



Efficacy of the ESP-DLux[®] to Control Contamination of *Listeria Monocytogenes* on Environmental Surfaces

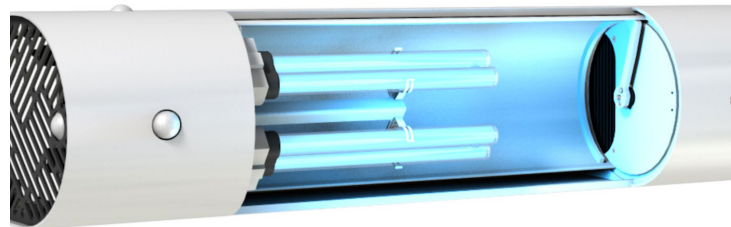
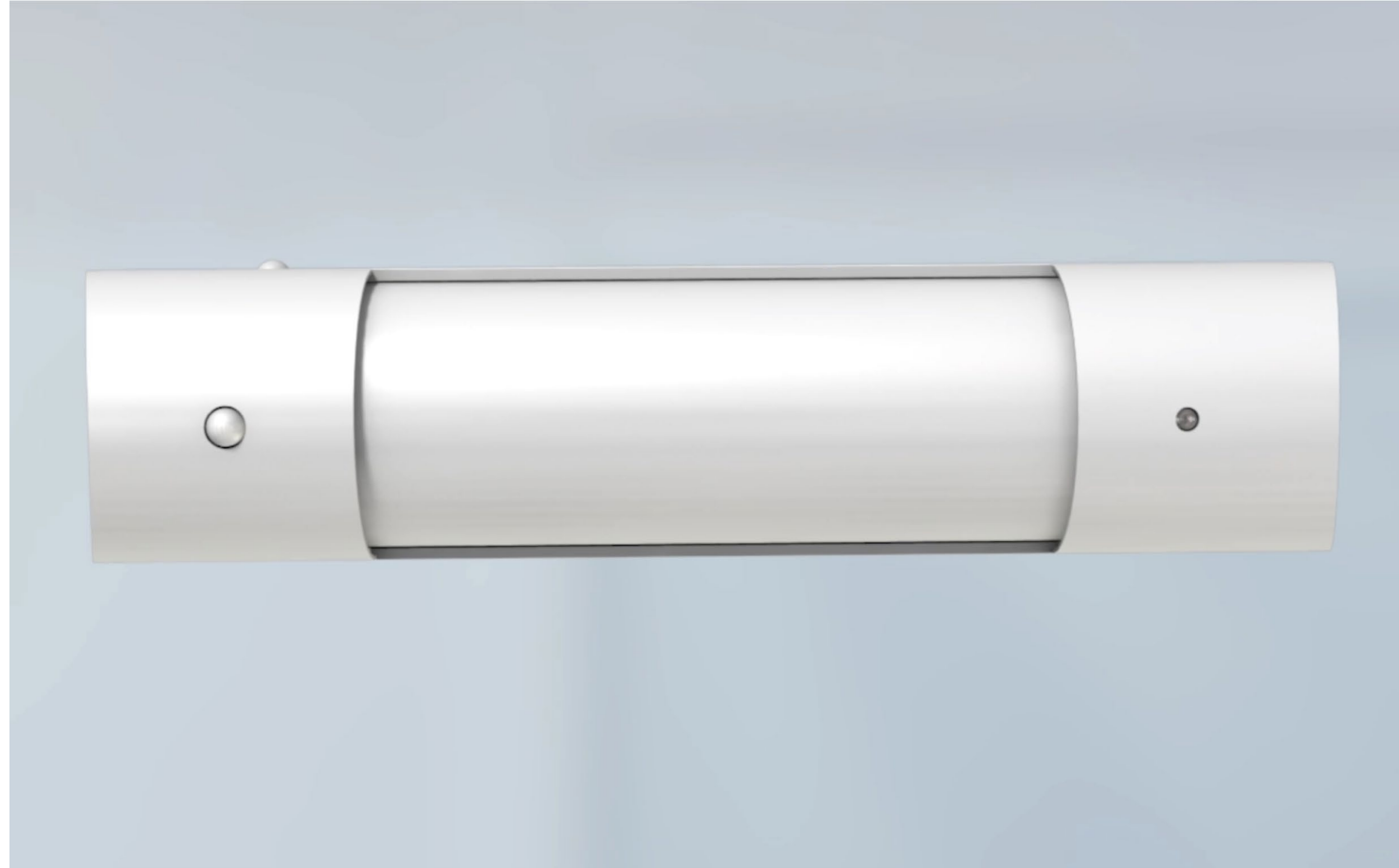
Presenter

