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Laboratory Certification
AIHA LAP #183867
CDC Elite since 2009
NY State Legionella Certified #12050
State of TN #03147
EPA license #801-14

Experimental trials conclude that the VentorLux Soulis Air Disinfection System is effective at eliminating Airborne Mold Spores and Bacteria.

Product Testing Lab
August 28, 2019

Experimental Overview

- Assured Bio Labs, LLC was contracted by VentorLux to conduct time series analysis to determine the capacity of their Soulis air sterilization equipment at eliminating airborne mold spores and bacteria.

- An experimental time-series trial was conducted to determine the capacity of the VentorLux Soulis system for airborne microbial reduction. Microbial concentrations were measured at regular intervals following inoculation of the room which housed the VentorLux Soulis equipment.

- M-TRAP® capture cassettes were used to measure microbial concentrations via DNA analysis, using high-fidelity, quantitative PCR technology.

- The testing procedure consisted of surface sample collection at the beginning and end of the experiment, 24 hours apart. Surface samples were collected from shelfing and floor sections, and analyzed, to assess the Soulis' effect on the settling of viable airborne microbes. (Reference: Figures 5-6)

- Air samples were collected from four room locations as well as from the Soulis' exhaust port at hourly intervals. The four room locations are denoted as "A, B, C, & D". The Exhaust port sample was indicated with a "W". Five air samplings were conducted in the hours following initial inoculation of the room. The final sampling was conducted 24 hours from initial inoculation. (Reference: Figures 2, 3-4)

- The mold species used in the study, *Penicillium brevicompactum*, is a common contaminant of the built-environment when water intrusion, elevated humidity or "sick building syndrome" issues are reported. The mold species was cultured on sterilized corn kernels for maximum spore production (see Table 1, Figure 1).

- The bacteria chosen for the trial was *E. coli*, which is a very common contaminant found in the medical setting. A stock of *E. coli* was cultured and suspended in saline to be introduced into the air via an atomizing sprayer.

Key Findings

- In the experimental trial the VentorLux Soulis removed 99.99% of mold spores and bacteria from the airstream within 24 hours of room inoculation.

- The concentration of the airborne *Penicillium brevicompactum* spores was reduced from an average starting concentration of >1.6 million spores to an average of 7459 spores within five hours of inoculation. Following 24 hours from inoculation, the average airborne spore concentration had been reduced to an average of 181 spores. (see Figure 3).

- At the point of inoculation, airborne E.coli cell concentrations were recorded at an average of >18,000 cells. At the four hour mark, the average airborne E.coli cell concentration was recorded as 29 cells. 24 hours from inoculation, airborne bacterial cells had been reduced to zero. (see Figure 4)

Table 1. Target Organisms.

Organism	Strain	Inoculum Substrate
Penicillium brevicompatum	DAOMC 192262	Sterilized Corn Kernels
Escherichia coli	ATCC 11303	Tryptic Soy Agar

Figure 1. Mold sporulation on sterilized corn kernels. *Penicillium brevicompactum* is colonizing the kernel in the photograph below. Spores were physically removed from kernels before introduction into the room housing the VentorLux Soulis system.

