African Scientist Vol. 4, No. 3, September 30, 2003
Printed in Nigeria

1595-6881/2003 $12.00 + 0.00

http://www.klobexpublishers.com

AFS 2003008/4303

Repellent and toxic activities of fumes of some plant materials against *Culex* mosquito

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(Received February 20, 2003)

ABSTRACT: Mosquito coils (bars), formulated from three plant leaves, namely; *Acalypha torta, Carica papaya* and *Calotropis gigantica*, and seeds of *Peganum harmala*, were tested as repellents or toxicants against laboratory reared *Culex sp.* adult mosquitoes when burnt as an incense. None of the plants showed toxic activity, as knockdown was less than 5% in all cases. Slight repellency was observed with *Acalypha sp.* (0.21) and *P. harmala* (0.19), as these showed significant difference ($P < 0.05$) from values recorded for the control, i.e. bars without plant material. The fumes from these plants had no visible deterrent effects on the mosquitoes. The possible scientific challenges posed by this approach to the search for possible mosquito control agent were highlighted.

Key Words: Mosquito repellents; Repellent activities; Toxicants; *Culex* sp.

Introduction

Adult mosquitoes, due to their haematophagous and antropophilic habits, constitute a significant public health problem to humans particularly in the tropics (Dziem and Cupp, 1983). They also cause irritation and annoyance while attempting to suck human blood. Hence, man has resorted to the reduction of mosquito contact as one of the ways of controlling the diseases mosquitoes transmits. This has been achieved mainly by the use of barriers, which could be biological, physical, mechanical and chemical. Chemical barriers are usually naturally occurring or synthetic chemicals which act as behaviour modifiers, such as repellents or toxicants (Kumar, 1984). Whereas, toxicants are more popular and can be used with a higher precision over larger areas, repellents minimizes destruction to the ecosystem and forces down the over dependence on toxic insecticides, particularly synthetic ones (McGovern *et al*., 1977). Quite a number of preparations with these features have been reported (Critchley, 1971) some of which are of plant origin (Hwang *et al*., 1985).

One method of controlling mosquitoes that is most readily acceptable to peasants is the burning of mosquito coils within the confines of the room. It is relatively cheaper and offers a relatively prolonged effect. In this study, an attempt is made to test fumes from mosquito coils made from some locally available plant materials, earlier listed as possessing insecticidal activities (Secoy and Smith, 1983; Olaifa *et al*., 1987; Ahmed *et al*., 1981 and Ande, 2001) for trial as mosquito toxicant or repellent.

Materials and Methods

Seeds of *P eganum harmala* and leaves of *Acalypha torta* (Euphorbiaceae), *Carcia papaya* (Caricaceae), and *Calotropis gigantica* (Asclepiadaceae) were collected, air-dried in a shade, pulverized and kept in a screw cap brown bottle. Respective coils were prepared from the pulverized plant materials, dried pulverized bark of *Machilus macaranthar* (a binding agent) and starch (a filling agent) in the ratio of 25%, 20% and 55% wt/wt, respectively. These were mixed in some water and molded into cylindrical bars in a syringe with a plunger. The bars were air dried in a shade. The controls included bars devoid of plant material (C_2) and a no fume situation (C_1).

Adult *Culex sp*. of mosquitoes was raised in the laboratory. 25 individuals, randomly selected from the laboratory culture, were introduced into each cage and allowed a resting period of 30 minutes before experiment was initiated. The method of Mace (1969) was adopted for the repellency test in a room of $3m^3$. The bar was ignited and allowed to burn for 60 minutes under a slowly rotating fan. The numbers of mosquitoes in the outer cage were monitored every 5 minutes. Six replicates were monitored for each plant material and the averages noted. Repellency index was calculated for each plant material (Rip) and fume (Riff) as follows:

$$RIp = Np - Nc_2/Np + Nc_2$$

$$RIf = Nf - Nc_1/Nf + Nc_1$$

Where:- Np = Number of mosquitoes repelled by fume with plant material

Nf = Number of mosquitoes repelled by fume

Nc_1 = Number of mosquitoes repelled in control without fume

Nc_2 = Number of mosquitoes repelled by fume without plant material. The data obtained were subjected to student ‘t’ test.

