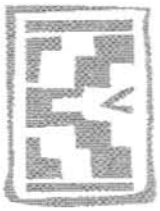

RESEARCH COMMUNICATION

Effect of host age in the distribution of adult *Trichinella zimbabwensis* in the small intestines of golden hamsters (*Mesocricetus auratus*) and Balb C mice

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ABSTRACT

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Golden hamsters (*Mesocricetus auratus*) and Balb C mice were experimentally infected with *Trichinella zimbabwensis* to determine the effect of host age in the distribution of adult stages in the small intestines. The hamsters and mice were divided into two groups of young and old animals. Hamsters aged 90 days were designated as young and those aged 360 days were designated as old while mice of 30 days of age were designated as young and those aged 90 days as old. To recover the adult parasites of *T. zimbabwensis*, the small intestines of each animal were separated and divided into four equal parts and each part was slit open longitudinally. The contents were incubated in 0.85 % saline for 4 h at 37 °C before the adult worms were recovered from the saline. They were fixed in 70 % alcohol and counted under a dissecting microscope. In both young and old hamsters and mice, *T. zimbabwensis* adult worm counts were significantly higher ($P < 0.05$) in the second segment of the intestines thus invariably reflecting a significantly high count ($P < 0.05$) in the first (anterior) half of the small intestines. From this study it was demonstrated that host-age had no effect on the distribution of *T. zimbabwensis* adult worms in the different segments of the small intestines of golden hamsters and Balb C mice.

Keywords: Balb C mice, golden hamsters, host age, small intestines, *Trichinella zimbabwensis*

INTRODUCTION

It has been proved that the distribution of helminth parasites in large organs, such as the small intestines, is not random (Sukhdeo 1991) and they often occupy certain habitats that are often separable longitudinally and radially in the gut (Holmes 1973; Kennedy 1984). Recently, a new non-encapsulated *Trichinella* spp. was reported in the crocodile *Crocodylus niloticus* (Foggin, Vassilev & Widdowson 1997) and this has been designated *Trichinella zimbabwensis* n. sp. (Pozio, Foggin, Marucci, La Rosa, Corona, Rossi & Mukaratirwa 2002). Studies on the transmission and infectivity of this parasite to the indigenous Zimbabwean pig (*Sus scrofa*) known colloquially as *Mukota*, rat (*Rattus norvegicus*) and Balb C mice have been reported by Mukaratirwa & Foggin (1999) and Mukaratirwa, Magwedere, Matenga & Foggin (2001).

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The relative distribution of other *Trichinella* spp. larvae such as those of *T. spiralis* in various muscles of the domestic pig (Zimmermann 1970); rat (Gould 1945; Larsh & Hendricks 1949; McCracken 1982); mice (Stewart & Charniga 1980) and foxes (Kapel, Henriksen, Dietz, Henriksen & Nansen 1994) have been reported.

Several factors, some acting independently, or in concert, have been found to affect the distribution of adult *Trichinella* spp. in the small intestines of their mammalian hosts (McCracken 1982). The majority of adult worms of *T. spiralis* have been reported to inhabit the anterior part of the small intestines in mature rats (Larsh & Hendricks 1949), in mature mice (Larsh & Hendricks 1949; Belosevic & Dick 1980; McCracken 1982) and in young mice (Campbell 1967; McCracken 1982). On the contrary, it has been reported that the majority of adult worms of *Trichinella spiralis* inhabit the posterior part of the small intestine in young rats and mice, and guinea pigs of unspecified age (Larsh & Hendricks 1949). Sukhdeo & Croll (1981) have suggested that the physico-chemical conditions of the anterior portion of the small intestines are optimal for the reproductive fitness of this parasite.

The objective of this study was to determine the effect of host-age in the distribution of adult stages of *T. zimbabwensis* in the small intestines of golden hamsters (*Mesocricetus auratus*) and Balb C mice.

MATERIALS AND METHODS

Experimental animals

Information regarding the experimental animals used in this study and their age categories is given in Table 1. Forty golden hamsters (*Mesocricetus auratus*) were divided into two categories according to their age. They were housed in cages and fed commercial feed and had access to water *ad libitum*. The same procedure was followed for 40 Balb C mice. The hamsters and mice were each infected by oral administration with first-stage larvae (L_1) of *T. zimbabwensis* following methods described by Kapel, Webster, Bjørn, Murrell & Nansen (1998). All the animals were sacrificed on day 7 post-infection after being anaesthetized with ether prior to sacrifice. The small intestines from each animal were removed, separated and divided into four equal segments which were processed to recover the adult *T. zimbabwensis* according to methods described by McCracken (1982). Each segment was slit open longitudinally and placed in a separate petri-dish containing warm 0.85 % saline and incubated for 4 h at 37 °C. The gut fragments from the segments were removed and all adult worms which had migrated into the saline from the tissues of each segment of each animal were fixed and stored in 70 % alcohol. The adult *T. zimbabwensis* that were collected from each segment were counted with the aid of a dissecting microscope.

