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Monitoring of Insecticide Resistance in *Anopheles Sacharovi* (Favre, 1903) in Borderline of Iran, Armenia, Naxcivan and Turkey, 2001

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Abstract:
Malaria has recently been resurged in some parts of Iran which is bordered with Armenia, Naxcivan and Turkey. An attempt was made to asses the current status of insecticide resistance in the main malaria vector , *An.sacharovi.* Adult engorged mosquitoes were collected from dwellings during the seasonal activity of the vector, which is synchronized in summer 2001. Mosquitoes were subjected to the diagnostic dose of insecticides based on WHO method. Results showed that this species is still resistant to DDT, tolerant to dieldrin but susceptible to other insecticides such as, bendiocarb, propoxur, malathion, fenitothion, deltamethrin, permethrin, cyfluthrin, lambdacyhalothrin, and etofenprox with low frequency of tolerant gene in some population to some above mentioned insecticides.

Keywords: *Anopheles Sacharovi*, Iran, Insecticide, Malaria

Introduction

Malaria is endemic in southern parts of Iran. According to recent information a total of 18000 cases are reported from these areas. In northern part of Iran only small imported cases of malaria are reported. After independence of southern countries of former Soviet Union and occurrence of Ghara-Bagh civil war, the malaria cases increased in these regions. Accordingly in some parts of West Azerbaijan of Iran, several malaria foci were observed. Various factors can affect the malaria resurgence; they may be construction of dam, traveling of people from neighboring countries to Iran, socioeconomic factors, urbanization, lack of malaria vector control and shortage of drug supply. Epidemiological investigations approved the local transmission of malaria, which is mainly *Plasmodium vivax*.

The major antimalarial activities of local authorities are increasing malaria case detection, prompt treatment, community education and focal insecticide application. An investigation was carried out for monitoring of insecticide resistance status on this species. *Anopheles sacharovi* Fevor is the principle vector of malaria transmission in West Azerbaijan province of Iran. The geographical range of its distribution includes; southern former USSR, Yugoslavia, Austria, Italy, Greece, Cyprus, Turkey, Iraq, Syria, Lebanon, Jordan and Palestine (10). This species is also one of the malaria vectors in Iran and has a more localized distribution in central, northwest, west, southwestern and Fars province (12). The first report of resistance of *An.sacharovi* to DDT occurred in 1959 from Kazeroon, subsequently from Izeh and Meshkinshahr (12). There are several studies on the ecology of malaria vectors in Iran. The published papers on the susceptibility of *An.sacharovi* in borderline of Iran are mainly from Turkey. There is no current information on the status of susceptibility of *An.sacharovi* to the different new WHO-recommended insecticides. Therefore, this study was conducted to asses the susceptibility of this species to different insecticdes. The results can provide a clue for control of malaria vectors in the region.

Materials and Methods

Study area: West Azerbaijan province with surface area of 37598 Km^2 is located in northwest of Iran (between 35◦, 58'-39◦, 47' N latitude, and 44◦, 14'-47◦, 19'E longitude). The province is bounded by Naxcivam Autonomous Republic (with Armenia-proper) on the north, 135 Km by Turkey and Iraq on the west, 686 Km by Kurdistan province on the south and by East Azarbaijan and Zanjan provinces in the east. The study area is located 16 Km northwest of Poldasht county. It is plain area which is situated alongside the bank of Aras River. Its elevation is 815 meter above sea, with the tropical type climate. The total population is 9700 people. The study area offers an ideal anopheline breeding places.

Mosquito collection:

In the study area, engorged female *An.sacharovi* was collected from indoor resting sites using mouth aspirators. The significant proportion of this species resting in human dwellings has fed upon the occupants. In order to reduce the mortality of adults, they were kept in holding tubes with a wet towel on it and then transferred to the laboratory for insecticide testing.

Testing method:

Tests on adults were carried out according to the method of WHO (15, 17). At each test at least 100 mosquitoes representing 4-5 individual replicates of 20-25 adults were tested. To reduce variability in the replicates, engorged females were used. The exposure tubes were held in a vertical position during the tests. The exposure time for each insecticide, except fenitrothion, was 1 hour. For fenitrothion the 2 h exposure time were used. The mortality rate was scored after a 24 h recovery period. Insecticide exposure took place in a room with a temperature of 27±2◦C and holding

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tubes were held in a room condition of 27±2◦C and relative humidity 55-60%.

Insecticides Impregnated papers:

The following insecticides impregnated papers were supplied by WHO:

DDT 4%, dieldrin 0.4%, malathion 5%, fenitrothion 1 %, bendiocarb 0.1%, propoxure 0.1%, lambdacyhalothrin 0.05% , deltamethrin 0.05%, permethrin 0.75%, cyfluthrin 0.15%, etofenprox 0.5%. For the control of organochlorine insecticides, organophosphate, carbamate and pyrethroids insecticides the, mineral oil, olive oil and silicon oil impregnated papers were used, respectively.

