# Complexation Polymer System for Bacteriostatic and Antibacterial Effects

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## Introduction

Bacteria and bacterially derived products stimulate inflammation and lead to the destruction of structural tissues in conditions such as periodontitis and peri-implantitis. To enable tissue regeneration, the first step is to minimize/eliminate the microbial burden.

In this project, the polymer blend system of cellulose acetate phthalate (CAP) and Pluronic F-127 is being explored for use in killing bacteria. Intrinsic antimicrobial activity of the polymer blend system is being assessed first, followed by its use for controlled release of antimicrobial peptides. The molecule used in these studies was WLBU2, which is a peptide that kills a variety of bacteria.

The purpose of this study was to determine antibacterial effects of the polymer and peptide using *E. coli* and *S. gordonii* as test species.

## Methods

Drug-loaded CAP-Pluronic microspheres were made by a water-acetone-oil-water triple emulsion process. Release devices were made by alternately layering and pressure-sintering microspheres to enable modulation of the drug concentration profiles. Six-layer devices gave three peaks of increased peptide concentration. Under simulated physiological conditions, the total duration of release was nine to eleven days. The release profiles can be controlled by varying polymer layers, coating method, and release conditions.

Initial bioactivity studies used *E. coli* and *S. gordonii* for determining bacteriostatic effects of the degraded polymer. Following degradation at 37ºC, dilutions of 100, 50, 25, 12.50, 6.25, 3.13, and 1.56% polymer and PBS alone were used.

WLBU2 peptide concentrations of 25, 12.5, 6.25, 3.125, 1.56 and 0.7 µM were tested against *E. coli* under an incubation period of 30 minutes. Peptide concentrations of 50, 25, and 12.5 µM were tested against *S. gordonii* under an incubation of 30 minutes.

In tests of peptide-polymer combinations, the polymer dilution used was 6.25%, which was selected based on the experiments of polymer alone. *S. gordonii* were treated with 50, 25, and 12.5 µM WLBU2 along with polymer. *E. coli* were treated with 6.25, 3.125, and 1.56 µM peptide concentrations and polymer. All solutions were then incubated for 30 minutes.

## Results and Discussion

CAP-Pluronic alone resulted in a concentration-dependent inhibition of bacterial growth (Figure 1). Below approximately 6.25% polymer degradation products, bacterial growth increased. Even at the lowest concentration (1.56%), however, growth was still >20 times less than controls.

In testing the WLBU2 antimicrobial peptide alone, it was effective against *S. gordonii* at 25 µM and against *E. coli* at 3.125 µM.

Polymer-peptide combinations were more effective against both bacterial species than was polymer alone. As shown in Figure 2, 6.25% polymer plus 12-50 µM peptide dose-dependently reduced the number of *S. gordonii* bacteria. Interestingly, interaction between polymer and peptide may be reducing activity of WLBU2.

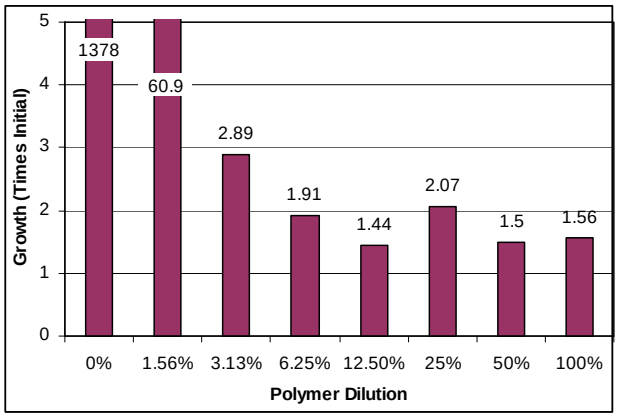


Figure 1. Bacteriostatic effect of polymer on *E. coli*.

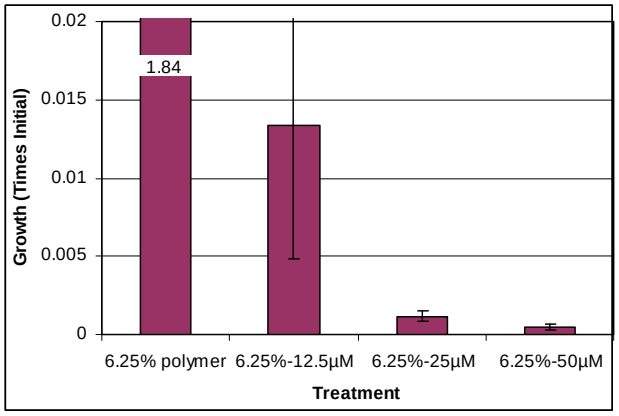


Figure 2. Antibacterial effect of polymer with WLBU2 against *S. gordonii*.

## Conclusions

The CAP/PF-127 polymer blend has bacteriostatic properties, and its antibacterial activity is enhanced with WLBU2 antimicrobial peptide. This system may be useful for controlling microbial contamination.

## Acknowledgment

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