CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

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Project Number

31409

Project Title

An Analysis of the Microencapsulation Efficiency of Novel Chitosan Microcapsules as Vehicles for Drug-Delivery Systems

Abstract

Objectives/Goals

Orally administered drug-delivery systems in treatments of diseases are highly favored because of cost-effectiveness and dosage control. However, the viability of the administered drug is very low because of the environmental damages inflicted by the body. Extreme pH levels, heat, and the immune system all pose as hazards to a standard drug-delivery system. The method of microencapsulation, encapsulating a drug within a protective membrane, has been explored in my experiment to increase the viability of drug-delivery systems and to allow the encapsulated drug to maintain a longer dosing period. Chitosan, a novel material in the area of drug-delivery systems, will be used to synthesize microcapsules alongside standard protocol material polylysine to test their overall viability in a simulated oral administration involving a digestive tract. It is hypothesized that Chitosan will have the same level of microencapsulation efficiency as Polylysine.

Methods/Materials

Microcapsules synthesized from alginate-chitosan and alginate-polylysine during an atomization procedure were used to encapsulate fluorescent beads for testing. Batches of capsules were monitored through UV-Spectrophotometry to monitor pre-digestive tract leakage, where there was a 100% encapsulation efficiency in all. The capsules, alongside control capsules of simple alginate capsules, were suspended in separate vials into simulated digestive tracts of Gastric and Intestinal fluids in a shake bath for 120 minutes and then 22 hours, respectively. Samples were taken every 60 minutes to be quantified using a UV-filter for a fluorescent imaging microscopes.

Results

Chitosan experienced deswelling of hydrogel properties during the intestinal tract while Polylysine was very unstable. There was visible wrinkling of the polylysine membrane. Roughly 75% of the membranes experienced this as well as membrane tearing and leakage. Chitosan's microcapsules remained in the same condition as pre-digestive tract capsules. Roughly 98% of the capsules were completely intact.

Conclusions/Discussion

Polylysine's unstable membrane was due to its amino-acid properties which causes the membrane's degradation. Chitosan's membrane was very stable and experienced little leakage or membrane tearing. Chitosan is far superior as a viable microcapsule membrane for orally-driven drug-delivery systems because of its viability in extreme pH environments.

Summary Statement

Drug-delivery systems are improved in cost-efficiency and viability through implementing Chitosan as a membrane material for microcapsules.

Help Received

Performed experiment at San Jose State University under the supervision of Dr. Maryam Mobed-Miremadi