STUDIES ON THE LIVERPOOL AND MALAYSIAN STRAINS OF *AEDES (FINLAYA) TOGOI*

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INTRODUCTION

Since the finding of *Aedes (Finlaya) togoi* along the east coast of West Malaysia (Ramalingam, 1969), there has been considerable interest as to whether it could serve as a vector of filariasis in Malaysia. *A. togoi* has been incriminated as a probable natural vector of *Brugia malayi* in Southern Japan (Sasa *et al.*, 1952) and as a natural vector of *Wuchereria bancrofti* and *B. malayi* in the southern and coastal areas of China (Gan Dzyan-chzan, 1960). Hence it is relevant to find out the vectorial capacity of the Malaysian strain of this mosquito. The present study compares the vector efficiency of the Liverpool and Malaysian strains of *A. togoi* for filarial infections under laboratory conditions.

MATERIALS AND METHODS

Mosquito feeding: The colonies of *Aedes togoi* (Malaysian and Liverpool strains) were kept in an insectarium at a temperature of 80°F and relative humidity of 80%. Four to five day old females were starved a day before experimental feeding.

Brugia malayi and *Brugia pahangi* infected cats used in the experiment were anaesthetized with Nembutal intraperitoneally before mosquito feeding. The cat was placed on its side on top of the feeding cage and mosquitoes were allowed to feed through the gauze roof of the cage.

Before feeding, a sample of 30 mosquitoes was removed, killed with ether and weighed individually on a torsion balance. Immediately after feeding, another 30 fed mosquitoes were removed from the cage, killed and weighed individually. Smears were made of their stomach contents and the slides after drying overnight were stained with Giemsa and examined for microfilariae. 60 c.mm thick blood films from the cat were made before and after feeding and after drying overnight, were stained with Giemsa and the microfilarial count recorded.

After feeding. the unfed mosquitoes were removed and the fed mosquitoes were maintained on sugar water. The mosquitoes were dissected individually for infective larvae on the twelfth day after feeding. The number of infective larvae for each mosquito was recorded.

Site of feeding: A second series of experiments were performed to compare the intake of microfilariae by *Aedes togoi* at 2 different sites of feeding on the cat hosts. The two sites of feeding selected were the ear and body of the animal host. These experiments were done to find out whether there was any significant difference in microfilarial counts at different sites since the blood smears taken before and after the experimental feedings were from pricks in the cats' ears.

Six experiments were done with subperiodic *B. malayi* infected cats. The mean experimental intake and mean expected intake of microfilariae for each of the experiments were calculated.

RESULTS

Weight of blood-meal: The mean weight of blood-meal in each experiment was calculated

Table 1

Showing the mean weight of blood-meal and mean unfed weights of the two strains of *Aedes togoi*.

Filarial species	Microfilarial count (60 c.mm)	*A. togoi* (Malaysian)		*A. togoi* (Liverpool)	
		Mean wt. of blood-meal (mg)	Mean Unfed wt. (mg)	Mean wt. of blood-meal (mg)	Mean Unfed wt. (mg)
Brugia malayi	92	2.46	2.85	4.12	3.49
	125	3.34	2.55	2.69	3.03
	368	1.80	3.37	3.70	2.32
	598	2.60	2.46	2.42	2.59
	664	2.53	2.86	3.18	3.49
	995	2.93	2.47	3.08	3.08
Brugia pahangi	54	2.61	2.53	4.66	3.38
	228	1.89	2.98	2.60	2.97
	482	3.54	1.50	4.20	2.06
	972	2.50	2.55	2.80	3.02

from the mean weight of the unfed and fed samples of mosquitoes. From the results obtained in Table 1, it is observed that for the Malaysian strain of *A. togoi*, the mean weight of blood-meal is inversely proportional to the mean unfed weight of the mosquito ($r = -0.855, P < 0.01$). However, for the Liverpool strain of *A. togoi*, these two variables are independent of each other as observed by Ramachandran *et al.*, (1967) ($r = -0.11$). The mean weights of blood-meal for the Malaysian strain of *A. togoi* range from 1.80-3.54 mg while those of the Liverpool strain range from 2.42-4.66 mg. Statistical analysis reveals that there is no significant difference between the mean weights of blood-meal for the 2 strains of *A. togoi* ($t = 0.809$, $P > 0.1$). This finding indicates that the volume of blood ingested is not dependent on the individual size of the mosquito.

