

# Photoinduced Bactericidal Effect of Titania Thin Film against *Legionella pneumophila*

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**Abstract :** In this study, the photoinduced bactericidal or disinfectant effect of titanium dioxide ( $\text{TiO}_2$ ) based films against *Legionella pneumophila* (*L. pneumophila*) was examined. The *Legionella* species are environmentally abundant bacteria isolated from water and soil, and they are increasingly recognized as a cause of severe pneumonia for elderly people. The titania ( $\text{TiO}_2$ ) thin film photocatalyst was prepared by dip coating on a glass plate. The bactericidal effect was evaluated by the observation of the bacterial cell walls using a scanning electron microscope (SEM), and by the degradation of leaking endotoxin, as well as by the bacterial survival rate. When the  $\text{TiO}_2$  photocatalyst was exposed to ultraviolet irradiation (UV-A or UV-C), it showed a strong bactericidal effect on *L. pneumophila*, which was confirmed by the destruction and dissolution of the bacterial cell walls through the SEM. UV irradiation without  $\text{TiO}_2$  photocatalyst also caused bacterial inactivation and disruption leading to the leakage of endotoxin. However, the complete degradation of leaking endotoxin was only observed when the titania thin film was exposed to the UV irradiation. Furthermore, the disruption and dissolution of the cell wall were shown by the use of  $\text{TiO}_2$  photocatalyst with UV irradiation, however, between the UV rays, UV-C caused a bactericidal effect earlier and more profoundly than UV-A. Although the generally used disinfectants, such as hydrogen peroxide and hypochlorous acid, are able to sterilize bacteria, they did not show a complete degradation effect for endotoxin. Consequently, in this study, the antibacterial effect of  $\text{TiO}_2$  thin film photocatalyst with UV irradiation was proven by showing the abilities of the bacterial inactivation and disruption and the degradation or detoxification of endotoxin. It was also suggested that the use of  $\text{TiO}_2$  photocatalysts as a disinfectant would be a safer and cleaner alternative technology for environmental protection against microbial pollution than other chemical disinfectants.

**Key words :**  $\text{TiO}_2$  photocatalyst, Disinfectant, *Legionella pneumophila*, Endotoxin