Road and disease-challenge tests with a modified prototype livestock trailer

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SUMMARY

The overall goal of the work conducted was to assess the performance of an improved prototype livestock trailer with ventilation, heating, misting and air filtration systems in maintaining a welfare-friendly and pathogen-free environment during transport. The testing and evaluation comprised of road tests and disease-challenge tests. The road tests aimed to evaluate the performance of the trailer's ancillary systems (ventilation, heating, misting systems) in maintaining acceptable environmental conditions for the pigs, and assess the general welfare of the animals during transport. The disease-challenge tests, on the other hand, were carried out to assess the effectiveness of the trailer in protecting against airborne pathogens from the external environment. So far, four road tests and two disease-challenge tests have been completed. Based on the results, the trailer's ancillary system was able to maintain acceptable environmental conditions in the animal compartment during transport. In addition, results of the disease-challenge tests showed that the installation of an air filtration system in the trailer could protect the pigs from exposure to airborne transmissible diseases such as Influenza A virus. Additional road and disease-challenge tests are currently underway to provide a more definitive conclusion on the impact of the trailer equipped with an air filtration system on the environmental conditions of pigs and in preventing disease infection during transport.

"Results suggest the air filtration system in the trailer was capable of protecting the pigs from IAV infection.."

INTRODUCTION

To protect pigs against transmission of airborne diseases such as PRRS, Influenza A virus (IAV), Classical Swine Fever and PEDv, pig producers have installed air filtration systems in their swine barn facilities. However, the protection provided by the barn filtration system ends once the animals are taken out of the barn during transport, which is a routine practice in pig production. As animal transportation has proven to play a vital role in disseminating airborne viruses, a previous project developed a new prototype trailer fitted with air filtration and ventilation systems to bridge the biosecurity gap and protect the animals from airborne transmissible diseases during transport. Aside from the biosecurity concerns, the welfare of pigs during transport is also of utmost importance. The welfare of pigs depends on different factors, including the design of transport trailers, the condition of the animal at various phases of the journey (loading, time in transit, and unloading), space allowance, the environmental conditions inside the trailer such as ambient temperature and humidity, social stress, handling, unfamiliar noises, vibrations, and sudden speed changes. The primary objective of this study was to evaluate the effectiveness of the enhanced filtered trailer in maintaining a pathogen-free and welfare-friendly environment inside the trailer loaded with pigs under actual transport conditions. Once proven successful, this study will help address one critical component of preventing the spread of airborne transmissible diseases within the Canadian swineherd.

EXPERIMENTAL PROCEDURES

The prototype trailer is a dual (top and bottom) straight-deck trailer, with totally enclosed, positive-pressure fan-ventilated animal compartments. Inlet air must pass through a series of filters before entering the animal compartment. In addition, various features such as hydraulic loading platform, hinged floor and roof, a variety of sensors and electronic controllers, among others, were incorporated into the trailer design. Each deck is divided into two pens (front and rear) by a gate. Each pen has installed pig drinkers, feeders, spray misting nozzles, LED light, and sensors for temperature, relative humidity (RH), air flow, and carbon dioxide gas for environmental monitoring and control system. In front of the trailer animal compartment is a separate space which holds the ventilation fans, the bank of filters, electronic controllers, supplemental heaters, and data loggers (Figure 1).

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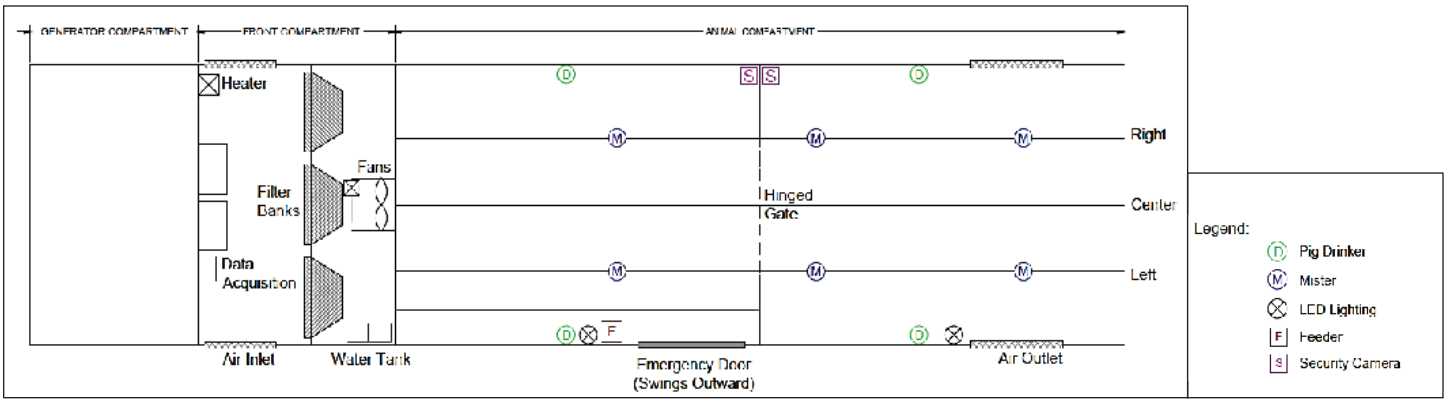

