

Mosquito Repellents¹

C. Roxanne Rutledge and Jonathan F. Day²

A female mosquito feeds on blood to acquire protein that allows the development of her eggs (Figure 1). When she bites, she releases saliva into the area where she is feeding. Her saliva contains proteins that may cause some people to have an allergic reaction, such as itchy red bumps and swollen hives. For those with increased sensitivity to bites, a blister, bruise, or large inflammatory reaction may occur. If a mosquito is harboring a pathogen, such as a virus, a protozoan, or a nematode worm, it is possible that she can transmit the pathogen to humans through her saliva. In Florida, some of the viruses that mosquitoes transmit cause encephalitis. The most important mosquito-borne diseases in Florida are St. Louis encephalitis, eastern equine encephalitis, and West Nile encephalitis.

The best way to avoid mosquito bites is to avoid infested areas, wear protective clothing, and wear insect repellent.

How Do Mosquito Repellents Work?

Repellents make humans unattractive to a mosquito so that it will avoid areas of the body that have been treated with the product. Repellents do not kill mosquitoes. The best repellents will provide protection from bites for a long period of time (> one hour) with a single application. University of Florida mosquito researchers test and evaluate the effectiveness of mosquito repellents based

on the amount of time the product will continue to repel mosquitoes after one application to the skin. This is known as Complete Protection Time (CPT).



Figure 1. Female mosquito taking a blood meal
Credits: James Newman UF/IFAS/FMEL

What Kinds of Mosquito Repellents Are Available?

Repellents that are currently available are either synthetic chemicals, such as DEET, picaridin, and IR3535, or plant-derived chemicals such as citronella and oil of lemon eucalyptus. Various formulations of these repellents are available that differ in the amount of active ingredient, which is the substance that actually repels the mosquito.

1. This document is ENY-671, one of a series of the Entomology and Nematology Department, UF/IFAS Extension. Original publication date July 2002. Revised July 2014. Visit the EDIS website at <http://edis.ifas.ufl.edu>.
2. C. Roxanne Rutledge and Jonathan F. Day, professors at the Florida Medical Entomology Laboratory, Entomology and Nematology Department, UF/IFAS Extension, Vero Beach, FL 32962.

The use of trade names in this publication is solely for the purpose of providing specific information. UF/IFAS does not guarantee or warranty the products named, and references to them in this publication do not signify our approval to the exclusion of other products of suitable composition.

The Institute of Food and Agricultural Sciences (IFAS) is an Equal Opportunity Institution authorized to provide research, educational information and other services only to individuals and institutions that function with non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, marital status, national origin, political opinions or affiliations. For more information on obtaining other UF/IFAS Extension publications, contact your county's UF/IFAS Extension office.

U.S. Department of Agriculture, UF/IFAS Extension Service, University of Florida, IFAS, Florida A & M University Cooperative Extension Program, and Boards of County Commissioners Cooperating. Nick T. Place, dean for UF/IFAS Extension.

These products are available as sprays, wipe-ons, sticks, foams, lotions, and area repellents.

Product Labels

It is very important to read and understand the label instructions before using any mosquito repellent. Of particular importance:

- Both N,N-diethyl-m-toluamide and N,N-dimethylbenzamide are chemical names for DEET; the label may or may not have the word “DEET” on it under the listed active ingredients
- There are different recommendations for frequency of application for different repellents; do not over apply
- Check the container for an EPA-approved label and registration number; never use a repellent that has not been approved by the EPA for use
- Make sure that the repellent label lists the specific insect that you wish to repel; some repellents are not formulated for certain insects

What about Products That Combine Repellents and Sunscreen?

The Centers for Disease Control and Prevention (CDC) does not recommend using products that combine DEET with sunscreen. Sunscreens are intended for generous and frequent use while DEET is intended for less frequent use. The concern is that use of a repellent that combines the two compounds may promote increased and unnecessary use of DEET. Additionally, blending DEET with a sunscreen decreases the efficacy of both compounds. The CDC recommendation is to apply sunscreen first, then the insect repellent containing DEET, to be sure that each product works as specified.

What about Devices That Emit Sound To Repel Mosquitoes?

There is no evidence that wearing devices that emit sound will repel mosquitoes.

Will Garlic, Bananas, or Vitamin B Repel Mosquitoes?

There is no scientific evidence that eating garlic, vitamins, onions, or any other food will make a person less attractive to host-seeking mosquitoes. The attractant level of an individual to biting arthropods is based on a complex

interaction of many chemical and visual signals. Certain foods in certain individuals may affect their individual attractiveness to biting arthropods, for better or for worse.

How To Decide Which Repellent Is Best

Read the label to determine what the active ingredient is and what percentage of the active ingredient is in the container. Use Table 1, based on University of Florida research, as a guideline to compare products. Some provide protection for a long period of time and some have very short protection times.

In 2005, the CDC revised their recommendations on mosquito repellents and added two repellents, in addition to DEET: Picaridin [1-Piperidinecarboxylic acid, 2-(2-hydroxyethyl)-, 1-methylpropylester] and Oil of Lemon-Eucalyptus [p-menthane 3,8-diol (PMD)]. The oil of lemon eucalyptus has not been tested against mosquitoes that spread malaria and some other diseases. The label for oil of lemon eucalyptus specifies that it should not be used on children under 3 years of age.

