GASTRO-INTESTINAL PARASITISM AMONG TWO SWINE POPULATIONS IN MALAYSIA: HIGHLIGHTING THE ZOONOTIC TRANSMISSIBLE PROTOZOAN *BALANTIDIUM COLI* INFECTIONS

TAN T.K.[1], LOW V.L.[1], LEE S.C.[1], CHANDRAWATHANI P.[2], PREMAALATHA B.[2] AND YVONNE A.L. LIM[1]*

1 Department of Parasitology, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia

2 Veterinary Research Institute, 59, Jalan Sultan Azlan Shah, 31400, Ipoh, Perak, Malaysia

* Corresponding author. limailian@um.edu.my

ABSTRACT. Limited information is available regarding gastro-intestinal (GI) parasitic infections in Malaysian swine populations. Hence, the present study aims to determine the prevalence of GI parasites in two swine populations in Malaysia, using formalin-ether concentration technique. In the present study, three helminths and two protozoa were detected in 91 swine rectal fecal samples. The zoonotic transmissible protozoan, *Balantidium coli* (22.0%) had the highest infection rate, followed by strongyle (4.4%), *Entamoeba* spp. (2.2%), *Fasciolopsis* spp. (1.1%) and *Trichuris suis* (1.1%). The co-infection between *T. suis* and *B. coli* was also found in this study

Keywords: *Balantidium coli*, parasitic infection, swine

INTRODUCTION

Up to 2011, the swine population in Malaysia has reached 1.8 million and contributed 231,000 million tons of pork products. The pork consumptions (229,820 million tons) were 9 and 1.4 folds higher than mutton (24,221.3 million tons) and beef (168,273 million tons), respectively (Department of Veterinary Services, Malaysia, www.dvs.gov.my). These data indicates the significant contribution of swine to the livestock production on local economies as well as the need to safeguard this industry as a source of reliable nutrition for Malaysia.

The high demands of swine products in Malaysia require better farm management to minimize the impact of gastro-intestinal (GI) parasitic diseases which might cause reduced productivity in terms of weight loss and ill health. As reviewed by Waller (2006), nematode parasites have been the most hazardous helminths to livestock, causing severe losses in the agriculture industry. Among these helminths, *Ascaris suum* (5.2% to 72.7%), *Oesophagostomum* spp. (2.5% to 25%) and *Trichuris suis* (5.7% to 37.5%) have been the commonest parasites detected in swine with a wide range of infection rate (Roepstorff *et al.*, 1998; Eijck and Borgsteede, 2005; Weng *et al.*, 2005; Lai *et al.*, 2011). In addition, several zoonotic transmissible protozoa have also been commonly reported in swine (i.e., *Balantidium coli*, *Cryptosporidium* spp. and *Giardia* spp.) (Roepstorff *et al.,* 1998; Weng *et al.,* 2005; Lai *et al.,* 2011).

Over the years, a number of studies on GI parasitic infections in livestock (i.e., sheep, goats, deer and cattle) have been reported in Malaysia (Singh and Krishnasamy, 1980; Ikeme *et al.*, 1987; Dorny *et al.*, 1995; Jalila *et al.*, 1998; Chandrawathani *et al.*, 2009; Norhamizah *et al.*, 2011). Unfortunately, the most recent reported GI parasitic infections among swine have been 26 years ago (Lee *et al.*, 1986; Lee *et al.*, 1987; Lee *et al.*, 1988). There has been a serious lack of information regarding the GI parasitic infection in swine populations in Malaysia. Hence, the aim of the present study was to determine the prevalence of GI parasites in swine populations in Malaysia. The findings of this study are crucial for the development of a better understanding of the GI parasite fauna in swine and for the prevention of the spread of infectious parasitic diseases among swine as well as humans.

MATERIALS AND METHODS

The experimental design in this study (MEC Ref. No. 896.36) was approved by the Ethics Committee of the University Malaya Medical Centre (UMMC), Malaysia. The scatological survey was carried out in two farms in Malaysia: Farm A situated in Tapah from the state of Perak and Farm B situated in Bau from the state of Sarawak. In both farms, Yorkshire breed swine aged between six to eight months were raised under intensive farming.

