JOURNAL OF PURE AND APPLIED MICROBIOLOGY, March 2012. Vol. **6**(1), p. 417-421

Rattus norvegicus Berkenhout and Zoonoses: A Preliminary Study from Vembanadu Wetlands

Manuel Thomas[1], Ramya Kumaran[2], K. Abraham Samuel[3] and Punnen Kurian[4]

[1]Sr. Gr. Scientist, Tropical Institute of Ecological Sciences,
Velloor P.O., K.K Road, Kottayam, Kerala 686 501, India.
[2]Department of Medical Microbiology, Karuna Medical College, Chittoor, Palghat, India.
[3]Department of Zoology, CMS College, Kottayam - 686 001, India.
[4]Department of Zoology, St. Mary's College, Manarcadu, Kottayam - 686 032, India.

(Received: 27 April 2011; accepted: 30 May 2011)

Wetland ecosystems are unique ecologically and incessant human dependence is noted from time immemorial. Water rats (*Rattus norvegicus*) play a vital role in disease transmission and a study was conducted to assess the pathogenic diversity among water rats (*Rattus norvegicus*) inhabiting Vembanadu-Kol wetland agroecosystem. A total of twelve bacterial pathogens were isolated from the trapped six water rats including *Salmonella enterica, Klebsiella pneumoniae* and *Staphylococcus aureus*. Fifteen fungal pathogens were isolated including two dermatophytes (*Microsporum audouinii* and *Trichophyton rubrum*). Genus *Aspergillus* was more predominant representing four species. The presence of *Trichosoporon biegelii* was observed in both blood and lungs. Six parasites were also identified with more prevalence of *Ancylostoma duodenalae* (100%) followed by *Hymenolepis diminuta* (66.67%). As human-water-rat contact is inevitable in wetland ecosystem, the presence of pathogens in rats inhabiting in it are a matter of serious concern.

Key words: Zoonoses, Rats, Wetland, Agro-ecosystem, Vembanadu.

The Vembanad-Kol wetland and its associated drainage basins lie in the humid tropical region between 09°00' -10°40'N and 76°00'-77°30'E. It is unique in terms of physiography, geology, climate, hydrology, land use and flora and fauna. Rodents in Vembanad-Kol wetlands include water rat (*Rattus norvegicus*), Black rat (*Rattus rattus*) and the larger bandicoot rat (*Bandicota indica*). Rodents are the most noxious vertebrate pests to man and are the potential source of several infections among man and animals (Mills, 2006). As rodents are commensal to man, the encounters are inevitable, especially in wetland agro-ecosystems. Wetland agroecosystems are biological and natural resource system managed by humans for the primary purpose of producing food as well as other socially valuable non-food goods and environmental services (Wood *et al*., 2000). However, very little reports are available to assess the zoonotic threat posed by an animal inhabiting the wetland agroecosystems like water rat (*Rattus norvegicus*) to the interacting community. The present study is undertaken in this background.

* To whom all correspondence should be addressed.

MATERIALS AND METHODS

Vembanadu-Kol Wetland is the largest lake in Asia (Ramsar site) and fringe area occupies the most extensive agricultural fields of the state. Water rats (*Rattus norvegicus*) were trapped from Oil Palm Plantation of Kallara Grama Panchayath, Kottayam using live rat traps baited with *Nymphae* flowers were set in the field IST 19 hours and checked at 06 hours in the next morning. The farmers in the region are regularly trapping rats and such rats were used for the study. The approval of Institute Animal Ethics Committee (IAEC) was obtained for the study. The collected rats were anaesthetized with chloroform (body weight/ volume) weighed, sexed and morphometrically measured. The specimens such as blood, lungs, tail scrapings, dorsal hairs, ventral hairs, nails and whiskers were inoculated into respective mycological media and incubated for 5 – 15 days at room temperature. The developed colonies were then subcultured and identification was done with typical microscopic and macroscopic features. Rodent specimens (throat swab, blood, lungs, liver, kidney and intestine) were also inoculated into respective bacteriological media, incubated and standard biochemical reactions were performed and identified. Examination for parasites was carried out with rat intestine, heart, liver, kidney and brain. The intestinal components were removed into petri dish containing normal saline and transferred into slides for microscopic examination. Impression smear was performed for other organs.

