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# Swine Housing Impacts on Environment and Behavior: A comparison between hoop structures and total environmental control

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# Swine Housing Impacts on Environment and Behavior: A comparison between hoop structures and total environmental control

## **Abstract**

The effect of housing on animal environment and behavior have been studied in a comparative trial with three deep-bedded hoop structures and one totally, environmentally- controlled slatted-floor building. In order to assess animal welfare, behavior indicative of both poor and rich welfare were quantified. Behavior indicative of poor welfare were considered to be the performance of aberrant behavior, stereotypical behavior and excessive fighting. Behaviors indicative of rich behavior were the performance of normal maintenance behaviors and play behavior. Hoop structures experienced lower winter air temperatures than did the confinement building (mean, 4.8<sup>0</sup> vs. 18.1<sup>0</sup> C), but effective temperatures for the animals were enhanced in the hoop structure by heat generated by the decomposing bedded pack (ranging from approximately -1.1<sup>0</sup> C to 47<sup>0</sup> C). The confinement building maintained a higher ammonia level than did the hoop structures. Pigs raised in the confinement system which did use bedding were found to be resting more often (P < .03); however, they were also found to perform more aberrant and stereotypical behavior in addition to more frequent fighting (P < .03). Pigs raised in the hoop structure were found to perform more play behavior than confinement raised pigs (P < .03). Based on the greater incidence of aberrant, stereotyped, and agonistic behavior of confinement pigs and the greater incidence of play behavior by hoop raised pigs; the welfare of hoop raised pigs is considered to be richer than that of confinement raised pigs. The major contributing factor to explain this is likely the provision of bedding, which allows the pigs an opportunity to perform species typical behavior.

## **Keywords**

swine, housing, welfare

## **Disciplines**

Animal Sciences | Bioresource and Agricultural Engineering | Statistics and Probability

## **Comments**

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# SWINE HOUSING IMPACTS ON ENVIRONMENT AND BEHAVIOR: A COMPARISON BETWEEN HOOP STRUCTURES AND TOTAL ENVIRONMENTAL CONTROL

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## ABSTRACT

The effect of housing on animal environment and behavior have been studied in a comparative trial with three deep-bedded hoop structures and one totally, environmentally- controlled slatted-floor building. In order to assess animal welfare, behavior indicative of both poor and rich welfare were quantified. Behavior indicative of poor welfare were considered to be the performance of aberrant behavior, stereotypical behavior and excessive fighting. Behaviors indicative of rich behavior were the performance of normal maintenance behaviors and play behavior. Hoop structures experienced lower winter air temperatures than did the confinement building (mean, 4.8<sup>0</sup> vs. 18.1<sup>0</sup> C), but effective temperatures for the animals were enhanced in the hoop structure by heat generated by the decomposing bedded pack (ranging from approximately -1.1<sup>0</sup> C to 47<sup>0</sup> C). The confinement building maintained a higher ammonia level than did the hoop structures. Pigs raised in the confinement system which did use bedding were found to be resting more often ( $P < .03$ ); however, they were also found to perform more aberrant and stereotypical behavior in addition to more frequent fighting ( $P < .03$ ). Pigs raised in the hoop structure were found to perform more play behavior than confinement raised pigs ( $P < .03$ ). Based on the greater incidence of aberrant, stereotyped, and agonistic behavior of confinement pigs and the greater incidence of play behavior by hoop raised pigs; the welfare of hoop raised pigs is considered to be richer than that of confinement raised pigs. The major contributing factor to explain this is likely the provision of bedding, which allows the pigs an opportunity to perform species typical behavior.

**KEYWORDS:** swine, housing, welfare

## INTRODUCTION

Total confinement systems of swine production offer several benefits and costs in terms of animal welfare. Swine raised in total confinement are protected from environmental extremes and predators; however, concern for their welfare stems from observations of stereotypic behavior and lameness of pigs that are common in some of these systems. Total confinement systems are also expensive to build and maintain compared to less intensive systems. For these reasons, producers have become interested in buildings termed “hoop” structures. These structures provide an inexpensive alternative to total confinement buildings. “Hoop” structures recently have been introduced as an inexpensive alternative to today’s total confinement system. These structures are made of 1.8 meter side walls with a tarp pulled over trusses to form a Quonset shaped structure. In addition to being open aired structures with just one large area to house finishing pigs, this system uses bedding to manage manure and provide warmth for the swine. To investigate this new method of swine housing, we compared the behavior and the response to handling of pigs housed in hoop structures to pigs housed in a system that used floor spacing typical of that found in today’s systems and in which no bedding was provided.

