PhD Project Advertisement

Project No/title: FBS2026 48 Megaw qa / *Plastic biodegradation by compost microorganisms: a sustainable strategy to mitigate microplastic contamination in food systems*

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Project Details

Plastics are integral to modern food systems, serving roles in production, packaging, and preservation. However, their widespread use has made the food industry a major contributor to global plastic pollution. Microplastics are now pervasive in soil, water, and food products, posing risks to ecosystems, food safety, and human health. Microbial plastic degradation offers a sustainable solution, as certain microorganisms can break down synthetic polymers using enzymes originally evolved for natural polymers such as lignin, cutin, and cellulose. Compost systems, rich in decomposing organic matter, host diverse microbial communities adapted to degrade complex polymers, making them promising yet underexplored reservoirs of plastic-degrading organisms. Our preliminary research has identified compost-derived bacteria capable of degrading plastics at higher rates than previously reported. Harnessing these microbes and their enzymes could enable innovative biotechnological strategies to mitigate plastic waste, supporting circular economy principles and reducing environmental contamination within food systems.

Research aims: To explore compost systems as reservoirs of plastic-degrading microorganisms, identify and characterise novel organisms and enzymes, and assess their biotechnological potential for mitigating plastic waste. This research seeks nature-based solutions to reduce plastic contamination in food systems and promote environmental sustainability principles within the food system.

What you will do: The project will begin by collecting compost samples from diverse domestic and commercial sources. Plastic pieces (high-purity films and real-world materials) including polyethylene, polyethylene terephthalate, polypropylene, and polystyrene will be incubated in compost to selectively enrich plastic-colonising microbes. Microorganisms recovered from the plastic surfaces will be cultured, identified, and screened for plastic-degrading activity using mass loss measurements, microscopy, and spectroscopy. High-performing strains will undergo optimisation and detailed analyses to determine degradation mechanisms and substrate range. Whole-genome sequencing of isolates and metagenomic profiling of compost samples will identify candidate plastic-degrading genes and assess community-wide functional potential. Selected genes will be cloned and expressed in heterologous systems, with recombinant enzymes tested in cell-free assays to validate activity and elucidate mechanisms. This pipeline from environmental sampling to functional validation will generate insights into microbial ecology and enzymatic pathways for plastic degradation, driving innovation in precision waste management and promoting sustainability within food systems.

References: Coughlin SA, McFall A, Kelly SA, Megaw J. 2025. Polyolefin colonization and partial degradation by Gordonia sp., and Arthrobacter sp. isolated from wetlands and compost. Polymer Degradation and Stability 241. doi: 10.1016/j.polymdegradstab.2025.111558.

McFall A, Coughlin SA, Hardiman G, Megaw J. 2025. Strategies for biofilm optimization of plastic-degrading microorganisms and isolating biofilm formers from plastic-contaminated environments. Sustainable Microbiology 1. doi: 10.1093/sumbio/qvae012.

Student profile

Essential for project: A background in one or more of the following: microbiology, environmental science, biotechnology, biochemistry, or related disciplines, with demonstrable interest in sustainability, microbial ecology, and applied bioscience.
Desirable for project: Experience in microbial culture techniques, molecular biology, bioinformatics, or analytical methods (e.g., spectroscopy, microscopy) is desirable, however full training will be provided.
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**.** Demonstrable skills in problem-solving, team-working, communication and time management.

Training

Project specific training opportunities: This project offers comprehensive, project-specific training across environmental microbiology, analytical chemistry, genomics, and biotechnology. The student will gain hands-on experience in isolating and culturing plastic-degrading microorganisms, microbial identification using MALDI-TOF mass spectrometry, and advanced biodegradation assays employing microscopy, spectroscopy, and thermogravimetric analysis. Bioinformatics training will support genomic and metagenomic data analysis, including genome assembly, annotation, and functional prediction using specialist databases. Molecular biology skills will be developed through gene cloning, heterologous protein expression, purification, and enzymatic activity assays. Cross-institutional collaboration will provide experiential learning, including visits to co-supervisors' laboratories at Aberystwyth University and Queen's University Belfast School of Pharmacy. Engagement with compost suppliers and industry stakeholders will enhance real-world understanding of waste management challenges. This integrated, interdisciplinary training will equip the student with a robust skillset for careers in environmental bioscience, industrial biotechnology, and sustainable innovation.

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 supported by a multidisciplinary supervisory team across Queen's University Belfast and Aberystwyth University. The lead supervisor will hold fortnightly 1:1 meetings, supplemented by ad hoc meetings as needed. The student, along with other group members, will present at monthly lab group meetings, supporting peer learning and collaborative discussion. The wider supervisory team will meet with the student at least quarterly to review progress and provide cross-disciplinary input. Annual visits to the external co-supervisor's site and meetings with the internal co-supervisor as needed will support specialised analytical and molecular training. The student will also participate in formal annual progress reviews and cohort training activities. Feedback on written work will be provided within two weeks of submission. The supervisory team has a strong track record of PhD completions and is committed to consistent, inclusive support through regular communication and collaborative mentoring.

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.