3D Printed Microfluidics for Inertial Focusing of Bacteria

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Background

Overview

This project focuses on 3D printed microfluidics for inertial focusing of bacteria.

These microfluidic channels will be used to detect the presence of *Salmonella* on meat products in record time and affordable cost to manufacturers or the environment.

Foodborne related pathogens per year:
- Global: 600 million illnesses and 420,000 deaths.
- US: ~38.4 million illnesses, and 1,700 deaths.

Foodborne illness annual cost:
- $36-78 billion in direct medical costs, lost productivity, and premature death.

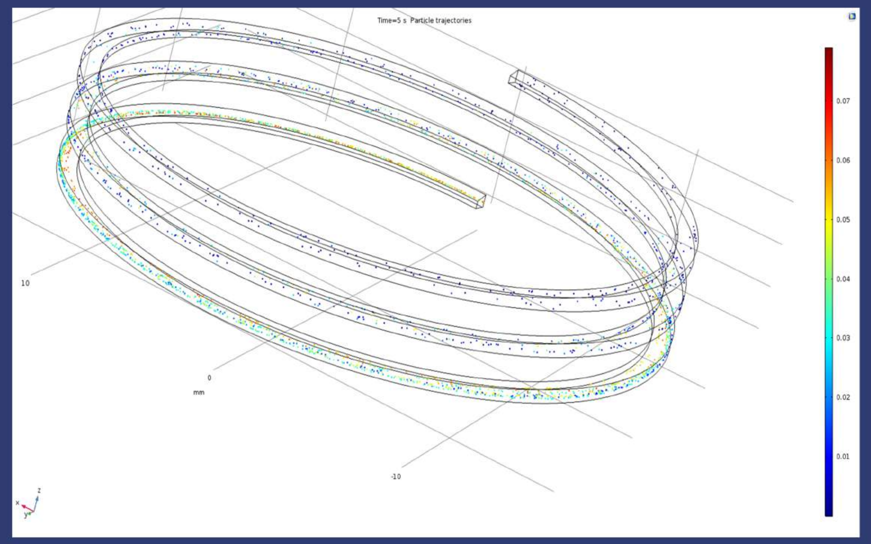
Gap of Knowledge

Biosensors:
- Device that uses living organisms or biological molecules to detect the presence of chemicals.
- Current ones take 48 hrs to detect by plate count.

Microfluidic channels:
- Separating particles based on their size.
- Helical tube to increase the inertial focusing.

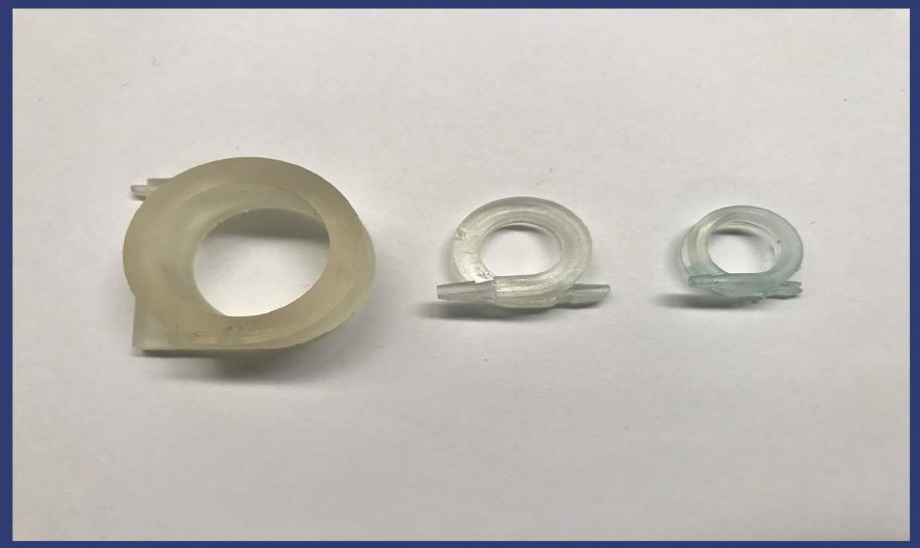
3D printing:
- Provide low cost.
- Rapid fabrication of application specific microfluidic channels.

