Certain gut microbes make mosquitoes more prone to carry malaria parasite

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Dietary sugars and gut microbes play a key role in promoting malaria parasite infection in mosquitoes. Researchers in China have uncovered evidence that mosquitoes fed a sugar diet show an increased abundance

of the bacterial species Asaia bogorensis, which enhances parasite infection by raising the gut pH level. The study appears April 20 in the journal *Cell Reports*.

"Our work opens a new path for investigations into the role of mosquito-microbiota metabolic interactions concerning their disease-transmitting potential," says co-senior study author Jingwen Wang of Fudan University in Shanghai, China. "The results may also provide useful insights for the development of preventive strategies for vector control."

Mosquitoes rely on nectar-derived sugars, such as glucose, for energy, survival, and reproduction. Similarly, glucose is the primary energy source supporting the proliferation of Plasmodium—malaria parasites that are transmitted to human hosts by female mosquitoes of the genus Anopheles. Some indirect evidence also suggests that carbohydrate metabolism influences the capability of mosquitoes to transmit malaria parasites. Although glucose metabolism is expected to play a role in regulating Plasmodium infection in mosquitoes, the underlying mechanisms have not been clear.

To address this question, Wang teamed up with co-senior study author Huiru Tang of Fudan University. They found that feeding Anopheles stephensi mosquitoes a solution containing glucose for five days increased the number of Plasmodium berghei oocytes in the midgut after infection with the parasite. But mosquitoes treated with an antibiotic cocktail did not show this effect, pointing to a critical role for gut microbes in the sugar-induced enhancement of Plasmodium infection.

The sugar diet specifically increased the abundance of A. bogorensis in the mosquito midgut. Infected mosquitoes that were fed glucose and colonized only with A. bogorensis showed an increased number of P. berghei oocytes. Taken together, the findings suggest that sugar intake promotes Plasmodium infection in mosquitoes by increasing the

proliferation of A. bogorensis. Additional experiments provided evidence that this bacterial species mediates the sugar-induced enhancement of infection by raising the midgut pH level, which facilitates the sexual development of P. berghei.

"Our study provides crucial molecular insights into how the complex interplay between glucose metabolism of mosquitos and a component of their gut microbiota, A. bogorensis, influences malaria parasite infection ," Tang says. "Targeting mosquito glucose metabolism might be a promising strategy to prevent malaria parasite transmission."

The study also provides evidence that the specific sugar composition of plant saps might influence malaria transmission by affecting the proliferation of A. bogorensis. Specifically, Parthenium hysterophorus—a plant species that mosquitoes feed on quite frequently—did not promote A. bogorensis proliferation or P. berghei infection when compared with other mosquito-preferred plants. According to the authors, planting this species might reduce malaria transmission. But further studies are needed to investigate the influence of natural plant saps on the microbiota composition of field mosquitoes and to examine the influence of A. bogorensis from field mosquitoes on malaria parasite infection.

The researchers will continue to investigate the metabolic interactions between mosquitos and their microbiota and the influence of these interactions on pathogen transmission. "Our goal is to find out the key metabolites or chemicals that could inhibit malaria parasite infection in mosquitoes," Wang says.

More information: *Cell Reports*, Wang, An, and Gao et al.:" Glucose-mediated proliferation of a gut commensal bacterium promotes Plasmodium infection by increasing mosquito midgut pH" www.cell.com/cell-reports/full … 2211-1247(21)00306-5 , DOI:

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