A total of 91 rectal fecal samples were collected from both farms (Farm A=69, Farm B=22). Formalin-ether concentration technique (Allen and Ridley, 1969) was performed prior to the examination of the GI parasites. The processed samples were smeared on the clean slides followed by Lugol's iodine stain and examined by using light microscope with low power of 100× total magnification for helminth egg detection and high power of 400× total magnification for protozoan (oo)cysts detection. Besides, Ziehl-Neelsen staining technique (Casemore *et al.*, 1985) was also applied on the samples to detect the presence of *Cryptosporidium* under 1000× total magnification.

The identification of the GI parasites was based on the morphological characteristics described by Kaufmann (1996) and Taylor *et al.* (2007). The samples were considered as GI parasite positive when at least one parasite egg or (oo)cyst was detected in each parasitic detection technique.

RESULTS

In the present study, five GI parasites (three helminths and two protozoa) were detected in 91 swine rectal fecal samples. The zoonotic transmissible protozoa, *B. coli* (22.0%) recorded the highest infection rate, followed by strongyle (4.4%), *Entamoeba* spp. (2.2%), *Fasciolopsis* spp. (1.1%) and *T.*

suis (1.1%) (Table 1). Different species of parasites were observed in two farms with the exception of *B. coli* being found in both farms. In farm A, *B. coli* (7 or 10.1% of 69) was the commonest GI parasites detected followed by strongyle (4 or 5.8% of 69) and *Fasciolopsis* spp (1 or 1.4% of 69) (Table 2). Similarly, *B. coli* (13 or 59.1% of 22) reported the highest infection rate in Farm B and a low number of swine were infected by *Entamoeba* spp. (2 or 9.1% of 22) and *T. suis* (1 or 4.5% of 22) (Table 2). With regards to the multi-parasitism in swine, only one sample (1 or 3.7% of 27) showed co-infection between *T. suis* and *B. coli* (Table 3).

DISCUSSION AND CONCLUSION

Lower GI parasite diversity and infection rate were observed in the present study as compared to the study conducted in 26 years ago at Shah Alam Abattoir in Selangor, Malaysia, where *B. coli* (65%), coccidial oocysts (59%), *Entamoeba suis* (42%), *Schistosoma incognitum*-like eggs (7%), strongyle (4%), *Strongyloides* spp. (2%), *Trichuris* spp. (5%), *Ascaris* spp. (2%) and *Capillari*a spp. (1%) have been reported from 100 gastrointestinal tracts of swine (Lee *et al.*, 1987).

The frequently reported nematode, *T. suis* was found less common among studied swine samples compared to other countries over the world, such as 32.2% in Kenya (Nganga *et al.*, 2008), 11.1-37.5% in The Netherlands (Eijck and Borgsteede, 2005), 5.7-10.1% in China (Weng *et al.*, 2005; Lai

Table 1: Overall prevalence of gastrointestinal parasites in swine.

Parasitic infection	Swine (N=91)	
	n	%
Helminth	5	5.5
Protozoa	22	24.2
Total	**27**	**29.7**

Table 2: Infection rate of gastrointestinal parasites by species in swine.

Livestock / Parasitic infection	Swine					
	Farm A (N=69)		Farm B (N=22)		Total	
	n	%	n	%	n	%
Helminth						
Fasciolopsis sp.	1	1.4	-	-	1	1.1
Strongyle	4	5.8	-	-	4	4.4
Trichuris suis	-	-	1	4.5	1	1.1
Protozoa						
Balantidium coli	7	10.1	13	59.1	20	22.0
Entamoeba sp.	-	-	2	9.1	2	2.2

Table 3: Prevalence of monoparasitism and polyparasitism in GI parasites positive swine samples

Type of Parasitism	Swine	
	n	%
Monoparasitism	26	96.3
Poliparasitism		
Helminth + Protozoa		
Trichuris suis + *Balantidium coli*	1	3.7

et al., 2011) and 4.6% in Ghana (Permin *et al*., 1999). With regards to 5.8% (4 of 69) of strongyle infected swine samples in Farm A, species specific molecular analyses were performed for the detection of *Haemonchus contortus* and *Trichostrongylus* spp. (Tan *et al*., 2014), but none of the samples were positive for these species. It has been suggested that the common strongyle species, *Oesophagostomum* spp. might be the possible species infected in the studied swine populations given that these parasites have been frequently reported in many studies (2.5-25%) (Eijck and Borgsteede, 2005; Weng *et al*., 2005; Lai *et al*., 2011). However, this statement has yet to be confirmed since no fecal culture and molecular approach was performed for the detection of *Oesophagostomum* spp. On the other hand, *B. coli* was the only pathogenic protozoa parasite detected in the present study. As compared to the present study, the overall infection rates were apparently lower than the survey in the pig herds in Western Australia and Nigeria where more than 50% of the samples have been infected with *B. coli* (Mercy *et al*., 1989; Yatswako *et al*., 2007). Nonetheless, the infection rate in the current study concurred with the reports from China (Lai *et al*., 2011) and Ghana (Permin *et al*., 1999).

