

## FoodBioSystems DTP - PhD Project Advertisement Template

### Project Title:

FBS2021-93-Draper: Integration of food intake biomarker data with minimal self-reported dietary information to assess eating behaviour and evaluate nutrient intake in individuals and populations.

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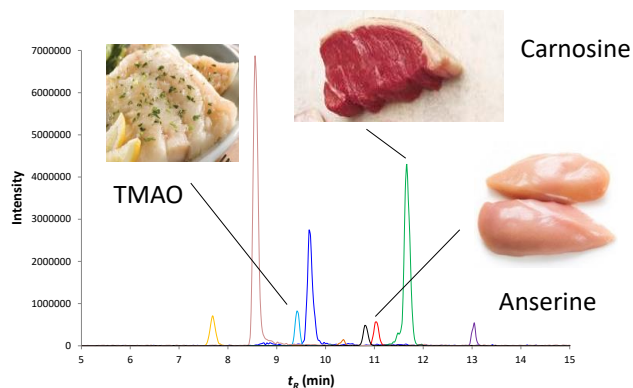
Dr Rosalind Fallaize, Reading

### Project Description:

“**You are what you eat**” is a commonplace adage, meaning 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 of these stories 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 entrenched 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 x 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 in **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.

## Chemicals quantifying red meat, poultry and fish 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 metabotype. We hypothesise that objective dietary exposure data and a 'Healthy Eating Index' reflective of true nutritional status and individual nutritional metabotype can be developed by integration and analysis of dietary exposure data derived from both urine metabolome and a mini-FFQ 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 clinical 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 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 metabotype 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 clinical intervention studies.

### 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 1<sup>st</sup> 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 metabolite 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 Upper Second class honours degree in the Life Sciences generally, preferably with a background that included some aspect of Human Biology. Ideally the candidate would have some 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.

#### **Funding Note**

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.

The studentship is open to UK and international students (including EU countries) however due to funding rules, no more than 30% of the projects can be allocated to international students.

The funding will include a tax free stipend (minimum £15, 285 per year), support for tuition fees at the standard UK rate (currently £4,407 per year) and a contribution towards research costs. **Please note** that the host universities have not yet confirmed the level of fees charged to international students funded by the DTP. Fee levels may vary across the institutions. This information will be shared on the FoodBioSystems DTP website as soon as it becomes available.

#### **To apply**

Please go to [FoodBioSystems DTP website](#) for information on how to apply for this studentship. The closing date for applications will be 8 February 2021.

#### **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>

Beckmann et al. (2020) A standardized strategy for simultaneous quantification of urine metabolites to validate development of a biomarker panel allowing comprehensive assessment of dietary exposure. *Molecular Nutrition and Food Research* <https://doi.org/10.1002/mnfr.202000517>

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>

Franco, R. Z., Fallaize, R., Hwang, F., & Lovegrove, J. A. (2019). Strategies for online personalised nutrition advice employed in the development of the eNutri web app. *Proceedings of the Nutrition Society* <https://doi.org/10.1017/S0029665118002707>