Identification of Elevated Esterase Activity in a Pyrethroid-Resistant Population of *Anopheles albimanus* Wiedemann

Theeraphap Chareonviriyaphap[a,*], Claudia F Golenda[b], Donald R Roberts[c] and Richard G Andre[c]

[a] Division of Biology, Faculty of Liberal Arts and Science, Kasetsart University, Kamphaengsaen Campus, Nakhon-Pathom 73140 Thailand.

[b] Department of Entomology, Walter Reed Army Institute of Research, Washington DC 20307-5100 USA.

[c] Department of Preventive Medicine and Biometrics, USUHS, 4301 Jones Bridge Road, Bethesda, MD 20814-4799 USA.

* Corresponding author: Fax: +66-34-351894 Tel: +66-34-351895 E-mail: faasthc@nontri.ku.ac.th

Received 21 Apr 1999

ABSTRACT The standardized diagnostic World Health Organization (WHO) susceptibility test was used to evaluate DDT, permethrin, and deltamethrin on 2 laboratory colonized populations of *An. albimanus* from El Salvador (Santa Tecla) and Guatemala (El Semillero) and 2 field populations from northern (Corozal District) and southern (Toledo District), Belize. The Santa Tecla colony and Corozal field population were susceptible to all 3 compounds while the El Semillero colony showed resistance to all 3 compounds. The Toledo field population showed some resistance to DDT. The specific activity of esterase was measured in 5 populations of *An. albimanus*. These included Santa Tecla colony from El Salvador, El Semillero colony from Guatemala, Cayo population from Central Belize, Toledo population from Southern Belize, and Corozol population from Northern Belize. There was a 4 to 7 fold increase in the specific activity of esterase as measured by the hydrolysis of alpha- and beta- naphthylpropionate in the El Semillero colony compared to all the other populations, to include the TO population. This suggests that the development of physiological resistance to synthetic pyrethroids in the El Semillero colony from Guatemala may be related to increased esterase activity. Based on these overall results, permethrin and deltamethrin are potentially useful for *An. albimanus* control in Belize. The use of DDT in Toledo District seems effective, but warrants close monitoring in the future.

KEYWORDS: *Anopheles albimanus*, pyrethroid resistance, esterase activity.

INTRODUCTION

Resistance to insecticides has been recorded in 504 species of arthropods.[1] This includes *Anopheles albimanus* Wiedemann, one of the most important malaria vectors in Central and South America.[2] This species has demonstrated resistance to all major types of insecticides, including organochlorine compounds such as DDT; organophosphorus compounds such as malathion and fenitrothion; carbamates such as propoxur and bendiocarb; and synthetic pyrethroids such as permethrin and deltamethrin.[3]

The conventional method for measuring resistance is based on the World Health Organization (WHO) susceptibility test[4] which requires a comparatively high number of mosquitoes for testing. This susceptibility test can be complemented by biochemical assays that may give additional information on the underlying mechanisms of insecticide resistance. Two biochemical techniques, the microplate assay and the filter paper test, are often used to evaluate enzyme levels in field populations.[5] These tests are based on reactions that produce visual color differences. Biochemical tests can be used under field conditions without sophisticated equipment,[6] several insects can be evaluated simultaneously, and the same insect can be tested for other enzymes.[7] Esterase activity is often evaluated in organophosphate, carbamate-, and pyrethroid-resistant mosquitoes.[8] A microtiter plate technique was used to detect elevated levels in organophosphate and pyrethroid resistant *An. albimanus*.[3]

In this study, we conducted series of susceptibility tests using the standard WHO diagnostic test on the colonized populations from El Salvador and Guatemala, and 2 field populations of *An. albimanus* from Toledo and Corozal Districts, Belize. In addition, supplementary data were obtained by using the microtiter plate assay to measure the level of whole body esterases in *An. albimanus* obtained from 2 colonies (El Salvador and Guatemala) and 3 field populations from Belize.