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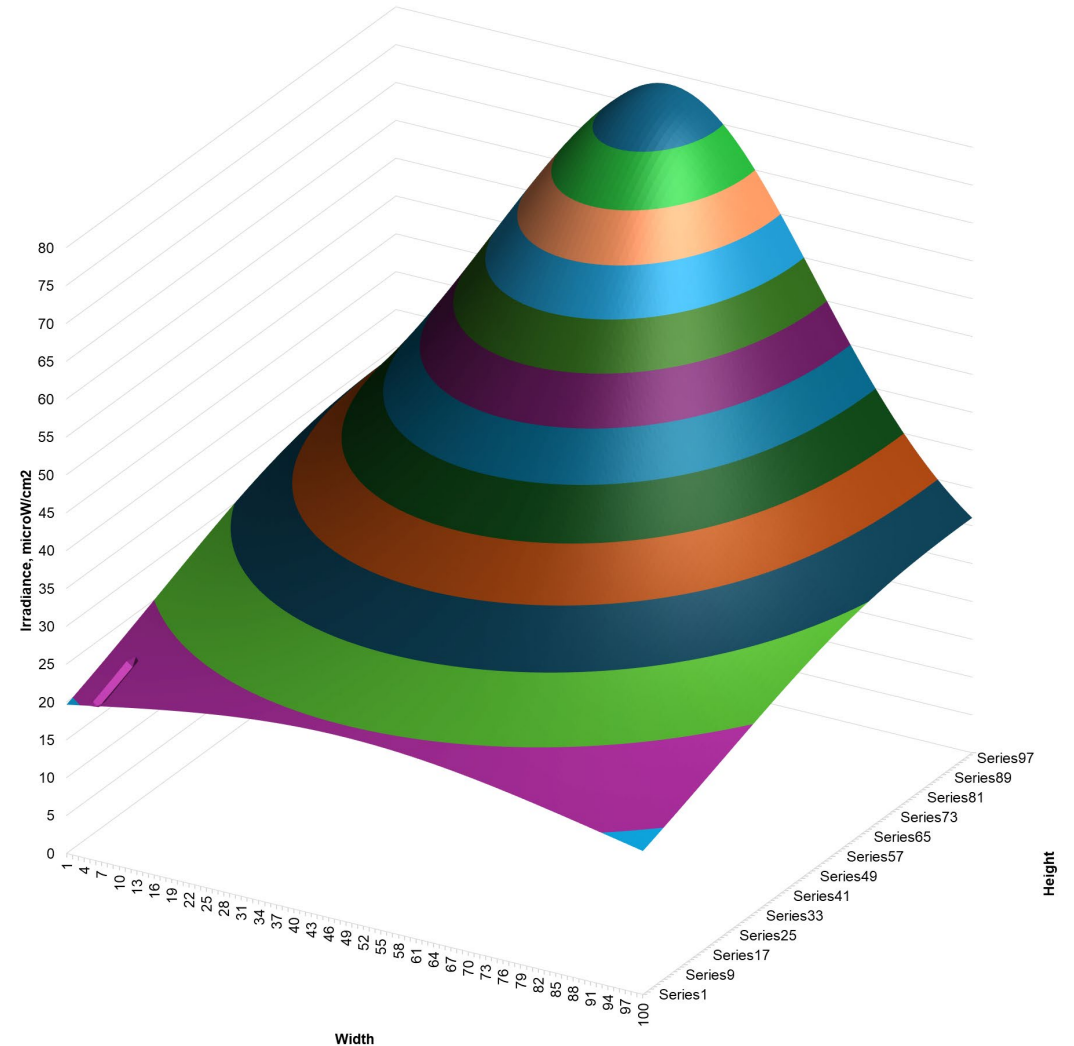
Description of the ESP-DLux[®]

