

FoodBioSystems DTP - PhD Project Advertisement Text

Project Title: FOODBIOSYSTEMS - Optimising the sensorial and nutritional value of plant based milk alternatives

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Research Group: FOODBIOSYSTEMS BBSRC DTP

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Project Description: Plant based milk alternative (PBMA) sales increased 33% between 2015 and 2017 and almost a quarter (23%) of Brits are using these products, with many choosing oat-milk alternatives (OMA) that are considered the most sustainable. However, PBMA's have issues in both their sensory and nutritional profile. This project provides an exciting opportunity to substantially improve the sensory and nutritional profile of OMAs through a fundamental investigation and integration of sensory drivers of consumer acceptability and drivers for nutritional optimisation. The PhD student undertaking this project will belong to the food and sensory science research group at the University of Reading and the nutrition group at the University of Surrey, and benefit from our partnership with both the sensory and nutrition teams at Arla Foods.

The sensory profile of OMAs considers the aroma, taste and mouthfeel of the beverage, and the compounds in the milk that result in such sensory characteristics. Oat milk-alternatives (OMAs) contain a variety of non-volatile tastants (sugars, polyphenolics) and volatile aroma compounds (predominantly lipid and Maillard derived) that contribute to the product's aroma and taste, and that are affected by thermal treatment. However, crucial to acceptability of OMAs is the extent of astringency and mouthdrying. Oats contain avenanthramides (phenolic alkaloids) and avenacosides (saponins), which may contribute to astringency by binding to salivary proteins, thus reducing lubrication. In addition, protein fortification of beverages can lead to an alternative form of mouthdrying. Previous research at the University of Reading has shown that fortification of beverages with protein causes a drying sensation, building over repeated consumption, which correlates with the adhesion of protein to the oral cavity (mucoadhesion).

Dairy milk makes a substantial positive impact on the nutritional composition of western diets, particularly through the provision of high quality protein with a complete amino acid profile, calcium in a bioavailable form, and iodine. Unlike plant proteins, whey and casein are complete protein sources, which lead more readily to muscle synthesis. Dairy milk contains 3.4% protein compared to just 0.3 to 1.0 % (w/v) typical in commercial OMAs. Oat protein consists predominantly of globulin; characterised by its high lysine content making it nutritionally superior to other cereal proteins. Calcium in dairy milk is more bioavailable than from other sources;

in plants absorption is hindered by oxalates and phytates. These anti-nutritional compounds form insoluble complexes reducing absorption. Oats have a number of positive nutritional factors; they are high in β -glucans, soluble fibre leading to slower absorption of carbohydrates with benefits such as improved blood sugar control, lowering cholesterol, improved immune function. These benefits need to be considered alongside the known positive effect that bovine milk proteins have on blood pressure and on insulin stimulation in relation to type 2 diabetes. Additionally, the avenanthramides in oats have anti-inflammatory, antiatherosclerosis and anticancer effects whilst the avenacosides have been noted for cholesterol lowering effects.

By integrating our knowledge of food chemistry, sensory science and nutritional we propose that the student undertaking this project will optimise the sensory profile on OMAs whilst increasing protein content and calcium bioavailability.

We propose a series of objectives where the student will be trained in key specialist skills. This will start with the development of OMAs varying in content of polyphenols, sterols and protein that will be heat treated before testing their sensory profile with a trained sensory panel. The volatile profile will be measured by GCMS (gas chromatography mass spectrometry) and statistically correlated to the sensory profile. To investigate the causes of astringency and mouthdrying we have methods to test mucoadhesion and binding to salivary protein. Working with all partners the student will explore methods to increase calcium bioavailability, including fermentation to degrade the anti-nutritional compounds, and investigate the influence of this on the sensory profile. In the final part of the PhD there will be the opportunity to carry out in-vitro digestion of different OMA preparations to investigate factors influencing calcium bioavailability.

The potential impact of this project is in enabling a substantial shift in the UK market from bovine milk to an oat based milk alternative, moving such products from niche to mainstream consumer commodity products.

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.

This project is a CASE studentship with Arla Foods. Arla will provide a 3 month training placement and provide additional financial support to the project consumables.

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/.](https://research.reading.ac.uk/foodbiosystems/)

Training opportunities: This project provides a wealth of training opportunities at the University of Reading (UoR), University of Surrey (UoS) and Arla Foods. You will use the state of the art facilities of the Sensory Science Centre (UoR) and be trained in a number of fundamental sensory and mucoadhesion (in-vitro or ex-vivo) methodologies developed in-house, in addition to methods testing friction and lubrication. UoR were the first to develop and publish temporal sensory methods to assess astringency and mouthdrying specifically important in understanding the mouthdrying properties of beverages, and you will be trained in these methods. At the Flavour Centre (UoR), world leading in both volatile and non-volatile analysis, you will be trained in extraction

techniques and GCMS/GCO and, if required, LCMS. At UoR you will also be offered a range of courses to enhance your academic skills (e.g. in statistics, presentation skills, time management, academic writing, etc.). With UoS you will benefit be trained in methods to assess bioavailability of minerals, in addition to gaining expertise in evaluating protein quality and glycaemic index. Arla provides access to commercial sensory facilities, in-house laboratory expertise, and can provide you an excellent training in dairy product and dairy alternatives manufacture.

Student profile: This project would be suitable for a student with a background in food science and / or nutrition, or a student from a pure science background, particularly from any biological sciences degree, biochemistry or from a chemistry degree. Mature students currently working in sensory science are also encouraged to apply.