TABLE 1 Summary of information on the experimental animals used in the study

Category	N	Age in days	No. of L_1 per animal
Young hamsters	20	180	675
Old hamsters	18	360	675
Young mice	20	30	195
Old mice	20	90	195

Parasite strain

The *T. zimbabwensis* strain which was used to infect all the animals was maintained under laboratory conditions by periodical passages through rats (*Rattus norvegicus*). The number of L_1 administered to each animal is shown in Table 1.

Statistical analysis

For statistical comparison the four intestinal segments equal in length were designated group A and the first half and second half of the small intestine as group B. The non-parametric Mann Whitney U-test for independent samples was used to compare between categories within a species while the Wilcoxon matched-pairs signed-ranks test for related samples was used to determine the distribution of adult worms within a group and category. Significance was set at the 5 % level.

RESULTS AND DISCUSSION

The worms recovered from the intestines of both hosts at day 7 post infection were fully mature and were identified as *T. zimbabwensis*. Two hamsters in the "old" category were removed from the experiment because of ill-health. In the young hamsters, the second segment of the first half of the small intestines had significantly higher numbers of worms ($P < 0.05$) than the first segment (Table 2). In the second half of the small intestines, the third segment had significantly higher counts ($P < 0.05$) than the fourth segment. Similar results were obtained in both young and old mice (Table 2). However, in old

TABLE 2 Mean (± SE) of adult worms of *Trichinella zimbabwensis* recovered from the small intestines of young and old hamsters and mice at 7 days post infection

Category	N	Group A				Group B		Total
		Small intestine segments				Small intestine halves		
		1	2	3	4	1st Half	2nd Half	
1. Young hamsters	20	17.2 ± 1.9^{ab1}	23.9 ± 1.2^{c3}	17.8 ± 2.1^{b5}	13.9 ± 1.5^{a7}	20.6 ± 1.6^{a9}	15.8 ± 1.5^{b11}	72.8 ± 4.6^{13}
2. Old hamsters	18	15.2 ± 2.6^{ab1}	18.3 ± 2.4^{bc3}	19.9 ± 2.4^{c5}	12.2 ± 2.0^{a7}	16.8 ± 2.2^{a9}	16.1 ± 2.1^{a11}	65.6 ± 7.7^{13}
1. Young mice	20	4.7 ± 0.9^{a2}	11.2 ± 2.0^{c4}	7.1 ± 1.1^{b6}	3.2 ± 0.6^{a8}	16.0 ± 2.8^{a10}	10.3 ± 1.4^{a12}	26.2 ± 4.0^{14}
2. Old mice	20	9.8 ± 2.0^{c2}	13.8 ± 2.4^{d4}	6.9 ± 1.2^{b6}	3.6 ± 0.6^{a8}	23.6 ± 4.3^{a10}	10.5 ± 1.6^{b12}	34.0 ± 5.7^{14}

Values without a common superscript letter within rows in each group are significantly different ($P < 0.05$)

Values without a common superscript number within a column in each host species are significantly different ($P < 0.05$)

hamsters, although similar results were obtained, there was no significant difference in worm numbers between the first and second segments (Table 2).

In both mice and hamsters, with the exception of old hamsters, the first half of the intestine had significantly ($P < 0.05$) higher worm counts than the second half. In both species, comparisons made between age groups within intestinal segments consistently revealed that age did not have a non-significant effect ($P > 0.05$) on the number of adult worms recovered from the different intestinal segments.

This study shows that the majority of adult worms of *T. zimbabwensis* were encountered in the anterior half of the intestines of both mice and hamsters irrespective of their age. This finding is in agreement with studies on *T. spiralis* in rats (Gardiner 1976) and mice (McCracken 1982) in which adult worm counts were significantly higher in number in the first (anterior) half of the intestines in both species. The relatively high numbers of *T. zimbabwensis* in the anterior half of the intestines might mean that the first half of the intestines constitutes an optimum habitat for establishment of the parasite although the specific factors determining the optimal conditions in the host species are unknown. Metrick & Podesa (1974) suggested that factors such as nutrition or hormonal or biochemical gradients along the length of the intestines are important. It is important to mention that the parameters measured in this study may not have been an adaptation to specific conditions in mice and hamsters as the parasite strain used was maintained in rats for 6 months after isolation from an infected crocodile.

It has been reported by Fretwell & Lucas (1970) and Partridge (1979) that free-living organisms select their habitats by assessing the reproductive success in different sites before making a choice of habitat. Parasites such as *T. spiralis*, which are passively carried to their site, are unable to use this strategy (Sukhdeo 1991). These are believed to be carried to their habitats by local currents of ingesta and habitat selection which consists of pre-programmed patterns is triggered as they enter the small intestines (Sukhdeo 1990).

Based on the results obtained in this study, it can be conluded that adult worms of *T. zimbabwensis* have a similar distribution to that of *T. spiralis* in the small intestines of the mammalian host. Factors influencing the habitat selection are yet to be clarified.

