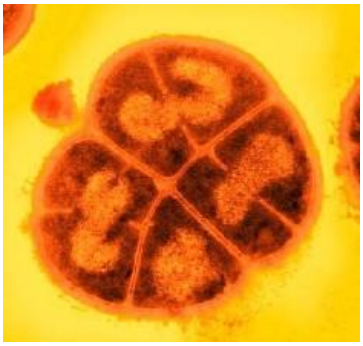
The SMALTIS'tory – episode #7

Conan the Bacterium



Once upon a time there was a canister sterilized by ionizing radiation, which revealed a new bacterial species.

We are then in 1956 at the Oregon Agricultural Experiment Station, when the American Arthur Anderson noticed something interesting after having massively irradiated with gamma rays a can of corned beef, that its contents were spoiled. That's how Anderson discovered the existence of the bacterium *Deinococcus radiodurans*, the Greek prefix Deinos meaning "strange, unusual".

It turned out that this bacterium was a true champion of survival, because in addition to its resistance to a high level of radioactivity, it defies UV light, hydrogen peroxide, high and low temperatures, vacuum, desiccation, not to mention the absence of food.

But what is the secret of "Conan the Bacterium"?

Firstly, let's dive into the heart of its genome. Polyploid, meaning present in several copies in each cell, it is made up of two circular chromosomes, a megaplasmid and a small plasmid. It contains repeated sequences and many genes coding for enzymes that detect and repair DNA damage. These enzymes contribute to the incredible resistance of *D. radiodurans* to various forms of stress. Indeed, the bacterium has an extraordinary network of mechanisms for the reparation of DNA repair, which was described in 2006 by Miroslav Radman's team. In the first step, the destroyed parts of DNA are reconstituted from the remaining DNA fragments and thanks to polyploidy. When chromosomes are broken down into thousands of fragments, the latter can be reassembled through their complementarity. DNA polymerase I then synthesizes new strands from the free ends of the new fragments. This enzyme uses as a template the complementary DNA of an overlapping fragment belonging to another genomic copy in the same cell. These neosynthesized "sticky bits" then reassociate by binding to the contiguous fragments. In the second step, the RecA protein gathers the long DNA fragments by homologous recombination, allowing the reconstitution of the degraded chromosomes.

Another particularity of *D. radiodurans* was highlighted in 2010. The team led by Michael Daly showed that manganese was very present in this species. In the form of an orthophosphate complex, it is involved in the protection of proteins against free radicals. In addition, this element is essential to the enzyme Mn-Superoxide Dismutase, which reduces the level of these harmful radicals. The protection of proteins against oxidative stress generated by extreme conditions may therefore play a decisive role in the bacterium's survival.

The resistance mechanisms put in place by *D. radiodurans* coupling DNA repair and protein protection thus give the bacterium an extraordinary ability to resuscitate a few hours after its genetic material has been reduced to 20-30 kb segments.

A machine that could prove very promising for various fields such as regenerative medicine or the clean-up of nuclear sites...