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Study of 5AIGR and 5AIGNG Inesfly Paint in Selected Communities in North Central Nigeria: Review of a Technical Project Report

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Abstract

The need to apply innovative products in the management of malaria in Nigeria is encouraged by relevant policy. With the growing resistance to some known malaria vector insecticides, review was carried out for a mini-study that used wall cone bioassay on 5AIGR and 5AIGNG Inesfly Paint in GidanZakara of Keffi LGA and Masaka of Karu LGA, Nasarawa State, North Central Nigeria to determine the effectiveness (knock-down) of the products for the control of local mosquito vectors and the residual efficacies of the products on the local mosquito vectors over a period of six months. The presented communication constitutes a review on the effectiveness of anti-mosquito paints that were deployed in twenty (20) randomly selected houses per site. The houses were painted with Inesfly paint (5AIGR and 5AIGRN) on the plastered walls. Pyrethrum Spray Catch (PSC) of mosquitoes was carried out in the randomly selected houses before (control) and after they were painted. Cone bioassay was performed on 10% of the households to assess the quality of the painting. In both sites, monitoring was carried through cone bioassay and PSC for the period of six months post painting to determine the residual efficacy of the insecticide embedded admixture against the mosquitoes. Larval sampling was also carried in the two sites to collect Anopheles larvae. The larvae were reared to adulthood and preserved for the study. Though residual efficacy found that, on the average, 98%-100% *Anopheles* mosquitoes exposed to the paint were susceptible, this review will provide useful information for the discovery of effective anti-mosquito paints for malaria vector control in Nigeria and fill the gaps in knowledge.

Keywords

Anti-Mosquito Paint, Malaria, Inesfly Paint

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1. Introduction

Globally, malaria remains a disease of great public health importance. With fifteen countries in sub-Saharan Africa and India carrying almost 80% of the global malaria burden, five countries account for nearly half of all 219 million malaria cases worldwide, and Nigeria accounts for 25% of this burden [1]. This endemic disease is hindering the economic growth and development of the countries affected. Thus, it remains a troubling trend, worse so with increasing incidence of over 500,000 above the previous year (2016). There is a reported growing insecticide resistance globally which poses a threat to malaria control achievements over the years. Emerging resistance has been reported for the four commonly used insecticide classes: pyrethroids, organochlorines, carbamates and organophosphates in all major malaria vectors across the WHO regions globally, including Africa [2].

A comprehensive approach that includes innovations in vector control is required, now more than ever, to get back Nigeria on track towards a global common vision: a malaria-free world.

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Anti-mosquito paints are being considered as an upcoming vector control tool. Inesfly paint has a composition of 5AIGR and 5AIGRNG. The former, 5AIGR contains two organo-phosphates, chlorpyrifos and diazinon, and an insect growth regulator, pyriproxyfen [3], while the latter contains alphacypermethrin, D-allethin and pyriproxyfen [4]. The products are vinyl paints with aqueous base which allows a gradual release of its active ingredients which reside within calcium-based micro-capsules [3]. These products have been deemed to be safe from toxicology studies conducted [5, 6]. Studies have demonstrated a high residual efficacy of the constituents 5AIGRand 5AIGRNG [3, 4, 7].

It is for the reasons of high residual efficacy and product safety that a review of an innovative vector control tool, the anti-mosquito Inesfly paint was carried out to assess for effectiveness and fill gaps by proposing suitable recommendations.

2. Methodology

2.1. Study Area

The study of was carried out in two different locations of Masaka and GidanZakara communities in Karu and Keffi LGAs, respectively, of Nasarawa State in North Central Nigeria. Keffi is about 53Km away from the Federal Capital Territory, Abuja while Karu is about 15km away from Abuja.

2.2. Study Sample

Twenty (20) houses were randomly selected per site and the houses were painted with Inesfly paint (5AIGR and 5AIGRN) on the plastered walls.

2.3. Sampling Technique

Pyrethrum Spray Collection (PSC) of mosquitoes was carried out in the randomly selected houses before (control) and after they were painted. Cone bioassay was performed on 10% of the households to assess the quality of the painting/implementation. In both locations monitoring was done through cone bioassay and PSC for the period of six months post painting to determine the residual efficacy of the insecticide embedded admixture against the mosquitoes.

