Study examines bacteria living in and on mosquitoes

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NC State study finds more bacterial diversity internally than externally, a surprising discovery. Credit: John B. Strider

Avoiding mosquitoes to protect against bites is always a good idea. But a new North Carolina State University study shows that the bacteria-ridden exteriors of mosquitoes may be another reason to arm yourself with a swatter.

The first-of-its-kind study, published in *PLOS ONE*, examined both the exterior surface and interior microbiome of mosquitoes found in homes in Africa's Cote d'Ivoire—the Ivory Coast.

"When you're exposed to mosquitoes, you worry about blood feeding," said R. Michael Roe, William Neal Reynolds Distinguished Professor of Entomology at NC State and co-corresponding author of the study. "Our hypothesis is that mosquitoes can physically transfer bacteria by landing on you or by defecating on household surfaces, like flies do.

"They may not, but no one has studied it before."

Research collaborators at the Centre Suisse de Recherches Scientifiques collected 79 adult female *Anopheles coluzzii* mosquitoes from homes in a rice-producing province in Cote d'Ivoire. The mosquitoes were sent to NC State for analysis of the microbiome inside and on external body surfaces.

Some of the findings were surprising.

"We found greater bacterial diversity internally than externally, which didn't match what has been found with blow flies, for example," said Loganathan Ponnusamy, an NC State principal research scholar in entomology and co-corresponding author of the paper.

"At the same time, we found lots of external bacterial differences between homes, but not much difference internally between homes, which makes sense. Much of what is found internally relates to nectar or honey consumed as mosquitoes forage outdoors."

The researchers also found—for the first time in the academic literature—fructobacillus, which is generally found in nectar sources like flowers and beehives, pointing to mosquitoes visiting those plants or

nectar sources, said Kaiying Chen, an NC State postdoctoral researcher and first author of the paper.

Perhaps more ominously, the researchers also found large amounts of *Staphylococcus* and two variants of *Rickettsia*. The genus of these bacteria are associated with human and animal diseases.

"This is another risk," Roe said. "Mosquitoes carry bacteria externally and internally and come into your home, possibly transferring pathogenic bacteria."

The researchers hope to continue the work by exposing mosquitoes to a bacteria that would never be found on human skin and seeing whether the bacteria transfers to an artificial membrane. They then could perform the same test on human arms.

NC State Ph.D. researchers Chouaïbou S. Mouhamadou and Jean M. Deguenon co-authored the paper, as did Behi Kouadio Fodjo, Gba Christabelle Sadia and France Paraudie Kouadio Affoue from the Centre Suisse de Recherches Scientifiques, Abidjan, Cote d'Ivoire, Africa. Funding was provided by a grant from the Department of the Army under a Deployed Warfighter Protection (DWFP) Program Grant W911QY1910003.

More information: Kaiying Chen et al, Internal and external microbiota of home-caught Anopheles coluzzii (Diptera: Culicidae) from Côte d'Ivoire, Africa: Mosquitoes are filthy, *PLOS ONE* (2022). DOI: 10.1371/journal.pone.0278912

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