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Differential Establishment of *Angiostrongylus costaricensis* in Laboratory and Wild Rats

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Abstract

Experimental *Angiostrongylus costaricensis* infection was carried out in inbred strains of rats (DA, JAR-2, LOU/M, NIG-III, WBN/Kob and WM) and two species of wild rodents, *Rattus norvegicus* and *R. rattus*. *A. costaricensis* infection could occur in all strains of rats and wild rats. Marked differences in infection rats and in worm burden were found among inbred strains of rats tested.

Key words: *Angiostrongylus costaricensis*, rat, host susceptibility

Angiostrongylus costaricensis is found mainly in Central America, and is parasitic in rodents as well as humans, causing abdominal angiostrongyliasis characterized by intestinal granuloma (Morera, 1973; Tesh *et al.*, 1973; Loría-Cortés and Lobo-Sanahuja, 1980). Because of the medical importance of human angiostrongylosis, many medical and biological aspects of this parasite have been studied (Morera *et al.*, 1977; Oku *et al.*, 1984; Matsuoka, 1985; Terada *et al.*, 1987; Ishii and Sano, 1989; Ishih *et al.*, 1990). This parasite has the potential to spread from endemic areas to other regions of the world, similar to the related *A. cantonensis* (Alicata, 1965). Epidemiological studies of this parasite suggested that several rodents, including *Sigmodon hispidus* and *Rattus rattus,* were implicated as definitive hosts under natural conditions. This parasite has not been naturally encountered in *R. norvegicus,* although Morera and Ash (1970) found the adult parasites in albino rats 34 days after inoculation with larvae. The variability in recovery of parasites from animals of different strains has suggested to many workers that the host genetic constitution has marked influence on the susceptibility or resistance to infection. The present study was designated to clarify the susceptibility of rats to *A. costaricensis* infection.

Six inbred strains of rats (DA, JAR-2, LOU/M, NIG-III, WBN/Kob and WM) were tested in the current experiment. Two wild colonies from two species of rodents, *R. norvegicus* and *R. rattus,* were also examined. Wild rats were originally collected at Gifu Prefecture in 1984 and have since been maintained and bred in the Institute for Experimental Animals, Yagi Memorial Park, Gifu Prefecture, Japan for use as experimental laboratory animals. Five or 6 male rats, 5- to 6-weeks-old, were used in each group. Infective third-stage larvae of *A. costaricensis* (Costa Rican strain) were obtained from experimentally infected snails, *Biomphalaria glabrata* (Puerto Rican strain), by artificial digestion using 0.2% pepsin in 0.7% HCl for 30 min at 37°C. Rats were given 40 third-stage larvae orally via a stomach tube. Worms were recovered from the rats 5 weeks post-infection. Feces collected at autopsy were examined for the first-stage larvae to determine the sexual maturity of the worm. To

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examine the differences in worm recovery, mean values were compared by the Student's *t*-test. *P* values less than 0.05 were considered to be statistically significant.

The results of the investigation of the infectivity of *A. costaricensis* in rats at autopsy are summarized in Table. The current study clearly confirms that *A. costaricensis* infection can occur in 6 laboratory inbred strains and two wild colonies from *R. norvegicus* and *R. rattus,* as expected from the previous report (Morera and Ash, 1970). It must be stressed, however, that marked differences in infection rate and in worm burden were found between two species of rats. The mean worm recovery for *R. rattus,* the definitive host in nature, was significantly higher than that for another species as analyzed using the Student's *t*-test. From the examination of the first-stage larvae in rat feces, the worms attain sexual maturity and the females are capable of laying fertile eggs. In spite of the fact that *R. norvegicus* infected with *A. costaricensis* has not been found in nature, the parasite is obviously adapted to this species of host. The reason why there are no reports of this parasite in *R. norvegicus* collected in a number of locations in endemic areas may thus be closely related to behavioral factors of the host. To clarify the importance of the intermediate host molluscs in maintaining *A. cantonensis* in nature, Uchikawa *et al.* (1987) examined the feeding ability and preference of the host rat, *R. rattus,* for certain species of snails. Their results showed that *R. rattus* preferred small molluscs, whose prevalence, and intensity of infection with *A. cantonensis* were low, rather than heavily infected large molluscs such as *Achatina fulica* which was widely spread and seemed to be suitable as an intermediate host snail. More attention should be paid to the feeding ability and preference of *R. norvegicus* for molluscan intermediate hosts in nature.

