Using flies to understand how pregnancy drives food cravings

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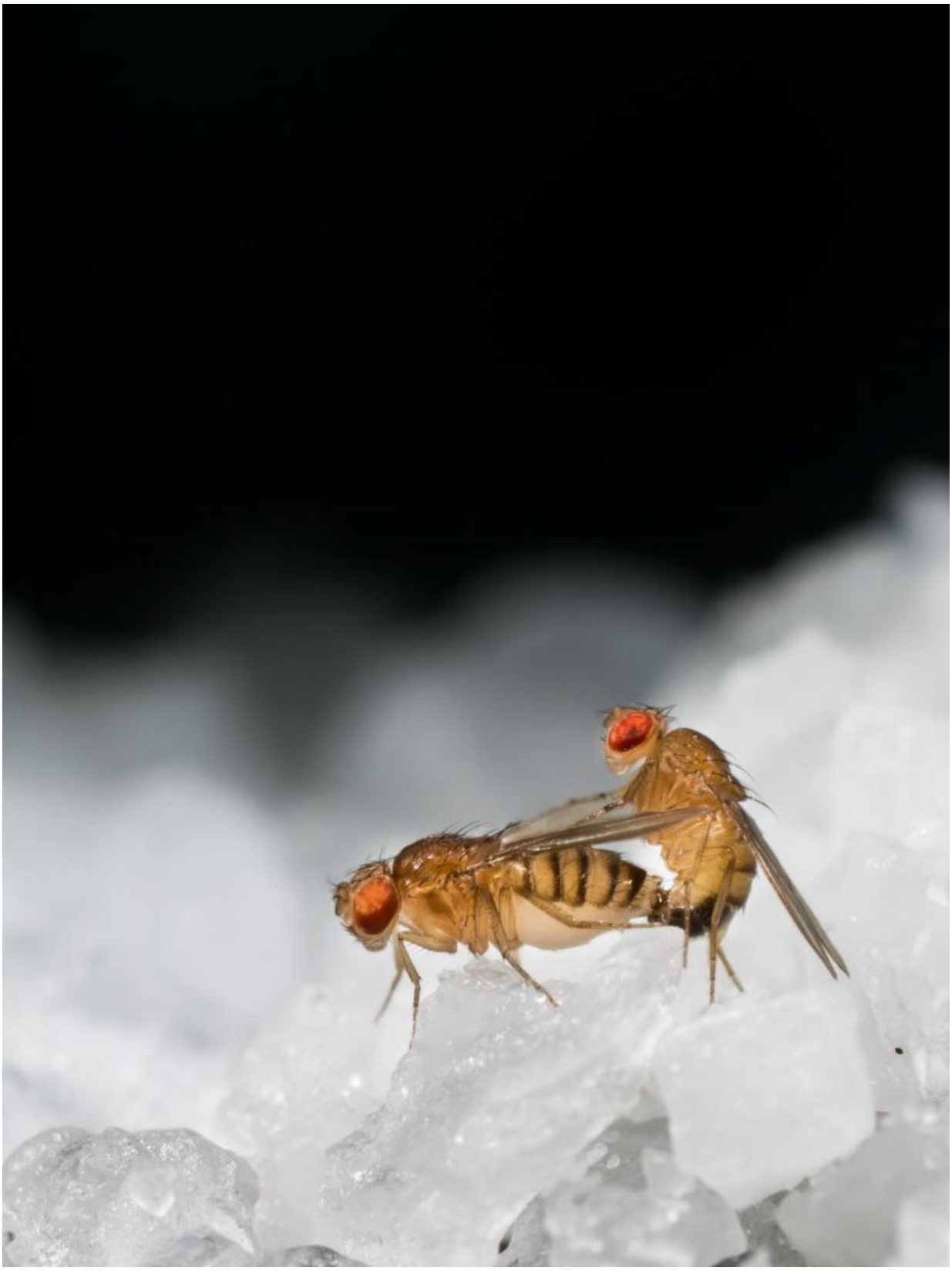

Researchers at the Champalimaud Centre for the Unknown in Lisbon discover that fruit flies share the human craving for salt during pregnancy and shed light on how the nervous system controls this behavior. Credit: Francisco Romero

Researchers at the Champalimaud Centre for the Unknown in Lisbon discovered that fruit flies share the human craving for salt during pregnancy and shed light on how the nervous system controls this behaviour. The study is published today, September 24th in the scientific journal *Current Biology*.

