Survival of lichens to simulated Mars conditions

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Lichens, as extremophilic organisms at Earth, have demonstrated their survival capacity at space. Previous experiments performed (LICHENS, Foton M2-2005 and LITHOPANSPERMIA, Foton M3-2007) [1,2] have shown that short term exposures to LEO (Low Earth Orbit) conditions do not have a significant deleterieous effect on their vitality, meanwhile long term experiments show more relevant changes (LIFE experiment, EXPOSE-E, ISS, 2008-2009) [3]. This could be explained by the lichens structural and physiological features, which allowed them to survive the harsh environmental conditions on Earth (high UV radiation, extreme temperatures and desiccation), as well as in space (high UV space radiation, UV-vacuum, extreme temperatures and microgravity). But not too much research has been performed with lichens at Mars environmental conditions that have been simulated in the laboratory (Mars UV radiation, Mars CO_2 atmosphere and pressure, and Mars temperature) [4].

In this work we report the results obtained with the most resistant lichen species known until now to harsh space conditions: Circinaria gyrosa (renamed from A. fruticulosa see Sohrabi, M., 2012), a vagrant lichen collected at the steppic highlands of Central Spain. This lichen has been exposed to harsh space conditions, tested in the Experiment Lithopanspermia [5], and to Mars simulated conditions, reproduced at the EVT-1, EVT-2 and SVT tests performed at the DLR-Planetary simulation chambers of DLR (Deutsches Zentrum für Luft- und Raumfahrt, Cologne, Germany). These tests are necessary to check the resistance and survival capacity of biological samples in preparation of the next EXPOSE R2 space mission, sheduled for 2013, when the EXPOSE-R2 facility with 3 astrobiological experiments, one of them the experiment BIOMEX-ESA (Biology and Mars Experiment, PI: DLR-Berlin, de Vera), including our lichen Circinaria gyrosa, will be placed on the ISS, to real space and to simulated Mars conditions for 1 to 1.5 years (2013 to 2014). Different sets of samples in contact with Martian regolith surrogates P-MRS and S-MRS (early acidic and late basic regolith simulants), were exposed to the same conditions. The results have shown no significant differences of the PS-II activity or photochemical efficiency measured with a PAM fluorometer before and after exposure to simulated Mars UV solar radiation ($> 200\,\mathrm{nm}$, Mars CO_2 atmosphere at a pressure of 930 Pa. These tests demonstrate the optimal resistance and survival capacity of Circinaria gyrosa, a lichen species defined as model system in Astrobiology which could contribute to the better understanding of the habitability of a planets surface, i.e. Mars, as well as to the Lithopanspermia hypothesis [6].

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