Microfluidic Analysis of E. coli Thermotaxis

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Thermotaxis, the directional motion of an organism towards specific temperatures, has been observed in several species of bacteria. Quantitative studies of thermotaxis in bacteria however have been complicated by the lack of tools to generate stable temperature gradients and to select for motile bacteria. In this study, the microfluidic device that was designed during the previous year was created with polydimethylsiloxane (PDMS), producing stable linear profiles of temperature across a 500µm gradient channel for the migration of motile cells. In addition, a special H-filter was incorporated into the design to separate flagellated E. coli cells from the non-flagellated bacteria. The stability of the temperature gradient along the gradient channel was assessed spectrophotometrically, incorporating a buffer-dye system consisting of a temperature dependent buffer that changes pH with varying temperature and a pH dependent florescent dye. Utilizing this device, it was observed that E. coli can change their thermal response in the presence of different concentrations of glycerol and methionine. High concentrations of glycerol promoted a peak of bacterial swarming near 37°C in contrast to lower concentrations which shifted the preferential temperature to around 32°C. In contrast, Methionine was shown to increase the number of recorded E. coli and promoted a stronger peak of bacterial activity. The microfluidic analysis presented in this study demonstrates quantitative data on a high-throughput of flagellated E. coli cells that had sufficient time to explore the temperature gradient and arrive at a preferential temperature. Moreover, the experiment was done over a long period of time to ensure only a few cells would enter the imaging zone per analysis.

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