Hide-and-seek: In some landscapes an effective strategy against predatory bacteria

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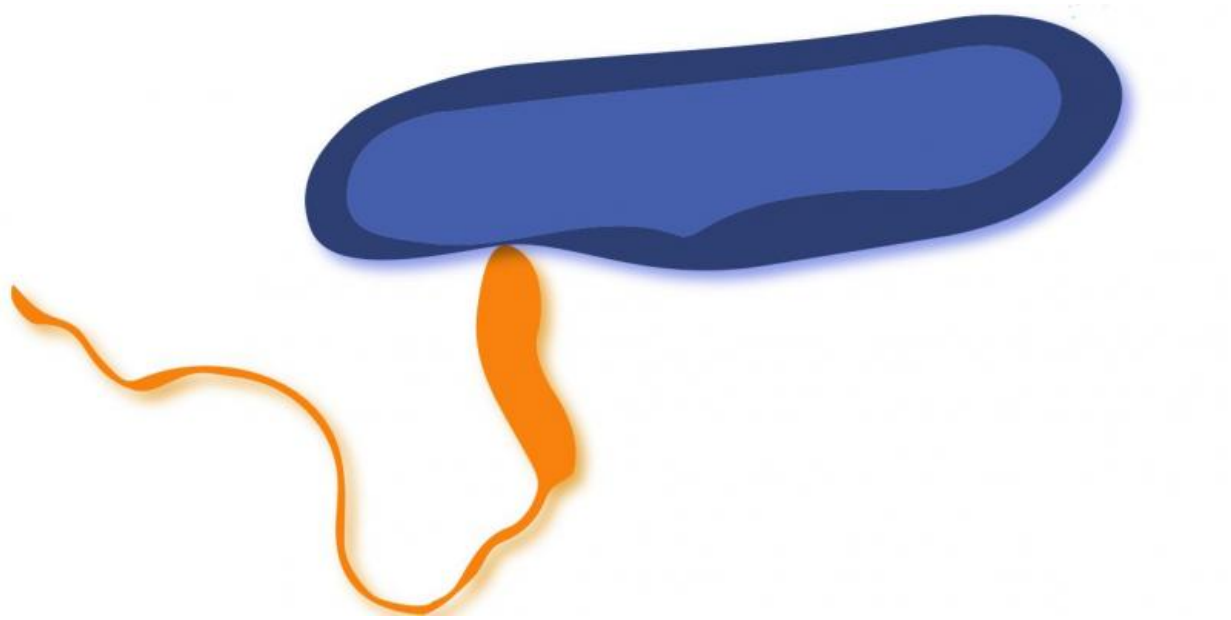

Credit: Delft University of Technology

Predators and prey can be found across the tree of life, even among bacteria. *Bdellovibrio bacteriovorus* is one such bacterial predator, and an efficient killer of the prevalent E. coli bacterium. This bacterial predator enters its prey and devours it from the inside while dividing into four or six progenies. The predator bacteria then burst open their prey and start their hunt for the next. B. bacteriovorus is present in soil, and just like its prey E. coli, it can also be found in our gut. In order to understand how

E. coli is able to survive in the presence of such an effective predator in natural environments, scientists from the Kavli Institute of Nanoscience at TU Delft (The Netherlands) together with colleagues from the Hebrew University of Jerusalem (Israel), studied the struggle in different environments. E. coli did not stand a chance in 'open space', but it maintained a surprisingly large population in an environment with many small chambers.

An article by the researchers will be published on Wednesday 10 February in the *Proceedings of the Royal Society B.* The research is an important contribution to understanding the behaviour of predatory bacteria. In addition, predatory bacteria could become a possible alternative to antibiotics in the future.

85 chambers

In order to study the struggle between predatory bacteria and their prey, the researchers created two environments for the bacteria. "The first one consists of 85 chambers, each 100 x 100 x 15 micrometres in size, linked by narrow channels. The second one is an open space of a similar size. In the open environment, which can be compared to a bare open space, E. coli did not stand a chance to survive. The entire population was eliminated within a couple of hours," Hol explains. Hol, who has extensive experience in creating micro-environments for bacteria, worked on this research with Dr Daniel Koster, an expert on predatory bacteria.

Fighter jet

It is not so surprising that E. coli cannot survive in an open environment. Bdellovibrio bacteriovorus is a formidable opponent: Apart from being an efficient killer, it is also extremely fast. "B. bacteriovorus is a champ

when it comes to speed swimming and is able to swim ten times as fast as E. coli. Although the bacterium itself is hardly one micrometer long, it can reach speeds of 160 micrometers per second. While that might not sound very impressive, on a human scale it's the equivalent of a fighter jet," says Felix Hol.

Hiding in the corners

Surprisingly, a population of E. coli was able to survive in the fragmented environment. "One possible explanation is that E. coli does this by recolonizing spaces where the predatory bacterium has been present, by moving into them from an adjacent space. However, we believe this may not be the dominant effect. It seems more likely that groups of E. coli 'hide' in the many corners of the fragmented environment, where they cluster into biofilms. We know that bacteria in biofilms secrete a wide variety of substances, and this probably helps to protect them against B. bacteriovorus. Our findings provide important information because in natural environments (e.g. in our gut) the bacterium also lives in fragmented spaces."

Programmable antibiotics

While it is not yet known in detail how E. coli is able to defend itself against predatory bacteria, it is an important question in terms of dealing with harmful bacteria. Dr. Daniel Koster: "In the future, we might be able to modify predatory bacteria to specifically target harmful bacteria, while leaving beneficial bacteria untouched. The advantage of such bacteria over antibiotics is that they don't cause a the widespread eradications of the gut flora that is of importance to human health." Using predatory bacteria might in the future constitute a viable alternative to these antibiotics, against which bacteria are increasingly developing resistance. Knowledge of the defence mechanisms of

bacteria is therefore crucial.

More information: Bacterial predator–prey dynamics in microscale patchy landscapes, *Proceedings of the Royal Society B*, DOI: 10.1098/rspb.2015.2154

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