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Abstract Title:
Bacillus subtilis biofilm formation under simulated microgravity – a multi-methodological approach

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Microbial II: Biofilms

Abstract:
Gravity is the most consistent physical parameter to which all life has so far been subordinated and has not changed from the beginning of evolution to the present day. Since Apollo 16 the Gram-positive bacterium *Bacillus subtilis* has been used to study the influence of gravity on vegetative cells, spores and biofilms and still it remains unclear to what extent biofilm formation is influenced by the loss of gravity. As a model, *B. subtilis* can be used to investigate the intrinsic resistance of biofilms under space conditions. Biofilms are a challenge in medicine and in industry and with increasing space activities and manned long-term missions or even moon bases, new insights into the behavior of biofilms under altered gravity conditions are becoming increasingly important. We used *B. subtilis* NCIB 3610 as spore and biofilm-forming model organism as well as biofilm deficient mutants to investigate the influence of simulated microgravity (sim-µg) on structural and resistance properties. For the simulation, a fast-rotating 2-D clinostat was used in combination with a standardized method for growing and harvesting biofilms on filter membranes to achieve highly reproducible results. By comparing biofilm growth under normal gravitational conditions (1g) and sim-µg, the results of profilometry showed no significant changes in biofilm topography. Scanning electron microscopic images of biofilm cross-sections and transmission microscopic analyses showed differences in the internal biofilm structure. Typical biofilm properties such as matrix development in the basal regions of biofilms were increased in sim-µg. Growth and resistance properties of biofilms grown under sim-µg showed small differences, but hydrophobicity values were significantly increased under simulated microgravity. Spores isolated after sim-µg treatment showed homogeneous germination behavior in contrast to 1g spores and tended to germinate more spontaneously.