The request is to complete the literature review of technologies directed to remove or inactivate airborne pathogens and also to bring together a group of industry leaders to obtain input on strategies/procedures for rapid deployment to contain bioaerosols. The plan is to have these meetings during the months of June-August. So far there has been one meeting with veterinarians attending the Swine Disease Eradication Center meeting in February where they expressed the need to rapidly deploy technologies for biocontainment and interest in subsequent discussions.

I. Evaluation of technologies, protocols, strategies and ideas for the biocontainment of infectious aerosols in response to emerging disease outbreaks (Project id # 21-109)
Montse Torremorell (P.I)
University of Minnesota
05/15/2022

II. Stated Objectives from original proposal

The main goal of this proposal is to help in the decision making process to prevent the spread of infectious bioaerosols capable of causing disease outbreaks with significant economic consequences. More specifically, we propose to:

Objective 1: Identify existing and emerging aerosol technologies and procedures, and review them for their ability to contain bioaerosols in the face of disease outbreaks in swine

Objective 2: Provide a cost-benefit and feasibility analysis on the technologies and procedures for their applicability to swine farms for both, short-term deployment and longer term development

Objective 3: Assess a subset of technologies for their specific capabilities to biocontain viruses with different transmission routes and biological characteristics

III. Progress toward meeting objectives

Objective 1: We have completed the literature review of technologies directed at removing airborne particles from the air.
Currently the group is writing a report/manuscript where the technologies will be presented, discussed and assessed for their implementation in agricultural settings.

The technologies identified so far include: fibrous filtration, ionization, bipolar ionization, ultraviolet light type C, ultraviolet light type A, electrostatic precipitation, microwave, photo electrochemical oxidation, non-thermal plasmas, and air filters coated with antimicrobial property materials.

We have also held a meeting with veterinarians attending the Swine Disease Eradication Center Meeting in February. During the meeting there was a strong support for biocontainment strategies and the group pledged support to subsequent meetings to discuss rapid deployable strategies. The plan is to expand this group and bring the group together again during June-August to obtain input and ideas on what's implementable to help in future testing of technologies.

Objective 2: Not started

Objective 3: Not started

IV. Status of project in regards to stated timeline

The delay in the project had to do in part because of the delay in starting the project and also due to other project/responsibilities that represented a conflict in the PI's time. Thus, there is approximately a 3-month delay in the timeline proposed in the original proposal. Having an extension until the end of September will help complete the objectives of the grant.

V. Modifications of project from original proposal

We have not made modifications to the original proposal.

VI. Preliminary results

As part of the literature review being conducted in Objective 1 we have identified more than 80 references and these are being stored in Mendeley. The breakdown of references and a description of the most prevalent technologies is as follows:

Fibrous Filtration (11 references): Filtration is the most well-established and widely applied approach for biocontainment. Its method of action is the indiscriminant removal of particles from flowing airstreams. There is a balance between the particle size dependent removal efficiency for a filter, which should be as high as possible, and the pressure drop across the filter for a given flow rate, which is directly related to the energy costs of filter operation. Furthermore, filter loading increases pressure drop but also efficiency, and must be considered in filter application.

Ultraviolet light technologies (16 references): UV-C light at 254 nm is an established route towards pathogen inactivation in aerosols and in surfaces, as nucleic acid molecules readily absorb photons near this wavelength. UV-C (and potentially UV-A) sources can be incorporated in-ducts to directly inactivate pathogens in aerosols, in-conjunction with filters to inactivate collected pathogens and in upper room bulbs to inactivate larger spaces.

However, the latter typically cannot be operated continuously, as UV-C can be mutagenic or carcinogenic at high enough exposure levels.

Electrostatic precipitation (10 references): Commonly used in the combustion industry, electrostatic precipitation is a process wherein particles are unipolarly ionized through interaction with gas phase ions, and ionized particles are exposed to DC electric fields, which lead to their deposition. Electrostatic precipitators (ESPs) are competitive technologies with filters, able to achieve similar-to-better collection efficiencies with minimal pressure drops. They still require periodic cleaning of particles from deposition electrodes, and their performance does change over time as particles deposit.

Other ionization, catalysis, and disinfection technologies: Fibrous filtration, UV light sources, and ESPs are all established technologies used in commercial and residential and health settings, and all of which could be adopted in biocontainment strategies. There are a number of more recently developed ionization schemes (16 references), photocatalytic approaches (9 references), and disinfection technologies (13 references) which are still at the developmental stage and need to be (1) tested for efficacy at scales relevant to agricultural biocontainment and (2) tested for animal safety.