

EXPERIMENTAL HUT TRIALS FOR THE EVALUATION OF BENDIOCARB (FICAM W) AGAINST *ANOPHELES STEPHENSI* KHESHT DISTRICT, KAZEROUN, SOUTHERN IRAN, 1977¹

N. ESHGHY, B. JANBAKSH AND M. MOTABAR

Department of Environmental Health, School of Public Health, University of Teheran, Teheran, Iran.

ABSTRACT. To evaluate the effectiveness of bendiocarb (Ficam W) for the control of *Anopheles stephensi* Liston the main malaria vector in the south of Iran, a preliminary experiment based on experimental hut trials was carried out in the village of Khesht, Kazeroun, southern Iran, in 1977. One round of spraying was implemented at dosage rates of 200 mg/m²

and 400 mg/m² of a.i. in newly built huts, beginning of July 1977.

The technical difficulties encountered in southern Iran were the resistance of *An. stephensi* to DDT and dieldrin, the exophilic and exophagic habits of *An. dthali*, *An. superpictus* and *An. fluviatilis*, and the ecology of the inhabitants.

INTRODUCTION

After the development of resistance in *An. stephensi* Liston, the main vector of malaria in the southern part of Iran, first to DDT in 1957 and then to dieldrin in 1960 (Mofidi et al. 1958, 1960), malathion treatment, 50% w.d.p., 2 g/m², 1 to 3 rounds per annum, was implemented in 1968, and has resulted in partial control of *An. stephensi* on the littoral plain. However, in the foothill and mountainous areas, where the activity of *An. stephensi* was reduced, other secondary vectors such as *An. dthali*, *An. superpictus* and *An. fluviatilis* were still active.

The possibility of resistance of *An. stephensi* to malathion makes it desirable to learn of suitable compounds which can be used as replacements (Eshghy et al. 1975, 1976).

Bendiocarb (2,2-dimethyl-1,3-benzodioxol-4-yl N-methyl carbamate) formulated as an 80% w.p. (Ficam W), was evaluated in experimental huts in the village of Khesht Kazeroun, southern Iran, July-October 1977.

This paper describes a series of field experiments aimed at extending the use

of bendiocarb for the control of *An. stephensi*.

MATERIALS AND METHODS

AREA OF OPERATION. The village of Khesht in which the trials were carried out is located 60 km southwest of Kazeroun and 110 km from the Persian Gulf at an altitude of 560 m. The study area is situated on the southern slopes of the Zagros Mountains and has a subtropical climate. The summer is long and hot with a maximum temperature over 40°C. The winter is moderate, and the temperature rarely drops below zero. The relative humidity is usually about 40-50%.

THE EXPERIMENTAL HUTS. Six new huts, each fitted with an outlet window trap, were made for this special study. Each was 2.5 m x 2.5 m square and 2 m high, built of sun dried bricks and plastered with clay and with a concrete floor. The roof was made by mat and wooden beams. The huts consisted of a single room without any partition. Each room had only one wooden door and a small hole, 7 x 10 cm with wooden shutters.

The huts were treated by a Hudson X-pert® sprayer with a HSS-8002 nozzle. The output and dosage applied was calculated, and 0.5 and 1.0% suspensions were used.

¹ This study was carried out by the School of Public Health and Institute of Public Health Research of the University of Teheran.

In 2 huts the dosage was 200 mg/m² of a.i. and in the other two the rate was 400 mg/m². Two huts served as untreated checks. Fortnightly observations were made during the course of study.

METHOD OF ENTOMOLOGICAL EVALUATION. In each series of bendiocarb-treated huts the following measures were conducted:

1. Biological evaluation—on sorbent and non-sorbent surfaces of sprayed huts at 30-min exposure with laboratory reared *An. stephensi* (WHO 1970).

2. Bioassay of the airborne effect on bendiocarb sprayed on the interiors of huts.

3. Experimental hut tests—This was done by releasing sufficient and known numbers of laboratory bred *An. stephensi*, freshly blood-fed into the experimental huts.

