

# Comparison of The Bactericidal Effect of a SIAD Photonic Lamp with an Ultraviolet Lamp on a Strain of *Escherichia coli*

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## Aim:

To compare the bactericidal effect of a SIAD Photonic Lamp with an ultraviolet [UV] light source at various distances from Bacterial cell suspensions of *Escherichia coli* (*E. coli*) at varying sample depths.

## Materials and Methods:

### Lamps:

- Water Purification, Inc
  - Ultraviolet Lamp # FB01
    - Range: UVC
    - Watts: 22
    - Voltage: 117AC
    - Amps: 0.19
    - Physical Dimensions: 20 inch lighted length x 0.625 inch diameter
- Synergene, Inc.
  - SIAD 8" Photonic Lamp
    - Range: UVA, UVB, &UVC
    - Watts: 1500
    - Voltage: 117AC
    - Amps: 13
    - Physical Dimensions: 8 inch lighted length x 0.375 inch diameter

*Escherichia coli* is an enteric, gram-negative, motile, non-spore forming rod commonly used as an indicator organism for fecal contamination of water supplies. In this study a strain of *E. coli* (ATCC #47056) was grown on the surface of 10 Tryptic Soy Agar (TSA) plates and harvested after 18 hours of incubation at 37° C in 5.0 % CO<sub>2</sub> in air. The cells were suspended in sterile full-strength "Ringers" solution and placed in stainless steel trays of varying capacities and

depths (tables 1 & 2). Saline was used rather than water to diminish the effect of cell lyses due to osmotic pressure. The trays were then placed directly below each lamp (Figure 1) and exposed for periods of 3 and 7 seconds at a distance (R) of 2.25 inches from the lamp. A third trial was conducted with the UV light using an exposure of 120 seconds. All trials included five varying depths (B) of cell suspension (Table 1 & 2). Voltage, lamp temperature and fluid temperatures at both the start and end of exposure were recorded at each trial for the SIAD Photonic Lamp. An attempt was made to maintain constant lamp voltage and temperature for the SIAD Photonic Lamp throughout the study.

Following exposure an aliquot of cell suspension was removed from each tray, plated onto TSA and incubated at 37° C, in air, for 24 hrs. The recoverable cell counts were determined by plating appropriate dilutions onto TSA and compared to those of unexposed cell suspensions of *E. coli*.

#### **Results:**

Table 1 shows that the voltage and temperature of the SIAD Photonic Lamp remained relatively stable throughout the study. The voltage for trials 1 and 2 were 523 and 525 volts respectively while the lamp temperature ranged from 150° C to 160° C. The fluid temperature remained stable and did not exceed 22° C, well within a range that would not alter viable cell counts.

Total viable count was reduced to undetectable levels in nine of ten samples exposed to the SIAD Photonic Lamp with an average cell recovery rate of 2.03 colony forming units (cfu)/ml (Table 1). This was in sharp contrast to the UV lamp exposures that resulted in an average cell recovery of  $1.09 \times 10^9$  cfu/ml (Table 2) representing an average drop in viable count of 2.35 log units compared to an average drop of almost 10 log units for the SIAD Photonic Lamp (Chart 1). A decrease in bacterial kill was observed for the UV light samples with increased sample depth for all three time exposure times, while only one sample exposed to the photonic lamp

#### **Conclusions:**

The SIAD Photonic Lamp provided greater sample penetration and bactericidal effect than the ultraviolet light tested. This data suggests that the SIAD Photonic Lamp may be useful in the control and eradication of viable *E. coli* from water and other fluids.

