

The SMALTIS'tory – episode #5

Ants as inspiration to fight against antibiotic resistance!

Once upon a time, there were South American ants, called *Attina*, which for millions of years have harboured bacteria in the folds of their cuticle and exocrine glands, in return for their protection against "parasites".

But why was this mutualistic relationship established?

The *Atta cephalotes* ants, in order to feed, bring waste to the nest in which they allow the moulds they feed on to grow. Unfortunately, a mould of the genus *Escovopsis*, which is toxic, can sometimes come and parasitize these crops, destroying the food resources of the ants. To remove this scourge, they then found a solution by offering a habitat to actinobacteria, in exchange for their ability to synthesize anti-*Escovopsis* molecules.



Thus, bacteria of the genus *Pseudonocardia* synthesize dentigerumycin, nystatin P1, and gerumycin A, B, and C, and *Streptomyces* produce candididin and antimycin, compounds that inhibit unwanted mold.

Interestingly, even after several million years, *Escovopsis* does not appear to have developed lasting resistance to these molecules. But how is this possible? Is there a real co-evolutionary arms race behind this?

It turns out that *Pseudonocardia* and *Streptomyces* produce different variants of the anti-*Escovopsis* compounds, thanks to the presence in their genome of several clusters of genes coding for these antimicrobials.

Moreover, over time, these clusters have evolved through genetic rearrangements or mutations in response to the emergence of resistance in *Escovopsis*.

In addition, rather than rapidly eliminating all moulds, the bacteria simply contain their growth.

Thus, *Pseudonocardia* and *Streptomyces* constantly co-evolve with their host, and it is subtly, over time, that bacterial strains vary and adapt, leading to the formation of a balanced cocktail of antimicrobials for the right inhibition of contaminating molds.

One of the keys to deal with the global challenge of antimicrobial resistance could be to draw inspiration from these strategies adopted by the mutualist bacteria of the fungus ants.