Abstract

Bdellovibrio bacteriovorus is a small Gram-negative bacterium that parasitize and kill other Gram-negative bacteria, including human pathogens, e.g. *Escherichia coli* or *Pseudomonas aeruginosa*. The *B. bacteriovorus* cell is asymmetrically arranged with a flagellum at one cell pole and a pilus at the other (the invasive pole). The intriguing life cycle of this predator consists of two phases: in the free-living, non-replicative attack phase this highly motile bacterium searches for its prey and enters to the cell periplasm; in the growth phase *B. bacteriovorus* degrades the host's macromolecules to form its own cell structures. Inside prey's periplasm predatory bacterium formes long filament and when the resources of the host cell are exhausted, the elongated cell synchronously septates to form odd or even number of progeny cells.

Due to its ability to kill Gram-negative pathogens, *B. bacteriovorus* is considered as a potential "live antibiotic". However, extensively research on the detailed understanding of the life cycle of this bacterium is carried out using only *E. coli* as the prey cell. If *B. bacteriovorus* will be used as an antibacterial "agent", its life cycle should be examined during proliferation in various Gram-negative pathogenic bacteria.

In this work, for the first time, it was demonstrated that *B. bacteriovorus* reproduces through both binary and non-binary fission and switching between the two modes correlates with the prey size. In small prey cells *B. bacteriovorus* undergoes binary fission; the FtsZ ring assembles in the middle of the filament and the mother cell splits into two progeny cells. In larger prey cells, *B. bacteriovorus* switches to non-binary fission and creates (at least two) multiple, asynchronously assembled FtsZ rings to produce three or more daughter cells. Completion of *B. bacteriovorus* life cycle critically depends on precise spatiotemporal coordination of chromosome replication with other cell-cycle events, including cell division. It was showed that *B. bacteriovorus* always initiates chromosome replication at the invasive pole of the cell but the choreography of further steps depends on the fission mode and the number of progeny cells. In non-binary dividing filaments producing five or more progeny cells, the last round(s) of replication may also be initiated at the former flagellar pole.

In summary, this research provides new insights about *B. bacteriovorus* life cycles. Depending on the size of the prey cell, this predator divides in a binary or non-binary fission. Moreover, the size of the prey cell and the number of daughter cells shape the choreography of the chromosome replication process.