- Compact High Intensity UV Source
- Wall mountable
- Power: 22 W UV Output
- Open Shutter: Whole Room Disinfection
 - Room Unoccupied
- Closed Shutter: Forced Air Disinfection
 - Room Occupied



Analysis of the Efficacy of the ESP-DLux[®]

- Mode 1: Forced Air Disinfection
 - 50 cfm
 - 2.6 EAC
- Mode 2: Surface and Air Disinfection
 - 5 minutes exposure per hour
 - 0.200 W/m² room average
 - Unoccupied
- Luminaire Efficiency is approximately 24%
- Typical Upper Room UV systems have about 15% LR
- Ozone Free



UV Irradiance (microW/cm²) on Floor of a 12x12 Room

Objective of Study

- To determine the efficacy of the ESP-DLux® to control *Listeria Monocytogenes* contamination on surfaces that are common in a meat processing plant
- UV has been successful in many air, water and surface disinfection studies
- Recent applications in the food industry have encountered difficulties with certain environmental surfaces

Significance of Listeria to Food Processing Companies

- Listeria is a well-documented environmental bacterium and forms biofilms
- Companies invest significant resources in controlling Listeria contamination
- The USDA has zero tolerance for Listeria
- May grow on surfaces that are difficult to clean
- No log reduction requirements in the USA
- EU Regulations: FBOs (Food Business Operators) must prove 100 CFU/gm or less of *Listeria*, or else zero tolerance (0 CFU in 25 gm).

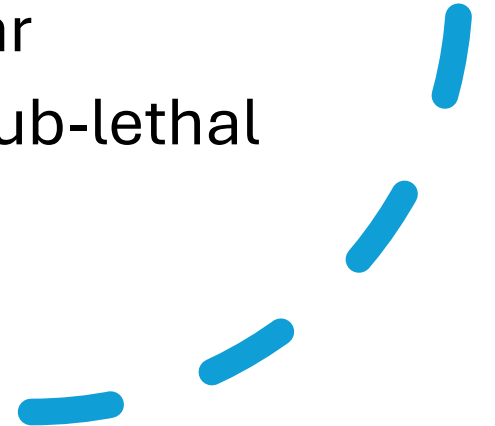
Log Reduction	Population	Survival	Survival, %
0	1	1	100
1	10	0.1	10
2	100	0.01	1
3	1000	0.001	0.1
4	10000	0.0001	0.01
5	100000	0.00001	0.001
6	1000000	0.000001	0.0001

Economic Impact of Listeria Monocytogenes

- The overall cost estimates for Listeria infections in the U.S. run from \$228 million to \$7.6 billion yearly.
- Medical costs that Listeria infections had caused each year were said to run from \$61.7 to \$64.8 million
- Campylobacter, Salmonella, E. coli O157:H7, and Listeria Monocytogenes: the total cost in the United States for these four pathogens at \$6.5 billion a year.
- For Listeria specifically, it was estimated that costs amounted to \$2.3 billion per year, based on 2,493 cases, which involved 2,298 hospitalizations and 499 deaths per USDA (2000).

Methods for Preparation of Listeria Culture and Surface Application

- Culture: Fresh ground beef mixed with saline
- Listeria were grown in trypticase soy broth
- Bacterial population was >99.99% of Listeria
- A foam paint brush was used to apply the inoculant to surfaces: stainless steel, plastic, tile, grout
- Inoculated surfaces were dried for 30 minutes
- Each 5x10 cm area (50 cm²) was swabbed using a template
- Samples were pour plated on agar
- Incubated for 72 hours to allow sub-lethal injury recovery



