How 'Victor/Victoria' Mosquitoes Can Help Cure Zika

By Lila Abassi — February 18, 2016

courtesy of shutterstock

The success of battling mosquito-borne viral invaders such as Zika, Dengue and Chikungunya may rest in the hands of two American researchers.

According to a paper published in the journal *Trends in Parasitology*, Zach Adelman and Zhijan Tu, from the Departments of Entymology and Biochemistry at Virginia Tech, have devised a technique to increase female-to-male conversion of *Aedes aegypti* mosquitoes, which would provoke the eradication of females, effectively reducing mosquito populations. (With some imagination, some might say it's loosely similar to the gender-switching plot of the beloved movie of yore, *Victor Victoria*, where Julie Andrews' character pretends to be a male actor who plays female impersonator.)

The scientists have identified a male determining factor (M factor) that is found on the Y chromosome (at the M locus) in Anopheles mosquitoes the species responsible for malaria. Because these regions are similar across species they were able to determine that there is an M locus in *A. aegypti*, the mosquito responsible for the current Zika outbreak. Within the M locus, scientists identified a specific gene, called the Nix gene, which when deleted turned all the genetic male mosquitoes turned into female mosquitoes. When they added this gene to where it did not normally exist, the genetic female mosquitoes all developed internal and external male genitalia.
Only female mosquitoes are blood-sucking, disease-spreading vectors the males are innocuous and nectar-drinking. The authors have already had success creating sterile female anopheles mosquitoes, the species that transmits malaria, using the CRISPR-Cas9 gene editing technique. What makes CRISPR-Cas9 genetic modification different from genetically modified organisms (GMOs) is that "GMOs" are transgenic organisms, meaning that a gene from a different species has been added to their genome. But in the case of organisms modified using CRISPR-Cas9, what’s edited was there to begin with. Technically, nothing has been added from a different species.

We are at a turning point in our understanding of how mosquitoes determine whether to become a male (a good choice for us) or a female (trouble for us) as well as our ability to permanently modify wild populations using gene drive techniques, said Dr. Adelman, the entomologist in the partnership.

This discovery sets the stage for future efforts to leverage the Crispr-Cas9 system to drive maleness genes such as Nix into mosquito populations," said Professor Tu, his biochemist colleague, "thereby converting females into males or simply killing females. Either outcome would help reduce mosquito populations. And, we daresay, reduce mosquito-borne illnesses.

The scientists say their findings, coupled with gene editing, could be used to edit out females altogether.

"Given recent breakthroughs in the development of CRISPR-Cas9 reagents as a source of gene drive, more advanced technologies at driving maleness, the ultimate disease refractory phenotype, become possible and may represent efficient and self-limiting methods to control mosquito populations," they said.

The authors also point out that our current method of preventing mosquito-borne infectious diseases depends on controlling the vectors and resistance of these mosquitoes to available insecticides has proven to be a huge challenge.

Previous methods of vector control that demonstrated success were developed by a British company called Oxitec, where they genetically modified sterile male mosquitoes and released them into the wild. In some regions of Brazil, mosquito populations have decreased by up to 80 percent. The main drawbacks to this method, however, is that the release of these sterile male mosquitoes has to be continuous, large in scale, separate the sexes prior to release and represent a heavy financial and administrative burden.

Let’s hope the capability of creating all male mosquitoes provides the key to help eliminate horrible mosquito-borne diseases that leave devastation in their wake.

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