2.3.1. Mosquito Larval Sampling

Intensive mosquito larval sampling was carried out for the period of three days each month during the study and monitoring period at both locations. The larvae were reared to the adult stage in the insectary. The 2 – 3-day old mosquitoes were used in the field for the cone bioassay testing on the painted walls.

2.3.2. Pyrethrum Spray Catch (PSC) Protocols for Mosquitoes Collection

Sampling of the 20 houses per site for mosquito collection was done using the PSC method as described by the WHO (1975) protocol for sampling indoor-resting mosquitoes [8]. The houses were sprayed by two people, one inside and the other one outside using an aerosol insecticide (Raid) containing the active ingredients of 0.250% Allethrin, 0.150%, Tetramethrin, 0.015%, Deltamethrin% and 99.5 85% inert ingredients. The two sprayers began spraying at the same time as they move in opposite directions spraying inside the room as well as the caves outside of the house. The door was then closed for 15 minutes. Mosquitoes that were knocked down were collected, using forceps, from the white sheets of cloth laid prior to spraying, and placed in petri dishes containing damp filter paper. *Anopheles* mosquitoes were kept on damp absorbent paper in a cool box and later identified to the species level by morphological criteria [9-12]. All samples collected from the field were sent for further processing and analysis.

2.3.3. Residual Efficacy of Insecticide

An evaluation/assessment of the bio-efficacy and residual efficacy of 'Inesfly' insecticide paint on the walls at the study sites were carried out on monthly bases for a period of six months from the month of January to June 2015 to ascertain the mortality of the exposed mosquitoes from the surrounding breeding sites. The bio-efficacy and decay rate of the insecticides paints was measured using standard World Health Organization (WHO) cone tests in the (20) randomly selected houses per site on different plastered and on walls painted with the Inesfly paint. The unpainted houses served as controls. To ensure the quality of spraying/painting, the cone test commenced 24 hours after the paint application to the walls. This continued on monthly bases, post-painting, for a period of six monthsto determine the residual efficacy of the insecticide paint.

i. Cone Wall Bio Assay Test

Three cones were fixed using a masking tapes on the painted walls at three varied points, i) the lower point of 0.5meter, ii) middle point at 1.0 meter and the iii) upper point of the houses at 1.5meter. Three to five-day-old unfed female *Angambiae*s. l reared from larvae collected from the wild were used for the test as shown in Figure 1. Ten mosquitoes were gently transferred into each cone by an aspirator and exposed for 30 minutes and then observed for a period of 60 minutes. At the end of exposure time, the mosquitoes were transferred into insecticide free holding paper cup for further observation for a 60-minute, and 24-hour period. The mosquitoes were fed with 10% sugar solution inside paper cups with favourable vector environmental condition.

Mortality was observed after 24hrs post exposure and mosquitoes classified as dead if they were immobile or unable to stand or fly in a coordinated way.

Figure 1. Wall Cone Bioassay (*photo credit: Y. A. B.*).

ii. Cone Bioassay on mosquito Nets

Non-blood-fed susceptible female mosquitoes aged 2-5 days were introduced into WHO plastic cones for a period of 3 minutes. To minimize the chances of mosquitos' interruption during the short exposures on netting, batches of only 5 females were introduced into each of the four cones that were applied to the same net sample. A total of 10 replicates of 5 mosquitoes were used for each sample tested, giving a total of 50 mosquitoes per sample. Post-exposure, females were placed in l50-ml plastic cups under favourable vector environmental conditions. There were two potential alternatives to the use of WHO cones. These are: (1) the use of WHO test tubes (cylinders) for adult mosquitoes; and (2) the wire-ball test, however, further calibration with the WHO cone test is required before it can be widely used in testing and evaluation of insecticide for treatment of mosquito nets.

2.4. Data Analysis

Data was analyzed using Excel for simple frequencies.

3. Results

3.1. Residual Efficacy Using Cone Bioassay Test

The residual efficacy in GidanZakara between January and April showed 100% susceptibility to 5AIGR INESFLY paints. In Mayit fluctuated according to the heights of wall cone bioassay. At 0.5m, houses I and II had 97% efficacy, while house III recorded 100%. At a height of 1.0m, houses I and III had 90% and 99% efficacy, respectively, while house II recorded 100%. Residual efficacy at a cone height of 1.5m in house I and III recorded 96% each, and 98% in house II. For the month of June, and for a cone height of 0.5m, 96% residual efficacy was observed in house I and 97% in house II, it however recorded 100% in house III. For cone height of 1.0m, 90% and 96% mortality were observed in houses I and III, respectively, with 100% in house II. The cone height of 1.5m had houses I and II recording 98% and 95% residual efficacy, respectively, with 100% residual efficacy achieved in house II (Table 1, Figure 2).

