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Study explores evolution of bacteria that can be used to fight dengue

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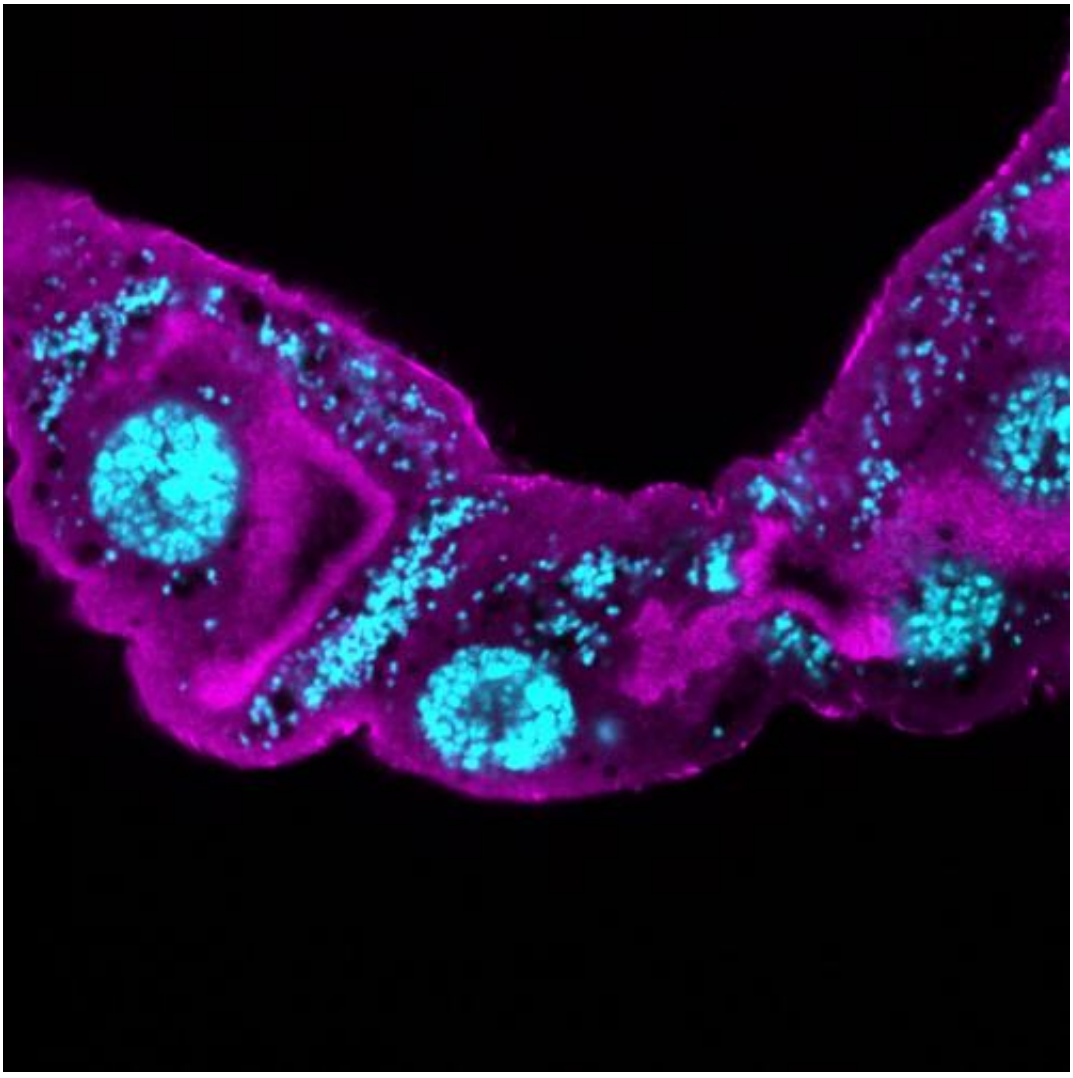

This shows the organ of the fruit fly *Drosophila melanogaster* infected with the *Wolbachia* bacteria (blue speckles). Credit: Luís Teixeira (IGC)

Wolbachia, a symbiont that resides naturally up to 70% of all insect species, are probably the most prevalent infectious bacteria on Earth. In 2008 Luis Teixeira, now a principal investigator at the Instituto Gulbenkian de Ciência (IGC, Portugal), and other scientists have discovered that *Wolbachia* can protect their hosts against viral infections. Since then, several studies have been made to further investigate the interactions between *Wolbachia* and insects, aiming to build new strategies to use this bacterium in the control of diseases transmitted by mosquitoes, such as dengue. Now, Luis Teixeira's research team studied the genetic variability of *Wolbachia* strains and discovered that bacteria that give stronger protection against virus grow to higher concentrations and often shorten the host's lifespan. These results help to understand *Wolbachia* evolution in nature and open the way to the identification of the best strains to be used in the biocontrol of mosquito-spread diseases. This work was published in the latest issue of *PLOS Genetics*.

Since the beginning of the 20th century, different lines of fruit flies are being collected and analysed in laboratory, which allowed the identification of five strains of *Wolbachia*. Nowadays, the strains that are more predominant are not the same that existed in the beginning of the past century, even though the later still endure. Luis Teixeira's team proposed to study these five *Wolbachia* strains and see how they behave in terms of antiviral protection.

The researchers tested the mortality of fruit flies upon infection with two viruses, the Drosophila C virus and the Flock House virus. As expected, all flies carrying the different variants of *Wolbachia* survived better than flies that did not have *Wolbachia*. But the researchers found that some variants conferred higher protection to the viral infection than others. Next, the research team investigated whether the *Wolbachia* variants could have a "biological cost" to the fruit flies in the absence of a viral infection. Their results showed that the variants that give stronger antiviral protection replicate more and reach higher concentrations in the

fly than other *Wolbachia* strains. As a result, fruit flies that carried some of the more protective *Wolbachia* strains would have a shorter lifespan. These results suggest that there is a cost for the host organism when infected with bacteria that offer stronger protection against viruses.

Based on genetic studies, the research team established the phylogeny of *Wolbachia* strains, and found that that the most protective strains were more closely related to the most abundant ones in the beginning of the 20th century. The strains that currently exist are less protective but more benign to their host, the fruit fly, allowing them longer lifespan. Furthermore, analysis of the DNA sequences allowed the identification of putative genes that may play a role in *Wolbachia* replication and protection to viruses.

Ewa Chrostek, PhD student at Teixeira's laboratory and first author of this study, says: "We found that some of the most protective *Wolbachia* variants reduce the survival of their hosts, suggesting that there may be a trade-off between the protection mediated by the symbiotic bacteria and other components of fitness. Altogether, we can understand better how *Wolbachia* are evolving in nature."

Luís Teixeira adds: "Our findings can feed into the research that is currently being done to disrupt dengue transmission between people by introducing in nature mosquitoes infected with *Wolbachia*. By knowing better the genetic variability of the *Wolbachia* variants, a more effective strain can be used in this biocontrol strategy. Moreover, this work helps to predicted the evolution of *Wolbachia* in these altered mosquito populations."

More information: Chrostek E, Marialva MSP, Esteves SS, Weinert LA, Martinez J, et al. (2013) Wolbachia Variants Induce Differential Protection to Viruses in Drosophila melanogaster: A Phenotypic and Phylogenomic Analysis. *PLoS Genet* 9(12): e1003896. DOI:

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