

Project title:	The potential health impacts associated with food waste storage, collection and processing
Research Theme:	Waste Management
Key words:	Food waste, bioaerosols, microbiology
Supervisory team:	Dr Toni Gladding, School of Engineering and Innovation, toni.gladding@open.ac.uk Dr Carl Boardman, School of Engineering and Innovation, carl.boardman@open.ac.uk

Project Highlights:

- An applied laboratory based project working with waste companies and regulators to optimise safe food waste collection and treatment.
- International travel opportunities for training and conferences.
- Training in viable culturing and molecular biology including qPCR and sequencing.

Overview:

UK households produce around 7 million tonnes of food waste each year, which is either collected by local authorities, home composted, fed to animals or discharged into the sewer. The majority of the waste (4.7 million tonnes in 2012) is collected by local authorities predominantly through refuse collection services, but also through food recycling schemes. The composition of the waste is likely to contain meat, dairy, vegetable matter, bread products, fish and other organic matter of varying ages and at various stages of decomposition (Figure 1).

As soon as these materials are discarded they will begin to be broken down by microorganisms. The rate of this breakdown might be affected by type of waste container, storage interval, vehicles used and bulking/transferring activities, variables which have all been found to have an impact on the by-products of decomposition, e.g. emissions of biological particles. Microorganisms will grow on any material where there is sufficient supply of nutrients and water, making food waste an ideal breeding ground for bacteria and fungi.

This project intends to study the microbiological composition of food waste and the potential for it to emit bioaerosols (airborne microorganisms) in the context of public health, for the householder, the waste collector and the waste site operative.

This is an exciting new research area that builds on previous work which has highlighted that indoor storage of organic wastes leads to increased microbial contamination levels in the home (Wouters *et al* 2000). Research has also shown that green waste generates a significant bioaerosol load to collectors (Wouters *et al* 2006), and is emitted from compost sites. There is however a knowledge gap regarding bioaerosol emissions from the separate collection and treatment of food waste.

As food waste is being targeted for increased collection and treatment as a way of improving local authority recycling rates, this research is intended to improve the information available to the waste industry regarding the public and occupational health concerns that need to be taken into account.



Figure 1: A typical collection of food waste

Methodology:

It is intended this research will specifically address the storage, collection and processing of food waste by carrying out the following activities:

- 1) Determination of food waste content in defined collection schemes, examining container, vehicle and storage/collection intervals.
- 2) Testing of biodegradability and microbiological characterisation of food waste materials in the laboratory including identification of pathogens and community analysis via culturing and qPCR, and testing for endotoxin and glucan and potentially mycotoxins.
- 3) Examination of potential exposure routes for householders and waste handlers including hand to mouth and via bioaerosols involving swabbing and air monitoring for indicator microorganisms.
- 4) Provision of information regarding risk and health considerations for the waste industry regarding separate storage, collection and processing of food wastes.

Partners and collaboration (if applicable)

This work will build on previous research funded by Zero Waste Scotland, the Waste Resources Action Programme and Natural Resources Wales. The Waste Resources Action Programme (WRAP Cymru) will be actively involved in this research project and will support the research.

Further reading:

- Gladding T.L., Gwyther C.L. (2017) A Study of the Potential Release of Bioaerosols from Containers as a Result of Reduced Frequency Residual Waste Collection. *Science of the Total Environment*. 576: 481-489
- Wouters I.M., Douwes J., Doekes G., Thorne P.S., Brunekreef B., Heederik D.J. (2000) Increased levels of markers of microbial exposure in homes with indoor storage of organic household waste. *Appl. Environ. Microbiol.* 66(2):627-631
- Wouters I., Spaan S., Douwes J., Doekes G., Heederik D. (2006) 'Overview of personal occupational exposure levels to inhalable dust, endotoxins, β (1 \rightarrow 3)-glucans and fungal extracellular polysaccharides in the waste management chain' *Ann Occup Hyg* 50(1):39-53

Further details:

Students should have a strong background in microbiology and/or environmental biology, and enthusiasm for learning new techniques and development of new methods. Experience of PCR is desirable. The student will join the Open University's Integrated Waste Systems team researching ways of reducing the environmental impact of solid waste management.

Please contact Dr Toni Gladding (toni.gladding@open.ac.uk) for further information.

Applications should include:

- 1000 word cover letter outlining how they are equipped in their educational background and expertise to conduct the research project,
- a CV including contact details of two academic references
- An Open University application form, downloadable from: <http://www.open.ac.uk/postgraduate/research-degrees/how-to-apply/mphil-and-phd-application-process> (Note: This is an Advertised studentship and you do not need to submit a proposal).
- IELTS English Language test scores on application. An average of 6.5 and no less than 6 in anyone of the four components. Applicant should have these results when applying.

Applications should be sent to STEM-EI-Research@open.ac.uk by 28 February 2019