

SUSCEPTIBILITY OF MOSQUITO LARVAE TO CONVENTIONAL INSECTICIDES IN A TROPICAL ARID ECOSYSTEM

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ABSTRACT

The susceptibility of 4th instar larvae of Aedes aegypti and Culex quinquefasciatus to dieldrin, dichlovos and cypermethrin were evaluated in laboratory. Larval mortality was assessed 24 hour after exposure. The result showed that the LD₅₀ values for Aedes aegypti exposed to dieldrin, dichlovos and cypermethrin were 0.48, 37.09 and 0.29 µg per liter respectively. The LD₅₀ values for Culex quinquefasciatus of exposed to dieldrin, dichlovos and cypermethrin were 0.11, 10.05 and 0.05 µg per liter respectively.

Keywords: *Aedes aegypti*, *Culex quinquefasciatus*, LC₅₀, Dieldrin, Dichlovos, Cypermethrin.

INTRODUCTION

The development of resistance in mosquitoes to a wide variety of conventional insecticides has posed a serious problem for vector control program (Brown, 1986; Boike *et al.*, 1989; WHO, 1992; Deedat, 1994; Chandre *et al.*, 1999). These invariably led to the development of new insecticides for mosquito control besides the use of other control measures and multiple overdosed treatments, thus fostering serious human health concerns (Rozendaal, 1997; Brown, 1983). Pesticide resistant is a major constraint to mosquito control (Busvine, 1978).

To keep tract of these problems, the screening for susceptibility status of mosquitoes in the local environment is imperative. Little work is done to establish the susceptibility status of mosquitoes to commonly used insecticides in arid tropical ecosystem of Maiduguri, Nigeria.

The present study compares the susceptibility status of larvae of two vector mosquito species viz: *Culex quinquefasciatus* and *Aedes aegypti* to three conventional insecticides (Dieldrin, Dichlovos and Cypermethrin) using field strains of mosquitoes.

MATERIALS AND METHODS

Study Areas: The study was conducted in Maiduguri located in the Sahel Savanna region of Northeastern Nigeria at latitude 11°05' North and longitude 13°05' East (BSBLS, 2004). Maiduguri has mean annual rainfall of about 625 mm. The mean annual temperature and is about 32°C. The mean annual relative humidity for dry and rainy seasons was 40% and 60% respectively while the mean annual evaporation rate is about 1600 mm (Marte, 1986).

Dieldrin: Old stock of dieldrex 20 EC was obtained from a pesticide store. Dieldrex is a brand of dichlovos with a chemical formula: C₁₂H₈Cl₆O. It is a contact and stomach poison with highly mammalian toxicity. They are Persistent insecticide (Kumar, 1984). The stock

solution was serially diluted to obtain 20, 40, 60, 80 and 10 µg per liter.

Dichlovos: Nuvan 100EC was purchased from a pesticide store in Maiduguri. Nuvan is a brand of dichlovos with a chemical formula: C₄H₇Cl₂O₄P. It is a fumigant, contact and stomach poison with low mammalian toxicity (Kumar, 1984). The stock solution was serially diluted to obtain 20, 40, 60, 80 and 10 µg per liter.

Cypermethrin: Cypercot 25 EC was purchased from a pesticide store in Maiduguri. Cypercot 25EC is a brand of cypermethrin with a chemical formula: C₂₂H₁₉Cl₂NO₃. It is a contact poison with low mammalian toxicity (Kumar, 1984). The stock solution was serially diluted to obtain 20, 40, 60, 80 and 10 µg per liter.

Rearing of Mosquitoes: The larvae of *A. aegypti* and *C. quinquefasciatus* were collected from their natural breeding habitats in Maiduguri, Borno State. The adults of both sexes were fed with 10 % glucose solution (Sneller and Dadd, 1977). In addition, females were fed on blood meal twice a week from restrain chicken with shaved abdominal feathers (Azmi *et al.*, 1998). A 250 ml glass beaker containing 150 ml of distilled water with a filter paper smoothly adhered to the inner wall serves as oviposition sites for *A. aegypti* and a plastic container with little quantity of water serve as oviposition sites for *C. quinquefasciatus*. The larvae of each species were separately held in plastic containers and were daily fed on a pinch of finely powdered liver and brewer's yeast mixed at the ratio of 3: 2 (wt: wt) (Roberts, 1998).

