

The Ability of Salmonella Bacteria to Penetrate Mucus Barriers

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Using data found in the Schroeder et al.'s (2020) study of gastrointestinal mucus antibodies and the motility of *Salmonella Typhimurium* in the mucus, we observe how the positions of *S. Typhimurium* bacterial cells in mouse intestinal mucus change over time. The mucus in this study was treated with Immunoglobulin G (IgG) that binds specifically on one side to the unique lipopolysaccharide (LPS) present in *S. Typhimurium*'s cell wall, and on the other side to the glycoproteins in the mucus (aka mucins). It is expected that as time passes the antibodies bind to (one or multiple) bacterial cells and stop the movement of the bacteria due to the large mass as well as the bindings to the mucins. This expectation may (partly) end up unmet because *S. Typhimurium* has flagella to propel them in the mucus and may break the bacterium-antibody-mucin links. By tracking the positions of the bacteria in mucus over time, we hope to find the average speed of the bacteria, as well as possibly a regression between time and average velocity. The bacteria can be sorted into three groups based on their movement patterns-- "Swimming", "Hindered", or "Immobilized" (Schroeder, et al., 2020). In this project, we will seek to identify which of these 3 groups tracked bacteria fall into and using the speed of the "swimming" bacteria, we will model the time required for a bacteria cell to cross the mucus barrier and then find what proportion of bacteria will cross the barrier.

The overall goals for this project are as follows:

- Find the average speed of bacteria in mucus
- Sort the bacteria into one of three groups based on their movement. (Swimming, Hindered, Immobile)
- Find the average speed of bacteria in each group
- Predict mean first passage time for bacteria to cross the mucus barrier

Works Cited

Schroeder, H. A., Newby, J., Schaefer, A., Subramani, B., Tubbs, A., Forest, M. G., . . . Lai, S. K. (2020). LPS-binding IgG arrests actively motile *Salmonella Typhimurium* in gastrointestinal mucus. *Mucosal Immunology* (13), 814-823. <https://doi.org/10.1038/s41385-020-0267-9>