Fighting Bacteria with Liposomes:
A Better way to Deliver Antibiotics

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Background

- Antibiotic resistance is a problem of increasing severity; bacteria are becoming resistant to our existing treatments
- Liposomes have been used to combat antibiotic resistance by enclosing the medicine
- It is unclear in the research whether or not liposomes can improve antibiotic efficacy in non-resistant strains of bacteria

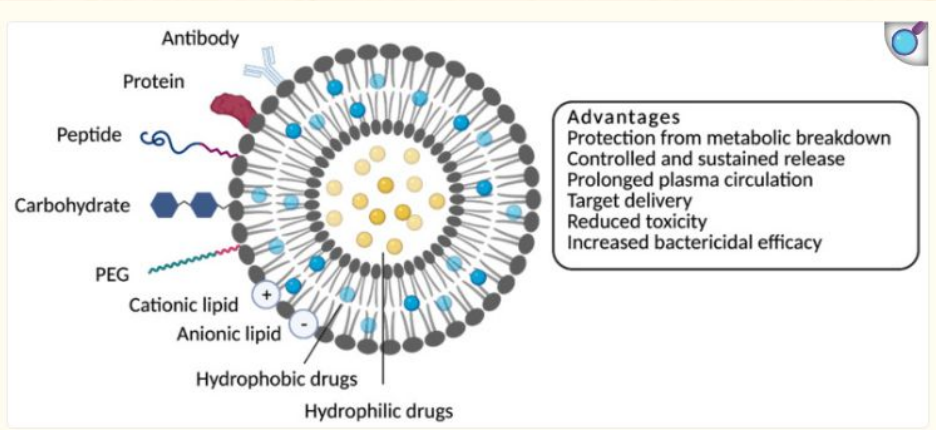

Figure 1. Schematic Representation of Different Types of Liposomes
Ferreira, M., Ogren, M., Dias, J. N. R., Silva, M., Gil, S., Tavares, L., Aires-da-Silva, F., Gaspar, M. M., & Aguiar, S. I. (2021). Liposomes as Antibiotic Delivery Systems: A Promising Nanotechnological Strategy against Antimicrobial Resistance. Molecules (Basel, Switzerland), 26(7), 2047. https://doi.org/10.3390/molecules26072047

Objective + Hypothesis

Objective

Cause E.coli to be inhibited by liposomes-enclosed mixtures of ampicillin and streptomycin

Hypothesis

Liposomal enclosure of antibiotics ***will*** improve drug efficacy in E.coli inhibition

Methods: Petri Dishes

Goal

Draw clear segments that *E.Coli* could be scratched onto and treatments furthermore applied to

Roles

My mentor provided all the supplies, including the petri dishes, markers, and agar. My job was to measure and cleanly mark the plates

Procedure

Agar was poured onto multiple petri dishes of 85 mm diameter
Perpendicular lines were drawn that split the plate into quarters
Every 10 mm from the edge of the plate, a line was drawn to the length of the dish
Label every other square with a unique number and designate them each a treatment

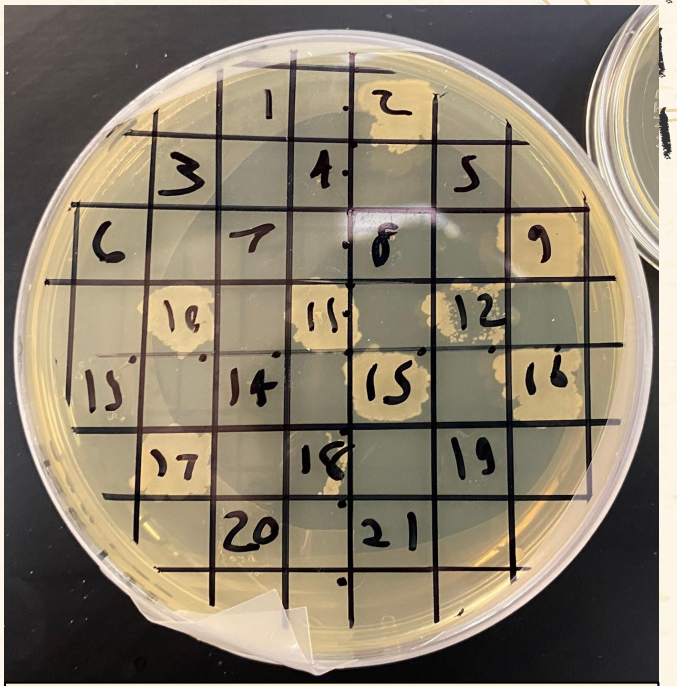

Image 1. Petri dish with markings after treatment, Doane 2026

Methods: Treatments

Goal

Test the inhibitory effect of 10, 50, 100 µg/mL mixtures of both ampicillin and streptomycin (with and without liposomes) on *E.coli*