Keep in mind that repellents do not protect all users equally. The effectiveness of a repellent depends on the mosquito species that is biting as well as the age, sex, level of activity, and attractiveness of the human using the repellent. Consider the following when choosing a repellent:

- Are you in an area where you know that mosquito-borne diseases are present?
- What is the mosquito population like? (A lot of bites expected? Or occasional bites?)
- Will time spent outdoors at night be longer than an hour?
- Will you be around heavily vegetated, humid areas during the day?
- What type of activity are you engaged in: exercising, gardening, yard work, etc.?
- Is the humidity and temperature high and wind speed low?

How To Apply Mosquito Repellents

- READ AND UNDERSTAND THE LABEL!!! Apply according to the directions on the label. Do not use any repellent that has not been approved by the EPA. To find this information, you can visit the EPA's website www.epa.gov or look for an EPA registration number on the label.

- As with all over-the-counter products, use common sense when applying. Watch for reactions, some people may be allergic to ingredients in the repellent.
- Do not apply to the mouth or eyes, cuts, wounds, or on sunburned or irritated skin.
- To apply to face, spray on hands first and then rub on face.
- Apply ONLY to the parts of the body that are exposed. Some repellents can be applied directly to clothing, but check the label first. Do not apply to skin that will be covered by clothing.
- Do not allow young children to apply repellents.
- Apply only as often as the label says. More is NOT better! If the repellent wears off earlier than expected, read the label to determine how often it is safe to re-apply.
- Keep in mind that some things may decrease the effectiveness of a repellent such as: activities that cause perspiration, high humidity, high temperature, rainfall, and swimming.

Safety of Mosquito Repellents

The EPA has determined that the normal use of DEET does not present a health concern to the general US population, and DEET used normally not classifiable as a human carcinogen. The American Academy of Pediatrics (AAP) updated their recommendation for the use of DEET products on children (2005) to state that repellents containing DEET with a concentration of 10% appear to be as safe as products containing a 30% concentration when used according to label instructions. The AAP suggests that it is acceptable to apply repellents with low concentrations of DEET to infants over 2 months old. Non-DEET repellents have not been as thoroughly studied as DEET and may not be safe to use on children. There are no reported adverse events following use of repellents containing DEET in pregnant or breastfeeding women.

Oil of lemon eucalyptus should not be used on children under 3 years of age. In the University of Florida research, summarized in Table 1, it should be noted that one subject experienced a skin reaction when testing the efficacy of the oil of lemon eucalyptus; the subject discontinued that portion of the study.

Natural Products

“Natural” is a word that is sometimes used to promote “safe” products. Unfortunately, the wording can be misleading for the uninformed individual. “Natural” products are usually essential oils distilled from plants; oils that have

evolved with plants to defend the plant from insect feeding. These oils can be toxic and irritating in high concentrations. “Natural” repellents are not necessarily *safe* repellents.

Useful References

CDC Insect Repellent Use & Safety: <http://www.cdc.gov/westnile/faq/repellent.html>

How to use insect repellents safely: <http://cfpub.epa.gov/oppref/insect/index.cfm>

Reregistration of the insect repellent DEET: <http://www.bvsde.paho.org/bvsapud/i/fulltext/deet2/deet2.htm>

Fradin, M. S. and J. F. Day. 2002. Comparative efficacy of insect repellents against mosquito bites. *N. Engl. J. Med.* Vol. 347(1)13-18.

Xue, R.D., G.C. Muller and J.F. Day. 2014. Commercially available insect repellents and criteria for their use, Chapter 19, pp: 337-348. In M. Debboun, S.P. Frances and D. Strickman (eds.), *Insect Repellents: Principles, Methods, and Uses*, 2nd edition. CRC Press, Boca Raton, FL.

Table 1. Protection Times of Tested Mosquito Repellents.

Products	Active Ingredient	Average Complete Protection Time
OFF! Deep Woods	23.8% DEET	5 hours
Sawyer Controlled Release	20% DEET	4 hours
OFF! Skintastic	6.65% DEET	2 hours
Repel Lemon Eucalyptus Insect Repellent	Oil of lemon eucalyptus; p-menthane 3,8-diol (PMD)	2 hours
Bite Blocker for Kids	2% Soybean Oil	1.5 hours
OFF! Skintastic for Kids	4.75% DEET	1.5 hours
Skin-So-Soft Bug Guard Plus	7.5% IR3535	23 minutes
Natrapel	10% Citronella	20 minutes
Herbal Armor	12% Citronella; 2.5% peppermint oil; 2% cedar oil; 1% lemongrass oil; 0.05% geranium oil	19 minutes
Green Ban for People	10% Citronella; 2% peppermint oil	14 minutes
Buzz Away	5% Citronella	14 minutes
Skin-So-Soft Bug Guard	0.1% Citronella	10 minutes
Skin-So-Soft Bath Oil	Active Ingredient not known	10 minutes
Skin-So-Soft Moisturizing Suncare	0.05% Citronella	3 minutes
Gone Original Wristband	9.5% DEET	0
Repello Wristband	9.5% DEET	0
Gone Plus Repelling Wristband	25% Citronella	0