

FoodBioSystems DTP - PhD Project Advertisement Text

Project Title: FOODBIOSYSTEMS - Development of novel tools including biomarkers and dietary assessment apps for nutritional intake and metabolic biotype assessment

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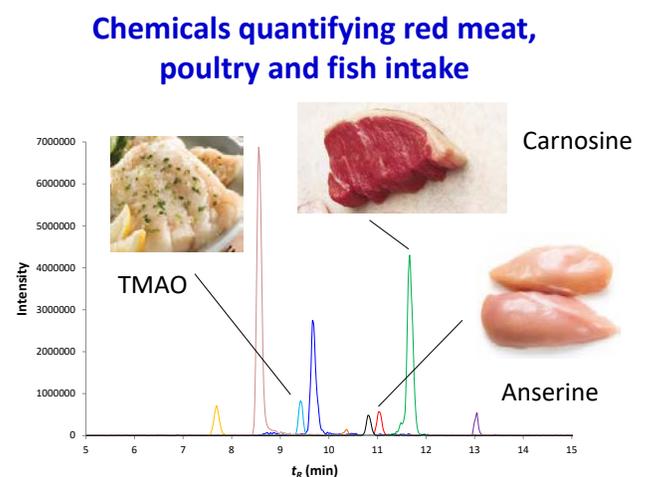
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Research Group: FOODBIOSYSTEMS BBSRC DTP
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Project Description: “**You are what you eat**” is a commonplace adage, suggesting that your choice of diet over the years has a major impact on your health and wellbeing. Almost every week there are news stories informing consumers what foods to eat and what to avoid. Unfortunately, few are based on validated scientific facts and even when research is reported from a reputable team the study often finds only weak correlations between specific foods and a particular health outcome. Three factors interact to confound research in nutritional science: (1) Inherent variability in food composition; (2) Poor self-reported assessment of **dietary intake** often resulting from miss-reporting; (3) Individual differences in metabolic handling of nutrients and foods interactions, commonly referred to as **nutritional metabotype**. In addition to providing important tools for nutrition research, a capability to demonstrate objectively links between diet and health will also have a profound impact on the food industry and public health internationally. ***The central aim of this Ph.D. project is to help to develop the knowledge necessary to make a step-change in the way we study diet and health relationships.***

Using **metabolomics** and **machine learning** (AI) technology, the team in **Aberystwyth** has demonstrated that specific metabolites derived from individual foods present in urine samples provide objective **Biomarkers of Food Intake** (see Figure showing urine biomarkers of meat exposure). It is also thought that the relative concentrations of such chemicals may reflect an individual’s nutritional metabotype. Although coverage already includes a wide range of foods of high public health significance (including e.g. red meat, oily fish, wholegrain, fruits, leafy vegetables) a different technological approach is required to measure intake of important starchy or high fat foods which do not contain distinctive secondary metabolites. Dietary exposure is recorded using self-reported measures such as **Food Frequency Questionnaires** (FFQs). To provide scope for digitising and scaling up of research studies, the team at the Hugh Sinclair Unit of Human Nutrition at **Reading**



University has developed and validated an online FFQ (eNutri) which automatically analyses food data via a web-application to make precise estimates of nutrient intake.

Working with collaborators in a range of clinical trials a biobank of urine samples has been developed, complete with substantial meta-data relating to food intake. The biobank will be ideal for validating the performance of urine biomarkers and investigating the most effective way of sampling populations to assess habitual diet and nutritional metatype. We hypothesise that objective dietary exposure data and a 'Healthy Eating Index' reflective of true nutritional status and individual nutritional metatype can be developed by integration and analysis of dietary exposure data derived from both urine metabolome and a mini-FFQ we will be developed using the eNutri FFQ database.

Working with the support of an established and integrated team of postdoctoral researchers and technicians the student will develop a project centred on interacting objectives that can be prioritised, depending on individual research interests:

- (1) Validate in collaboration with ongoing human dietary trials which dietary components are efficiently monitored by biomarkers and which need to be assessed by a mini-FFQ.
- (2) Adapt eNutri tool to integrate biomarker data with a mini-FFQ covering foods not likely to be well measured by biomarkers
- (3) Validate the performance of the combined tool to assess habitual diet in a small human dietary intervention study and conduct focus groups to determine the acceptability (study participants) and suitability (healthcare professionals and researchers) for widespread use in future nutrition studies or national dietary surveys.
- (4) Analyse differential metabolism of diet-related metabolites to identify biomarkers likely to be sensitive to nutritional metatype differences in a study population.
- (5) Develop a novel 'Healthy Eating Index' utilising data generated using the combined tool (biomarker data and mini-FFQ), for use in future large-scale human intervention studies.

Funding Notes: 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. Due to restrictions on the funding, this studentship is only open to UK students and EU students who have lived in the UK for the past three years.

The FoodBioSystems DTP is a collaboration between the University of Reading, Cranfield University, Queen's University Belfast, Aberystwyth University, Surrey University and Brunel University London. Our vision is to develop the next generation of highly skilled UK Agri-Food bioscientists with expertise spanning the entire food value chain. We have over 60 Associate and Affiliate partners. To find out more about us and the training programme we offer all our postgraduate researchers please visit

<https://research.reading.ac.uk/foodbiosystems/>

Training opportunities: The student will have first-hand experience of working in a major clinical trial monitoring diet (in this case undernutrition and frailty risk) by interacting with the STREAM ('Eat well, feel well, stay well') study in Southampton (Prof Draper, AU). The STREAM trial aims to recruit 7400 participants and will be conducted at 100 GP sites.

During an extended placement with UoR for mini-FFQ development work the student would get training in dietary assessment and have opportunity to design a human dietary study including the use of focus groups to

determine the consumers' opinion of this new technology. Formal training will also be provided on obtaining study ethical approval, Good Clinical Practice and qualitative research methods.

In AU, the student will undertake training in both metabolomics technology and advanced data analysis methods using machine learning; a course in 'R' programming to process and analyse 'omics' data and a postgraduate module in advanced statistics will be taken in the 1st year.

We anticipate that 1-2 weeks placements will be available to the student to interact with collaborators in Spain, UK and France running clinical trials in which collection of urine samples and meta-data relevant to nutritional status are important components. In the UK, access to biobanked urine samples from the representative UK National Diet and Nutrition Survey population will be requested for metabotype analysis. This can be compared with the detailed dietary data freely available online.

Student profile:

The project would be suitable for a student with a first degree in the Life Sciences generally, preferably with a background that included some aspect of nutrition or Human Biology. Ideally the candidate would have knowledge of nutrition research and 'omics' technology. An interest in computerized (HPC) data processing and advanced data analysis would be valuable but not essential as training will be provided. An ability to engage with study participants would be essential.

References:

Amanda Lloyd et al. (2013) "Data-driven strategy for the discovery of potential urinary biomarkers of habitual dietary exposure". *The American Journal of Clinical Nutrition*

<https://doi.org/10.3945/ajcn.112.048033>

Amanda Lloyd et al. (2019) "Developing a Food Exposure and Urine Sampling Strategy for Dietary Exposure Biomarker Validation in Free-Living Individuals" *Molecular Nutrition and Food Research*

<https://doi.org/10.1002/mnfr.201900062>

Franco, R. Z., Fallaize, R., Lovegrove, J. A., & Hwang, F. (2018). Online dietary intake assessment using a graphical food frequency app (eNutri): Usability metrics from the EatWellUK study. *PloS one*

<https://doi.org/10.1371/journal.pone.0214931>