Adhesion profiles and viability of *Staphylococcus aureus* cells on structured surfaces

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Understanding and controlling microbial adhesion is an important biomedical problem. While it is known that adhesion is mediated by thermally fluctuating cell wall macromolecules [1], many properties, such as the distribution of adhesive strength over the cell wall, are still unknown. In addition, it is still unclear how different materials and their natural or artificial structuring affect bacterial adhesion and viability. Here, we use a combination of single-cell force spectroscopy (SCFS) and wet plating to determine the adhesion and viability of *Staphylococcus aureus* on structured surfaces. The resulting ‘adhesion profiles’ in SCFS, force-distance curves, can be interpreted with the help of Monte Carlo simulations: By changing the parameters in the simulations, different phenomena can be decoupled, for example, the mechanical stretching of macromolecules from the area accessible for bacterial adhesion. We find that simple geometric considerations of accessible bacterial surface area are insufficient to explain the adhesion profiles. Rather, angle dependent molecule-substratum interactions are responsible for ‘bathtub’-like adhesion profiles. Furthermore, several distinct spots of high adhesion capability are responsible for peaked adhesion profiles, corroborating the view that a bacterium can be seen as a ‘patchy sphere’.

[1] Christian Spengler, Erik Maikranz, Ludger Santen and Karin Jacobs, Front. Mech. Eng., 7:661370 (2021).