Improved endotoxin detection and characterisation from biowaste and intensive agriculture

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The biowaste and intensive agriculture industries emit bioaerosol of significance to human health. Whilst some progress has been made in characterising emissions from these industries relatively little headway has been made in: understanding exposure of the general public to bioaerosol from these sources; putting process-based exposures into the context of background exposure to natural bioaerosol; or in quantifying health risk and setting health-based standards. A critical limiting factor in all of these areas is the lack of advanced microbiological methods (sampling, analytical, interpretative) to characterise and quantify bioaerosol emissions and dispersion. Our current evidence base is almost entirely reliant on short duration "snapshot" sampling and culture-dependent microbiology. New fast and efficient methods are needed to understand the nature and significance of non-viable bioaerosol fractions and to develop a new generation of monitoring approaches to deal with the research questions posed above.

Aerosolised endotoxin is an attractive research subject in this context. It is ubiquitous in biowaste and agricultural emissions.

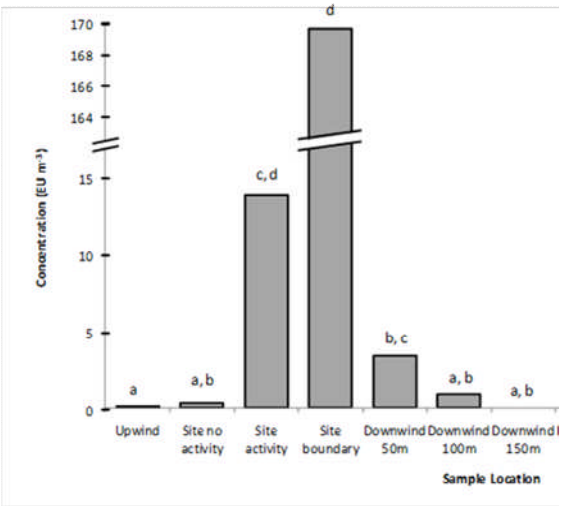

Figure 1. Endotoxin concentrations around a composting facility in the United Kingdom.

Previous occupational bioaerosol research has established an exposure-response relationship. In the Netherlands, endotoxin is regarded as the prime candidate for health-based bioaerosol emission limits / exposure guidelines for workers and the public. Yet, confidence in the development and implementation of evidence-based regulation of this bioaerosol molecule continues to be constrained by gaps in our fundamental understanding of the nature of endotoxin in ambient air which in turn stems from limitations in measurement techniques. In this paper we will describe the latest development of new methodologies to:

- develop new methods to size fractionate endotoxin and elucidate structural features;
- develop a novel biosensor for rapid detection of endotoxin, other inflammatory agents and cells (live/dead);
- use a fluorescence-based bioaerosol sensor to understand emission and dispersion of bioaerosol
- characterise industry-specific bioaerosol emissions at composting and farm sites;
- detect microbial pathogens at biowaste and intensive agricultural facilities using novel methods;
- generate improved exposure assessments around biowaste / intensive agricultural facilities using dispersion modelling and Openair.

The latest results of a large consortium project funded by the UK Natural Environment Research Council will be presented within the context of the regulation of industrial emissions and the protection of public health.

Uncertainty with respect to health effects from regulated industrial processes is deleterious to all stakeholders concerned including the public, regulators, the Government, industry and investors. The public remains fearful of the potential health impacts. Regulators face uncertainty in terms of striking the right balance between public health protection and encouraging economic development. Planning and licensing delays constrain Government waste strategy and economic development initiatives and create problems for entrepreneurs trying to deliver Government targets and establish viable businesses. The potential to translate new bioaerosol science into an impactful regulatory science evidence base will be the focus of the presentation.

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