Methods Used for UV-C Application and Statistical Analysis

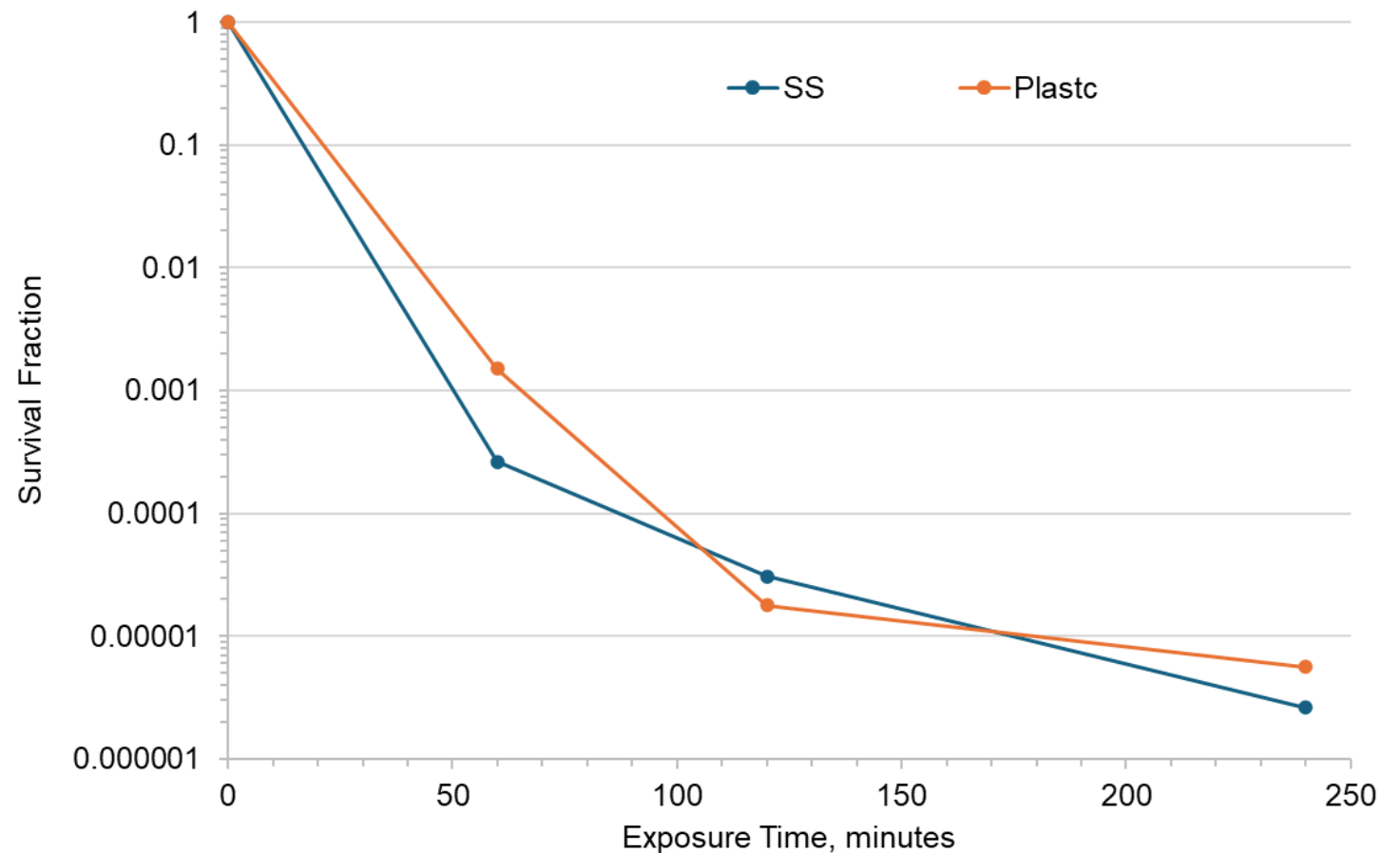
- The ESP-DLux[®] was positioned 2 meters above the inoculated surfaces
 - Stainless Steel, Plastic, Tile & Grout
- Sample surfaces received 0, 60, 120, & 240 minute exposure times
- The experiment was performed twice
- 36 plates and surfaces were exposed with 15 unexposed controls ($t = 0$)
- Statistical analysis was performed for all four surface data sets using Winks SDA ver. 7.0

6 Log Reduction of *Listeria* on Stainless Steel and Plastic

- 99.9999% Reduction
- Survival tail at 120 minutes did not prevent 6 log reduction

Table 1: Log Reductions of *Listeria monocytogenes*

Exposure Time Et, min	Stainless Steel	Plastic
0	0	0
30	3.58	2.82
60	4.51	4.75
120	5.58	5.25

