The Development of a Microfluidic Device to Assess the Thermotaxis of Bacteria

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Thermotaxis, the directional motion of an organism towards specific temperature gradient, has been observed in several species of bacteria. However, quantitative studies of thermotaxis in bacteria have been complicated by the lack of tools to generate a stable temperature gradient. In this study, a microfluidic device was designed for the generation of stable linear profiles of temperature across a long gradient channel. The channel was made from polydimethylsiloxane (PDMS) which formed a narrow environment of 500μm for cells to migrate from side to side with respect to specific current speeds. Moreover, the channel allowed mobile cells to be motile and thermotaxis to be readily observed. In addition, a special H-filter was incorporated into the design to separate flagellated cells from the entire population. To assess the stability of the temperature gradient along the gradient channel, a buffer-dye system was utilized. In this system, a temperature dependent buffer was prepared that changes its pH with varying temperature. As the pH of the buffer changes, the color intensity of the hydroxypyrene trisulfonic acid (HPTS) dye also changes. By assaying spectrophotometrically the color intensity of dye over the width of the gradient channel, and correlating these results with known temperature and pH values for the buffer, it is possible to analyze the temperature gradient and to generate quantitative data. The presented technology can be applied to studies of thermotaxis in various bacteria like E. coli.