When Do Mosquitoes Prefer A Blood Banquet, Or A Sugar Feast? Three Genes Make The Call

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Entomologists have isolated three key genes that determine when female mosquitoes feed on blood and when they decide to switch to an all-sugar diet to fatten up for the winter.

David Denlinger, professor of entomology at Ohio State University, hopes this discovery will lead scientists to other genes that help the mosquitoes survive cold weather – in particular, those genes related to how insects handle the West Nile Virus when they enter a kind of hibernation.

Denlinger and Rebecca Robich, a former doctoral student at Ohio State and now a research fellow at the Harvard School of Public Health, published their findings in the online edition of the Proceedings of the National Academy of Sciences.

Only female mosquitoes draw blood, and only females survive the winter. Proteins in the blood they suck from humans and other animals enable the mosquitoes to produce eggs, and the sugars – which they eat in the form of rotting fruit or nectar – let them double their weight in fat so they can survive without food until the next spring.

Though researchers have long known about this diet change, this is the first time anyone has determined exactly why it happens. As the days begin to get shorter, two genes that code for digesting blood switch off,

and a different gene for digesting sugar and retaining fat switches on.

“Normally mosquitoes are out taking blood from you and me, but when they're programmed to begin this hibernation phase we call diapause, the blood response shuts down. They can't tolerate a blood meal at that time. They switch completely to sugar, so that's a pretty dramatic metabolic shift,” Denlinger said. “Then they spend the winter in culverts and caves, and basements of houses.”

These three genes are the first big discovery to come out of Denlinger's relatively new mosquito research program; his students ventured into the Columbus city sewers in September of 2000, to collect larvae of a local variety of Culex pipiens – a mosquito known to carry the West Nile Virus – and established a colony of this “Buckeye strain” in the lab.

They reared the colony with 15 hours of light a day. Then they made half of the adult females enter diapause by switching them to nine hours of light a day to mimic early autumn conditions.

Denlinger and Robich compared the genes expressed in the normal females to the ones that had entered diapause. After only a few days in short-light conditions, the mosquitoes that had entered diapause stopped expressing two genes for blood digestion, and started expressing one for sugar digestion and fat retention.

“We are just beginning to understand the genes that regulate diapause,” Denlinger said. “There are other genes that we are looking at, and we want to find the ones that signal the switch from one state to another. The genes for these digestive enzymes provide a kind of marker, so you can detect whether an insect is in diapause, but I think other genes are the ones that cause diapause to begin.”

Understanding these genes is important, he said, because scientists

suspect that mosquitoes have some genetic trick for controlling the West Nile Virus when they enter diapause.

“There are suggestions that the virus survives through the winter, inside the bodies of these females,” he said. “When the mosquito goes dormant, we think something in its body causes the virus to go dormant, too. The virus stops replicating, then starts replicating again in the spring when the mosquito leaves dormancy.”

Whether scientists could use this information to manipulate mosquito populations to control the spread of West Nile will take years to find out, he added.

Source: Ohio State University

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