Methods & Results

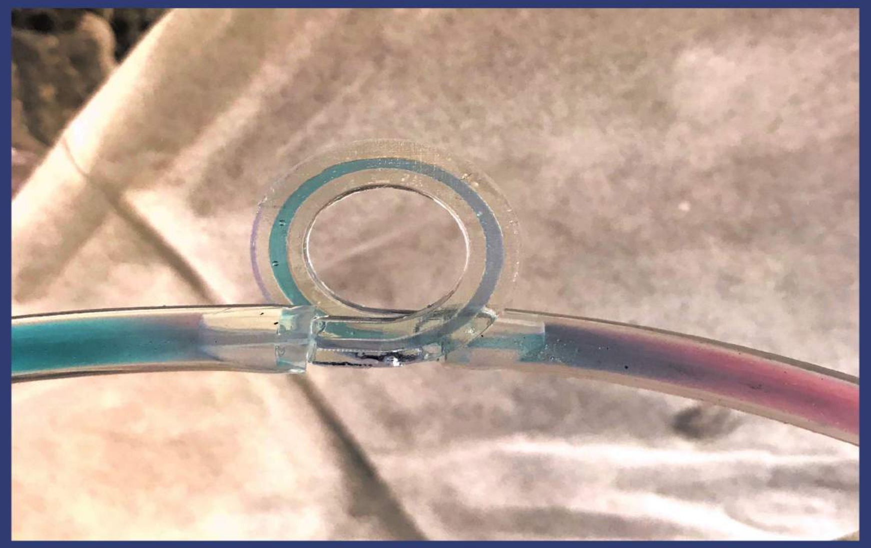


1. Computational Modeling
- Cross platform finite element analysis, solver, and multi-physics simulator.
- Test with 1000 particles of sizes 0.1 - 0.9 μm to imitate the size of bacteria.
- Test lasted 10 seconds.

2. CAD/3D Modeling
- Solid modeling computer - aided design and engineering computer program.
- Trapezoidal opening and a helix tube.
- Later models have two outlets.



3. 3D PRINTING
- Commercial resin.
- Height:6mm * Width:10mm * Length:10mm
- Opening:0.35mm * 1mm * 1mm * 0.6mm



4. TESTING
- No obstruction in part.
- Takes 7 minutes to test.
- Tested using isopropyl alcohol.
- Larger particles binds to the microfluidic channel.

Conclusions

We did not completely reach our goal, but we found that 3D Printing allows the dimensions that we want to actually separate particles.

We were able to separate particles in COMSOL that are 0.5 μm, however the target goal was 0.3μm which is the size of *Salmonella*.

Future Work

- To increase the likelihood of antibody antigen binding to *Salmonella*.
- The target time for us to achieve in the future is 10 - 30 minutes for the microfluidic channel to detect.
- Future work for the research is to test the parts using actual *Salmonella* from meat products to see it split the *Salmonella* from other bacteria in meat.
- The parts could also be able to adapt to other harmful bacteria like *Escherichia coli*.
- The biosensor will be able to be bought by other companies in the food industry.

References

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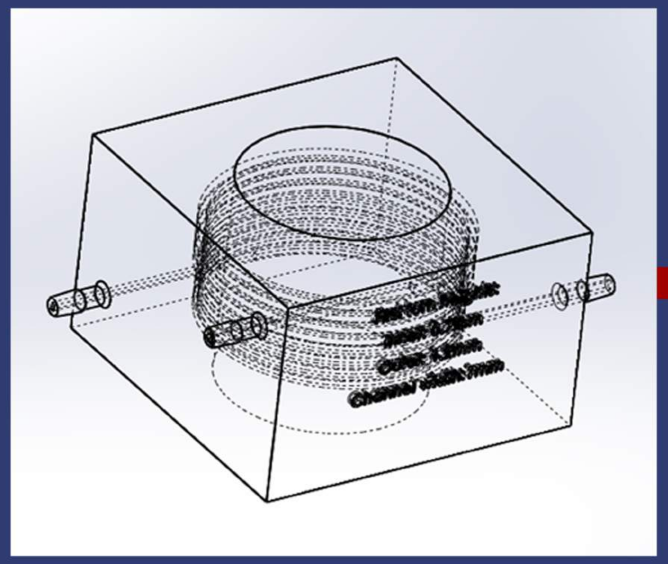

