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DEFINING A SPACEFLIGHT BIOFILM EXPERIMENT THROUGH COMPREHENSIVE ASSESSMENTS OF MATERIAL, MEDIA, AND HARDWARE BIOCOMPATIBILITY

Abstract

Biofilm formation has been observed on board spacecraft on different materials and conditions. Biofilms pose a risk to long-duration spaceflight due to their ability to decrease the efficiency and lifetime of equipment and their ability to increase the risk of pathogen transmission. Furthermore, microorganisms in biofilms tend to have an increased resistance to disinfectants, antibiotics, and environmental stresses and other adverse conditions. In order to gain knowledge into the unique properties of biofilm formation in microgravity and to contribute to safe long-duration human space missions, the NASA-funded project "Biofilm in Space (BFS)" will be performed on the International Space Station where *Pseudomonas aeruginosa* biofilm will be studied on spaceflight-relevant materials. In order to optimize and define the growth conditions for each material, a comprehensive assessment was conducted to mature the experimental design. The array of spaceflight-relevant materials assessed included carbon fiber, stainless steel, aluminum 6061, titanium Ti-6Al-4V, polycarbonate, silicone, quartz, and cellulose membrane. For each material, *Pseudomonas aeruginosa* was cultured in four different media: 3% tryptic soy broth, 8.8 mg/L iodine solution, LB, and a modified artificial urine media. By assessing a variety of materials, media, and adhesive combinations, the spaceflight culturing conditions for *Pseudomonas aeruginosa* were defined and optimized to produce sufficient biofilm on the down-selected materials. Additionally, spaceflight equipment compatibility was taken into consideration and ground testing was conducted on the same hardware planned to be used on spaceflight – BioServe's 12-Well BioCell. Given the inevitable differences between common laboratory conditions and spaceflight experiment hardware, ground testing has also included assessments into growth and biofilm differences, bacterial and media temperature sensitivity, and biofilm adherence to the hardware itself. The data produced from this ground-based testing, presented here, will help define the spaceflight experiment design.

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