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A Guide To Mosquito Repellents, From DEET To ... Gin And Tonic?

Susan Brink

Editor's note: This story was originally published in 2016 and has been updated.

People do the darnedest things in hopes of avoiding mosquito bites. They burn cow dung, coconut shells or coffee. They drink gin and tonic. They eat bananas. They spray themselves with mouthwash or slather themselves in clove/alcohol solution. And they rub themselves with Bounce. "You know, those heavily perfumed sheets you put in your dryer," says Dr. Immo Hansen, professor at the Institute of Applied Biosciences at New Mexico State University.

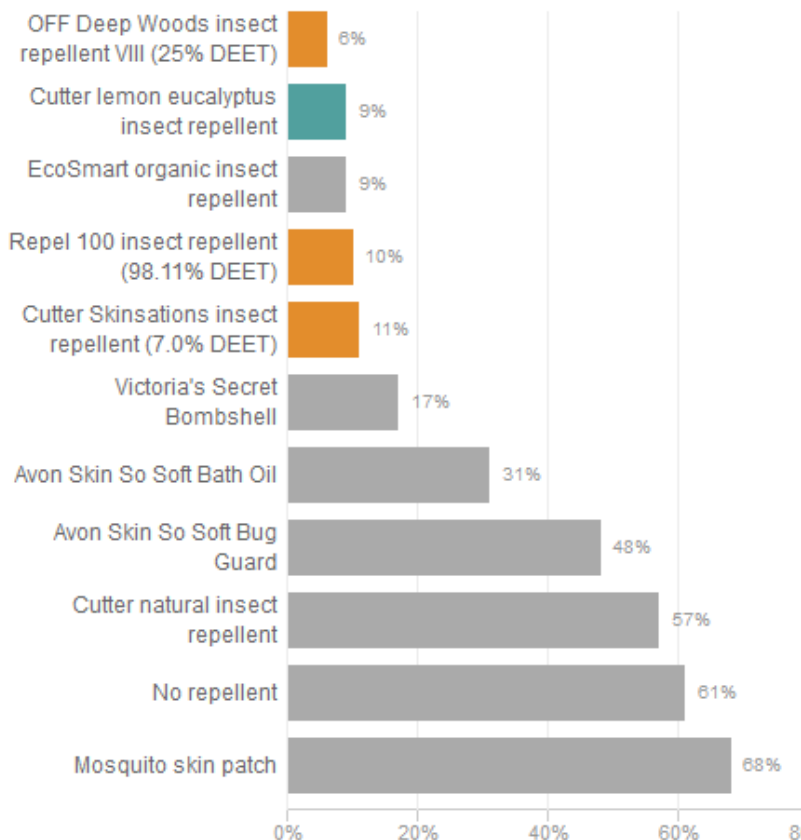
None of those techniques have been tested to see if they actually keep mosquitoes away. But that doesn't stop people from trying them, according to a study that will be published this summer by Hansen and colleague, Stacey Rodriguez, lab manager at the Hansen Lab at NMSU, which studies ways to prevent mosquito-borne diseases. They and colleagues asked 5,000 people what they did to protect themselves against mosquitoes. Most used conventional mosquito repellents.

Testing The Effectiveness Of Mosquito Repellents

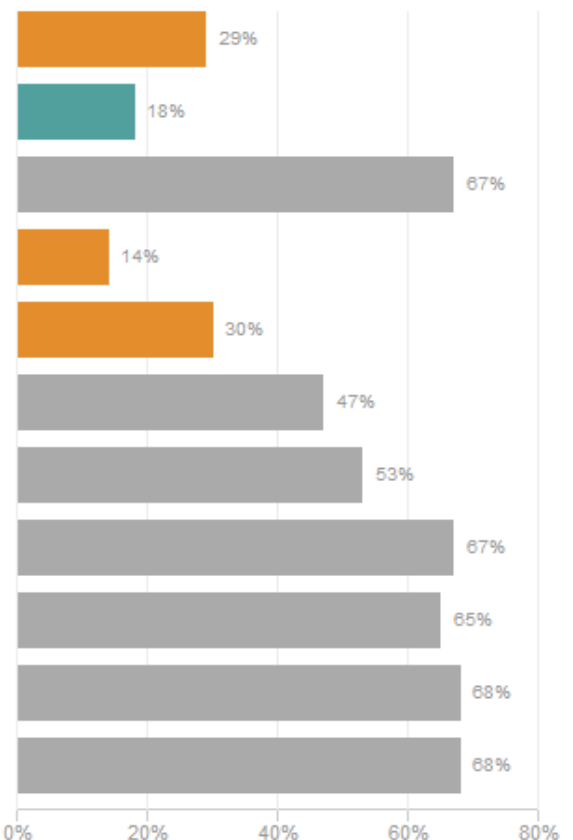
A 2015 study tested eight commercial mosquito repellents, two fragrances and a vitamin B patch by releasing mosquitoes into a sealed chamber with a treated hand. The study found that after four hours, the most effective were **products containing DEET**, as well as **one "natural" DEET-free spray**.