Table 1. Residual Efficacy of Inesfly Paint using Wall Cone Bioassay Test in GidanZakara, January – June 2018.

Location	Months of cone Bioassay test	Cone Bioassay wall parameters	House hold numbers and percentage of mosquitoes knockdown/Mortality status after 24hours		
			Number one	Number two	Number three
GidanZakara	January	0.5m	100%	100%	100%
		1.0m	100%	100%	100%
		1.5m	100%	100%	100%
	February	0.5m	100%	100%	100%
		1.0m	100%	100%	100%
		1.5m	100%	100%	100%
	March	0.5m	100%	100%	100%
		1.0m	100%	100%	100%
		1.5m	100%	100%	100%
	April	0.5m	100%	100%	100%
		1.0m	100%	100%	100%

Location	Months of cone Bioassay test	Cone Bioassay wall parameters	House hold numbers and percentage of mosquitoes knockdown/Mortality status after 24hours		
			Number one	Number two	Number three
		1.5m	100%	100%	100%
	May	0.5m	97%	97%	100%
		1.0m	90%	100%	99%
		1.5m	96%	98%	96%
	June	0.5m	96%	97%	100%
		1.0m	90%	100%	96%
		1.5m	98%	100%	95%

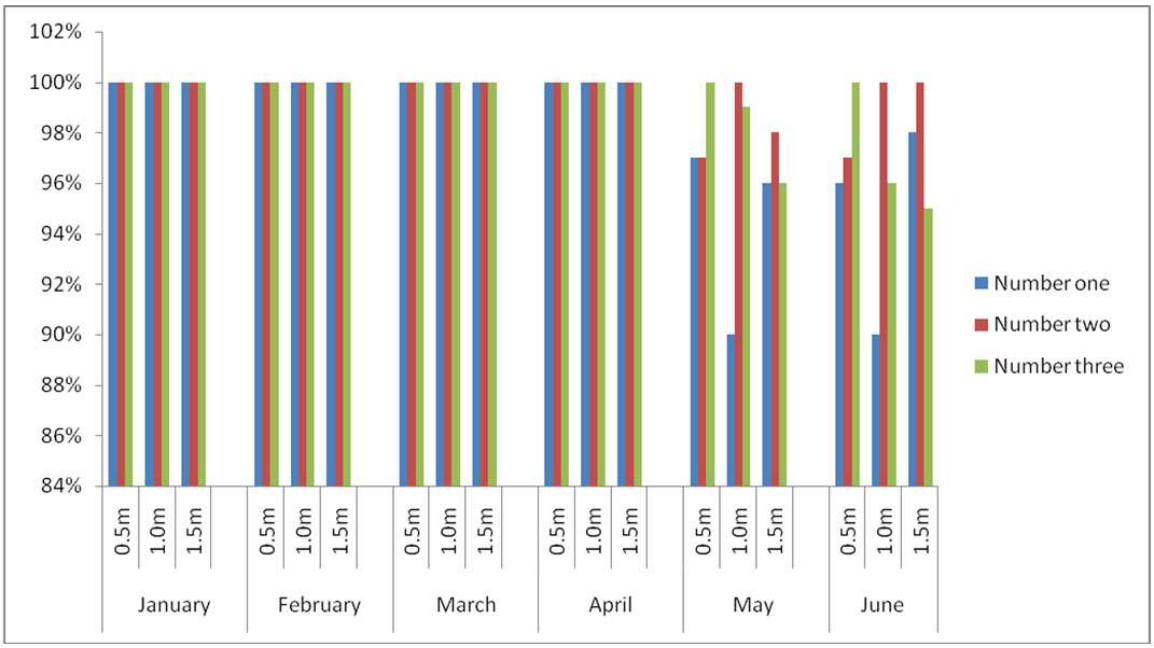

Figure 2. Cone wall Bioassay susceptibility test (GidanZakara).

