New and alternative sanitization procedures for antibiotic-free swine barns

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SUMMARY

Certain barns that switched to antibiotic-free production observed increased prevalence of pathogens after a few years on the program. Developing improved sanitization and disinfection procedures is an important step to reduce the pathogen load in antibiotic-free barns, which was the goal of this study.

This project identified and screened various disinfection strategies comprised of conventional and non-conventional disinfection measures. The screening phase determined calcium oxide, peracetic acid (PAA), quaternary ammonium compounds (QACs), electrolyzed water (Slightly-acidic electrolyzed water (SAEW) and Alkaline electrolyzed water (AEW)), and silver nanoparticles as the most promising alternative measures. During laboratory-scale evaluations, the application of SAEW and PAA were identified as the most promising disinfection strategies, which were investigated further in in-barn tests.

The performance of PAA and SAEW was comparable to conventional disinfectants (Virkon) and showed longer effectivity than Virkon at 4 to 24 hours after its application. Economic analysis showed that SAEW reduces the overall cost of disinfectant used per pig while PAA costs a bit more than conventional disinfectants. This study indicates that SAEW and PAA solutions could be a better alternative to conventional disinfectants.

INTRODUCTION

Restrictions on the use of antibiotics in livestock production have been implemented in response to the increasing public concern about the development and prevalence of antimicrobial resistance (AMR) to medically important drugs, particularly antibiotics. Despite various strategies developed to keep swine herds healthy with the reduced availability or total absence of antibiotics, disease outbreaks still occur caused by the gradual increase of microbial load in barns.
Currently, the most commonly used method for controlling pathogens in swine barns is the use of disinfectants such as quaternary ammonium compound (i.e. Synergize) and potassium peroxymonosulfate (i.e. Virkon). However, some pathogens develop resistance to these chemical disinfectants decreasing their biocidal capabilities. This study aimed to develop alternative disinfection measures to control the growth and transmission of disease-causing pathogens.

EXPERIMENTAL PROCEDURES

The first phase of this study consisted of a comprehensive literature review that identified 18 potential sanitation and disinfection measures, which were evaluated based on their applicability in swine barns, intrinsic properties, and safety. The six most promising measures were then subjected to laboratory-scale evaluation where polycarbonate coupons inoculated with microbial load collected from the Prairie Swine Centre barn were used as test surfaces to mimic in-barn conditions. The coupons were treated with the selected alternative disinfectants together with commonly used barn disinfectants such as Virkon as Control, and their efficacy in reducing the microbial load was assessed and compared.

The second phase of the study investigated the two most promising disinfection strategies in in-barn tests. Rooms were pressure-washed following standard cleaning practices in commercial barns, except for the sanitizing/disinfecting step, which was part of this experiment. With Virkon as control, the selected treatments were evaluated in grow-finish, nursery and farrowing rooms and applied on various types of surfaces: concrete (flooring), metal (drinkers), plastic (penning), and wood (partitions).

The final phase of the experiment consisted of a feasibility analysis to determine the applicability of the most promising disinfection strategies in reducing microbial population levels in various production stages in a commercial pig barn. The main components of the analysis included all the costs associated with the disinfection strategies, materials and equipment required, labour, and operating costs.

RESULTS AND DISCUSSION

The screening phase yielded calcium oxide, peracetic acid (PAA), quaternary ammonium compounds (QACs), electrolyzed water (Slightly-acidic electrolyzed water (SAEW) and Alkaline electrolyzed water (AEW)), and silver nanoparticles as the most promising alternative measures. Of those, the laboratory-scale evaluation identified the application of SAEW and PAA as the most promising disinfection strategies, which were further assessed in the in-barn experiment.

High-pressure washing reduced the microbial population by approximately 99%. A further reduction in microbial population was achieved after applying the three disinfection methods (Virkon, SAEW and PAA). The performance of PAA and SAEW was comparable to conventional disinfectants (Virkon). The microbial population at 4 hrs and 24 hrs after disinfection with Virkon increased relative to the initial concentration after pressure washing, but remained almost unchanged after disinfection with SAEW or PAA (Figure 1).

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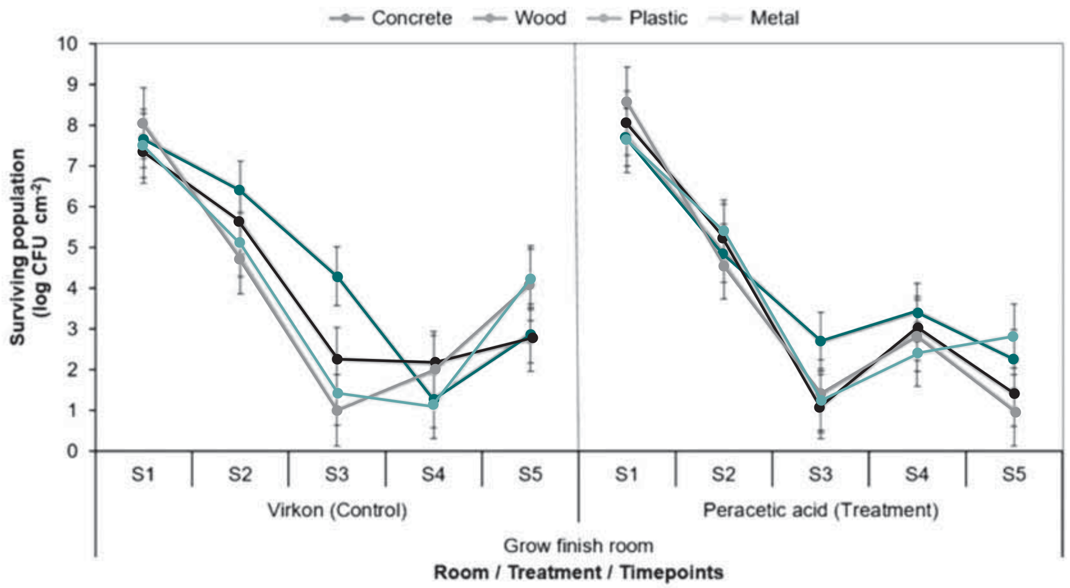
A