Roles

My mentor aided in making the solutions of the treatments, while I made plates of *E.coli* and applied treatments

Procedure

Make solutions of the antibiotics at 10, 50, and 100 ug/uL.
Mix liposomes and solutions
Scratch every labeled 1 cm^2 segment with *E.Coli*
Apply 1 µL of the proper solution to their respective labeled segments on the petri dish
Incubate bacteria at 37℃ overnight

Methods: Measurements

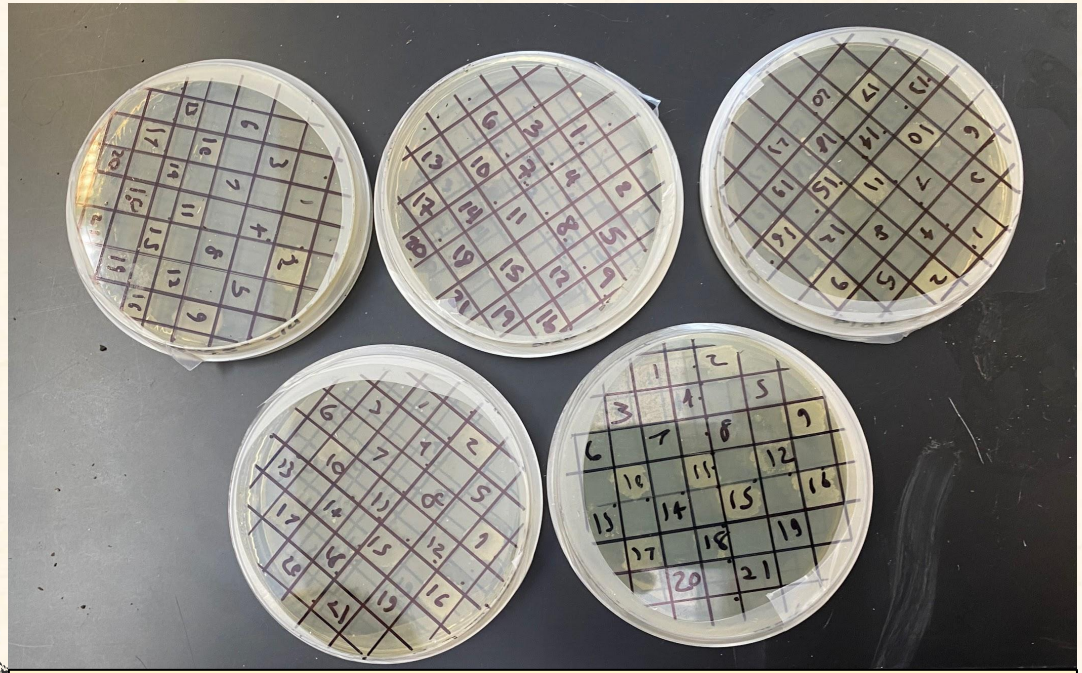

Image 2. All five petri dishes after treatment, Doane 2026

Goal

Reliably and consistently take measurements for the diameter for the zone of inhibition for each of the 1 cm^2 segment.

Roles

My mentor would take the plates out of the incubator, and I would measure and record the diameter of the zone of inhibition.

Procedure

Take plates out of the incubator
Use a ruler and measure the approximate diameter of the zone of inhibition
Record results for each unique spot

Results + Analysis

There was found to be **no** statistically significant difference between the groups with and without liposomes

This means that enclosing the antibiotics in liposomes did not significantly change their efficacy in inhibiting E.coli growth

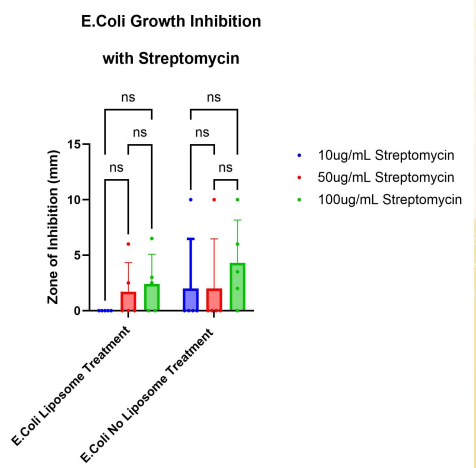

Figure 2: Inhibition of *E.Coli* via Streptomycin with/without liposomes Doane 2026 ****= <0.0001

