Health

External Audience Protocol (EAP)

Insect Repellents

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Introduction

The following document presents the protocol for testing insect repellents at Consumer Reports. With Lyme disease, Zika and West Nile virus and other insect-borne diseases in the news, consumers want to know what repellents will protect them from biting mosquitoes and ticks.

Our tests determine the relative efficacy of insect repellents against two species of mosquitoes; based on our past tests, repellents that are effective against mosquitoes should also be effective against ticks. We also evaluate the propensity of the products to damage materials or surfaces that are likely to come into contact with repellents in use. Since repellents are applied to people’s skin, we also provide scent and skinfeel descriptions.

A high level description of our test process can be summarized by the following list of attributes:

1. Effectiveness against Two Species of Mosquitoes
2. Propensity to Damage Materials
3. Scent and Skinfeel Description

Description of Test Processes

Efficacy testing is performed at a contract laboratory. All other tests are done in-house in our laboratories.

Effectiveness Against Two Species of Mosquitoes

Repellents are tested for efficacy against two species of mosquitoes: Aedes aegypti and Culex quinquefasciatus. All mosquitoes used in the studies are specially bred and disease-free; they have never received a blood meal prior to the test.

Repellent efficacy testing is conducted at a contract laboratory. Tests are patterned after the EPA Product Performance Test Guidelines: OPPTS 810.3700 Insect Repellents to Be Applied to Human Skin, July 7, 2010. The test products, relevant supporting information such as Material Safety Data Sheets, and the test protocol and methodology are reviewed by an independent Institutional Review Board (IRB) before testing begins. All repellents are blind-coded so that the laboratory staff will not know what products are being tested.

Repellent efficacy testing is conducted using four human subjects, two male and two female. Test subjects are non-smokers, and are instructed to avoid alcohol, moisturizers and fragrance products (e.g., soap, perfume, cologne, hair spray, lotion, antiperspirant, deodorant) for 12 hours before and during the test.

Tests are conducted using separate pairs of side-by-side 2'x2'x2' cages, each cage containing either 200 female Aedes aegypti mosquitoes or 200 female Culex quinquefasciatus mosquitoes.
Mosquito species are never mixed within a cage.

Before repellent is applied, each subject’s attractiveness to the test mosquitoes is assessed. This is done by having the subject expose his forearm to the mosquitoes in assigned test cages for up to 60 seconds, until they receive 10 landings. If 10 mosquito landings occur within 60 seconds, the subject’s attractiveness to mosquitoes is considered confirmed.

Once attractiveness has been confirmed, test subjects wash their forearms, wrist to elbow, with unscented soap, then rinse with water, followed by a solution of 50% isopropyl alcohol in water. Arms are dried with a clean towel.

Once the skin has dried, and the smell of alcohol can’t be detected, laboratory staff measure and mark a 250 sq cm area for treatment on the forearms of the test subjects. Adjacent areas above and below the treated area are protected with elastic bandages held in place with surgical tape. Hands are protected with latex or nitrile gloves.

Each subject tests two repellent products per test day. A statistical design is supplied by CR, specifying the test order and to which arm the repellent is to be applied, for each test subject.

Test subjects receive one repellent treatment on each forearm. The application rate for topical repellents is 1 ml per 600 sq cm, as indicated in EPA Product Performance Test Guidelines: OPPTS 810.3700 Insect Repellents to Be Applied to Human Skin, July 7, 2010.

Liquid repellents are applied by spraying them into a beaker, then using a micropipette or syringe (without needle) to apply the necessary amount. Repellents in wipe or towelette form are squeezed over a beaker until enough liquid is in the beaker to apply the correct amount; this is then applied in the same manner as liquid products. The repellents are evenly spread on the treatment area by a laboratory staff member with a gloved finger. Repellents are allowed to dry for 30 minutes before testing.

Two subjects at a time, one male and one female, use each pair of cages. The subject places their treated arms into separate side-by-side individual cages containing the same mosquito species. Arms treated with the same product were placed into one cage, such that, for example, subject A, with product 1 on his left hand and product 2 on his right, sits opposite subject B, who has product 1 on her right hand and product 2 on her left.

The subjects expose their treated forearms to the mosquitoes in the paired test cages for 5 minutes. Laboratory staff observe and record landings, probes and bites received by each subject during that period. Subjects then move to the cages with the other species of mosquito and insert their treated forearms to be tested in a similar fashion.

This first exposure is done at 30 minutes after the application of the repellent, then 30 minutes later (at 1 hour after application), and then once every hour until the repellent on that arm is determined to be no longer effective (“repellent breakdown”) or until 8 hours have elapsed.
following repellent application, whichever occurs first.

*Repellent breakdown* is recorded as the time of the first confirmed bite. A confirmed bite is a bite followed by another bite within the same or immediately following exposure period. Once the second and confirming bite is received on an arm, testing against that mosquito species is discontinued on that arm.

**Propensity to Damage Materials**
Each insect repellent is tested to ascertain if it causes permanent damage, such as tackiness or other change in appearance and/or texture, to various materials with which repellents are likely to come into contact while in use. These include vinyl (PVC), automotive paint on metal, nail polish, polycarbonate eyeglass lenses, leather, polyurethane, and cotton, polyester and polyester/spandex fabrics.

The repellents are applied to the substrates and allowed to dry for 24 hours.

After the 24-hour drying period, for all substrates but the fabrics, a damp cloth or paper towel is used to wipe off the repellent. The wiped substrate is allowed to air dry for a few minutes before lab staff assess the substrates for damage.

For the fabrics, the stained swatches are machine washed along with clean ballast cloths, using a mild detergent. They are allowed to air dry, then assessed for damage.

**Sensory Assessment of Scent and Skinfeel**

All repellent samples are blind-coded. Products are evaluated in a random order. Trained sensory panelists evaluate each repellent, providing a description of the repellent’s scent and its intensity, as well as the skinfeel upon application, and after a brief time has elapsed.

Consensus descriptions of scent and skinfeel for each repellent are provided in a report to the project leader.