SHARE OF MOSQUITOES ATTRACTED...

UPON APPLICATION



AFTER FOUR HOURS



Notes

The study tested two mosquito species. The chart above shows attraction rates for the *Aedes aegypti* species.

Source: *Journal of Insect Science*

Credit: Katie Park/NPR

Then researchers asked about their traditional home remedies. That's when the cow dung and dryer sheets came out. In interviews, Hansen and Rodriguez shared some of the responses they received. [Their paper](#) has been published in the peer-reviewed journal *PeerJ*.

Beyond folklore and traditional remedies, there are proven ways to protect against mosquitoes and the diseases they carry. NPR talked with researchers, many of whom spend lots of time in mosquito-infested jungles, marshes and tropical areas.

Which repellents work best to stop mosquitoes from biting?

Products containing **DEET** have been shown both safe and effective. DEET is shorthand for the chemical N,N-diethyl-meta-toluamide, the active ingredient in many insect repellents. A 2015 article in the [Journal of Insect Science](#) examined the effectiveness of various commercial insect sprays, and products containing DEET proved effective and relatively long lasting. Rodriguez and Hansen were authors of the 2015 study, and replicated the results in a [2017 article](#) in the same journal. DEET appeared on store shelves in 1957. There was some early concern about its safety - speculation that it was linked to neurological problems. But [recent reviews](#), for example a study published in June 2014 in the journal *Parasites and Vectors*, says, "Animal testing, observational studies and intervention trials have found no evidence of severe adverse events associated with recommended DEET use."

DEET isn't the only weapon. Products containing the active ingredients **picaridin** and **IR 3535** are as effective, says [Dr. Dan Strickman](#), with the Global Health Program at the Bill and Melinda Gates Foundation (which is a funder of NPR) and author of [Prevention of Bug Bites, Stings, and Disease](#). Repellents with any of those active ingredients are [recommended as safe and effective](#) by the Centers for Disease Control and Prevention. They are widely available around the world. Actually, Strickman gives the edge to picaridin.

"Picaridin is a little more effective than DEET and seems to keep mosquitoes at a greater distance," he says. When people use DEET, mosquitoes may land on them but not bite. When they use a product containing picaridin, mosquitoes are less likely to even land. Repellents with IR 3535 are slightly less effective, Strickman says, but they don't have the strong smell of other products.

Then there is **oil of lemon eucalyptus, or PMD**, a natural oil extracted from the leaves and twigs of the lemon-scented gum eucalyptus plant, also recommended by the CDC. PMD is the ingredient in the oil that makes it repellent to insects. NMSU researchers found that a product containing oil of lemon eucalyptus was about as effective and as long lasting as products containing DEET. "For some people, there's a stigma to using chemicals on their skin. They prefer a more natural product," says Rodriguez.

One surprising finding in 2015 was that a perfume, Victoria's Secret Bombshell, was a pretty good repellent. Hansen and Rodriguez said they added it to the products they tested as a positive control, believing its floral scent would attract mosquitoes. It turned out bugs hated the smell.

Their more recent 2017 study also held a surprise. A product called Off Clip-On attaches to clothing and contains a cartridge containing the area repellent, metofluthrin, also recommended by the CDC. The wearable device is designed for someone sitting in one place, like a parent watching a softball

game. The person switches on a small battery-operated fan that blows a small fog of repellent into the air immediately surrounding the clip-on wearer. "It actually worked like a charm," says Hansen. It was about as effective as DEET or oil of lemon eucalyptus at keeping the bugs away, he says.

Are there products that just don't work?

