5-2005

Ammonia Concentration Evaluation in Deep-Bedded and Concrete Floor Housing Systems for Grow-Finish Swine in Brazil

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Abstract
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Keywords
Swine, housing systems, ammonia

Disciplines
Bioresource and Agricultural Engineering

Comments
This proceeding is from Proceedings of the Seventh International Symposium, 18-20 May 2005 (Beijing, China). Publication Date 18 May 2005, ASAE Publication Number 701P0205. Ed. T. Brown-Brandl.

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This is not a peer-reviewed article.
Livestock Environment VII,
Proceedings of the Seventh International Symposium, 18-20 May 2005 (Beijing, China)
Publication Date 18 May 2005, ASAE Publication Number 701P0205.

AMMONIA CONCENTRATION EVALUATION IN DEEP-BEDDED AND CONCRETE FLOOR HOUSING SYSTEMS FOR GROW-FINISH SWINE IN BRAZIL

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ABSTRACT

Swine production represents an important economic and social activity in Brazil, however, its traditional exploration is considered by the ambient institutions as an activity of great pollutant potential. The objective of this study was to compare ammonia level in the traditional slatted concrete floor system, a bedded system with wood shavings on top of the concrete floor, or a bedded system with rice hulls on top of the concrete floor. The study was conducted at the EMBRAPA Swine Research Station in Concordia, Santa Catarina, Brazil during August to November 2002. Significant differences among the treatments were observed; the concrete flooring system had the lowest ammonia levels, whereas both bedded systems shared fairly similar levels. However, these measured values in all the treatments were below the threshold level of 20 ppm.

KEYWORDS: Swine, housing systems, ammonia

INTRODUCTION

Swine production represents an important economic and social activity in Brazil, however, its traditional practices are considered by the ambient institutions as activity of great pollutant potential.

The challenge of the swine production is the demand of the environmental sustainability of the areas of intensive production. The conventional housing system for intensive grower-finisher swine production used in Brazil features open sidewalls, solid or partially slatted concrete floors, and manure-flushing gutters.

Many systems have been developed to successfully raise swine from deep bed finishing facilities, including both permanent and portable designs.

A litter manure handling system consists of dry, absorbent material (litter) such as wood shavings or peanut hulls that are spread on the floors of animal housing facilities to absorb manure (NRAES, 1992).

Ammonia from animal wastes and fertilizers was believed to constitute about 90% or more of the anthropogenic NH_3 emission (Buijsman *et al*., 1987). Ammonia is the most important gas healthwise found in swine buildings (Heber et al., 1996).

High concentrations of NH3 inside the animal houses represent potential health hazards to human and animals (Crook *et al*., 1991).

The Swine and Poultry Research Division of EMBRAPA was the pioneer in Brazil in studying bedded housing systems for swine production. According to McGlone (1999), pigs raised on bedding showed less cannibalism, less cushion lesions at the slaughter plant, and tended to have

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fewer respiratory problems than pigs raised on concrete slatted floors. However, few studies have been made in Brazil to evaluate these systems.

The objective of this study was to compare ammonia level in the traditional slatted concrete floor system, a bedded system with wood shavings on top of concrete floor, or a bedded system with rice hulls on top of concrete floor.

MATERIALS AND METHODS

The study was conducted at the EMBRAPA Swine Research Station in Concordia, Santa Catarina, Brazil during August to November 2002. Three open-sided and naturally ventilated buildings were used, one per treatment of conventional slatted concrete floor, a bedded system with wood shavings, a bedded system with rice hulls. Each building had four pens (6.0 x 5.0 m each) and shared the same structural characteristics and orientation. There was a 10 m separation distance between the ends of the buildings.

A total of 216 pigs (Landrace x Large White, mixed sex) at an initial body weight of about 25 kg were obtained from the EMBRAPA stock for the study. The animals were acclimated under the same conditions prior to start of the treatment comparison. They were then randomly assigned to groups of 18 per pen or 72 pigs per building.

The periods are defined in animal days of life: Period 1 – 64 to 98 days of life (25-50 kg); Period 2 – 99 to 126 days of life (50-75 kg); Period 3 – 127 to 162 days of life (75-105 kg) and Period 4 – 163 to 186 days of life (105-120 kg).

