Bacterial Antibiotic Resistance in Space

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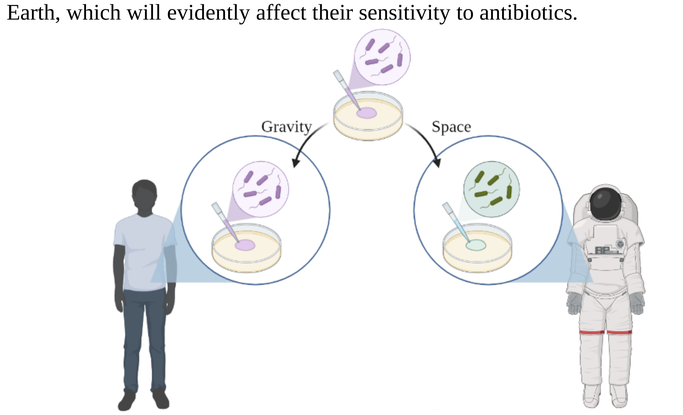
What if astronauts get sick?

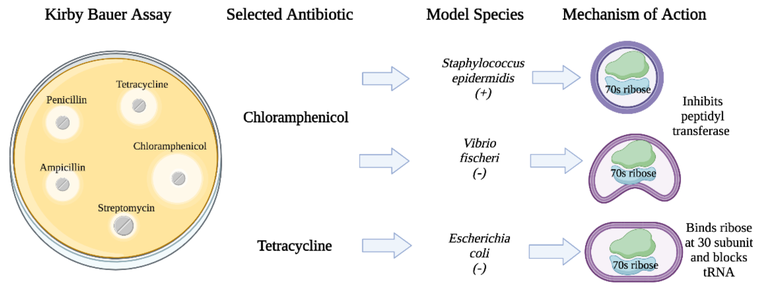
- Experiments conducted on the International Space Station (ISS) have shown that bacteria exhibit different behavior under space conditions compared to those on Earth, which will evidently affect their sensitivity to antibiotics.



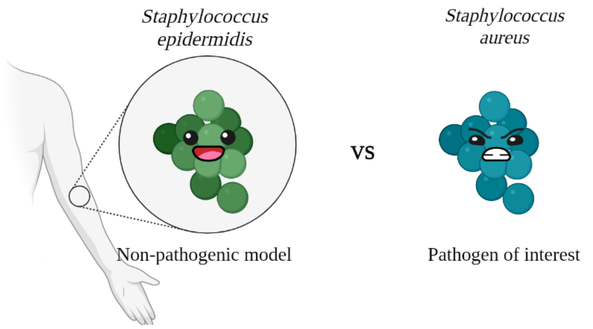
Bacterial gene expression known under gravity, Antibiotic concentration for inhibition known and standard treatment cycle effective.

Bacterial gene expression unknown in microgravity, Antibiotic concentration for inhibition must be recalculated to find effective treatment duration.

- Antibiotics are a class of drugs used to treat bacterial infections. They work by killing or inhibiting the growth of bacteria. Antibiotics can come from a variety of sources, including naturally occurring microorganisms such as bacteria, fungi, and actinomycetes.



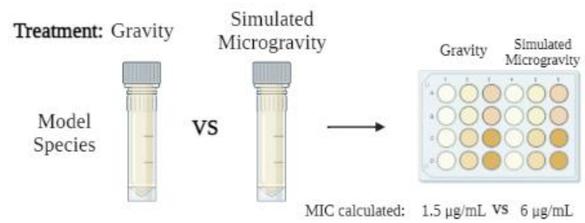
- The experiment utilized non-pathogenic bacteria models as substitutes for commonly found pathogens that astronauts may come across.



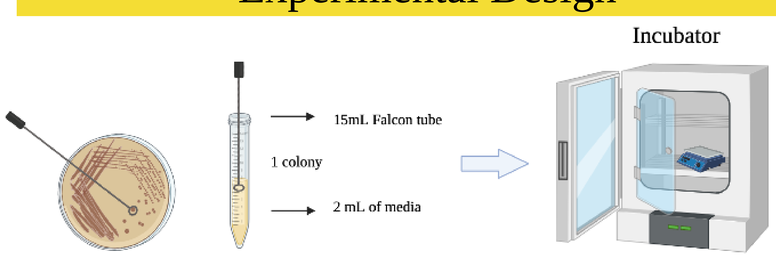
- *E. coli* K12 modeled gastrointestinal pathogenic *E.coli*. *S. epidermidis* modeled *Staphylococcus aureus* responsible for MRSA, and *V. fischeri* modeled *Vibrio cholerae* which causes Cholera.

