Airborne Dust, Endotoxin and DNA Downwind From Swine Barns: An Update

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Introduction

The intensive livestock industry is under continuous scrutiny in relation to potential environmental impacts and health safety issues. Adverse health affects due to dust exposure from intensive livestock facilities have received increasing attention and today are a major concern. There is reason to believe that endotoxins and microbial DNA are present in dust exhausted from swine barns. Endotoxin is a pulmonary irritant contained in the cell wall of Gram-negative bacteria that when inhaled may cause cough, phlegm, wheezing,

Adverse health effects due to dust from livestock facilities is a cause for concern.

fever and in severe cases may lead to chronic airway inflammation. In addition, a natural property of the immune system is to respond to the stimulus of microbial DNA. In order to determine the impact of barn aerosols, endotoxin and DNA concentrations must be investigated. Therefore, the objective of this study is to quantify the amount of airborne endotoxin and DNA downwind from a swine facility. It is hypothesized that increased levels of endotoxin and DNA will be detected close to the exhaust fans and that airborne endotoxin and DNA a few hundred meters away will not be different from "fresh air" upwind from the barn.

Experimental Procedures

Project Sites

The project sites were Prairie Swine Centre, Elstow Research Farm Inc. and Big Sky Farms, Rama, SK. Total dust sampling for the determination of airborne endotoxin and DNA commenced in April 2001 and was completed in August 2002.

Air Sampling

A total suspended solids high volume air sampler was used. Three samples were taken at each time point, prior to seeding, during seeding and in mid-summer to incorporate times of high and low dust loading. High volume sampling was performed at 2400m upwind ("fresh air"), 600m downwind from the barn and at an outlet (0.1m). A standard sampling time of 24 hours was used as recommended by Saskatchewan Environment. Total dust was determined by weighing the filters, in triplicate, before and after each sampling event. A weather station that provided continuous data on wind direction, wind speed, air temperature, and relative humidity was established by Dr. Maule to aid in the interpretation of all air samples. Three samples were excluded from analysis (and repeated) due to change in wind direction or other problems.

Post sampling, the dust was then extracted from the filter with sterile nonpyrogenic water during incubation in a sonicator. The extract was analyzed for endotoxin, using a Limulus Amebocyte Lysate test kit, and DNA, using standard UV absorbance techniques.

Statistical Method

A Kruskal-Wallis one-way analysis of variance was used to compare the data. A value of $P<0.05$ was considered statistically significant.

Results and Discussion

Total dust (Figure 1; $P<0.001$) and endotoxin (Figure 2; $P<0.001$) concentrations declined significantly at a distance from the barn. Comparison of mean ranks indicated that at both study sites there was no significant difference between the dust and endotoxin concentrations 600m downwind compared to 2400m upwind but the concentrations at the outlet were significantly higher than the upwind and downwind locations. Location did not have a significant effect on DNA concentrations ($P=0.0733$; Figure 3) around the swine barns. Season did not have an impact on total dust ($P=0.3496$), endotoxin ($P=0.3982$) or DNA ($P=0.8117$) concentrations downwind from swine barns.

The results support the hypothesis that the concentration of total dust and endotoxin 600m downwind from the barns is not statistically different from the "fresh air" upwind from the barn. However, neither distance from the barn nor season had a statistical impact on DNA. Microorganisms are ubiquitous, therefore more detailed research is required to attribute the endotoxin and DNA found in the air downwind from the barns to the swine operation. The data shows that contaminants expelled from the two Saskatchewan swine barns, are diluted to that of background levels 600m downwind from the barn. It may be suggested that airborne contaminants downwind from swine operations are not necessarily a direct result of the swine facility itself, especially in agriculturally active areas. In addition, many environmental factors may have an impact on the distribution of the airborne contaminants. For the purposes of this study it was assumed that the activity within the barn was consistent and would not have an impact on the output of contaminants from the barn. However, the activities within the barn could in fact have an impact on the types of contaminants and the amount of contaminants exiting the barn.

Contaminants expelled from the test barns are diluted to background levels 600m downwind.

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Implications

There appears to be modest environmental impact downwind from barns, which may be managed with controls such as landscaping. These results are applicable to modern confinement livestock operations that interact with neighbours or the general public.

Environmental impact is modest, and can be managed with controls like landscaping.

Acknowledgements

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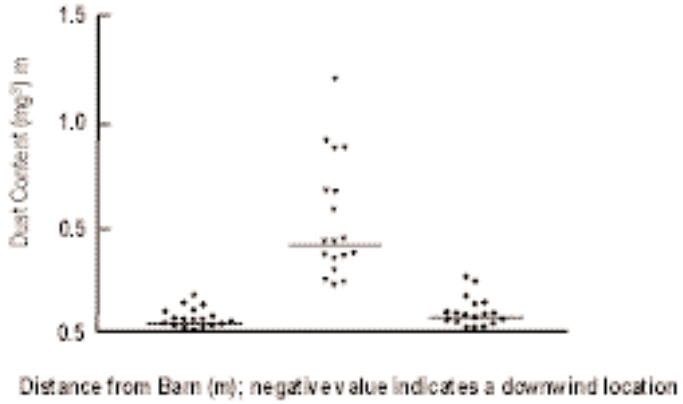

Figure 1: *Total dust concentration (mg/m^3) upwind 2400m, at the outlet (0.1m) and 600m downwind from the barns.*

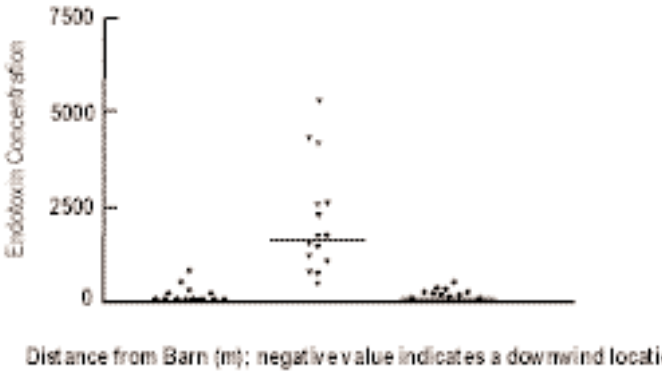

Figure 1: *Endotoxin concentrations (EU/m^3) upwind 2400m, at the outlet (0.1m) and 600m downwind from the barns.*

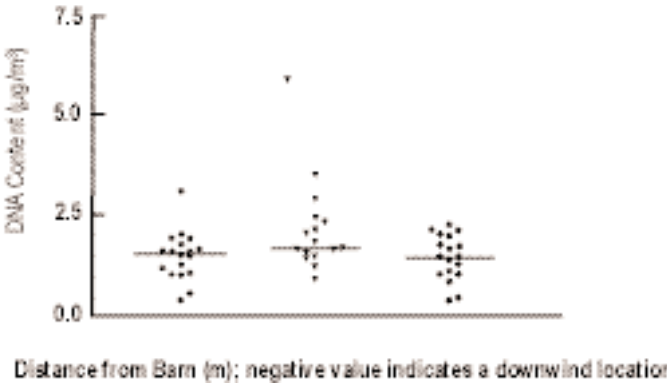

Figure 1: *DNA concentrations (ug/m^3) upwind 2400m, at the outlet (0.1m) and 600m downwind from the barns.*