Figure 1

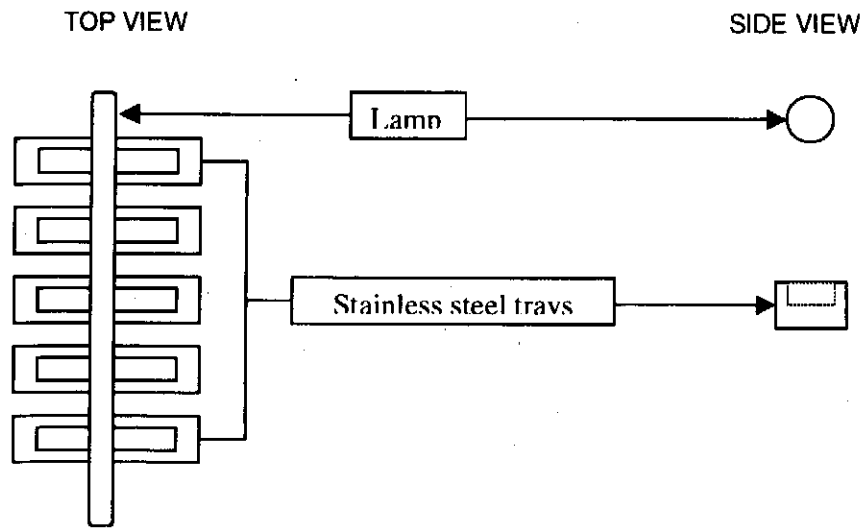


Table 1

## Effect of SIAD Photonic Lamp on 18hr Culture of E. coli

Trial#	Sample#	Exposure (sec.)	R <sup>1</sup> (in.)	B <sup>2</sup> (in.)	Voltage	Lamp Temp.	Fluid Temp		Viable Count
							Start	End	CFU/ml
	0	Unexposed	N/A	N/A	N/A	N/A	N/A	N/A	9.47E+09
1	1	7	2.25	0.500	523	150oC	21oC	22oC	0.00E+00
	2	7	2.25	0.375	523	150oC	21oC	22oC	0.00E+00
	3	7	2.25	0.250	523	150oC	21oC	22oC	0.00E+00
	4	7	2.25	0.125	523	150oC	21oC	22oC	0.00E+00
	5	7	2.25	0.065	523	150oC	21oC	22oC	0.00E+00
2	6	3	2.25	0.500	525	160oC	21oC	21oC	2.03E+01
	7	3	2.25	0.375	525	160oC	21oC	21oC	0.00E+00
	8	3	2.25	0.250	525	160oC	21oC	21oC	0.00E+00
	9	3	2.25	0.125	525	160oC	21oC	21oC	0.00E+00
	10	3	2.25	0.065	525	160oC	21oC	21oC	0.00E+00

