Optimizing temperature requirements of pigs to reduce energy use in swine production

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APPLICATION FOR PRODUCERS

Raising sows and grow-finish pigs at environmental temperatures preferred by the animals can reduce energy cost and greenhouse gas emissions. Previous work with sows has shown a significant cost savings.

SUMMARY

The overarching goal of this research project is to investigate the optimum environmental temperature requirements of sows and grower-finisher pigs to reduce energy costs and greenhouse gases while maintaining their long-term overall productivity and performance. The project consists of four phases; 1) group-housed gestating sows will be kept for 6 weeks either at 16.5 °C (current recommended set-point) or 8 °C (preferred temperature determined in a previous study); 2) determine the preferred environmental temperature of grower-finisher pigs, using the operant mechanism and experimental protocols developed in the previous sow study; 3) grow-finish pigs will be kept for 6 weeks at either the current recommended set-point temperature, or the preferred temperature determined in phase 2; 4) assessment of environmental (carbon) footprint, cost analysis and development of recommendations for practical application of the optimized temperature management in commercial barns. Preliminary results of phase 1 show a reduction in energy consumption of >50% in group-housed gestation rooms with a setpoint of 8 °C vs. 16.5 °C.

INTRODUCTION

Rising cost of energy has caused financial hardship for many producers, with energy costs for a typical 500 sow farrow to finish pig production unit in Saskatchewan estimated to be ~$6.70 per pig sold. Heating costs are a substantial part of the total energy costs, so reducing temperature set-points in the barn to reduce how often the heater is running would help reduce energy costs.

A previous research project showed that group-housed sows could tolerate temperatures up to 8 °C lower than the typical set-point (16.5 °C) currently maintained in most gestation barns, without compromising the welfare and productivity of the animals. However, the impact of raising sows at this lower temperature on their long-term reproductive performance still needs to be evaluated in order to fully assess the economic benefits of adopting this technology across the industry.

Presently, no study has been conducted yet on the feasibility of a similar temperature set-point reduction for grower-finisher pigs. Thus, this project has been conceptualized to fill this gap by conducting a series of experiments to validate and update the current industry recommendations on temperature set-points for grower-finisher pigs and to assess the impact on energy costs and overall pig production performance.

EXPERIMENTAL PROCEDURES

Phase 1: Building upon the findings from the previous project, the goal of this phase is to implement the preferred temperature set-point determined from the previous study in actual sow gestation rooms to assess the impact on energy consumption and the long-term reproductive performance of the sows under conditions that represent actual commercial sow barns. Two identical sow rooms at the PSC pig production barn configured for group housing system will be used. One room will be designated as Control with temperature maintained at 16.5 °C (which is the typical set-point currently applied in commercial sow gestation barns) while the other room designated as Treatment will have temperature maintained at the sows' preferred temperature determined from the previous study (8 °C). A total of 3 sow trials will be conducted, with each room housing 45 sows per trial. Each trial will last for 6 weeks.

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Phase 2: The aim of this phase is to determine the preferred environmental temperature of grower-finisher pigs, using the operant mechanism and experimental protocols developed in the previous ADF study. Two fully instrumented, controlled-environment chambers at the Prairie Swine Centre (PSC) barn facility will be used. To train the grower-finisher pigs to control their own environmental temperature, the developed operant mechanism will be installed in each chamber. The mechanism is configured to allow the pigs access to a switch that controls the heating system of the chamber as well as a small radiant heater which provided an immediate feedback reward. In addition to the functioning heat control switch, a 'dummy' switch that does not operate the radiant heater (i.e., unrewarded activity) will also be installed close to the real switch to distinguish between deliberate behavior by the pigs to control the room temperature and random interaction with the mechanism. As proven in the previous ADF study, this set-up will allow the pigs to demonstrate their preferred environmental temperature by enabling them to control the operation of the heating and ventilation equipment installed in the room. A total of 5 replicate trials will be carried out in the environmental chambers during winter months, with each chamber housing 5 grower-finisher pigs. The duration of each replicate trial is 3 weeks with the first week dedicated to allowing pigs to acclimatize to the chamber and to learn to use the operant mechanism, while the remaining 2 weeks is designated for data collection.

