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/m³ (GSD=2.8) and 474 EU/m³ (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

<table>
<thead>
<tr>
<th>Engineering Control</th>
<th>Number</th>
<th>Geometric Mean</th>
<th>Geometric Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litter Amendment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>14</td>
<td>2.92</td>
<td>1.68</td>
</tr>
<tr>
<td>LT</td>
<td>37</td>
<td>3.48</td>
<td>1.73</td>
</tr>
<tr>
<td>A7</td>
<td>18</td>
<td>1.85</td>
<td>1.80</td>
</tr>
<tr>
<td>Ventilation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan</td>
<td>29</td>
<td>2.29</td>
<td>1.82</td>
</tr>
<tr>
<td>Tunnel</td>
<td>40</td>
<td>3.34</td>
<td>1.77</td>
</tr>
<tr>
<td>Heater</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brooder</td>
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<td>3.16</td>
<td>1.97</td>
</tr>
<tr>
<td>No Brooder</td>
<td>42</td>
<td>2.66</td>
<td>1.74</td>
</tr>
<tr>
<td>Total Population</td>
<td>69</td>
<td>2.85</td>
<td>1.84</td>
</tr>
</tbody>
</table>

Discussion

• Inhalable dust concentrations, measured while litter sampling, exceeded the industry specific recommended exposure limit of 2.7 mg/m³.
• The geometric mean endotoxin concentration was below the industry specific recommended exposure limit of 614 EU/m³.
• 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.

Acknowledgements

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