VentorLux®

Soulis™ Efficacy Study

Product Testing Results

September 2019

Experimental trials conclude that the **VentorLux® Soulis™ Air Disinfection System** is *effective* at *eliminating* airborne mold spores and bacteria.

Actual prototype Soulis™ 8400 unit tested shown in AirJet™ Black

assuredbio labs
228 Midway Lane, Suite B
Oak Ridge, TN 37830

Laboratory Certifications

AIHA Accredited Microbiology Laboratory LAP #183867
CDC ELITE Laboratory #5001635 *since 2009*
EPA license #801-14 - EPA Lab ID: TN01361
New York State Dept. of Health ELAP Approved Lab
NY State Legionella Certified #12050
State of TN #03147, ISO / IEC 17025:2005

Department of Health

Executive Summary

Experimental Overview

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

Table 1. Target Organisms.

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

***Mold** and **bacterium** were chosen in the Fall of 2019 because it has been proven that **viruses** are easier to kill. If **Soulis™** is effective with mold spores, then everything else is well within the required germicidal capabilities to kill any viruses.*

Surface Pathogen: 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.

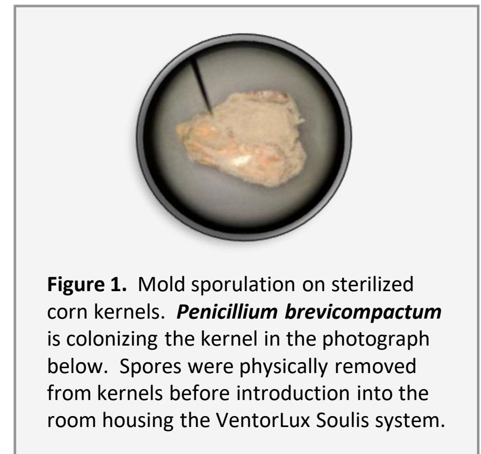
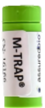


Figure 1. Mold sporulation on sterilized corn kernels. ***Penicillium brevicompactum*** is colonizing the kernel in the photograph below. Spores were physically removed from kernels before introduction into the room housing the VentorLux Soulis system.

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

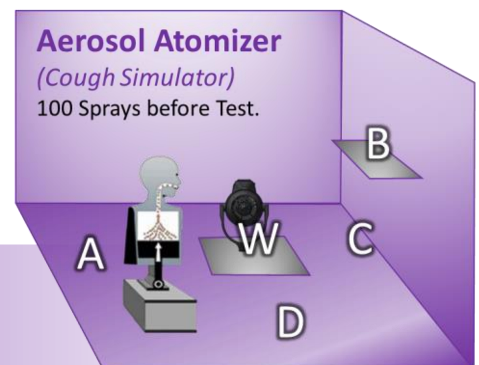
1. An experimental **time-series trial** was conducted to determine the capacity of the VentorLux **Soulis**™ system for **airborne microbial reduction**. Microbial concentrations were measured at regular intervals following inoculation of the room which housed the Soulis test unit.



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

2. 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)

3. 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)



Key Findings

1. In the experimental trial the VentorLux Soulis **removed 99.99%** of mold spores and bacteria from the airstream within 24 hours of room inoculation.
2. 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).
3. At the point of inoculation (T0), 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 (T6), airborne bacterial cells had been reduced to **zero**. (see Figure 4)

Figure 2. Time series for trial for the **VentorLux Soulis** - Sampling Schedule.

#	Time	Date	Sample Types (Air / Surface)	Note / Resultss
T0	8:45 AM	8/30/2019	**Baseline Sampling: Air & Surface**	Innoculation Begins
T1	9:00 AM	8/30/2019	Air Sample: M-Trap Testing	***Soulis Engaged***
T2	10:00 AM	8/30/2019	Air Sample: M-Trap Testing	1 hour of use
T3	11:00 AM	8/30/2019	Air Sample: M-Trap Testing	2 hours of use, ***> 99% Reduction***
T4	12:00 PM	8/30/2019	Air Sample: M-Trap Testing	3 hours of use
T5	1:00 PM	8/30/2019	Air Sample: M-Trap Testing	4 hours of use
T6	9:00 AM	9/1/2019	**Final Sampling: Air & Surface**	24 hours - Test Complete **> 99.99%**

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.