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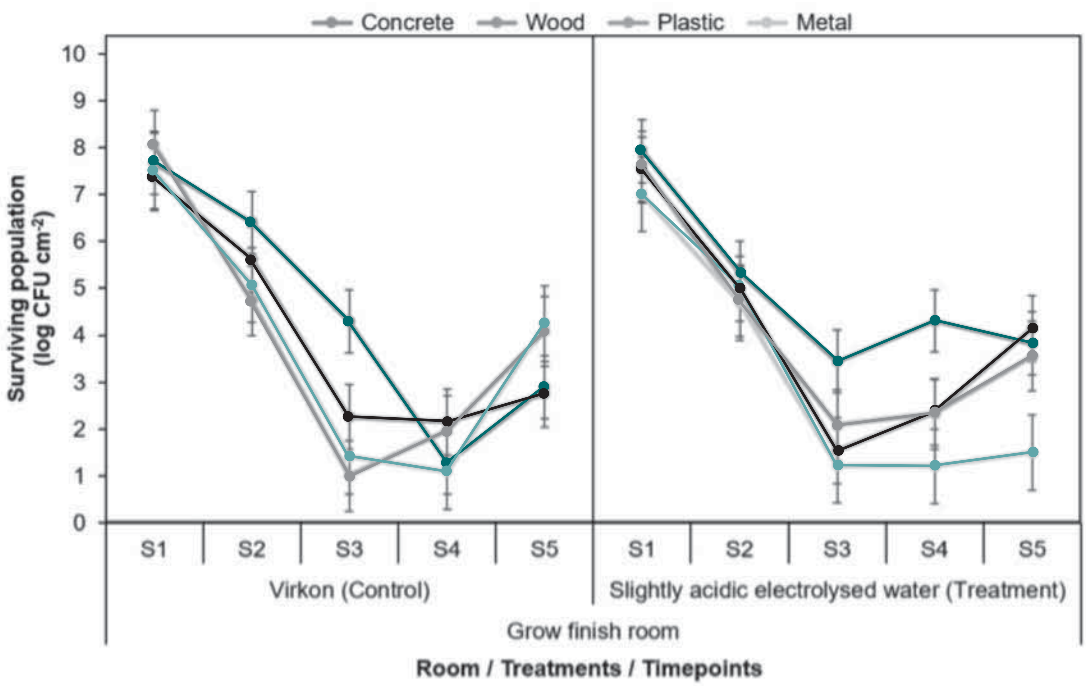

Figure 1. Mean (± SD) of log CFU cm-2 of A) Virkon (Control) and Peracetic acid (treatment) B) Virkon (Control) and Slightly acidic electrolyzed water (treatment) from different types of sampling surfaces in a grow-finish room; S1= before washing; S2 = right after washing and drying; S3 = treatments applied after washing; S4 = 4 hrs after disinfection; S5 = 24 hrs after disinfection. Performance of the control and treatment on different surfaces (from S1 to S5) are not significantly different (P>0.05).

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The feasibility analysis showed that relative to the cost of using current conventional disinfectants (e.g., Virkon), in the long run the application of SAEW reduces the total cost of disinfectant used per pig by about 20% for grow-finish and nursery rooms and about 26% in farrowing rooms. Compared to SAEW, peracetic acid yielded higher total cost with CAD$0.24/pig for grow-finish and nursery rooms, and CAD$1.42/pig for farrowing rooms, which are slightly higher compared to the conventional disinfectant (Virkon) with CAD$0.20/pig and CAD$1.21/pig, respectively. However, this can be compensated by its better effectiveness in reducing microbial concentration to lower levels (compared to the other treatments) and longer residual effects in keeping the microbial loads down. These results suggest that the use of SAEW and PAA solutions during sanitation could be a better alternative to conventional disinfectants. Specific recommendations and guidelines for applying these potential measures in a swine barn are summarized in Table 1.

IMPLICATIONS

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Table 1. Specific recommendations and guidelines for the application of PAA and SAEW in commercial barns.

	Peracetic acid	Slightly acidic electrolyzed water
Preparation of the working solution	- Concentration: 400 mg L-1 - Based on the actual-in barn trials, 12 L of working solution is sufficient for a 100-head room	- Concentration: 50 mg L-1 (active chlorine concentration) - Based on the actual-in barn trials, 12 L of working solution is sufficient for a 100-head room
Additional parameters	---N/A---	Required pH: 5.0 - 6.5 Input Voltage: 20 V Electrolyte: 36 g of salt/4 L of water
Storage of disinfectants	- Store the active ingredient in refrigerator (4˚C) when not in use - Always use freshly made working solution every disinfection process	- Always use freshly made working solution every disinfection process
Application of the working solution	- Disinfectant can be sprayed on target surfaces - Apply the disinfectant following the required dosage - Apply the working solution within an hour of preparation - Longer exposure time for rough surfaces like concrete - Wear PPEs during the disinfection process	