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MICROBIAL ECOLOGY OF SPACE CONFINED HABITATS AND BIOFILM DEVELOPMENT ON SPACE MATERIALS: THE PROJECT MARS500 - MICHA

Abstract

Microbial contamination aboard the International Space Station (ISS) is crucial for the safety of astronauts as well as for the maintenance of the space vehicle itself. The same issue will also be fundamental to establish successfully future planetary bases. We have previously carried out research about biofilm metabolic activities of some reference bacteria on either conventional or innovative space materials, commonly used for aerospace industry and currently examined for space greenhouses. The effect of a mixture of biosurfactants produced by *Pseudomonas* strain AD1 was evaluated. Results showed a diverse affinity of materials for bacterial biofilm formation and occasionally sessile colonization was rejected. Pre-conditioning with the biosurfactant mix led in some cases to a diminish of biofilm dehydrogenase activity and development compared to untreated materials; this was due to experimental conditions and to relationships between physical traits of materials and level of bacterial adhesion. The scientific project MICHA addressed the survey of the microbial flora in the MARS500 modules, at both environmental and human level, from the start till the end of the simulation study (520 days). During the confinement the development of microbial biofilm on aluminum panels assembled inside the gym room of the NEK facility was monitored. The BIOFILM experiment implied six experimental thesis based on the following treatments: 1) none (control); 2) hydrogen peroxide 6%; 3) biosurfactant mix; 4) physico-chemical coating of silica and silver; 5) chemical antifungal product; 6) hydro-alcoholic extract of propolis. The panels were sampled every three months by the crew, the biological material was preliminary analyzed for cultivable microorganisms and then frozen for further analyses. The investigation showed that surface contamination due to bacteria was higher than that caused by fungi. Moreover, taking into account the overall trend of viable cell counts, microbial biofilms were inhibited at a larger extent by biosurfactants

and propolis, whereas fungal biofilms were more affected by the chemical product and propolis. Beside such a long-term simulation study, we are presently investigating microbial biofilm development in a flight experiment (VIABLE) inside the ISS for about 4 years. Experimental insights from both studies will be useful to select appropriate materials for life support hardware in order to decrease the risk of surface biocontamination inside space modules leading to biocorrosion and health problems, a great challenge to support long-term human space missions.