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The objective of our research was to compare the welfare of pigs and the environmental quality between a Hoop structure (Hoop) and a non-bedded confinement system (NBCS). An objective analysis of these two systems would allow for future research to concentrate on optimizing the welfare and environment in both systems, and it will provide information to producers on how to best manage pigs in either system.

## MATERIALS AND METHODS

The following experiments were conducted with the approval of the Iowa State University Committee on Animal Care (Log number, 1-9-4092-1-S). Four experiments were conducted, two in the winter and two in the summer, to assess the welfare of pigs based on: the incidence of aberrant behavior, and the performance of play behavior. A portion of the data for Experiments 1 and 2 have been previously published (Lay et al., 2000); therefore this paper will concentrate on those data obtained during Experiments 3 and 4. Environmental quality was assessed by evaluating air temperature and ammonia levels in both treatments and by the bedded pack temperature of the decomposing manure in the hoop structures.

All four experiments were conducted similarly. The Hoop pigs (450) were housed in one of three hoop structures (n = 150 per hoop) measuring 9.1 x 18.3 m each, providing approximately 1.1 m<sup>2</sup> per pig. The hoop structures were bedded with bales of cornstalks such that the entire floor was covered except for a 5.5 x 9.1 m concrete slab on which two feeders (12 feeder spaces each, Pride of the Farm) and two waterers (2 water spaces each, Richie) were placed. When the bedding started to become wet new bedding was added on top of the existing bedding.

The NBCS was designed as a total confinement, slatted floor building with 3.96 x 4.11 m pens over a shallow manure pit for liquid manure management. Each of the six pens housed 22 pigs from the start of the study until they reached slaughter weight (approximately 114 kg), providing approximately .74 m<sup>2</sup> per pig. Pens were separated from each other and an access alley by vertical metal gating. The pens were equipped with two double headed nipple waterers and one feeder providing eight feeder spaces. Room temperature fluctuated between seasons from approximately 15 to 24°C.

Both the confinement unit and the Hoop structures were located on the same farm, separated by approximately 45 meters. Both treatments received the same feed and were managed by the same personnel to decrease treatment differences due to management.

### Behavioral Observations

Pigs in both treatments were observed simultaneously by trained observers. All occurrences of aberrant behavior such as urine drinking, anal massage, belly nosing, repetitive biting or chewing on a conspecific, and bar biting were recorded. In addition, "manipulation" was recorded when a pig bit, chewed, or rooted on another pig's body anywhere besides the belly, tail and ear, as these behaviors were considered separately. All agonistic encounters during the 15-minute observations were recorded. Agonistic encounters were defined as "long" if they were more than five seconds or "short" if they were five seconds or less. All occurrences of play behavior were also recorded. Play behavior consisted of spontaneous scampering, spontaneous running (for Hoop pigs this would occur often with cornstalk in mouth), and chasing (when partners switched roles).

### Environmental Conditions

Temperature of the bedded pack area were obtained by measuring with a digital thermocouple probe at 7.6 and 15.2 cm below the surface of the pack. Air quality was assessed by measuring both air temperature and ammonia levels. In the NBCS facility the temperature and relative humidity were continuously monitored using remote sensors. Ammonia was occasionally measured using dosimeter tubes. Air temperature was also measured continuously in the hoop structures.

Data for all behavioral observations were corrected for the number of animals per pen by dividing the rate of the behavior by the number of animals in the pen. The general linear model procedure of SAS (1988) was used on the log-transformed (to homogenize the variance) data. The pen was

considered the experimental unit and the main effects in the model were: treatment, day, session (observation during the day), and appropriate interactions.

## RESULTS

### Behavioral data

Results between Experiments 3 and 4 were consistent with pigs housed in the NBCS performing more manipulations and belly nosing of other pigs ( $P < .01$ , Figure 1). Similarly, pigs in the NBCS system also had fewer incidences of play behavior ( $P < .0001$ ). These results are consistent with those of the previous two Experiments. We also found that pigs housed in the NBCS had a greater frequency of eating during both experiments ( $P < .0001$ ).

