystem health.

The University of Reading (UoR) and the University of Surrey (UoS) are committed to inclusion and diversity; UoR is a top 100 Stonewall Employer and the School of Biological Sciences at UoR holds a Athena Swan Silver award while UoS holds a Athena Swan Bronze award. This project is offered as a full time or part-time project (minimum 50% of full time equivalent) in line with UKRI principles. Flexible working arrangements are possible; UoR has childcare facilities and information about relocation with families is given here: https://www.reading.ac.uk/graduateschool/how-we-support-you/gs-bringing-your-family.aspx. The University of Surrey also has tailored support for students from different backgrounds, life experiences and family situations here: (https://www.surrey.ac.uk/student-support/student-communities). Information about additional support available to students at the University of Reading is at: https://www.reading.ac.uk/graduateschool/how-we-support-you/gs-additional-support.aspx

Training opportunities:

At the University of Reading, the student will undergo practical training in *C. elegans* laboratory techniques including cultivation, manipulation and genomic engineering and in vivo fluorescent microscopy imaging of nematodes. The student will participate in additional training in microbiology, molecular biology and molecular ecology, and there are possibilities of attending a range of training courses on the Reading Research Development Programme supplied by the graduate school. In the Chemical Analysis Facility at Reading, the student will have access to and learn advanced techniques in microscopy and spectroscopy, including Fourier-Transform Infrared Spectroscopy and Raman, for analysis of microplastic particles and Scanning Electron Microscopy for visualising the nematode-MP interactions. At the University of Surrey, the student will receive

training in isolation and cultivation of gut microbiome bacteria strains and through participating in regular research group meetings they will develop their understanding of the impact of gut microbiome on animals. The student will be trained in effective experimentation design, with a view on sound statistical principles together with efficient data collection and management. The student will have access to a range of generic skills training activities both at Reading and Surrey, such as statistical methods and analysis tools in R, conference presentation and writing skills.

Student profile:

The project integrates the fields of molecular and microbiology, molecular ecology, zoology and soil science and thus would be suitable for a graduate student with a background and interest in one or more of these disciplines. The candidate must have a strong and passionate enthusiasm for scientific research and good interpersonal skills for working both responsibly and independently within a lab environment. Desirable attributes of the candidate would be strong numerical, laboratory skills in microbiology and molecular biology with good writing and oral presentation skills.

References:

Kevei É, Pokrzywa W, Hoppe T. (2017) Repair or destruction-an intimate liaison between ubiquitin ligases and molecular chaperones in proteostasis. FEBS Lett. 2017 Sep;591(17):2616-2635. doi: 10.1002/1873-3468.12750.

Tawo, R., Pokrzywa, W., Kevei, E., Akyuz, M. E., Balaji, V., Adrian, S., Hohfeld, J. & Hoppe, T. (2017) The Ubiquitin Ligase CHIP Integrates Proteostasis and Aging by Regulation of Insulin Receptor Turnover, Cell. 169, 470-482.

Stedman A, A Van Vliet, M Chambers and J. Gutierrez-Merino. 2020. Gut commensal bacteria show beneficial properties as wildlife probiotics. Ann NY Acad Sci, 1467, 112-32

Edwards-Gayle, C. J. C., Barrett, G., Roy, S., Castelletto, V., Seitsonen, J., Ruokolainen, J. and Hamley, I. W. (2020) Selective antibacterial activity and lipid membrane interactions of arginine-rich amphiphilic peptides. ACS Applied Bio Materials, 3 (2). pp. 1165-1175.

Funding Note

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.
The studentship is open to UK and international students (including EU countries) however due to funding rules, no more than 30% of the projects can be allocated to international students.
The funding will include a tax free stipend (minimum £15, 285 per year), support for tuition fees at the standard UK rate (currently £4,407 per year) and a contribution towards research costs. **Please note** that the host universities have not yet confirmed the level of fees charged to international students funded by the DTP. Fee levels may vary across the institutions. This information will be shared on the FoodBioSystems DTP website as soon as it becomes available.

To apply

Please go to FoodBioSystems DTP website for information on how to apply for this studentship. The closing date for applications will be 8 February 2021.