Can bacteria from Mars analogue sites on Earth survive on Mars? - Impact of perchlorates, drought, and radiation in an anoxic atmosphere

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Introduction: On Earth extreme environments are inhabited by a variety of microorganisms adapted to their specific habitat. Such extremophiles are useful model organisms to study the potential survivability of Earth organisms on Mars. Especially the Martian surface is characterised by deleterious environmental parameters, e.g. very low water activity, presence of oxidizing compounds, and high ionizing radiation under anoxic conditions. The survival of bacteria from Mars analogue sites exposed to single and combined Mars relevant parameters under anaerobic conditions was investigated.

Bacterial strains and exposure conditions: The following microorganisms, namely *Buttiauxella* sp. MASE-IM-9 (DSM 105071), *Clostridium* sp. MASE-IM-4 (DSM 105631), *Halanaerobium* sp. MASE-BB-1 (DSM 105537), *Trichococcus* sp. IM-5 (DSM 105632), and *Yersinia intermedia* MASE-LG-1 (DSM 102845) were obtained in the context of the MASE project (EC FP7 project 2014 – 2018, Mars Analoges for Space Exporation, Grant agreement Nr. 607297). The survival was determined after exposure to individual and combined Mars relevant stress factors, i.e. sodium perchlorate up to 4M, desiccation, Martian atmosphere and pressure, and X rays up to 3000 Gy for different periods of time.

Results and conclusions: The selected organisms obtained from extreme anoxic analogue environments on Earth were shown to possess not only a high tolerance against the environmental stresses that occur in their normal habitat, but also exhibit a substantial tolerance to individual and combined Mars relevant stresses, i.e. desiccation, Martian atmosphere and pressure, ionizing radiation, and the presence of perchlorates in a species-specific manner. The observed effects of combined stresses were found to be additive in the case of *Buttiauxella* sp. MASE-IM-9 and *Halanaerobium* sp. MASE-BB-1, and synergistic in the case of *Clostridium* sp. MASE-IM-4 and *Trichococcus* sp. MASE-IM-5. The desiccation step seems to give a relative advantage to cells to cope with other stress factors which could give us clues in the search for live on Mars. Moreover, these MASE strains were even able to grow in the presence of Martian relevant concentrations of Na-perchlorate under anoxic conditions. Therefore, a possible survival in Martian environments, i.e. Martian brines, can be assumed. In conclusion, the tested organisms are good new model candidates for further investigations on the habitability of planet Mars.

References:

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