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In Vitro Effects of Blue Laser Light as an Antimicrobial Agent on Microbial-Infected Fibroblast Cells

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Pseudomonas aeruginosa, Staphylococcus aureus, and Streptococcus pyogenes are key pathogens that delay healing and pose challenges due to their antibiotic resistance. Antimicrobial photobiomodulation (aPBM) using blue light (400-470 nm) has been shown to have antibacterial properties; however, its effects on mammalian cells are not well understood. We investigated the effect of blue laser light (470 nm, 82.7 mW/cm², 10 J/cm², 2 min) on bacteria-infected BJ-5ta fibroblast cells. BJ-5ta cells were co-cultured for 24 h with each of the three bacterial strains (1.50 x 10³ CFU/mL) and then exposed to blue light. Fibroblast cell viability and bacterial colony counts were assessed 24 h post-aPBM. Control cells (0 J/cm²) infected with S. aureus exhibited 95% fibroblast cell viability and increased bacterial counts (1.80 x 10⁵ CFU/mL). Control cells (0 J/cm²) infected with S. pyogenes and P. aeruginosa showed 89.5% fibroblast cell viability, with bacterial counts increasing to 3.00 x 10⁵ and 2.36 x 10⁵ CFU/mL, respectively. In irradiated (10 J/cm²) BJ-5ta cells infected with S. aureus, P. aeruginosa, and S. pyogenes, fibroblast cell viability was 89.2%, 94.6%, and 77.6%, respectively. As compared to the controls, bacterial counts decreased to 1.30 x 10⁵ CFU/mL, 1.35 x 10⁵ CFU/mL, and 1.20 x 10⁵ CFU/mL, respectively. Blue light (470 nm, 82.7 mW/cm², 10 J/cm²) induced bacterial death while preserving fibroblast cell viability after a single exposure. aPBM has the potential to address the medical challenges associated with infected wounds and open new avenues for future research.

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