Carcass Management Research at LBREC

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A foreign animal disease outbreak or other catastrophic event impacting the swine industry may require the need to depopulate facilities, resulting in large numbers of mortalities. If these mass mortalities are not managed properly, there can be negative economic consequences and challenges with biosecurity. Current methods to dispose of swine mortalities include composting bins for routine carcass disposal, composting windrows, shallow burial, landfill disposal, rendering for non-infected carcasses, and incineration.

However, these existing methods pose a risk to biosecurity if the animals were diseased with a highly pathogenic virus. Removing carcasses from an infected facility poses an immediate threat to biosecurity because of the exposure of the pathogen to the environment via air, water, soil, vegetation, or fomites (i.e., people, vehicles, and carcass handling equipment); therefore, more biosecure methods of mortality management strategies are needed for swine. The goals of this research (Figure 1) were to create a novel mobile test facility replicating a typical swine finishing barn, validate the facility performance, and execute tests for in-barn carcass management strategies to characterize carcass response.

Approach

A small-scale, mobile swine confinement laboratory was designed and built to mitigate the challenges faced in a full-scale barn. The mobility of the laboratory enables it to travel to swine farms to obtain fresh animal specimens, which

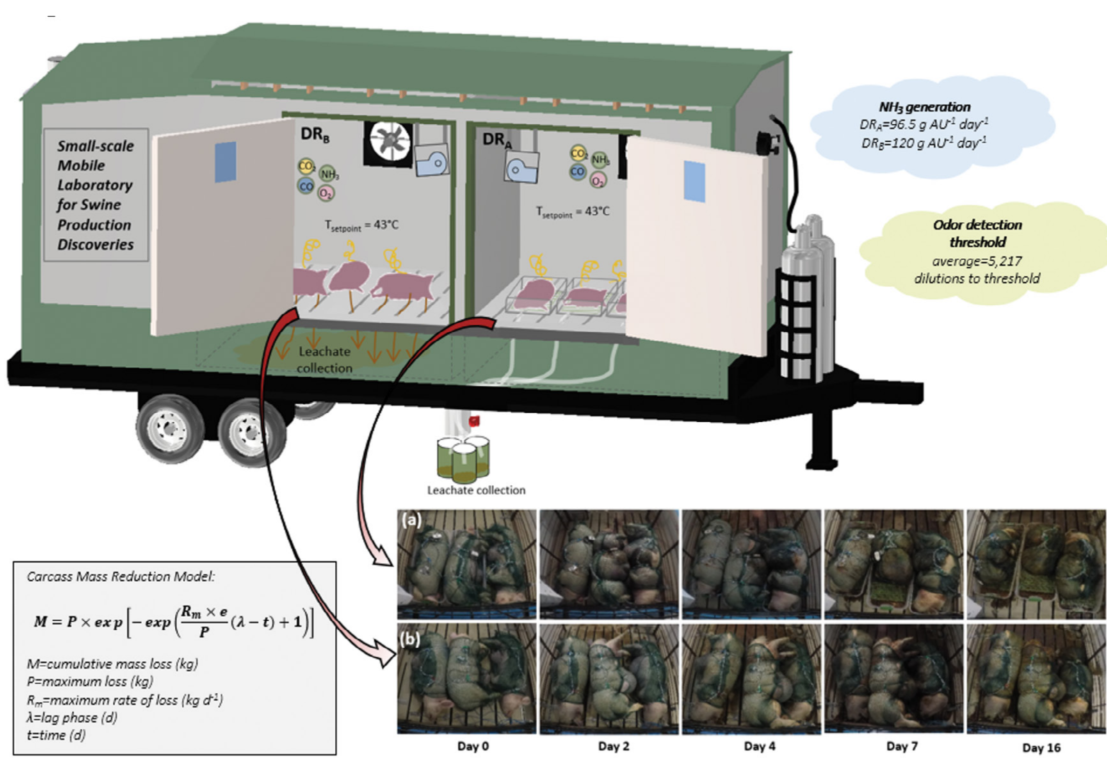

Figure 1. Graphical abstract depicting the mobile small-scale facility with two discovery rooms and an overview of the carcass composition and thermal research.

allows the experiments and data collected to be more representative of an in-barn application. The model facility, built on a flat-bed trailer, has two identical, fully instrumented rooms (L × W × H) of 2.24 × 2.29 × 2.05 m (88.0 × 90.0 × 80.5 in.) with a 0.46 m (18 in.) shallow pit, replicating typical swine finishing rooms. Walls were composed of typical wood-frame construction with interior paneling and metal clad on the exterior. Instrumentation allows the environment and air quality of the rooms, along with other parameters, to be controlled and monitored. The rear portion of the trailer includes an instrumentation room to house necessary computers, controllers, and associated equipment. Commissioning of components and verifying function of equipment were performed, which included quantifying infiltration and performing a thermal analysis for each room.

