Industrial Strategy Challenge Fund Proof of Concept Projects – 2018

Assessment of waste allium biorefinery comparing three extraction methods prior to anaerobic digestion

Award Holder: Bipro Nath Dubey, Sheffield Hallam University
Academic Partners: Ray Marriott, Bangor University & Davide Dionisi, University of Aberdeen
Industrial Partner Companies: William Jackson Food Group, & Clearflea Ltd

Project Outcome Public Summary

Food waste utilization by extracting valuable materials and sustainable utilization of end waste are the key challenges faced by the food industry in the UK as a whole. The partner company, WJFG, produces a huge amount of waste streams comprising onion-peelings (ca 8,000 tonnes/annum), dry garlic-peelings (ca 600 tonnes/annum) and wet garlic-pressings. The objective of the project is to maximize the sustainable utilization of the high water contained food waste by extracting valuable materials (such as flavour, aroma, and antioxidant) and producing useful organic components via anaerobic digestion (AD) and biogas/green fuel. Four different extraction processes have been studied to isolate valuable and antimicrobial materials from wet allium waste followed by anaerobic digestion to convert solid residue into platform chemicals. The present study shows that the extraction process has significant influences on the kinetics and the conversion yield of the anaerobic digestion. The collaborative project is delivered by the National Centre of Excellence for Food Engineering at Sheffield Hallam University, University of Bangor, University of Aberdeen, William Jackson Food Group, Clearflea Group Ltd. and association with Biorenewable Development Centre (Bangor University).

Microwave-assisted hydrothermal extraction of pectic oligosaccharides from potato waste

Award Holder: Eleanor Binner, University of Nottingham
Academic Partners: Afroditi Chatzifragkou, University of Reading & Bob Rastall, University of Reading
Industrial Partner Company: B-Hive Innovations Ltd

Project Outcome Public Summary

Branston Potatoes produce 30,000 tonnes of out of specification potatoes each year, and this project was motivated by their desire to use them to develop a new valuable product. While the main part of potato tubers’ dry weight is starch, other minor components are also of interest for potential use as functional food products such as prebiotics. Pectins are a complex group of heteropolysaccharides with a structure divided into smooth and hairy regions. Recent research has shown pectins rich in hairy structures are a promising source of prebiotics, and that potatoes contain these structures. However, the current commercial (smooth) pectin extraction process is not suitable for the extraction of hairy pectins, as the hot acid used destroys the hairy regions, and therefore the inability to extract large quantities of hairy pectins is a barrier to progress in this area.

This study aimed to develop a novel, clean and scalable methodology to extract hairy pectin regions as a source of prebiotics. The outcomes demonstrate the feasibility of applying microwaves in order to extract potato-derived
polysaccharides using only water as solvent. The process was scaled-up through the construction of a pilot-plant continuous rig that allowed the production of gram quantities for detailed characterisation and testing.

As a result of this project, the collaboration between the Universities of Nottingham and Reading will continue. New pectin sources will be processed with the large-scale rig, with the aim of testing the biological activities of the most promising ones and ultimately developing new products that provide a range of health benefits from food waste.

**Deactivation of polyphenol oxidase enzymes in apple pomace at point of source**

**Award Holder:** Eleanor Binner, University of Nottingham  
**Industrial Partner Company:** A&R House (BCL) Ltd

**Project Outcome Public Summary**

The most widespread processing technique in the apple industry consists on their juicing for cider or apple juice production. This results in a significant waste stream of apple pomace that accounts for more than 4 Mt yearly worldwide. Generally, its use is limited to anaerobic digestion, mulch and animal feed. Recently, attempts have been made to upgrade this pomace for human consumption as a dietary fibre. A major barrier to its valorisation is the rapid browning it undergoes after juicing, thanks to the oxidation of phenolic compounds into melanin due to the polyphenol oxidase enzyme (PPO) activity. Additionally, PPO causes food deterioration that significantly reduces storage life and market value. Current commercial techniques focus on PPO inactivation by adding acidulants or performing thermal treatments. However, their effect is temporary and they can damage the nutrient content, respectively. This project was motivated by the possibility of averting the apple pomace browning for long periods of time while avoiding any food deterioration issues.

This study aimed to investigate the suitability of microwave energy in the enzymatic deactivation of apple pomace and to develop a scalable system for its on-line valorisation. The outcomes demonstrate the feasibility of applying microwaves in order to curtail the browning of different types of apple pomace for at least seven days. The process was scaled-up through the construction of a pilot-plant continuous rig that allowed the treatment of 300 ml/min of pomace.

As a result of this project, further collaboration with industrial partners with the aim of spreading the use of the tested microwave technique will be sought, where ultimately an industrial scale system will be designed and built. This system could potentially be portable, allowing stabilisation of apple pomace at the point of source, enabling transportation to a central processing facility for further valorisation as a range of functional food ingredients such as high fibre sugar and fat replacers.