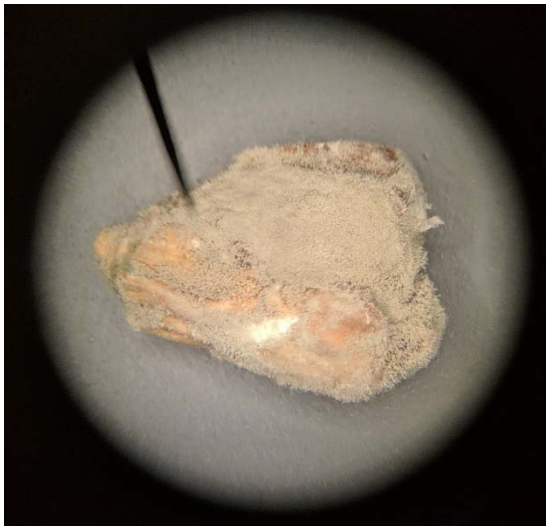
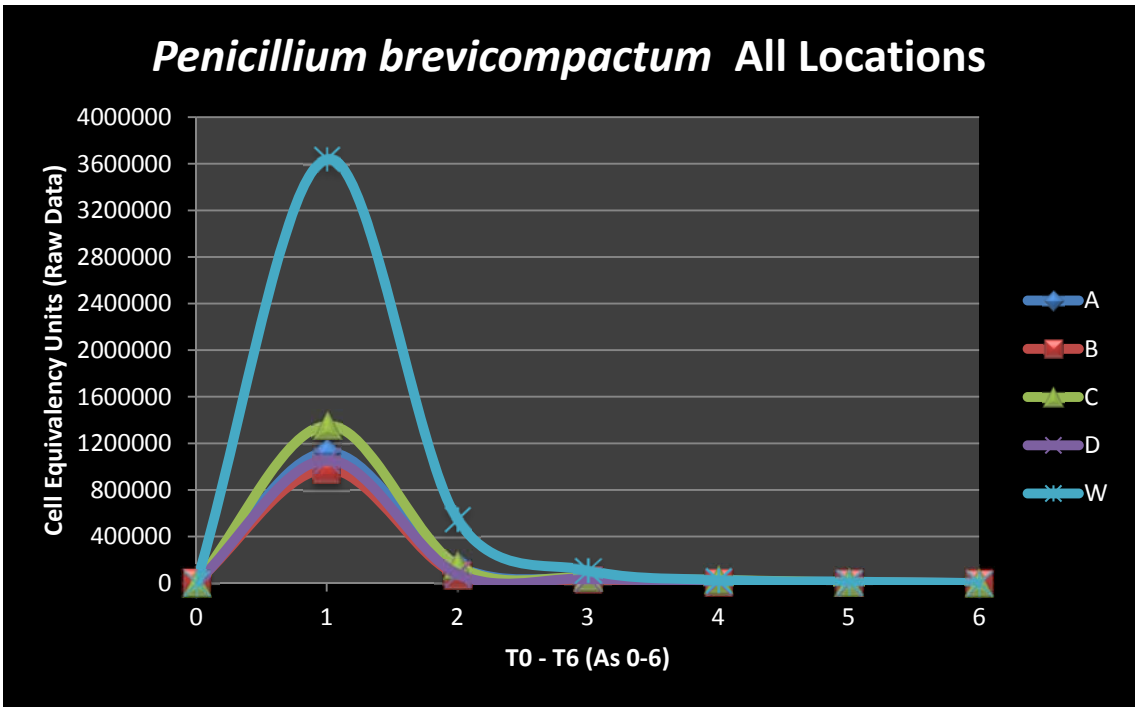


Figure 2

VentorLux- Sampling Schedule	
T0- Baseline Testing: Air and Surface	
Inoculation 8/30/19 8:45am	
T1- 9:00am- Air Testing	
T2- 10:00am- Air Testing	
T3- 11:00 am- Air Testing	
T4- 12:00pm- Air Testing	
T5- 1:00pm- Air Testing	
T6- Final Sampling- Air and Surface 9/1/2019 9:00:00 AM	

Figure 3. Time series for trial for the mold species *Penicillium brevicompactum*. Evidence suggests that the VentorLux Soulis disinfection system removed 99.99% of mold spores from the air within the 24 hour allotted time period.



