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2024 Discovery Day – Office of Undergraduate Research

Simulated Microgravity and Ionizing Radiation changing *Escherichia coli's* Growth Dynamics

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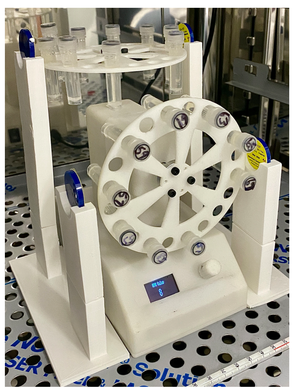
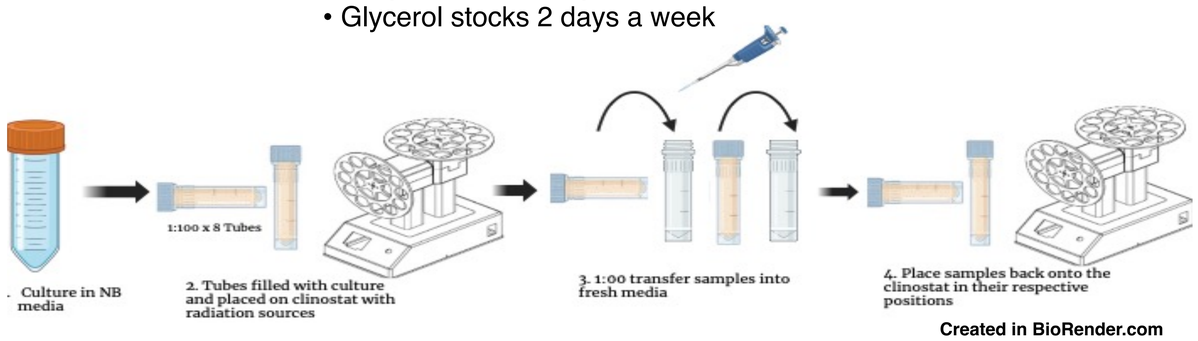
With the push for increased human space exploration, we must explore the effects of the extreme environment of space to ensure mission success. Research has shown that the increased exposure to space stressors such as microgravity (μG) and increased low-dose ionizing radiation can result in significant physiological and cellular responses. These responses have been observed to include transient and long-term impacts on astronaut microbiomes that alters immune system function. In this study we explored how the antagonistic and synergistic activities of bacteria responded to simulated microgravity (SMG) environments using *Escherichia coli.* We measured growth rates during and post prolonged exposure to radiation and simulated microgravity.

Experimental Design

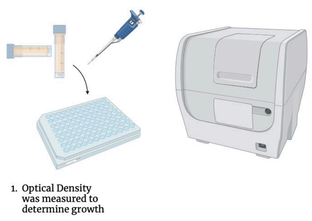


Initial Exposure Experiment Design

- *Escherichia coli* (Intestinal Microflora)
  - Gram Negative
  - Rod Shaped
- Low-dose ionizing radiation
  - 4 Cs-137 sources
  - 10μCi activity
  - Gamma Radiation
  - Sources placed on 3D printed stands
  - ~ 1.7μSV per hour (unshielded)
  - 3 water tanks were used for shielding inside the incubator
- Simulated Microgravity and Gravity conditions
  - 3D printed EagleStat
- Prolonged Exposure cultures were grown for 28 days
  - Daily transfers 5 days a week
  - Glycerol stocks 2 days a week



Created in BioRender.com



1. Optical Density was measured to determine growth

Post Exposure Experiment Design

- *Escherichia coli* samples from initial exposure
- Samples grown on 24-well plate with fresh media
- Samples grown in plate reader at 30°C
- Optical Density (OD) measured every hour for 15 hours
- No Radiation or Microgravity

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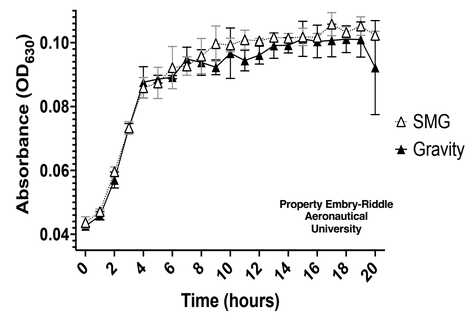
Growth Results

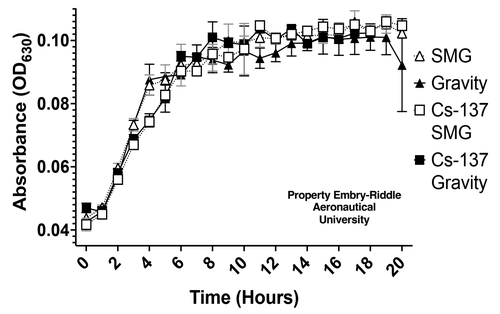
- Slight increase of cells under simulated μG compared to gravity analog

***E. coli* Simulated μG Growth Curve**



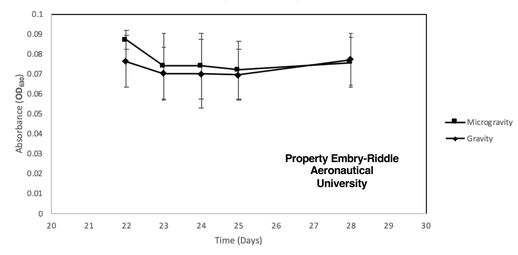
- Initial Low-dose ionizing radiation growth curve test
- ~ 0.5 mSv/Hr

***E.coli* Low-Dose Ionizing Radiation Growth Curve Data**



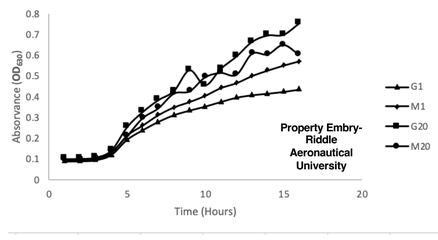
- After 4 weeks of exposure no significant difference between μG and gravity analog

Week 4 E. coli Optical Density Measurements



- Increase of cells on day 20 compared to day 1 in both μG and gravity analog

E. coli Growth Curve 15H Post Exposure Day 1 vs Day 20



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Ongoing Research

- Long Duration SMG and Low-Dose Ionizing Radiation study on other models
- Further evaluation of response to long duration with DNA and RNA sequencing and biofilm assays.

Acknowledgements

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