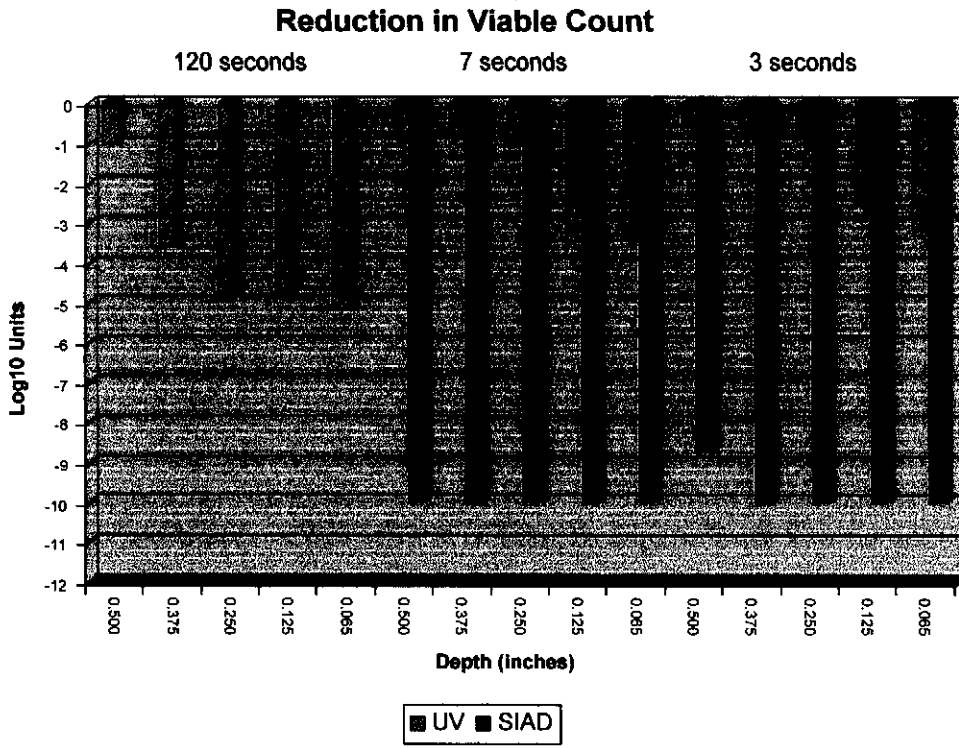
Table 2

## Effect of Ultraviolet Lamp # FB01 on 18hr Culture of E. coli

Trial#	Sample#	Exposure (sec.)	R (in.)	B (in.)	Voltage	Lamp Temp.	Fluid Temp		Viable Count
							Start	End	CFU/ml
	0	Unexposed	N/A	N/A	N/A	N/A	N/A	N/A	1.02E+10
1	1	120	2.25	0.500	117	25.7	25.0	25.0	1.06E+09
	2	120	2.25	0.375	117	25.7	25.0	25.0	2.85E+06
	3	120	2.25	0.250	117	25.7	25.0	25.0	1.77E+05
	4	120	2.25	0.125	117	25.7	25.0	25.0	1.48E+05
	5	120	2.25	0.065	117	25.7	25.0	25.0	7.32E+04
2	6	7	2.25	0.500	117	25.7	24.3	24.3	3.25E+09
	7	7	2.25	0.375	117	25.7	24.3	24.3	2.85E+09
	8	7	2.25	0.250	117	25.7	24.3	24.3	1.26E+09
	9	7	2.25	0.125	117	25.7	24.3	24.3	6.71E+06
	10	7	2.25	0.065	117	25.7	24.3	24.3	4.07E+06
3	11	3	2.25	0.500	117	25.7	24.5	24.5	3.41E+09
	12	3	2.25	0.375	117	25.7	24.5	24.5	2.68E+09
	13	3	2.25	0.250	117	25.7	24.5	24.5	1.79E+09
	14	3	2.25	0.125	117	25.7	24.5	24.5	3.90E+07
	15	3	2.25	0.065	117	25.7	24.5	24.5	7.11E+06

<sup>1</sup> "R" = distance from the center of the lamp to the surface of the bacterial cell suspension<sup>2</sup> "B" = depth of sample

Chart 1



**Comprison of UV vs. SIAD Device on 24 hour culture of E.coli (ATCC #47056) in Water**

**Ultraviolet**

Exposure Time = 120 sec

Distance from the surface of the sample = 2.25 inches

Sample Depth (in.)	Recoverable Cells (CFUs/ml)	Reduction in Log Units	% Kill
Control	10,227,272,727	N/A	N/A
0.500	1,056,910,569	0.99	89.86576332%
0.375	2,845,528	3.56	99.97217706%
0.250	176,829	4.76	99.99827100%
0.125	148,374	4.84	99.99854923%
0.065	73,171	5.15	99.99928455%

**SIAD**

Exposure Time = 3 sec

Distance from the surface of the sample = 2.25 inches

Sample Depth (in.)	Recoverable Cells (CFUs/ml)	Reduction in Log Units	% Kill
Control	9,469,696,970	N/A	N/A
0.500	20	8.67	99.99999979%
0.375	0	9.98	100.00000000%
0.250	0	9.98	100.00000000%
0.125	0	9.98	100.00000000%
0.065	0	9.98	100.00000000%

NOTE:  
Percent Difference