Residual and Fumigant Effects of Bendiocarb WP80 in a Malarious Areas in Borderline of Iran and Pakistan

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Abstract

Background: Malaria and leishmaniasis are the public health problems in southern Iran. The main activity of vector control is indoor residual spraying using pyrethroids. The aim of study was to evaluate the biological assays of bendiocarb WP at different surfaces of wall.

Materials and Methods: The residual effect of bendiocarb WP80 at 400 mg/m² was evaluated on various local surfaces of rooms such as mud and plaster as well as thatch roofs and wooden. WHO standard cones using contact bioassays were carried out using laboratory reared sugar-fed, 48-72 h old females of *Anopheles stephensi*. Contact bioassays were carried out on sprayed surfaces for 150 days.

Results: Contact bioassay on surfaces treated with bendiocarb WP80 different surfaces was estimated about 2 months. Fumigant tests of bendiocarb WP80 at 400 mg/m² revealed 50-93.83% mortality with one month persistency.

Discussion: The results showed that carbamate insecticide could be used as rotation with pyrethroids for malaria vector control.

Background

Malaria is one of the most important communicable diseases transmitted by anopheline mosquitoes (Diptera: Culicidae) to humans. More than 80% of malaria cases in Iran are reported from three provinces in southern and southeastern areas of the country. The most routes of malaria cases are immigration from Afghanistan and Pakistan to southern and southeastern areas of the country (WHO, 2017) (1). From 1952 by using DDT, malaria vector control was started and then replaced by other insecticides. The chemical control of vectors now is restricted to endemic malarious areas of south-eastern part of the country with deltamethrin and bendiocarb as rotation strategy as well as long lasting permethrin impregnated nets (Olyset) for personal protection. For larviciding the *Bacillus thuringiensis* is applying in the breeding places.

Materials And Methods

Study area; Malarious and Leishmaniasis area of Sistan and Baluchistan province, southern Iran was selected for experiments (Fig. 1).

2.2 Insecticide used: Bendiocarb WP80 were used (Fig. 2)

Composition of mosquitoes in the region

The fauna of *Anopheles* mosquito in the study area are *Anopheles culicifacies*, *An. stephensi*, *An. fluviatilis*, *An. dthali*, *An. miticolor*, *An. turkudi* (Fig. 3)

Strain used for bioassay test

the adult females of *Anophels stephensi* collected from field were used for bioassay tests

Choosing different surfaces for bioassay tests. Different surfaces including plaster, mud, wood which are the structures of the houses in the region were selected and sprayed with bendiocarb WP80 according to the standard method which is described by World Health Organization. Indoor residual spraying of insecticides is normally done using portable compression sprayers (Hudson). Before starting a spray operation, the equipment must be checked. Faulty sprayers may result in poor control or over-treatment. The sprayer visually was examined to ensure that all parts are present, assembled correctly and in good working order. Correct type of nozzle should be fitted and is not damaged or worn. The nozzle tip should be of hardened stainless steel, ceramic or equivalent material to withstand erosion of the nozzle where water contains sand particles (Fig. 4).

Method of bioassay tests

Bioassay aspirator tubes especially 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 (Fig. 5).

Method of fumigant effects

3 cylindrical cages (14 × 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 (Fig. 6).

Results

Result of contact bioassay Bendicocarb WP80. The results of bioassay test on different surfaces are illustrated in Figs. 7–10.

Residual effect of Bendiocarb at 400 mg/m² in plaster surfaces

In plaster surface a total of 696 mosquitoes were used. The standard mortality which is 70% could be obtained 60 days after application. After 30 day of application, a total mortality of 89.59 ± 3.55 were observed.

Residual effect of Bendiocarb at 400 mg/m² in Mud surfaces

In mud surface a total of 292 mosquitoes were used. The standard mortality which is 70% could be obtained 60 days after application. After 75 days of application 100% mortality were observed

Residual effect of Bendiocarb at 400 mg/m² in Wood surfaces

In wood surface a total of 212 mosquitoes were used. The standard mortality which is 70% could be obtained 60 days after application. After 75 days 100% mortality were observed.

Fumigant effect Bendiocarb at 400 mg/m²

The fumigant effect of Bendicarb is presented in Fig. 11. In fumigant test a total of 929 mosquitoes were used and 50% mortality were obtained after 30 days.

