

Laboratory Evaluations of Controlled-Release Repellent (Neem Oil and Deet) Treated Papers on Human Volunteers against Mosquitoes

Dong-Kyu Lee, Won Ja Lee¹, Jong Hwa Kim¹ and Yoon Sik Lee¹

Department of Biological Sciences, Kosin University,

¹Division of Medical Zoology, National Institute of Health

Three controlled-release personal-use paper insect repellent formulations of 5% N,N-diethyl-3-methylbenzamide (deet), 10% and 15% neem oils were evaluated in mosquito cages in an environmental chamber on volunteers for their repellency effects against three mosquito species, *Culex pipiens pallens*, *Aedes aegypti* and *Ae. togoi*. The tests were conducted in the chamber maintained at 27 ± 1 °C and relative humidity $75 \pm 5\%$. The light intensity was regulated at 200-300 lux for the testing of day-biting mosquitoes and at about 10-50 lux for the night biters. For testing, each repellent treated paper (3x10x0.5 cm or 3x10x1.0 cm) was attached onto a 3x10 cm marked area of one forearm of each of 2 human volunteers (27 years old). Each arm was covered by a paper sleeve with a 3x10 cm exposed area corresponding to the marked and treated site. In width of 0.5 cm of repellent paper tests, all 10% and 15% neem oil, and 5% deet effectively provided 81% or better repellency ($P < 0.05$) for 6 hours against *Cx. pipiens pallens*. Three kinds of repellent treated papers demonstrated equal repellency against the mosquito species. Mean biting on the control was 1.6 ± 1.8 bites. On the other hand, those on 10% and 15% neem oil, and 5% deet were 0.3 ± 0.2 , 0.3 ± 0.3 , and 0.1 ± 0.2 bites, respectively. All tested repellent papers had significant repellency against *Ae. aegypti* showing average of over 40%. However, 5% deet (avg. 67% repellency) had significantly greater repellency than 10% and 15% neem oils. In the test of *Ae. togoi*, 10% and 15% of neem oil treated papers did not show mosquito repellency but 5% deet had repellency (avg. 54%). The results in width of 1.0 cm of repellent paper tests were not much different with those of the 0.5 cm paper tests against *Ae. togoi*. In short, the neem oil treated papers were not effective against three species of mosquitoes, and repellency was not directly related to the neem oil concentration in the two different controlled-release repellent formulations. Deet provided protection against *Cx. pipiens pallens*, *Ae. aegypti* and *Ae. togoi* for at least six hours. The results of the environmental chamber evaluations confirmed the responses for each repellent treatment obtained under cage conditions. The best protection under the indoor condition was provided by the 5% deet treated paper. This study demonstrates the potential of 5% deet as paper repellent against both day- and night-biting mosquitoes. The two neem oils can not be formulated with papers as mosquito repellents in various forms to replace deet, the most common chemical repellent currently available.