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Endo-parasite fauna of rodents caught in five wet markets in Kuala Lumpur and its potential zoonotic implications

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Abstract. Rodents were collected from five wet markets (Chow Kit, Dato Keramat, Setapak, Jinjang and Kepong) in Kuala Lumpur, Federal Territory between March to April 2006. Ninety-seven rats were trapped using wire traps measuring 29 x 22 x 50 cm baited with fruits, coconuts, dried fish or sweet potatoes. A total of 17 different species of parasites were identified from three species of rats out of which 11 (65%) were identified to be zoonotic. The helminths identified from the urban rats were nematodes- *Capillaria hepatica*, *Gongylonema neoplasticum*, *Heterakis spumosa*, *Heterakis* sp., *Masterphorus muris*, *Nippostrongylus brasiliensis*, *Physolaptera* sp., *Pterogodermatis* sp., *Rictularia tani* and *Syphacia muris*; cestodes- *Hymenolepis nana*, *Hymenolepis diminuta*, *Hymenolepis sabnema*, *Hymenolepis* sp., *Raillietina* sp. and *Taenia taeniaeformis*, and acanthocephalan- *Moniliformis moniliformis*. The following parasites are of potential medical importance: *C. hepatica*, *G. neoplasticum*, *R. tani*, *S. muris*, *H. diminuta*, *H. nana*, *Raillietina* sp. and *T. taeniaeformis*.

INTRODUCTION

Rodents are a key mammalian group and are highly successful in adapting to many environments throughout the world. There are more than 1700 species of rodents identified in the world (RatZooMan, 2006). Rodents particularly those belonging to the family Muridae form the largest group of mammals in Malaysia (Ow-Yang, 1971). They are known to transmit diseases and act as reservoir host for many zoonotic pathogens including parasites that pose a health risk to humans (Walsh *et al*., 1993; Mayer *et al.*, 1995; Singleton *et al*., 2003).

Endo-parasites of rodents play an important role in the zoonotic cycles of many diseases, e.g. schistosomiasis and angiostrongyliosis. Several studies on endo-parasites of commensal and forest rodents have been carried out in Malaysia (Singh & Cheong, 1971; Leong *et al.*, 1979; Yap *et al*., 1977; Krishnasamy *et al*., 1980; Ambu *et al*., 1996). The present study was carried out on rats caught in five wet markets in Kuala Lumpur. The aim of this study was to identify the endo-parasites found in these rats and their zoonotic implications.

MATERIALS AND METHODS

Trapping locations

Trapping of rodents was conducted for seven days between March and April 2006 in the five wet markets using 100 live traps. Fruits, coconut, dried fish or sweet potatoes were used as baits. The rodents were trapped from the following wet markets: Chow Kit, Dato Keramat, Setapak, Jinjang and Kepong in Selangor & Kuala Lumpur.

Trapping

All the rodents were trapped alive using specially made wire traps measuring 29 X 22 X 50 cm in all five wet markets. Trapped rodents were killed humanely by placing the trapped rodent into a cloth bag containing cotton wool soaked with chloroform. The animal was then tagged for identification.

Identification of rodent species

Keys and illustrations developed by Harrison & Quah (1962), Medway (1983) and Payne *et al.* (1985) were used to identify the rodents to species level. These keys were used when it was difficult to identify the rodent species by morphological measurements and physical appearances.

Collection, preservation and examination of helminths

Post-mortem of the rats was conducted according to standard procedures as described by Rusli (1988). The skin was removed and the body cavity was slit open from throat to anus revealing the esophagus, stomach, intestine, liver and urinary bladder. The viscera were removed without damaging the other organs and dissected carefully under the dissecting microscope and examined for helminths.