RESULTS

Altogether, twelve bacteria, fifteen fungi and six parasites (Table 1, 2 and 3) were identified among the trapped six water rats inhabiting Vembanad-Kol wetland agroecosystem. More bacterial diversity was observed in throat swab and intestine of the rats (nine species each) followed by kidney (four species) (Fig:1). The presence of *Salmonella enterica* was observed in 50% of the tested rats (Table: 1). Fungal pathogens was more diverse in ventral side (eleven species) followed by tail scrapings (ten species) and dorsal side (nine species) (Fig:2). The genus *Aspergillus* was more predominant represented by four species

Table 1. List of bacterial pathogens isolated from *Rattus norvegicus* (n=6)

	Bacteria	Frequency of occurrence (%)
1.	*Acinetobacter calcoaceticus*	33.33
2.	*E. cloacae*	13.33
3.	*Enterobacter sp.*	100
4.	*Enterococcus sp.*	66.66
5.	*Escherichia coli*	50
6.	*K. pneumoniae*	100
7.	*Klebsiella oxytoca*	66.66
8.	*Micrococcus sp.*	16.67
9.	*Proteus mirabilis*	33.33
10.	*Pseudomonas aeruginosa*	16.67
11.	*Salmonella enterica*	50
12.	*Staphylococcus aureus*	16.67

Table 2. List of fungal pathogens isolated from *Rattus norvegicus* (n=6)

	Bacteria	Frequency of occurrence (%)
1.	*Aspergillus flavus*	83.33
2.	*A. niger*	50
3.	*A. fumigatus*	66.66
4.	*A. ustus*	16.67
5.	*Chrysosporium sp*.	100
6.	*Curvularia geniculata*	33.33
7.	*Microsporum audouinii*	50
8.	*Penicillium citrinum*	33.33
9.	*P. purpurogenum*	16.67
10.	*P. verrucosum*	50
11.	*Paecilomyces variotii*	50
12.	*Scopulariopsis brevicaulis*	33.33
13.	*Trichophyton rubrum*	50
14.	*Trichosporon biegelii*	16.67
15.	*Verticillium sp.*	16.67

Table 3. List of parasites isolated from *Rattus norvegicus* (n=6)

Parasites		Frequency %
1.	*Ancylostoma duodenalae*	100
2.	*Angiostrongylus cantonensis*	33.33
3.	*Clonorchis sinensis*	16.67
4.	*Enterobius vermicularis*	50
5.	*Hymenolepis diminuta*	66.67
6.	*Strongyloides stercoralis*	33.33

(*Aspergillus flavus, A. niger, A. fumigatus* and *A. ustus*) and genus *Penicillium* ranks second with three species (*Penicillium citrinum, P. purpurogenum* and *P. verrucosum*) (Table: 2). The presence of *Ancylostoma duodenalae* was observed in all the rats tested and *Hymenolepis diminuta* (66.67%) ranks second (Table: 3).

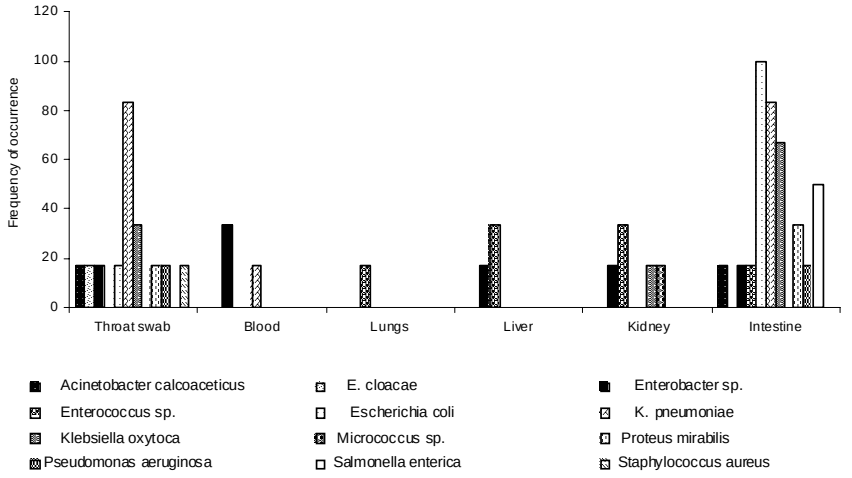

Fig. 1. Comparison of bacterial pathogens from various organs of *R. norvegicus* tested (n=6)

