Alternative sanitization measures to control pathogen growth in antibiotic-free production

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SUMMARY

This project set out to develop and evaluate alternative sanitization and disinfection measures that may be effective for control of potentially antibiotic-resistant pathogens, as well as measures that might prevent or further reduce development of antimicrobial resistance in pig production.

Various sanitation technologies identified and screened, included the use of alternative chemical-based disinfectants, selected nanoparticles, thermal and irradiation technologies, among others, which were also evaluated for their potential application in pork production. A follow up survey designed to gather additional information from various stakeholders reinforced the screening criteria in order to identify the top four potential sanitation alternatives. The top four alternatives will further receive an in-depth assessment in laboratory-scale and in-barn tests.

Initial results from the laboratory trials showed the efficacy of the silver nanoparticle treatment in reducing the microbial load on test surfaces. Subsequent tests are on going to compare the performance of the other treatments, followed by actual in-barn testing of the top measures.

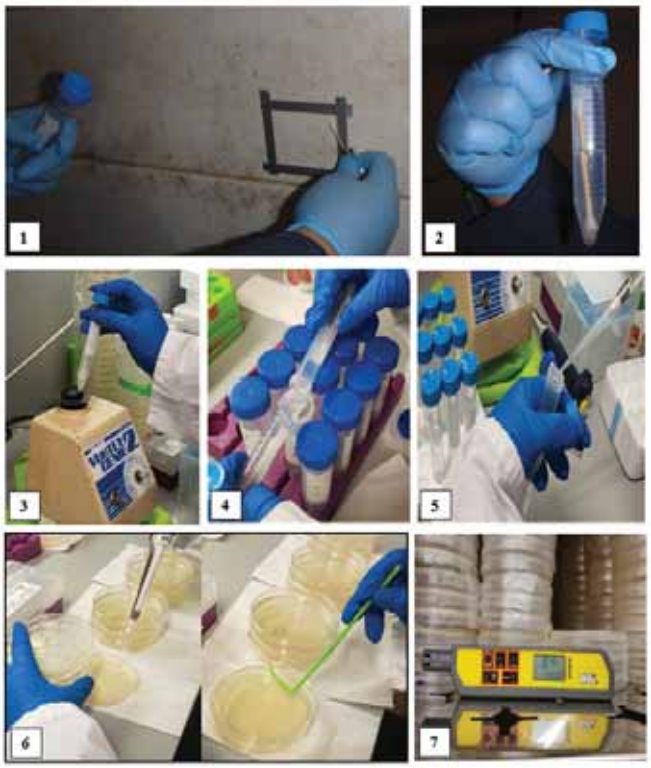
INTRODUCTION

Due to the increasing public concern with the development and prevalence of antimicrobial resistance (AMR) to medically-important antibiotics, restrictions on the use of antibiotics in livestock production have been recently implemented. As a result, pig producers have adapted practices that eliminate or minimize antibiotic use in their production system, such as feeding prebiotics and enhanced vaccination programs. Maintaining high herd health status is difficult to sustain, and some pig operations inevitably still experience disease outbreaks, thus necessitating treatment of the affected pigs with antibiotics.

Currently, the most commonly used sanitization and disinfection strategies involve the application of chemical disinfectants such as peroxygen (i.e., Virkon) and glutaraldehyde/quaternary ammonium compound (i.e., Synergize). However, some studies showed these chemical disinfectants now have lower biocidal capabilities as pathogens develop resistance to them. Therefore, an assessment of the efficacy of currently used disinfectants as well as potential alternative disinfection and sanitization methods will help pork producers manage herd health.

Alternative measures identified include the application of ozone, slightly acidic electrolyzed water, non-thermal plasma, and ultraviolet germicidal irradiation. In addition, their potential applicability, feasibility, and efficacy in swine barns were evaluated against a set of criteria, which included cost, properties, and safety. From the initial screening, six treatment measures will be subjected to evaluation in laboratory-scale testing, with the best performing treatment to be subsequently tested in a room-scale experiment.

The overall approach for this project is to determine various potential sanitization methods available in other applications and then evaluate the effectiveness of the most promising ones for controlling the growth of disease-causing microorganisms under swine production conditions.



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EXPERIMENTAL PROCEDURES

***Phase 1**: Evaluation of applicability of potential sanitization and disinfection techniques to swine production*

A comprehensive literature review assessed various potential sanitization procedures and technologies developed and applied in other industries and applications (water treatment facilities, hospitals, food processing and manufacturing facilities) to determine their possible adaption and application in pork production. Identified sanitation measures include technologies such as ultraviolet germicidal irradiation, non-thermal plasma, ozonation, thermo-assisted drying and decontamination, use of slightly acidic electrolyzed water, among others. Nanoparticles (zinc oxide, silver nanoparticle, and titanium dioxide) combined with various chemical-based disinfectants with different active ingredients (peracetic acid, hydrogen peroxide, chlorine dioxide, sodium hypochlorite) were also included in the screening and evaluation in laboratory-scale experiments.

The next phase includes stakeholder survey, which gathered more practical information related to cleaning and disinfection that may not be available from published literature. A short online survey was developed and distributed to target stakeholders including pig producers, barn workers, truck wash operators, disinfectant suppliers, veterinarians, and other researchers.

***Phase 2**: In-barn testing of the selected most promising sanitization techniques*

The top two sanitation methods identified in phase 1 will be further evaluated on-farm for their efficacy of controlling the growth of disease-causing microorganisms. After each room cycle with pigs, the selected room will be pressure-washed following standard cleaning practices in commercial barns, except the sanitizing/ disinfecting step; this last step will be carried out as part of this experiment by applying the selected alternative sanitization measures.

***Phase 3**: Feasibility analysis and development of recommendations and application guidelines*

The final phase is a feasibility analysis assessing the costs and requirements for the proper implementation of the top treatments in a commercial pig production unit. The analysis will focus on all the costs associated with the sanitization technologies, materials and required equipment, as well as labour and operating costs. Also included will be recommendations and guidelines for the proper application of the most effective sanitization techniques in commercial barns.

RESULTS AND DISCUSSION

Based on the literature search we identified and evaluated 18 potential sanitation and disinfection measures. Results from the literature search showed that the most commonly employed method for controlling pathogens in livestock facilities is the use of chemical disinfectants. The potential alternative and experimental measures identified from the literature search included ultraviolet (UV) germicidal irradiation, ozonation, thermo- assisted drying, non-thermal plasma, the use of slightly acidified water spray, with varying degrees of efficacy in inactivating pathogens. The result of the preliminary assessment and ranking of various potential measures allowed the initial identification of the most promising ones for the next phase of the study (i.e., testing under pig barn conditions).

To reinforce the screening process, an industry survey will supplement and verify the information gathered on each potential measure. Each sanitation and disinfection measure will receive a final rating based on its level of effective in controlling various pathogens.

IMPLICATIONS

Based on initial results (laboratory-scale trials), it appears that silver nanoparticle treatment can be applied at 10 ppm and contact time of 30 minutes.

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