Toxicity was monitored in cages located within the room trough the transparent Perspex screen. Knock downs were noted every 5 minutes and after the expiration of the experiment. All knocked down individuals were allowed 15 minutes to recover. All experiments were conducted during the day. At the expiration of the 60 minutes, the bars were put off and the quantity of plant material burnt in each case calculated by differential method.

Results and Discussion

Table 1 shows the repellent activities of the fumes produced from the various plant materials over a 60-minute period as compared with the controls without fumes (C_1) and that without plant material (C_2). Of the four plant materials tested, only *A. torta* and *P. harmala* showed weak repellent activity with significantly different ($P < 0.05$) RIp values of 0.21 and 0.19 respectively. The other two plants were neither repellent nor attracting. Although the RIp value of *A. torta* was slightly higher, but not significantly different ($P > 0.05$) from that of *P. harmala*, a greater proportion of the leaf material (5.26g) was burnt to achieve the result as compared with 3.08g of *P. harmala*. Thus *P. harmala* is the more efficient and potent repellent of the two plants. The order of efficacy of the plants was similar to that reported on housefly metamorphosis (Ande, 2001), i.e. *P. harmala* > *torta* > *Carica papaya* = *Calotropis gigantica*.

The number of insects outside the room (indicating repellency), increased with time, especially within the first 30 minutes in all cases including the control (C_2). Thus fumes may have contributed to the repellent activities noticed. This was confirmed by the relatively higher Repellency Indices (RIf) of 0.72, 0.71, 0.61, 0.54 and 0.51 for *A. torta, P. harmala, C. papaya, C. gigantica* and C_2 fumes, respectively (table 1). The fumes, no doubt, agitated the adult mosquitoes most of which were restless during the1-hour of fumigation, a situation that was not noticed in the control without fume (C_1). More so that the experiment was carried out during the day when the mosquitoes are supposed to be roosting (Gillet, 1971).

The fumes of all the plant materials were not toxic to the adult mosquitoes as less then 5.00% deaths were recorded. These deaths were sporadic in occurrence hence could not be adduced to fumes from any of the plants. Thus the assertion of Secoy and Smith (1983) that the four plant materials possess potent biocides against mosquitoes does not hold when offered as incense. The burning of the plants may have destroyed the potency of such active ingredients.

This approach to mosquito control, though noble and worthy of further investigation with other plants, may pose some scientific problems which includes the possibility of destroying active ingredients in the plant while burning, possible synergism resulting from the burning of other plant items used as filting or binding agents and the possible implication of such fumes to human health.

Table 1: Mean percentage of repelled adult mosquitoes and repellency indices on exposure to fumes from mosquito coils formulated from various plant materials.

Time (mins.)	**Percentage of repelled Mosquitoes**					
	Treatments					
	Acalypha torta	*Carica papaya*	*Calotropis gigantica*	*Peganum harmala*	*Control with fume(C_2)*	*Control no fume (C_1)*
0	0.00	0.00	0.00	0.00	0.00	0.00
5	15.33	13.67	12.67	12.71	9.32	0.00
10	20.67	11.33	11.32	18.00	12.00	2.00
15	22.00	13.33	14.67	20.66	13.33	2.00
20	30.00	17.33	18.18	27.33	15.33	5.33
25	35.33	23.67	18.66	32.00	19.33	4.00
30	40.00	21.33	22.67	36.00	22.00	3.33
35	44.00	28.66	23.33	42.67	22.00	4.00
40	41.67	31.33	26.00	47.33	20.67	7.33
45	48.00	36.00	28.60	48.00	24.66	7.33
50	52.67	35.33	28.66	50.00	25.33	8.67
55	52.67	35.33	29.33	50.67	26.66	7.33
60	53.33	35.33	28.67	48.00	26.66	8.67
RIf	0.72	0.61	0.54	0.71	0.51	-
RIp	0.21[b]	0.04[a]	0.03[a]	0.19[b]	-	-
Wt. Burnt (g)	5.26	4.67	4.62	3.08	0.00	-

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