Discussion

The persistency of bendiocarb WP80 at 400 a.i. mg/m² was one month. The fumigation effect of bendiocarb WP80 was showed 50-69.70% mortalities during one-month persistency. The residues of bendiocarb WP80 on Whatman papers was estimated 1.1 mg/m² during 120–150 days evaluation period. Eshghi al (1987) (2) used bendiocarb WP80 at dosage of 200 mg/m² against *An. stephensi* in Kazeroun against different surfaces of plaster, mud, cement and wood. They found 1 months residual effect. Ansari & Razdan (2004) (3) used bendiocarb WP80 at dosage: 200 mg/m² against *An. culicifacies* in India at different surfaces of mud, cement and brick. They found 2-2.5 months residual effect. A longitudinal study was carried out to evaluate the bioefficacy of indoor residual spraying of bendiocarb 807 wettable powder (WP) at 0.2 and, 0.4 g/m² against *Anopheles culicifacies*, a principle malaria vector. Bioassay tests revealed that persistence of insecticide against *An. culicifacies* mortality was observed for about 10, 8, and 10 weeks on mud, cement, and brick wall surfaces, respectively (4). An experimental hut trial comparing the effectiveness of bendiocarb sprayed on five substrates (cement, wood, tin, mud, and vegetative materials) was carried out against *Anopheles* species in two study sites located in the eastern foothills of Madagascar. No significant difference was detected in either exophily or blood-feeding rates between treated and untreated huts. The mortality rate was significantly greater in treated huts compared to untreated huts. Efficacy up to 80% was found for 5 months post treatment (5). Residual efficacy of the insecticides used for PMI/USAID-supported IRS campaigns was measured in Benin, Burkina Faso, Ethiopia, Ghana, Kenya, Liberia, Madagascar, Malawi, Mali, Mozambique, Nigeria, Rwanda, Senegal, Tanzania, Uganda, Zambia and Zimbabwe. The WHO cone bioassay tests were used to assess the mortality rate of mosquitoes exposed to insecticide-treated mud, wood, cement, and other commonly used housing materials. The residual efficacy of bendiocarb ranged from 2 weeks to 7 months (average = 2.8 months) and failed to achieve proposed minimum efficacy on 14 occasions. Lastly, long-lasting pirimiphos-methyl efficacy ranged from 2 months to 9 months (average = 5.3 months), but reported 13 incidents of underperformance (6). In a study the effect of temperature on the standard insecticide resistance test, using resistant or susceptible strains of two major malaria vectors (*An. arabiensis* and *An. funestus*) were performed. Toxicity of the pyrethroid, deltamethrin and the carbamate bendiocarb was assessed at different temperatures (18, 25 or 30°). Results show that temperature impacts toxicity of both insecticides, but in a different way. Bendiocarb lost efficacy at higher temperatures for both species, regardless if they were resistant or susceptible (7).

Conclusion

The results of study revealed that bendiocarb as recommended dosage as residual spraying may be control the malaria vector during the transmission season. If here is resistant to pyrethroids in malaria vector, then bendiocarb could be used as rotation measure. There are several works in the country on different aspects of malaria including insecticide resistance monitoring, using bednets and long lasting impregnated nets ,vector control (8–16). Monitoring and mapping of insecticide resistance to WHO recommended adulticide is recommended periodically.

Declarations

Ethics approval and consent to participate:Not applicable

Consent for publication: Applicable

Competing interests: The authors declare there is no conflict of Interest.

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Figures

Figure 1

Location of the study area, Sistan and Baluchestan Province, southeastern Iran 2.2 Insecticide used: Bendicocarb WP80 were used (Fig.2)

Figure 2

The bendiocarb WP80 were used in the study area

Figure 3

Species composition of mosquitoes

Figure 4

Site selection and types of surfaces for residual spraying

Figure 5

Bioassay test using WHO specified conical device

Figure 6

Determination of fumigant effects of insecticide

Figure 7

Residual effect of Bendiocarb at 400 mg/m² in plaster surfaces

Figure 8

Residual effect of Bendiocarb at 400 mg/m² in mud surfaces

Figure 9

Residual effect of Bendiocarb at 400 mg/m² in wooden surfaces

Figure 10

Fumigant effect of Bendiocarb