PhD Project Advertisement

Project title: Developing next-generation portable rapid tests for food authenticity
Project No: FBS2023-08-Campbell-qr

Lead supervisor: Katrina Campbell, Institute for Global Food Security, Queen's University Belfast
Email: katrina.campbell@qub.ac.uk
Co-supervisors:
Alexander Edwards, University of Reading, Adrian Rogers, Bio-Check (UK)

Project description:

The past few years have seen remarkable changes in diagnostic testing for infections, with home covid testing as lateral flow devices adopted enthusiastically into our homes. This shows how biological assays - such as immunoassays – for a range of diagnostic applications no longer need to be conducted in laboratories. Yet there are many other areas that are critical to public health and safety and industrial productivity where samples still get processed using traditional long winded laboratory methods. For example, the determination of the contamination of foodstuffs with pathogens, chemicals, toxins, allergens and/or adulterants throughout complicated supply chains has become a recurring issue. Although public interest has fallen since the horse meat scandal in 2013, food authenticity is increasingly a major concern for the food industry with enhanced media and social media attention not only damaging reputation and causing severe economic impacts in recalls, it can also pose significant risks to human health through the spread of infectious diseases and food allergens but also raise moral and ethical concerns for persons of certain faiths and beliefs. Examples include cross-contamination of other ingredients or food products with animal-based ingredients and deliberately altering or mislabelling the composition of a food for financial profit. The development of robust authentication and traceability systems implemented across the supply chain will help improve food safety and food fraud prevention. As such there is an increasing need to develop rapid innovative diagnostic tools that can detect multiple contaminants simultaneously in situ or at point of site testing. This is particularly important for animal-based and vegan foods which are often highly processed and include many different ingredients and additives. Adulteration of meat is described as “the fraudulent practice which involves substitution or mixing of flesh of cheaper variety which is objectionable for the reason of health, religion and economics”. Meat speciation testing, the identification of animal species, is performed for these reasons. To date there is no rapid one method fits all approach commercially available for speciation testing of animal-based or vegan products; a range of approaches including ELISA, PCR and lateral flows are applied as a toolbox of tests.

Such food contamination can be detected using immunoassays that detect particular targets found in specific species. As observed during COVID a major advantage of immunoassays (over laboratory PCR or mass spectrometry) is portability and simplicity of use for the operator or analyst. Lateral flow immunoassay (LFA) devices are mass-manufactured keeping costs down, and easy to operate outside a lab, giving immediate results. One well-known limitation of lateral flow is analytical sensitivity: current lab tests can detect 100-1000 lower levels of a contaminant than standard LFA.

This project will apply the latest discoveries in biorecogniton element discovery using bioinformatics and immunoassay technology, such as smartphone detection and microfluidics, to develop a new generation of inexpensive, portable, multi-target, food security tests. This research project will apply recent developments and discoveries in the field of miniaturised immunoassay, to the problem of food authenticity. The student will balance two equally critical drivers of bioassay technology: exceptional analytical performance, yet they must remain cost-effective and manufacturable.

The aim of this proposal is to develop a simple effective diagnostic test for the simultaneous multiplex analysis of different animal species for example cow, sheep, porcine, turkey, chicken, equine, donkey and goat that can be used for field-based analysis.

The student will explore the feasibility of adapting current lateral flow immunoassays using several recent developments

including, for example: improved fluidic configurations; smartphone readout using bespoke low-cost illumination systems; multiplexing using different combinations of microfluidics. These innovations will be explored alongside biorecognition element design and assay development for the industrially- and public safety-driven targets.

The PhD conducted mainly at Queen's University Belfast will offer placements at Reading University for biotechnology design and is supported by an industrial partner BIO-CHECK UK who will bring further insight into practical constraints of cost-effective mass-manufacture, marketing and basic business skills for the student.

By applying analytical science to this specific problem, the student will be able to systematically optimise assay performance, at the same time as recognising the pathway to real product development through industrial oversight.

Training opportunities:

Training will include the application of recent innovations in diagnostic testing to food security. Training will include developing skills in bioinformatics, immunogen design, producing biorecognition elements to specific targets and techniques for their purification and characterisation. Training will be provided in microfluidics, biosensor development, food sample prepartion techniques for (bio) analytical testing and in analytical testing methods eg lateral flow devices, ELISA, PCR and other techniques as relevant to the project.

The student will be able to attend modules in Advanced Food Safety and Biotechnology at Queen's University and join the Reading Researcher Development Programme. The project PI is leading modules in these courses and is extensively involved with the teaching activities. The student whilst at QUB will be a member of the Graduate School and will have opportunities to develop further transdisciplinary skills for example in leadership and management. The student will also work with industry at Bio-Check to gain an understanding of the commercial diagnostics sector.

The student will also be able to attend national and international conferences in appropriate subject areas both identified by the academic leads (academic meetings) and the commercial partner Bio-Check (industrial trade fairs) to gain an understanding of marketing and business development.

Student profile:

A student with a background and/or experience in biotechnology, immunology, molecular biology and/or biochemistry or chemistry would be appropriate for this project. It is a multidisciplinary project and thus strengths in 1-2 areas would be suitable as training will be given in the other related areas. It would be desirable that the student has an interest in the Agrifood sector with the right focus for developing additional and complimentary skills that would be appropriate for this studentship.

Stipend (Salary):

FoodBioSystems DTP students receive an annual tax free stipend (salary) that is paid in instalments throughout the year. For 2022/23 this will be £17,668 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.

References:

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