Odd smell: Flies sniff ammonia in a way new to science

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The stink of ammonia in urine, sweat, and rotting meat repels humans, but many insects find ammonia alluring. Now, UConn researchers have figured out how the annoying insects smell it, a discovery that could lead

to better ways to make them buzz off.

The sense of smell is enormously important. Mammals devote a third of their genetic code to odor receptors found in the nose, and have more than 1,000 different kinds that allow us to smell an estimated trillion different odors.

Flies don't have noses. Instead, they smell with their antenna. Each antenna is covered with tiny hairs called sensilla. Each sensilla contains a few neurons—fly brain cells. Each neuron expresses one type of odor receptor, and they all fall into two main classes—or so scientists thought.

But recent work by UConn neuroscientist Karen Menuz and her colleagues, reported online in June in *Current Biology*, identified a new type of odor neuron devoted to sniffing ammonia, and the receptor it uses is unlike any other odor receptor known.

Flies and other insects use the scent of ammonia to find food sources. Mosquitoes find humans to bite by following the faint scent of ammonia in our sweat, along with other clues. Many crop pests do the same, locating fruit and agricultural products to infest and consume. "When an odor binds to a receptor, the cell depolarizes, and sends a signal saying 'hey, the odor is here!' Insects are small, and odors come in plumes, so most insects will fly straight as long as the concentration is the same or growing. If they lose the odor plume, they'll do a casting behavior, flying in zig zags to find it," Menuz says.

Knowing exactly how the insects smell ammonia might yield effective ways to block them from following that scent plume—and from finding us and our crops.

But figuring out exactly how and what a fly smells is tricky. Menuz and her colleagues are able to gently hold a fly down and use incredibly fine

pieces of glass to probe individual neurons in sensilla on the fly's antenna. Then they let the ammonia waft.

They probed all three types of scent neurons in the flies' sensilla, but they didn't respond to ammonia. But the fly was obviously smelling it. So the researchers realized there had to be a fourth scent neuron they hadn't known was there. And they found it—but it didn't seem to have the usual odor receptors on it. It was covered in ammonia transporter (Amt) a molecule that is known to allow ammonia in and out of cells.

No one had ever known a transporter molecule to also act as an odor receptor. But there it was. When they selectively killed off only that type of neuron, the flies did not respond to ammonia at all. And when the team forced scent neurons that don't normally respond to ammonia to express Amt on their surfaces, those neurons began responding to ammonia, too.

The team hopes to learn whether mosquitoes use the same system to smell ammonia. If it's used by both mosquitoes and flies, it's a good bet the Amt receptor-as-sniffer is used by all insects, and developing ways to block Amt could be an effective way to protect people and crops from pests attracted to ammonia.

More information: Alina Vulpe et al, An ammonium transporter is a non-canonical olfactory receptor for ammonia, *Current Biology* (2021). DOI: 10.1016/j.cub.2021.05.025

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