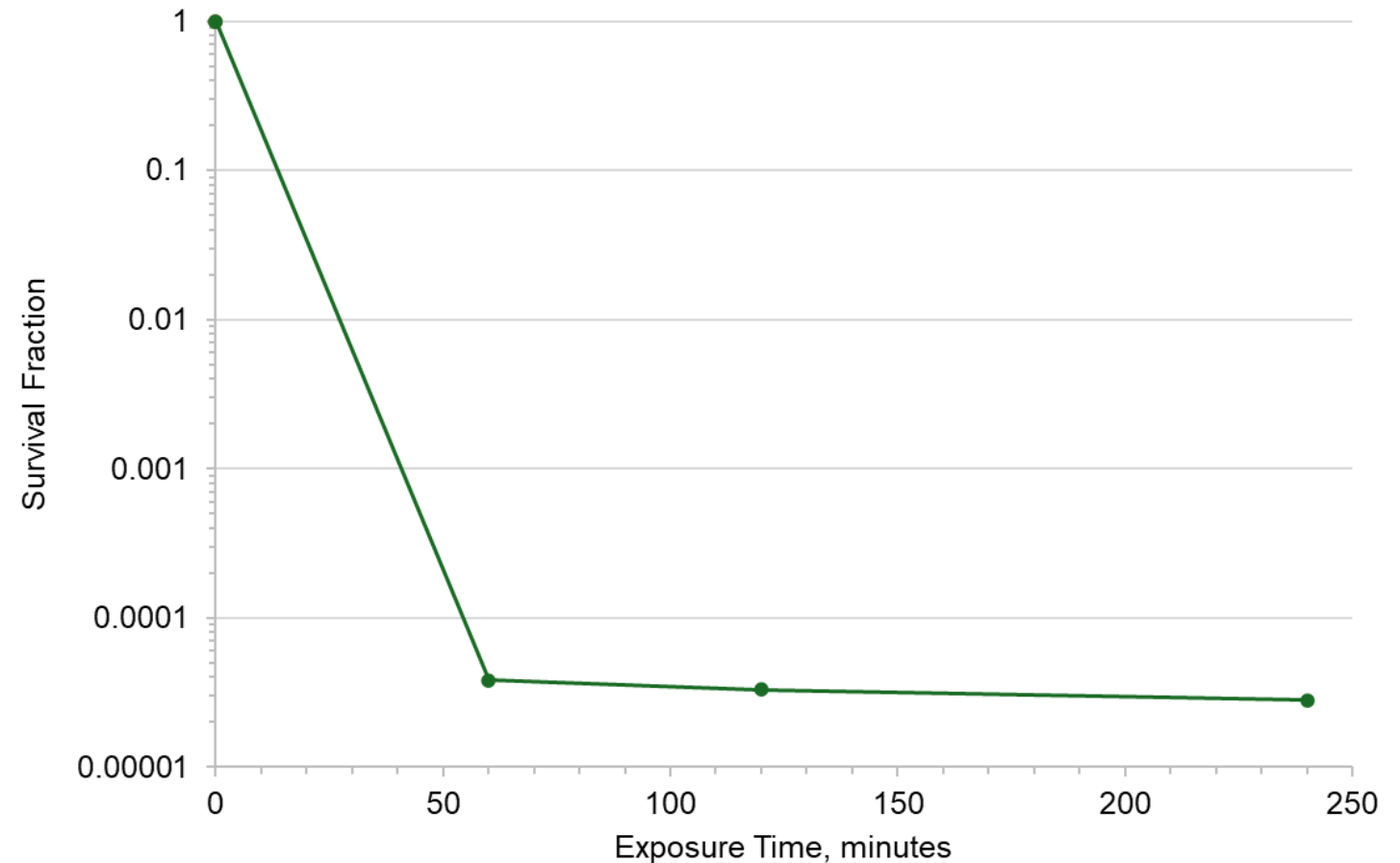


4.5 Log Reduction of Listeria on Tile

- 99.999% Reduction
- Pore size of Tile likely protects 1 in 50,000 cells

Table 2: Log Reductions of Listeria Monocytogenes

Exposure Time ET, min	Tile
0	0
30	4.42
60	4.485
120	4.55

