Production Practices Associated with Personal Exposure to Inhalable Aerosols during Work in Broiler Chicken Production

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Background

- The United States is the largest exporter of poultry meat.
- Workers are exposed to organic dust while completing tasks in broiler chicken production houses.
- Poultry dust contains the following inflammatory agents: endotoxin, ammonia and bioaerosols.
- Inhalation exposure to poultry dust has been associated with respiratory diseases in agriculture workers and animals.
- Little information is available regarding personal exposure to inhalable aerosols or the impact of production practices on personal inhalation exposure during broiler chicken production.

Objectives

- Determine which production practices are associated with a reduction in personal dust and endotoxin exposure.

Methods

- Personal exposure to inhalable dust and endotoxin during work in commercial broiler farms was measured.
- Personal breathing zone dust samples (n= 69) were collected (Button Aerosol Sampler, SKC, Inc., Eighty Four, PA) while workers completed litter sampling at farms similar in structure and production.
- The association of production practices on inhalable exposures were evaluated using one-way ANOVA analyses (SAS 9.3, Cary, NC).
- Concentrations were compared between houses using the following production practices:
  - Litter Amendment (none, dry or liquid)
  - Ventilation (fan or tunnel)
  - Heater (brooder or no brooder)

Results

- Geometric mean inhalable dust and endotoxin concentrations were 3.9 mg/m^3 (GSD=2.8) and 474 EU/m^3 (GSD=2.09), respectively.
- Inhalable dust exposure concentrations collected in broiler chicken houses using mechanical fan ventilation and a liquid litter amendment were significantly reduced, when compared to use of tunnel ventilation and dry litter amendment, p = 0.0005 and p = 0.009 respectively.
- Brooder heater use within these poultry houses had no significant effect on dust concentrations measured (p=0.255).

Table 1. Descriptive characteristics of personal dust samples

Engineering Control	Condition	Number	Geometric Mean	Geometric Standard Deviation
Litter Amendment	None	14	2.92	1.68
	PLT	37	3.48	1.73
	A7	18	1.85	1.80
Ventilation	Fans	29	2.29	1.82
	Tunnel	40	3.34	1.77
Heater	Brooder	27	3.16	1.97
	No Brooder	42	2.66	1.74
Total Population		**69**	**2.85**	**1.84**

Figure 1. Poultry litter sampling task

Discussion

- Inhalable dust concentrations, measured while litter sampling, exceeded the industry specific recommended exposure limit of 2.7 mg/m^3.
- The geometric mean endotoxin concentration was below the industry specific recommended exposure limit of 614 EU/m^3.
- Personal dust samples were collected over two seasons at multiple locations; temperature and humidity levels may not have been consistent for the sampling duration of the population, creating a seasonal effect.

Conclusion

- Inhalable dust concentrations are lower in houses using mechanical fan ventilation and liquid litter amendments.
- Inhalable dust concentrations exceeded the industry specific recommended exposure limit. However, endotoxin concentrations were below the recommended limit.

Future Research

- Future work is needed to learn more about inhalation hazards and the use of multiple controls within broiler chicken production.
- A future study with a larger sample size, including repeated measures in the same season, may be valuable in effectively evaluating the effects of these engineering controls on inhalable dust concentrations.
- Because bird activity is known to positively correlate with dust concentrations, curtains or light programs should also be implemented to reduce bird movement that result in higher dust concentrations.
- Combining engineering controls and personal protective equipment could effectively reduce dust exposure in the agricultural industry.

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