Results

The mortality rates of *An.sacharovi* after 1 hour exposure time followed by 24 hour recovery period are given in table 1 and illustrated in fig.1.

Table 1. Mortality of *Anopheles sacharovi* adult females to different insecticides in study area.

Insecticides	Number of mosquito tested	Percentage of knock-down after 1 hour exposure	Mortality ± Standard Error	Exposure time (hour)
DDT 4%	101	25	39±5	1
Dieldrin 0.4%	100	82	90±3	1
Malathion 5%	100	99	100	1
Fenitrothion 1%	100	100	100	2
Bendiocarb 0.1%	100	86	96±2	1
Propoxur 0.1%	100	95	100	1
Lambdacyhalothrin 0.1%	100	95	98±2	1
Deltamethrin 0.05%	100	95	100	1
Permethrin 0.75%	100	95	98±2	1
Cyfluthrin 0.15%	100	98	100	1
Etofenprox 0.5%	100	90	96±2	1
Control	100	0	1	1

Fig.1. Mortality of *Anopheles sacharovi* adult females to different insecticides in study area.

By applying WHO criteria (98-100% mortality indicates susceptibility, 80-97% mortality requires confirmation of resistance with other methods and < 80% mortality suggests resistance), it was found that filed samples were resistant to DDT, tolerant to dieldrin, and from the results it can be concluded that they are susceptible to malathion, fenitrothion, bendiocarb, propoxur, lambdacyhalothrin, deltamethrin, permethrin , cyfluthrin and etofenprox . (Table 1 and fig.1).

Discussion:

It can be concluded that *An.sacharovi* exhibits resistance to DDT and tolerance to dieldrin. In 1957 for the first time *An.sacharovi* were tested against DDT 4% in Fars province. Results showed that this species was susceptible to DDT 4%. In 1957 DDT was used for malaria vector control in the region. In 1959 the mortality of *An.sacharovi* to DDT 4% decreased to 35-40% indicating occurrence of resistance in this population. Due to DDT resistance, dieldrin was replaced for vector control since 1961. Subsequently after 2 years of dieldrin, application resistance to this insecticide was reported (19). In 1967 malathion was used in the region and until 1973 there was no report of malathion resistance in this population. In 1998 Ghavami (8) showed that *An.sacharovi* collected from Kazerun region, is susceptible to DDT. It is often asserted that insecticide resistance in a mosquito population is gradually lost and reversion to susceptibility occurs after withdrawn of insecticide pressure (1, 3, 14). In 2000 it was reported that this species is resistant to DDT and dieldrin in Parsabad and Germi counties in ardebil province of Iran (18). In 2000 reported resistance to 12 insecticides of specimens of *An.sacharovi*, both in laboratory and those collected in the malarious areas located in southern part of Turkey. In Adana, Adiyaman and Antalya *An.sacharovi* was susceptible only to malathion and pirimiphos methyl (Kasap et al (9). In our study pirimiphos methyl was not used. In other parts of Turkey this species was susceptible to dieldrin, fenitrothion, lambdacyhalothrin, cyfluthrin, etofenprox malathion and pirimiphos-methyl (9). It should be noted that they used both vertical and horizontal position during exposure time. Hemingway (1985) (4) reported that DDT resistance in *An.sacharovi* was being scattered in the population in 1984 despite the replacement of DDT by malathion for malaria control 13 years ago. He also reported that populations of this species in Cukurova had an altered acetyl cholinesterase resistance mechanism, conferring broad-spectrum resistance against organophosphates and carbamates. Specimens of *An.sacharovi* collected in the field in 1989-90 were still resistant to DDT, organophosphate and carbamates, although at lower frequencies than in 1984 (5). In addition to the acetyl cholinesterase resistance mechanism, there is evidence of an increased level of glutathione S-transferase in some of the *An.sacharovi* population tested. This is known to be correlated with DDT resistance in other anophelines.

In Iraq, Manouchehri et al (13) reported *An.sacharovi* was resistant to DDT but susceptible to malathion in 1980.

In this study DDT resistance and dieldrin tolerance was performed. Selection for resistance in malaria vectors can result from agricultural application of Insecticides (3, 7, 11). According to department of agriculture in the province 9 types of organophosphates and 3 types of pyrethroid insecticides have been distributed among farmers for agricultural pest control. Due to extensive use of permethrin for agricultural pest control and occurrence of cross-resistance between peremthrin and DDT was performed in malaria vectors (16).

From our results it can be assumed that DDT resistance in the population of *An.sacharovi* may be due to cross-resistance to permethrin. In this respect, study on the mechanism/s of DDT and permethrin resistance is highly recommended. It can be concluded that except organochlorine insecticides other groups of them may be recommended for malaria vector control. In our study *An.sacharovi* partly fed on animal, so that recently sponging cattle with deltamethrin has been shown to be effective in killing zoophilic anophelines (6).

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