Public health risks of bioaerosols from intensive farms – a review

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Air Pollution – Definition

According to the WHO, air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere.

Bioaerosols
Biological emissions: Bioaerosols
Where do bioaerosols come from?
Bioaerosol exposure & health

**Upper Respiratory System**

- **Region 1 (> 10 μm):**
  1. Nasal cavity
  2. Throat (pharynx)
  3. Voice box (larynx)

- **Potential Health Effects:**
  - Allergy/Inflammation:
    - Hayfever (allergic rhinitis)
    - Allergic sinusitis
    - Infection

**Region 2 (2.5-6 μm):**

- Connecting airways:
  4. Windpipe (trachea)
  5. Smaller branching airways (bronchus)

- **Potential Health Effects:**
  - Allergy/Inflammation:
    - Asthma
    - Chronic obstructive pulmonary disease (COPD)
    - Toxic pneumonitis
    - Infection

**Region 3 (0.5-2.5 μm):**

- Lungs:
  6. Small airways (bronchioles)
  7. Air sacs (alveoli)

- **Potential Health Effects:**
  - Allergy/Inflammation:
    - Asthma
    - COPD
    - Toxic pneumonitis
    - Alveolitis
    - Infection

**Lower Respiratory System**

(<0.5 μm exhaled)
Public health implications

- Public concern over health effects of living near composting sites
- Systematic review reported qualitative evidence linking bioaerosol emissions from large-scale composting facilities to poor respiratory health in nearby residents
- IED - Main EU instrument regulating pollutant emissions from industrial activities.
- Aims to reduce harmful industrial emissions across the EU, thereby reducing the potential risks to human health & the environment from such emissions

Intensive farms

• Under the IED an intensive farm is defined as rearing poultry or pigs in an installation with more than 40,000 places for poultry or 2000 places for production pigs over 30 kg or 750 places for sows.

• Number of intensive farms has increased in recent years

• Cause of concern: Release a host of harmful pollutants into the air – odours, gases (ammonia, hydrogen sulphide) & BIOAEROSOLS!

• Major sources of bioaerosols are animals, animal wastes, feed & bedding matter
Environmental permitting & the role of PHE

- The IED is implemented in England & Wales legislation through the Environmental Permitting Regulations.

- In England, permitting arrangements require operators to undertake a site-specific bioaerosol risk assessment if an intensive farming operation is within 100 m of a sensitive receptor.

- PHE plays an important role in providing an expert & independent opinion to the regulator (Environment Agency) on the potential health impacts of emissions arising from existing or proposed regulated facilities at the permit application stage.

- Important that the advice we give is based on the best current scientific evidence.
Given the very limited direct evidence of bioaerosol emissions from intensive farming we have considered information on bioaerosol generation from large scale composting facilities. Composting sites are known to produce considerable quantities of bioaerosols and when permitting these industries the Regulator has prescribed a minimum distance of 250 metres from local communities [6]. Exceptions to this 'limit' are allowed if effective mitigation techniques are employed. This limit is based on published studies which indicate that bioaerosols are generally reduced to background levels within 250 metres of the facility, although it is accepted that under certain circumstances, such as stable atmospheric conditions, bioaerosol concentrations may occasionally not be reduced to background levels within 250 metres. We anticipate that further information on the potential of intensive farming industries to generate bioaerosols will become available over the next few years and we would expect this information to be incorporated into future reviews of PPC permits.

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Review

A systematic review of the public health risks of bioaerosols from intensive farming

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Search strategy

• 2 electronic databases (PubMed & Scopus)

• Search of grey literature

• 2-stage screening process based on (1) titles & abstracts; and (2) full texts according to strict inclusion & exclusion criteria
Inclusion criteria

- Peer-reviewed articles or published by a recognised institution between January 1960 and April 2017
- **Design**: Epidemiological studies – experimental and observational
- **Type of facility**: animal (poultry, pig) feeding operations (if it was not clear from the description in the paper whether it was an intensive farm, the paper was included)
- **Exposure**: measured concentrations of bioaerosol components
- **Health outcome**: respiratory, lung function indices, cardiovascular effects, GI effects
- **Population**: workers, residents
- **Data analysis**: the analytic techniques have been reported
- **Language**: English and non-English languages
Selection of included studies

**Screening**
- 5555 References screened by title/abstract
- 5488 References excluded – main reasons:
  - Not farming, or focussed on waste operations
  - Not bioaerosols-related
  - Review papers
  - Full text not available

**Eligibility**
- 67 Full text articles assessed for eligibility
- 30 References excluded – main reasons:
  - Not intensive farming
  - Review papers

**Included**
- 38 Articles included:
  - 22 studies measuring health and exposure outcomes
    - 21 conducted in occupational settings
    - 1 conducted in a community setting
  - 16 studies measuring health outcomes and using an exposure proxy
    - All were conducted in community settings
Main results (1)

- **Occupational studies**: evidence linking occupational bioaerosol exposure to respiratory-tract symptoms

- **Community studies**:
  - **Adults**: results overall were inconclusive
  - **Children**: modest but consistent evidence supporting increased self-reported asthma rates among those children living or attending schools located within close vicinity of an intensive farm (but not clear if this represents a causal association)

- In some studies, health effects were observed at distances >100m BUT no sufficient evidence to support a change from EA’s current permitting guidance of at least 100 m
Main results (2)

- Number of limitations of the existing evidence base – such as the use of self-reported data in many of the health studies and the extensive heterogeneity among the studies

- Identifies a number of research needs that could improve the ability to make causal inferences

  - For example, need for more research with emphasis on speciation to evaluate the potential health effects - some of Dr Emma Marczylo’s research focuses on the development of quantitative assays in order to improve the identification of fungal to species level
  - The need for better measures of health outcomes to replace self-assessments.
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Thank You