In Malaysia, public health concern on swine was heightened because of the outbreaks of Japanese encephalitis and Nipah viruses (Chua, 2010). However, parasitic infections in Malaysian swine have been totally neglected, particularly the zoonotic transmissible parasites (i.e., *B. coli*). Despite balantidiosis being uncommon in humans, several outbreaks and human infection cases have been reported around the world (Walzer *et al*., 1973; Cooper and Guderian, 1994; Anargyrou *et al*., 2003; Vasilakopolou *et al*., 2003). In addition, it has also been reported that *B. coli* infection may occur due to the close contact with swine among farm workers and pork-butchers; ingestion of swine feces contaminated foods and drinks; and inappropriate waste disposal management (Ferry *et al*., 2004; Owen, 2005). Therefore, the occurrence of *B. coli* in the studied swine populations could pose a risk of balantidiosis to farm workers. It is crucial to enhance the current farm management, especially the hygiene regulation and proper sewage management in order to prevent the spreading of GI parasites and enhance the healthiness of livestock as well as the farm workers.

In conclusion, low diversity and infection rate of GI parasites were observed among swine samples from two populations in Malaysia. However, to unravel the diversity of GI parasite fauna in Malaysian swine populations, additional sampling efforts should be carried out in the near future

REFERENCES

1. Allen AV and Ridley DS (1970). Further observations on the formal-ether concentration technique for faecal parasites. *Journal of Clinical Pathology* **23**: 545-546.
2. Anargyrou K, Petrikkos GL, Suller MTE, Skiada A, Siakantaris MR, Osuntoyinbo RT, Pangalis G and Vaiopoulos G (2003). Pulmonary *Balantidium coli* infection in a leukemic patient. *American Journal of Hematology* **73**: 180-183.
3. Casemore DP, Armstrong M and Sands RL (1985). Laboratory diagnosis of cryptosporidiosis. *Journal of Clinical Pathology* **38**: 1337-1341
4. Chandrawathani P, Nurulaini R, Adnan M, Premalaatha B, Khadijah S, Jamnah O, Zaini CM, Khor SK and Zawida Z (2009). A survey of parasitic infection on small ruminant farms in Kinta and Hilir Perak districts, Perak, Malaysia. *Tropical Biomedicine* **26**: 11-15.
5. Chua KB (2010). Epidemiology, surveillance and control of Nipah virus infections in Malaysia. *Malaysian Journal of Pathology* **32**: 69-73.
6. Cooper PJ and Guderian RH (1994). Gastrointestinal illness associated with *Balantidium coli* infection in rural communities in Ecuador. *Parasitología al día* **18**: 51-54.
7. Department of Veterinary Services Malaysia. Malaysia: Consumption of Livestock Products, 2004-2013. http://www.dvs.gov.my/
8. Dorny P, Symoens C, Jalila A, Vercruysse J and Sani R (1995). Strongyle infections in sheep and goats under the tradition husbandry system in Peninsular Malaysia. *Veterinary Parasitology* **56**: 121-136.
9. Eijck IAJM and Borgsteede FHM (2005). A survey of gastrointestinal pig parasites on free-range, organic and conventional pig farms in The Netherlands. *Veterinary Research Communications* **29**: 407-414.
10. Ferry T, Bouhour D, De Monbrison F, Laurent F, Dumouchel-Champagne H, Picot S, Piens MA and Granier P (2004). Severe peritonitis due to *Balantidium coli* acquired in France. *European Journal of Clinical Microbiology and Infectious Diseases* **23**: 393-395.
11. Ikeme MM, Fatimah I and Lee CC (1987). Seasonal changes in the prevalence of *Haemonchus* and *Trichostrongylus* hypobiotic larvae in tracer goats in Malaysia. *Tropical Animal Health and Production* **19**: 184-190.
12. Jalila A, Dorny P, Sani R, Salim NB and Vercruysse J (1998). Coccidial infections of goats in Selangor, Peninsular Malaysia. *Veterinary Parasitology* **74**: 165-172.
