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Insecticidal and Behavioral Avoidance Responses of *Anopheles minimus* and *Culex quinquefasciatus* (Diptera: Culicidae) to Three Synthetic Repellents

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Abstract

Escape responses, knockdown (KD), and toxicity of laboratory strains of *Anopheles minimus* Theobald and *Culex quinquefasciatus* Say to three synthetic mosquito repellents, DEET (*N*, *N*-diethyl-3-methylbenzamide), IR3535, or picaridin, at 5% v/v concentrations, were evaluated using repellent-treated papers in standard WHO tube assays and an excito-repellency (ER) test chamber system. The tube assays recorded knockdown effects of each repellent immediately after 30-min exposure and the final morality following a 24-h holding period. DEET showed 100% KD at 30 min and complete toxicity at 24 h against both species. Both actions were either minimal or absent for IR3535 and picaridin, respectively. *Culex quinquefasciatus* showed significantly greater escape with DEET compared with the other compounds in both contact irritancy (excitation) and noncontact spatial repellency trials. *Anopheles minimus* showed much more pronounced irritancy and repellency flight escape to IR3535 than picaridin. DEET was the most active irritant and repellent compound against *Cx. quinquefasciatus*. When adjusting contact test responses based on paired noncontact repellency assays, DEET and IR3535 showed much stronger spatial repellent properties than irritancy with *An. minimus*. Picaridin performed poorly as an irritant or repellent against both species. We conclude that DEET, followed by IR3535, act as strong spatial repellents at 5% concentration. DEET also performs as a strong toxicant. Our findings show that different mosquitoes can respond contrastingly to repellents, thus the importance to test a wider range of species and populations to assess the full range of chemical action.

Key words: DEET, IR3535, picaridin, mortality, excito-repellency

Mosquito-borne diseases are important public health issues globally, particularly in tropical and subtropical areas with limited means of prevention. Among the most successful tools for minimizing the transmission risk of diseases like malaria and dengue fever has been the use of various forms of vector control. Chemical control using synthetic chemicals remains a common and useful means of reducing pathogen transmission and protection from mosquito bites. However, this approach has had several drawbacks, including recurring high costs, being labor intensive, the development of chemical resistance in target vector populations, and the possibility of unintentional environmental contamination adversely impacting nontarget organisms. The routine application of chemicals has inevitably led to the selection of numerous insecticide-resistant mosquito populations and species worldwide (including Thailand), thereby

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