All parasites were washed with saline, fixed in warm 70% alcohol and later transferred to cool 70% alcohol. For clearing and identification of nematodes, 5% glycerin in 70% alcohol or lactophenol was used as temporary mounts. As for trematodes, cestodes and acanthocephala they were stained in Paracarmine stain, dehydrated in alcohol series, cleared in methyl salicylate oil and mounted in Permount or Canada balsam for identification. The helminths were identified using keys, illustrations and publications by Singh & Cheong (1971), Yap *et al.* (1977), Leong *et al.* (1979), Krishnasamy *et al.* (1980), Rusli (1988), Miyazaki (1991) and Ambu *et al.* (1996).

RESULTS AND DISCUSSION

A total of 97 rats were trapped from the five wet markets comprising *Rattus rattus diardii* (n=89), *Rattus novergicus* (n=7) and *Rattus exulans* (n=1). All of them were found infected with at least one parasite. *R. r. diardii* alone was found to harbor 3 groups of helminths comprising 17 different species. *Rattus rattus diardii* was also found to have the highest record of single, double, triple and multiple helminth infections (Table 1).

A total of 17 different species of helminths were identified from the three species of rats from the wet markets. They were ten species of nematodes, six species of cestodes and an acanthocephalan (Table 2). The zoonotic nematode *Capillaria hepatica* was recovered from rats in all the five locations in this study.

In Malaysia, *C. hepatica* was first reported by Audy *et al.* (1950) and later by Schacher & Cheong (1960) and Singh & Cheong (1971). *Capillaria hepatica* in rodents is mainly transmitted through scavenging of carrion. Other methods such as predation or feacal and mechanical transmission by carrion beetles and fly larvae have been suggested by Momma (1930) and Mobedi & Arafaa (1971) as possible modes

Table 1. The number of helminth infections in three rats species caught in wet markets

Rat host	Single infection	Double Infections	Triple Infections	Multiple infections			Total
				4	5	6	
R. r. diardii	34	29	8	5	4	1	81
R. norvergicus	3	0	3	4	5	0	15
R. exulans	1	0	0	0	0	0	1
Total infection	38	29	11	9	9	1	97

Note: R – *Rattus*

Table 2. Total worm burden in rats caught from five wet markets in Kuala Lumpur

Parasites	Kepong	Jinjang	Setapak	Chow Kit	Keramat	Totals
	No. of +ve rats / No. of worms	No. of +ve rats / No. of worms	No. of +ve rats / No. of worms	No. of +ve rats / No. of worms	No. of +ve rats / No. of worms	Total no. of +ve rats / Total no. of worms
NEMATODES						
Capillaria hepatica *	6/15	1/6	5/6	3/4	6/12	21 / 43
Gongylonema neoplasticum *	3/15	5/16	2/2	3/15	4/8	17 / 56
Heterakis spumosa	–	–	–	3/33	2/8	5 / 41
Heterakis sp	–	–	–	2/7	–	2 / 7
Masterphorus muris	–	–	–	3/14	1/20	4 / 34
Nippostrongylus brasiliensis	–	1/12	–	8/63	4/27	13 / 102
Physolaptera sp	–	–	–	3/3	–	3 / 3
Pterogodermatis sp	1/6	–	–	–	–	1 / 6
Rictularia tani *	–	–	1/9	–	–	1 / 9
Syphacia muris *	–	1/5	–	1/2	1/10	3 / 17
CESTODES						
Hymenolepis diminuta *	1/5	–	7/23	3/7	1/1	12 / 36
Hymenolepis nana *	–	–	5/14	4/17	1/1	10 / 32
Hymenolepis sabnema *	1/6	2/3	–	–	–	3 / 9
Hymenolepis sp. *	1/3	2/13	–	5/11	1/5	9 / 32
Raillietina sp. *	6/13	–	6/23	5/11	1/7	18 / 54
Taenia taeniaeformis *	2/2	3/3	8/11	4/4	7/10	24 / 30
ACANTHOCEPHALA						
*Moniliformis moniliformis**	–	–	1/1	3/30	1/20	5 / 51
Total	21/65	15/58	35/89	50/210	30/129	

