Evaluation of a modified prototype livestock trailer through road and disease-challenge tests

B. Predicala[1] , M. Sapaden[1,2], A. Alvarado[1,2], and S. Kirychuk[3]

Bernardo Predicala

Alvin Alvarado

SUMMARY

This project set to develop an improved (prototype) trailer that addresses emerging biosecurity risks and enhance animal welfare during transport. The trailer incorporates an environmental control system that is versatile in nature and equipped with a data logging system capable of displaying data in real-time, providing data access during transit. The truck driver can bypass or modify the system if the need arises. In addition, reliable and robust types of sensors for temperature, relative humidity (RH), CO2 and airflow were installed that will withstand the wide range of environmental conditions inside the trailer. The new design modifications also include emergency hatch, feeders, drinkers, misters, portable heaters, video cameras, and LED lights.

INTRODUCTION

Hog operations can suffer devastating losses due to pathogens that spread via aerosols. A previous project "Reducing Pathogen Distribution from Animal Transportation" developed a prototype trailer aimed to protect the animals from airborne transmissible diseases during transport. This project aimed to mitigate the consequences of infection by airborne transmissible diseases during transportation through pig-dense areas where serious swine diseases can be present.

In addition, public demand for enhanced animal welfare in food production animal has increased in recent years. Transport-related animal welfare concerns may include animals experiencing stress, fatigue, injury, morbidity, and mortality, which can be due to feed and water deprivation. Other factors include potential extreme thermal conditions inside the trailer due to trailer design, exposure to noise, vibrations and toxins, and poor animal handling (Nielsen et al., 2011; Pilcher et al., 2011; Torrey et al., 2008; Xiong et al., 2015).

While the design of the prototype trailer assembled in the previous project tried to integrate as many features as possible – to mitigate the risk of airborne infection and to improve the welfare of animals transported – the initial prototype is still a first attempt at developing an entirely new platform. It is not yet perfect, thus, this project aims to optimize and further enhance the previously developed prototype by integrating new design characteristics.

EXPERIMENTAL PROCEDURES

Activity 1 *- Enhancement and optimization of the design of the prototype trailer*

This activity focuses on implementing modifications to the existing prototype trailer optimizing the biosecurity and welfare properties during transportation. We identified two areas of modifications: 1) the instrumentation systems, and 2) the physical and structural modifications of the trailer. The first steps included modifications to the environmental control and data logging systems, followed by retrofitting additional physical and structural features on the trailer.

Activity 2 *– Testing and Evaluation*

This portion of the project evaluates the modified prototype trailer on road tests as well as in disease challenge tests to determine its performance in maintaining a pathogen-free and welfare-friendly environment for pigs during transport. Planning and preparation for the road and disease challenge tests, including protocol development are in development.

RESULTS AND DISCUSSION

Activity 1 *– Enhancement and optimization of the design of the prototype trailer*

Modifications to the environmental control and data logging system, including ventilation and heating controls and the misting and drinking systems are completed. The system has an independent and separate control for the top and bottom deck fans governed by temperature, RH and CO2 levels inside the trailer. In addition, the new system has more reliable data logging features capable of displaying data in real-time, and it allows access to the data while in transit. The driver can also access and make setting adjustments if the need arises. In addition, we upgraded the existing temperature, RH, CO2 and airflow sensors in the trailer to more reliable and robust models that can withstand the varying environmental conditions inside the trailer.

Figure 1 shows the locations of the sensors, data acquisition system, components of the misting and drinking system, and lighting.

1 Prairie Swine Centre Inc, PO Box 21057, 2105 – 8th Street East, Saskatoon, SK S7H 5N9
2 Department of Chemical and Biological Engineering, College of Engineering, University of Saskatchewan, 57 Campus Drive, Saskatoon, SK S7N 5A9
3 Canadian Centre for Health and Safety in Agriculture, University of Saskatchewan, 104 Clinic Place, Saskatoon, SK S7N 2Z4

