

● ALTERNATIVES

PLANT-BASED MOSQUITO REPELLENTS: MAKING A CAREFUL CHOICE

BY CAROLINE COX

Mosquitoes are animals most of us would rather do without. When they also carry a disease, such as West Nile virus, the need to protect ourselves from their bites seems even more important. Much of the literature about mosquitoes provided by government agencies recommends regular use of a mosquito repellent, most often the chemical DEET. Because of the health and environmental problems associated with DEET, many people are looking for repellents based on other chemicals. (See pp. 10-14 or www.pesticide.org/DEET.pdf for details about the hazards of DEET.) A variety of plant-based products have been developed to meet this need.

Are these new products effective? What are the health problems associated with their use? This article has brief answers to those questions.

Citronella

Oil of citronella is a common ingredient in plant-based mosquito repellents. It is distilled from two species of grasses and is a mixture of more than 80 different compounds.¹

U.S. Department of Agriculture (USDA) entomologists tested the efficacy of three citronella-based mosquito repellents in 2004. The "protection time" provided by these products varied between 0 and 5 hours, depending on the product and the species of mosquito used in the test.² An older study by a North Carolina dermatologist and a University of Florida entomologist found protection times of about 15 minutes for two citronella-based products.³

Evaluations of citronella by govern-

ment agencies have come to different conclusions about its potential hazards. The U.S. Environmental Protection Agency (EPA) noted skin irritation, and that one type of citronella oil caused some allergic reactions. Longer-term toxicology tests were waived.¹ The National Institute for Occupational Safety and Health (NIOSH) reported that citronella oil caused eye and skin irritation in rabbits and genetic damage in bacteria.⁴ Canada's Pest Management Regulatory Agency (PRMA) identifies more serious concerns,⁵ noting that the U.S. Department of Health and Human Service's National Toxicology Program found that a chemical called methyl eugenol, a component of citronella oil, causes liver and stomach tumors, as well as genetic damage.⁶

EPA has exempted most citronella products from registration requirements as "minimum risk pesticides." The label of the product is required to identify all ingredients.⁷

For examples of citronella-based repellent products, see <http://www.quantumhealth.com> and <http://www.natrapel.com>.

Geraniol

Geraniol is an alcohol found in

many plant oils, including citronella, lemongrass, and oil of rose.⁸ It is used as a fragrance in personal care products and detergents and also to flavor drinks, ice cream, and candies.⁹

In the late 1990s, research at the University of Florida identified geraniol as "the first effective alternative to products containing DEET."¹⁰ USDA researchers found that a geraniol-based repellent protected against mosquito bites between two and four hours, depending on the species of mosquito.²

Evaluations of geraniol have identified a few potential health hazards. According to EPA, geraniol causes moderate eye and skin irritation.⁹ Longer-term toxicology tests were waived. According to NIOSH, it is severely irritating to skin.¹¹

EPA has exempted geraniol products from registration requirements as "minimum risk pesticides." The label of the product is required to identify all ingredients.⁷

For examples of geraniol-based products, see <http://www.bugband.net>.

p-Menthane-3,8-diol

p-Menthane-3,8-diol is found in eucalyptus plants. (For commercial use, it is synthesized chemically.) It is also a major breakdown product of menthol,¹² the alcohol in mint oils used as peppermint flavoring.¹³ p-Menthane-3,8-diol has been registered with EPA as a mosquito repellent since 2000.¹⁴

When USDA researchers tested the success of p-menthane-3,8-diol as a mosquito repellent, they found that it provided protection from bites for about 7 hours.²

Evaluations of p-menthane-3,8-diol have identified some health hazards. According to EPA, repellents containing this chemical caused severe eye irritation in rabbits as well as skin allergies in guinea pigs. Follow-up tests



Centers for Disease Control and Prevention

Caroline Cox is JPR's editor.

with human skin did not demonstrate any allergies, however. Longer-term skin exposure caused microscopic kidney lesions, as well as inflammation and redness of skin.¹⁴ Like EPA, Canada's PMRA noted eye irritation caused by this chemical, but also noted one study showing genetic damage.¹²

EPA classifies p-menthane-3,8-diol as a biochemical pesticide. This means that fewer studies were required as part of the registration process than would be required for a conventional pesticide.¹⁴

There are two registered p-menthane-3,8-diol repellents. Both are at least 90 percent unidentified "inert" ingredients.¹⁵ Thus it is currently impossible to fully evaluate the potential hazards of these products.