Natural infection of *Mus musculus* with *A. costaricensis* has never been recorded (Tesh *et al.*, 1973; Malek, 1981), and hence several strains of mice were examined to investigate the susceptibility of mice to *A. costaricensis* infection (Ishii and Sano, 1989). Since both host mortality and worm burden seemed to be affected by differences in the major histocompatibility complex, they suggested that further genetic studies, using congenic inbred

Table 1 Infection rates and worm recovery in *Angiostrongylus costaricensis*-infected rats

Animals	No. positive / No. used	No. of worms recovered (mean ±SD)
Rattus norvegicus		
Laboratory inbred strains		
DA	5 / 5	5.4±1.1
JAR-2	4 / 5	2.6±1.5
LOU/M	3 / 5	1.6±2.1
NIG-III	5 / 5	3.0±1.2
WBN/Kob	5 / 5	4.4±1.1
WM	5 / 5	5.8±2.2
Wild colony		
Car-Mit	3 / 5	2.0±2.0
R. rattus		
Wild colony		
Tan-Mit	6 / 6	11.2±4.3*

Rats were given 40 third-stage larvae and killed 5 weeks post-infection for worm reocvery.

*Significantly higher worm recovery than the other rats ($p<0.05$, Student's *t*-test).

strains of mice, were necessary to clarify the final host specificity of this parasite. Genetic, immunologic and histopathologic studies using the inbred strains of rats, as well as the inbred mice strains, would promote the better understanding of the final host specificity of *A. costaricensis*.

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References

1) Alicata, J. E. (1965): Biology and distribution of the rat lung-worm, *Angiostrongylus cantonensis*, and its relation to eosinophilic meningitis and other neurological disorders of man and animals. In Advances in Parasitology, Vol. 3, Dawes B., ed., Academic Press, London and New York, 223–248.
2) Ishih, A., Rodriguez, B. O. and Sano, M. (1990): Scanning electron microscopic observations of first- and third-stage larvae and adults of *Angiostrongylus costaricensis*. Southeast Asian J. Trop. Med. Pub. Hlth., 21, 568–573.
3) Ishii, A. I. and Sano, M. (1989): Strain-dependent differences in susceptibility of mice to experimental *Angiostrongylus costaricensis* infection. J. Helminthol., 63, 302–306.
4) Loría-Cortés, R. and Lobo-Sanahuja, J. F. (1980): Clinical abdominal angiostrongylosis. A study of 116 children with intestinal eosinophilic granuloma caused by *Angiostrongylus costaricensis*. Am. J. Trop. Med. Hyg., 29, 538–544.
5) Malek, E. A. (1981): Presence of *Angiostrongylus costaricensis* Morera and Céspedes 1971 in Colombia. Am. J. Trop. Med. Hyg., 30, 81–83.
6) Matsuoka, Y. (1985): Migration and development of *Angiostrongylus costaricensis* and *A. siamensis* in mice following oral, intraperitoneal, subcutaneous and intravenous infection. Jpn. J. Vet. Res., 33, 85.
7) Morera, P. (1973): Life history and redescription of *Angiostrongylus costaricensis* Morera and Céspedes, 1971. Am. J. Trop. Med. Hyg., 22, 613–621.
8) Morera, P. and Ash, L. R. (1970): Investigación del huésped intermediario de *Angiostrongylus costaricensis* (Morera y Céspedes, 1971). Bol. Chil. Parasitol., 25, 135.
9) Morera, P., Arroyo, R. and Solano, E. (1977): Infección de ratas salvajes con *Angiostrongylus costaricensis* por vía subcutánea e intraperitoneal. Rev. Biol. Trop., 25, 257–261.
10) Oku, Y., Kamiya, M., Ohbayashi, M. and Kudo, N. (1984): Hybridization studies of *Angiostrongylus siamensis* Ohbayashi, Kamiya and Bhaibulaya, 1979 and *A. costaricensis* Morera and Cespedes, 1971. J. Parasitol., 70, 845–846.
11) Terada, M., Ishii, A. I., Dharejo, A. M., Hayashi, M. and Sano, M. (1987): Studies on chemotherapy of parasitic helminths (XXVIII). *In vivo* efficacy of milbemycin D against larval stages of *Angiostrongylus cantonensis* and *A. costaricensis*. Jpn. J. Parasitol., 36, 24–29.
12) Tesh, R. B., Ackerman, L. J., Dietz, W. H. and Williams, J. A. (1973): *Angiostrongylus costaricensis* in Panama. Prevalence and pathologic findings in wild rodents infected with the parasite. Am. J. Trop. Med. Hyg., 22, 348–356.
13) Uchikawa, R., Noda, S., Matayoshi, S. and Sato, A. (1987): Food preference of *Rattus rattus* for some terrestrial molluscs and experimental infection of *R. rattus* with *Angiostrongylus cantonensis*. Jpn. J. Parasitol., 36, 94–99.