

Preliminary Report on Mosquito Repellents

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During the season of 1942 certain proprietary mosquito repellents and various chemical combinations were tested at Lafayette, Indiana, to determine their efficacy in repelling mosquitoes.

Materials Tested: Of the repellents tested the following five gave the most promising results: Repellent 1, which consisted of one part



Fig. 1. Biting frequency per minute was determined by exposing untreated arm for five minutes to mosquito attack.

oil of cedar wood, two parts oil of citronella, and two parts spirits of camphor; repellent 2, which consisted of four parts diethylene glycol monoethyl ether acetate and one part of castor oil; repellent 3, which consisted of four parts diethylene glycol monoethyl ether and one part

of castor oil; repellent 4, which consisted of one part oil of eucalyptus, one part oil of lavender, one part oil of thyme, one part oil of pennyroyal, one part oil of rosemary, and two-thirds part linyl acetate; repellent 5, which was *Sta-Way*, a proprietary compound. No active ingredients were given on the label of this material. The inert ingredients are alcohol, 28 per cent, and corn oil, 7 per cent.

Methods and Procedure: Six subjects, who varied in their susceptibility to mosquito attack, were used to test the efficiency of the repellents. The reactions of a number of people as to whether the odor of each of the repellents was pleasing, neutral or objectionable were obtained.

Tests were also made to determine if the repellents had an irritating effect on the skin and if they stained or bleached various kinds of cloth.

Specimens of the mosquitoes present at each test were collected. It was found that there was always two or more species present, the most common of which was *Aedes vexans*.

The procedure, which followed that used by Granett* rather closely, was as follows:



Fig. 2. The repellent was applied to arm with a rubber-handled glass rod.

1. At the beginning of the test an untreated arm or leg of the subject was exposed for five minutes so as to determine the biting frequency per minute of the mosquitoes before the application of the repellent (Fig. 1). No results are reported here in which the biting frequency was less than four per minute. 2. One cc. of the repellent to be tested was spread evenly by means of a rubber handled glass rod on the arm, or two cc. on the leg of the subject (Fig. 2). 3. The treated arm or leg was exposed continuously to the attack of the mosquitoes throughout the test while the rest of the body was kept covered except that an untreated leg or arm was exposed for two minutes at 10 minute intervals

* Granett, Philip. Studies of Mosquito Repellents. Jour. Econ. Ent. **33**(3); 563-572. 1940.

to determine the biting frequency during the process of the test. It was found that a common bee-veil was effective in protecting the face, head and neck against the attack of the mosquitoes (Fig. 2). 4. The lapse of time between the exposure of the treated arm or leg and the first definite mosquito bite was recorded as the repellent time. The time between the first and second bite was also recorded.

Results: The repellent time of each of the five repellents reported on at this time is shown in figure 3.

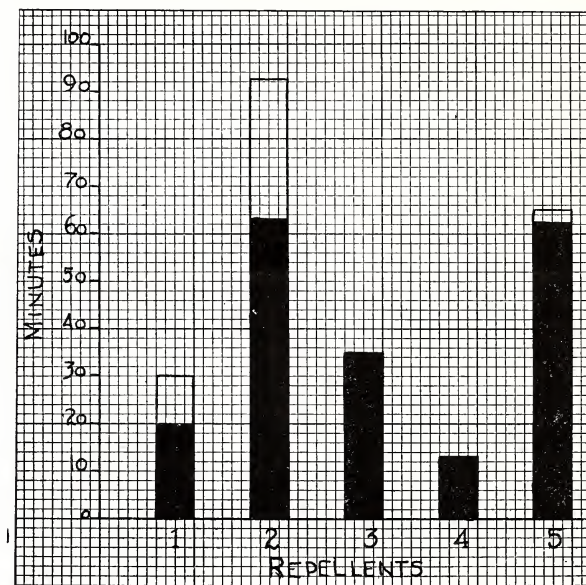


Fig. 3. Graph showing repellent time of various repellents. The black area shows the average repellent time.

Repellent 1 repelled the mosquitoes for 20 minutes on the average and for a maximum of 30 minutes not only from the treated surface of the body, but also from the immediate vicinity of the subject for a distance of five to ten feet. This material stained the least of any of those tried. It had no irritating effect on the skin, nor was its odor objectionable, especially when used in the open.

Repellent 2 repelled for 63 minutes on the average and for a maximum of 92½ minutes. It was nonirritating and had but a slight odor. However, it repelled the mosquitoes only from the surfaces where it was applied. Although not as consistent in its repellent time as Repellent 5, its maximum repellent time was 27 minutes longer.

Repellent 3 was effective for 35 minutes but it protected only the parts where it was applied. It stained only slightly and had no irritating effect on the skin. Its odor was pleasing to most people.

Repellent 4 repelled mosquitoes for 13 minutes, making it the least effective of the mixtures reported here. It protected only the treated areas and has a rather nauseating odor, especially when used in inclosed areas.

Repellent 5 repelled for 62 minutes on the average with a maximum repellent time of 65 minutes. It was the most consistent in its results of all of the repellents used, the range of repellent time on three subjects was from 56 to 65 minutes. However, it protected only the areas treated and stained more than any of the above preparations. It caused a slight irritation to the skin of three out of seven subjects, especially when applied to the face.

Although all of the mixtures used stained somewhat, these stains were in all cases removed by either a cleaning fluid (carbon tetrachloride) or by soap and water.