GULBENKIAN CIÊNCIA

PRESS RELEASE

How are the interactions between bacteria, host and vector regulated?

October 2nd, 2020 – Researchers discover how bacteria act together to activate the necessary factors to infect their hosts and their vectors. The study published in the journal **mBio**, from **American Society for Microbiology**, reveals that the bacterium *Erwinia carotovora* uses a quorum sensing mechanism both to activate the degradation of plant tissues and colonize the gut of the vector insect. This discovery is particularly relevant to understand the strategies employed by bacteria during the transmission between hosts in the context of vector-borne diseases.

Many insects contribute to the spread of pathogenic microorganisms among different hosts. In these triangular interactions, microorganism, vector and host influence each other, directing the system to an end that can be beneficial for some but detrimental for others. Such is the case of bacteria that infect plants and use insects as vectors. Bacteria from the genus *Erwinia*, in particular, depend on insects to spread between plants and cause the soft rot disease (characterized by the softening/rotting of the plant tissues), which affects many crops around the world. The bacterium *Erwinia carotovora* interacts with each of its hosts through the production of different factors. When infecting plants, like the potato plant, produces proteins that degrade the stiff cell wall, softening the tissues and allowing their invasion. On the other hand, when infecting one of its vectors, the fly *Drosophila melanogaster*, triggers the expression of virulence factors that allow the transient colonization of the gut. Previous studies showed that, during plant infection, this bacterium monitors its cell density and activates the expression of proteins that soften the tissues in response to quorum sensing. **Quorum sensing** is a specific type of cell communication, used to synchronize gene expression in bacterial populations according to their cell density.

Given the importance of quorum sensing for the interaction of the bacterium *Erwinia carotovora* with plants, researchers from Instituto Gulbenkian de Ciência (IGC) aimed at understanding if it was also crucial for the interaction with the insect vector *Drosophila melanogaster*. “We found that the strategies employed by this bacterium to infect its vector are activated according to the population density in response to the molecules of quorum sensing. Like this, the expression of the necessary factors for the interaction with the vector are independent of its presence, suggesting an anticipatory strategy that should favour a stronger interaction between the bacterium and the vector”, explains **Filipe Vieira**, main author of the study.

"Despite the need of different factors for this bacterium to interact with each host, we saw that when it reaches its quorum in the plant, both the plant and insect virulence factors are activated even in the absence of the insect. We think that this kind of simultaneous regulation is important for the transmission between different hosts", explains **Karina Xavier**, IGC principal investigator and head of the team that conducted this research. **Luís Teixeira**, co-author of the study, adds that "this might be a mechanism that allows bacteria to anticipate and prepare to infect insects that are attracted by the rotting tissues of the plants."

The focus on the interaction between the bacterium and the vector insect also showed that the result of this confrontation can be more negative than previously thought. "More than damaging the intestine as previously described by others, we observe that it also causes a developmental delay during vector development, which can completely prevent the adult from being formed", explains **Filipe Vieira**. This is a consequence of the activation of repair mechanisms by the insect, putting its own development on hold to gain time to repair what was damaged. "In order to not compromise its spread, it's important for the bacteria to regulate their genes in a precise and controlled way as well as the damage they cause to the vector, or they will incur the risk of not spreading at all. Now we finally understand which quorum sensing mechanisms they employ to achieve this", adds the researcher.

This study highlights the idea that, throughout evolution, organisms can reuse the same regulation pathways to activate new functions, used in different contexts, like the example of this bacterium and its ability to infect different hosts. A better understanding of the genetic regulation behind these phenomena can reveal a lot more similarities and propel new global strategies to prevent vector-borne diseases.

This study was developed at Instituto Gulbenkian de Ciência. Funding was provided by Fundação para a Ciência e Tecnologia (FCT) and Marie Skłodowska-Curie fellowships, together with support from Programa Operacional Regional Lisboa 2020.

Original Paper: Vieira FJD, Nadal-Jimenez P, Teixeira L, Xavier KB. 2020. *Erwinia carotovora* quorum sensing system regulates host-specific virulence factors and development delay in *Drosophila melanogaster*. **mBio**.

DOI: https://doi.org/10.1128/mBio.01292-20.

For more information

Ana Morais
Institutional Communication Coordinator
@: anamorais@igc.gulbenkian.pt
Telm.: +351 965 249 488