Evaluation of residual effects of deltamethrin wg250 on different surfaces against An. stephensi, in a malarious area, southern Iran

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Abstract

Objective: Malaria is one of the public health problem in southern Iran. The main activity of vector control is indoor residual spraying using pyrethroids. The aims of study was to evaluate the biological assays of deltamethrin WG250 at different surfaces of wall.

Materials and methods: The persistency of deltamethrin WG250 at 25 mg/m$^2$ was studied on different local surfaces of rooms such as plaster and mud surfaces (sorbent) as well as wooden and thatch roofs (as non-sorbent). Contact bioassays were carried out using WHO standard cones and lab-bred sugar-fed, 48-72 h old females of Anopheles stephensi (Iranshahr strain). In contact bioassays carried out on sprayed surfaces for 150 days,

Results and discussion: deltamethrin WG250 (25 mg/m$^2$) caused 43.43-100.0% on sorbent surfaces and 61.11-100.0% on non-sorbent surfaces and persist about 3.5 months in the environmental condition of Saravan district. The fumigant bioassay of deltamethrin WG250 revealed 50-100% mortalities after one month.

1. Introduction

Malaria and other mosquito-borne disease are the major problems worldwide. Malaria presents a major health problem globally. It is estimated that globally 243 million cases of malaria led to 863,000 deaths in 2008. Currently there are proven and effective tools to fight against malaria including vector control measures $^1$. A total of 228 million cases of malaria occurred worldwide in 2018. Most malaria cases (93%) were in African Region. Plasmodium falciparum is the most prevalent malaria parasite $^2$. Iran is one of the malaria-endemic countries in the world, especially in southern provinces. The total number recorded cases have dropped to less than 89 locally-transmitted cases in 2017. Iran started a malaria elimination programme with a goal to achieve this target by 2025. There has been excellent progress since, but the continued risk of importation of malaria cases from Pakistan and Afghanistan. Main malaria vectors are Anopheles stephensi, An.culicifacies, An.dthali, An.fluviatilis, An. superpictus An.maculipennis and An. sacharovi $^3$. Distribution of malaria vectors is shown in Fig. 1.

Insert Figure 1 here.

Campaign against malaria vectors was started from 1952 by DDT spraying and then replaced by dieldrin, Malathion, propoxur, lamdbacyhalothrin and deltamethrin, respectively. The chemical control of vectors now is restricted to endemic malarious areas of south-eastern part of the country with Deltamethrin and residual spraying and long lasting permethrin impregnated nets (Olyset) for personal protection, while biological control is conducting by Bacillus thuringiensis as larvicide. There are different aspects of malaria including insecticide resistance monitoring $^4-15$, novel methods for vector control $^{16-28}$, using bednets and long lasting impregnated nets $^{29-35}$, vector control $^{36}$, repellent evaluation $^{37}$. 
2. Materials And Methods

2.1. Study area; The experiments was carried u in a malarious areas in Saravan, Sistan and Baluchistan province, southern Iran (Fig. 2)

Insert Figure 2 here.

2.2. Composition of mosquitoes in the region: Fig. 3 shows the composition of Anopheles mosquito in the study area:

2.3. Strain used for bioassay test: the adult females of *Anopheles stephensi* (Iranshahr strains were used for bioassay tests)

Insert Figure 3 here.

2.4. Method of bioassay tests: Bioassay aspirator tube specially narrow with glass arm were used. The conical exposure chamber made of transparent polished plastic and then adhesive sponge plastic for lining rim of exposure chamber.

2.5. Method of fumigant effects: 3 cylindrical cages (14 x 20 cm) were employed. The number of mosquitoes per cage was 30-35, female, unfed, 2-3 days old. They were exposed 60 min in conical chamber and then the mortality was calculated after 24-hours.

3. Results

Result of contact bioassay on Deltamethrin WG250 (25 mg/m²). The results of bioassay test on different surfaces are illustrated in Figures 4-8.

Insert Figures 4-8 here.

4. Discussion

In the present study the residual effect of deltamethrin WG250 according the WHO method at dosage of 25 mg/m² using local species of *An. stephensi* at different surfaces of plaster, mud, thatch, wood is 4 months and fumigant effect= 5-30 days (MR=50-100%). There are several reports on bioefficacy of deltamethrin against different malaria vectors worldwide.

The residual effects of deltamethrin WG 25% on different surfaces was assessed in southern part of Iran using *An. stephensi*. based on results, from 100% to about 70%. At 25, 40 and 50 mg a.i./m2 the WG formulation of deltamethrin had a bioefficacy for about 2, 3 and 4 months respectively [38]. Deltamethrin at dosage of 50 mg/m² resulted 100% mortality against *An.gambiae* for 5.5 months [39].
The bioefficacy of indoor residual sprayed deltamethrin wettable granule (WG) formulation for the control of malaria was compared with the current dose of deltamethrin wettable powder (WP) in malaria endemic areas in Balai Ringin, Sarawak. Doses of 20 mg/m$^2$ WP (control), 20 mg/m$^2$ WG, 30 mg/m$^2$ WG and 40 mg/m$^2$ WG were sprayed separately on different surfaces namely, wooden, rough-bamboo, smooth-bamboo and brick surfaces. Residual activity of WP and WG formulations was tested against lab-bred *An. maculatus* using WHO standard procedure. Deltamethrin at 30 mg/m$^2$ WG exhibited the highest sustainable level of effectiveness against *An. maculatus*. Mortality was between 95% - 100% up to week 60 post-spraying when sprayed on smooth-bamboo surface.$^{[40]}$

5. Conclusion

The results of study revealed that deltamethrin as recommended dosage as residual spraying could control the malaria vector during the transmission season. Monitoring and mapping of insecticide resistance to WHO recommended adulticide is recommended periodically.

Declarations

**Conflict of interest (mandatory for all article types, also for Editorials, Commentaries and Letters)**: The authors declare that there is no conflict of Interest

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* **Informed consent**: All the authors agree for submission of paper

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References


**Figures**
Figure 1

Spatial distribution of malaria vectors in Iran

Figure 2

Map of study area
Figure 3
Composition of Anopheles mosquito in the study area

Figure 4
Results of contact bioassay test of deltamethrin on plaster surface
Figure 5

Results of contact bioassay test of deltamethrin on mud surface
Figure 6
Results of contact bioassay test of deltamethrin on plaster surface

Figure 7
Results of contact bioassay test of deltamethrin on wood surface
Figure 8

The fumigant effect of deltamethrin