13. Kaufmann J (1996). Parasitic infections of domestic animals: a diagnostic manual. Basel; Boston; Berlin; Birkhäuser.
14. Lai M, Zhou RQ, Huang HC and Hu SJ (2011). Prevalence and risk factors associated with intestinal parasites in pigs in Chongqing, China. *Research in Veterinary Science* **91**: e121-e124.
15. Lee CC, Sheikh-Omar AR, Chandrawathani P and Mohna SS (1986). Finding of *Schistosoma incognitum*-like eggs in local pigs. *Tropical Biomedicine* **3**: 225-226.
16. Lee CC, Chandrawathani P, Sheikh-Omar AR and Mohna SS (1987). An abattoir survey of gastrointestinal parasites of pigs. *Kajian Vete*rinar **19**(1): 27-32.
17. Lee CC, Sheikh-Omar AR and Chandrawathani P (1988). Finding of *Capillaria* eggs – a new record in local pigs. *Malaysian Applied Biology* **17**(2): 145-146.
18. Mercy AR, de Chaneet G and Emms Y (1989). Survey of intestinal parasites in Western Australian pig herds. 1. Prevalence. *Australian Veterinary Journal* **66**: 4-6.
19. Norhamizah AH, Julaida S, Slamah B, Saudah S and Rashidah AL (2011). Cryptosporidiosis in a commercial dairy cattle farm in Malaysia. *Malaysian Journal of Veterinary Research* **2**: 33-39.
20. Owen LL (2005). Parasitic zoonoses in Papua New Guinea. *Journal of Helminthology* **79**: 1-14.
21. Permin A, Yelifari L, Bloch P, Steenhard N, Hansen NP and Nansen P (1999). Parasites in cross-bred pigs in the Upper East Region of Ghana. *Veterinary Parasitology* **87**: 63-71.
22. Roepstorff A, Nilsson O, Oksanen A, Gjerde B, Richter SH, Ortenberg E, Christensson D, Martinsson KB, Bartlett PC, Nansen P, Eriksen L, Helle O, Nikander S and Larsen K (1998). Intestinal parasites in swine in the Nordic countries: prevalence and geographical distribution. *Veterinary Parasitology* **76**: 305-319.
23. Singh KI and Krishnasamy M (1980). Helminth parasites of the lesser mouse-deer *Tragulus javaicus* Osbeck from Peninsular Malaysia. *Southeast Asian Journal of Tropical Medicine and Public Health* **11**: 418-420.
24. Tan TK, Panchadcharam C, Low VL, Lee SC, Ngui R, Sharma RSK and Lim YAL (2014). Co-infection of *Haemonchus contortus* and *Trichostrongylus* spp. among livestock in Malaysia as revealed by amplification and sequencing of the internal transcribed spacer II DNA region. *BMC Veterinary Research* **10**: 38.
25. Taylor MA, Coop RL and Wall RL (2007). Veterinary Parasitology. 3rd edition. Oxford: Blackwell Publishing Ltd.
26. Vasilakopolou A, Dimarongona K, Samakovli A, Papadimitris K and Avlami A (2003). *Balantidium coli* pneumonia in an immunocompromised patient. *Scandinavian Journal of Infectious Diseases* **35**: 144-146.
27. Waller PJ (2006). From discovery to development: Current industry perspectives for the development of novel methods of helminth control in livestock. *Veterinary Parasitology* **139**: 1-14.
28. Walzer PD, Judson FN, Murphy KB, Healy GR, English DK and Schultz MG (1973). Balantidiasis outbreak in Truk. *American Journal of Tropical Medicine and Hygiene* **22**: 33-41.

29. Weng YB, Hu YJ, Li Y, Li BS, Lin RQ, Xie DH, Gasser RB and Zhu XQ (2005). Survey of intestinal parasites in pigs from intensive farms in Guangdong Province, People's Republic of China. *Veterinary Parasitology* **127**: 333-336.
30. Yatswako S, Faleke OO, Gulumbe ML, Daneji AI (2007). *Cryptosporidium* oocysts and *Balantidium coli* cysts in pigs reared semi-intensively in Zuru, Nigeria. *Pakistan Journal of Biological Sciences* **10**: 3435-3439.

ACKNOWLEDGEMENT. The authors would like to thank the farmers of swine farms for their collaborative efforts. This study was supported by University of Malaya grants PV024/2011B. The funders had no role in study design, data collection, decision to publish or preparation of the manuscript.