CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

S1519

Project Title

A Novel Treatment for Biofilms Using Nanocurcumin, Chitosan, and nAg, and an Innovative Coating in Preventing Biofilms

Abstract

Objectives/Goals

Biofilms are strong bacterial communities that adhere to surfaces due to certain gene expressions in reaction to the environment. They are 1000 fold more resistant to antibiotics and communicate through quorum sensing. Biofilms commonly form on areas such as catheters, pacemakers, and prosthetic replacements, contributing greatly to the downfall of patients. My research proposes a combined treatment of nanocurcumin, nanosilver, and chitosan (nCnSC) to combat the strong bacterial defense. Additionally, I have developed a preventing coating onto a PTFE sheet that is a preventive measure against the formation of biofilms.

Methods/Materials

A wet-milling method was used to make nanocurcumin. The environmental indicator, sucrose, stimulated the growth of the biofilm of S. mutans. The MIC and the Disk Diffusion Assays were used to determine the antimicrobial effects. Results were analyzed both in the form of mm of inhibition and minimum inhibitory concentrations (µg/ml), and the control was Erythromycin. The anticoating was devised through novel manners. Three trials were conducted.

Results

Nanocurcumin was the strongest individual treatment (20. µg/ml), whereas chitosan was the weakest (200. µg/ml). nAg and curcumin had equal anti-microbial effects (50. µg/ml). nCnSC alone inhibited biofilm formation on an average of 7.5 mm and had the lowest minimum inhibitory concentration value of 10.µg/ml. The anticoating with the fluorinated oil and nCnSC had 9 mm of inhibition. The combined treatment worked better than any of the individual treatments, meaning that the compound successfully bonded into another stronger compound. Additionally, nCnSC and nanocurcumin had higher inhibition values than the antibiotic. Standard deviations and p value were calculated, and the data is not due to chance and is significant.

Conclusions/Discussion

My hypothesis was correct and my test results confirmed my hypothesis: The cumulative compound, nCnSC, will inhibit the biofilm of S. mutans, and the preventive anticoating will protect surfaces from biofilm formation. This compound inhibits the actual formation of biofilms and the biofilms in an advanced stage. Moreover, the compound can be manufactured as a Teflon film that is useful in preventing the formation of biofilms before they get to an advanced stage.

Summary Statement

My experiment shows that the cumulative compound of nanocurcumin, chitosan, and nAG will effectively inhibit the biofilm formation of Streptococcus mutans, and the preventive coating will protect surfaces from biofilm formation.

Help Received

I used the lab equipment at the Harker School under the supervision and mentorship of Dr. Gary Blickenstaff and Mr. Chris Spenner.