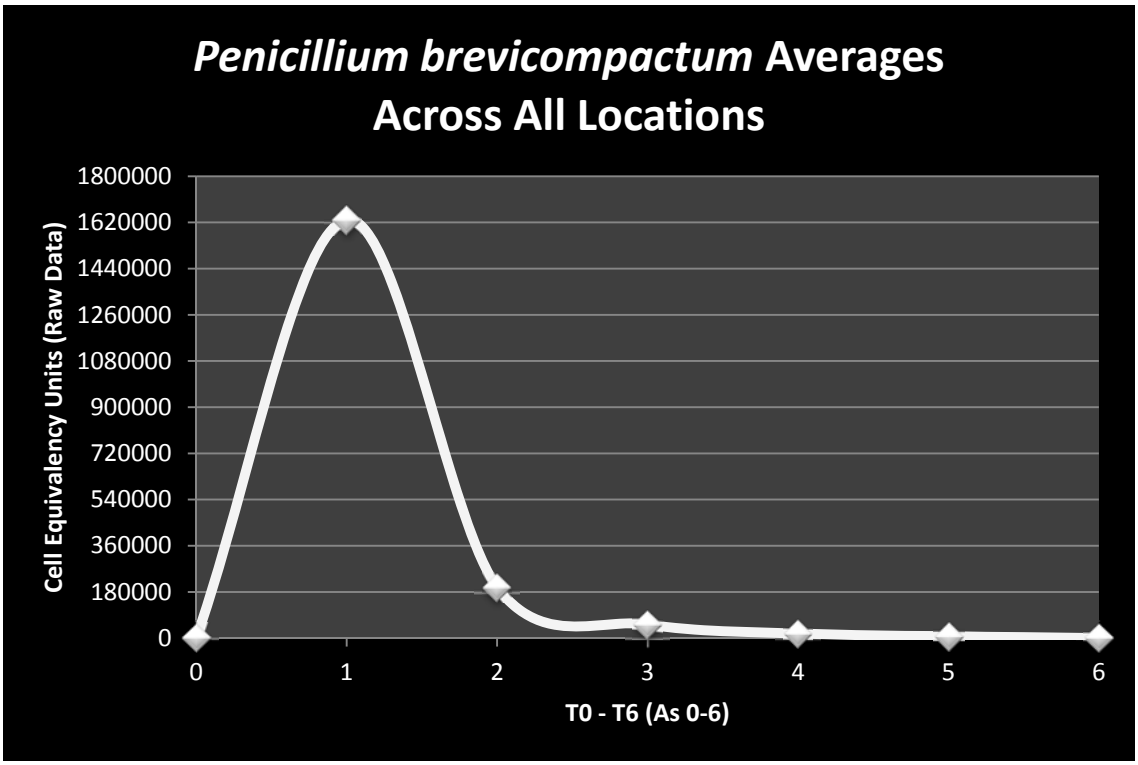
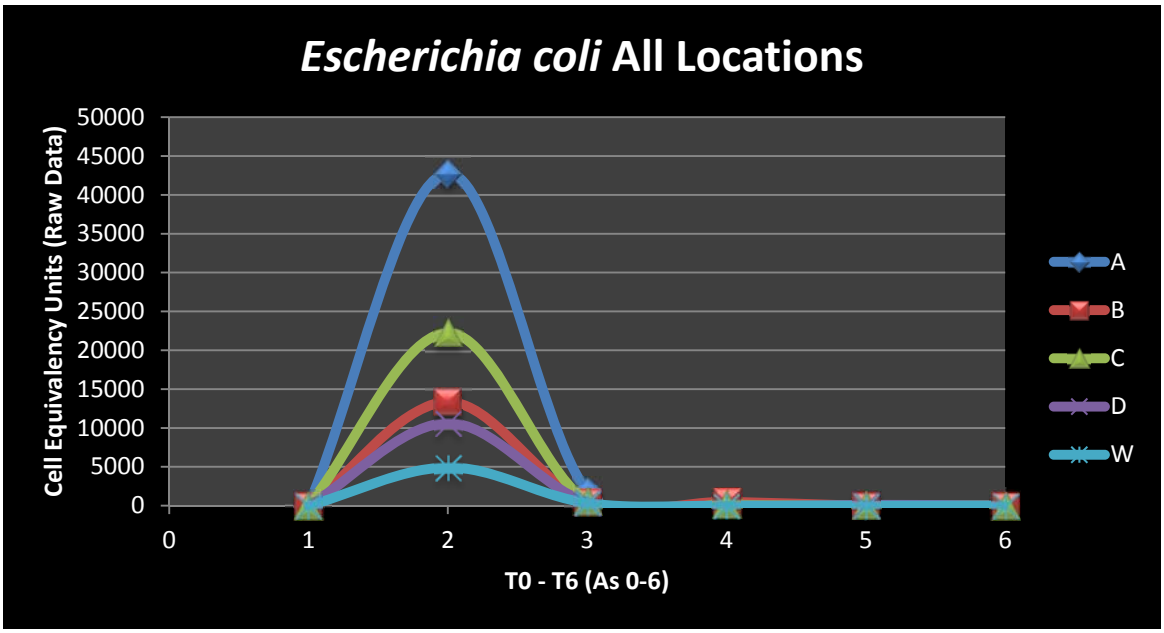


Figure 4. Time series for trial for the bacteria species *Escherichia coli*. Evidence suggests that the VentorLux Soulis disinfection system removed 99.99% of bacterial cells from the air within the 24 hour allotted time period.



