Developing Poly lactic-co-glycolic acid (PLGA) particles

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Outline

• Introduction
• Methods
• Experiment/data collection
• Results
• Discussion
• Conclusion
• Future directions
• Acknowledgements
Introduction

• Microbubbles
  • Gas filled lipid bubbles made up of varying components

• The physics of ultrasound
  • Ultrasound: longitudinal pressure wave
    • Alternately compresses and expands the media through which it travels
  • Microbubbles are compressed at high pressure and expanded at low pressure
    • Stable vs. inertial cavitation

• Research has already looked at vaccine and cancer drug delivery

Fig. 1 taken from Lentacker, Ine & De Smedt, Stefaan & Sanders, Niek. (2009). Drug loaded microbubble design for ultrasound triggered delivery. Soft Matter. 5. . 10.1039/b823051j.
Mechanisms of drug release/delivery

- Cavitation results in rupture of drug loaded carriers, resulting in a local release of drugs
- Shock waves and microjets may temporarily perforate cell membranes
- Permeation of blood vessels, promoting extravasation of drugs
- Microparticles vs. nanoparticles

Fig. 2 taken from Lentacker, Ine & De Smedt, Stefaan & Sanders, Niek. (2009). Drug loaded microbubble design for ultrasound triggered delivery. Soft Matter. 5. . 10.1039/b823051j.
Methods

Water Phase 1 (W1)

Oil Phase (O) Primary Emulsion (W1+O)

Water Phase 2 (W2) Secondary Emulsion (Primary +W2)

Evaporation of DCM
Experiment/data collection
Results:

- Thought that ultrasound will increase number of particles
- Each concentration and RPM was collected three times and the average was taken
- Calculated percent change using the equation
  \[
  \text{%change} = \frac{\text{US} - \text{NonUS}}{\text{NonUS}}
  \]
- 1 mg particles with 1000 RPM had best result
  - 26% increase in particles
Discussion

• 7-10 micrometer particles were developed with 1000 RPM
  • 200 RPM created larger particles (12-20 micrometers)

• 1 mg/mL had better outcome for the ultrasound parameters used
  • US frequency: 1 MHz; amplitude: 0.2 V
  • 5 mg/mL concentration was too saturated and would have needed a higher ultrasound frequency = more energy
Conclusion

• Current cancer treatments are vary taxing to our bodies
• Dose concentration and size has an impact on ultrasound efficacy
• Ultrasound is able to disrupt particles
Future directions

• Determine the threshold of ultrasound in additional particle sizes
• Load particles
• Test in mice
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Questions

Link to evaluation survey
Supplemental Material

• Particle size was verified by scanning electron microscopy [Anh-Vu]