Gut bacteria adhesion investigated by interfacial rheology

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Bacteria adhesion layers are highly complex biological assemblies composed of bacterial cells embedded in an extracellular polymeric matrix. Such bacteria layers are ubiquitous and may cause severe environmental and health problems but also protect and support the gut flora during digestion. Therefore it is intriguing to understand the influence factors on formation and destruction of bacteria layers [1 - 3]. In this contribution, we study the initial kinetics of bacterial attachment as well as the transient layer formation of model bacteria at the oil/water interface mimicking the gut mucosa layer through interfacial rheology and tensiometry. Electrophoretic mobility measurements and bacterial adhesion tests were performed to characterize selected bacteria. To validate the interfacial rheology measurements, we monitored layer formation by adhesion assay using intestinal epithelial surface molecules for a set of model organisms present in the human gastrointestinal tract, confocal laser scanning microscopy, and light microscopy. Using this combination of techniques, we were able to observe the interfacial tension and elasticity development over time, from the first bacterial attachment up to layer formation as depicted in Figure 1 [4].

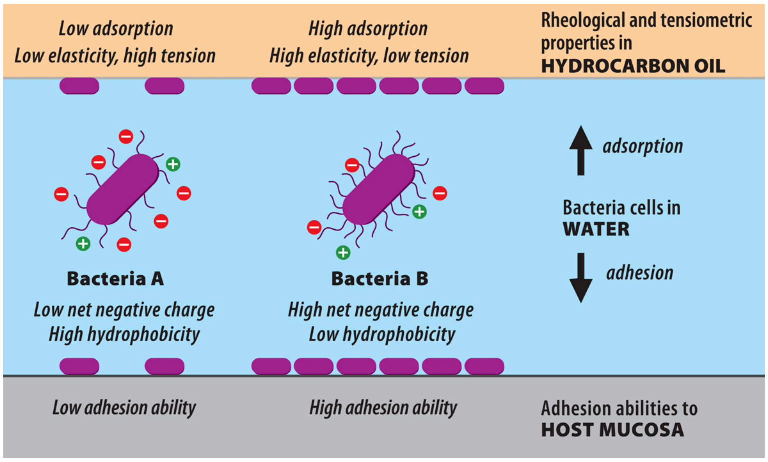

Figure 1: Summary of bacterial adhesion. The capacity of bacteria to adhere is a function of physico-chemical charges and surface properties of the bacteria. Through bacterial adsorption at a hydrophobic interface, the interfacial elasticity increases and interfacial tension decreases. These parameters can be used to quantitative measure the physico-chemical properties of different bacterial strains and to predict bacteria's potential to adhere to biological surfaces like the intestinal mucosa.

Interfacial rheology proved to be a valuable tool for studying bacteria adhesion layers as the influence of temperature, media type, bacterial strain, pH, and surfactant concentration could be observed successfully during their formation. The results of both interfacial rheology and interfacial tension measurements are fully in line with microbiological adhesion assays and support our claim to use them as non-destructive methods to study the mechanical properties of bacteria adhesion layers.

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