The bedded pack of decaying corn stalks and manure creates a large amount of heat (Figure 2). The pattern of heat generation, in terms of location in the hoop, is likely to change but its characteristic expression of the amount of heat is most likely consistent. Bedding temperature in the hoop was highest in the sleeping/resting area, and lowest along the east and north walls of the hoop, as indicated in Figure 2. The sleeping/resting area had a moisture content of approximately 50% (wet basis), which was adequate to support rapid decomposition but porous enough to remain largely aerobic. Lower temperatures in the wetter regions correspond with moisture levels in the range of 60 to over 70%. Throughout this region we observed the pig traffic on moist or dung-filled bedding caused severe packing and greatly reduced porosity. We hypothesize this translated into anaerobic conditions in this area, so that decomposer microorganisms were unable to fully oxidize carbon sources and thus did not generate much heat.

Because the pack generated heat, the pigs could burrow down into a desired degree of warmth. A significant number of the agonistic encounters recorded in the hoop structures occurred as pigs tried to maneuver toward these desired locations, dependant upon the weather. The second, and major, area of agonistic encounters occurred around the feeders and waterers.

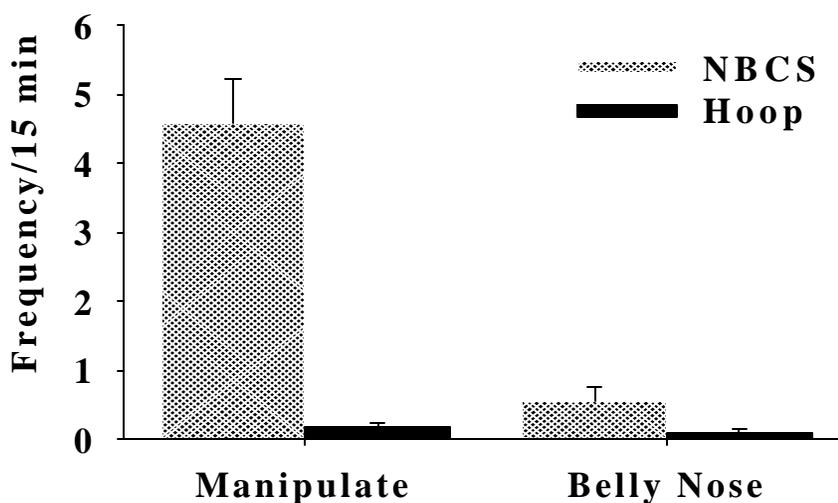


Figure 1 indicates that NBCS pigs performed more manipulations and belly nosing than Hoop raised pigs ( $P < .01$ ).