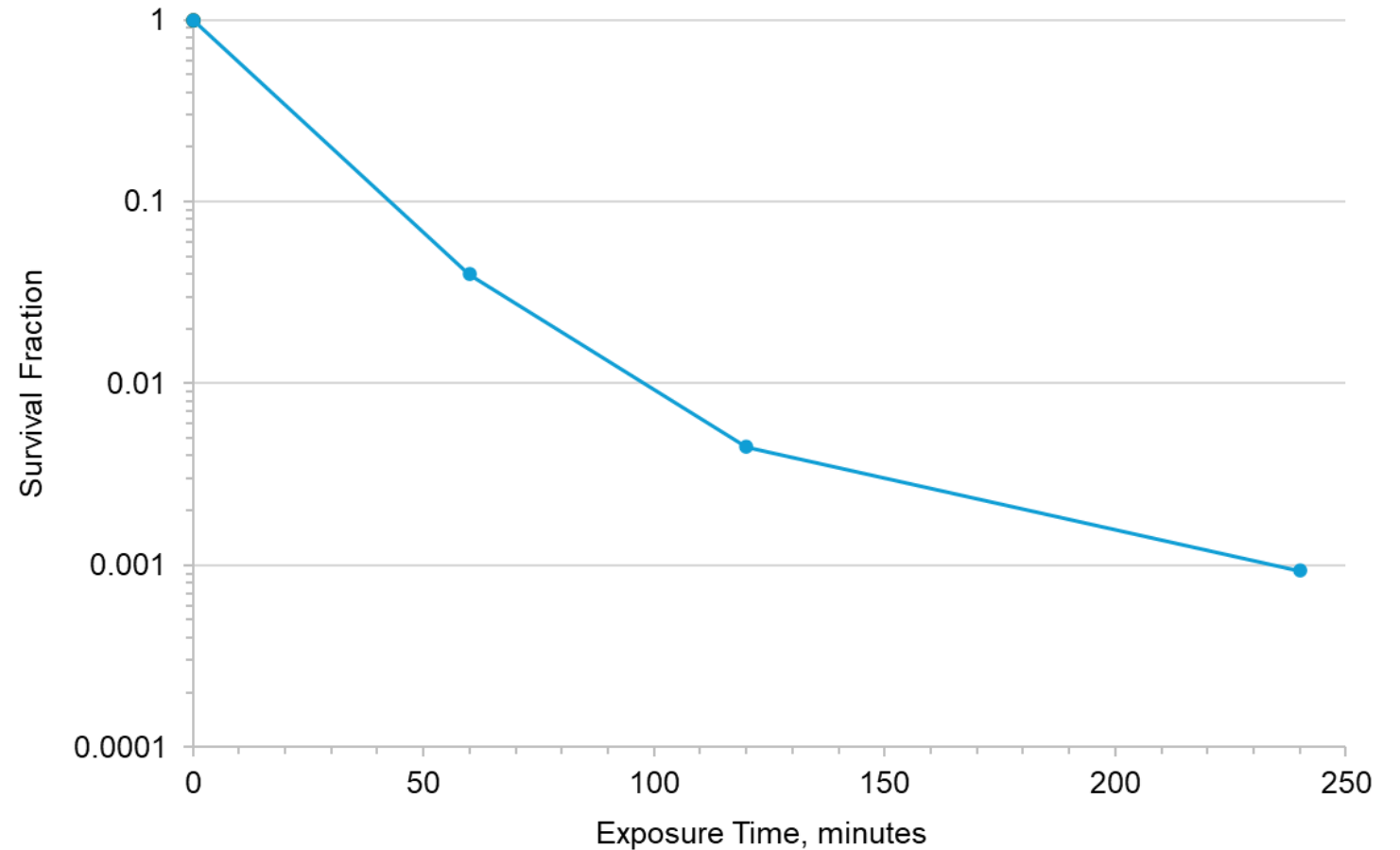


3 Log Reduction of *Listeria* on Grout

- 99.9% Reduction
- No previous studies found for UV disinfection of grout

Table 3: Log Reductions of *Listeria monocytogenes*

Exposure Time Et, min	Grout
0	0
30	1.4
60	2.35
120	3.03

