Electrostatic netting opens a whole new world of malaria vector control

September 11 2015, by Christopher Packham

Credit: CDC

(Phys.org)—Mosquito-borne infectious diseases are a huge public health burden, which carry high human and economic costs. Malaria, Chikungunya, West Nile virus and dengue are difficult to treat, and controlling the disease vector—mosquitos—is imperative.

The WHO recommends the use of four classes of public health insecticides, but widespread use has inevitably resulted in the development of insecticide-resistant mosquitos. Additionally, larval exposure to low residual doses of agricultural insecticide has been a major driver of resistance in mosquitos. Thus, the WHO advises health officials to rotate the use of both agricultural and vector-targeting insecticides to assert control over the expression of resistant genes.

Nonetheless, conventional methods of mosquito control are becoming less effective over time, and researchers seek alternatives to existing techniques in an effort to stay one step ahead of adaptation. Now, a group of health and ecological science researchers in Johannesburg, South Africa, and Liverpool, England, have reported in the *Proceedings of the National Academy of Sciences* the use of an electrostatic coating that binds insecticide particles.

The authors report that the method delivers such high levels of insecticides to mosquitos that even those with high levels of resistance are killed effectively. It consists of a coating, originally developed to trap and bind airborne pollen, which is applied on different substrates, including conventional mosquito netting for deployment in households. The coating has an electrostatic charge that binds particles via polarity. Though such techniques have been effectively applied in agriculture, this study is the first to demonstrate efficacy against disease-carrying mosquitos.

The researchers tested the electrostatic netting on six strains of Anopheles mosquitos with different methods of adaptive pyrethroid resistance from across Africa. Fluorescent dust tests with the netting showed visual support of high powder transfer efficiency to flying insects, even with very short contact. "Even with a mere 5-second contact and at 15-fold lower dose, the impact of deltamethrin on electrostatic netting was significantly higher than the impact of deltamethrin on a [standard] long-lasting insecticidal net," the authors write.

They applied multiple public health insecticides with the electrostatic coating, successfully transferring them to the polyester fibers of the netting. The researchers note that the application technique has a variety of potential uses and can be applied to other surfaces including walls, via paint. Additionally, electrostatic netting fibers can be washed up to 40 times while retaining their electrostatic charge, extending the active life of the netting.

However, the electrostatic netting is not considered by the WHO to be suitable for bed nets, for which only pyrethroid impregnation techniques are approved. It is useful, however, for house-screening products that will not be handled frequently, and the researchers are investigating the use of such nets in Tanzanian households.

"In conclusion," the authors write, "the application of electrostatically adhered particles can boost the efficacy and provide resistance-breaking applications of currently recommended public health insecticides."

More information: "Electrostatic coating enhances bioavailability of insecticides and breaks pyrethroid resistance in mosquitoes." *PNAS* 2015 ; published ahead of print August 31, 2015, DOI: 10.1073/pnas.1510801112

Abstract
Insecticide resistance poses a significant and increasing threat to the control of malaria and other mosquito-borne diseases. We present a novel method of insecticide application based on netting treated with an electrostatic coating that binds insecticidal particles through polarity. Electrostatic netting can hold small amounts of insecticides effectively and results in enhanced bioavailability upon contact by the insect. Six pyrethroid-resistant Anopheles mosquito strains from across Africa were

exposed to similar concentrations of deltamethrin on electrostatic netting or a standard long-lasting deltamethrin-coated bednet (PermaNet 2.0). Standard WHO exposure bioassays showed that electrostatic netting induced significantly higher mortality rates than the PermaNet, thereby effectively breaking mosquito resistance. Electrostatic netting also induced high mortality in resistant mosquito strains when a 15-fold lower dose of deltamethrin was applied and when the exposure time was reduced to only 5 s. Because different types of particles adhere to electrostatic netting, it is also possible to apply nonpyrethroid insecticides. Three insecticide classes were effective against strains of Aedes and Culex mosquitoes, demonstrating that electrostatic netting can be used to deploy a wide range of active insecticides against all major groups of disease-transmitting mosquitoes. Promising applications include the use of electrostatic coating on walls or eave curtains and in trapping/contamination devices. We conclude that application of electrostatically adhered particles boosts the efficacy of WHO-recommended insecticides even against resistant mosquitoes. This innovative technique has potential to support the use of unconventional insecticide classes or combinations thereof, potentially offering a significant step forward in managing insecticide resistance in vector-control operations.

Citation: Electrostatic netting opens a whole new world of malaria vector control (2015, September 11) retrieved 27 April 2024 from https://phys.org/news/2015-09-electrostatic-netting-world-malaria-vector.html