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Probing Microbial Interactions with the Mucus Barrier

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Mucus is a biological gel that lines all wet epithelia in the body, including the mouth, lungs, and digestive tract, and has evolved to protect us from pathogenic invasion. Microbial pathogenesis in these mucosal systems, however, is often studied in mucus- free environments, which lack the geometric constraints and microbial interactions that are found in natural, three-dimensional mucus gels. To bridge this gap, my laboratory has developed a model test systems based on purified mucin polymers, the major gel-forming constituents of the mucus barrier. We use this model to understand how the mucus barrier influences bacterial virulence, and moreover, to elucidate strategies used by microbes to overcome the normal protective mucus barrier. I will discuss data showing that the mucus environment has a significant impact on the physiological behavior of microbes, including surface attachment, quorum sensing, the expression of virulence genes, and biofilm formation. The picture is emerging that mucins are key host players in the regulation of microbial virulence and are critical to consider when studying mucosal pathogenesis. Our work may also be the basis for the design of synthetic gels that mimic the basic selective properties and virulence-neutralizing capacity of mucus gels.