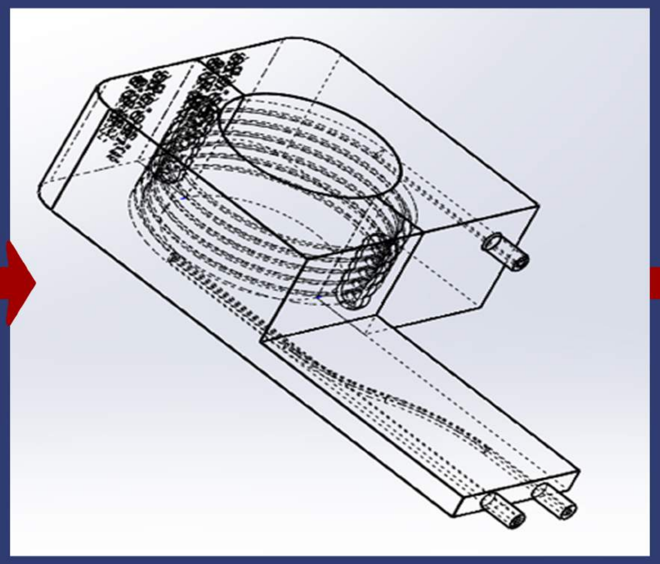

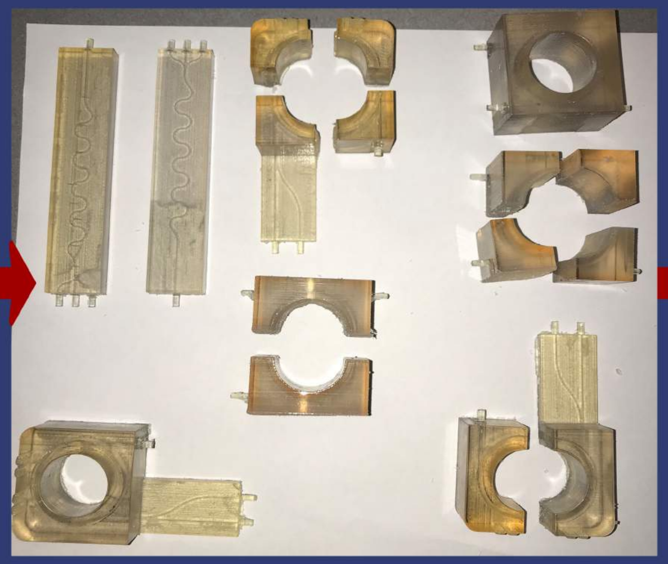

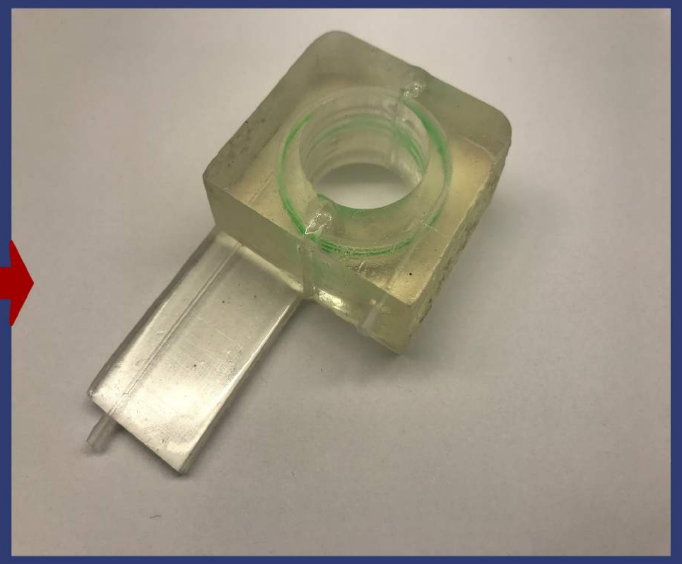

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