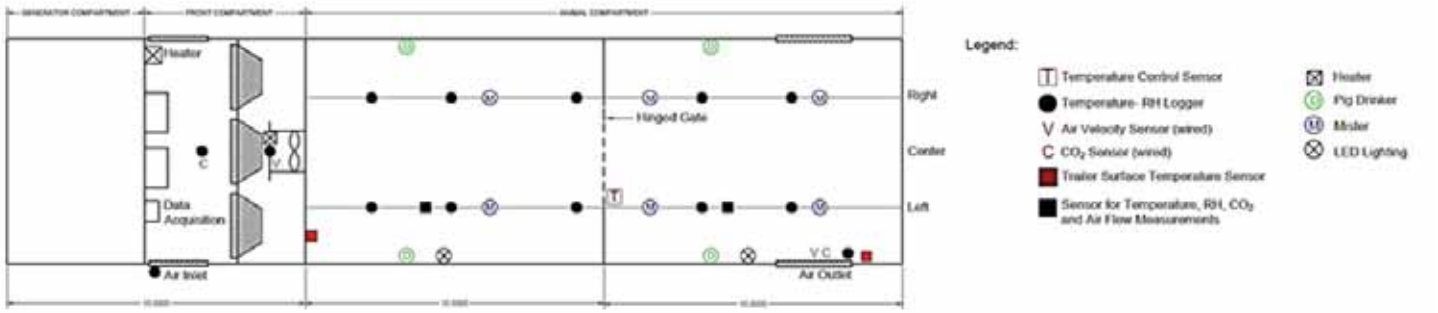

Figure 1. Updated trailer schematic diagram.

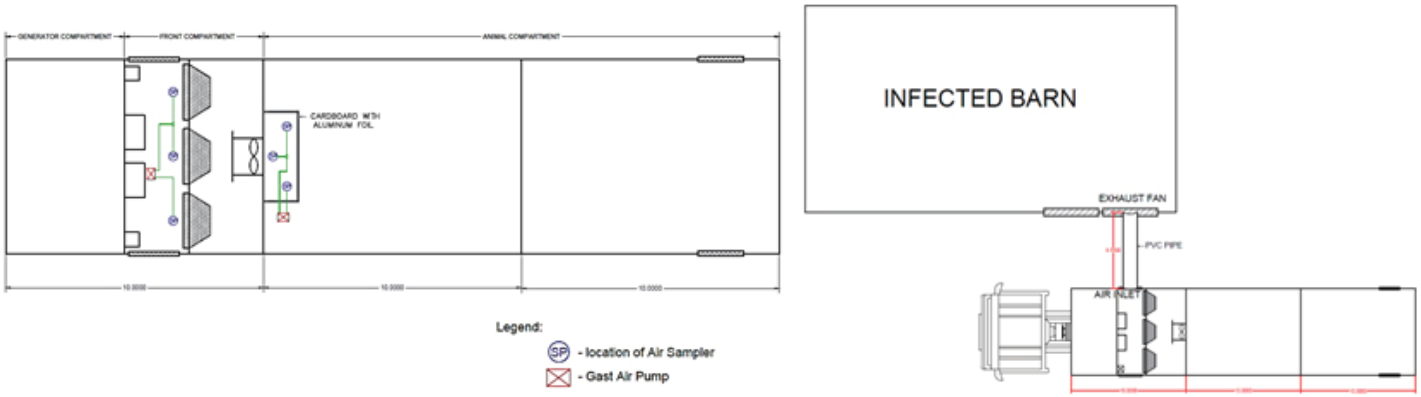

Figure 2. Experimental set-up during disease-challenge test.

To date, changes to the physical components of the trailer include the installation of LED lights, drinkers, misters in addition to portable heaters installed on the fans. Modifications of the other physical and structural areas are expected to be completed soon. All of the necessary preparations for the remaining physical and structural modifications such as preparing work drawings, discussion with contractors/fabricators, sourcing out of materials and equipment, among others, have already been carried out.

Activity 2 *– Testing and Evaluation*

Over the past year, we have identified and developed several critical parameters required for the road and disease-challenge tests. These include:

- Development of the overall framework of the disease-challenge tests to determine the critical test parameters and procedures such as number of pigs, viral load of contaminated barn air, flow rate of infected air passing through the trailer, blood testing procedures, among others.
- Based on the suggested stocking density of pigs set by the Code of Practice for the Care and Handling of Farm Animals during transport we will use 40 weaned pigs per group, reducing it by 25% during hot humid weather conditions.
- Weaned pigs will come from a barn known to be IAV-negative.
- Prior to the disease-challenge test, a preliminary sampling of the exhaust air of a IAV-positive barn will ensure the viral load in the exhaust air is sufficient to cause infection.
- A polyvinyl chloride pipe will connect the exhaust of the infected barn and the inlet of the trailer to ensure maximum exposure to contaminated air from the barn.
- We will use two groups of pigs for the disease challenge tests. One group will be exposed to contaminated air with no air filtration system installed in the trailer (Control) while the other group will be exposed to contaminated air but with air filtration system installed (Treatment).
- Following the exposure to IAV-contaminated air, we will move the trailer to a designated site for a 14-day observation period.
- Blood samples will be taken on days 7 and 14 for serological testing to confirm their IAV status.

IMPLICATIONS

Incorporating new design and monitoring components into trailers will assist producers in reducing losses associated with transporting pigs due to airborne transmissible disease infection.

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