Canada-Alberta Hog Industry Development Fund

PORK RESEARCH & DEVELOPMENT REPORT

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Manure Storage and Barn Emissions Study

Researchers: Ike Edeogu, MSc, John Feddes, PhD, and Rick Atkins, MSc

Take Home Message:

- *Odours from pig operations are made up of a mixture of different odourous compounds*
- *Odour concentrations are determined by olfactometry*
- *Air dispersion models can predict odour concentrations downwind from livestock operations*
- *Odour intensity is measured by trained Nasal Rangers®*
- *Nasal Rangers® can detect bursts of strong odour, but odour bursts are not detectable in composite odour samples presented to odour panelists*

INTRODUCTION:

Odours from pig operations are made up of a mixture of a number of different odourous compounds. These originate primarily from decomposing manure. However, some odours can come from animals themselves. Odour concentrations are determined by olfactometry. Odour samples are collected in the field in Tedlar sampling bags. The samples are then taken to the lab and presented to trained odour panelists, through an olfactometer. Panelists smell each odour sample and press a button when they first detect an odour. This choice is recorded by a computer program, which then calculates the concentration for each odour sample.

Odours from livestock operations are considered to be a nuisance by *Alberta's Agricultural Operations Practices Act* (AOPA). As a result, the act requires a minimum distance separation (MDS) between new or expanding livestock operations and neighbouring residences. The MDS formula in AOPA was developed based on 20 years of field observations and experience, and is used to calculate the required separation distances. However, since the separation distances are not calculated using scientifically measured odour data, questions of accuracy and fairness of the formula have arisen.

The purpose of this study was to measure odour emission rates from barns and manure storage facilities on pig operations, and use the collected data to scientifically predict odour concentrations downwind from pig operations using an air dispersion computer program (air dispersion model). In addition, this research set out to determine if a relationship existed between odour concentration (as measured by olfactometry) and odour intensity (as measured by Nasal Rangers® – trained human assessors).

MATERIALS AND METHODS:

Odour Emission Rates: Odour emissions were determined for manure storage facilities and animal barns at two farrow-to-finish pig operations in central Alberta. Manure from one barn was stored in an earthen manure storage with a straw cover for odour control, while the other used an open concrete manure storage tank. Odour emissions from the manure storage facilities were

measured using a floating chamber (wind tunnel). The wind tunnel was designed to create a vented chamber over the manure surface that simulated a wind sweeping across the manure surface. Odour samples were collected in 10 L bags from the outlet of the wind tunnel and shipped to the University of Alberta's (U of A) olfactometry lab for odour concentration analysis.

Samples of odours emitted from the exhaust fans of the same two barns were collected in bags and also underwent olfactometry at the U of A. Odour emission rates from barns were then calculated using odour concentrations and ventilation rates for each room. The room ventilation rates were based on the amount of dilution of the CO_2 produced by the pigs. Odour samples were collected, and Nasal Ranger® measurements were conducted for four weeks at each of the farms on Tuesdays at 06:00, Wednesdays at 18:00 and Thursdays at 12:00.

Air Dispersion Modeling: Odour emission rates measured from the manure storage facilities and animal barns at the two pig production sites were incorporated in an air dispersion model to predict odour concentrations at various distances downwind from the barns. Weather data, including wind speed, wind direction, and ambient temperature were measured on site and incorporated into the computer model.

In order to assess the accuracy of the computer model's predictions, Nasal Rangers® carried out a number of field odour measurements at distances ranging from 250 to 950 m from the two pig production sites. Odour concentrations predicted by the computer model were then compared to odour concentrations measured by the Nasal Rangers®.

RESULTS:

Odour emission rates, measured as odour units (OU) per seconds (s) per m^2 of manure surface area from the straw covered manure storage facility ranged from six to 65 OU/s/m^2, while those from the concrete open storage tank ranged from eight to 47 OU/s/m^2. There were no differences between the emission rates from either manure storage system in this study. The odour emission rates from the barns themselves ranged between 0.01 and 0.79 OU/s/kg of pig mass at the first farm with the straw covered manure storage, and between 0.01 and 0.89 OU/s/kg at the second farm with the concrete manure storage tank. Odour intensity, as measured by the Nasal Rangers®, did not correlate well with odour concentration as measured by olfactometry. Odour emissions from both the manure storage facilities and the barns were variable and depended on the day and time of day that odour samples were collected.

DISCUSSION:

A number of comparisons were made between downwind odour concentrations predicted by the dispersion model and concentrations measured in the field by the Nasal Rangers®. However, the relationship between the predicted and actual measurements were found to be weak. Nasal Rangers® were able to immediately detect bursts of strong odour when in the field, but these odour bursts were not captured in the composite odour samples in the sample bags presented to the odour panelists at the U of A.

Further work needs to be conducted to develop better protocols to accurately measure odour emission rates from barns and manure storage facilities and to develop protocols to increase the accuracy of measurements by trained assessors. From the work conducted on this project, the Odour Control Initiative, a collaborative association between Alberta Agriculture, Food and Rural Development, the University of Alberta, Alberta Research Council and Alberta's livestock industry was initiated.

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For more information, contact:

Alberta Pork, 4828 - 89 Street, Edmonton, Alberta, Canada T6E 5K1

Phone: (780) 474-8288 Fax: (780) 479-5128

E-mail: info@albertapork.com Web site: www.albertapork.com