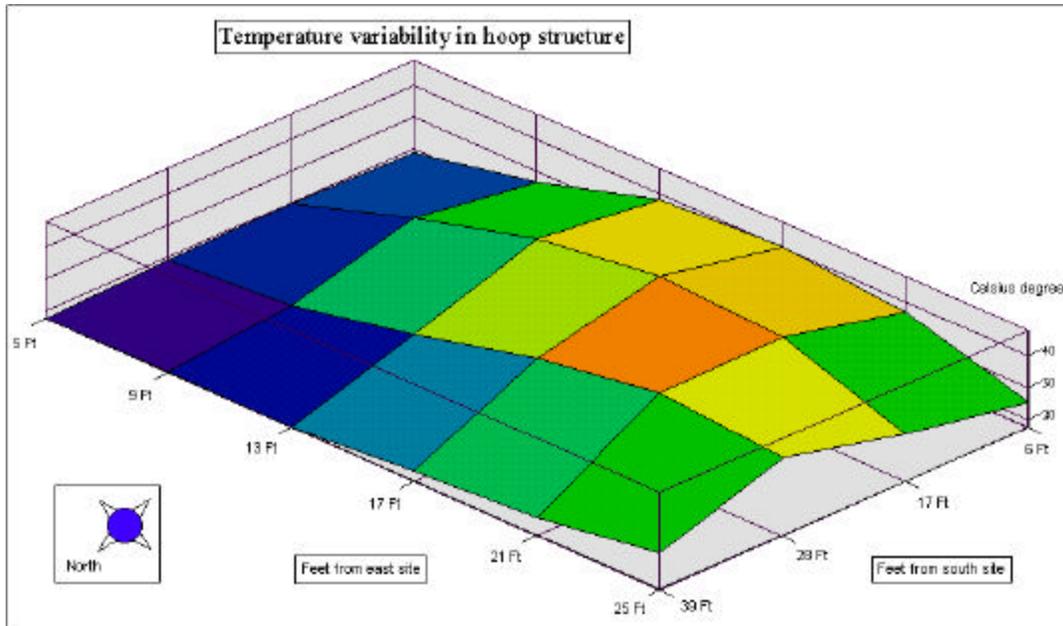


Figure 2 showing the variation in bedding temperature within a hoop structure.

Tables 1 and 2 give average monthly temperatures for Experiments 2 and 3 (data for Exp. 4 was similar). During trial 2, the average temperatures for the two building styles were similar but the standard deviations for the hoops were larger. This could indicate that the diurnal temperature swing was larger in the hoop, giving these animals a better chance to recover from daytime heat stress conditions. Table 4 illustrates the large advantage that the TEC has over the hoop structures in maintaining a temperature within the thermoneutral zone during the winter.

Table 1 Monthly Average Air Temperatures for Experiment 2.

	Totally Enclosed Confinement		Average Hoop	
	Ave °F (°C)	Std Dev	Ave °F (°C)	Std Dev
July 1998	76.0 (24.4)	6.3 (3.5)	76.7 (24.8)	7.8 (4.3)
August 1998	76.4 (24.7)	5.1 (2.8)	75.4 (24.1)	6.8 (3.8)
September 1998	73.7 (23.2)	7.0 (3.9)	71.2 (21.8)	9.4 (5.2)
October 1998	64.7 (18.2)	4.8 (2.7)	54.7 (12.6)	8.2 (4.6)
November 1998	58.9 (14.9)	2.9 (1.6)	38.2 (3.4)	7.9 (4.4)

Table 2 Monthly Average Air Temperatures for Experiment 3.

	Totally Enclosed Confinement		Average Hoop	
	Ave °F (°C)	Std Dev	Ave °F (°C)	Std Dev
December 1998	73.9 (23.3)	1.2 (0.7)	21.2 (-6.0)	13.0 (7.2)
January 1999	63.4 (17.4)	3.5 (1.9)	31.3 (-0.4)	5.6 (3.1)
February 1999	60.3 (15.7)	2.4 (1.3)	36.5 (2.5)	8.8 (4.9)
March 1999	61.6 (16.4)	3.1 (1.7)	41.7 (5.4)	10.7 (5.9)
April 1999	63.1 (17.2)	3.7 (2.1)	53.4 (11.9)	9.3 (5.2)
May 1999	65.0 (18.3)	5.6 (3.1)	60.0 (15.6)	9.0 (5.0)

## DISCUSSION

This study was designed to compare two completely different systems for housing swine: hoop structures vs. non-bedded confinement system. Because of the inherent differences in these two

systems it is impossible to attribute the differences in behavior and physiology that were found to exist between these two populations of pigs to any one factor. Obvious differences between the systems that could have contributed to biological differences between pigs are: provision of bedding, temperature, space, group size, complexity of the environment, the ability of the animal to choose a microenvironment, and the ability to perform “natural” behaviors.

The ability of the bedded pack to generate heat and the open space provided in the hoop structures allows pigs to choose the microenvironment in which they are most comfortable. This ability of choice may be one important factor in modulating the pigs exposure to stress.

### **SUMMARY**

McBride (1984) challenged ethologists to formulate management systems “. . .in which all of the natural behaviors and activities of livestock are facilitated, into a productive life, more appropriate for their behavioral repertoires than most modern systems.” And he suggests that this approach will help to decrease the chronic welfare problems associated with animals not adapting to intensive production. It appears the Hoop structures are a move in this direction. Our study found that pigs raised in Hoop structures performed fewer abnormal behaviors and had a greater rate of play behavior. Based on these findings it appears that pigs housed in hoop structures are less affected by stressors in their environment. Future research should attempt to determine which factors are most important to the pig and then try to incorporate these into production systems.

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