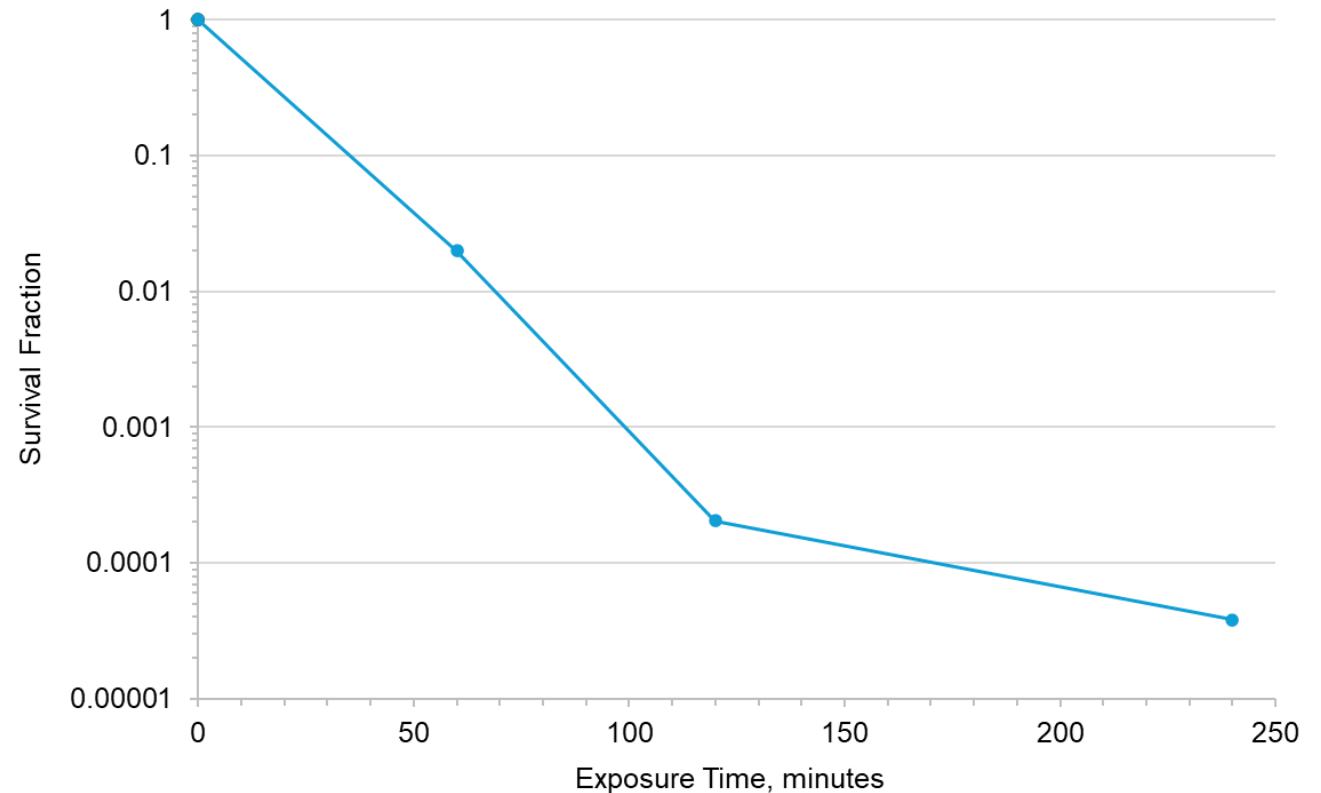


Prior ESP-DLux[®] Study: Reduction of Aerobic Bacteria

- Greater than 4 Log Reduction of Aerobic Bacteria
- Dickson (2017), “Efficacy of a device to control environmental contamination in a meat processing facility” study in a meat processing facility

