Supporting Information

Visible Light-Activated Bactericidal Functions of Carbon "Quantum" Dots

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1. Light-Activated Bactericidal Effect of Carbon Dots on *Bacillus Subtilis*:

Bacillus Subtilis, a Gram-positive bacterium, has been a popular laboratory model organism, often considered as the Gram-positive equivalent of *Escherichia coli*, which is an extensively studied Gram-negative bacterium. It was used in the evaluation on the light-activated antibacterial function of EDA-carbon dots.

Fresh grown *Bacillus Subtilis* cells in nutrient broth (Fisher Scientific, Pittsburgh, PA) were washed three times and then re-suspended in deionized water. With the use of 96-well plates, to a well was added a bacteria-carbon dots mixture (150 μL), in which the bacteria concentration was about 10^7 CFU/mL and the concentration of EDA-carbon dots was varied (triplicates for each concentration). The plates were either exposed to visible light (12 V 36 W light bulb) or kept in dark for 30 min. The solutions in the wells were then transferred to 1.5 mL centrifuge tubes, followed by centrifugation at 8,000 rpm for 5 min. The supernatants were discarded, and the bacterial pellets were washed with PBS twice. The cells were re-suspended in PBS, and the viable cell numbers in the treated samples and the controls were determined by the traditional plating method. For each sample, serial dilutions were made with PBS, and aliquots of 100 μL appropriate dilutions were surface-plated on Luria-Bertani agar plates (Fisher Scientific, Pittsburgh, PA), and the plates were incubated at 37 °C for 24 h. The number of colonies was counted, and the viable cell numbers of the treated samples and the controls were calculated in CFU/mL. The results are shown in Figure S1.

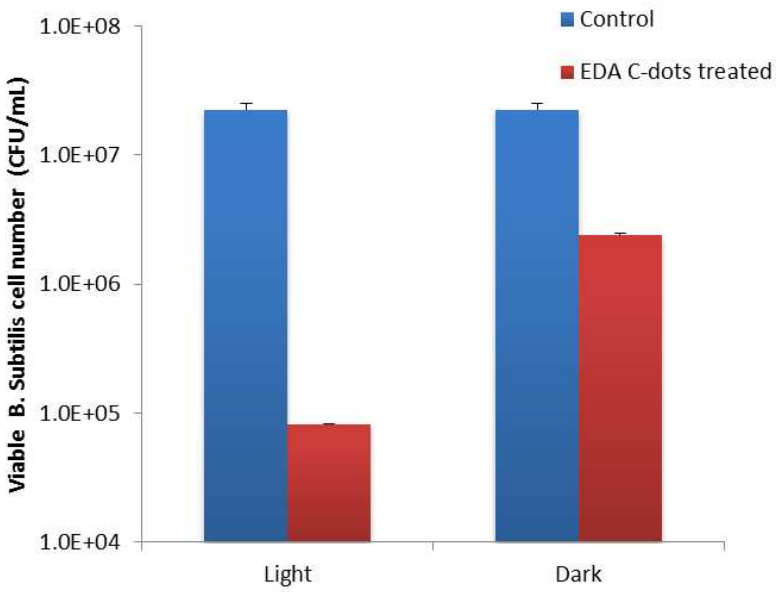

Figure S1. The viable cell number results for *Bacillus subtilis* cells.

According to the viable cell number results in Figure S1, the treatment with EDA-carbon dots coupled with visible light illumination was obviously much more effective in the bactericidal effect, with about 2.5 logs viable cell reduction of *Bacillus subtilis* against the control. The results from the treatment of the carbon dots in the dark might be affected by the ambient light exposure during the preparation of the samples in the viable cell number experiments, probably a reflection on the high efficiency of the carbon dots plus light against bacterial cells. In further investigations, a more quantitative determination of the obviously more efficient bactericidal effect of carbon dots with light will be performed by strictly controlling the light - dark conditions over the entire experimental protocol (from sample preparation to plating and so on).

2. Light-Activated Bactericidal Effect of Carbon Dots on Pathogenic *E. coli*:

Pathogenic *E. coli* O157:H7 has been responsible for a number of infamous public health incidences in recent years, nicknamed "burger bug" (for the contaminated hamburgers causing many illnesses and deaths). Therefore, there are ongoing needs for effective bactericidal agents against the pathogen in food and water safety applications. EDA-carbon dots under visible light were found to be effective in bactericidal effect on the pathogen.