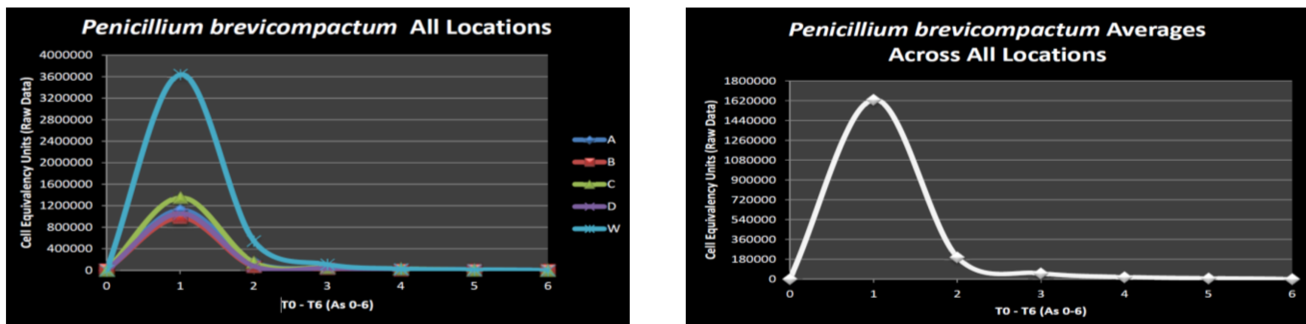


Figure 4. Time series for trial for the bacteria species **Escherichia coli.** Evidence suggests that the **VentorLux Soulis** disinfection system **removed 99.99%** of bacterial cells from the air within the **24** hour allotted time period.

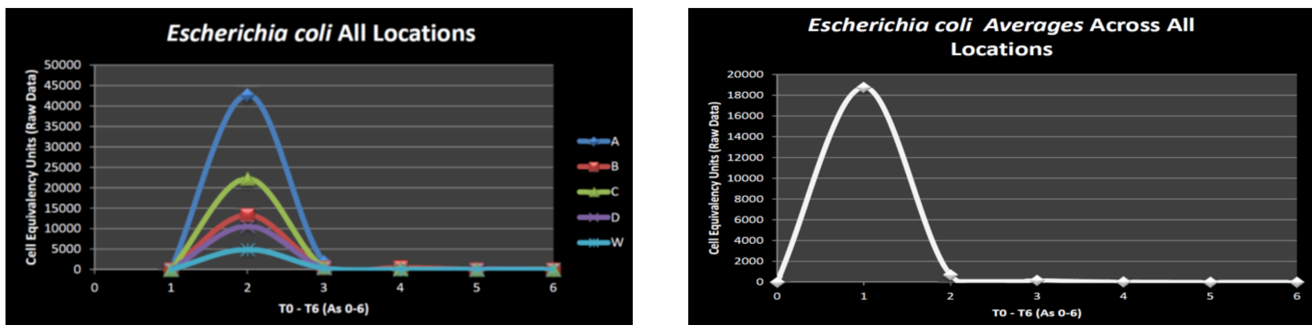


Figure 5. The table below indicates pre-test and post-test sample data for viable

Penicillium brevicompactum

Surface & Air Viability	T0 Pre-Test	T6 Post-Test
Sample Location	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

Escherichia coli

Surface & Air Viability	T0 Pre-Test	T6 Post-Test
Sample Location	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

Time Series Trials

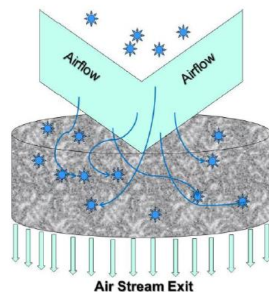
To begin the trial, one container of corn kernels colonized with sporulating *P. brevicompactum* was opened and agitated for 10 seconds to release the aerosolized fungal spores. The *Escherichia coli* suspension was introduced into the room via 100 sprays from the atomizing sprayer. Sample collection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

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.



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.