Not all products deliver what they promise. The 2015 study found vitamin B1 skin patches to be ineffective at repelling mosquitoes. The 2017 study added citronella candles to the list of products that don't keep mosquitoes away.

So-called bug-repellent wristbands and bracelets fail to repel mosquitoes, according to the recent study. These products contain a variety of oils including citronella and lemongrass.

"I've had mosquitoes land right on the bracelet that I was testing," says Rodriguez. "They market [the wristbands and bracelets] as protecting you against Zika [a virus spread by mosquitoes that, in pregnant women, can result in serious birth defects], but they're completely ineffective."

Ultrasonic devices, using tones people can't hear but marketers claim mosquitoes hate, don't work, either. "The sonic device we tested had no effect," says Hansen. "We've tested others before, too. None of them work. There's no scientific evidence that mosquitoes are repelled by sound.

How often should you reapply a repellent?

Generally, it's a good bet to follow the manufacturer's instructions, experts said. People who will be outside for an hour or two should be protected with, say, a product that contains a lower concentration of DEET (about 10 percent - identified on the label). Those who will be out in the woods, or jungle or marshland, should use a higher concentration of 20 to 25 percent, and refresh every four hours or so, says [Dr. Jorge Rey](#), interim director of the Florida Medical Entomology Laboratory in Vero Beach. "The higher the concentration, the longer it lasts," says Rey.

And again, follow manufacturer's directions on the amount used. "A lot of people think that if a little is good, a lot is better," says [Dr. William Reisen](#), professor emeritus at the School of Veterinary Medicine at the University of California, Davis. "You don't have to take a bath in the stuff."

What kind of clothing helps protect against bites?

When Rey goes on research trips to highly infested areas, like the Florida Everglades, he suits up. "We wear long pants and long-sleeved shirts," he says. "If it's particularly bad, we use hats with nets coming down over the face. And we depend on repellent on exposed areas." That could mean hands, neck and face. But don't spray the face, experts say. To avoid irritating the eyes, put the repellent on hands and rub it on the face.

And don't forget the feet. Mosquitoes have quirky olfactory preferences. Many of them, especially the *Aedes* variety that transmits the Zika virus, love the smell of feet.

"Wearing sandals isn't a good idea," says Rodriguez. Shoes and socks are called for, and tucking pants into socks or shoes helps keep mosquitoes from getting inside clothing. She wears long pants when outdoors in mosquito territory - and definitely not yoga pants. "Spandex is very mosquito friendly. They bite through it. I wear baggier pants and long sleeved shirts, doused in DEET."

What else can reduce the risk of mosquito bites?

Mosquitoes can bite at any time of day, but the *Aedes aegypti* species that transmits Zika prefers midmorning and early evening, says Strickman. If possible, stay indoors in screened-in or air-conditioned buildings during those times.

Since these particular mosquitoes breed in standing water in containers like plant pots, old tires, buckets and trash cans, people should rid their immediate area of things that can collect water.

"Swimming pools, unless they're abandoned, are OK," says Rey. The chemicals used to keep pools

safe for swimming also keep mosquitoes away. It takes some close looking to find every possible breeding ground for mosquitoes. "I've seen some developing in a film of water next to a sink, or in the bottom of a glass people use to brush their teeth," says Strickman. Cleaning up areas of standing water can greatly reduce the number of mosquitoes.

The more people do that kind of basic cleanup, the fewer mosquitoes there will be. "It may not be perfect, but you'll lower the number of mosquitoes tremendously," says Strickman.

What's on the horizon to help people avoid mosquito bites and the diseases they bring?

Hansen says his lab is working on a technique in which male mosquitoes are sterilized with radiation, then released into the environment. They mate with females who lay eggs, but the eggs never hatch. The technique would target specific species, like the *Aedes aegypti* that transmit Zika, dengue fever and other diseases.

And a team of scientists in Massachusetts is working on a mosquito repellent that will stay on the skin and remain effective for hours or even days, says Dr. Abraar Karan, physician at Brigham and Women's Hospital. He is one of the creators of Hour72+, which he says cannot penetrate the skin and enter the blood stream - and only wears off through natural skin shedding.

Hour72+ won the DUBILIER \$75,000 Grand Prize in this year's annual Harvard Business School's [New Venture Competition](#). Karan plans to further test the prototype, which is not on the market, to see how long it remains effective.