ID TRABALHO: 204/3274-0

ÁREA DO TRABALHO: PATOGENICIDADE BACTERIANA

TÍTULO DO TRABALHO: Photodynamic Inactivation: Combination Of Curcumin And Lactic Acid For Enhanced Photodynamic Effects

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RESUMO:

Bacterial antibiotic resistance continues to limit the treatment options for many infections, driving a need for novel therapies. Photodynamic therapy (PDT) presents itself as a promising strategy for microbiological control, especially when used in combination with other therapies. One problem with PDT is the low solubility of the photosensitizers (PS) utilized. Curcumin has a low solubility in aqueous solutions and tends to form agglomerates, losing photodynamic efficiency and impairing its diffusion into the bacterial cell. This study aimed to enhance the photodynamic efficacy of curcumin by modulating its tautomeric equilibrium through acidification with lactic acid (LA), and to investigate the synergistic interaction of LA with aPDT against Staphylococcus aureus. First the bacteria were tested against both monotherapies. PDT was done using curcumin concentrations of 10 uM, 5 uM, 2.5 uM, 1.25 uM and light fluence of 10 J/cm² and 5 J/cm². LA treatment was performed using concentrations of 2%, 1%, 0.5% and 0.25% and incubation times of 1, 2 and 4 hours. Sequential combination treatment was carried out by first incubating the bacteria with LA for 40 minutes followed by 20 minutes of PS incubation. Synergy was determined by the Bliss method. aPDT showed bacterial reductions of 2 log CFU/mL (2.5 uM, 5 J/cm²) to 5 log CFU/mL (10 uM, 5 J/cm²). Lactic acid treatment achieved reductions of 3.5 log CFU/mL (1%) and 5.6 log CFU/mL (2%) in the first hour. Photodegradation analysis revealed that curcumin is more photostable under acidic conditions (pH 1.73 and 4.04), where the keto-tautomer predominates, maintaining higher absorbance under illumination. This stability, combined with the ability of LA to acidify the medium and neutralize negative charges on the bacterial surface, promoted improved solubility and internalization of the PS. Simultaneous combination treatment of LA (0.25% or 0.5%) and curcumin (5 or 10 µM), was performed by incubating the bacteria with curcumin and LA at the same time for 20 minutes before irradiation and showed enhanced inactivation even at lower light doses (2.5 J/cm²), achieving reductions ≥5.5 log CFU/mL in all conditions tested. Bliss independence analysis confirmed synergy, particularly when LA was applied prior to curcumin, suggesting that acid-induced modulation of curcumin bioavailability and bacterial permeability enhances photodynamic action. These findings support the innovative use of LA as an adjuvant to potentiate curcumin-based aPDT and highlight the relevance of pH in optimizing antimicrobial

photodynamic protocols.