

Article

# Enhancement of the Efficacy of Photodynamic Therapy against Uropathogenic Gram-Negative Bacteria Species

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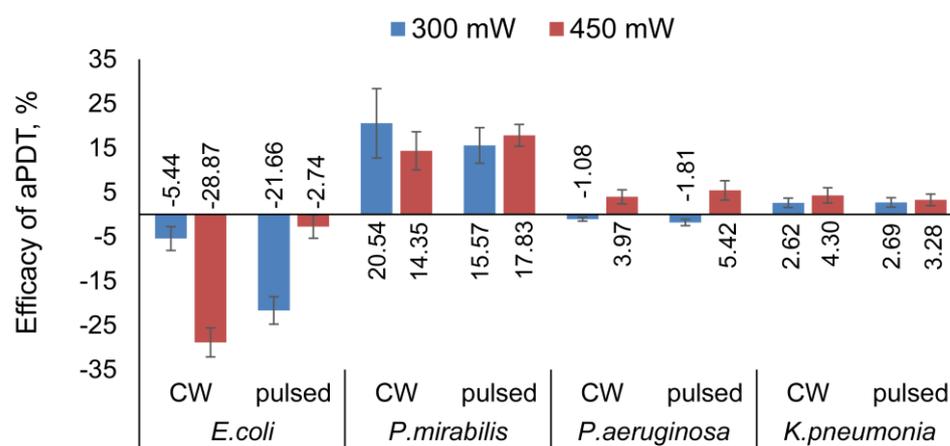
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**Abstract:** Antimicrobial photodynamic therapy (aPDT) was demonstrated to be effective against various species of Gram-positive bacteria. However, the complex structure of a Gram-negative bacteria envelope limits the application of aPDT. Thus, the goal of this study was to improve the efficiency of antimicrobial photodynamic therapy with Fotoditazin against uropathogenic Gram-negative bacteria. The non-ionic detergent Triton X-100 and emulsifier Tween 80 were tested. The effect of extracellular photosensitizer on aPDT efficacy was analyzed. Moreover, the irradiation regime was optimized in terms of output power and emitting mode. It was found that Triton X-100 at 10% vol enhanced the efficacy of aPDT of *E. coli* up to 52%. The subsequent observation demonstrated that, when the photosensitizer was removed from the extracellular space, the efficacy of aPDT of various Gram-negative species decreased dramatically. As to the irradiation mode, an increase in the laser output power led to an increase in the aPDT efficacy. The pulsed irradiation mode did not affect the aPDT efficacy. Thus, to achieve optimal aPDT efficacy, bacteria should be irradiated at 450-mW output power in the presence of Triton X-100 and a photosensitizer in extracellular environment. However, it should be noted that the efficacy of aPDT of *K. pneumoniae* was significantly lower than for other species. The developed aPDT technique may be effective in a native environment of uropathogenic microorganisms.

**Keywords:** Gram-negative bacteria; antimicrobial photodynamic therapy; Fotoditazin; laser; Triton X-100; Tween 80



**Figure S1.** The influence of output laser power and irradiation mode on the efficacy of aPDT of Gram-negative bacteria without Fotoditazin and Triton X-100.