ASSESSMENT OF MOSQUITO DIVERSITY AND EVALUATION OF IMPACT OF HOUSE TREATMENT WITH DDT ON THEIR POPULATION IN AMAURO, OKIGWE LOCAL GOVERNMENT AREA, IMO STATE, NIGERIA.

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Abstract

Malaria, a disease that has increasingly been ravaging human population still has no sustainable remedy. Therefore, mosquito diversity and impact of house treatment with dichlorodiphenyltrichloroethane (DDT) on their population were investigated by the use of miniature Centre for Disease Control light trap (model 512) and WHO – approved compression sprayer in Amauro, Okigwe Local Government Area, Imo State, Nigeria. A total of 9,114 adult mosquitoes belonging to Anopheles, Aedes and Culex genera were captured and identified in this study prior to the DDT indoor residual spray. Virtually all the living houses (93) in the area were treated with a total of 25kg of DDT active ingredient (concentration of DDT active ingredient: 10%). Mosquito populations reduced significantly (P<0.05) by 89.82% six months after house treatment with DDT. This shows that DDT insecticide is highly effective in controlling mosquito vectors. Mosquito species incriminated by this study suggest serious public health implications in the area.

Key words: *Mosquito, diversity, dichlorodiphenyltrichloroethane, indoor residual spray, public health.*

Introduction

Mosquitoes are obnoxious and notorious blood-sucking insect pests that have been ravaging human population through malaria attack (Gillies and Warrel, 1993). However, other mosquito-borne diseases transmitted by *Anopheles, Aedes and Culex* species such as bancroftian filariasis, yellow fever and arboviruses in general, which have serious public health implications on man abound (Udonsi, 1999). In recent time, World Health Organization (WHO) estimates that there are 300 – 500 million cases of clinical malaria per year, with 1.4 – 2.6 million deaths, mainly among African children (Curtis and Lines, 2000) in which Nigeria is part. Malaria is therefore a major cause of infant mortality and perhaps the only insect borne parasitic disease whose devastating impact is comparable to AIDS (Curtis, 2002). The importance of malaria has since alarmed the learned world and gingered concerned groups into action. The result of this concern was the development of anti-malaria drugs and vaccines but unfortunately these have not yielded sustainable results (Alonso *et al.,* 1994).

The vectors of human malaria all belong to the genus *Anopheles* whose adults are recognized by their dappled wings in most tropical species, “tail in the air” posture and long pair of palps beside the proboscis in the female (Imms, 1957). As in other mosquitoes, only the females bite.

In the absence of sustainable alternatives to malaria control (first motivational factor), scientists can afford to review vector control by DDT indoor residual spray. DDT is the first of the chlorinated organic insecticide that was originally prepared in 1873, but it was not until 1939 that Paul Muller of Geigy pharmaceutical in Switzerland discovered the effectiveness of DDT as an insecticide (Melanby, 1992). The unusual persistence of DDT is one feature of the insecticide that was initially attractive, because of the potential for long-term control of pests without re-application (Boul, 1994). In the 1950’s, DDT was used in agriculture in far larger quantities than against malaria mosquitoes which probably led to its ban for agricultural purposes in United States of America and some other countries (Enger *et al*., 1998).

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However, according to (WHO, 2004), reasonable number of countries have successfully used DDT in malaria control and an estimated 19 countries are currently using it to fight malaria while six other countries were listed as more recent users. These are Malaysia, Argentina, Guyana, Peru, Zimbabwe and Botswana. Meanwhile, as much as 31 countries of the world are planning to deploy the use of DDT in malaria control. These form part of the motivation of this study.

The aim of house treatment with DDT is to reduce the transmission of malaria and other mosquito-borne diseases by killing and reducing the longevity of mosquitoes that enter dwellings to rest after feeding (Curtis, 2002 and WHO, 2004). Therefore, this paper sought to assess mosquito diversity and evaluate the impact of DDT residual spray on the population of mosquitoes in Nigerian environment, by measuring and comparing the pre-treated and post-treated population of this notorious vector. Any data on mosquito diversity is highly relevant in predicting the public health implications of incriminated mosquitoes and planning preventative strategies in the control of the associated diseases. This work is part of a detailed study on the environmental implication of controlling mosquito vectors using DDT indoor residual spray at WHO recommended dose.

Materials and Methods

Study Area

This study was carried out in Amauro, a secluded village in Okigwe Local Government Area, Imo State, Nigeria. Okigwe lies between latitude 5.45 North and longitude 7.15 East and has a land mass of 326km^2 with a population of 93,911 (NPC – FOS, 2000). The village is practically sandwiched between extensive water bodies and rice paddies. The hydrology of the area varies from marshes, streams and to rivers.

Choice of Study Area

Amauro was chosen for this study because of its secluded location and nature of prevailing houses, as areas with mostly modern and painted houses may refuse access to spray homes. Moreover, Amauro possesses characteristics that are important in the ecology of mosquito vectors. For instance, vegetation of the place is thick, rainfall is heavy, water bodies and rice paddies are numerous. These conditions favour rapid breeding of mosquito vectors.

Determination of Pre-treated and Post-treated Mosquito Population in the Area

Miniature Centre for Disease Control (CDC) light traps (model 512) baited with 300 g of dry ice carbon IV oxide (CO_2) was used to sample host-seeking mosquito population prior to house treatment with DDT and six months after the indoor residual spray. Traps were hung inside and outside (at peripheries of homes) at heights ranging from 2 to 4 m in potential adult resting places. In the laboratory, collected mosquitoes were pooled into genus and species (to determine populations) using identification keys published by Edwards (1941), Hopkins (1952) and Chandler (1955) and further identified employing polymerase chain reaction (PCR).

