COCKROACHES FROM URBAN HUMAN DWELLINGS: ISOLATION OF BACTERIAL PATHOGENS AND CONTROL

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Abstract. A study was carried out to determine the distribution of cockroaches in two different housing areas with central sewerage or individual septic tanks in an urban area in Kuala Lumpur, Malaysia. Six species of cockroaches were present and of these *Periplaneta americana* and *Periplaneta brunnea* were found in greater abundance. Seventeen species of bacteria were isolated and of these *Escherichia coli* and *Klebsiella p. pneumoniae* were isolated in greatest numbers. Control measures carried out using lambda cyhalothrin showed that there was no significant difference between treated and control sites.

INTRODUCTION

Cockroaches are nocturnal in nature and are found in a variety of human habitats. The importance of cockroaches as domiciliary pests is gaining widespread public attention in Malaysia. Studies have been carried out to determine the species composition of cockroaches in Klang and in Penang, Malaysia (Oothuman *et al*, 1984; Yap *et al*, 1991; Lee *et al*, 1993).

Cockroaches are also known to harbor a wide range of bacteria and other pathogenic organisms (Roth and Willis, 1957; Oothuman *et al*, 1989). Cockroaches are known to enter houses through the sewerage system and feed indiscriminately, thus serving as mechanical carriers of pathogens. Most of the studies carried out previously were confined to the infestation and relative abundance in different localities in housing estates.

The objectives of this study were to determine the distribution of cockroaches in two different housing areas with central sewerage system or individual septic tanks, isolation of bacterial pathogens, and their control.

MATERIALS AND METHODS

Study sites

Two study sites were chosen in the Federal Territory of Kuala Lumpur : 1) in Taman Ibu Kota consisting of rows of single storey linked houses, each with it's own septic tank ; 2) in Setapak Jaya consisting of long houses with a central sewerage system.

Collection of cockroaches and identification

Cockroaches were collected using the beaker trap method of Jeffrey *et al* (1984). The upper one fifth of the inner surface of the beaker was coated with a suspension of talcum powder and alcohol. Mice chow was used as food. Cockroaches once entering beakers lured by food are unable to climb out. Ten houses were chosen at random in each area and trapping was carried out fortnightly from April 1993 to May 1994. Three traps were set in each house, one trap in each of the following areas: kitchen, store room and dining area. Traps were collected on the fifth day after setting and transported to the laboratory for further processing. Cockroaches were identified using the criteria outlined in Cochran (1982) and were also compared with reference collection maintained in the Entomology Division, Institute for Medical Research.

Bacteria isolation

Cockroaches were killed with chloroform then disinfected with alcohol and legs and wings were removed. Guts of cockroaches were dissected out and emulsified in petri dishes containing normal saline. Bacterial smears were carried out as de-

scribed by Oothuman *et al* (1989). A small amount of the emulsion was transferred into sterile peptone water and a loopful of the suspension was inoculated on to Oxoid blood agar base containing 5% blood and MacConkey medium. The plates were incubated aerobically for 18-24 hours at 37°C. Bacterial identification was then carried out by the methods described by Cowan and Steel (1974). The identity of all Enterobacteriaceae was confirmed by API 20E test kit.

Control of cockroaches

In January 1994, 10 more houses were chosen in Taman Ibu Kota for the purpose of control studies, and trapping of cockroaches was carried out. In June 1994, we sprayed the septic tanks of five of these houses with Lambad-cyhalothrin at a dosage of 80 ml/m^2. As control the septic tanks of the remaining five houses were sprayed with water. Trapping was carried out as stated earlier in these 10 houses until December 1994.

RESULTS

The results obtained are shown in Table 1. Only six species of cockroaches were present and of these *Periplaneta americana* and *Periplaneta brunnea* were found in greater abundance compared to other species. However, a species of *Blattelidae* was found in great abundance, especially the nymphs.

A larger number of *Neostylopyga rhombifolia* was found in Setapak Jaya compared to Taman Ibu Kota. As for *Supella longipalpa* it was found in greater numbers in Taman Ibu Kota but only a single nymph was found in Setapak Jaya. *Blattella germanica* was found only in Setapak Jaya. Fig 1 shows the distribution of *P. americana*, *P. brunnea* and nymphs from Setapak Jaya over a period of one year. There was no significant difference in the adult population of *P. americana* and *P. brunnea* throughout the year, but there was a significant difference in the nymphal population.

Fig 2 shows the distribution of *P. americana, P. brunnea* and nymphs in Taman Ibu Kota. *P. brunnea* nymphs showed peaks in numbers in October and February in both sites. Adults of *P. brunnea* were found in low numbers at the beginning of the study and regular trapping seemed to deplete their numbers. However, *P. americana* adults were found in greater numbers than nymphs in most of the months, except towards the end of the trapping period (February-April).

