Kissing bugs, vector for Chagas disease, successfully gene edited for first time

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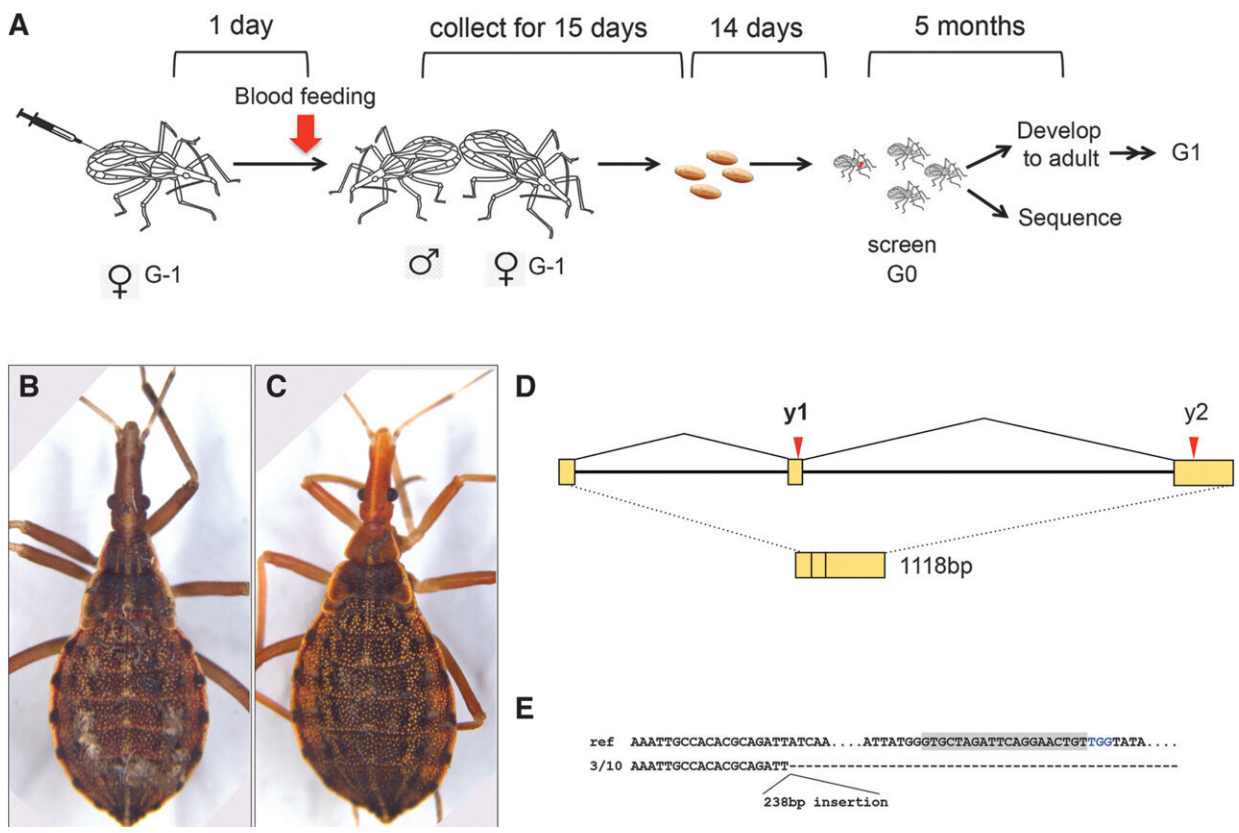

CRISPR-directed gene edition events in the yellow locus. Credit: *The CRISPR Journal* (2024). DOI: 10.1089/crispr.2023.0076

Kissing bugs, or triatomine bugs, are the primary vector for Chagas disease, a major public health concern in Central and South America and even the southern United States. However, there aren't many good treatment options available, which means that to stop the spread of the potentially life-threatening disease, it's essential to control the organisms that carry the parasite.

New research from an international team, including a Penn State researcher, demonstrates—for the first time—the use of CRISPR-Cas9 gene editing in kissing bugs and opens the door to research on applied strategies for Chagas disease control. Their results appear in the April print issue of The CRISPR Journal.

"People have tried to do CRISPR and genetic engineering in triatomine bugs for a long time, but no one has been able to do it because traditional methods are very difficult in these bugs," said Jason Rasgon, Dorothy Foehr Huck and J. Lloyd Huck Endowed Chair in disease epidemiology and biotechnology and co-author of the study.

"For the last six years, we have been developing tools to genetically modify difficult organisms. Here, we showed that you could genetically modify this vector insect. Our technology has the potential to make gene editing more efficient, easier and cheaper in a wide range of animals."

When it comes to gene editing, researchers typically perform what's called embryonic microinjections, injecting the CRISPR gene editing material directly into embryos. But the technique involves expensive equipment and can be inefficient with no guarantee that the genetic engineering will work. This technique is also difficult in kissing bugs because their eggs are too hard to pierce.

"Instead, we've developed a technology—Receptor-Mediated Ovary Transduction of Cargo or 'ReMOT Control'—where you can inject the materials directly into the circulatory system of the mother and guide that material to the developing eggs," Rasgon said. "It's the equivalent of injecting every single egg in her body all at the same time."

The team's goal was to conduct a proof-of-concept of the ReMOT Control technology in triatomine bugs. They targeted genes associated with eye color and cuticle, or outside covering, color. After injecting the female kissing bug, the team examined the offspring to see if they had altered eye or cuticle color. The visible changes indicated that the genetic edits were successful and the targeted genes were deleted.

Kissing bugs are also a model system to study insect physiology. The development of this new protocol will allow scientists to investigate fundamental biological questions about insects and disease transmission, the researchers said.

"This has important implications for basic research, but it also brings triatomine bugs and Chagas disease into conversations about genetic technologies for the control of vector-borne pathogens," Rasgon said. "We are on the cusp of having the technology and tools available to be able to do that."

Other authors on the paper include: Helena Araujo, Leonardo Lima, Mateus Berni, Jamile Mota, Daniel Bressan, Alison Julio and Robson Cavalcante from the Institute for Biomedical Sciences, Federal University of Rio de Janeiro; Vanessa Macias from the Department of Biological Sciences, University of North Texas; and Ethan Bier and Zhiqian Li from the Department of Cell and Developmental Biology, University of California, San Diego.

More information: Leonardo Lima et al, Gene Editing in the Chagas Disease Vector Rhodnius prolixus by Cas9-Mediated ReMOT Control, *The CRISPR Journal* (2024). DOI: 10.1089/crispr.2023.0076

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