Bacterial plasmid transfer under space flight conditions: the Mobilisatsia experience

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Background. Microorganisms are subject to a genetic evolution, which may lead to the capacity to colonize new environments and to cause infections. Central players in this evolutionary process are mobile genetic elements (phages, plasmids and transposons). The latter help to mobilize and reorganize genes, be it within a given genome (intragenomic mobility) or between bacterial cells (intercellular mobility). Confined environment and space flight related factors (such as microgravity and cosmic radiation) may influence the frequency with which mobile genetic elements are exchanged between microorganisms. Aim. Within the frame of the Mobilisatsia experiment a triparental microbial plasmid transfer was promoted aboard the International Space Station (ISS). The efficiency of the plasmid exchange process was compared with a synchronously performed ground control experiment. An experiment was carried out with well-characterized Gram-negative test strains and one experiment was done with Gram-positive test strains. Results. The experiment took place during the Soyouz Mission 8 to the ISS from April 19th until April 30th 2004. Liquid cultures of the bacterial strains Cupriavidus metallidurans AE815 (final recipient) , Escherichia coli CM1962 (carrying a mobilisable vector with a nickel-resistance marker) and E. coli CM140 (carrying the Broad Host Range plasmid RP4) (for the Gram-negative experiment) and Bacillus thuringiensis (Bti) AND931 (carrying the conjugative plasmid pXO16), Bti 4Q7 (with mobilisable vector pC194 carrying a resistance to chloramphenicol) and Bti GBJ002 (final recipient) (for the Gram-positive experiment) were transferred to two separate RECOMB-K bioreactors. The hardware was packed and sent under cooled conditions to the ISS. The plasmid transfer was promoted by incubating the hardware at 30 °C and mixing the bacterial strains at a specific timing. Afterwards, the experiment was stored at 4 °C until retrieval. It was observed by culture-based methods that plasmid exchange between the Gram-positive bacterial strains was at least a factor 10 more efficient in the space flight experiment than in the ground control experiment. For the Gram-negative bacteria, no significant differences could be observed between space flight and ground control. Conclusion. The experiment indicates that microorganisms exchange genetic information under space flight conditions

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