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CAN MARS AND EUROPA BE ENVISIONED AS POTENTIAL SCENARIOS FOR LIFE?

Abstract

Mars and Europa are two of the planetary objects of prime astrobiological importance in the Solar System primarily due to the existence of a vast salty water ocean below the ice crust of Europa, the possibilities to find hydrothermal activity as a source of energy, and the confirmed detection of sulfates dissolved in the water of Europa's ocean. On the other hand, the recent discovery of geological evidences pointing to the existence of salty water running on the surface of Mars, the presence of a mineral rich subsurface, and the knowledge of an ancient wet Mars, are all facts that have raised the question of whether Europa's interior as well as Mars sub-surface may harbor environments favorable for life subsistence. Motivated by these precedents we performed studies aimed to investigate the capabilities of *Cobetia marina*, a moderate halophile, and *Bacillus pumilus*, a halotolerant bacterium, to survive in different conditions that mimic the sub-surface of the planet Mars and the interior of Europa's liquid ocean. We compare the growth rate, and the duplication time of *C. marina*, and *B. pumilus*, when exposed to media exhibiting different water activities determined by the presence of distinct contents of NaCl, MgSO4, CaSO4, Na2SO4, FeSO4, or MgCl2. We characterized, by quantitative proton nuclear magnetic resonance, the compatible solutes accumulated by each one of the selected strains. The results show that both bacteria grew optimally in all the essayed modified media as they can use the adaptation strategy of accumulation of compatible solutes. We identified betaine as the osmoprotectant mainly accumulated by *B. pumilus* in media with low aw, while *C. marina* accumulates betaine, ectoine, and hydroxyectoine depending on the salt content of its environment. So far, no specific values for the salinity on the ocean of Europa or the surface of Mars have been presented. Empirical constraints for Europa based on the Galileo data allow values from 1.1 to 96.8 g of MgSO4 per kg of water. Extrapolating the salt concentration used in our experiments, we have covered an interval of 2.4 to 220.3 g of MgSO4/kg of water. Specific information about Mars surface or sub-surface is needed. Nevertheless our results imply that the selected bacterial strains are perfectly capable of surviving in the actual salty conditions of both planetary bodies. A detailed discussion based on the role of compatible solutes as an osmoadaptation strategy will be presented.