

# Introduction to Chemical Mosquito Repellents

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## Chemical Mosquito Repellents

In general, mosquito repellents work by interfering with the female mosquito's ability to detect the environmental cues (for example heat, CO<sub>2</sub>, and water vapor) that she uses to find a host. Repellents are applied to the skin, used to treat clothing, or released into the air.

There are a variety of synthetic and plant-derived chemicals known to repel mosquitoes. Few are considered safe enough to be applied repeatedly to the skin. The most commonly used synthetic chemical repellent is called deet (N,N-diethyl-3-methylbenzamide). Deet is used by more than 50 million Americans annually for protection from mosquito bites. It has been applied more than one billion times over the 40+ years that it has been commercially available. However, some safety concerns have arisen during this time. As of 1995, there had been 14 cases of neurotoxicity, primarily childhood encephalopathy, associated with frequent and heavy use of deet. However, in most of these cases little effort was made to eliminate possible involvement of the more common known causes of encephalopathy, such as viral infections. Because of the concerns about deet-associated neurotoxicity and dermatitis, the Environmental Protection Agency has released additional guidelines for deet use (see Fact Sheet 5.526).

In general, the length of mosquito protection provided by deet increases as the concentration of active ingredient in the product increases, with 100% products providing 8 or more hours of protection under many conditions. An exception is 3M Ultrathon, the commercial version of the product used by the US military, which is a 32% slow release formulation that provides similar protection.

There also are many repellent products containing plant derived chemicals. The most common of these is citronella, although a variety of other essential oils are used as well. In general, these products are just as repellent as deet but do not last as long. An exception may be MosquitoSafe, a new product based on geraniol, which is reported to have similar longevity to that of deet. As long as it is understood that frequent reapplication is necessary, plant-derived repellents should provide the same protection against mosquito bites as deet. Also, it should be noted that these chemicals are generally regarded as safe by the Environmental Protection Agency and therefore have undergone much less safety testing than deet.

There are many studies comparing the effectiveness of mosquito repellents. However, it is difficult to compare among studies because of the variety of methods used in comparing products. Two recent studies are summarized in Tables 1 and 2 to provide an idea of the variety of products available and of the range of efficacy of these products. It is important to keep in mind that these tests usually involve mosquito species that are vectors of virus diseases such as West Nile and that results may not apply to other important vector groups. For example, the plant-derived repellents are generally ineffective against ticks and deet is much less effective against some of the mosquito species that transmit malaria.

Deet and citronella repellents also are available as treated wristbands. However, recent tests indicate that these are ineffective (Tables 1 and 3). Repellents containing the active ingredient permethrin may be applied to clothing, but not the skin, for long lasting protection against mosquitoes, biting flies, and ticks. Permethrin is primarily a fast-acting insecticide and has some repellent activity as well.

Repellents and adulticides (insecticides intended to kill adult mosquitoes) may also be released into the air by burning (coils and candles). Results have been mixed, with some studies indicated moderate biting suppression and others indicating no effect (for example, Table 3). Also, there are some health concerns associated with inhalation of smoke generated in this manner. The mosquito plant is supposed to release repellents into the air as well, but several studies have shown no effect or slightly increased biting rates (for example, Table 3).