

Permethrin Insecticide

*A personal protective device
developed by DoD and its partners*

UNITED STATES ARMY MEDICAL RESEARCH
AND MATERIEL COMMAND



Product name: Permethrin factory treated clothing was approved for U.S. DoD use in 1990, and civilian use in 2003.

Application: May kill biting insects on contact, and repel blood-sucking insects and arthropods (effects may depend on concentration of permethrin).

Date of EPA approval: Permethrin was registered for use by the general public in 1977 by the U.S. Environmental Protection Agency (EPA). Four impregnation methods for DoD use have been EPA-registered. EPA has focused on environmental safety of pesticides rather than product efficacy.

Type of product: Permethrin, first synthesized in 1972 by M. Elliott in the United Kingdom, is a synthetic pyrethroid based on natural pyrethrum derived from the crushed and dried flowers of daisies and chrysanthemums.

Target microorganism/associated disease: Major vector-borne diseases (i.e., diseases transmitted by arthropods including insects and ticks) of mission-degrading potential to the U.S. military include malaria, dengue, leishmaniasis, Rift Valley fever virus, and various rickettsial diseases. These diseases are common in tropical and subtropical locations around the world, and no relevant licensed preventive vaccines are available.

Reasons for development: Repellents applied to clothing significantly reduced the incidence of scrub typhus among troops in the Pacific Theatre in 1944, but early compounds were problematic in terms of skin irritation, odor, dissolving plastics and lack of durability. DoD has played a significant role in testing the efficacy of permethrin products.

Role of Department of Defense in product

development: In 1977, permethrin products were first marketed, and the U.S. Department of Agriculture commenced investigations of permethrin treatment of clothing for DoD. The DoD began using and evaluating permethrin for clothing treatments in 1979. In a 3-day field evaluation at Camp Lejeune, North Carolina, 21 subjects participated in studies which revealed that permethrin-treated clothing showing protected against chigger mites. Pressurized sprays of commercially available permethrin (0.5%) or DEET (20% or 30% concentrations) applied to military field uniforms were evaluated as protectants against bites from the tick *Ixodes dammini* at Great Island, West Yarmouth, Massachusetts, USA (where lyme disease and babesiosis are ongoing problems) in May 1984. A one-minute application of

permethrin to the exterior surface of pants and jackets provided 100% protection against attack by all life stages of the tick, whereas application of DEET provided much less protection. Field evaluations in Harford County, Maryland in the summer of 1988 revealed similar results in terms of protecting service members from bites of local ticks. Investigations involving US Army Natick laboratories showed that long-lasting permethrin clothing impregnations can be achieved in an industrial dye bath process with both polyester-cotton and nylon-cotton uniform fabrics.



A preventive medicine technician with the Marines 1st Force Service Support Group sprays permethrin onto uniforms in Kuwait in February 2003.

Current status:

Although useful as a topical treatment for head lice and scabies, permethrin is ineffective as an insecticide when applied to the skin because the compound does not bond to the skin and is quickly deactivated by skin's esterase actions. Permethrin is effective as an insecticide when used as a clothing or bed net treatment. (Currently, only pyrethroid-treated insecticides are approved for application to bednets, and sleeping under such pyrethroid-treated bednets is an important lifesaving tool in preventing malaria in both military and civilian populations residing in malarious areas.) Unlike DEET, which can harm some fabrics and plastics, permethrin is an odorless, water-based and ultimately biodegradable compound with low mammalian toxicity which will not damage plastics and is harmless to natural and synthetic fabrics, even silk, and is somewhat resistant to degradation by sunlight (ultraviolet light). Permethrin's insecticide effect can last 2-6 weeks despite weekly launderings but is promptly removed by dry cleaning. A cumulative "herd effect" has been noted when a large group of personnel wearing permethrin-treated uniforms is congregated. Service members are directed to wear both permethrin-treated clothing and topical DEET applied to the skin when entering regions where vector-borne diseases exist.

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