Male Determining Gene Nix May Bring an End to Transmission of Diseases through Mosquitoes

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Abstract
Female mosquitoes take blood from humans to gain protein needed to produce eggs, and in the process, they can transmit viruses such as Zika, Dengue, and chikungunya, or parasites, such as malaria. Male mosquitoes do not transmit diseases. This literature review will examine what is known about how sex is determined in mosquitoes and how this can be used to manipulate the females that spread diseases to humans. Using CRISPR Cas9, the lab of Zhijian Tu removed the Nix gene from mosquito embryos; all of these were feminized. Ectopic over-expression of Nix gene product in mosquito embryos caused even genetically female mosquitoes to have male genitalia. Nix has been shown to be a regulating factor for doublesex and fruitless, two other genes known to be involved in sex determination. The Nix gene has highly repetitive features similar to other genes in the Y chromosome of other organisms. Researchers in London have already demonstrated that CRISPR technology can be used to disrupt the female form of doublesex in a population of caged mosquitoes. The females become sterile and the population declines, Nix could be used in a similar way to change female mosquitoes to harmless males.

First, DNA strands of both males and female were aligned and compared to one another using the Illumina data of both sexes to look for a Y chromosome-like region called the M locus region that is only found in male mosquitos. The 164 contigs were aligned with RNA-seq data. RNA-seq is sequencing of cDNA made from mRNA using reverse transcriptase. Presence in the embryo RNA-seq and, absence from female-derived RNA-seq reduce the number of contigs by 140. From the 24 remaining strands, one had a sequence gene contig similar to the TRA2 gene, that is involved in the splicing of doublesex (dsx) and fruitless (fru). They named that gene Nix.

Citation

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