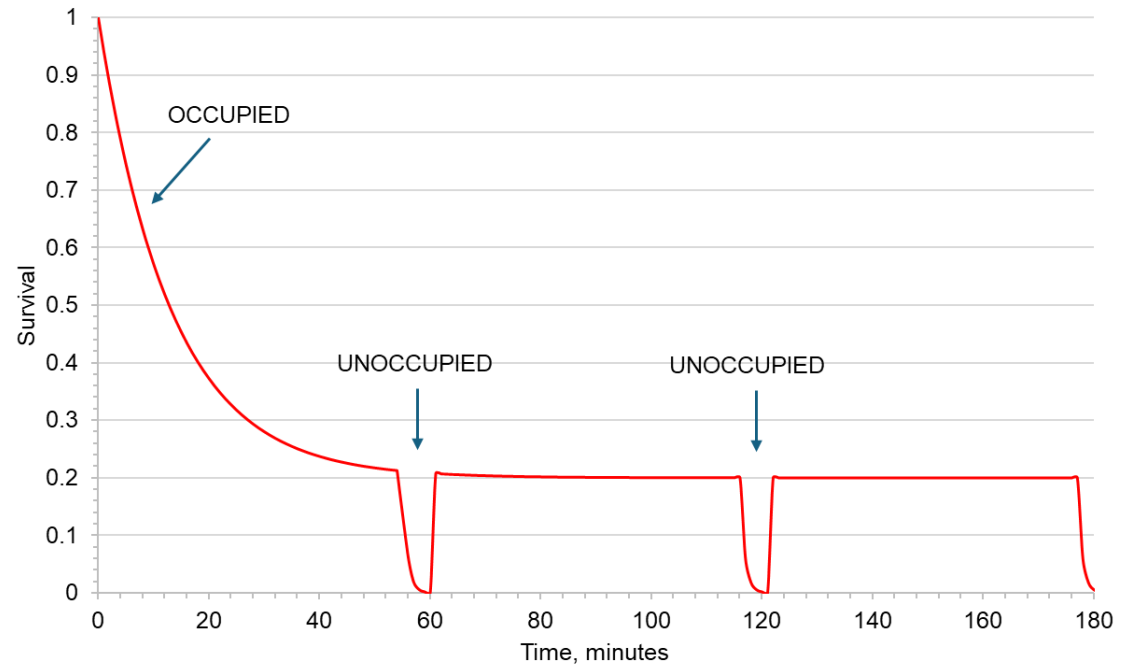
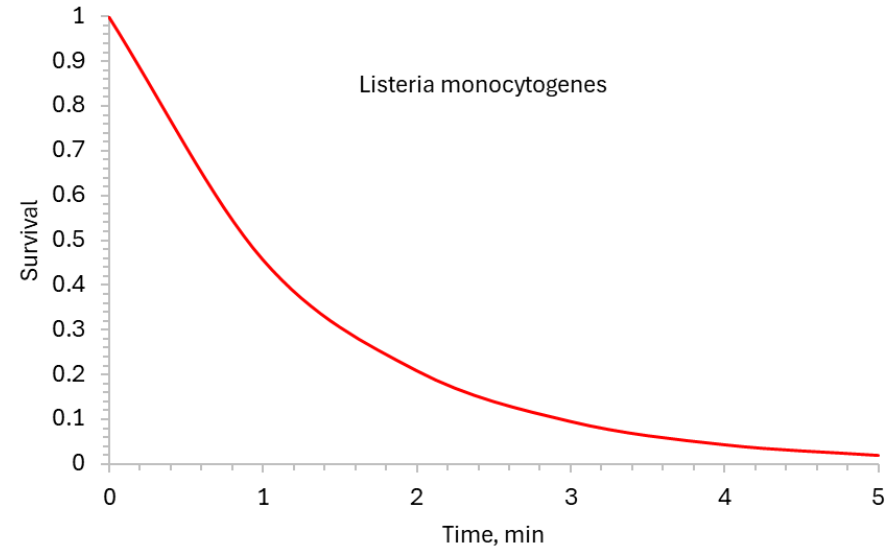
Table 4: Log Reductions of *Aerobic Bacteria*

Exposure Time Et, min	Log Reduction
0	0
30	1.7
60	3.69
120	4.42



Analysis of Performance in a 12x12 Room

- Listeria $k = 0.06547 \text{ m}^2/\text{J}$
- Model Room
- Cyclic operation
- Steady State reached in 60 minutes.
- Complete purging every hour
- Surfaces disinfected for 5 minutes every hour



Conclusions

- The ESP-DLux® provides superior disinfection results on Food Industry surfaces
- 6 Log Reduction (99.9999%) of *Listeria* on Stainless Steel and Plastic
- 4.5 Log Reduction on Tile
- On Grout, a previously untested material, a 3 Log Reduction was achieved
- Cyclic operation in a 12x12 room reduces airborne contamination during forced air cycle
- Cyclic operation reduces surface contamination through direct exposure while room unoccupied

Acknowledgements:

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For More Information, Please See Our Website

ESP-DLux.com

Thank You!

