World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

# Response of Planktonic and Aggregated Bacterial Cells to Water Disinfection with Photodynamic Inactivation

**Authors :** Thayse Marques Passos, Brid Quilty, Mary Pryce

**Abstract :** The interest in developing alternative techniques to obtain safe water, free from pathogens and hazardous substances, is growing in recent times. The photodynamic inactivation of microorganisms (PDI) is a promising ecologically-friendly and multi-target approach for water disinfection. It uses visible light as an energy source combined with a photosensitiser (PS) to transfer energy/electrons to a substrate or molecular oxygen generating reactive oxygen species, which cause cidal effects towards cells. PDI has mainly been used in clinical studies and investigations on its application to disinfect water is relatively recent. The majority of studies use planktonic cells. However, in their natural environments, bacteria quite often do not occur as freely suspended cells (planktonic) but in cell aggregates that are either freely floating or attached to surfaces as biofilms. Microbes can form aggregates and biofilms as a strategy to protect them from environmental stress. As aggregates, bacteria have a better metabolic function, they communicate more efficiently, and they are more resistant to biocide compounds than their planktonic forms. Among the bacteria that are able to form aggregates are members of the genus Pseudomonas, they are a very diverse group widely distributed in the environment. Pseudomonas species can form aggregates/biofilms in water and can cause particular problems in water distribution systems. The aim of this study was to evaluate the effectiveness of photodynamic inactivation in killing a range of planktonic cells including Escherichia coli DSM 1103, Staphylococcus aureus DSM 799, Shigella sonnei DSM 5570, Salmonella enterica and Pseudomonas putida DSM 6125, and aggregating cells of Pseudomonas fluorescens DSM 50090, Pseudomonas aeruginosa PAO1. The experiments were performed in glass Petri dishes, containing the bacterial suspension and the photosensitiser, irradiated with a multi-LED (wavelengths 430nm and 660nm) for different time intervals. The responses of the cells were monitored using the pour plate technique and confocal microscopy. The study showed that bacteria belonging to Pseudomonads group tend to be more tolerant to PDI. While E. coli, S. aureus, S. sonnei and S. enterica required a dosage ranging from 39.47 J/cm2 to 59.21 J/cm2 for a 5 log reduction, Pseudomonads needed a dosage ranging from 78.94 to 118.42 J/cm2, a higher dose being required when the cells aggregated.

**Keywords :** bacterial aggregation, photoinactivation, Pseudomonads, water disinfection
**Conference Title :** ICSRD 2020 : International Conference on Scientific Research and Development
**Conference Location :** Chicago, United States
**Conference Dates :** December 12-13, 2020