INSECT REPELLENTS

What attracts insects to humans?

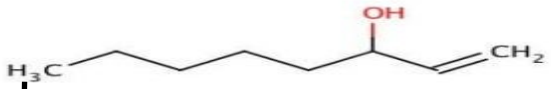
Biting insects use a combination of **sight**, **heat** and **smell** to locate their host.

1-octen-3-ol is a compound found in human sweat and breath, that is an insect attractant. Mosquitoes and other such insects have two receptors on their antennae specific for **1-octen-3-ol and carbon dioxide**; their simultaneous stimulation causes attraction.

This is the main way that insects are attracted, but they may also be attracted in other ways:

1. They may be attracted to smells such as **lactic acid** (meaning that exercise can result in more insect attraction).
2. They may also be attracted to **body heat**, and especially the moisture surrounding one's body, which is why they thrive in humid climates.
3. They may also use sight, and wearing **red, or darker colours** makes you easier to spot for them.
4. Another attractant is blood type; research has found that people with **type O blood** are twice as likely to attract insect than those of type A or B.

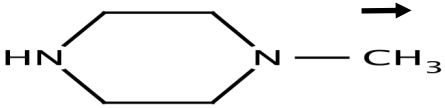
There are many other theories as to why insects may be attracted to you, such as beer intake increasing your chance of insect attraction, or being pregnant being more attractant as well, but the above are the most common theories.



1-octen-3-ol, $C_8H_{16}O$

No need for repellents?

On our skin, we have a naturally occurring compound called **1-methyl piperanzine** which makes humans 'invisible' to mosquitos. This could come from secretions or surface bacterial activity.

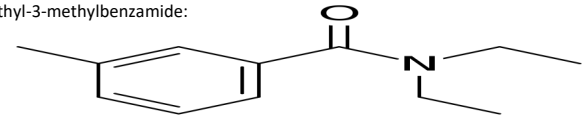


1-methylpiperanzine

What is in Insect Repellents?

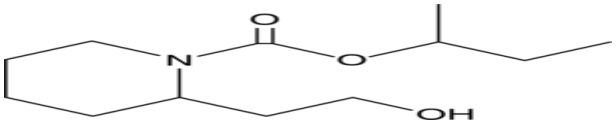
Below I have listed a few of the many active ingredients in insect repellents. Each insect repellent usually has one active ingredient, along with other ingredients., such as fragrances and water.

N, N-diethyl-3-methylbenzamide:



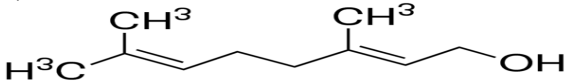
DEET: Developed in 1946 by the army for soldier protection, at 10-35% concentration, DEET will provide adequate protection for 2-8 hours. It can be found in creams, lotions, solutions, gels, aerosols and in many more forms. It is also currently the standard issue repellent given to the military, and is the most common used worldwide as well, as it is recommended by the WHO. One issue is that It can dissolve plastics and synthetic materials.

2-(2-hydroxyethyl)-1-piperidinecarboxylic acid 1-methylpropyl ester:



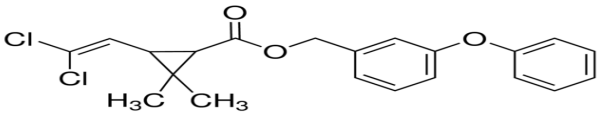
Picaridin: First made in the 1980s, at concentrations of 7-20%, Picaridin will provide adequate protection. It is odourless and it is neither sticky nor oily when applied. Further-more, it isn't toxic nor is it an irritant. It seems to have similar efficacy to DEET for the same time frame, 2-8 hours.

3,7-dimethylocta-trans-2,6-dien-1-ol:



Geraniol: Primarily a mosquito, tick and mite repellent, it is found as a naturally occur-ring terpenoid in food plants. It can be a skin irritant, but is largely considered safe. For this reason, it is often used on infant's repellent bands.

3-Phenoxybenzyl (1RS)-cis,trans-3-(2,2-dichlorovinyl) -2,2-dimethylcyclopropanecarboxylate:

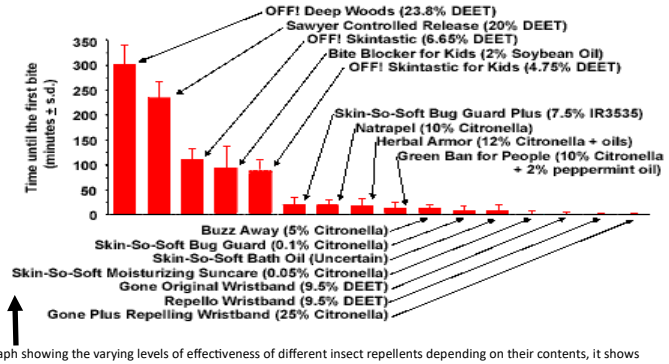


Permethrin: An insecticide requiring direct contact with insects to work. It isn't suitable for skin, but is used for agriculture and home pest control. It could be sprayed on clothes or tent walls. It should be sprayed for 30 seconds and rest for 2-4 hours before being worn, but it retains its potency for 2 weeks, even if washed. At high doses it has toxic effects including: eye and skin irritation, tremors, loss of coordination, hyperactivity and paralysis. It is also highly toxic to some animals including cats.

How do they work?

Different insect repellents work in different ways; below they are listed in order of what is the most to least common method:

1. Some create a **vapour barrier** that deters the insect from coming into contact with the skin. To the insect the vapour has an unpleasant odour and taste.
2. Some **disintegrate the 1-octen-3-ol** in our sweat.
3. Some **affect an insect's senses** such as smell (by binding to the insect's olfactory receptors) and taste to prevent it from finding a human or animal host, as they can't sense the carbon dioxide or lactic acid.



Graph showing the varying levels of effectiveness of different insect repellents depending on their contents, it shows varying concentrations of DEET and some herbal remedies. DEET seems to be more effective than the herbal remedies.

Future developments

I will now look at a couple of areas where repellents may be developed in the future. There are a few main problems with existing repellents, which need to be improved. They need to **be active at low concentration**, have a **high user acceptability** (for example DEET has a bad odour and permeates the skin very quickly), have a **low production cost** and be deemed **safe** for use.

Botanical repellent technologies and essential oils have a good efficacy and are safe to us (not toxic), and therefore seem more appropriate than synthetic insecticides; however, at the moment, they are short-lived, in some cases, no longer than 30 minutes. Therefore, more research is needed into different plant types, or how these plants can be developed.

Evidence suggests that insects may become somewhat **'immune' to the effects of certain repellents** after long-term exposure; thus work may be needed to minimise, if not eliminate this threat when synthesising new repellents.