To quantify exposure to ammonia, 16 instantaneous measurements of concentration (ppm) per treatment were taken at 0.20 m above the floor (animal snout height) throughout the experimental period. It was measured with a portable electrochemical ammonia sensor (GasMan II, Crowcon, with accuracy of ±1ppm) (0 – 50 ppm). The sensor had a calibration certificate provided by the manufacturing company. The measurements were taken in two hours (9:00 and 14:00 h), during experimental period.

The airflow in the boxes was measured at 0, 20 m above the floor, but not significantly different between the treatments was found. The data was performed using analysis of variance and regression. Means were compared using Tukey's test at 5% significance level.

RESULTS AND DISCUSSION

In Table 1 ammonia concentration values are presented. Significant differences among the treatments were observed: the concrete flooring system had the lowest ammonia levels, whereas both bedded systems shared fairly similar levels.

However, these measured values in all the treatments were below the threshold level of 20 ppm as recommended by Hamilton et al. (1996) and NIOSH (2003) for animal housing. (Figure1).

Table 1. Medium values and Standard deviation of ammonia concentration (ppm), in Treatments performed, during experiment period (16 replicates per treatment).

Period	Treatment 1 (wood shavings)	Treatment 2 (rice hulls)	Treatment 3 (concrete floor)
1	6,2a (7,1)	6,5a (6,0)	3,4a (2,6)
2	6,4a (6,6)	6,5a (6,1)	3,9b (2,3)
3	7,5a (6,9)	7,3a (7,0)	3,7b (2,4)
4	7,6a (6,8)	6,6a (5,9)	2,5b (1,9)
Mean	6,9	6,7	3,4

Values followed by the same small letter in the row and capital letter in the column were not significantly different (P>0.05)

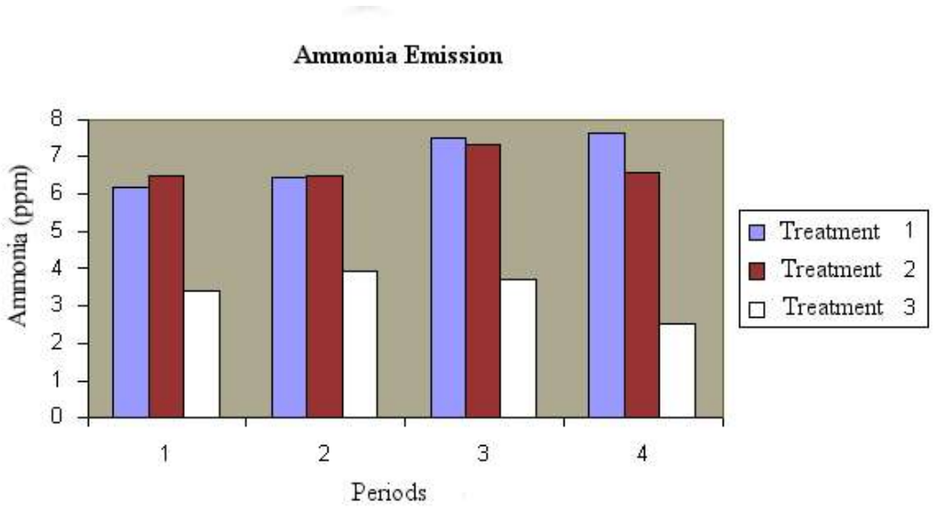

Figure 1. Ammonia concentration in the wood shavings-bedded (treatment 1), rice hulls- bedded (treatment2) and conventional concrete floor (treatment 3) system.

CONCLUSION

For the experimental period of August to November, in Concórdia – SC, the following conclusions were drawn:

- Significant differences among the treatments were observed; the concrete flooring system had the lowest ammonia levels, whereas both bedded systems shared fairly similar levels. However, these measured values in all the treatments were below the threshold level of 20 ppm.
- Deep-bedding system for grow-finish swine in open buildings under Brazilian climate seems to be a promising, viable option for the industry, due to adequate ammonia levels observed.

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