Scientists reveal why tummy bugs are so good at swimming through your gut

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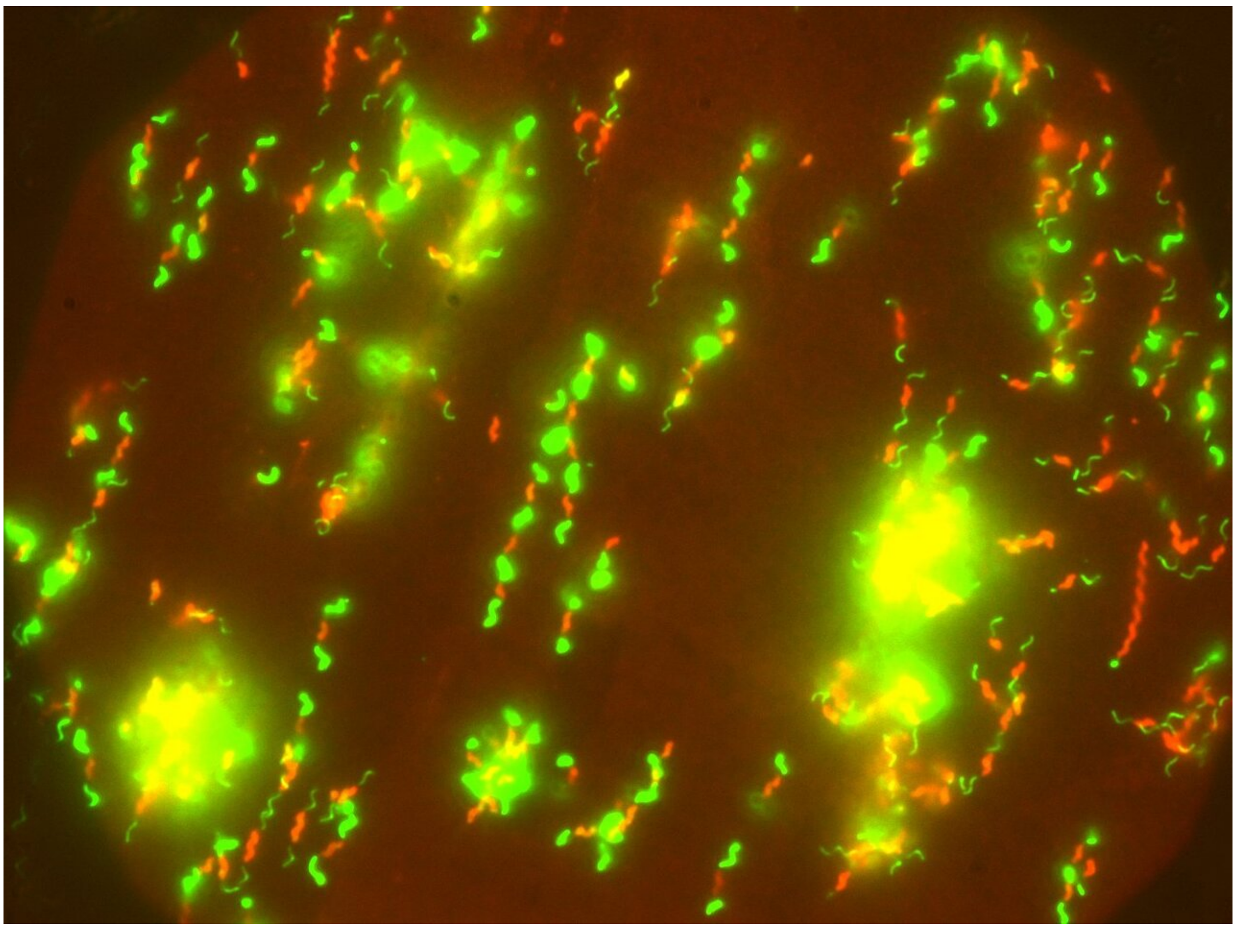

C. Jejuni cell bodies (red) and flagella (green). Credit: Eli Cohen / Imperial College London

Researchers have solved the mystery of why a species of bacteria that causes food poisoning can swim faster in stickier liquids, such as within guts.

The findings could potentially help scientists halt the bacteria in its tracks, because they show how the shape of the bacteria's body and the components that help it swim are all dependent on each other to work. This means any disruption to one part could stop the bacteria getting through to the gut.

Campylobacter jejuni is responsible for millions of food poisoning cases every year, and a key step in its invasion of the body is swimming through the viscous (sticky) mucous layer of the guts. Researchers have observed that *C. jejuni* swims faster in viscous liquids than in less-viscous liquids, like water, but until now they didn't know why.

Now, researchers from Imperial College London, Gakushuin University in Tokyo and the University of Texas Southwestern Medical Center have filmed *C. jejuni* in action to uncover the mystery. Their results are published today in *PLOS Pathogens*.

C. jejuni uses its two opposing tails, called flagella, to help it move. It has a flagellum at each end of its body that spin around to propel itself through liquid. However, the opposing flagella have confused scientists.

Co-first author Dr. Eli Cohen, from the Department of Life Sciences at Imperial, said: "It seemed very strange that the bacteria had a tail at both ends—it's like having two opposing motors at either end of a ship. It was only when we watched the bacteria in action that we could see how the two tails work cleverly together to help the bacteria move through the body."

The team created *C. jejuni* strains that have fluorescent flagella and used high-speed microscopy to see what happened as they swam around. They discovered that to move forward, the bacteria wrap their leading flagella around their helically shaped bodies, meaning both flagella were then pointing in the same direction and providing unified thrust.

To change direction, they changed which flagella were wrapped around their body, enabling quick 180 degree turns and potential escape from confined spaces.

They also found that the process of wrapping the flagella was easier when swimming through viscous liquids; the stickiness helping push the leading flagella back around the body. In less-viscous liquids neither flagella were able to wrap around the body.

Lead researcher Dr. Morgan Beeby, from the Department of Life Sciences at Imperial, said: "Our study kills two birds with one stone: in setting out to understand how *C. jejuni* moves, we resolved the apparent paradoxes of how it swims in one direction with opposing flagella and how it swims faster in more viscous liquid.

"As well as solving some long-standing mysteries, the research could also help researchers find new way to prevent infection by *C. jejuni*, by targeting any of its interconnected structures that help it move around."

The research also revealed that the helical shape of the bacteria body is crucial for allowing the flagella to wrap around it, showing how the two components are reliant on each other. This adds to the team's previous work showing how parts of the 'motor' that drives the flagella are co-dependent, and that none would work without the others.

More information: Campylobacter jejuni motility integrates specialized cell shape, flagellar filament, and motor, to coordinate action of its opposed flagella, *PLOS Pathogens* (2020). DOI: 10.1371/journal.ppat.1008620

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