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The microbiome of the International Space Station (ISS)

Petra Rettberg[1], Maximilian Mora[2], Lisa Wink[2], Ines Kögler[2], Alexander Mahnert[2], Petra Schwendner[3], René Demets[4], Charles Cockell[3], Tatiana Alekhova[5], Andreas Klingl[6], Robert Krause[2,7], Anna Zolotariof[3], Alina Alexandrova[5], Christine Moissl-Eichinger[2,7]

[1] German Aerospace Center (DLR), Institute of Aerospace Medicine, Cologne, Germany
[2] Medical University of Graz, Department of Internal Medicine, Graz, Austria
[3] University of Edinburgh, School of Physics and Astronomy, Edinburgh, UK
[4] European Space Research and Technology Centre (ESTEC), Noordwijk, The Netherlands
[5] Lomonosov Moscow State University, Biological Faculty, Moscow, Russia
[6] Ludwig Maximilians University of Munich, Department of Biology I, Biocenter, Planegg-Martinsried, Germany
[7] BioTechMed Graz, Austria

Introduction:
The International Space Station (ISS) is a unique, completely confined habitat for the human crew and co-inhabiting microorganisms. In the experiment EXTREMOPHILES we investigated the microbial bioburden and biodiversity from three surface and air sampling events aboard the ISS during increments 51 and 52 (2017) with respect to: i) microbial sources, diversity and distribution within the ISS, ii) functional capacity of microbiome and microbial isolates, iii) extremotolerance and antibiotics-resistance (compared to ground controls), and iv) microbial behavior towards ISS-relevant materials such as biofilm formation, or potential for degradation.

Methods:
Wipe samples were analysed by amplicon and metagenomics sequencing, cultivation, comparative physiological studies, antibiotic resistance tests, genome analysis of isolates and co-incubation experiments with ISS-relevant materials.

Results:
The major findings were: i) the ISS microbiome profile is highly similar to ground-based confined indoor environments, ii) the ISS microbiome is subject to fluctuations and indicative for the location, although a core microbiome was present over time and independent from location, iii) the ISS selects for microorganisms adapted to the extreme environment, but does not necessarily induce genomic and physiological changes which might be relevant for human health, iv) cleanrooms and cargo seems to be a minor source of microbial contamination aboard, and v) microorganisms can attach to and grow on ISS-relevant materials. Biofilm formation might be a threat for spacecraft materials with the potential to induce instrument malfunctioning with consequences for mission success.

Conclusions:
We conclude that our data do not raise direct reason for concern with respect to crew health, but indicate a potential threat towards biofilm formation and material integrity in moist areas.

Reference:
Mora et al., (2019) Space Station conditions are selective but do not alter microbial characteristics relevant to human health, Nature Communications 10:3990, https://doi.org/10.1038/s41467-019-11682-z

IMPORTANT: I am holding a PhD degree since more than 3 years.