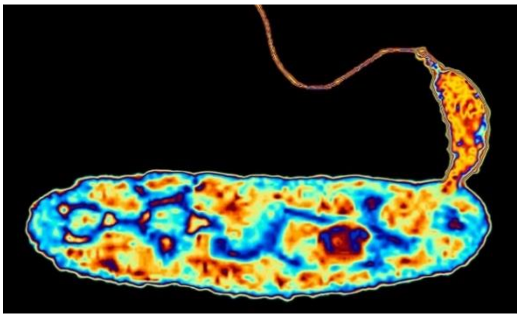
The SMALTIS'tory – episode #8

CanniBALO Bacteria



Once upon a time there were bacteria eaten by... other bacteria.
It was in 1962, at the Institute of Bacteriology in Berlin, that the German microbiologist Heinz Stolp fortuitously put the first species responsible for bacterial cannibalism in the air.

Looking to isolate anti-*Pseudomonas* bacteriophages, he ran out of the filters he used to obtain his phage solutions and decided to replace them with larger ones. After inoculation of the bacteria with the solutions and incubation of the Petri dishes, no lysis was observed. But Stolp kept the plates for two more days and later lysis plaques appeared. Their microscopic observation revealed the presence of small curved bacteria moving at high speed, sometimes attaching themselves to certain bacteria... until they were destroyed.

Thus was discovered *Bdellovibrio bacteriovorus*, the first species of *Bdellovibrio And Like Organisms* (BALO), a polyphyletic group of small, highly mobile Gram-negative cannibalistic bacteria that ensure their survival by driving out other Gram-negative bacteria. Their inability to biosynthesize at least nine amino acids makes them obligate specific predators.

Widely distributed within the biosphere, BALOs are found in waters and wetlands, as well as in animal and human faeces.

It is from the 2000s onwards, faced with the emergence of multi-resistant bacteria to antibiotics, that their study began to really take off. The development of genomic technologies has led to advances in the knowledge of their physiology and cell cycle.

This cycle begins with an attack phase in which the non-replicating bacteria have a vibrio type form, maintained by the MreB2 protein. Its unique flagellin, composed of six types of flagellin, as well as three pairs of MotAB motor proteins, give it high motility. It then detects its prey by chemotaxis and then attaches itself irreversibly to their membrane.

Then, the predatory strategy adopted is either epibiotic or periplasmic. Epibiotic, the predator remains attached to the envelope of its prey, destroying it while remaining in the extracellular space. The cannibal then multiplies in a binary way. The second strategy consists in invading the periplasmic space of the prey via a local lysis of the cell envelope. The prey then constitutes a protective and nutritional niche for the predator, which develops in the form of a long polynucleotide filament, the bdelloplast. After septation, the later gives rise to several individualized cells. The prey is finally lysed, releasing the mobile predators.

This broad-spectrum cannibalism and the remarkable ability of BALOs to adapt to the environment give them a key role in the balance, diversity, and resilience of ecosystems.

These predators are also serious candidates in the fight against bacteria in aquaculture, but also in agriculture and medicine.

Indeed, their inability to multiply in cell cultures, combined with low inflammatory power, justifies major therapeutic prospects. Moreover, natural or even acquired resistance to these predatory bacteria has appeared infrequently. Moreover, BALOs can also attack Gram-positive bacteria when they have sufficient time to adapt to these preys. They are also capable of disintegrating, probably in connection with certain exotic cell proteases, complex biofilms consisting of mixed prey. In humans, a multicentre study also revealed a clear deficit in the digestive carriage of *B. bacteriovorus* in several types of patients with Crohn's disease, celiac disease, or ulcerative colitis. In parallel, work has highlighted the safety of these predators and their *in vivo* efficacy in animal models.

The BALOs could thus pave the way for new synergistic probiotic and antibacterial approaches or alternatives to antibiotics.

To be continued...