FoodBioSystems DTP - PhD Project Advertisement Text

Project Title: FOODBIOSYSTEMS - Food Processing with Solid State Microwave Technology for Higher Product Quality and Lower Carbon Footprint

Lead Supervisor: Prof. Savvas Tassou, Brunel University London, Institute of Energy Futures
Email: savvas.tassou@brunel.ac.uk

Co-Supervisors:
Dr Maria Jose Oruna-Concha, University of Reading, Department of Food and Nutritional Sciences
Dr Valentina Stocjeska, Brunel University London, Institute of Energy Futures
Dr Julia Rodriguez-Garcia, University of Reading, Department of Food and Nutritional Sciences

Research Group: FOODBIOSYSTEMS BBSRC DTP
Project ID: FBS2020-52
Application Deadline: 6 March 2020

Project Description: Microwaves are well-established as sources of dry heat and are very widely used in the home and some industrial applications in the food sector. They are volumetric (i.e. they heat the product interior directly) which leads to higher efficiency and faster heating/baking compared to conventional methods. For this reason, microwave processing can be more suitable for mild processing of food products. Traditional microwaves based on magnetrons, however, suffer from non-uniform heating. Also, crust formation is difficult in commonly baked products such as bread. Emerging solid state microwave technology has the potential to overcome many of the disadvantages of conventional magnetron systems through their ability to provide uniform heating and modulate radiation (heating) intensity to satisfy specific product characteristics. To date, very little research and in-depth investigations have been carried out on the performance characteristics of Solid State Microwave Ovens (SSMOs) and evaluation and quantification of their performance over conventional systems.

This project and the Doctoral Researcher will make significant contributions in this area. The research will involve in-depth experimental, analytical and simulation studies on the processing of food products with state of the art solid-state microwave technology to explore in detail its performance characteristics and identify design, operational and control parameters that optimise processing of specific products in terms of final product quality (sensorial, nutritional, structure, texture and appearance) and resource use. The focus of the PhD will primarily be on:

i) convenience foods to explore the nutrient-retentive advantages of Solid State Microwave technology for controlled dehydration of fresh vegetables and fruit into snack forms, and
ii) bread baking to explore the ability of the technology to recreate the sensorial characteristics, including brownish and crunchy crust, roasty aroma and a soft and elastic crumb texture with a moist mouthfeel which are very difficult to achieve with conventional microwave ovens.

The research will be undertaken within the Centre for Sustainable Energy Use (CSEF) (www.foodenergy.org.uk) at Brunel University London and the Department of Food and Nutritional Sciences at the University of Reading (www.reading.ac.uk/food/). Most of the experimental investigations will be performed on a bespoke SSMO in CSEF. This innovative and unique system offers the capability to control power distribution and characteristics at different portions of the oven and food. Nutritional characterisation of the products, microstructure, physico-

chemical properties, flavour, acrylamide formation as well as sensory evaluation will be carried out at the UoR. The main research activities will involve:

a. A comprehensive literature review to develop in-depth understanding of baking processes in domestic, service and high volume industrial applications and establish state of the art of conventional baking technologies and desired product characteristics for the products to be investigated.
b. Characterisation and comparison of the performance of the SSMO against that of high quality state of the art electric resistance, gas and microwave (magnetron) ovens through extensive testing in the laboratory to establish benchmarks for the research outputs.
c. Detailed investigations backed by comprehensive measurements and analysis on the baking of selected vegetable and fruit snacks and bread to explore the influence of control variables on the quality attributes (physico-chemical, sensorial and nutritional) of the final product. The data produced will provide a strong scientific information base for the further development of multi-frequency microwave processing.
d. Extensive simulation of solid state microwave food processing using appropriate software and techniques. The models will be validated and calibrated with data from the experimental programme and used to investigate the influence of important design and control parameters on product quality and energy consumption.

Utilisation of results from the experimental test programme and simulations to draw conclusions on the potential of SSMOs to provide improved product quality with lower energy input compared to conventional baking approaches and identify areas for further development.

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.

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/.

Training opportunities: The student will have the opportunity to engage with a top research group on microwave food processing technology of a multinational food company and spend some time with the group to benefit from their experience and use some of their laboratory equipment. The student will also be encouraged and funded to attend relevant training courses and attend and present papers at national and international conferences.

Student profile: This project would be suitable for students with a BEng/BSc (2.1 or above) or MSc in Chemical Engineering, Biotechnology, Food Science/Technology or any related discipline, ideally with some knowledge of food engineering and food product formulation. A lower degree class may also be considered for applicants with relevant industry experience.

References:

https://doi.org/10.1111/jfpe.13328
https://doi.org/10.1080/10408398.2017.1408564