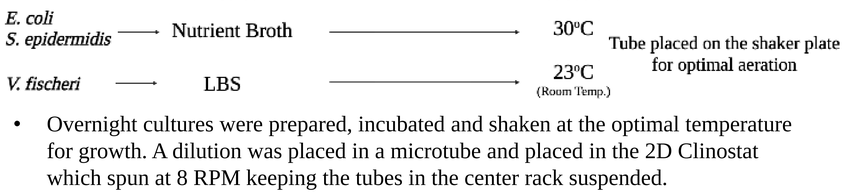
Hypothesis

- Based on the current understanding of the impact of environmental conditions on bacterial growth and antibiotic susceptibility, it is hypothesized that the Minimum Inhibitory Concentration (MIC) of the antibiotic selected for a specific species will change after exposure to simulated microgravity compared to terrestrial gravity.

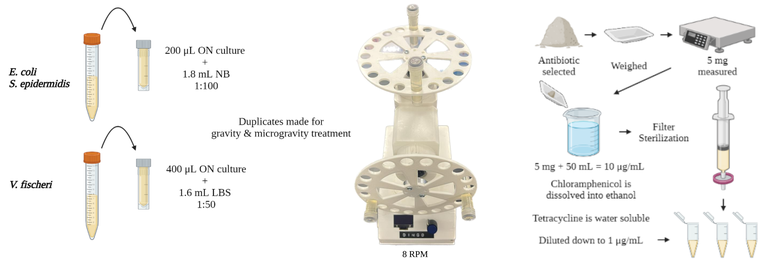


Experimental Design

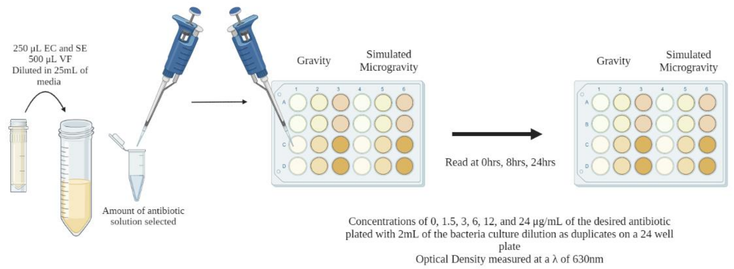




- Overnight cultures were prepared, incubated and shaken at the optimal temperature for growth. A dilution was placed in a microtube and placed in the 2D Clinostat which spun at 8 RPM keeping the tubes in the center rack suspended.

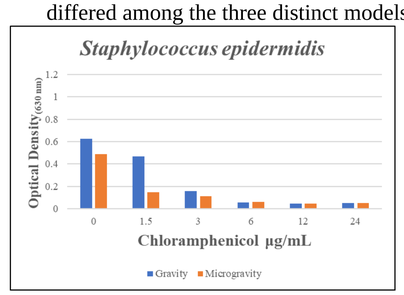


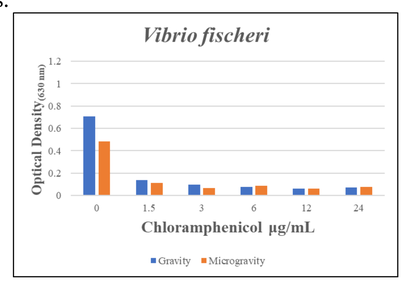
- The antibiotic stock solutions were measured out and filter sterilized to 1 µg/mL. The microtubes were diluted in 25 mL of media, and specific concentrations were plated in a 24 well plate to incubate and have Optical Density measured which gauged growth and inhibition.

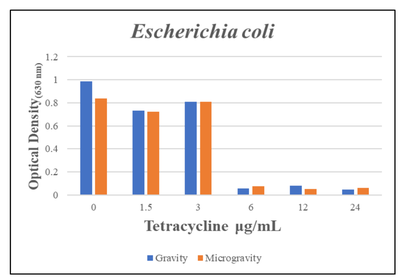


Results

- The preliminary results indicate that the Minimum Inhibitory Concentration (MIC) differed among the three distinct models.



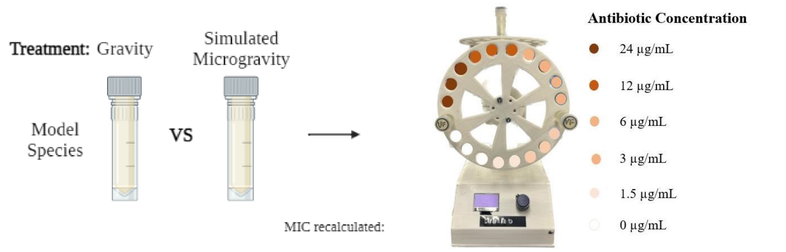




- *Escherichia coli* exhibited the greatest growth among the tested bacterial strains and displayed inhibition at the highest concentration of 6 µg/mL.
- Notably, only *Staphylococcus epidermidis* developed a significant disparity in the onset of inhibition between the microgravity and gravity treatment.

Ongoing Research

- This study conducted a preliminary research to recalculate the minimum inhibitory concentration (MIC) for different models after exposure to microgravity.
- The colonies retained the effects of the treatment even after being removed from the clinostat, as microgravity promotes the selection of certain qualities in biofilms, such as increased “stickiness” and more efficient substrate metabolism.
- **The ultimate objective is to recalibrate the MIC values during microgravity exposure to provide a more accurate representation of the conditions in space.**



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