An in vitro Anti-microbial Photodynamic Therapy (aPDT) with Blue LEDs to Activate Chlorophylls of Alfalfa Medicago sativa L on Aggregatibacter actinomycetemcomitans

Ernie Maduratna Setiawatie[1], Suryani Dyah Astuti[2], A. H. Zaidan[2]*

1. Department of Periodontics, Faculty of Dentistry, Airlangga University
2. Department of Biomedical Engineering Post Graduate School, Airlangga University

Abstract

Aggregatibacter actinomycetemcomitans is one of bacteria which play role in aggressive periodontitis. A. actinomycetemcomitans has been implicated as the reason that aggressive periodontitis does not respond to conventional therapy alone. These pathogens are known to remain in the tissues after therapy to reinfect the pocket. A. actinomycetemcomitans as a dominan periodontopathic bacteria and the discovery that this organism penetrates the tissues offered another perspective to the pathogenesis of aggressive periodontitis. Anti microbial photodynamic therapy (aPDT) is a medical treatment that utilizes light to activate a photosensitizing agent. The exposure of light to photosensitizer results in the formation of oxygen species, causing localized photodamage and cell death. The aim of this study was to investigate the effect of aPDT LED with various of quantum yield density or laser irradiation energy dose to activate chlorophyll of Alfalfa Medicago sativa L on A. actinomycetemcomitans bacteria.

To determine the antimicrobial effect on A. actinomycetemcomitans, samples were distributed to 3 groups as follow: (1) Groups A (treated with MIC of chlorophylls and LED 453 nm with varying quantum yield density (4.09; 7.73; 12.28; 16.38, and 20.48 J/cm2), (2) Group C- (negative control, no exposure to either chorophylls), (3) Group C+ (treated only with chlorophylls). The suspension was planted on sterile media and incubated at a temperature of 37oC 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 chlorophyll of Alfalfa Medicago sativa L absorption for LED 435 nm exposure is 77,2%. Irradiation of LED with various of quantum yield (4.09; 7.73; 12.28; 16.38 and 20.48) J/cm2 can activate chlorophyll of Alfalfa Medicago sativa L to produce ROS that cause damage to the bacterial cell. The control (+) and control (-) group did not significantly differ each other ($p>0.05$). The blue LED treatment group resulted in statistically significant decrease of CFU ($p<0.05$) compared to the control group. The Tukey post hoc test result that the highest quantum yield density 20.48 J/cm2 reduce CFU of A. actinomycetemcomitans up to 81%.

Irradiation of LED with various of quantum yield can activate chlorophyll of Alfalfa Medicago sativa L to produce ROS that cause damage to the bacterial cell. An increase in the density of the quantum yield reduce the number of bacterial viability. The effectiveness of quantum yield for producing a particular ROS type depends on photosensitizer, the availability of oxygen, and the reaction environment.

Experimental article (J Int Dent Med Res 2016; 9: (2), pp. 118-125)

Keywords: aPDT, blue LED, chlorophyll, Agregatebacter actinomycetemcomitans.

Received date: 9 June 2016 **Accept date:** 1 July 2016

Introduction

Periodontitis, an inflammation of the gingiva and the adjacent attachment apparatus, is characterized by loss of connective tissue attachment and alveolar bone. The primary etiology is bacterial plaque, which can initiate destruction of the gingival tissues and periodontal attachment apparatus[1-2]. It may be sub-classified based on etiology, clinical presentation, or associated complicating factors. The microbial etiology of periodontitis has been extensively

Corresponding author:
Suryani Dyah Astuti
Department of Biomedical Engineering Post Graduate School, Airlangga University

E-mail: suryanidyah@fst.unair.ac.id