The assessment of the effectiveness of bendiocarb by this test was estimated by the following formulae (WHO 1975):

- a = Number dead in window trap
- b = Number alive in window trap
- c = Number of b still alive after 24 hr
- d = Number dead on floor sheet

e = Number alive caught by hand in hut

f = Number of e still alive after 24 hr then a + (b - c) + d + (e - f) = total dead = X and a + b + d + e = total mosquitoes caught = Y then $\frac{X}{Y} = 100 = \% \text{ mortality}$

RESULTS AND DISCUSSION

The results of biological evaluation of bendiocarb within a 30-min exposure period showed a mortality rate of 16.8% and 66% on mud walls up to 60 days after spraying with the dosages of 200 mg/m² and 400 mg/m² respectively. However, by 90 days, the rate had dropped to 0.9% and 41.4%.

Wood bioassay gave 64% and 97.9% mortality up to 60 days, and 90 days after spraying, the rate of mortality decreased to 17.6% and 69.6% with the dosages of 200 mg/m² and 400 mg/m² respectively (Table 1).

Observations of the air-borne killing effect of bendiocarb were made in the interiors of huts. A total of 3 cages of 50 blood fed *An. stephensi* were used in each test, of

Table 1. Results of bioassay *An. stephensi* exposed 30 minutes to bendiocarb sprayed surfaces, Khesht, Kazeroun, southern Iran, 1977.

Month	Days after spraying	%Mortality of mosquitoes after 24 hours recovery							
		200 mg/m ²				400 mg/m ²			
		Mud	Wood	Combined	Control	Mud	Wood	Combined	Control
July	2	89	100	94.5	0	100	100	100	0
		(100)	(101)	(201)	(20)	(101)	(100)	(201)	(20)
	15	51	100	75.6	0	100	100	100	0
(100)		(101)	(201)	(20)	(101)	(102)	(203)	(21)	
August	30	30.6	81	55.7	0	86	100	93	0
		(101)	(100)	(201)	(21)	(100)	(102)	(202)	(20)
	45	22.7	73	47.7	0	73.5	100	86.6	0
(101)		(100)	(201)	(20)	(102)	(101)	(203)	(21)	
September	60	16.8	64	40.2	0	66	97.9	81.5	0
		(101)	(100)	(201)	(20)	(103)	(98)	(201)	(21)
	75	5.8	39	22.2	0	50	81.5	65.8	0
(102)		(100)	(202)	(22)	(102)	(103)	(205)	(21)	
October	90	0.9	17.6	9.3	0	41.4	69.6	55.7	0
		(101)	(102)	(203)	(19)	(99)	(102)	(201)	(21)
	105	—	—	—	—	32.6	53	42.7	0
					(101)	(98)	(199)	(21)	

Figures in parentheses represent the number of mosquitoes tested.

Table 2. Results of air borne effect *An. stephensi* exposed 6 hours to bendiocarb sprayed surfaces, Khesht, Kazeroun, southern Iran, 1977.

Month	Days after spraying	% Mortality of mosquitoes caged in huts, after 24 hours recovery			
		200 mg/m ²		400 mg/m ²	
		Exposed	Control	Exposed	Control
July	2	100 (102)	1.9 (51)	100 (103)	0 (50)
	15	41.1 (102)	3.9 (51)	100 (103)	0 (51)
August	30	17.8 (101)	0 (52)	66.3 (101)	0 (50)
	45	13 (100)	0 (50)	48 (102)	0 (51)
September	60	8.9 (101)	1.9 (52)	35.2 (102)	0 (49)
	75	0.98 (102)	0 (52)	17.1 (99)	0 (51)
October	90	0 (98)	0 (49)	9.1 (99)	0 (52)
	105	—	—	1.9 (103)	0 (48)

Figures in parentheses represent the number of mosquitoes tested.

Table 3. Results of experimental hut tests with *An. stephensi* on bendiocarb sprayed surfaces, Khesht, Kazeroun, southern Iran, 1977.