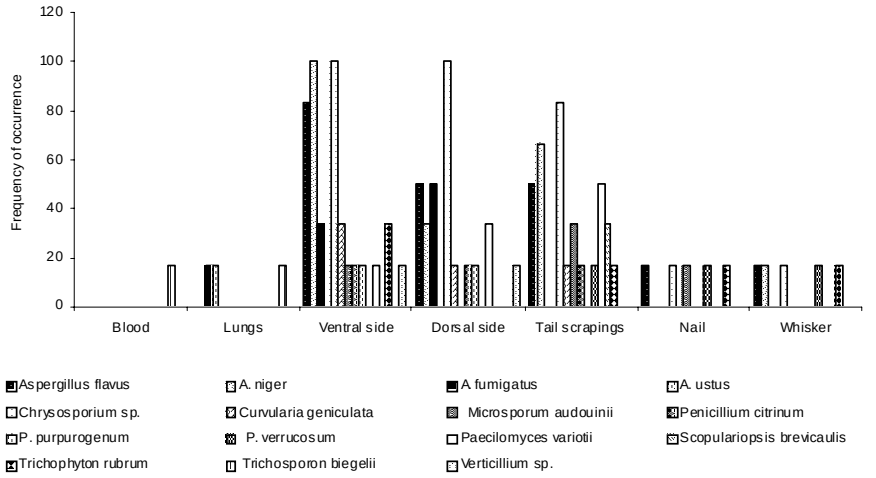

Fig. 2. Comparison of fungal pathogens from various organs of *R. norvegicus* tested (n=6)

DISCUSSION

Rodents, which represent 40% of mammalian species, have been pointed out as the major host and vector of zoonoses since they have been responsible for several regional and worldwide epidemics in history (Jittapalapong *et al.,* 2009). Investigations on pathogens among rodents are significant, because rats and mice are commensal to man, especially in agroecosystems. The present investigation shows that *Rattus norvegicus*, the principal rodent species of Vembanadu-Kol wetland agroecosystem is potentially carrying a variety of pathogens. A total of twelve bacterial pathogens, fifteen fungal pathogens and six parasites were observed from

the six rats tested. Wincewicz (2002) also reported the presence of several bacteria and fungi among the tested rats. Majority of the bacterial isolates are *Enterobacteriaceae* members. Oral cavity often supports luxuriant growth and survival and the chances of transmission during rat bites can't be ignored as similar reports are available (Elliot, 2007). Majority of the isolates have enough disease causing potential, especially in immunocompromised individuals. It should be noted that the present isolates are regularly recorded from rats tested irrespective of geographical region (Battersby *et al.*, 2002; Musshtaq-Ul-Hussan *et al*., 2008). *Salmonella* sp. causes chronic illness in both people and animals. Rats are natural hosts of *Salmonella* and hence, the carrier status among rats is widespread with significant difference in prevalence (Meerberg and Kijlstra, 2007).

Reports available on isolation of fungi from rodents show a more or less diversity and density. Thiermann and Jefferies (1980) reported 15 different fungi from five rodent specimens tested. The isolation of numerous species of fungi is significant from the public health purview, as these are pathogenic in animals and humans. The diversity of fungi was more in ventral side followed by tail scrapings, as these body parts are in constant contact with soil and almost all fungi are soil saprophytes (Desmukh *et al*., 2010). The genus *Aspergillus* and *Penicillium* are most abundant in tropical countries like India (Manoharachary *et al.*, 2005) and the present results are also in tune with the available reports. These fungi have enough pathogenecity in animals and humans. Aspergillosis is considered as an emerging disease with very complex clinical manifestations (Lat *et al*., 2010). The present study also highlights the significant role of rats in transmission of dermatophytosis. Fungal diseases are emerging globally (McCall and Baddley, 2010) and animal reservoirs have important role in transmission of these diseases.

Regarding parasites, *A. duodenale* was present in all the tested rats. The ability of rodents to harbour and transmit a wide spectrum of diseases to humans and his livestock are reported earlier (Schmaljohn and Hjelle, 1997; Taylor *et al*., 2008). The typical body structure of the rodents support luxuriant growth of infectious agents (Fichet-Calvet *et al*., 2000). It can be concluded that the present rate of isolation is extremely high and it shows a significant carrier status of the rats inhabiting Vembanad-Kol wetland agroecosystem. Certainly, it poses serious public health threat as the human rodent contacts are inevitable. The ecology and transmission dynamics of rodentborne infections are complex. The factors that influence transmission are unique to each disease (Davis *et al*., 2005). The situation in developing world is more severe as the socio-economic and environmental conditions are extremely conducive for the sustenance and infection to other animals and humans. However, barring all these differences between developing and developed world, zoonoses have emerged as significant cause of morbidity and mortality during the past few decades. More detailed investigations are needed to expose the relation between bacteria, fungi and parasite pathogens, rats and related host cyclicity in Kerala. The exclusive climatic characteristics of Kerala complicate these dynamic relationships.

