FoodBioSystems DTP - PhD Project Advertisement

Project title:
FBS2021-71-Tassou: Low-carbon Food Processing with Solid State Microwave Technologies

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Project description:
Microwaves are well-established sources of 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, 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 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 the 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. The 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.

Training opportunities:

The DR 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 DR 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.

References:

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

Funding Note

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.
The studentship is open to UK and international students (including EU countries) however due to funding rules, no more than 30% of the projects can be allocated to international students.
The funding will include a tax free stipend (minimum £15, 285 per year), support for tuition fees at the standard UK rate (currently £4,407 per year) and a contribution towards research costs. **Please note** that the host universities have not yet confirmed the level of fees charged to international students funded by the DTP. Fee levels may vary across the institutions. This information will be shared on the FoodBioSystems DTP website as soon as it becomes available.

To apply

Please go to FoodBioSystems DTP website for information on how to apply for this studentship. The closing date for applications will be 8 February 2021.