Medical Xpress

For first time, researchers can measure insecticide on surface of mosquito nets

January 2 2019

Insecticide-infused mosquito netting is in widespread use around the world to limit the spread of mosquito-borne diseases, such as malaria. Researchers from North Carolina State University and the U.S. Centers for Disease Control and Prevention (CDC) have now come up with a technique that actually measures how much insecticide is found on the surface of these nets—paving the way for efforts to determine how long the nets are effective.

"Until now, there was no established technique for measuring the distribution and concentration of insecticides on the surface of the netting," says Chuanzhen Zhou, a researcher scholar at NC State's Analytical Instrumentation Facility (AIF) and co-author of a paper on the work. "And that's important, because only the insecticide on the surface is bioavailable and able to kill mosquitoes."

"We were looking for a way to address this problem—and we've now developed a way to measure two of the most common insecticides used on any type of netting," says coauthor Fred Stevie, senior researcher in the AIF. "And, presumably, we'll be able to extend the technique for other insecticides as well.

"This has worldwide impact," Stevie says. "There are more than a billion nets out there, and our new technique can tell us how long the pesticide on those nets lasts and how often they need to be replaced. Ultimately, the technique could help us examine a range of fabrics embedded with insecticides, from military uniforms to high-end hiking gear."

The researchers began by focusing on permethrin, one of the most widely-used insecticides used in netting. The researchers analyzed a sample of permethrin using a mass spectrometer to obtain the insecticide's chemical fingerprint. They then used the same technique to obtain the chemical fingerprint of the netting material. This gave the researchers the baseline information they needed to tell the substances apart once they began analyzing permethrin-embedded netting.

The research team then used a technique called time-of-flight secondary ion mass spectrometry (ToF-SIMS) to analyze samples of the permethrin-embedded netting.

In ToF-SIMS, a sample is bombarded with bismuth ions, which eject ions from the surface of the sample material. The ions that have been knocked loose are then collected, and the amount of time it takes each ion to arrive at the collection point tells researchers which atom or molecule the ion was part of; heavier ions are slower than lighter ones. Looking at the collective data, researchers can determine the overall make-up of the sample's surface.

The researchers also utilized a technique that implants ions into the sample, allowing them to determine not only which materials are present but their relative abundance.

Using both techniques, the researchers performed multiple analyses of mosquito netting samples that had seen varying degrees of use. The samples ranged from brand new netting to netting that had been in use for years. By comparing data on samples that still killed mosquitoes with data from samples that no longer worked, the researchers identified a level at which permethrin became ineffective.

The researchers are continuing with their efforts to determine how long the netting remains effective under various conditions, and are working to apply this methodology to other insecticides used in mosquito netting.

More information: Stephen C. Smith et al, Imaging and quantitative analysis of insecticide in mosquito net fibers using Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS), *PLOS ONE* (2018). DOI: 10.1371/journal.pone.0209119

Provided by North Carolina State University