Figure 1. Schematic diagram of the additional features installed in the prototype livetsock trailer

Testing and evaluation of the prototype transport trailer comprised of road tests and disease-challenge tests. For the road tests, 40 pigs were loaded in the bottom deck of the trailer. Prior to each road test, the body weight and rectal temperature of the selected pigs were measured while in the PSC barn, and an assessment of the physical condition and behaviour was made to ensure all pigs are fit and healthy prior to loading to the trailer. All sensors and recording devices were activated prior to loading, and continued operation during the entire trip. A route was mapped to cover at least a 5-hour trip from PSC to a cooperating farm. Upon arrival at the destination, all pigs were inspected again to assess their physical condition and overall welfare. Only 10 pigs were retained in the trailer for the disease-challenge tests, while the rest were unloaded at the destination barn.

The disease-challenge tests consisted of two test conditions: 1) with the trailer filtration system in operation (Treatment), and 2) without the filtration system (Control). For each test, a group of 10 pigs were loaded in the prototype trailer, transported to an IAV-positive barn site, and then the trailer was exposed to the exhaust air from the barn for 14 hours by connecting a duct from a nursery room exhaust fan to the trailer air inlet (Figure 2). The two groups (Treatment and Control) were tested on separate trips to the site using the same prototype trailer. After exposure, the trailer was moved to a location away from the IAV-positive barn, and pigs were cared for following standard guidelines and observed for 14 days for signs of IAV infection.

RESULTS AND DISCUSSION

Four road tests have been completed to date. The first three road trips took about 6 hours to complete, while road test 4 took 4 hours and 50 minutes. During the four road tests, no animal-related issues were encountered. A consistent rise of temperature and humidity ratio was observed during loading and the first 30 minutes of the trips, which can be attributed to the heat production of pigs as a result of increased activities and adapting to the motion during travel. Temperature from start of loading to early period of the trips ranged from -0.5 °C to 14.1 °C and from -5.5 °C to 9 °C for the first and third monitoring trips, respectively. Temperatures inside the animal compartment for the first monitoring trip had somewhat stabilized over the main duration of the travel period until the trailer arrived at the cooperating barn. On average, temperatures ranged from 5 °C to 15 °C. However, for the third monitoring trip, a slight decrease in temperature was observed during the first 2 hours of the trip, and then, a sudden increase in temperature ranging from 12 °C to 14 °C was recorded in the last 3 hours of the travel (Figure 3). This can be attributed to the weather condition during the first 3 hours of the third monitoring trip, which was a combination of light snow, drizzle and periods of pouring rain. Interior moisture levels gradually decreased and stabilized as it reached the stable periods of both trips. Temperature ranging mainly from 0 °C to 10 °C had been measured in most trailer locations. Temperatures at locations close to the fan were relatively warmer than in areas close to the exhaust.

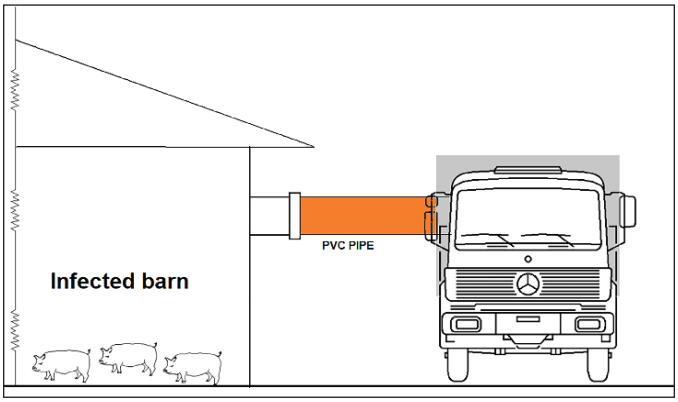

Figure 2. Experimental setup during the exposure period of the disease-challenge test.

