

From extreme environments on Earth to space: *Buttiauxella* sp. MASE-IM-9 and *Salinisphaera shabanensis* as new model organisms in Astrobiology

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Background

Mars analogue environments are some of the most extreme locations on Earth. Their unique combination of multiples extremes (e.g. high salinity, anoxia, and low nutrient availability) make them a valuable source of new polyextremophilic microbes in general and for exploring the limits of life. These are seen as vital sources of information for Astrobiology, with implications for planetary protection and the search for life outside our planet.

Mars, especially the surface, is still considered very hostile to life. Nevertheless, there are probably geological niches where the occurrence of life is conceivable. Current knowledge on the capability of (facultative) anaerobic microbes as single strains or in communities to withstand Martian conditions is still very sparse. Therefore, space experiments are needed to substantiate the hypotheses of habitability on Mars which is one of the main goals of the project MEXEM (Mars EXposed Extremophiles Mixture). Selected model organisms will be exposed to space in a 3-month passive experiment and survivability will be evaluated after their arrival back on Earth.

Methods and Results

The survivability of two strains originating from extreme environments was investigated after exposure to Mars relevant stress factors: *Salinisphaera shabanensis*, isolated from a deep-sea brine pool within the Red Sea, and of *Buttiauxella* sp. MASE-IM-9, isolated from a German sulphidic spring. Both organisms showed survival after anoxic desiccation up to three months. Survival after desiccation could even reproduced if the cells were mixed, as an artificial community, before desiccation treatment.

The desiccation tolerance could be further extended (nearly doubled) by adding artificial Mars regolith (MGS-1S; 0.5 % wt/vol) and sucrose (0.1 M). The addition of these two components resulted in an elevation of the survival rate after desiccation up to three orders of magnitude in general and for longer time periods. The presence of these two components also influenced the survival after exposure to polychromatic UV (200 - 400 nm) up to 12 kJ/m² in liquid and in a desiccated form positively. To discuss the reasons for this positive change in survivability, different fluorescent-based microscopic techniques were applied.

The survival capabilities of the two strains after Mars relevant stress factors make them valuable new model microorganisms in Astrobiology in general and for space experiments in specific.