# PhD Project Advertisement

**Project title:** Microplastics in milk and dairy products: the future of milk in the Plastic Age
**Project No:** FBS2024-105-Al-Sid-Cheikh-sr

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## Project description:

Justification. The annual human consumption of microplastics (MPs; <5mm) ranges from 39,000 to 52,000 particles(1). This has been demonstrated by the detection of MPs in placentas (2) or human stool (3). While the harmful effects of MPs are evidenced on model organisms, their extend to human is still a matter of debate (4). Thereby, while the precautionary principle should be engaged, the extensive lack of scientific knowledge on the matter should be tackled.

MPs have been detected in sea salt (5), drinking water (6), baby formula (7), and milk (7,8). Due to the analytical challenges in quantifying MPs in biological/food matrices, the estimations of MPs human consumption highly vary. This makes difficult to relate findings from experiments performed at different MP concentrations with human health risk (6). A globally shared protocol is needed to harmonize results and to plan the monitoring of MPs, especially in key food product such as milk and diary.

Sources of MPs in dairy could be the animal alimentation or be introduced during the production process/packaging. Little is known on MPs transfer mechanisms from packaging to food. Packaging composition, container filling temperature, fat content of the milk can play key roles in these mechanisms and are yet overlooked. To the best of our knowledge, there is currently no EU/UK investigation of MPs in dairy products that quantify the origin of MPs in milk. This is key to establish risk mitigation plans. The aim of this interdisciplinary project is to combine analytical chemistry, modelling and food science to quantify and characterise the nature and source of MPs in dairy milk products, throughout the entire process from milk collection to to the final product.

Hypotheses (H):

H1: As MPs are detected in cow milk, they will be measured in varying quantities in dairy products.

H2: The environment of dairy production, from milk production through the processing chain including packaging, will influence MP concentrations and composition in dairy products.

H3: Temperature and fat content will impact the MPs release during production and packaging.

H4: The interaction of MPs with milk components will modify their fate and behaviour during the milk processing chain.

Objectives (Obj.):

Obj.1-H1: Analytical methods development for milk.

a)Literature review on MPs in packaging, milk and dairy cattle feeds, including analytical methods available to quantify MPs in water/milk.

b)Develop extraction and analytical methods for milk, and associated retail dairy products, using microscopy (shape-form), -FTIR, Raman spectroscopy (compositional analysis).

Obj.2-H2: Determine MPs in milk at every stage of the process.

a)Modelling MPs release during packaging: effect of temperature, fat content, packaging composition, validation by analytical data.

b)Sampling of feed, water and milk through processing (homogenisation, pasteurisation, cheesemaking, yoghurt making, UHT) from several cows at the UoR's Centre for Dairy Research (CEDAR) and Food Processing Pilot Plant.

c)Samples will be analysed for MPs content using methods established in Obj.1. Retailers dairy products will also be analysed and compared with UoR's products.

Obj.3-H3: Determine the contribution of cow diet to milk MPs content.

a)Determine environmental factors affecting MPs concentrations in milk: following a simulated rumen environment. Different diets/components (i.e. total mixed ration, grass silage, fresh grass, maize silage) typically used for dairy cows will be incubated using a semi-continuous culture (Rumen Simulation Technique, RUSITEC) for 7 days. MP content of samples of the diet , fermentation vessels and effluent will be measured daily.

b)Modelling of the fate and behaviour of MPs in milk. Modelling of the interactions between MPs and milk components (including casein and lactose) with the aim of understanding the fate and behaviour of MPs in the milk production chain.

**Training opportunities:**

The project will provide through the University of Surrey's expertise in microplastic analysis and the University of Reading's expertise in dairy farming and processing. They will learn key research skills in analytical chemistry, molecular modelling and dairy science.

Technical skills:

- Systematic review and meta-analysis, research methods, and project & data management.
- Chemical Analysis, including: UV, IR, Raman, Mass Spectrometry.
- Open Research practices
- Dairy processing, primary dairy production and on the use of in vitro digestion techniques

Soft skills. they will attend group/departmental seminar presentations. At group meetings, various national and international conference, they will present on research progress and develop communication skills. They will develop skills in inter-disciplinary communication and collaboration through participation in events offered by Surrey's Special Interest Group in "Plastics in the Environment".

Networking. The student will take advantage of the established Researcher Development Programmes for PGRs at UoS and UoR, which cover all aspects of progression on the PhD and associated skills in communication, networking, science communication (Pint of Science, Bright club) and outreach. There will also be opportunities for demonstrating in teaching labs and associated pedagogical training (PGCertHE). Access to a career mentoring scheme with academic and industrial mentors (UoS).

**Student profile:**

This project would suit a candidate with a biological or chemical sciences background, with a keen interest in applying experimental science to real-world scenarios. Strong interest in promoting and improving sustainability.

## Stipend (Salary):

This studentship is available FoodBioSystems DTP students receive an annual tax free stipend (salary) that is paid in instalments throughout the year. For 2023/24 this will be £18,622 and this 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.

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

## References:


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