EVALUATION OF CARBON DIOXIDE AND 1-OCTEN-3-OL AS MOSQUITO ATTRACTANTS

Indra Vythilingam, Chiang Geok Lian and Chan Seng Thim

Division of Medical Entomology, Institute for Medical Research, Kuala Lumpur, Malaysia.

Abstract. CDC Light traps were used to study the attractant effect of CO_2 and 1-octen-3-ol on trap catches of mosquito populations at three different locations in Malaysia. There was a significant increase in the number of mosquitos caught in traps baited with CO_2 and CO_2 with 1-octen-3-ol. The number of mosquitos caught in the CDC light trap and in the CDC light trap baited with 1-octen-3-ol alone were very few. 1-octen-3-ol and CO_2 acted synergistically in attracting significantly greater numbers of *Culex tritaeniorhynchus*. However *Anopheles* sp. were not very attracted to light traps even with attractants added to them.

INTRODUCTION

Researchers have used CDC light traps to sample mosquito populations for many years (Service, 1976). However, of late various modifications have been added to increase the efficiency of the traps. These include carbon dioxide and other components of host odor such as acetone, lactic acid and 1-octen-3-ol (octenol). Takken and Kline (1989) carried out field tests with carbon dioxide and octenol and found that octenol has potential as a mosquito attractant. Vale and Hall (1985) were successful in attracting tsetse flies to traps baited with octenol.

Besides CO_2 and octenol, the potential of butanone, honey extract, lactic acid and phenols as attractans for mosquitos have been evaluated by Kline *et al* (1990b). However the CO_2 baited light traps have been evaluated in Malaysia (De La Cruz 1973) and in Thailand (Miller *et al,* 1969).

Thus, the objective of this study was to further evaluate CO_2 and to determine the potential of octenol as attractants to local medically important species of mosquitos under field conditions.

MATERIALS AND METHODS

Four day trials were conducted in three areas in Malaysia. Seri Kembangan, Serdang which is located just outside Kuala Lumpur in Selangor is a residential area which is a disused mining pool filled with *Eichornia* plants. Previous surveys reveal that the main species in this area belong to the genera *Culex* and *Mansonia.* Pos Betau is about 200 km east of Kuala Lumpur and is situated in Pahang state. It is an aboriginal village in a mountainous area near the jungle fringe. It is a highly malarious area and *An. maculatus* is the main vector species in that region. Taman Beringin in Jinjang is a Chinese New Village in Kuala Lumpur and the main species found here belong to the genera *Mansonia* and *Culex.*

Each study consisted of 4 consecutive days' trapping trial. The CDC battery-operated light traps were used throughout the study. Four traps were placed in a straight line, 200 m apart. Each trap was provided with a different treatment combination daily according to a Latin square design (4 × 4). The treatment combinations used included CO_2, octenol and CO_2 + octenol. The CDC trap with light served as the control. The traps were alternated so that each trap occupied each of the 4 linear positions for a single night at each study area. Two replicates were carried out for each type of trap. The traps were operated from 1800 hours each night to 0700 hours the next morning.

Carbon dioxide gas was obtained from a piece of dry ice placed in a wooden box 6″ × 6″ × 6″ suspended adjacent to the light trap. The gas was supplied to the trap through a rubber tube from the box. The tube was placed near the trap entrance.

Octenol (1-octen-3-ol) was released from a small vial through a saturated wick (pipe cleaner) protruding through the plastic cover of the vial.

The vial containing 4 ml of octenol was fixed near to the trap entrance and when used in combination with CO_2, they were fixed adjacent to the CO_2 release point. Although other insects were present, only mosquitos collected during the study were counted and identified to species. Number of mosquitos/trap/night were transformed to log (X + 1). This transformation is necessary in view of the many influences other than population changes that affect the size of trap collections (Bidlingmayer, 1969). The transformed data were analysed using the Minitab program available in the Institute for Medical Research Computer Service, for the analysis of variance and mean comparisons.

RESULTS

At Serdang, *Culex tritaeniorhynchus* outnumbered all other mosquito species. Nine other species were present but only another two species ie *Culex quinquefasciatus* and *Mansonia uniformis* were used for the analysis as the rest were in very small numbers. Although the mean catch of *Cx. tritaeniorhynchus* was higher in the trap with the combination of CO_2 + octenol when compared with the trap with only CO_2, it was not significantly different ($p > 0.05$) as shown in Table 1. The same applies to *Ma. uniformis* and *Cx. quinquefasciatus*. The results from Serdang indicate that the traps supplemented with CO_2 and CO_2 + octenol were much more efficient than the light trap and the light trap supplemented with octenol alone as shown in Table 1.

In Pos Betau, a total of 12 species of mosquitos were present in the traps. However, only three species were analysed since the rest of the species were in very low numbers. The three species were *Ma. dives, Ae. albopictus* and *An. maculatus*. Although studies carried out in this area shows that *An. maculatus* is the main species present, the numbers present in the traps were much lower than *Ma. dives* and *Ae. albopictus*. However, there was a significant difference ($p < 0.05$) for the *An. maculatus* present in the traps supplemented with CO_2 when compared with the other three traps, as shown in Table 2. While for *Ma. dives* traps supplemented with CO_2 + octenol seems better than the rest although there is no significant difference ($p > 0.05$). In this site also there was no significant difference in the mosquitos present in the light traps compared to those present in the traps supplemented with octenol alone.

In Jinjang, a total of 16 species were present in the traps. However, only six species were present

Table 1

Mean catch ± standard error per trap per day for different CDC light traps in Serdang and Pos Betau.

