

Microbial ecology of confined habitats and human health (MICHA) – a MARS 500 experiment

Mars 500 is the first ground based full duration simulation of a manned flight to Mars. The study was performed from June 2010 to November 2011 by the Institute of Medical Problems (Moscow) together with ESA and international partners providing a unique opportunity to investigate the influence of confinement on human and environmental microbial communities. The international crew (six members) lived, worked and performed scientific experiments in this closed habitat. One of the scientific experiments is called Microbial ecology of confined habitats and human health (MICHA).

Humans are hosting approximately 10^{14} microbial cells on skin or intestinal which might have a beneficial or harmful effect. Under normal conditions the majority does not cause diseases, but may instead participate in maintaining health. Prolonged confinement of humans might have influences on the selection, development and composition of different microbial populations in closed habitats. It is unclear if commensally pathogens might thrive better, spread and accumulate in the environment. This effect might lead to an increased threat to a weakened person. The conditions and the influence of closed systems on the microbial community were unknown and are not comparable with natural environments.

The aim of MICHA is the survey of the microbial flora in different biotopes from the start till the end (520 days).

Therefore, the microbial load and biodiversity in the air and on surfaces as well as their changes over time were monitored. The cultivation approach showed that the overall microbial load in the air and on different surfaces was moderate compared to other non-confined rooms. Despite the detection of fluctuations in microbial load over time and places, microbial hotspots were identified. Phylogenetic investigations revealed a higher diversity on surfaces than in air indicating the dominance of human-associated microorganisms (e.g. staphylococci). Besides cultivation-based analyses, the microbial inventory was also studied on the molecular level via PhyloChip analysis to quantitatively measure the microbiome. The whole microbiome structure exhibited no significant influence for factor time. However, significantly different microbiome structures were identified for both investigated modules. Furthermore, potentially pathogenic organisms and microbes with degradation capacities were unveiled. Since the majority of microorganisms were not harmful there was no alert and health concern due to potential danger caused by microorganisms.

The collection of bioburden and biodiversity data is essential to develop strategies to maintain a non-hazardous environment for the astronauts during long time manned space missions.