3.2. Cone Bioassay in Masaka

At heights of 0.5m, 1.0m and 1.5m of wall cone bioassay test between January to April, 100% mortality of mosquitoes after 24hours was observed across board (Table 2). However, in May and June, 0.5m had 90% knockdown in house I, followed by house II (96%) mortality and house III (94%).

In June, at 0.5m household I had 90% knockdown, household II had 97% and household III 96%, respectively. Households I and II at 1.0m had 94% knockdown each as against house III with 99% total mortality of mosquitoes. At 1.5m in household I and III, 98% knockdown each was recorded while household II had 93%. (Table 2, Figure 3)

Table 2. Residual Efficacy of Insefly Paint using Wall Cone Bioassay Test in Masaka, January - June, 2018.

Location	Months of cone Bioassay test	Cone Bioassay wall parameters	House hold numbers and percentage of mosquitoes knockdown/Mortality status after 24hours		
			Number one	Number two	Number three
Masaka	January	0.5m	100%	100%	100%
		1.0m	100%	100%	100%
		1.5m	100%	100%	100%
	February	0.5m	100%	100%	100%
		1.0m	100%	100%	100%
		1.5m	100%	100%	100%
	March	0.5m	100%	100%	100%
		1.0m	100%	100%	100%
		1.5m	100%	100%	100%
	April	0.5m	100%	100%	100%
		1.0m	100%	100%	100%
		1.5m	100%	100%	100%
	May	0.5m	90%	96%	94%
		1.0m	96%	90%	98%
		1.5m	98%	93%	98%
	June	0.5m	90%	97%	96%
		1.0m	94%	94%	99%
		1.5m	98%	93%	98%

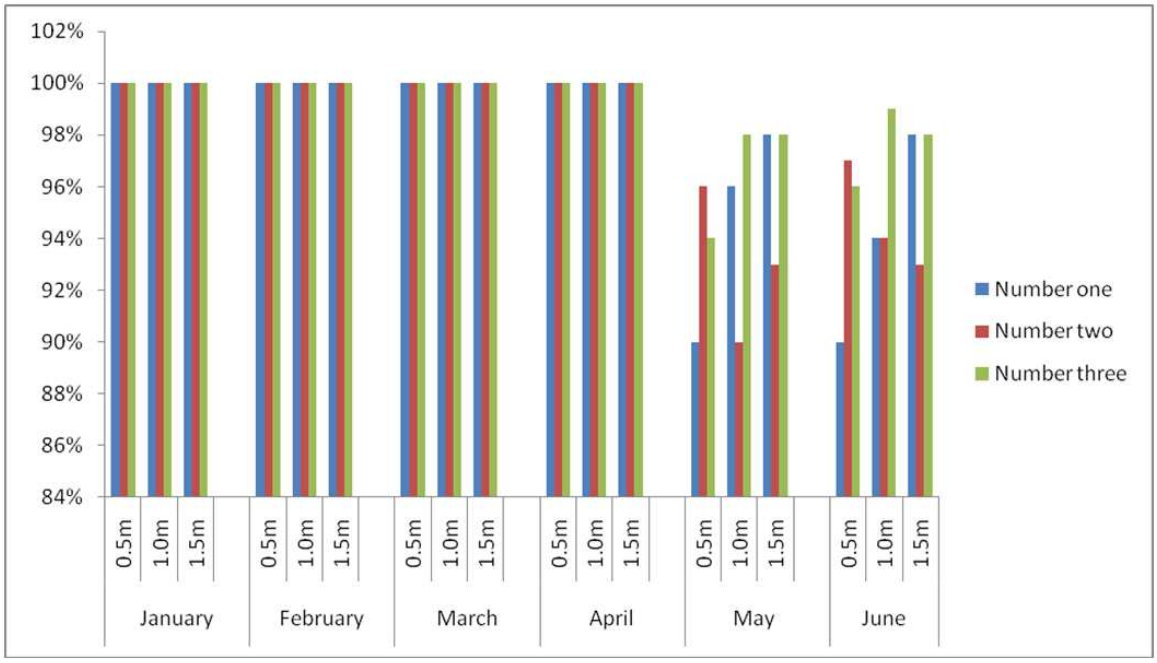

Figure 3. Cone wall Bioassay susceptibility test (Masaka).

4. Discussion

The study revealed the anthropophilic female *Anophelesgambiae* adult mosquitoes as the predominant vector in the communities in North Central Nigeria. This is in keeping with other studied conducted in this region of Nigeria [13, 14]. In our opinion, studies on anti-mosquito paints are very few, hence, an impediment to exhaustive literature review.

