

Modification of the Prototype Air-Filtered Trailer to Enhance Biosecurity and Welfare of Pigs During Transport

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Summary

The development of a prototype trailer was aimed to address emerging biosecurity risks and enhance animal welfare during transport through the optimization of a current prototype trailer design. Trailer improvements were focused on enhancement of environmental control and data logging systems as well the addition or modification of necessary features such as drinkers, misters, and lighting in the animal compartment of the trailer.

Introduction

Airborne transmissible diseases have the potential to create significant economic losses due to loss in productivity, added costs of medication and eradication measures, and even loss of access to markets. A previous project examined the development of a new prototype trailer design aimed to protect the animals (such as high-value breeding stock) from airborne transmissible diseases during transport.

The design of the prototype trailer assembled in the previous project tried to integrate as many features as possible identified by stakeholders. The initial prototype was a first attempt at developing an entirely new platform for animal transport, however it still requires additional work before it can be widely adapted and commercialized. This project focused on the enhancement of trailer major components by integrating new desired characteristics in response to new and emerging concerns.

Experimental Procedures

The first phase of the project looked at implementing modifications to the existing prototype trailer to optimize its biosecurity and welfare properties for swine transport. Recommendations from previous work were re-examined to come up with a list of suggested modifications to the prototype air-filtered trailer, and supplemented by a search of information from various sources such as product brochures, feature articles, and promotional videos of various improved and modern livestock trailers. The search aimed to identify relevant, innovative and applicable features that can be part of the new trailer design. Further investigation also included

the inspection of two existing state-of-the-art commercial pig trailers, manufactured in Europe, to gain first hand knowledge on available and promising new features.

Results and Discussion

Two aspects of trailer modification included: 1) modification of the instrumentation systems; and, 2) physical or structural modifications of the trailer. Table 1 presents a summary of modifications recommended for the prototype trailer.

Implications

A new and more versatile environmental control system was developed. The system has an independent and separate control for the top and bottom deck fans and will be governed by temperature, RH and CO₂ levels inside the trailer. The new system has more reliable data logging features that are capable of displaying data in real-time, allowing the driver to access to the data, or bypass the system, while in transit.

Acknowledgements

We would like to acknowledge the financial support for this research project from the Saskatchewan Agriculture Development Fund and the Canadian Agrisafety Applied Research Program funded by Agriculture and Agri-Food Canada. As well, Polar Pork Farms is acknowledged for the invitation to visit their modern hog trailer purchased from Europe. The authors would also like to acknowledge the strategic program funding provided by Sask Pork, Alberta Pork, Ontario Pork, the Manitoba Pork Council and the Saskatchewan Agriculture Development Fund. In addition, we also wish to acknowledge the support of the production and research technicians at Prairie Swine Centre that make it possible to conduct this research.



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Table 1. List of suggested modifications to the prototype trailer

Area of Modification	Description of Desired Modification / Reason for Modification
I. Instrumentation – Environmental Control and Datalogging System	
Ventilation system control	<ol style="list-style-type: none"> Independent and separate control for the top and bottom deck fans. The system is governed by: <ol style="list-style-type: none"> Temperature – primary RH and CO₂ levels – could bypass temperature if RH and CO₂ levels are extremely high (exceed a set threshold level) while at minimum ventilation due to low temperatures. Ability to log temperature, RH and CO₂ levels, as well as air flow inside the trailer at selected time intervals. Also, if possible, the % fan capacity at which each fan is running. This is to keep a log of ventilation flow rate for the entire journey. Real-time display and access to above data while in transit, and capability to be bypassed by the truck driver if the need arises. In-cabin controls and alarms.
Misting system	Ability to activate manually or automatically if certain temperature level is reached inside the trailer.
Portable heater	Ability to activate automatically or manually at certain temperature level in the trailer front compartment (i.e., close to air inlet, before the air filters)
Monitoring and data logging of the above parameters	<ol style="list-style-type: none"> Upgrade/replacement of sensors and stand-alone data loggers <ul style="list-style-type: none"> - shall be wired for permanent installation in the trailer, such that sensors (and its housing) can withstand washing and disinfection (including baking), or sensors can be easily removed/detached prior to washing and can be re-installed without technical complications. Parameters to be monitored and logged: <ol style="list-style-type: none"> temperature RH CO₂ level air speed/air flow trailer surface temperature – this parameter should be monitored real-time during baking to confirm when desired surface temperature is attained to achieve proper disinfection GPS location monitoring
II. Physical / Structural Modifications	
Hydration control system	<ol style="list-style-type: none"> Water tank/s, water heater and water distribution system, with appropriate controller to activate the water tank heater at pre-set ambient temperature (i.e., European trailers have -10°C threshold, below which level the water system is not used). Design safety for water distribution (e.g., avoid protrusions or pinch points) shall be considered.
Lighting	<ol style="list-style-type: none"> Interior lights will be permanently installed following welfare criteria on lighting, with manual or automatic control switches. Installation of lights on rear exterior of animal compartment that can be activated together with hydraulic ramp control, for use during loading/unloading before dawn or after dusk.
Portable heater at front compartment	Heater/s shall be installed on the floor at the front compartment. This requires appropriate positioning and ducting to uniformly distribute the supplemental heat within the compartment, and then into both decks.
Space allotted for the front compartment	In the current prototype, the front compartment takes up much of the length of the trailer. For research, this may be convenient for conducting tests and data gathering, but for subsequent design, the front compartment space should be minimized to maximize the animal compartment capacity.
Access for inspection	This is required by regulation, especially at border crossing. This can be achieved by installing air-tight hatches along the side walls, which can be opened to carry out the inspection without compromising the biosecurity of the animals (i.e., prevent entry of unfiltered air into the compartment).
Wireless remote control of the hydraulic lift	The current wired controller for the operation of the hydraulic lift is quite inconvenient to use; a wireless option should be investigated.
Man-door or side access ladder	Walk-thru side door or a ladder on one side of the trailer at the rear part near the hydraulic lift should be installed for easy access to the hydraulic lift and into the animal compartment during loading/unloading.
Emergency unloading door for animals	In conjunction with the inspection hatch, this is needed in emergency situations when the hydraulic lift failed to operate.
Emergency plan in case of ventilation system failure/malfunction	Also in conjunction with inspection hatch/unloading door, alternate openings for natural ventilation of the animal compartment should be installed in case of prolonged shutdown of the main ventilation system.
Water-proofing of sensor/data loggers housing	Appropriate protective housing for electronic components should be installed. Alternatively, the sensors should be easily detachable prior to trailer washing and disinfection.
Generator exhaust pipe	Current exhaust pipe on the side of the trailer may allow the exhaust fumes to enter the air inlet of the front compartment. The exhaust pipe needs to be extended to vent the fumes at the top of the trailer.
Cleanability of animal compartment	Floor joists of the upper deck and support structures for trailer roof are exposed to which dirt can adhere. Currently, dirt accumulation is avoided by thorough power washing of these spots, but options to cover up the exposed structures should be explored to minimize washing time and to ensure better cleanability of the trailer.
Hydraulic lift side panels	Based on regulation, the required minimum height of the hydraulic lift side panels should be 90 cm. However, it has been noted during the tests of the prototype trailer that the current height of the existing hydraulic lift side panels is not sufficiently high for animal and handler safety. Options should be explored to increase the height of the side panels by adding detachable extension panels, without hindering the opening and closing of the hydraulic lift gate.