Gelatin in Microgravity: Bridging Molecular Food Science and Hospitality

Student Spaceflight Experiments Program : Mission 21

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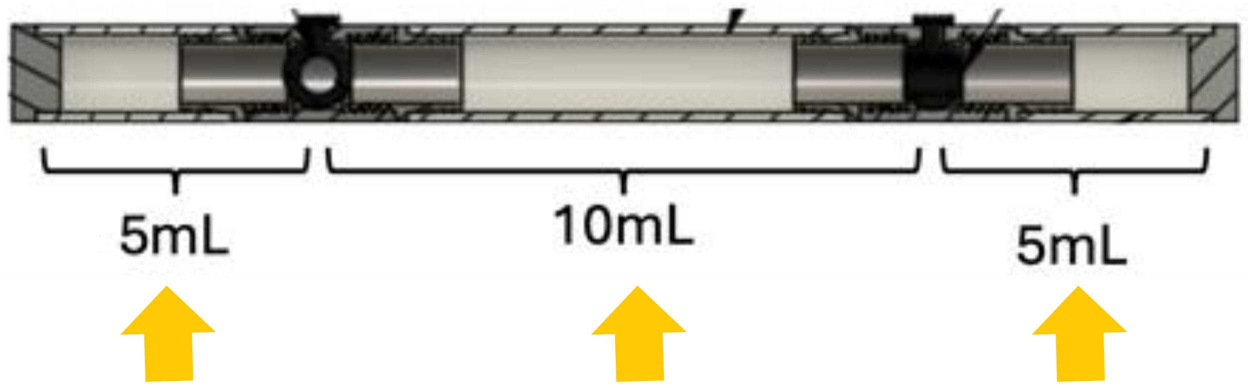
Background

Gelatin is a thermoreversible hydrocolloid valued for its ability to form elastic, water-retaining gels with desirable textures. On Earth, gelation is shaped by gravity-driven forces like convection and sedimentation, which influence solute distribution and network formation. In microgravity, these forces are suppressed, allowing molecular diffusion to dominate. This study examines how microgravity affects gelation rate, matrix uniformity, and water retention by comparing orbital samples to matched Earth controls. Insights will support the design of texture-diverse, emotionally resonant food systems that enhance sensory satisfaction and psychological well-being in space environments.

Methods

The experiment uses 1.5 g of food-grade gelatin and 10 mL of distilled water in a Type 3 RhFET-01 mini-lab with three chambers and two manually operated valves. Gelatin (Chamber 2) and water (Chamber 1 & 3) remain separated until ISS crew open both valves on Day A+2, initiating gelation with 15 seconds of agitation. A second agitation on Day U–2 is performed to promote late-stage structural reorganization. Ground controls use identical materials, sterile handling, and matched timing at 22–25 °C. This setup ensures true microgravity exposure and enables comparative post-flight analysis of gel structure and stability.

Rhodium Fluid Experiment Tube (RhFET-01) Mini-Laboratory Configuration



5 ml Distilled Water **1.5 G Food Grade Gelatin** **5 ml Distilled Water**

*A **15% w/v** gelatin concentration was selected to balance structural integrity with manageable viscosity, ensuring reliable gelation under microgravity conditions*

Expected Outcome and Analysis

- Gelatin is expected to form a more uniform, isotropic matrix in microgravity due to the absence of convection and sedimentation.
- Reduced gravitational forces may result in smoother texture, minimized bubble migration, and altered water retention.
- Microgravity conditions may influence polymer cross-linking kinetics, affecting mechanical properties such as elasticity and firmness.
- Post-flight analysis will include compound microscopy to assess pore structure and matrix uniformity.
- Gel strength, water separation, and overall structure will be measured using indentation tests and volume tracking over time.

Conclusion

- Microgravity suppresses convection and sedimentation, allowing gelatin to gel through diffusion-dominated processes.
- Orbital samples may show smoother texture, more uniform gel structure, and altered water retention compared to Earth controls.
- Findings support the design of space-adapted food systems that enhance texture, emotional satisfaction, and operational efficiency for astronauts.

References

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