Bacteria isolated from the cockroaches trapped in Taman Ibu Kota and Setapak Jaya are shown in Table 2. Seventeen species of bacteria were isolated and of these *Escherichia coli* and *Klebsiella p. pneumoniae* were isolated in greatest numbers. Others isolated in considerably large numbers were *Bacillus* sp., *E. cloacae* and *Streptococcus* sp. Most of the isolates were from *P. americana*, fewer from *P. brunnea* and *N. rhombifolia*. Four isolates were also obtained from the species of *Blattellidae*.

Before the treatment of septic tanks the mean number of cockroaches collected from houses in

Table 1

Cockroaches collected from Taman Ibu Kota and Setapak Jaya-April 1993 to May 1994.

Species	Taman Ibu Kota				Setapak Jaya			
	Males	Females	Nymphs	Total	Males	Females	Nymphs	Total
P. americana	119	110	159	388	88	136	256	480
P. brunnea	40	55	442	537	23	30	496	549
Blattelidae	9	12	270	291	12	28	135	175
N. rhombifolia	1	3	1	5	3	7	27	37
S. longipalpa	6	3	11	20	0	0	1	1
B. germanica	0	0	0	0	0	2	27	29

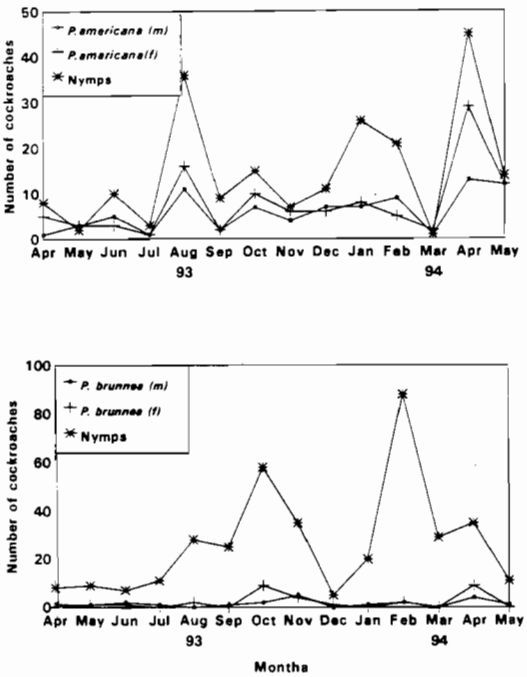

Fig 1–Monthly distribution of *P. americana* and *P. brunnea* in Setapak Jaya.

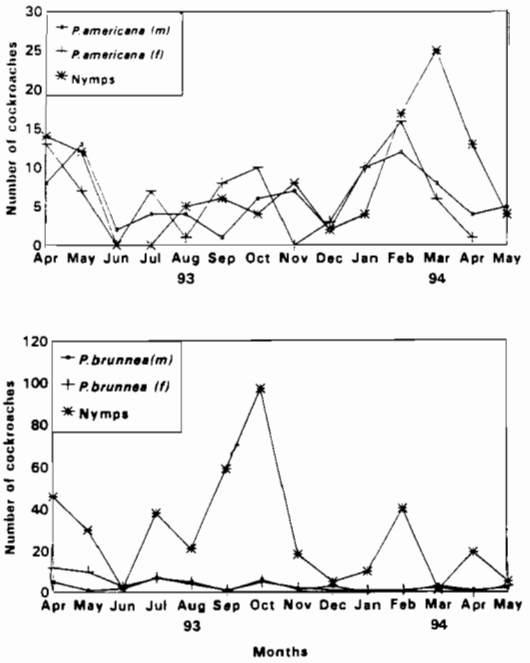

Fig 2–Monthly distribution of *P. americana* and *P brunnea* in Taman Ibu Kota.

Table 2

Bacteria isolated from cockroaches trapped in Taman Ibu Kota and Setapak Jaya, Kuala Lumpur.

Bacteria	Setapak Jaya		Taman Ibu Kota			
	P. americana (29)	*P. brunnea* (5)	*N. rhombifolia* (3)	*P. americana* (5)	*P. brunnea* (6)	*Blattellidae* (1)
Acinetobacter caloaceticus				1	1	1
Bacillus spp	8	2	2	11	2	
Citrobacter freindii	5	1		2		
Enterobacter agglomerans	4	1		2		
E. agglomerans2	2			1		
E. agglomerans3	2			2		
E. cloacae	11	2	1	5		1
E. intermedium			1	2		
Escherichia coli	17	2	3	6	4	
E. vulneris	1					
Klebsiella oxytoca	2	1		1		
K.p. pnueumoniae	17	2	1	5	4	1
K.p. ozaenae	1			2	1	
K.p. rhinocleromatis				1		1
Proteus mirabilis	2	1		2	1	
P. vulagris	4	2				
Streptococcus spp	10	3		6	5	

Table 3

Mean (and range) of cockroaches trapped before and after the treatment of septic tanks with lambda cyhalothrin at Taman Ibu Kota, Kuala Lumpur.

