Journal of Medical Entomology, 55(1), 2018, 193–199
doi: 10.1093/jme/tjx188
Advance Access Publication Date: 6 October 2017
Research Article

Evaluation of the Constituents of Vetiver Oil Against *Anopheles minimus* (Diptera: Culicidae), a Malaria Vector in Thailand

Rungarun Tisgratog,[1] Chutipong Sukkanon,[1] John P. Grieco,[2] Unchalee Sanguanpong,[3] Kamlesh R. Chauhan,[4] Joel R. Coats,[5] and Theeraphap Chareonviriyaphap[1,6]

[1]Department of Entomology, Faculty of Agriculture, Kasetsart University, Bangkok 10900, Thailand, [2]Department of Biological Sciences, Eck Institute for Global Health, University of Notre Dame, 243 Galvin Life Science, Notre Dame, IN 46556, [3]Faculty of Agriculture Technology, Rajamangala University of Technology Thanyaburi, Patumthani 12110, Thailand, [4]Invasive Insects Biocontrol and Behavior Laboratory, USDA-ARS, BARC-West Building 007, Room 303, 10300 Baltimore Avenue, Beltsville, MD 20705, [5]Department of Entomology, Iowa State University, Ames, IA 50011-3140, [6]Corresponding author, e-mail: faasthc@ku.ac.th

Subject Editor: Lawrence Hribar

Received 7 April 2017; Editorial decision 28 August 2017

Abstract

The development of resistance by mosquitoes to current synthetic compounds has resulted in reduced effectiveness of prevention and control methods worldwide. An alternative nonchemical based control tools are needed to be evaluated particularly plant-derived essential oils. Several components of vetiver oil have been documented as insect repellents. However, detailed knowledge of those components action against insect remains unknown. In this study, behavioral response of *Anopheles minimus* to four constituents of vetiver oil (valencene, terpinen-4-ol, isolongifolene, vetiverol) was evaluated by using the high-throughput screening assay system. Vetiverol and isolongifolene exhibited strong contact irritancy action at 1.0% (80.2% escaping) and 5.0% (81.7% escaping) concentration, respectively, while moderate action was found in both valencene and terpinen-4-ol at 5.0% (57.6% escaping). Only at 1.0% (0.7 spatial activity index [SAI]) and 5.0% (1.0 SAI) of valencene and 0.5% (0.7 SAI) of isolongifolene showed spatial repellency activity. High mortality (58.9–98.2%) was recorded in all concentration of vetiverol and isolongifolene. Meanwhile, valencene exhibited high mortality only at 5.0%, terpinen-4-ol showed very low toxic action (0–4.3%) in all concentration. These proved that valencene in vetiver oil is the promising constituent that can be developed as an alternative mosquito control mean in efforts to prevent disease transmission.

Key words: Vetiver oil, contact irritancy, spatial repellency, *Anopheles minimus*, natural repellents

Malaria is one of the most common infectious diseases and a worldwide public health problem, including the country of Thailand (Manguin et al. 2008, Sriwichai et al. 2016). The greatest number of cases of malaria continues to occur in provinces that share a border with Myanmar, Cambodia, and Laos, especially in forested and forest fringe areas of these provinces (CDC 2013, Sriwichai et al. 2016). The number of confirmed malaria cases reported in these regions of Thailand demonstrated a decrease from 2.9 million to 1.6 million cases between the years 2000 to 2014. Thailand projects to achieve an additional 50% decrease in case incidence by 2015 (WHO 2016). In 2014, a reported 37,921 confirmed cases and 38 reported deaths occurred in nationwide (WHO 2016) and 5,933 known malaria cases and four deaths in 2015 (Bureau of Epidemiology 2016). In 2015, the proportion between *Plasmodium falciparum* and *P. vivax* was 1:1 (*P. falciparum* 50% [up to 75% in some areas] and *P. vivax* 50% [up to 60% in some areas]) with *Plasmodium vivax* being higher on the Thai side of the border (CDC 2016). *Plasmodium ovale*, *Plasmodium malariae*, and *Plasmodium knowlesi* have been found in small portions (CDC 2013).

Anopheles minimus is the primary malaria vector in Thailand (Rattanarithikul et al. 2006, Manguin et al. 2008, Saeung 2012). Indoor residual spraying, impregnated mosquito nets, and alternative vector control strategies such as fogging, the use of mosquito repellents, and bioenvironmental control have all been used in the current mosquito control programs in Thailand.

The use of synthetic insecticides for mosquito control has negatively impacted biological control efforts as the result of their effects on nontarget organisms and natural predators (Gill and Garg 2014). It has also resulted in the development of insecticide resistance as well as having undesirable effects on the environment and human health (Thomas et al. 2004, Gokulakrishnan et al. 2013). Safer and more environmental friendly alternatives, such as plant essential oils,