Note: * Zoonotic. (–) No intact worms recovered.

of infection. The feeding habits of these beetles are well known but the development and transmission of infective eggs of *C. hepatica* through beetles have not been fully established. This parasite appears to be widespread throughout Malaysia with a wide range of hosts among the rodent species. Sinniah *et al.* (1979) reported 15.5% of the 3,324 rats examined from 15 localities in peninsular Malaysia were infected with *C. hepatica*. However, they reported only 0.7% infection rate among the urban rats which is relatively lower compared to our studies (21.6%). It is interesting to note that four decades ago not a single house rat out of the 709 trapped in Kuala Lumpur and its surroundings were found infected with *C. hepatica* (Schacher & Cheong, 1960).

The high prevalence of *C. hepatica* infections in our study may probably be due to trapping of rats within a limited area where the foci of infection may have been high. Furthermore infections of rats depend on the availability of the parasites to rats. Since most of the rats feed and live within a small area, infections are easily maintained among the population. The prevalence rate of 21.6% of *C. hepatica* infection in the urban rats in this study poses a health risk to humans. It should be noted that the infection percentage (21.6%) was derived on actual recovery of adult worm via dissection of the infected organ. There were several rodents found with severe characteristic of *C. hepatica* lesion in the liver but on examination of the lesion we were not able to detect any worms.

The first reported human infection of *C. hepatica* was in a soldier from India (Sinniah *et al.*, 1979). Worldwide about 30 cases of *C.*

hepatica infections in humans have been documented mostly in children from one to five years of age (Battersby, 2002). The parasite can cause an acute or sub-acute hepatitis with marked eosinophilia and persistent fever in humans. Hepatomegaly (which is non-specific on radiography or sonography) may develop, with eggs in the liver parenchyma inducing necrosis and abscess in infected humans (Miyazaki, 1991). Surprisingly, despite the high infection rate of urban rodents, there is no record of *C. hepatica* infections among humans in Malaysia. The reasons for this are not clearly understood but it could be due to under diagnosis.

Other nematode parasites identified in the urban rats were *Syphacia muris*, *Heterakis* sp., *Masterphorus muris*, *Nippostrongylus brasiliensis*, *Rictularia tani* and *Pterogodermatis* sp. *Rictularia* sp. has been reported to infect humans (Waugh, 2006) and in this survey only two adult worms of *Rictularia* were recovered from a single *R. r. diardii* from Setapak (Table 2).

There were six different species of cestodes recovered from the urban rats. *Hymenolepis nana*, *Hymenolepis diminuta*, *Hymenolepis* sp., *Raillietina* sp. and *Taenia taeniaeformis* found in all the five locations (Table 2). *Hymenolepis nana*, *H. diminuta* and *T. taeniaeformis* are known to have been transmitted to humans (Miyazaki, 1991). *Hymenolepis sabnema* was only recorded in Kepong and Jinjang and this species too is highly suspected to be zoonotic although there are no records of human infection so far.

Hymenolepis nana or "dwarf" tapeworm is essentially a parasite of rats and distributed worldwide. Sinniah *et al.* (1978) reported infections of *H. diminuta* and *H. nana* in 0.7% of the oil palm estate workers positive for helminths. Khairul (1978) reported the same rodent tapeworm infection in a Malay man from a fishing community in Teluk Bahang, Penang. Sandosham (1955) reported 1% of the 1,300 hospital patients in Singapore were infected with *H. nana*. Transmission of these zoonotic parasites to humans has been reported to be prevalent in areas where temperatures are high and sanitary conditions are poor (Miyazaki, 1991).

