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Introduction:

Staphylococcus aureus contamination of food processing and contact surfaces is a source for food-borne infection for consumers of meat and meat products

Purpose:

In this study surfaces contaminated with high loads of *Staphylococcus aureus* were exposed to 265nm and 275nm UV-C LED to assess the effects of multiple doses and irradiances.

Methods:

One inch square stainless steel targets inoculated with *Staphylococcus aureus* were exposed to a UV-C LED (265nm) array light source (Phoseon Technology) at 1.3, 1.5, 2.0, 2.5 and 3.0 mW/cm² (at the emitting window) from a distance of 15 mm. Doses (at the emitting window) ranged from 26 mJ/cm² through 150 mJ/cm² initially. Additional experiments extended the range of doses and included a second UV-C wavelength (275nm). UV-C lamp output was assessed to enable precise control of delivered dose.

Surfaces were contaminated with 1.2 - 5.2 x 10⁶ cfu/target. After UV-C exposure, surviving bacteria were serially diluted, plated, and colony forming units (cfu) assessed. Log₁₀ reduction was calculated as the difference in the Log₁₀ of geometric means between the unexposed control and the exposed test samples. Each test sample included four independent exposures at each condition over a total of 30 UV-C LED irradiance and dosage conditions.

Results:

Irradiances of 1.3 and 1.5 mW/cm² (at the emitting window) resulted in 4-5 Log₁₀ reduction of *Staphylococcus aureus* CFU on exposed targets. This corresponded to doses of between 20 and 52 mJ/cm² (at the emitting window). Increasing the irradiance to 2, 2.5, and 3.0 mW/cm² (at the window) to deliver a dose of 150 mJ/cm² (667 μJ/cm² at the target) resulted in a 5 Log₁₀ reduction in all cases. Consistent 5 Log₁₀ reduction in *S. aureus* CFU was achieved in between 40 and 75 seconds.

Significance:

Short UV-C exposures (265nm or 275nm) of ≤60 seconds were sufficient to result in a 4 Log₁₀ reduction of *Staphylococcus aureus*. Treatment of food products by 265nm (or 275nm) UV-C LEDs represents a viable investigation path for decreasing food-borne *Staphylococcus aureus* infections in consumers.

