

Sniffing out new repellents: Why mozzies can't stand the DEET

October 27 2014, by Cameron Webb



Someone didn't put on the DEET. This is the Yellow Fever mosquito *Aedes aegypti*. Stephen Doggett/Pathology West - ICPMR Westmead, Author provided

The smell of mozzie repellent is as much a part of summer as barbecues and the cricket. Despite supermarket and pharmacy shelves overflowing with insect repellents, there are actually only a few active ingredients to be found across the different formulations.

The most widespread of these is N,N-Diethyl-meta-toluamide, commonly known as [DEET](#), and thanks to [research published](#) in the *Proceedings of the National Academy of Sciences* today, we now know exactly why mosquitoes find it so repulsive.

To a mosquito, DEET makes you smell awful.

Knowing how repellents work is particularly important as there are around 5,000 cases of disease caused by the mosquito-borne Ross River virus every year in Australia. Some regions are also at risk of more serious pathogens such as dengue and [Murray Valley encephalitis](#) viruses.

While [control programs](#) in some parts of Australia may help reduce the activity of mosquitoes, for most of us, the first line of defence against these biting pests will be [insect repellents](#). We know these products work, but not *exactly* how they work.

What is DEET?

DEET was first synthesised through collaboration between the US Department of Defense and US Department of Agriculture in the late 1940s. The repellent became available to the public in 1957 and has since become the "gold standard" in topical insect repellents.

There is a [considerable body of work](#) that demonstrates the effectiveness of DEET in providing protection from blood-seeking mosquitoes and DEET-based insect repellents are a mainstay of recommendations provided by [Australian health authorities](#) to reduce the risk of mosquito-borne disease.

If DEET is so effective, why the need to search for new repellents? The [safety of DEET](#) continues to be raised but despite being used by millions

of people every year, there are [very few reported cases](#) of adverse health impacts if repellents are used as directed.



Well, it definitely works. Credit: PNAS, CC BY

We know it works ... but how?

We know from laboratory and field tests that DEET-based repellents stop mosquito bites, but there has been some debate surrounding the exact mode of action. Does DEET block the blood-feeding behaviour of mosquitoes or does it just smell so bad that mosquitoes actively avoid it?

It has been described as a "[confusant](#)" by some researchers who propose that it disrupts detection of host odours. Some conclude it can [mask host odours](#). Others have suggested mosquitoes [smell and actively avoid DEET](#).

Once we understand how mosquitoes [detect and respond](#) to repellents, it will make the search for new mosquito repellent compounds more efficient. It may also help us understand the potential for mosquitoes to become [insensitive to DEET](#).

In an attempt to settle the debate, researchers from the University of California, Davis studied the response of the southern house mosquito (*Culex quinquefasciatus*) to DEET, non-DEET insect repellents and a range of other chemical compounds.

By using a range of behavioural and electrophysiological approaches, the researchers showed that exposure to DEET activates an odour receptor, specifically CquiOR136, in the mosquito's antennae.

Besides confirming that, at least in this mosquito species, an odorant receptor is critical in determining its repellency to DEET, it also provides an opportunity to screen for novel mosquito repellents.

Researchers looked to a new source of potential repellents, plants. Botanical extracts of plants, [particularly essential oils](#), have been extensively studied as possible insect repellents.

But what is interesting in this study is that the compound identified as a potential [mosquito repellent](#), methyl jasmonate, is released by injured plants used to activate the [expression of defensive genes](#) in nearby plants. Could plant communications provide us with new mosquito repellents?

Where to from here?

While there have been many studies in recent times identifying [new mosquito repellent candidates](#), they rarely address one of the key issues that must be resolved: user compliance.

It could be argued that we don't really need new topical mosquito repellents, but we need effective spatial repellents. Spatial repellents are new formulations that are passively released from devices and offer protection for a number of individuals – not just the person who has applied their topical repellent correctly.

Some synthetic insecticides, such as [metofluthrin](#), already hold this potential. However, once we understand how mosquitoes detect and respond to new products we may be better able to develop new strategies.

These new repellents may be a while off yet so for this summer, stick to what is available and what we know works. Both DEET- and picaridin-based repellents will provide the longest lasting protection against [mosquitoes](#).

Make sure you have a nice even coverage on all exposed areas of skin and reapply after a swim or sweaty activity. Stop the bites and you'll reduce to risk of catching a mosquito-borne disease.

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Source: The Conversation

Citation: Sniffing out new repellents: Why mozzies can't stand the DEET (2014, October 27)
retrieved 10 April 2024 from
<https://phys.org/news/2014-10-sniffing-repellents-mozzies-deet.html>

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