PhD Project Advertisement

Project title: Multi-Functional Fibres as Biobased Food Binders, Selectively Modified Using Green Technologies and Enzymes

Project No: FBS2022-39-Koidis-qr

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Project description:

Introduction

Consumers' drive and regulators pressure for more sustainable foods has transformed the food industry. This is embodied in profound consumer shifts to vegan foods and plant proteins. There is an abundance of grain proteins which can be blended in mixtures offering tailored composition and flavour. The technological and physicochemical properties are, however, challenging to be controlled. Normally, binding agents - food grade molecules with protein binding capability - are required to achieve the structure and the stability that is expected in a food formulation, e.g., a vegan meal. Traditional binding agents, like gelatine, lecithin, or gums are either not vegan friendly or can induce allergies or simply not optimised to synergistically work with plant proteins. Some legume or seed starches used are either expensive or unsustainable to mass produce. Currently, the golden standard is methyl cellulose (E461), that is derived from wood fibres and includes chemical modifications. Conveniently, the thermogelation properties of this polysaccharide provides firmness above 60°C simulating the texture of meat. However, it is perceived as artificial and non-sustainable, an unpopular choice for health and environmentally conscious consumers and thus, there is a drive by food suppliers to develop alternative sustainable and clean label solutions. One of the most sustainable alternative sources are biotechnologically produced fibres sourced from by-products of the agri-food sector. Fibres can have multiple functionalities, including binding agent, rheology modifier, bulking material, emulsifier, and fat mimic as ingredients in food products.

Therefore, there is a clear need and considerable market opportunity to develop alternative sustainably sourced fibrous binder using green technologies with similar, to the competition, capacity but achieving a clean label and a low environmental footprint.

Aims and objectives

The aim is to improve our fundamental understanding for developing novel, vegan-friendly fibrous binding agents derived from an agri-food by-product streams using green (bio)processing technologies. Previous work by our partner CelluComp and University of Reading showed that micro-fibrillated cellulosic type material (MFC) extracted from sugar beet pulp and carrot peels has a promising protein binding capability that could be explored further.

This structure of the project is:

- Screening of various natural sources, starting from micro-fibrillated cellulose and expanding to other sustainable biopolymers including hemicellulosic fractions to evaluate their fit for purpose.
- Exploration of the chemical modification of the fibrous biopolymers using a variety of green processing technologies.
- Investigation on the enzymatic modification of fibrous molecules of various molecular weights though oxidation reaction or grafting.
- Characterisation of the rheology, texture, gel formation, emulsifying and binding properties of these candidate

molecules on their own and in model systems with other ingredients.
- Selection the most promising material for their inclusion in reformulated food applications, such as vegan meat alternatives meals, in collaboration with the NI artisan food manufacturer, Finnebrogue.

Methods

The methods that will be used will range from green processing technologies used in chemical modification such as ultrasonication, cold plasma, microwave processing and potentially high-pressure processing, to the enzymatic processing of the biopolymers to confer different characteristics. Characterisation will be achieved through chemical and functional analysis (e.g., binding capacity, rheology, emulsification, water holding capacity, thermogelation properties) in both model and real food systems, that resemble the expected shape and properties of vegan foods. The student will also be engaging in advanced chemical analysis to determine the structure of the biopolymers (e.g., size exclusion and ion exchange chromatography, matrix-assisted laser desorption ionization, nuclear magnetic resonance).

The PhD student will be joining a team of food scientists, biologists and engineers including experts in food chemistry, biotechnology, food structure, polymer functionality and advanced chemical analysis with experience in leading research projects with the Food Industry.

Training opportunities:

This project will train the PhD student to become an expert in the isolation, characterisation and modification of natural sustainable biopolymers as the means to customise their structure and activity, specifically towards binding of plant proteins. These skills are much needed in the UK food industry and expertise that is currently underrepresented in UK academia.

The PhD student will benefit from access to facilities and expertise at QUB (food chemistry, analysis, food physics and green processing technologies), as well as at the UoR (biotechnology and processing). The three-month placement at CelluComp will enable the student to undertake application-focused research and understand how innovation and operations at a dynamic SME environment. Finally, through the interaction with the food industry in various consultations, the student will be able to gain experience and some understanding of the food system and the working environment of the commercial food sector.

Student profile:

The student should have a background in biotechnology and food processing, ideally coupled with knowledge of food analysis and food physics.
An interest in the food industry, global sustainability challenges, the role of plant proteins and vegan foods is a plus. This project would be suitable for students with a BSc honours degree in chemistry, physics, chemical engineering, food science or a closely related subject.

References:

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Funding particulars:

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