2017 Research Week Proposal Instructions and Template

Posters and Presentations

Title – Biodegradable Microcarriers for Drug Delivery

Program of Study – Biomedical Sciences, Department of Biology and Chemistry

Presentation Type – Print Poster

Mentor(s) and Mentor Email – Randall Hubbard (rhubbard@liberty.edu)

Student name(s) and email(s) – Taylor Lonjin (tlonjin@liberty.edu), Jonathon Avon (jtavon@liberty.edu)

Category – Choose one of the following: Basic

Microcarriers are microspheres ranging from a few nanometers to some hundreds of micrometers. One thousand nanometers equal one micrometer which is roughly half a millionth of an inch. The advantages of using polymeric microcarriers include biodegradability, low toxicity, and slow release. Microcarriers for drug delivery may be formed from a polyesters such as poly(lactide-*co*-glycolide) (PLGA). PLGA microcarriers can successfully be synthesized through a double emulsion process using sonication. These polyesters degrade *in vivo* by hydrolysis of their ester backbone into nontoxic products, which are excreted by the kidneys. The ratio of lactide to glycolide in the PLGA polymers, the molecular weight and the terminal group of the PLGA polymer determine how fast drug release occurs. Carboxyl-terminated PLGA polymers offer faster drug release compared to ester-terminated PLGA.

In order to use microcarriers for a more effective drug delivery, the following hurdles had to be overcome. First, we had to show that we were able to formulate a consistent protocol for the production of microparticles. The next hurdle we had to overcome was the encapsulation

process. We had to show that we were able to encapsulate a relatively large compound. Next, we had to find a way to release the encapsulated molecule. All of these components of making and releasing a molecule, usually a drug, from a microparticle have to be shown in order to partner with LUCOM for testing *in vivo* studies.

A 50:50 acid terminated PLGA was used with polyvinyl alcohol to encapsulate FITC-dextrose. We were able to image our microspheres using a confocal microscopy. The use of a fluorescently tagged sugar allows us to prove that we can successfully encapsulate a relatively large complex. We next encapsulated immunoglobulin A (IgA), an protein made by the immune system. We selected IgA because of its size and its importance in the body. To release our encapsulated molecule, our mircoparticles traveled through a simulation representing the intestinal system. First, our microparticle were placed in an acidic pH of 2, simulating the conditions of the stomach. Then, the microparticles were placed into a basic pH of 10.5, simulating the pH of the intestines. The acidic pH started to break down the PLGA coating, then when the microparticles reached the basic pH, the drug released.

This proof of concept protocol shows that we were able to encapsulate a relatively large molecule and have effective release of the molecule into the intestines. This allows for a more targeted release of a drug, thus allowing scientists to use a lower dosage of drug.

Christian worldview integration: The Christian Gospel is the message of "good news" for how God has reconciled his image bearers to himself by offering forgiveness through the life, death, and resurrection of Jesus Christ. Moreover, further pointing to the goodness of creation, in the incarnation of Jesus, the eternal Son of God became flesh. Those who are in Christ are to be working against the disorder that exists within the world. The benefits of polymeric nanoparticle

medicine could change the view of medicine in third world countries, where medicine is expensive and scarce. The Bible tell us in Mark 16:15 to spread the gospel to the whole Earth. If a nanoparticle that can be developed, by Christian's, that can be administered to those who have HIV one will be able to save their life, and the gospel can be shared with them. Also, there is design in making the nanoparticles. There are many steps that are performed in making a nanoparticle. Each step has a defined purpose in accomplishing the task of helping the nanoparticle become biocompatible. An average human cell has a membrane that is both hydrophilic and hydrophobic. This concept has to be integrated into our nanoparticle. We use certain polymers, like PLGA, and proteins, like BSA, to create the hydrophobic and hydrophilic components. God has given us a model, the cell, and has shown us that we are able to replicate this idea into a new technique for medicine. It is incredible that something that is classified as "nonliving" can form into an intelligent design to help God's people.

References

[1] A.-S. Guedj, A. J. Kell, M. Barnes, S. Stals, D. Gonçalves, D. Girard, C. Lavigne. Preparation, characterization, and safety evaluation of poly(lactide-*co*-glycolide) nanoparticles for protein delivery into macrophages. *Int. J. Nanomedicine* **10**:5965-5979 (2015).

[2] A. Lamprecht, H. Yamamoto, N. Ulbrich, H. Takeuchi, P. Maincent, Y. Kawashima. FK506 Microparticles mitigate experimental colitis with minor renal calcineurin suppression. *Pharm. Res.* **22**:193-199 (2005).