Cestodes of the genus *Hymenolepis* generally need various intermediate hosts such as insects, fleas and cockroaches for their development. However, *H. nana* does not necessarily always need an intermediate host. Through an exceptional development pathway called autoinfection, the eggs of this particular species hatch in the intestine of the host without being passed outside and grow into adult worms. This causes the number of adult worms in the host of the intestine to increase, causing severe pathological problems to the host (Miyazaki, 1991). It is estimated that more than 21 million people in the world suffer from hymenolepiasis and the majority of them are in the tropics and subtropics (Parija, 1990).

The Acanthocephala *Moniliformis monoliformis* was recovered from *R. r. diardii* and *R. norvergicus* in Setapak, Chow Kit and Dato Keramat wet markets. Lim *et al.* (1974), during a survey of urban rats in Penang island found only a single *R. norvergicus* infected and recovered not more than eight worms. In this study, a total of 51 worms were recovered from *R. r. diardii* from the 3 urban locations (Table 2). The first human case of *Moniliformis moniliformis* infection was reported in Japan in a 14-month-old baby boy. It was speculated that the infection was associated with the high infection rate of this parasite in *Rattus norvergicus* in the baby's locality (Miyazaki, 1991). There is no record of *M. dubius* infection in humans in Malaysia.

Among the five wet markets, rats from Chow Kit and Dato Keramat areas were found to be infected with a wide range of endo-parasites with zoonotic potential. Of the 18 different species of helminths identified 11 (61%) of them are zoonotic (Table 2). *R. r. diardii* was the predominant rodent species infected with a wide range of parasites many of which are zoonotic. The possibility of these rats contaminating the environment, food and water sources with their parasites poses a public health threat since these rats live in close association with humans. The close association of this host species to human activities may facilitate the

transmission of these zoonotic parasites to humans. It is recommended that the present rat control measures to be reviewed by the relevant authorities and also to improve its rat-borne disease surveillance programmes.

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REFERENCES

Ambu, S., Krishnasamy, M., Ramachandran, P. & Ramos, R. (1996). Helminth infections of rodents in Orang Asli settlement in Selangor, Malaysia-possible health risks. *Tropical Biomedicine* **13**: 23-127.

Audy, J.R., Harrisons, J.L. & Smith, W. (1950). A survey of Jarak Island, Straits of Malacca. *Bulletin Raffles Museum* **23**: 230-261.

Battersby, S.A. (2002). Urban rat infestations- Society's response and public health implications. PhD Thesis, University of Surrey, Guildford, Surrey, United Kingdom.

Harrison, J.L. & Quah. (1962). The house and field rats of Malaysia. *Bulletin No.12, Institute for Medical Research*. Federation of Malaya pp. 38.

Khairul, A., Ramachandran, C.P. & Paran, T.P. (1978). Parasitic disease among fishermen living on Penang Island. *Medical Journal of Malaysia* **32**: 321-327.

Krishnasamy, M., Inder Singh, K., Ambu, S. & Ramachandran, P. (1980). Seasonal prevalence of the helminth fauna of the Wood Rat *Rattus tiomanicus* (Miller) in West Malaysia. *Folia Parasitologica (Praha)* **27**: 231-235.

Leong, T.S., Lim, B.L., Yap, L.F. & Krishnasamy, M. (1979). Parasite fauna of the house rat *Rattus Rattus diardii* in Kuala Lumpur and nearby villages. *Southeast Asian Journal of Tropical Medicine and Public Health* **10**(1): 122-126.

Lim, B.L., Ramachandran, C.P. & Krishnasamy, M. (1974). Helminth infection among small mammals in Penang Island, Peninsula Malaysia. *Federation Museum Journal* **19**: 57-65.

Medway, L. (1983). *The Wild Mammals of Malaya* (Peninsula Malaysia) and Singapore. Second Edition, Oxford University Press, pp. 131

Mayer, A.N., Shankster, A., Langton, S.D. & Jakes, G. (1995). National commensal rodent survey. *Journal Emerging Infectious Diseases* **4**(**4**): 529-537.