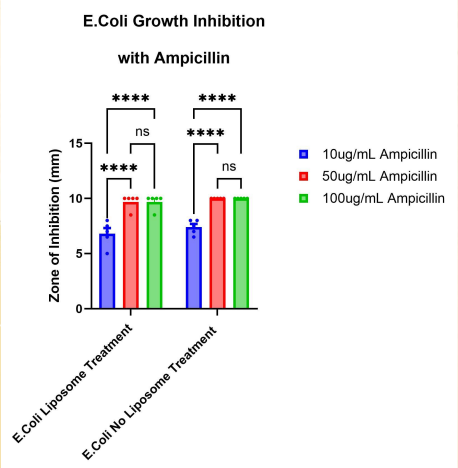

Figure 3: Inhibition of *E.Coli* via Ampicillin with/without liposomes Doane 2026 ****= <0.0001

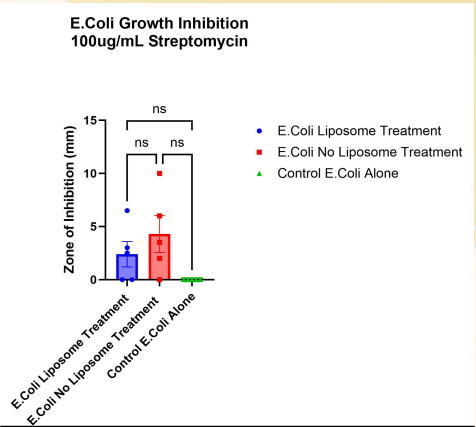

Figure 4: Inhibition of *E.Coli* via Streptomycin with/without liposomes at 100 ug/mL Concentration Doane 2026

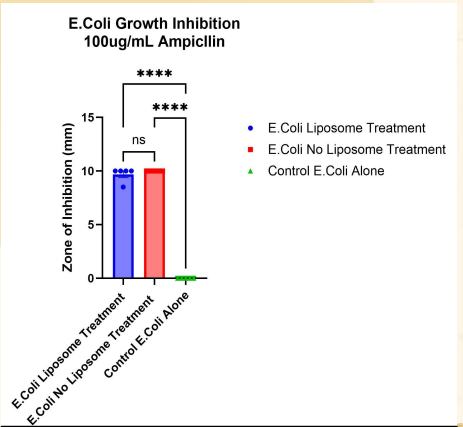

Figure 5: Inhibition of *E.Coli* via Ampicillin with /without liposomes at 100 ug/mL Concentration Doane 2026

Applications

Resistant Bacteria:

- Liposomes have been shown to be more effective at delivering antibiotics to resistant bacteria than antibiotics alone
- Liposomes have also been shown to effectively penetrate biofilms

Cancer:

- Liposomal enclosure of chemotherapy medication has been used since vascularized tumors tend to absorb medicine more readily than the tissue around it.
- The liposomes reduce the toxicity of the medication until it reaches the tumor
- Radio-emitters have been

Potential:

- Liposomes can be functionalized by adding desired proteins to its surface, allowing it to target specific cells.

Conclusion + Discussion

Conclusion

It was hypothesized that liposome delivery of antibiotics would inhibit *E.Coli* growth more than *E.Coli* treated without liposomes.

However, Statistical analysis showed that there was no significant difference in the treatment of *E.Coli* with and without liposomes. Therefore, the hypothesis was not supported.

Future Research

A similar experiment could be conducted on gram-positive bacteria such as *Bacillus subtilis*, as there is a different method of transport of liposomes through the membranes of cells.

Use a different method of liposomes development: such as by using the ethanol-injection method.

THANK YOU

Ethan Doane

Bibliography:

Ferreira, M., Ogren, M., Dias, J. N. R., Silva, M., Gil, S., Tavares, L., Aires-da-Silva, F., Gaspar, M. M., & Aguiar, S. I. (2021). Liposomes as Antibiotic Delivery Systems: A Promising Nanotechnological Strategy against Antimicrobial Resistance. Molecules (Basel, Switzerland), 26(7), 2047. https://doi.org/10.3390/molecules26072047