Experimentally, *E. coli* O157:H7 (5-strain cocktail) was centrifuged at 4,000 rpm for 12 min and diluted to a concentration of 10^7 CFU/mL with PBS. With the use of 96-well plates, to a well was added a bacteria-carbon dots mixture (150 μL bacterial culture and 150 μL EDA-carbon dots). The sample of bacteria + deionized water was used as the control. All samples (each in triplicates) were exposed to a visible LED light (10 mW/cm^2) for 1, 2, and 3 h, or remained in the dark for 3 h. The Log survival was enumerated by plating on SMAC and incubation at 37 °C for 24 h. The results shown in Figure S2 clearly suggest that the carbon dots with visible light are effective in killing pathogenic *E. coli* O157:H7.

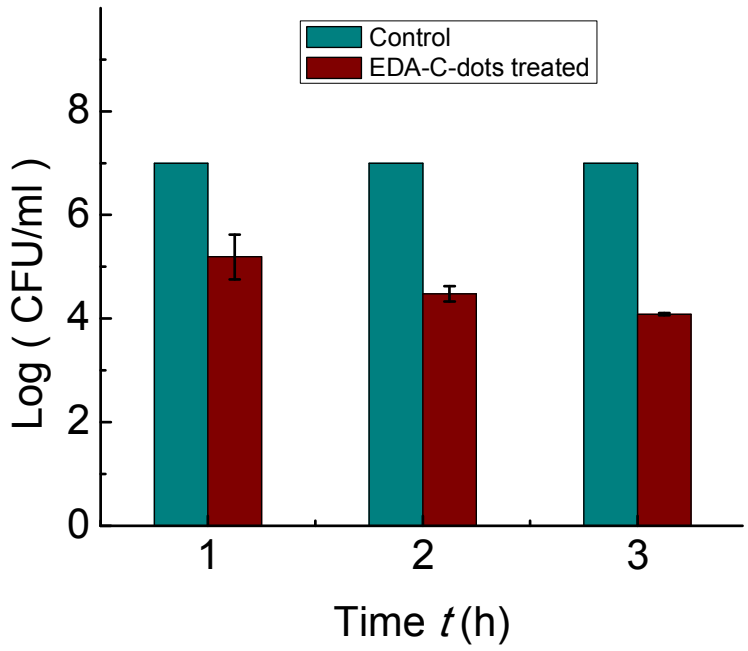

Figure S2. Results of cell survival for *E. coli* O157:H7 treated with EDA-carbon dots and visible light for 1, 2, and 3 h.

3. Figure 6 in a different presentation signifying the validation by Student *t* test:

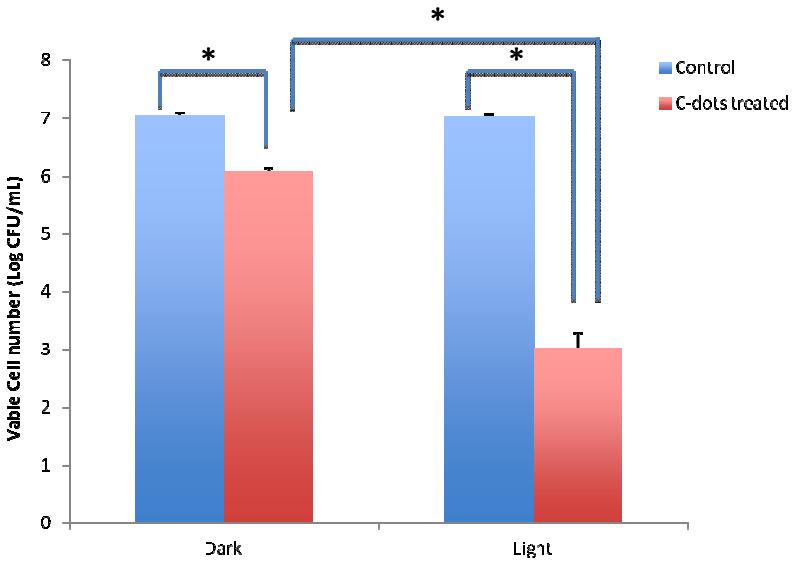

Figure S3. The reductions in the viable cell number after *E. coli* cells were treated with the EDA-carbon dots for 30 min with or without light (presented as mean ± standard deviation of triplicate experimental results). Statistical analysis of experimental results was performed using Student *t* test, with $P < 0.05$ considered as significant difference.