Miyazaki, I. (1991). *An Illustrated Book of Helminth Zoonoses*. SEAMIC Publication No. 62, Tokyo, Japan, pp. 494.

Mobedi, I. & Arafaa, F. (1971). Probable role of ground beetle in the transmission of *Capillaria hepatica*. *Journal of Parasitology* **57:** 1144-1145.

Momma, K. (1930). Notes on modes of rats infestation with *Hepaticola hepatica*. *Annals of Tropical Medicine and Parasitology* **24**: 109-113.

Ow-Yang, C.K., (1971). Studies on the nematode parasites of Malaysian rodents. The Rhabdiasidae, Trichuridae and Oxyuridae. *Journal of Helminthology* **45**(2/3): 93-109.

Parija, S.C. (1990). *Review of parasitic zoonoses*. AITBS Publishers Distributers, Delhi, India.

Payne, J.P., Charles, M. & Karen, P. (1985). *A fieldguide to the mammals of Borneo*. Weng Fatt Sdn. Bhd, Kuala Lumpur.

Rat Zoo Man (2006). Rats and human health in Africa: *Proceedings of an International Workshop on Rodent-Borne Diseases and the Rat ZooMan Research Project.* May 3-6, malelane, Republic of South Africa.

Rusli, I. (1988). Satu kajian taksonomi tentang *Hymenolepis* Weinland, 1858 (Cestoda: Hymenolepididae), dan *Raillietina* Fuhrmann, 1920 (Cestoda: Davaineidae) daripada tikus rumah dan tikus mondok di Malaysia. Medical Laboratory Technology Programme, University Kebangsaan Malaysia.

Sandosham, A.A. (1955). A checklist of helminth parasites of man in Malaya with brief notes on their incidences. *Proceedings Alumni Association of Malaysia* **8**: 258-265.

Schacher, J.F. & Cheong, C.H. (1960). Malaysian Parasites. XLVII. Nematode parasites of three common house rat species in Malaya with notes on (*Rictularalia*) = *Rictularia tani* Hoeppli, 1929. *Studies Institute Medical Research F.M.S.* 29:209.

Singh, M. & Cheong, C.H. (1971). On collection of nematode parasites from Malayan rats. *South East Asian Journal of Tropical Medicine and Public Health* **2(4)**: 516-522.

Singleton, G.R., Lyn Hinds, Charley Krebs & Dave Spratt. (2003). *Rats, mice and people: an interwowen relationship*. Rodent Biology and Management. ACIAR Monograph No. 96, pp 564.

Sinniah, B., Sinniah, D., Singh, M. & Poon, G.H. (1978). Prevalence of parasites infections in Malaysian oil-palm estate workers. *Southeast Asian Journal of Tropical Medicine and Public Health* **9**: 272-276.

Sinniah, B., Manmohan, S. & Khairul, A. (1979). Preliminary survey of *Capillaria hepatica* (Bancroft, 1893) in Malaysia. *Journal of Helminthology* **53:**147-152.

Walsh, J.F., Molyneux, D.H. & Birley, M.H. (1993). Deforestation effects on vector-borne diseases. *Journal of Parasitology* **106**: 55-75.

Waugh, C.A., Linda, J.F., Poranda, P., Santana, A.M., Lorenzo Morales, J. & Robertson, R.D. (2006). Population distribution and zoonotic potential of gastrointestinal helminths of wild rats *Rattus rattus* and *Rattus norvegicus* from Jamaica. *Journal of Parasitology* **92**(**5**): 1014-1018.

Yap, L.F., Lim, B.L., De Witt, G.F., Krishnasamy, M., Sivanandam, S. & Peter Yen Kim Foong. (1977). Protozoan and helminth parasites of small wild mammals in a new Felda Settlement Jenderak Utara, Central Pahang, Peninsula Malaysia. *Southeast Asian Journal of Tropical Medicine and Public Health* **8**: 345-353.