Laboratory Bioassay: A batch of 20; 4th instars larvae of *A. aegypti* or *C. quinquefasciatus* were separately exposed to 20, 40, 60, 80 and 10 µg of dieldrin, dichlovos and cypermethrin per liter of distilled water respectively. Larval mortality was assessed after 24 hours after exposure. The experiment was conducted at 37 ± 5 °C and 80 – 90 % relative humidity. The data obtained was subjected to probit

analysis using Statsdirect Statistical Software Version 4.2. (Statsdirect, 2005).

RESULTS

The result of the study is presented in table 1. The result showed that the LD₅₀ values for *A. aegypti* exposed to dieldrin, dichlovos and cypermethrin were 0.48 37.09 and 0.29 µg per liter respectively. The LD₅₀ values *C. quinquefasciatus* exposed to dieldrin, dichlovos and cypermethrin were 0.11, 10.05 and 0.05 µg per liter respectively.

Table 1: Comparative toxicity of synthetic insecticides to *A. aegypti* and *C. quinquefasciatus*

Insecticide	Mosquito species	
	<i>A. aegypti</i>	<i>C. quinquefasciatus</i>
Dieldrin	0.481 (0.60-0.05)2	0.111 (0.16-0.08) 2
Dichlovos	37.09 (42.13-32.63)	10.05 (13.62-6.89)
Cypermethrin	0.29 (0.40-0.23)	0.05 (0.59-0.03)

L LD₅₀ values in µg per liter, 295 % Confidence interval

DISCUSSIONS

Pesticide resistant is a major constraint of insect vector control (Busvine, 1978). Resistance in pest or vector population is expected to develop quickly whenever all individuals in the population are intensively selected with insecticides for several generations (Malcom, 1988). Results obtained in this study reveal that both *A. aegypti* and *C. quinquefasciatus* are less susceptible to dichlovos but more susceptible to cypermethrin and dieldrin. This confirms the findings of Molta and Ali (1998) who indicates that permethrin is potent against *Anopheles* species in northeastern Nigeria. The high mortality recorded with cypermethrin could be due to intoxication effects at different levels of pharmacokinetic interaction, thus; penetration of barrier tissue, distribution, storage, metabolism in internal tissue, and molecular interaction with the target site (Narahashi, 1976; WHO, 1980; Shamaan *et al.*, 1993; Curtis *et al.*, 1996).

Several other studies have revealed organophosphorus resistance in various species of mosquitoes (Don-Pedro and Adegbite, 1985; Amin and Peiris, 1990). The present study has shown that *A. aegypti* and *C. quinquefasciatus* were less susceptible to dichlovos. Thus their use in mosquito control may not be effective in the local environment. However, studies by Georghiou, (1980) and WHO (1992) showed that dichlovos could be use in mosquito control with effective resistance management techniques. These authors used higher concentrations than the ones used in this study. Although the present study did not indicate selection to dieldrin and cypermethrin in the local environment, other studies have revealed the resistance of mosquitoes to dieldrin (WHO, 1986; Amin and Hemingway, 1989) and cypermethrin (Chandre *et al.*, 1999). The studies of Kristan *et al.* (2003) revealed that resistance to pyrethroid insecticides was caused by the *kdr* gene in the malaria vector *Anopheles gambiae* Giles s.s. (Diptera: Culicidae).

Although the present study indicates that both mosquito species were susceptible to dieldrin and cypermethrin, the later is recommended for mosquito control because dieldrin has undesirable effects (Metcalf, 1980) and has been banned in many countries including Nigeria. As suggested by Dorta *et al.* (1993) synthetic pyrethroids could be effectively employed in integrated vector control operations. However, several reports have shown resistance to pyrethroids in several species of mosquitoes (WHO, 1992; Vulule *et al.*, 1994). Their results further revealed that *A. aegypti* is less susceptible to all the three insecticides than *C. quinquefasciatus*. This could be due to interplay of several factors Viz: biochemical (Hill, 1985), genital (Hemingway, 1983), behavioral (Miller and Gibson 1994) and physiological (Lockwood *et al.*, 1984).

It is concluded from the present study that, of the insecticides tested cypermethrin can be effectively used for controlling mosquito vectors and shall play a vital role in reducing the morbidity and mortality of mosquito borne-diseases in northeastern Nigeria and other mosquito endemic countries. However, pyrethroids insecticides could be used rationally, otherwise resistance problem to these insecticides will appear in the local environment in the future.

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