	Pre-treatment		Post-treatment	
	Treated intervention	Control untreated	Treated intervention	Control untreated
Cockroaches				
Mean	[c]3.52[a]	[b]4.38[a]	[c]1.66[d]	[b]2.67[d]
Range	1-23	1-19	1-5	1-9

Significance of difference:
[a]p not significant at p = 0.05, [b]p significant at p = 0.05, [c]p not significant at p = 0.05,
[d]p not significant at p = 0.05 by Student's *t*-test.

treated and control areas was not significantly different. During the months of post treatment, mean number of cockroaches collected from treated and control houses was not significantly different ($p > 0.05$) (Table 3). However, in the control area there was a significant difference in the number of cockroaches before and after ($p = 0.05$) Table 3.

DISCUSSION

In previous studies carried out in this country (Oothuman *et al*, 1984; Yap *et al* 1991; Lee *et al*, 1993) it was shown that *P. americana* was the dominant species. However, although larger numbers of adults of *P. americana* was collected from both areas, the nymphs of *P. brunnea* was found in larger numbers in both areas. We cannot explain why the numbers of nymphs of *P. brunnea* was more than that of *P. americana*. *P. brunnea* was first reported from this country by Jeffrey *et al* (1982) and is known to coexist with *P. americana*. It is possible that *P. brunnea* was misidentified in earlier studies.

Eight to nine species of cockroaches have been reported from previous studies (Jeffery *et al*, 1982; Oothuman *et al*, 1984; Yap *et al*, 1991). These studies covered urban as well as rural areas. However in this study all species found in the urban areas have been reported and in addition *B. germanica* is reported from Setapak Jaya. This species is usually found in restaurants (Cornwell, 1968). This is a first report of *B. germanica* being found in a house in this country. *S. longipalpa* was found in Taman Ibu Kota in small numbers while in Setapak Jaya only a single nymph was present. This species is usually found beneath tables and other furnitures and feeds on gum and paste (Oothuman *et al*, 1984).

The *Blattelidae* species, especially nymphs, were found in large numbers in both areas. In this study trapped cockroaches were not released back to the same environment. We found that regular trapping caused a depletion in the population.

Studies have shown that cockroaches can serve as carriers of pathogens and act as intermediate host for a number of parasites (Oothuman *et al*, 1989; Rampal *et al*, 1983). Even in comparatively clean houses bacteria have been isolated from cockroaches and this is because they are known to enter houses from outside through sewerage and manholes where they may become contaminated (Oothuman *et al*, 1989).

Although cockroaches are known to harbor bacteria, it is difficult to incriminate them as vectors of bacterial diseases. The following bacteria were isolated for the first time from cockroaches in peninsular Malaysia: *Acinetobacter calcoaceticus, Citrobacter freindii, Enterobacter agglomerans* 2, *Enterobacter agglomerans* 3, *Enterobacter intermedium, Enterobacter vulneris, E. cloacae, Klebsiella p. rhinocleromatis, K.p.pneumoniae, Proteus mirabilis* and *Proteus vulgaris*. Several potentially pathogenic bacteria were isolated from the cockroaches in this study. *Klebsiella* spp has been associated with neonatal septicemia in a hospital in Thailand (Pengsaa *et al*, 1996); *Escherichia coli* and *Proteus vulgaris* have been associated with

urogenital intestinal infections and gastroenteric tract infection respectively (Burgess and Cowan, 1993). More bacteria was isolated from cockroaches in Setapak Jaya which has the central sewerage system than from the cockroaches in Taman Ibu Kota which had individual septic tanks. One would expect that the cockroaches from individual septic tanks would harbor more bacteria as they are in direct contact with the sewage. It is also shown that *P. americana* harbors more bacteria than the other species.

There was no significant difference in the numbers of cockroaches between the treated and control sites. One possible reason for this was that the population was being depleted with regular trapping carried out by us. This was shown in the control site as the numbers was significantly lower after spraying. The day after spraying many dead cockroaches were found in the traps.

Pyrethrins are repellent and used for flushing (Rust *et al*, 1991). Thus it could be that lambda cyhalothrin killed some cockroaches but flushed away many that may have escaped lethal exposure. More work has to be carried out on the control of cockroaches. It would be better if the cockroaches trapped before spraying were counted and released back to the sewers. In this way the actual effect of spraying insecticides could be determined. However house owners would not be happy with this procedure.

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