

## PhD Project Advertisement

**Project title:** *Designing next-generation plant-dairy hybrid ingredients to support gut health and immunity*

**Project No:** FBS25-15-Tocmo-rq

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**Project description:** Emerging evidence suggests that 'hybrid' or blended food matrices have the potential to introduce the next-generation of functional, healthy, and more sustainable food ingredients. Significant research efforts are underway to develop plant-dairy protein formulations with improved quality and ingredient performance, as well as functionalities accepted by consumers. However, there is a need to improve current understanding of the gastrointestinal fate of these novel ingredients, including their digestion, nutrient bioavailability, and health effects. There is growing evidence on the critical role of dietary protein in the maturation and development of innate and adaptive immune system, a function that is independent of their nutritional role. This project aims to provide basic insights into diet-immune cell interactions, which may have profound clinical relevance.

This project will explore the development of hybrid plant-dairy protein matrices that promote overall gut health through modulation of intestinal immunity, barrier integrity and gut microbiota function. Hybrid protein matrices will be optimised by blending hydrolysed plant protein concentrates with milk proteins. Plant protein concentrates contain other healthful components (e.g., dietary fibre and bioactive polyphenols), whereas milk proteins offer superior techno-functional and nutritional properties (e.g., high-quality protein, calcium). Therefore, the hybrid ingredient formulations to be developed are envisaged to not only provide high-quality protein nutrition, but also offer other health beneficial components such as dietary fibre, bioactive polyphenols, calcium, or bioactive peptides derived from milk proteins or those present in plant protein hydrolysates. We hypothesise that these hybrid plant-dairy matrices will have unique digestion and absorption profiles, and possess superior ability to promote a beneficial gut microbiota and modulate mucosal immune responses compared to either plant protein or milk protein alone.

This project will design lab-scale prototypes of plant-dairy protein hybrid matrices. It will then investigate the digestibility of these novel matrices using *in vitro* digestion methods. Prototypes developed will then be screened using *in vitro* systems (primary human immune and intestinal cells) to reveal mechanistic insights into their impact on immune responses and intestinal barrier integrity. Finally, an *in vivo* study using an appropriate mouse model will be conducted to evaluate the impact of selected hybrid matrices on the development and maturation of innate and adaptive arms of intestinal immune system, as well as modulation of gut microbiota function.

**Training opportunities:** The successful candidate will be trained in dietary protein characterisation and ingredient functionality profiling, *in vitro* digestion studies, cell culture techniques, flow cytometry, liquid- and gas-chromatography, mass spectrometry, cellular biology techniques, and *in vivo* (mice) studies. Specific training in immunological and cellular biology techniques will be provided, including: isolation of primary immune cells (macrophages, dendritic cells, CD4<sup>+</sup> T cells), multi-colour flow cytometry-based immune cell phenotyping, immunoassays (ELISA, cell proliferation), and immunofluorescence (confocal microscopy) to investigate intestinal barrier function. The student will gain training in designing and conducting an animal study (with team supervision) and applying statistical techniques in handling datasets. As a Collaborative Awards in Science and Engineering (CASE) studentship, the student will get an opportunity for a 3-month placement at Ingredion Inc (Bridgewater, New Jersey, USA). During the placement, the student will train within the R&D and Analytical Characterization and Texture Science programs of the company, which offers an industry-level environment, networking opportunity, and one-on-one mentoring by industry experts.

**Project supervision plan:** The complimentary skillsets of the supervisory team provides the successful candidate a unique experience in basic and translational research. The lead supervisor will meet with the student during regular 1-to-1 meetings throughout the training program. The student will also meet the supervisory team (lead supervisors and co-supervisors) in separate pre-determined meetings. During these meetings, the student will have a chance to present their progress and provided constructive feedback and mentoring in areas covering research, scientific writing, career development, and project management. Supervisors will provide timely feedback to which the student will be given substantial time to process and respond. The student will also be provided 1-to-1 supervision and mentoring by co-supervisors during their visit to the co-supervisor's lab at Queen's University Belfast and during the placement at Ingredion in New Jersey, USA.

**Student profile:** We seek students with a background in immunology, biochemistry (metabolism), microbiology, nutrition, food science, or a closely related subject. This project would be suitable for a student with an interest in *in vitro* (cell culture) and *in vivo* (animal studies) approaches for understanding the impact of diet on host health through modulation of immune responses and gut microbiota. Due to the multidisciplinary nature of this program, we do not expect the successful candidate to have knowledge and experience in all relevant areas. Full support and training will be provided by experienced staff.

**Other information:** This project is a CASE PhD studentship and includes three to five months placement at Ingredion Inc (Bridgewater, New Jersey, USA). The student will receive financial support during this placement to cover accommodation, roundtrip airfare, and land transportation costs.

**Stipend (Salary):**

FoodBioSystems DTP students receive an annual tax-free stipend (salary) that is paid in instalments throughout the year. For 2024/25 this is £19,237 (£21,237 at Brunel University) 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.

These are opt-in processes.

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](#).**