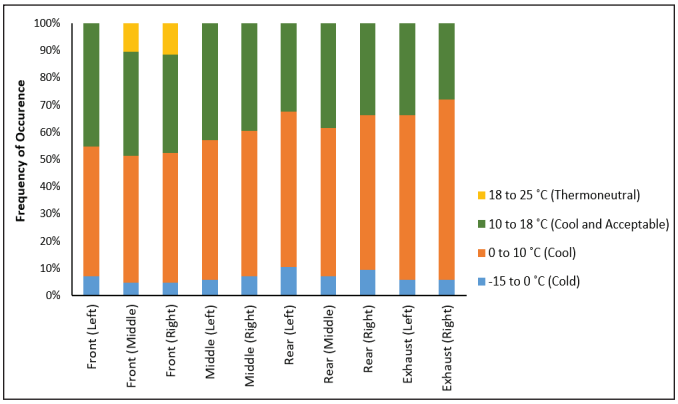

Figure 3. Thermal comfort classification of the different locations in the trailer during the third monitoring trip.

Two disease-challenge tests have been completed to date. During the first test, the air filtration system in the trailer was not installed (Control 1) while the second test had the air filtration system installed and operational (Treatment 1). For Control 1, IAV were detected in air samples collected from both upstream (before the air filtration system) and downstream (after air filter setup) locations, indicating that the pigs in the animal compartment were exposed to IAV-positive air. For Treatment 1, however, air samples collected upstream were positive for IAV, whereas air samples collected in the trailer (after the air filtration system) were negative for IAV, indicating that the air filtration system in the trailer was capable of removing IAV in the air, thereby protecting the pigs in the animal compartment from potential IAV exposure. During the 14-day observation period post-exposure, some pigs of the Control 1 group developed IAV symptoms, and one pig died on day 6, therefore the trial was terminated on day 7. Seven pigs were tested positive for IAV in their blood samples on day 7 (Table 1). On the other hand, during the Treatment 1 trial, pigs were healthy throughout the entire 14-day observation period after exposure. No clinical symptoms nor signs of IAV infection were observed. Both blood and nasal swab samples collected on days 7 and 14 were negative for IAV.

IMPLICATIONS

During the Control 1 disease-challenge test, pigs were exposed to IAV-infected air as indicated by the IAV-positive air samples collected from the animal compartment. As a result, pigs became sick starting on day 5 after the exposure. In contrast, the air samples collected in the animal compartment during the Treatment 1 test were negative for IAV. As a result, pigs remained healthy over the course of 14 days after the exposure. This result suggests that the air filtration system in the trailer was capable of protecting the pigs from IAV infection. Additional disease-challenge tests are currently underway to provide a more definitive conclusion on the impact of the air filtration system in preventing IAV infection in pigs.

ACKNOWLEDGEMENTS

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Table 1. IAV tests results, weights, rectal temperature and clinical signs of IAV infection during the Control 1 disease-challenge trial.

Pig ID	Weights, kg		Rectal temperature, °C		Influenza A virus test		Clinical signs/symptoms
					Blood samples	Nasal swabs	
	Day 0	Day 7	Day 0	Day 7	Day 7	Day 7	
C1-01	27.6	32.3	40.5	40.6	Positive	Negative	Slight abdominal breathing (day 7)
C1-02	26.1	29.4	39.7	41.1	Positive	Negative	None
C1-03	26.6	30.0	40.1	40.6	Positive	Negative	None
C1-04	25.4	30.1	39.8	39.7	Positive	Negative	None
C1-05	28.0	32.8	40.7	41.2	Negative	Negative	None
C1-06	25.0	21.71	39.1	-			Coughing, weight loss (day 5); Died on day 6
C1-07	25.8	25.1	40.7	39.4	Positive	Negative	Slight abdominal breathing; weight loss (day 6)
C1-08	28.2	29.5	40.1	40.1	Positive	Negative	None
C1-09	25.0	29.1	40.5	39.9	Positive	Negative	None
C1-10	26.3	31.8	39.7	40.8	Negative	Negative	Slight coughing (day 6)