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Author: Mrs. Charlotte Pouwels
International Space University (ISU), The Netherlands

Mrs. Polina Shtern
International Space University (ISU), France
Ms. Margot Issertine
University of Montpellier, France
Mr. Gauravam Majmudar
France
Ms. Rowan Moorkens O'Reilly
International Space University (ISU), France
Dr. Alexandra Lissouba
International Space University (ISU), France

UV LIGHT FOR SPACE LAUNDRY: MITIGATING MICROBIAL RISKS ON LONG-DURATION CREWED MISSIONS

Abstract

Recent studies have shown that the skin microbiota is impacted during spaceflight, with significant changes observed in microbial diversity and composition. Astronauts often use topical creams and corticosteroids to combat skin issues in space, which can affect their performance, and the spread of infections among the crew is a concern. As washing clothes aboard the ISS is not feasible, fresh clothes must be constantly resupplied from Earth. However, this model is unsustainable for a long-duration mission. The skin is home to a diverse ecosystem of bacteria, fungi, and viruses collectively known as the skin microbiota. They play a vital role in protecting against pathogens and supporting our immune system. However, disturbances can lead to skin diseases and even systemic illnesses. To address this challenge, an ISU research group is focused on mitigating the effects of long-duration spaceflight on the human skin microbiome. The goal is to address and develop a mitigation mechanism for the NASA Human Research Roadmap gap Micro-401 by reducing the microbial counts on astronaut's clothes using UV-light. The hypothesis is that the use of UV-C radiation for space laundry can be used as an alternative solution and help reduce microbial proliferation on garments worn by astronauts, contributing to maintaining microbial types and virulence at terrestrial levels, with the added benefit of extending the period of use for a single garment. To validate this hypothesis, a study was conducted during the analog mission APICES. As a demonstration we utilized a portable device capable of both drying functions and UV-C radiation. The study involved six analog astronauts, composed of three males and three females, divided into test and control groups. The test group used the device for both drying and UV cleaning of socks and t-shirts, while the control group only used the drying function. Both groups performed body and clothes swabs at the beginning and end of the mission. Additionally, samples from the clothes were collected for further analysis. To gather qualitative data, the astronauts completed a questionnaire. This comprehensive approach allowed us to obtain a diverse data set to test our hypothesis. Viable microbial count from skin and clothes samples was performed and microbiome data is being analyzed from DNA using 16S rRNA amplicon sequencing by Illumina Technology. This research has thus vital implications for the health and well-being of astronauts on long-duration space missions, but also provides a variety of useful applications for life on Earth.