House Treatment with DDT

Having obtained the consent of the people and with the assistance of some Village Leaders, the 93 living houses (347 rooms) in Amauro were virtually treated with DDT insecticide. A total of 25kg of DDT active ingredient (concentration of DDT active ingredient: 10%) was used in the house treatment. When all the wettable powder were mixed with about 175 litres of distilled water, the chosen WHO recommended dose of 0.002kg of DDT active ingredient per square metre (m^2) of sprayed surface was realised. Spraying of the insecticide was done using the compression sprayer calibrated in litres. About 1 litre of the resulting mixture was used to spray 2 rooms (about 72m^2 of wall surfaces). Houses were treated (as scientifically recommended) during the peak of dry season when most mosquitoes were not so abundant.

Assessment of the Effectiveness of DDT House Spray in the Control of Mosquitoes of the Study Area

Adult mosquito population in the area was determined using the miniature CDC light trap prior to the indoor DDT residual spray and re-determined six months after house treatment. Both results were statistically compared. If DDT insecticide significantly reduced mosquitoes in the area, invariably, it was effective in controlling malaria and other mosquito-borne diseases. Otherwise, it had no impact on mosquito vectors of the area.

Statistical Analysis

Population of mosquitoes, pre and post house treatment with DDT were compared statistically using the test of variance, Z – statistic (Wadley, 1967).

Results and Discussion

A total number of 9,114 adult mosquitoes representing eight species were captured during the study period prior to house treatment with DDT (Table 1). This result revealed mosquito species belonging to three genera (*Anopheles, Aedes and Culex*) which are known vectors of four different human diseases (Malaria, bancroftian filariasis, yellow fever and arboviruses in general).

These incriminated mosquito species in decreasing order of number were *Anopheles gambiae* 3,609(39. 60%), *Anopheles funestus* 1,686 (18.50%), *Culex quinquefasciatus* 1,185 (13.00%), *Anopheles pharoensis* 911 (10.00%), *Aedes aegypti* 775 (8.50%), *Culex pipiens fatigans* 547 (6.00%), *Anopheles rhodesiensis* 219 (2.49%) and *Culex trigripes* 182 (2.00%). The serious public health implications of these incriminated mosquitoes species is the possibility of outbreaks of infectious diseases in the area. That the genera, *Anopheles*, *Aedes* and *Culex* specialise in implicating the health of man is supported by numerous literatures (Evans, 1938; Gilliet, 1971; Okorie, 1978; Igbinosa, 1989 and Nwoke *et al*., 1993). Though all the four *Anopheles spp* captured in the study area were potential vectors of malaria, collected data revealed that *Anopheles gambiae* was the most important malaria vector in the area and a potential vector of yellow fever and arboviruses alike. This indicates a high potential for malaria transmission in the area as Wagbatsoma and Ogbeide (1995) documented these incriminated mosquitoes of the study area as potential vectors of mosquito-infectious diseases. That various mosquito vectors were implicated by this study can reasonably be attributed to the presence of ecological features in the area that favoured rapid breeding of mosquitoes. This was a significant observation. No wonder Amusan *et al*. (2005) reported high mosquitoes abundance in areas with rice paddies. It is now obvious why Amauro harboured various mosquito species.

From the findings of this study, a total number of 864 mosquitoes were captured after DDT applications in homes. This implied that mosquito populations reduced significantly ($P<0.05$) by 89.82% six months after house treatment with DDT (Table 1). This result agreed markedly with the spectacular about 95% reduction in mosquito populations recorded in equatorial Africa after DDT spraying (Curtis and Lines, 2000). The current mean high reduction of mosquitoes of the study area was undoubtedly as a result of the indoor DDT residual spray since mosquitoes' population reduced to about 10% after DDT application. Therefore, this study deduced that DDT when sprayed indoors at WHO recommended dose reduced significantly prevalence of malaria parasitaemia and other mosquito-borne diseases in the area. The inference here about the relationship between mosquitoes abundance and associated diseases is supported by Okorie (1978).

Table 1. Mosquito Diversity and Impact of DDT House Spray on their Populations in Okigwe L.G.A., Imo State, Nigeria.

MOSQUITO SPECIES CAPTURED	MOSQUITO POPULATION BEFORE DDT HOUSE SPRAY [n (%)]	MOSQUITO POPULATION AFTER DDT HOUSE SPRAY [n (%)]	PERCENTAGE REDUCTION OF MOSQUITO POPULATION AFTER DDT HOUSE SPRAY
Anopheles gambiae	3,609 (39.60)	274 (31.71)	92.41
Anopheles funestus	1,686 (18.50)	157 (18.17)	90.69
Culex quinquefasciatus	1,185 (13.00)	128 (14.81)	89.20
Anopheles pharoensis	911 (10.00)	124 (14.35)	86.39
Aedes aegypti	775 (8.50)	88 (10.19)	88.65
Culex pipiens fatigans	547 (6.00)	50 (5.79)	90.86
Anopheles rhodesiensis	219 (2.40)	43 (4.97)	80.37
Culex trigripes	182 (2.00)	__ __	100.00
TOTAL POPULATION OF MOSQUITOES [n (%)]	9,114 (100)	864 (100)	MEAN (%) ↓ 89.82

Conclusion

Based on the results of this study, the mosquito diversity of Amauro in Okigwe L.GA, Imo State, Nigeria suggests that the public health of residents of the area is implicated. However, house treatment with DDT proved effective in reducing significantly the population of mosquito vectors in the area.

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