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Microgravity Sciences on board of Space stations (6)

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SPACE STATION HAS A UNIQUE AND EXTREME MICROBIAL AND CHEMICAL ENVIRONMENT DRIVEN BY USE PATTERNS

Abstract

Space habitation poses unique challenges, particularly in maintaining built environments isolated from Earth. This study aimed to produce a comprehensive 3D map of the microbes and metabolites throughout the United States Orbital Segment of the International Space Station (ISS), involving 803 samples collected during spaceflight, including controls. The project conducted comprehensive microbial detection and evaluated the corresponding influence of the spaceflight environment on microbial and metabolomic profiles. Leveraging cutting-edge next-generation sequencers and high-throughput mass spectrometers, coupled with proprietary bioinformatics algorithms, we provided accessible and interpretable data to the scientific community. By analyzing these samples, we discovered that the use of each of the nine sampled modules within the ISS significantly influences the microbiology and chemistry of the habitat. Our findings reveal that, similar to human microbiomes, built environment microbiomes align naturally along an axis of industrialization, with the ISS serving as an extreme example of an industrialized environment. Our approach addressed the challenges of generating and interpreting complex metagenomic and metabolomic data, offering insights into microbial species and their natural products within the unique and dynamic environment of spaceflight. This comprehensive analysis is crucial for developing strategies to mitigate the risks associated with long-duration spaceflights and ensuring the sustainability of human health in space exploration endeavors.