Month	Days after spraying	% Mortality of mosquitoes released into huts, after 24 hours recovery			
		200 mg/m ²		400 mg/m ²	
		Exposed	Control	Exposed	Control
July	2	99.5 (400)	0 (200)	100 (402)	2 (200)
	15	97 (402)	0 (199)	99.3 (397)	1.5 (198)
August	30	76.1 (398)	1.5 (195)	98.8 (359)	0 (197)
	45	54.6 (399)	1.5 (195)	89.2 (401)	2.5 (200)
September	60	42.1 (403)	0.4 (202)	79.9 (405)	2.1 (192)
	75	23.8 (406)	2.4 (206)	70.1 (395)	2.5 (196)
October	90	9.9 (394)	0.98 (203)	55.4 (406)	1.5 (191)
	105	—	—	43.2 (402)	2.5 (195)

Figures in parentheses represent the number of mosquitoes tested.

which 2 were installed in sprayed huts and 1 kept as control. The time of exposure was 6 hr from 7 a.m. to 1 p.m. and the holding time was 24 hr.

The type of cage used in these tests was a cylindrical cage, 10 × 16 cm in size, which was hung at 50 cm distance from the wall and ceiling in treated huts. The kill was 17.8% and 66.3% 30 days after spraying in 200 mg/m² and 400 mg/m² sprayed huts respectively; 18.9% and 35.2% kill occurred 60 days post-treatment, and with the same dosages the mortality rate was observed nil and 9.1%, 90 days after spraying (Table 2).

Experimental hut tests were conducted in the evening. The following morning, at sunrise, collections of mosquitoes from the exit traps and from the floor were carried out. Then, the collection of indoor living mosquitoes was performed between 7 and 8 a.m. The overnight mortality was estimated on the basis of the number of dead and living mosquitoes found on the floor, in window traps and in the hut.

A mortality rate of 42.1% and 79.9% was observed up to 60 days after spraying with the dosages of 200 mg/m² and 400 mg/m² respectively. The mortality rate decreased to 9.9% and 55.4%, 90 days after spraying with the same dosages. The mortality rate 75 days after spraying was 70.1% with the dosage of 400 mg/m² (Table 3).

On the basis of the results obtained, it was concluded that bendiocarb (Ficam W) is an effective insecticide against *An. stephensi*. It is recommended that village scale trials be conducted.

ACKNOWLEDGMENT. This work was supported by a grant from Fisons Limited.

References Cited

- Eshghy, N. and Janbakhsh, B. 1976. Insecticide resistance of *Anopheles stephensi mysorensis* in the province of Fars, southern Iran, 1975. *Mosquito News* 36:336-339.
- Eshghy, N., Motabar, M., and Janbakhsh, B. 1975. Field trials of sumithion (OMS-43) and malathion residual sprays for control of *Anopheles stephensi mysorensis* in the Mamasani area, southern Iran, 1974. *Mosquito News* 35:372-380.
- Mofidi, Ch. and Samimi, B. 1960. Resistance of *Anopheles stephensi* to dieldrin in Iran. *Inst. Parasit. & Malariol. Teheran, Iran. Publ.* 650:3-4.
- Mofidi, Ch., Samimi, B., Eshghy, N. and Ghiassedin, M. 1958. Further studies of anopheline susceptibility to insecticides in Iran: results of Busvine and Nash method, *Inst. Parasit. & Malariol. Teheran, Iran. Publ.* 585:1-7.
- W.H.O. 1970. Insecticide resistance and vector control. 17th report of the WHO Expert Committee on Insecticides. *Tech. Rep. ser.* 443:152-157.
- W.H.O. 1975. Manual on practical entomology in malaria. Part II, W.H.O. publication No. 13:41-43.

VIRGINIA MOSQUITO CONTROL ASSN.

Room 209, 401-A Colley Avenue
Norfolk, Virginia 23507

President: Richard Cockrell, Jr.
1st Vice President: Frank Miller, Jr.
2nd Vice President: Frank Mathews
3rd Vice President: J. D. Barefoot
Secretary/Treasurer: R. E. Dorer