Endurance of desert-cyanobacteria biofilms to space and simulated Mars conditions during the EXPOSE-R2 space mission

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The aim of the experiment Biofilm Organisms Surfing Space (BOSS), part of the EXPOSE- R2 space mission, is to test whether biofilms can withstand long-term exposure to space and Martian conditions than planktonic counterpart. Three desert isolates of Chroococcidiopsis spp. were included in the BOSS experiment: strain CCMEE 029 from endolithic commu- nities in the Negev Desert, and strains CCMEE 057 and CCMEE 064 from endolithic and hypolithic communities in the Sinai Desert. Dried biofilms and dried multilayered planktonic samples were exposed to both ground-based simulations and to space and Martian simulated conditions in Low Earth Orbit (LEO) within the ESA facility EXPOSE-R2 outside the Inter- national Space Station. Samples were exposed for 16 months to space and Martian simulated conditions, characterized by temperature variations, ionizing radiation, vacuum or simulated Martian atmosphere, in the dark or under attenuated space and Mars-like and solar UV ir- radiation. The effects of those environments on cyanobacterial samples were investigated by using confocal laser scanning microscopy to visualize the biofilm architecture and quantify photosynthetic pigment autofluorescence, PCR-based assays to asses DNA damage and and colony forming ability to test the recovery upon rehydration. Results from the flight mission are consistent with previous ground-based simulations of the mission1,2 and demonstrate an overall higher resistance of biofilms when compared to the planktonic counterpart, showing the former an increased viability and lower amounts of DNA damage.

References

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