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SALMONELLA TYPHIMURIUM, SHEWANELLA ONEIDENSIS MR-1, AND ISS-ISOLATED STAPHYLOCOCCUS EPIDERMIDIS: THE EFFECT OF SIMULATED MICRO-, LUNAR, AND MARTIAN GRAVITIES ON GROWTH AND SIZE, AND PRACTICAL IMPLICATIONS

Abstract

Understanding bacterial growth and behavior in the space environment is crucial to astronaut health and well-being, as well as for potential biotech applications towards sustainable human presence in space. While many studies have interrogated various microbial aspects under microgravity conditions, less is known about responses in reduced gravity environments. This NASA-funded research aimed to investigate the growth of three different, unrelated bacterial strains with potentially diverse applications under conditions of simulated Micro-, Lunar, and Martian gravities achieved via inclined clinorotation. *Salmonella typhimurium* was selected for this study due to its potential negative impact on astronaut health; *Shewanella Oneidensis* MR-1 for its potential use for biologically-based *in situ* resource utilization (ISRU) (biomining); and *Staphylococcus epidermidis*, given that it is an opportunistic pathogen that finds refuge on the skin of humans and has been isolated from the International Space Station (ISS). Cultures of *S. typhimurium* grown under the three simulated reduced gravity levels showed a slowed exponential growth rate with respect to the 1 g controls, with the highest and lowest yields observed under simulated microgravity and 1 g, respectively. A slowed exponential growth rate was also observed for cultures of *S. oneidensis* under simulated reduced gravities, although the highest and lowest yields in this case were observed under simulated Martian gravity and 1 g, respectively. Cultures of *S. epidermidis* grown under the three simulated reduced gravity levels showed a more rapid exponential growth rate with respect to the 1 g controls, while the highest and lowest yields were again observed under simulated microgravity and 1 g, respectively. Under the simulated microgravity regime and with respect to 1 g, significant increases in cellular length and width were observed for *S. oneidensis* and *S. epidermidis*. The higher yield of *S. typhimurium* and *S. epidermidis* under simulated reduced gravities, with respect to 1 g controls, may have negative implications for astronaut health. On the other hand, the increased cell growth of *S. oneidensis* under simulated Martian gravity may be beneficial for its application for metal reduction from Martian regolith.

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