

## New Project Summary Report for M 061: Bioaerosol Concentrations in Mushroom Farm Packhouses

<b>Project Number</b>	31900610
<b>Title</b>	Assessing Bioaerosol Concentrations in Mushroom Farm Packhouses and Growing Facilities
<b>Short Title</b>	M 061
<b>Lead Contractor</b>	Open University
<b>Other Contractors</b>	N/A
<b>Start &amp; End Dates</b>	1 September 2013 to 31 March 2014
<b>Industry Representative</b>	John Burden, Mill Farm Mushrooms
<b>Project Budget</b>	£12,100
<b>AHDB Contribution</b>	£12,100

### The Problem

This project aims to establish the concentrations of bioaerosols present in mushroom farm pack houses and growing units; and to determine whether they contain concentrations associated with health effects in research e.g. infection from viable microorganisms and allergenic/toxic effects from components such as endotoxin and glucan. It is also intended to undertake health questionnaires of workers within those areas to determine whether there are any potential health outcomes.

A cross section of five commercial mushroom farms will be chosen for the survey. This will consist of both large and small operators in order to obtain a representative sample of the industry.

Finally samples or aliquots of samples will be frozen for future investigations when the samples can be re-analysed e.g. for *Trichoderma* assays etc., should survey data be of use in future projects. It will also be possible to analyse these samples utilising real-time PCR in the future to identify to species level.

The British mushroom industry remains a large sector in protected horticulture with a retail value of some £170m per annum. The industry is however very diverse with no trade organisation or body to represent the interests of the various companies. This also means there has historically been no central database of information on issues such as bioaerosol exposure for the industry to refer to. Hence this study intends to establish base line data on bioaerosol concentrations within the working environments on

mushroom growing units to provide the industry with much needed management information which is not readily available at present.

The composition of bioaerosols released from mushroom composting facilities has been previously discussed by Swan et al (2003) amongst others, and they have been found to contain (but are not limited to) airborne bacteria and fungi (viable e.g. live but also dead microorganisms), endotoxins and glucan (cellular wall components with toxicological properties), viruses, yeasts, and also, potentially, secondary metabolites including mycotoxins. This scoping study will concentrate mainly on dust, viable bioaerosols and endotoxin/glucan, but may take other components into account or recommend future work depending on the data as it is collected.

Movement of the mushroom compost through the various production phases, (Phase I, II and III) result in the compost being mixed, blended and tumbled on many occasions all releasing large quantities of bioaerosols that are known to have a potential negative effect on human health. These stages have been well documented (Swan et al, 2003) and controls have been engineered to reduce the impact on those working in those environments. With the checks and controls imposed today, personnel that are affected by the organisms present are quickly identified and removed from exposure. This survey will not involve compost making facilities where it is known that the potential impact from composting bioaerosols are more prevalent.

Mushroom pack houses and growing facilities do not have moving or tumbling compost when the crop is being packed or harvested, indeed the compost is covered with the casing layer and both materials are fully colonised by the mushroom mycelium. However, both locations will have developed their own microflora and it is the specific air quality of these areas that the survey aims to capture and record. The industry is aware of some of the potential hazards posed by the materials involved in growing mushrooms and has imposed some measures and modified procedures to counter their impact on staff working in those environments. But there remains a very limited knowledge of expected bioaerosol concentrations in packing and growing facilities within mushroom farms and potential health outcomes.

Most bioaerosol studies concentrate on the presence of viable microorganisms such as *Aspergillus fumigatus*, this study attempts to diversify and broadly identify the range of genus present in the work place and quantify non-viable components that have a known health outcome. The study will use a variety of modern sampling techniques to establish concentrations of both viable counts, range of genus present and endotoxin/glucan concentration present in the work environment. The study will fill an information gap that when associated with past and current health records will aid interpretations of future incidences, where currently there is no established base line. This could potentially save the industry substantial amounts in future compensation claims.

Research has shown (Frederickson et al 2013) that in highly contaminated and potentially damp environments that an impinger approach is the most efficient way of characterising concentrations of viable cells and their components. Personal sampling requires filters however (Gladding et al 2003). Hence the approach suggested here is to combine a liquid impinger with filter impaction techniques to

obtain data on personal exposure and potential 'hot spots' personnel could enter for short periods; in a comparative analysis of the various facilities tested. All analyses will take place at the Open University.

There are no exposure limits set for Bioaerosols in the UK and this project does not attempt to set any. However, there is substantial information available in international research on other industries that gives exposure guidelines regarding potential health outcomes (Gladding et al 2003, Swan et al 2003, Stagg et al 2010) hence the importance of establishing whether the same is true in the mushroom industry.

Although not a prime aim of the report a brief personnel organic dust-related health questionnaire on past and recent health issues of staff working in the locations tested will be posed in an attempt to give an indication of the relevance of isolates recorded to the history of recorded health aspects on the farms sampled. Any results presented will be anonymous and not be site specific. However as this is a small scoping study it is not anticipated advanced statistical analysis will be able to be carried out due to the limited amount of samples and participants, but the study will give enough information to determine whether this area of research should be explored further.

The project leader Dr Toni Gladding is a renowned authority on Bioaerosols, especially in performing workplace surveys and an authority on appropriate sampling procedures. At the Open University, which contains one of the best equipped modern laboratories for bioaerosol sampling and enumeration within the UK, she has conducted surveys and published on bioaerosols for and with Defra, The Health and Safety Executive, The Environment Agency, the Waste Resources Action Programme, Zero Waste Scotland and various international waste management companies. Dr Toni Gladding is also the editor of the current bioaerosol sampling protocol that the Environment Agency dictates must be used in surveys on waste compost sites. Her knowledge and experience in the subject is unsurpassed in the United Kingdom.

Dr Toni Gladding belongs to the Open University Integrated Waste Systems (IWS) group, which is an interdisciplinary research and consultancy group concerned with generating policy-relevant understanding of complex waste and resource use issues applicable to the development of sustainable waste management practices (<http://iws.open.ac.uk/>). Scientific and technological work includes research on waste characterisation and environmental impact, health impacts of emissions, compost/digestate standards and bio-processing technologies and evaluation. The group consists of 6 academic staff and approximately 10 technicians.

## **Aims and Objectives**

(i) Project aim(s): The primary aim of this project is to survey bioaerosol exposure to workers within the mushroom growing industry and to enable the industry to understand the risks associated with exposure to bioaerosols.

(ii) Project objective(s): The specific objectives are:

A. To survey concentrations of viable bioaerosols and to identify the major genus present in the working

environment of the pack house and growing facilities on five mushroom farms.

B. To survey concentrations of the bioaerosol components endotoxin and glucan which are as important as viable concentrations in health outcomes.

C. To conduct a basic questionnaire health survey of current staff working in those environments and evaluate potential issues experienced by workers in association with the recorded air quality monitoring results.

D. To assist farms with information regarding potential health outcomes which could potentially result from the working environment containing bioaerosols.

E. To divide the samples into sub samples and store for possible further evaluation on other specific tests at a later date, should such material ever be required.