Both sites showed 100% efficacy of the paints after 24hrs of bioassay test at ambient temperature and relative humidity between January and April, with variability in May and June and at different cone heights. Though it is unclear what dose was applied to the walls, there is a need for standardization of application doses, as in other studies [3]. This in order to determine the level of concentration required for effective knock down of the vector, and also preventing wastage. By so doing, the safety of the application to young children who are easily susceptible to a wide range of contaminants would also be assured. It would also have been interesting to have a control sample from insecticide-free painted rooms for objective comparison, as was performed in another study [3].

Efficacy had reduced by the fifth month on the surfaces treated in both sites. This is similar to another study in which efficacy reduced by the sixth month, at a dose of 1 Kg/6 m^2, on cement surface [3]. Though, as has been mentioned earlier, knowledge of the dose of insecticide applied to the paint would have allowed for better comparison. In contrast, a study in Benin on cement-made surfaces, mortality rates revealed very high mortality rates, 98-100%, six months after treatment, at a dose of 1 Kg/6 m^2 [15]. Perhaps the cement mixture varied per location.

5. Conclusion

With growing insecticide resistance across the country, tested and approved alternative vector control tools are welcome at this time. The recorded varying levels of efficacy of the insecticide paint after the fourth month reveals there is a need for a follow-on study, this time ascertaining application surface types, standardizing the insecticide dose in the paint applied, and providing for control samples during the study. These would enhance the determination of true efficacy, and probably allow for scalability.

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Data Availability

The data used to support the findings of this study is available on request to the corresponding author.

References

[1] World Malaria Report 2018. Geneva: World Health Organization; 2018. Licence: CC BY-NC-SA 3.0 IGO.

[2] Global report on insecticide resistance in malaria vectors: 2010– 2016. Geneva: World Health Organization; 2018.

[3] Mosqueira B, Duchon S, Chandre F, Hougard J et al. Efficacy of an insecticide paint against insecticide-susceptible and resistant mosquitoes. Malaria Journal 2010 9: 340.

[4] Improved Case Detection and Vector Control for Leishmaniasis. Accessed online at https://clinicalstudys.gov>NCT03269006 on 24/11/2018 at 3: 42am.

[5] Spanish Ministry of Health and Consumer Affairs: Report on the study of the toxicity and irritability of Inesfly 5A. Health Institute Carlos III Madrid; 1996.

[6] International center of training and medical investigations (CIDEIM): Toxicity studies on Inesfly 5A IGR. CIDEIM, Cali (Colombia); 2003 [http://www.cideim.org.co].

[7] Amelotti I, Catalá SS, Gorla DE: Experimental evaluation of insecticidal paints against Triatoma infestans (Hemiptera: Reduviidae), under natural climatic conditions. Parasites & Vectors 2009, 2: 30-36.

[8] Manual on Practical Entomology in Malaria. Geneva: World Health Organization; 1975.

[9] Gillies MT and Meillon B. The Anophelina of Africa South of the Sahara (Ethiopian zoogeographical region) 1968. Publications of the South African Institute for Medical Research.

[10] Gillies MT and Coetzee. A Supplement to the Anophelina of Africa South of the Sahara (Afrotropical region) 1987. Publications of the South African Institute for Medical Research.

[11] Gillet JD. Common African Mosquitoes and Their Medical Importance. 1972. Accessed online at https://www.cabdirect/abstract/19722902081.

[12] Kent RJ. The Mosquitoes of Mach, Zambia. 2006. Accessed online at https://static1.squarespace.com/static/58d002f017bffc99fe21889/t/5a7ca49dc83.

[13] Bruce - Chwatt LJ. Malaria in Nigeria. Bull World Health Organ. 1954; 4: 301-327.

[14] Okwa O O, Akinmolayan F I, Carter V, Hurd H. Transmission dynamics of malaria in four selected ecological zones of Nigeria in the rainy season. Ann Afr Med 2009; 8: 1-9.

[15] Mosqueira B, Chabi J, Chandre F, Akogbeto M, Hougard JM, Carnevale P, Mas-Coma S: Efficacy of an insecticide paint against malaria vectors and nuisance in West Africa. Part II: Field evaluations. Malar J. 2010.