A molecular brake for the bacterial flagellar nano-motor

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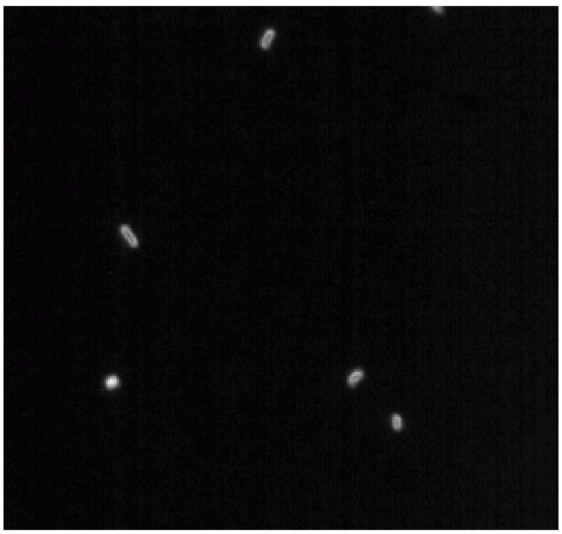

Dark-field microscopic movie of swimming E.Coli bacteria. (Click 'Enlarge').

Researchers at the University of Basel, Switzerland, have discovered that *Escherichia coli* bacteria harness a sophisticated chemosensory and signal transduction machinery that allows them to accurately control motor rotation, thereby adjusting their swimming velocity in response to changing environments. The research results that were published online in *Cell* on March 18, 2010, may foster the development of novel strategies to fight persistent infections.

Bacteria can swim through liquids at speeds up to 30 times their body length per second. It has been known for a long time that different bacterial species swim at different speeds, but it was not known if this is a species specific trait and if bacteria can actively adjust their velocity.

The research team from Switzerland and Germany, led by Alex Böhm and Urs Jenal from the Biozentrum has now discovered that *E. coli*, and probably many other bacteria can actively regulate their swimming velocity.

This behaviour is governed by a molecular motor-brake protein that upon binding of the bacterial second messenger cyclic dimeric GMP interacts with a specific subunit of the flagellar nano-motor and thereby curbs motor output. The intracellular concentration of cyclic dimeric GMP is controlled by a network of signaling proteins.

When bacteria are faced with nutrient depletion this network is actived, produces more cyclic dimeric GMP and triggers motor-brake engagement. Because slow swimming enhances the probability of a bacterial cell to permanently attach to surfaces, this behaviour might prime bacteria to switch into a sessile life style.

Colonization of epithelial surfaces in the human host can lead to the formation of antibiotic tolerant and immune system resistent ‘biofilms’ that are the basis of many chronic bacterial infections. Thus, understanding the molecular basis of surface colonization and biofilm formation may foster the development of novel strategies to fight persistent infections. In addition, the discovery of flagellar motor curbing could be exploited for biotechnological applications, for example to engineer nanopumps in microfluidics or to build cell-based microrobots.

More information: Alex Boehm, et al., Second Messenger-Mediated Adjustment of Bacterial Swimming Velocity. *Cell* (2010); doi:10.1016/j.cell.2010.01.018

Provided by University of Basel