CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Melissa R. Fagan

Project Number

S1507

Project Title

Creation of Alginate Microparticles as a Novel Drug Delivery Vehicle

Abstract

Objectives/Goals

Bacterial resistance is a growing issue in the modern world. Silver is an antimicrobial that does not have the same issues with resistance associated with antibiotics. The success of silver depends upon a dose that maximizes antimicrobial activity but minimizes toxicity.

Methods/Materials

Alginate microparticles, encapsulating silver antiseptics, were engineered through emulsification and internal gelation with the objective of minimizing the downsides of rapid silver deactivation and toxicity. Microparticles were synthesized with and without the encapsulation of silver sulfadiazine (SSD) and tested for their ability to inhibit the growth of Staphylococcus epidermidis, a substitute for the pathogenic Staphylococcus aureus. Research was also conducted to determine stability, size and density of the microparticles.

Results

Results demonstrated that the alginate microparticles had an average size of between 1-10μm and were stable with regard to density, particle size and appearance. Antimicrobial testing at 24 and 48 hours showed that alginate microparticles containing SSD produced significantly increased antimicrobial activity when compared to alginate microparticles alone ($p<0.001$). Results also demonstrated a significant increase in the zone of inhibition of alginate microparticles containing SSD from 24 to 48 hours ($p<0.05$ vs. SSD alone). The release continued through 96 hours ($p<0.001$ vs. SSD alone). Further experimentation was conducted to investigate release of SSD from alginate microparticles. Pre-treatment with alginate-lyase showed a decrease in anti-microbial activity from 24 to 48 hours ($p<0.05$).

Conclusions/Discussion

These findings illustrate the ability of alginate to provide a continual release of encapsulated agents. Additionally, results gathered from pre-treatment with alginate-lyase suggest that alginate-lyase breaks down the microparticles causing immediate release of SSD. This continual release technology, therefore, has the potential to negate many of the current issues with silver-based treatments.

Summary Statement

My project provides a means of helping patients with chronic wounds fight off bacterial infection by encapsulating antimicrobials into a micro-sized alginate shell, thereby minimizing costs and pain associated with frequent dressing changes

Help Received

Used lab equipment (chemicals, glassware etc.) from school under the supervision of Dr. Willoughby as required by school policy.