Phase 3: After the preferred environmental temperature of the grower-finisher pigs is established from the previous phase, the goal of this phase is to implement the preferred environmental temperature in actual grow-finish rooms to assess the impact on energy consumption and the pigs' performance under actual commercial barn conditions. Two identical grow-finish rooms at the PSC barn will be used, one room will be designated as "Pre-set" with temperature maintained at the typical set-point applied in grow-finish barns using a typical controller, while the other room designated as Treatment will have temperature maintained at the pigs' preferred temperature determined from phase 2. A total of 3 trials will be conducted, with each room housing 100 pigs per trial. Each trial will last for 6 weeks.

Phase 4: Following the actual in-barn experiments, an environmental footprint assessment will be performed using a sustainability assessment tool developed in a related study to determine the resulting carbon footprint from the application of the preferred temperature set-points in gestation and grow-finish barns. In addition, a feasibility analysis will be conducted to determine the costs and requirements for the proper implementation of the optimized temperature management approach in a typical commercial swine production facility. The data collected from this study, together with the information on all the expenditures and costs incurred during actual in-barn implementation including the purchase of materials and equipment, and labour and operating costs, will be used in the economic analysis. Recommendations for practical application of the optimized temperature management in commercial barns will also be developed.

RESULTS

Phase 1 trials are currently underway. Some of the measured parameters from the first trial conducted from March 6 to April 17, 2024, are presented below.

A. Room temperature

Figure 1 illustrates the average air temperature across various spatial locations within each room. In the Control room with set-point maintained at 16.5 °C (which is typical for commercial gestation barns), the measured air temperature ranged between 15.5 and 16.9 °C over the duration of the trial. In comparison, the Treatment room (with temperature set-point maintained at 8 °C, which was determined as the sow's preferred temperature based on a previous study) exhibited air temperatures ranging from 7.4 to 10 °C.

B. Relative humidity

Figure 2 shows the average relative humidity (RH) in both rooms over the duration of the completed trial. The RH values in the Control room ranged between 57.0 to 60.7% and had an average of 58.6 ± 1.6%. On the other hand, the Treatment room had an average RH of 56.0 ± 0.3% and ranged from 55.7 to 56.4%. Both rooms showed RH levels within the recommended range for swine barns, which is between 50 to 65%.

C. Energy consumption (electricity and natural gas)

The electrical energy usage in each room included electricity consumption by the ventilation fans, furnace motor, and room lighting, while the natural gas utilized by the furnace for room heating during the experiment was also monitored (Table 2). For the duration of the trial, the total electrical energy usage in the Control room was measured at 19.12 kWhr while the Treatment room recorded a total usage of 13.77 kWhr. For the total natural gas consumption, the Control room recorded usage of 3,214 BTU, which was more than double the gas consumption in the Treatment room, which totaled 1,355 BTU for the duration of the experiment.

Table 1. Total energy consumption measured from the Control and Treatment rooms during the first trial.

Eelectricity consumption, KWHr		Natural gas consumption, BTU	
Control room	Treatment room	Control room	Treatment room
19.12	13.77	3,214	1,355