CONCLUSION

The knowledge of the rodentborne pathogens will help to predict the distribution of the pathogens and assess the potential risk for human health which risk may indicate the probability of infection in a given habitat. The zoonotic risks associated with *R. norvegicus* in wetland agroecosystems can't be ignored in the wake of emerging zoonotic diseases. As human-water-rat contact is inevitable in wetland ecosystem, the presence of pathogens in rats inhabiting is a matter of serious concern.

REFERENCES

1. Battersby, S.A., Parsons, R. and Webster, J.P. Urban rat infestations and the risk to public health. *Journal of Environmental Health Research.* 2002; **1**(2): 4-12.
2. Davis, S., Calvet, E. and Leirs, H., Fluctuating rodent populations and risk to humans from rodentborne zoonoses. *Vectorborne and Zoonotic Diseases.* 2005; **5**(4): 305-314.
3. Deshmukh, S.K., Shilpa A, V., Archana, S., The occurrence of keratinophilic fungi in selected soils of Ladakh (India). *Natural Science.* 2010; **2**(11): 1247-1252.

4. Elliot, S.P., Rat Bite Fever and *Streptobacillus moniliformis*. *Clin. Micrbiol. Rev.* 2007; **20**(1): 13-22.
5. Fichet-calvet, E., Jomaã, I., Zaafouri, B., Ashford, R.W., Ben-ismail, R. and Delattre, P., The spatio-temporal distribution of a rodent reservoir host of cutaneous leishmaniasis. *Journal of Applied Ecology*. 2000; **37**: 603-615.
6. Jittapalapong, S., Herbreteau, V., Hugot, J., Arreesrisom, P., Karnchanabanthoeng, A., Rerkamnuaychoke, W. and Morand, S., Relationship of parasites and pathogens diversity to rodents in Thailand. *Kasetsart J. (Nat. Sci.).* 2009; **43**: 106-117.
7. Lat, A., Bhadelia, N., Miko, B., Furuya, E.Y. and Thompson, G.R., Invasive Aspergillosis after Pandemic (H1N1) 2009. *Emerging Infectious Diseases.* 2010; **16**(6): 971-973.
8. Manoharachary, C., Sridhar, K., Singh, R., Adholeya, A., Suryanarayanan, T.S., Rawat, S. and Johri, B.N., Fungal biodiversity: Distribution, conservation and prospecting of fungi from India. *Current Science*. 2005; **89**(1): 58-71.
9. Mc Call, M.J. and Baddley, J.W., Epidemiology of emerging fungi and fungi-like organisms. *Current Fungal Infection Reports*. 2010; **4**(4): 203-209.
10. Meerburg, B.G. and Kijlstra, A., Role of rodents in transmission of *Salmonella* and *Campylobacter*. *J. Sci. Food Agric.* 2007; **87**: 2774–2781.
11. Mills, J.N., Biodiversity loss and emerging infectious disease: An example from the rodent-borne hemorrhagic fevers. *Biodiversity*. 2006; **7**(1): 9-17.
12. Mushtaq-Ul-Hassan, M., Hussain, I., Shehzadi, B., Shaheen, M., Mahmood, M.S., Rafique, A. and Mahmood-Ul-Hassan, M., Occurrence of some zoonotic microorganisms in faecal matter of house rat (*Rattus rattus*) and house mouse (*Mus musculus*) trapped from various structures. *Pakistan Vet. J*. 2008; **28**(4): 171-174.
13. Schmaljohn, C. and Hjelle, B., Hantaviruses: a global disease problem. *Emerging Infectious diseases*. 1997; **3**: 95-104.
14. Taylor, P.J., Arntzen, L., Hayter, M., Iles, M., Frean, J. and Belmain, S., Understanding and managing sanitary risks due to rodent zoonoses in an African city: beyond the Boston Model. *Integrative Zoology*. 2008; **3**: 38-50.
15. Thiermann, A.B. and Jeffries, C.D., Opportunistic fungi in detroit's rats and opossum. *Mycopathologia*. 1980; **71**(1): 39-40.
16. Wincewiez, E., Microbiological examination of wild rats living in various environments in the epizootic aspect. *Electronic Journal of Polish Agricultural Universities.* 2002; 5(1).
17. Wood, S., Sebastian, K. and Scherr, S.J., *Pilot analysis of global ecosystems agroecosystems.* World Resources Institute 2000.