REFERENCES

BELOSEVIC, M. & DICK, T. A. 1980. *Trichinella spiralis*: Comparison with an Arctic isolate. *Experimental Parasitology*, 49:266–276.

CAMPBELL, W.C. 1967. Distribution of *Trichinella spiralis* in the small intestines of young mice. *Journal of Parasitology*, 53: 395–397.

FOGGIN, C.M., VASSILEV, G.D. & WIDDOWSON, M.A. 1997. Infection with *Trichinella* in farmed crocodiles (*Crocodylus niloticus*) in Zimbabwe. *Proceedings of the 16th International Conference of the World Association for the Advancement of Veterinary Parasitology, Sun City, South Africa, 1997*: Abstract No. 110.

FRETWELL, S. D. & LUCAS, H. L. 1970. On territorial behavior and other factors influencing distribution in birds. I. Theoretical development. *Acta Biotheoretica*, 19:16–36.

GARDINER, C. H. 1976. Habitat and reproductive behaviour of *Trichinella spiralis*. *Journal of Parasitology*, 62:865–870.

GOULD, S. E. 1945. Trichinosis, in *Meat hygiene*, edited by C.C. Thomas, 9th ed. London: Bailliere Tindall Saunders.

HOLMES, J. C. 1973. Site selection by parasitic helminths interspecific interaction, site segregation, and their importance to the development of helminth communities. *Canadian Journal of Zoology*, 51:333–347.

KAPEL, C.M.O., HENRIKSEN, S.A., DIETZ, H.H., HENRIKSEN, P. & NANSEN P. 1994. A study on the predilection sites of *Trichinella spiralis* in experimentally infected foxes (*Alopex lagopus, Vulpes vulpes*). *Acta Veterinaria Scandinavica*, 35: 125–132.

KAPEL, C. M.O., WEBSTER, P., BJØRN, H., MURRELL, K.D. & NANSEN, P. 1998. Evaluation of the infectivity of *Trichinella* species for reptiles (*Caiman sclerops*). *International Journal for Parasitology*, 28:1935–1937.

KENNEDY, C.R. 1984. Host parasite interrelationship strategies of coexistence and coevolution, in *Producers and scroungers*, edited by C.J. Banard. New York: Chapman & Hall.

LARSH, J.E. Jr. & HENDRICKS, J.R. 1949. The probable explanation for the differences in localization of adult *Trichinella spiralis* in young and old mice. *Journal of Parasitology*, 35:101–106.

McCRACKEN, R.O. 1982. Lack of effect of host age on the distribution of *Trichinella spiralis* within the small intestine of laboratory mice. *Journal of Parasitology*, 68:159–162.

METTRICK, D.F. & PODESTA, R.B. 1974. Ecological and physiological aspects of helminth-host interactions in the mammalian gastrointestinal canal. *Advances in Parasitology*, 12: 183–278.

MUKARATIRWA, S. & FOGGIN, C..M. 1999. Infectivity of *Trichinella spp.* isolated from *Crocodylus niloticus* to the indigenous Zimbabwean pig (Mukota). *International Journal for Parasitology*, 29:1129–1131.

MUKARATIRWA, S., MAGWEDERE, K., MATENGA, E. & FOGGIN, C.M. 2001. Transmission studies on *Trichinella species* isolated from *Crocodylus niloticus* and efficacy of fenbendazole and levamisole against muscle L1 stages in Balb C mice. *Onderstepoort Journal of Veterinary Research*, 68:21–25.

PARTRIDGE L. 1979. Habitat selection, in *Behavioural ecology*, edited by J.B. Kreb & N. B. Davies. Massachusetts: Sinauer Associates.

POZIO, E., FOGGIN, C.M., MARUCCI, G., LA ROSA, G., CORONA, S., ROSSI, P. & MUKARATIRWA, S. 2002. *Trichinella*

zimbabwensis (Nematoda), a new non-encapsulated species from crocodiles *(Crocodylus niloticus)* of Zimbabwe also infecting mammals. *International Journal for Parasitology*, 32:1787–1799.

STEWART, G.L. & CHARNIGA, L.M. 1980. Distribution of *Trichinella spiralis* in muscles of the mouse. *Journal of Parasitology*, 66:689–691.

SUKHDEO, M.V.K. 1991. The relationship between intestinal location and fecundity in adult *Trichinella spiralis*. *International Journal for Parasitology*, 21:855–858.

SUKHDEO, M.V.K. & CROLL, N.A. 1981. The location of parasites within their hosts: Factors affecting longitudinal distribution of *Trichinella spiralis* in the small intestines of mice. *International Journal for Parasitology*, 11:163–168.

TYZZER, E.E. & HONEIJ, J.A. 1916. The effects of radiation on the development of *Trichinella spiralis*. *Journal of Parasitology* 3:43–46.

ZIMMERMANN, W.J. 1970. Reproductive potential and muscle distribution of *Trichinella* spiralis in swine. *Journal of the American Veterinary Medical Association*, 156:770–774.