PhD Project Advertisement

Project title: Mechanistic and applied strategies for the production of vitamin B12-enriched milk
Project No: FBS2024-013-Stergiadis-rq

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Project description:

In humans, Vitamin B12 (B12) prevents megaloplastic anaemia and neuropathy, and works synergistically with folate in physiological processes. B12 deficiencies in different countries and demographics range 5.0-61.3%, and in the UK 12.4% of women of childbearing age are B12 deficient. B12 is synthesised by microbiota inhabiting cows' rumen using precursors from animal diet, and is not synthesised/found in plants. The ever-increasing replacement of milk/dairy products with plant-based alternatives can reduce population B12 intakes by >50%; whilst the ageing population (1 in 6 people >60 years of age by 2030) requires more B12 because its absorption capacity is reduced with age. Recent studies recommend that B12 reference nutrient intake (RNI) should be increased for pregnant women, thus enlarging the risk for future larger-scale deficiencies.

Milk/dairy products are excellent source of B12, and in the UK may cover 77-91% of the B12's RNI in adults and exceed RNI supply to children <10 years of age. In contrast with B12 supplements, milk/dairy products are affordable, consumed by >90% of the population and their B12 is more bioavailable. However, milk B12 concentrations vary up to >3 times between animals under the same conditions, animal diets (i.e. contrasting fibre, starch, protein, cobalt contents) or rumen environment (pH, volatile fatty acids); and is currently unknown the extent this influences milk B12 concentrations at large-scale.

To meet current/future population B12 needs via milk/dairy products, this study will explain the metabolic mechanisms for the origin/synthesis of B12 in the rumen, and identify animal feeding practices to increase milk B12.

The objectives and the individual studies of this work will cover:

1. an investigation of the role of rumen microbiota and their metabolic mechanisms on B12 synthesis,
2. an assessment of the forage type on B12 synthesis, metabolism and transfer into milk at animal level, and
3. an evaluation of the impact of herd husbandry strategies (feeding, breeding, management) on milk B12 concentration at herd level.

Training opportunities:

Training will be provided via all partners and will cover cross-disciplinary transferable skills to enhance student's future career prospects. At Reading, the student will be trained for (i) data analysis including ANOVA using LME, Shapiro-Wilko test to assess normal distribution, pairwise comparisons using Fischer's LSD tests (Genstat), principal components and multivariate redundancy analyses (CANOCO), (ii) Vitamin B12 analysis in milk and rumen fluid using LC-MS/MS and/or analytical kits, (iii) metabolomics analyses of the NMR spectral data by supervised OPLS-DA, cross validation and response permutation tests to assess predictive accuracy

(SIMCA), and metabolite annotation (literature, databases and Chenomx), (iv) correlation of metabolites on metabolic pathways (KEGG). At QUB (up to 3-month visit) the student will be trained on metataxonomic and metagenomic sample processing, sequencing and downstream analysis. During the animal trials, the student will be trained on data and sample collection in animal feeding trials. The development of other skills (e.g. research, writing, personal, work, presentation) will be monitored by URE's Graduate School formal procedures, including a Learning Needs Appraisal (assessment of prior learning and identify/prioritise learning and development needs), and the Researcher Development Framework (personal development plan and implementation via a series of University workshops/courses).

Student profile:

We are looking for applicants with an upper second-class degree in a related science (e.g. animal science, veterinary, food science, biology), and a background/interest in animal nutrition/physiology, -omics technologies and/or bioinformatics. A keen interest in dairy research, including collection and laboratory analysis of samples, and animal trials is required. The ability to learn skills around research conduct/ethics and communication, -omics technologies, bioinformatics, food analysis, and factorial/multivariate statistical analyses, is essential.

Stipend (Salary):

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