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Commentary

Microbiology Advances in Space

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COMMENTARY

Microbial research in space has now been going on for about 50 years. For the past ten years, the closed system of the International Space Station (ISS) has served as a microbial observatory, performing research on microorganism adaptability and survivability in space. Crew personnel and spacecraft may benefit or suffer the effects of this adaption. As a result, it's critical to figure out how radiation and microgravity affect microbial life aboard the International Space Station. Understanding the mechanisms of microbial adaptation to space environments aids in the development of countermeasures to their potentially damaging effects and allows us to take advantage of their biotechnologically advantageous characteristics.

A variety of microbiological activities have been studied in space or with technologies that can simulate space conditions. However, research on only a few microbes is currently limited, and extensive research on biotechnologically important microbes is required to enable long-term space missions self-sustaining. Understanding the mechanisms of microbial adaptation to space environments aids in the development of countermeasures to their potentially damaging effects and allows us to take advantage of their biotechnologically advantageous characteristics. A variety of microbiological activities have been studied in space or with technologies that can simulate space conditions. However, research on only a few microbes is currently limited, and extensive research on biotechnologically important microbes is required to enable long-term space missions self-sustaining.

The International Space Station (ISS) is home to a wide range of microorganisms that came from Earth as contaminants, components of studies, or the crew's natural microbiota. Microbial viability under space circumstances has been studied for more than 50 years. The first tests with microorganisms exposed to spaceflight conditions began in 1935 with balloon flights and rocket payloads. During the Gemini IX and XII flights in 1966, the National Aeronautics and Space Administration (NASA) launched studies in which bacteriophage T1 and spores of the fungus *Penicillium roqueforti* were exposed to space conditions for 16.8 and 6.5 hours, respectively. However, they determined that microbiological survival was almost non-existent. This was later revealed to be due to nonpenetrating radiation in space, such as solar UV light or soft X-rays, because covering the samples with a thin layer of aluminium (0.4 mm) resulted in a 3,000-fold increase in bacteriophage T1 survival and nearly 100% survival of fungal spores.

One of the earliest studies to look at the limits of microorganism viability in space conditions was this one. Several techniques, such as the use of freeze-dried food and pre-flight crew quarantine, have been introduced to monitor the microbial population on the ISS since the beginning of manned space flights. However, due to the subjects' weakened state and their exposure to spaceflight settings, otherwise commensal microbes could become pathogenic. Microorganisms are known to undergo genetic and physiological changes in order to adapt to severe environments, and the ISS is a challenging environment for biological life. Several studies have been undertaken to better understand how microorganisms adapt to these extreme environments, but these studies are confined to a few species and require researchers to dig deeper into genetic modifications.