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EVALUATION OF A NONCONTACT, ALTERNATIVE MOSQUITO REPELLENT ASSAY SYSTEM

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ABSTRACT. A novel noncontact repellency assay system (NCRAS) was designed and evaluated as a possible alternative method for testing compounds that repel or inhibit mosquitoes from blood feeding. Deet and *Aedes aegypti* were used in a controlled laboratory setting. Using 2 study designs, a highly significant difference were seen between deet-treated and untreated skin placed behind the protective screens, indicating that deet was detected and was acting as a deterrence to mosquito landing and probing behavior. However, a 2nd study showed significant differences between protected (behind a metal screen barrier) and unprotected (exposed) deet-treated forearms, indicating the screen mesh might restrict the detection of deet and thus influences landing/biting response. These findings indicate the prototype NCRAS shows good promise but requires further evaluation and possible modification in design and testing protocol to achieve more desirable operational attributes in comparison with direct skin-contact repellency mosquito assays.

KEY WORDS Deet, *Aedes aegypti*, noncontact repellency assay system, repellency, protection time

INTRODUCTION

Human-biting mosquitoes remain a significant cause of suffering due to blood feeding and as vectors of disease pathogens such as *Plasmodium* parasites and dengue viruses. Transmission of pathogens is dependent on complex interactions between environment, pathogenic agents, disease vectors, and behavior of susceptible human hosts. Natural or induced manipulations of any of these factors can play an important role in influencing risk of disease transmission. One of the most effective means for combating disease transmission has been through use of chemicals for reduction of vector population densities relative to humans, decreased longevity of adult vectors, or use of personal protection methods (e.g., treated bed nets) that prevent blood feeding (Roberts et al. 1997, Chareonviriyaphap et al. 2013, Debboun and Strickman 2013).

A variety of chemical compounds, either natural or synthetic-based, can provide varying levels of protection from blood-feeding insects by 2 major modes of actions, either as repellents (so-called "excito-repellency," a combination of excitation caused by physical contact with a chemical and spatial repellency without need for physical contact) operating at sublethal doses and/or as toxins at concentrations sufficient to kill the insect (Roberts et al. 1997). Most studies have focused on the toxic action of chemicals, whereas fewer investigations have directed attention to the excito-repellent properties, leading to behavioral avoidance and reduced vectorial capacity (Grieco et al. 2007).

One of the most common insect "repellent" active ingredients available is *N,N*-diethyl-*m*-toluamide (or diethyl methylbenzamide), commonly referred to as deet, a synthetic compound developed in 1946 that has been used for decades by tens of millions of people (McCabe et al. 1954, Katz et al. 2008). This compound is found in the majority of commercial topical (skin) applications and products to prevent mosquito bites (Debboun and Strickman 2013). This compound has long been demonstrated to provide excellent, broad-spectrum protection against most mosquitoes and other blood-sucking arthropods (Schreck 1985, Curtis et al. 1990, Frances 2007, Lupi et al. 2013). Typically described as a repellent with a similarly defined mode of action (i.e., noncontact spatial detection of chemical producing avoidance from the source), others have shown that deet can also inhibit an insect's odor-activated receptors thereby effectively masking the presence of a host and preventing blood feeding (Ditzen et al. 2008, Bohbot and Dickens 2010). Whether deet performs primarily as a spatial excito-repellent or an inhibitor, or whether it has additional modes of action producing multiple disruptive effects on mosquito behavior, it remains the leading topical active ingredient in use today.

Numerous other synthetic chemicals have been evaluated for repellent activity against mosquitoes

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