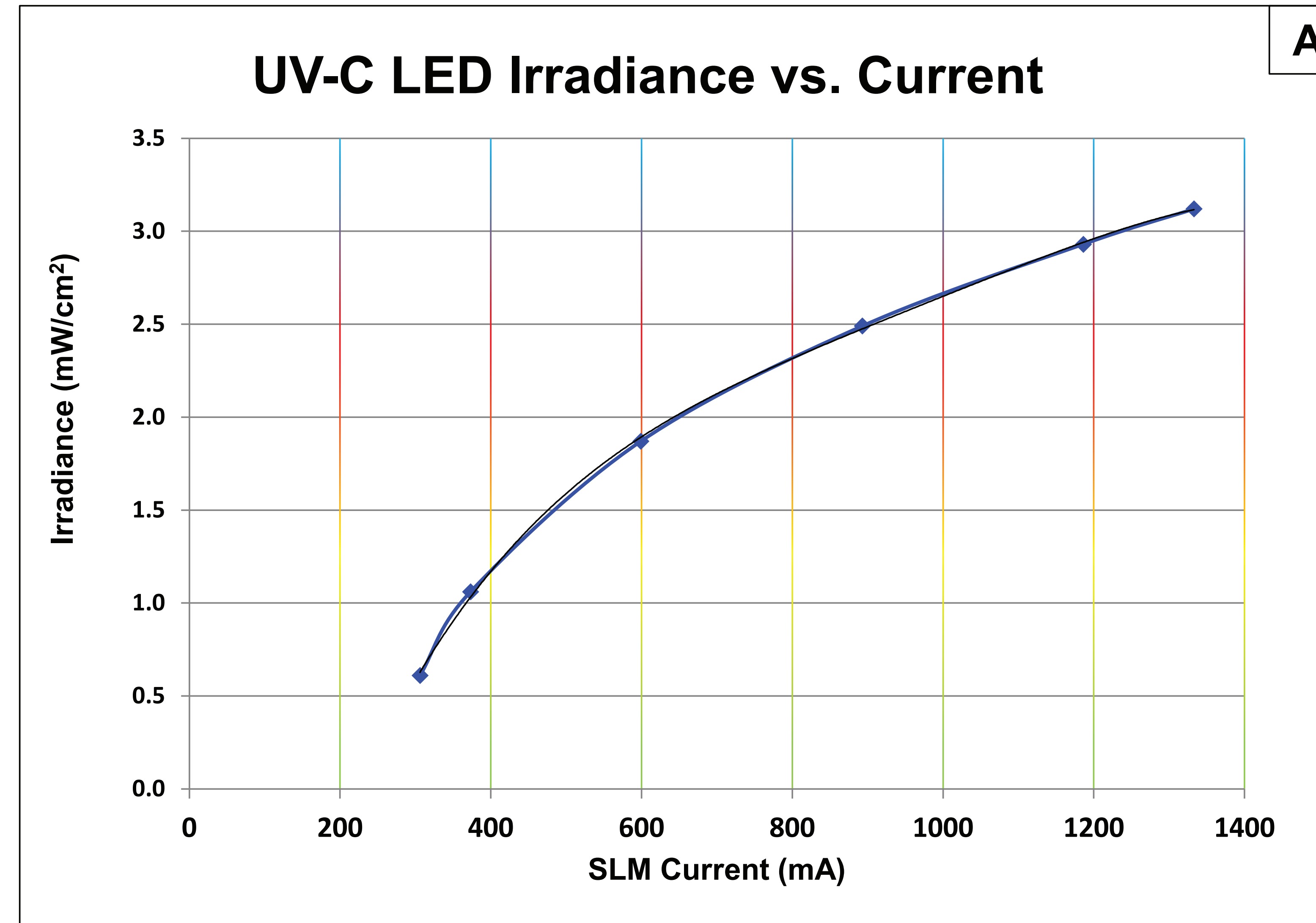


Figure A: UV-C LED Irradiance vs. Current.
Irradiance of the lamp at the emitter window agrees with the formula:
 $y = -4E-12x^4 + 2E-08x^3 - 2E-05x^2 + 0.0169x - 2.7956$ with an $R^2 = 0.9996$.

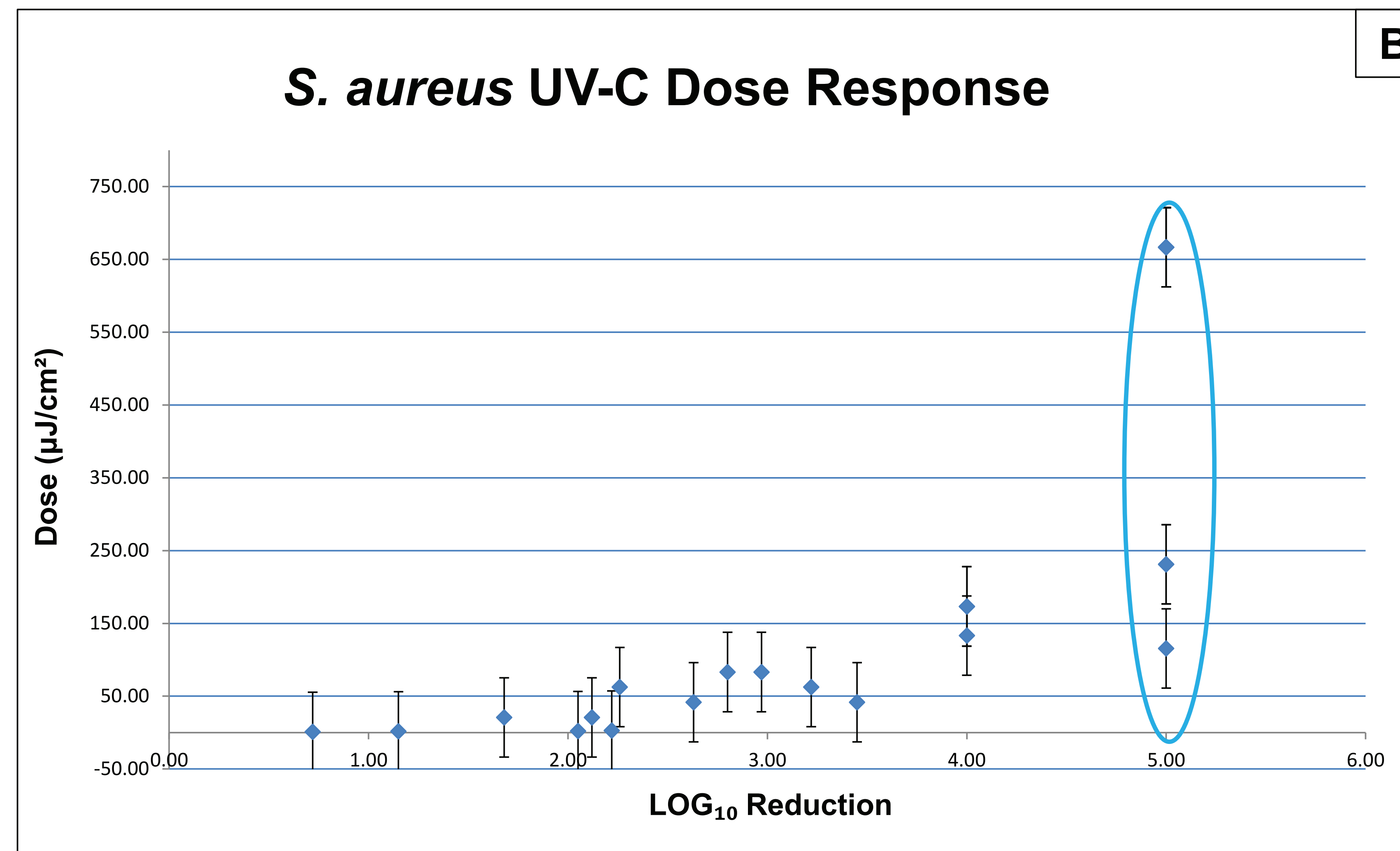


Figure B: *S. aureus* UV-C Dose Response.
Each data point represents at least 4 independent exposures. The blue oval surrounds data points that correspond to 5 Log₁₀ reduction.