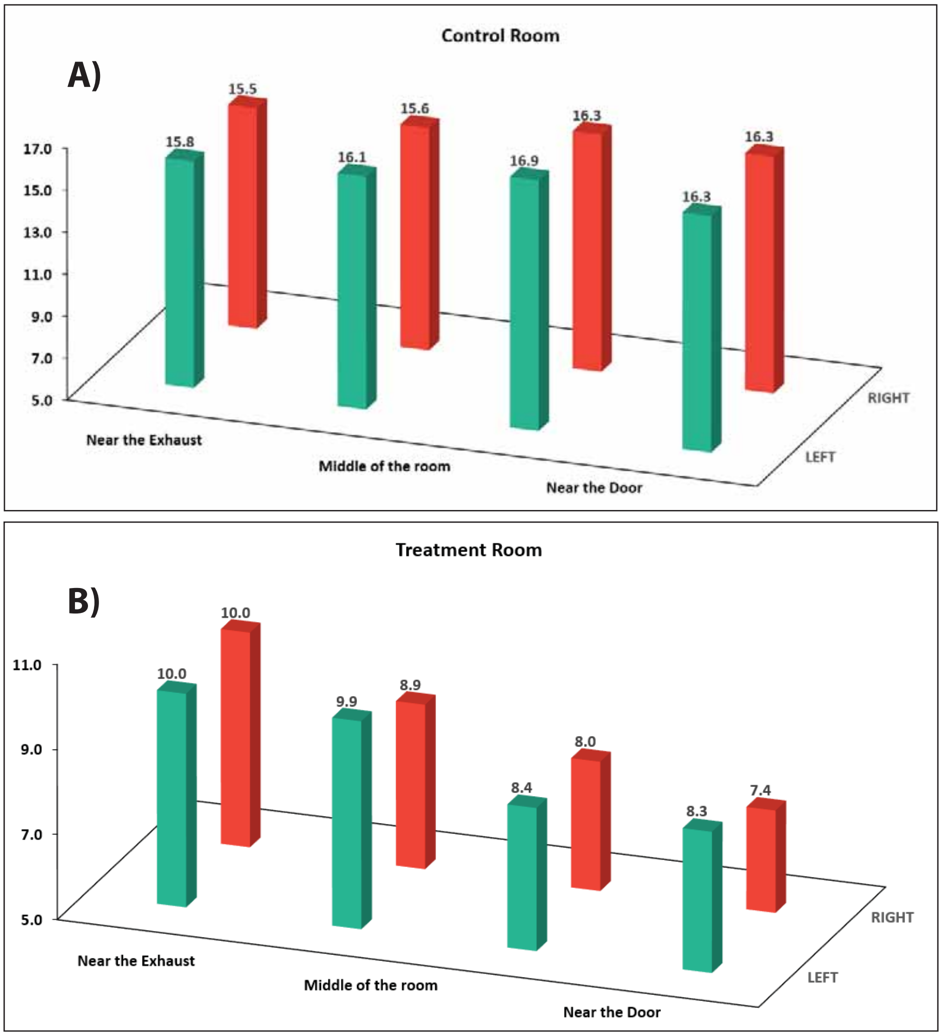

Figure 1. Average air temperature measured at various sampling locations in the Control (A) and Treatment (B) rooms (n = 6,074 to 6,078 temperature readings).

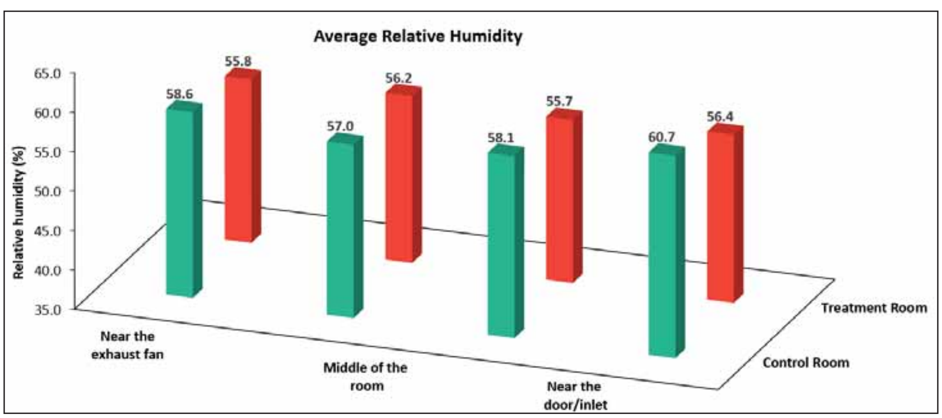

Figure 2. Average relative humidity measured at the occupied space of the sows in the Control and Treatment rooms over the duration of the trial (n = 6,078 to 6,085 RH readings).

IMPLICATIONS

This work has been conceptualized to validate and update the current industry recommendations on temperature set-points for gestating sows and grower-finisher pigs and to assess the impact on energy costs and overall pig production performance. The expected deliverables from this project are: 1. optimized temperature requirements for sows and grower-finisher pigs that reduce barn energy use while maintaining productivity and performance, and 2. economic feasibility of implementing updated temperature management in gestation and grow-finish barns.

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