Flies that fight off parasites produce offspring with greater genetic mix

Infections may lead organisms to diversify their next generation's DNA.

Richard Hodson

13 August 2015

Female fruit flies that fall sick produce offspring more genetically diverse than those of healthy flies, researchers have found.

Dahlia Nielsen/NC State University.

A female fruit fly.

The discovery, published on 13 August in *Science*,[1] fits with a long-standing biological principle: faced with a harsh environment — such as heat[2] or lack of food[3] — organisms tend to produce offspring with greater genetic variety, so as to give at least some of them a better chance of surviving the threat in future.

Bacterial or parasitic infection might have the same effect. But until now, biologists had only found tentative evidence[4] for the idea.

A team led by Nadia Singh, a biologist at North Carolina State University in Raleigh, deliberately infected female fruit flies (*Drosophila melanogaster*) with a variety of bacterial strains before allowing the survivors to mate. They found that the resulting fly offspring were more likely to have experienced an event called genetic recombination, in which genes are shuffled between chromosomes, than were the progeny of healthy flies. This shuffling occurs when egg cells are first being created. (It does not occur when male fruit flies make sperm).

Exactly why infected fruit-fly offspring end up with more shuffled DNA is unclear, Singh says. The effect occurs in offspring born from eggs already present in the parent fly before it became infected — so it is not simply a case of the infection driving increased gene-swapping during egg development.

Shuffling the deck

Instead, it is possible that, in the event of infection, existing eggs that happen to have experienced greater recombination are more likely to produce a viable embryo — for reasons unknown. “We have a lot of experiments planned for that in the future,” says Singh.

One of the most surprising aspects of the work, Singh adds, was what happened when fruit-fly larvae were exposed to the parasitic wasp *Leptopilina clavipes*. These wasps lay an egg inside the fruit-fly larva’s body cavity. The egg later hatches and eats its way out — unless defeated by the fly’s immune system. Even when the flies became infected in this manner, at the larval stage — before the females' ovaries had fully developed — researchers still saw greater genetic variation in the eventual offspring of the survivors.

It is unclear how an infection this early on in the fly's life cycle could create a signal that leads to increased genetic diversity in the offspring, says Singh. “We really have absolutely no idea what the signal could be,” she adds.

“The study provides a major step forward in our understanding of the evolutionary process,” says Nick Priest, a biologist at the University of Bath, UK, who studies how genetic variation brought on by stress may underpin evolution[5].

Parent flies who are good at fighting off infections, Priest points out, have a greater probability of passing on that strong immune system to their offspring — which means these progeny could run the risk of losing advantageous genes by genetic recombination. So Priest expects that it is the sickest flies — those that struggle to fight infection — which would be most likely to mix up the genes of their offspring. “That is the next crucial test,” he says.

Singh says that there is no reason that the effect should be unique to fruit flies. “We want to know whether other species do this, because it represents a novel way that parents can influence the potential fitness of their offspring,” she says.

References

1. Singh, N. D. *et al*. *Science* **349**, 747–750 (2015).
2. Stern, C. *Proc. Natl Acad. Sci. USA* **12**, 530–532 (1926).
3. Neel, J. V. *Genetics* **26**, 506–516 (1941).
4. Fischer, O. & Schmid-Hempel, P. *Biol. Lett.* **1**, 193–195 (2005).
5. Zhong, W. & Priest, N. K. *Behav. Ecol. Sociobiol.* **65**, 493–502 (2011).