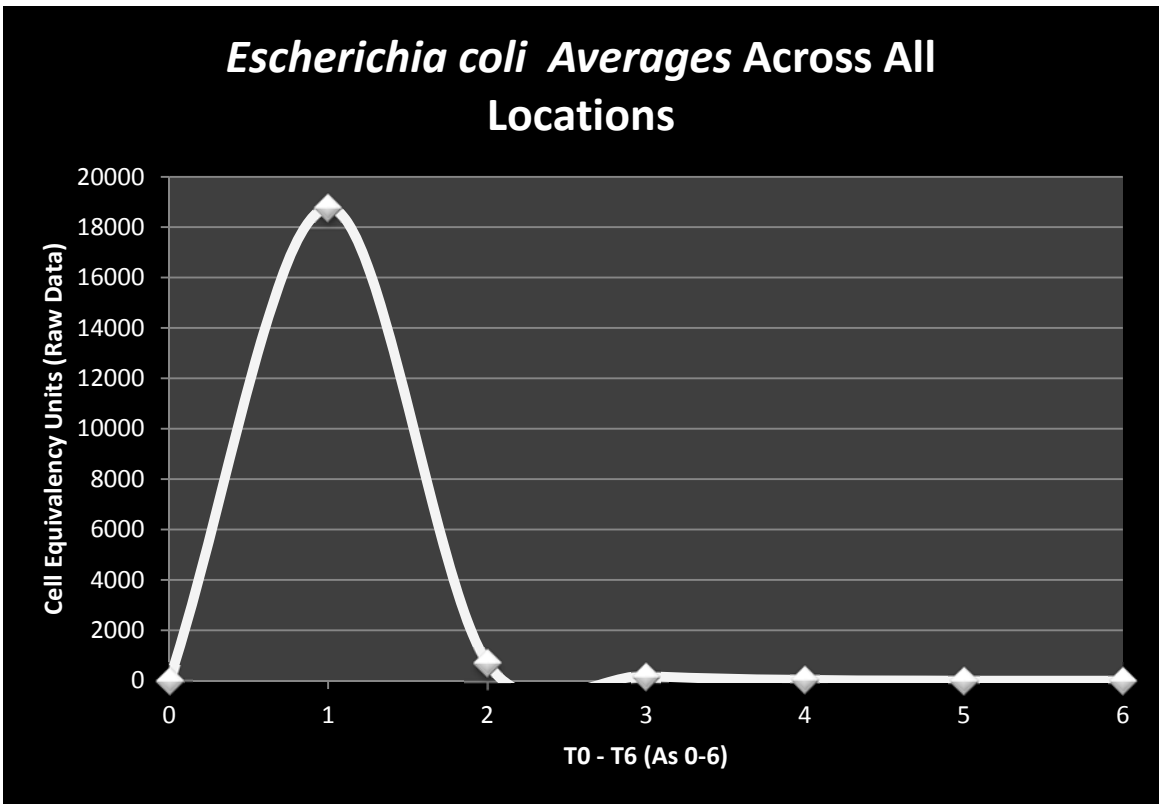


Figure 5-
The table below indicates pre-test and post-test sample data for viable *P. brevicompactum*.

Penicillium brevicompactum

Surface & Air Viability Sample Location	T0-Pre Test Colony Forming Units/Sample	T6-Post Test Colony Forming Units/Sample
(Air) Andersen 1	30	0
(Air) Andersen 2	10	0
(Surface) Floor 29	0	0
(Surface) Floor 44	20	0
(Surface) Floor 48	1000	0
(Surface) Shelf 11	70	0
(Surface) Shelf 12	90	0
(Surface) Shelf 1	20	0

Figure 6-
The table below indicates pre-test and post-test sample data for viable *E. coli.*

Escherichia coli

Surface & Air Viability Sample Location	T0- Pre Test Colony Forming Units/Sample	T6- Post Test Colony Forming Units/Sample
(Air) Andersen 1	0	0
(Air) Andersen 2	0	0
(Surface) Floor 29	0	50
(Surface) Floor 44	0	0
(Surface) Floor 48	0	10
(Surface) Shelf 11	0	0
(Surface) Shelf 12	0	0
(Surface) Shelf 1	0	0

Experimental Methods

Fungal Spore Preparation.
Penicillium brevicompactum (192262) was obtained from the Canadian Collection of Fungal Cultures (DAOMC). The fungi was cultured on malt extract agar for 10 days. Spores were harvested and suspended in sterile distilled water. Corn kernels were sterilized by autoclaving for 1 hour in 500 ml polypropylene containers. Following sterilization, 6 containers were inoculated with 10 ml of the *P. brevicompactum* suspension. Containers were mixed for 30 minutes on a platform shaker to evenly distribute the spore inoculum. All containers were incubated at 27 degrees centigrade for 14 days.

Bacterial Culture Suspension Preparation
Escherichia coli (11303) was obtained from American Type Culture Collection (ATCC). The bacteria was cultured on Tryptic Soy Agar for 3 days at 35 degrees centigrade. Bacteria was removed from plates and suspended in sterile distilled water. The bacterial suspension was placed into an atomizing sprayer for the airborne introduction.

Time Series Trials
To begin the trial, one container of corn kernels colonized with sporulating *P. brevicompactum* was opened and agitated for 10 seconds to release the aerosolized fungal spores. The *Escherichia coli* suspension was introduced into the room via 100 sprays from the atomizing sprayer. Sample collection followed the schedule outlined in Figure 2.

Analysis & Reporting
M-TRAP® capture cassettes were processed according to Assured Bio Labs, American Industrial Hygiene accredited DNA mold analysis methods (AIHA LAP #183867). Quantitative PCR analysis was run for two DNA probe and primer sets that corresponded to calibrations standards for *P. brevicompactum* and *E. coli*. Data was reported in spore equivalents or total spore concentration from the in-room samples at the beginning of each time series trial and for each VentorLux Soulis exhaust sample collected during recirculation.