

# Bacterial protein acts as aphrodisiac for choanoflagellates

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United States researchers investigating how single-celled organisms evolved to become multicellular stumbled across a strange phenomenon during their experiments: Single-celled eukaryotes called choanoflagellates, which are the closest living relatives to animals, begin to sexually reproduce in response to a protein produced by bacteria. Why this happens in natural settings is still unclear, though they speculate that

it could help the choanoflagellates easily mate with others from the same species. The finding is presented August 31 in the journal *Cell*.

Choanoflagellates are a collection of protists that are used as model organisms for investigating the evolutionary origin of animals. University of California, Berkeley and Harvard Medical School researchers were studying how certain [bacteria](#) influence multicellular development in the unicellular choanoflagellate *Salpingoeca rosetta* when they observed the unexpected side effect.

"We knew that this bacterium, *Vibrio fischeri*, did not induce multicellular development, which made it a great negative control" says co-senior author Nicole King, a cell biologist and geneticist at Berkeley. "But when we looked right away after adding the bacteria, we saw a very strange swarming behavior. And it turned out that this was a prelude to mating."

Swarming among unicellular organisms often precedes sexual reproduction because it rapidly increases population density in a small area, whereas it would be much rarer for two choanoflagellates to spontaneously encounter each other and mate under normal conditions. The researchers used genotyping to ascertain that mating, rather than just "stickiness" or cell fusion, was occurring, confirming a change from asexual to sexual behavior.

"Choanoflagellates have a lot of flexibility in their life history. They can go on and on being asexual, but here we're showing that they can be sexual, and that the switch to sexuality is regulated by a bacterial cue," says King. "In the animal world, a molecule that induces or elicits [sexual behavior](#) can reasonably be called an aphrodisiac."

*S. rosetta* and *V. fischeri* are both marine organisms, encountering each other in the same ocean habitats. The researchers showed, in fact, that

even low environmental levels of the bacteria (400 cells per milliliter) were sufficient to induce swarming and mating by the choanoflagellates. Furthermore, that behavior could be traced to the activity of a specific protein constantly secreted by the bacteria, a protein that they dubbed EroS in reference to the Greek god of sex.

"I was certain that it would be a small molecule, like sex pheromones in sea anemones or something along those lines. So when we discovered it was a large protein, that was a big shock," says co-senior author Jon Clardy, a chemical biologist at Harvard Medical School.

Investigating further, the researchers showed that EroS is a chondroitinase, an enzyme that degrades a specific type of sulfated molecules found in the extracellular matrix of *S. rosetta* that was previously thought to be exclusive to animals. They also found that if this enzymatic function was inhibited, then swarming did not occur, while chondroitinases from other aquatic bacteria reproduced the aphrodisiacal effects.

Looking forward, the researchers plan to investigate the finer molecular points of how chondroitinases such as EroS induce mating. They also point out that the ability to use EroS to spur mating opens up a whole new level of experimental control in probing the cell biology of choanoflagellates.

Both authors also reflect on the serendipity of the project as one of its more rewarding aspects. "So much now, we write grant proposals, or write papers, or teach students how to do science, and it looks very cut-and-dry and very-planned ahead. To spot something odd that could be interesting and have it turn out like this, that is not all that usual in how we do research day-to-day," Clardy says.

**More information:** *Cell*, Woznica et al.: "Mating in the closest living

relatives of animals is induced by a bacterial chondroitinase"

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