Microfilarial intake: As observed by other workers for various species of mosquitoes, (Jordan and Goatly, 1962; Ramachandran and Zaini, 1967) the average number of microfilariae taken up per mosquito was found to be unrelated to the mean blood-meal weight (Malaysian strain $r = 0.193$; Liverpool strain $r = 0.014$) nor to the microfilarial density in the hosts' peripheral blood (Malaysian strain $= r = 0.592$; Liverpool strain $= r = 0.500$) for both the strains of *A. togoi*.

Table 2 shows the mean microfilarial intake of the 2 strains of *A. togoi* at various microfilarial densities. The ratios of experimental intake/expected intake for the Liverpool strain are higher than those of the Malaysian strain of *A. togoi*. Statistical analysis reveals a significant difference for 6 out of 10 experiments performed thus indicating that the Liverpool strain is a better vector than the Malaysian strain.

Development of infective larvaa: Ramachandran and Zaini (1968) found that parasitism of *A. togoi* in the laboratory with subperiodic *B. malayi* seemed to have little effect on the mosquitoes' survival thus indicating good vector efficiency of *A. togoi* for *B. malayi* infections. Table 3 shows the mean

Table 2

Microfilarial intake by the Malaysian and Liverpool strains of *Aedes togoi* at various microfilarial densities.

Experiment No.		1	2	3	4	5	6	7	8	9	10
Microfilarial density in 60 c.mm of host's blood		92	125	368	598	664	995	54	228	482	972
Mean wt. of blood-meal (mg).	I	2.46	3.34	1.80	2.60	2.53	2.93	2.61	1.89	3.54	2.50
	II	4.12	2.69	3.70	2.42	3.18	3.08	4.66	2.60	4.20	2.80
Experimental intake of mf. per mosquito	I	2.7	4.4	3.6	0.9	13.3	40.6	1.0	0.9	1.7	2.4
	II	6.7	3.7	9.4	1.3	23.1	44.3	7.0	1.5	7.6	4.8
Expected intake of mf. per mosquito	I	3.8	6.9	10.7	27.0	22.4	67.0	2.4	7.0	28.0	40.5
	II	6.3	5.6	22.1	25.0	35.0	31.0	4.3	9.9	34.0	45.4
Experimental intake / Expected intake	I	0.43	0.64	0.34	0.03	0.38	0.61	0.04	0.13	0.06	0.06
	II	1.07	0.66	0.43	0.05	0.66	1.39	1.63	0.15	0.22	0.11

Key: I: *Aedes togoi* (Malaysian strain).
II: *A. togoi* (Liverpool strain).

Table 3

Mean number of infective larvae per fed mosquito of the Malaysian and the Liverpool strains of *Aedes togoi* at various microfilarial densities.

Filarial species	Expt. no.	Microfilarial density in 60 c.mm blood	Mean number of infective larvae per fed mosquito	
			Malaysian strain	Liverpool strain
Brugia malayi	1	92	116/36 = 3.22	—
	2	125	318/322= 0.99	135/80 = 1.69
	3	368	66/65 = 1.02	89/56 = 1.59
	4	598	76/198 = 0.38	132/132 = 1.00
	5	664	72/100 = 0.72	118/105 = 1.12
	6	995	223/57 = 3.91	803/176 = 4.56
Brugia pahangi	7	54	20/421 = 0.05	665/204 = 3.26
	8	228	10/141 = 0.07	204/155 = 1.32
	9	482	184/109= 1.69	220/109 = 2.02
	10	972	20/202 = 0.09	377/271 = 1.39

Table 4

Microfilarial intake by *Aedes togoi* at 2 different sites of feeding.