Species	Baits			
	CO_2	CO_2 + Octenol	Octenol	None
Serdang				
Culex tritaeniorhynchus	$25.15 \pm 0.38_a$	$65.37 \pm 1.10_a$	$0.32 \pm 0.32_b$	$0.41 \pm 0.22_b$
Cx. quinquefasciatus	$6.29 \pm 0.23_a$	$7.38 \pm 0.39_a$	$1.21 \pm 0.11_b$	$0.41 \pm 0.22_b$
Mansonia uniformis	$10.75 \pm 0.66_a$	$22.88 \pm 0.40_a$	$0.68 \pm 0.39_b$	$0.41 \pm 0.22_b$
Pos Betau				
Ma. dives	$1.14 \pm 0.62_{ac}$	$5.46 \pm 0.43_a$	$0.19 \pm 0.19_{bc}$	$0.57 \pm 0.31_{bc}$
Aedes albopictus	$4.25 \pm 0.05_a$	$1.81 \pm 0.51_{ac}$	$0.32 \pm 0.32_{bc}$	$0.19 \pm 0.19_{bc}$
Anopheles maculatus	$3.24 \pm 0.23_a$	$0.89 \pm 0.89_{ab}$	$0 \pm 0_{ab}$	$0.89 \pm 0.89_{ab}$

The means in the same row followed by the same letter are not significantly different ($p > 0.05$).

Table 2

Mean catch ± standard error per trap per day for different CDC light traps in Jinjang.

Species	Baits			
	CO_2	CO_2 + Octenol	Octenol	None
Mansonia uniformis	$46.86 \pm 0.49_a$	$43.67 \pm 0.21_a$	$1.72 \pm 0.11_b$	$0.41 \pm 0.22_c$
Ma. indiana	$3.95 \pm 0.36_a$	$4.71 \pm 0.34_a$	$0.19 \pm 0.19_b$	$0 \pm 0_b$
Culex tritaeniorhynchus	$18.95 \pm 0.7_a$	$20.98 \pm 0.32_a$	$0 \pm 0_b$	$0 \pm 0_b$
Cx. fuscocephala	$5.43 \pm 1.55_a$	$4.28 \pm 0.47_a$	$0 \pm 0_b$	$0 \pm 0_b$
Cx. quinquefasciatus	$5.92 \pm 0.37_a$	$3.10 \pm 0.31_a$	$0.19 \pm 0.19_b$	$0.19 \pm 0.19_b$
Cx. gelidus	$4.88 \pm 0.16_a$	$1.92 \pm 0.30_{ab}$	$1.41 \pm 1.21_b$	$0 \pm 0_b$

The means in the same row followed by the same letter are not significantly different ($p > 0.05$).

in numbers enough for statistical calculation. Here the main species present was *Ma. uniformis* followed by *Cx. quinquefaciatus*. However, there was no significant difference ($p > 0.05$) between the traps supplemented with CO_2 and CO_2 + octenol, although the CDC light trap supplemented with CO_2 + octenol seems to have some synergistic effect in attracting more mosquitos.

DISCUSSION

Light traps have been generally found to be useful in monitoring and surveillance of vectors of Japanses encephalities such as in Korea using Yoshizawa Black light traps (Self *et al*, 1973), in China using New Jersey light traps (Mitchell and Chen, 1973), and in Thailand (Phanthumachinda, 1989), Indonesia (Suroso, 1989) and in Sarawak, East Malaysia (Hill, 1970) using CDC light traps. This study showed that the CDC light trap by itself was not attractive to the various species studied at the three different sites. In all the three sites the number of mosquitos present in the CDC light traps were very few, sometimes even zero.

These data demonstrate that octenol by itself was not attractive to the various species of mosquitos. Hall *et al* (1984) demonstrated the role of octenol identified in the expired breath of oxen, as an attractant for *Glossina* sp. Only in one site the octenol baited trap showed a significant difference to the CDC light trap for *Ma. uniformis*. However, since in all the three sites the octenol supplemented traps did not attract many mosquitos it does not seem to have the potential of being used as an attractant by itself in the CDC light traps for the surveillance of mosquitos. Kline *et al*, (1990a) also found that significantly fewer mosquitos were caught with octenol alone than with either CO_2 alone or octenol supplemented with CO_2. However, in their studies, about 5 times more were trapped with octenol than in the CDC traps without an attractant. Mainly *Mansonia* sp. were attracted to the octenol baited traps compared to other species.

Carbon dioxide baited light traps has been proven to be a good tool for sampling of mosquitos (Service, 1976; Gillies, 1980). In this study also the results demonstrate that there is no significant difference between the light trap supplemented with CO_2 and that with both CO_2 + octenol. However species like *Cx. tritaeniorhynchus* were present in larger numbers in the traps supplemented with CO_2 + octenol.

For *An. maculatus* there was a significant difference between the traps baited with CO_2 and CO_2 + octenol, although the numbers present were very small. Previous studies showed that *An. maculatus* is attracted to cows, with an approximately 2 : 1 preference for cow (Loong *et al*, 1990). However here though the traps were supple-

mented with octenol they were not successful in attracting *Anopheles* spp. Hii *et al* (1986) found the CDC light trap to be an efficient sampling tool for the *An. balabacensis* in the forested hilly areas of Sabah. Perhaps, in Pos Betau more trapping have to be conducted especially during the peak season.

Though not statistically different, the synergistic effect of octenol and CO_2 shows some promise for use in surveillance of some of the vectors. Kline *et al* (1991) has confirmed that the different species of mosquitos respond differently to the various combinations of attractants. More intensive trapping will have to be carried out in order to determine the best attractant to be used.

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