Soybean Oil

Soybean oil is made from soybeans and is a common ingredient in food.⁸

Centers for Disease Control and Prevention



About 13 million pounds of soybean oil are consumed by Americans every year, mostly in baked goods, fried foods, and salad dressings.¹⁶

When USDA researchers tested the success of a soybean oil repellent, they found that it provided protection from bites between 5 and 8 hours, depending on the species of mosquito they studied.² Another study found that a soybean-oil based repellent protected against mosquito bites for about 1 1/2 hours.³

Evaluations of soybean oil used as a pesticide have found few hazards. EPA reported that "it is not likely to

MESH CLOTHING

Would you rather not use a repellent? Are you spending time in areas where there are so many mosquitoes that repellents aren't enough protection? Consider mesh clothing, which you can purchase from outdoor suppliers. Hats, shirts, pants, socks, and jackets are available.

For examples of mesh clothing, see <http://www.buzzoffoutdoorwear.com>.



result in adverse human health effects, based upon available reports and information."⁸ In a more detailed analysis, Canada's PMRA noted a study showing that blood cholesterol levels increased in laboratory animals fed a diet high in soybean oil. Another study showed that the incidence of breast tumors increased in laboratory animals infected with a tumor virus and fed a high-soybean-oil diet. These effects occurred when over 15 percent of the diet was soybean oil.¹⁷

Soybean oil was first registered for use as an insecticide and miticide (a pesticide used to kill mites) in 1959.⁸ Soybean oil pesticides are now exempt from registration requirements as "minimum risk pesticides." The label of the product is required to identify all ingredients.⁷

For examples of soybean oil-based mosquito repellents, see <http://www.biteblocker.com>.

Conclusion

Because using a mosquito repellent means direct exposure to you, your family, and your pets, NCAP suggests that you choose carefully if you need to use repellents. Consider both the effectiveness of a repellent and its potential health hazards. ♣

References

1. U.S. EPA. Office of Pesticide Programs. Undated. Reregistration eligibility decision: Oil of citronella. <http://www.epa.gov/oppsrd1/REDS/3105red.pdf>.
2. Barnard, D.R. and R. Xue. 2004. Laboratory evaluation of mosquito repellents against *Aedes albopictus*, *Culex nigripalpus*, and *Ochlerotatus*

triseriatus (Diptera: Culicidae). *J. Med. Entomol.* 41(4):726-730.

3. Fradin, M.S. and J.F. Day. 2002. Comparative efficacy of insect repellents against mosquito bites. *N. Engl. J. Med.* 347:13-18.
4. National Institute for Occupational Safety and Health. 2003. Registry of toxic effects of chemical substances: citronella oil. <http://www.cdc.gov/niosh/rtecs/ge8583b0.html>.
5. Health Canada. Pest Management Regulatory Agency. 2004. Re-evaluation of citronella oil and related active compounds for use as personal insect repellents. <http://www.pmra-arla.gc.ca/english/pdf/pacr/pacr2004-36-e.pdf>.
6. U.S. Dept. of Health and Human Services. Public Health Service. National Toxicology Program. 2005. Report on carcinogens, eleventh edition. <http://ntp-server.niehs.nih.gov>.
7. U.S. EPA. 2000. Pesticide registration (PR) notice 2000-6. http://www.epa.gov/PR_Notices/.
8. U.S. EPA. Prevention, Pesticides and Toxic Substances. 1993. Reregistration eligibility decision: Flower and vegetable oils. http://www.epa.gov/oppsrd1/REDS/old_reds/flower_veggie_oils.pdf.
9. U.S. EPA. 2004. Geraniol; Exemption from the requirement of a tolerance. *Fed. Reg.* 69(82):23146-23151, Apr. 28.
10. Univ. of Florida. 1999. UF entomologist develops safe, effective alternative to DEET insect repellents. <http://www.napa.ufl.edu/99news/nodeet.htm>.
11. National Institute for Occupational Safety and Health. 2004. Registry of toxic effects of chemical substances: 2,6-Octadien-1-ol, 3,7-di, ethyl-, (E)-. <http://www.cdc.gov/niosh/rtecs/rg58f570.html>.
12. Health Canada. Pest Management Regulatory Agency. 2002. Proposed regulatory decision document: p-Menthane-3,8-diol. <http://www.pmra-arla.gc.ca/english/pdf/prdd/prdd2002-02-e.pdf>.
13. Merriam-Webster. 2003. MedlinePlus medical dictionary. <http://www.nlm.nih.gov/medlineplus/mplusdictionary.html>.
14. U.S. EPA. 2000. p-Menthane-3,8-diol (011550) biopesticide registration eligibility document. http://www.epa.gov/pesticides/biopesticides/ingredients/tech_docs/tech_011550.htm.
15. Washington State Univ. 2005. Pesticide information center online. Query for eucalyptus citriodora crystal. <http://picol.cahe.wsu.edu>.
16. United Soybean Board. 2000. U.S. soybean oil consumption. http://www.unitedsoybean.org/soystats2000/page_27.htm.
17. Health Canada. Pest Management Regulatory Agency. 1999. Proposed regulatory decision document: Soybean oil. <http://www.pmra-arla.gc.ca/english/pdf/prdd/prdd9902-e.pdf>.