Molecular response of *Deinococcus radiodurans* exposed to vacuum conditions of Low Earth Orbit

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Presentation: Poster
Session: VAAM/Space microbiological focus on environmental extremes

Abstract:
The polyextremophile, gram-positive bacterium *Deinococcus radiodurans* is able to withstand harsh conditions of real and simulated outer space environment, e.g., extreme temperature fluctuations, desiccation, UV radiation, and ionizing radiation. A long-term space exposure of *D. radiodurans* has been performed in exposure experiments at low Earth orbit in frames of the Tanpopo orbital mission aiming to investigate the possibility of interplanetary transfer of life. Although it is important to analyse the impact of space environmental factors simultaneously, it is also crucial to investigate these factors separately under controlled conditions in order to decipher fundamental response mechanisms involved. Space vacuum (10^{-4}-10^{-7} Pa) is a harmful factor, which affects microbial integrity. Vacuum induced dehydration is the main process disturbing biological samples exposed to space vacuum and causing severe damage to the cell components: lipids, carbohydrates, proteins, and nucleic acids. However, the molecular strategies by which microorganisms protect their integrity on molecular and cellular levels against vacuum damage are not yet fully understood. In this simulation experiment, performed together with the German Aerospace Centre and team of the Tanpopo orbital mission, we exposed dried *D. radiodurans* cells to vacuum conditions (10^{-4}-10^{-7} Pa) for 90 days and subsequently examined the alterations on protein and metabolite level compared to control samples. Furthermore, an RNA-extraction was performed in order to analyse the rRNA integrity. Apart from the growth rate, which was determined via OD600 measurements, colony forming units were calculated and the rRNA integrity was examined. Molecular analysis was performed on primary metabolite level via GC-TOF and on protein level via LC-Orbitrap. Together with the differences in growth performance, combined comparative analysis of alterations of protein and metabolite levels will help to identify molecular key players in the stress response of *D. radiodurans*, thus elucidating the mechanisms behind its extraordinary regenerative abilities and enabling this microorganism to withstand vacuum stress.