Development of an Air Filtration System for Swine Transport Vehicles to Protect Against Airborne Diseases During Transport

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SUMMARY

The overall goal of this project is to protect high-value pigs during transport using a trailer with an air filtration system. A comprehensive literature search and a survey of various information sources on trailer filtration were conducted to identify components of a trailer air filtration system and the various options available for each component. Using a set of relevant design criteria, the different options were evaluated to select the components included in the prototype design. Presently, the proper components are being assembled for retrofit into the prototype trailer. Remaining steps to complete the project include prototype testing, design optimization, and feasibility analysis.

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INTRODUCTION

The growth and success of the Canadian pork industry over the past decades depended significantly on access to highly improved genetics. Transporting breeding stock is a daily occurrence across Canada, and individual farms have biosecurity procedures to reduce the potential for disease outbreaks. However, the risk of infection of the breeding stock during transport can be significant, particularly during passage through pig dense areas, where disease outbreaks can still happen despite current biosecurity protocols in place. Thus, it is imperative that measures be developed to protect breeding stock during transport, thereby avoiding infection of these high-value animals and the consequent significant economic loss, and more importantly, to close this biosecurity gap through which potential infection can be introduced to high-health commercial herds. The overall goal of this work is to design, develop, and evaluate an air filtration system that can be fitted to a transport vehicle to prevent infection of the high-value breeding stock during transport.

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RESULTS AND DISCUSSION

In this project, an air filtration system was designed and developed to filter the air entering an animal transport trailer, to protect high-value animals from infection with airborne transmissible diseases during transport. A literature review supplemented with a survey of relevant resources (i.e., veterinarians, truckers, genetics companies, etc.) was conducted to compile information on existing and potential designs for an air filtration system for transport vehicles, followed by selection of best design based on comprehensive evaluation of various options available for each component of the filtration system.

Information on designs of air filtration systems of existing filtered animal transport vehicles was gathered from literature and by contacting and interviewing different contact persons and organizations with filtered trucks/trailers. Organizations based in Europe (France, Netherlands) and USA were interviewed, which belonged to the following categories: swine genetics company; swine technical support/consulting firm/swine research; swine transport service and swine/livestock trailer/truck manufacturer.

The length of the filtered trailers from these organizations varied from 20 to 53 ft. The trailer/truck manufacturer based in Netherlands has multi-deck filtered trailers, which were used for transporting smaller pigs (e.g., 23-kg pig); the rest has one-deck filtered trailers. Unfortunately, only the general design of its air filtration system was described and shared by the company. From the literature search and survey results, the critical factors that need to be considered in the design of the ventilation and air filtration system for the trailer were identified as: 1. *animal spacing requirement and trailer capacity*, 2. *pig heat generation and equivalent air conditioning requirement,* 3. *ventilation requirement as a function of air temperature inside the trailer and pig size*, 4. *available filter technology*; and 5. *power generation needed to run the whole system.*

The major parts of a trailer filtration system were components for: 1. temperature control, 2. filtration, 3. ventilation, and 4. air distribution. Additionally, there are secondary components of the system that were identified; these include components for: 1. air exhaust, 2. emergency openings, 3. parameter monitoring, 4. cleaning and disinfection, and 5. bedding and watering supply.
Based on the designs of the surveyed trailers, the type of fans commonly used in these filtered trailers were axial fans. High efficiency particulate air (HEPA) filters and Di-octyl Phthalate (DOP)-tested filters were the type of filters installed in these filtered transport vehicles, with five currently using HEPA filters. Typical source of power needed to operate the fans was the diesel-type generator.

After gathering all the available information on trailer components and the associated options for each component, the specific option that will be included in the design of the prototype system was selected by having each project team member evaluate the different options according to the following criteria: 1. robustness, 2. impact on trailer environment (air quality, air flow, thermal environment), 3. power requirement, and 4. costs. The project team evaluated each option and based on the ratings, the design of the air filtration system for the prototype trailer includes the following major components: 1. non-airconditioned, 2. MERV filters, 3. axial fans, and 4. no air diffuser.

In the current phase of the project, the required components of the trailer filtration system will be gathered and installed on the trailer. Ventilation system of the prototype design will consist of high performance axial fans to overcome pressure drop across the filtration system. Incoming air will be filtered in a sealed chamber operating under negative pressure, and the filtered air will be distributed to the trailer decks. Air filtration will consist of minimum efficiency reporting value (MERV) 14 and MERV 16 air filters (90 - 95 % composite average particle size arrestance efficiency) and high efficiency particulate air (HEPA) filters. Calculation of stocking density per deck, ventilation rate per deck, air velocity per deck, heat generation by pig per deck, and expected air temperature inside the trailer were done according to applicable recommended guidelines for Canadian conditions.

CONCLUSIONS

Comprehensive literature search and survey of different information sources on trailer filtration were conducted to identify the major trailer filtration components and the various options for each component. Based on evaluation of the different options, the components included in the prototype design of the air filtration system that will be fitted to a swine transport trailer were selected. The prototype system will be installed in an actual livestock trailer and will be tested for effectiveness in preventing airborne-transmitted pathogens transmission during transport, and in providing suitable thermal environment to the animals under Canadian conditions. Finally, after re-design and optimization steps, a feasibility analysis will be conducted to assess the viability of installing air filtration systems on swine transport trailers.

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