

Evaluation of Efficacy of Ultraviolet Germicidal Chambers in Swine Farms

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Courtesy of the Swine Disease Eradication Center

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Background

- Ultraviolet (UV) germicidal chambers, also known as UV boxes, are used in swine farms to decontaminate objects entering farms.
- UVC light is used to inactivate pathogens by destroying or disrupting the pathogen's nucleic acid but we know little about how effective the chambers are in swine farms.

Objectives

- Evaluate the inactivation rate of non-hemolytic *Escherichia coli* by UVC germicidal chambers in swine farms.
- Obtain information on current use of UVC germicidal chamber protocols in swine farms.

Material and methods

- Test plates were created by placing an *E. coli* inoculum (10^8 CFU/mL) in blank petri dishes.
- Test plates were sent to 48 conveniently selected farms. Each farm received six test plates to be UV tested following the farm UV chamber operation practices. A control (untreated) plate was also sent to account for bacterial losses due to transport and handling. Farm personnel were asked to also answer questions regarding UV chamber operational practices.
- Three plates were tested during the same run and placed in diagonal at the base of the chamber to evaluate the variation of UV exposure within the UV chamber. The other 3 plates were tested in a second run that consisted of having one plate in the left corner of the UV chamber, another plate taped to the side of a cardboard box, and the last plate taped on top of the cardboard box.
- After UV treatment, plates were shipped to the laboratory for bacterial quantification (CFU/ml). Bacterial percentage inactivation was calculated using bacterial counts in the control plate as reference.

Results:

- The questionnaires revealed differences in operation protocols and design among UV chambers in farms. Forty five percent (14/31) were homemade UV chambers, 45% (14/31) were commercial UV chambers, and 9% (3/31) were UV rooms. Main differences in operational procedures and UVC chamber designs included time of UVC exposure, lack of using an empty cycle prior to treating materials, location of bulbs, bulb light replacement procedures and placement of objects within the UVC chamber.
- The average farm inactivation rate was 93.81% and ranged between 62.6% and 100%. Only 1 farm had inactivation rates of 100% in all test plates.
- Differences between the test plates were not statistically significant ($p < 0.05$) indicating that there were no significant differences between inactivation rates obtained between cycles, or location within the UV box. However, inactivation rates in the side of the cardboard boxes were consistently lower.
- The homemade UV chambers had higher inactivation rates compared to commercial chambers with values of 99% vs. 88% for the homemade and commercial chambers respectively ($p = 0.04$).

Conclusions and Implications

- The level of bacterial inactivation in on-farm UV chambers varied among farms.
- There was variability in inactivation rates depending on location within the chambers with the lowest inactivation rates obtained in the lateral part of the cardboard boxes although these differences were not statistically significant.
- There was also significant variability in the protocols, procedures, and UV box dimensions reported by farm employees.
- Current UV protocols used to decontaminate fomites in swine farms are not homogenous and do not appear to fully inactivate bacteria that may be present on the fomites.
- Limitations: the farms were conveniently selected and may not be representative of the US farms at large. Variability in shipping conditions may have varied between farms which may influence the results.

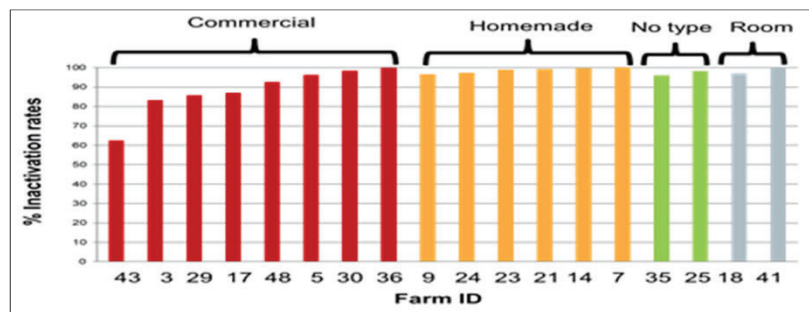


Figure 1: Total inactivation rates by farm and UVC chamber type



Figure 2: Inactivation rates by plate location within the UVC chambers

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