Defensive bacterial symbionts of fruit flies attack ribosomes of parasitic wasps

July 6 2017

A female parasitic wasp (*Leptopilina heterotoma*) inserts her ovipositor into a *Drosophila* larva. She will lay an egg in its body cavity. Credit: Michael Martin, Reed College/National Science Foundation

Bacteria of the *Spiroplasma* genus produce toxic, ribosome-inactivating proteins (RIPs) that appear to protect their symbiotic host flies against parasitic wasps, according to new research published in *PLOS Pathogens*.

Spiroplasma bacteria were already known to protect some *Drosophila* flies against parasitic roundworms and wasps that lay their eggs inside the flies. In fact, they are just one example of many microbial symbionts that defend their hosts against enemies. However, the mechanisms of such defense are poorly understood.

In an earlier study, Finn Hamilton and Steve Perlman of the University of Victoria, Canada, and colleagues showed that the *Spiroplasma* strain found in *Drosophila neotestacea* protects the fly against roundworms and produces an RIP that attacks and disables the parasite's ribosomes. In the new study, Perlman and Matt Ballinger, also of the University of Victoria, investigated whether *Spiroplasma* RIPs also attack wasps.

Ballinger and Perlman exposed *D. neotestacea* and *D. melanogaster* (the common fruit fly) to three parasitic wasps. Some of the flies were infected with species-specific strains of *Spiroplasma*, and some were not. In *Spiroplasma*-infected flies, molecular analysis of the wasps' ribosomes revealed key signs of RIP attack. The encounter with *Spiroplasma* was deadly in two of the three wasp species; the third, a parasitic wasp that develops outside of the host's body, was not significantly affected.

Further testing showed that *Spiroplasma* RIPs attack wasp ribosomes immediately after the wasps hatch from eggs laid inside an infected fly. The researchers also showed that flies suffer very little collateral damage to their own ribosomes from *Spiroplasma* RIPs.

The genome of the *Spiroplasma* strain that infects *D. melanogaster* contains genes for five different types of RIP. In the new study, Ballinger and Perlman found that the genome of the strain that infects *D.*

neotestacea possesses similar RIPs, as well as two RIP genes that are not shared with the *D. melanogaster* strain. "The symbiont has figured out how to target two dissimilar parasites without harming its host," says Ballinger. "We want to know how it does this, and we think an important clue is that *Spiroplasma* strains are collecting lots of different toxin genes in their tiny genomes." This diversity could explain why *Spiroplasma* protects against roundworms in *D. neotestacea* but not in *D. melanogaster*.

Further research could explore the role of toxins in other protective symbiotic relationships and investigate how toxin diversity may contribute to the evolution of symbiont defense against specific parasites.

More information: Ballinger MJ, Perlman SJ (2017) Generality of toxins in defensive symbiosis: Ribosome-inactivating proteins and defense against parasitic wasps in Drosophila. *PLoS Pathog* 13(7): e1006431. doi.org/10.1371/journal.ppat.1006431