Carcasses were desiccated by subjection to heat at a room air temperature of 43°C (110°F) for 16 days. Three carcasses (average = 82 kg, SE = 1.27 kg) were elevated over individual leachate collection systems in Discovery Room (DR) A, thereby removing leachate from the room. Three carcasses in DRB were placed on concrete slats with cumulative leachate collection in the pit below. Environmental data were collected for DR, outdoor, and slat temperatures; and CO_2, CO, O_2, and NH_3 gas concentrations. Carcasses were characterized by rectal and shoulder temperature monitoring and daily weighing of carcasses and leachate in DRA. The air exchange rate for this unventilated system was quantified based on wind and thermal-driven infiltration. Room environments were compared for thermal performance and gas levels.

Key Findings

A mobile, general-purpose laboratory replicating a typical swine production setting equipped with full instrumentation was designed and constructed for small-scale in-barn experimentation. The laboratory is built in style of a typical swine finishing building but allows more control than a full-scale barn and requires less labor and other monetary inputs. The mobility of the laboratory makes it ideal for testing in remote locations and isolation if necessary. Many useful features such as cameras, environmental monitoring, and remote ventilation control make the laboratory a preferred space to carry out a variety of studies on a small-scale. Verification of laboratory function and quantification of parameters, such as infiltration, have been documented and recorded.

Carcass temperatures were compared, and data suggested no significant impact of flooring material on internal carcass temperature. Gompertz and logistic models were fit to leachate production data and carcass mass reduction data (Figure 2). Ammonia generation rates were found to have a peak production rate of 96.5 g AU-1 day-1 (15.8 g animal-1 day-1) in DRA and 120 g AU-1 day-1 (19.7 g animal-1 day-1) in DRB. Over the study, the generation of NH3 in DRB (360 g) was nearly twice that of DRA (182 g) due to leachate removal.

Additionally, knowledge of carcass decomposition rates and internal carcass temperature will help gauge when mortalities can be removed from group-housed confinements to continue decomposing using an established carcass management method. This research will assist the swine industry by providing more biosecure in-barn alternatives to carcass management than existing methods in the event of a disease outbreak or other mass mortality event. This work will advance the existing knowledge of in-barn strategies for swine and, if adopted, will aid in reducing potential disease spread due to poor carcass management.

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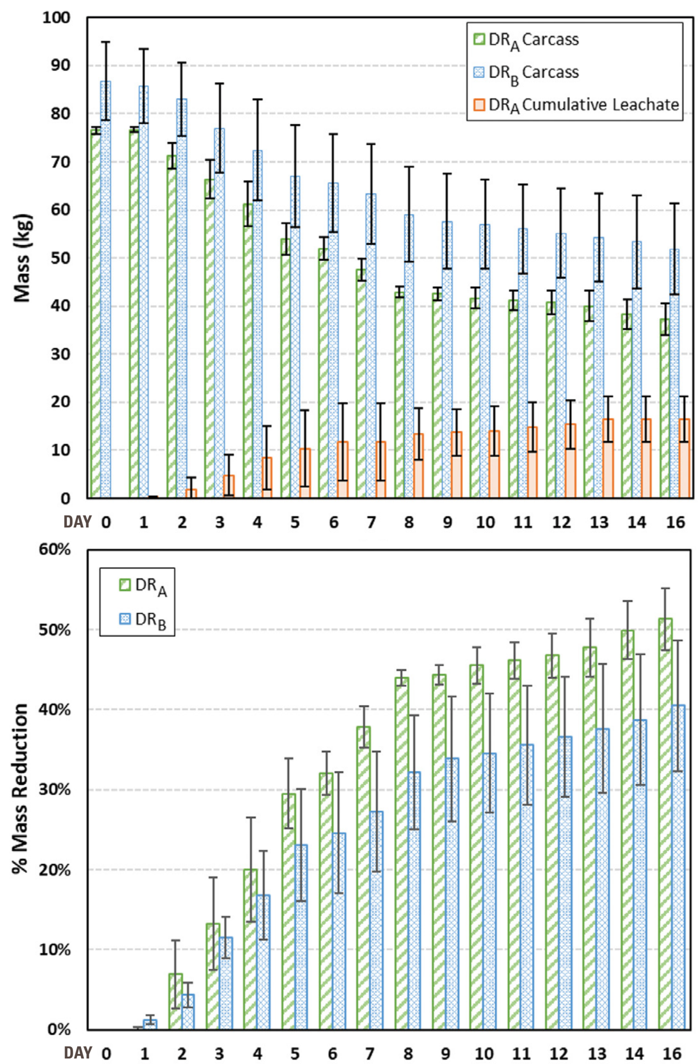

Figure 2. Daily carcass weights and leachate weights by room with standard deviation uncertainty (top); daily average carcass percent mass reduction with standard deviation uncertainty (bottom).Remaining leachate in collection bins was averaged and added to daily leachate totals. Carcass and leachate were not weighed on day 15 of the trial.