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Antarctic rock fungi in space and Mars simulated conditions

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The Antarctic desert in the Victoria Land represents the extreme ice-free environment on Earth, where the McMurdo Dry Valleys covers the widest area. There, the environmental conditions are characterized by high dryness, high UV radiation and very low temperatures, reaching about –50˚C during the Austral Winter, with strong thermal fluctuations. Precipitations are represented only by snow, generally well below 100 mm water equivalent per year, most of which sublimes, therefore only a few melts wetting the rocks (Nienow and Friedmann, 1993); in the meantime, the strong evaporation causes salts accumulation on the surface. The rock surfaces appear mostly sterile; rare epilithic lichens grow in protected niches while, under the rock crust, can live peculiar cryptoendolithic microbial communities, among which the lichens dominated community is the most widespread (Friedmann and Ocampo, 1976; Friedmann, 1982). In these microbial communities, living at the absolute biological limits for life, black meristematic fungi belonging to the new and possibly endemic genera *Cryomyces* and *Friedmanniomyces* (Selbmann et al., 2005), are present. These microorganisms, adapted to colonize the closest Martian environment on Earth, evolved in complete isolation and under the high environmental pressures characterizing their habitat. For these reasons they have been already suggested as the best eukaryotic model for exobiological studies (Onofri et al., 2004). Results obtained with tests performed in vitro highlighted an uncommon ability of surviving under different external stressors (Onofri et al., 2007) of two strains of *Cryomyces antarcticus* and one of *C. minteri*; they showed high resistance to seven repeated freezing and thawing cycles,

after which their ability of germination remains practically unaffected. They showed also high resistance at UV-B irradiation (2.5 W/m^2), with 50% of propagules able to germinate after 90' of irradiation (*C. antarcticus* CCFEE 534) between 105' and 120' (*C. minteri* CCFEE 5187) and between 120' and 240' (*C. antarcticus* CCFEE 515); complete inhibition was reached only after 10 hours. Finally, all the strains tested were also able to tolerate osmotic stress being able to reproduce even in a 24% NaCl amended medium. Studies on the ability of Antarctic rock fungi to withstand space-simulated conditions were carried out in view of direct and long term space exposition on the International Space Station (ISS) in the framework of the LIchen and Fungi Experiments (LIFE, EXPOSE-EuTEF, ESA). Using the space simulation facilities at the German Aerospace Centre (DLR, Cologne, Germany), either dried cryptoendolithic Antarctic communities within small rock fragments or Antarctic strains of *C. antarcticus* and *C. minteri* were tested in simulated space and Mars conditions (Experiment Verification Tests, EVTs). Samples were exposed in the EVT-E1 to vacuum conditions (10^{-5}Pa for either 1h or 1 week), repeated freeze and thaw cycles (–20 to 20˚C for 2 weeks), UV-C (254 nm at 10, 100 and 1000 Jm-^{2}) and total UV (200-400 nm, at 1.5, 1.5x10^3, and 1.5x10^5 kJm^{-2}). In EVT-E2 samples were tested in vacuum plus total UV, and CO_2 Mars atmosphere plus total UV (1.5x10^5 kJm^{-2}). Results on survival of these extremo-tolerant fungi in space and Mars simulated conditions are given.

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