Effects of Microgravity on Mutualistic Bacteria

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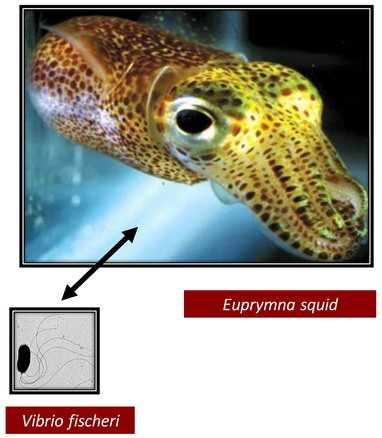
Introduction

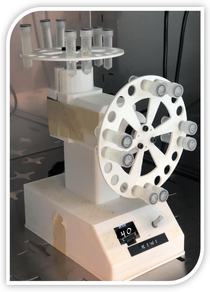
- Changes in environmental conditions represent a challenge for all terrestrial organisms, including the organisms involved in mutualistic associations (when both organisms obtain a benefit from each other).
- Changes in the environment might include fluctuations in gravity and microgravity which represents a new frontier for space biology research.
- This study utilized *Vibrio fischeri*, a beneficial symbiotic bacterium of squids and monocentrid fishes.



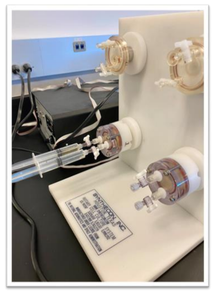
- Previous microbiology studies observed altered virulence and antibiotic resistance in response to space stressors
- Further microgravity study is needed to include virulence-related phenotypes such as biofilm formation to determine bacterial plasticity and adaptatio
- The survival strategy of *Vibrio fischeri* biofilm formation will serve as a mutualistic model system for this microgravity study

Microgravity Simulations

- An EagleStat and a Rotary Cell Culture System (RCCS) were utilized to simulate microgravity conditions.



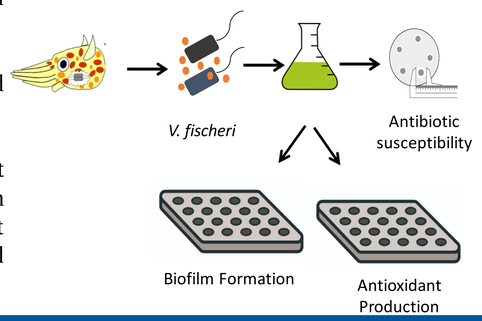
EagleStat



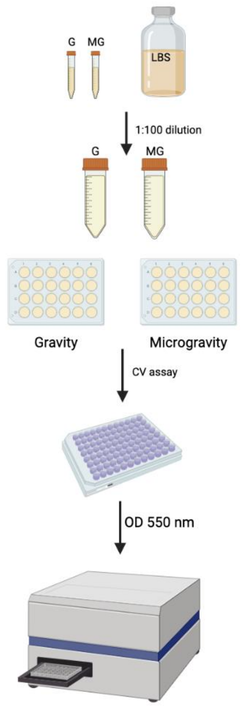
RCCS

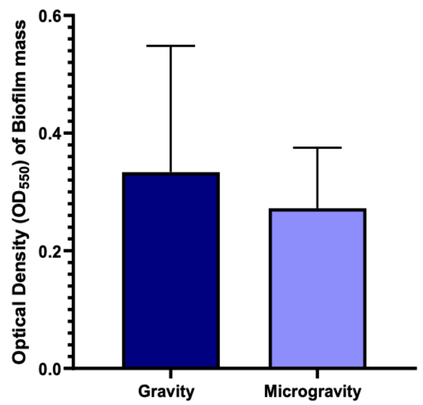
Material and Methods

- *V. fischeri* was harvested from a squid
- The bacteria was then cultured for experimentation
- The cultures were used to test antibiotic resistance, biofilm formation, and antioxidant production in microgravity and gravity conditions



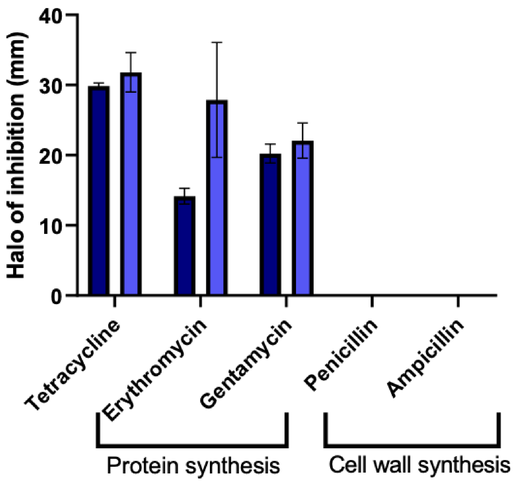
Biofilm Formation

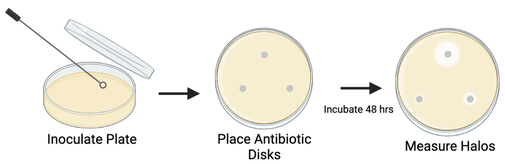




- V. *fischeri* biofilm formation measures the structural development of the strain's membrane within 48 hours for both treatment and control
- Increased mass is due to successful colony formation with surviving factors like membrane integrity and nutrient utilization within a liquid media
- Data was collected via optical density readings conducted by spectrophotometer

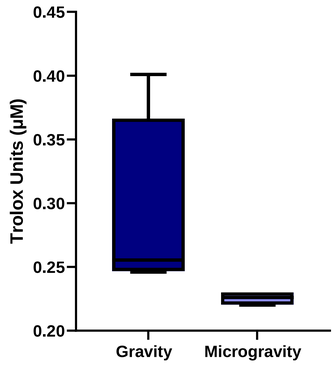
Antibiotic Resistance

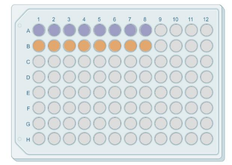




- V. *fischeri* antibiotic resistance was measured using the Kirby Bauer method.
- Zones (halos) of clear media where no growth occurs were measured as indicative of the antibiotic disc limiting bacterial growth.

Antioxidant Production





- V. *fischeri* antioxidant production was measured using the Trolox assay
- The introduced radical is colored and reacts with the antioxidants and gets reduced with decrease in the color
- The ability of the antioxidant or test sample to decrease the color is measured by a spectrophotometer

Future Research

- V. *fischeri* develops colony morphological variation under simulated microgravity.
- Phenotypical features pictured here can be described as a filamentous margin
- The texture of the colonies grown in simulated microgravity are wrinkled compared to the smooth colonies grown in gravity
- Further research is needed to define the mechanisms behind these phenotypical characteristics, such as gene sequencing

Expected Results

Biofilm Growth

- Increased biofilm growth for simulated µg analogs
- Indicated by increased OD during spectrophotometry assay versus gravity analog

Antibiotic Resistance

- Slight increases in inhibition zones around antibiotics for simulated µg analogs
- Indicated by relative size measurements between gravity and simulated µg analogs

Oxidative Stress

- Downregulation of Catalase Enzymes with simulated µg analogs
- Indicated by spectrophotometry assay and comparing with gravity analogs

References

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