学位論文内容の要約

学位論文題目

Synthesis and antibacterial photodynamic assessments of lysozyme-Au nanoclusters/rose bengal conjugate

（リゾチーム金ナノクラスター/ローズベンガル複合体の合成と光線力学的評価）

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Abstract
Antibacterial photodynamic therapy (aPDT) is anticipated for reducing infection via generation of singlet oxygen (1O2) against dental diseases, instead of antibiotic therapy. Reportedly, Au nanoclusters (Au NCs) showed the properties of aPDT effects and biosafety. To promote the antibacterial effect of aPDT using Au NCs, we synthesized lysozyme-Au NCs/rose bengal (Lys-Au NCs/RB) conjugate as a novel photosensitizer. It is expected the reduction of bacterial growth by antibacterial protein, Lys and enhancement of 1O2 generation related to resonance energy transfer (RET) mechanism with Au NCs/RB conjugate. Accordingly, we characterized Lys-Au NCs/RB irradiated with white light emitting diode (LED) and assessed the antibacterial and biosafe effect of photoexcited Lys-AuNCs/RB.
1O2 generation of Lys-Au NCs/RB irradiated with white LED (420~750 nm) was detected by a methotrexate (MTX) probe. UV–Vis absorption spectroscopy and steady-state fluorescence spectroscopy measurements were performed to confirm the RET process in the Lys-Au NCs/RB. Subsequently, the antibacterial effects of photoexcited Lys-Au NCs/RB was assessed by bacterial growth experiments, live/dead staining and morphological observations using oral bacterial cells. In addition, the biosafety of Lys-Au NCs/RB was examined using NIH3T3 mammalian cells.
We confirmed the 1O2 generation ability of Lys-Au NCs/RB using the 1O2 detection probe. The fluorescent lifetime measurements demonstrated that the RET process likely occur from the Au NCs to the RB in Lys-Au NCs/RB. Antibacterial activity of Lys-Au NCs/RB was significantly greater than that of Lys-Au NCs alone or RB alone ($P<0.01$). In addition, Lys-Au NCs/RB reduced the bacterial turbidity of both gram positive and negative bacterial cells. Bacterial cells were morphologically damaged by application of photoexcited Lys-Au NCs/RB. Furthermore, photoexcited Lys-Au NCs/RB increased red fluorescence (indicating dead cells) of in vitro biofilm of S. mutans. However, photoexcited Lys-Au NCs/RB did not negatively affect the adhesion, spreading, and proliferation of mammalian cells. In conclusion, Lys-Au NCs/RB conjugate exhibited aPDT activity to be beneficial for dental treatment.