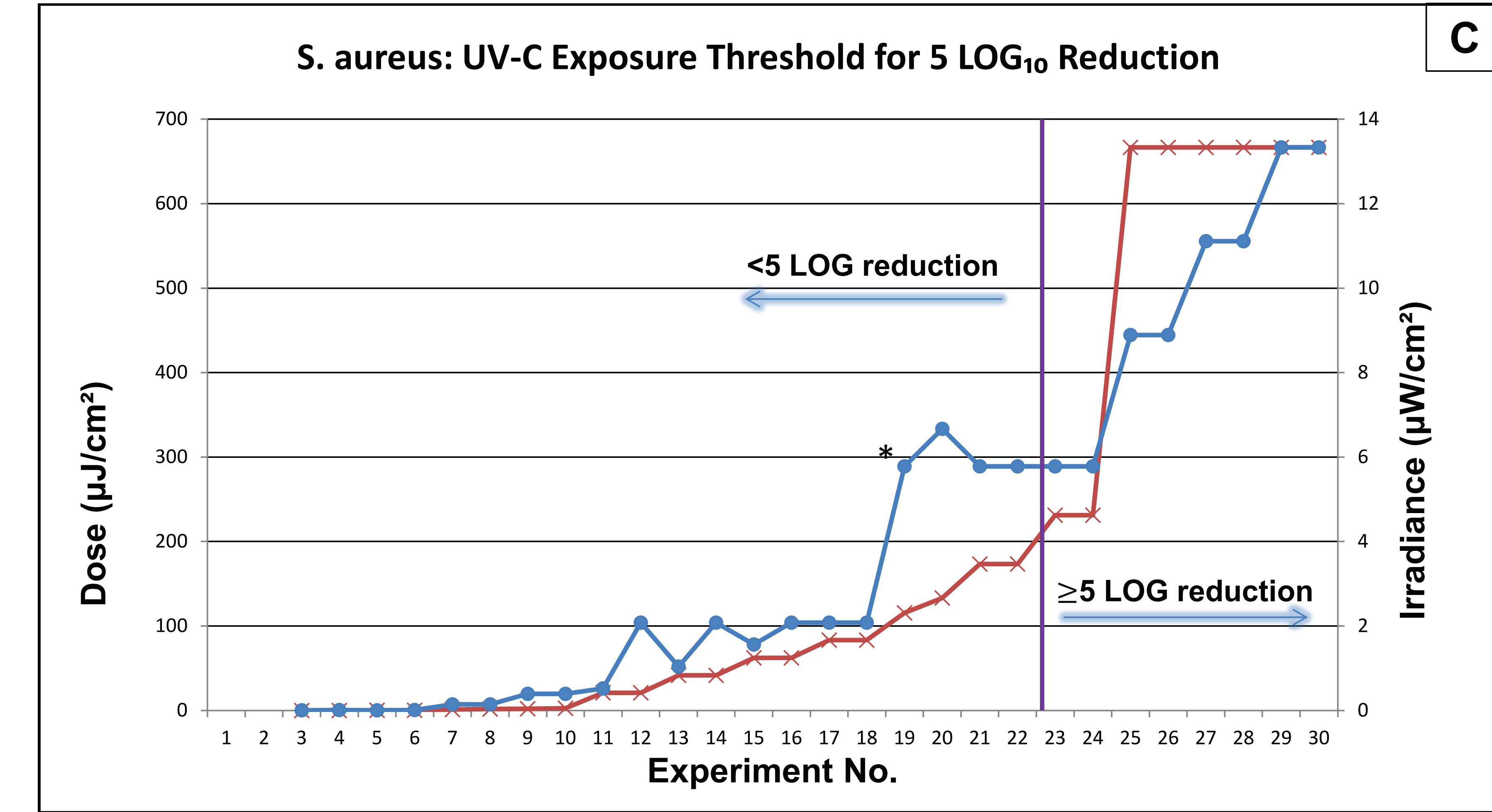


Figure C: UV-C Exposure Threshold for 5 LOG₁₀ Reduction.
Determination of the UV-C dose threshold for 5 Log₁₀ reduction in colony forming units on an exposed surface. Dose is shown in red (x, μJ/cm²). Irradiance is shown in blue (o, μW/cm²). The starred data point also had a 5 Log₁₀ reduction. Repeatable 5 Log₁₀ reduction was achieved under the exposure and irradiance conditions to the right of the purple line.

