

Antimicrobial Photodynamic Effects of Polychromatic Light Activated By Magnetic Fields to Bacterial Viability

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Abstract

The *Escherichia coli* (*E. coli*) is Gram negative bacteria, that normally live in the digestive tracts of humans and animals, can cause bloody diarrhea, severe anemia or kidney failure and other illnesses which can lead to death. Systemic therapy with antibiotic cause bacteria resistant. So, an alternative method is needed, one of them is Photodynamic therapy (PDT). This research aims to investigate antimicrobial photodynamic effects of the light emitting diode (LED) activated by magnetic fields 1.8 mT irradiation to bacteria viability.

To determine the antimicrobial effect of treatments, three measurements of bacterial colony growth (in %) were carried out. Three measurements groups as follow: Groups I to measurements the effects of LED irradiation by varying wavelength (469nm, 541 nm and 626 nm); Groups II to measurements effects of magnetic fields 1.8 mT to antimicrobial efficacy; Groups III to determine the effects and efficacy of LED 541 nm and magnetic fields irradiation with varying LED intensity (0.62, 2.50, 6.27, and 8.21) mW/cm² and time irradiation (20, 30, 40, 50) minutes, respectively. The suspension was planted on sterile media and incubated at a temperature of 37°C for 24 hours. After incubation, the number of colony-forming units per milliliter (CFU/ml) was determined. The results were analyzed by analysis of variance (ANOVA) and the Tukey test. A P value ≤0.05 was considered to indicate a statistically significant difference.

The LED treatment group 469 nm, 541 nm and 626 nm resulted in statistically significant decrease of CFU ($p < 0.05$) compared to each other. The LED 541 nm treatment group with magnetic fields resulted significantly differ with treatment group without magnetic fields. The LED 541 nm treatment with magnetic fields 1.8 mT at various light intensity and time irradiation resulted significantly differ each other ($p < 0.05$). LED irradiation with intensity 6.27 mW/cm² and time irradiation 50 minutes (energy dose 18.81 J/cm²) resulted highest decreases the number of bacteria *E. coli* 80%.

LED irradiation combined by magnetic fields can improve the efficacy of antimicrobial photodynamic effects.

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Introduction

Escherichia coli (*E. coli*) bacteria is the name of bacterium that normally live in the digestive tracts of humans and animals. There are many types of *E. coli*. Most of them are

harmless and actually are an important part of a healthy human intestinal tract. However, some strain of *E. coli* are pathogenic, meaning they can cause illness, either bloody diarrhea or illness outside of the intestinal tract, severe anemia or kidney failure, respiratory illness and pneumonia, and other illnesses which can lead to death. The types of *E. coli* that can cause diarrhea can be transmitted through contaminated water or food, or through contact with animals or persons¹⁻². *E. coli* is a gram-negative bacteria, facultative anaerobe and chemoorganotrophic. It lives on the temperature that ranges from 20 to 40 °C, but

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