Pregnancy is famed to inspire relentless food cravings in women, who will allegedly stop at nothing until they get the food they desire, be it a grilled cheese sandwich, olives, or ice-cream on a cold winter night. It is commonly believed that these cravings are not just arbitrary whims, but are linked, at least to some extent, to the nutritional needs of the foetus their bodies are nurturing. This is particularly true for nutrients such as proteins and salt.

What changes in the brain during pregnancy cause food cravings? More specifically, how does the brain know what the body needs and then, what changes in the brain's perception of the world lead women to seek out certain foods during pregnancy?

To pursue the answers to these challenging questions, the team of Carlos Ribeiro at the Champalimaud Centre for the Unknown in Lisbon, chose to study the neural basis of changes in nutrient intake in female fruit flies after mating.

"Nutrition is a highly complex topic. To understand how the brain regulates nutrient intake, you need to work in an organism that gives you access to a lot of diverse technologies. In that respect, the fruit fly is

unbeatable," says Dr. Ribeiro. "We wanted to exploit these tools to uncover how the female fly's food preferences changed after mating. Many mammalian species increase their preference for salt during pregnancy; but until now it was not known if the fruit fly shared this behaviour."

Following a series of experiments, the researchers revealed, for the first time, not only that flies indeed share mammals' inclination towards salt during pregnancy, but also that higher salt levels in the diet result in higher production of offspring.

"We found that there is a direct correlation between the amount of salt in the diet and the amount of eggs they were able to produce," explains Dr. Ribeiro. "It seems that salt is important everywhere, from flies, to elephants, to humans. It also suggests the existence of unifying biological principles underlying this behaviour that could be traced across species."

Surprisingly, even though different levels of salt directly influenced offspring production, the researchers discovered that the salt craving was not based on the precise needs of the body. On the contrary, "even if their egg production was disabled, mated females showed increased salt preference, demonstrating that salt-craving was independent of the actual needs of the body," says Dr. Ribeiro.

It appears that the brain of the female knows that she will need more salt to produce eggs and so it automatically changes the way the animal perceives salt to allow the animal to ingest higher amounts of this important nutrient. Just as in humans, the "tongue" of the flies becomes much more responsive to the taste of salt, leading her to prefer saltier food. The key question now was: "What is the biological mechanism that leads to this change in salt sensation in pregnant animals?"

According to Samuel Walker, the PhD student in the Ribeiro lab who

was the main researcher of this study, during mating the male injects a molecule called Sex Peptide into the female which manipulates the taste perception of the female. "The molecule activates neurons in the uterus of the female. From there, we found that a short chain of neuronal interactions signals the brain to ´dial up the salt preference.'"

By piecing together this complicated puzzle, the researchers were able to demonstrate that salt-craving exists in flies much as it does in mammals, and that this craving plays an important role in their reproductive abilities. They were also able to identify the trigger for salt-craving and map several steps in the neural circuitry that brings about this behavioural change. "Now", concludes Dr. Ribeiro, "we move on to the next question, which is to identify how the brain's response to salt changes after mating to bring about this cross-species behaviour. We will continue using the fruit fly, an organism that is unbeatable in its array of genetic tools, which will be essential to understand a topic as complex as nutrition."

More information: Walker SJ, Corrales-Carvajal VM, Ribeiro C. (2015). Postmating circuitry modulates salt taste processing to increase reproductive output in Drosophila. *Current Biology*. DOI: 10.1016/j.cub.2015.08.043

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