Mosquito behavior may be immune response, not parasite manipulation

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This is a micrograph of a mature oocyst of a malaria parasite. Credit: Read Group, Penn State

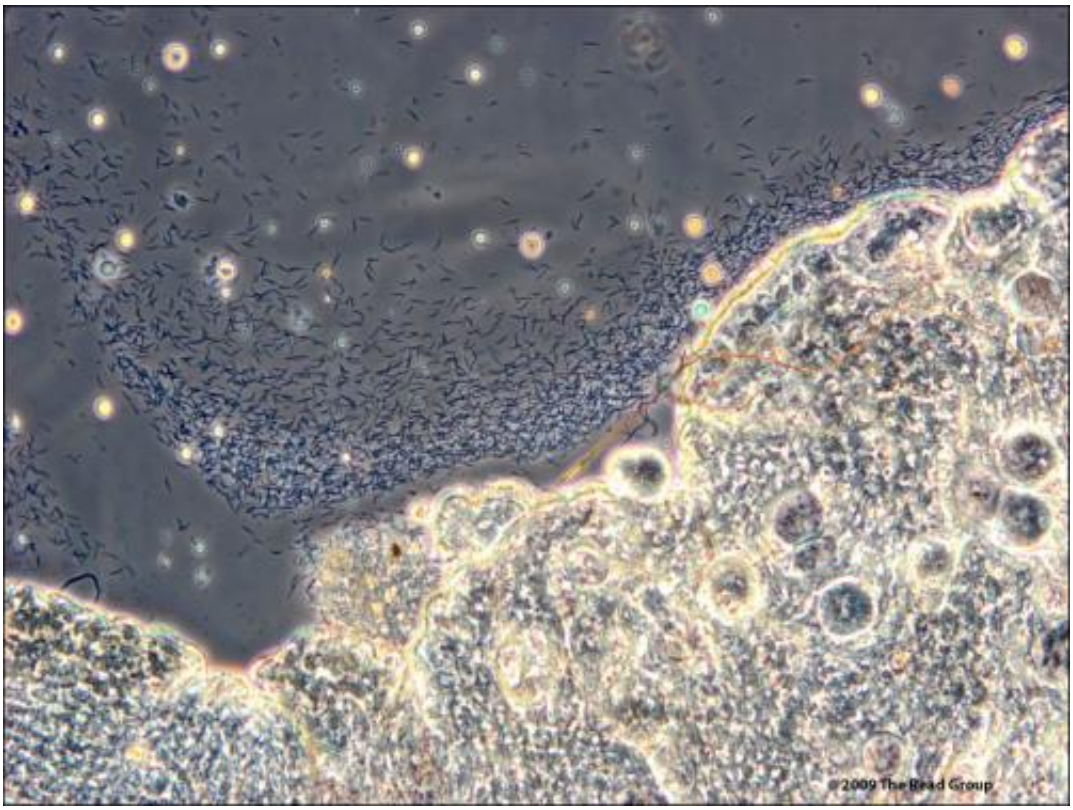
Malaria-carrying mosquitos appear to be manipulated by the parasites they carry, but this manipulation may simply be part of the mosquitos' immune response, according to Penn State entomologists.

"Normally, after a female mosquito ingests a blood meal, she matures her eggs and does not take another one until the meal is digested," said Lauren J. Cator, postdoctoral fellow in entomology and a member of the Center for Infectious Disease Dynamics, Penn State. "If infected, however, mosquitos will wait to eat until the parasites developing within the gut mature and migrate to the salivary glands."

It was thought that fasting until malaria could be transmitted was beneficial to the malaria parasite because if the female mosquito was not feeding, she was not being swatted. The return of hunger seemed to correlate with the migration of parasites to the salivary glands. The hungrier the mosquitos are, the more they feed and the more chances to find new hosts.

Cator and colleagues who included Justin George, postdoctoral fellow; Simon Blanford, research associate; Courtney C. Murdock, postdoctoral fellow; Thomas C. Baker, professor of entomology; Andrew F. Read, professor of biology and entomology and alumni professor in biological sciences; and Matthew B. Thomas, professor of entomology, used a mouse model and showed that indeed female mosquitos behaved in this way.

It was unclear if the malaria parasite caused the mosquitos' response or if something else was in play. The researchers also looked at how the infected mosquitos searched for meals and how they responded to the smell of humans. Although the mosquitos used were biting mice, they also look to humans for a meal.



This is a micrograph of malaria sporozoites being released from a mosquito salivary gland. Credit: Read Group, Penn State

George ran the experiments testing the mosquito's sense of smell during various stages of parasite maturity and found that the mosquitos responded to human smell much more readily once the parasites were ready to transfer to their hosts. The same was found of the meal-seeking behavior of the mosquitos.

The researchers dissected the insects to determine the exact stage of the parasite in each mosquito they tested and what they found surprised them. They published their results in the *Proceedings of the Royal Society B* today (May 22).

"There were mosquitos that took an infected blood meal, but didn't get

infected or fought off the infection," said Cator. "These mosquitos behaved in the same way as the infected mosquitos."

The researchers then injected mosquitos with killed *E. coli* to see the response. While the degree of fasting and food seeking was smaller, the noninfected, *E. coli*-challenged mosquitos behaved in the same way. They fasted for about the same time and then went searching for a meal. Their responses to human smell and meal searching behavior also mirrored that of malaria-infected mosquitos.

"Recently, a group from the Netherlands published in *PLOS* and while they were only looking at the mature parasites in the salivary glands, they found the same response to human odor," said Cator. "This supports that the response is a generalized response to a challenge rather than a manipulation by the malaria parasite and that our findings are probably relevant for human malaria transmission."

More information: 'Manipulation' without the parasite: altered feeding behaviour of mosquitoes is not dependent on infection with malaria parasites: rspb.royalsocietypublishing.or … .1098/rspb.2013.0711

Provided by Pennsylvania State University

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