Filarial species		*Brugia malayi* (sub-periodic)					
Experiment No:		1	2	3	4	5	6
Mf. density in 60 c.mm blood		106	151	163	270	787	928
Experimental intake of	E	1.6	4.1	2.1	4.2	10.9	17.3
mf. per mosquito	B	0.7	0.9	1.6	3.9	7.3	15.6
Expected intake of	E	9.3	5.5	6.0	12.4	36.6	67.9
mf. per mosquito	B	8.7	3.3	5.8	17.2	35.2	56.5
Experimental Intake	E	0.17	0.75	0.35	0.34	0.30	0.25
Expected Intake	B	0.08	0.29	0.28	0.23	0.21	0.28

Key: E : Ear
B : Body

number of infective larvae per fed mosquito of the 2 strains of *A. togoi* for the various microfilarial densities. Of the 9 paired experiments performed, 7 showed statistically significant differences between the number of infective larvae recovered in the two strains. The Liverpool strain has a higher recovery of infective larvae than the Malaysian strain at the various microfilarial densities.

Microfilarial intake at two different sites: From Table 4, it is observed that there is no significant difference in the microfilarial intake by *A. togoi* for five out of the six experiments performed ($P > 0.05$). This indicates that the site of feeding does not affect microfilariae intake.

DISCUSSION

Besides being a natural vector for some filarial infections, *A. togoi* has been shown to be an extremely good experimental vector of the periodic and sub-periodic strain of *B. malayi*, the rural strain of *W. bancrofti*, *B. pahangi* and *Dirofilaria immitis* (Ramachandran *et al.*, 1963). Since the strain of *A. togoi* found on the east coast of Peninsular Malaysia may have been introduced into the country by sea, its potential as a vector for filarial infections should be given serious consideration.

Comparative studies between the Malaysian and Liverpool strains of *A. togoi* have shown them to be similar in their response to experimental infection with *B. malayi* and *B. pahangi*. Thus the mean weights of blood-meals by both strains are similar. However, unlike the Liverpool strain, it was found that the mean weight of blood-meal in the Malaysian strain was inversely proportional to the mean unfed weight of the mosquito. Individual mosquitoes were also found to take in varying numbers of microfilariae when fed on the same host at the same time. This phenomenon was also observed by Hinman (1933, 1935) in his investigations with *Culex quinquefasciatus* and *A. aegypti* for *D. immitis* and also by Galliard (1936). Most of the mosquitoes took in fewer microfilariae than expected, except for 8.3% of the Malaysian strain and 14.3% of the Liverpool strain.

The Liverpool strain mosquitoes were also more efficient in the uptake of microfilariae showing it to be a more efficient experimental

vector. This was again reflected in the higher mean recovery of infective larvae per fed mosquito compared with that of the Malaysian strain. Although the experimental vector efficiency of the Malaysian strain is lower than that of the Liverpool strain, there can be no doubt that it is susceptible to both *B. malayi* and *B. pahangi* with mean recovery of infective larvae per fed mosquito as high as 3.9 and 1.7 respectively. However, this strain of *A. togoi* has a tendency to be autogenic (Ramalingam, 1969). Thus, further studies on its distribution and natural filarial larval infections in Malaysia and the neighbouring countries should be carried out to determine its vectorial importance.

SUMMARY

Comparative studies of vector efficiency were done with the Liverpool and Malaysian strains of *Aedes (Finlaya) togoi* for subperiodic *Brugia malayi* and *Brugia pahangi*. The Malaysian strain of *A. togoi* was found to take in fewer microfilariae under the same experimental conditions than the Liverpool strain. Also, for various microfilarial densities in the host's peripheral blood, the Malaysian strain had less mean infective larvae per fed mosquito than the Liverpool strain. The microfilarial intake of *A. togoi* was not affected by the site of feeding on the host. Most of the mosquitoes took in fewer microfilariae than expected. It is concluded from these studies that the Malaysian strain of *A. togoi* is a susceptible and reasonably good vector for subperiodic *B. malayi* and *B. pahangi*. Further field studies should be carried out to determine its importance as a natural vector of Brugian filariasis.

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