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Avoidance Behavior to Guava Leaf Volatile Oil by Three Medically Important Mosquito Vectors

Pairpailin Jhaiaun,[1] Amonrat Panthawong,[1] Chutipong Sukkanon,[2,] and Theeraphap Chareonviriyaphap[1,3,]

[1]Department of Entomology, Faculty of Agriculture, Kasetsart University, Bangkok, 10900, Thailand, [2]Department of Medical Technology, School of Allied Health Sciences, Walailak University, Nakhon Si Thammarat, 80160, Thailand, and [3]Corresponding author, e-mail: faasthc@ku.ac.th

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Abstract

Volatile organic compounds from various plants have received popular interest as one of the vector control tools due to their eco-friendliness and insect-repellent activities. In this study, an excito-repellency assay system was used to examine the noncontact repellency, contact excitation, and knockdown (KD) effects of guava leaf (*Psidium guajava* L.) oil against *Anopheles minimus* (Theobald), *Anopheles epiroticus* (Linton & Harbach), and *Culex quinquefasciatus* (Say). The organic components of guava oil were identified by gas chromatography–mass spectrometry analysis with DL-limonene (17.4%), cymene (5.49%), and α-terpinene (5.20%) as the major constituents. At concentrations of 2.5 and 5.0%, 100% escape of *An. minimus* was recorded in the contact assay and 96–98% escape in the noncontact assay. Guava oil stimulated potent irritant (92% escape) and repellent (61–86% escape) effects against *Cx. quinquefasciatus*. A lower repellency action was observed against *An. epiroticus* (17–20% escape). No KD effect was observed for guava oil against *An. minimus* and *Cx. quinquefasciatus* at any concentration. However, *An. epiroticus* was more prone to KD effects, with the highest percentage KD (44% in nonescape group) observed with 5.0% guava oil in the noncontact assay. Mortalities of 35% and 11% were observed for *An. epiroticus* in the nonescape groups in the contact and noncontact assays, respectively. Concentrations of 1.0% and 2.5% guava oil led to <2% mortality in *An. minimus*. Our findings highlight guava oil as a promising plant-based mosquito repellent that can be included in insecticide formulations for future mosquito control programs.

Key words: *Anopheles epiroticus*, *Anopheles minimus*, *Culex quinquefasciatus*, excito-repellency, *Psidium guajava*

Anopheles minimus (Theobald) is one of the most important malaria vectors in the forested regions of Southeast Asia, including Thailand (Sinka et al. 2012, Tananchai et al. 2019). *Anopheles epiroticus* (Linton & Harbach) is a secondary malaria vector in Thailand that is primarily found along coastal areas with brackish water habitats (Sinka et al. 2012). *Culex quinquefasciatus* (Say) is an urban species and is a potential vector for *Wuchereria bancrofti* that causes human lymphatic filariasis (Chareonviriyaphap et al. 2000). Prevention of human-to-mosquito contact either by insecticides or repellents remains the most effective means of disease prevention (Maia and Moore 2011). However, the use of insecticides comes with the risk of resistance development, which has made current insecticides (e.g., temephos, fenitrothion, lambda-cyhalothrin, deltamethrin, propoxur) less effective (Achee et al. 2012, Chareonviriyaphap et al. 2013; Amelia-Yap et al. 2018). Cases of acute poisoning in humans due to exposure to chemical insecticides have been reported as a public health concern (Narendra 2008, Gifford et al. 2019). This has led to investigation into the use of numerous plant-based compounds as an alternative vector control approach (Desgrouas et al. 2016, Tisgratog et al. 2018, Nararak et al. 2020, Sukkanon et al. 2020). Several studies on bioinsecticides have also demonstrated that these compounds are less toxic to humans and the environment (Thorsell et al. 1998). Therefore, the insect-repellent properties of natural compounds should be integrated into the current vector control programs (Tisgratog et al. 2018).

Psidium guajava (L.), known as "guava", has been used as a medicinal plant for decades (Joseph and Priya 2011). Guava is an evergreen shrub, with smooth peeling bark, a white flower, and yellow fruits with pink flesh. It is used in a wide range of traditional medicines to treat disease symptoms (Lutterodt 1989, Jaiarj et al.

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